VOLUME II OF II

(APPENDICES D TO N-2)

Draft Environmental Impact Statement

PROPOSED HOʻĀLA HONOKŌWAI PROJECT, LAHAINA, MAUI, HAWAIʻI

(TMK No. (2) 4-4-001:097, 098, and 100)



Prepared for:

West Maui Resort Partners, L.P.

November 2025

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Planning. Project Management. Sustainable Solutions.

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APPENDIX D

GREENHOUSE GAS ASSESSMENT

Greenhouse Gas Assessment

Proposed Hoʻāla Honokōwai Project

Prepared for:

West Maui Resort Partners, L.P.

Sepember 2025

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Greenhouse Gas Assessment

Proposed Hoʻāla Honokōwai Project

Prepared for:

West Maui Resort Partners, L.P.

September 2025

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List of Acronyms

CAA	Clean Air Act
CalEEMod	California Emissions Modeler
CH_4	Methane
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
cy	Cubic Yard
EF	Emission Factor
EPA	Environmental Protection Agency
ERM	Environmental Resources Management Limited
ft.	Feet
GHG	Greenhouse Gas
GHGRP	Greenhouse Gas Reporting Program
HAR	Hawai‘i Administrative Rules
HRS	Hawai‘i Revised Statutes
in.	Inch
IPCC	Intergovernmental Panel on Climate Change
KBC	Kā‘anapali Beach Club
kg	Kilogram
lb	Pound
MSL	Mean Sea Level
MT	Metric Ton
N_2O	Nitrous Oxide
UNFCCC	United Nations Framework Convention on Climate Change Conference

EXECUTIVE SUMMARY

I. EXECUTIVE SUMMARY

This Greenhouse Gas Assessment Report has been prepared for the Hoʻāla Honokōwai Project to assess Greenhouse Gas (GHG) emissions generated by the proposed beach restoration action. There are three proposed methodologies of beach restoration assessed in this report - Beach Nourishment, Beach Maintenance, and Beach Stabilization. GHG impacts are assessed for the sand recovery and sand transport phases of construction for each of the alternatives, and in the case of Beach Stabilization, this report also assesses groin construction. The No Action alternative was not assessed for potential GHG impacts as specific information relating to removal of the temporary erosion skirt has not yet been finalized.

The table below summarizes the results of the GHG Assessment.

Table 1. Total GHG Emission Estimates for Each Project Alternative

	Beach Stabilization	**Beach Nourishment**	**Beach Maintenance**
Sand Recovery and Transport (Barge) (MT CO_2e)	310.8	254.3	442.7
Sand Transport (Land), Placement and Groin Construction (MT CO_2e)	2,149.0	612.0	1,225.0
Total (MT CO_2e)	**2,459.8**	**866.3**	**1,667.7**
Project Design Life (Years)	50	10	50
Total Per Year of Project Lifespan (MT CO_2e/year)	**49.2**	**86.6**	**33.4**

Source: Munekiyo Hiraga

As shown in **Table 1**, the Beach Nourishment alternative would have the lowest overall cumulative emission value (866.3 MT CO_2e), but when considering the emissions based on the project design life the model shows Beach Maintenance and Beach Stabilization as the most efficient alternatives when assessed based on GHG emission total and the project design life (49.2 and 33.4 MT CO_2e/year, respectively).

The State of Hawai'i produced 20.18 million MT CO_2e in 2021, the most recently reported value. Based on this amount, total emissions for any of the beach restoration alternatives, as assessed by the model, would account for 0.01 percent or less of the State CO_2e emissions. When considering this project on a statewide scale, these impacts are negligible.

INTRODUCTION 1

II. INTRODUCTION

This Greenhouse Gas Assessment Report (Report) has been prepared for the Hoʻāla Honokōwai Project to assess Greenhouse Gas (GHG) emissions generated by the proposed action alternatives. Specifically, this Report focuses on GHG emissions associated with the implementation of beach restoration. There are no impacts related to GHG emissions anticipated post-construction/implementation and as such, these impacts are not addressed in this Report. Furthermore, the No Action alternative was not assessed as the specific methodologies for removal of the temporary erosion skirt have not yet been defined.

A. PROJECT OVERVIEW

West Maui Resort Partners, L.P. is proposing to restore and preserve Honokōwai Beach (Proposed Action) in Honokōwai, Maui, Hawaiʻi. Honokōwai Beach is located on the west coast of Maui, north of Kāʻanapali and south of Honokōwai Beach Park and Kahana Bay, in the Kāʻanapali District and Honokōwai Ahupuaʻa. See **Figure 1** (Regional Location Map). Honokōwai Beach is an important natural, cultural, and aesthetic resource that supports a wide variety of cultural, recreational, and economic uses. Honokōwai Beach offers perpendicular and lateral shoreline access, public parking, and public restrooms. The beach also acts as a natural buffer that absorbs wave energy and protects the backshore and infrastructure from the destructive forces of the ocean that can cause erosion and flooding.

In 2016, a combination of persistent North Pacific swell and elevated water levels produced high waves, strong currents, and abnormally high tides. This combination of factors led to significant erosion and beach loss at Honokōwai Beach. The backshore area eroded, and a vertical escarpment (steep slope) formed along the shoreline creating a risk to public health, safety, and welfare, and impeding public access to and along the shoreline. The shoreline retreated 6 to 12 feet (ft.) in just a few months, and the beach was almost entirely eroded. Approximately 5,600 square feet (s.f.) of fast land was lost to erosion, and over 1,000 cubic yards (cy) of alluvial sediment (i.e., clay, silt, boulders) was discharged into the ocean. The eroded sediment caused turbidity plumes (i.e., brown water) to form in the nearshore waters, which negatively impacted water quality and inhibited access to and use of the shoreline for cultural and recreational activities. The erosion dramatically altered the configuration, appearance, and stability of Honokōwai Beach.

The portion of beach proposed for restoration is located in front of Kāʻanapali Shores (TMK (2)4-4-001:097) on the northernmost end, the Kāʻanapali Beach Club (KBC) (TMK (2)4-4-001:098), and Maui Kai Condominiums (TMK (2)4-4-001:100) on the southernmost end. See **Figure 2**. Access to this portion of Honokōwai Beach is provided from a paved road

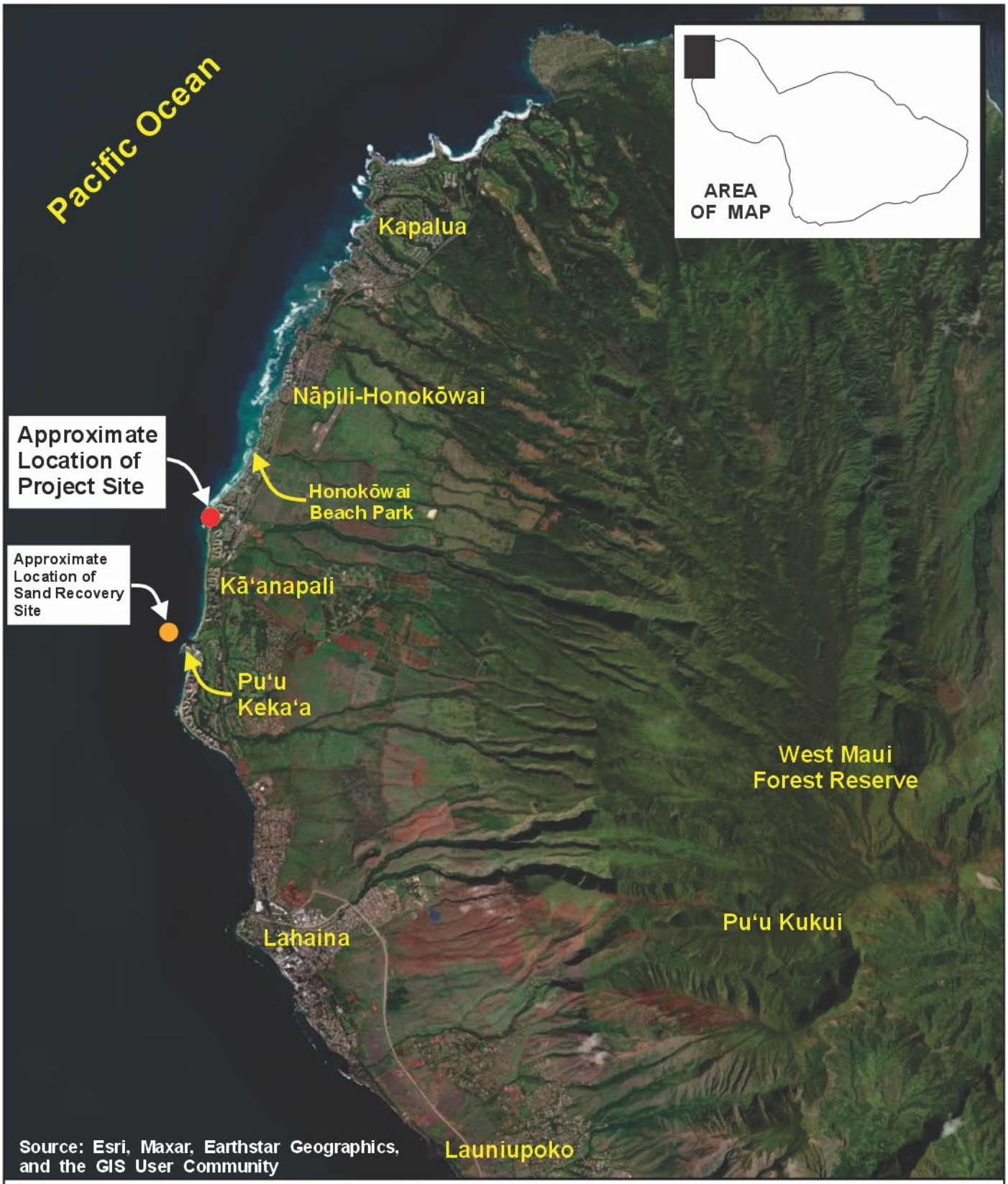


Figure 1

Ho‘āla Honokōwai
Regional Location

0 4,000 8,000
Feet

MUNEKIYO HIRAGA

Prepared for: West Maui Resort Partners, L.P.

HGV\KBC Beach Restor\Apps\Figures\GHG Rpt\RegLoc



Figure 2

Ho'āla Honokōwai
Project Location

0 175 350
Feet

Prepared for: West Maui Resort Partners, L.P.

MUNEKIYO HIRAGA

HGV\KBC Beach Restor\Apps\Figures\GHG Rpt\ProjLoc

and parking lot and a concrete sidewalk on the north end of the KBC property off of Kāʻanapali Shores Place, and through the resort.

Beach restoration is a mid-term solution to address beach loss and sea level rise, allowing time to plan, obtain permits, and implement long-term adaptations. Beach restoration is considered a nature-based alternative for shoreline management in Hawaiʻi. Three methods of implementing beach restoration are being considered for the Project and will be assessed in this Report. These methods are summarized below.

1. Beach Nourishment

Beach Nourishment refers to an individual action (project) that involves the placement of additional sand to increase beach width and sand volume to offset the effects of erosion without modifying existing structures or installing any new structures.

At Honokōwai Beach, the Beach Nourishment alternative would involve placing sand at the south end of the Honokōwai littoral cell, along approximately 1,000 ft. of shoreline between Honokōwai Stream to the north and Honokōwai Point to the south. The beach would have a crest elevation of +8.5 ft. mean sea level (MSL) and a beach slope of 1V:8H. Approximately 27,000 cy of sand would be added, providing a minimum beach width of 25 to 30 ft. See **Figure 3**. Without stabilizing structures, the expected lifespan of benefits associated with a one-time Beach Nourishment action at Honokōwai Beach is 10 years, although the lifespan could be shortened by episodic erosion events. This lifespan can be increased by subsequent nourishment (i.e., Beach Maintenance) or with stabilizing structures (i.e., Beach Stabilization), discussed below.

2. Beach Maintenance

Beach Maintenance refers to a series of actions (program) that consist of periodic beach nourishment actions combined with sand pushing and/or sand back passing, without modifying existing structures or installing any new structures. Beach Maintenance actions are typically intended to be conducted on a recurring, periodic basis over a specified period of time and are therefore considered to be programmatic in nature.

At Honokōwai Beach, the initial nourishment effort would be identical to the Beach Nourishment alternative described above. Approximately 27,000 cy of sand would be placed at the south end of the Honokōwai littoral cell along approximately 1,000 ft. of shoreline, providing a minimum beach width of 25 to 30 ft. Because there would be no stabilizing structures, periodic beach maintenance would be performed after the initial nourishment and throughout the 50-year design life to maintain a stable



Source: Sea Engineering, Inc.

Figure 3 Ho‘āla Honokōwai Beach Nourishment and Beach Maintenance Project Alternatives

NOT TO SCALE

Prepared for: West Maui Resort Partners, L.P.

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HGV\KBC Beach Restor\Apps\Figures\GHG Rpt\Alternatives

beach. This maintenance would require sand added at time intervals corresponding to when the beach erodes. To maintain a minimum beach berm width of 25 to 30 ft., it is anticipated that renourishments would be required approximately every 10 years. This is based on future shoreline change rate projections that anticipate 1.27 ft. of shoreline recession per year. Over a 50-year period, four renourishment efforts would be required to maintain the desired beach width of 40 ft. Each renourishment effort would require approximately 5,000 cy of sand, resulting in a total of 20,000 cy of additional sand to restore the beach and provide a minimum beach width of 25 to 30 ft. In total, 47,000 cy of sand would be required for the initial nourishment event and four renourishment efforts. Refer to **Figure 3**.

3. Beach Stabilization

Beach Stabilization refers to an individual action that involves placement of sand to nourish the beach and either (i) modifying existing structures, and/or (ii) installing new structures (e.g., groins) to stabilize the sand (i.e., keep the sand in place and prevent it from being washed away). Beach stabilization projects are typically designed to be implemented as a single, discrete project with a specified design life.

At Honokōwai Beach, the Beach Stabilization alternative would involve beach nourishment along with the construction of three T-head groins and one L-head groin. The beach and groin layout are presented in **Figure 4**. The groins would extend seaward from the existing backshore and would be spaced along the shoreline.

The southwest groin near Honokōwai Point and the northwest groin near Honokōwai Stream are considered terminal groins, meaning that they are at the ends of the beach system. The other groins will have sand on either side. Sand fill will be placed between the groins to create a beach with a minimum width of 25 to 30 ft., a +8.5-foot MSL elevation, and a 1V:8H slope from the crest to the sea bottom. An estimated 33,000 cy of sand would be required for this alternative. Beach Stabilization would have a design life of 50 years.

There is the potential for the southern terminal groin to allow sand accretion in front of the Maui Kai Condominiums, outside of the beach cells. The northern terminal groin would most likely prevent sand from accumulating at the mouth of Honokōwai Stream, allowing for uninterrupted flow into the ocean. These would be considered secondary benefits of the project, but cannot be assured.



Source: G70

Figure 4

Ho'āla Honokōwai
Beach Stabilization Alternative

NOT TO SCALE

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HGV\KBC Beach Restor\Apps\Figures\GHG Rpt\BchStblAlt

The groins have been designed to be adaptable to sea level rise beyond their specified design life. The groin crests would have cast-in-place concrete crest caps, which will serve as a base for groin modification as sea level rises. If vertical extensions to the groins are needed with rising sea levels, a crown wall can be constructed on top of the concrete core to increase the height of the groins. This adaptable design allows the initial design to have lower elevations to provide a more open view plane rather than designing taller groins at the outset.

B. CONSTRUCTION METHODOLOGY

The potential impacts related to GHG emissions from the proposed beach restoration actions are primarily associated with construction activities for project implementation. While the three beach restoration methodologies described above vary in approach, there are common elements of construction methodology that apply across Beach Nourishment, Beach Maintenance, and Beach Stabilization. The proposed action will require sand recovery, sand transport, and sand placement. This construction methodology is outlined below as it will provide a basis for conducting the GHG emissions analysis. Unique to Beach Stabilization is stone transportation for the construction of groins.

1. Sand Recovery

Sand Recovery will be done at an offshore sand deposit (herein referred to as the Sand Recovery Site). This site is about 1.5 miles south of the Project Site and is approximately 1,500 to 2,000 ft. off the coast of Puʻu Kekaʻa. Sand will be recovered by an environmental clamshell bucket and then loaded on to a barge until the barge is full. See **Figure 5**. Sand recovery time varies based on the total volume of sand needed for each alternative, but is not a variable of the model.

2. Sand Transport

Barges will originate on Oʻahu and be moved to Maui for work. GHG emissions were not calculated for this portion of the project. When a barge is fully loaded with wet sand, it will travel north, around West Maui to the Kahului Harbor West Dock. The West Dock at Kahului Harbor is assumed to be the offload site and temporary stockpile site for this project. The round trip is anticipated to take the barge eight hours.

Once the sand is offloaded and stockpiled at the offload site, trucks will then transport the sand directly to the Project Site at Honokōwai Beach. The volume of sand and number of trips varies by beach restoration methodology.

For project analysis, sand transport has been separated into two methods, land and barge.

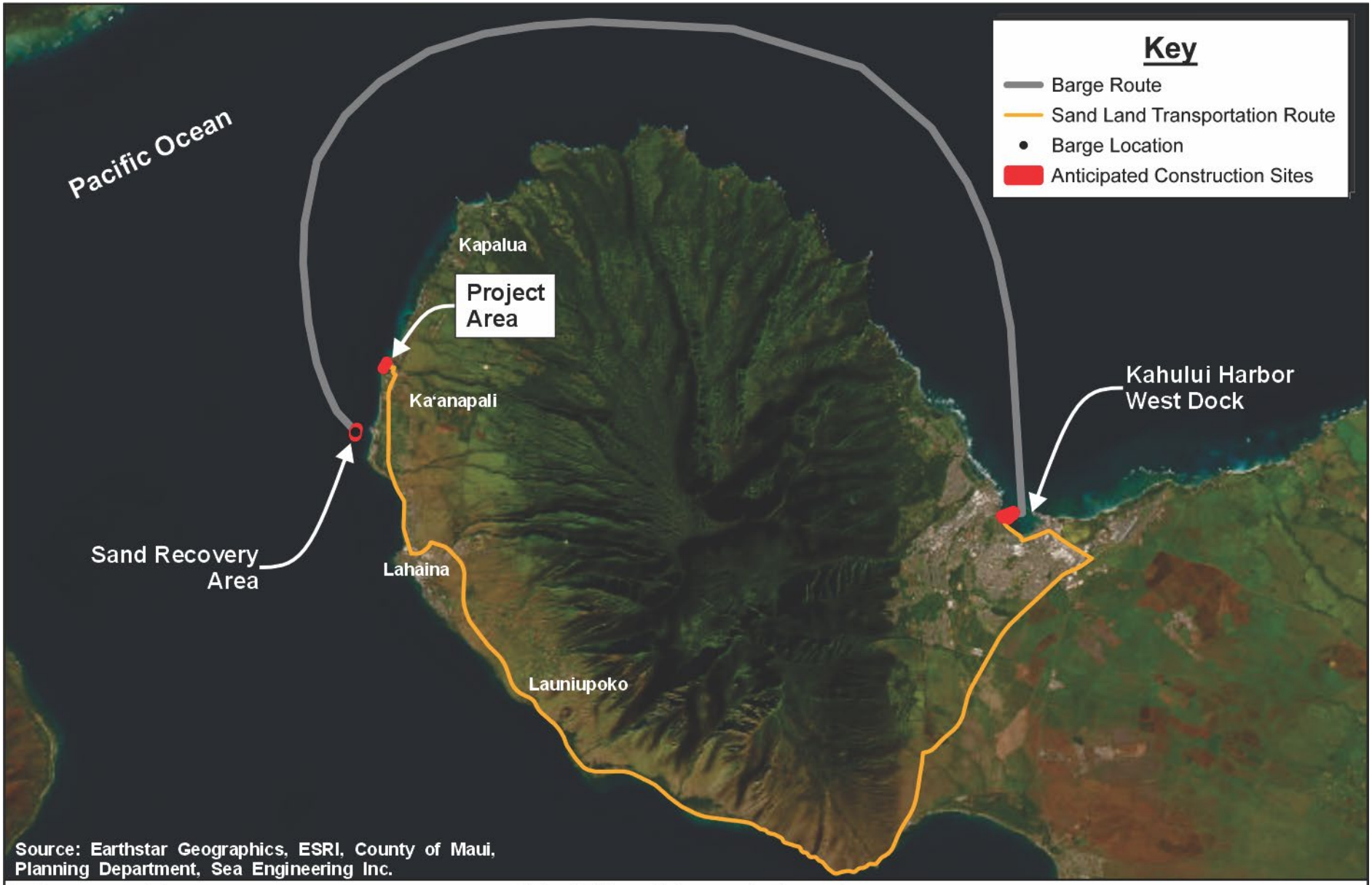


Figure 5

Ho'āla Honokōwai
Sand Transportation Routes

0 8,750 17,500
Feet

MUNEKIYO HIRAGA

Prepared for: West Maui Resort Partners, L.P.

HGV\KBC Beach Restor\Apps\Figurs\GHG Rpt\SandTransport

3. Sand Placement

Sand placement occurs once the sand has been trucked to the Project Site. This step will include the use of construction equipment such as wheeled loaders and bulldozers. It includes building the new beach to the previously outlined design criteria.

4. Groin Construction

For the Beach Stabilization alternative, there is one additional step associated with construction of the groins. Groin construction involves an added component to project implementation, extending the construction duration and the duration in which construction equipment will be utilized, generating additional GHG emissions. The added work requires the use of excavators to move the stone to form the groins on the beach and requires transportation of stone from the HC&D Baseyard in Puʻunēnē, the assumed source of the stone to the Project Site. This step is done concurrently with sand placement.

C. GREENHOUSE GAS AND CLIMATE CHANGE

The greenhouse effect is the natural ability of the Earth's atmosphere to trap in heat from the sun. Gases such as Carbon Dioxide (CO_2), Methane (CH_4), and Nitrous Oxide (N_2O) play a crucial role in trapping solar radiation from the sun to insulate the earth. Without the greenhouse effect, life as we know it would not exist on earth. Despite the importance of GHGs, too much of these gases can have a negative effect as there is too much insulation, which creates a warmer average temperature on the Earth. A temperature increase of just 2 degrees Celsius from pre-industrial levels is considered a critical threshold for the Earth being able to maintain natural functions as we know them (NASA, 2023). As such, it has been deemed important to monitor GHG emissions on a global scale.

GHG emissions are linked to anthropogenic (i.e., environmental change caused or influenced by people, either directly or indirectly) climate change and associated impacts. While it is true that the earth experiences natural fluctuations in temperature over millennia, average global temperature has continued to rise since the industrial revolution, to levels never before recorded (NASA, 2023). Problems from the exorbitant amount of GHG emissions are well documented and include warmer average temperatures, melting ice caps resulting in rising sea levels, cyclones with an anticipated increase in intensity, and fire weather becoming more common (IPCC, 2023). Due to these impacts, it has become increasingly important to understand GHG emissions associated with project activities such as construction and operation.

D. GHG EMISSIONS ESTIMATION METHODOLOGY

This study will assess the potential GHG emissions associated with construction of the three beach restoration alternatives – Beach Nourishment, Beach Maintenance, and Beach Stabilization. Two methodologies are used to estimate GHG emissions in this report, as described below.

1. Sand Recovery and Transport (Barge)

GHG emissions associated with sand recovery and transportation via barge are calculated using an emission factor developed for the British Monarchy of the United Kingdom's GHG and emission analysis for barge activity. This emission factor is being applied to project specific uses related to volume of sediment and duration of barge activity. Support vessels that will be used at the Project Site are assumed to be included in the emission factor and are not additionally calculated. Furthermore, the initial source of the barge (i.e. transport from O'ahu to Maui) is not assessed in this study.

2. Sand Transport (Land), Sand Placement, and Groin Construction

Sand transportation on land and construction related to sand placement and groin construction (Beach Stabilization only) are being assessed using the California Emissions Estimator Model (CalEEMod), developed by the California Air Pollution Control Officers Association (California Air Pollution Control Officers Association, 2022). Although this model is designed for California, the basic functionality of assessing GHG emissions based on workload and construction duration is applicable in Hawai'i. The model did not include trips for workers traveling to and from the construction site.

Assumptions on construction requirements are shown in **Table 2**. Each input variable is assumed to be operating eight hours per day and with a load factor of 0.5. It is noted that the equipment list presented in **Table 2** is a preliminary list and is subject to change based on the contractor's means and methods. The assumption of a load factor of 0.5 and an 8-hour daily operation was to ensure the model does not underestimate potential emissions.

Table 2. Required Equipment and the Days it will be Used for Land Based Construction

EQUIPMENT	BEACH STABILIZATION (DAYS)	BEACH NOURISHMENT (DAYS)	BEACH MAINTENANCE (DAYS)
PC-400 Excavators[1]	271	0	0
WA-380 Wheeled Loaders	271	128	256
HM-300 Articulating Dump truck	271	128	256
D-65 Bulldozers	271	128	256

Source: Sea Engineering
[1] The PC-400 Excavator will only be used for Beach Stabilization for the groin construction

REGULATORY FRAMEWORK AND EXISTING GHG EMISSIONS

III

III. REGULATORY FRAMEWORK AND EXISTING GHG EMISSIONS

A. INTERNATIONAL AND FEDERAL GREENHOUSE GAS EMISSION FRAMEWORK

Most international climate guidance comes from the Paris United Nations Framework Convention on Climate Change Conference (UNFCCC) in 2015, also known as the Paris Agreement. The Paris Agreement, an international treaty on climate change adopted by 196 parties at the 2015 Paris UNFCCC has legally binding obligations for parties to update their nationally determined contributions to emissions. The goal of this treaty is to hold the increase in global average temperature to well below 2.0 degrees Celsius above pre-industrial levels. The temperature limit is set by scientific guidance provided by the Intergovernmental Panel on Climate Change (IPCC).

In support of the Paris Agreement, the governors of Hawai‘i and 21 other states as well as Puerto Rico and Guam joined together in a bipartisan group called the U.S. Climate Alliance to meet GHG targets. These targets are planned to be met by focusing on policy and infrastructure improvements to guide America to net-zero carbon emissions.

The Clean Air Act (CAA) is the primary basis for federal regulatory guidance on GHG emissions. The CAA is primarily enforced by the U.S. Environmental Protection Agency (EPA). In 2009, the EPA implemented mandatory reporting of GHG emissions and created the Greenhouse Gas Reporting Program (GHGRP). This legislation required corporations to report emissions to the EPA if they were over an agency-defined threshold. Also, in 2009, in what is known as the EPA Endangerment Finding, the EPA determined that six GHG, including CO_2 needed to be regulated as they will impact public health and welfare. Because of these findings, the EPA found that GHG can be regulated under the CAA and thus began to regulate emissions to mitigate impacts associated with climate change. In 2022, as a result of a Supreme Court case, *West Virginia vs. EPA*, the supreme court limited the EPA’s ability to impose broad regulations on power plants without explicit Congressional authority. However, the EPA still does maintain authority in narrower contexts such as for vehicle emissions.

In addition to what has been done by the EPA, the Department of Transportation National Highway Traffic Safety Administration, who oversees regulating fuel economy standards, set corporate average fuel economy standards to regulate a minimum distance per gallon of fuel. This regulation is intended to reduce GHG emissions associated with transportation, a significant contributor to GHG emissions accounting for approximately 28 percent of emission in the United States (EPA, 2023).

B. STATE OF HAWAIʻI GREENHOUSE GAS EMISSION FRAMEWORK

In 2007, the Hawaiʻi State Legislature enacted Act 234, which created the GHG Emissions Reduction Task Force and established the foundations for the Hawaiʻi GHG Program. Act 234 also declared the State's policy to reduce GHG emissions in the State to 1990 levels by 2020. Portions of this act have been codified in Hawaiʻi Revised Statutes (HRS) 342B. In 2018, Act 15 of the Legislature of the State of Hawaiʻi, established a goal for a statewide energy portfolio of one hundred percent renewable energy by 2045. This act is a legally binding benchmark in support of the 2015 Paris Climate Accord. Additionally, Act 238 of 2022 established a goal for the statewide GHG emissions limit to be 50 percent below 2005 levels by 2030. These acts are guiding the State towards a reduction in non-renewable energy usage. While these acts are guiding energy sourcing and usage, there is no State legislation setting any maximum allowable amount of emissions, also known as an emissions cap, although Federal law still applies.

As mentioned in the federal framework section, emissions over benchmark levels are to be reported through the GHGRP. That responsibility is delegated to the Hawaiʻi Department of Health, Clean Air Branch. The benchmark for mandatory reporting in Hawaiʻi is set at 25,000 metric tons (MT) of CO_2 equivalent (CO_2e) (GHGs besides CO_2 are converted into the equivalent warming potential of CO_2) per year.

Chapter 343 HRS requires the analysis of Significance Criteria through Hawaiʻi Administrative Rules (HAR) § 11-200.1-13 when preparing an Environmental Assessment or Environmental Impact Statement. One of these criteria requires an assessment as to whether a proposed action will, "Require substantial energy consumption or emit substantial greenhouse gases." Significance Criteria are used to determine if an action will have a significant impact on various parts of the environment. As such, assessing GHG impacts is a crucial and necessary step in the completion of an Environmental Assessment or an Environmental Impact Statement.

C. EXISTING STATEWIDE GREENHOUSE GAS EMISSIONS

As described herein, the State of Hawaiʻi is working to reduce net GHG emissions. The most recent data shows that in 2021, total GHG emissions for the State stood at 20.18 million MT CO_2e. Net emissions, which consider carbon sinks, were 17.79 million MT CO_2e. The energy sector was the largest emitter at 86.7 percent. Emissions have been trending down in Hawaiʻi since the early 2000s. As a result of the COVID-19 pandemic, emissions were down in 2020, lower than 2021, but 2021 is still lower than the previous years of 2017-2019. Nevertheless, projections for future emissions are still estimated to be above the 2030 and 2045 targets by roughly 1.5 million MT and 10.5 million MT CO_2e, respectively (State of Hawaiʻi, Department of Health, Clean Air Branch, 2024).

GREENHOUSE GAS ASSESSMENT

IV

IV. GREENHOUSE GAS ASSESSMENT

For ease of analysis, all GHG emissions are assessed in terms of CO_2e. CO_2e calculates the values of other GHG such as methane (CH_4) or nitrous oxide (N_2O) and converts the impacts associated with those gases into their CO_2 equivalence. For example, the IPCC has reported that one kilogram (kg) of CH_4 is equivalent to 29.8 kg of CO_2. The use of CO_2e helps to understand the total GHG impacts of a project in a simpler way than reporting values for each GHG emitted. Impacts from each type of GHG associated with land-based construction are assessed in the appendix corresponding to the action alternative.

A. SAND RECOVERY AND TRANSPORT (BARGE)

1. Introduction

Sand will be dredged from the Sand Recovery Site using an environmental clamshell bucket. The recovered sand will be loaded onto barges and transported to Kahului Harbor. The total amount of sand required for restoration varies by action alternative.

2. Methodology

Due to the lack of preferred GHG models for barging activities that use detailed information to assess a project over its lifespan for emissions, an emissions factor (EF) will be used to quantify emissions associated with dredging and barging operations. EFs have long been used to set emission inventories and guide policy decisions. An EF can be understood as a standardized representational value used to assess CO_2e based on an activity (EPA, 2024). The project EF is derived from a 2010 study published by The Crown Estate whose parent organization is the Monarchy of the United Kingdom. The report was created by Environmental Resources Management Limited (ERM). ERM found that GHG from cradle to grave, or the full life span of when the barge sets off to when the barge returns with dredged sand for trips less than 12 hours, can quantify emissions as 6.41 kilograms (kg) of CO_2e per MT of sand (Aumônier, Hartlin and Peirce, 2010). The dredging operation will obtain wet sand, the weight for which is assumed at 3,240 pounds (lb.)/cubic yard (cy) (EPA, n.d.).

An analysis using the assumed weight of a cubic yard of sand was conducted for each project alternative based on the volume of sand required for the totality of the project lifespan as defined in **Table 3**.

Table 3. Description of Basic Requirements for Each Methodology

Project Alternative	Total Cubic Yards of Sand	Project Lifespan	Sand Recovery Days
Beach Stabilization	33,000	50 years	66
Beach Maintenance	47,000	50 years	94
Beach Nourishment	27,000	10 years	54
Source: Sea Engineering, Inc. (2024)			

Based on the assumptions noted above, the total emissions for each alternative were estimated by using the total volume of sand, converting the volume to weight in MT, and applying the EF of 6.41 kg of CO_2e/MT of sand. Calculations based on these assumptions and the total values of MT CO_2e are shown in **Table 4**.

Table 4. Total Metric Tons of CO_2e Calculated for Each Project Alternative

	Unit	Beach Stabilization	Beach Nourishment	Beach Maintenance
(A) Total Volume of Sand	cy	33,000	27,000	47,000
(B) Weight of Sand (= A *3,240 lb./cy)	MT	48,498.10	39,680.20	69,073.00
(C) Emissions Factor	kg of CO_2e/MT	6.41	6.41	6.41
(D) Emissions (= B * C)	**MT CO_2e**	**310.8**	**254.3**	**442.7**
Source: Munekiyo Hiraga				

It is noted that other methods were considered for analyzing GHG emissions associated with barging and dredging such as the 2024 SmartWay Barge Tool from the EPA. SmartWay is intended to function as a partnership between the EPA and the freight industry to increase fuel efficiency. As such, it was not deemed to be the proper measurement tool for this project. As the distance of the barge trip is relatively short, but not yet exactly known, using an emissions factor based off of a metric ton of sand rather than miles per hour was determined to be more appropriate since the weights of the product required are known.

3. Results

Using the Emissions Factor of EF = 6.41 kg of CO_2e / MT of sand, estimated GHG emissions are shown in **Table 5** as both a total number and as per year of project design life.

Table 5. Summary of Results: Sand Recovery and Transport – Barging

	Beach Stabilization	Beach Nourishment	Beach Maintenance
MT CO_2e	310.8	254.3	442.7
Project Design Life (Years)	50	10	50
MT CO_2e/year	6.2	25.4	8.9
Source: Munekiyo Hiraga			

B. SAND TRANSPORT (LAND), SAND PLACEMENT, AND GROIN CONSTRUCTION

1. Introduction

Sand placement, construction, and land transportation will be analyzed for all three project alternatives: Beach Stabilization, Beach Nourishment, and Beach Maintenance. This portion of the analysis estimates emissions associated with the transportation of the sand from Kahului Harbor to the Project Site and construction at the Project Site including construction vehicle emissions.

2. Methodology

The GHG estimation analysis for sand transportation (land), placement, and groin construction was performed for each project alternative (groin construction is only for Beach Stabilization). The California Emissions Estimator Model (CalEEMod) version 2022.1 was used to analyze each methodology and can be found in **Appendix "A"**, **Appendix "B"**, and **Appendix "C"** for Beach Stabilization, Beach Nourishment, and Beach Maintenance, respectively. The CalEEMod is a computer program that uses inputs such as type and use scenario of construction equipment, vehicle miles traveled, volume of sand moved, and other related factors to assess GHG and air pollutant values. These variables are input into the model which assesses the impacts and computes an assessed GHG emission value based on the information supplied.

CalEEMod is limited to off-road vehicle input, to an extent. Classifications were done to best model and replicate the information supplied based on construction estimates. Passenger vehicles such as flat beds and ¾ ton trucks were not incorporated in the analysis although are anticipated to be used for all project alternatives. Additionally, worker trips (i.e., from workers' homes to the Project Site and back) have been excluded from the model as there is still uncertainty as to where the contractors will be traveling from.

The method used for analysis, CalEEMod, accounts for all aspects of construction as shown in **Appendices "A"**, **"B"**, and **"C"**. Although the model was built for

California, it still provides a reasonable estimate for emissions related to construction and is the best available model for analyzing emissions.

3. Results

The results of the GHG analysis for each alternative are shown in **Table 6**.

Table 6. Sand Transport (Land), Placement, and Groin Construction - MT of CO_2e for each alternative assessed

	Beach Stabilization	Beach Nourishment	Beach Maintenance
MT CO_2e	2,149	612	1,225
Project Lifespan (Years)	50	10	50
MT CO_2e/year	42.9	61.2	24.5
Source: Munekiyo Hiraga			

Further details such as GHG values for carbon dioxide, methane, nitrous oxide, sulfur dioxide, nitrogen oxides, particulate matter, and the values associated with the various land-based aspects of construction can be viewed in the respective appendix for each project alternative.

C. SUMMARY

The combined effects of sand recovery and transport (barge), sand and stone transport (land), sand placement, and groin construction are shown in **Table 7**.

Table 7. Total GHG emission estimates for each project alternative

	Beach Stabilization	Beach Nourishment	Beach Maintenance
Sand Recovery and Transport – Barging (MT CO_2e)	310.8	254.3	442.7
Sand Transport (Land), Sand Placement and Groin Construction (MT CO_2e)	2,149	612	1,225
Total (MT CO_2e)	**2,459.8**	**866.3**	**1,667.7**
Project Design Life (Years)	50	10	50
Total Per Year of Project Lifespan (MT CO_2e/year)	**49.2**	**86.6**	**33.4**
Source: Munekiyo Hiraga			

This summary calculation of the two methods of GHG analysis was conducted to best estimate the impacts from acquiring and placing sand (and stone) on the beach using the most accurate information related to sand volume and construction requirements available. The Beach Nourishment alternative would have the lowest overall cumulative emission value (866.3 MT CO_2e), but when considering the emissions based on the project design life the model shows Beach Stabilization and Beach Maintenance as more

efficient alternatives when assessed based on GHG emission total and the lifespan of benefits (49.2 and 33.4 MT CO_2e/year, respectively).

Beach Stabilization will be completed in one action and all emissions are associated with that construction period. Beach Maintenance will be a recurring action that will have impacts approximately every 10 years as a result of recurring construction. As transport of barging equiptment from O‘ahu to Maui is not accounted for, this is missed in the analysis for Beach Maintenance which would require five total maintenance actions.

The State of Hawai‘i produced 20.18 million MT CO_2e in 2021, the most recently reported value. Based on this amount, total emissions for any of the beach restoration alternatives would account for 0.01 percent or less of the State CO_2e emissions. When considering this project at a statewide scale, these impacts are negligible. To provide some context for the proposed work, the average American produces 16 metric tons of CO_2e per year (Nature Conservancy, n.d.). Emissions associated with Beach Stabilization would account for approximately 169 American’s yearly emissions or individual emissions attributed to 500 passengers on a flight from Kahului Airport (OGG) to Los Angeles Airport (LAX) (ICAO Carbon Emission Calculator, 2025).

SIGNIFICANCE CRITERIA AND CUMULATIVE EFFECTS

V

V. SIGNIFICANCE CRITERIA AND CUMULATIVE EFFECTS

The only set criteria for GHG emission consideration in the State of Hawai‘i relates to the Greenhouse Gas Reporting Program (GHGRP). The threshold for GHGRP is 25,000 MT CO_2e per year in Hawai‘i. The three methodologies for implementing beach restoration will generate emissions ranging from 866.3 MT CO_2e to 2,459.8 MT CO_2e, well below the 25,000 MT CO_2e threshold and do not require reporting. As previously mentioned, Statewide limits have been set as a cap for GHG emissions to meet thresholds for reductions. Given the nominal level of GHG emissions associated with the three methodologies of beach restoration, the proposed action will not materially impact the State's ability to meet these goals.

The project is expected to have minor air quality impacts during construction in addition to GHG emissions. Dust control and air pollution control best management practies (BMPs) have been identified in the Best Management Practices Plan prepared for the project. Minor air quality impacts will cease when construction ends and include particulate matter, dust, etc.

REFERENCES VI

VI. REFERENCES

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APPENDIX

A

BEACH STABILIZATION GHG ANALYSIS

CalEEMod is a California based software that is intended for use in California. As such, customizable location cannot be set to Hawai‘i. Despite this limitation, the principal analysis of a GHG assessment remains the same for Hawai‘i locations. The results of the study are not inherently different based on the fact that the software is operating outside of California. There are additional features within CalEEMod that when used for operation in California, will provide details on mitigation, fire risk, and other factors that can be beneficial but are ultimately superfluous to a GHG impact analysis as they do not affect the model’s ability to account for GHG based on use description.

Hoala Honokowai Beach Stabilization Detailed Report

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1.1. Basic Project Information

Data Field	Value
Project Name	Hoala Honokowai Beach Stabilization
Construction Start Date	1/1/2030
Lead Agency	—
Land Use Scale	Project/site
Analysis Level for Defaults	County
Windspeed (m/s)	2.60
Precipitation (days)	19.8
Location	32.83676833755551, -117.28126143218918
County	San Diego
City	San Diego
Air District	San Diego County APCD
Air Basin	San Diego
TAZ	6306
EDFZ	12
Electric Utility	HIOA eGRID Subregion Values
Gas Utility	San Diego Gas & Electric
App Version	2022.1.1.29

1.2. Land Use Types

Land Use Subtype	Size	Unit	Lot Acreage	Building Area (sq ft)	Landscape Area (sq ft)	Special Landscape Area (sq ft)	Population	Description
City Park	3.60	Acre	3.60	0.00	0.00	0.00	—	—

1.3. User-Selected Emission Reduction Measures by Emissions Sector

No measures selected

2. Emissions Summary

2.1. Construction Emissions Compared Against Thresholds

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Un/Mit.	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	6.69	5.36	48.8	36.9	0.15	1.73	2.36	4.09	1.60	0.58	2.18	—	17,164	17,164	0.69	1.07	10.3	17,510
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	6.68	5.36	49.0	36.9	0.15	1.73	2.36	4.09	1.60	0.58	2.18	—	17,166	17,166	0.69	1.07	0.27	17,502
Average Daily (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	4.78	3.83	35.0	26.3	0.11	1.24	1.67	2.91	1.14	0.41	1.55	—	12,260	12,260	0.49	0.76	3.18	12,503
Annual (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	0.87	0.70	6.39	4.81	0.02	0.23	0.30	0.53	0.21	0.08	0.28	—	2,030	2,030	0.08	0.13	0.53	2,070

2.2. Construction Emissions by Year, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2030	6.69	5.36	48.8	36.9	0.15	1.73	2.36	4.09	1.60	0.58	2.18	—	17,164	17,164	0.69	1.07	10.3	17,510

Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2030	6.68	5.36	49.0	36.9	0.15	1.73	2.36	4.09	1.60	0.58	2.18	—	17,166	17,166	0.69	1.07	0.27	17,502
2031	6.59	5.32	47.7	36.7	0.15	1.70	2.36	4.06	1.57	0.58	2.15	—	16,980	16,980	0.69	1.07	0.24	17,316
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2030	4.78	3.83	35.0	26.3	0.11	1.24	1.67	2.91	1.14	0.41	1.55	—	12,260	12,260	0.49	0.76	3.18	12,503
2031	0.18	0.15	1.31	1.01	< 0.005	0.05	0.06	0.11	0.04	0.02	0.06	—	465	465	0.02	0.03	0.11	474
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2030	0.87	0.70	6.39	4.81	0.02	0.23	0.30	0.53	0.21	0.08	0.28	—	2,030	2,030	0.08	0.13	0.53	2,070
2031	0.03	0.03	0.24	0.18	< 0.005	0.01	0.01	0.02	0.01	< 0.005	0.01	—	77.0	77.0	< 0.005	< 0.005	0.02	78.6

3. Construction Emissions Details

3.1. Sand Transportation (2030) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.22	0.22	—	0.03	0.03	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Dust From Material Movement	—	—	—	—	—	—	0.22	0.22	—	0.03	0.03	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.16	0.16	—	0.02	0.02	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.03	0.03	—	< 0.005	< 0.005	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.18	0.04	3.49	1.38	0.02	0.04	0.89	0.93	0.04	0.24	0.29	—	3,003	3,003	0.12	0.47	4.99	3,152
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.18	0.04	3.63	1.39	0.02	0.04	0.89	0.93	0.04	0.24	0.29	—	3,004	3,004	0.12	0.47	0.13	3,148

Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.13	0.03	2.59	0.99	0.02	0.03	0.63	0.66	0.03	0.17	0.20	—	2,145	2,145	0.08	0.34	1.54	2,250
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.02	0.01	0.47	0.18	< 0.005	0.01	0.11	0.12	0.01	0.03	0.04	—	355	355	0.01	0.06	0.25	372

3.3. Sand Transportation (2031) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.22	0.22	—	0.03	0.03	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.01	0.01	—	< 0.005	< 0.005	—	—	—	—	—	—	—

Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	< 0.005	< 0.005	—	< 0.005	< 0.005	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.16	0.04	3.49	1.35	0.02	0.04	0.89	0.93	0.04	0.24	0.29	—	2,915	2,915	0.12	0.47	0.12	3,059
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	< 0.005	0.10	0.04	< 0.005	< 0.005	0.02	0.03	< 0.005	0.01	0.01	—	79.8	79.8	< 0.005	0.01	0.05	83.8
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	< 0.005	0.02	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	13.2	13.2	< 0.005	< 0.005	0.01	13.9

3.5. Rock Transportation (2030) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e

Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.30	0.30	—	0.05	0.05	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.30	0.30	—	0.05	0.05	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.21	0.21	—	0.03	0.03	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.04	0.04	—	0.01	0.01	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.19	0.04	3.70	1.45	0.02	0.05	0.95	0.99	0.05	0.26	0.31	—	3,200	3,200	0.12	0.51	5.33	3,359
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.19	0.04	3.84	1.46	0.02	0.05	0.95	0.99	0.05	0.26	0.31	—	3,201	3,201	0.12	0.51	0.14	3,354
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.14	0.03	2.75	1.04	0.02	0.03	0.67	0.70	0.03	0.18	0.22	—	2,286	2,286	0.09	0.36	1.64	2,397
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.03	0.01	0.50	0.19	< 0.005	0.01	0.12	0.13	0.01	0.03	0.04	—	378	378	0.01	0.06	0.27	397

3.7. Rock Transportation (2031) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.30	0.30	—	0.05	0.05	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.01	0.01	—	< 0.005	< 0.005	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	< 0.005	< 0.005	—	< 0.005	< 0.005	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.17	0.04	3.69	1.41	0.02	0.05	0.95	0.99	0.05	0.26	0.31	—	3,105	3,105	0.12	0.51	0.12	3,259
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	< 0.005	0.10	0.04	< 0.005	< 0.005	0.03	0.03	< 0.005	0.01	0.01	—	85.1	85.1	< 0.005	0.01	0.06	89.3
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	< 0.005	0.02	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	14.1	14.1	< 0.005	< 0.005	0.01	14.8

3.9. Sand and Rock Placement (2030) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	6.31	5.28	41.6	34.0	0.11	1.64	—	1.64	1.51	—	1.51	—	10,961	10,961	0.44	0.09	—	10,999
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	6.31	5.28	41.6	34.0	0.11	1.64	—	1.64	1.51	—	1.51	—	10,961	10,961	0.44	0.09	—	10,999
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Off-Road	4.51	3.77	29.7	24.3	0.08	1.17	—	1.17	1.08	—	1.08	—	7,829	7,829	0.32	0.06	—	7,856
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.82	0.69	5.42	4.44	0.01	0.21	—	0.21	0.20	—	0.20	—	1,296	1,296	0.05	0.01	—	1,301
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.11. Sand and Rock Placement (2031) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	6.26	5.24	40.5	33.9	0.11	1.61	—	1.61	1.48	—	1.48	—	10,960	10,960	0.44	0.09	—	10,998
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.17	0.14	1.11	0.93	< 0.005	0.04	—	0.04	0.04	—	0.04	—	300	300	0.01	< 0.005	—	301
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.03	0.03	0.20	0.17	< 0.005	0.01	—	0.01	0.01	—	0.01	—	49.7	49.7	< 0.005	< 0.005	—	49.9
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

4. Operations Emissions Details

4.10. Soil Carbon Accumulation By Vegetation Type

4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Vegetation	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.2. Above and Belowground Carbon Accumulation by Land Use Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Species	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

5. Activity Data

5.1. Construction Schedule

Phase Name	Phase Type	Start Date	End Date	Days Per Week	Work Days per Phase	Phase Description
Sand Transportation	Site Preparation	1/1/2030	1/14/2031	5.00	271	—
Rock Transportation	Site Preparation	1/1/2030	1/14/2031	5.00	271	—
Sand and Rock Placement	Building Construction	1/1/2030	1/14/2031	5.00	271	—

5.2. Off-Road Equipment

5.2.1. Unmitigated

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Sand and Rock Placement	Excavators	Diesel	Average	3.00	8.00	257	0.50
Sand and Rock Placement	Dumpers/Tenders	Diesel	Average	1.00	8.00	332	0.50
Sand and Rock Placement	Rubber Tired Loaders	Diesel	Average	3.00	8.00	191	0.50
Sand and Rock Placement	Rubber Tired Dozers	Diesel	Average	3.00	8.00	217	0.50

5.3. Construction Vehicles

5.3.1. Unmitigated

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Sand Transportation	—	—	—	—
Sand Transportation	Worker	0.00	12.0	LDA,LDT1,LDT2
Sand Transportation	Vendor	—	7.63	HHDT,MHDT
Sand Transportation	Hauling	32.0	30.0	HHDT
Sand Transportation	Onsite truck	—	—	HHDT

Rock Transportation	—	—	—	—
Rock Transportation	Worker	0.00	12.0	LDA,LDT1,LDT2
Rock Transportation	Vendor	—	7.63	HHDT,MHDT
Rock Transportation	Hauling	32.0	32.0	HHDT
Rock Transportation	Onsite truck	—	—	HHDT
Sand and Rock Placement	—	—	—	—
Sand and Rock Placement	Worker	0.00	12.0	LDA,LDT1,LDT2
Sand and Rock Placement	Vendor	0.00	7.63	HHDT,MHDT
Sand and Rock Placement	Hauling	0.00	20.0	HHDT
Sand and Rock Placement	Onsite truck	—	—	HHDT

5.4. Vehicles

5.4.1. Construction Vehicle Control Strategies

Non-applicable. No control strategies activated by user.

5.5. Architectural Coatings

Phase Name	Residential Interior Area Coated (sq ft)	Residential Exterior Area Coated (sq ft)	Non-Residential Interior Area Coated (sq ft)	Non-Residential Exterior Area Coated (sq ft)	Parking Area Coated (sq ft)

5.6. Dust Mitigation

5.6.1. Construction Earthmoving Activities

Phase Name	Material Imported (Ton of Debris)	Material Exported (Ton of Debris)	Acres Graded (acres)	Material Demolished (sq. ft.)	Acres Paved (acres)
Sand Transportation	33,000	0.00	0.00	0.00	—
Rock Transportation	22,442	0.00	0.00	0.00	—

5.6.2. Construction Earthmoving Control Strategies

Non-applicable. No control strategies activated by user.

5.7. Construction Paving

Land Use	Area Paved (acres)	% Asphalt
City Park	0.00	0%

5.8. Construction Electricity Consumption and Emissions Factors

kWh per Year and Emission Factor (lb/MWh)

Year	kWh per Year	CO2	CH4	N2O
2030	0.00	1,575	0.16	0.02
2031	0.00	1,575	0.16	0.02

5.18. Vegetation

5.18.1. Land Use Change

5.18.1.1. Unmitigated

Vegetation Land Use Type	Vegetation Soil Type	Initial Acres	Final Acres

5.18.1. Biomass Cover Type

5.18.1.1. Unmitigated

Biomass Cover Type	Initial Acres	Final Acres

5.18.2. Sequestration

5.18.2.1. Unmitigated

Tree Type	Number	Electricity Saved (kWh/year)	Natural Gas Saved (btu/year)

6. Climate Risk Detailed Report

6.1. Climate Risk Summary

Cal-Adapt midcentury 2040–2059 average projections for four hazards are reported below for your project location. These are under Representation Concentration Pathway (RCP) 8.5 which assumes GHG emissions will continue to rise strongly through 2050 and then plateau around 2100.

Climate Hazard	Result for Project Location	Unit
Temperature and Extreme Heat	9.62	annual days of extreme heat
Extreme Precipitation	2.55	annual days with precipitation above 20 mm
Sea Level Rise	—	meters of inundation depth
Wildfire	0.00	annual hectares burned

Temperature and Extreme Heat data are for grid cell in which your project are located. The projection is based on the 98th historical percentile of daily maximum/minimum temperatures from observed historical data (32 climate model ensemble from Cal-Adapt, 2040–2059 average under RCP 8.5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Extreme Precipitation data are for the grid cell in which your project are located. The threshold of 20 mm is equivalent to about ¾ an inch of rain, which would be light to moderate rainfall if received over a full day or heavy rain if received over a period of 2 to 4 hours. Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Sea Level Rise data are for the grid cell in which your project are located. The projections are from Radke et al. (2017), as reported in Cal-Adapt (Radke et al., 2017, CEC-500-2017-008), and consider inundation location and depth for the San Francisco Bay, the Sacramento-San Joaquin River Delta and California coast resulting different increments of sea level rise coupled with extreme storm events. Users may select from four scenarios to view the range in potential inundation depth for the grid cell. The four scenarios are: No rise, 0.5 meter, 1.0 meter, 1.41 meters
Wildfire data are for the grid cell in which your project are located. The projections are from UC Davis, as reported in Cal-Adapt (2040–2059 average under RCP 8.5), and consider historical data of climate, vegetation, population density, and large (> 400 ha) fire history. Users may select from four model simulations to view the range in potential wildfire probabilities for the grid cell. The four simulations make different assumptions about expected rainfall and temperature are: Warmer/drier (HadGEM2-ES), Cooler/wetter (CNRM-CM5), Average conditions (CanESM2), Range of different rainfall and temperature possibilities (MIROC5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.

6.2. Initial Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	N/A	N/A	N/A	N/A
Wildfire	N/A	N/A	N/A	N/A
Flooding	N/A	N/A	N/A	N/A
Drought	N/A	N/A	N/A	N/A
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores do not include implementation of climate risk reduction measures.

6.3. Adjusted Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	N/A	N/A	N/A	N/A
Wildfire	N/A	N/A	N/A	N/A
Flooding	N/A	N/A	N/A	N/A
Drought	N/A	N/A	N/A	N/A
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores include implementation of climate risk reduction measures.

6.4. Climate Risk Reduction Measures

7. Health and Equity Details

7.1. CalEnviroScreen 4.0 Scores

The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Exposure Indicators	—
AQ-Ozone	40.0

AQ-PM	47.5
AQ-DPM	24.9
Drinking Water	29.0
Lead Risk Housing	38.8
Pesticides	0.00
Toxic Releases	27.5
Traffic	14.5
Effect Indicators	—
CleanUp Sites	5.64
Groundwater	74.8
Haz Waste Facilities/Generators	61.6
Impaired Water Bodies	23.9
Solid Waste	0.00
Sensitive Population	—
Asthma	5.05
Cardio-vascular	1.52
Low Birth Weights	73.5
Socioeconomic Factor Indicators	—
Education	0.15
Housing	48.1
Linguistic	0.00
Poverty	22.2
Unemployment	29.4

7.2. Healthy Places Index Scores

The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Economic	—

Above Poverty	80.91877326
Employed	90.79943539
Median HI	55.10073143
Education	—
Bachelor's or higher	97.39509817
High school enrollment	100
Preschool enrollment	65.09688182
Transportation	—
Auto Access	6.467342487
Active commuting	75.33684075
Social	—
2-parent households	13.49929424
Voting	91.09457205
Neighborhood	—
Alcohol availability	22.46888233
Park access	81.35506224
Retail density	97.86988323
Supermarket access	79.14795329
Tree canopy	10.00898242
Housing	—
Homeownership	18.9272424
Housing habitability	26.42114718
Low-inc homeowner severe housing cost burden	23.81624535
Low-inc renter severe housing cost burden	23.72642115
Uncrowded housing	83.16437829
Health Outcomes	—
Insured adults	79.94353907
Arthritis	2.3

Asthma ER Admissions	95.2
High Blood Pressure	4.0
Cancer (excluding skin)	0.8
Asthma	95.7
Coronary Heart Disease	3.6
Chronic Obstructive Pulmonary Disease	62.6
Diagnosed Diabetes	61.5
Life Expectancy at Birth	71.8
Cognitively Disabled	39.7
Physically Disabled	38.4
Heart Attack ER Admissions	96.8
Mental Health Not Good	99.2
Chronic Kidney Disease	5.2
Obesity	94.0
Pedestrian Injuries	87.3
Physical Health Not Good	86.2
Stroke	17.3
Health Risk Behaviors	—
Binge Drinking	86.1
Current Smoker	99.6
No Leisure Time for Physical Activity	88.3
Climate Change Exposures	—
Wildfire Risk	0.0
SLR Inundation Area	57.3
Children	76.4
Elderly	1.3
English Speaking	95.0
Foreign-born	32.9

Outdoor Workers	89.0
Climate Change Adaptive Capacity	—
Impervious Surface Cover	11.6
Traffic Density	65.2
Traffic Access	87.4
Other Indices	—
Hardship	6.6
Other Decision Support	—
2016 Voting	91.4

7.3. Overall Health & Equity Scores

Metric	Result for Project Census Tract
CalEnviroScreen 4.0 Score for Project Location (a)	10.0
Healthy Places Index Score for Project Location (b)	74.0
Project Located in a Designated Disadvantaged Community (Senate Bill 535)	No
Project Located in a Low-Income Community (Assembly Bill 1550)	No
Project Located in a Community Air Protection Program Community (Assembly Bill 617)	No

a: The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.
b: The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

7.4. Health & Equity Measures

No Health & Equity Measures selected.

7.5. Evaluation Scorecard

Health & Equity Evaluation Scorecard not completed.

7.6. Health & Equity Custom Measures

No Health & Equity Custom Measures created.

8. User Changes to Default Data

Screen	Justification
Characteristics: Utility Information	These values are updated to be specific to Oahu per the HIOA eGrid Subregion for 2022
Construction: Construction Phases	All work will be occurring concurrently so updates have been provided to show emissions associated with delivery of sand from the stockpile site to the project site. Rocks for the groins from the source to the project site, and all groin construction. Total work days are set to 270 days of work with work occurring 5 days a week.
Construction: Off-Road Equipment	Construction Equipment by Horsepower value. Load factor for all is set to 0.5. 217 = D-65 Bulldozer 191 = WA-380 Wheeled Loader 257 = PC-400 Excavator 332 = HM-300 Articulating dump truck
Construction: Dust From Material Movement	NA
Construction: Trips and VMT	Sand Transportation is 2 trucks one way per hour per 8 hour work day from the Kahului Harbor sand storage site. Rock Transportation is 2 trucks one way per hour per 8 hour work day from a potential source of the stone.
Construction: Electricity	Values are updated from the current HIOA eGrid Sub region (year 2022)

APPENDIX B

BEACH NOURISHMENT GHG ANALYSIS

CalEEMod is a California based software that is intended for use in California. As such, customizable location cannot be set to Hawai‘i. Despite this limitation, the principal analysis of a GHG assessment remains the same for Hawai‘i locations. The results of the study are not inherently different based on the fact that the software is operating outside of California. There are additional features within CalEEMod that when used for operation in California, will provide details on mitigation, fire risk, and other factors that can be beneficial but are ultimately superfluous to a GHG impact analysis as they do not affect the model’s ability to account for GHG based on use description.

Hoala Honokowai Beach Nourishment Detailed Report

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8. User Changes to Default Data

1. Basic Project Information

1.1. Basic Project Information

Data Field	Value
Project Name	Hoala Honokowai Beach Nourishment
Construction Start Date	1/1/2030
Lead Agency	—
Land Use Scale	Project/site
Analysis Level for Defaults	County
Windspeed (m/s)	2.60
Precipitation (days)	19.8
Location	32.83676833755551, -117.28126143218918
County	San Diego
City	San Diego
Air District	San Diego County APCD
Air Basin	San Diego
TAZ	6306
EDFZ	12
Electric Utility	HIOA eGRID Subregion Values
Gas Utility	San Diego Gas & Electric
App Version	2022.1.1.29

1.2. Land Use Types

Land Use Subtype	Size	Unit	Lot Acreage	Building Area (sq ft)	Landscape Area (sq ft)	Special Landscape Area (sq ft)	Population	Description
City Park	3.60	Acre	3.60	0.00	0.00	0.00	—	—

1.3. User-Selected Emission Reduction Measures by Emissions Sector

No measures selected

2. Emissions Summary

2.1. Construction Emissions Compared Against Thresholds

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Un/Mit.	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	5.52	4.49	40.4	27.9	0.10	1.52	1.27	2.79	1.40	0.30	1.70	—	10,374	10,374	0.42	0.53	4.99	10,548
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	5.51	4.49	40.6	28.0	0.10	1.52	1.27	2.79	1.40	0.30	1.70	—	10,375	10,375	0.42	0.53	0.13	10,544
Average Daily (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	1.93	1.58	14.2	9.80	0.03	0.53	0.44	0.97	0.49	0.10	0.60	—	3,638	3,638	0.15	0.19	0.76	3,698
Annual (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	0.35	0.29	2.60	1.79	0.01	0.10	0.08	0.18	0.09	0.02	0.11	—	602	602	0.02	0.03	0.13	612

2.2. Construction Emissions by Year, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2030	5.52	4.49	40.4	27.9	0.10	1.52	1.27	2.79	1.40	0.30	1.70	—	10,374	10,374	0.42	0.53	4.99	10,548

Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2030	5.51	4.49	40.6	28.0	0.10	1.52	1.27	2.79	1.40	0.30	1.70	—	10,375	10,375	0.42	0.53	0.13	10,544
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2030	1.93	1.58	14.2	9.80	0.03	0.53	0.44	0.97	0.49	0.10	0.60	—	3,638	3,638	0.15	0.19	0.76	3,698
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2030	0.35	0.29	2.60	1.79	0.01	0.10	0.08	0.18	0.09	0.02	0.11	—	602	602	0.02	0.03	0.13	612

3. Construction Emissions Details

3.1. Sand Transportation (2030) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.38	0.38	—	0.06	0.06	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.38	0.38	—	0.06	0.06	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.13	0.13	—	0.02	0.02	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.02	0.02	—	< 0.005	< 0.005	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.18	0.04	3.49	1.38	0.02	0.04	0.89	0.93	0.04	0.24	0.29	—	3,003	3,003	0.12	0.47	4.99	3,152
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.18	0.04	3.63	1.39	0.02	0.04	0.89	0.93	0.04	0.24	0.29	—	3,004	3,004	0.12	0.47	0.13	3,148
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.06	0.01	1.27	0.48	0.01	0.01	0.31	0.32	0.01	0.08	0.10	—	1,053	1,053	0.04	0.17	0.76	1,105
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.01	< 0.005	0.23	0.09	< 0.005	< 0.005	0.06	0.06	< 0.005	0.02	0.02	—	174	174	0.01	0.03	0.13	183

3.3. Sand Placement (2030) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	5.33	4.45	36.9	26.6	0.07	1.47	—	1.47	1.36	—	1.36	—	7,371	7,371	0.30	0.06	—	7,396
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	5.33	4.45	36.9	26.6	0.07	1.47	—	1.47	1.36	—	1.36	—	7,371	7,371	0.30	0.06	—	7,396
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.87	1.56	13.0	9.32	0.03	0.52	—	0.52	0.48	—	0.48	—	2,585	2,585	0.10	0.02	—	2,594
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.34	0.28	2.36	1.70	< 0.005	0.09	—	0.09	0.09	—	0.09	—	428	428	0.02	< 0.005	—	429
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

4. Operations Emissions Details

4.10. Soil Carbon Accumulation By Vegetation Type

4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Vegetation	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.2. Above and Belowground Carbon Accumulation by Land Use Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Species	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

5. Activity Data

5.1. Construction Schedule

Phase Name	Phase Type	Start Date	End Date	Days Per Week	Work Days per Phase	Phase Description
Sand Transportation	Site Preparation	1/1/2030	6/27/2030	5.00	128	—
Sand Placement	Building Construction	1/1/2030	6/27/2030	5.00	128	—

5.2. Off-Road Equipment

5.2.1. Unmitigated

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Sand Placement	Dumpers/Tenders	Diesel	Average	1.00	8.00	332	0.50
Sand Placement	Rubber Tired Loaders	Diesel	Average	3.00	8.00	191	0.50
Sand Placement	Rubber Tired Dozers	Diesel	Average	3.00	8.00	217	0.50

5.3. Construction Vehicles

5.3.1. Unmitigated

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Sand Transportation	—	—	—	—

Sand Transportation	Worker	0.00	12.0	LDA,LDT1,LDT2
Sand Transportation	Vendor	—	7.63	HHDT,MHDT
Sand Transportation	Hauling	32.0	30.0	HHDT
Sand Transportation	Onsite truck	—	—	HHDT
Sand Placement	—	—	—	—
Sand Placement	Worker	0.00	12.0	LDA,LDT1,LDT2
Sand Placement	Vendor	0.00	7.63	HHDT,MHDT
Sand Placement	Hauling	0.00	20.0	HHDT
Sand Placement	Onsite truck	—	—	HHDT

5.4. Vehicles

5.4.1. Construction Vehicle Control Strategies

Non-applicable. No control strategies activated by user.

5.5. Architectural Coatings

Phase Name	Residential Interior Area Coated (sq ft)	Residential Exterior Area Coated (sq ft)	Non-Residential Interior Area Coated (sq ft)	Non-Residential Exterior Area Coated (sq ft)	Parking Area Coated (sq ft)

5.6. Dust Mitigation

5.6.1. Construction Earthmoving Activities

Phase Name	Material Imported (Cubic Yards)	Material Exported (Cubic Yards)	Acres Graded (acres)	Material Demolished (sq. ft.)	Acres Paved (acres)
Sand Transportation	27,000	0.00	0.00	0.00	—

5.6.2. Construction Earthmoving Control Strategies

Non-applicable. No control strategies activated by user.

5.7. Construction Paving

Land Use	Area Paved (acres)	% Asphalt
City Park	0.00	0%

5.8. Construction Electricity Consumption and Emissions Factors

kWh per Year and Emission Factor (lb/MWh)

Year	kWh per Year	CO2	CH4	N2O
2030	0.00	1,575	0.16	0.02

5.18. Vegetation

5.18.1. Land Use Change

5.18.1.1. Unmitigated

Vegetation Land Use Type	Vegetation Soil Type	Initial Acres	Final Acres

5.18.1. Biomass Cover Type

5.18.1.1. Unmitigated

Biomass Cover Type	Initial Acres	Final Acres

5.18.2. Sequestration

5.18.2.1. Unmitigated

Tree Type	Number	Electricity Saved (kWh/year)	Natural Gas Saved (btu/year)

6. Climate Risk Detailed Report

6.1. Climate Risk Summary

Cal-Adapt midcentury 2040–2059 average projections for four hazards are reported below for your project location. These are under Representation Concentration Pathway (RCP) 8.5 which assumes GHG emissions will continue to rise strongly through 2050 and then plateau around 2100.

Climate Hazard	Result for Project Location	Unit
Temperature and Extreme Heat	9.62	annual days of extreme heat
Extreme Precipitation	2.55	annual days with precipitation above 20 mm
Sea Level Rise	—	meters of inundation depth
Wildfire	0.00	annual hectares burned

Temperature and Extreme Heat data are for grid cell in which your project are located. The projection is based on the 98th historical percentile of daily maximum/minimum temperatures from observed historical data (32 climate model ensemble from Cal-Adapt, 2040–2059 average under RCP 8.5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Extreme Precipitation data are for the grid cell in which your project are located. The threshold of 20 mm is equivalent to about ¾ an inch of rain, which would be light to moderate rainfall if received over a full day or heavy rain if received over a period of 2 to 4 hours. Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Sea Level Rise data are for the grid cell in which your project are located. The projections are from Radke et al. (2017), as reported in Cal-Adapt (Radke et al., 2017, CEC-500-2017-008), and consider inundation location and depth for the San Francisco Bay, the Sacramento-San Joaquin River Delta and California coast resulting different increments of sea level rise coupled with extreme storm events. Users may select from four scenarios to view the range in potential inundation depth for the grid cell. The four scenarios are: No rise, 0.5 meter, 1.0 meter, 1.41 meters
Wildfire data are for the grid cell in which your project are located. The projections are from UC Davis, as reported in Cal-Adapt (2040–2059 average under RCP 8.5), and consider historical data of climate, vegetation, population density, and large (> 400 ha) fire history. Users may select from four model simulations to view the range in potential wildfire probabilities for the grid cell. The four simulations make different assumptions about expected rainfall and temperature are: Warmer/drier (HadGEM2-ES), Cooler/wetter (CNRM-CM5), Average conditions (CanESM2), Range of different rainfall and temperature possibilities (MIROC5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.

6.2. Initial Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	N/A	N/A	N/A	N/A
Wildfire	N/A	N/A	N/A	N/A
Flooding	N/A	N/A	N/A	N/A
Drought	N/A	N/A	N/A	N/A
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.

The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores do not include implementation of climate risk reduction measures.

6.3. Adjusted Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	N/A	N/A	N/A	N/A
Wildfire	N/A	N/A	N/A	N/A
Flooding	N/A	N/A	N/A	N/A
Drought	N/A	N/A	N/A	N/A
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores include implementation of climate risk reduction measures.

6.4. Climate Risk Reduction Measures

7. Health and Equity Details

7.1. CalEnviroScreen 4.0 Scores

The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Exposure Indicators	—
AQ-Ozone	40.0
AQ-PM	47.5
AQ-DPM	24.9
Drinking Water	29.0

Lead Risk Housing	38.8
Pesticides	0.00
Toxic Releases	27.5
Traffic	14.5
Effect Indicators	—
CleanUp Sites	5.64
Groundwater	74.8
Haz Waste Facilities/Generators	61.6
Impaired Water Bodies	23.9
Solid Waste	0.00
Sensitive Population	—
Asthma	5.05
Cardio-vascular	1.52
Low Birth Weights	73.5
Socioeconomic Factor Indicators	—
Education	0.15
Housing	48.1
Linguistic	0.00
Poverty	22.2
Unemployment	29.4

7.2. Healthy Places Index Scores

The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Economic	—
Above Poverty	80.91877326
Employed	90.79943539
Median HI	55.10073143

Education	—
Bachelor's or higher	97.39509817
High school enrollment	100
Preschool enrollment	65.09688182
Transportation	—
Auto Access	6.467342487
Active commuting	75.33684075
Social	—
2-parent households	13.49929424
Voting	91.09457205
Neighborhood	—
Alcohol availability	22.46888233
Park access	81.35506224
Retail density	97.86988323
Supermarket access	79.14795329
Tree canopy	10.00898242
Housing	—
Homeownership	18.9272424
Housing habitability	26.42114718
Low-inc homeowner severe housing cost burden	23.81624535
Low-inc renter severe housing cost burden	23.72642115
Uncrowded housing	83.16437829
Health Outcomes	—
Insured adults	79.94353907
Arthritis	2.3
Asthma ER Admissions	95.2
High Blood Pressure	4.0
Cancer (excluding skin)	0.8

Asthma	95.7
Coronary Heart Disease	3.6
Chronic Obstructive Pulmonary Disease	62.6
Diagnosed Diabetes	61.5
Life Expectancy at Birth	71.8
Cognitively Disabled	39.7
Physically Disabled	38.4
Heart Attack ER Admissions	96.8
Mental Health Not Good	99.2
Chronic Kidney Disease	5.2
Obesity	94.0
Pedestrian Injuries	87.3
Physical Health Not Good	86.2
Stroke	17.3
Health Risk Behaviors	—
Binge Drinking	86.1
Current Smoker	99.6
No Leisure Time for Physical Activity	88.3
Climate Change Exposures	—
Wildfire Risk	0.0
SLR Inundation Area	57.3
Children	76.4
Elderly	1.3
English Speaking	95.0
Foreign-born	32.9
Outdoor Workers	89.0
Climate Change Adaptive Capacity	—
Impervious Surface Cover	11.6

Traffic Density	65.2
Traffic Access	87.4
Other Indices	—
Hardship	6.6
Other Decision Support	—
2016 Voting	91.4

7.3. Overall Health & Equity Scores

Metric	Result for Project Census Tract
CalEnviroScreen 4.0 Score for Project Location (a)	10.0
Healthy Places Index Score for Project Location (b)	74.0
Project Located in a Designated Disadvantaged Community (Senate Bill 535)	No
Project Located in a Low-Income Community (Assembly Bill 1550)	No
Project Located in a Community Air Protection Program Community (Assembly Bill 617)	No

a: The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.
b: The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

7.4. Health & Equity Measures

No Health & Equity Measures selected.

7.5. Evaluation Scorecard

Health & Equity Evaluation Scorecard not completed.

7.6. Health & Equity Custom Measures

No Health & Equity Custom Measures created.

8. User Changes to Default Data

Screen	Justification
Characteristics: Utility Information	These values are updated to be specific to Oahu per the HIOA eGrid Subregion for 2022

Construction: Construction Phases	All work will be occurring concurrently so updates have been provided to show emissions associated with delivery of sand from the stockpile site to the project site. Total work days are set to 90 days of work with work occurring 5 days a week.
Construction: Off-Road Equipment	Construction Equipment by Horsepower value. Load factor for all is set to 0.5. 217 = D-65 Bulldozer 191 = WA-380 Wheeled Loader 332 = HM-300 Articulating dump truck
Construction: Dust From Material Movement	NA
Construction: Trips and VMT	Sand Transportation is 2 trucks one way per hour per 8 hour work day from the Kahului Harbor sand storage site.
Construction: Electricity	Values are updated from the current HIOA eGrid Sub region (year 2022)

APPENDIX C

BEACH MAINTENANCE ANALYSIS

CalEEMod is a California based software that is intended for use in California. As such, customizable location cannot be set to Hawai‘i. Despite this limitation, the principal analysis of a GHG assessment remains the same for Hawai‘i locations. The results of the study are not inherently different based on the fact that the software is operating outside of California. There are additional features within CalEEMod that when used for operation in California, will provide details on mitigation, fire risk, and other factors that can be beneficial but are ultimately superfluous to a GHG impact analysis as they do not affect the model’s ability to account for GHG based on use description.

Hoala Honokowai Beach Maintenance Detailed Report

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8. User Changes to Default Data

1. Basic Project Information

1.1. Basic Project Information

Data Field	Value
Project Name	Hoala Honokowai Beach Maintenance
Construction Start Date	1/1/2030
Lead Agency	—
Land Use Scale	Project/site
Analysis Level for Defaults	County
Windspeed (m/s)	2.60
Precipitation (days)	19.8
Location	32.83676833755551, -117.28126143218918
County	San Diego
City	San Diego
Air District	San Diego County APCD
Air Basin	San Diego
TAZ	6306
EDFZ	12
Electric Utility	HIOA eGRID Subregion Values
Gas Utility	San Diego Gas & Electric
App Version	2022.1.1.29

1.2. Land Use Types

Land Use Subtype	Size	Unit	Lot Acreage	Building Area (sq ft)	Landscape Area (sq ft)	Special Landscape Area (sq ft)	Population	Description
City Park	3.60	Acre	3.60	0.00	0.00	0.00	—	—

1.3. User-Selected Emission Reduction Measures by Emissions Sector

No measures selected

2. Emissions Summary

2.1. Construction Emissions Compared Against Thresholds

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Un/Mit.	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	5.52	4.49	40.4	27.9	0.10	1.52	1.22	2.74	1.40	0.29	1.69	—	10,374	10,374	0.42	0.53	4.99	10,548
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	5.51	4.49	40.6	28.0	0.10	1.52	1.22	2.74	1.40	0.29	1.69	—	10,375	10,375	0.42	0.53	0.13	10,544
Average Daily (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	3.87	3.15	28.5	19.6	0.07	1.06	0.85	1.91	0.98	0.20	1.19	—	7,276	7,276	0.29	0.37	1.51	7,397
Annual (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	0.71	0.58	5.19	3.58	0.01	0.19	0.16	0.35	0.18	0.04	0.22	—	1,205	1,205	0.05	0.06	0.25	1,225

2.2. Construction Emissions by Year, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2030	5.52	4.49	40.4	27.9	0.10	1.52	1.22	2.74	1.40	0.29	1.69	—	10,374	10,374	0.42	0.53	4.99	10,548

Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2030	5.51	4.49	40.6	28.0	0.10	1.52	1.22	2.74	1.40	0.29	1.69	—	10,375	10,375	0.42	0.53	0.13	10,544
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2030	3.87	3.15	28.5	19.6	0.07	1.06	0.85	1.91	0.98	0.20	1.19	—	7,276	7,276	0.29	0.37	1.51	7,397
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2030	0.71	0.58	5.19	3.58	0.01	0.19	0.16	0.35	0.18	0.04	0.22	—	1,205	1,205	0.05	0.06	0.25	1,225

3. Construction Emissions Details

3.1. Sand Transportation (2030) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.33	0.33	—	0.05	0.05	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.33	0.33	—	0.05	0.05	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.23	0.23	—	0.04	0.04	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.04	0.04	—	0.01	0.01	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.18	0.04	3.49	1.38	0.02	0.04	0.89	0.93	0.04	0.24	0.29	—	3,003	3,003	0.12	0.47	4.99	3,152
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.18	0.04	3.63	1.39	0.02	0.04	0.89	0.93	0.04	0.24	0.29	—	3,004	3,004	0.12	0.47	0.13	3,148
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.13	0.03	2.55	0.97	0.02	0.03	0.62	0.65	0.03	0.17	0.20	—	2,106	2,106	0.08	0.33	1.51	2,209
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.02	0.01	0.46	0.18	< 0.005	0.01	0.11	0.12	0.01	0.03	0.04	—	349	349	0.01	0.06	0.25	366

3.3. Sand Placement (2030) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	5.33	4.45	36.9	26.6	0.07	1.47	—	1.47	1.36	—	1.36	—	7,371	7,371	0.30	0.06	—	7,396
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	5.33	4.45	36.9	26.6	0.07	1.47	—	1.47	1.36	—	1.36	—	7,371	7,371	0.30	0.06	—	7,396
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	3.74	3.12	25.9	18.6	0.05	1.03	—	1.03	0.95	—	0.95	—	5,170	5,170	0.21	0.04	—	5,187
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.68	0.57	4.73	3.40	0.01	0.19	—	0.19	0.17	—	0.17	—	856	856	0.03	0.01	—	859
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

4. Operations Emissions Details

4.10. Soil Carbon Accumulation By Vegetation Type

4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Vegetation	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.2. Above and Belowground Carbon Accumulation by Land Use Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Species	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

5. Activity Data

5.1. Construction Schedule

Phase Name	Phase Type	Start Date	End Date	Days Per Week	Work Days per Phase	Phase Description
Sand Transportation	Site Preparation	1/1/2030	12/24/2030	5.00	256	—
Sand Placement	Building Construction	1/1/2030	12/24/2030	5.00	256	—

5.2. Off-Road Equipment

5.2.1. Unmitigated

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Sand Placement	Dumpers/Tenders	Diesel	Average	1.00	8.00	332	0.50
Sand Placement	Rubber Tired Loaders	Diesel	Average	3.00	8.00	191	0.50
Sand Placement	Rubber Tired Dozers	Diesel	Average	3.00	8.00	217	0.50

5.3. Construction Vehicles

5.3.1. Unmitigated

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Sand Transportation	—	—	—	—

Sand Transportation	Worker	0.00	12.0	LDA,LDT1,LDT2
Sand Transportation	Vendor	—	7.63	HHDT,MHDT
Sand Transportation	Hauling	32.0	30.0	HHDT
Sand Transportation	Onsite truck	—	—	HHDT
Sand Placement	—	—	—	—
Sand Placement	Worker	0.00	12.0	LDA,LDT1,LDT2
Sand Placement	Vendor	0.00	7.63	HHDT,MHDT
Sand Placement	Hauling	0.00	20.0	HHDT
Sand Placement	Onsite truck	—	—	HHDT

5.4. Vehicles

5.4.1. Construction Vehicle Control Strategies

Non-applicable. No control strategies activated by user.

5.5. Architectural Coatings

Phase Name	Residential Interior Area Coated (sq ft)	Residential Exterior Area Coated (sq ft)	Non-Residential Interior Area Coated (sq ft)	Non-Residential Exterior Area Coated (sq ft)	Parking Area Coated (sq ft)

5.6. Dust Mitigation

5.6.1. Construction Earthmoving Activities

Phase Name	Material Imported (Cubic Yards)	Material Exported (Cubic Yards)	Acres Graded (acres)	Material Demolished (sq. ft.)	Acres Paved (acres)
Sand Transportation	47,000	0.00	0.00	0.00	—

5.6.2. Construction Earthmoving Control Strategies

Non-applicable. No control strategies activated by user.

5.7. Construction Paving

Land Use	Area Paved (acres)	% Asphalt
City Park	0.00	0%

5.8. Construction Electricity Consumption and Emissions Factors

kWh per Year and Emission Factor (lb/MWh)

Year	kWh per Year	CO2	CH4	N2O
2030	0.00	1,575	0.16	0.02

5.18. Vegetation

5.18.1. Land Use Change

5.18.1.1. Unmitigated

Vegetation Land Use Type	Vegetation Soil Type	Initial Acres	Final Acres

5.18.1. Biomass Cover Type

5.18.1.1. Unmitigated

Biomass Cover Type	Initial Acres	Final Acres

5.18.2. Sequestration

5.18.2.1. Unmitigated

Tree Type	Number	Electricity Saved (kWh/year)	Natural Gas Saved (btu/year)

6. Climate Risk Detailed Report

6.1. Climate Risk Summary

Cal-Adapt midcentury 2040–2059 average projections for four hazards are reported below for your project location. These are under Representation Concentration Pathway (RCP) 8.5 which assumes GHG emissions will continue to rise strongly through 2050 and then plateau around 2100.

Climate Hazard	Result for Project Location	Unit
Temperature and Extreme Heat	9.62	annual days of extreme heat
Extreme Precipitation	2.55	annual days with precipitation above 20 mm
Sea Level Rise	—	meters of inundation depth
Wildfire	0.00	annual hectares burned

Temperature and Extreme Heat data are for grid cell in which your project are located. The projection is based on the 98th historical percentile of daily maximum/minimum temperatures from observed historical data (32 climate model ensemble from Cal-Adapt, 2040–2059 average under RCP 8.5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Extreme Precipitation data are for the grid cell in which your project are located. The threshold of 20 mm is equivalent to about ¾ an inch of rain, which would be light to moderate rainfall if received over a full day or heavy rain if received over a period of 2 to 4 hours. Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Sea Level Rise data are for the grid cell in which your project are located. The projections are from Radke et al. (2017), as reported in Cal-Adapt (Radke et al., 2017, CEC-500-2017-008), and consider inundation location and depth for the San Francisco Bay, the Sacramento-San Joaquin River Delta and California coast resulting different increments of sea level rise coupled with extreme storm events. Users may select from four scenarios to view the range in potential inundation depth for the grid cell. The four scenarios are: No rise, 0.5 meter, 1.0 meter, 1.41 meters
Wildfire data are for the grid cell in which your project are located. The projections are from UC Davis, as reported in Cal-Adapt (2040–2059 average under RCP 8.5), and consider historical data of climate, vegetation, population density, and large (> 400 ha) fire history. Users may select from four model simulations to view the range in potential wildfire probabilities for the grid cell. The four simulations make different assumptions about expected rainfall and temperature are: Warmer/drier (HadGEM2-ES), Cooler/wetter (CNRM-CM5), Average conditions (CanESM2), Range of different rainfall and temperature possibilities (MIROC5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.

6.2. Initial Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	N/A	N/A	N/A	N/A
Wildfire	N/A	N/A	N/A	N/A
Flooding	N/A	N/A	N/A	N/A
Drought	N/A	N/A	N/A	N/A
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.

The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores do not include implementation of climate risk reduction measures.

6.3. Adjusted Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	N/A	N/A	N/A	N/A
Wildfire	N/A	N/A	N/A	N/A
Flooding	N/A	N/A	N/A	N/A
Drought	N/A	N/A	N/A	N/A
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores include implementation of climate risk reduction measures.

6.4. Climate Risk Reduction Measures

7. Health and Equity Details

7.1. CalEnviroScreen 4.0 Scores

The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Exposure Indicators	—
AQ-Ozone	40.0
AQ-PM	47.5
AQ-DPM	24.9
Drinking Water	29.0

Lead Risk Housing	38.8
Pesticides	0.00
Toxic Releases	27.5
Traffic	14.5
Effect Indicators	—
CleanUp Sites	5.64
Groundwater	74.8
Haz Waste Facilities/Generators	61.6
Impaired Water Bodies	23.9
Solid Waste	0.00
Sensitive Population	—
Asthma	5.05
Cardio-vascular	1.52
Low Birth Weights	73.5
Socioeconomic Factor Indicators	—
Education	0.15
Housing	48.1
Linguistic	0.00
Poverty	22.2
Unemployment	29.4

7.2. Healthy Places Index Scores

The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Economic	—
Above Poverty	80.91877326
Employed	90.79943539
Median HI	55.10073143

Education	—
Bachelor's or higher	97.39509817
High school enrollment	100
Preschool enrollment	65.09688182
Transportation	—
Auto Access	6.467342487
Active commuting	75.33684075
Social	—
2-parent households	13.49929424
Voting	91.09457205
Neighborhood	—
Alcohol availability	22.46888233
Park access	81.35506224
Retail density	97.86988323
Supermarket access	79.14795329
Tree canopy	10.00898242
Housing	—
Homeownership	18.9272424
Housing habitability	26.42114718
Low-inc homeowner severe housing cost burden	23.81624535
Low-inc renter severe housing cost burden	23.72642115
Uncrowded housing	83.16437829
Health Outcomes	—
Insured adults	79.94353907
Arthritis	2.3
Asthma ER Admissions	95.2
High Blood Pressure	4.0
Cancer (excluding skin)	0.8

Asthma	95.7
Coronary Heart Disease	3.6
Chronic Obstructive Pulmonary Disease	62.6
Diagnosed Diabetes	61.5
Life Expectancy at Birth	71.8
Cognitively Disabled	39.7
Physically Disabled	38.4
Heart Attack ER Admissions	96.8
Mental Health Not Good	99.2
Chronic Kidney Disease	5.2
Obesity	94.0
Pedestrian Injuries	87.3
Physical Health Not Good	86.2
Stroke	17.3
Health Risk Behaviors	—
Binge Drinking	86.1
Current Smoker	99.6
No Leisure Time for Physical Activity	88.3
Climate Change Exposures	—
Wildfire Risk	0.0
SLR Inundation Area	57.3
Children	76.4
Elderly	1.3
English Speaking	95.0
Foreign-born	32.9
Outdoor Workers	89.0
Climate Change Adaptive Capacity	—
Impervious Surface Cover	11.6

Traffic Density	65.2
Traffic Access	87.4
Other Indices	—
Hardship	6.6
Other Decision Support	—
2016 Voting	91.4

7.3. Overall Health & Equity Scores

Metric	Result for Project Census Tract
CalEnviroScreen 4.0 Score for Project Location (a)	10.0
Healthy Places Index Score for Project Location (b)	74.0
Project Located in a Designated Disadvantaged Community (Senate Bill 535)	No
Project Located in a Low-Income Community (Assembly Bill 1550)	No
Project Located in a Community Air Protection Program Community (Assembly Bill 617)	No

a: The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.
b: The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

7.4. Health & Equity Measures

No Health & Equity Measures selected.

7.5. Evaluation Scorecard

Health & Equity Evaluation Scorecard not completed.

7.6. Health & Equity Custom Measures

No Health & Equity Custom Measures created.

8. User Changes to Default Data

Screen	Justification
Characteristics: Utility Information	These values are updated to be specific to Oahu per the HIOA eGrid Subregion for 2022

Construction: Construction Phases	All work will be occurring concurrently so updates have been provided to show emissions associated with delivery of sand from the stockpile site to the project site. Total work days are set to 230 days of work with work occurring 5 days a week.
Construction: Off-Road Equipment	Construction Equipment by Horsepower value. Load factor for all is set to 0.5. 217 = D-65 Bulldozer 191 = WA-380 Wheeled Loader 332 = HM-300 Articulating dump truck
Construction: Dust From Material Movement	NA
Construction: Trips and VMT	Sand Transportation is 2 trucks one way per hour per 8 hour work day from the Kahului Harbor sand storage site.
Construction: Electricity	Values are updated from the current HIOA eGrid Sub region (year 2022)

APPENDIX E

VISUAL IMPACT ANALYSIS

Ho‘āla Honokōwai

Conceptual Renderings

February 2025



Beach Stabilization Alternative | Site Plan



Beach Stabilization Alternative | Oblique Aerial Perspective



Beach Stabilization Alternative | Oblique Aerial Perspective



Beach Stabilization Alternative | Ground-level Perspective



Beach Stabilization Alternative | Ground-level Perspective



Beach Stabilization Alternative | Ground-level Perspective



Beach Stabilization Alternative | Shoreline Perspective



Beach Stabilization Alternative | Shoreline Perspective



Note: The perspective presented here represents the beach after the initial nourishment action. The Beach Nourishment alternative is a one-time action with an estimated 10-year design life. Beach Maintenance involves subsequent re-nourishment events to maintain beach width over the project's 50-year design life.

Beach Nourishment & Maintenance Alternatives | Post-construction Oblique Aerial Perspective



Note: The perspective presented here represents the beach after the initial nourishment action. The Beach Nourishment alternative is a one-time action with an estimated 10-year design life. Beach Maintenance involves subsequent re-nourishment events to maintain beach width over the project's 50-year design life.

Beach Nourishment & Maintenance Alternatives | Post-construction Oblique Aerial Perspective









Note: The perspective presented here represents the beach after the initial nourishment action. The Beach Nourishment alternative is a one-time action with an estimated 10-year design life. Beach Maintenance involves subsequent re-nourishment events to maintain beach width over the project's 50-year design life.

Beach Nourishment & Maintenance Alternatives | Post-construction Oblique Aerial Perspective



Note: The perspective presented here represents the beach after the initial nourishment action. The Beach Nourishment alternative is a one-time action with an estimated 10-year design life. Beach Maintenance involves subsequent re-nourishment events to maintain beach width over the project's 50-year design life.

Beach Nourishment & Maintenance Alternatives | Post-construction Ground-level Perspective



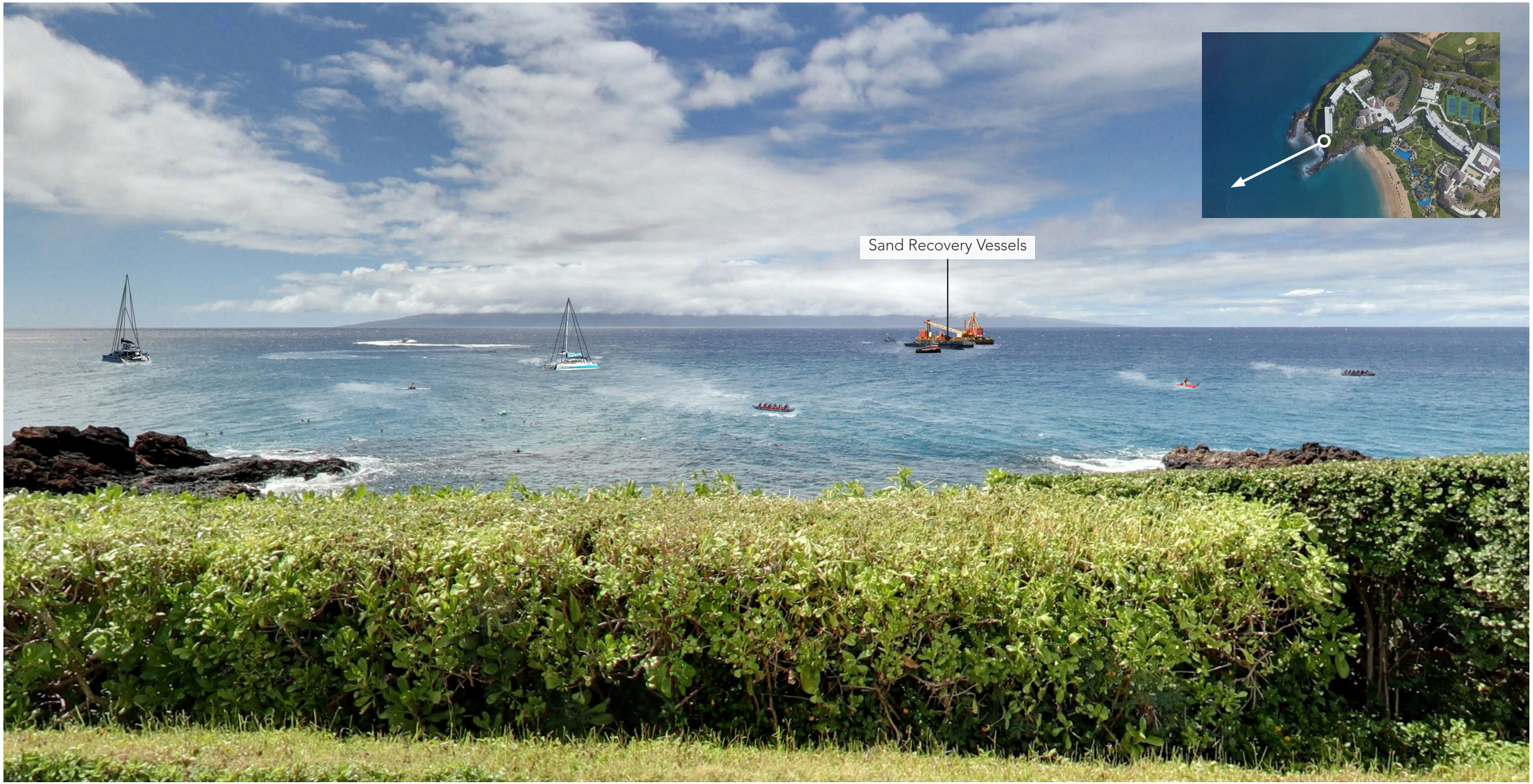
Note: The perspective presented here represents the beach after the initial nourishment action. The Beach Nourishment alternative is a one-time action with an estimated 10-year design life. Beach Maintenance involves subsequent re-nourishment events to maintain beach width over the project's 50-year design life.

Beach Nourishment & Maintenance Alternatives | Post-construction Ground-level Perspective



Note: The perspective presented here represents the beach after the initial nourishment action. The Beach Nourishment alternative is a one-time action with an estimated 10-year design life. Beach Maintenance involves subsequent re-nourishment events to maintain beach width over the project's 50-year design life.

Beach Nourishment & Maintenance Alternatives | Post-construction Ground-level Perspective


Sand Recovery Vessels

APPENDIX F

ARCHAEOLOGICAL LITERATURE REVIEW AND FIELD INSPECTION

AA Project No. 2207

Final

Archaeological Literature Review and Field Inspection for the Proposed Hoʻāla Honokōwai Project

Honokōwai Ahupuaʻa, Kāʻanapali Moku, Lāhainā Modern Tax District, Maui Island
TMK: (2) 4-4-001:097, 098, and 100 (seaward)

ʻĀINA ARCHAEOLOGY

AA Project No. 2207
AA Permit No. 24-01

Final

Archaeological Literature Review and Field Inspection for the Proposed Hoʻāla Honokōwai Project

Honokōwai Ahupuaʻa, Kāʻanapali Moku, Lāhainā Modern Tax District, Maui Island
TMK: (2) 4-4-001:097, 098, and 100 (seaward)
1/21/2025

Project Proponent
Sea Engineering
and
West Maui Resort Partners, L.P.

Under Contract To:
Honua Consulting
Honolulu, HI

Prepared By:
Tanya Lee-Greig, M.A.

ʻĀina Archaeology
Oʻahu: 725 Kapiolani Blvd, C400 Honolulu, HI 96813
Maui: 1305 N. Holopono St., Suite 6, Kīhei, HI 96753

Management Summary

Project Name:	Hoʻāla Honokōwai Project
Summary of Project Description:	The proposed Hoʻāla Honokōwai Project seeks to implement solutions that would restore and preserve Honokōwai Beach to improve beach stability, preserve and enhance cultural and shoreline access, increase resilience to coastal hazards and sea level rise, and enable planning for long-term adaptation to sea level rise. These include the following proposed alternatives (see also Section 1.1): • Beach Nourishment, • Beach Maintenance, and • Beach Stabilization
Project Area (PA)	Situated within Honokōwai Ahupuaʻa, Kāʻanapali Moku (Lāhainā Modern Tax District), Maui Island (TMK [2] 4-4-001:097, 098, and 100 [seaward]). More specifically, the PA covers the area where the shoreline transitions from predominantly sandy beaches, dunes, and unarmored shoreline (south of Honokōwai Point) to predominantly rocky or armored shoreline (north of Honokōwai Point) and consists of 1,000 linear ft. (lf) of shoreline that is fronted by a sandy beach. Shoreline armoring begins approximately 800 ft south of the PA and extends north to Kahana Bay.
Land Owner and/or Jurisdiction:	Land Owner: Private • Maui Kai Condominium • Kāʻanapali Shores Condominium • Kāʻanapali Beach Club
Funding Sources:	Private
Regulatory Context:	The lands of the proposed project are privately held with project funding sources derived through private funds. Therefore, any future permit applications submitted to State and County agencies during the entitlement phase of the project would be subject to review by the Hawaiʻi State Historic Preservation Division (SHPD) under Hawaiʻi Revised Statutes (HRS) §6E-42 and in accordance with Hawaiʻi Administrative Rules (HAR) Chapter 13-284. T

Archaeological Considerations and Recommendations

Archaeological Considerations for the Proposed Beach Nourishment Alternative

- Involves adding sand to affected shorelines to increase beach width and sand volume.
- Groundwork would include mechanical sand placement on the shoreline.
- Based on erosion history in the context of this alternative, the likelihood of encountering in situ significant or sensitive sites would be low.
- No further archaeological investigation may be required.

Archaeological Considerations for the Proposed Beach Maintenance Alternative

- Involves adding sand to affected shorelines to increase beach width and sand volume.
- Groundwork would include mechanical sand placement and periodic maintenance.
- Similar to the Beach Nourishment Alternative, the probability of encountering in situ historically significant or culturally sensitive sites would be low.
- No additional archaeological investigation may be needed.

Archaeological Considerations for the Proposed Beach Stabilization Alternative

- Involves sand placement with potential modification or installation of stabilizing structures (e.g., groins).
- Groundwork may include site preparation, grading, and construction of stabilizing structures, followed by sand placement.
- Given the results of the cultural-historical background research and review of previous archaeological studies, the potential for construction-related excavation in the backshore area may require archaeological testing once the design is finalized.
- Challenges in pre-construction testing due to underlying utilities may affect the testing strategy.
- - Archaeological monitoring during construction may be considered as a more appropriate identification measure.

Archaeological Considerations and Recommendations (continued)

Archaeological Considerations for the Proposed Sand Recovery Area

- Involves extracting sand from a 12-acre offshore area approximately 450 meters off Puʻu Kekaʻa (SIHP 50-50-03-01206).
- Utilizes one crane barge, two deck barges, one tugboat, and one support vessel.
- Archaeological Concerns:
  - Tow camera survey footage did not identify traditionally significant objects along documented transects.
  - Potential remains for culturally significant objects in un-surveyed areas or beneath the sand surface.
  - Archaeological monitoring during dredging and placement of recovered sand onto the deck barge is recommended to address potential discoveries.
- Puʻu Kekaʻa and Leina a ka ʻUhane (SIHP 50-50-30-01206):
  - While the historic property documentation is focused on the physical landmass of Puʻu Kekaʻa (Hommon 1973), the leina a ka ʻUhane extends into the sea, representing the soul's journey into pō and alignment with the setting sun (Emerson 1902; Lewis 1980).
  - Temporary industrial presence of two barges at the leina potentially creates a temporary adverse effect on the setting and feel of the leina which could disrupt the perceived pathway of the soul's journey.
  - This study defers to the Cultural Impact Assessment (Appendix H) prepared for the project EIS which acknowledges this temporary adverse effect on the leina and addresses associated cultural implications.

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1.0 INTRODUCTION

Honokōwai Beach is an important natural, cultural, and aesthetic resource that supports a wide variety of cultural, recreational, and economic uses. The beach also acts as a natural buffer that absorbs wave energy and reduces exposure of the backshore land and infrastructure to erosion and flooding. In 2016, a combination of persistent North Pacific swell events and elevated water levels resulted in substantial wave action, strong littoral currents, and high tidal levels, that lead to pronounced erosion and significant beach loss. The backshore area experienced direct exposure to erosional forces, culminating in the formation of a vertical escarpment between 5 to 8 feet high along the southern shoreline segment, and 3 to 5 feet high along the central and northern segments of the shoreline. The formation of the escarpment posed a threat to public health, safety, and welfare, while also creating an obstruction to public access to and along the coastal zone.

Overall, the event resulted in the loss of approximately 5,600 square feet of fast land and discharge of over 1,000 cubic yards of alluvial sediment, comprised of clay, silt, and boulders, into the marine environment. Unlike beach sand, the above loss is not typically restored through natural processes (e.g., accretion) which effectively results in permanent loss. In 2018, a temporary erosion control structure was installed along the shoreline fronting Kāʻanapali Beach Club under emergency permits issued by the Hawaiʻi Department of Land and Natural Resources, Office of Conservation and Coastal Lands (DLNR-OCCL) and the County of Maui, Department of Planning.

Situated within Honokōwai Ahupuaʻa, Kāʻanapali Moku (Lāhainā Modern Tax District), Maui Island (TMK [2] 4-4-001:097, 098, and 100 [seaward]) (Figure 1-1 and Figure 1-2), the proposed Hoʻāla Honokōwai Project seeks to implement solutions (Sea Engineering Inc. 2022:15) that would restore and preserve Honokōwai Beach to improve beach stability, preserve and enhance cultural and shoreline access, increase resilience to coastal hazards and sea level rise, and enable planning for long-term adaptation to sea level rise. As a part of the restoration effort, recovery of sand from an off-shore source to augment the existing beach would be required. With respect to the beach restoration footprint, the proposed Project Site, Honokōwai Beach, is located north of Kāʻanapali and south of Kahana Bay on the west coast of the island of Maui. This footprint covers the area where the shoreline transitions from predominantly sandy beaches, dunes, and unarmored shoreline (south of Honokōwai Point) to predominantly rocky or armored shoreline (north of Honokōwai Point) and consists of 1,000 linear ft. (lf) of shoreline that is fronted by a sandy beach. Shoreline armoring begins approximately 800 ft south of the PA and is also present immediately north of the PA to Kahana Bay. With respect to the sand recovery area, the approximate footprint of the recovery area covers an approximate 12-acre area 450 meters off Puʻu Kekaʻa.



Figure 1-1. A portion of the USGS National Map, portions of the Lahaina and Napili Quadrangle sections (United States Department of the Interior 2019), showing the proposed project parcels.

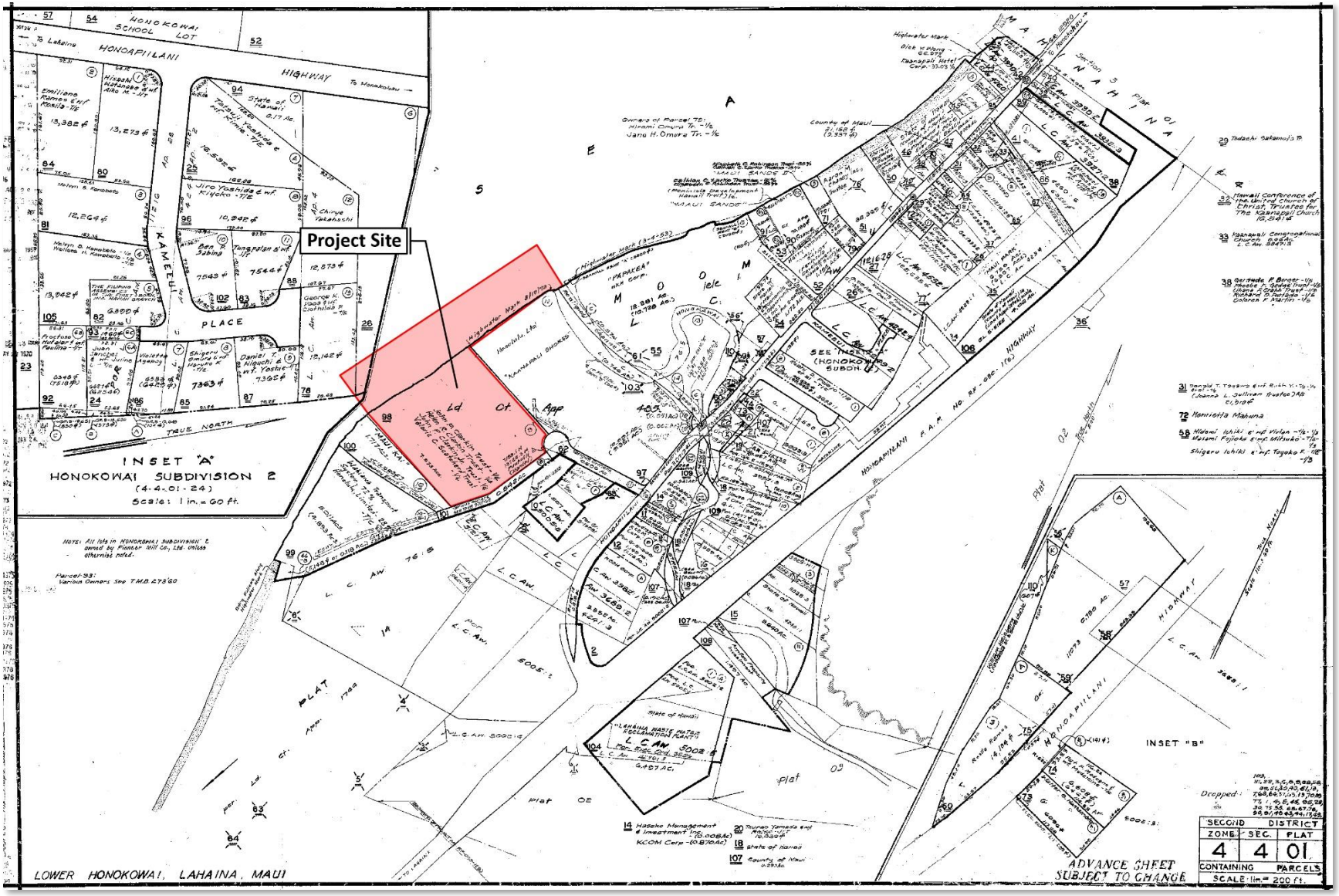


Figure 1-2. TMK Map for (2) 4-4-01 showing the project site outlined in red.

At the request of Sea Engineering and under contract to Honua Consulting, ʻĀina Archaeology completed a field inspection of the proposed project site, along with a literature review of historical narratives of the overall area and previous archaeological studies within a one-mile radius of the proposed project.

1.1 PROJECT DESCRIPTION

The proposed alternatives for the proposed revitalization project include beach nourishment, beach maintenance, and beach stabilization. The following sections describe each alternative and potential ground-disturbing activities.

1.1.1 Beach Nourishment

Beach Nourishment is an individual action (a single project) that involves the placement of additional sand to increase beach width and sand volume to offset the effects of erosion without modifying existing structures or installing any new structures.

The beach nourishment alternative would consist of placing sand directly along the shoreline without any structures to stabilize the sand. The sand would be placed along 1,000 linear feet (lf) of shoreline with a beach crest elevation of +8.5 ft MSL and a beach slope of 1V:8H (vertical to horizontal). This alternative would require approximately 27,000 cubic yards (cy) of sand and result in a minimum beach width of 40 feet.

1.1.2 Beach Maintenance

Beach Maintenance refers to a series of actions (program) that consist of periodic beach nourishment combined with sand pushing and/or back passing, without modifying existing structures or installing any new structures. Beach maintenance actions are typically intended to be conducted on a recurring, periodic basis over a specified period and are therefore considered to be programmatic in nature.

It is anticipated that the program would consist of an initial beach nourishment project, followed by periodic sand pushing or sand back passing, and then a series of successive beach renourishment projects. This program of actions would be repeated over a specified period of time.

- *Sand pushing* involves moving sand from the lower beach face to the upper beach to restore an eroded beach profile and reduce exposure of the backshore to wave action.
- *Sand back passing* involves recovering sand from portions of a beach where sand has accreted and placing it in areas that are experiencing erosion and beach loss.

Approximately 27,000 cy of sand would be placed at the south end of the Honokōwai littoral cell along approximately 1,000 ft. of shoreline, providing a minimum beach width of 40 ft. Because there would be no stabilizing groins, periodic beach maintenance would be performed after the initial nourishment and throughout the 50-year design life to maintain a stable beach.

This maintenance would require sand to be added at time intervals that correspond to beach erosion. It is estimated that over a 50-year period, four renourishment efforts would be required to maintain a beach width of 40 ft. Each renourishment effort would require approximately 5,000 cy of sand, resulting in a total of 20,000 cy of additional sand to maintain 40 ft. of beach. In total, 47,000 cy of sand would be required for the initial nourishment event and four renourishment efforts for this alternative.

1.1.3 Beach Stabilization

Beach Stabilization refers to an individual action that involves the placement of sand to nourish the beach, (i) modifying existing structures, and/or (ii) installing new structures (e.g., groins) to stabilize the sand. Beach stabilization projects are typically designed to be implemented as a single, discrete project with a specified design life.

The Beach Stabilization alternative would involve beach nourishment along with the construction of three T-head groins and one L-head groin that would extend seaward between 220 ft. and 250 ft. from the existing backshore and would be spaced between 330 ft. and 340 ft. along the shoreline. Approximately 33,000 cy of sand would be placed between the groins to create a beach with a minimum 40-foot width, +8.5-foot MSL crest elevation, and a 1V:8H slope from the beach crest to the beach toe.

The groins would be designed to accommodate up to 3.3 ft. of sea level rise, which corresponds to a design life of 50 years based on the anticipated Project start date. The design could also be modified to include cast-in-place concrete crest caps which would serve as a base for groin modification as sea levels continue to rise. If vertical extensions to the groins are needed due to rising sea levels, a crown wall can be constructed on top of the concrete core to raise the height of the groin. The groins would not extend beyond the Nearshore Scour Zone, a primarily barren area consisting of either sand and rocks or a bed of rocks and cobble.

1.1.4 Sand Recovery

All of the above beach restoration alternatives will involve sand recovery, transportation, and placement as a part of the solution. The project proponent proposes to implement clamshell dredging as a recovery method which includes mechanically scooping and lifting sediment from the seafloor with a clamshell, or level-cut bucket, from a barge anchored with a minimum four-point mooring in the recovery area. The environmental clamshell bucket would be deployed from a crane in an open position. Upon reaching the seafloor, the bucket would close to excavate material, which would then be lifted and transferred to a hopper barge. A bucket with a 15-cubic-yard (cy) capacity would have an open footprint of approximately 13 ft by 13 ft and penetrate 2 to 6 ft into the seafloor, recovering about 12 cy of material per operation. This depth would align with the depth range of the composite sand sample collection. Seafloor depressions created by dredging would measure approximately 2 to 6 ft deep with a side slope ratio of 1:3, resembling natural depressions formed by tidal currents. Over time, the surrounding sand would be expected to refill the depressions naturally, with tidal currents and wave action smoothing the side slopes.

1.2 SCOPE OF WORK

The lands of the proposed project are predominantly State-owned while project funding sources would be derived through private funds. Therefore, any future permit applications submitted to State and County agencies during the entitlement phase of the project would be subject to review by the Hawaiʻi State Historic Preservation Division (SHPD) under Hawaiʻi Revised Statutes (HRS) §6E-42 and in accordance with Hawaiʻi Administrative Rules (HAR) Chapter 13-284. To develop the historical contexts and identify known historic properties within the current project area as a part of the project Environmental Impact Statement, as well as assist in facilitating permitting review by identifying areas of potential historic preservation concern, the following scope of work served as guidance for this documentary review and the compilation of information contained herein:

- Research on the locations and results of previous archaeological studies completed within a one-mile radius of the proposed project;
- Research on the locations of known historic properties within a minimum one-half-mile radius of the proposed project;
- Archaeological field inspection to characterize the project area and identify and summarize any immediate concerns;
- Incorporation of the above research into a report detailing the archaeological history of the surrounding vicinity to be comprised of:
    - Incorporation of the findings of the field inspection,
    - Summaries of previous archaeological studies,
    - Identification and descriptions of specific historic properties within the one-half-mile review radius,
    - Development of relevant GIS maps that illustrate the above findings.

1.3 METHODS

1.3.1 Document Review

Research venues included a search of the State Historic Preservation Division's HICRIS system, the physical libraries of SHPD at Kapolei and Wailuku, the historic map archive of the Department of Accounting and General Services' Land Survey Division, the EA and EIS digital library hosted by the Office of Environmental Quality Control (http://oeqc2.doh.hawaii.gov), and Hale Hoʻikeʻike at the Bailey House, as well as in-house digital resources.

1.3.2 GIS Methods

Previous archaeology study areas, site location maps, historic maps, and AutoCAD files were georeferenced in relation to Maui Island TMK shapefile and portions of the Lahaina and Napili Quadrangles of the USGS National Map (United States Department of the Interior 2019) using known points and ArcGIS Pro 3.3.2. All geographic maps presented herein were created using ArcGIS Pro 3.3.2. Figures showing the project area boundary overlain on historical maps and in relation to

previously identified historic property locations should be considered approximate and used for informational purposes only.

2.0 ENVIRONMENTAL SETTING

2.1 NATURAL ENVIRONMENT

The overall environment of the surrounding vicinity falls at the base of the West Maui Mountains, which extends from the summit and down into the deeply incised valleys that extend leeward from Kāʻanapali to Lāhainā and incorporate the alluvial fans and historically broad coastlines that were a result of once perennial streams depositing debris in greater volume than was removed by waves and ocean currents (Macdonald et al. 1983:387). As noted previously, the current project area is situated along the leeward shoreline of the West Maui Mountain Range and near the muliwai (stream outlet) of Honokōwai Stream.

The general soils of the project area are of the Pulehu-Ewa-Jaucas association (University of Hawaii Agricultural Experiment Station 1971) which can be found on alluvial fans and basins and are described as nearly level to moderately sloping, well-drained, and excessively drained soils that are developed in alluvium and weathered in basic igneous rock, coral, and seashells (Foote et al. 1972:8). More specifically, the individual soil units of the project area are dominated by Pulehu silt loam with 0-3% slopes (PpA) in the backshore and a narrow band of beach sand (BS) that characterizes Honokōwai Beach (Figure 2-1). Soils of the Pulehu Series have slopes that range from 0 to 12% and consist of well-drained soils that formed from alluvium washed from basic igneous rock and found on alluvial fans, as well as stream terraces and in basins. The general hue of the soil column is 10YR or 7.5YR with a C horizon that ranges in thickness from less than 1 inch to more than 1 foot and in texture from sand to silty clay loam. Some gravel is on the surface and throughout the soil (Official Series Description - PULEHU Series (usda.gov)). The specific texture of PpA soils is silt loam, rather than the typical clay loam, and was utilized primarily for sugar cane with small acreages dedicated to home sites (Foote et al. 1972:116). Soils and sediment described as Beaches (BS) include sandy, gravely, or cobbly areas that are washed by waves. While a few of the beaches are dark colored because their sands are basalt and andesite derived, most beach sands, like Honokōwai Beach, consist primarily of light-colored sands that are the result of weathered coral and seashell accumulation. At the time of the USDA soil survey, beaches were observed as being generally suitable for recreational use or resort development with no farming value (Foote et al. 1972:28).

The overall climate and rainfall in the area falls at the base of the West Maui Mountains, which extends from the summit and runs down the deeply incised valleys, extending leeward from Kāʻanapali to Lāhainā. These cone-shaped peaks capture wind from any direction and funnel air towards the summit; therefore, resulting in an annual rainfall maximum of well over 354 inches (Giambelluca et al. 1986). Average overall rainfall across the project area is approximately 33.74 inches a year, with the heaviest from November to April (a time period called Hoʻoilo), which is associated with cooler temperatures and infrequent trade winds causing periodic rainfall; and, little to no rainfall from May to October– during a time period called Kau that is associated with warmer temperatures and steady trade winds (Giambelluca et al. 2013). The above results in topography that consists of gentle to steeply sloping hillsides cut by the Honokōwai Gulch.

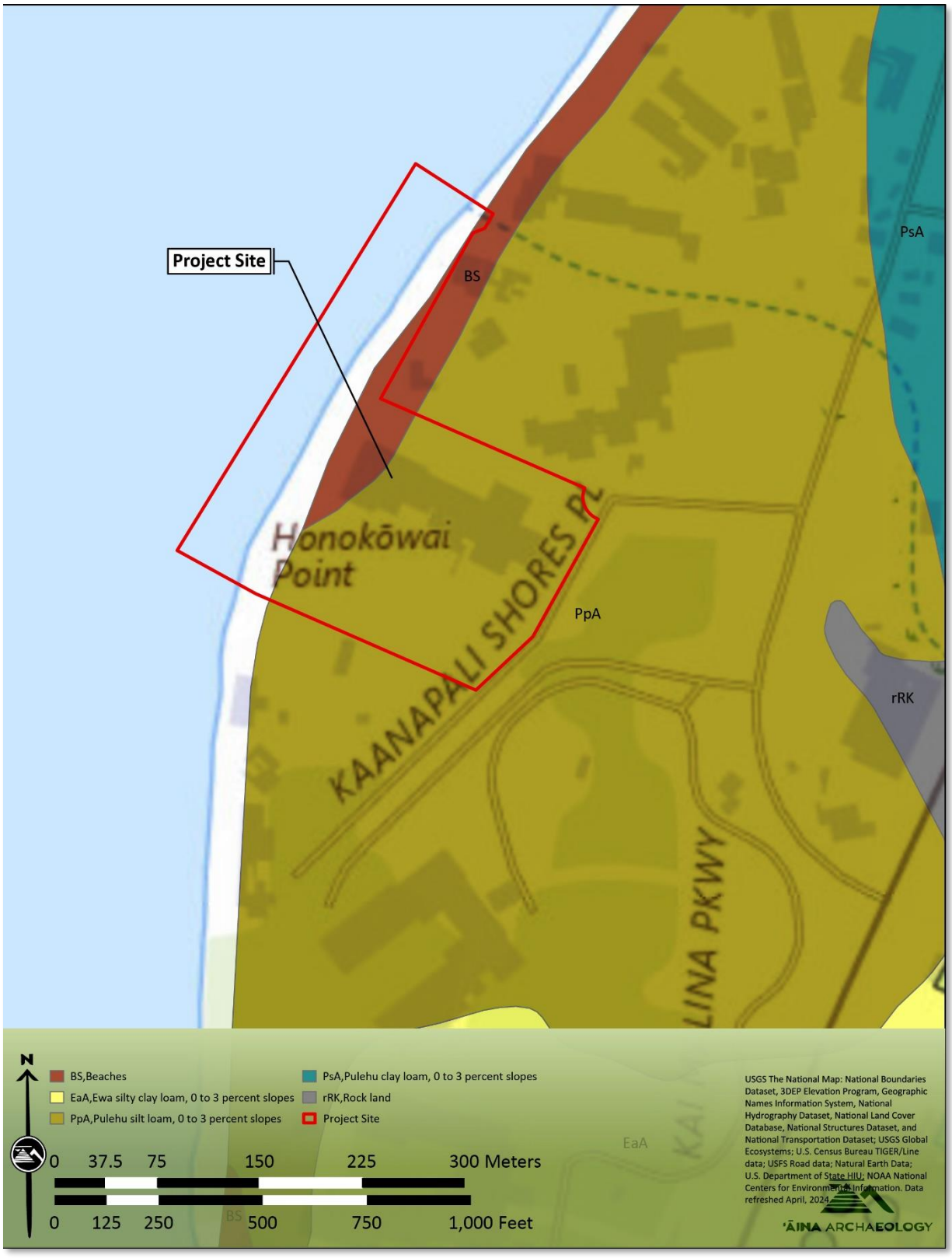


Figure 2-1. USGS National Map, portions of the Lahaina and Napili Quadrangle sections (United States Department of the Interior 2019), showing the proposed project parcels in relation to the underlying soil series (USDA-NRCS-NCGC 2001).

The above soils, topography, and rainfall patterns would have sustained a lowland dry shrubland and grassland within and just back from the current project area (Pratt and Gon III 1998:122). Prior to human modification, these lands would have supported pili (*Heteropogon contortus*) or kāwelu (*Eragrostis variabilis*) with shrublands of ʻaʻali'i (*Dodonaea viscosa*), ʻākia (Wikstroemia species), koʻokoʻolau (*Bidens species*), ʻūlei (*Osteomeles antbyllidifolia*), and other shrubs.

2.2 BUILT ENVIRONMENT

With parcel access off of the two-laned Lower Honoapiʻilani Highway, all three project parcels have been completely built out for resort development. This includes three multi-story condotels (Kāʻanapali Shores Condominium, Kāʻanapali Beach Club, and Maui Kai Condominiums) with ancillary amenities (e.g. outdoor pools and pool decks with seating, restaurants, and landscaped grounds) (Figure 2-3). The shoreline of the project area is characterized by engineered structures including seawalls, revetment, hybrid seawall-revetments, and drainage headwalls (Figure 2-2).



Figure 2-2. Shoreline structures in the vicinity of the project area (photo courtesy of Sea Engineering).



Figure 2-3. A portion of the ESRI World Imagery data set (ESRI et al. 2021) showing the proposed project parcels in relation to the built environment (outlined in blue).

3.0 CULTURAL HISTORICAL OVERVIEW

The division of Maui's lands into political districts occurred during the rule of Kakaʻalaneo, under the direction of his kahuna, Kalaihaʻōhiʻa (Beckwith 1970:383). This division resulted in the creation of twelve districts or moku during traditional times: Kula, Honuaʻula, Kahikinui, Kaupō, Kīpahulu, Hāna, Koʻolau, Hāmākua Loa, Hāmākua Poko, Na Poko or Na Wai Eha (Wailuku), Kāʻanapali, and Lāhainā (Alexander 1882; Sterling 1998:3). The moku o loko, or moku as it is most commonly called, literally means "to cut across, divide, separate" (Lucas 1995:77). When used as a term for traditional land tenure, a moku is similar to a modern political district. The current project area is situated within the moku of Kāʻanapali on the northwest side of the West Maui Mountain Range.

Within these moku are smaller units of land called ahupuaʻa, the name of which is derived from the Hawaiian term ahu (altar), which were erected at the points where the land boundary intersected the alaloa (main road encircling the island), upon which a carved puaʻa (hog) image made of kukui wood and stained with red ochre was placed along with the tax of food items from that particular land unit as payment to the aliʻi (chief) during the annual progression of the akua makahiki (Alexander 1882:4).

The typical configuration of the ahupuaʻa extends from the sea to the mountain so that the aliʻi and makaʻāinana (native tenant) could have access to resources of the wao lāʻau or wao nahele (forested region), the wao ʻamaʻu and wao kanaka (cultivated land), and the kula uka and kula kai (the lower grasslands and shoreline) (Alexander 1882:4; Mueller-Dombois 2007). While the boundaries of an ahupuaʻa generally followed prominent landforms (i.e., ridge lines, the bottom of a ravine, a depression in the earth), there were times when a stone or rock that was notable from a tradition or sacred use would mark a corner or determine a line (Alexander 1890:105-106). Along similar lines, the growth of a certain kind of tree, herb, or grass, or the habitat of a certain kind of bird would sometimes define a division (Alexander 1890:105-106).

Kāʻanapali Moku is currently known to be comprised of eleven ahupuaʻa, which, from north to south, include: Honokōhau, Honolua, Honokahua, Nāpili, Honokeane, Alaeloa, Mailepai, Kahana, Māhinahina, Honokōwai, and Makaiwa. The current project area is situated along the shoreline of Honokōwai Ahupuaʻa and extends into the waters off the stretch of beach referred to as Honokōwai Beach.

Honokōwai Ahupuaʻa was once home to hundreds of ʻohana (families) that lived in the ahupuaʻa under the stewardship of Keʻeaumoku Pāpaiahiahi. After his passing, Honokōwai was transferred to Keʻeaumoku "George Cox" and then John Adams Kaluaikonahale Kuakini. At the onset of the Great Mahele, Honokōwai was set aside as Crown Lands that were then divided into some 70 Royal Patent Grants (see Section 3.2.1.2).

3.1 HE MAU MO'OLELO NO HONOKŌWAI AHUPUA'A I KA WA KAHIKO – TRADITIONS OF THE HONOKŌWAI REGION PRIOR TO WESTERN ARRIVAL

The island of Maui has been known by several names throughout history and across the pae 'āina. The ancient name of Ihikapalaumaewa, after the child of Wakea and Papa who is the ancestral origin of the people of Maui, was once attributed to the island of Maui. Maui has also been referred to as Kulua for the two prominent volcanoes that comprise the island, Nā Hono-a-Pi'ilani for Pi'ilani, the great 16th Century chief of Maui, and Maui Nui a Kama for Kamalalawalu the grandson of Pi'ilani (Kapiikauinamoku 1956; Sterling 1998:1). An origin story of the Hawaiian people speaks to the creation of their islands as being born to the gods Papa and Wakea. In the ancient oli (chant) that tells this origin story, Hawai'i Island is first to be born, followed by Maui, and then the rest:

Hanau o Maui he moku, he aina, Na kama o Kamalawalu e noho.	*Maui was born an island, a land,* *A dwelling place for the children of Kamalalawalu.* *(Fornander 1916:2-3)*

In this chant, Maui is called, "a dwelling place for the children of Kamalawalu," who was the grandson of Pi'ilani, a 16th-century Mō'ī (paramount ruler) of Maui and founder of one of its greatest dynasties (Barrere 1975:1). Thus, the traditional poetic name for Maui as Maui-a-Kama, named after Kamalawalu, whose children are the people of Maui. It's because of them that we have the ability to know the historical names, mo'olelo (traditional stories), cultural sites, and practices of the area in and around Honokōwai.

3.1.1 Wahi 'Inoa

In Hawai'i, names were given to virtually everything. In the preface of *Place Names of Hawaii*, Samuel Elbert states that:

> Hawaiians named taro patches, rocks and trees that represented deities and ancestors, sites of houses and heiau, canoe landings, fishing stations in the sea, resting places in the forests, and the tiniest spots where miraculous or interesting events are believed to have taken place.
>
> Place names are far from static … names are constantly being given to new houses and buildings, land holdings, airstrips, streets, and towns and old names are replaced by new ones … it is all the more essential, then to record the names and the lore associated with them (the ancient names) now. (Pukui et al. 1974:x)

Intrinsic in these statements of Elbert is the knowledge that the oldest place names held meaning and could tell the story of an area, or recorded the resources of a particular place, prior to European contact. A study of the place name meanings for the study area may yield some insight into the stories, patterns of life, and land use within Honokōwai. Lyons notes that as a consequence of the long tenancy of the people on land, "every piece of land had its name, as

individual and characteristics as that of its cultivation" (C. J. Lyons 1903:23). The place names listed below are for land areas, fisheries, land divisions, markers, and other resources specific to Honokōwai. These areas were identified through research of the Māhele ʻĀina documents and other available map resources (Dodge 1885; Ho 1940; Monsarrat and Kahookele 1912; U.S. Geological Survey 1992), as well as, consultation with kamaʻāina (native-born) and kūpuna (elders) of the region. Unless indicated otherwise, the spelling, orthography, and translations presented below are adapted from Pukui and others (1974).

Table 3-1. Place Names of Honokōwai Ahupuaʻa

Aipopoʻo (*ʻili*)	An ʻili associated with LCA 3688 Apa. 3 to Meeau and LCA 3930 Apa. 4 to Nauwele. Also written "Aipohopoho" in foreign testimony.
Amalu (stream)	Stream, Lāhainā qd., West Maui
ʻEke (peak)	Crater and peak (4,480 feet high), near the border between Lāhainā and Wai-luku qds., West Maui.
Haʻenanui (*ʻili*)	An ʻili associated with LCA 4549 to Amai and LCA 76 to William Shaw. It is noted that Haenanui was a farm given to him by Hoapili Wahine (LCA 76).
Haʻenaʻiki (*ʻili*)	An ʻili associated with LCA 3765 Apa. 5 to Aio, 6459 to Keokeo, LCA 6460 to Kaihe, LCA 6601 Apa. 2—3 to Piimoku (spelled "Haaeniki"), LCA 6722B Apa. 1 to Mai (spelled "Haaeneiki), LCA 6741 Apa. 2 to Inoa.
Honoapiʻilani	Lit.: bays [acquired] by [Chief] Piʻilani. Six West Maui bays whose names begin with Hono- (bay) and the islands seen from them (Kahoʻolawe, Lānaʻi, Molokaʻi) were ruled by Piʻilani and are famous in son; the six bays are Honokahua, Honokeana, Honokōhau, Honokōwai, Honolua, Hononana. Piʻilaniʻs daughter Piʻikea, married ʻUmi in the early 1500s.
Honokōwai (*ahupuaʻa, stream, plantation camp, point)*	Lit., bay drawing water One of six famous West Maui bays whose names begin with the word hono, or bay. Collectively they are known as Nā Honoaapiʻilani, "the bays acquired by Piʻilani" (a chief). Land section, ditch, point, stream, beach park, Lāhainā qd., Maui
Ilikikoo (*ʻili*)	An ʻili associated with LCA 3689 Apa. 1 to Maui, LCA 3765 Apa. 4 to Aio ("Ilikikoa"), LCA 3852 Apa. 2 to Pokole (written "Uilikiko" in Buke Mahele), LCA 3988 Apa. 4 to Hilahila, LCA 4249 Apa. 3 ("Uilikiko") to Kameeui Documented as "Uilikiko" in LCA 3852 and LCA 4249, and "Ilikikoa" in LCA 3765.

Kāʻanapali (*moku*)	Lit. Kāʻana (the division) cliff Beach, Kāʻanapali, Maui. Wide calcareous sand beach fronting the Kāʻanapali resort complex. Puʻu Kekaʻa, a cinder cone more commonly known as Black Rock, divides the beach into two sections. The center of the south section between Hanakʻoʻo Beach Park and Puʻu Kekaʻa is also known colloquially as Dig Me Beach, while the north section between Puʻu Kekaʻa and Honokōwai Point is known as North Beach (Clark 2002)
Kaelepuni (*ʻili*)	An ʻili associated with LCA 4248 Apa. 3 to Kekalohe and LCA 6601 Apa. 6 to Piimoku
Kahanaiole (*ʻili*)	An ʻili associated with LCA 3925D Apa. 2 to Hualii
Kaneʻauʻau (*ʻili*)	An ʻili associated with LCA 5005 Apa. 2—3 to John White
Kapili (*ʻili*)	An ʻili associated with LCA 3192 Apa. 1 to Kahinu, LCA 3850 to Paki, LCA 3925 to Nahuli, LCA 3932 Apa. 7 to Nalepo, LCA 3987 Apa. 2 to Holona, LCA 4239 Apa. 3, 4, 7—9 to Kaukau, LCA 4248 Apa. 3 to Kekalohe, LCA 4254 Apa. 3 to Kaumaumau, LCA 5002 Apa. 4—6, 9 to Kahanaumaikai, LCA 5121 Apa.2 and 3 to Kane, LCA 6539 Apa. 2, 3 to Hoonoho
Kaulalewalewa (mountain)	A mountain (2,980 feet elevation), Lāhainā, Maui
Kipapa (*ʻili*)	An ʻili associated with LCA 3689 Apa. 2 to Maui, LCA 4244 to Kuemanu, LCA 4260 Apa. 2 to Kaluaiuka
Kou (*ʻili*)	An ʻili associated with LCA 327B Apa. 2 to John Previer, within Waihale
Kumukahi (*ʻili*)	An ʻili associated with LCA 327B Apa. 6 to John Preever, within Waihale
Loainalu (*ʻili*)	An ʻili associated with LCA 4793B to Hanuna whereby kalo is cultivated. William Shaw notes in LCA 76 Apa. 2 that the ʻāina is a farm given to him by Hoapili Wahine (spelled "Loinui)."
Maele (*ʻili*)	An ʻili associated with LCA 3925B to Pulali (misspelled "Maili") and LCA 3925H Apa. 1 to Kaaha.
Makahiku (*ʻili*)	An ʻili associated with LCA 3766 Apa. 5 to Akaku, LCA 3847 Apa. 1 to Puhi, LCA 3927 Apa. 3—5 to Nakoholua, LCA 3932 Apa. 8 and 10 to Nalepo, and LCA 4260 Apa. 1 to Kaluaiuka. Misspelt occasionally "Makahiki".
Moʻomuku (*ʻili*)	An ʻili kū in Honokōwai that belonged to Kekauonohi (LCA 11216:28). Identified as "he ili hookahi ilaila" in Honokōwai. Portions appear in the following LCAs: LCA 3765 Apa. 1—3 to Aio, LCA 3851 to Napoohiwi, LCA 3925E Apa. 1—3 to Kanealii, LCA 3932 Apa. 9 to Nalepo, LCA 4552 Apa. 2, 4, 6 to Aumai, LCA 4793B Apa. 3 to Hanuna, LCA 4923 to Kalua, and LCA 5120 to Kauwealoha. Occasionally misspelt. "Moomoku".
Nāpili	Lit., the joinings or pili grass. (RC 74). Bay and land section, Lāhainā, Maui.

Naunaunawele (*ʻili*)	An ʻili associated with LCA 3688 Apa. 2 to Meeau, LCA 3766 Apa. 2—4 to Akaku, 3847 Apa. 3 to Puhi, LCA 3853 Apa. 2 to Poohina, LCA 3925H Apa. 2 to Kaaha, LCA 3926 Apa. 2 to Nika, LCA 3927 Apa. 1 to Nakoholua, LCA 3930 Apa. 3 to Nauwele, LCA 3932 Apa. 3—6 to Nalepo, LCA 4239 Apa. 5 to Kaukau, LCA 4242 Apa. 1—2 to Kaaea, LCA 4253 to Kaiama, LCA 4260 Apa. 4 to Kaluaiuka, LCA 4552 Apa. 3 to Aumai, and LCA 5904 to Polea. Documented as "Naunaunahawele" in LCA 4239 to Kaukau.
ʻŌhiʼa (*ʻili*)	An ʻili associated with LCA 6460 Apana 2 to Kaihe, LCA 6601 Apa. 5 to Piimoku, LCA 6722 Apa. 2 to Pa, LCA 6722B Apana 2 to Mai.
Palaha (*ʻili*)	An ʻili associated with LCA 4241 to Kaluakini
Papaʻōlena (*ʻili*)	An ʻili associated with LCA 3192 Apa. 2 to Kahinu, LCA 4742 Apa. 1 and 2 to Makuahine, LCA 6476 to Keliikuli
Pohakea (*ʻili*)	An ʻili associated with LCA 3688 Apa. 4 to Meeau
Pohakiki (*ʻili*)	Lit. Ka-ʻāina-iki: the small land An ʻili associated with LCA327B Apa. 3 to John Previer
Poehu (*ʻili*)	An ʻili associated with LCA 3988 Apa. 1—3 to Hilahila, LCA 5002 Apa. 3 and 8 to Kahanaumaikai, LCA 3765 Apa. 5 to Aio. Misspelled "Poohumoi" and "Poelu".
Poʻopōhaku (*ʻili*)	An ʻili associated with LCA 3925C Apa. 4 to Kahope and LCA 5002 Apa. 7 to Kahanaumaikai. Also spelled "Popohaku".
Puʻu Lena (*ʻili*)	Lit., Yellow Hill. An ʻili associated with LCA 3766 Apa. 1 to Akaku, LCA 3852 Apa. 3—4 to Pokole, LCA 3853 Apa. 1 to Poohina, LCA 3925 R to Kahena, LCA 3925S Apa. 2 to Olomana, LCA 3926 Apa. 1 to Nika, LCA 3929 to Umi, LCA 3932 Apa. 1—2 to Nalepo, LCA 4239 Apa. 6 to Kaukau, LCA 4254 Apa. 4 to kaumauma, LCA 4257 Apa. 2 to Kauluhua, and LCA 6539 Apa. 4 to Hoonoho (spelt "Poolena").
Waihale (*ʻili*)	An ʻili associated with LCA 327B to John Previer, possibly an older name for the ahupuaʻa Honokōwai
Wainalu (*ʻili*)	An ʻili associated with LCA 3987 to Holona, 4793B Apa. 1—2 to Hanuna, 6601 Apa. 4 to Piimoku
Wanaloa (*ʻili*)	An ʻili associated with LCA 3925C Apa. 2—3 to Kahope (misspelled "Analoa") and 6432 to Kaninau.
Puʻukukui	Lit., candlenut hill. Peak (5,788 feet high), the highest point on West Maui, Lāhainā qd. (Macdonald et al. 1983:324)

Uilikiko (ʻili)	An ʻili associated with LCA 3754:4 to Aio, LCA 3988:4 to Hilahila, LCA 3689:1 to Maui, LCA 3852:2 to Pokole, and LCA 4249 to Makeeui.
Waihale (*ʻili*)	An ʻili associated with LCA 327B to John Preever. Possible that Waiale may be an older name for the ahupuaʻa.
Wainalo (*ʻili*)	An ʻili associated with LCA 6601 to Piimoku
Wainalu (*ʻili*)	An ʻili associated with LCA 327 to John Prever and LCA 3987 to Holona
Wanaloa (*ʻili*)	An ʻili associated with LCA 6432 to Kaninau. Also recorded as "Analoa" in LCA 3925C to Kahope

E. S. Craighill Handy et al. (1991) summarize the relationship between Hawaiians and the natural environment best in the following passage:

> The sky, sea, and earth, and all in and on them are alive with meaning indelibly impressed upon every fiber of the unconscious as well as the conscious psyche. Hawaiian poetry and folklore reveal this intimate rapport with the elements, (E. S. Craighill Handy et al. 1991:23-24)
>
> (T)he relationship which existed from very early times between the Hawaiian people … is abundantly exemplified in traditional mele (songs), in pule (prayer chants), and in genealogical records which associate the ancestors, primordial and more recent, with their individual homelands, celebrating always the outstanding qualities and features of those lands. (E. S. Craighill Handy et al. 1991:42)

This relationship of Hawaiians to the natural environment is especially prevalent in the moʻolelo (traditional knowledge) of the wider moku of Kāʻanapali, a large part of which revolves around the lyrical descriptions of the elemental characteristics of the ʻāina (land) where the names of the ahupuaʻa are noted in name chants and the winds and rains of the region are recounted in legends and poems. In the story of Lonoikamakahiki, son of Keawenuiaumi, as retold by Fornander, an oli (chant) is recited by Kaikilani in honor of Lonoikamakahiki (Fornander 1917). This oli recounts the various ahupuaʻa of Maui, including Honokōwai:

...	...
O ka eke ia ku i ka ieie	That is the bag that will bring fame,
O ka eke ia, Kaeke-a	That is the bag, the bag of –
Elu-a–	Two–
Elua ia Honokeana Keana,	There are two of Honokeana Keana;
Elua ana Opihi,	There are two caves of Opihi
Ekolu Kahana,	There are three Kahana;
Elua Mailepai,	Two Mailepai,
Elua Honokawai,	Two Honokawai;
O Kawailua,	Kawailua;
I kolu ia Kekaa.	Kekaa making the third.
Eha la Māhinahina,	There are four Māhinahina

O ka luna i Alaeloa.	On the top of Alaeloa.
Eha la aina hono,	There are four lands containing Hono:
O Honokahua,	Honokahua,
O Honolua:	Honolua,
Honokōhau, **Honokawai**	Honokōhau, **Honokawai**
O Honopou,	Honopou
Aha la aina hono	That makes four lands containing Hono.
...	...
	(Fornander 1917:302-303)

The various rains of Hawaiʻi were also given names. Some were named after people, others after their particular traits or the way they interacted with the area and local vegetation. Different rains from different parts of the islands often share the same name. The book *Hānau Ka Ua Hawaiian Rain Names* (C. L. Akana and Gonzalez 2015) contains many of the rain names that were recorded in newspapers from the 1800s and other primary source materials. As C. L. Akana and Gonzalez (2015:xv) point out:

> They knew that one place could have several different rains, and that each rain was distinguishable from another. They knew when a particular rain would fall, its color, duration, intensity, the path it would take, the sound it made on the trees, the scent it carried, and the effect it had on people.
>
> Some rain terms have recognizable Polynesian counterparts and are probably ancient, connecting us to our ʻohana across the oceans and across time… Some rains are named after people…. Rain names may be used for their literal or figurative meaning… Many rain names refer to native vegetation…. Some describe the rain's interaction with these plants…. Some rains may act different at certain times or may indicate a certain season…. Rains represent many things to our people. First and foremost, rains are integral to our survival.

Through extensive research of Hawaiian language sources C. L. Akana and Gonzalez (2015) have identified and compiled the following names for the rains of Honokōwai:

> The Līlīlehua Rain (C. L. Akana and Gonzalez 2015:156) from a mele hoʻoilina (legacy song) for ʻEmalani Kaleleonālani:
>
Hopu Kahana i ka ua Līlīlehua	*Kahana seized the Līlīlehua rain*
Palaheʻa nō i ke pili o Honokōwai	*Stained by the pili grass of Honokōwai*
ʻUku liʻi ka pua onaona, nonoho i ka mauʻu	*The fragrant blossoms are tiny,*
Nonohe nō, me he līlīlehua ala	*dwelling upon the grass*

Ka ʻapoa e ka Nahua o nā pali	*Attractive like the līlīlehua flower* *Caught by the Nahua of the cliffs*

The Līlīlehua Rain of Honokawai (C. L. Akana and Gonzalez 2015:224) from a mele hoʻoilina (honorific chant) for ʻEmalani Kaleleonālani:

Ke oho ua Paʻūpili o Lele Līlīlehua i uka o Honokawai	*Tresses that sweep like the Paʻūpili rain of Lele* *Like the Līlīlehua wind and rain above Honokawai*

The Nahua Rain of Honokōwai (C. L. Akana and Gonzalez 2015:180-181) from a *mele* (song) for Lāhainā and Kāʻanapali that notes the plains of Honokōwai:

Me he lole ʻula i pili ala ka Nahua Ka pili ʻaʻai i ke kula o Honokōwai	*Like a red cloth clinging there is the Nahua* *Clinging – bright and brilliant– to the plains of Honokōwai*

Hawaiian proverbs, or ʻōlelo noʻeau, have been passed down through oral traditions. Many ʻōlelo noʻeau have been collected and published in Hawaiian language newspapers and other primary and secondary sources. They often have both a literal and metaphorical meaning (called kaona), which is given where applicable. ʻŌlelo noʻeau about geography can help us to understand natural phenomena, land use, and the history of a place. While there are several ʻōlelo noʻeau that refer to Kāʻanapali Moku, there is only one that is specifically related to Honokōwai.

There are four ʻōlelo noʻeau (Pukui 1983) that describe the landscape and people of Kāʻanapali:

> Kāʻanapali wāwae ʻulaʻula.
> *Red-footed Kāʻanapali.*
>
> A term of derision for the people of Kāʻanapali. The soil there is red, and so the people are said to be recognizable by the red soles of their feet. (ʻŌlelo Noʻeau 1280)
>
> Ka pali hinahina o Kāʻanapali.
> *The gray hills of Kāʻanapali.* (ʻŌlelo Noʻeau 1526)
>
> Ka ua leina hua o Kāʻanapali.
> *The rain of Kāʻanapali that leaps and produces fruit.* (ʻŌlelo Noʻeau 1582)
>
> Ka ua Lililehua o Kāʻanapali.
> *The tiny-drops-on-the-lehua rain of Kāʻanapali.* (ʻŌlelo Noʻeau 1583)

One ʻōlelo noʻeau (Pukui 1983) provides insight into the origin of the name Honokōwai.

> Na hono a Piʻilani.
> *The bays of Piʻilani.*
>
> The realm of Piʻilani, a powerful ruling chief of Maui, included the islands of Molokaʻi and Lānaʻi, as well as all the bays of Maui whose names begin with hono. (ʻŌlelo Noʻeau 2218)

3.1.2 Nā Moʻolelo o nā Aliʻi ma Honokōwai – The Stories of Chiefs at Honokōwai

3.1.2.1 Alapaʻinui and Peleʻioholani

In 1738, a battle ensued in Honokōwai between Alapaʻinui and Peleʻioholani over control of Maui. On a visit to Lāhainā, Alapaʻinui– Chief of Hawaiʻi Island and great-uncle of Kamehameha I learned that Kauhiaimokuakama, also known as Kauhipumaikahoaka, was challenging the authority of the newly appointed *mōʻī* (chief) of Maui, Kamehamehanui. After hearing this information, Alapaʻinui and his cousin, Kamehamehanui, returned to Hawaiʻi to prepare men and materials for war with Kauhiaimokuakama. In *Ancient History of the Hawaiian People,* Fornander recounts the battle that followed:

> In the following year, say 1738, Alapainui returned to Maui with a large fleet, well equipped, accompanied by Kamehamehanui. With headquarters at Lahaina, his forces extended from Ukumehame to Honokawai. Meanwhile Kauhi had not been idle during the absence of Alapai. Besides his own forces and the chiefs that adhered to him, he had sent presents and messages to Peleioholani, now king of Oahu, to come to his assistance, which that restless and warlike prince accepted, and landing his fleet at Kekaha, encamped his soldiers about Honolua and Honokahua.
>
> It is said that Alapai proceeded with great severity against the adherents of Kauhi in Lahaina, destroying their taro patches and breaking down the watercourses out of the Kauaula, Kanaha, and Mahoma valleys.
>
> Though details of this war are not given in the legend, yet the following facts may be gathered from scattered passages, viz., that Alapai arrived at Lahaina with his fleet before Peleioholani had landed at Kekaha; that Kauhi, being unable to cope alone with the large force under Alapanui, retreated to the uplands and ravines back of Lahaina, where he was kept in check by a corps of observation; that Peleioholani, after landing and finding Kauhi in this position, resolved to march to his relief, and by engaging Alapai's forces in a general battle, enable Kauhi to descend and form a junction with his Oahu allies.
>
> To this effect Peleioholani advanced to Honokawai, where he found a detachment of Alapaiʻs army, which he overthrew and drove back with great loss to Keawawa. Here they rallied upon the main body of the Hawaii troops. The next morning Alapai had moved up his whole force, and a grand battle was fought between the Oahu and Hawaii armies. The fortune of the battle swayed back and forth from Honokōwai to near into Lahaina; and to this day heaps of human bones and skulls, half buried in various places in the sand, attest the bitterness of the strife and the carnage committed. That result was probably a drawn battle, for it is related that, after great losses on both sides, the two kings – Alapainui and

> Peleiholani – met on the battlefield, and, instead of coming to blows, they saluted each other, and, considering their mutual losses on behalf of others, they made a peace between themselves and renewed the treaty of Naonealaa on Oahu. (Fornander and Grant 1996:141)

3.1.2.2 Puʻu Kekaʻa, "The Leaping Place of Souls" and Chief Kahekilinuiʻahu-manu

Kekaʻa, 1.5 miles south of the project area, was the capital of Maui at the time of Kaʻalaneo ruling West Maui (Kaha and Fornander 1872:540). The bustling village included the cultivation of potatoes, bananas, and sugarcane, and was home to Puʻu Kekaʻa. Puʻu Kekaʻa, otherwise known as "the leaping place of the souls," or "Hill of the Rumbling" (Tarallo-Jensen 1987:26), is commonly referred to as Black Rock at Kāʻanapali Beach (Kennedy 1997:F). It has long been believed that atop this puʻu, spiritual forces converge and form a leina a ke akua, a place from which the spirits leap into the sea of eternity. If judged to be worthy, a soul's aumakua (animal spirit) would be waiting in a "ghostly canoe" to take them to Po, the unknown netherworld. But if judged poorly, the spirit would go to ao kuewa where they would wander between dead and living for eternity (Kennedy 1997:F). Others also believe that Puʻu Kekaʻa is the site of the Hoʻakua, the Transmutation Ritual performed after the death of a chief (Tarallo-Jensen 1987:26).

The hill was bounded by Kekaʻa village to one side, and the Loʻi Hiehie (royal taro patch) to the other. Below the summit of the black rock is a cave named for the God Moemoe, the patron of restful sleep, who was thought to have lived at Kekaʻa with Maui for some time (Kaha and Fornander 1872:544). It was on this hill that the High Chief Kahekilinuiʻahu-manu proved his bravery to the ancestors by diving off the rock into the ocean and surviving (Tarallo-Jensen 1987:26).

In contemporary times, both tourists and local residents frequently engage in recreational activities by jumping from this puʻu into the ocean, typically with minimal incidents. However, historically, this hill was regarded with significantly more foreboding, as it was associated with supernatural occurrences and believed to be haunted. Kaha and Fornander (1872) wrote on the strange incidents recorded at Puʻu Kekaʻa and the numerous bones known to be there:

> Concerning the frequent death of all those who went alone. This was a strange, phenomenon connected with this hill. From the time I commenced living down at Lahaina, A. D. 1859-1872, it seemed there were nine persons who died there without any apparent cause. Keokiko was one of the corpses buried there, and is there at this time; that is the white thing on top of that hill.
>
> Concerning the great amount of human bones at this place. On account of the great number of people at this place there are numerous skeletons, as if thousands of people died there; it is there that the Lahainaluna students go to get skeletons for them when they are studying anatomy. The bones are plentiful there; they completely cover the sand.
>
> This is also a ghostly place. Sometimes a number of people came from Kaanapali (from the other side) going to Lahaina during - the dark. When they came to Kekaa stones rolled

> clown from the top of the hill without any cause. Listening to it, it seemed as if the hill was tumbling down; the people going along were startled and they explained, "Kekaa is ghostly! Kekaa is ghostly!" Certainly this is a strange thing for this hill to do. (Kaha and Fornander 1872:540-544)

Later, Kekaʻa was the site of a thriving plantation camp, and the puʻu was the burial site for hundreds of plantation workers (A. Akana 1997).

3.1.3 Nā Poʻe Kahiko o Honokōwai – Traditional Hawaiian Settlement of the Honkōwai Ahupuaʻa

In response to inquiries by E.S.C. Handy about the agriculture of Kāʻanapali Moku, D.T. Fleming writes:

> In all three valleys which you mention – Honokōwai, Honokohua, and Honolua, as well as Kahana, there were considerable taro raised in the olden times; as a matter of fact, a great deal was raised in Honokōwai, where there must have been 30 or 40 acres under cultivation at one time. (D. T. Fleming in Sterling 1998:46)

Claims for traditional resources and agricultural areas at the time of the Māhele confirm this account and offer insight into additional traditional agricultural and resource-gathering practices (see Section 3.2.1.2). While kalo (taro) was most certainly a staple crop in the agricultural system throughout Hawaiʻi and particularly in Honokōwai, kuleana claims and awards (LCAs) also show that ʻuala (potatoes) were important crops of the area. LCA testimonies indicate that these lands were also used to cultivate maiʻa (banana), lauhala (pandanus leaves), wauke (mulberry) olonā (a native shrub *Touchardia latifolia*, the bark from which was valued as fiber for cordage and nets), and kula (pasture land).

3.1.3.1 *Ka ʻOihana Lawaiʻa o Honokōwai – Aquaculture and the Fishing Traditions of Honokōwai*

One of the fishing grounds of Kāʻanapali is described as being very shallow from twenty to thirty fathoms in depth and extending from Hāwea Point at Kāʻanapali to the eastern point of Lānaʻi (Kahāʻulelio 2006:59). Like the moʻolelo (traditional stories) of Pōhaku Kāʻanapali, John Kapaku also shared the following fishing story with Barbara Lyons about fishing partners who lived near each other and would fish together at night:

> Long ago, two men who lived near each other at Kahana beach near Kaanapali were in the habit of fishing together at night. During the day both worked at other vocations, but in the evenings they would swim out through the cool, dark water, holding between them a long net.
>
> When the net was placed, they swam toward shore, then returned, beating the water with their hand to chase the fish into their nets. Then they would dive down and hauled the net up and swim with it to the beach.
>
> They took it to a nearby cave to empty it, and there in the deep gloom the owner of the net divided the fish by sense of touch. Meanwhile his friend took the net to stretch it out on the beach to dry. Then each would take home his pile of fish.

> One morning while the wife of the man who did the dividing was stringing up her fish on a line, her neighbor's wife chanced to see her and was struck by the size of the fish. They were twice as big as any her husband brought home! She brooded over this until she saw him again.
>
> "What does it mean?" she demanded. "Why do our neighbors have such large fish, when you bring only small ones home?"
>
> The husband grew very thoughtful.
>
> That night as he and his friend swam out to the net he pulled ahead and was the first to dive down. The net was loaded with fish. Quickly rising to the surface, he shouted, "Go and tell my wife that I am at the point of the fish!"
>
> His friend, taking this to mean that a shark was attacking him, swam to shore in terror. He hurried to his friend's house to take the bad news to his wife.
>
> "Your husband is being eaten by a shark!" he cried.
>
> The poor wife was distraught and ran along the beach, weeping and calling her husband's name, stumbling in her haste.
>
> The other man walked home with the sound of her wailing in his ears. He wondered if he might, after all, have been able to help his fellow fisherman. But it was too late now. Across the vast expanse of water the island of Lanai rose darkly. The ocean between lay calm and undisturbed, seen dimply by the light of the stars.
>
> As the distraught wife passed the entrance to the cave, a ghostly sound issued from within. Trembling, she stood still and listened.
>
> "Here I am," a voice called sepulchrally as it echoed against the walls of the caver. "I'm here, in this cave."
>
> Her husband's ghost! She stood poised for flight, yet wanting to remain. As she hesitated, her husband came from the cave and took her arm. It was he, alive!
>
> He explained to her what he had done, deliberately misleading the other so that he could see the night's catch for himself. He took his wife into the cave and together they divided the fish, and this time carried home all of the biggest ones.
>
> Never again did the man who owned the net have his neighbor's help in fishing. Through his own selfishness, he had lost not only a helper but a friend. (B. Lyons 1957)

The fishing practice described in the above moʻolelo (traditional stories) may be a type of fishing called lauahi, where on a good dark night with no waves the lauahi would be cast and the net subsequently drawn in from the breakers in sheltered bays (Kahāʻulelio 2006:11). Kahāʻulelio goes on to say that in a half a night of lauahi fishing, three to four gunny sacks could be filled with

kūmū (*Parupeneus porphyreus*), pāʻūʻū (*Caranx ignobilis*), nānue (*Kyphosus sandwicensis*), weke (*Mulloides flavolineatus*), and other kinds of fish.

In 1839, clarity of the fishing grounds and fish of the makaʻāinana (common people) and that of the konohiki (landlord) and aliʻi (chief) were written down as a part of the Kingdom laws, a pattern which may be an extension of a traditional management system. The King declared that the fishing grounds without the coral reef and the lūheʻe (octopus fishing) grounds were for the people (Kepā Maly and Maly 2003:244). But the fishing grounds from the coral reefs to the sea beach are for the landlords, and for the tenants of their several lands, but not for others. If a species of fish that the landlord claims as his own should go onto the grounds of the common people, then that specific fish is kapu (forbidden).

3.1.3.2 Ka ʻOihana Mahi ʻAi i Loko o Honokōwai – Traditional Agriculture at Honokōwai Ahupuaʻa

In response to inquiries by E.S.C. Handy about the agriculture of Kāʻanapali Moku, D.T. Fleming writes:

> In all three valleys which you mention – **Honokowai**, Honokohua, and Honolua, as well as Kahana, there was considerable taro raised in the olden times; as a matter of fact, a great deal was raised in Honokowai, where there must have been 30 or 40 acres under cultivation at one time.(in Sterling 1998:46, emphasis added)

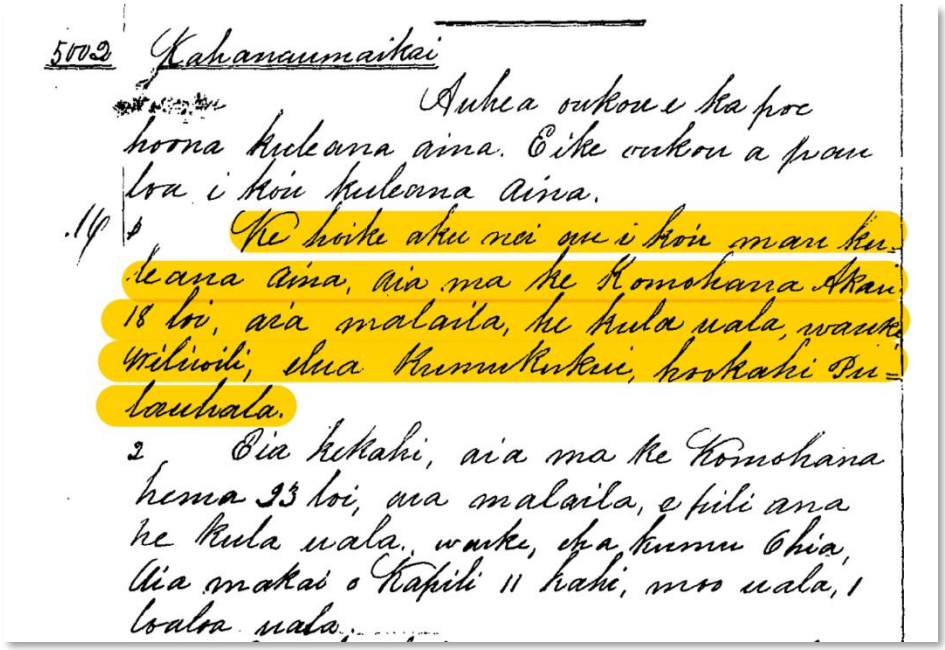
In the landmark ethnographic study *Native Planters*, Handy and others described agricultural cultivation of these four valleys as follows:

> …The first four all had extensive loʻI lands in their valley bottom, where terraces rose tier on tier in symmetrical stone-faced loʻI…. (E.S. Craighill Handy et al. 1991:494, emphasis added)

Claims for traditional resources and agricultural areas at the time of the Mahele also offer insight into the traditional agricultural and resource-gathering practices of Honokōwai (see also Section 3.2.1.2 Kuleana Land Claims and Royal Patent Grants in Honokōwai). While these claims also support D.T. Fleming's 1940 observations, it is important to note, however, that by the time of the Mahele in 1848, the native Hawaiian population had suffered a significant decline due to introduced disease and out-migration (Schmitt 1977). This suggests that pre-contact agricultural cultivation in and around Honokōwai may have been well over double the extent of what was recorded in the land claims.

Overall, while kalo (taro), with over 700 loʻi (wetland) claimed during the Mahele ʻĀina, was most certainly the primary agricultural endeavor in Honokōwai, kuleana claims and awards also show that ʻuala, with multiple claims for kula ʻuala (potato lands), pali ʻuala, or loaloa (elongated garden plots for sweet potato), was also important in this area (Figure 3-1 and Figure 3-2). Waihae (land use term used specifically on Maui) or moʻo waihae and sections of wauke were also included in the claims of native tenants. Some of the more interesting claims included banana land (LCA

3925E.2 to Kanealii in Moomuku); wiliwili, kukui trees, a lauhala clump (5002 to Kahanaumaikai in Kaneauau); and a kahawai with bananas, olonā, sugar cane (6539 to Hoonoho in Kapili and Puulena, Figure 3-3). Finally, claims for pahale (house lots), or areas of long-term residency, also appear to have been focused nearer to the coastline.

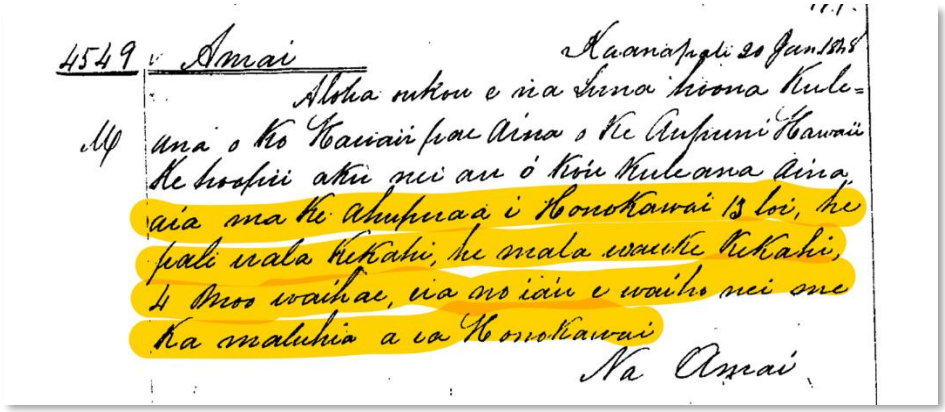

5002 Kahanaumaikai

Aohea owhou e ka poe hoona kuleana aina. E ike owhou a pau loa i kou kuleana aina.

.14 ¢ Ke hoike aku nei au i kou mau kuleana aina, aia ma ke Komohana Akau 18 loi, aia malaila, he kula wala, wauke, wiliwili, elua Kumukukui, hookahi Puulauhala.

2 Eia kekahi, aia ma ke Komohana hema 23 loi, aia malaila, e pili ana he kula wala, wauke, ehia kumu Ehia, Aia makai o Kapili 11 kahi, mau wala, 1 loaha wala.

Figure 3-1: A Native Register claim by Kahanaumaikai for Land Commission Award 5002, highlighting Apana 1 as a land used for cultivating loʻi, potato, wauke, kukui and lauhala [Native Register, Reel 4, Volume 6, Image 00020, (Office of Hawaiian Affairs 2011)]


4549 Amai

Kaanapali 20 Jan 1848

Aloha owhou e na Luna hoona Kuleana o Ko Kauai poe Aina o Ke Aupuni Hawaii Ke hoopii aku nei au o kou Kuleana aina, aia ma Ke ahupuaa i Honokawai 13 loi, he pali wala kekahi, he wala wauke kekahi, 4 mau waihae, eia no iaia e waiho nei one Ka maluhia a ia Honokawai

Na Amai

Figure 3-2: A Native Register claim by Amai for Land Commission Award 4549 highlighting the presence of 13 loʻi, 1 sweet potato land on the cliffs, 1 wauke garden, and 4 moʻo waihae [Native Register, Reel 3, Volume 6, Image 0134, (Office of Hawaiian Affairs 2011)]

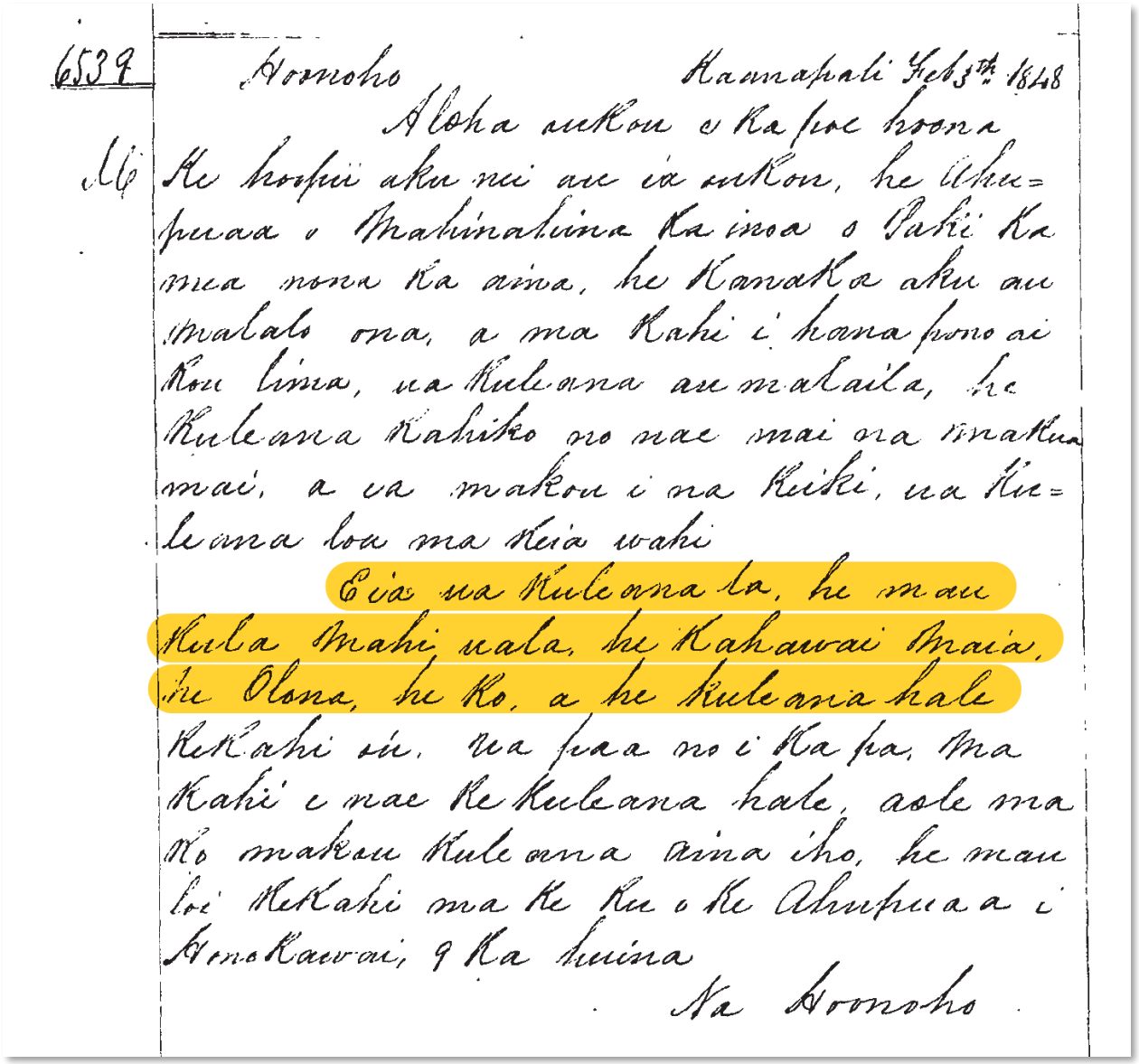

6539 Hoonoho Kaumahali Feb 3th 1848
No Aloha aukou e Ka Lae hoona
Ke hoopii aku nei au ia aukou, he Ahu=
puaa o Mahinahina Ka inoa o Paki Ka
mea noona Ka aina, he Kanaka aku au
malalo ona, a ma Kahi i hana pono ai
Kou lima, ua Kuleana au malaila, he
Kuleana Kahiko no mae mai ona maKua
mai, a ua makou i na Keiki, ua Ku=
leana loa ma Keia wahi
E ia na Kuleana la, he mau
Kula Mahi uala, he Kahawai Maia,
Iu Olona, he Ko, a he Kuleana hale
KeKahi iu. Na puaa no i Ka pa, Ma
Kahi e mae Ke Kuleana hale, aole ma
Ko makou Kuleana aina iho, he mau
loi KeKahi ma Ke Ku o Ke Ahupuaa a i
HonoKawai, 9 Ka luina
Na Hoonoho

Figure 3-3: A Native Register Claim made by Hoonoho for Land Commission Award 6539, highlighting the land as a place for sweet potato, banana, olona sugar cane, and a kuleana house [Native Register, Reel 4, Volume 6, Image 00192, (Office of Hawaiian Affairs 2011)]

3.2 ARRIVAL OF WESTERN VESSELS AND 19TH-CENTURY CULTURE CHANGE

In 1778, Captain James Cook made Hawai‘i known to the West, and the flow of seamen, merchants, missionaries, and plantation owners that followed forever altered the land, people, and culture of Hawai‘i. The sections below explain how these changes impacted the people and lands of Honua‘ula.

The nineteenth century brought a multitude of commercial, demographic, social, and religious changes to nearby Lāhainā, and the surrounding lands which include the study area, encouraged by the burgeoning foreign influx on Maui. In 1819 the first whaling ships arrived in Hawaiian

waters, and Lāhainā Harbor became a primary port of call for provisioning ships in the islands. Closely following the arrival of the first whaling ships, the first Protestant missionaries and their families arrived in Lāhainā in 1823. With an increasing population of foreigners entering nearby Lāhainā, there was a need to increase the traditional agricultural surplus that fell primarily under the control of the aliʻi (chief) class, for economic trade. Henry Whitney, editor for The Pacific Commercial Advertiser, implies that western vegetables became a common and abundant constituent of the Hawaiian gardens in the following excerpt about Maui Island:

> ...Fruits are generally abundant. The grape seems to luxuriate in the rich soil, and the sunny, clear weather of Lāhainā is, par excellence, the fruit of this place or Islands. Figs, bananas and melons are produced in abundance, and pumpkins enough for all New England to make pies for a general Thanksgiving (Whitney 1858).

After the consolidation of the rulership of the Hawaiian Islands by Kamehameha I early in the nineteenth century, nearby Lāhainā became the "capital" of the kingdom until the 1840s when the government moved to Honolulu. The sugar cane Ellis observed in the environs of Lāhainā in the 1820s, along with the introduction and mass cultivation of pineapple, would become the bases for commercial ventures that would reshape the landscape along the tabletop ridges and alluvial plains of Honokōwai.

3.2.1 The Great Māhele

By the mid-1800s, the Hawaiian Islands were bustling with foreign entrepreneurs, traders and whalers, expedient farmers, missionaries, and others, all hoping to reap the benefits of the Hawaiian ʻāina (land). Prior to the 1800s, Hawaiian land tenure was under the control of the King and appointed aliʻi nui (high chiefs), aliʻi, and konohiki (chief of the ahupuaʻa) charged with the kuleana (responsibility) to manage the land (Beckwith 1970:383). However, on the global stage, Hawaiian land proprietorship began to shift. The Great Māhele of 1848 gained traction due to the actions of King Kamehameha III in the years prior (Commissioner of Public Lands 1929:VII). In 1840, with the passing of the Constitution of the Kingdom of Hawaiʻi and the Organic Acts of 1845 and 1846, the Hawaiian Government marked an end to the traditional system of governance and became a constitutional monarchy (Spaulding 1931:3; Van Dyke 2008:32-33).

The actual Māhele, or land division, began in 1848. The intent was for King Kamehameha III to retain his own individual lands, the Crown Lands, and for the remaining lands to be divided into thirds: land entitled to the government or Government Lands, land entitled to the aliʻi and konohiki or Konohiki Lands, and the makaʻāina or Kuleana Lands (Chinen 1958:15-16). In order to secure the title to any land, residents would submit their claims to The Board of Commissioners to Quiet Land Titles, or Land Commission Board. The Board would then determine the validity of those claims and issue a Land Commission Award (hereafter referred to as LCA) to successful claimants that would then be conferred following the payment of a commutation fee (Chinen 1958:8-9, 21). These fees were waived to all native tenants as long as the claimant could prove successful land cultivation pre-1845 through testimony (Alexander 1890:115).

The Crown, Government, Konohiki, and Kuleana Lands all functioned slightly differently. Crown Lands were defined as the,

> … private lands of His Majesty Kamehameha III., to have and to hold for himself, his heirs and successors forever; and said lands shall be regulated and disposed of according to his royal will and pleasure subject only to the rights of tenants. (Kingdom of Hawaii 1848a)

At the death of Kamehameha III, the Crown Lands passed to Kamehameha IV. But at the death of Kamehameha IV, there was no immediate heir to the throne which created confusion as to the inheritance of Crown Lands and whether it followed the family line or the throne. It was decided by the Supreme Court under the confirmatory Act of June 7th, 1848 that "the inheritance is limited to the *successors* to the *throne*," and "the wearers of the crown which the conqueror had won," and that at the same time, "each successive possessor may regulate and dispose of the same according to his will and pleasure as private property, in the manner as was done by Kamehameha III" (Alexander 1890:121).

Government Lands, on the other hand, were defined and set aside in a manner more typical of public lands. They were defined as:

> … those lands to be set apart as the lands of the Hawaiian Government, subject always to the rights of tenants. And we do hereby appoint the Minister of the Interior and his successors in office, to direct, superintend, and dispose of said lands, as provided in the Act … (p)rovided, however, that the Minister … shall have the power, upon the approval of the King in Privy Council, to dispose of the government lands to Hawaiian subject, upon such other terms and conditions as to him and the King in Privy Council, may seem best for the promotion of agriculture, and the best interests for the Hawaiian Kingdom. (Kingdom of Hawaii 1848a)

In designations of lands as either Crown or Government, and all awards of whole ahupua'a, 'ili, and later land sales to foreigners, the rights of the native tenants were expressly reserved, "*Koe na Kuleana o Kanaka"* (Reserving the Rights of Native Tenants);(Alexander 1890:114). The Kuleana Act of 1850 waived the commutation fee, although a survey of the land was still required, and enabled land ownership titling for native tenants (Alexander 1890:115). Tenants could make claims for any lands that they cultivated through testimony to the Land Commission, often including multiple 'ili, or apana (parcels), located both mauka and makai. These claims were granted to native Hawaiians, non-Hawaiians born on the island, naturalized foreigners, and long-time residents foreigners who could prove their occupancy on the land prior to 1845 (Lee-Greig et al. 2014:44). However, in a Congressional hearing from 1920 leading to the formation of the DHHL, Prince Jonah Kūhiō stated that,

> But so far as the common people were concerned, they did not divide up the lands and say to the common people, 'These are your lands' as they did with the King and chiefs. No; they said to the common people, 'Not, if you have any right in the lands of the Kingdom, come and make your claim before the board of royal commissioners, and you are allowed two

> years to do it in, and if you do not make your claim in two years' time you will be barred forever from making any further claim to the lands of the Kingdom.' The common people never knew the real value of the lands. All they knew of the value of the lands was in the cultivation of same for their food. ("H. R. 13500" 1920:68)

The intent of the Māhele was for the land to be divided equally among the government, the chiefs, and native tenants, the outcome was far from equitable. Native tenants received less than one percent of all the land in Hawaiʻi, a total of 28,658 acres, while 32 missionary families received 41,000 acres (Van Dyke 2008:48). Additionally, these 28,000 acres were spread across so many individuals that according to Prince Kūhiō, it was common for grants to be for parcels as small as one-eight of an acre, or one-quarter, and so on ("H. R. 13500" 1920:69).

3.2.1.1 Crown Lands of Honokōwai

At the onset of the Māhele in 1848, Honokōwai was retained as Crown Lands by Kamehameha III (Buke Mahele 1848:22-25; Kingdom of Hawaii 1848b) which is shaded in gold on the Hawaiian Government Survey map of Maui (Dodge 1885). In order to ease the process of land titling, both native Hawaiians and other residents could purchase land outright from either Crown Lands or Government Lands through Palapala Sila Nui (Royal Patent Grants);(Kepā Maly and Maly 2005:152), in addition to kuleana claims through LCAs. In Honokōwai, all but one of the LCAs awarded also received a Royal Patent Grant.

3.2.1.2 Kuleana Land Claims and Royal Patent Grants in Honokōwai

Between 1849 and 1897, there were 70 petitions for land claims in Honokōwai, and 59 were successfully awarded Land Commission Awards (LCA). Of these 59 claimants, 56 were native Hawaiians and 3 foreigners (LCA 76 to Shaw, 5005 and 5005B to White, and 327B to Previer). In total, native Hawaiians received approximately 166.34 acres in LCA claims, with the exception of a Kekauʻonohi, while the three foreigners received 961.71 acres combined.

The majority of the LCA makaʻainana, or commoner claims, were for small portions of agricultural land across the fertile waters of the Honokōwai Gulch. The larger LCAs went to aliʻi and notable haole. Below are two of the largest awards granted in the project area: LCA 76 to William Shaw, and LCCA 11216:28 to Mikahela Kekauʻonohi:

> LCA 76 was a 675-acre parcel awarded to William Shaw. It included the Honokowai Valley and River and the minor gulch system south of Honokowai Stream. Shaw, a haole from Dublin, Ireland, arrived in Lahaina in 1807 when he was 14 years old. Shaw married a Hawaiian woman and their daughters inherited aliʻi rank, becoming hanai (fostered) daughters to Kauaiwa Kamehameha, who gave them lands in Lahaina. Shaw was given lands in Honokowai (at Haenanui and Loiʻunui) and Waikapu by Kamehameha I (Donham 1994:4-5).
>
> Award number 11216:28 went to Mikahela Kekauʻonohi (Donham 1994:4-5). This LCA included the entirety of Moʻomuku Ahupuaʻa (334.05 acres) on the north side of Honokowai Stream, with the exception of a few small LCAs. Kekauʻonohi was a kapu aliʻi,

> daughter of Kahoʻanoku Kinaʻu, a son of Kamehameha I and Peleuli (Kamakau 1992:208). Kekauʻonohi became the wife of Liholiho (Kamakau 1992:250) and was nearly appointed Governor of Maui, until William Richards challenged her nomination, convincing the chiefs that John Young should be governor of Maui because he knew more English and be a better delegate with foreign lands. The chiefs gave into Richards and appointed Young Governor to Maui, and Kekauʻonohi Governor of Kauai (Kamakau 1992:397).

All other LCA awards claimed in Honokōwai were typically makaʻainana lands for irrigated taro cultivation occurring at elevations at least as high as 1200-1250 feet above the valley bottom (Donham 1994:4-5). The native claims included roughly 100 acres of kula land, 25 acres of kalo land, 55 acres of both kula and kalo land, 55 acres of kula ʻuala land, 40 acres of house lots, 2 acres of aina laʻau, and 0.2 acres of banana land. Agricultural claims on these lots included about 700 loʻi, 8 dry loʻi, 30 waihae, 23 moʻo waihae, 30 loaloa, 2 moʻo loaloa, 3 pali uala, 7 moʻo uala, and 2 wauke.

The small amount of acreage granted to native Hawaiians relative to foreigners was typical of the Māhele process. Often these claims were either insufficient to support a family's subsistence lifestyle or were unawarded altogether. In Honokōwai, a total of 11 claims went unawarded. However, six of these claims were granted under another LCA number (LCA 186 to White→ LCA 5005, 3768 to Aio→ 3765, 3925F to Kalikuli → 6476, 3928 to Nalepo→3932, 3989 to Hoonoho→3932, and 6614 to Nakoholua→3927). The remaining 5 claims (LCA 1913 to Umalele, 6186 to Pipipi, 5146 to Kaolii, and 6722B to Mahoe, 3767 to Alawa) were outright unawarded because they were either deceased by the time the grant was submitted (3767 to Alawa), or for a variety of other reasons including inability to prove cultivation prior to the Māhele, personal issues with the Konohiki, etc.

The following table summarizes all 70 claims; their acreage, resources, and location within Honokōwai. A note about Hawaiian terms in the chart: Waihae— The term "waihae" is translated as an agricultural term used commonly in the 1840s, especially on Maui, however, the exact translation is unknown. Loaloa— translated as elongated garden plot, nothing else known about this specific term (Ulukau Hawaiian Electronic Library).

Table 3-2. Land Commission Awards (LCA) to Native Tenants, Awarded and Unawarded, all in Honokōwai Ahupua'a

LCA	Claimant	Royal Patent	Acreage	Additional Info/Placenames
76	Shaw, William	7661	No. 1.1: 320 acres (mauka) No. 1.2: 310.9 acres (dwelling lot) No. 1.3: 32.8 acres No. 1.4: 9.7 acres (kula and kalo) No. 2: 2 acres (kalo) 675.40 acres total	LCA: "a certain farm in Honokōwai by the name of Haenanui, which farm has a fishing ground connected with it [and] another farm by the name of Loinui which extends up into the mountains." No. 1.2 is a coastal "dwelling lot" named Haainainui that extends north from Puʻu Kekaa No. 2 (Loinui) is said to contain all the Pali of Honokōwai Valley- extending to the heads of the Mountain joining Waihee, and also all of Honokōwai river, from its source to its mouth." Loinui also borders the ʻili of Moʻomuku ----- No. 1 is in Haenanui (also called Haainanui) No. 2 is in Loinui
186 **Unawarded**	White, John (Keoni)	---	---	Unawarded- see award 5005
327B	Previer, John	7691	Part 1 (pahale): 11.70 acres Part 2: 6.86 acres Part 3 (kula): 6.30 acres Part 4 (kula): 4.80 acres Part 5 (kula and kalo): 34.80 acres Part 6 (mauka): 160 acres 224.46 acres total	LCA: A claim to a house lot bounded by the ocean to the west (Part 1), multiple parcels of kula and kalo land (Parts 2—5), and mountain land (Part 6). Land generally known as Waihale. ----- Part 2 is in Kou Part 3 is in Pohakiki Part 6 is in Kumukahi
1913 **Unawarded**	Umalele, Joel	---	---	Unawarded
3192	Kahinu	N/A	Apana 1: 0.69 acres Apana 2: 0.31 acres	Apana 1 is in Kapili ʻili Apana 2 is in Papaolena ʻili

LCA	Claimant	Royal Patent	Acreage	Additional Info/Placenames
3688	Meeau	4596	Apana 1 (kula ʻuala): 1.33 acres Apana 2 (kalo and kula ʻuala): 0.30 acres Apana 3 (kula ʻuala): 1.80 acres Apana 4 (kalo): 0.86 acres	FT: Claimant had loʻi and kula pieces of land NR: Claimant stated to have four waihae and one loaloa ----- Apana 2 is in Naunaunahawele Apana 3 is in Aipohopohi ili Apana 4 is in Pohakea ili
3689	Maui	7995	Apana 1 (kula ʻuala): 1.53 acres Apana 2 (kula ʻuala): 0.46 acres	NR: A claim to roughly 10 small loaloa ----- Apana 1 is in Ilikikoo Apana 2 is in Kipapa
3765	Aio	7997	Apana 1 (pahale): 0.59 acres Apana 2 (kalo): 0.02 acres Apana 3 (kalo): 0.10 acres Apana 4 (kula ʻuala): 0.5 acres Apana 5 (kalo): 0.08 acres	LCA: A house lot and multiple pastures ----- Apana 1—3 are in Moomuku Apana 4 is in Ilikikoa Apana 5 is in Poehu
3766	Akaku	6187	Apana 1 (kalo): 0.11 acres Apana 2: 0.22 acres Apana 3 (kalo): 0.16 acres Apana 4 (kula ʻuala): 0.25 acres Apana 5 (kula ʻuala): 0.32 acres	FT: A claim for multiple loʻi, potato grounds, and kula land. A total of 6 pieces of land, 5 are in Honokōwai and the 6th is in Māhinahina ahupuaʻa ----- Apana 1 is in Puulena Apana 2—4 are in Naunaunahawele Apana 5 is in Makahiku
3767 **Unawarded**	Alawa	---	---	Unawarded NT: "Alawa has deceased, he has no claim. Alawa's wife Naumu lives in Honolua, both have no claim in the least."
3768 **Unawarded**	Aio	---	---	Unawarded-See LCA 3765

LCA	Claimant	Royal Patent	Acreage	Additional Info/Placenames
3847	Puhi	5390	Apana 1 (kula ʻuala): 0.61 acres Apana 2 (pahale): 0.60 acres Apana 3 (kalo a kula): 0.94 acres	NR: A claim for 11 loʻi and kula land ----- Apana 1 is in Makahiku Apana 3 is in Naunaunahawele
3850	Paki, Abner	4207	Apana 1 (kula ʻuala): 0.32 acres Apana 2 (kula ʻuala): 2.64 acres Apana 3 (kalo): 0.16 acres	NR: A claim for loʻi, a small loaloa, and a small waihae LCA: All within the ʻili of Kapili
3851	Napoohiwi (Poohiwi)	4608	Apana 1 (kalo): 2.32 acres	NR: A claim for 35 loʻi, two moʻo waihae, and a southwest land boundary wall. LCA: Within the ʻili of Moomuku
3852	Pokole	4206	Apana 1 (pahale): 1.24 acres Apana 2 (kula ʻuala): 0.36 ccres Apana 3 (kula ʻuala): 0.26 acres Apana 4 (kalo): 0.26 acres	NR: A claim for 9 loʻi, one small loaloa, and a moʻo waihae ----- Apana 2 is in Ilikikao Apana 3 and 4 is in Puulena
3853	Poohina	5391	Apana 1 (kalo): 0.26 acres Apana 2 (kalo): 0.08 acres	NR: A claim for 20 loʻi, 3 waihae, 2 loaloa, and 8 dry loʻi ----- Apana 1 is in Puulena Apana 2 is in Naunaunahawele
3925	Nahuli	2911 ½	Apana 1 (kula ʻuala): 0.86 acres Apana 2 (kalo): 0.06 acres	NR: A claim for 10 loʻi and one loaloa FT: All within the ʻili of Kapili
3925B	Piilali	5394	0.14 acres (kalo and pasture)	Within the ʻili of Maele (or Maili) of Honokōwai
3925C	Kahope	3337	Apana 1 (pahale): 0.81 acres Apana 2 (kula ʻuala): 1.19 acres Apana 3 (kalo): 0.47 acres Apana 4 (kalo): 0.36 acres	RP: Apana 1 is bounded by the ocean to the west ----- Apana 2 and 3 are in Analoa (also called "Wanaloa") Apana 4 is in Poopohaku ʻili (also called "Popohaku")

LCA	Claimant	Royal Patent	Acreage	Additional Info/Placenames
3925D	Hualii	4177	Apana 1 (kalo): 0.24 acres Apana 2: 0.19 acres	FT: Five pieces of land in total, two within Honokōwai --- Apana 2 is in Kahanaiole
3925E	Kanealii	7996	Apana 1 (kalo): 0.16 acres Apana 2 (banana): 0.13 acres Apana 3 (kalo): 0.68 acres Apana 4 (kula ʻuala): 0.74 acres	Apana 1—3 are in Moomuku ili
3925F **Unawarded**	Keliikuli	---	---	Unawarded- see LCA 6476
3925H	Kaaha	7945	Apana 1 (kula ʻuala): 0.89 acres Apana 2 (kalo and kula ʻuala): 0.44 acres	FT: A claim for 4 taro loʻi, a total of 6 land parcels, 2 are within Honokōwai --- Apana 1 is in Maele Apana 2 is in Naunaunawele
3925R	Kaheana	4626	Apana (kalo): 0.06 acres	Within the ʻili of Puulena
3925S	Olomana	6074	Apana 1 (pahale): 0.45 acres Apana 2 (kalo): 0.20 acres	FT: The house lot (Apana 1) is on the boundary between Kāʻanapali and Lāhainā. --- Apana 2 is in Puulena
3926	Nika	4589	Apana 1 (kalo): 0.26 acres Apana 2 (kalo): 0.74 acres Apana 3 (pahale): 0.75 acres	FT: Apana 1 includes 5 loʻi, Apana 2 includes 19 loʻi --- Apana 1 is in Puulena Apana 2 is in Naunaunawele
3927	Nakoholua	2153	Apana 1 (pahale and kalo): 0.11 acres Apana 2 (kula ʻuala): 1.72 acres Apana 3 (kula ʻuala): 1.02 acres Apana 4 (kula ʻuala): 2.81 acres Apana 5 (kalo and kula): 1.84 acres	FT: Includes three loʻi (Apana 4), and 15 loʻi (Apana 5) LCA: There are two property lines in Section 5 bisected by a stream, described further in the LCA --- Apana 1 is in Naunaunawele Apana 3—5 are in Makahiku

LCA	Claimant	Royal Patent	Acreage	Additional Info/Placenames
3928 **Unawarded**	Nalepo	---	---	Unawarded- see LCA 3932
3929	Naumi (Umi)	4208	0.83 acres	NR: A claim for 18 loʻi FT: Land includes a house lot, potato grounds, and taro Within the ʻili Puulena of Honokōwai
3930	Nauwele	4591	Apana 1 (pahale): 0.71 acres Apana 2 (pahale and kula): 0.56 acres Apana 3 (kalo and kula): 0.70 acres Apana 4 (kula ʻuala): 0.71 acres	NR: A claim for 22 loʻi LCA: Apana 1 is bounded by the ocean to the west ----- Apana 3 is in Naunaunawele Apana 4 is in Aipopoo
3932	Nalepo	4595	Apana 1 (kalo): 0.18 acres Apana 2 (kula): 0.78 acres Apana 3 (kula): 0.61 acres Apana 4 (kalo): 0.08 acres Apana 5 (kalo): 0.13 acres Apana 6 (kalo): 0.08 acres Apana 7 (kula): 0.98 acres Apana 8 (kula) Apana 9 (kula) Apana 10 (kula)	NR: A claim for 25 loʻi, 2 waihae, and 2 loaloa FT: Apana 8 through 10, acreage unavailable. ----- Apana 1 and 2 are in Puʻulena Apana 3—6 are in Naunaunahawele Apana 7 is in Kapili Apana 8 and 10 are in Makahiku Apana 9 are in Moʻomuku
3987	Holona	3023	Apana 1 (pahale): 1.40 acres Apana 3 (pahale): 2.60 acres Apana 4 (kalo): 0.23 acres	NR: “Ke hoopii aku au ia oe, he mau loi kalo, he umikumahiku, he pa aina lima mau aina waihae.” [A claim for 17 kalo loʻi and 5 waihae] All within Wainalo
		2910 ½	Apana 2 (kalo): 0.16 Acres	FT: A claim for 10 loʻi ----- Apana 2: Kapili

LCA	Claimant	Royal Patent	Acreage	Additional Info/Placenames
3988	Hilahila	4590	Apana 1 (kalo): 0.47 acres Apana 2 (kula): 0.73 acres Apana 3 (kula): 1.11 acres Apana 4 (kula): 0.68 acres Apana 5 (pahale)	NR: A claim for 18 loʻi, 4 waihae, and 2 loaloa ----- Apana 1—3 are in Poehu (misspelled "Poohumoi" in LCA) Apana 4 is in Ilikikoo
3989 **Unawarded**	Hoonoho	---	---	Unawarded- see LCA 6539
4239	Kaukau	4203	Apana 3 (kula ʻualaʻ): 0.67 acres Apana 4 (kula ʻualaʻ): 0.24 acres Apana 5 (kalo): 0.30 acres Apana 6 (kalo): 0.40 acres Apana 7 (kalo): 0.56 acres Apana 8 (kalo): 0.20 acres Apana 9 (kalo): 0.22 acres	NR: A claim for 35 loʻi, three moʻo waihae, and two loaloa, across 12 land sections. LCA: In testimony, Apana 2 and Apanas 10-12 were included, but later dropped after a revised survey with the consent of Konohiki and claimant. ----- Apana 3,4, and 7—9 are in Kapili Apana 5 is in Naunaunawele Apana 6 is in Puʻulena
4241	Kaluakini	4594	Apana 1 (kalo): 0.15 acres Apana 2 (kalo): 0.16 acres Apana 3 (kula ʻualaʻ): 3.25 acres Apana 4 (kula ʻualaʻ): 2 acres Apana 5 (ʻāina laʻau): 1.43 acres	NR: "Aloha oukou e ka poe houna kuleana. Ke hoopii aku nei au ia oukou he maul oi 28, he mau waihai 2, he wahi loaloa, aia ma Palaha" [A claim for 28 loʻi, 3 waihae, and a small loaloa] All within the ʻili of Palaha
4242	Kaaea	4204	Apana 1 (kalo): 0.13 acres Apana 2 (kalo): 0.30 acres Apana 3 (kula): 0.30 acres Apana 4 (kula): 0.54 acres Apana 5 (pahale): 0.41 acres	NR: A claim for loʻi and waihae ----- Apana 1 and 2 are in Naunaunawele
4244	Kuemanu	6063	Apana 1 (kalo and kula): 0.94 acres Apana 2 (kula ʻualaʻ): 2.48 acres Apana 3 (kula ʻualaʻ): 1.66 acres	NR: A claim for 30 loʻi, 2 moʻo loaloa, 6 moʻo waihae All within Kipapa

LCA	Claimant	Royal Patent	Acreage	Additional Info/Placenames
4248	Kekalohe	4443	Apana 2 (kula ʻuala): 0.22 acres Apana 3 (kalo): 0.61 acres	RP: Three pieces of land total in this LCA, two of which are in the Honokōwai ahupuaʻa --- Apana 2 is in Kapili Apana 3 is in Kaelepuni
4249	Kameeui	5174	Apana 1 (kula ʻuala): 1.85 acres Apana 2 (kula): 1.61 acres Apana 3 (kula ʻuala): 0.92 acres Apana 4 (kalo): 0.21 acres	NR: "Ke hoopii aku ei au ia oukou i koʻu mau wahi loi 10, he mau waihae 1, he mau loaloa elua, aia ma wahi kuleana, aia ma Honokōwai mokupuni o Maui" [A claim for 10 loʻi, 1 waihae, and 2 loaloa] --- Apana 3 is in Uilikiko
4253	Kaiama	4444	Apana 1 (kula ʻuala): 1.82 acres Apana 2 (kalo): 0.22 acres	NR: "Aloha oukou a pau e na luna kuleana aina. Ke hoopii aku nei au ia makou a pau, he mau wahi loi iwah, he mau loaloa ekolu." [A claim for 9 loʻi and two loaloa] All within Naunaunawele
4254	Kaumauma	4205	Apana 1 (pahale): 1.77 acres Apana 2: 0.5 acres Apana 3 (kula ʻuala): 0.93 acres Apana 4 (kalo): 0.24 acres	NR: "Aloha oukou e na luna ke hoopii aku nei au ia oukou, he mau loi 22, he loaloa kekahi aia i Kapili i Kukeanuanua" [A claim for 22 loʻi and loaloa] --- Apana 3 is in Kapili Apana 4 is in Puʻulena

LCA	Claimant	Royal Patent	Acreage	Additional Info/Placenames
4257	Kauluhua	8365	Apana 1 (pahale and kula): 0.30 acres Apana 2 (kalo and kula): 0.36 acres	NR: "Ke hoopii aku nui au ia he mau loi 11 ka huina. Na pani he loaloa hookahi" [A claim for about 11 loʻi and 1 loaloa] RP: "application has been made to the Commissioner of Public Lands by the Pioneer Mill Co., Ltd., present owner, for a patent of the land herein described…" Fee simple land granted in 1927 by acting Governor Bailey, Commissioner of Public Lands. --- Apana 2 is in Puʻulena
4260	Kaluaiuka	4564	Apana 1 (kula ʻuala): 1.26 acres Apana 2 (kalo): 0.14 acres Apana 3 (kula ʻuala): 1.22 acres Apana 4 (kula ʻuala): 0.24 acres Apana 5 (pahale): 0.38 acres Apana 6 (pahale): 3.52 acres	NR: A petition for 13 loʻi LCA: Apana 5 (house lot) is bounded by the ocean --- Apana 1 is in Makahiki Apana 2 is in Kipapa Apana 4 is in Naunaunawele
4549	Amai	4603	0.94 acres (pahale)	NR: "Aia ma ke ahupuaa I Honokōwai 12 loʻi, he pali uala kekahi, he mea la wauke kekahi, 4 moo waihae, ua no Iaʻu e waiho nei one ka maluhia a ia Honokawai." [A claim for 12 loʻi, 1 potato cliff, 1 wauke, and 4 moʻo waihae] Within Haenanui
4552	Aumai	636	Apana 1 (pahale): 0.24 acres Apana 2 (kula ʻuala): 0.32 acres Apana 3 (kula ʻuala): 0.53 acres Apana 4 (kalo): 0.11 acres Apana 5 (pahale): 2 acres Apana 6 (kalo) 0.06 acres	NR: A claim for a long-time occupant of the ili Moomuku, claiming 28 loʻi in Moomuku (Apana 1 and Apana 2) and another 30 loʻi throughout the ahupuaʻa of Honokōwai --- Apana 2, 4, and 6 are in Moʻomuku ʻili Apana 3 is in Naunaunawele

LCA	Claimant	Royal Patent	Acreage	Additional Info/Placenames
4742	Makuahine	3336	Apana 1 (kalo): 0.48 acres; 0.04 acres Apana 2 (kula): 3.37 acres Apana 3 (pahale): 0.58 acres	NR: A claim for 6 loʻi, and a moʻo waihae LCA: Apana 3 is bounded by the ocean to the west ----- Apana 1 and 2 are in Papaolena
4793B	Hanuna	6169	Apana 1 (pahale): 0.04 acres Apana 2 (kalo): 0.61 acres Apana 3 (kalo): 0.57 acres Apana 4 (kula): 0.53 acres Apana 5 (kula ʻuala): 0.24 acres	NR: "E ike oukou i keia onau loi 31 loi, Wainalo Pahale hale moo waihae." [A claim for 31 loʻi, a house lot, and 4 moʻo waihae] ----- Apana 1 and 2 are in Wainalu Apana 3 is in Moʻomuku
4923	Kalua	635	Apana 1 (pahale): 1.27 acres Apana 2 (kula ʻuala): 1.06 acres Apana 3 (kalo): 0.06 acres Apana 4 (kalo and kula): 0.70 acres Apana 5 (kalo and kula): 1.14 acres	NR: "23 loi maloko o Moomuku, he mau moo waihae kekahi, he mau pali palalae, he kulana hale." [A claim for 23 loʻi, 1 moʻo waihae, a pali, and a house] Within the ʻili of Moʻomuku
5002	Kahanaumaikai	3559	Apana 1 (pahale): 1.16 acres Apana 2 (kula ʻuala): 4.58 acres Apana 3 (kula ʻuala): 1.94 acres Apana 4 (kula ʻuala): 2.50 acres Apana 5 (kula ʻuala): 3.10 acres Apana 6 (kula ʻuala): 2.18 acres Apana 7 (kula and kalo): 1.35 acres Apana 8 (kula and kalo): 1.10 acres Apana 9 (kalo): 0.48 acres	NR: A claim for multiple pieces of land with many loʻi, potato lands, wauke, wiliwili, two kukui trees, and one clump of lauhala. ----- Apana 3 and 8 are in Poehu Apana 4—6, and 9 are in Kapili Apana 7 is in Poʻopohaku
5005	White, John (Keoni)	1684	Apana 1 (kula): 45.84 Apana 2 (kula): 7.64 Apana 3 (kalo): 7.72	FT: "The land is called 'Kaneuau' […] the claimant cultivates the kalo land. He does not cultivate the kula but keeps cattle." ----- Apana 2 and 3 are in Kaneauau
5005B	White, John (Keoni)	7817	0.85 acres	See 5005

LCA	Claimant	Royal Patent	Acreage	Additional Info/Placenames
5120	Kauwealoha	7994	1.2 acres (kalo)	NR: A claim for 4 loʻi Within the ʻili of Moʻomuku
5121	Kane	6653	Apana 1 (pahale): 0.54 acres Apana 2 (kalo): 0.53 acres Apana 3 (kula): 10 acres	NR: A claim for loʻi and kula land ------ Apana 2 and 3 are in Kapili
5146 **Unawarded**	Kaolii	---	---	Unawarded
5904	Polea	6326	Apana 2 (kalo): 2.45 acres	NR: A claim for 18 loʻi in Honokōwai Within Naunaunawele
6186 **Unawarded**	Pipipi	---	---	Unawarded
6432	Kaninau	1843	0.41 acres	FT: Within Wanaloa (sometimes written as "Analoa")
6459	Keokeo	6125	0.54 acres (kalo o ʻāina laʻau)	NR: "…18 loi kalo, hookahi moo uala, hookahi pali uala, hookahi kula, ma Kahikiola, na ka lelele o kula wahi uala." [A claim for 18 loʻi, 1 potato moʻo, 1 steep potato planting, and 1 kula at Kahikiola] Within Haenaiki
6460	Kaihe	4171	Apana 1 (kalo): 0.11 acres Apana 2 (kalo): 0.32 acres	NR: A claim for 20 loʻi ----- Within Haenaiki Apana 2 is further defined within Ohia
6476	Keliikuli	7962	Apana 1 (kalo and pahale): 0.73 acres	FT: "It is one piece, a house lot, and garden" Within Papaolena

LCA	Claimant	Royal Patent	Acreage	Additional Info/Placenames
6539	Hoonoho	4130	Apana 2 (kalo): 0.06 acres Apana 3 (kula ʻualа): 0.59 acres Apana 4 (kalo): 0.04 acres	LCA: A total of 4 portions, 3 of which are within Honokōwai NR: A claim for sweet potato kula, and a kahawai (valley area) with bananas, olona, and sugar cane. There is also a house lot enclosed by a fence, but outside this claim. There are 9 loʻi in the Honokōwai ahupuaʻa --- Apana 2 and 3 are in Kapili Apana 4 is in Puʻulena
6601	Piimoku	4818	Apana 1 (kalo): 0.10 acres Apana 2 (kalo): 0.09 acres Apana 3 (kalo): 0.36 acres Apana 4 (pahale): 0.20 acres Apana 5 (kalo): 0.09 acres Apana 6 (kalo and kula): 0.48 acres	NR: A claim for 51 taro loʻi, potato land, a mountain area, and a house. The land boundary is the fence. --- Apana 2 and 3 are in Haaeniki Apana 4 is in Wainalu Apana 5 is in Ohia Apana 6 is in Kaelepuni
6614 **Unawarded**	Nakoholua	---	---	Unawarded- same award as 3927
6722	Pa, E	4173	Apana 1 (pahale): 0.68 acres Apana 2 (kalo): 0.35 acres	NR: “he 16 loi, ekolu moo uala me Ka Waihae, Hookahi pali uala a he kula no hoi, a he uka laau no hoi kahi.” [A claim to 16 loʻi, 3 potato moʻo, a waihae, 1 steep potato planting, and a kula and upland area.] --- Apana 2 is in Ohia
		4172	Apana 3 (kula): 19.85	Within Ohia
6722B **Unawarded**	Mahoe	---	---	Unawarded NR: Eia hoi ko Mahoe mau loi inoa, hookahi moo waihae, a mala uala no hoi kahi, Na Mahoe. [1 moʻo waihae, and potatoes]

LCA	Claimant	Royal Patent	Acreage	Additional Info/Placenames
6722B **Awarded**	Mai	3939	Apana 1 (kula): 6.19 acres Apana 2 (kalo): 0.94 acres	NR: Eia hoi ko Mai maul oi, he 18 loi hookahi moo waihae, a he mala uala no hoi. [A claim for 18 loʻi, 1 moʻo waihae, and a potato mala] LCA: Apana 1 is bounded by the ocean to the west. Note: Also referred to as 6722C --- Apana 1 is in Haaeneiki Apana 2 is in Ohia
6741	Inoa	6127	Apana 2 (kalo): 0.82 acres	NR: A claim to 6 potato moʻo and 16 taro loʻi. RP: Apana 1 (kalo, 0.2 acres) was sold to John Nowlein in March 1855. Apana 2 was given to claimant. Within Haenaiki
11216:28	Kekauonohi, Mikahela	8531	Apana 1: 21.22 acres Apana 2: 0.97 acres Apana 3: 20.49 acres Apana 4: 291.37 acres	An ʻili kū in Honokōwai that belonged to Kekauonohi (LCA 11216:28), and was given to the great-granddaughter of King Kekaulike. Identified as “he ili hookahi ilaila” in Honokōwai, Apana 4. NR: “Wa hui maui oia no hona ama o Honokōwai Moomuku he ili ma Kaanapali, ma ka mokupuni o Maui, no ka mea, wa luaa ia ia kua” Indices of Awards: in the “Lands of Aliis and Chiefs”, granted to “Kekauonohi, M. (W): Great-granddaughter of Kekaulike—King of Maui, wife of A. Kealiiahonui, who died June 23, 1849, also wife of L Haalelea, who died June 2, 1851”

3.2.2 Economic Changes in West Maui and the Arrival of Commercial Sugar Ventures

The unifying of the Hawaiian Islands in 1790 and the arrival of missionaries in the 1820s changed the socioeconomics and agricultural practices of the region. The traditional Hawaiian ahupua'a subsistence-based economic system struggled against the growing market-based economy. The Civil War prevented the South from milling sugar which allowed room for Hawai'i to compete in the lucrative California sugar market (MacLennan 1997:99), leading many entrepreneurs to begin various milling operations in the islands. For nearly a century following 1840, sugar milling in West Maui grew from a small cane field cultivated by David Malo (Rolph 1917:168-169), to a massive 10,000-acre operation operated by the Pioneer Mill Company (Honolulu Star-Bulletin 1947).

Kō, or sugar cane (*Saccharum officinarum*), made its first appearance in Hawai'i during the initial settlement by Polynesians. The highly adaptable cane evolved multiple variations as it traveled and thrived throughout the Pacific Islands for generations (E. S. Craighill Handy et al. 1991:183). In Hawaiian wet-taro farming, kō was found along embankments separating flooded terraces, while in dry-taro and sweet-potato farming the kō was planted as hedges or a windbreak (E. S. Craighill Handy et al. 1991:186). Sugar cane was a "lifesaver" at times of famine, a treat in times of abundance, an easement for unpalatable medicine, and possibly a hygienic tool to clean teeth (Abbott 1992:41; E. S. Craighill Handy et al. 1991:186). Kō was also planted for its colorful aesthetic (Abbott 1992:40). Leaves of the plant were sometimes used as wall coverings, the stalk as a dart in games, and the skin for plaiting braids (E. S. Craighill Handy et al. 1991:187).

3.2.2.1 West Maui Sugar Company

The beginning of the industrial sugar boom occurred when Captain Pardon Edwards brought a "bundle of choice" sugarcane from the Marquesas Islands to Kauai in 1854, making a pit stop in Lāhāina and dropping some off with Consul Chase and F.A. Oudinot. The new cane outperformed the previous Cuban variety in growth rate, healthier rooting, sweetness, and hardiness against pests. It quickly became known as the "Lāhainā Cane," and catalyzed the sugar mill industry (Royal Gardens Kew 1894:418-419). The preferable Lāhainā Cane quickly catalyzed the sugar mill industry (Davies 1884), leading a number of small sugar companies to begin cane cultivation (Donham 1994:4-5).

In 1864, King Kamehameha V, F.W. Hutchison of the Lāhainā Sugar Company (The Pacific Commercial Advertiser 1861:2), and James Makee of the Rose Ranch in 'Ulupalakua, joined efforts to begin the West Maui Sugar Company in Lāhainā. Z.S. Spalding joined as manager and helped acquire the Lāhainā Sugar Campany in the late 1860s (Lee-Greig et al. 2008:30). After sugar prices plummeted in 1870, James Makee's son, Parker Makee, took over as manager (ibid). Shortly after, the mill began to slow as the Makees became preoccupied with running the Makee Sugar Co. in Kauai with future King Kalākaua (Thrum 1925:86). King Kamehameha V died in 1872, and by 1874, the remaining associates decided to sell the West Maui Sugar Company to the Pioneer Mill Company (The Pacific Commercial Advertiser 1874:3). By the turn of the century, Pioneer Mill would purchase 12,500 acres of land in Lāhainā, Launiopoko, Wahikuli, and Kā'anapali (Donham 1994:4-5).

3.2.2.2 Pioneer Mill Company in the 19th Century

James Campbell, a Lāhāina carpenter, began a small sugar mill in 1860 and was soon joined by Henry Turton and James Dunbar (Wilcox 1996:19 and 126) under the company name Campbell & Turton (HSPA Plantation Archives 2004). In 1862, the plantation became known as the Pioneer Mill Company, (The Pacific Commercial Advertiser 1864) and ten years later acquired the West Maui Sugar Company (The Pacific Commercial Advertiser 1874). For years Campbell was known locally as "Ona Milliona," the millionaire of West Maui (The Hawaiian Gazette 1900). In 1877, Campbell turned over his company share to Turton (McCandless 1936:65; The Honolulu Advertiser 1935) who built a plantation railroad in 1882, which eased transportation of cane to the mill (Ramsay 1966:16) (see section 3.3.2 for the modern-day "Sugar Cane Train" tourist destination ("The Sugar Cane Train: The Lahaina, Kaanapali & Pacific Railroad"). In 1885, Hackfeld & Co. (later known as American Factors and modern-day Amfac/JMB) purchased controlling shares of the Mill (Jones and Osgood 2015:160; Wilcox 1996:126) and acquired additional land tracts controlled by Bernice Pauahi Bishop Estate that included important water sources vital to plantation expansion (Lee-Greig et al. 2008:31).

Another narrative places Benjamin Pittman as the founder of the Pioneer Mill in 1862 (Jones and Osgood 2015:160). Pittman then entered into a mortgage deed with Campbell and Turton in 1867 (Kepa Maly and Maly 2007:984). A separate account places this same sale in 1876 (The Honolulu Advertiser 1935), but this is likely a transposition of the year since a court case between Campbell and Turton and a neighboring cane field places the plantation ownership pre-1871 (The Hawaiian Gazette 1871). It is possible that Campbell and Turton began the Mill in the early 1860s on land belonging to Pittman, but based on numerous sources it seems that Campbell and Turton were likely the founders of the Pioneer Mill Company.

As the Mill expanded into the 20th century, major change was also occurring across the Hawaiian Islands. Queen Liliʻuokalani had worked determinedly to restore power to the monarchy after the death of King Kalākaua in 1891 but was illegally overthrown and imprisoned in her own home two years later. At the same time, the U.S. entered war with Spain. With the threat of losing both a strategic military position and economic hub in the Pacific, President McKinley signed an annexation resolution in July 1898, at the protest of native Hawaiians and the Queen herself, making the Hawaiian Islands a Territory of the United States (Daws 1968:284-290). This act largely benefited industrious foreign businessmen on the Islands and was directly in opposition to the desires of over half the population of native Hawaiians (Schamel and Schamel 1999).

3.3 HONOKŌWAI AHUPUAʻA AND THE CURRENT PROJECT AREA IN THE 20TH CENTURY

3.3.1 1900-1950 – Early 20th Century Sugar Industry

The sugar industry ramped up in the 1900s, acquiring additional water sources and solidifying water agreements with the Honolua Ranch (later known as the Baldwin Packers, then Maui Pineapple Company, then in 1969 the Maui Land and Pine or ML&P, see section 3.3.2.1) who built and owned the Honokōhau Ditch, the largest water resource for the Mill (Wilcox 1996:131). The plantation also built water systems of its own totaling seven additional small systems: Kahoma,

Kanaha, Kauaula, Launiupoko, Olowalu, and Ukamehame. Some of these streams also supplied nearby villages, the county, and the power plant (Wilcox 1996:134). In 1913, a new Honolua Ditch was built to support the failing Honokōhau Ditch (Wilcox 1996:130). These agreements and resources largely contributed to Pioneer Mills' success at the turn of the 20th century (Wilcox 1996:126).

The Pioneer Mill also hired the McCandless Brothers to drill for groundwater in 1883 (McCandless 1936:65), creating the "Maui-type well," (a vertical mine-like shaft) and allowing for greater cultivation of land. The plantation expanded from 525 acres of land harvested in 1895 to nearly 3,000 acres in 1905 (Lee-Greig et al. 2008:32). By 1921, the McCandless Brothers had drilled 36 wells in Kā'anapali and 26 in Lāhainā (McCandless 1936:65).

Tunneling for perched water began just after well drilling, and included the collection of and dispersion of water straight from stream headlands deep in West Maui. Tunnels were driven into lava formations at high elevations to intercept large water flows and carried down the tunnel to the point of use (Wadsworth 1933:152). To these industrial men, water was an important resource for the technological expansion of the sugar mill across the dry plains of Lāhainā. But to Hawaiians, water is life. As Wilcox (1996) explains,

> While in English the word "water" means "a transparent, odorless, tasteless liquid, a compound of hydrogen and oxygen," in Hawaiian the word "wai" has many meanings: water and blood and passion and life. (Wilcox 1996:24)

Water diversion began in West Maui as early as 1876. The practice began deceptively, resembling agricultural practices similar to growing taro. But unlike taro production, the water used was not returned to the stream but instead permanently transported out of the watershed. Traditional agriculture failed with the loss of water to sugar plantations, and with few legal resources against these giant industries, little could be done by the native population (Wilcox 1996:29-32). Deforestation of native forests also contributed to these devastating environmental effects, leading public policy to shift toward conservation-focused development in the late 1900s (Wilcox 1996:38-42).

Following water expansion, the Plantation Mill Company built one of the first rail systems for hauling cane from the fields. This six-mile narrow-gauge railroad connected the Mill to the sugar fields ("The Sugar Cane Train: The Lahaina, Kaanapali & Pacific Railroad"). Further improvements included the construction of a 225-foot high brick-and-concrete smokestack to ease sugar cane processing (Lahaina Restoration Fund 2020). By 1930, the Pioneer Mill was the largest sugar producer in West Maui, and second in all of Maui Nui (Jones and Osgood 2015:158). A year later, the Pioneer Mill purchased the Olowalu Sugar Company, and by 1935 the Mill was producing over 10,000 acres of cane (HSPA Plantation Archives 2004).

3.3.1.1 Labor and Strikes in the 20th Century

The Pioneer Mill Plantation has been characterized as a "family-oriented" place for laborers. To foster familial ties, the plantation employed an arguably "creepy amount of knowledge about

their workers' private lives," echoing mechanics of "Fordist" capitalism (Isaki 2016:85). In a study investigating the impacts of tourism on the lives of plantation workers, Isaki (2016) writes:

> Remembered time softened the edges of then-existing menaces to retired-workers' intimate worlds. Nothing happened that could not have been survived, say the survivors. Sexual encounters were sanitized. Even the company's repression of labor union action, and the latter's impassioned resistances have been cabined within the confines of the anecdote. (Isaki 2016:91)

A mentality of "work or be hungry" (Masuda in Isaki 2016:91) engineered by the plantation economy allowed for a collective re-writing of the horrors of plantation life for laborers and their families. One example of the brutal treatment at the plantation is embodied by manager Louis Barkhausen, a German cousin of Hackfeld's who began working at the Pioneer Mill in the early 20th century. Many recall that he was a "rough, brutal, savage, and inhumane" manager (Solamillo 2012). Arthur Waal, the Lāhainā postmaster, recalled observing Barkhausen chase a group of Japanese laborers down a steep hill to Kāʻanapali Gate with vicious dogs. The laborers later had to be treated for the wounds back at the plantation camp and incurred a wage deduction for the day (Waal in Solamillo 2012).

In 1900, in response to the accidental death of three workers at the Pioneer Mill, the Japanese workers demanded compensation for the families affected, for better hours, and firing of most of the overseers. The strike grew from Pioneer Mill to over 20 of the other plantations across Maui with participation from nearly 8,000 workers. Workers won numerous concessions, and in 1905 they went on strike again in response to a worker who was beaten while on duty. This led to additional concessions by the management (Jones and Osgood 2015:89-90) and Barkhausen left the Pioneer Mill in 1908 (Solamillo 2012).

In 1910 there were 1,600 workers employed by the Pioneer Mill (HSPA Plantation Archives 2004). Roughly seventy-seven percent of those workers were comprised of Japanese individuals (Solamillo 2012). A sense of patriotism grew among Japanese workers, especially following a 1905 Japanese victory against Russia, leading to greater solidarity in subsequent strikes throughout the 20th century (Solamillo 2012). In 1932, the Mill had the highest number of "old time" Japanese sugar workers in all of the Hawaiian Islands (HSPA Plantation Archives 2004). By that time, the plantation included The Lāhainā Light and Power Company, Lāhainā Ice Company, the Lāhainā and Puʻukoliʻi Stores, and the Pioneer Mill Hospital (HSPA Plantation Archives 2004).

In 1947, with the loss of labor to soldiers in WWII, additional labor strikes, and the internment of Japanese Americans in Haiku (Mebel and Pignataro 2007), the Mill lost $700,000 and had roughly 7,000 acres of cultivatable land (Honolulu Star-Bulletin 1947:5). Railroad operations were abandoned in August of 1952, effectively ceasing all plantation railroading on the island of Maui (Ramsay 1966:26). In 1984, the Mill only harvested 4,000 acres (Hawaiian Sugar Planters' Association 1984:3). The plantation began to restructure the property for tourism, but even with these measures, the Mill lost $7 million dollars between 1994 to 1999. The Mill finally closed its doors at the turn of the 21st century (Honolulu Star-Bulletin 1999:A12).

The Mill's workers slowly left their plantation camp homes. Wainee Village, the last of the West Maui plantation camps, closed in 1993, giving employees two to three years to find new housing accomodations (Associated Press 1993). Efforts were made to begin converting Lāhāina into a tourist destination following the fall of the agriculture industry. The transition was a time for reflection, bringing environment groups to call attention to the unsustainable practices utilized by the Pioneer Mill (such as dumping wastewater into the ocean at Launiupoko, settling wastewater in local ponds, and the air pollution from burning sugar cane) with hopes that the future hotel industry would use eco-friendly practices (Isaki 2016:92). The transition also opened new employment opportunities for women who had little role in the workforce during the plantation era (Isaki 2016:90 and 91).

The plantation era was commemorated in West Maui through the Pioneer Mill smokestack (Isaki 2016:90), and city-wide celebrations such as the "Lahaina Plantation Days" (Tsutsumi 2010), replaced the Indigenous history of the region with memorials to the 19th-century agricultural history (Isaki 2016:93).

3.3.2 Mid-20th Century to the Modern Era – Planes, Trains, and Condominiums: Infrastructure for Tourism

Resort construction on the Kāʻanapali coast began in 1959 as the Pioneer Mill owner, American Factors (now Amfac/JMB), began looking for other sources of income. The entrepreneurial dream was to create "one of the foremost resort areas in the world" (Honolulu Star-Bulletin 1962a:21). The Royal Lahaina resort complex was the first to open in December 1962 (Bryan 1964:6), closely followed by the Sheraton Maui Hotel (Honolulu Star-Bulletin 1962b:25). The same year, Amfac, Inc. also opened the Kāʻanapali Airstrip with the goal of opening West Maui to more tourism. The airstrip closed in 1982 when news that Hawaiian Airlines would soon create its own airport in West Maui ("Kaanapali Airstrip" 2020). In 1987, the Kapalua Airport opened, located immediately east of the project area. The airport is still in use today and owned by the State Department of Transportation ("Kapalua Airport: West Maui" 2020).

By the late 1970s, Lāhāina was a leading tourist destination so much so that it was a model for other islands across the Pacific (Fisher 2006:130). Historic landmarks, like the Pioneer Mill smokestack ("Pioneer Mill Smokestack" 2017) and the Mill's "Lahaina, Kaanapali & Pacific Railroad" ("History" 2014) were converted to tourist destinations. According to statistics from Maui County, Lāhāina/Kapalua/Kāʻanapali had the highest number of visitor units in 2016 (County of Maui 2017).

Hotel construction, especially on the coast, required the removal of hundreds of burials (Rockett 2010), specifically surrounding Puʻu Kekaʻa. Puʻu Kekaʻa, the Hawaiian name for "Black Rock," is the lava point at the northernmost end of Kāʻanapali Beach. Those who were involved in the grading of the surrounding lands for the various hotels in the area remembered seeing hundreds of bones scattered throughout which were removed and re-interred, "but the spirits of [Hawaiian] ancestors still walk the land" (A. Akana 1997).

In 2001, the Hawaiian organization *Na Kupuna O Maui* staged a peaceful demonstration walking the path connecting two sacred West Maui sites: the Puʻu Kekaʻa and Mokuʻula in Lāhāina. The demonstration ended with leaps from the Puʻu, spanning the space between the physical and spiritual realms (Rockett 2010).

3.3.2.1 Maui Land & Pine Company

Missionaries have long impacted the landscape of the Hawaiian Islands. One of the most prolific missionary families was the Baldwins when Reverend Dr. Dwight Baldwin and his wife Charlotte arrived in Lāhainā in the 1830s (Gomes 2009). Over the next century, the family purchased land across the island, finding more lucrative business as landowners than proselytizers.

The beginning of the pineapple industry on Maui started in 1890 when D.D. Baldwin began experimental pineapple plantings in Haiku, eventually incorporating the Haiku Fruit & Packing Co., Ltd. in 1903 (Baldwin 1920:12). In West Maui, the Baldwins owned the Honolua Ranch where they raised cattle. In 1904, the Honokōhau Ditch was completed, financed by the Pioneer Mill, and owned and maintained by the Honolua Ranch (Jones and Osgood 2015:114). Ten years later, the Baldwins diversified their Honolua Ranch by adding a pineapple-growing operation (Gomes 2009). In 1920 the Honolua Ranch was renamed Baldwin Packers, where they grew and canned pineapple at the Honolua Plantation, utilizing the Pioneer Mills Co.'s railroad to assist in hauling the fruit (Baldwin 1920:15). Three years later, the Baldwin Packers owned 22,000 acres in West Maui (Gomes 2009). By 1969, the Baldwins and Alexander & Baldwin Inc., merged their West Maui and East Maui ventures forming the Maui Land & Pineapple Company, Inc., and listed the company's stock for public sale (Hawaii Tribune-Herald 1969:8).

Looking to further expand their entrepreneurial ventures across Maui, the Baldwins expanded into resort development, taking advantage of their nine miles of "breach-fringed coastline" (Sutton 1978). In 1969, Colin Cameron took control of ML&P from Alexander & Baldwin (Cho and Tanji 1999:A1), and quickly rezoned 325 acres (Gomes 2009) of their 22,000 acres of farmland for resort development under the Kapalua Land Company, a subsidiary of ML&P (Sutton 1978). By 1978, the "centerpiece to the whole pineapple paradise: The Kapalua Bay Hotel" opened with 196 rooms (Gomes 2009), fronting "Fleming's Beach," locally named for D.T. Fleming, long-time sugar and pineapple land manager (Sutton 1978). In 1985, the Kapalua Bay Hotel was sold for $26 million to a California limited partnership in order to shore up the financial condition of the Kapalua Land Co. (Harpham 1985:B-5). The purchase included the facilities of the hotel, while the ML&P retained ownership of the land (Gomes 2009).

In 1988, the ML&P set aside 8,304 acres of land in the West Maui Mountains for the Puʻu Kukui Watershed Preserve (Maui Land & Pineapple Company Inc. 2020), managed in partnership with The Nature Conservancy. Four years later, ML&P officially granted The Nature Conservancy a conservation easement to open the Preserve to the state's Natural Area Partnership program and to receive state funding to maintain the acreage. Among the flora and fauna of the Preserve are *ʻōhia* forests and other endemic plants such as greensward, as well as *ʻiʻiwi*, *ʻapapane*, and ʻ*amakihi* birds (The Honolulu Advertiser 1992:A4).

The 1990s marked a significant change in the ML&P's entrepreneurial focus. Instead of focusing on their pineapple subsidiary, the company continued to shift towards resort development. In 1992, the Kapalua Land Co. partnered with the Ritz-Carlton Hotel Co. and Nissho Iwai Corp. of Japan to open the 550-room Ritz-Carlton Kapalua hotel (Tanji 1989:A-4). Once construction began, however, the project became less acclaimed for the resort venture but rather from a spectacular feat of grassroots activism. During the excavation of the sand dunes at Honokōhau Bay, Hawaiian *iwi* (bones) were found, totaling 1,200 burials (Richardson 2019). Burials were reinterred and protest efforts forced hotel construction to move further inland. Eventually, in 1990, the Hawaiian burial treatment law was passed ensuring that unmarked burials receive the same protections as modern-day cemeteries (Richardson 2019).

In 1999, AOL founder Steve Case purchased 41% of stock in ML&P becoming the largest stakeholder in the company and stabilizing its finances (Cho and Tanji 1999:A2). In further efforts to revitalize ML&P, the company decided to partner with other resort conglomerates to raze the Kapalua Bay Hotel and replace it with a $300 million condominium and luxury time-share resort (Shaefers 2006). At the end of the 20th century, the agricultural operations of West Maui began to flail as the neighboring resort industry boomed. In response, ML&P ended pineapple canning in 2007, focusing on their own resort development enterprises. In 2008, the company cut its pineapple production in half, and the following year shut down roughly 3,000 acres of pineapple production in Hāliʻimaile, Haleakalā, and Honokōwai. The Ritz-Carlton Club and Residences at Kapalua Bay, a joint venture with ML&P and others, opened the same year (Gomes 2009).

Back in 2002, when the DHHL had acquired additional funds to expand homelands through Federal action (see following section), ML&P began leasing their 510 acres of agricultural land (TMK 4-4-02:015 & 18) in Honokōwai from the DHHL through lease S-5267 (Department of Hawaiian Home Lands 2002:36). This lease was to expire come 2011, but with their focus shifting towards resort development and with the pineapple industry in West Maui slowly failing, they severed the lease of these lands in 2009 (Department of Hawaiian Home Lands 2010:77).

ML&P continued to retain their ownership of the Honokōwai Reservoir, built in 1918 and modified in 1999, in the center of the project area up until present-day (DLNR Engineering Divison 2020).

3.3.2.2 Department of Hawaiian Home Lands (DHHL) Expands

Across the islands, kuleana lands slowly disappeared since the days of the Mahele. In 1940, only 35% of these lands had survived, and by 1980, only 19% remained. Areas that were impacted the most included plantation districts where large-scale farms slowly surrounded and impeded natural resources, eventually forcing owners off their kuleana land (Kelly 1983). In Honokōwai, none of the 442.66 acres of LCA/Royal Patent Grant awards within the project area remained owned by their original claimant.

In continued efforts to remedy land dispossession of the Hawaiian people, DHHL received Federal assistance to expand the program. In 1992, the Federal Government reallocated money and additional lands to the Hawaiian Home Lands program "as compensation for the state's improper

or unauthorized use or transfer of 30,000 acres of Hawaiian home lands since statehood in 1959" (Dunford 1992). This process resulted in $13.8 million "set aside for DHHL to develop more homes and agricultural lots for native Hawaiians," specifically $925,000 to develop former sugar cane lands at Honokōwai (Dunford 1992). By 2002, Maui had received an additional 2,625 acres of public lands (Department of Hawaiian Home Lands 2002:18), and by 2003, the DHHL was prepared to begin development planning of 790 acres of land in Honokōwai with up to 1,000 single-family homes (Hurley 2003).

According to the 2004 Maui Island Plan from the DHHL, 510 acres of the 776.5 aces of available land in Honokōwai (TMK 4-4- 01:15, 36 and TMK 4-4-02: 03, 08, 09, 11, 15, and 18) was in use by the Maui Land & Pineapple Company, Inc. (TMK 4- 4-02:15 and 18, portion) until their lease expired in 2011 (PBR Hawaii 2004:5-6). However, in December 2009 following a global recession, Maui Land & Pineapple Company, Inc. closed its pineapple operations, (Gomes 2009) and terminated their lease of 510 acres of pineapple land in Honokōwai (Department of Hawaiian Home Lands 2010:77). The ML&P has however retained ownership of the Honokōwai Reservoir (State ID: HI00058) up to present-day (DLNR Engineering Divison 2020).

In 2011 DHHL completed an exploratory well in Honokōwai to provide potable water to the development of Villages of Leialiʻi Phase 1B development and began an environmental impact assessment for the region (Department of Hawaiian Home Lands 2013:35). DHHL continued to lease out lands to private pineapple farmers and local resorts, until 2019 when the planning for the Honokōwai Master Plan began.

3.3.2.3 Conservation Efforts and Advocacy for the Natural Resources of Honokōwai

3.3.2.3.1 Wahikuli-Honokōwai Watershed Management Plan

The Wahikuli and Honokōwai Watershed Plan were created to identify land-based pollutants and to determine a plan of action and implementation to remediate their effects on coral reefs (Sustainable Resources Group Intenʻl 2012:i). Over the past century, a drastic alteration of the landscape– via housing developments, infrastructure, and tourism– has resulted in a 50% decline in the health and presence of coral reefs along northern Kāʻanapali (Sustainable Resources Group Intenʻl 2012:i). A study was conducted to address pollutant control in an effort to improve water quality, clarity, and overall aquatic health.

3.3.2.3.2 The Honokōhau Ditch Controversy

In 2019, a group of West Maui community members filed a complaint against the owners of the Honokōhau Ditch for wasting water from the Honokōhau Stream. Those owners included Maui Land & Pine, Kapalua Water Co., a subsidiary of ML&P, and Kaanapali Land Management Corp. (KMLC). The Honokōhau Ditch currently diverts "most of the stream water to areas between Lahaina and Kaanapali […] on MLP lands" (Lahaina News 2019). People claimed to have seen large amounts of water dumped flowing through the Hahakea/Wahikuli Gulch, meanwhile, local *loʻi* farmers had minimal water for their own crops (Lahaina News 2019). In response, the Commission on Water Resource Management unanimously approved recommendations for

ML&P to upgrade the Honokōhau Stream and fix damages from 2018 hurricanes in order to prevent further water wasting (Imada 2019).

3.3.2.3.3 Pu'u Kukui Watershed Preserve and Makai Conservation Lands

Maui Land & Pineapple Co. Inc. currently owns and manages the 8,304-acre Puʻu Kukui Watershed in partnership with the State of Hawaiʻi DLNR, The Nature Conservancy of Hawaiʻi, and Kamehameha Schools Maui. The Preserve is the largest privately owned preserve in the State, home to endangered flora and fauna and a vital water resource for West Maui (Pu'u Kukui Watershed Preserve 2014).

3.3.2.3.4 Kapunakea Preserve

Kapunakea Preserve was established in 1992 when Pioneer Mill Company, Ltd., a subsidiary of Amfac/JMB Hawaii Inc., granted the Nature Conservancy a conservation easement of 1,264 acres in the West Maui Mountains in order to preserve native ecosystems and rare flora and fauna. The Preserve stretches across dry lowland forests at 1,000 feet to montane bogs of Puʻu Kukui at 5,400 feet. The north half of the Preserve is within Honokōwai and includes the upper reaches of the Honokōwai Stream, which is diverted at this time for agricultural use. The southern ridge is within Hanakaʻoʻo (The Nature Conservancy 2020). Remnants of the Pioneer Mill's water diversion and other agricultural construction are still evident along the Honokōwai Gulch (Donham 1994:5).

3.4 PREVIOUS ARCHAEOLOGY

A search of archaeological investigations within a one-mile radius of the current project area shows the publication of roughly 25 completed studies. Table 3-3 provides an overview of these studies with Figure 3-4 illustrating the locations of these studies in relation to the current project area.

Table 3-3. Summary of Previous Archaeological Studies within a One-mile Radius of the Current Project Area

Author	Type of Archaeological Study and Summary of Results
Kaschko 1974	Pedestrian Survey: Surface survey of 8 gulch basins within the Honolua Watershed Honokōwai results – Site 6 (SIHP 50-50-03-01208) includes a complex of several low stone alignments and platforms located on the north slope of the gulch and previously recorded in the 1973 Statewide survey.
Griffin et al. 1976	Survey and Salvage: Salvage excavations on a previously identified cultural deposit documented as SIHP -00217 and -00218 at Māhinahina Gulch by Kaschko (1974). During the course of excavation it was determined that the two historic properties were extension of the same deposit and consolidated under a single number, SIHP -00225. Fieldwork resulted in the identification of hearths scattered throughout with recovery of marine fauna to include shell and fish remains. Recovered charcoal returned radiocarbon dates ranging from A.D. 1000 to A.D. 1778.

Author	Type of Archaeological Study and Summary of Results
Davis 1977	Pedestrian Survey: Archaeological surface survey of a well and water transmission line crossing at Honokōwai Gulch. The survey results indicated that the lower portion of the gulch had undergone significant modification, while the upper portion featured terraced pond-fields, habitation platform-terraces, and associated structures.
Barrera 1989	Reconnaissance: Pedestrian survey of three alternatives for the then proposed Lahaina Bypass, beginning at Puamana Beach Park and branching out to various elevations and terminating at either Hanakaōʻō (all three alternatives) or Honokōwai (Alternative C -- upper elevation). In Honokōwai, reconnaissance-level survey resulted in the initial identification of SIHP -01207 (Honokōwai Petroglyphs), and SIHP -01208 (Honokōwai House Outline).
Jensen 1991	Inventory Survey: Pedestrian survey of an approximate 7-mile corridor including a crossing at Honokōwai Gulch. Four historic properties comprised of 28 component features were identified within or adjacent to the study corridor while six additional historic properties were noted as being close but outside of the project area of potential effect. Identified features included a trail (SIHP -02489A) habitation and possible habitation sites (terraces [ACH 10-17-90, SIHP -02485, -20490C] and walled enclosures [SIHP -02489C, -02490A]), agricultural sites (terraces [SIHP -2489A and D, -2490B, -2491] and walled enclosures [SIHP -2847A), boundary features (walls [SIHP -02487B and C]), and confirmed and possible burial areas (Puʻu Koliʻi Cemetery, SIHP -02489).
Sinoto and Pantaleo 1991	Inventory Survey: Systematic pedestrian inspection of an approximate 6.5-acre study area. Recent trash debris, areas of asphalt pavement, and the presence of two back dirt piles from the previous excavation were noted during the survey. Extensive land alterations were attributed to activities related to sugar cane cultivation and no historically significant sites were identified or documented as a result of the survey.
Donham 1992	Isolated Underwater Find: Modified stone identified and recovered from a depth of 260 ft. by coral divers approximately 2.6 to 3.4 miles west of Hanakaʻoʻo Point on a coral bed surrounding a pinnacle. Based on stone modifications, and the absence of an apparent line groove to facilitate the attachment of a rope, the stone was interpreted as a possible kuʻula or ceremonial stone rather than a net/anchor weight or pōhaku kuʻi waʻa (canoe breaker).
McGerty and Spear 1996	Inventory Survey: Pedestrian survey and subsurface testing of an approximate 3.3-acre project area. Seven historic properties were identified and included a historic era agricultural alignment (SIHP 50-50-03-04215); a low wall dry-stacked wall (SIHP -04216) related to historic era agriculture; a well-constructed terrace, alignment, low wall, rock mound, sub-surface ash deposit, and irregularly shaped well (SIHP -04217) related to historic era agriculture; a historic cemetery (SIHP -04218); a multi-component platform with a soil interior and two terraces (SIHP -04219) interpreted as burial markers; a rock-faced terrace and three alignments (SIHP -04220), and a kiowai (SIHP -04221).

Author	Type of Archaeological Study and Summary of Results
Fredericksen and Fredericksen 2003	Inventory Survey: Systematic pedestrian survey of 4,325 acres documented 81 new historic properties (SIHP 50-50-03-05241 through -05321), along with Puʻu Koliʻi Cemetery (SIHP -02893). The newly identified site types include single and multiple component dry land agricultural sites, and a large, loʻi agricultural complex within Honokōwai Gulch composed primarily of terraces. Other identified site types include temporary and permanent or long-term habitation areas, several petroglyph panel sites, possible ceremonial areas and shrines, possible burial features, and plantation-era sites. Targeted sub-surface survey was completed in the former location of Puʻu Koliʻi Camp and accomplished through mechanically assisted excavation of 44 stratigraphic trenches. No intact cultural material deposits, culturally enriched stratigraphic layers, or other types of historic properties were identified as a result of the subsurface testing program.
Monahan 2003	Inventory Survey: Pedestrian survey and backhoe testing comprised eight trenches completed. Subsurface excavation showed the presence of modern refuse and fill, along with sand that had likely been introduced. No historic properties were identified.
Tulchin and Hammatt 2003	Inventory Survey: Pedestrian survey and subsurface testing consisting of four 40 cm x 40 cm shovel tests within a 0.2-acre parcel. No historic properties were identified.
Pantaleo and Titchenal 2004	Inventory Survey: Pedestrian survey and subsurface testing of approximately 360 acres. Systematic pedestrian survey and mechanical excavation of 20 linear trenches resulted in the identification of two historic properties. SIHP 50-50-03-05553 is an abandoned flume located within Mahinahina 1-3 Gulch and SIHP -05641 which consists of a historic bottle scatter. Additionally, an isolated hammerstone or ulu maika was identified on a pineapple road in the southeastern portion of their project area. No intact subsurface cultural material deposits were identified during mechanical testing.
Chun and Dega 2005	Inventory Survey: Pedestrian survey and subsurface testing consisting of 8 backhoe trenches within a 0.11-acre area (23 m x 23 m). Excavated to an average depth of 2 m, the soil profile showed two layers of red loamy clay soils followed by a cinder layer and compact gley soils. No historic properties were identified.
Havel and Dega 2005	Inventory Survey: Pedestrian survey and testing consisting of 9 backhoe trenches across 0.11 acres of a larger parcel. Results of testing showed consistent stratigraphy across all trenches where the surface contained remnants of modern debris followed by clay loam and clay silt loam overlying decomposing bedrock or saprolites clay loam. No historically significant sites or culturally sensitive deposits were identified as a result of the survey.
Hill et al. 2006	Monitoring: Archaeological monitoring of posthole auguring for dust barrier relocation. No previously identified archaeological sites were present within or in proximity to the monitored construction area, and no cultural materials were observed during the monitoring efforts.

Author	Type of Archaeological Study and Summary of Results
Hill et al. 2007	Monitoring: Archaeological monitoring of irrigation installation noted that the stratigraphy of the project area consisted of aeolian deposits of beach sand. While no historically significant cultural deposits or subsurface architectural sites were encountered, newly identified historic property consisting of a possible koʻa (fishing shrine, SIHP 50-50-03-06275) was noted and documented on the surface of the dune system fronting the open space area adjacent to the Westin Kāʻanapali.
Ogg and Dega 2007	Inventory Survey: Systematic pedestrian survey and excavation of 10 stratigraphic units along the perimeter fence of the Lahaina Wastewater Reclamation Facility and old cane haul road to a minimum depth of one meter in Parcel 029. Parcel 033 was not tested. The stratigraphy along the tested corridor showed extensive ground disturbance associated with sugar cane cultivation and the development of wastewater infrastructure. No historically significant deposits or culturally sensitive sites were encountered during the study.
Hill et al. 2008a	Monitoring: Archaeological monitoring of landscaping and irrigation improvements. No archaeological deposits, artifacts, or other significant cultural material were encountered during tree-planting excavations and irrigation trenching.
Hill et al. 2008b	Monitoring: Archaeological monitoring of posthole auguring for the installation of a dust fence and grubbing activities for construction site preparation. No historically significant cultural material deposits or subsurface architectural features were identified.
Willman et al. 2009	Monitoring: Archaeological monitoring of construction activities related to sand dune reconstruction. No historically significant cultural material deposits or subsurface architectural features were identified during monitoring.
Perzinski and Dega 2013	Inventory Survey: Study was limited to a pedestrian survey and documentation of an existing seawall/revetment along the coastal edge of the property. The study determined that due to modern alterations the revetment did not constitute a significant historic property.
Dagher and Dega 2014	Inventory Survey: Pedestrian and subsurface survey of six areas within Honokahua (Area 1); Honokeana (Area 2 and 3); and Honokōwai (Areas 4-6). Area 4 - no historic properties identified. Area 6 - no historic properties identified.
Adricci and Dega 2015	Inventory Survey: Pedestrian survey and archaeological testing consisting of six, five meter long mechanically excavated trenches across a 0.9-acre parcel. Stratigraphy across the units were consistent and consisted of silt and silty clay overlying gleyed soils. No historically significant sites or culturally sensitive deposits were identified as a result of the study.
Medeiros and Hammatt 2017	Monitoring: Archaeological observation of grubbing, utility installations, landscaping installation, construction of beach crossings. While two isolated finds consisting of a railroad spike and a marine shell fragment were documented during monitoring, no historically significant deposits or buried architectural sites were identified. .

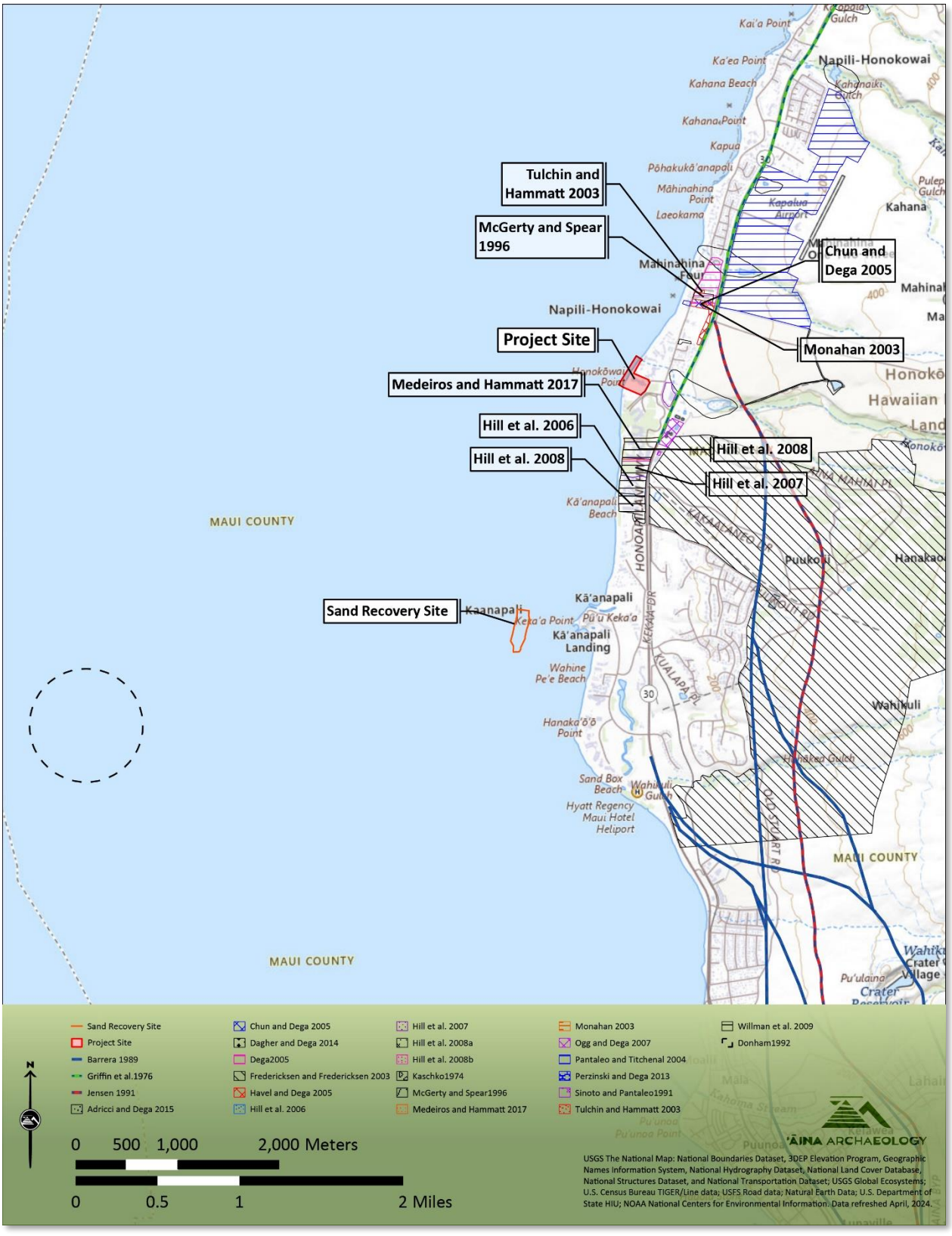


Figure 3-4. A portion of the USGS National Map, portions of the Lahaina and Napili Quadrangle sections (United States Department of the Interior 2019), showing the proposed project parcels (shaded in red) in relation to published archaeological study areas within a one-mile radius.

3.5 PREVIOUSLY IDENTIFIED HISTORIC PROPERTIES WITHIN A ONE-MILE RADIUS OF THE CURRENT PROJECT AREA

Due to the cultural sensitivity of traditional Hawaiian burial interments, the following provides a brief overview of identified historic properties within a one-mile radius of the proposed beach restoration area, with a detailed table for non-burial related historic properties provided below (Table 3-4 and Figure 3-5):

- **Pre-contact Habitation, Agriculture, and Ceremony:** SIHP-00225 consists of a thick cultural deposit that indicates sporadic occupation between AD 1000 and 1778. Petroglyph sites like SIHP-01207 and -05037 feature boulders with triangular glyphs and anthropomorphic figures, while SIHP -01208 shows above-ground evidence of inland houses and stone alignments, representing pre-contact habitation. Agricultural sites and complexes (SIHP-02001 and -04104) with terraces and walls, as well as, a possible shrine feature, retaining walls near gulch banks (SIHP-02003) Finally, SIHP-06275 is a ceremonial fishing shrine with small polished coral pebbles, emphasizing cultural practices that connect to the sea while the promontory of Puʻu Kekaʻa (SIHP -01206) has been identified as a leina a kaʻuhane (leaping off place of the spirits).
- **Pre-contact to Historic Era:** In the pre-contact to historic transition period, the landscape was shaped by the continuous use of agricultural and water management systems. SIHP-04217 encompasses a complex of terraces, rock mounds, and alignments, while SIHP-04220 features a faced terrace with limestone and basalt cobbles that saw use from pre-contact through historic periods. SIHP-04221 highlights a water control feature, a kiʻowai, that appeared on both early maps and modern surveys. Agricultural systems were further developed at sites like SIHP-05263, which contains three terraces, SIHP-05264, featuring seven roughly constructed terraces, and SIHP-05310 small agricultural terraces, showing continued use of land for cultivation.
- **Historic Era**: The historic period is marked by boundary walls, reservoirs, and other agricultural modifications associated with commercial sugar production, all of which are situated upland of the current project area. SIHP-02002 features a wall extending toward the streambed, possibly a fence line from the plantation era. The documentation of agricultural infrastructure, consisting of a reservoir complex (SIHP-02847) and a flume (SIHP-0553), reflects the extensive infrastructure developed during this period, showcasing the industrial scale of agricultural practices characteristic of the plantation era. Historic-era residential settlement in the upland area is also present and reflected in the presence of historic cultural materials (SIHP-04215 and 04216) including limestone alignments and a historic cemetery used by the Kaukau family (SIHP-04218).

Table 3-4. Historic Properties Identified within a One-Mile Radius of the Proposed Project Area (see Figure 3-5)

State Site No	Formal Type	Inferred Function	Age	Brief Description
Kuʻula Isolated Find	Modified Stone	Ceremonial	Pre-contact	Weighing 40 pounds, the stone consists of medium-grained basalt that has been naturally worn to form a generally cylindrical shape with the base. The base of the stone is flat and the top is slightly constricted and rounded. The overall length is 35 cm; the diameter ranges from 15 to 18.0 cm, with the narrowest portions at the base and top. The stone weighs 40 pounds. While the majority of the shape appears natural, one small section of the base exhibits weathered pecking scars. On the surface of the stone, one area has the appearance of having been ground and slightly polished. This area is 5.2 by 3.1 cm, with the long axis oriented with the long axis of the stone. It presents a distinctive depressed section in the center of the stone when viewed from a profile perspective. Below this smoothed area is a knob-like protrusion 8.0 by 7.0 by 1.2 cm. A section around the perimeter of this protrusion appears to have been pecked, resulting in a greater definition of the protrusion. This section is 4.25 cm long around the bottom margin of the protrusion.
00225	Cultural Deposit	Habitation	Pre-contact	Extensive pre-contact cultural deposit, approximately 20 cm thick, was discovered beneath 0.5 to over 1 meter of recent alluvium at the base of Māhinahina Gulch. This deposit contains shell-midden material, firepit features, and possible post holes, although no constructed features were identified. Radiocarbon dating indicates sporadic occupation of the site between AD 1000 and AD 1778.
01206	Leina a kaʻuhane	Ceremonial	Pre-contact	The leina or leaping off point into po begins at Kekaʻa, a basalt outcrop that forms a cliff approximately 10 to 15 m high above a white-sand beach and extends approximately 35 m into the ocean (Hommon 1973).

State Site No	Formal Type	Inferred Function	Age	Brief Description
01207	Petroglyphs	Rock Art	Pre-contact	Honokōwai Petroglyphs consisting of boulders covered with a minimum of 45 petroglyphs of primarily triangular-bodied glyphs over an approximate 100 m area.
01208	Complex	Habitation	Pre-contact	Inland area with house outlines and associated platforms with multiple stone alignments, including pre-contact house yards demarcated by low walls. Two ʻulu maika stones and a section of an adze were found within this area, which spans approximately 30 by 38 meters on the north slope of the gulch.
02001	Complex	Agriculture	Pre-contact	Long, narrow complex approximately 46 by 579 meters, primarily consisting of small, simple features scattered along terraces on the northern side of the north gulch. The terraces typically have minimal stonework, with a few stones forming small retaining alignments or simple stacked walls adjacent to natural flat areas. The retaining walls range from 0.2 to 0.7 meters (0.66 to 2.3 feet) in height and 1 to 3 meters (3.3 to 9.8 feet) in length and width, with one retaining wall reaching 0.7 meters (2.3 feet) high. Near the west end of the complex is a basalt slab, 0.6 meters (2 feet) high, set upright next to a cobble alignment, which could represent a simple shrine, although no further evidence supports this interpretation. At the upper (east) end of the complex, south of the streambed, a long, narrow terrace, possibly part of a trail, extends in two sections measuring 21 and 5 meters (68.9 and 16.4 feet) in length, 1 to 2 meters (3.3 to 6.6 feet) in width, and 0.3 to 1 meter (1 to 3.3 feet) in height.

State Site No	Formal Type	Inferred Function	Age	Brief Description
02002	Wall	Boundary	Historic	Wall extends from the south side of the gulch towards the streambed, possibly representing a section of a former fence line. At the time of the recordation, it functioned as a retaining wall for alluvium. The wall is approximately 10 meters (32.8 feet) in length, 2.5 meters (8.2 feet) wide, and stands up to 0.3 meters (1 foot) high on the upper side and 0.35 to 0.8 meters (1.2 to 2.6 feet) high on the lower side.
02003	Wall-Retaining	Indeterminate	Pre-contact	Retaining wall runs parallel to the gulch bank near its top. While there may be a terrace behind the wall, at the time of recordation, it was obscured by a pile of large boulders that were bulldozed from the adjacent sugar cane field. The retaining wall measures approx. 6 meters (19.7 feet) in length, 0.7 to 1 meter (2.3 to 3.3 feet) in height, and about 0.3 meter (1 foot) in thickness.
02847	Complex	Reservoir	Historic	Three features (A-C) that include an enclosure (Feature A), a nine-meter-long wall segment (Feature B) that abuts the east side of Feature A and appears to have extended outside and mauka of modified alignment corridor, and a ten-meter-long wall segment (Feature C) that abuts the west side of Feature A
04104	Complex	Agriculture	Pre-Contact	Large agricultural complex
04215	Alignment and Cultural Material Deposit	Possible Agriculture/ Habitation	Historic	Limestone alignment with an associated deposit of historic cultural material debris consisting of whole and partial bottles and jars, fragmented ceramic bowls and shards, and rusted metal fragments.

State Site No	Formal Type	Inferred Function	Age	Brief Description
04216	Wall	Agriculture	Historic	Structure constructed from stacked limestone and waterworn basalt cobbles and boulders, with a height averaging one course but reaching up to two courses in some areas. It measures 7.3 meters long, 0.4 to 1.3 meters wide, and 0.26 to 0.45 meters in height. Three pits, likely the result of pot-hunting activities, were found nearby, with back dirt containing basalt cobbles, glass fragments, opihi shells, and animal teeth, likely cow. Recent trash, including pieces of a garden hose, beer and soda cans, old bedding, and a chicken coop, was scattered around the area. Cultural materials collected from a nearby shovel test (ST-8) included ceramic shards and a single artifact consisting of a fragment of glass and part of the metallic backing from a handheld mirror.
04217	Complex	Agriculture	Pre-contact to Historic	Complex of six features across and approximately 54 m by 18 m area. Features include a faced terrace, alignments, a rock mound, a low wall with an associated rock mound, and a well.
04218	Cemetery	Cemetery	Historic	Measures 27.0 by 16.0 m and is enclosed with a modern hollow tile wall. A descendent of Kaukau who claimed the site during the Mahele, stated that he was told by his grandmother the section containing the cemetery had been used for burials by the Kaukau family for generations. In addition, it seems that although the cemetery was not a part of the local church (Lahui o Kalani), members of that church were often buried there.
04220	Terrace	Agriculture	Pre-contact to Historic	Site consists of a faced terrace constructed of limestone and basalt cobbles and three alignments. Traditional construction and the presence of historic artifacts are indicative of continuous use from pre-contact to the historic time frame.
04221	Kiʻowai	Water Control	Pre-contact to Early Historic	Water collection area measures approximately 29.0 by 16.0 m.

State Site No	Formal Type	Inferred Function	Age	Brief Description
05263	Terrace	Agriculture	Pre-contact to Early Historic	Three terraces are located near the upper slope of the northern side of the northern fork of Hanakaōʻō Gulch.
05264	Complex	Agriculture	Pre-contact to Early Historic	Seven roughly constructed terraces (Features A-D) located in Hanakaōʻō Gulch at the base of the northeastern gulch slope and c. 5 meters north of the streambed. Overall site dimensions are c. 20 meters NW/SE by c. 14 meters NE/SW.
05268	Complex	Agriculture	Pre-contact to Early Historic	Three terrace features (Features A-C) and a petroglyph panel on a large vertical outcrop at the eastern edge of the site containing three images (Feature D). The overall dimensions of this complex are approximately 32 meters E/W by 15 meters N/S.
05307	Petroglyph	Rock Art	Pre-contact	Pecked petroglyphs on a large boulder measuring 3.4 meters in width (WNW/ESE) and 2 meters in height. The boulder's eastern face has a flat, vertical surface that contains at least four images. All of these images appear to depict standing human figures, though they are heavily weathered and difficult to distinguish in direct sunlight.
05310	Terrace	Agriculture	Pre-contact to Early Historic	Small terrace located along the southwestern slope of the southern fork of Hanakaōʻō Gulch, approx. 150 meters southeast, upstream, of the confluence of the two gulch forks and approximately 100 meters southwest of Puʻu Koliʻi Cemetery. Overall site dimensions are 3.40 meters in length NW/SE by 1.20 meters NE/SW in width by 0.80 meter in maximum height.
05553	Flume	Agriculture	Historic	Constructed in 1898 by the Pioneer Mill Company, the structure consists of semicircular galvanized iron supported by wooden braces and trestles. It was built to transport water to the sugarcane fields and extends across and along the slope of the gulch.

State Site No	Formal Type	Inferred Function	Age	Brief Description
06275	Koʻa (Fishing Shrine)	Ceremonial	Pre-Contact-Historic	SIHP-6275 is comprised of three ceremonial features. Feature B was described as an ʻiliʻili pavement. Two small pebbles of polished coral were also observed. Feature A and Feature B are 4.5 meters distance from each other and both overlook Lanai and Molokai.

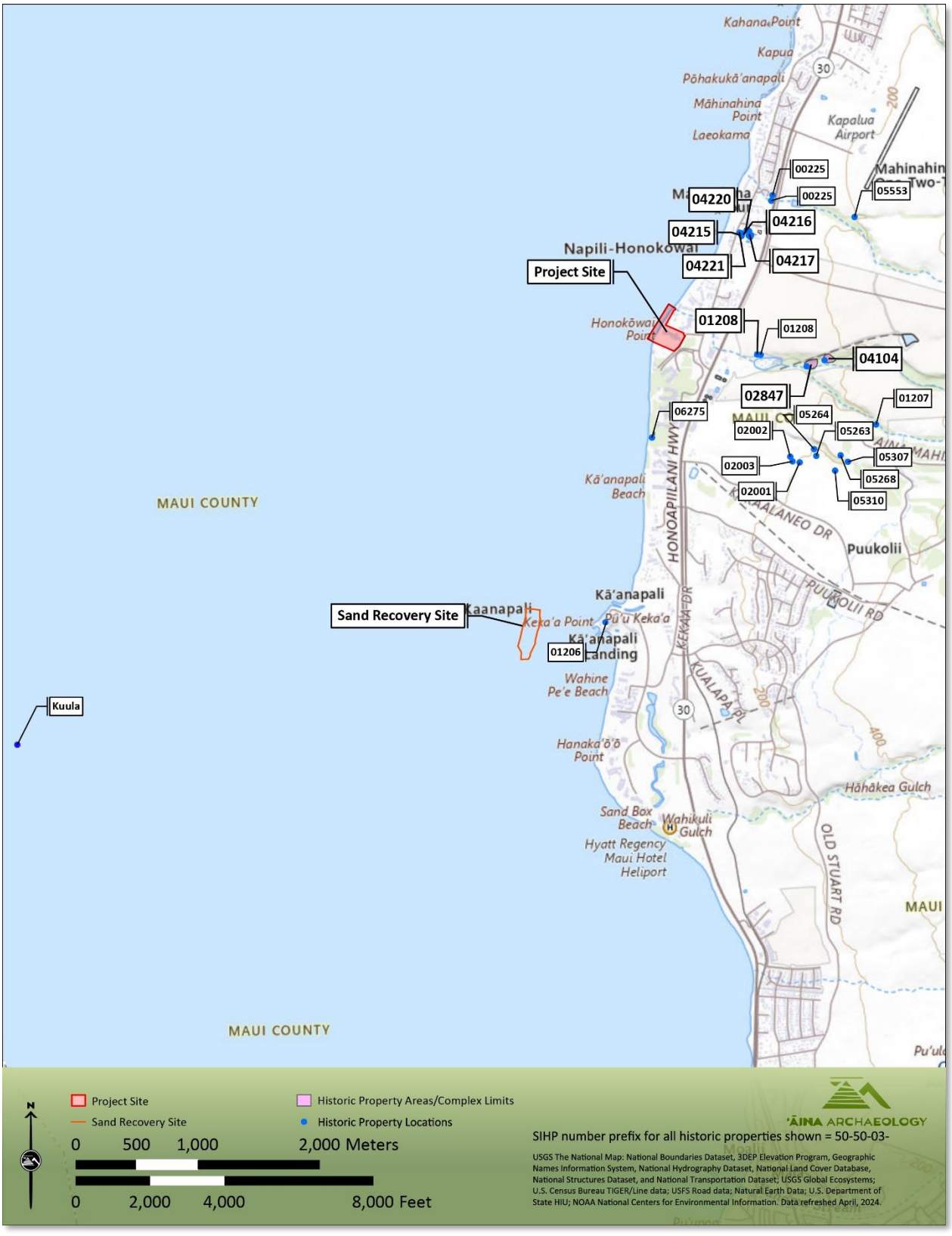


Figure 3-5. A portion of the USGS National Map, portions of the Lahaina and Napili Quadrangle sections (United States Department of the Interior 2019), showing the proposed project parcels (shaded in red) in relation to known previously identified historic properties within a one-mile radius.

3.6 SUMMARY OF BACKGROUND RESEARCH AND PROJECT AREA EXPECTATIONS

The arrangement of a typical Hawaiian ahupuaʻa extended from several fathoms out from the coastline to the upland forested areas. Depending on the location within this broad makai to mauka context, and guided by knowledge of the natural environment, a wide variety of cultural practices and resources within the ahupuaʻa could be found. Such resources and rights would include marine resources and fishing rights in the coastal area, arable lands for crop cultivation, as well as water rights in the planting zones, and valuable bird catching along with plant and timber harvesting privileges at the higher elevations and toward the valley headwater. Based on the land commission award distribution in Honokōwai, stories and information gathered from historical narratives and written history, as well as the results of previous archaeological studies it is apparent that settlement and land use within Honkōwai Ahupuaʻa functioned in the typical traditional sense. In the pre-contact to historic transition period, the landscape was shaped by the continuous use of agricultural and water management systems and the subsequent development of industrial-scale agricultural pursuits focused on sugarcane cultivation.

Along the coastline and in the immediate vicinity of the current project area, archaeological expectations would revolve primarily around the presence or absence of residential settlement, from both pre-contact and historic era periods. This would be reflected in the archaeological record by cultural material deposits and the potential presence of buried structural remnants indicative of both long-term and intermittent habitation as illustrated by the findings of archaeological studies conducted to the north of the project area (Griffin et al. 1976; McGerty and Spear 1996). In addition to previous archaeological findings, Land Commission Awards (LCA) for pahale claims along the coastline and immediate surrounding area also indicate a heightened likelihood of encountering such deposits and features within the immediate area (Figure 1-2 and Table 3-2). In locations of dense pre-contact Hawaiian settlements, such as Honokōwai, the presence of both traditional Hawaiian ceremonial sites and burial interments would be anticipated. Along a coastline with well-documented fishing traditions, these ceremonial sites may include koʻa (shrines) situated both on land in areas associated with marine resource use (Hill et al. 2007) and in the water (Donham 1992). With regard to pre-contact traditional Hawaiian funerary practices, and while it is widely known that areas of Jaucus Sand and Beach Sand are preferred locations for burial interment, the possibility for encountering traditional burials within alluvial soils like SIHP 50-50-03-08512 should not be discounted. Under circumstances where the shoreline has not been heavily affected by wave action and sand loss, traditional Hawaiian burials along the coastline, including that of the current project area, would have been considered highly sensitive for such sites with a high probability of encountering in situ traditional burial interments.

4.0 RESULTS OF FIELD INSPECTION

Tanya L. Lee-Greig, M.A. of ʻĀina Archaeology completed an archaeological field inspection of the stretch of open beach within the project area, as well as the seaward portion of the Kāʻanapli Beach Club to cover the possible area of effect should the alternative with Beach Stabilization be selected as the preferred option. February 18, 2023, consisted of a cursory walk-through of the area to assess the current site conditions and understand the potential for encountering historically significant and/or culturally sensitive sites. Additionally, a side scan sonar and tow camera survey of the proposed sand recovery area was conducted as part of the technical study for the project EIS. The footage from this survey was reviewed for this study due to the recovery of a potential kuʻula stone within the channel and the results of consultation presented in the documenting report (Donham 1992; see also Sections 3.4 and 3.5).

4.1 BEACH RESTORATION AREA

The inspected area fronting the Kāʻanapali Beach Club reveals no exposed backshore. The pool deck located in the southern section of the parcel extends up to the temporary stabilization measures, and consists of sandbags (Figure 4-1 and Figure 4-2). These stabilization measures continue to an iron gate that demarcates the boundary between an expansive pool deck and the beachfront (Figure 4-3 and Figure 4-4). Electrical and gas utilities are observed throughout the makai portion of the parcel, indicating substantial prior ground disturbance in the area that may be potentially affected by the alternative that includes the construction of stabilization structures such as groins. The only identified testable area is situated in the northern section of the hotel frontage, where a grassy surface is present. Observations of gas torches along this grassy area and adjacent to beach lounge chairs, however, further suggest the presence of subsurface gas lines, which may impose constraints on archaeological testing (Figure 4-5).

Finally, a walk-through of the sandy stretch of beach showed a relatively narrow expanse of beach sand at the time of the field inspection which is consistent with documented beach loss following the 2016 surge event. Additionally, the presence of a manhole to the south of the beach that fronts the Kāʻanapali Beach Club and directly adjacent to the northern boundary minimally illustrates previous ground disturbance along the shoreline and in the spaces between the resort areas in the shoreline area (Figure 4-6).

Altogether, field inspection results indicate that the entire frontage area potentially affected by the proposed beach restoration project, including the stabilization alternative, has been fully developed. No pre-contact or historic-era archaeological sites or structures were identified on the surface during the field inspection.



Figure 4-1. Photos illustrating the proximity of temporary stabilization measures to the project proponent's property. Note lawn area, wrought iron fence, and boardwalk in relation to sandbags., view to north.



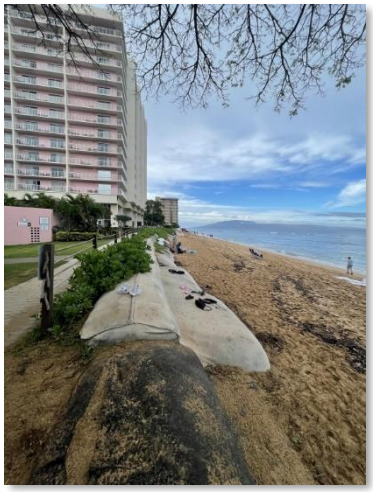


Figure 4-2. Photos illustrating the proximity of temporary stabilization measures to the project proponent property. Note the lawn area, wrought iron fence, and boardwalk in relation to sandbags. Views to south

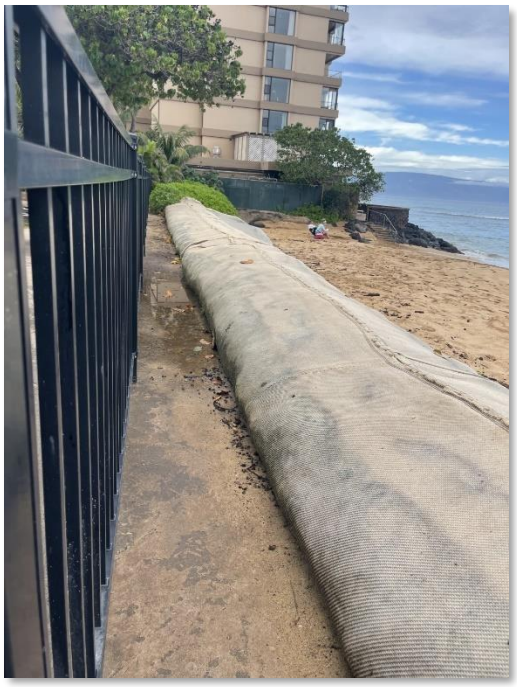


Figure 4-3. Proximity of pool deck behind the pool slide to temporary stabilization measures, Maui Kai Condominiums in the background, view to south.



Figure 4-4. Slide area and pool deck extent, note electrical utilities in the grassy area between the pool deck and naupaka hedge in the upper right photo and in the middle ground of the lower photo.



Figure 4-5. Possible archaeological test areas, note torch placement, and potential gas lines view to north.







Figure 4-6. Drainage and drainage grate at the south end of the Kāʻanapali Beach Club property and along the shoreline.

4.2 SAND RECOVERY AREA

As noted previously, Sea Engineering undertook a Sidescan Sonar and Tow Camera Survey of the proposed sand recovery area. The recovery of a probable ku'ula stone within the channel by coral divers, combined with insights from divers familiar with the area (Donham 1992:4-5), has raised concerns about the potential presence of significant traditional Hawaiian objects within the channel. Twenty-two minutes and 66 seconds of tow camera footage from a total of seven transects (Figure 4-7) were reviewed as a part of this study.

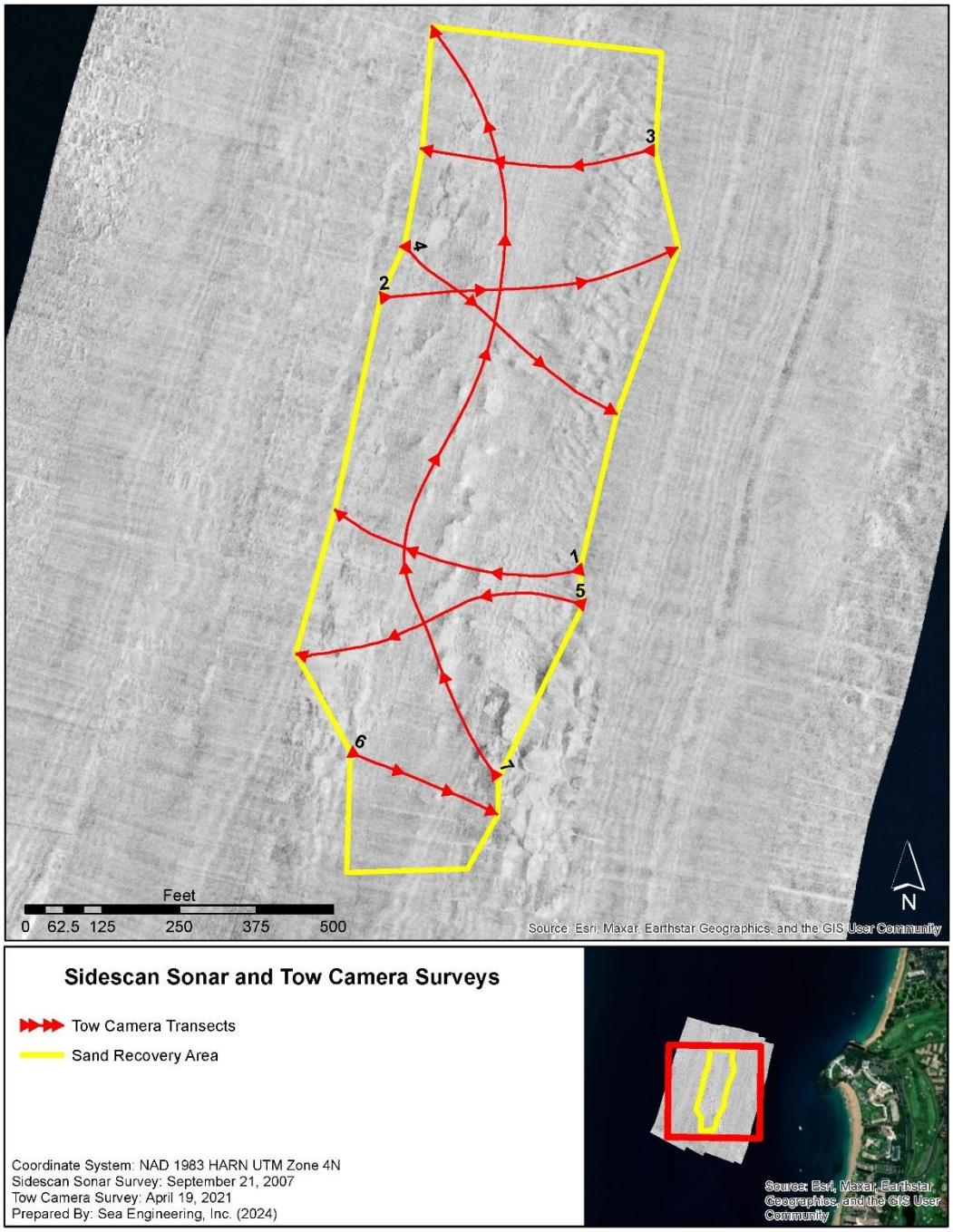


Figure 4-7. Sidescan Sonar and Tow Camera Survey transects in relation to the proposed sand recovery area (map courtesy of Sea Engineering)

In general, the sand source consists of a dense accumulation of sand surrounded by calcified green algae identified *Halimeda kanaloana*, a common and abundant algal species in Hawaii (Andy Bohlander, Sea Engineering, personal communication November 21, 2024) Figure 4-8 and Figure 4-9). White flaky material visible on the surface of the seafloor are attributed to shed segments of *Halimeda* (Figure 4-10), which decompose and eventually become carbonate sand. The edges of the dense *Halimeda* meadows have been identified as the boundaries of the Sand Recovery Area. The overall topography of the sand source is undulating with linear sand waves likely formed by tidal currents (Figure 4-11). The only objects of potential archaeological interest identified during the review of the tow camera survey results were observed along Transect 7 between 0:19 and 0:50 (Figure 4-12). These objects consisted of three pōhaku and what appears to be a line. Although visibility of the line is poor to fair, its general form appears consistent with that of a derelict anchor line (Andy Bohlander, Sea Engineering, personal communication).

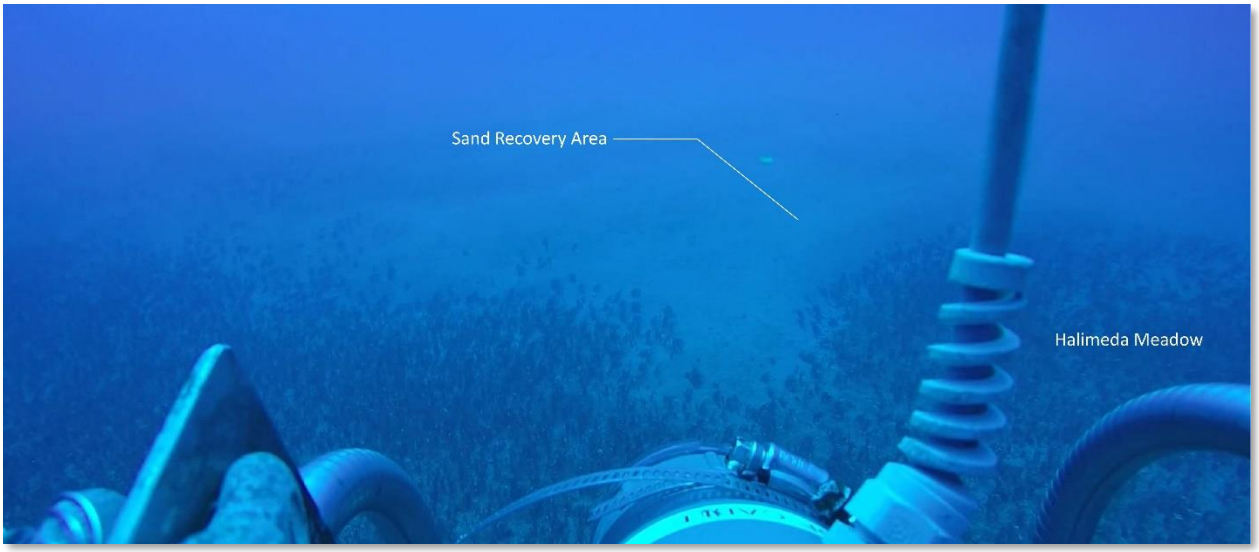


Figure 4-8. Transect 5, start of transect (0:05) showing Halimeda meadow in relation to the sand recovery area.



Figure 4-9. Transect 2, end of transect (1:49) showing Halimeda meadow in relation to the sand recovery area.

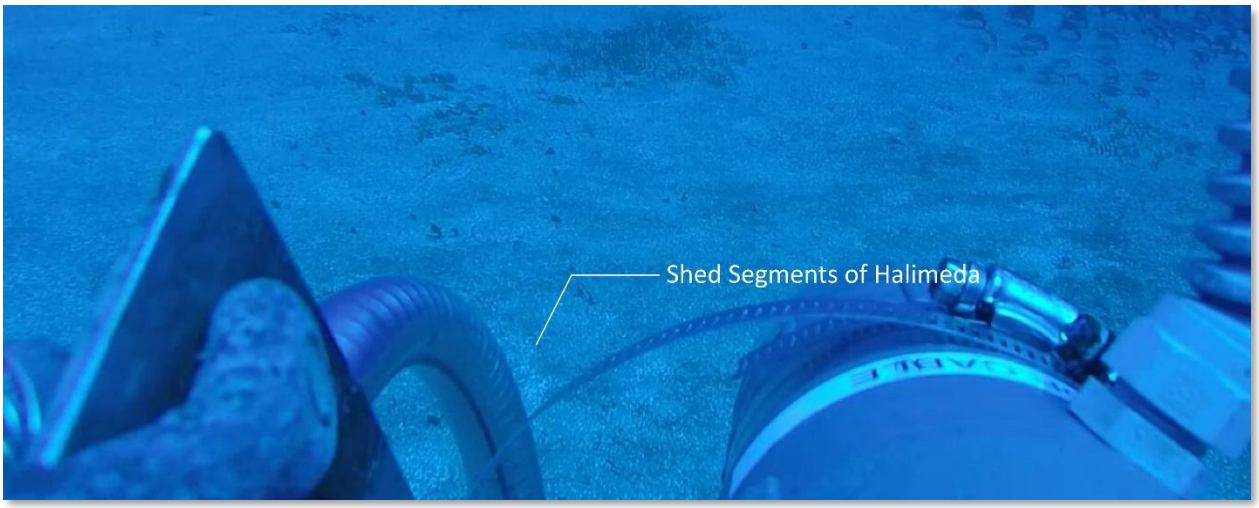


Figure 4-10. Transect 6 (0:41) showing shed segments of Halimeda.



Figure 4-11. Transect 4 (2:14) showing sand ripples and undulating topography of the sand source.

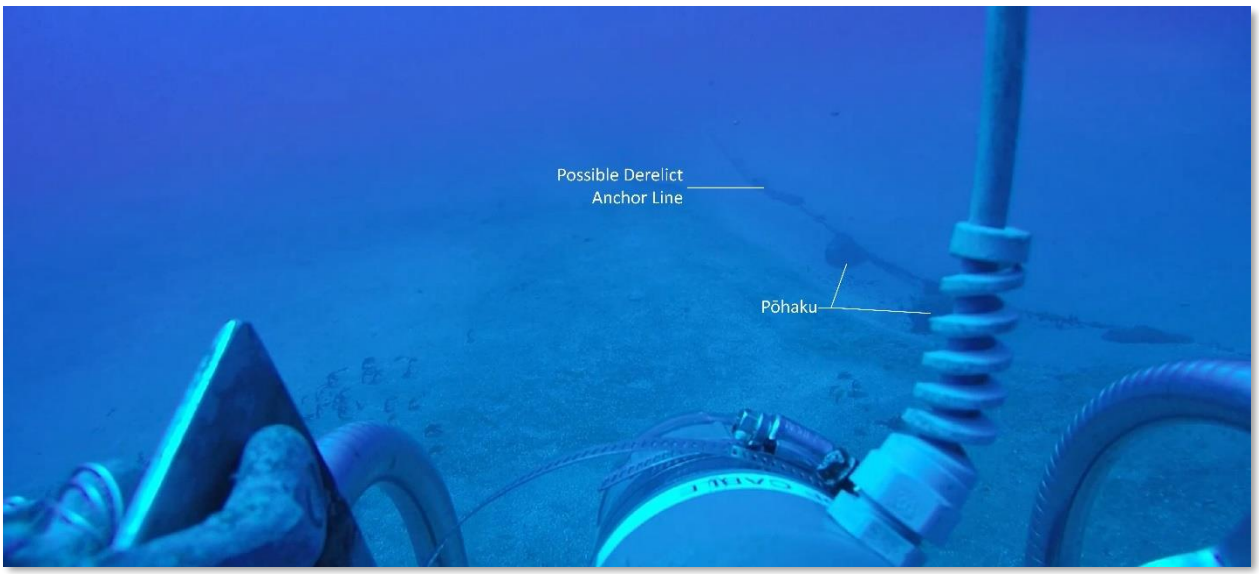


Figure 4-12. Transect 7 (0:32) showing a point of interest.

5.0 ARCHAEOLOGICAL CONSIDERATIONS FOR THE PROPOSED HO'ALA HONOKŌWAI PROJECT

When compared to the conditions of the beach following the 2016 beach loss event and exposure of the backshore soils and underlying rocky terrain (Figure 5-2 and Figure 5-1), it is apparent that the natural beach shoreline where the alluvium grades to the sandy beach would have been further off-shore during the height of pre-contact traditional Hawaiian settlement. Considering the loss of sand and shoreline retreat toward the backshore and exposure of the alluvial escarpment, the probability for encountering such historically significant sites within sandy contexts appears to be significantly low.



Figure 5-1. Erosion and structural damage resulting from the 2016 beach loss event (photos courtesy of Sea Engineering).



Figure 5-2. Conditions before and after temporary erosion control installation (photos courtesy of Sea Engineering).

5.1 ARCHAEOLOGICAL CONSIDERATIONS FOR THE PROPOSED BEACH NOURISHMENT ALTERNATIVE

To recount the proposed Beach Nourishment Alternative, this action would involve the placement of additional sand along the affected shoreline to increase beach width and sand volume (see also Section 1.1.1). Groundwork would entirely consist of mechanical placement of sand directly on the shoreline. Based on the documented erosion history following the 2016 beach loss event, the probability of encountering in situ historically significant or culturally sensitive sites is low. Therefore, further archaeological investigation may not be required if this alternative is pursued.

5.2 ARCHAEOLOGICAL CONSIDERATIONS FOR THE PROPOSED BEACH MAINTENANCE ALTERNATIVE

To recount the proposed Beach Maintenance Alternative, this action would include a combination of (i) periodic beach nourishment, (ii) sand pushing, and/or (iii) sand back passing. It is anticipated that the program would consist of an initial beach nourishment project, followed by periodic sand pushing or sand back passing, followed by a series of successive beach

renourishment projects. (see also Section 1.1.2). Groundwork would entirely consist of the initial mechanical placement of sand directly on the shoreline and subsequent programmatic mechanical work to maintain and re-nourish the beach with sand. As with the one-time beach nourishment alternative, based on the documented erosion history following the 2016 beach loss event, the probability of encountering in situ historically significant or culturally sensitive sites is low. Therefore, further archaeological investigation may not be required if this alternative is pursued.

5.3 ARCHAEOLOGICAL CONSIDERATIONS FOR THE PROPOSED BEACH STABILIZATION ALTERNATIVE

To recount the proposed Beach Stabilization Alternative, this action would include both the placement of sand to nourish the beach along with (i) modification of existing structures, and/or (ii) installation of new structures (e.g., groins) to stabilize the sand. Groundwork may include mechanical grubbing and grading for site preparation and subsequent construction of either new structures, such as groins, or modification of existing structures. This would be followed by mechanical placement of the sand directly onto the shoreline. Given the potential need for excavation, if Beach Stabilization is selected as the preferred alternative, archaeological testing within the construction footprint in the backshore area may be warranted once the design is finalized. However, as noted in the field inspection results, the presence of underlying utilities poses challenges in identifying suitable areas for pre-construction testing, which may limit the effectiveness of an archaeological testing strategy. Therefore, archaeological monitoring during construction may serve as a more appropriate identification measure in the context of this alternative, should it be chosen.

5.4 ARCHAEOLOGICAL CONSIDERATIONS FOR THE PROPOSED SAND RECOVERY AREA

The Sand Recovery effort involves the extraction of sand from an approximately 12-acre offshore area located roughly 450 meters off Puʻu Kekaʻa (SIHP 50-50-03-01206). This process would require one crane barge, two deck barges, one tugboat, and one support vessel. The two-deck barges will be in constant rotation between the sand recovery area and Kahului Harbor. As one deck barge is being loaded (during dredging), the other will be in transit to/from Kahului Harbor for offloading. Archaeological and historic preservation concerns related to this action are twofold.

With regard to archaeology, while the tow camera survey footage did not reveal the presence of traditionally significant objects along the documented transects, the potential remains for such objects to exist in un-surveyed portions of the recovery area or beneath the surface of the deposited sand. As noted by Mr. Severens during consultation regarding the probable kuʻula stone and his deep-sea diving experience in the channels, certain areas are known to concentrate Hawaiian net weights, heʻe lure weights, and anchor stones, and the location of the kuʻula stone aligns with his observations (Donham 1992:4-5). Given these factors, archaeological monitoring of the dredging process is recommended to address the potential for inadvertent discovery of significant cultural objects during sand recovery.

With regard to Puʻu Kekaʻa and the Leina a ka ʻUhane, while the historic property documentation of the leina (SIHP 50-50-30-01206) focuses on the physical landmass identified as the puʻu (Hommon 1973), the entry into pō and the journey of the soul after leaping extends into the sea (Emerson 1902). In one account where a soul leaping from a leina is described, the soul "leaped from a rock into the sea, where it followed the path of the setting sun and plunged beneath the ocean" (Lewis 1980:26). At Kekaʻa, depending on the season and the direction of the setting sun, the industrial presence of two barges off the leaping point would present a temporary adverse effect on the setting and feel of the leina disrupting the perceived pathway of the soul's journey (Figure 5-3). The Cultural Impact Assessment (Appendix H) prepared for the project EIS also acknowledges this temporary adverse effect on the leina and addresses its cultural implications.



Figure 5-3. Leina a ka ʻUhane, Puʻu Kekaʻa to the right of the photo frame.

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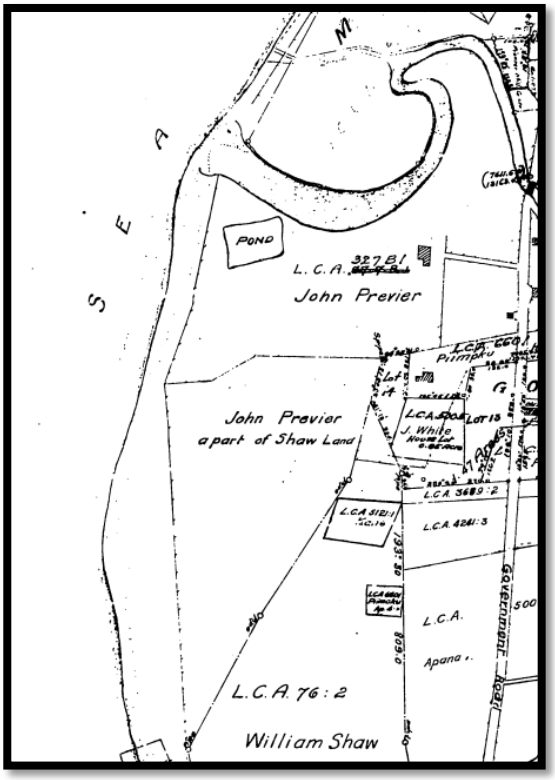
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APPENDIX

G-1

CULTURAL IMPACT ASSESSMENT



Cultural Impact Assessment for Hōʻala Honokōwai Beach Restoration Project

Honokōwai Ahupuaʻa, Kaʻanapali Moku

TMKs: (fronting) (2) 4-4-001:097, (2) 4-4-001:098, (2) 4-4-001:100

Prepared for

Hoʻāla Honokōwai

Prepared by

HONUA CONSULTING

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Authors and Lead Researchers

Trisha Kehaulani Watson, J.D., Ph.D.

Assistant Authors and Researchers

Ethan McKown, M.A.
Julie Au, M.A.
Matthew Kawaiola Sproat
Catherine Thetford
Kepa Maly
Kaiminaauao Kahikina, M.A.

Note on Hawaiian Language Use

In keeping with other Hawaiian scholars, we do not italicize Hawaiian words. Hawaiian is both the native language of the pae‘āina of Hawai‘i and an official language of the State of Hawai‘i. Some authors will leave Hawaiian words italicized if part of a quote; we do not. In the narrative, we use diacritical markings to assist our readers, except in direct quotes, where we keep the markings used in the original text. We provide translations contextually when appropriate. Unless otherwise noted, all translations are by Honua Consulting authors.

Cover Image

Portion of Registered Map 2534 (1912). Wall (Surveyor). Hawaii State Archives.

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Executive Summary

At the request of Munekiyo Hiraga and on behalf of the applicant West Maui Resort Partners, L.P. (WMRP), Honua Consulting, LLC, has prepared this Cultural Impact Assessment (CIA) for the Hoʻāla Honokōwai project, located at Honokōwai Beach on Maui Island, fronting Tax Map Key (TMK) parcel (2) 4-4-001:097, (2) 4-4-001:098, (2) 4-4-001:100 in support of a Draft Environmental Impact Statement (DEIS).

WMRP proposes restoring and preserving Honokōwai Beach in Honokōwai, Maui (herein referred to as the Proposed Action). Currently, three alternatives for restoring Honokōwai Beach are being considered: 1) Beach Nourishment, 2) Beach Maintenance, or 3) Beach Stabilization. The three beach restoration alternatives would require dredging from an offshore sand source and bringing that sand to the project area. A "No Action" alternative is also being evaluated. Beach Stabilization has been identified as the preferred alternative. A more detailed description of this alternative is provided in the DEIS.

The Proposed Action is titled "Hoʻāla Honokōwai," reflecting its primary objective of restoring this critical natural and cultural resource for the West Maui community. Hoʻāla means "to awaken," and this title reflects the project's intent to uplift the area's natural and cultural resources. Additional objectives are to preserve and enhance cultural and shoreline access, increase resiliency to coastal hazards, and enable planning for long-term adaptation to sea level rise. Honokōwai Beach is a dynamic shoreline almost entirely eroded by an episodic erosion event in 2016. That event resulted in approximately 5,600 square feet of land being eroded, structural damage, degraded water quality, and shoreline access. Honokōwai Beach also experiences chronic erosion, which is projected to accelerate.

The research for this report involved a comprehensive examination of Hawaiian-language documents, including, but not limited to, the Bishop Mele Index and various archival materials from the Bishop Museum, such as the Hawaiian-language archival cache. Hawaiian-language experts reviewed all documents to search for relevant information to include in this report. Relevant documents are included in this analysis, with translations provided where pertinent to the discussion. Additionally, interviews with certain individuals who identify as lineal and/or cultural descendants are summarized.

Based on the information gathered and the resource assessment, it is anticipated that cultural resources, and traditional and customary practices may be intermittently impacted during sand recovery activities at the sand source location, approximately 1,500 feet offshore in West Maui. The anticipated impacts are expected to be short-term. To timely

address any anticipated impacts, cultural monitoring may be appropriate to allow area descendants to monitor these activities.

Also recommended in order to address potential impacts are additional evaluation and documentation of Puʻu Kekaʻa as a traditional cultural property, potentially including preparation of an application to the state and national registers of historic places. As part of that process, additional consultation and ethnographic data recovery should be completed in consultation with the State Historic Preservation Division (SHPD) during the Hawaii Revised Statutes (HRS), Chapter 6E review process that occurs during project entitlement.

Further evaluation of identified historic properties will occur after the preferred alternative is selected and the Proposed Action design is developed. The Proposed Action should avoid permanently impacting the tangible features of any historic properties.

Interviewees noted potential impacts arising from all the alternatives except for the “No Action” alternative, including impacts to fishing, gathering, surfing, paddling, and other practices due to the Proposed Action. The impacts noted apply to two locations: The first is Puʻu Kekaʻa resulting from the offshore sand recovery, which would apply to all alternatives except for the “No Action” alternative, and the second is the coastal area fronting the properties. Specifically as to the coastal area fronting the properties, the most impacts would result from Beach Stablization, specifically from installation of groins. The groins associated with the Beach Stabilization alternative will adversely affect cultural practices in the project area and need appropriate decision-making to address this.

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Abbreviations and Acronyms

AIS: Archaeological Inventory Survey
BMP: Best Management Practice
CIA: Cultural Impact Assessment
DEIS: Draft Environmental Impact Statement
EIS: Environmental Impact Statement
EISPN: Environmental Impact Statement Preparation Notice
ERP: Environmental Review Program, Office of Planning and Sustainable Development, State of Hawaii (formerly the Office of Environmental Quality and Control)
HAR: Hawaii Administrative Rules
HRS: Hawaii Revised Statutes
ILK: Indigenous Local Knowledge
Ka Pa'akai: *Ka Pa'akai O Ka 'Āina v. Land Use Commission*, 94 Haw. 31 (2000)
LCA: Land Commission Award
LRFI: Literature Review and Field Inspection report
NRHP: National Register of Historic Places, U.S. National Park Service
OEQC: Office of Environmental Quality and Control, State of Hawaii (now known as the Environmental Review Program).
ROI: Range of Influence
SHPD: State Historic Preservation Division, Department of Land and Natural Resources, State of Hawaii
SIHP: State Inventory of Historic Places
SLH: Session Laws of Hawaii
SMA: Special Management Area
TEK: Traditional Ecological Knowledge
TMK: Tax Map Key
USGS: U.S. Geological Survey
WMRP: West Maui Resort Partners, L.P.

1.0 Project Description and Compliance

At the request of Munekiyo Hiraga, on behalf of the applicant West Maui Resort Partners, L.P (WMRP), Honua Consulting, LLC, has prepared this Cultural Impact Assessment (CIA) for the Hoʻāla Honokōwai project, located at Honokōwai, Beach on Maui Island, in support of a DEIS. Honokōwai Beach is located on the west coast of Maui, north of Kāʻanapali and south of Kahana Bay, in the Kāʻanapali District and Honokōwai Ahupuaʻa. The Project Site is referred to as Honokōwai Beach because it is located within the Honokōwai littoral cell between Honokōwai Point and Honokōwai Stream. The primary Project Site at Honokōwai Beach is located approximately 2,500 feet (ft.) south of Honokōwai Beach Park. The portion of the beach proposed for restoration is fronting Kāʻanapali Beach Club (KBC) (TMK (2)4-4-001:098) and Kāʻanapali Shores (TMK (2)4-4-001:097) to the north and Maui Kai Condominiums (Maui Kai) (TMK (2)4-4-001:100) to the south.

1.1 Project Description and Proposed Action

WMRP proposes restoring and preserving Honokōwai Beach, fronting its property in Honokōwai, Maui (herein referred to as the Proposed Action). Currently, three alternatives for the restoration of Honokōwai Beach are being considered: 1) Beach Nourishment, 2) Beach Maintenance, or 3) Beach Stabilization. The three beach restoration alternatives would require dredging from an off-shore sand source and bringing that sand to the project area for use. A “No Action” alternative is also being evaluated. A more detailed description of each alternative is provided in the DEIS.

The Proposed Action is titled “Hoʻāla Honokōwai,” reflecting its primary objective of restoring this critical natural and cultural resource for the West Maui community. Hoʻāla means “to awaken,” and this title reflects the project’s intent to uplift both the natural and cultural resources of this area. Additional objectives are to preserve and enhance cultural and shoreline access, increase resiliency to coastal hazards, and enable planning for long-term adaptation to sea level rise. Honokōwai Beach is a dynamic shoreline that was almost entirely eroded by an episodic erosion event in 2016. That event resulted in approximately 5,600 square feet of land being eroded, structural damage, degraded water quality, and shoreline access. Honokōwai Beach also experiences chronic erosion, which is projected to accelerate.

The DEIS and the CIA evaluated the three alternatives, plus the “No Action” alternative. They also assessed the impacts associated with the sand recovery activity from the offshore sand source and the effects on the project's construction, including how the sand will be brought to the project site.

1.2 Background and Compliance

The State and its agencies have an affirmative obligation to preserve and protect Native Hawaiians' customarily and traditionally exercised rights to the extent feasible and reasonable.[1] State law further recognizes that the cultural landscapes provide living and valuable cultural resources where Native Hawaiians have and continue to exercise traditional and customary practices, including hunting, fishing, gathering, and religious practices. In *Ka Paʻakai*, the Hawaiʻi Supreme Court provided government agencies an analytical framework to ensure the protection and preservation of traditional and customary Native Hawaiian rights while at the same time taking into consideration contemporary development interests. This is accomplished through:

1) The identification of valued cultural, historical, or natural resources in the Project Area, including the extent to which traditional and customary Native Hawaiian rights are exercised in the Project Area;
2) The extent to which those resources—including traditional and customary Native Hawaiian rights—will be affected or impaired by the proposed action; and,
3) The feasible action, if any, to be taken to reasonably protect Native Hawaiian rights if they are found to exist.

The appropriate information concerning the Project Area has been collected, focusing on areas near or adjacent to the Project Area. The primary Project Area is discontiguous and includes two primary areas: the first being the property and the adjacent coastal area (Honokōwai Beach Restoration Project Area or primary Project Area, see Figure 1 - Figure 2) and a second area being Puʻu Kekaʻa where the sand reclamation area is located (Puʻu Kekaʻa Sand Recovery Site or Secondary Project Area) (see Figure 3). The larger region, including Honokōwai Ahupuaʻa, mostly the makai area, and the north coastal portion of Hanakaʻōʻō are researched as the Study Area (Study Area) and considered for potential indirect and/or cumulative impacts. A thorough analysis of Proposed Action and its potential impacts on cultural resources, historical resources, and archaeological sites is included in this CIA.

[1] Article XII, Section 7 of the Hawaiʻi State Constitution, *Ka Paʻakai O Ka ʻĀina v. Land Use Commission*, 94 Haw. 31 [2000] (Ka Paʻakai), Act 50 SLH 2000.

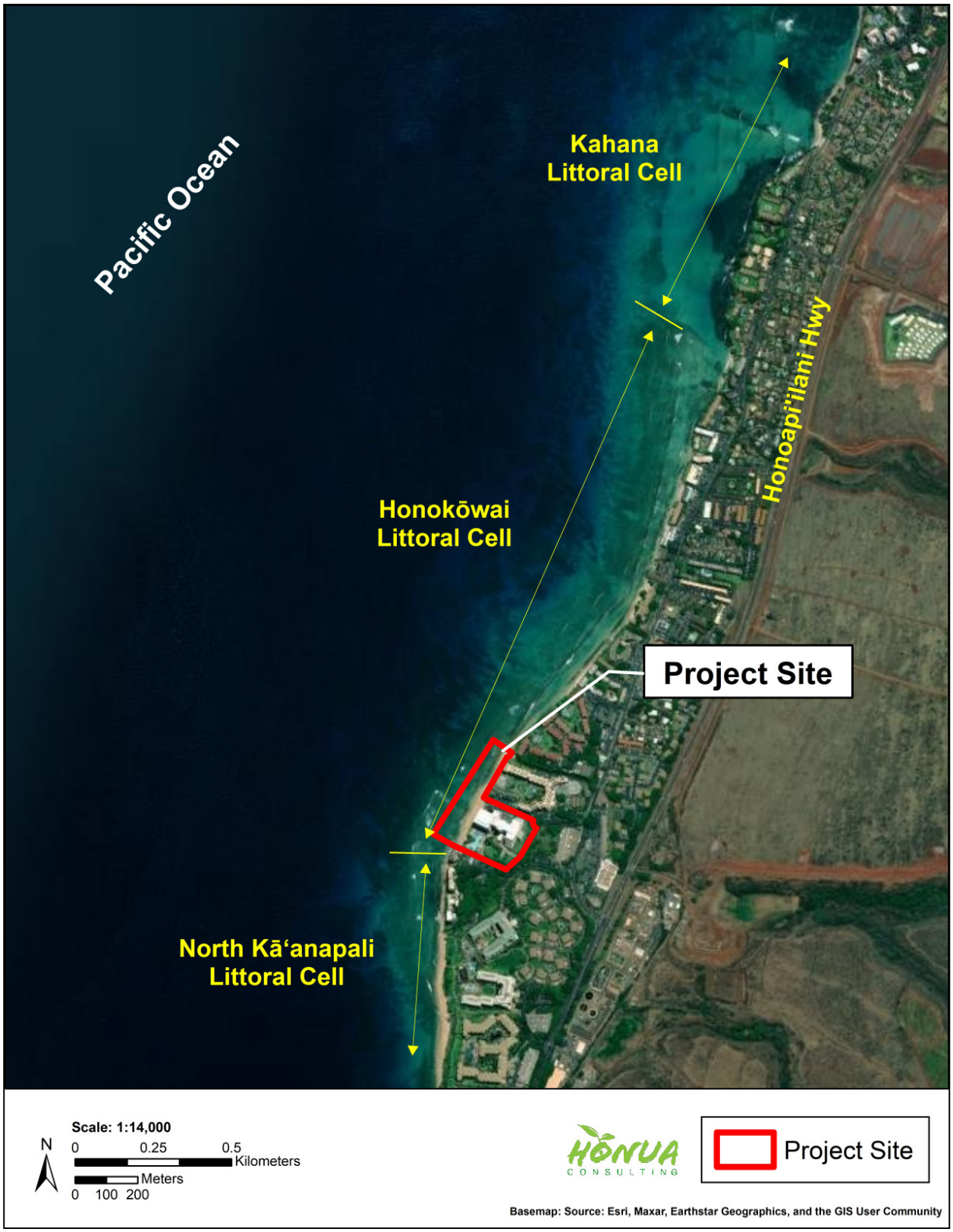


Figure 1. Map showing the primary Project Site within the Honokōwai Littoral Cell



Figure 2. Map showing the primary Project Area and neighboring properties

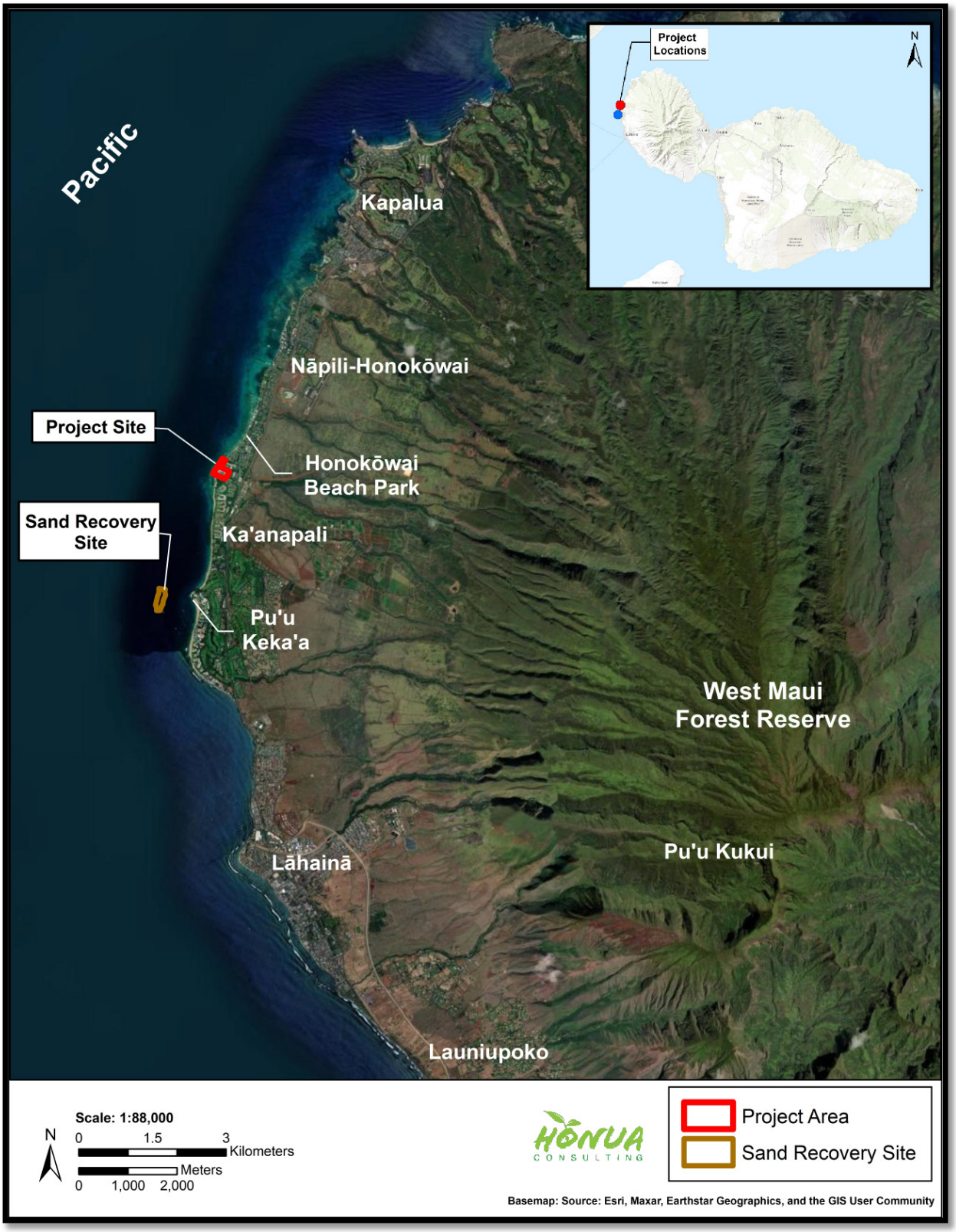


Figure 3. Map showing the primary Project Area and secondary Project Area

This CIA includes an ethnographic survey which provides an overview of cultural and historic resources in the Project Area through a comprehensive literature review, consultations with community and cultural practitioners, and high-level, project-specific surveys. This CIA focuses on identifying areas where disturbance should be avoided or minimized to reduce impacts to historic properties or culturally important features. The primary goal in completing the CIA is to minimize impact by avoiding sensitive areas and to implement mitigation measures if avoidance is not feasible.

1.3 Geographic Extent

The geographic extent for potential impacts to cultural resources and historic properties includes the Project Area and its localized surroundings, which, for the purpose of this study, includes Puʻu Kekaʻa. As noted above, the primary Project Area is discontiguous and includes two primary areas: the first being the property and the adjacent coastal area and a second area being Puʻu Kekaʻa, where the sand reclamation area is located. The larger region, including Honokōwai Ahupuaʻa, mostly the makai area, and the north coastal portion of Hanakaʻōʻō, are researched as the Study Area and considered for potential indirect and/or cumulative impacts.

This CIA also reviews some of the resources primarily covered by the regulatory review. It focuses on researching and reviewing the range of biocultural resources identified through historical documents, traditional knowledge, information found in the Hawaiian language historical cache, and oral histories and knowledge collected from cultural practitioners and experts.

The best practice for ethnographic surveys is to define a geographic extent beyond the identified or typical boundaries of the Project Area. The recommended area is typically the size of the traditional land area (ahupuaʻa) or region (moku), but this can be larger or smaller depending on what best helps to identify the resources appropriately.

The geographic extent for this CIA is unique. The primary Project Area is Honokōwai Beach fronting the Kaʻanapali Beach Club and adjacent property, but the Proposed Action alternatives would require use of sand that would be recovered from an off-shore site located, in some historic maps, adjacent to the Hanakaʻoʻo ahupuaʻa. This secondary location where the sand reclamation is to take place is identified for the purposes of this CIA as the secondary Project Area, as Puʻu Kekaʻa is a significant location for Hawaiians, and this was emphasized during the oral interviews. In addition to its association with the area known as Kekaʻa, Puʻu Kekaʻa has long been recognized as a leina, or a leaping off point for souls. There are leina throughout the Hawaiian Islands; all of them are

considered sacred sites. Therefore, the CIA will include Puʻu Kekaʻa within the geographic extent for this study.

1.4 Goal of Ethnographic Survey

This survey, along with the archaeological work being conducted by ʻĀina Archaeology, aims to fulfill the requirement of considering the Proposed Action's potential impacts on historic and cultural resources. At a minimum, it will describe: a) any valued cultural, historic, or natural resources in the area, including the extent to which traditional and customary Native Hawaiian rights are exercised there, b) the extent to which those resources – including traditional and customary Native Hawaiians rights – will be affected or impaired by the Proposed Action; and c) the feasible actions, if any, to be taken to reasonably protect Native Hawaiian rights if they are found to exist.

2.0 Methodology

The approach to developing the CIA is as follows:

1) Gather Best Information Available
   a) Gather historic cultural information from stories and other oral histories about the affected area to provide cultural foundation for the report;
   b) Inventory as much information as can be identified about as many known cultural, historic, and natural resources, including previous archaeological inventory surveys, CIAs, etc. that may have been completed for the possible range of areas; and
   c) Update the information with interviews with cultural or lineal descendants or other knowledgeable cultural practitioners.
2) Identify Potential Impacts to Cultural Resources
3) Develop Reasonable Mitigation Measures to Reduce Potential Impacts
   a) Involve the community and cultural experts in developing culturally appropriate mitigation measures; and
   b) Develop specific BMPs, if any are required, for conducting the Proposed Action in a culturally appropriate and/or sensitive manner as to mitigation and/or reduce any impacts to cultural practices and/or resources.

While numerous studies have been conducted on this area, few have utilized Hawaiian language resources and Hawaiian knowledge. This appears to have impacted modern understanding of this location, as many of the relevant documents are native testimonies given by Kanaka Hawai‘i (Hawaiians) who lived on this land.

While hundreds of place names and primary source historical accounts (from both Hawaiian and English language narratives) are cited on the following pages, it is impossible to tell the whole story of these lands in any given manuscript. A range of history spanning the generations has been covered. Importantly, the resources herein are a means of connecting people with the history of their communities—that they are part of that history. Knowledge of place will, in turn, promote appreciation for place and encourage acts of stewardship for the valued resources that we pass on to the future.

The Office of Environmental Quality Control (OEQC) (now the Environmental Review Program (ERP)) provides guidance on properly scoping the range of cultural practices. In their guidance documentation, they explain:

> In scoping the cultural portion of an environmental assessment, the geographical extent of the inquiry should, in most instances, be greater than the area over which

> the proposed action will take place. This is to ensure that cultural practices which may not occur within the boundaries of the project area, but which may nonetheless be affected, are included in the assessment. Thus, for example, a proposed action that may not physically alter gathering practices but may affect access to gathering areas would be included in the assessment. An ahupua'a is usually the appropriate geographical unit to begin an assessment of cultural impacts of a proposed action, particularly if it includes all of the types of cultural practices associated with the project area. In some cases, cultural practices are likely to extend beyond the ahupua'a and the geographical extent of the study area should take into account those cultural practices (OEQC 2012: 11).

Background research for the literature review was conducted using materials obtained from the State Historic Preservation Division (SHPD) library in Kapolei and the Honua Consulting LLC. report library. On-line materials consulted included the Ulukau Electronic Hawaiian Database (www.ulukau.com), Papakilo Database (www.papakilodatabase.com), the State Library on-line (http://www.librarieshawaii.org/Serials/databases.html), and Waihona ʻĀina Māhele database (http://www.waihona.com). Hawaiian terms and place names were translated using the on-line Hawaiian dictionaries (Nā Puke Wehewehe ʻŌlelo Hawaiʻi) (www.wehewehe.com), *Place Names of Hawaiʻi* (Pukui et al. 1974), and *Hawaiʻi Place Names* (Clark 2002). Historic maps were obtained from the State Archives, State of Hawaiʻi Land Survey Division website (http://ags.hawaii.gov/survey/map-search/), UH-Mānoa Maps, Aerial Photographs, and GIS (MAGIS) website (http://guides.library.manoa.hawaii.edu/magis). Maps were geo-referenced for this report using ArcGIS 10.3. While GIS technology is not 100% precise and historic maps have inherent flaws; it is important to undertand that geo-referenced maps may contain some built-in inaccuracies.

While conducting the research, primary references included, but were not limited to: land use records, including the Hawaiian L.C.A. records from the Māhele ʻĀina (Land Division) of 1848; the Boundary Commission Testimonies and Survey records of the Kingdom and Territory of Hawaiʻi; and historical texts authored or compiled by: David Malo (1987); Samuel M. Kamakau (1964, 1991, 1992); records of the American Board of Commissioners of Foreign Missions (A.B.C.F.M.) (1820–1860); Charles Wilkes (1845); Alexander & Preston (1892–1894); Abraham Fornander (1916–1919); and many other native and foreign writers. This CIA also includes several native accounts from Hawaiian language newspapers (primarily compiled and translated from Hawaiian to English by K. Maly), and historical records authored by nineteenth century visitors, and residents of the region.

Historical and archival resources were located in the collections of the Hawai‘i State Archives, Survey Division, Land Management Division, Survey Division, and Bureau of Conveyances; the Bishop Museum Library and Archives; the Hawaiian Historical Society and the Hawaiian Mission Children‘s Society Library; University of Hawai‘i-Hilo Mo‘okini Library; the National Archives and Records Administration (NARA), Maryland; the Library of Congress, Washington D.C.; the National Oceanic and Atmospheric Administration National Library, Maryland; the Smithsonian Institution Natural History and National Anthropological Archives libraries, Washington, D.C.; the Houghton Library at Harvard; the United States Geological Survey (USGS) Library, Denver; the Paniolo Preservation Society and Parker Ranch collections; private family collections; and in the collection of Kumu Pono Associates LLC. This information is generally cited in categories by chronological order of the period depicted in the narratives.

M. P. Nogelmeier (2010) discusses the adverse impacts of methodology that fails to properly research and consider Hawaiian language resources. He strongly cautions against a mono-rhetorical approach that marginalizes important native voices and evidence, specifically in the field of archaeology. For this reason, Honua Consulting consciously employs a poly-rhetorical approach, whereby all data, regardless of language, is researched and considered. Failing to access the millions of pages of information within the Hawaiian language cache could arguably be a violation of Act 50, as such an approach would fundamentally fail to gather the best available information. This is especially significant considering the voluminous historical accounts available for native tenants in the Hawaiian language.

Hawaiian culture views natural and cultural resources as largely being inseparable: without the resources provided by nature, cultural resources could and would not be procured. From a Hawaiian perspective, all natural and cultural resources are interrelated, and all natural and cultural resources are culturally significant. Kepā Maly (2001), ethnographer and Hawaiian language scholar, emphasizes, “In any culturally sensitive discussion on land use in Hawai‘i, one must understand that Hawaiian culture evolved in close partnership with its natural environment. Thus, Hawaiian culture does not have a clear dividing line of where culture ends and nature begins” (Maly 2001:1). As a leading researcher and scholars on Hawaiian culture, Maly, along with his wife, Onaona, have conducted numerous ground-breaking studies on cultural histories throughout Hawai‘i. A substantial part of the archival research utilized in this CIA was previously compiled and published by Kepā and Onaona Maly. They have granted permission to use their important work and are properly identified as associated authors and researchers to this CIA.

This CIA also specifically looks to identify intangible resources. Tangible and intangible heritage are inextricably linked (Bouchenaki 2003). Intangible cultural resources, also identified as intangible cultural heritage (ICH), are critical to the perpetuation of cultures globally. International and human rights law professor Federico Lenzerini notes that, "At present, we are aware on a daily basis of the definitive loss—throughout the world—of language, knowledge, knowhow, customs, and ideas, leading to the progressive impoverishment of human society" (Lenzerini 2011:12). He goes on to warn that:

> The rich cultural variety of humanity is progressively and dangerously tending towards uniformity. In cultural terms, uniformity means not only loss of cultural heritage—conceived as the totality of perceptible manifestations of the different human groups and communities that are exteriorized and put at the others' disposal—but also standardization of the different peoples of the world and of their social and cultural identity into a few stereotyped ways of life, of thinking, and of perceiving the world. Diversity of cultures reflects diversity of peoples; this is particularly linked to ICH, because such a heritage represents the living expression of the idiosyncratic traits of the different communities. Preservation of cultural diversity, as emphasized by Article 1 of the UNESCO Universal Declaration on Cultural Diversity, 'is embodied in the uniqueness and plurality of the identities of the groups and societies making up humankind'. Being a 'source of exchange, innovation and creativity', cultural diversity is vital to humanity and is inextricably linked to the safeguarding of ICH. Mutual recognition and respect for cultural diversity—and, *a fortiori*, appropriate safeguarding of the ICH of the diverse peoples making up the world—Is essential for promoting harmony in intercultural relations, through fostering better appreciation and understanding of the differences between human communities. (Lenzarini 2011:103)

Therefore, tradition and practice, as elements of Hawaiian ICH, are essential to the protection of Hawaiian rights and the perpetuation of the Hawaiian culture.

2.1 Native Hawaiian Rights: Identifying Traditional or Customary Practices

It is within this context that traditional or customary practices are studied. The concept of traditional or customary practices can often be challenging for people to grasp. In order to help readers and decision makers better understand Native Hawaiian rights and practices, author Dr. Trisha Kehaulani Watson developed the following framework to research, analyze, and assess impacts to traditional or customary practices as they pertain to Native Hawaiian rights.

Native Hawaiian rights are rooted in traditional and customary practices that have sustained Hawaiian communities and their relationship to the land, sea, and natural resources for centuries. These rights are grounded in the indigenous worldview of mālama ʻāina, or care for the land, and reflect the reciprocal relationship between people and nature that is central to Native Hawaiian identity. Traditional practices like fishing, farming, gathering, and ceremony are not only means of survival but are also cultural expressions that embody Hawaiian values, spirituality, and knowledge systems.

Legally, Native Hawaiian rights are recognized under both Hawaiian Kingdom law and U.S. federal and state law, specifically under the Hawaiʻi State Constitution, which provides protections for Native Hawaiian traditional and customary rights. Court cases such as *Public Access Shoreline Hawaii v. Hawaiʻi County Planning Commission (1995)* have affirmed that these rights include access to natural resources essential for customary practices, even if these areas are located on private lands. Therefore, it is important to have a framework through which these rights can be identified so they can be properly assessed. This requires a sound framework for identifying traditional or customary practices within a particular geographic area. Traditional or customary practices can be defined as follows:

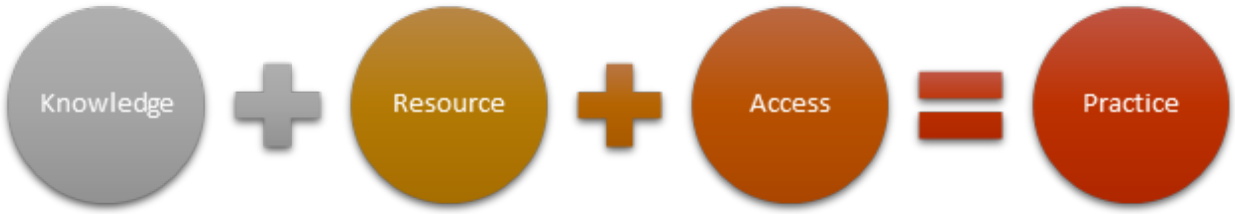


Figure 4. *Diagram of elements that contribute to traditional or customary practices (Honua Consulting)*

The first element is knowledge, often referred to as traditional ecological knowledge (TEK), Indigenous local knowledge (ILK), or ethnoscience. The most applicable Hawaiian term for it would be ʻike.

In Hawaiian culture, the term ʻike signifies a profound sense of knowledge, awareness, and insight, extending beyond mere information to a deep, lived understanding. Rooted in the Native Hawaiian worldview, ʻike is often intertwined with traditional ecological knowledge (TEK), reflecting a comprehensive and relational approach to the natural world. This knowledge is not static; it is accumulated through generations of observation, interaction, and experience with the environment, and it embodies a holistic understanding of ecosystems that sustain communities and cultural practices.

Traditional ecological knowledge in Hawaii is conveyed through oral traditions, cultural practices, and specific terms like ʻike, which underscore the importance of experiential learning. Rather than seeing humans as separate from nature, Hawaiian TEK, informed by ʻike, perceives humans as integral parts of the environment. This perspective fosters respect, stewardship, and reciprocal relationships, where maintaining the health of the land and ocean ensures the well-being of the community.

ʻIkepili, or specific bodies of knowledge, for instance, may include practices related to fishing, farming, or resource management that have adapted to Hawaii's unique islands and microclimates. Hawaiian knowledge systems thus embody sustainability and resilience, as they adapt to environmental changes while remaining rooted in cultural principles. Modern conservation efforts in Hawaii increasingly recognize the value of ʻike and traditional ecological knowledge, integrating these insights into practices that respect indigenous values and support ecological and cultural restoration. In this way, ʻike serves as a bridge between the past and present, linking ancestral wisdom with contemporary environmental stewardship.

In the context of this CIA, it encompasses the information, data, knowledge, or expertise Native Hawaiians or local communities possessed or possess about an area's environment, an area's ʻikepili. Traditionally, this would have included information Hawaiians needed to utilize the area's resources for various purposes, including, but not limited to, travel, food, worship or habitation. This element is largely intangible.

The second element is the resources themselves, which are primarily tangible resources. These include archaeological resources (i.e., habitation structures, walls, etc.) and natural resources (i.e., plants, animals, etc.). They can also encompass places, such as a sacred or culturally important sites or wahi pana. Sometimes these wahi pana are general locations, which does not diminish their importance or value. Nonetheless, it is important to recognize that potential eligibility as a "historic site" on the National Register of Historic Places (NRHP) would require identifiable boundaries of a site.

The third element is access. The first two elements alone are not sufficient for traditional or customary practices to take place; practitioners must have access to the resources to practice their traditional customs. Access entails not only the physical ability to access a location but also means the availability of the resources. For example, if a particular plant is used for medicinal purposes, there needs to be a sufficient amount of that plant available for practitioners. Therefore, any action that would adversely impact the population of a culturally significant plant would impact a practitioner's ability to access that plant, thereby adversely impacting the traditional or customary practice.

Prohibiting or restricting access to natural resources can have far-reaching adverse effects on traditional and customary practices, particularly in indigenous communities. In Hawaii, many traditional practices—such as fishing, gathering plants, or engaging in cultural ceremonies—are intimately tied to specific lands, waters, and ecological systems. When access to these resources is limited, it disrupts not only the physical act of gathering but also the cultural continuity of knowledge, relationships, and stewardship that define these practices.

Even the perception that access has been limited or discouraged can cause impacts, known as indirect access impacts. When community members perceive that areas they traditionally accessed are now restricted, it can lead to feelings of alienation, fear, and uncertainty. This perception often causes individuals to self-limit their access, ceasing or reducing their practice of traditional activities even when formal restrictions may not explicitly prohibit them. This, in turn, can interrupt the intergenerational transmission of knowledge, as fewer practitioners may be able to teach younger generations about these cultural practices.

Additionally, perceived restrictions can alter people's relationships with their cultural landscapes. Traditional practices often depend on consistent access to specific resources in familiar locations, fostering a connection with these places and an understanding of their ecological dynamics. When people believe these areas are no longer available to them, this connection can be eroded, leading to cultural loss. Thus, the perceived barriers, even without formal prohibition, can weaken community identity, cultural resilience, and the ability to sustain customary practices in meaningful ways.

Traditional or customary practices are, therefore, the combination of knowledge(s), resource(s), and access. Each of these individual elements should be thoroughly researched and identified when assessing any potential impacts on these practices.

2.2 Traditional Knowledge or Ethnoscience, and the Identification of Cultural Resources

The concept of ethnoscience was first established in the 1960s and has been defined "the field of inquiry concerned with the identification of the conceptual schemata that indigenous peoples use to organize their experience of the environment" (Roth 2019). Ethnoscience includes a wide range of subfields, which includes, but is not limited to, ethnoecology, ethnobotany, ethnozoology, ethnoclimatology, ethnomedicine, and ethnopedology. These fields are important to properly identify traditional knowledge within a certain area.

Traditional Native Hawaiian practitioners were scientists and expert natural resource managers by necessity. Without modern technological conveniences to rely on, Hawaiians developed and maintained prosperous and symbiotic relationships with their natural environment for thousands of years. Their environments were their families, their homes, and their laboratories. They knew the names of every wind and every rain. The elements taught and inspired. The ability of Indigenous people to combine spirituality and science led to the formation of unique land-based methodologies that spurred innovation. Therefore, identifying significant places requires a baseline understanding of what made places significant for Hawaiians.

Hawaiians were both settlers and explorers. In *Plants in Hawaiian Culture,* B. Krauss explains: "Exploration of the forests revealed trees, the timber of which was valuable for building houses and making canoes. The forests also yielded plants that could be used for making and dying tapa, for medicine, and for a variety of other artifacts" (Krauss 1993). Analysis of native plants and resource management practices reveals the depth to which Hawaiians excelled in their environmental science practices:

> [Hawaiians] demonstrated great ability in systematic differentiation, identification, and naming of the plants they cultivated and gathered for use. Their knowledge of the gross morphology of plants, their habits of growth, and the requirements for greatest yields is not excelled by expert agriculturists of more complicated cultures. They worked out the procedures of cultivation for every locality, for all altitudes, for different weather conditions and exposures, and for soils of all types. In their close observations of the plants they grew, they noted and selected mutants (spores) and natural hybrids, and so created varieties of the plants they already had. Thus, over the years after their arrival in the Islands, the Hawaiians added hundreds of named varieties of taro, sweet potatoes, sugarcane, and other cultivated plants to those they had brought with them from the central Pacific (Krauss 1993).

Thus, Native Hawaiians reinforced the biodiversity that continues to exist in Hawai'i today through their customary traditional natural resource management practices.

The present analyses of archival documents, oral traditions (oli or chants, mele or songs, and/or hula dances and ha'i mo'olelo or storytelling performances), and Hawaiian language sources including books, manuscripts, and newspaper articles, is focused on identifying recorded cultural resources present on the landscape, including: Hawaiian and non-Hawaiian place names; landscape features (ridges, gulches, cinder cones); archaeological features (kuleana parcel walls, house platforms, shrines, heiau [places of

worship], etc.); culturally significant areas (viewsheds, unmodified areas where gathering practices and/or rituals were performed); and significant biological, physiological, or natural resources. This research also looks to document the wide range of Hawaiian science that existed within the geographic extent.

2.3 Moʻolelo ʻĀina: Native Traditions of the Land

Among the most significant sources of native moʻolelo are the Hawaiian language newspapers printed between 1838 and 1948 and the early writings of foreign visitors and residents. Most of the accounts that were submitted to the papers were penned by native residents of areas being described and noted native historians. Over the last 30 years, Kepā Maly has reviewed and compiled an extensive index of articles published in the Hawaiian language newspapers, with particular emphasis on those narratives pertaining to lands, customs, and traditions. Many traditions naming places around Hawaiʻi are found in these early writings. Many of these accounts describe native practices, the nature of land-use at specific locations, and native moʻolelo (history, narrative, story). Thus, we are given a means of understanding how native people related to their environment and sustained themselves on the land.

2.4 Historic Maps

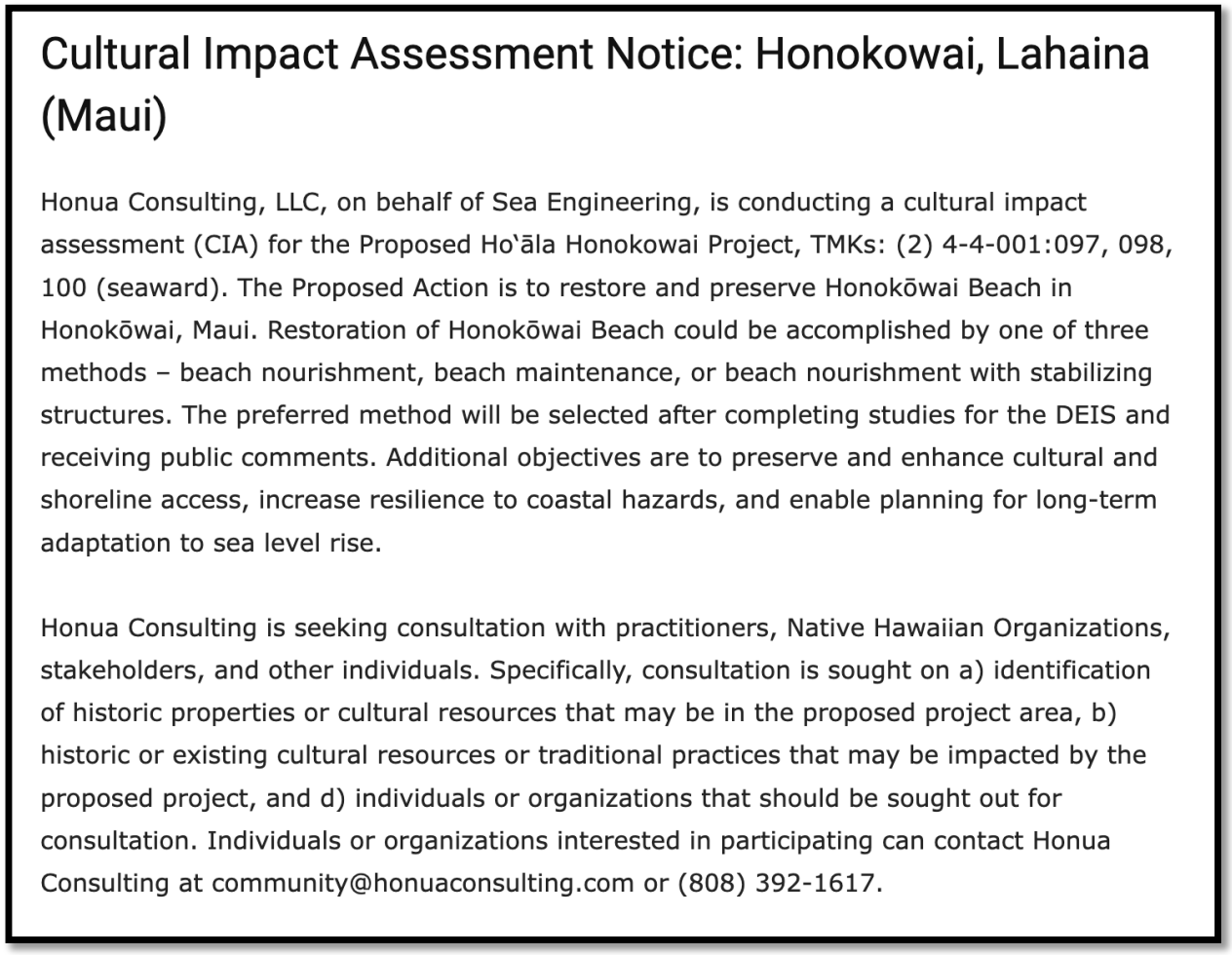
There are also numerous informative historic maps for the region. Surveyors of the eighteenth and nineteenth centuries were skilled in traversing land areas and capturing important features and resources throughout Hawaiʻi's rich islands. Historic maps were carefully studied, and the features detailed therein were aggregated and categorized to help identify specific places, names, features, and resources throughout the geographic extent. From these, among other documents, new maps were created that more thoroughly captured the range of resources in the area.

2.5 Ethnographic Methodology

Information from lineal and cultural descendants is instrumental in procuring information about the Project Area's transformation over time and its changing uses. The present analyses of archival documents, oral traditions (including oli or chants, mele or songs), and/or hula dance), and Hawaiian language sources including books, manuscripts, and newspaper articles, are focused on identifying recorded cultural and archaeological resources present on the landscape, including: Hawaiian and non-Hawaiian place names; landscape features (ridges, gulches, cinder cones); archaeological features (kuleana parcel walls, house platforms, shrines, heiau or places of worship, etc.); culturally significant areas (viewsheds, unmodified areas where gathering practices and/or rituals were performed); and significant biocultural resources. The information gathered through

research helped to focus interview questions on specific features and elements within the Project Area.

In June 2023, a notice was placed in the *Ka Wai Ola*, published by the Office of Hawaiian Affairs (Figure 5). There were no responses, but the Honua team nevertheless identified area practitioners and descendants of the area who were then approached for interviews.



Cultural Impact Assessment Notice: Honokowai, Lahaina (Maui)

Honua Consulting, LLC, on behalf of Sea Engineering, is conducting a cultural impact assessment (CIA) for the Proposed Hoʻāla Honokowai Project, TMKs: (2) 4-4-001:097, 098, 100 (seaward). The Proposed Action is to restore and preserve Honokōwai Beach in Honokōwai, Maui. Restoration of Honokōwai Beach could be accomplished by one of three methods – beach nourishment, beach maintenance, or beach nourishment with stabilizing structures. The preferred method will be selected after completing studies for the DEIS and receiving public comments. Additional objectives are to preserve and enhance cultural and shoreline access, increase resilience to coastal hazards, and enable planning for long-term adaptation to sea level rise.

Honua Consulting is seeking consultation with practitioners, Native Hawaiian Organizations, stakeholders, and other individuals. Specifically, consultation is sought on a) identification of historic properties or cultural resources that may be in the proposed project area, b) historic or existing cultural resources or traditional practices that may be impacted by the proposed project, and d) individuals or organizations that should be sought out for consultation. Individuals or organizations interested in participating can contact Honua Consulting at community@honuaconsulting.com or (808) 392-1617.

Figure 5. Copy of the public notice placed in the Ka Wai Ola in June 2023

3. Historic Background

The purpose of this section is to characterize the Hawaiian cultural landscape within which the Project Area is located; this includes a description of west Maui's relevant and representative inoa ʻāina (place names), moʻolelo (oral-historical accounts), wahi pana (legendary places), and other natural and cultural resources. A general (ahupuaʻa-wide) summary is followed by a Project Area-specific discussion.

3.1 Traditional Period

Maui has a unique geography; it is considered to be two islands, joined together by an isthmus. Land divisions on Maui are unlike those on other islands (Sterling 1998). Ancient names for Maui include Ihikapalaumaewa and Kulua (Sterling 1998: 2).

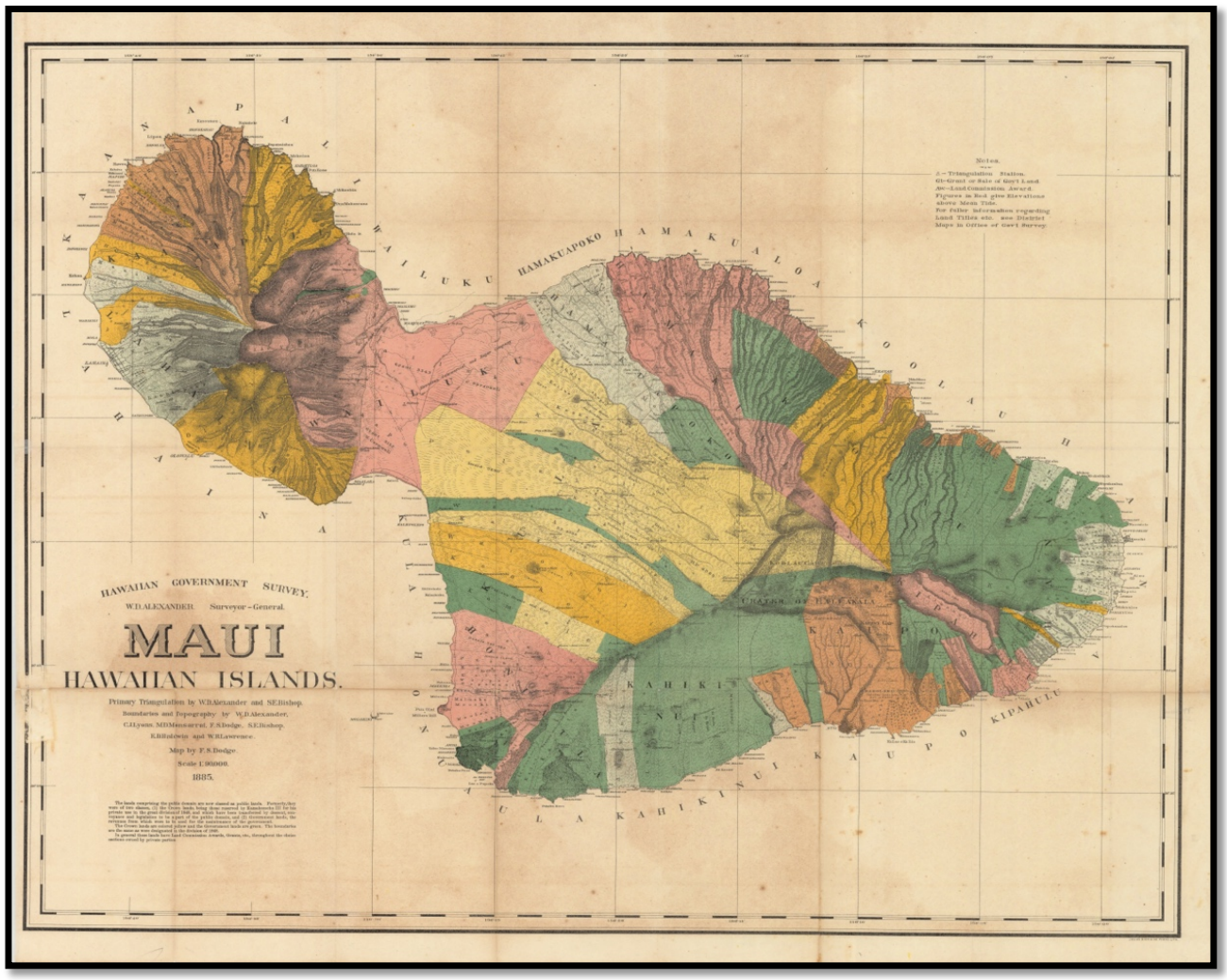


Figure 6. Map of Maui by W.D. Alexander and F.S. Dodge (1885)

Since Maui's land divisions are distinct from the other islands, it is important to understand the unique geopolitical construct of Maui's landscape.

> The division into district of the islands of the Maui group has not simplicity observed in the other islands. The configuration of the island of Maui, which is really a double island made up of two distinct mountain masses joined by a low flat isthmus, is probably the explanation for the group number of districts on that island, namely Kaanapali and Lahaina in West Maui, and the districts of Hamakua Poko, Hamakua Loa, Koolau, Hana, Kipahulu, Kaupo, Kahikinui, Honuaula and Kula in East Maui. The ahupuaa of Kahakuloa in Kaanapali and the ahupuaas[2] (sic) of Olowalu and Ukumehame in Lahaina were at times termed kalanas (sic). The ahupuaas (sic) of Waihee and Waiehu were independent of any moku and are listed in the Book of the Mahele as being in "Puali Komohana," i.e., West Isthmus. The large ahupuaas (sic) of Wailuku of Waikapu, which appropriated almost the whole of the isthmus, belonged to no district and in the Mahele were said to be in Na Poko, Na Poko in this case meaning a smaller division of the island. C. J. Lyons says "with reference to the ahupuaas of Waihee, Waiehu, Wailuku and Waikapu, on the map it was necessary to form a new district and call it Wailuku, Nawaieha, 'the four waters,' being too cumbersome and ill understood'' (Sterling 1998: 3).

This Proposed Action primarily occurs on the West side of Maui in the ahupua'a of Honokōwai (meaning the bay drawing water), while the sand recovery area is located offshore in the boundary between Honokōwai and Hanaka'ō'ō. For more information on the traditional period of Maui, please see the section titled **(5.1 Mo'olelo).**

[2] In the Hawaiian language, the plural form of words is not created by adding an "s" to the end of the word, hence "(sic)" has been added where "s" was added to Hawaiian words in an attempt to make Hawaiian words plural in this manner. Words are instead made plural through the use of the kahakō and/or the plural definite article, for example, the plural form of the word he haumana (a student, singular) is nā haumāna (the students, plural).

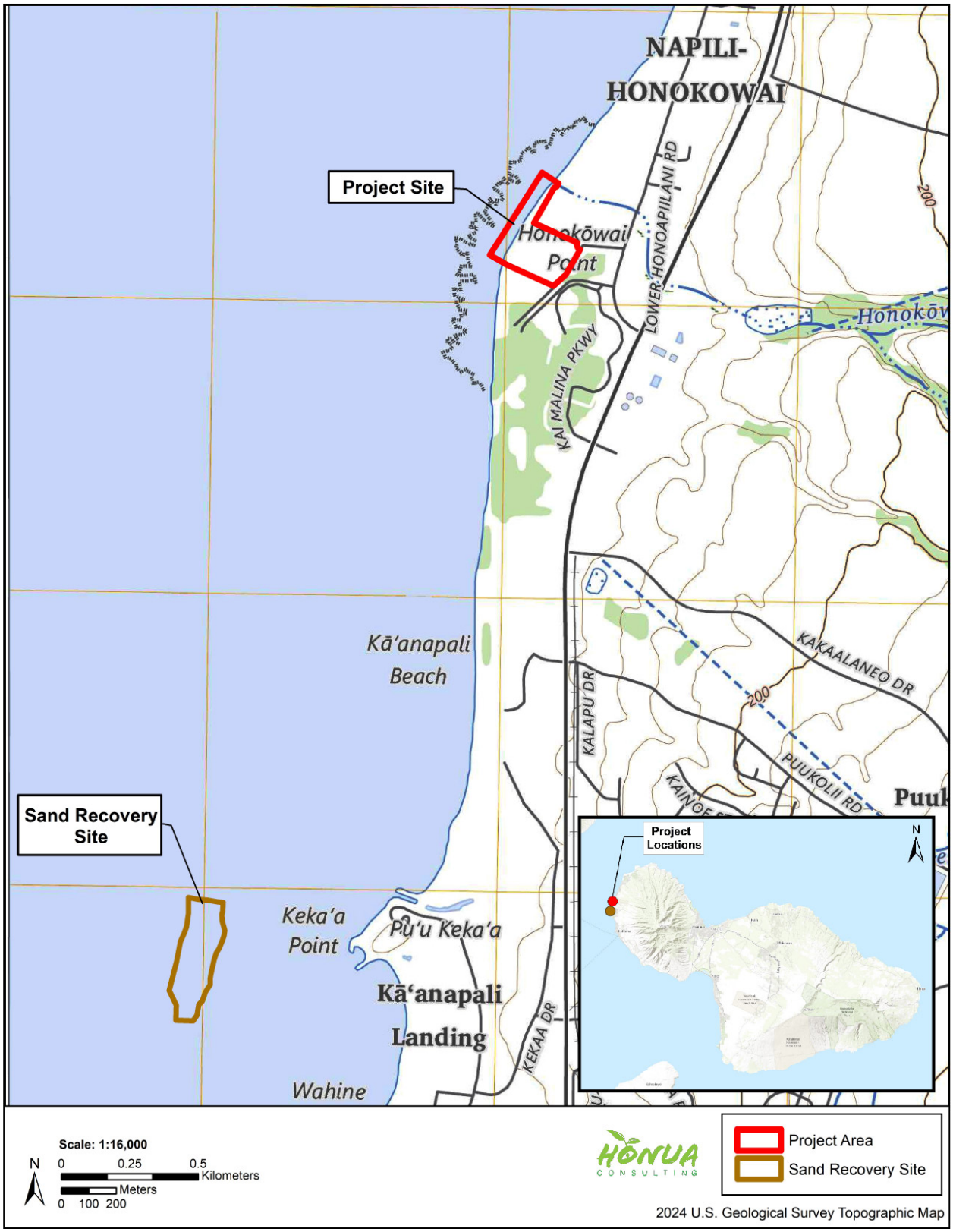


Figure 7. Map showing both the primary Project Area and secondary Project Area



Figure 8. Aerial image showing both the primary Project Area and secondary Project Area

3.2 Changes to Maui Land Boundaries during the Kingdom Era

Throughout history, the geopolitical boundaries of the islands have changed multiple times. Maui's boundaries are unusually complex in this regard. Understanding land boundaries today can be traced to the Kingdom era. The Kingdom of Hawaii passed modern boundaries outlined in the 1859 Civil Code "For taxation, educational, and judicial purposes…"(Civil Code of 1859, Section 498). In this, it specifically stated of Maui:

> The islands of Maui, Molokai, Lanai, and Kaahoolawe (sic), shall be divided into six districts, as follows: 1, From Kahakuloa to Ukumehame, including Kahoolawe, to be called the Lahaina district; 2, From Waihee to Honuaula inclusive, to be called the Wailuku district; 3, Kahikinui, Kaupo, Kipahulu, Hana and Koolau, to be called the Hana district; 4, Hamakualoa, Hamakuapoko, Haliimaile, Makawao and Kula, to be called the Makawao district; 5, Molokai; 6, Lanai.

This was the beginning of the district known as the modern Lahaina (or Lāhainā, as is an alternate spelling) today. From historic records, identifying the differences between which land areas were considered ahupua'a versus 'ili can be challenging.

This determination mattered, not only in regards to the disposition of land but for tax purposes as well. The Laws of 1848 called for property taxes to be paid to the Kingdom accordingly:

> All landed divisions, denominated Ili, through the islands, shall pay a yearly tax, as follows:
>
> > Ili No. 1, five dollars.
> > Ili No. 2, three dollars.
> > Ili No. 3, one dollar and a half.
>
> In those parts of the islands were there is no distinct division into ilis, but merely into ahpuaas, each ahupuaa shall pay a yearly tax for support of the government, as follows:
>
> > Ahupuaa No. 1, ten dollars.
> > Ahupuaa No. 2, five dollars.
> > Ahupuaa No. 3, three dollars.

> This tax however, may be diminished, at the discretion of the tax officer, he keeping in view, not merely the size of the land, but also the number of its occupants and its value, and preserving a just proportion between said value and the taxation.
>
> This shift to the use of the ʻauhau tax system and away from a hoʻokupu tribute system marked a significant social and political change for the young monarchy. Until approximately 1839, kānaka effectively paid taxes to the chiefly class through the sharing of crops or crafts. In the early to mid-1800s, the Kingdom began to codify this tax, and it changed from food and materials goods into the need to pay the tax in cash. The new government's need for money, particularly against the influx of foreigners, motivated this change (Woods 2011).
>
> Eventually, the growing pressure from Westerns began to erode the authority of the Kingdom, Woods explains: "Unlike previous laws, these new laws from 1850 to 1852 completely separated the Kingdom from its traditional kapu laws and weakened the monarchy as the Kingdom conformed to a constitutional government and Western-style law. The tax law of 1850 reflected this rush toward Westernization. In a major change, for the first time, the Kingdom required payment of taxes in currency only (Woods 2011: 27).

A 1935 description explained the resulting changes:

> The system of land tenure which prevailed in ancient times was radically changed in the reign of Kamehameha III by the Mahele of 1848, yet the boundaries of the ancient subdivisions of land remain unchanged to the present day. This applies particularly to the ahupuaʻa which has been termed the unit of land in Hawaii; the boundaries of ahupua'a are said to have been "fixed about twenty generations back in Hawaiian tradition," or about five hundred years ago if the Stokes based of chronology is used. The district boundaries were fixed at the same time as that of the ahupuaʻa, and there is no known instance where an ahupuaʻa boundary overruns an ancient district boundary.
>
> Since the advent of legislative government, or from about 1846, many modifications have been made of the ancient district boundaries and there are many instances where other names have been substituted for the old district names. Some of these changes were made for political reasons and others for convenience, but the principal changes in boundaries were caused by movements in population reflecting new uses of the land areas.

> These new district boundaries did not always conform to the ahupuaʻa boundary and there are examples today of an ahupuaʻa being situation in more than one district where no such condition existed in ancient times (King 1935).

Therefore, while the Project Area would be considered largely outside Lahaina today, it is still appropriate to research within and reference the Lahaina region for the purposes of this study and analysis.

3.2.1 Kahekili and Kalaniʻōpuʻu

The region in which the Proposed Action occurs has significance due to its relationship with various aliʻi or chiefs. In 1776, Kalaniʻōpuʻu, the king of Hawaiʻi, invaded Maui and engaged the warriors of Kahekili in battle on the plain of Kamaʻomaʻo. In 1778, Kalaniʻōpuʻu invaded the kingdom of Kahekili again, attacking Kaupō, Kahoʻolawe, and Lahaina. During these battles, the young Kamehameha exhibited his skill on the battlefield. Maui's forces eventually drove Kalaniʻōpuʻu's army from Maui, and they took Lānaʻi by force. The people and resources of Lānaʻi were abused and overtaxed, leading to a famine on the island. Kalaniʻōpuʻu then set sail to Koʻolau, Maui, and Kamakau described the events in the following narratives:

> Ka-lani-ʻopuʻu decided to go on to Koʻolau, Maui, where food was abundant. He went to Kaʻanapali and fed his soldiers upon the taro of Honokahua… At Hamakualoa Ka-lani- ʻopuʻu landed and engaged in battle, but Ka-hekili hastened to the aid of his men, and they put up such a fierce fight that Ka-lani-ʻopuʻu fled to his canoes. Landing at Koʻolau he slew the common people and maltreated the captives by urinating into their eyes. Descendants of people so treated are alive today. From Hana, Mahi-hele-lima, commander of the fortress Kaʻuiki, joined forces with Ka-lani-ʻopuʻu, and for six months the fighting continued. During this campaign, carried on for half a year, from 1778 to 1779, with fighting at Kaupo, Lahaina, Lanai, Hamakualoa, and Koʻolau, Kamehameha, as well as his master in warfare, Ke-ku-hau-piʻo, distinguished himself for skill and bravery in war… (Kamakau 1961:91).

Kamakau also recorded that while the battles were occurring on Maui, Captain James Cook and his ships sailed along the coast of Maui Hikina. In Kamakau's version of the arrival, readers learn that Cook anchored near Haʻaluea Rock.

> While Ka-lani-ʻopuʻu was in Wailua in Koʻolau, Maui, on the evening of November 19, 1778, Captain Cook's ship was sighted northeast of

> Mokuhoʻoniki with the prow turned a little to the southeast. It was seen at Kahakuloa, and the news spread over the island, then at Hamakua, and at evening it was seen in Koʻolau. The night passed, and the next day the ship was anchored at Ha'aluea just below Wailua. When they saw that its appearance exactly fitted the description given by Moho, there was no end of excitement among the people over the strange object. “The tower of Lono! Lono the god of our fathers!” they exclaimed, redoubling their cries at the thought that this was their god Lono who had gone to Kahiki. The men went out in such numbers to visit the ship that it was impossible for all to get on board.
>
> When the canoes returned to shore, Kalaʻi-mamahu’ persuaded Kamehameha and one other to remain on board, and that night the ship sailed away taking Kamehameha and his companions and by morning it had disappeared. Ka-lani-ʻopuʻu thought that Kamehameha must have gone away to Kahiki. He was displeased and ordered Ke-paʻalani to bring them all back. Ke-paʻa-lani took six paddlers and a large single canoe supplied with food and water. Puhie declared that within two days and two nights they would sight the ship. Maui disappeared, and Mauna Kea rose before them out of the waves. Kamehameha, looking out, saw a white object on the wave and said to Kalaʻimamahu’, “Is that a canoe or only a wave?” “Where?” “Yonder.” As they watched it became clearly a canoe, and Kamehameha guessed that it was Ke-paʻa-lani come to seek them. But Captain Cook had no intention of carrying them away; he only wanted them to guide him to a good harbor on Hawaii. Captain Cook may have sailed by a map made by the Spaniards, for how else could he have found the proper harbors at Waimea, Mahukona, and Kealakekua? As for Ke-paʻa-lani he was relieved, for he had already sailed two [page 97] days and nights without sighting the ship. Kamehameha pointed out the canoe to Captain Cook and then pointed toward Maui. Cook would not consent; he pointed to the ship and then to Hawaii. Again Kamehameha pointed to Maui, and the ship turned about and reached Wailua in a single night…(Kamakau 1961:98).

Lahaina and West Maui generally would be exceptionally important areas in the early days of what would formally become the Kingdom of Hawaiʻi.

3.2.2 Land Awards

One of the most significant events in 19th-century history was the Māhele ʻĀina of 1848, a land redistribution process that fundamentally changed the way land was owned and

used in Hawai‘i. Prior to the Māhele, all land in Hawai‘i was considered the property of the ali‘i, who managed it on behalf of the people. Land use was granted to the native tenants by the high chiefs or their konohiki. Land ownership was not a concept in Hawai‘i at that period. Land tenure was a foreign, introduced concept that was significantly different from the Hawaiian system of land stewardship. Before the 1840s, the lands in the islands were reapportioned among the Ali‘i each time there was a new Mō‘ī while the hoa‘āina were generally allowed to retain use of the land they occupied or cultivated over many generations.

By 1845, the Hawaiian system of land tenure was undergoing radical changes and the foundation for implementing the Māhele ‘Āina (Land Division) of 1848 was set in place. This change in land tenure was promoted by the missionaries who had arrived in the 1820s. This period saw a growing western population and increasing business interests in the island kingdom. There were at least two main arguments for creating a land ownership system. On one hand, foreigners were hesitant to invest and construct improvements or enter into business deals on lease-hold land. The other factor was that the missionaries believed it was a God-given right to provide natives with their own ‘āina. The Māhele introduced the concept of private land ownership, influenced by Western notions of property rights.

Maui ali‘i played a central role in the Māhele, and the redistribution of land had far-reaching consequences for the people of Maui, west Maui in particular. Many maka‘āinana (commoners) who had traditionally worked the land found it difficult to claim ownership under the new system, leading to widespread dispossession and the eventual concentration of land in the hands of a few wealthy individuals and foreign landowners. This shift had profound economic and social consequences for the population, contributing to the decline of traditional agricultural practices and the growth of commercial agriculture, particularly sugar plantations.

On December 10, 1845, the Mō‘ī, Kauikeaouli, Kamehameha III signed into law a joint resolution establishing and outlining the responsibilities of the Board of Commissioners to Quiet Land Titles. The actions called for, and laws to be implemented were as follows:[3]

Article IV. – Of The Board Of Commissioners To Quiet Land Titles.

> Section I. His Majesty shall appoint through the minister of the interior, and upon consultation with the privy council, five commissioners, one of whom shall be the attorney general of this kingdom, to be a board for the investigation and final ascertainment or rejection of all claims of private

[3] *The Polynesian*; January 3, 1846:140

individuals, whether natives or foreigners, to any landed property acquired anterior to the passage of this act; the awards of which board, unless appealed from as hereinafter allowed, shall be binding upon the minister of the interior and upon the applicant.

Section II. Said commissioners shall, before acting, take and subscribe an oath to be administered to them by the minister of the interior in the following form:

We and each of us do solemnly swear that we will carefully and impartially investigate all claims to land submitted by private parties against the government of the Hawaiian Islands; and that we will equitably adjudge upon the title, tenure, duration and quantity thereof, according to the terms of article four of the seventh chapter of the first part of an act entitled "An act to organize the executive departments of the Hawaiian Islands," passed at Honolulu, —— day of ——, 18—.

Subscribed and sworn to, this —— day of ——, 18—.
Before me, ———
Minister of the Interior.

Which oath, having been sworn to, shall remain on file in the interior department.

Section III. It shall be the duty of said board of commissioners to select one of their number as president…

Section IV. The president of said board shall, at least once in each month, from the date of their first convention, report their proceedings to the minister of the interior—the number of claims then pending before them—the number to that date confirmed or rejected, and the reasons for confirmation and rejection of any particular claim to land, with all the evidence adduced to and reduced before them.

Section V. It shall be the special duty of board to advertise in *The Polynesian* newspaper, during the continuance of their sessions the following public notice, viz.:

To All Claimants Of Land In The Hawaiian Islands.—The undersigned have been appointed by His Majesty the King, a board of commissioners to

investigate and confirm or reject all claims to land arising previously to the __ day of__, 18__ [Dec. 10, 1845].

Patents in fee simple, or leases for terms of years, will be issued to those entitled to the same, upon the report of which we are authorized make, by testimony to be presented to us.

The board holds its stated meetings weekly at ——, in Honolulu, island of Oahu, to hear the parties or their counsel, in defense of their claims; and is prepared, every day to receive in writing, the claims and evidence of title which parties may have to offer, at the ——, in Honolulu between the hours of 9 o'clock A.M. and 3 o'clock P.M.

All persons are required to file with the board specifications of their claims to land, and to adduce the evidence upon which they claim title to any land in the Hawaiian Islands, before the expiration of two years from this date, or in default of doing so, they will after that time be forever barred of all right to recover same, in the courts of justice.

Section VI. The said board shall be in existence for the quieting of land titles during the two years from the first publication of the notice above required, and shall have the power to subpoena and compel the attendance of witnesses by discretionary fine; in like manner, when in session for the hearing of arguments, to punish for contempt; and they shall have the power to administer oaths to witnesses, and to perpetuate testimony in any case depending before them, which, when so perpetuated, shall be valid evidence in any court of justice created by the act to organize the judiciary.

Section VII. The decisions of said board shall be in accordance with the principles established by the civil code of this kingdom in regard to prescription, occupancy, fixtures, native usages in regard to landed tenures, water privileges and rights of piscary, the rights of women, the rights of absentees, tenancy and subtenancy, —primogeniture and rights of adoption; which decisions being of a majority in number of said board, shall be only subject to appeal to the supreme court, and when such appeal shall not have been taken, they shall be final.

Section VIII. All claims to land, as against the Hawaiian government, which are not presented to said board within the time, at the place and in the manner prescribed in the notice required to be given in the fifth section of

this article, shall be deemed to be invalid, and shall be forever barred in law, unless the claimant be absent from this kingdom, and have no representative therein.

Section IX. The minister of the interior shall issue patents or leases to the claimants of lands pursuant to the terms in which the said board shall have confirmed their respective claims, upon being paid the fees of patenting or of leasing (as the case may be) prescribed in the third part of this act, unless the party entitled to a lease shall prefer to compound with the said minister in the succeeding section allowed.

Section X. The minister of the interior shall have power in concurrence with the privy council, and under the sanction of His Majesty, to issue to any lessee or tenant for life of lands so confirmed, being an Hawaiian subject, a patent in fee simple for the same, upon payment of a commutation to be agreed upon by his Majesty in privy council.

Section XI. The patents and leases issued in accordance with the award of said commissioners, shall be recorded at the expense of the patentee or lessee, as prescribed in the third part of this act, in a book to be kept for that purpose by the minister of the interior.

Section XII. The said board shall not have power to entertain any claims to lands set up by any private person or persons until the claimant shall have deposited with the minister of finance a bond conditioned to defray the costs and expenses incident to the proposed investigation, according to the rates of charge prescribed in the third part of this act; which costs and expenses, shall, after award rendered, be taxed by the president of said board, and a certificate thereof shall be given to the claimant who shall exhibit the same to the minister of finance, whose certificate of full payment, together with the award of the commissioners, shall authorize the delivery of the awarded patent or lease to such confirmed claimant, by the minister of the interior, and not without.

Section XIII. The titles of all lands claimed of the Hawaiian government anterior to the passage of this act, upon being confirmed as aforesaid, in whole or in part by the board of commissioners, shall be deemed to be forever settled, as awarded by said board, unless appeal be taken to the Supreme Court, as already prescribed. And all claims rejected by said board, unless appeal be taken as aforesaid, shall be deemed to be forever

> barred and foreclosed, from the expiration of the time allowed for such appeal.

The lands in Honokōwai would undergo the same shifts as the rest of the islands. The land in the Project Area would be awarded through the land commission award process to John Preveer[4]. The following land documents detail the lands awarded to Lot Kapuiwa through the Māhele, which include the primary Project Area.

> [Application Number] 327.B. John Preveer
>
> This is a claim to a house lot, situated in the district of Kaanapali, Island of Maui.
>
> The Claimant has submitted to the Board a deed of this land, from his Majesty Kamehameha III and Governor Adams, executed on 6th day of January in the year of our Lord 1840 conveying this tract to in connection with a land called Wailuku West at the Rights privileges and appurtenances thereunto belonging, to the Claimant John Preveer and his Hawaiian born heirs to have and to hold for ever; but upon the condition, that they shall never dispose of the same to any alien.
>
> There can be no question about the Character & validity of the Claimants title; and the Board award to John Bruces and his Hawaiian born heirs, the above named tracts both to have and to hold to them for ever, upon the condition that the said Bruces or any of his heirs shall never dispose of the same, or any portion thereof, to any alien. The bounds of this lot are defined by the following Survey of J. Metcalf Esq.
>
> "Notes of Survey" of Wailanu in Kaanapali Maui Commencing at Stake on bank of trail on S boundary of this land, joining Waikapu 3d; and running in 77° 50' E 4.5 ch along between this land and Waikapu Rd 75° 15' W 7ch, 12 ch to Stake There S 28° 45' W 6 ch 0 to + along Laimi to Trig at high water mark. Thence S 6° 80' E to ch 22 ch to little water ditch between Loimai and Waiehu along in N 34° 36' E 9 ch 54 ch along Waiehu road to Honokawai River. Thence following the course of Honokawai Stream to the Sea. The following Sea shore to S Boundary of this land.

[4] It is critical to note for future researchers that while the native testimony clearly writes the surname as "Preveer," Preveer's name would be regularly written as "Previer" in other official documents, including with Indices of Awards.

Including an area of 450 17/100 acres.

Note: Wm. Bran claims part of this land. See diagram attached here. Amounting to 6 77/100 acres. Included in above.

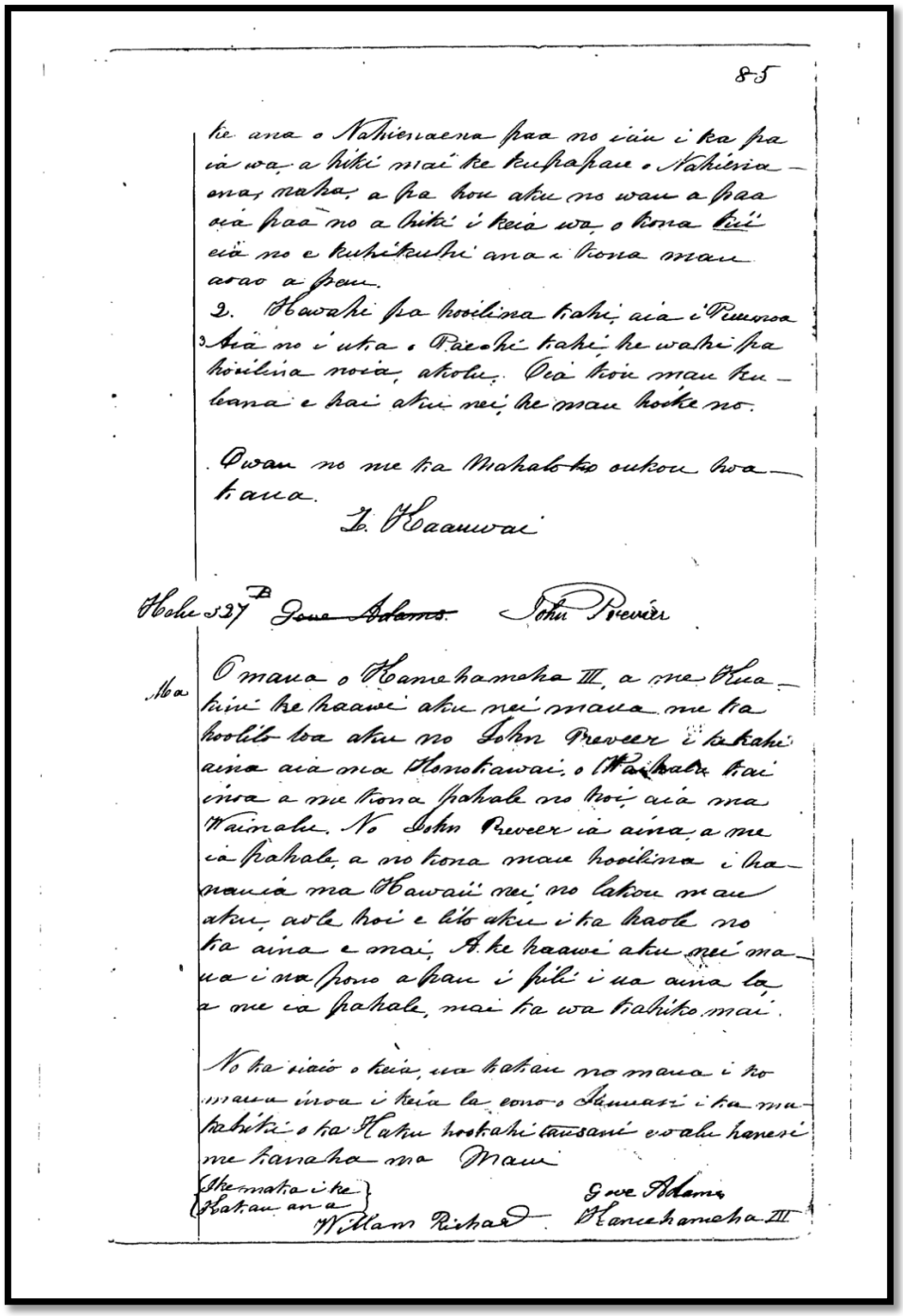


Figure 9. Image of the original native register for Land Commission Award 327-B to John Preveer (from the Papakilo Database)

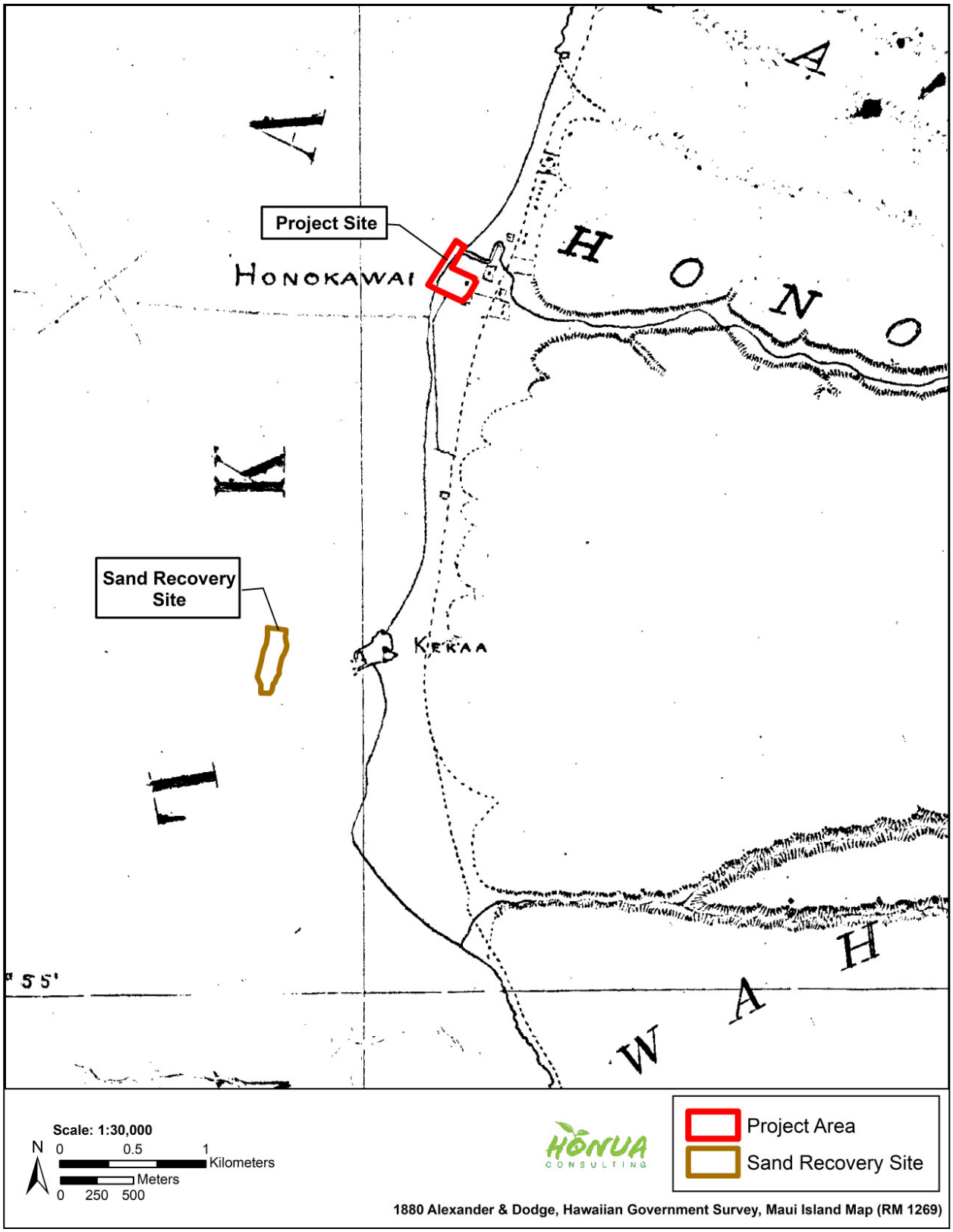


Figure 10. Primary Project Area and secondary Project Area shown on a 1880 Government Survey Map (Registered Map 1269)

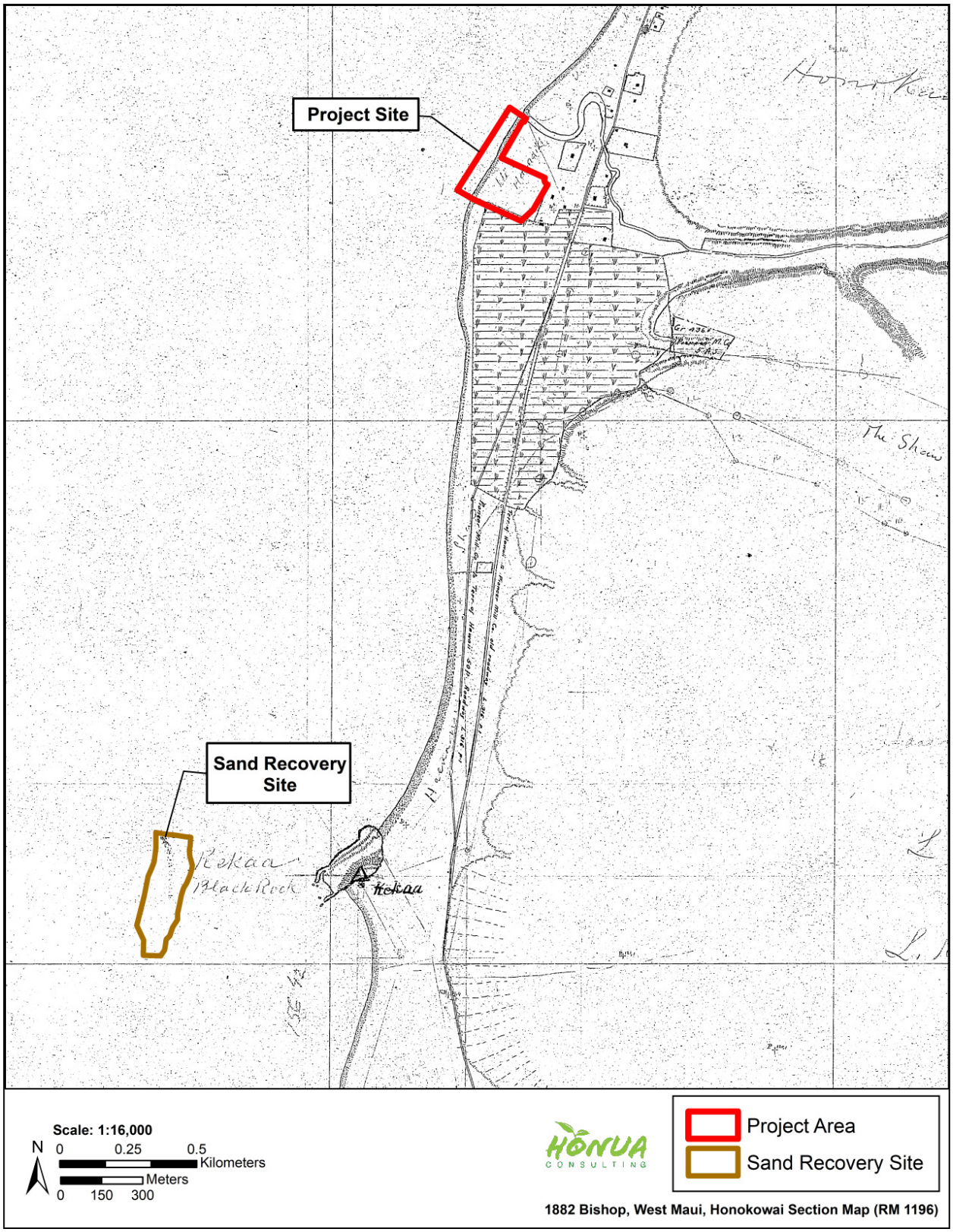


Figure 11. 1882 Registered map of the Project Areas, the writing is challenging to read, but it may define the primary Project Area as "Ili o Haeneiki" (the land area of Haenaiki)

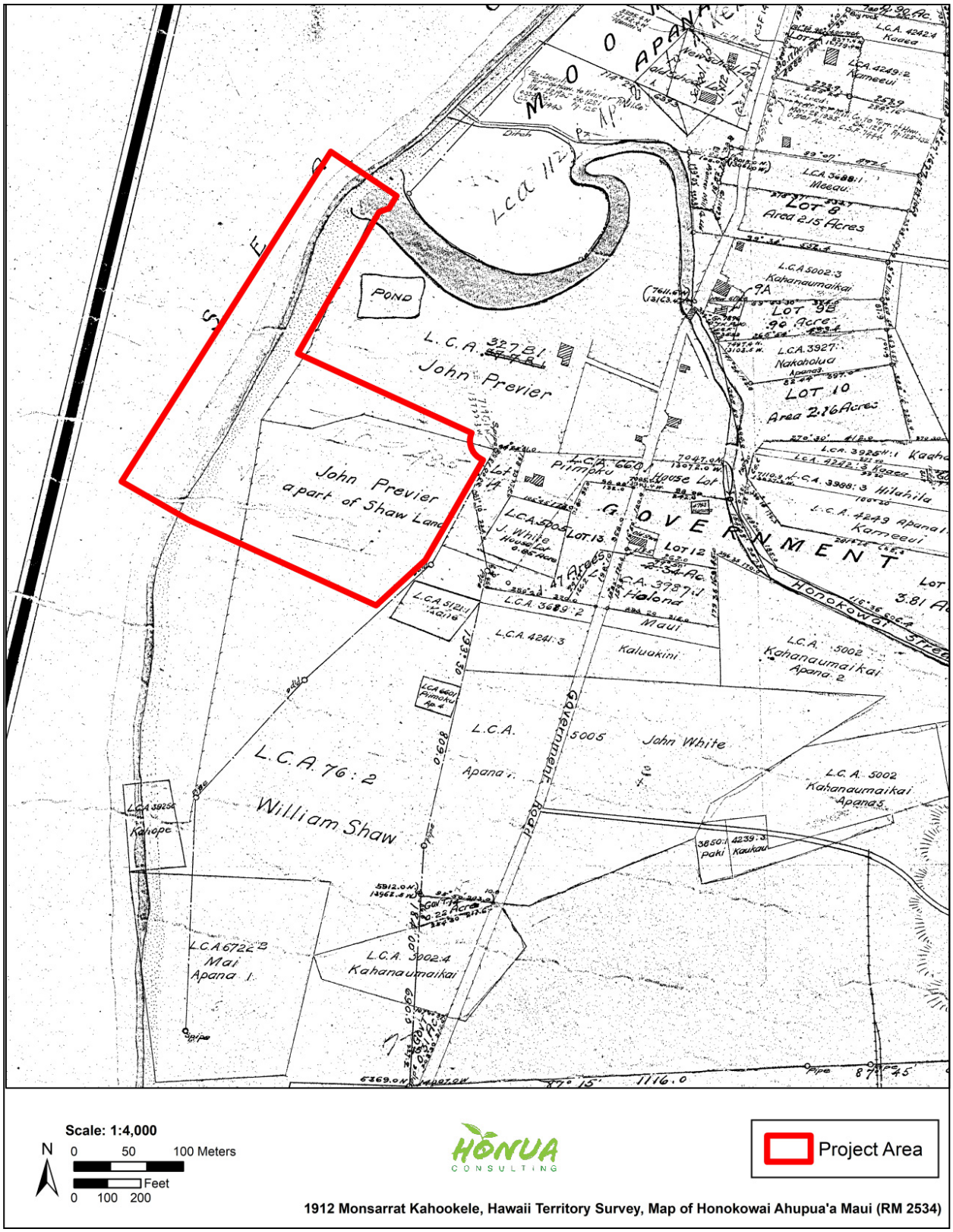


Figure 12. Portion 1912 map of the primary Project Area showing historic uses in the area, including a pond and the Previer land award area

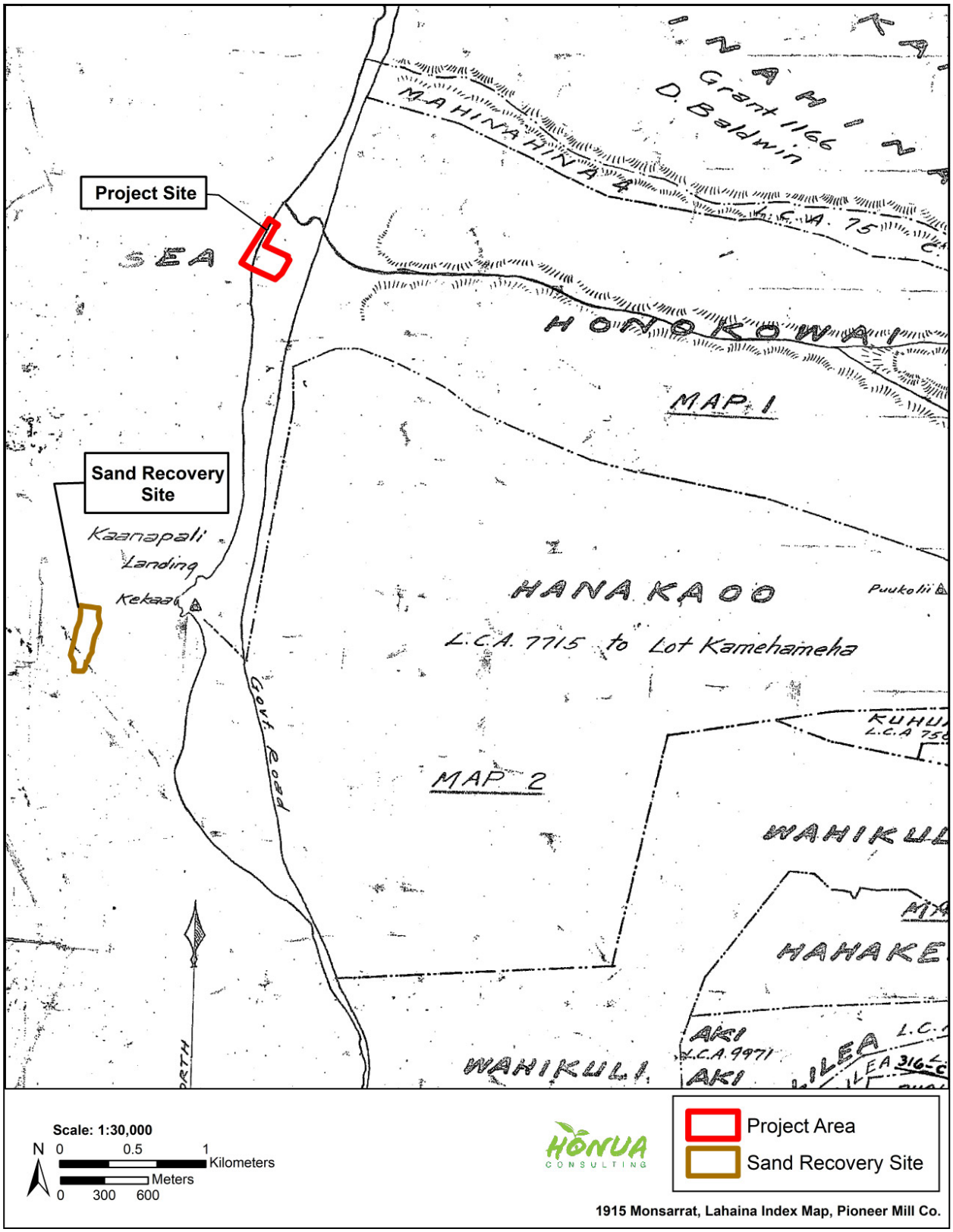


Figure 13. 1915 map from Pioneer Mill Company showing the Project Areas

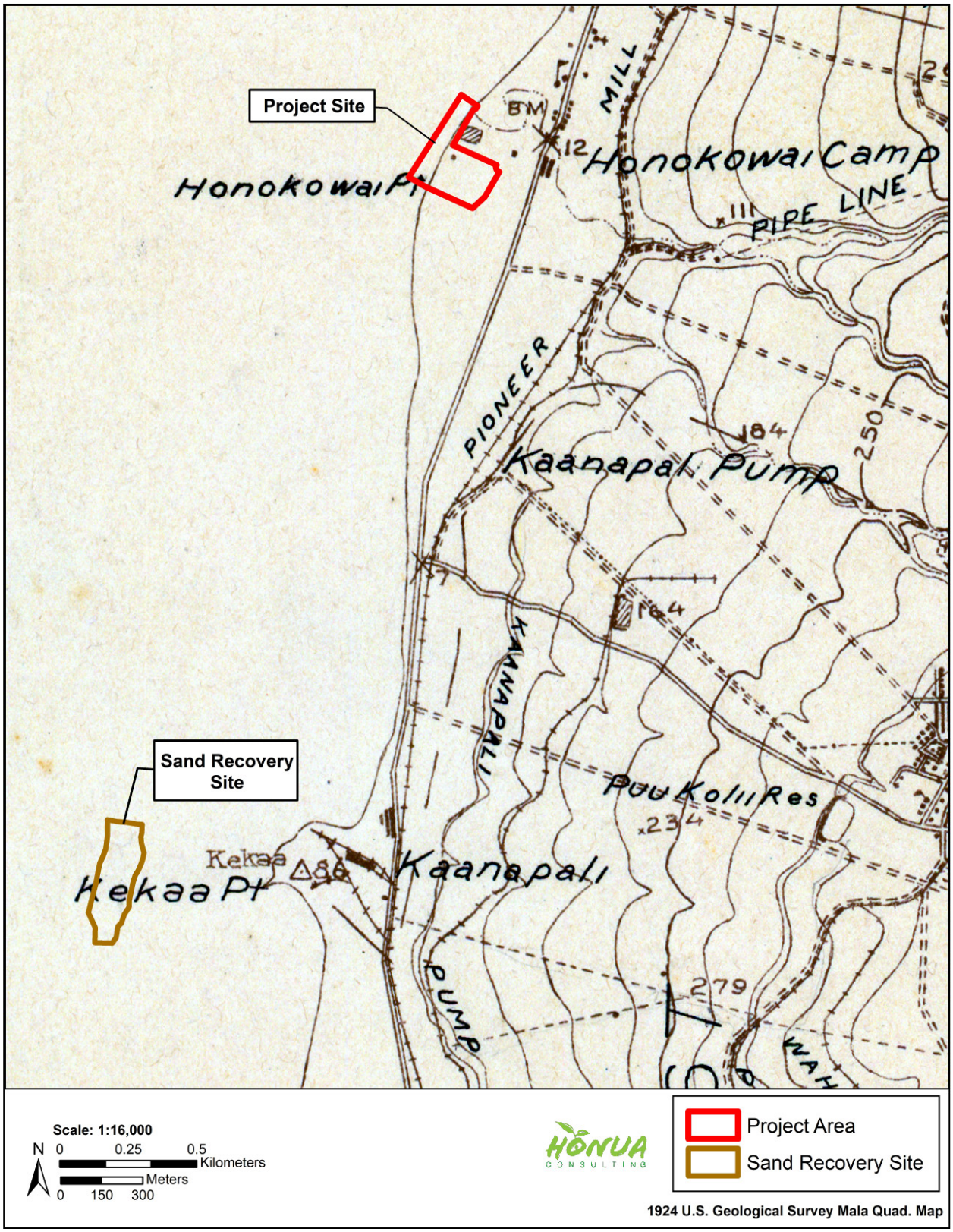


Figure 14. 1924 map shows the continued expansion of the area for Pioneer Mill

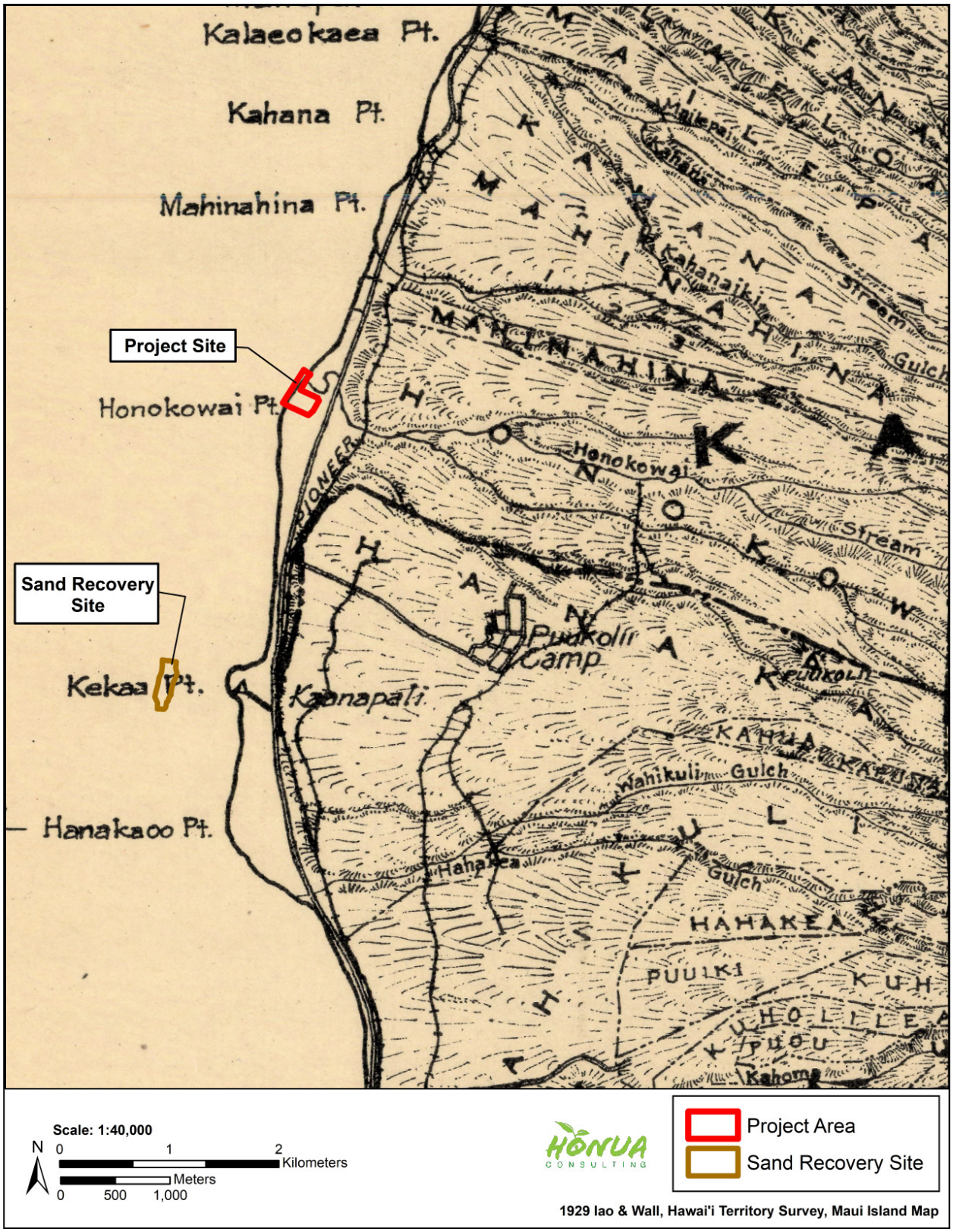


Figure 15. 1929 map of the Project Areas; by this time, the Pioneer Mill rail line was in use, as shown on this map

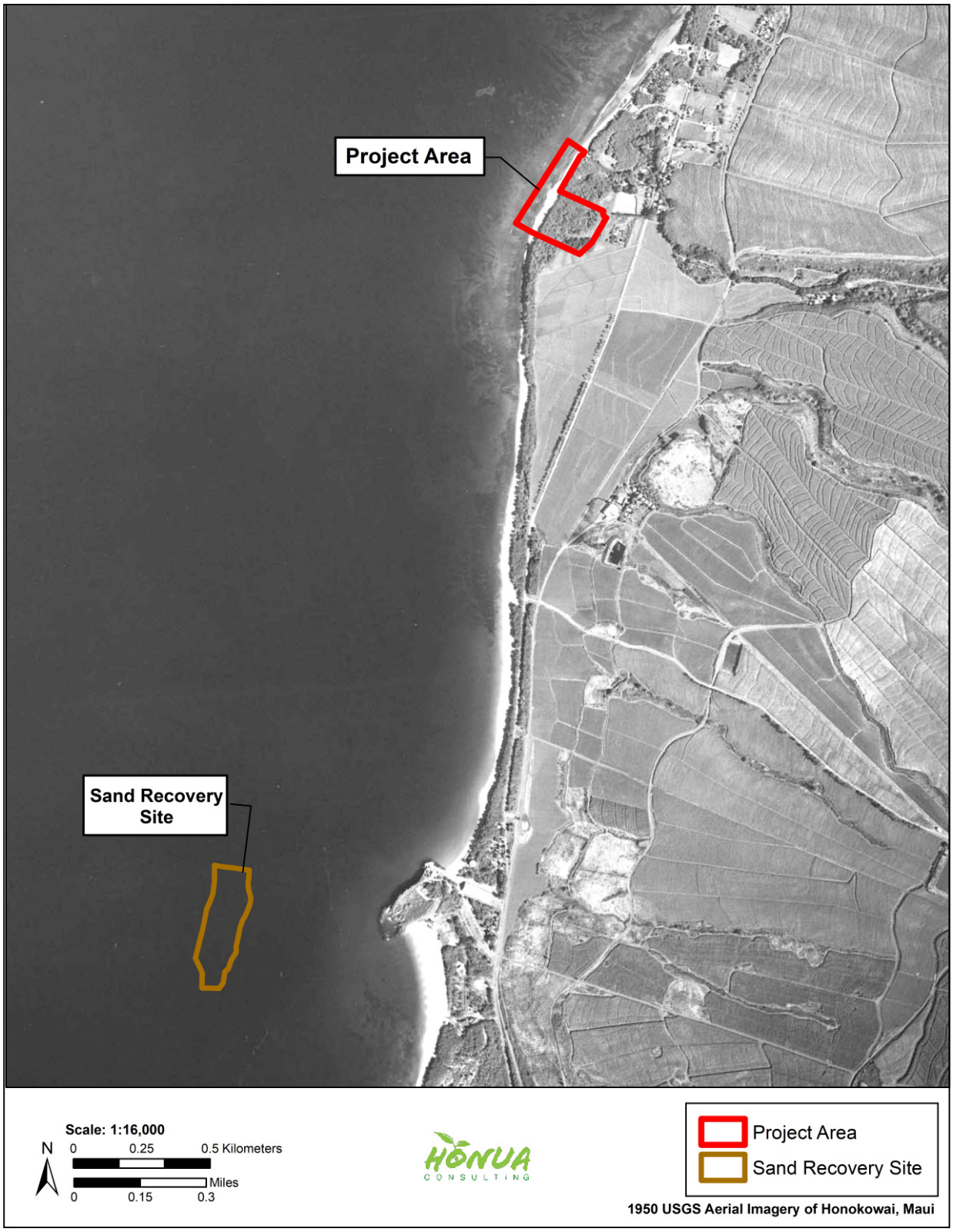


Figure 16. 1950 aerial imagery shows continued use of the area for agriculture

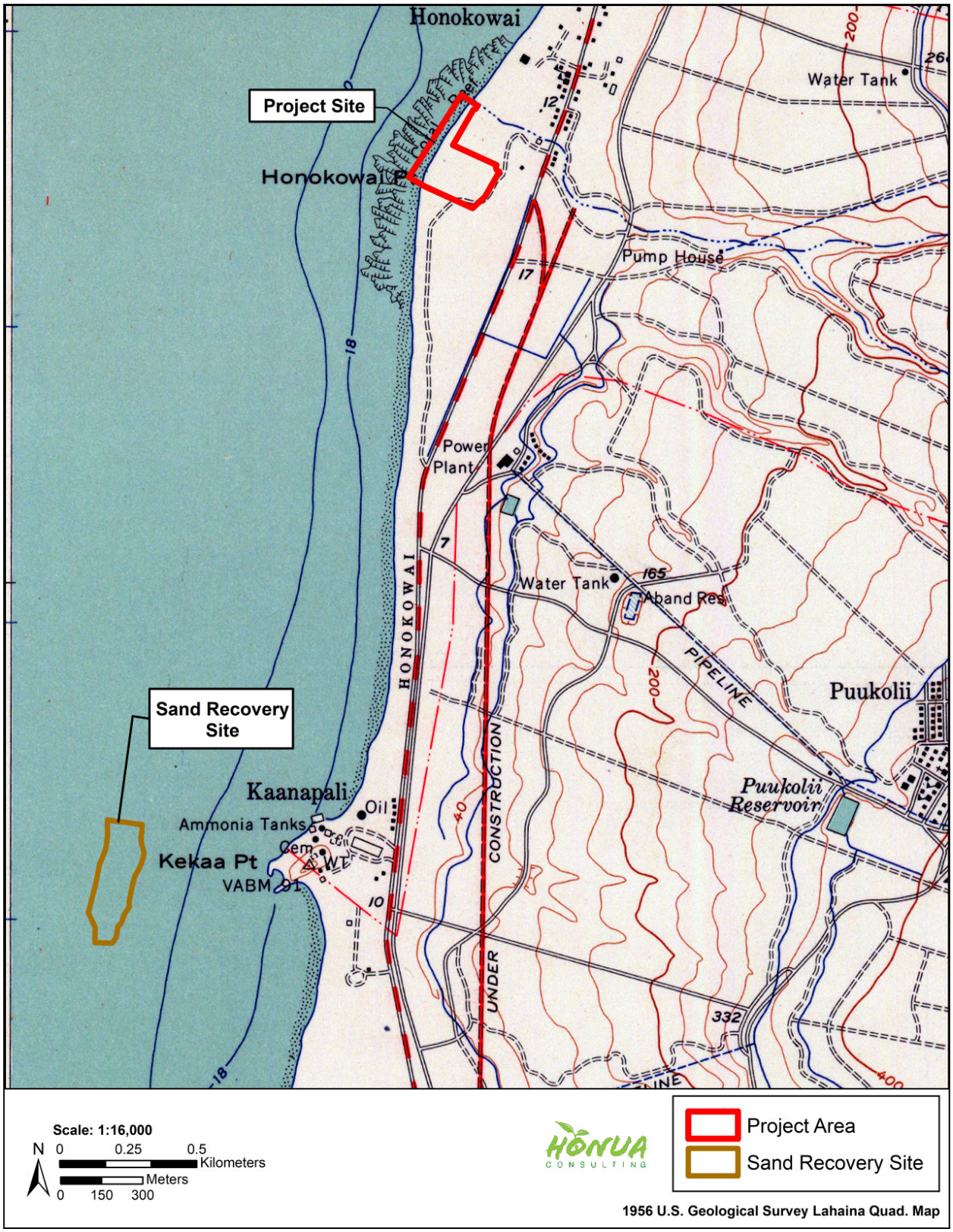


Figure 17. USGS map showing the Project Areas



Figure 18. 1965 aerial of the area shows heavy planation use and nearby residences, likely for plantation workers



Figure 19. 1976 USGS arieal image of the area shows the transition from planation uses to visitor industry uses

3.2.3 Inoa ʻĀina

Inoa ʻĀina, or place names, are critical in understanding how Hawaiians valued and understood their surrounding environment. A selection of place names from the Project Area and their description are is provided below.

Table 1. Inoa ʻĀina Place Names

Inoa Aina	Description
Aipopoo	ʻili ʻaina
Amalu Stream	stream
Haenaiki	ʻili ʻaina
Haenanui	ʻili ʻaina
Haenanui Stream	stream
Honokowai	ahupuaʻa
Honokowai Stream	stream
Honokowai Tunnel	water tunnel
Ilikikoo	ʻili ʻaina
Kaainaiki	ʻili ʻaina
Kaainanui	ʻili ʻaina
Kaawaiki Gulch	gulch
Kaelepuni	ʻili ʻaina
Kahanaiole	ʻili ʻaina
Kaneauau	ʻili ʻaina
Kapaloa Stream	stream
Kapili	ʻili ʻaina
Kipapa	ʻili ʻaina
Kou	ʻili ʻaina
Kumukahi	ʻili ʻaina
Laau*	place
Limalau Gulch	gulch
Loainalu	ʻili ʻaina
Loinui	ʻili ʻaina
Maele	ʻili ʻaina
Makahiki*	ʻili ʻaina
Makahiku	ʻili ʻaina
Moomoku*	ʻili kū
Moomuku	ʻili kū
Naunaunawele	ʻili ʻaina
Ohia	ʻili ʻaina

Onepeha Gulch	gulch
Palaha	ʻili ʻaina
Palaha Gulch	gulch
Papaolena	ʻili ʻaina
Poehu	ʻili ʻaina
Poelu*	ʻili ʻaina
Pohakea	ʻili ʻaina
Pohakiki	ʻili ʻaina
Poohumoi*	ʻili ʻaina
Poopohaku	ʻili ʻaina
Puu Lena	ʻili ʻaina
Uilikiko*	ʻili ʻaina
Waihale	place
Waikiki Stream	stream
Wainalo	ʻili ʻaina
Wainalu	ʻili ʻaina
Wanaloa	ʻili ʻaina

Table 2. Selected inoa ʻāina from the surrounding area

Inoa	Description
Hanakaʻōʻō	Ahupuaʻa within the Lāhaina moku. Meaning the ʻōʻō bay (hana).
Lahaina (sometimes written as Lahaʻina in historic records, also written traditionally as Lāhainā	Name of the moku, meaning the scorching sun, likely in reference to its hot, drought conditions.
Kekaʻa, which would include Puʻu Kekaʻa	Sacred site and traditional cultural property. Said to have been the capital of Maui under Kakaalaneo's rule of West Maui. Historic accounts use this name for the general area, not only the point or hill. Name means the rumble.
Keawaawa or Ke Awaawa	A name from traditional moʻolelo, specifically moʻolelo of Maui, the deity. See He Moʻolelo No Maui (Section 3.1.1).

Hāhākea	Land division and gulch, meaning unknown, possibly to white stalk (as in a type of kō, or sugarcane).
Makaiwa	Beach, meaning mother of pearl eyes (also for Lono, whose kiʻi, images, would be adorned with mother of pearl eyes)
Wahikuli	Land section, gulch and ditch in Lāhainā, meaning noisy place.
Keawaiki	Lighthouse and place name in Lāhainā, meaning small passage.
Kapunakea	Land section in Lāhainā, means the clear spring or the white coral.
Kaioʻo or Kai ʻOʻo	Place in Lāhainā, possible meaning strong sea.
Honokōwai	Land section in modern Lāhainā, but traditionally in Kāʻanapali ahupuaʻa. Also a stream, point, and beach park. One of bays of Piʻilani, meaning bay drawing water.
Mala	Land division and port in Lāhainā, literally meaning garden.
Kāʻanapali (also Pōhaku-Kāʻana-Pali or Kāʻanapali-pōhaku)	District and village, meaning Kāʻana cliff or rolling precipices.
Puʻu Kolii (or Puʻukoliʻi)	Hill in Hanakaʻōʻō, literally meaning koliʻi shrub hill
Kaleinaakaʻuhane	Sacred site where the spirits leapt into the next world, currently located west of the Sheraton Maui.
Alanuikikeekee a Maui (or Alanui Kīkeʻekeʻe)	Road with many turns, name for the winding road in Kekaʻa
Ahuamoemoe	Mound backing Puʻu Kekaʻa on the grounds of the Sheraton, literally mound of Moemoe.

3.4 Historic Traditions and Customs

Historic narratives align with detailed native accounts and historical descriptions of land use and residency in Maui. The elevational zones of most significant usage ranged from the shore to around the 2,000-foot elevation. Above that, up to around the 3,500-foot elevation, limited agricultural work was undertaken; above that, specialized uses, as

discussed earlier, occurred. It is important to note that the upper rain forests, frequently covered by clouds, were called “wao akua” (region of the gods). The wao akua is so named because of the cloud cover pattern and precipitation that settles upon the mountain slopes. This covering was interpreted as concealing from view the activities of the gods and deities therein (cf. David Malo 1951:16-18; and M.K. Pukui, pers. comm. 1975). Maly presents a narrative of traditional Hawaiian land management strategies and the different environmental zones recorded in the Hawaiian Language newspaper, *Ka Hoku o Hawaii* (September 21, 1916):

> Hawaiian customs and practices demonstrate the belief that all portions of the land and environment are related, like members of an extended family. Each environmental zone was named, and their attributes were known. Acknowledging the relationship of one environmental zone (wao) to another is rooted in traditional land management practices and values. Just as place names tell us that areas are of cultural importance, a Hawaiian nomenclature for environmental zones also tells us that there was an intimate relationship between Hawaiians and their environment.
>
> ...
>
> Through one of the riddles [the] reader learn[s] about the traditional wao or regions of land, districts, and land divisions of the administrators who kept peace upon the land. The environmental zones include:
>
> 1 – Ke kuahiwi; 2 – Ke kualono; 3 – Ke kaumauna; 4 – Ke ku(a)hea; 5 – Ke kaolo; 6 – Ka wao; 7 – Ka wau ma‘u kele; 8 – Ka wao kele; 9 – Ka wao akua; 10 – Ka wao lā‘au; 11 – Ka wao kānaka; 12 – Ka ‘ama‘u; 13 – Ka ‘āpa‘a; 14 – Ka pahe‘e; 15 – Ke kula; 16 – Ka ‘ilima; 17 – Ka pu‘eone; 18 – Ka po‘ina nalu; 19 – Ke kai kohola; 20 – Ke kai ‘ele; 21 – Ke kai uli; 22 – Ke kai pualena; 23 – Kai Pōpolohua-a-Kāne-i-Tahiti.
>
> 1 – The mountain; 2 – The region near the mountain top; 3 – The mountain top; 4 – The misty ridge; 5 – The trail ways; 6 – The inland regions; 7 and 8 – The rain belt regions; 9 – The distant area inhabited by gods; 10 – The forested region; 11 – The region of people below; 12 – The place of ‘ama‘u (fern upland agricultural zone); 13 – The arid plains; 14 – The place of wet land planting; 15 – The plain or open country; 16 – The place of ‘ilima growth (a seaward, and generally arid section of the kula; 17 – The dunes; 18 – The place covered by waves (shoreline); 19 – The shallow sea (shoreline reef flats); 20 – The dark sea; 21 – The deep blue-green sea; 22 – The

> yellow (sun-reflecting sea on the horizon); and 23 – The deep purplish black sea of Kāne at Tahiti (Maly 2001: 3).

Prior to contact and modernization, a range of cultural practices likely took place in the Project Area. These practices would have been predominantly related to traditional agriculture and were obstructed beginning in the 19th century by western modernization. Access to wahi pana (legendary places) and resources were adversely impacted by fee simple ownership of the area by foreigners.

4.0 Cultural Resources

This section characterizes archaeological studies and results in and around the Project Area to identify resources that may be significant to the community. The first subsection provides an overview of studies and results within the immediate vicinity of the current Project Area and its surrounding area.

4.1 Cultural and Historic Sites

ʻĀina Archaeology is completing a Literature Review and Field Investigation for the Project Area. Historic sites will be identified through that process and documentation.

4.2 Natural Resources with Cultural Significance - A History of the Biocultural Environment and the Cultural Landscape

To employ the Hawaiian landscape perspective and emphasize the symbiosis of natural and cultural resources, Honua Consulting refers to them as 'biocultural,' with additional sub-classifications by attributes.

A brief further discussion of environmental zones and traditional Hawaiian land management practices is necessary to understand the tangible and intangible aspects of the Hawaiian landscape. Additionally, it is essential to point out that all-natural and cultural resources are interrelated and culturally significant in the Hawaiian landscape. Natural, unaltered landscape features such as rocky outcrops, cinder cones, intermittent streams, or an open plain may carry as much significance as a planted grove of wauke (Broussonetia papyrifera) or a boulder-lined ʻauwai (canal).

On the island of Maui, Lahaina and Kaʻanapali traditionally had a significant population and resources. Included in these resources were agricultural fields, usually dryland kula (open pastures) and kīhāpai (farming plots) where crops such as ʻuala (sweet potatoes), kō (sugar canes), kalo (taro), maiʻa (bananas and plantains), and wauke (paper mulberry) were cultivated. The native tenants undertook intensive development of dry land agricultural fields, and depending on the localities, daily activities ranged from near-shore to above the 4,000-foot elevation. This allowed for seasonal variations in weather and growing cycles (cf. records of the Māhele ʻĀina, 1848-1855).

The large districts (moku-o-loko) and sub-regions (ʻokana and kālana) were divided into manageable units of land that were tended to by the makaʻāinana (people of the land). Perhaps the most significant management unit was the ahupuaʻa. Ahupuaʻa are subdivisions of land usually marked by an altar with an image or representation of a pig placed upon it (thus the name ahu-puaʻa or pig altar). In their configuration, the ahupuaʻa may generally be compared to wedge-shaped pieces of land that radiate out from the

island's center, extending to the ocean fisheries fronting the land unit. Their boundaries are defined by topographic or geological features such as puʻu (hills), ridges, gullies, valleys, craters, or areas of a particular vegetation growth (cf. Malo 1951: 16-18; Lyons 1875; and testimonies recorded before the Boundary Commission).

The ahupuaʻa were also divided into smaller manageable parcels of land (such as the ʻili, kōʻele, māla, kīhāpai, moʻo and paukū etc.), generally running in a mauka-makai orientation, and often marked by stone wall alignments. In these smaller land parcels, the native tenants cared for and cultivated crops necessary to sustain their families and the chiefly communities they were associated with. As long as sufficient tribute was offered and kapu (restrictions) were observed, the common people living in a given ahupuaʻa had access to most of the resources from mountain slopes to the ocean. These access rights were almost uniformly tied to residency on a particular land and earned through being a responsible steward of the natural environment and supplying the needs of their aliʻi (see Malo 1951:63-67 and Kamakau 1992:372-377).

Entire ahupuaʻa, or portions of the land, were generally under the jurisdiction of appointed konohiki or lesser chief landlords, who answered to an aliʻi-ʻai-ahupuaʻa (chief controlling the ahupuaʻa resources). The aliʻi-ʻai-ahupuaʻa, in turn, answered to an aliʻi ʻai moku (chief who claimed the abundance of the entire district). Thus, ahupuaʻa resources supported not only the makaʻāinana and ʻohana who lived on the land but also contributed to the support of the royal community of regional and island kingdoms. This form of district subdividing was integral to Hawaiian life and a product of strictly adhered resources management planning. In this system, the land provided fruits and vegetables and some meat in the diet, and the ocean provided a wealth of protein resources. Also, in communities with long-term royal residents, divisions of labor (with specialists in various occupations on land and in the procurement of marine resources) came to be strictly adhered to (Malo 1951: 63-67). This is the setting in which Honokaʻōʻō and Kekaʻa were initially named and managed.

4.3 Intangible Cultural Resources

It is important to note that Honua Consulting's unique methodology divides cultural resources into two categories: biocultural resources and built environment resources. We define biocultural resources as natural elements in Hawaiʻi without human contact. These resources and their significance can be shown, proven, and observed through oral histories and literature. Honua defines built environment resources as elements that exist through human interaction with biocultural resources whose existence and history can be determined, examined, and proven through anthropological and archaeological observation. Utilizing this methodology is critical in preparing a CIA, as many resources,

such as those related to Akua, do not necessarily result in material evidence but are significant to members of the Native Hawaiian community.

4.3.1 ʻŌlelo Noʻeau

ʻŌlelo noʻeau is another source of cultural information about the area. ʻŌlelo noʻeau means "wise saying," and they encompass various literary techniques and multiple layers of meaning common in Hawaiian. Considered the highest form of cultural expression in old Hawaiʻi, ʻōlelo noʻeau brings us closer to understanding the everyday thoughts, customs, and lives of those who created them. There are no identified ʻōlelo nōʻeau for the immediate Project Area.

4.3.2 Mele (Songs)

The *Buke Mele Lahui* (Hawaiian National Songbook), published in 1895, is "the largest number of political and patriotic Hawaiian songs ever printed in one place," featuring mele that "echo the steadfast resilience of Hawaiians of that time as they weathered the political turbulence of the 1880s and 1890s that completely altered their world" through the overthrow and establishment of a foreign-led provisional government and subsequent annexation to the U.S. (Nogelmeier and Stillman 2003:xii). There are mele and ʻoli composed for and inspired by the larger Project Area. Specifically composed mele in or for the Project Area are shown below.

4.3.2.1 Honokōwai

This is a mele written by Nicholas Kealiʻi Lum to celebrate the ʻāina of Honokōwai and the efforts of groups like the West Maui Preservation Association and others to restore the abundance of the fisheries and the land surrounding Honokōwai. Composer: Nicholas Kealiʻi Lum Producer: Keauhou Recording and Mixing Engineer: Michael Grande, Studio Ala Moana Music Video Production: Chelsie Machado, Jon Spenser, Ha'e Kane

Aia i ka nani aʻo Honokōwai,	There in the beauty of Honokōwai
I ka pali hinahina o Kāʻanapali,	In the gray cliffs of Kāʻanapali
Kaʻa iho i kai o Hāʻenanui,	Reaching the sea of Hāʻenanui
I ka papa holo iʻa a ka nui manu,	In the abundant reef of the flock of birds
A uka hoʻi au i kapakai o Wainalu,	And I return to the shore of Wainalu
Me ka pōhuehue aʻo ia puʻeone,	With the pōhuehue of the sand dunes
Kau aku nā maka iā ʻAuʻau,	The eyes gaze upon ʻAuʻau channel
ʻIke ʻia Lānaʻi i ka ʻehu kai,	Lānaʻi is seen in the sea spray
Haʻina ʻia mai ana ka puana,	Told is the refrain
Aia i ka nani aʻo Honokōwai,	

There in the beauty of Honokōwai

4.3.2.2 He Inoa no Kekaa

This mele, named “He Inoa no Kekaa,” was published in *Ka Nupepa Kuokoa* on August 6, 1864. The song can be found there on page 3. This mele references place names on Maui and Lānaʻi and hosts various wind and plant names. Though no context is given to the meaning of the mele, it seems to garner sexual power with references to the sea cucumber, the ocean, as well as ships (all forms of sexual innuendo.) The mele was written by Mrs. Haaheo, Mrs. Kahele, and Mrs. Kahoohuli.

No ka Pali o Kaholo ke aloha—la,	From the Cliff of Kaholo with love,
I ke ku kilakila maikai—la,	It stands beautifully majestic.
Huli aku ke alo i ka moana—la,	Turn your face to the ocean,
I ke ohe makani Maa-a—la,	In the gentle breeze called Maʻaʻa
Ua aa ka manao e ike—la,	The thought dares to look,
I ka lai o Kaunolu—la,	To the serene place of Kaunolu,
Inu aku i ka wai o Paao—la,	Drink of the waters of Pāʻao
I ka wau opunui hoi—la,	In the big-bellied water indeed,
E walea ka wahine ilaila—la,	The women relaxes there,
I ke kui pua kou lei—la,	Stringing a kou flower lei,
Nana i ka i-a hiialo—la,	Look to the fish in front,
Ke hana liilii ianei—la,	Doing little work here
E na kupa hoi olaila—la,	To the natives living there
Na keiki kamaaina—la,	The native born children
Me kaneapua i ka lae—la,	With Kāneapua in the cape,
Lae o Mapuna i ke kai—la,	The cape of Mapuna in the sea,
Ko mai kaupalu e uwali—la,	The sea cucumber is massaged until
O Kekaa no hoi he inoa—la.	smooth,
Mrs. Haaheo.	Kekaʻa is indeed the name

I puupehe aku ko mai—la,	At Puʻupehe it is towed,
Kela moku au i ke kai—la,	That ship sailing in the sea,
Ke pauma nei i ka moana—la,	It pumps in the ocean,
Me he manu la ia e au nei—la,	Like a bird that swims,
O ka hone ae a Kamaiki—la,	Of the sweet scent of Kamaik,
Ikiiki wale au ia Naha—la,	I am weary while going toward Naha,

I ke alo haliu i ka makani—la,	Turning my face to the wind,
I ka ehukai a ka Moae—la,	To the sea mists of the Moae wind,
Ho ae ka olu i Lopa—la,	Lopa gives comfort,
I ka malu o ka niu o laila—la,	Under the shade of the coconut tree,
E pipio lua ana i ke one—la,	It bends in the sand,
I ke one alohi i na maka—la,	The sand that sparkles in the eyes,
Ehuehu ka uka o ke koa—la,	Inland from Koʻa (Lanaʻi) it is misty,
A he koa nui no inei—la,	And a great Koa resides here,
A he kamaeu hoi nolaila—la,	And a mischievous one dwells there indeed,
No ke awa lai o Awakee—la,	Of the calm harbor of Awakeʻe,
Ko mai kaupalu e uwali—la,	The sea cucumber is massaged until smooth
O kekaa no hoi he inoa—la.	Kekaʻa is indeed the name

Mrs. Kahele.

Aia ko mai i Kaena—la,	Your genitals are in Kaʻena,
I ka honunee o Polihua—la,	by the moving turtle of Polihua,
I ka uka o Keahiakawelo—la,	In the uplands of Keahiakawelo,
Ka lehua kamahao i ke kula—la,	The astonishing lehua in the plain lands,
Ke kuiia nei e ka manu—la,	Being strung by the bird,
I lei kahiko no Kekaa—la,	Into a lei adorned for Kekaʻa,
Huli aku ke alo i ka mauna—la,	Turning the face toward the mountain,
O ka nee mai a ka na [kana] noe—la,	For its mists move along,
Kipu ko olua i ke anu—la,	There you both remain in the cold,
I mehana i ka lau Akolea—la,	Warmed by the ʻākōlea fern,
I ka wai olu o Kaiholena—la,	In the comforting water of Kaiholena,
Oia wai noho i ka palai—la,	It is a water that sits in the palai,
Ko mai kaupalu e uwali—la,	The sea cucumber is massaged until
O kekaa no hoi he inoa.	smooth,
Mrs. Kahoohuli.	Kekaʻa is indeed the name

Pelekane, Honokohau, Iulai 19, 1864.

5.0 Traditional or Customary Practices Historically in the Study Area and Surrounding Area

In traditional (pre-western contact) culture, named localities served a variety of functions, informing people about (1) places where the gods walked the earth and changed the lives of people for good or worse; (2) heiau or other features of ceremonial importance; (3) triangulation points such as koʻa (fishing markers) for fishing grounds and fishing sites (4) residences and burial sites; (5) areas of planting; (6) water sources; (7) trails and trailside resting places (oʻioʻina), such as a rock shelter or tree-shaded spot; (8) the sources of particular natural resources/resource collections areas, or any number of other features; or (9) notable events which occurred at a given area. Knowledge of the past and places of significance was handed down through place names across countless generations. There is an extensive collection of native place names recorded in the moʻolelo (traditions and historical accounts) published in Hawaiian newspapers.

This is not intended to be a comprehensive collection of all the historical or contemporary practices in West Maui, including Hanakaʻōʻō, Kekaʻa, or Honokōwai. It is meant to show the range of traditional or customary practices that took place to a larger geographic extent. Many of these practices may not have occurred within the specific confines of the Project Area, and many of those that may have do not currently occur within the Project Area. However, they may actively occur within the larger region.

5.1 Moʻolelo

Moʻolelo is the practice of storytelling and developing oral histories to transmit knowledge, information, and values intergenerationally. It is particularly critical in protecting and preserving traditional culture because it is the primary form through which information was transmitted over many generations in the Hawaiian Islands, particularly in the Native Hawaiian community.

Storytelling, oral histories, and oration are widely practiced throughout Polynesia and are essential in compiling the area's ethnohistory. Native Hawaiian newspapers were particularly valued for their regular publication of different moʻolelo about native Hawaiian history. Without the newspapers' foresight to allow for the printing and publication of moʻolelo, far less information about the cultural history of the Hawaiian people would be available today. The following are examples of the numerous moʻolelo about the Project Area.

5.1.1 He Wahi Moʻolelo no Kauaʻula a me Kekāhi ʻĀina o Lahaina i Maui

The first humans to arrive on Maui came through the channel between Lānaʻi and Kahoʻolawe from Kahiki. The Channel was later named Ke ala i Kahiki. These settlers

landed somewhere between Kekaʻa and Launiupoko. The area known as Lahaina would be a central node in the migration of peoples from the South Pacific into Hawaiʻi for many generations, bringing with them more immigrants and goods. (Maly et al. 2007) [page 63-64]

Regarding the naming of Lahaina, Maly et al. continue,

> The population of the district of Lahaina in the very early days mainly spread out between Kekaa and Kahakuloa. A king or chief governed all the land between Uku-me-ha-me and Honokahau. This king lived at or near Kekaa in the locality of Kaanapali. He was known as the chief of the "Red Feet" because the people of this place had red feet, discolored by the red dust of that region. In the *valley of Ka-u-wa-ula there was a settlement of farmers, so one day this chief of the red feet and his subjects visited the valley of Ka-u-wa-ula, starting in the forenoon from Kaanapali, passing through the present town of Lahaina, then only a hamlet, unnamed (there were no names in those days). He started up from Lau-niu-poko for the valley of Ka-u-wa-ula a little after noon. When half way there it was early afternoon, the hottest part of the day. The heat was even worse that afternoon than usual. The chief stopped beside a large rock and wiping the perspiration from his brow exclaimed, "Keu-keia-ka-la-haina." "what a hot day", which to make one word of two spells Lahaina.* (From W.F. Pogue. June 7, 1920.) [page 270]

Kekaʻa is, therefore, a vital wahi pana (storied place) in the origin of the Hawaiian people, having been the landing spot of so many ancestors to these shores. Kekaʻa was also known to be extensively storied and populated, as seen in the following moʻolelo.

5.1.2 He Moʻolelo No Maui

Kekaʻa appears extensively throughout traditional moʻolelo (stories, histories, legends). One such moʻolelo is "He Moʻolelo No Maui," the legend of Maui (referring to the deity and not the location). This moʻolelo was recorded by Fornander and credited to Lemuel K. N. Papa Jr. It is provided in its entirety in both Hawaiian and English. It is done so as there are inoa ʻāina that appear in these moʻolelo that are not otherwise commonly found in Hawaiian language place name books, dictionaries, or other documents. These inoa ʻāina, gathered from a range of historic resources, are provided in the table of place names (Table 1) in Section 3.2.1.

HE MOOLELO NO MAUI

O Maui he keiki keia na Hinalauae laua o Hina. O ko lakou nei wahi i noho ai aia ma Makaliua, maluna aku o Kahakuloa, akau ponoi mai Lahainaluna nei aku.

AKAHI: NA HANA A UA KEIKI NEI I KONA WA ILOKO O KA OPU O HINA.

I ka wa o ua keiki nei e noho ana iloko o ka opu, a, ua hoomaopopo kona mau makua he keiki io keia, a i kekahi manawa malie kalae ka lani, omaomao na kuahiwi, pau ke poi kupinai ana a ka nalu, hele aku na kanaka i ke kaka uhu maluna o ka waa, a ma kahi kupono i ka lawaia, ike nae lakou nei i keia keiki e lele kawa ana me na hiohiona maikai. Alualu ia maila keia, holo keia a pee ma ka auwai paki, aia ma Makamakaole, he wai lele mai maluna, a, he maloo aku o loko; noho keia a puka iwaho me ka manao e hoi a komo iloko o ka opu; ike e ia nae, a, alualu hou ia, holo no ua keiki nei a komo iloko o ka hale, e kuku ana o Hina.

Komo ana ua mau kanaka a ninau ana: “Auhea la ke keiki i komo mai nei iloko nei?” “Aohe keiki; o wau wale no.” Ike maila kana kane, holo maila oia me ka manao e pepehi ia laua (nokamea he kapu ke komo kekahi kanaka i ka wa e noho wale ana ka wahine aohe kana kane ponoi). Ninau mai ua kanaka nei: “Heaha ka olua o onei?” “I alualu mai nei maua he keiki; holo mai nei no ua keiki nei a komo iloko nei” “He keiki aku no aia iloko o ka opuoiala. Pehea auanei eponoai?” wahi aua kane nei. Ko laua nei hele noia e imi i puaa, moa lawa, niu hiwa, ia ula, kapa ula, ame ka awa. A mohai imua o ua keiki nei o ka puka aku la noia. A kapa ia ihola kona inoa o Maui. Aole nae i hiki i ka wa hanau.

ALUA: KANA HANA I KONA WA I PUKA MAI AI I WAHO.

I ka wa o ua Maui nei e noho ana, a, i kekahi manawa, nui loa kona aloha i kona makuahine no kana mea kaulai; aole e liuliu iho ke kau ana a ka la, puka aela no a napoo koke aku la no, kupu ka manao e kii i ka la e alehe, i hele malie. Hele keia a hiki i ka lae o Hamakua, ike keia ia Moemoe e moe ana i ka lua pao o Kapepeenui o Wailohi; ike keia i ka puka o ka la ma Hana, hele keia a ma Haleakala nana keia a he kupono; hoi keia a hiki i kahi o na makua, nana hou keia i ka la o kana hana a mau no. Hele keia a hiki ma Peeloko i Waihee, luku aku ana keia i ka niu apau i lalo, kii keia i ka pulu, hana a nui, hele keia e alehe i ka la.

Pane kikoi mai o Moemoe: “Aohe e loaa ka la, he lopakuakea;” pane aku o Maui: “Make kuu enemi, a ko kuu iini, make oe ia’u.” Hele keia a hiki i Haleakala, a kau pono maluna oia nei, e alehe ae ana keia i ka pulu niu,

haki kahi kukuna, alehe hou keia pau na kukuna ikaika o ka la. I aku keia: “Make oe i a’u no ko holo wikiwiki loa.” I mai ka la: “E ola au, e nana mai oe i kuu hele aku;” nana keia ua lohi ka hele ana, pau ko ianei manao kii hou. Oia ka mea i hele lohi ai o ka la. A o Haleakala e kapa ia nei, aole oia ka pololei, o Alehe la; no ke alehe ana a Maui i ke kukuna o ka la.

Ma ia huli hoi ana mai ana, a hiki i ko Moemoe wahi, aole keia, huli loa maila no a loaa i Kawaiopilopilo. Aia ia wahi mawaena o Kekaa ame ka ulu ko a Kimo ma; ike nae ua Moemoe nei, holo i uka, i kai pela kona hele kekee ana. Nui loa ihola ka huhu o Maui, e lele mai ana keia maluna a loaa mauka iho o Kekaa pepehi keia a make; ua lilo nae i pohaku. Aia no ia pohaku makai iho o ke alanui hou e moe loihi aia; o kona loa ua aneane ehiku kapuai. Aia i keia wa a Maui e hele nei, aia no kona makuahine ua hapai hou, a hanau he pueo, ke keiki.

AKOLU : KONA LOAA ANA I KA PILIKIA AME KONA OLA ANA.

I ka hoi ana o Maui a hiki i kona wahi hanau ai ma Makaliua, ike keia he pueo ke hanai ia ana e kona mau makua, aole no o Maui i hoowahawaha iaia. O kana hana ia manawa ana i hoi aku ai, o ka lawaia; o kana lawaia makemake loa o ke kamakoi po; a i kekahi po hele keia i ka lawaia, a, iaia nei e nanea ana, hiki ana ka waa huli heana na ke alii (he kanaka e kau ai i ka lele), loaa keia lawe ia keia i heana na ke alii ma Halulukoakoa, aia ia wahi ma Moalii, Maui komohana, mai Lahainaluna nei aku; a i kekahi la e kau ia ai i ka lele. Ia manawa loaa ia Hina ma ka hihio no na mea e pill ana no Maui, o ko Hina hele maila noia me ka pueo a hiki i Pohakowahinemauna, aia ia wahi mawaena o Keawaawa ame Kokonamoku, noho o Hina ilaila, lele akula ka pueo a hiki i kahi i kiai ia ai. Aole no i pau na kiai i ka moe. Ike akula keia ua paa o Maui i ka hauhoa ia i ka aha (puluniu ua hilo ia). Pela ke kiai ana o ua pueo nei a wanaao, aole no he moe iki o keia kiai.

Olelo ae o Maui: “E Aina e, koia ka po i loihi.” Loihi hou ka po, a pau loa na mea apau i ka moe. Ke kono akula noia o ua pueo nei a loaa keia, a pai akula no ia i na mea i hoopaa ia ai, hemohemo aela; ko laua hele akula no ia a hiki i kahi a Hina i noho ai, o ke ao koke noia. E hookomo aku ana o Hina ia Maui a mawaho aku no keia. Puka maila ka la; wehe ae la keia i kahi kapa moe, a halii ihola iluna o na uha, haule aku; a o ua pueo nei ua lele akula a. lima o Kekaa. Hiki ana ka huli, ninau ana: “Aole anei oe i ike i ka heana a ke lii?“ “Aole, o ko’u aia ana aela noia la, a o ka pumehana hoi o ka la, haule ihola i ka uku o kahi kapa.” Ia lakou la no a hala, ko lakou nei pii akula no ia mauka; mamua o ka pueo, o Maui mawaena, o Hina nohoi mahope a hiki i ko lakou wahi. Pela i pakele ai o Maui i ka make.

O ka pau keia o kahi i hai ia mai ia'u, a, ua hai ano nui ia mai, kona hele ana e kaapuni ia Hawaii ame na moku e ae, ame kana hia ana i ka lae o ka alae, a pela aku.

A LEGEND OF MAUI[5]

Maui was a son of Hinalauae and Hina. Their residence was at Makaliua, above Kahakuloa, and in a northerly direction from Lahainaluna.

First: what this child did while yet in the womb of hina.

While this child was yet in the womb, and its parents realized that there was a child, on one day when the sky was clear, the mountains were green, and the sea no longer reverberated in its breaking, some men went out on canoes to fish for uhu. Arriving at the fishing grounds, they saw a handsome child diving from the precipice into the water. He was given chase; he ran and hid in the waterfall at Makamakaole;[4] the water fell from above, but back of that was dry; he waited there and finally came out thinking to get back to the mother's womb; but he was again seen and again pursued. He ran and entered the house. Hina was making kapa.

The men entered and asked: "Where is the child who came into this house?" "There is no child; I am alone." Her husband saw this, so he came with the intention of killing these men (because it was against the law to have any man enter a house where a woman was and her husband not present). The husband asked: "Why are you here?" "We pursued a child. He ran and entered this house. There is a child but it is in that one's womb. What shall be done?" asked the husband. The men went to seek a pig, a white chicken, black coconut, red fish, red kapa and awa root, and offered them as sacrifice to the child; after which they went off. He was named Maui; but he was not yet born.

Secondly: what he did after he was born.

While Maui was living with his parents, he felt sorry for his mother because of what she had to dry. The sun did not carry long on its journey; it arose and set very quickly. The idea sprung up in him to go and snare the sun so that it would go slower. He went and at the cape of Hamakua he saw

[5] Footnotes from the original translation have been removed.

Moemoe sleeping in the cave of Kapepeenui at Wailohi; he saw the sun rising at Hana; he climbed Haleakala and inspected it and found it satisfactory. He went back to his parents' place; he noticed that the sun still kept on in its old ways. So he came along to Peeloko at Waihee and threw down a lot of coconuts; he secured a plenty of husk and with it he went off to snare the sun.

Moemoe called out sarcastically, "You can not catch the sun for you are a low down farmer." Maui answered," When I conquer my enemy and satisfy my desire I shall kill you." He came to Haleakala, and when the sun passed directly over him he snared it with the coco-husk, and broke some of its rays; he repeated this and broke all the strong rays of the sun. He said: "I am killing you because you travel so fast." The sun requested, "Let me live; you watch how I travel." He looked and beheld that it traveled slower, so he desisted from going after it again. That is why the sun goes slowly. And the name "Haleakala" given to it now is not correct; it should be Alehela, on account of Maui's snaring the rays of the sun.

On his return he called at Moemoe's place. It was absent. Maui traced it to Kawaiaopilopilo. This place is between Kekaa and James' cane field; Moemoe saw him, and it went on in an irregular manner, now towards the mountain and now towards the sea. Maui became greatly angered, so he flew right on and caught the other above Kekaha; he killed it; it turned, however, into a rock. That rock is still lying along there makai of the new road. Its length is nearly seven feet. While Maui was off on this journey his mother became pregnant with and bore another child, an owl.

Thirdly: concerning his getting into trouble and how he was saved.

On Maui's return to his birthplace at Makaliua he saw that an owl was being raised by his parents. Maui did not treat him with contempt. What he did on his return this time was to go fishing. His favorite mode of fishing was pole fishing at night; one night he went out and while he was idling away a canoe came along looking for a man to be offered in sacrifice by the king; Maui was taken prisoner and brought to the chief at Halulukoakoa. This place is at Moalii, Maui, in a westerly direction from Lahainaluna. He was to be placed on the altar the following day. At this time, Hina saw in a vision what was happening to Maui. So Hina and the owl followed along and at Pohakuawahinemauna Hina stayed there. This place is between Keawaawa and Kakonamoku. The owl flew to where Maui was being guarded; the guards were not asleep. He saw that Maui was tied up with coconut-husk cords. The owl waited until early dawn, but the guard would not sleep. Maui then spoke: "O thou Aina, retard the night that it may

be prolonged!" The night was prolonged and everyone went to sleep. The owl entered and came to him; he struck at his bonds and they fell off. They set off; they came to where Hina was waiting. It was then daylight. Hina hid Maui [under the stone] and she sat right outside of him. The sun rose. She opened her sleeping garment and spread it on her lap and looked for fleas. The owl had flown to the height of Kekaa. The searching party appeared and asked, "Have you seen the man which was to be offered by the chief for a sacrifice?" "No; I have just now arisen, and because of the warmth of the sun I sought after the fleas in my kapa." No sooner had the others gone when these started going mauka. The owl led, while Maui followed and Hina came last. They went on in this way until they arrived at home. That was how Maui escaped death. This is the end of what was told me; the other trips were outlined to me; how he made the circuit of Hawaii and other islands, how he rubbed the forehead of the mudhen, and so forth.

5.1.3 Kumumanao o Kekaa

Another highly informative moʻolelo about the area is "Kumumanao o Kekaa," or "Relating to Kekaa." This moʻolelo is from Fornander's collection of moʻolelo and attributed to S. Katta. It should be noted for the contemporary reader that the tone of the moʻolelo (and its English translation) reflects a historical period during which Hawaiian traditional beliefs were considered and treated as inferior to the emerging modernity of the 19th century.

Kumumanao o Kekaa

Kekahi no keia o na puu kaulana o Maui nei, a wahi pana no hoi keia no ke aupuni Hawaii nei. Ua kakau nui ia no na moolelo ma ka Moolelo Hawaii.

Elike me ka manao ana o na kupuna o keia lahui Hawaii, na Papa mai no i hanau keia pae aina, a i ole ia na Wakea maoli i hana, me kona lima ponoi. Ua manao hoi kekahi mai a Kumuhonua mai i loaa ai o Hawaii nei; o kekahi poe hoi, manao lakou ua hoea wale mai no keia pae aina, aka, o ka manao o ka poe naauao, ka poe hoi o ke au o ka malamalama, ke olelo nei lakou, na ka Pele i hapai mai keia paemoku mai loko mai o ka moana hohonu, pela no o Kekaa, me he la elike me keia mau mea i manao wale ia pela no paha i loaa mai ai o Kekaa.

Eia kekahi: O Kekaa, oia kekahi kulanakauhale 'lii o Maui nei, i ka wa e noho alii ana o Kaalaneo, i alii no Maui Komohana nei, ua olelo ia, he nui loa na kanaka ma ia wahi; ua kukulu nui ia na hale, ua mahiai nui na kanaka i ka uala, maia, ko, a me na mea ano like e ae. Ma kuu lohe mai, ua paa i ke kanu ia mauka iho o Kekaa a hiki i Hahakea, a me Wahikuli, ma kela

kula panini N. W. mai Lahainaluna nei aku; ua lilo no hoi o Kekaa i kulanakauhale lehulehu loa o na kanaka; a na keia alii (Kaalaneo) no hoi i kanu na uki makai o Lahaina, a me na laau kukui.

I kekahi manawa a keia alii e kanu ulu ana, a me kekahi o kona poe kanaka, hele no lakou mamua, uhuki mai no o Kaululaati i na ulu, mahope, na kapaia kekahi o keia mau kumu ulu, S. W. mai ka papu aku o Lahaina, o ka ulu Kauheana. Ua hoolei ia keia Kaululaau ma Lanai, kahi nui o ke akua, me ka manao ia e make, aole nae pela. A hala kekahi manawa, ua ike ia aku no ke ahi e a mai ana, nolaila, kahaha na 'lii, kai no paha ua make o Kaululaau, ke a maila no ke ahi. O ka mea nui i loaa mai ma keia mau wehewehe ana, o Kekaa, ke one hanau o Kaululaau ka mea kaulana nana 1 nai o Lanai a puni me ka hakaka ana me na akua he lehulehu o Lanai, a lilo ia i aina no kanaka i keia manawa.

O kekahi mea kaulana i hana ia malaila, o ke puhi kohola i ka wa e ola ana o Keokiko, he hapahaole ia. O kekahi o kana mau hana i kona wa e ola ana, oia keia, puhi kohola; ua hooikaika nui oia ma keia hana, ua loaa nui na ia, ua puhi nui ia ke kohola malaila A. D. 1849-1859 paha, ke ole au e kuhihewa, a he wahi puhi no hoi na ake mano. Aia malaila he ipuhao i puhi kohola a he pahu hoopaa kohola no hoi kekahi; ua hele nui na kanaka malaila e nana, a e makaikai ia mea hou iloko oia mau makahiki.

O ka make pinepine ana o na kanaka apau e hele mehameha ana: he mea kupanaha no keia i ike ia ma ia puu, mai kuu hoomaka ana mai e noho makai o Lahaina, A. D. 1859-1872, me he la, ua eiwa kanaka i make malaila, me ke akaka ole o ke kumu, o Keokiko no kekahi kupapau e waiho la malaila, a hiki i keia wa, oia kela mea keokeo mahma o kela puu.

O ka lehulehu loa o na iwi kanaka ma ia wahi; me he la, no ka nui loa o na kanaka ma ia wahi, nolaila, lehulehu loa na iwi kanaka me he la he mau tausani kanaka i make ma ia wahi, a malaila no hoi e kii mau ai ko Lahainaluna nei poe, i mau iwi na lakou ke hiki i ka wa e ao ia ai ka Anetomio a ua lehulehu loa ia mea malaila, ua uhi paapu ia na one.

He wahi lapu no hoi keia. I kekahi manawa, hele maila kekahi poe mai Kaanapali mai, ma kela aoao mai, e hele ana i Lahaina ae nei i ka wa poeleele, a hiki ma Kekaa, helelei maila na pohaku nui mailuna mai o ka puu, me ke kumu ole; i ka hoolohe ana aku, me he la, ua hiolo okoa mai no ka pali, puiwa aela ka lehulehu o ka poe a pau e hele ana, me ka olelo ana, "Lapu o Kekaa e! lapu o Kekaa e!" He mau hana kupanaha no keia a keia puu.

Ua olelo ia, aia a make ke kanaka, hele ka uhane i Kekaa; a ina he makamaka kona malaila, ua make raua, nana no e kipaku mai i ka wa e kokoke aku ana e lele ka uhane i Kekaa. I kekahi manawa, ua hoi hou ka

uhane o ke kanaka a komo hou iloko o kona kino, a ola hou aela ia, oia ka poe e ola hou mai nei; ua nui no na uhane i hele ma keia wahi o Kekaa. Ua kapaia ia wahi o leina a ka uhane. Ko na kanaka makaainana mau uhane wale no ke hele ma Kekaa; ko na lopa mau uhane a pau, o ko na 'lii hoi, ma na lua pele e hele ai ko lakou mau uhane i ko lakou wa e make ai. A ina hoi he mau makamaka ko lakou malaila kipaku ia mai no kahi poe o lakou, a ola hou no.

Ma Kekaa e noho ana o Maui a me Moemoe; o ka puni a kekahi o ka hiamoe; kau ke poo i ka uluna o Welehu ka malama, oia hoi o Moemoe. O ka puni a kekahi o ka hele. I ka wa i moe ai o Moemoe, a hele no hoi o Maui elike me ka laua puni, i ka wa e moe ana o Moemoe, a kahe mai ka wai, paapu loa ua Moemoe la i ka lepo, a koe ka puka ihu, a kau ka hua kukui ma kona puka ihu, a kupu keia kukui a loihi iki ae, ia manawa ua maneo ka puka ihu o Moemoe, nolaila, ala kona hiamoe, a olelo iho oia penei: "o ka'u puni hoi o ka moe, ala ana ka hoi i keia wahi laau kukui ino," nolaila. kupu ka manao iloko ona e hoopau i kona puni a e imi ia Maui kona hoa.

A ua kapaia, mamuli o kekahi o keia mau kanaka kekahi alanui e pill ala ma ka aoao akau hikina iki o Kekaa, "o ke alanui kikeekee a Maui." O ka mea nae nana i hele mua ia alanui o Eleio, ke kukinf" mama a Kaalaneo, ke alii kupu eu oia wa.

Nolaila, ke kau leo aku nei au ia oukou a pau, e na makamaka o ke au malamalama o keia manawa, ka poe hoi e ao ia nei ma ke kahua hohonu o ka naauao, mai Hlo ko oukou manao a hooiaio i keia mau mea o ke au pouli, ke au hoi o ka naaupo; mai haliu hou aku kakou a nana i ke au poliakua a Kane. Ua hala ke ait kahiko a me kana mau haukae; eia kakou i ke au hou, a me kana mau pono.

January 24, 1872.

RELATING TO KEKAA.

This is one of the famous hills on Maui; it is a noted landmark of the kingdom of Hawaii nei. The stories concerning it are profusely written in the Moolelo Hawaii.

Some of the ancestors of this Hawaiian race thought that Papa begat these islands, or that Wakea made them with his own hands, while still others held that they originated from Kumulionua, or they simply appeared; while yet the intelligent folk, the people of the civilized age, say that volcanic forces raised these islands from the bottom of the sea; so it is with Kekaa. It may be that Kekaa was obtained through one of the agencies above guessed at.

Here is another thing: Kekaa was the capital of Maui when Kaalaneo was reigning over West Maui. It is said that there were many people there. Many houses were constructed, and people cultivated a great deal of potatoes, bananas, sugarcane, and other things of a like nature. From what I have been told, that country from above Kekka to Hahakea and Wahikuli, that country now covered with cactus in a northwesterly direction from Lahainaluna, was all cultivated; Kekaa became a city populated by a great many; this chief [Kaalaneo] also planted the breadfruit and kukui trees down at Lahaina.

One time, this chief and his people planted breadfruit trees. While they went ahead planting, Kaululaau followed after pulling them up. Some of these trees southwest of the Lahaina fort were called the breadfruit trees of Kauheana. This Kaululaau was banished to Lanai, where ghosts were plentiful with the idea that he would be killed; but it did not turn out that way. After some fame, a fire was seen burning [on Lanai]. Therefore, the chiefs wondered whether or not Kaululaau was dead on account of this lighted fire. The important point from these explanations is that Kekaa was the birthplace of Kaululaau, the famous one who traveled all over Lanai fighting the numerous ghosts there and made it a land fit to be inhabited by human beings as it is at the present time.

Another noted thing that was done there was cooking whales during the lifetime of Keokiko, a half-white. When he was living, this was one of his occupations, that is, to cook whales. He gave a great deal of his time to this work. He caught many fish he cooked many whales there during the years 1849-1859, if I mistake not. It was also a place for cooking sharks' livers. At that place is a large pot for cooking whales and also a box for confining whales. Many people went there to see and examine that strange thing during those years.

Concerning the frequent death of all those who went alone. This was a strange phenomenon connected with this hill. From the time I commenced living down at Lahaina, A. D. 1859-1872, it seemed there were nine persons who died there without any apparent cause. Keokiko was one of the corpses buried there and was there at this time; that is the white thing on top of that hill.

Concerning the great amount of human bones at this place. On account of the great number of people at this place, there are numerous skeletons, as if thousands of people died there; it is there that the Lahainaluna students go to get skeletons for them when they are studying anatomy. The bones are plentiful there; they completely cover the sand.

This is also a ghostly place. Sometimes, a number of people come from Kaanapali (from the other side) and go to Lahaina during- the dark. When they came to Kekaa, stones rolled down from the top of the hill without any cause. Listening to it, it seemed as if the hill was tumbling down; the people going along were startled, and they explained, "Kekaa is ghostly! Kekaa is ghostly!" Certainly this is a strange thing for this hill to do.

It is said that when a person dies, his spirit journeys to Kekaa; if he has a friend there who had previously died, that one would drive it away when the spirit is nearing Kekaa. Sometimes, the spirit of a person would return and re-enter the body, and cause it to come to life[8] again; that is what has happened to those who are living again. Many souls came to this place, Kekaa. It is called the Leina-a-ka-uhane, the leaping place of the soul. Only the spirits of subjects go to Kekaa; the souls of farmers[9] and the souls of chiefs go to the volcano when they die. If they have friends there, some of them are driven back [whence they re-enter the body] and live again.

At Kekaa lived Maui and Moemoe; the great desire of one was to sleep; his head was on the pillow, and there he would lie until Welehu became the month. This person was Moemoe. The other desired to travel. When Moemoe slept, Maui was traveling, each according to his taste. While Moemoe was sleeping, a freshet came down and covered him with debris, with the exception of his nostrils; a kukui nut, however, rested on his nostrils and commenced to grow. It grew tall and, at the same time, tickled the nostrils of Moemoe, so he awoke and said: "Here I am at my favorite pastime, asleep, and yet I am awakened by this cursed kukui tree." So he made up his mind to give up this to which he was addicted and to search for his friend, Maui.

A road on the northeast side of Kekaa was named after one of these men; it is called "*ke alanui kikeekee a Maui*"– the zigzag pathway of Maui. However, the first one who trod this pathway was Eleio, the fast runner of Kaalaneo, the excellent king of that period.

Therefore, I advise all of you, friends of enlightened civilization of this age, those who are being educated at this famous institution of learning, not to allow your thoughts to be swayed by, nor approve of, these things of an age of ignorance; let us not glance back and look upon the gross darkness of Kane. The old order of things with its wickedness has passed away; we have entered a new era and its excellence.

January 24, 1872.

Kekaʻa is an important cultural and spiritual landmark, serving as the leaping place of departed spirits. The following is an excerpt from Fornander (1919) detailing the multiple leina around the archipelago. Kekaʻa is named here as one of two leina on Maui. (575)

> Eia kekahi: aia ma ka aina maloo kahi e noho ai ka uhane mahope iho o ka make ana o ke kino, a ua kapaia keia mau wahi o ke leina a ka uhane. Ua lawa keia inoa ma na wahi a pau o Hawaii nei kahi i noho ai ke kanaka. O kahi e noho ai ka uhane o ko Niihau poe, Kapapakiikii, o ka lua, Mauloku, ma Lehua, ko Kauai aia ma Hanapepe, ko Oahu o Kaimalolo, ko Molokai aia ma ka palena o koolau a me kona, o Wainene ka aina nui. Ko lanai, Hokunui, ko Maui elua wahi e noho ai, o Kekaa a me ke kula o Kamaomao, a ko Hawaii ekolu wahi e noho ai, o Hilo, Waipio a me ka Palilua. O keia mau wahi a pau, ua kapaia o ka leina o ka uhane. Ina e hiki ka uhane ma keia mau wahi aole hiki ke hoi hou mai.
>
> Another thing: The spirit is found in the dry lands after it has passed from the body. These places were called the leaping places of the soul. This name was sufficient for all places around Hawaiʻi where people lived. A place where the Niʻihau peoples' spirits dwell is Kapapakiʻikiʻi, and the second is Mauloku at Lehua Island. For Kauaʻi's people, it is located at Hanapēpē, and for Oʻahu at Kaimalolo. Molokaʻi is situated at the boundary of the windward and leeward sides, and Waineʻe is the prominent place. For Lanaʻi, Hōkūnui, and Maui, the spirits dwell in two places: Kekaʻa and the plain of Kamaʻomaʻo. For Hawaiʻi, the spirits dwell in three places: Hilo, Waipiʻo, and the Palilua. All these places are called the leaping place of the soul. If the soul arrives at any of these places, it cannot return.

5.1.4 Ka Moolelo o Eleio.

Another insightful moʻolelo about Kekaʻa is "Ka Moolelo o Eleio," rich in place names. Eleio is the attendant and runner for the chief Kakaalaneo, who resides at Kekaʻa. One day, ʻEleio runs into trouble while fetching the chief's favorite ʻawa. The story unfolds into an epic chase where Eleio must run to save his life. This moʻolelo was taken from a serial that ran in *Ka Nupepa Kuokoa.* This excerpt of the moʻolelo was published on September 5, 1863, and can be found on the first page. Below is a transcription and translation of the moʻolelo. The original page is also included here.

> **"Ka Moolelo o Eleio."** ***Ka Nupepa Kuokoa,*** **Kepakemapa, 5, 1863, ʻaoʻao 1.**

E pono paha kakou ke kamailio maanei no Eleio, ke kahu o Kakaalaneo kekahi o na ‘Lii o Maui, a mahope aku e kamailio kakou no Kaululaau, ke keiki ponoi a Kakaalaneo, ame Kelekeleiokaula kekahi alii wahine o Hawaii, ke kaikuahine o Kaleihaohia kekahi alii o Hawaii.

Ua olelo ia o Eleio, he kahu no Kakaalaneo kekahi o na ‘Lii o Maui, a ua manao wale ia, o Kakaalaneo, oia ka hanauna elima o na ‘Lii o Maui. Ina paha e hoonohonoho ponoia ko lakou mookuauhau mai a Kumuhonua mai a ia Kakaaleno, alaila, ua hiki io no i ka lima o ka hanauna

Aka, no ke kamailio ia Eleio, he pono hoi kakou e kamilio nona. O Eleio, he kanaka mama i ke kukini, a no ka mama o Eleio, nolaila, ua koho no o Kakaalaneo ia Eleio i mea nana e hooko kona makemake ma na wahi loihi loa.

Peni paha kakou e hoomapopo ai he kanaka mama o Eleio. I ka wa e hoomakaukau ai na Aipuupuu a Kakaalaneo i ka ai, a me ka lawalu ana i ka i-a a ke ‘Lii. Ia manawa, hoouna ae la ke ‘Lii ia Eleio e holo i awa no ke ‘Lii, aia a hiki mai ka awa a Eleio e kii ai, alaila, hoomaka ka ahaaina a ke ‘Lii.

O kahi nae o ka awa a Eleio e kii ai no ke ‘Lii, he wahi loihi loa, aia ia wahi i Koolau, o Maui, o Waiohue ka inoa oia aina.

Ina e hoomaka o Eleio e kii i ka awa i Waiohue, aole e mo-a na lawalu i-a, hiki e mai no o Eleio mamua o ka manawa e hoomaka ai ka ahaaina a ke ‘Lii. O ka Eleio hana mau no ia, o ke kii mau i ka awa no ke ‘Lii: o kahi hoi e noho ai ke ‘Lii, aia ma ka aoao mauka o Kekaa, kela puu ku la ma Kaanapali, makai ae o Kealakikeekee a Maui.

Ua nui no na kii ana a Eleio i ka awa no ke ‘Lii, aka, aole nae i loaa o Eleio i ka pilikia, aka, i kekahi kii hou ana aku.

Ia manawa, halawai o Eleio me ka popilikia, no ka mea, i ka manawa a Eleio i hoi mai ai me ka awa mai Waiohue mai, e noho ana keia Akua o Koolau i ke alanui, o “Aahualii” kona inoa.

Ia manawa, nonoi mai la o Aahualii ia Eleio i ka awa, “E Eleio, e kapu aku no hoi ka awa no ko Alii, i wahi huluhulu mai no hoi ko’u.”

Ia manawa koke no, hoole aku la o Eleio, “Aole,” alaila, hoopohopoho aku la o Eleio i kona lemu ia Aahualii, ame ko Eleio haawi aku i na huaolelo inoino loa. Ia manawa, huhu loa iho la o Aahualii, a o ka uhai akula no ia ia Eleio, a maanei kakou e ike ai i ka mama launa ole mai o Eleio.

I ka manawa o Eleio e kii mau nei i ka awa no ke Alii, o ka lima paha ia o kona kii ana i ka awa. I ka manawa o Eleio i alualuia’i e Aahualii, alaila, hoomau no o Eleio i ka holo imua, me kona hoike i kona ano mama. Eia nae, ia laua no e hoomaka ana e hookuu i ko laua mau kino i ka mama loa, oia mau no ko laua kowa kaawale ma waena o ko laua kulana kukino [pn]. Ua holo mai laua mai Koolau mai o Maui, a hiki mai i Hamakualoa, Hamakuapoko, a pela mai no ko laua holo ana a hiki i Wailuku, a Kamaalaea, a ka pali o Aalaloloa, a ka ihona o Papalaau, alaila, alawa aku la Eleio i hope, a ike aku la oia i ke akua ia Aahualii e hoomau mai ana no i ke alualu iaia nei, alaila, hoolele ia ae la ko Eleio luna manao e ka makau, no ka mea, ua aneane kokoke loa mai la o Aahualii, hookahi nae a Eleio mea makau ia manawa a laua nei e holo ana, o ka lapalapa mai o ka waha o Aahualii me he ahi la, me he mea’la ka waha o Aahualii e upoi iho ana ia Eleio. Hoomau mai no nae keia i ka holo a hala o Ukumehame, hiki keia i Olowalu, a hala Olowalu, hiki keia i Awalua, a hala o Awalua, hiki keia i Kulanaokalai, a hala o Kulanaokakalai, hiki keia i Launiupoko, a hala o Launiupoko, hiki keia i Waianuukole, ia ia nei nae i Waianuukole, hookokoke loa ae la o Aahualii mahope o ia nei.

Aka, i keia manawa hoi a Aahualii e alualu nei ia Eleio, alaila, hoomaka ae la keia e holo mai ma loko mai o ka ulu niu, a me ka ulu, ia Eleio i hoomaka ai e holo mai ma ka ulu niu, a me ka ulu, alaila, hoomaka mai no hoi o Aahualii e holo mai mahope o Eleio, aka, no ka paapu o mua i ka laau, nolaila kuhihewa o Aahualiii [pn] i ka laau e ku mai ana mamua o Eleio ia, nolaila, hopu hewa o Aahualii i na laau.

A mamuli o ia hopu hewa ana o Aahualii i na laau, oia iho la ke kokua nana i hookaawale aku ia Eleio ia manawa. A puka aku la o Eleio mawaho o Mala, aia no o Aahualii maloko o ka uluniu, a me ka ulu kahi i hopu hewa ai.

A i ka puka loa ana aku hoi o Aahualii i waho o Mala, alaila, ike pono aku la o Eleio, aia no e holo ana imua, alaila, hookuu hou aku la o Aahualii i kona ano mama, a aneane no o Aahualii e hookokoke loa aku mahope o Eleio, aka, piha loa mai la o Eleio i ka makau.

Ia Eleio no e holo ana mamua o Aahualii, ia manawa, ikiiki loa mai la o Eleio i ka naenae a me ka paupauaho.

Alaila, kahea aku la o Eleio me ka leo nui ia Kakaalaneo. [P]enei ke kahea ana, “e Kakaalaneo—e! E wehe ae i ka puka,” “e Kakaalaneo—e! E wehe ae i ka puke[.]” I ka loha ana mai o Kakaalaneo, ame na kanaka o ka hale i keia leo kahea ia manawa, wehe ia ae la ka puka o ka hale o Kakaalaneo, alaila, ike pono aku la lakou i keia mea kupanaha, e ulaula mai ana ka waha o Aahualii me he ahi la, ia wehe ia ana ae o ka puka o ka hale, o ka manawa ia komo ana o Eleio iloko o ka hale. I ko Eleio manawa i komo ai iloko o ka hale, o kona waiho aku la no ia me he mea ala ua make, no ka mea, ua pau ke aho i ka holo ana, no ka loihi o kahi i holo mai ai. Ia Eleio no hoi i komo ai iloko o ka hale, alaila, papani ia ae la ka puka, ia manawa no hoi ku ana o Aahualii mawaho o ka pa o ka hale. (Maanei e waiho iki kakou i ke kamailio ana no Eleio me Aahualii.)

“The Story of Eleio.” *Ka Nupepa Kuokoa,* September 5, 1863, Page 1.

It would perhaps be good to talk about Eleio, the attendant of Kakaalaneo, one of the chiefs of Maui. Afterward, we will speak about Kaululaau, the child of Kakaaleno and Kelekeleiokaula, a chiefess of Hawai‘i, and the older sister of Kaleihaohia, a chief of Hawai‘i.

It was said of Eleio that he was an attendant of Kakaalaneo, one of the chiefs of Maui. Kakaaleno belongs to the fifth generation of chiefs of Maui. Should his genealogy be organized from Kumuhonua to Kakaalaneo, then he would be precisely five generations hence.

Regarding Eleio, it would be fitting to start talking about him first. Eleio was speedy when running as a messenger. Because of his speed, Kakaalaneo chose him to fulfill his desires in far-off places.

In this way, we can see how Eleio was a quick runner. When Kakaalaneo’s cooks were preparing food and bundled fish for the chief, the chief [Kakaalaneo] sent Eleio to fetch ‘awa for him. When Eleio returned, the meal would be served for the chief.

The place where Eleio was to fetch the ‘awa was very far away in Koolau, Maui. The name of the place is Waiohue. If Eleio started his run to fetch the

ʻawa in Waiohue before the bundled fish was cooked, Eleio would arrive before the meal was served to the chief. This continued to be Eleio's responsibility: to fetch the ʻawa for the chief. Kakaalaneo lived inland of Kekaʻa, the hill that stands at Kaʻanapali on the ocean side of the crooked road of Māui.

Eleio fetched ʻawa for the chief many times but never ran into any issues until one day. On this day, Eleio met trouble because when he was returning with the ʻawa from Waiohue, a god met him on the road. His name was ʻAʻahualiʻi.

At this time, ʻAʻahualiʻi requested the ʻawa from Eleio, [saying] "Eleio reserve the ʻawa of your cheif for my feathers." Eleio refused and bent over, revealing his anus (a sign of contempt), and he continued to curse [at ʻAʻahualiʻi]. Then ʻAʻahualiʻi became enraged as Eleio began a chase. Here, we will see Eleio's incredible swiftness.

When Eleio went to fetch ʻawa, it was his fifth time doing so. When he was being chased by ʻAʻahualiʻi, he continued to charge forward, showing off his swiftness. Another detail is that while they were beginning to speed up their chase, it was also when the distance they ran revealed their skill as runners. They went from Koʻolau, Maui, until Hāmākualoa, Hāmākuapoko, then on to Wailuku, Kamaʻalaea, the cliff of ʻAʻalaloloa, and the passage of Papalāʻau. Eleio glanced back and saw the god ʻAʻahualiʻi pursuing him in the chase. Then Eleio became frightened because ʻAʻahualiʻi was getting closer. There was only one thing that caused Eleio fear while they were running: the blazing mouth of ʻAʻahualiʻi like a fire. It was as if the mouth of ʻAʻahualiʻi would envelop Eleio. Eleio continued running, passing Ukumehame, arriving in Olowalu, passing Olowalu, arriving in Awalua, passing Awalua, arriving in Kulanaokalai, passing Kulanaokalai arriving in Launiupoko, passing Launiupoko and arriving in Waianuʻukole. While he was in Waianuʻukole, ʻAʻahualiʻi was nearing close.

At this time, Eleio became increasingly afraid of being caught by ʻAʻahualiʻi. He thought to himself that if he were to go to the ocean side, he would soon be caught by him [ʻAʻahualiʻi]. He thought this because the road on the ocean side was old from Puʻunoa, Molakia, and Mokuhinia to Luaʻehu, Pelekane, until Aki at the sands of Puʻunoa.

However, at this time, Eleio was being chased by ʻAʻahualiʻi, so he began to run into the coconut and ʻulu groves. ʻAʻahualiʻi started to close in on Eleio, but because the trees were so dense, ʻAʻahualiʻi mistook the trees for Eleio and seized them instead.

Because ʻAʻahualiʻi mistakenly seized the trees instead of Eleio, it was of great help to Eleio to separate the two at this time. Then Eleio emerged from Māla while ʻAʻahualiʻi remained in the coconut and ʻulu grove with the ʻulu he mistakenly grabbed.

When ʻAʻahualiʻi emerged out of Māla, Eleio could see that he [ʻAʻahualiʻi] was moving ahead. Then ʻAʻahualiʻi sped up even faster and was almost near Eleio. Eleio was filled with fear.

While Eleio continued ahead of ʻAʻahualiʻi, he began to feel discomfort in his panting and breathlessness. Then, Eleio called out in a loud voice to Kakaalaneo. In this way, he called out, “Kakaalaneo! Open the door,” Kakaalaneo! Open the door.” When Kakaalaneo and his party heard this call, they flung open the house door. Then they saw something astonishing: the red of ʻAʻahualiʻi’s mouth like a fire. When the door was open, Eleio entered the house and lay there as if he were dead because he was out of breath from running and because of the distance from whence he came. As soon as Eleio went into the house, the door was shut. At the same time, ʻAʻahualiʻi stood outside of the house. (Here, we will briefly digress from talking about Eleio and ʻAʻahualiʻi.)



KA NUPEPA KUOKOA.

Ke Kilohana Hawaii

Pookela no ka

BUKE II. HELU 36. HONOLULU, SEPATEMABA 5, 1863. NA HELU A PAU 93.

MOLUHI,
HE KAAO
NO HAWAII NEI.
MOKUNA 3.

I A MANAWA, OLIOLI O KEKAHA kuu o Loeau, no ka hoake ana o Moluhi e hele lakou a ekolu ma Hilo e makaikai ai, no ka mea, na lohe pinepine na mau keiki nei, i ka holo ana o na hoale ame na kanaka maoli ma Hawaii. I keia holo ana o ka Moluahi, he kanakolu hvole—a kanalua kahi—a he kanalima paha kahi hele ana, o na kanaka maoli, he nui wale.

O Kekaha, ua ee pinepine oia ma ka Moku kuahi, aole nae i holo na kau wahi e aku.

Pela no hoi o Loeau, ake mai lana e holo, a noi mai i ka makuakane, oia hoi o Moluhi, e ne mai i ka luna hele ana ma Lahaina, a ma ia wahi aku ia wahi aku.

Ia manawa, hoole aku la i ka makuakane, " Aole pono ia'u ke hookuu wale aku ia oia e hele ma kahi loihi aku, oia kekahi kumu o ka haunaele ma Hawaii nei, ame ka poino o ka hele wale ana o na kaikamahine, me ka mea ole mau e malama pono ia lakou."

O Moluhi, un holo ma ka moku i kekahi manawa, a ua mapopo ia ia, aole pono i kana mau keiki ke holo, ke ole oia kekahi me lana ; nolaila, un olelo oia ia laua, " E noho malie oluu, a hiki mai ka manawa kupono ; alaila, o kakou pu ke hele." Pela ka Moluhi olelo i ka makahiki i hala iho nei.

Ia makahiki, un loi ikaika o Loeau e hele, me ka i aun aku i ka makuakane, " Hanka ka mea e hoopanee ai, me he mea la aole e holo iki ana ?"

Olelo mai la makuakane ia ia, ame ka haka pono mai, " No kou ole nui i kou kahe e kakou, hookohi hanerl dala ($100.00) i koe ; hooha la nuanei ? E pono anei ia kakou e hualele i ka luna, a e hele mamuli o ka nanaaina."

Mai hilahila loa o Loeau i keia pane ana mai o ka makuakane, no ka mea, un nei pinepine aku na kaikamahine nei i hale loa ; a mamuli o ke ano kamalii ke nei ana, a pelnei no ia, " O mea, un keone i ka hale laau; a o mea hou, ua komo i ka hale laau, ua pau i ka papa—ua paku pono ia, a he mee nui —he kapa apanapano, a in mea aku ia mea aku e pono ai ka hale."

Ina e hookolokolo ka makuakane ia ia no ke ano o kona mau kapa kome, ame na palapala, alaila, uwe koke mai la keia, me ke ano huhu ; a hoopuka mai la oia i ka olelo ma ia ano. " Ma hea kahi pono e waiho ai ka'u mau mea a pau, aole o'u kenu, aole o'u pahu pa i ka laka ; aole papa o kahi e waiho ai o ka'u mau palapala, a he wahi ole ma ke kihi o ka hale ; mahaila e kau ai ka'u mau wahi lole, oia iho la no. Ina e hele iki ua ma kahi e, a hoi mai, ua luia ka'u mau wahi palapala no nalowale aku kaa peuleka, a pau ka waihona ole mai ka'u mau kuwaa naau.

Aole ana wahine e kokua mai ai ia ia, aka, he makuahine kona, he wahine miki oia i ka hana, aun ma Kauai ua makuahine la ; o kana hana oia no ka ulana ana i na eke kaleha na ke poe mahiko. A i kona ananawa, e ulana ana kela wahine ekolu haneri eke, oia no ke kumukuai o ka holoku pahoehoe mekiki lona.

A mauao o Moluhi e noi ia ia i dala no ke kukulu hoo ana i ka hale ; a ua haawi mai ka makuahine i na dala a pau mamuli o ka manao o Moluhi, pela ka makuahine, nolaila, ua kuai ka lole ma ke kumukuai hana i pau koke ka hale, alaila, imi ke dala no ka pahoehoe. A o Moluhi, kuai aku oia i ka pono ananna, me kekahi mau lio, ame kekahi mau waiwai e ae.

A ua kukulu ka hale i ikeia ma ka hela nua o keia kano ; a ua kau ka aie a pau, a ua pau no hoi ke kihapai nui i ke kanuiu ; nolaila, manao o Moluhi e hele pu me ua keiki ana, ma kekahi mokupant e aku. Hoomaukaukau lakou i na mea e pono ai ka lakou hoa ana ma ka moku, ame ka noho ana maaka.

Ia manawa, makemake o Loeau e lawe i kona pahu me ka ukana he nui wale ; a no ke aha la ke aku la ka makua me ka i aku, " Mai hele kaumaha kakou, me ka ukana kupono ole ; o ka pakeke kapa Wale no ka makai loa, aole e noho e like me ka ipu Hawaii. Aole no hoi e imoku ke pulu i ka un e like me ka puhu iii."

A ua hele i ka hale kuai, a un kuai i ka pakeke maikai no Loeau, a un hookeneln o kona mau kapa a puu i kupono no ke lawe ana. O ka pepeke oona, i paa i ka puk lole, aole nae e hiki ke komo un mimamua loa iho la o Loeau ; makemake oia e makihiki i ka huinaka, a pau ma kona lima.

A olelo aku o Kekaha ia ia, " E hoomanao oe i keia kaikamahine a kaua e ike ai, i keia ku ana o ka Mokuahi, oe ae ana keia me ka helelei o ka waimaka, no ke pepe loa o kona popule oonna, un hiuna nei ke kapa o kahi moe maluna o ka moku, ua moe oia, a pepe loa o inoino no hoi."

A o Kekaha, ua makemake e lawe i kona wahine i like me na hoale ana e like ai me luna o ka moku ; a ua i kona makuakane, " E ake ka hoolumiina ana o ka noho me ka lio ma Lahaina, a ma Hilo paha."

A makaukau ka ukana kupono no ka hele ana, ee lakou maluna o ka moku i ka hora eha o ke ahiahi ; akahi wale no a holo au. keiki ana ma ka moku, a nana pono laua i ka emi ana o Honolulu mahope, ame na lalo e Nuuanu, ame na puhu Hae, ame Kawaihoa, ame na wahi kickie loa ; ua kokoke e nalowale, a po ia la. Alaila, imi laua me ka makuakane i kahi pono e noe ai, un hoi ua hoole iloko o ka moku, a un puapa loa maluna i na kanaka maoli ; makena loa ! a e noho ana lakou e puina. a e kamailio ana, a e puhi paka ana, a ikuka mai la ka makani, alaila, mee lakoo no ka pilikia i ka mai.

A ke aiea la ka noeau ma Lahaina, aole lelo o Moluhi nku, no ka nanahuaii loa o na keiki, oia hoi o Kekuhe, ame Loeau, a hala ka la ame ka po, olueiu ko lua mai ; ala ae la laua iluna, a ui iho la i keiahi ipu, kahiki, a nana aku la lua i kekahi mau olua, ua ee ua ka moku ma Lahaina, ke kahi o na poe la, he wahi luahine nalapala lon me kana moopuna, a imi mai ke kupanawahine i wahi malumalu ma ka palekai o ka moku, no ka mea, he nui ka wela o ke keiki a uwe pinepine oia.

Ninau aku la o Loeau ia Moluhi, " Mahea kahi e holo ai keia luahine me ke keiki mai ?"

I mai la ka makuakane, " I Hamakua, mailiula mai keia wahine ; a o kana kaikamahine kanua kahi, un holo mahe nei Lahaina, un noho malalia a mare i ke kane, he kane inu rama—pepe—a noho ahaaha a hiki mai ka make me he aihue la i ka po. A o kana wahine, un noho me ke pilikia maoli ; a loohia i ka mai, a kauoha aku oia i kona makuahine ma Hamakua e holo koke mai ; a un, holo koke mai ka makuahine me ka manawa loa ! ame kaikamahine mahuka, hiki keia ma Lahaina, un make e ke kaikamahine, o kana keiki wale no koe, a ke hoihoi nei ke kupanawahine i keia keiki e malama pono ia ia."

A i keia kamailio ana o Moluhi ma, pii mai la keiahi kaikamahine hanbeo mailalo mai o ka moku, e imi ana i wahi malumala nona iho, no ka mea, un wela loa la ; a i ka uwe ana o ke keiki mai, hii ae la ka kupunawahine ia ia, e hele aku la e hoonana i ke keiki, a e imi ana i ka wai e ine nona ; a un, ike mai la ke kaikamahine hahee, no malumalo kahi moe o ka luahine, hele wikiwiki mai la ua kaikamahine nei, a hapai ae la i ke kapa moe o ka luahine ame ka wahine ai, me ka ipu kuha, ame un ukana a pau, a noe iho la. Mamoli o ka hoi ana mai a un luahine nei me ke keiki mai, a nana aku i kona wahi, un lilo i keia kaikamahine, a un kiolaia kona wahi moe ma kahi wela loa i ka la ; nolaila, noho iho la ua luahine nei me ka ekemu ole.

Nolaila, un ike o Moluhi me i keia hana apiki mai ka mua a i ka hope ; a ninau aku i kona mau keiki, " Pehea ko olua manao, ua haki anei kekahi kuauwai o ke Akua i keia kaikamahine kaili wale."

Pane koke mai la lua, " Ae, ua haki no."

Ninau hou ka makuakane, " Ke kuauwai hee haki haki ?"

Pane koke mai o Loeau, " Eia, mai pepehi kanaka oe."

I aku la ka makuakane, " Mai wikiwiki oe, a heake aku me ka noonoo ole."

Olelo mai o Loeau, " Aole, un noonoo au meuei, ina paha e make keia keiki pilipaio, no ka nee no kahi ekolu loa o ka wela o ke la, aole nei e pili keia hana a ke kaikamahine i ka pepehi kanaka."

Ae mai la ka makuakane, " Ae, un polelei paha ka noonoo ana."

I aku la o Moluhi ia Kekuhe, " Pehea hoi kou manao ? Hesha ke kauawai i hakiia keia kaikamahine?"

I mai la keia, " Eia paha. o ke kauawai umi, ' Mai kiko oe i kekahi mea a kou hoalauna,' i ka'u mamoo, ua kuko ke kaikamahine i keia wahi mele o ka wahine mea keiki mai."

" Oiaio no," wahi a Moluhi, " aka, mai huli olua iwaena o na kauawai he umi wale no, e nana ae o Kekahi ma Mateio VII ; 12."

Ia wa, weke ae la oia i ke poi o ka pakeke, no ka mea, ua lawe mai o Moluhi i ke Kauoha Hou, a ua wanee i ke Kauoha Kohiio ma ke kahe, no ke kaumaha ona nui loa.

Heluhelu ae la o Kekuhe, " O na mea a pau a oukou e makemake ai, e hanaia mai ia oukou e na kanaka, oia ka oukou e hana aku ai ia lakou."

O Moopopo lua, ke kauawai aloha keia," wahi a Kekahi, " aka, eia ka mea pohihihi a'u. Owai ka mea pomaikai—ka mea malama i keia kauawai. o ka mea maiama ole paha. no ka mea, o ke kaikamahine uhiki i keia kauawai, ke nee nei ma kahi malu loa."

Ia kamailio ana imua o kakou a elelu, aole e hiki no hoi i na mea o ka moku, ke ano e uwe hou ke keiki mai, nana lakou, ia ia, hoohuli ke ihu o ka moku, a un lawela ka malu o ke kaikamahine aloha ole ; e ua kau malunu o ka wahine ame ke keiki mai. Kahaha o Loeau ma, no ke kokua ana o ke Akua mamuli o ka wahine mea keiki mai ; a walho wale ke kaikamahine keiki wale, ma lahi wela loa o ka la.

(Aole i pau.)

KA MOOLELO
—o—
ELEIO.
HELU 1.

HE PONO PAHA KAKOU KE KAmailio maanei no Eleio, ke kahu o Kakaalaneo kekahi o na 'Lii o Maui, o mahope aku e kamailio kakou no Kauhihina, ke keiki penei o Kakaalaneo, ame Kelekelekokahi kekahi alii wahine o Hawaii, ke kaikuahine o Kalehaehia kekahi alii o Hawaii.

Ua olelo ia o Eleio, he kahu no Kakaalaneo kekahi o na 'Lii o Maui. a, ua manao wale ia, e Kakaalaneo, oia ka hanauna elima o ma 'Lii o Maui. Ina paha e hoonohonoho ponoia ke kakou mookuauhau mai a Kumuhonua mai a ia Kakaalaneo, alaila, ua hiki no no i ka lima e ka hanauna.

Aka, no ke kamailio ia Eleio, he pono hoi kakou e kamailio nona.

O Eleio, he kuaka mama i ke kukini, a no ka mama o Eleio, nolaila, ua koho no o Kakaalaneo ia Eleio i mea nana e hooke kona aukeneake naa na wahi loihi loa.

Penei paha kakou e hoomopopo ai he kuaka mama o Eleio.

I ka wa o hoomakaukau ai na Aipuepua a Kakaalaneo i ka ai, ame ka lawalu ana i ka i-a-a ke Lii. Ia manawa, hoouna ae la ke Lii ia Eleio e holo i awa no ke Lii. aia i hiki mai ka awa a Eleio e kii ai, alaila, hoonnkn ka ahaaina a ke Lii.

O kahi nae o ka awa a Eleio e kii ai no ke Lii, he wahi loihi loa, aia la wahi i Koolau, o Maui. o Waiohue ka inoa oia aina.

Ina e hoomaka o Eleio e kii i ka awa i Waiohue, aole e moo na lawalu ia, hiki e mai no o Eleio mamua o ka manawa e hoomaka ai ka ahaaina a ke 'Lii. O ka Eleio hana inau no ia, o ke kii mai i ka awa no ke Lii ; o kahi hoi e noho ai ke 'Lii, aia ma ka aoao mauka o Keksa, keia puu e ku la ma Kaanapali, makai ae o Keolukiekee a Maui.

Ua mai no na kii ana a Eleio i ka awa no ke 'Lii, aka, aole nae i loaa o Eleio i ka pilikia, aka, i kekahi kii hou ana aku.

Ia manawa, halawai o Eleio me ka popiikiu, oe ka mea, i ka manawa a Eleio i hoi mai ai me ka awa mai Waiohue mai, e noho ana keia Akua o Kookua i ke alanui, o "Auhuiili" kona inoa.

Ia manawa, nonoi mai la o Auhuiili ia Eleio i ka awa. " E Eleio, e kapu aku no hoi ka awa no ke Alii, i wahi hulahula mai no hoi ko'u."

Ia manawa koke no, hoole aku la o Eleio, o ka i aua hoi ia i hiki mai ai i keia wahi la Lahaina i ka mea i hana ia e ke Akua Auhuiili. A pau ka ke Alii hoolakeia ma alaila, waiho ihe aku la ua ka awa o Lanakila i kona poinaiuea o ke Alii, a pau ae kana mailio ana, alaila, kukeluku ae la luna iki ma e make ai o Auhuiili, alaila, wali pono iho ke Aupuni o Kakaalaneo, a me kona mau kanaka.

(Aole i pau.)

HE MAU WAHI MEA KUPANAHA
No Generala Stonewall Jackson,
i make aku nei

Ua olelo un kekahi wahi mea kupanaha no Stonewall Jackson, ka Olelo o ka Hoku, e kekahi wahi kuuwa nona ame kona alohaia me ka hilinai nui ia ia e kona kauoa o ka wa i hala aku nei, a ma ia ma e ikeia'i ke kupanaha o kekahi o kana mau hana.

Ua nanaua na wahi nka kauwa nei a ua o Jackson, i ke kumu a me ke ano o kona alohaia me ka hilinai nui ia ia e kona kauoa o ka wa i hala aku nei, a ma ia ma e ikeia'i ke kupanaha o kekahi o kana mau hana.

Ua nanaua na wahi nka kauwa nei a ua o Jackson, i ke kumu a me ke ano o kona alohaia me ka hilinai nui ia ia e kona kauoa o ka wa i hala aku nei, a ma ia ma a pau. Eia ka olelo a un wahi nka nei i kona wa i nanaua'ku ai, " Aole he olelo mua mai o kou lnskn ia'u; aka, o kou mua wale no e ike ai penei—he pule nana no oia i ke kakahiaka a me ke ahiahi; aka, ina oia e lele iho ana mai kona waha moe i ka po, a kukulu e pule, alaila hoomakaukau mua au, no ka mea, na mapopo ia'u e weli ana no kana oia la ae." No konn ike i ke ano o ka hana a kona haku i ao mai ai e ike iho, o ke kanaka i manaoio i ka pono o ka noao ana e kaua'i me ka manao ia mea iluna o kona pnowai a loki i ka wa ana i u ai me ka hoomanawanui, me ke nei mpdi aku imua o ke alo o ke Akua Mana Loa. he kanaka ona e hoolkaika mau ana me ka manao emi ole.

Aole no hoi oia he kanaka i komo ole i o ke aloha. Ua olelnia nona, i kekahi wa ka, ua pio i na km lio o Gen. Ashby, kekahi kahunalapaau o kekahi puali kua o ke aupuni, a me na'lii kon no hoi elua, a ua lawen lakou imua o ua Generala Jackson nei. A i kona ike ana mai ua mau poe pio aupuni nei i hai mua ia ae la, pane mai la oia, " O oukou o na Kevoiomana, ka mea nana i hoopakele i ka wainai o kekahi manawa, no ka nupepa *London Times*, a i keia manawa ua noiia luna kona oia mahoko o kekahi puali kua kipi, he Alii Koa Beritania oia mamua. O ke poo o ua mauao la a ua Alii Koa Beritania la, "He poe doko o ka hale kou o Stonewall Jackson," a oia mahope nei kana mau olelo:

" Ua manao au e halawai ana au me kekahi kanaka elemakule, a kohu ole loa, aka, ua hoolele oluoluia ko'u oli, i ka ike ana aku i kona ano. He kanaka lioihi oia, a he ui no hoi, a he ano ikaika kona hanaia ana, he wiwi nae. He lauoho aula, a he umiumi aula no hoi. A o ke ano o kona waha, he ano kupaa. He lahilahi kona lehelehe, a he pilipua no hoi, he ulnih haeleele kona mau maka, a he ano maka ikaika i ka nana. Ua lana mai ia'u, he kanakolukumamawalu ka nui o kona mau makahiki, o kona ano nae, me he mea la ua kanaha. Aohe ano hookano o un Generala la, nana pono no i wehe ae i ko'u kuka pulu, a nana pono

Kakaalaneo was a chief of Lahaina who lived on the hill of Kekaʻa. According to Martha Beckwith, Kakaalaneo:

> "[o]wned fishponds in the Hana district on the opposite end of the island, and planted a famous breadfruit grove, and took to wife the Molokai chiefess whom Eleio found for him and who brought him the first feather cape seen on Maui, by whom he had the mischievous son Kaululaau who killed off the spirits on Lanai. In his day the old name of Lele became attached to Lahaina. In the legend of the red-skinned kupua of Puna Kepaka-ili-ula, Kakaalaneo is represented as a skillful spearsman…Tradition places in Kakaalneo's time the arrival of a party of strangers (haole) who played an active part in court life and whose names, were according to Kamakau, kept in memory as late as Captain Cook's day, for to the question whether Cook's party were gods or men, the kahunas expressed the opinion that they were 'men from the land of Kaekae (Kakae) and Kukanaloa.'" (Beckwith: 1970, 384)

The following moʻolelo will look at politics and war within the regions near Honokōwai.

5.1.5 Ka Moʻolelo o Kamehameha I

The following moʻolelo was taken from a series published in *Ka Nupepa Kuokoa* and authored by Samuel Mānaiakalani Kamakau. The battle seen below is between the opposing forces of Alapaʻi, the king of Hawaiʻi, Peleiōhōloani the king of Oʻahu, Kauaʻi, and Niʻihau, and Kauhiʻaimokuakama, the king of Maui. A powerful war tactic is shown in this excerpt as Alapaʻi's forces dried up the waters of Kauaʻula, Kanahā, and Kahoma, which impacted the livelihoods of warriors and common folk alike on Maui. Because this war tactic was so substantial, Alapaʻi and his warriors protected the waters of Ukumehame, Wailuku, and Honokōwai. These waters were and still are extremely important.

> **Ka Nupepa Kuokoa, Novemapa 3, 1866, 'ao'ao 1.**
>
> He makahiki okoa ko Alapai ko ka Moi o Hawaii i hoomakaukau ai no ka hele i ke kaua i Maui. I ka A.D. 1738—holo mai la o Alapai i Maui i ke kaua: o ke kaua i kaua ai me Kauhi, he hulihonua ke ano o ke kaua, he aha la ke ano o keia kaua[?] O ke ano maoli paha o keia kaua, o ke kaua maoli pu ole aku o ka hoomaloo i ke kahawai o Kauaula me Kanaha a me Kahoma (oia no kahawai i pili ia Lahainaluna.) Ua hoomaloo ia na loi a me na kahawai i loaa ole ka ai i na koa o Kauhiai-mokuakama, a i loaa ole ka ai

kona mau makaainana. Nolaila, ua kiai ia na kahawai o Olowalu, o Ukumehame, o Wailuku, me Honokawai, e na koa o Alapai ka Moi o Hawaii.

I ka lohe ana o Peleioholani, aia i Alapai ma Lahaina; nolaila pau mai la o Peleioholani ma Honokahua, a ma Honolua. Hele mai la na koa o Peleioholani i ke kaua i Honokawai me na koa o Alapai, a ua luku ia na koa o Alapai a hee aku la a hiki i Keawawa. Lohe o Alapai ua hiki mai o Peleioholani a ua pae mai i Honokahua, aia ka huna o ke kaua i Keawawa. Hoomakaukau iho la o Alapai a me kona mau alihikaua a me na lunakaua a me na koa. Ma ka auwaa kekahi, a mauka kekahi. O ka huna o kaua i Kokoonamoku ma Kaawawa o ke Oahu, I laula i ikea ia'ku ai na keiki moamahi a Peleioholani i ke koa launa ua lilo na mea make a ka Hawaii i wai auau, aka, aole e hiki i na wahi koa uuku ke alo aku iloko o ka neepu. I laila o Hana ke aikane koa a Peleiholani me Malamakuhiena, Makokalai, o Kulepa, Opuhalii, o Kuakea, o Lononuiakea, o Paikahawai, o Kaweloikaikulu, o Kamahuakoaie. O keia ka poe kaulana o Peleioholani i ke koa, a me ke akamai i ka hoouka kaua, aka, hookahi lau koa me na kanaha eono. Aka, he elua mano hookahi lau me na kanaha keu eha na koa ia Alapai. Oia hoi na moku eono o Hawaii. I ko Peleioholani manao e hui me na koa o Kauhiaimokuakama, aka, ua paa e o Lahaina ia Alapai, mai Ukumehame a hiki i Mala ma ka pea akau o Lahaina ka paapu i na koa o Alapai ka Moi o Hawaii. Ua kokua o Peleioholani no ka pono o Kauhiaimokuakama, i kona kokua ana, ua loaa kona pilikia.
(Aole i pau.)

Ka Nupepa Kuokoa, November 3, 1866, Page 1.

It was a different year when Alapa'i (Hawai'i's King) prepared to go to war in Maui. In the year 1738, Alapa'i went to Maui to battle. The war was fought with Kauhi, a cataclysmic kind of war. What kind of war was this? It was not a real war as the rivers closest to Lahainaluna, Kaua'ula, Kanahā, and Kahoma were dried. The taro patches and rivers were dried to produce no food for Kauhi'aimokuakama's warriors and subjects. Therefore, the soldiers of the King of Hawai'i, Alapa'i, guarded the rivers of Olowalu, Ukumehame, Wailuku, and Honokōwai.

When Peleiōhōlani heard that Alapa'i was in Lahaina, Peleiōhōlani left Honokahua and Honolua. Peleiōhōlani and his warriors went to Honokōwai to battle with Alapa'i's warriors. Alapa'i's warriors were decimated, and they fled to Keawawa. Alapa'i heard that Peleiōhōlani had landed at Honokahua,

> and a little bit of the battle was fought in Keawawa. Alapai, his generals, officers, and warriors prepared themselves, some going by way of sea while the others went on shore. A battle was fought in Kokoonamoku at Kaawawa by the Oʻahu forces, who were spread out to be seen as the cherished forces of Peleiōhōlani. The weapons on the Hawaiʻi side were turned to bathwater, and the small group of warriors could not face them under the movement. Hana was there the favorite warrior of Peleiōhōlani along with Malamakuhiena, Makokalai, Kulepa, Opuhalii, Kualea, Lononuiakea, Paikahawai, Kaweloikaikulu, and Kamahuakoaie. These were the famous warriors of Peleiōhōlani, who were brilliant in rushing attacks and comprised 446 people. But there were over 8,444 warriors on Alapaiʻi's side from six districts. Peleōihōlani thought to meet with Kauhiʻaimokuakama, but Lahaina had been filled in by Alapaʻi's forces from Ukumehame until Māla. The northern border of Lahaina was also filled with the warriors of Alapaʻi, the King of Hawaiʻi. Peleiōhōlani helped in provisions with Kauhiʻaimokuakama, but with his help, he was taken by trouble.

5.2 Habitation

Hawaiians lived extensively throughout the islands. Handy, Handy, and Pukui (1991) identify how different kānaka and their ʻohana lived in accordance with what the authors termed "occupational contrasts" (286), meaning that based on occupation (i.e., planter or fisherman, for example), habitation systems differed. "The typical homestead or *kauhale*… consisted of the sleeping or common house, the men's house, women's eating house, and storehouse, and generally stood in relative isolation in dispersed communities. It was only when topography or the physical character of an area required close proximity of homes that villages exist. There was no term for village. *Kauhale* meant homestead, and when there were a number of *kauhale* close together the same term was used. The old Hawaiians, in other words, had no conception of village or town as a corporate social entity. The terrain and the subsistence economy naturally created the dispersed community of scattered homesteads" (284). Honokowai, being so rich in resources, was likely used for permanent or temporary habitation. The LRFI provides more detail on this history. The description of the land use history included in Section 3.2.2 also provides additional details on the history of kamaʻāina habitation in the primary Project Area.

5.3 Travel and Trail Usage

The ability to travel was essential to Hawaiians and enabled their sustainability. Travel, and the freedom to move throughout different areas, had different names, including huakaʻi, kaʻapuni, or kaʻahele. Traveling by sea had distinct names as well, like ʻaumoana. Traveling through the mountains was sometimes referred to as hele mauna. Travel, and

moving throughout various places and regions was an essential practice and way of life in traditional Hawai‘i.

The freedom to travel safely was so important that Kamehameha I would come to pass a well-known law protecting travelers, Ke Kānāwai Māmalahoe (The Law of the Splintered Paddle). It is explained by the William S. Richardson School of Law as follows:

> As a young warrior chief, Kamehameha the Great came upon commoners fishing along the shoreline. He attacked the fishermen, but during the struggle caught his foot in a lava crevice. One of the fleeing fishermen turned and broke a canoe paddle over the young chief's head. The fisherman's act reminded Kamehameha that human life was precious and deserved respect, and that it is wrong for the powerful to mistreat those who may be weaker.
>
> Years later when Kamehameha became ruler of Hawai‘i, he declared one of his first laws, *Ke Kānāwai Māmalahoe* (the Law of the Splintered Paddle), which guaranteed the safety of the highways to all. This royal edict was law over the entire Hawaiian kingdom during the reign of Kamehameha the Great. Considered one of the most important *kānāwai* (royal edict), the law gave the Hawaiian people an era of freedom from violent assault (William S. Richardson School of Law 2021).

The kānāwai (law) reads:

E nā kānaka	O my people
E mālama ‘oukou i ke akua	Honor thy god
A e mālama ho‘i	Respect alike, the rights of
Ke kānaka nui a me kānaka iki	All men great and humble
E hele ka ‘elemakule	See to it that our aged,
Ka luahine, a me ke kama	Our women, and children
A moe i ke ala	Lie down to sleep by the roadside
A‘ohe mea nana e ho‘opilikia	Without fear of harm
Hewa no, make	Disobey, and die

The law would have such long-lasting resonance that it would be expressly incorporated into the Hawai‘i State Constitution.[6]

[6] Article IX. Section 10 of the Hawaii State Constitution reads: "The law of the splintered paddle, mamala-hoe kanawai, decreed by Kamehameha I--Let every elderly person, woman

As traveling through traditional trails was the primary means by which people traveled on land throughout most of Hawaiian history, the traditional trail system is particularly important throughout the Hawaiian Islands. Throughout the islands, there were numerous trails that allowed for people to access different locations. This trail system was critical not only for maintaining a healthy population and managing this population, but it was also important for the traditional economic system of bartering. The trail system allowed for different localized communities to engage and interact. This also allowed for the trade of goods throughout island communities.

Traditionally, trails were widely used, as there was no other means of land transportation. This meant that these trails were essential to the ability of different ahupua‘a communities to interact. There were also important to allow for the governance of different ahupua‘a by konohiki and ali‘i.

Maui has a great trail that circumnavigated through the entire island. Keka‘a, specifically, also had fabled trails. In “Kumumanao o Kekaa”, that mo‘olelo recounts: “A ua kapaia, mamuli o kekahi o keia mau kanaka kekahi alanui e pill ala ma ka aoao akau hikina iki o Kekaa, “o ke alanui kikeekee a Maui.” O ka mea nae nana i hele mua ia alanui o Eleio, ke kukinf“ mama a Kaalaneo, ke alii kupu eu oia wa.” (Translation: “A road on the northeast side of Kekaa was named after one of these men; it is called “*ke alanui kikeekee a Maui*”– the zizgag pathway of Maui. The first one who trod this pathway, however, was Eleio, the fast runner of Kaalaneo, the excellent king of that period.”)

5.4 Huaka‘i Pō and Leina ka ‘uhane

Ethnographic data revealed that the area is a known for huaka‘i pō, or commonly referred to contemporaneously as “night marchers.” This chiefly procession, especially of ‘uhane (spirits), is also sometimes called ‘oi‘o. Pu‘u Keka‘a is a prominent lava promontory on Maui's Kā‘anapali Beach. In mo‘olelo, it is identified as a leina a ka ‘uhane, or "leap of the soul," where spirits would depart the earthly realm to join their ancestors. This sacred site was also the favored spot of Maui's last ruling chief, Kahekili, who demonstrated his prowess by performing lele kawa (cliff diving) from its heights, showcasing his spiritual strength and mana.

and child lie by the roadside in safety--shall be a unique and living symbol of the State's concern for public safety.”



Figure 21. Youth regularly jump from Puʻu Kekaʻa (Honua Consulting, 2024)

In Hawaiian culture, leina (also called leina a ka ʻuhane) are places where spirits are believed to leap from the earthly realm into the afterlife, transitioning to join their ancestors. These sites hold great cultural and spiritual significance, connecting people with their ancestors and the land itself. Traditionally, leina are located on cliffs or promontories facing west, symbolizing the direction of the setting sun and the entrance to the spirit world. An essential element of these sacred places is the view shed, the open visual expanse that stretches from the land out to the ocean, unimpeded by obstacles. Preserving the view shed is vital for maintaining the spiritual sanctity of these places, as it allows the spirits a clear path to journey onward. “Hawaiian cultural landscapes support the emerging identification of maritime cultural landscapes and their related historic sites and districts across the United States due to the intrinsically holistic nature of Hawaiian environmental epistemology, which was inclusive of the land, sea, and sky” (Watson 2018).

It is important to note that in some cases, leina also have modern recreational purposes. During a site visit, it was observed that many young individuals leaping from the puʻu. Those recreational uses are not discussed nor considered herein; rather, those uses are

identified and resolved in the Coastal and Marine Uses Report, which has been prepared for and is included as an appendix in the EIS.

One of the most well-known leina sites is Puʻu Kekaʻa. Historically, this rocky promontory served as a sacred space where the spirits of the departed would leap into the spirit world. Its cultural significance is amplified by stories of Kahekili, Maui's last ruling chief, who is said to have leapt from Puʻu Kekaʻa to demonstrate his strength and mana. Today, this site remains sacred to Native Hawaiians and is currently honored in a nightly cliff-diving ceremony conducted by and at the Sheraton Maui Resort, where the history of Puʻu Kekaʻa is preserved and shared with today's visitors and even members of the public. Feasible actions to reasonably protect the view shed at Puʻu Kekaʻa is essential to honoring the space's cultural significance, as it symbolizes the spirits' clear and unencumbered passage.

While leina exist throughout the islands, they are fairly rare. There are only a few, at most, on each island. On Oʻahu, a well-known leina is Leina a ka ʻUhane, near Kaʻena Point, located at the island's westernmost edge. This leina is associated with the transition between life and the afterlife and is considered one of the most important spiritual sites in Hawaiʻi. The area's expansive view of the ocean is essential, reflecting the spirits' journey into the unknown. According to tradition, the spirits of the deceased leap off Kaʻena Point, joining the ancestral spirits in Po, the Hawaiian realm of spirits. For Native Hawaiians, consideration of the visual integrity of Kaʻena Point's view shed is not only a matter of aesthetics but showing a deep respect for the cultural landscape that supports spiritual beliefs. Obstructions may be perceived as disrupting a pathway that has been spiritually significant for generations.

On Hawaiʻi Island, Ka Lae (South Point) is another recognized leina a ka ʻuhane. It is the southernmost point in Hawaiʻi and one of the oldest settled areas in the islands, dating back thousands of years. Molokaʻi's cliffs at Kalaupapa hold another significant leina, where spirits are also said to leap into the spirit world. On Kauaʻi, the cliffs around Polihale are also considered leina and hold deep spiritual meaning. Here, the view shed stretches far over the western ocean, symbolizing the spirits' path toward the ancestral land of Kahiki. This sacred place must be left visually open, for any disruption to the line of sight may be seen as a disruption of the spirits' journey.



Figure 22. Another view of youth leaping from Puʻu Kekaʻa (Honua Consulting, 2024)

Across Hawaiʻi, these leina sites serve not only as places of spiritual transition but also as symbols of the deep relationship between the Hawaiian people, the land, and their ancestors. Preserving the open view sheds at leina sites is essential to maintaining the cultural and spiritual integrity of these places. Development or obstructions that interfere with these sacred visual pathways may and are likely to be seen as a violation of the spirits' journey, disrupting the ancestral connection that has been respected for generations. Preserving and protecting the unobstruction of leina views is an acknowledgment of the Hawaiian worldview that cherishes the land as a living, interconnected space infused with spiritual meaning.

5.5 Farming

Since poi was the staple food for Native Hawaiians, it was of the utmost priority for the first settlers to establish loʻi. Kalo's prominence in the Hawaiian diet derived from its nutritional value, but even more so from its mythological significance. According to Hawaiian traditions, the first human (male) was born from the taro plant:

> The first born son of Wakea and Papa was of premature birth and was given the name Haloa-naka. The little thing died, however, and its body was buried in the ground at one end of the house. After a while, a taro plant shot up from the child's body, the leaf of which was named lau-kapa-lili, quivering leaf; but the steam was given the name Haloa.
>
> After that another child was born to them, whom they called Haloa, from the stalk of the taro. He is the progenitor of all the peoples of the earth. (Malo 1951:244)

The broader Study Area of Honokōwai has an extensive history of farming that extends well back into the pre-European contact era. However, because of introduced species of cattle, Hawaiians in the region struggled at times to manage the resources of their farming practices as cattle were known to decimate crops. The following is a passage detailing the issue in the year 1846:

> ***Ka Elele,* Pepeluali 10, 1846, 'ao'ao 177.**
> ***Honokowai, Nov. 20, 1845***
>
> Aloha oe e ka Elele Hawaii, ka pua rose o keia pae aina, ka mea hanohano, e noho mau ana iloko o ka Ahaolelo o na'lii.
>
> Ua heluhelu au, a imi, a noii, a halalo, a wehewehe, a ike iho la, i ka manao o P.K. ma ka pepa 16, aoao 123, e hoahewa ana i ka hana pono ole, a ka bipi, a me ka lio, a me na holoholona e ae. Nolaila la, hu ae ko'u manao, a me ko'u aloha e kokua aku mamuli o ia mau manao
>
> Eia makou o Honokawai nei, ke noho nei me ka pilikia, no ka pau loa o na mea kanu a o ko makou mau lima i kanu ai. Pau ko makou mau mala uwala, mala ipu, pau loa na kihapai, mai kela aoao a keia aoao, hele ka puaa, ka bipi, ka lio. Nolaila, he poino nui keia ma keia wahi.
>
> O ka poe i hopu i na holoholona, a hele aku a lawe ana e hoouku i ka poe nana ka lio, ka bipi, a hoike aku i ka mea nona ka lio, me ka i aku, "Ua hewa ko lio, ua ai i kau mau mea kanu. Nolaila, hele mai nei au e uku ae i ka hapaha e like me ke *kumu Kanawai.*
>
> O kekahi poe mea lio, hoole no, aole he kanawai i kauia, o kekahi i ka hapaha. Nui loa na lio, a me na bipi i kuu wale ia mai: no Lahainalalo mai keia mau holoholona, a no keia wahi no hoi kekahi. O ka poe malama loa i ko lakou mau holoholona, aole no lakou keia olelo.
>
> E na'lii, Na Lunakanawai, a me ka poe loio, e noho ana iloko o ka ahaolelo, a me ka poe makemake i keia.
>
> He wahi ninau ko'u, aole anei kanawai no ka holoholona kolohe i na mea kanu?

He oiaio no anei, aole e uku ia ka mea nana ka mea kanu i pau?
He pono nui loa keia; ke uwe nei makou no ko makou pilikia loa. A nolaila, ke kani aku nei keia waha, a me keia bila, a me keia ohe, e hooponopono mai oe me kou akamai, a me kou aloha maoli ia makou o Honokowai nei. Pehea la keia pilikia o makou nei? E pono anei e kokua aku oe mamuli o na mea holoholona?
Ina he mea pono e hoakaka mai i lohe makou o na kuaaina nei. He nui loa ka‘u mau mala uwala i pau i ka bipi, a me ka lio. Nolaila nui ko‘u pilikia

***Ka Elele, February* 10, 1846, Page 177.**
Honokōwai, Nov. 20, 1845.

Greetings to you, the Elele Hawaii, the rose blossom of this archipelago, the honorable one who continues to dwell in the court of the chiefs.

I read, sought out, researched, reflected, defined, and saw P.K.’s thought on page 123 of paper 16, to blame the cow, horse, and other animals for their wrongdoings. However, I bring my thoughts as well as my love to support by way of these ideas.

Here we are in Honokōwai, living in strife because all our hand-planted food crops have been decimated. Our sweet potato, squash, and vegetable gardens are finished. From one side to the other, the pigs, cows, and horses come. I met great misfortune in this place.

Those who catch the animals and bring them before their owners for payment say, “Your horse has done wrong and has eaten my vegetables. Therefore, I come to collect my payment one quarter in accordance with the law.”

The horse’s owner will refuse and say that there is no law requiring a quarter’s payment. A great many horses and cows have been released. These animals are from Lahainaluna and this place as well. For the people who continue to care for their animals, this isn’t for you.

Chiefs, lawmakers, and lawyers that sit within the council, and those interested in this, I have a question for you. Is there not a law for these animals that cause mischief over crops? Is it true that no payment shall be made to the person whose crops have been destroyed?

It would be really just as we are crying for our great strife. Therefore, this mouth, the instrument, and the flute, sound to have you make right this issue with your intelligence and true love for the people of Honōkowai. How is this issue of ours going to be treated? Isn’t it right that you folks help us because of the work of the animals?

> If it is right, explain it to us. We, the country folk, are listening. A great deal of my sweet potato gardens are gone because of the cow and horse. Therefore, my strife is great.

More recent agricultural practices have been associated with Pioneer Mill and plantations (see Figure 18).

5.6 Traditional Clothing (Clothes Making, Dyeing, and Lei Making)

Kapa (commonly known as barkcloth) was the traditional material made through a traditional method of gathering, treating, and beating plant fibers, often, but not limited to, wauke (*Broussonetia papyrifera*) to make fabric that was used to make lole (clothing). Pacific and Hawaiian kapa was known for its wide range of colors and the application of watermarks.

One article describes the process for making kapa:

> The finest kapa came from the paper of the mulberry tree. These trees were cultivated on plantations and grew to heights of more than twelve feet. As the tree grew, the branches were nipped off along the main trunk, insuring a long piece of bark which was easily peeled from the tree.
>
> The manufacture of kapa was an important occupation for women. After the bark had been peeled from the tree, the inner bark was separated and soaked in sea water to make it soft and pulpy. The softened bark was placed on an anvil and beaten with a cylindrical wooden beater. The first beating separted the fibers and produced strips about eight or nine feet long and ten to fourteen inches wide. These strips could be dried and stored until needed. When needed, the strips were soaked in water, placed in layers between banana leaves, and left for about ten days to mature by "retting" which is the decomposition and removal of softened tissues, leaving the finer fibers. These partially decomposed layered strips were beaten a second time with specially carved four-sided beaters. The patterns carved on the beaters were functional as they produced the necessary characteristics in the kapa for its end use. These carved designs left the equivalent of a watermark on the kapa.
>
> Kapa which was to be extremely soft and pliable, such as that used for the malo or loincloth, was subjected to an additional softening process. This process, which produced a finely ribbed fabric, was done by dampening the cloth, stretching it over a grooved board, and running a wooden grooving

> tool along the indentations in the board. When the cloth dried, permanent ribs remained. The hand was very similar to our crinkle gauze of today (Furer 1981:109-110).

Hawaiians were skilled at utilizing plants and materials to dye their clothing and other materials. Different methods would be employed to hōʻawa, extract dye colors from their source material(s). These dyes would be placed in a cup, known as a kā kāpala. Even foreign or exotic plants were utilized for this practice. Hawaiians used different words for the various types of dyeing activities and methods.

- Weʻa – a red dye or to print or dye red
- Hili – bark dye, as hili kukui, hili kōlea, hili noni; also kapa dyed with bark or the name for dyeing with the use of bark
- Kūhili – to dye (or stain) by soaking in water containing mashed bark, such as used for nets; also mulberry bark before it is beat into kapa
- Kūpenu – to dye by dipping material
- Kiʻolena – to dye kapa
- Hōlei –native tree (*Ochorosia compta*) related to the hao (*Rauvolfia*), which yields a yellow dye for kapa
- Kīheʻaheʻa palaʻā – dye made from the palaʻā (Sphenomeria chinensis syn. chusana) fern; palaʻā also references a kapa made from the māmaki (*Pipturus spp.*) bark which is then dyed a brownish-red with palaʻā fern

Hawaiians also had a lexicon for the various colors that could be achieved through this traditional practice.

- ʻŌlenalena – yellow
- Hili – Dark-brown dye made from bark
- Puakai – red
- Nao – dark red
- Pōkohukohu – color made from the noni (*Morinda citrifolia*) root
- ʻĀkala – color made from raspberry or thimbleberry juice
- ʻŌmaʻomaʻo – light green color made from maʻo leaves

Similarly, lei making was a regular occurrence in traditional Hawaii. Anderson-Fung and Maly (2009) write about the traditional practice:

> In old Hawaiʻi, lei could have important ceremonial functions, such as in religious offerings and for chiefly regalia, but lei were also enjoyed as personal adornment by Hawaiians of all levels of society. The aliʻi (chiefs)

and the makaʻainäna (the common people who tended the land) all wore lei. Even the akua (gods, deities, spirits), it was believed, sometimes wore lei when they walked the land in human form. The following observation by the French botanist Gaudichaud, who visited the islands in 1819, paints a picture of Hawaiʻi as a place where the lei was an integral part of everyday life:

> "It is indeed rare to encounter one of the natives of this archipelago who does not have an ornamental plant on his head or neck or some other part of his body…[The] women … change [the plants they wear] according to the seasons, [and for them] all the fragrant plants, all flowers, and even the colored fruits, serve as attire, one after another. …The young girls of the people, those of the island of Hawaiʻi especially, seem to be fond of the [kou, Cordia subcordata], a tree very abundant in all the cultivated areas… The young girls of the mountains, who live near the forests, give their preference to the flowers of the [Erythrina (wiliwili) and a species of Canavalia, called ʻawikiwiki], the lively color of which makes magnificent garlands. Such natural attire is much more rich, much more striking, than all the dazzling creations of the elegant European ladies."

This account and others like it suggest that lei worn for personal adornment were fashioned from the favorite plant materials that were readily available and abundant in the lei maker's environment. Lei making continues as an important practice today, as the making and giving of lei as an expression of aloha to loved ones still regularly occurs throughout the Hawaiian Islands. There is no indicator this occus in the primary Project Area or secondary Project Area, although it is continued in the broader Study Area in the region.

5.7 Kilo

Kilo are observational traditions and people who examine, observe, or forecast are identified as kilo and serve as traditional climate and weather experts. Kilo "references a Hawaiian observation approach which includes watching or observing [the] environment and resources by listening to the subtleties of place to help guide decisions for management and pono practices" (ʻĀuamo Portal 2021). The practice of kilo is seen to be resurgence on Hawaiʻi Island and in the Hawaiian Islands.

Kilo hōkū are traditional astronomers or those who study the stars. A hale kilo or hale kilo hōkū were observatories or star observatories, respectively. Kilo Makani were those who

traditionally observed the winds. Kilo Moana were traditionally oceanographers. Kilo ʻuhane were those who followed and communicated with spirits.

Traditionally, the practice of kilo, or observation, was critical to managing traditional Hawaiian landscapes. This practice is closely tied to traditional or customary access, as observers would require access to specific vistas, viewsheds, or areas to observe environmental phenomena.

As illustrated in the following section, Native Hawaiians created various terms to describe the environment and understand the ecosystems around them. These terms were often quite specific, and many were tied closely to a particular geographic area. This level of specificity illustrated the close kinship Hawaiians shared with their surrounding environment. The ability to observe and understand all elements of their ecosystem was essential to the successful care of natural resources and the survival of the Hawaiian people.

The ability to effectively and accurately read weather phenomena was essential to the ability of Hawaiian people to farm, fish, navigate, and conduct any number of practices sustainably and successfully. The knowledge Hawaiians acquired about the environment around them, including weather phenomena, resulted from multi-generational observations that comprised an extensive body of information passed down through oral traditions. The following Hawaiian names and their descriptions of weather phenomena include words for clouds, rains, and winds that are utilized by Kilo to help guide activities and practices:

- ao akua – godly cloud, symbolic representative of a rainbow.
- ao loa – long cloud or high, distant cloud. Status cloud along the horizon.
- ao ʻōnohi – cloud with rainbow, ʻōnohi, colors contained within it.
- ao puaʻa – cumulus clouds of various sizes piled together, like a mother pig with piglets clustered around her. The Kona coast is famous for ao puaʻa, a sign of good weather and no impending storms.
- ao pehupehu – continually growing cumulus typical of summer. Drifting with the tradewinds, these clouds pick up moisture and darken at their base, finally releasing rain on the windward mountain cliffs.
- hoʻomalumalu – sheltering cloud.
- hoʻoweliweli – threatening cloud.
- ānuenue – rainbow, a favorable omen.
- ua loa – extended rainstorm.
- ua poko – short rain spell.

Kilo practices may occur at the primary Project Area, primarily with fishermen who use observational skills to identify fish in the area. Kilo would have been particularly important in the area as Kekaʻa in the secondary Project Area, as the vantage would be valuable to locating schools of fish and the area was known for its fishing grounds.

5.9 Haku Mele, Haku Oli, and Hula

This practice, related to the composition of songs and chants, has existed for many centuries in Hawaiian culture. When the culture primarily relied on an oral tradition to pass on knowledge and information, the ability to create songs and chants was essential for passing information from one generation to the next. Donaghy (2013) notes that Hawaiians had hundreds of terms associated with this practice.

The environment around them largely influences songs and chants. As a pedagogical device, it was necessary, if not imperative, that these songs or chants effectively captured data from the environment around the composer and passed on this information for others to utilize when managing natural resources. The land and natural resources act as a muse for composers. The category of songs that provide information on or speak to natural resources is called mele ʻāina (songs of the land). As shown in the previous section, numerous traditional chants and songs about the Project Area and its surrounding landscape exist, and mele for this area have been historically written and well as recently written, as it is an active practice.

Much like mele and oli, hula serves as a way of honoring place and telling the story of place. Many hula, especially those based on mele ʻāina, require an intimate understanding of the place where the mele was composed, including the natural elements of that ʻāina. Hula hālau will regularly take huakaʻi, or journeys, to visit and honor the place a particular mele speaks of. The ability to see the place and learn about it is essential to hula practice.

Hula, as well as mele or oli, are also offered as gifts to kupuna or gods. This practice requires access to traditional sites. Associated with hula would have been lei-making practices and using plants to dye clothing.

5.10 Fishing and Loko Iʻa

In an interview conducted by Kepā Maly (2003) with Uncle Moon Keahinuiʻenaʻenaikaponookaʻōpua, Uncle Moon describes fishing at Kekaʻa rock and the story his father told him about the waters that turn red before a disaster in Lahainā. For years, Uncle Moon wondered what his father meant by this until, one day, it all clicked for Uncle Moon. The water turns red with the arrival of the ʻāweoweo fish. Uncle Moon was part of a team of anglers who sustained their community during that plantation strike of

‘58. Not only is this a narrative about fishing at Kekaʻa, but it is also about a community working together to provide vital resources in times of need, or “disaster,” as Uncle Moon puts it. The following is an excerpt from this oral history interview. (1073-1075)

> Uncle Moon Keahi was born in Māla in 1935. He began fishing for ʻōpelu with his father, Jacob Keahi (and nephew Gilbert Neizman), before he was ten years old. Uncle Moon has fished most of his life. During the interview, he describes the traditions and customs observed by his family while fishing, and shared the values held in common, by elder Hawaiian fisher-people, who care for the resources which sustain them.
>
> KM: Now you were just telling us about Kekaʻa and what your papa said about the Kekaʻa stone.
>
> MK: He always told us that… Well, he and I, we, in the afternoon when I come home from school, and then when I started working for the plantation when I come home from work. He and I used to patch net on the beach, *ʻōpelu* net or our surround net.
>
> KM: *ʻAe.*
>
> MK: He used to tell me about Kekaʻa. I don’t know if other people had the same story. This came from my dad. So he told me that every time there was a disaster in Lāhainā, the sea water would turn red. Like one time, when they had the Japanese strike, the plantation, that sea water turned red. And then they had the depression and it was the same thing. Even then, I wasn’t really sure what he meant when he said “the sea water turned red.”
>
> KM: Yes.
>
> MK: So when we went on the strike in 1958, I was captain of one of the boats. They had another captain this guy Andrew Kahahane, he was captain of the other boat. His father was our chairman, like. That morning, the first day we went on the strike we were down at Launiupoko, we made a couple surround over there for *kawelеʻā*. Then came this guy Harrison Neizman, that’s Gilbert’s cousin. He said, “How come we don’t go and catch the *ʻāweoweo* at Kaʻanapali.” We asked him, “Is it worth our while?” He said, “Get about fifty tubs.” This guy Kimo Kahahane, that was Andrew’s dad, he looked, “what you guys think?” “We might as well go and get them because the fish can go to the soup kitchen.” See had several soup kitchens in

Lāhainā. Before we went on the strike the union really mobilized. They had guys who took care of the wood cutting, guys who took care of the soup kitchen, guys who took care of the mechanical work. These mechanics were sent up to Kula to help the farmers up there. Help them with their trucks and tractors. The carpenters were set up to help too, to help with storage and stuff like that. We were kind of really, really mobilized. Us, we took care of the fishing. So we took our boat from Launiupoko, loaded it up with the nets and went over to Kaʻanapali. We made the surround around the rock, right around, a complete surround. I jumped into the water after that. As soon as I jumped into the water [smiling], then I realized what my father was talking about, that *ʻāweoweo.* They were stacked and all pili to the wall.

KM: All *pili* to the Kekaʻa stone?

MK: Yes, the Kekaʻa rock, they were all stacked. We made the surround. The first net that we brought up, was all *hei* fish so we brought it up on the sand. Let the guys who was hooking come get, come take home fish. They had plenty fish. The rest of the fish all went to the soup kitchen. We had one guy's house was up to the ceiling with fish. The Obongs, the old ladies, that was their job to clean all the fish. We had *ʻāweoweo* coming through our ears almost. They had them soup, they made ʻem fry, they made them all kinds of ways. It was good.

KM: Yes.

MK: In the mean time we still go fishing for other kind fish. We do surround net. In fact there was several times we went around the island for go catch fish. Most of it went straight to the soup kitchen. They cut them up and cook them for the working men. But that *ʻāweoweo*, ever since then I'd always told people about that *ʻāweoweo.*

KM: It's very interesting because you said papa or *kūkū* them, someone said it was a sign right of something *pilikia ʻana*?

MK: It was a sign, yes.

KM: And sure enough, Is that the last time you think that *ʻāweoweo* went like that in ʻ58? That you heard of?

MK: I don't know of any other disaster that happened in Lāhainā that would bring them back.

KM: Yes.

MK: I thought maybe, twice they had a hurricane. Right after ʻIniki, had one more coming in around four hundred miles out. My boss had asked what I thought about that hurricane because it was heading towards Hawaiʻi. I told him, "No, I don't think so." He looked at me, "How come you're so sure?" I told him about the ʻāweoweo.

KM: ʻAe.

MK: There was another hurricane that was coming to here and according to the news, it was supposed to come around here and hit Lāhainā through the back. And the same thing, it didn't happen. I asked my kids, sometimes they go swimming over there. I told them if they had seen the *ʻāweoweo* there. They said, "No, no more." "Okay," because I would have seen the sign.

KM: Interesting the association of *ʻāweoweo* with that Kekaʻa section like that?

MK: Yes. I mentioned this to some other people, and they are much older then [sic] me. And they said the ʻāweoweo was always like that. When that fish comes in something is going to happen. They're not sure. Yeah, what might happen. But my father always saying that there is some kind of disaster. So far [knocks on wooden table], it never happened again.



Figure 23. Honokowai Beach Park, photo from County of Maui.

Interviewees spoke of the importance of fishing and accessing ocean resources. Much of the fishing in Honokowai now occurs north of the project area at Honokowai Beach Park. Fishing also occurs in the Project Area, although practitioners expressed a preference for fishing at the public park due to its ease of access and parking availability.

5.11 Paddling

Canoe paddling, a popular and robust sport in the Hawaiian Islands and Pacific, has a rich history in Hawai‘i. In the mo‘olelo of *The Wind Gourd of La‘amaomao,* the young son of La‘amaumau and the high priest Kū‘anu‘uanu, Pāka‘a, stands out for his innovative tenacity. Credited by the author, Moses Kuaea Nakuina, for the development of sailing technologies, Pāka‘a’s story is a testament to the resilience and innovation of the Hawaiian people. The notion that Hawaiians sailed here from faraway lands hints at the mo‘olelo being part of an older tradition in the rest of the Pacific.

Kūanu‘uanu, having sailed to Kaua‘i from Waipi‘o Hawai‘i, fell in love with a woman from Kapa‘a named La‘amaomao. Soon, Kūanu‘uanu was called back to the court of

Keawenuiaʻumi, who missed his kahu dearly. His departure left Laʻamaomao destitute, with no one to care for her needs. Because the actual rank of her companion was kept a secret, her family rejected her, thinking she had squandered the opportunity of her youth and beauty by her pregnancy. She soon gives birth to a son named Pākaʻa, named after the cracked and scaley skin of Keawenuiaʻumi—who was an avid ʻawa drinker.

The strong familial bonds marked Pākaʻa's upbringing and support of his mother and her brother, Maʻilou. Recognizing his intelligence, they were not surprised when he expressed his desire to fish with the adults. With their approval, Pākaʻa was allowed to venture to the sea, a testament to the trust and support he had from his family.

After preparing his sail and other previously unknown technologies of deep-sea fishing, Pākaʻa was off with the adults, maneuvering his canoe in a fashion that would allow him to grab an excess of mālolo from their nets. Upon returning to shore, Pākaʻa challenges the adults to a heihei waʻa (canoe race). Surprised by his request, they compare the number of fish they have, ultimately ending in a deal. Should Pākaʻa win, he receives the lot of eight adults; should they win, they will receive his lot. Pākaʻa wins in an epic race and takes home his wins to share with his family.

In the 19th century, canoe paddling and racing continued to be popular sports, especially around King Kalākaua's birthday celebrations on November 16th of every year. The following passage from *Ka Nupepa Kuokoa* on October 16th, 1875, details the planning of these celebrations:

Ka Nupepa Kuokoa

Ka la hanau o ka Moi **Okatoba 16, 1875 (ʻAoʻao 2)**	**The birthday of the King** **October 16, 1875 (Page 2)**
Ke kokoke mai nei ka la hanau o ka Lani Kalakaua i ka 16 of keia Nov. Ae. O ia ka la maikai a kona mau makaainana naau lokahi e hoikike ai i kekahi hana hookahakaha nui, i mea e hoolealea ai no ia la kulaia. Ua lonolono wale mai makou, e paikau hookahakaha nui ana na koa pualu [sic]. Ua hapai wale ia mai hoi kekahi manao malia he lealea kupono ka heihei waapa a me ka heihei waa maoli ma ke awa nei; a o ka heihei au paha iloko o ke	The birthday of our chief, Kalākaua is soon approaching on the 16th of this coming November. It will be a great day for his harmonious subjects to showcase some large displays to liven up this celebratory day. It has been heard in rumor that there will be a great march of soldiers. We thought it might also be joyous to have a boat race with a canoe race at the harbor; perhaps even a swimming race in the ocean; and perhaps too a messenger on

kai; a o ke kukini wawae paha makai o Ainahou, ke haawiia kekahi mau makana i ka poe e eo ana.	the ocean side of Ainahou to be there to give prizes to those who win.

The moku of Ka‘anapali has a rich modern history of canoe paddling. The Lahaina Canoe Club, located on the far south side of Ka‘anapali Beach, was founded in 1971 by George Paoa, Sam Kaai, Bob McDonald, and Barbara Long. They started the club to “develop community-wide cooperation and participation in a true Hawaiian sport...[to] encourage Lahaina’s youth to train and compete in a sport that requires individual stamina, coordination, precision, and teamwork.”

The tight-knit canoe club continues to work toward developing “competitive race crews” for children and adults. The club also engages in community outreach initiatives and participates in programs via the Maui Cultural Lands Honokowai Valley Restoration project, a restoration project in the mauka lands in Honokowai. For more information on the Lahaina Canoe Club, please visit this link: https://www.lahainacanoeclub.com/history/.

5.12 Surfing

The region around the Project Area is famous for surfing. Uo, mentioned in the following excerpt, is a renowned surfing spot off the coast of Lahaina. While the exact location of Uo is not documented, it is believed to be more in the Lahaina area, which is south of the Project Area. The following passage was taken from “Na Hunahuna no ka Moolelo Hawaii” authored by John Papa ‘Ī‘ī. The excerpt follows the journey of Kamehameha and his family returning to Hawai‘i island from O‘ahu. After a series of issues with their ship leaking, the entourage of chiefs and the young prince (probably Kamehameha II) make their way past Moloka‘i and into the Lahaina region. The vignette depicts the sight of children surfing banana trunks at Pā Pelekane around the year 1812.

> **Na Hunahuna no ka Moolelo Hawaii, *Ka Nupepa Kuokoa,* Pepeluali 5, 1870.**

A hala na elima paha o ke ku ana o kahi moku kiakahi ma kahi ku moku, a pela ka haalele ana iho ia wahi, a po a ao aku iwaena moana, a po ana i Punakou, a ao aku i Kahalapalaoa, loaa iho la ka makani Maaa, oia kakae wale no a ku ana i Lahaina, a ike ana i na hono o Piilani. Kamahao ka nana ana ma o a maani [pn: maanei], a me ka ulu Ulu a ulu Niu o Lele, hoohaha mai ana, mai kela a keia pea mai; aia hoi na keiki e heenalu ana ma ka aoao akau o Pelekane, me na hamaia, oia ko lakou papa heenalu. A oiai e makaikai ana ua keiki nei ia lakou la e hoohialaai mai ana ia hana, e like me na kanaka makua, mawaho ae o Uo. A oiai ua pae aku lakou nei mai ka moku ae ma kekahi waa kamaaina i pili ae ua wahi moku nei, ike iho la ua keiki nei i ka limukala eleele, no Mokuhinia ae paha, alaila, hoomanao ae la ia i ka limu o kona one hanau, ka mea i maa iaia.

Perhaps five days passed when the ship stopped at the dock and then left that place, spending the night until day in the middle of the ocean. Night fell on them in Punakou, and day came while they were in Kahalapalaoa, where the Ma‘a‘a wind greeted them. They soon arrived at Lahaina and saw the bays of Pi‘ilani. It was a marvelous sight here and there, along with the ‘ulu and niu groves of Lele in the calm. From one end to the other, there were children surfing on the side of Pelekane (Pā Pelekane) using banana trunks as their surfboards. While the young chief observed the voraciousness of the surfing children, their adults [were seen] surfing outside of Uo. While they boarded a canoe from the boat to go to the ship, the young chief saw the limu kala ‘ele‘ele, perhaps from Mokuhinia, which then reminded him of the seaweed of his birth sands, the place he was familiar with.

Surfing continues to be a popular sport among locals within the moku of Ka‘anapali and Lahaina. For more information about local surfing activities, visit Maui Surfing Association’s website: https://hsamaui.org/.

6.0 Ethnographic Data

As discussed in **Section 2.5 (Ethnographic Methodology)**, information was collected from a wide range of individuals and sources. This section discusses the findings of those efforts. Ethnographic data supplements and, at the same time, does not supersede or replace the other research methods. It is one of a range of research tools employed to gather information about the Project Area.

Honua Consulting was tasked with gathering information from individuals identifying themselves with lineal and cultural ties to the area and its vicinity regarding regional biocultural resources, potential impacts on them, and mitigation measures to minimize and/or avoid them.

In its guidance on conducting cultural impact assessment, the Environmental Council noted: “Cultural impacts differ from other types of impacts assessed in environmental assessments or environmental impact statements. A cultural impact assessment includes information relating to the practices and beliefs of a particular cultural or ethnic group or groups. Such information may be obtained through scoping, community meetings, ethnographic interviews and oral histories. Information provided by knowledgeable informants, including traditional cultural practitioners, can be applied to the analysis of cultural impacts in conjunction with information concerning cultural practices and features obtained through consultation and from documentary research” (Environmental Council, 1997). The purpose for gathering this information was emphasized in Act 50, “the past failure to require native Hawaiian cultural impact assessments has resulted in the loss and destruction of many important cultural resources and has interfered with the exervise of native Hawaiian culture. The legislature further finds that due consideration of the effects of human activities on native Hawaiian culture and the exervise thereof is necessary to ensure the continued existence, development, and exercise of native Hawaiian culture” (Act 50, HSL 2000).

Sometimes, the information gathered regarding beliefs from practitioners can differ from information gathered from other sources. Therefore, it is important that the CIA faithfully capture and document beliefs from practitioners, even when these beliefs may be inconsistent with other data. The enabling statute for CIAs clearly states that “Articles IX and XII of the state constitution, other state laws, and the courts of the State impost on government agencies a duty to promote and protect *cultural beliefs*, practices, and resources of native Hawaiians as well as other ethnic groups.” (Act 50, HSL 2000, emphasis added). Therefore, the role of the CIA is to dutifully gather and disclose ethnographic data collected from practitioners that reflect their contemporaneous information about cultural beliefs, practices, and resources.

Ethnographic data is not the only information considered in a CIA. Information available from native testimonies and Hawaiian language sources was integrated into the cultural and historical overview section of this assessment. Those sources and responses to this Proposed Action were considered when researching the traditional or customary practices discussed in a previous section. Interviews were conducted with ten (10) individuals. This data helped identify possible additional resources and practices in the area as they might relate to the Project Area or potential sand source. Interviewees were provided maps of the Project Area during their interviews, as shown in the EISPN. This information also helped to corroborate the other research conducted for this report. Additionally, interviewees were asked about activities associated with Puʻu Kekaʻa.

Note: The interviews were conducted before the Lahaina Fire of 2023. Interviewees were asked post-fire if they wanted to update their interviews. Most chose to leave the interviews as is, while some interviewees did not respond to the request.

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6.1 Interview with Vernon Kalanikau

Interviewer: Mathew Sproat
Interviewee: Vernon Kalanikau
Date: 5/23/23
Location: via Zoom

Biography
Vernon Kalanikau works for the County of Maui in the Office of Economic Development. He was born in Wailuku and raised in Kahakuloa, Maui, and later in Happy Valley before moving to Kīhei. Today, Mr. Kalanikau lives in Kīhei.

Overview
Mr. Kalanikau is associated with the project area as a Native Hawaiian living in Maui. Mr. Kalanikau is also very engaged across the broader community of Maui and is concerned about Maui's natural and cultural resources. In his personal life, he accesses the area for beach activities, family activities, fishing, and general use.

General Discussion
Mr. Kalanikau shared that the area has changed over the course of his life, noting that there used to be much more beach. He explained that he has never had issues with accessing the beach.

Cultural Resources
Mr. Kalanikau explained that the biggest cultural resources in the area are ocean resources, including fish. He considers sand to be a kinolau[7], as sand previously came from a living reef.

Traditions and Customs
Mr. Kalanikau noted that the most likely traditional and customary practices that occur in the area likely revolve around fishing and gathering. He is not sure if people fish for subsistence in the area.

Impacts
Mr. Kalanikau shared concerns that beach hardening can cause beach loss in adjacent areas. In other areas on Maui where beach hardening has occurred, there have been adverse impacts on ocean and coastal resources. Mr. Kalanikau also shared concerns with putting in new sand from the cultural perspective that sand is a kinolau. Moreover,

[7] Hawaiian term for a body form of deities.

he noted that new sand could cover the reef and impact reef and marine life and fishing practices. However, Mr. Kalanikau explained that if done correctly, the project could create an environment that is helpful for marine and reef life.

Mitigation Measures and Recommendations
Mr. Kanalikau could not provide any mitigation measures or recommendations for the project. He believes that the only feasible long-term solution is managed retreat.

6.2 Interview with Rose and Walker Crichton

Interviewer: Mathew Sproat
Interviewee: Rose and Walker Crichton
Date: May 2, 2023
Location: via telephone

Biography
Both Rose and Walker Crichton are in the hospitality industry. Mr. Crichton works for a few hotels, and Mrs. Crichton works for a condominium complex. Mrs. Crichton was born and raised on Maui, and Mr. Crichton was born on Hawai‘i Island, but was raised on O‘ahu. Mrs. Crichton was raised in Lāhainā and has lived in West Maui since. Today, they reside in West Maui, five minutes from the project area.

Overview
Mr. and Mrs. Crichton are associated with the project area through the Lāhainā Canoe Club, which was established in 1971. They are both on the board of directors for the club, with Mrs. Crichton serving as the president and Mr. Crichton serving as the vice-president. Mrs. Crichton is also the head keiki coach, and Mr. Crichton is the adult assistant coach.

General Discussion
Mr. and Mrs. Crichton do not often access the beach near the project area since the area is mostly fishing grounds. In their interview, they made special mention of how the project could impact canoe paddling, surfing, diving, and fishing in the area. These practices have occurred in the area for generations.

Cultural Resources
Mrs. Crichton explained that the northern part of Black Rock is where they commonly paddle. There are currents which front the point area, and the currents flow in such a way that they can regroup in front of the Ka‘anapali Beach Club.

Mr. Crichton also explained that the area is also used by Native Hawaiian families for traditional fishing. He also shared that this area of the reef is known for tako (octopus) and other subsistence diving, and is also used for surfing under the right conditions.

Traditions and Customs

Mr. Crichton made a special point to note that paddling canoe is more than just going out in a canoe, it is a classroom. It is a way to show the keiki what used to be, and provide them a space to connect with a traditional practice. Mrs. Crichton explained that the area is used heavily by fishermen and is known as a traditional fishing and diving place.

Impacts

Mr. Crichton shared that any alterations to the area will change what the canoe club and paddlers have been doing for decades. Mrs. Crichton noted that the reef structure is what forms the current, and if additional sand or the t-groins were to alter the reef and currents, it may significantly impact their ability to paddle canoes. The project may also impact the reef break and surfing. For paddlers, if the area is no longer suitable for paddling, they will have to venture further out. However, contending with wind is a huge concern, and may not be possible.

Further, Mrs. Crichton noted that the reef in the area is protected, and shared that the sand could impact the biological resources of the reef. She also shared that there is no guarantee that what is done in the project area won't impact other areas along the coastline, explaining that residents have personal experiences of seeing how seawalls and other developments have resulted in beach erosion.

Mr. Crichton explained that this project, which is to accommodate tourists, is not worth losing all the resources that generations of people have used and enjoyed.

Mitigation Measures and Recommendations

Mrs. Crichton recommended investing in land upland. She shared that no one knows what will specifically happen in the area with t-groins and added sand. In other contexts like Florida, similar developments for beach restoration have not worked.

Mr. Crichton shared that the hotels and development along the coast in the area are already built on sand. As such, if development was relocated to an area further inland, there are suitable conditions for a new beach to be created.

6.3 Interview with Luana Kawa`a

Interviewer: Matthew Sproat
Interviewee: Luana Kawa`a

Date: 2/17/23
Location: Wailuku, Maui

Biography

Luana Kawa‘a was born on Maui and raised most of her life in the ahupua’a of Wailuku. She has always called the area of Nā Wai ‘Ehā her home. Mrs. Kawa‘a received her bachelor degree in Hawaiian studies from the University of Hilo and her master’s degree in education. After receiving her masters degree, she began her teaching career at Baldwin High School and Kamehameha Schools Maui campus as a Hawaiian language teacher. In 2016, she moved to the University of Hawaii Maui campus and runs a federally funded grant program. She is also a Kumu Hula and a Hawaiian Cultural Consultant.

Overview

Luana Kawa‘a is associated with Honokowai as a Hawaiian Cultural Consultant and historian for the island of Maui.

General Discussion

Mrs Kawa‘a spoke of the ocean fronting the project area is a popular fishing spot for many kama‘aina, but throughout the years have been met with many challenges regarding access and parking. She mentions that this project will increase the impacts upon the reef and the natural tides regarding fishing and the traditional practices in Honokowai. Mrs. Kawa‘a claims that there are a lot of subsistance fishermen in the Honokowai area that still depend upon the ocean resources in the project area and is concerned if the project will have an adverse affect upon those resources.

Cultural Resources

Mrs. Kawa‘a states the main cultural resources in the area are ocean resources such as fish, limu, and crustacean.

Traditions and Customs

Among the many traditions within the project area, Mrs. Kawa‘a states fishing and ocean resource gathering as the main cultural tradition within the area.

Impacts

The main impacts of the project would be the access to fishermen and the seasonal shift of the sand which is common in the Lahaina area. Any type of beach nourishment could cause an impact on the reef area and coral life.

Mitigation Measures and Recommendations

Mrs. Kawa'a says that she would not be the best person to request a mitigation measure. Instead, the local fishing community should be consulted in which would be the best solution for best management practices. Mrs. Kawa'a feels that pumping in sand from the outer ocean area is not favorable to her. She also is not familiar with T groins, but states that her personal feeling is to let nature do what it does. She ends with an olelo no'eau "He ali'i ka 'āina, he kauwā ke kanaka, The land is chief, we are its servant." We should not be forcing any man made changes.

6.4 Interview with Kekai Keahi

Interviewer: Mathew Sproat
Interviewee: Kekai Keahi
Date: 2/19/2023
Location: In person, Napili, Maui

Biography
Kekai Keahi is a teacher and carpenter. He was born and raised in Lāhaina. Mr. Keahi shared that he is a lineal and cultural descendant of the area, describing that his lineage has been there "since the first canoe".

Overview
Mr. Keahi is associated with the project area through being born and raised in the area. He lives approximately 5 miles from the actual project site. He is involved in paddling in the area and was also part of a group, Kamalu O Kahalawai, that restored streams and ecosystems in West Maui.

General Discussion
Mr. Keahi explained that the area's currents move extremely quickly, and the ocean geography funnels the wind and waves. As such, he believes that any added sand would be swept out quickly. He shared that the amount of sand required to maintain the current dry beach is much more than what the project currently has planned.

Cultural Resources
Mr. Keahi explained that the beaches have already been impacted from decades of development. He shared some of the cultural resources used for sustenance in the project

area include fish and limu. Limu kohu is one of the only present limu species in thea area currently. Other limu including limu lipoa, pepeʻe, and manauea are all gone.

Traditions and Customs
Mr. Keahi shared that paddling, surfing (usually on a south swell), fishing, and gathering take place in the general area.

Impacts
Mr. Keahi raised concerns about how marine and coastal life will adapt to a sudden change in environment, in this case tons of new sand being added into the environment. Mr. Keahi shared that the beach width changes seasonally. The limu in the area know to adapt with these seasonal changes. A drastic and sudden change to the environment may create a significant adverse impact.

Additionally, Mr. Keahi explained that seasonal swells displace and move an enormous amount of sand all across the area. As such, he raised concerns regarding the impacts from tons and tons of new, additional sand flowing across the reef with the drastic seasonal changes. He used the metaphor of sandpaper slowly scraping and rubbing across the reef over time. Mr. Keahi alluded to other locations where this has happened, and in these locations the reef ecosystem has been significantly adversely impacted.

Mr. Keahi believes that the t-groins may create some habitat for fish, but will destroy other habitats such as habitat for tako (octopus). The t-groins could also change the movement and habits of fish such as kala.

Importantly, Mr. Keahi shared that the proposed physical developments on the beach (t-groins) could also be psychologically and emotionally impactful. The beach is a culturally important area for the community and generations of people. Witnessing its sudden change through additional development can be hurtful.

Mitigation Measures and Recommendations
Mr. Keahi shared that he does not believe the proposed plans of adding sand to the area, in addition to t-groins, will be effective or good for the environment. He cited the importance of maintaining the gradient of the beach.

6.5 Interview with Kahu Glenn Kamaka

Interviewer: Mathew Sproat
Interviewee: Kahu Glenn Kamaka
Date: 2/19/23

Location: In person, Napili, Maui

Biography

Kahu Glenn Kamaka is a retired employee of the Napili Kai Beach Resort. He was born and raised in Honokahua, Maui and currently resides in Lahaina.

Overview and General Discussion

Rev. Kamaka is a lineal and cultural descendant of the area with at least 5 generations before him being from the Honokahua area. He states that most of the cultural resources on land such as ʻiwi, ancient cultural site, and native flora has been either been removed or moved from the area during the construction of Kaʻanapali and the resorts within the project area. Rev. Kamaka claims that he has never had any issues of accessing the shoreline in Kaʻanapali and claims that this project should not have any major impact on the resources or the customary practices within or near the project area. Rev. Kamaka requests that if this project should proceed, the focus will be to taking care of the ocean and bring back what needs to be brought back to allow the fish and limu to thrive

Cultural Resources

Rev. Kamaka states that since the development of Kaʻanapali over the last few decades, the area has been highly over-developed and whatever resources were there at one time have been built over or have been removed from the land. Rev. Kamaka claims that there used to be fresh water springs in the ocean left of the Kaʻanapali Shores. Those springs were noticable throgh bubbling up from the sand in the near shore waters. He makes note that many of the fresh water sources have been filled with concrete and diverted.

Ocean resources include fish and limu, honu, sharks, and many other aquatic species which the local communities depended on for food. Rev. Kamaka claims that the sharks that are found outside the reef area are ʻaumākua, and many of the locals will lay claim to those ʻaumākua. Rev. Kamaka also mentions that the surf break is really good in that reef area within the project area, and recalls that when he was growing up, the entire area was sandy.

Traditions and Customs

Amongst the cultural and customary practices within and near the project area, Rev. Kamaka notes fishing, surfing, and gathering of limu.

Impacts

Rev. Kamaka claims that the project should have little to no major impacts upon the resources and the customary practices within and near the project area. His concerns would be if the project would include pumping in sand from off shore of Lahaina, he claims that there are precious nabeta breeding grounds in the deep sandy ocean ground off Lahaina. He asks that if that is the project that is chosen, the project managers make sure the nabeta are protected while pumping in the sand from off shore in Lahaina.

Rev. Kamaka claims that mother nature will move the sand once it comes to shore and possibly cover the reef area. He states the sand shifts all the time as he walks the shoreline throughout Lahaina and Honokowai. It is inevitable that the sand will shift according to Re. Kamaka. He states that it could have a negative impact, but at the same time it could have a positive impact and we will not know until the project is done. Mother Nature will continuously replenish whatever she needs.

With regards to the surf spot in the project area, Rev. Kamaka states that it will change the surf break.

Mitigation Measures and Recommendations

With mitigation, Rev. Kamaka requests the nabeta are protected and are not pumped in with the sand from the deep and only sand is sifted through and brought to shore. He also requests if the T-groins are chosen to be used, make sure it could withstand the surf.

6.6 Interview with Jenny Lindsey

Interviewer: Mathew Sproat
Interviewee: Jenny Lindsey
Date: 4/6/23
Location: Lahaina, Maui

Biography

Ms. Lindsey was born and raised in Honokowai, Maui and currently lives in Kula. She states that her great grandmother, Waipulani Paki, was born in a cave in Honokowai and has always called Honokowai her home for many generations. Jenny is a member of the Lahaina Canoe Club, and states she was raised on the beach where the Lahaina Canoe Club resides (nicknamed Canoe Beach). Ms. Lindsey is at this beach every day paddling the shoreline from canoe beach all the way up the coastline past Honokowai approximately 3 to 4 times a week. Jenny also sails on the Hawaiian voyaging canoe named the Mo'okiha which utilizes ancient navigational skills for voyaging.

Professionally, Jenny is a substitute teacher at Princess Nāhi`ena`ena Intermediate School and a social media influencer.

Overview

As mentioned before, Ms. Lindsey was born and raised in Honokowai. The beach and the shoreline of Honokowai and Lahaina is an area which Jenny can be found daily. She is very knowledgeable of the coastline, currents, and fishing area as a lifelong community member, subsistence fisherman, and a canoe paddler with the Lahaina Canoe Club.

General Discussion

Ms. Lindsey is not in any way in favor of this proposed project. She feels that any type of unnatural beach nourishment will have drastic impacts upon the reef, reef fish, octopus, tidal currents, and surf break. Ms. Lindsey tells a story of her great grandmother Waipulani Paki when she would return from diving for octopus in Honokowai. As she emerged from the waters, octopus would be hanging from her waistline and the families would say it resembled a hula skirt of octopus.

As a paddler, Ms. Lindsey states that if the reef area is covered with sand, the tidal current would change making it difficult for the paddlers as they are navigating the coastline. When paddlers are traveling north from Lahaina and turn towards Honokowai, they must hug the shoreline because the winds are extremely strong. The current reef structure slows the currents allowing the paddlers to properly navigate through the treacherous current. If the reef area is covered with sand, Ms. Lindsey claims that the winds would blow them off course and the pathway that the steersmen have known for generations would be blocked.

Cultural Resources

Octopus is a main resource in the area. Other ocean resources like limu, manini, reef fish area plentiful along this reef area. This area is also known to have a popular surf break caused by the reef structure.

Traditions and Customs

Surfing, diving for reef fish and octopus, and picking limu is a daily practice to provide subsistence for the families of Honokowai. Paddlers utilize the in shore of Honokowai while navigating the northern path.

Impacts

While addressing the impacts of the project, Ms. Lindsey asks a question, “for whom is this project going to benefit?” She states that the only ones who will benefit from this project would be the tourists and the hotels. The impacts this project would have upon the resources and the customary practices would be devastating. Increased tourism is not a solution for the environmental issues in which Honokowai is and has been facing.

Ms. Lindsey states that increased sand will cover the reef which will displace all the octopus, reef fish, and the limu which the reef fish and local communities depend upon. The increased sand will definitely change the surf break as the reef is important to how the surf breaks.

Increased sand in the near shore on a windy day could make it difficult to navigate the shoreline and claims that the path would be blocked off which paddlers could possibly be blown off course. On days when paddlers navigate the northern coastlines, they need to hug the shorelines, which increased sand will cause them to be “pushed out or blown out”. Once the paddlers take the turn in Honokowai, the wind gusts are extremely strong and the paddlers depend on the reef at the shoreline to cut the tidal currents allowing them to maneuver and stay on course.

Mitigation Measures and Recommendations

According to Ms. Lindsey, there are no mitigation measure that can be taken. She feels that the project will degrade the reef system, shoreline, and the community’s way of life. Ms. Lindsey requests that the right thing be done and that is to do absolutely nothing. She states it is an absolute NO from her to the project and leave it the way it is. As padders, subsistence fisherman, and gathers, this project does not provide a solution or enhancement to any of the cultural resources or customary practices in the area.

6.7 Interview with Jakob Opunui

Interviewer: Mathew Sproat
Interviewee: Jakob Kalanimoku Opunui
Date: 4/5/23
Location: Lahaina, Maui

Biography

Mr. Opunui was born and raised in Honokowai across the street from the project area with lineal ties spanning over 10 generations in the area. He currently resides in Wailuku, Maui but works as a Beachboy/Beach Attendant for Aqualani fronting the Ka’anapali Ocean Resort.

Overview

Mr. Opunui's greatest passion is fishing and ocean activities. He has lived his entire life on the ocean in Honokowai and works daily on the beach in Ka'anapali. In his spare time, he will walk and clean the shoreline in Honokowai and fish that shoreline, an activity which he was taught by his kūpuna. Mr. Opunui is extremely knowledgeable of the ocean especially that surrounding the project area. He has seen many changes within Honokowai throughout the years and notes seasonal changes along the coastline constantly.

General Discussion

Mr. Opunui's concerns with this project is the fact that we as humans should not be trying to change the natural environment. Any type of beach nourishment according to Mr. Opunui is laughable**.** Where is the sand going to go? Directional swells will displace the sand both to the right and to the left. T groins would possibly kill the reef, displace fish, and create a different landscape underwater. It is unknown if it will affect the neighboring beaches and the fish movement.

There is a strong possibility of affecting the movement of game fish while pushing the bite further out to sea which changes the fishermen's strategies making it harder to have a food source. Previous beach nourishment projects at "S-Turns" near the project area has caused the entire reef area to be covered up with sand. Mr. Opunui clams that sandy grounds have have the possibility to bring tiger sharks near shore. Tiger sharks are sand bar sharks and prefer the sandy areas to prey for food. A story that Mr. Opunui recounts is last year he caught an ulua from the S-Turn beach area. While at home processing the fish, he noticed worms within the meat of the fish which made it inedible. He decided to return the fish to the place that it was caught "return back to the `āina" and within 5 minutes a six-foot tiger shark began to devour the fish. Mr. Opunui also states that at "S Turn"beach, the octopus grounds are now pushed out approximately 1/2 off shore due to the previous beach nourishment project in that area. He is concerned that this will have the same affect upon the project area also.

Cultural Resources

Resources in the project area include reef fish, papio, small amounts of limu, and a bountiful number of octopus. Mr Opunui states that the surf break is one of the best in the area.

Traditions and Customs

Amongst the cultural practices in the project area are fishing diving, surfing, and canoe paddling.

Impacts

Beach nourishment by pumping in offshore sand Mr. Opunui claims will not work. The ocean will take the sand and displace it somewhere else. He has seen the effects of seasonal movements of sand throughout the years and he claims that the idea of pumping in "fake sand" is laughable. Mr. Opunui states that in his 25 years of life, he has seen the beach "come and go" more times than anyone has visited that hotel. The seasonal movement of the sand is constant. T-groins would kill the reef and poison the waters with sand that should normally be in a movement seasonally.

Mitigation Measures and Recommendations

Mr. Opunui asks why are we trying to control nature? Why are we doing so much to try to control nature and what nature would do naturally? We cannot control nature. Nature will continuously do what it naturally does. According to Mr. Opunui, there are no mitigation measures for the project. Mr. Opunui feels that if the project is passed, it will be laughable, and he feels that the project coordinators will waste their time and money fighting nature. He further notes that the reef will die, but they will be left with the repercussions of their decisions.

Mr. Opunui's suggestion instead of a beach nourishment project is to push the property back and create a larger beach area on property.

6.8 Interview with Daryl Fujiwara

Interviewer: Mathew Sproat
Interviewee: Daryl Fujiwara
Date: 2/14/2023
Location: via telephone

Biography

Darryl Fujiwara is a graphic designer and works in PR marketing. He was born and raised on the island of Maui in Lāhaina, and currently resides in Wailuku. His parents still reside in their family home in Lāhaina.

Overview

Being a professional in marketing and working with many cultural organizations on the island of Maui, Daryl brings a great deal of knowledge regarding cultural issues and cultural understanding island wide. Mr. Fujiwara was born and raised in Honokowai which is adjacent to the project area. His family still resides there.

General Discussion

Ka'anapali is an area in West Maui that has gone through many changes within the last 30-40 years with the introduction of resorts and tourist accommodations. The result has been the depletion of many natural and cultural resources. A lot of the culture landscape and cultural resources in the area has been depleted through the continuous developments in Ka'anapali. Concerns that Mr. Fujiwara had with Ka'anapali and Honokowai has been beach access for the local communities. Subsistence fishing is still a cultural tradition that remains in this area for many local families, and he states that he has been tagged in many posts about access to shoreline fishing and activities has been limited and or blocked. Continued projects such as this could furthermore block access to the shoreline for many of the subsistence fishermen.

Cultural Resources

Mr. Fujiwara states the main cultural resources in the area are ocean resources such as fish, limu, and crustacean.

Traditions and Customs

Subsistence fishing and gathering of ocean resources.

Impacts

The main impacts of the project would be the access to fishermen and the seasonal shift of the sand which is common in the Lahaina area. Any type of beach nourishment could cause an impact on the reef area and coral life.

Mitigation Measures and Recommendations

Daryl suggests should the project proceed, the property should begin a restoration project of ocean resources such as limu and coral to help restore the area of depleted resources and also enhance a guest experience. Mr. Fujiwara also suggests that the community is well advised of the project development and allows community input in the development process, and also consult with community leaders in the progress of the project.

6.9 Interview with Darryl Kaina

Interviewer: Mathew Sproat
Interviewee: Darryl Kaina
Date: 4/6/23
Location: Lahaina, Maui

Biography

Mr. Kaina was born and raised in Honokowai and Napili, Maui which his family has lived for many generations. He is an avid fisherman and beachgoer and works as a tour guide for 808 Fishing Tale, a shoreline fishing charter company. His responsibility within the company is to take visitors to Maui shoreline fishing which is a catch and release program. The fishing charter that he operates stretches from Honokowai to Mahana.

Overview

Fishing has always been a part of his life as he was taught how to fish the area by his father and grandfather who were avid fishermen also. Mr. Kaina is on the shoreline daily working as a tour guide and would often fish and clean the beaches on his days off. He is very knowledgeable of the shoreline of Honokowai and understands the currents, breeding cycles and movement of gamefish, and limu identification.

General Discussion

Mr. Kaina walks the shoreline of Honokowai on a daily basis and understands how the movement of sand has changed throughout the years. He notes that as an avid diver he has seen seasonal changes of the sand on and off of the reef, the diminishing limu on the reef, and how human influenced changes to Honokowai like the diversion of the freshwater streams have changed the growth of seaweed and how the game fish reacts to these changes also. His concern is the amount of human intervention with the natural habitat of Honokowai as a fisherman.

Mr. Kaina feels that the project will have a great impact upon the fishing grounds of Honokowai. If there were T-groins put into place, he feels that it would change what he knows as a lifelong fisherman in the area. The possibility of pumping in sand from offshore would be the best solution, however, Mr. Kaina states that it would not be a permanent solution and the sand would push higher upon the shoreline or displace in the ocean surrounding the tidal area.

Cultural Resources

Main cultural resources are ocean resources like ‘a’ama crab, oio, moi, omilu, papio, ulua, weke, oama, kumu, andpopular edible reef fish. According to Mr. Kaina, Honokowai is the

best octopus grounds. limu ogo and limu kohu at one time was extremely plentiful in the area.

Traditions and Customs

Fishing and diving are the main customary practices within the project area.

Impacts

Mr. Kaina mentions that natural seasonal movement over the years have caused the sand to partially cover the reef area however, the same seasonal movements have pushed the sand on and off of the reef. He is concerned if certain actions are in place to permanently cover the reef with sand, it will devastate the reef and its habitat. Mr. Kaina claims he has never seen the reef completely covered in sand and the possibility of that happening would be very devastatig.

Mitigation Measures and Recommendations

Mr. Kaina would recommend that no changes be made to the area and the project not proceed, however, if there is an absolute necessity, pumping in sand from offshore would be best.

6.10 Interview with Cody Pueo Pata

Interviewer: Mathew Sproat
Interviewee: Cody Pueo Pata
Date: 2/3/23
Location: VIA Telephone

Biography

Kumu Hula Pueo Pata is a fluent Hawaiian language speaker and a well-respected hula master, having been raised in the hula traditions of legends like George Naope, Nona Kaluhiokalani, Keʻala Kukona, Jay Jay Akiona, and Hilda Keanaaina. His extensive training also afforded him opportunity to learn a wide range of moʻolelo and traditional skills from many revered kūpuna.

Pueo Pata's talents as a singer and musician first came to public attention when he won the statewide Frank B. Shaner Falsetto Singing Contest in 1999. Those talents have been honed and refined in the intervening years as he performed in hula and cultural events throughout the islands, continental U.S., and Japan. A panel of language experts and fellow composers have acknowledged his skills as haku mele (composer) in naming

Pueo a finalist in the prestigious Nā Hōkū Hanohano haku mele category a total of four times before he won the award in 2007 for Mili'opua from his *He Aloha…* album. Kumu Pueo is widely recognized as a gifted composer and he has taught the art of haku mele to students at Kamehameha Schools, Maui campus.

He was raised in Kihei, Maui and currently resides in Makawao, is a cultural practitioner, and has extensive knowledge about the project area. He was the last Kumu Hula to ʻūniki from hula great and Merrie Monarch founder George Naope. In 2003, Kumu Pueo inherited the hālau in which he was trained by Nona Mahilani Kaluhiokalani, a graduate of the ʻIlalaʻole hula lineage through master G. Lanakilakeikiahialii Naope. Renamed to honor her, Hālau Hula Ka Malama Mahilani provides Pueo the opportunity to stay true to the culture and traditions as they were shared with him while interpreting and choreographing mele and training dancers.

Overview

Pueo Pata is a noted Kumu from Maui and would have hula practice with his Kumu, Ke'ala Kukona on the KBC property when it was called the Embassy Suites, and also mentions that he would have hula practice at the nearby Kahekili Beach Park as well. Mr. Pata has done extensive place-name research of the 3 Moku of West Maui which include Honokowai and Ka'anapali. In 2022, Mr. Pata authored a book, *ʻOhuʻohu nā Mauna o ʻEʻeka: Place Names of Maui Komohana*, which detail the place names Maui.

General Discussion

Mr. Pata feels that the project will have a devastating affect toward the ocean resources and the community of Honokowai. The area has gone through a lot of development throughout the decades causing diversion of freshwater streams and muliwai "stream mouths" and feels that an increase of development or changes to the coastline will continuously degrade the natural resources like freshwater flow and fish activity.

As mentioned in his book, each place name in the area represents a particular part of the history of that place. Mr. Pata states that the name Honokowai means "the bay that draws forth water" usually signifying that the underground waterways push forth freshwater into the the bay. This reference notates the abundance of water in the area, but Pueo states that the developments have hampered the natural flow of freshwater into the ocean causing changes to the ocean reefs and the natural flow of fish activity.

Cultural Resources

Mr. Pata mentions that there are ancient waterways mauka of the property along with another stream south of the property which traditionally exits into the ocean near the Honua Kai Hotel. Pueo also states the abundance of ocean resources from limu and native fish species which the community of Honokowai depend upon.

Traditions and Customs

Mr. Pata states that subsistence fishing and gathering of ocean resources are prominent in the area. Mr. Pata also mentions there are families near the project area in Kahana that are noted akule fishermen in the area. Pueo has also mentioned while growing up, they would gather various kinds of limu in the region. Turtles are known to be along the reefs feeding upon the limu.

Pueo states that there are canoe halau in Lahaina and Kahana which are the adjacent ahupua'a.

Mr. Pata also refers to mele and creation of mele as a traditional customary practice and the most enduring traditional practice in existence with mele still being composed for the area.

Impacts

Mr. Pata states that any disturbance on the shoreline will drastically affect the local fishing community who are accustomed to certain reef resources that they depend on. Pueo mentions that if there are any impacts on the fishing in the area or are cut off of access due to construction would be an injustice.

Mitigation Measures and Recommendations

Mr. Pata mentions that there are no mitigation measures for the project. He feels the project would devastate the natural resources of the area. Pueo wants to address the property owners and asks if they wish to make drastic changes to the shoreline fronting their property, Pueo wishes if they could prove a benefit for the entire ahupua'a and not just their fronting shoreline. Additionally, Mr. Pata questions why they are addressing the shoreline when the shoreline is a result of what is happening on land. Instead of addressing the shoreline, why are we not addressing the issues that we are having on land. Mr. Pata mentions that many of the kahawai and muliwai have been diverted throughout the years and through development of the resorts in the area.

7.0 Impact Assessment

The impact is an important and required element of a CIA. It is one, of a number of, technical reports required for an EIS. The purpose of it is to ensure that practitioners and cultural stakeholders are given an opportunity to provide input into the Chapter 343 process. While ethnographic data is not the only data considered in a CIA, it is the only report that focuses on cultural beliefs, traditions and practices. Therefore, it is important to make appropriate deferences to the beliefs shared through the interview process. Based on the collected ethnographic data, the Proposed Action, as currently designed, may adversely impact cultural resources and/or traditional or customary practices to various degrees, based upon which of the three beach restoration alternatives is implemented. The action would temporarily impact the setting and feeling of the leina during sand reclamation at Puʻu Kekaʻa. Asd to the shoreline area, the groins implemented under the Beach Stabilization alternative would impact surfing, paddling, fishing, and other ocean-associated activities, as well as cultural resources. Beach Nourishment and Beach Maintenance would also impact cultural resources, although likely to a lesser degree than Beach Stabilization. The No Action alternative would avoid the impacts of the three alternatives currently contemplated in the Proposed Action, but it would also fail to address the purpose and need of the project and result in impacts of its own, including but not limited to beach loss and/or the corresponding loss of access. None of the interviewees expressed concern about potential impacts from the No Action alternative. Despite the potential loss of access to cultural resources and/or traditional or customary practices that would result from an impact such as beach loss under the “No Action” alternative, the persons interviewed did not necessarily express concern with any impact from that alternative.

7.1 Impacts on Culturally Significant Flora

The biological assessment did not identify any flora resources of concern in the terrestrial project area. Additionally, the marine study identified little to no limu within the nearshore scour zone at the project site. Interviewees nonetheless identified limu as being resources in both the primary Project Area, secondary Project Area, and Study Area, which supports subsistence practices and cultural practices. Interviewees also expressed concern about the impacts the project alternatives, except the No Action alternative, may have on the limu, which practitioners gather. The following impact analysis of flora is primarily based on ethnographic data gathered from the interviewees for this CIA.

Table 3. Alternative Analysis of Impacts to Culturally Significant Flora

Alternative	Impact to Honokōwai Project Area	Impact to Puʻu Kekaʻa Project Area

Beach Nourishment	Temporary effect to limu and other flora	Temporary effect to limu and other marine flora during reclamation
Beach Maintenance	Temporary effect to limu and other flora with each maintenance event	Temporary effect to limu and other marine flora during reclamation events
Beach Stabilization	Long term effect to limu and other flora	Temporary effect to limu and other marine flora during reclamation
No Action	No impact	No impact

7.2 Impacts on Culturally Significant Fauna

Interviewees expressed concern about the impact the project would have on fish species. While the Marine and Water Quality Assessment completed for the project did not identify any potential adverse effect to marine resources, interviewees expressed strong concerns that each of the alternatives, excluding the No Action alternative, will impact fish populations in the area, specifically that it will be migration patterns.

Table 4. Alternative Analysis of Impacts to Culturally Significant Fauna

Alternative	**Impact to Honokōwai Project Area**	**Impact to Puʻu Kekaʻa Project Area**
Beach Nourishment	Temporary effect to marine fauna, potential benefit to species like honu and/or monk seals who use the beach as habitat for basking	Temporary effect to marine fauna during reclamation
Beach Maintenance	Temporary effect to marine fauna, potential benefit to species like honu and/or monk seals who use the beach as habitat for basking	Temporary effect to marine fauna during reclamation events
Beach Stabilization	Long term effect to marine fauna	Temporary effect to marine fauna during reclamation events
No Action	No impact	No impact

7.3 Impacts on Historic Sites

The LRFI completed by ʻĀina Archaeology will fully speak to the potential impacts to historic sites. Puʻu Kekaʻa is a historic site that would be temporarily impacted by the sand

reclamation activity. As noted above, the project would create a temporary impact to the setting and feeling of the site, which are two of the aspects of intergrity untilized in evaluating a historic site.

It should be noted though, that vessels regularly moor off Puʻu Kekaʻa (see Figure 24 below). The visual effect of this project on the setting and feeling would be similar to the impacts of these vessels.

Table 5. Alternative Analysis of Impacts to Historic Sites

Alternative	**Impact to Honokōwai Project Area**	**Impact to Puʻu Kekaʻa Project Area**
Beach Nourishment	Potential effect to historic sites (to be resolved during HRS 6E process during entitlement)	Potential effect to historic sites (to be resolved during HRS 6E process during entitlement); temporary effect to viewplane during reclamation
Beach Maintenance	Potential effect to historic sites (to be resolved during HRS 6E process during entitlement)	Potential effect to historic sites (to be resolved during HRS 6E process during entitlement); temporary effect to viewplane during reclamation events
Beach Stabilization	Potential effect to historic sites (to be resolved during HRS 6E process during entitlement)	Potential effect to historic sites (to be resolved during HRS 6E process during entitlement); temporary effect to viewplane during reclamation events
No Action	No impact	No impact



Figure 24. Recreation vessels moored off Puʻu Kekaʻa. View from Kaʻanapali Beach Hotel (Project Site). Photo by author during a site visit in 2024.

7.4 Impacts on Intangible Cultural Resources

Intangible cultural resources refer to those resources without physical form, such as hula or mele. The groins installed under the Beach Stabilization alternative, because of their size, would adversely impact these resources, especially those like mele which are still being written about the area to this day.



Figure 25. Area residents jumping from the rocks below Puʻu Kekaʻa. Photo by the author during a site visit in 2024.

Table 6. Alternative Analysis of Impacts to Intangible Cultural Resources

Alternative	**Impact to Honokōwai Project Area**	**Impact to Puʻu Kekaʻa Project Area**
Beach Nourishment	Temporary effect to intangible cultural resources occurring in the sand placement area	Temporary effect to intangible cultural resources occurring in the sand reclamation area
Beach Maintenance	Temporary effect to intangible cultural resources occurring in the sand placement area	Temporary effect to intangible cultural resources occurring in the sand reclamation area
Beach Stabilization	Potential effect to intangible cultural resources occurring in the groin construction and sand placement area	Temporary effect to intangible cultural resources occurring in the sand reclamation area
No Action	Potential effect to intangible cultural resources occurring in	No impact

	the Project Area due to the loss of beach	

7.5 Impacts on Cultural Practices

Based on the interviews, area practitioners expressed concern that the Beach Stabilization alternative will impact practices associated with fishing, gathering, surfing, and padding. Diving regularly occurs off Puʻu Kekaʻa (see above), but the project would not likely affect the ability of area residents to participate in these activities.

Table 7. Alternative Analysis of Impacts to Cultural Practices

Alternative	**Impact to Honokōwai Project Area**	**Impact to Puʻu Kekaʻa Project Area**
Beach Nourishment	Temporary effect to fishing and other ocean gathering activities	Temporary effect to fishing and other ocean gathering activities in the sand reclamation area
Beach Maintenance	Temporary effect to fishing and other ocean gathering activities	Temporary effect to fishing and other ocean gathering activities in the sand reclamation area
Beach Stabilization	Potential effect to fishing and other ocean gathering activities	Temporary effect to fishing and other ocean gathering activities in the sand reclamation area
No Action	Potential effect to practices occurring in the Project Area due to the loss of beach	No impact

7.6 Cumulative and Indirect Impacts

The Beach Stabilization alternative would involve constructing groins in West Maui, a first for the region. However, there is concern that this would lead to long-term cumulative impacts, as other projects could pursue similar actions.

Table 8. Alternative Analysis of Impacts to Cumulative and Indirect Impacts

Alternative	**Impact to Honokōwai Project Area**	**Impact to Puʻu Kekaʻa Project Area**
Beach Nourishment	Temporary effect to area cultural resources	Temporary effect to resources during sand reclamation
Beach Maintenance	Temporary effect to area cultural resources	Temporary effect to resources during sand reclamation

Beach Stabilization	Potential effect to area cultural resources	Temporary effect to resources during sand reclamation
No Action	Potential effect to practices occurring in the Project Area due to the loss of beach	No impact

7.7 Mitigation and Best Management Practices

Any mitigation recommended under HRS 6E for impacts on historic sites should be implemented. Construction BMPs should also be implemented during construction activities to limit the potential effects on nearby water resources.

Reef-safe and/or appropriate native coastal plants should be used extensively throughout the Project Area to minimize erosion and create additional cultural resources for practitioners. The Project should develop a reef-safe landscaping plan with and in consultation with community groups to develop conservation programming that regenerates the coastal area and protects the nearshore reef area from runoff and other terrestrial erosion.

Every effort should be made to avoid impacts on paddling routes, fishing areas, gathering areas, surfing spots, and marine resources. Should the project proceed, the applicant should work closely with the community to develop a robust community benefits program to mitigate the adverse impacts.

Table 9. Potential Mitigation for the Project Alternatives

Alternative	**Mitigation for Honokōwai Project Area**	**Mitigation for Puʻu Kekaʻa Project Area**
Beach Nourishment	Avoidance, preservation of access, and/or restoration activities	Avoidance and/or preservation of access during sand reclamation process
Beach Maintenance	Avoidance, preservation of access, and/or restoration activities	Avoidance and/or preservation of access during sand reclamation process
Beach Stabilization	Avoidance, preservation of access, and/or restoration activities	Avoidance and/or preservation of access during sand reclamation process
No Action	No recommendation	No recommendation

8.0 Conclusion

As previously noted, natural and cultural resources in Hawaiian culture are primarily viewed as inseparable. Without the resources provided by nature, cultural resources could not and would not be procured. From a Hawaiian perspective, all natural and cultural resources are interrelated, and all natural and cultural resources are culturally significant. Ethnographer and Hawaiian language scholar Kepā Maly emphasizes, “In any culturally sensitive discussion on land use in Hawaii, one must understand that Hawaiian culture evolved in close partnership with its natural environment. Thus, Hawaiian culture does not have a clear dividing line of where culture ends and nature begins” (Maly, 2001:1).

The kinship between Hawaiians and their land extends back many generations. The depth and intimacy of this relationship enabled Hawaiians to thrive in sustainability on the islands for hundreds of years before Europeans arrived. Therefore, Hawaiians are entitled to the pain and anguish they feel at losing their lands and resources.

This loss lies at the heart of Hawaiian struggles for traditional or customary access. Therefore, the State's obligation to protect these rights is much more than a legal obligation, as such rights are a necessity of indigenous human life. Recognition and respect for these rights also enable a mutually respectful and beneficial relationship between Planned Development and Hawaiians.

In 2000, Act 50 was passed by the State recognizing:

> … the past failure to require native Hawaiian cultural impact assessments has resulted in the loss and destruction of many significant cultural resources. It has interfered with the exercise of native Hawaiian culture. The legislature further finds that due consideration of the effects of human activities on native Hawaiian culture and the exercise thereof is necessary to ensure the continued existence, development, and exercise of native Hawaiian culture (Act 50, SLH 2000).

The CIA is a construct of State law and a requirement of HRS Chapter 343. The legislative intent quoted above is critical to consider the proposed action's effects on cultural practices because it specifies the importance of ensuring “the continued existence, development, and exercise” of culture. This recognizes that culture is not static; it is dynamic. It changes over time. Act 50 specifically calls for considering the effects of a proposed action on the continued “development” of native Hawaiian culture. Which means it is insufficient to simply look back to historic practices. Considering effects to the

continued development of culture means the state, specifically the governing State or County agency, as the accepting authority of the Chapter 343 EIS, of which this CIA is a requirement.

The State ERP (formerly OEQC) also offers specific guidelines for what elements and issues a CIA should address. The section of this CIA that addresses that element is also provided.

Table 10. Table listing ERP compliance requirements and their corresponding sections in this assessment

ERP notes that in addition to the content requirements for the draft EIS, which are set out in HAR §11-200.1 et seq., the assessment concerning cultural impacts should address, but not necessarily be limited to, the following matters:	
A. A discussion of the methods applied and results of consultation with individuals and organizations identified by the preparer as being familiar with cultural practices and features associated with the project area, including any constraints or limitations which might have affected the quality of the information obtained.	A detailed methodology section is provided in **Section 2**, *Methodology*.
B. A description of methods adopted by the preparer to identify, locate, and select the persons interviewed, including a discussion of the level of effort undertaken.	A discussion of the effort to gather into from persons familiar with the area or other stakeholders is provided in **Section 2.5**, *Ethnographic Methodology*.
C. Ethnographic and oral history interview procedures, including the circumstances under which the interviews were conducted, and any constraints or limitations which might have affected the quality of the information obtained.	A discussion of procedures, including constraints or limitations, is provided in **Section 2.5**.

D. Biographical information concerning the individuals and organizations consulted, their expertise, and their historical and genealogical relationship to the project area, as well as information concerning the persons submitting information or interviewed, their particular knowledge and cultural expertise, if any, and their historical and genealogical relationship to the project area.	Biographical information was provided for each interviewee in **Section 6.0**.
E. A discussion concerning historical and cultural source materials consulted, the institutions and repositories searched and the level of effort undertaken. This discussion should include, if appropriate, the perspective of the authors, any opposing views, and any other relevant constraints, limitations or biases.	A discussion of the materials consulted is provided in **Section 2**. An extensive cultural and historical overview, which uses both Hawaiian and English language resources is also provided in **Section 2**. Stakeholders are given significant consideration. Petitions and other materials by project opponents are included in the appendices and are addressed in the context of this assessment.
F. A discussion concerning the cultural resources, practices and beliefs identified, and, for resources and practices, their location within the broad geographical area in which the proposed action is located, as well as their direct or indirect significance or connection to the project site.	In addition to the cultural and historical overview, an extensive discussion concerning cultural resources, practice and beliefs are provided throughout the document by subfield.
G. A discussion concerning the nature of the cultural practices and beliefs, and the significance of the cultural resources within the project area affected directly or indirectly by the proposed project.	A thorough discussion concerning the nature of traditional or customary practices and the significance of the cultural resources affected directly or indirectly by the proposed alternatives is provided in **Section 7.0**, *Impact Assessment*.

H. An explanation of confidential information that has been withheld from public disclosure in the assessment.	There was no confidential information withheld from public disclosure, except for personal emails, addresses, or phone numbers.
I. A discussion concerning any conflicting information regarding identified cultural resources, practices and beliefs.	There was no conflicting information regarding cultural resources, practices, or beliefs.
J. An analysis of the potential effect of any proposed physical alteration on cultural resources, practices or beliefs; the potential of the proposed action to isolate cultural resources, practices or beliefs from their setting; and the potential of the proposed action to introduce elements which may alter the setting in which cultural practices take place.	A thorough analysis is provided in **Section 7.0**.
K. A bibliography of references and attached records of interviews which were allowed to be disclosed.	References are included in **Section 10.0**.

The standard under which an EIS is considered sufficient is well-established in Hawaii State case law. The court has held:

> …an EIS need not be exhaustive to the point of discussing all possible details bearing on the proposed action but will be upheld as adequate if it has been compiled in good faith and sets forth sufficient information to enable the decision-maker to consider fully the environmental factors involved and to make a reasoned decision after balancing the risks of harm to the environment against the benefits to be derived from the proposed action, as well as to make a reasoned choice between alternatives" *Price v Obayashi Hawaii Corp*, 81 Hawaii 171, 182 (1996), upheld in *Kaleikini v Yoshioka*, 283 P. 3d 60, 74 (2012).

This CIA is obligated to disclose information as required under Act 50 sufficiently and in good faith so that the State may consider all impacts when acting as decision-maker to this Proposed Action. This assessment is not a policy document, nor does it intend to influence decision-making in any fashion. Instead, it has sought to document the complex and often elusive history of past and present cultural practices within the Project Area and the larger region. It is ultimately the responsibility of the State to accept or reject the adequacy of this assessment and then, if accepted, consider the information disclosed herein when deciding on the Proposed Action.

In applying *Ka Pa‘akai*, cultural, historical, or natural resources have been identified in the Project Area. Traditional or customary Native Hawaiian rights do not appear to be currently exercised in the Project Area but are practiced in nearby coastal areas. Any adverse effects to these practices can be avoided or minimized by implementing the recommendations provided in **Section 7**.

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Appendix I: Glossary of Hawaiian Terms

The following list of terms was used frequently throughout this report. All definitions were compiled using Pukui and Elbert's *Hawaiian Dictionary* (1986).

Ahupua‘a	Land division usually extending from the uplands to the sea, so called because the boundary was marked by a heap (ahu) of stones surmounted by an image of a pig (pua‘a), or because a pig or other tribute was laid on the altar as tax to the chief.
‘Āina	Land, earth. *Lit.* That which feeds.
Akua	1. God, goddess, spirit, ghost. 2. Divine, supernatural, godly.
Ala	Path, road, trail.
Ali‘i	1. Chief, chiefess, ruler, monarch. 2. Royal, regal. 3. To act as chief, reign.
‘Aumakua	Family or personal gods, deified ancestors who might assume the shape of sharks, owls, hawks, dogs, plants, etc. A symbiotic relationship existed; mortals did not harm or eat them, and the ‘aumakua warned or reprimanded mortals in dreams, visions, and calls.
‘Aumākua	Plural of ‘aumakua.
‘Auwai	Irrigation ditch, canal, waterway.
Hālau	1. Long house, as for canoes or hula instruction; meeting house. 2. Large, numerous; much.
Hale pili	House thatched with pili grass.
Heiau	Pre-Christian place of worship, shrine. Some heiau were elaborately constructed stone platforms, other simple earth terraces.
Ho‘i	1. To leave, go or come back; to cause to come back. 2. To enter, as an institution or last resting place. 3. A parting chant to which hula dancers dance as they leave the audience. 4. Marriage of a chief with the daughter of a brother or sister; to do so (a means of increasing offspring).
Hula	A Hawaiian dance form accompanied by chant or song.
‘Ili	Land section, next in importance to ahupua‘a and usually a subdivision of an ahupua‘a.
‘Ili kū	Shorted form of ‘ili kūpono.
‘Ili kūpono	A nearly independent ‘ili land division within an ahupua‘a, paying tribute to the ruling chief and not to the chief of the ahupua‘a. Transfer of the ahupua‘a from one chief to another did not include

	the ʻili kūpono located within its boundaries. Sometimes shorted to ʻili kū.
Kanaka	Human being, person, individual, party, humankind, population; often used for man.
Kānaka	Plural of kanaka.
Kāne	Male, husband, male sweetheart, man; brother-in-law of a woman.
Kanikau	1. Dirge, lamentation, chant of mourning, lament. 2. To chant, wail, mourn.
Kapu	1. Taboo, prohibition. 2. Special privilege or exemption from ordinary taboo. 3. Sacredness, prohibited, forbidden, sacred, holy, consecrated. 4. No trespassing, keep out.
Kinolau	Spiritual body form
Kuleana	Right, privilege, concern, responsibility, title, business, property, estate, portion, jurisdiction, authority, liability, interest, claim, ownership, tenure, affair, province.
Kupuna	Grandparent, ancestor, relative or close friend of the grandparent's generation, grandaunt, granduncle.
Kūpuna	Plural of kupuna.
Limu	A general name for all kinds of plants living under water, both fresh and salt, also algae growing in any damp place in the air, as on the ground, on rocks, and on other plants; also mosses, liverworts, lichens.
Loʻi	Irrigated terrace, especially for taro, but also for rice and paddy.
Loko iʻa	Traditional Hawaiian fishpond.
Makai	On the seaside, toward the sea, in the direction of the sea.
Mālama	To take care of, tend, attend, care for, preserve, protect, beware, save, maintain.
Mauka	Inland, upland, towards the mountain.
Mele	1. Song, anthem, or chant of any kind. 2. Poem, poetry. 3. To sing, chant.
Mele mākaʻikaʻi	Travel chant.
Mōʻī	King, sovereign, monarch, majesty, ruler, queen.
Moku	1. District, island, islet, section, forest, grove, clump, fragment. 2. To be cut, severed, amputated, broken in two.
Moʻo	Lizard, reptile of any kind, dragon, serpent.
Moʻolelo	Story, tale, myth, history, tradition, literature, legend, journal, log, yard, fable, essay, chronicle, record, article.
Moʻowahine	Female lizard deity.

Nīʻaupiʻo	Offspring of the marriage of a high-born brother and sister, or half-brother and half-sister.
ʻŌlelo noʻeau	Proverb, wise saying, traditional saying.
Oli	Chant that was not danced to, especially with prolonged phrases chanted in one breath, often with a trill at the end of each phrase; to chant thus.
Piʻo	Marriage of full brother and sister of nīʻaupiʻo rank, presumably the highest possible rank. Their offspring had the rank of naha, which is less than piʻo but probably more than nīʻaupiʻo. Later piʻo included marriage with half-sibling.
Pueo	Hawaiian short-eared owl (*Asio flammeus sandwichensis*), regarded often as a benevolent ʻaumakua.
ʻŪniki	Graduation exercises, as for hula, lua fighting, and other ancient arts (probably related to niki, to tie, as the knowledge was bound to the student).
Wahi pana	A legendary place; a place made special celebrated in stories associated with it. Often sacred.
Wahine	Woman, lady, wife; sister-in-law, female cousin-in-law of a man, female.
Wao	1. Realm. 2. A general term for inland region usually forested but not precipitous and often uninhabited.

KA PA‘AKAI FRAMEWORK OVERVIEW

APPENDIX G-2

KA PA‘AKAI FRAMEWORK OVERVIEW[1]

I. Background

The State of Hawai‘i is “obligated to protect the reasonable exercise of customarily and traditionally exercised rights of Hawaiians to the extent feasible.” *Public Access Shoreline Hawai‘i v. Hawai‘i County Planning Commission*, 79 Hawai‘i 425, 450 n.43, 903 P.2d 1246, 1271 n.43 (1995) (*hereinafter* “*PASH*”). The obligation recognized in *PASH* is derived from the Hawai‘i Constitution, which provides, in relevant part:

> The State reaffirms and shall protect all rights, customarily and traditionally exercised for subsistence, cultural and religious purposes and possessed by ahupua’a tenants who are descendants of native Hawaiians who inhabited the Hawaiian Islands prior to 1778, subject to the right of the State to regulate such rights.

Article XII, Section 7.

In 2000, the Hawai‘i Supreme Court established an analytical framework for government agencies “to help ensure the enforcement of traditional and customary Native Hawaiian rights while reasonably accommodating competing private development interests.” *Ka Pa‘akai ‘O Ka ‘Āina v. Land Use Commission*, 94 Hawai‘i 31, 35, 7 P.3d 1068, 1072 (2000). The Court observed that “[i]n order to fulfill its duty to preserve and protect customary and traditional Native Hawaiian rights to the extent feasible,” an administrative agency “must—*at a minimum*—make specific findings of fact and conclusions of law as to” three items. *See id.* at 47, 7 P.3d at 1084 (italics in original). The three items established by the Court’s framework were:

1) [T]he identity and scope of ‘valued cultural, historical, or natural resources’ in the [subject] area, including the extent to which traditional and customary Native Hawaiian rights are exercised in the [subject] area;
2) [T]he extent to which those resources—including traditional and customary Native Hawaiian rights—will be affected or impaired by the proposed action; and
3) [T]he feasible action, if any, to be taken by the [agency] to reasonably protect Native Hawaiian rights if they are found to exist.

[1] Compiled by Starn O‘Toole Marcus & Fisher and Honua Consulting.

Id.; *see also Matter of Conservation District Use Application HA-3568*, 143 Hawai‘i 379, 431 P.3d 752 (2018) (reviewing and upholding an agency’s application of the *Ka Pa‘akai* framework). The Court also took care to note that it “decline[d] to define the term, ‘cultural resources’” explaining that the term is “a broad category, of which native Hawaiian rights is only one subset,” and that it is not “synonymous with the constitutional term, customary and traditional native Hawaiian rights.” *Ka Pa‘akai*, 94 Hawai‘i at 47, n.27, 7 P.3d at 1084, n.27.

Several technical studies and accompanying reports were completed as part of the DEIS that may be relevant to an agency’s analysis and application of the *Ka Pa‘akai* framework. In completing this Overview, all the technical reports for the DEIS were reviewed, and relevant information was incorporated. The majority of information for this Overview was drawn from the following technical reports (listed in alphabetical order of their respective appendix):

A. Baseline Assessment of Marine Water Chemistry and Marine Biotic Communities (included in Appendix A), prepared by Marine Research Consultants, Inc.;
B. Terrestrial Biological Survey (Appendix C), prepared by AECOS, Inc.;
C. Archaeological Literature Review and Field Investigation (Appendix F), prepared by Tanya Lee-Greig, M.A.;
D. Cultural Impact Assessment (Appendix G-1), prepared by Honua Consulting; and
E. Coastal and Marine Uses Report (Appendix J), prepared by Ian ‘Akahi Masterson.

The observations and findings from these technical reports are provided to aid in future agency-application of the *Ka Pa‘akai* framework.

II. Identification and Scope of Resources in the Project Site

The first framework item – the identity and scope of valued cultural, historical, or natural resources in the project area, including the extent to which traditional and customary Native Hawaiian rights are exercised in the project area – consists of two separate elements: identification and access. *See* Appendix G-1, at 21-23 for further discussion. Identification, as the name suggests, consists of the identification and existence of valued cultural, historical, or natural resources. These resources are tangible in nature, and may include sacred places, culturally valuable plants, or religious or historic sites.

As noted in the Cultural Impact Assessment, access requires two things: 1) the existence of a resource (*e.g.*, a plant, animal, place, site, or other resource must exist in order for a cultural practitioner to access it); and 2) physical access (*e.g.*, the ability to physically access a plant, animal, site, or location associated with a particular practice, which can also include the traditional and customary route or path to access the resource). *See* Appendix G-1 at 21-23. Access may also include cultural protocols that exist when accessing a resource, which are often temporal (*i.e.*,

access protocols can be at a particular time of day or year). Therefore, the first framework item under *Ka Pa'akai* should include not only a listing of resources but also the identification of ways in which those resources are accessed and utilized in association with traditional and customary practice. This Overview has sought to identify the many resources that may exist in the Project Site or adjacent areas, as well as how those resources are accessed and utilized.

The technical reports show that potential resources may exist within the Project Site, although the scope and identity of resources varies among the technical reports. Potential resources identified include fishing and gathering activities and are discussed further below.

A. Baseline Assessment of Marine Water Chemistry and Marine Biotic Communities (included in Appendix A)

The Baseline Assessment of Marine Water Chemistry and Marine Biotic Communities (included in Appendix A) further identifies marine resources in and adjacent to the Project Site . The report analyzes offshore areas according to three reef zones: Nearshore Scour (beginning at the beach and extending approximately 100 m, or 328 ft., seaward), Mid-Reef Platform (located from approximately 100 m to 140 m, or 328 ft. to 459 ft., offshore), and Outer Reef (beginning approximately 140 m, or 459 ft., offshore). The report details the characteristics of the nearshore scour zone, describing that:

> While many of the rock surfaces are covered with a thin veneer of algal turf, there is virtually no filamentous macroalgae or corals present. The lack of filamentous algae and corals in the nearshore scour zone are likely due to intense concussive forces from breaking waves, which limits colonization and growth of benthic organisms). The exception to this was a small area near the shoreline along Transect 1 during the 2024 survey containing macroalgae comprised primarily of *Dictyota* sp., *Turbinaria ornata*, and *Halimeda* sp. (cross-reference omitted). The occurrence of macroalgae in this area is likely the result of a localized area sheltered from direct wave impacts.

Appendix A, Baseline Assessment of Marine Water Chemistry and Marine Biotic Communities Report at 15.

In the nearshore scour zone, the report identified fish as being "rare," and only eight species of fish were observed. Thirty-six species of fish were observed in the mid-reef platform. The report identifies that "the most commonly observed fish included schools of the black triggerfish (*Melichthys niger*) and roving schools of mixed surgeonfishes (*Acanthurids*) and wrasses (*Labrids*). The outer zones have more algae and species present. For example, fish biomass and diversity are higher in the mid reef zone when compared to the nearshore zone owing to more

complex bottom structure, greater availability of shelter for fishes, and less wave stress." *See id.* at 20. The study reports that "[f]ish were common on the outer reef with 38 species observed between the two survey years [2021 and 2024]." *See id.* The report further details:

> The most common and conspicuous fish were mixed schools (eight species) of *Acanthurids* (surgeonfish) transiting the reef surface and mid-water near the outer margin of the reef. Other commonly observed fish were seven species of *Chartodonitidae* (butterflyfishes), *Ladridae* (wrasses) and *Pomacentridae* (damselfishes). Fish observed in the outer reef coral zone represent typical assemblages found on Hawaiian reefs of similar physical and biotic structure.

Id. (italics added).

B. Terrestrial Biological Survey (Appendix C)

The Terrestrial Biological Survey identified several flora and fauna in the Project Site and immediately surrounding areas. Flora identified included one endemic (ʻākia or *Wikstroemia uva-ursi*) and six indigenous species. Of the indigenous flora, three are planted as part of landscaped vegetation (hala [*Pandanus tectorius*], hau [*Talipariti tiliaceum*], and ʻilima [*Sida fallax*]), and the other three appear to grow naturally, but are as well more likely plantings (naupaka, pohuehue, and milo [*Thespesia populnea*]). Aquatic faunae were identified in the Honokōwai Stream, which borders the Project Site to the north. Fishes observed include mosquitofish (*Gambusia affinis*), mullet (*Mugil cephalus*), tilapia (*Oreochromis mossambicus* and *Sarotherodon melanotheron*), and Hawaiian flagtail or ʻaholehole (*Kuhlia xenura*). Only one indigenous avian fauna was observed, the Black-crowned Night-Herron or ʻaukuʻu (*Nycticorax nycticorax*).

The report further notes that protected Hawaiian waterbirds (*e.g.*, the Hawaiian Duck, Hawaiian Coot, endemic subspecies of Common Gallinule, and endemic subspecies of Black-necked stilt) are unlikely to occur in the Project Site. Moreover, it is possible that night-flying Hawaiian seabirds are likely to overfly or otherwise use the Project Site and the Hawaiian hoary bat may use resources within the vicinity of the Project Site. Sightings of the Hawaiian monk seal (*Monachus schauinslandi*) at Honokōwai Beach have been reported 159 times between 2014 and 2023. Green sea turtles may also occur in the Project Site.

C. Archaeological Literature Review and Field Investigation (Appendix F)

The Archaeological Literature Review and Field Investigation conducted a search of previous archaeological investigations and previously identified historic properties within a one-mile radius of the Project Site. Approximately 25 previous archaeological investigations were identified, although none was identified within the Project Site or Sand Recovery Site. Several

previously identified historic properties were identified, including State Site No. 01206, a leina a ka ʻuhane, located at Puʻu Kekaʻa, near the Sand Recovery Site. Additional archaeological survey work will be conducted, and any impacts on historic sites and properties will be formally assessed through the HRS § 6E-42 process, which is required for this Proposed Action. In addition, an archaeological field inspection was conducted in the Project Site, and a side scan sonar and tow camera survey of the Sand Recovery Site was conducted.

No pre-contact or historic-era archaeological sites or structures were identified on the surface of Honokōwai Beach during the field inspection. The probability of encountering historically significant sites within sandy contexts in the Project Site appears to be significantly low, considering the historical loss of sand, shoreline migration, and exposure of the alluvial escarpment. The probability of encountering *in situ* historically significant or culturally sensitive sites at the Project Site is low for the Beach Nourishment and Beach Maintenance alternatives. The Beach Stabilization alternative may warrant archaeological testing within the construction footprint given the potential need for excavation, which may identify additional resources. The recovery of a probable kuʻula stone near the Sand Recovery Site has raised concerns that significant traditional Hawaiian objects may be present in the Sand Recovery Site. While tow camera survey footage did not reveal the presence of traditionally significant objects along the documented transects, the potential remains for such object to exist in un-surveyed portions of the Sand Recovery Site or beneath the surface of the deposited sand. Similar to the Cultural Impact Assessment, while historic property documentation of Puʻu Kekaʻa and the Leina a ka ʻUhane focuses on the physical landmass, the entry in pō and the journey of the soul after leaping extends into the sea.

D. Cultural Impact Assessment (Appendix G-1)

As discussed in section 4.3 of the Cultural Impact Assessment, cultural resources are divided into two categories: biocultural resources and built environment resources. Biocultural resources are defined as natural elements in Hawaiʻi without human contact. Their existence and significance can be shown or observed through oral histories and literature. Built environment resources are defined as elements that exist through human interaction with biocultural resources whose existence and history can be determined, examined, and proven through anthropological and archaeological observation. Of note, many cultural resources may be significant to members of the Native Hawaiian community but do not necessarily result in material evidence. Additionally, ethnographic data was gathered through interviews conducted as part of the Cultural Impact Assessment. The interviews indicate extensive current traditional cultural resources in the area that are used for traditional or customary practices. As discussed in the Cultural Impact Assessment, information gathered regarding beliefs from practitioners can differ from information gathered from other sources, and the Cultural Impact Assessment faithfully captured and documented beliefs from practitioners, even when these beliefs may be inconsistent with other data.

Several intangible cultural resources and traditional or customary practices historically in the Project Site and surrounding areas were examined, including ʻōlelo noʻeau (proverb, wise saying, traditional saying), mele (song, anthem or chant of any kind; poem, poetry; to sing, chant), ʻoli (chant that was not danced to), and moʻolelo (story, tale, myth, history, tradition, literature, legend, journal, log, yard, fable, essay, chronicle, record, article). No ʻōlelo noʻeau were identified for the immediate Project Site. Mele and ʻoli, including *Honokōwai* and *He Inoa no Kekaʻa*, were identified as being composed for and inspired by the larger Project Site. Similarly, several moʻolelo about the Project Site were identified, including, *He Wahi Moʻolelo no Kauaʻula a me Kekāhi o Lahaina i Maui*, *He Moʻolelo No Maui*, *Kumumanaʻo o Kekaʻa*, *Ka Moʻolelo o Eleio*, and *Ka Moʻolelo o Kamehameha I*. Puʻu Kekaʻa, located south of the Project Site near the Sand Recovery Site, is identified in moʻolelo as a leina a ka ʻuhane, or "leap of the soul," where spirits would depart the earthly realm into the afterlife to join their ancestors. An essential element of leina is their view shed, an open visual expanse that stretches from the land out to the ocean unimpeded by obstacles. Leina may also have modern recreational purposes, such as cliff diving, which were identified in the Coastal and Marine Uses Report (Appendix J).

Additional cultural practices include: lei making (which is continued in the broader Study Area, but not the Project Site); kilo (observational traditions, which may occur at the Project Site, primarily with fishermen); haku mele, haku oli, and hula (are recently and historically written about the Project Site and the surrounding area); fishing; and surfing. Ethnographic data collected during interviews also identified fishing, gathering of limu, canoe paddling, surfing, and diving. One interviewee also shared that he considered the sand to be a kinolau, or body form of deities, since the sand came from a previously living reef. Multiple interviewees also noted that some resources, such as limu, have decreased over the years.

E. Coastal and Marine Uses Report (Appendix J)

The Coastal and Marine Uses Report identified recreational uses of the Project Site and the Sand Recovery Site through surveys and site visits. While no traditional gathering activities, such as gathering ʻopihi or limu, were observed during site visits, a few ʻopihi were observed on the breakwall fronting the Maui Kai Condominium immediately south of the Project Site, and various types of limu were observed along the shoreline and in the shallow waters along Honokōwai Beach. As a result, the report notes that there is a high potential that gathering still occurs within and surrounding the Project Site. No gathering activities were identified at the Sand Recovery Site given its distance from the shoreline. Additionally, diving, spearfishing, surfing, fishing, cliff diving, and canoe paddling were identified within the vicinity of the Project Site and/or Sand Recovery Site.

F. Summary of the Identification and Scope of Resources in the Project Site

The ocean environment is a cultural resource, as it is used as a setting for fishing, gathering, surfing, paddling, and other activities. Practitioners access the resource through a variety of locations and methods. Upon review of the Baseline Assessment of Marine Water Chemistry and Marine Biotic Communities and the Coastal and Marine Uses Report, there are limited marine resources within the nearshore scour area, with increasing amounts of resources in the areas farther offshore.

III. Extent to Which Resources May Be Affected or Impaired

The second item under the *Ka Pa'akai* framework – the extent to which identified resources—including traditional and customary Native Hawaiian rights—will be affected or impaired by the proposed action – also examines two separate elements: the extent the resources itself is affected or impaired, and the extent that access to the resource is affected or impaired. First, whether the proposed action and its alternatives have an adverse impact on the existence of resources. This would include the alteration, destruction, modification, or harm of sites, including biological resources, sacred places, burial sites, etc., as well as a loss of species. Any adverse impact or harm to resources alone is an effect or impairment caused by the proposed action. Under this element, adverse impacts to historic sites or culturally utilized plants would all be identified adverse impacts. Under this same element, any indirect or cumulative effects would create an adverse impact under *Ka Pa'akai* if those actions harmed resources.

In addition, any action that impacts traditional and customary access to resources, even if there is no direct adverse impact to the resource itself, would result in an effect or impairment resulting from the proposed action. Therefore, the limitations on access that could result from the development or use of the Project Site could create an adverse impact under *Ka Pa'akai.*

A. Baseline Assessment of Marine Water Chemistry and Marine Biotic Communities (included in Appendix A)

Impacts associated with each alternative were identified in the Baseline Assessment of Marine Water Chemistry and Marine Biotic Communities. Under each alternative, potential temporary increases in turbidity in nearshore waters may occur during construction and, in the case of the Beach Restoration alternatives, during the post-construction equilibration period. With respect to the Beach Stabilization alternative, long-term impacts include the permanent coverage of existing marine habitat within the footprint of the proposed groins and sandfill, although these structures will also create new marine habitat and the loss of existing benthic habitat within the groin footprints is likely to be offset by new habitat created by the groins. Fish populations within the groin footprints and sand fill will be permanently displaced, although fish biomass and

biodiversity there are very low due to its location in the nearshore scour zone. As a result, impacts to fish populations or migration patterns are expected to are expected to be negligible. The cumulative impacts of the No Action alternative are anticipated to be broad-ranging and substantial, including beach narrowing, negative impacts to water quality and benthic habitat, loss of ecosystem services and critical natural habitats, and progressive degradation of the shoreline area as a result of continued erosion following removal of the existing erosion protection skirt.

B. Terrestrial Biological Survey (Appendix C)

The presence or use of machinery on the beach and backshore area may impact existing fauna. Impacts to waterbird and seabird species, such as disturbance from noise and human activity and mortality from ground disturbance and vehicle strikes, may occur during construction for each of the Beach Restoration alternatives. Impacts to Hawaiian hoary bats could occur only if trees are cleared. Threatened or endangered species, such as monk seals and sea turtles, may be impacted by disturbance from noise and human activity and an increase in nearshore turbidity for all Beach Restoration alternatives. Additionally, for the Beach Stabilization alternative, construction activity related to the groins could cause in-water disturbance to monk seals and sea turtles. Increased beach area for monk seals and sea turtles to haul out is anticipated as a beneficial impact of each Beach Restoration alternative.

C. Archaeological Literature Review and Field Investigation (Appendix F)

The Archaeological Literature Review and Field Investigation report noted potential temporary adverse effects on Puʻu Kekaʻa. The report notes that at Puʻu Kekaʻa, depending on the season and the direction of the setting sun, the presence of barges (*i.e.*, at the Sand Recovery Site) off the leaping point would present a temporary adverse effect on the setting and feeling of the leina, disrupting the perceived pathway of the soul's journey.

D. Cultural Impact Assessment (Appendix G-1)

In this case, area practitioners expressed concern about a potential indirect effect resulting from construction activities fronting the KBC hotel property. The extent of this impact is unknown, but practitioners expressed concern over a possible permanent impact on marine resources, namely fish and limu, which are actively gathered for subsistence purposes. Based on the interviews, the most potential effect would be from Beach Stabilization and the construction of groins, including potential impacts of sand on reef and marine, impacts on tako habitat, and the psychological and emotional impacts of development (*e.g.*, groin construction) on the beach. Practitioners also expressed concern over the possible indirect impact of Beach Nourishment and/or Beach Maintenance, such as the impact of additional sand on reef and marine life. No concern was expressed by the people interviewed over the potential significant and adverse impacts arising

from the No Action alternative. When weighed against the Baseline Assessment of Marine Water Chemistry and Marine Biotic Communities and the Coastal and Marine Uses Report, the potential impact for cultural practices is lowered due to the fact that the marine resources within the nearshore scour area are limited. The potential to affect cultural practices increases as the amount of resources increases in areas farther offshore.

E. Coastal and Marine Uses Report (Appendix J)

The Coastal and Marine Uses Report anticipates impacts for each Beach Restoration alternative, as well as the No Action alternative. Anticipated impacts from sand recovery and placement (applicable for each Beach Restoration alternative) include minor turbidity at the Sand Recovery Site during sand recovery operations and at the Project Site during construction and equilibration. Turbidity may temporarily impact gathering activities, fishing, diving, surfing, canoe paddling, and potentially cliff diving. Construction will temporarily impact gathering activities, fishing, diving, surfing, and canoe paddling by limiting access to the Project Area while construction activities take place. Similarly, sand recovery operations will temporarily limit access to the Sand Recovery Site which may impact fishing and canoe paddling. With respect to the Beach Nourishment and Beach Maintenance alternatives, in the event the effective life of the restoration is shorter than anticipated, beach narrowing or loss could occur without further action. The impacts of beach narrowing and/or loss are similar to those anticipated for the No Action alternative. Gathering activities, diving, surfing, fishing, and canoe paddling may be impacted by Beach Stabilization through the restoration of conditions similar to those before the episodic erosion event at the Project Site. The Beach Stabilization alternative may also impact surfing due to the presence of groins, although the report notes that an assessment is difficult to make with certainty due to dependence on swell direction and size.

For the No Action alternative, the report notes that if no action is taken, it is possible that eventually, the beach could disappear entirely and terrestrial sediment (alluvium) would be discharged, causing turbidity plumes that are potentially detrimental to corals and sea life. Beach narrowing and/or loss would negatively impact gathering activities (*e.g.*, gathering of limu and shells) and would negatively impact fishing in the short term and the long term. Additionally, the No Action alternative would create a more hazardous environment for divers (*e.g.*, due to increased turbidity), more hazardous surfing due to increased wave reflection and turbidity, and reduce safe access to and from the beach for canoe paddlers.

F. Summary of the Extent to Which Resources May Be Affected or Impaired

There would be temporary impacts to access in all of the three proposed Beach Restoration alternatives, but not in the no action alternative, which would have its own long-term impacts. There would be a temporary impact on Puʻu Kekaʻa, specifically the setting and feeling of this

significant historic site. Cultural practices in the area, like paddling or surfing, may also be temporarily impacted, as reflected in the Coastal and Marine Uses Report. Any shore-based activities would face long-term impacts with the loss of the beach in the Project Site. This would include fishing, surfing, and any other cultural practices that utilized beach access.

IV. Potential Feasible Actions to Reasonably Protect Native Hawaiian Rights

The third part of the *Ka Pa'akai* framework aims to identify "[t]he feasible action, if any, to be taken to reasonably protect Native Hawaiian rights if they are found to exist." Whether or not an action is suitable and "feasible" to reasonably protect Native Hawaiian rights is a matter for the State to determine. Feasible actions could include continued access to the Project Site, as needed to conduct cultural practices. Native planting may also be a potentially feasible action.

Some potential feasible actions identified in the technical reports include: reasonably protecting the view shed at Puʻu Kekaʻa to maintain spiritual sanctity and honor its cultural significance (Appendix G-1 at 84-85); protecting nabeta during sand recovery (Appendix G-1 at 110); restoring depleted ocean resources, such as limu and coral (Appendix G-1 at 115); developing a reef-safe landscaping plan in consultation with community groups (Appendix G-1 at 126); working with the community to avoid or mitigate impacts on paddling routes, fishing areas, gathering areas, surfing spots, and marine resources (Appendix G-1 at 126); conducting archaeological monitoring during sand recovery (for all alternatives) and construction (for the Beach Stabilization alternative) (Appendix F at 74); and implementing best management practices, such as biosocks and silt curtains (Baseline Assessment of Marine Water Chemistry and Marine Biotic Communities in Appendix A at 37).

Further inquiry into the potential extent of the impact on marine resources is necessary to propose action that the State can take to protect Native Hawaiian rights in the area. These actions may include increased restoration efforts or establishing access for fishers and practitioners.

APPENDIX H

PUBLIC TRUST RESOURCE ANALYSIS

PUBLIC TRUST RESOURCE ANALYSIS[1]

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[1] Compiled by Starn O'Toole Marcus & Fisher and Honua Consulting.

1.0 Introduction and Background

Article XI, Section 1 of the Hawai‘i Constitution declares that "for the benefit of present and future generations, the State and its political subdivisions shall conserve and protect Hawai‘i's natural beauty and all natural resources, including land, water, air, minerals and energy sources." Article XI, Section 7 further provides that "[t]he State has an obligation to protect, control and regulate the use of Hawai‘i's water resources for the benefit of its people." And, Article XII, Section 4 directs that all crown and government lands transferred to the State under the Admission Act, commonly known as 'ceded lands,' "shall be held by the State as a public trust for native Hawaiians and the general public."

The above provisions within the Hawai‘i Constitution establish that Hawai‘i's natural resources and ceded lands are held in trust by the State, and impose a fiduciary duty upon the State (including its agencies) to preserve and protect those resources and lands for the public. *See, e.g.*, *Kauai Springs, Inc. v. Planning Comm'n of Cnty. of Kauai*, 133 Hawai‘i 141, 174, 324 P.3d 951, 984 (2014) ("the public trust creates an affirmative duty of the State . . . to protect public trust uses whenever feasible" (emphasis in original; internal quotations omitted)); *In re Water Use Permit Applications (Waiāhole Ditch)*, 94 Hawai‘i 97, 11-2, 9 P.3d 409, 443-44 (2000) (hereinafter, *Waiāhole Ditch)* (holding that "article XI, section 1 and article XI, section 7 adopt the public trust doctrine as a fundamental principle of constitutional law in Hawai‘i").

In January 2025, the Hawai‘i Intermediate Court of Appeals ("ICA") summarized the public trust analyses of *Waiāhole Ditch* and its progeny, articulating "three procedural requirements" the State must fulfill "in executing its public trust." *See Frankel v. Bd. of Land and Nat. Resources*, 155 Hawai‘i 358, 378-79, 564 P.3d 1157, 1177-78 (App. 2025). The ICA provided that: "When compromising a public trust resource, Hawai‘i law requires the agency entrusted to protect that trust resource to (1) begin its analysis with the presumption in favor of public use when balancing between public and private purposes, (2) consider practicable alternatives, and (3) set forth its decision with clarity." *Id.* (citing *Waiāhole Ditch*, 94 Hawai‘i at 142, 143, 158, 171, 9 P.3d at 454, 455, 470, 483).

When performing as a trustee, State agencies are "duty bound to demonstrate that it has properly exercised the discretion vested in it by the constitution and statute." *See, e.g.*, *Waiāhole Ditch*, 94 Hawai‘i at 158, 9 P.3d at 470. The requirement is undergirded by the principle that State agencies "must take the initiative in considering, protecting, and advancing public rights in the resource at every stage of the planning and decision making process." *Id.* at 143, 9 P.3d at 455. Thus, when considering permits, rights of entry, or approvals that may affect or compromise State trust resources or lands, State agencies must fulfill the three procedural requirements articulated in *Frankel*. *Cf.* 155 Hawai‘i at 378-7, 564 P.3d at 1177-78; *see also Kauai Springs, Inc.*, 133 Hawai‘i at 173, 324 P.3d at 983 ("When an agency or other deciding body considers an application

for permits under circumstances that requires the deciding body to perform as a public trustee to protect a public trust resource, the agency or other deciding body must make findings sufficient to enable an appellate court to track the steps that the agency took in reaching its decision."). This responsibility ultimately rests with the State in carrying out its public trust duties pursuant to Article XI, Sections 1 and 7, and Article XII, Section 4 of the Hawai'i Constitution. *See Waiāhole Ditch*, 94 Hawai'i at 158, 9 P.3d at 470 (an agency "must not relegate itself to the role of a mere umpire passively calling balls and strikes for adversaries appearing before it, but must instead take the initiative in considering, protecting, and advancing public rights in the resource").

The Ho'āla Honokōwai Project involves State-owned beaches and submerged lands, *i.e.*, public trust resources and ceded lands. Recognizing the State's responsibilities that accompany this constitutional mandate, the applicant provides this public trust resource analysis as part of this Draft Environmental Impact Statement (DEIS) for the State's consideration. The DEIS discusses and demonstrates how the project aligns with public trust values by: 1) restoring a public beach resource; 2) preserving public access; 3) protecting cultural practices; 4) protecting water quality by reducing sediment discharge to nearshore waters; and 5) strengthening resilience against coastal hazards and sea level rise. Each of these objectives directly supports the State's constitutional trust duties to conserve resources for the benefit of present and future generations and to hold ceded lands in trust for both Native Hawaiians and the general public.

Providing this analysis in the DEIS assists DLNR and BLNR in making clear, evidence-based findings that comply with *Waiāhole Ditch* and its progeny when appropriate and as needed. This proactive approach helps ensure that the State's decisions will rest on a well-documented record that demonstrates how trust resources have been identified, how alternatives have been considered, and how the presumption in favor of public use has guided the project's design.

2.0 *Waiāhole Ditch* and Subsequent Case Law

Over the past quarter-century, Hawai'i's courts have opined on how the State implements and fulfills its public trust duties. In *Waiāhole Ditch*, the Hawai'i Supreme Court considered the State's public trust duties under Article XI, section 1 and Article XI, section 7 related to water. 94 Hawai'i at 131-32, 9 P.3d 443-44. The Court held that water is a public trust resource and required agencies to begin with a presumption in favor of public trust purposes (*i.e.*, public use, access, and enjoyment). *Cf. id.* at 155, 9 P.3d at 467. The Court further noted that while that State "must take the initiative in considering, protecting, and advancing public rights in the resource at every stage of the planning and decisionmaking process[,]" because of the public trust's "inherent presumption in favor of public use, access, and enjoyment[,]" under the public trust, "applicants have the burden of justifying their proposed uses in light of protected public rights in [a] resource." *See id.* at 143, 160, 9 P.3d 455, 472. Nevertheless, the Court found that "the state may compromise public rights in the resource pursuant only to a decision made with a level of openness, diligence, and foresight

commensurate with the high priority these rights command under the laws of our state. " *Id.* at 143, 9 P.3d at 455.

The principles espoused in *Waiāhole Ditch* were carried forward in *Sierra Club v. Department of Transportation*, where the Hawai'i Supreme Court found that the State erroneously exempted a harbor improvement project related to the Superferry from environmental review. 115 Hawai'i 299, 167 P.3d 292 (2007) (hereinafter, *Superferry*). Although *Superferry* did not involve the public trust doctrine, it did examine whether an agency followed correct procedures and considered appropriate factors in its decisionmaking. *See id.*at 317-18, 167 P.3d at 310-11; *see also Frankel*, 155 Hawai'i at 370-71, 564 P.3d at 1169-70. The Court in *Superferry* explained that the "applicable standard of review requires that th[e] court determine, as a matter of law, whether or not [the State of Hawai'i Department of Transportation] has followed the correct procedures and considered appropriate factors in making its determination[.]" *Id.* at 342, 167 P.3d at 335.

The Court further expounded on *Waiāhole Ditch* in *Kauai Springs, Inc. v. Planning Commission of Kauai*, in which it stressed that the public trust doctrine applies "at every stage of the planning and decision-making process." 133 Hawai'i 141, 173, 324 P.3d 951, 983 (2014). Public trust analysis, the Court explained, requires that "the agency or other deciding body must make findings sufficient to enable an appellate court to track the steps that the agency took in reaching its decision." *Id.* The Court further emphasized that "[u]nder the . . . principles and purposes of the public trust, it is manifest that a government body is precluded from allowing an applicant's proposed use to impact the public trust in the absence of an affirmative showing that the use does not conflict with those principles and purposes." *Id.* at 174, 324 P.3d at 984.

Similarly, in *In re Conservation District Use Application HA-3568 for the Thirty Meter Telescope at Mauna Kea Science Reserve*, the Hawai'i Supreme Court clarified the extent of public trust resources under Article XI, section 1 of the Hawai'i Constitution, holding that "conservation district lands owned by the State . . . are public resources held in trust for the benefit of the people[.]" 143 Hawai'i 379, 400, 431 P.3d 752, 773 (2018) (hereinafter *Mauna Kea*). The Court reaffirmed the requirements set forth in *Waiāhole Ditch*, such as "a balancing between the requirements of conservation and protection of public natural resources, on the one hand, and the development and utilization of these resources on the other in a manner consistent with their conservation." *Id.* The Court continued, noting that while "Article XI, Section 1, requires the state both to 'protect' natural resources and to promote their 'use and development, consistent with the conservation of the natural resources[,]" any balancing "must begin with a presumption in favor of public use, access[,] and enjoyment." *Id.* at 401, 431 P.3d at 774 (quoting *Waiāhole Ditch*, 94 Hawai'i at 139, 9 P.3d at 451). The Court ultimately upheld the permit, finding that "the [Board of Land and Natural Resources] met its duties as trustee under the Article XI, Section 1 public land trust through its Decision and Order." *Id.* at 402, 431 P.3d at 775.

The public trust doctrine's cultural and fiduciary dimensions are further detailed in *Ching v. Case*, where the Court recognized ceded lands are held in public trust and the State has a duty to preserve and protect them. 145 Hawai'i 148, 449 P.3d 1146 (2019). More recent cases, including *In re Maui Electric Co.*, 150 Hawai'i 528, 506 P.3d 192 (2022), *Carmichael v. Board of Land and Natural Resources*, 150 Hawai'i 547, 506 P.3d 211 (2022), and *Kia'i Wai v. Department of Water, County of Kauai*, 151 Hawai'i 442, 517 P.3d 725 (2022), reiterated that the public trust doctrine applies universally to natural resources, requiring agencies across contexts to provide clear, evidence-based rationales.

More recently in *Frankel*, the ICA vacated the BLNR's renewal of a revocable permit for the Kahala Hotel to use ceded beach lands. 155 Hawai'i 358, 564 P.3d 1157. The ICA found that the BLNR "did not make explicit findings showing it fulfilled the[] three procedural requirements from [*Waiāhole Ditch*] in executing its public trust duties. *Id.* at 379, 564 P.3d at 1178. The ICA further opined that while "[p]ursuant to *In re MECO*, even in the absence of explicit public trust findings in the agency's decision, the decision may nonetheless be upheld if the public record reflects an application of the public trust principles[,]" the BLNR still "failed to consider the appropriate factors" and "failed to follow proper procedure." *Frankel*, 155 Hawai'i at 379, 564 P.3d at 1178; *see also In re MECO*, 150 Hawai'i at 540, 506 P.3d at 204. Thus, as articulated by the ICA in *Frankel*, "[w]hen compromising a public trust resource, Hawai'i law requires the agency entrusted to protect that trust resource to (1) begin with a presumption in favor of public use when balancing between public and private purposes, (2) consider practicable alternatives, and (3) set forth its decision with clarity." *Frankel*, 155 Hawai'i at 378-79, 564 P.3d at 1177-78 (citing *Waiāhole Ditch*).

With respect to the Ho'āla Honokōwai Project, this framework provides an analytical lens through which the DLNR and BLNR might evaluate and analyze the DEIS and subsequent discretionary permit and/or land disposition applications in fulfilling their public trust duties.

3.0 Public Trust Resources at Honokōwai

The Project Area includes public trust resources and ceded lands covered under Articles XI and XII of the Hawai'i Constitution. The beach, nearshore waters, cultural landscapes, and supporting infrastructure collectively sustain traditional and customary practices, public access and recreation, ecological integrity, and resilience to coastal hazards and sea level rise. Each of these resources form part of the trust corpus that the State is obligated to manage for the benefit of present and future generations. The DEIS and its appendices provide extensive documentation of the environmental conditions at Honokōwai, including the ongoing threats of erosion and sea level rise, as well as the cultural and community practices that depend on a healthy shoreline. This section describes these public trust resources in detail, explaining how the project implicates them and why their protection is central to constitutional compliance.

3.1 Beaches and Submerged Lands

Honokōwai Beach is located seaward of the certified shoreline, which under Hawai‘i law belongs to the State of Hawai‘i. Therefore, the beach and its related submerged lands are held in trust under Article XII, Section 4 of the Hawai‘i Constitution. Article XII, Section 4 requires the State to oversee these lands for the benefit of both Native Hawaiians and the public, keeping them accessible for cultural practices, access, and recreation. Moreover, the beach is located within the State Conservation District and, as a result, is also a public trust resource under Article XI, Section 1. *See Mauna Kea*, 143 Hawai‘i at 400, 431 P.3d at 773. The DEIS for the Ho‘āla Honokōwai Project reports significant historical shoreline erosion occurring in recent decades, especially after the 2016 avulsion and beach loss event. That single event led to the shoreline migrating six to twelve feet mauka (landward) and released over 1,000 cubic yards of alluvial sediment (*i.e.*, clay, silt, boulders) into the nearshore environment, causing turbidity plumes that negatively impacted nearshore water quality, extending up to 1,500 feet offshore. *See, e.g.*, DEIS, Appendix A at 7.

The beach's continuing loss undermines its ability to serve the multiple functions that public trust law requires the State to preserve. First, beaches in Hawai‘i serve as corridors for lateral access along the shoreline, a right guaranteed under the Constitution, statute (HRS § 115-5), and case law such as *Waiāhole Ditch*. Second, beaches are integral spaces for cultural practices, including fishing, gathering, and ceremonial uses that connect Native Hawaiians to ancestral lands and waters. Third, beaches act as buffers against storm waves, protecting inland resources and communities from erosion and flooding. When Honokōwai Beach narrows, these trust values are directly compromised.

3.2 Nearshore Waters and Marine Environment

Article XI, Section 7 of the Hawai‘i Constitution establishes the State's obligation to "protect, control and regulate the use of Hawai‘i's water resources for the benefit of its people." This duty extends to the nearshore waters adjacent to Honokōwai Beach, which encompass critical wildlife habitats, essential fish habitats, coral reef ecosystems, and essential resources for subsistence and cultural practices. The Coastal Engineering Assessment (DEIS, Appendix A) provides detailed baseline data on bathymetry, wave climate, sediment transport, water quality, and benthic habitats, demonstrating both the richness of this environment and its vulnerability to sedimentation and erosion.

The DEIS notes that Honokōwai's nearshore waters provide habitat for a range of marine species, including those protected under federal law such as green sea turtles (honu) and Hawaiian monk seals. *See* DEIS, Appendix C (Terrestrial Biological Survey) at 17. The Project Area includes Federally-designated critical habitat for the Hawaiian monk seal. *See, e.g.*, 50 CFR § 226.201; *see also* HRS ch. 195D; HAR ch. 13-124. Coral reef systems in this area are particularly sensitive to turbidity and sedimentation, which reduce light penetration, inhibit coral recruitment,

and smother benthic organisms. *Cf.* DEIS, Appendix A at 153. The 2016 avulsion and beach loss event directly exposed this vulnerability, as the sudden discharge of over 1,000 cubic yards of alluvial sediment visibly clouded the nearshore waters and impacted benthic resources (DEIS, Appendix A).

3.3 Traditional and Customary Practices

Article XII, Section 7 of the Hawai‘i Constitution protects "the rights of Native Hawaiians to practice their traditional and customary rights." This includes fishing, gathering, and ceremonial practices exercised in the shoreline and nearshore areas of Honokōwai. The Cultural Impact Assessment (Appendix G-1) and *Ka Pa‘akai* framework (Appendix G-2) included in the DEIS document the continued presence and exercise of such practices. Interviews with practitioners confirm that Honokōwai remains a significant site for subsistence fishing, seasonal gathering, and cultural ceremonies associated with the ocean and shoreline.

3.4 Public Access and Recreation

Article XI, Section 1 of the Hawai‘i Constitution has been interpreted to include public access and recreation as trust purposes. The shoreline belongs to the people, and ensuring its availability for lateral passage, gathering, and recreation is a fiduciary duty of the State. At Honokōwai, this duty was compromised by the 2016 avulsion and beach loss event and is currently undermined by ongoing erosion and beach instability, which are degrading the public beach resource, obstructing lateral passage, and limiting safe recreational use. The DEIS documents that Honokōwai Beach is a vital recreational area, supporting ocean sports, fishing, walking, and cultural events. DEIS, Appendix J.

3.5 Environmental and Hazard Protection

Under Article XI, Section 1, the State's duty to conserve natural resources includes ensuring public safety from environmental hazards. Beaches and dunes are not just recreational features; they serve as natural infrastructure, dissipating wave energy, reducing flooding, and protecting inland areas from coastal hazards. The DEIS documents the threats facing Honokōwai, including chronic erosion, storm surge, and sea level rise, highlighting how shoreline loss exacerbates risks to public natural resources, as well as inland properties, infrastructure, and cultural sites. *See, e.g.*, DEIS, Section III.A.6; Appendix A, Section 7.3.4.

3.6 Economic and Social Values

Finally, although not explicitly listed in the Hawai‘i Constitution, Hawai‘i courts have consistently acknowledged that the public trust doctrine includes social, recreational, and community well-being alongside ecological and cultural values. *See, e.g.*, *Waiahole Ditch*, 94

Hawai‘i 97, 9 P.3d 409 (explaining that the public trust extends to the “maintenance of waters in their natural state, the domestic water use of the general public, the protection of traditional and customary Hawaiian rights, the maintenance of ecological balance and scenic beauty, and the preservation and enhancement of waters for recreational purposes”); *Kelly v. 1250 Oceanside Partners*, 111 Hawai‘i 205, 140 P.3d 985 (2006) (highlighting that the State’s fiduciary duties include safeguarding scenic and recreational values vital to community well-being); *Superferry*, 115 Hawai‘i 299, 167 P.3d 292 (emphasizing that the public trust serves broad community purposes, including recreation, cultural practices, and quality of life). The DEIS identifies Honokōwai Beach as both a key community gathering spot and an economic asset for West Maui’s visitor industry (DEIS, Appendices I and J). Recreational opportunities such as fishing, ocean sports, swimming, and gathering underpin community cohesion, while visitor enjoyment of beaches drives much of the regional economy.

4.0 Applying the *Waiāhole Ditch* Factors

The *Frankel* decision articulated certain public trust resource analysis factors established in *Waiāhole Ditch* and its progeny. As applicable here, *Waiāhole Ditch* requires that when compromising public trust resources (*e.g.*, authorizing activity on State-owned ceded lands, waters, or submerged areas), the State must (1) begin with a presumption in favor of public use, (2) consider practicable alternatives, and (3) set forth its decision with clarity.

4.1 Presumption in Favor of Public Use

The presumption in favor of public use, access, and enjoyment flows directly from Article XI, Section 1 and Article XII, Section 4 of the Hawai‘i Constitution. The courts have interpreted these provisions to mean that public use is the default orientation of trust resources, and applicants wanting to compromise the public trust resource must justify their proposed use, including by showing mitigating measures and the absence of practicable alternatives. *See, e.g.*, *Frankel*, 155 Hawai‘i at 369, 564 P.3d at 1168.

In *Waiāhole Ditch*, the Hawai‘i Supreme Court articulated this principle in the water context, requiring agencies to “begin their analysis with a presumption in favor of public use.” That reasoning has since been applied across resource sectors. In *Frankel*, the ICA faulted BLNR for failing to apply the presumption when it renewed the Kahala Hotel’s revocable permit to use ceded lands for private, commercial purposes. BLNR’s record began from the rationale of regulating existing private use rather than affirming the public purposes of those lands. This reversal of orientation violated the trust duty.

Here, the circumstances and underlying facts of the Hoʻāla Honokōwai Project are markedly distinguishable from those in *Frankel*. The Project’s stated objectives, specifically: improving beach stability, preserving and enhancing cultural and shoreline access, increasing

resilience to coastal hazards and human-induced sea level rise, and enabling planning for long-term adaptation to sea level rise are classic public trust purposes. The DEIS highlights that, without intervention, Honokōwai Beach will lose 1.4 acres of shoreline and contribute 20,000 cubic yards of sediment to nearshore waters over the next fifty years, which would eliminate access, harm cultural practices, degrade critical habitat, and weaken ecological function (DEIS, Ch.2 and Ch. 3; Appendix A). In contrast, the proposed beach restoration through Beach Stabilization restores and safeguards these functions.

The Project is not a "use of State land" in the sense of privatization but is instead a public trust resource restoration activity that aligns with public use, access, and enjoyment. Temporary construction impacts, such as turbidity, noise, and restricted access, must be acknowledged as part of the analysis, but they are limited in scope and duration. The long-term benefits overwhelmingly advance public trust purposes (*e.g.*, cultural continuity, ecological health, recreational access, and hazard mitigation). Honokōwai Beach and its nearshore waters are public trust resources. Their loss threatens core constitutional values. The Project seeks to reverse that trajectory. Beginning with the presumption in favor of public use ensures that the trust orientation of these resources remains central, aligning with both constitutional text and case law.

4.2 Consideration of Practicable Alternatives

The second *Waiāhole Ditch* factor is that agencies must consider practicable alternatives. This duty stems from *Waiāhole Ditch*, *Kauai Springs*, and *Superferry*, which collectively emphasized that agencies must explore all feasible means of protecting trust resources before authorizing actions that compromise them. In *Frankel*, the ICA criticized BLNR for failing to consider alternatives to the Kahala Hotel's existing use under the revocable permit, such as non-renewal or conditions limiting commercial activity.

The DEIS for Honokōwai provides a robust alternatives analysis, including: (1) Beach Stabilization (preferred), (2) Beach Nourishment, (3) Beach Maintenance, and (4) No Action. Each alternative is evaluated with respect to design life, sand volumes, engineering feasibility, environmental impacts, and ability to meet project objectives (DEIS Application, Ch. 2; Appendix A CEA). *See also* DEIS, Section II.F. (discussing additional alternatives that were dismissed as not practicable).

By documenting these alternatives and explaining why beach restoration through Beach Stabilization is the most practicable choice, the DEIS satisfies the second *Waiāhole Ditch* factor. The BLNR will need to adopt explicit findings comparing alternatives, explaining why the preferred alternative is justified, and tying the reasoning to constitutional trust duties. This ensures both compliance and clarity.

4.2.1 Beach Stabilization (Preferred Alternative)

Beach Stabilization, integrating groins and managed nourishment, provides a fifty-year design life, reduces the frequency of interventions, and minimizes long-term environmental disruption (DEIS Ch. 1 and Ch. 2, Appendix A). This alternative best achieves the project's objectives while protecting public trust resources. It maintains lateral and perpendicular access, preserves cultural practice areas, reduces sediment discharge, and strengthens resilience to sea level rise.

The Project's preferred alternative, in contrast to the No Action alternative, seeks to restore Honokōwai Beach through a stabilization plan that integrates beach nourishment and groins. The engineering appendix demonstrates that this approach provides the longest design life (fifty years), the greatest durability against sea level rise, and the fewest recurring construction impacts compared to the Beach Nourishment or Beach Maintenance alternatives (DEIS, Appendix A). By widening and stabilizing the shoreline, the Project would reestablish and stabilize the beach as a functional public trust resource, ensuring continued access, cultural practice, and protective functions. In this way, the Project represents not a privatization or encroachment of trust lands, as in *Frankel*, but their restoration and revitalization.

The Project seeks to address this degradation by stabilizing the beach and reducing chronic erosion. The preferred alternative proposes the use of groins to stabilize the public beach. By installing groins and implementing managed beach nourishment, the Project would trap sediment onshore, significantly reducing turbidity and sediment discharge into the reef system (DEIS, Appendix A). Best management practices (BMPs) and construction-phase mitigation, such as turbidity curtains, are also included to minimize temporary impacts. Over the long term, the Project is expected to create a net benefit for nearshore waters by restoring sand stability, improving water quality, and preserving healthy reef ecosystems.

In this way, the Project aligns with the trust duty articulated in *Waiāhole Ditch* and *Kauai Springs* that agencies must not only refrain from harming trust resources but actively manage them for restoration and resilience. The nearshore waters at Honokōwai are not simply recreational amenities; they are constitutionally protected resources that must be conserved for public use, cultural practice, and ecological sustainability.

In *Mauna Kea*, the Hawai‘i Supreme Court established that agencies must specifically identify the cultural practices at stake, the extent to which they are exercised, and feasible protective measures. Practitioners who contributed to the Cultural Impact Assessment (Appendix G-1) expressed strong concerns about potential impacts to marine resources of cultural significance, including reef fisheries, limu, and species used in ceremonies. These resources are integral to both subsistence and spiritual practice, and any decline in their abundance or health is viewed as a direct threat to cultural continuity. The DEIS acknowledges that sedimentation,

turbidity, and construction activities can temporarily affect these resources, and practitioners emphasized the need for robust monitoring and mitigation. While this section of the analysis highlights the broader constitutional trust obligations related to cultural practice, the applicant has prepared a separate *Ka Pa'akai* framework (Appendix G-2) to ensure that these issues are addressed in full detail. The DEIS and *Ka Pa'akai* framework provide such cultural information by identifying the practices (fishing, gathering, ceremony), documenting their ongoing use, and identifying potential feasible actions to reasonably protect Native Hawaiian Rights, such as measures to reduce sediment discharge.

The Project, by widening the beach and reducing erosion and sediment discharge, restores and preserves the ecological and physical conditions necessary for the continuation of cultural practices. This is particularly significant because cultural continuity is itself a trust value under Article XII, Section 4, which obligates the State to manage ceded lands for the benefit of Native Hawaiians. Unlike the revocable permit and use at issue in *Frankel*, the Honokōwai Project prioritizes the restoration of conditions enabling public access and the exercise of cultural practices. In this respect, it exemplifies how development can be aligned with constitutional trust duties rather than in conflict with them.

In contrast with the No Action alternative, Beach Stabilization would widen and stabilize the shoreline, reinstating and enhancing lateral access and ensuring recreational opportunities for future generations. By reducing erosion and sediment discharge, it also improves the quality of recreational experiences, restoring clear waters for swimming and safe sand corridors for walking and fishing. These outcomes fulfill the constitutional trust duty to preserve access and recreation as public uses.

Beach stabilization directly addresses additional concerns by restoring Honokōwai Beach as a natural resource and protective buffer. By stabilizing the shoreline, the Project reduces the likelihood of further avulsion and beach loss events, maintains a barrier against coastal hazards, and enhances resilience to sea level rise (Appendix A). These protective functions benefit not only adjacent property owners but the broader public, whose safety, access, and economic well-being are tied to the stability of the shoreline.

In this sense, hazard mitigation is essential to the fulfillment of the state's public trust obligations. Protecting public health and safety through natural infrastructure aligns with the State's fiduciary duty to conserve resources for the collective benefit. *See, e.g.*¸DEIS, Appendix A at 27-28 (section 2.5 discussing nature-based adaptation) By enhancing hazard resilience, the Project ensures that Honokōwai Beach continues to fulfill its constitutional role as a trust resource.

By restoring and stabilizing the shoreline, Beach Stabilization also creates a platform for continued community use and economic activity. Courts have consistently emphasized that public trust decisions must weigh communal benefits heavily against narrow private interests. Here, the

communal benefits are overwhelming: restored access, revitalized cultural practices, improved water quality, enhanced hazard protection, and increased resilience to sea level rise. The Project thus fulfills constitutional trust duties and broader social responsibilities, ensuring that Honokōwai Beach remains a place of gathering, sustenance, and identity for generations to come.

4.2.2 Beach Nourishment Alternative

Beach Nourishment alone would provide short-term relief by adding sand and the outcomes and impacts of Beach Nourishment would be similar to the preferred alternative. However, Beach Nourishments limited 10-year lifespan is significantly shorter than the preferred alternative and during this time, the Beach Nourishment would be at risk for episodic erosion and beach loss events.

4.2.3 Beach Maintenance Alternative

Beach Maintenance would constitute multiple Beach Nourishment events. One initial nourishment event would be followed by four subsequent renourishment actions that would occur approximately every 10 years over a period of 50 years. The repetitive actions would add sand as it is lost due to the natural seasonal and chronic erosion.. Like Beach Nourishment, the outcomes and impacts of Beach Maintenance would be similar to the preferred alternative. However, this alternative requires the most construction days overall, is the most costly over time, and is at risk for episodic erosion and beach loss events.

4.2.4 No Action Alternative

The No Action alternative, while cost-free in the short term, is projected to result in the severe loss of beach width, loss of an estimated 1.4 acres of beach, discharge of 20,000 cubic yards of sediment into nearshore waters, and elimination of shoreline access over the next fifty years. *See* DEIS, Appendix A. This would compromise lateral shoreline access within the beach transit corridor (as identified in HRS § 115-5), limit available shoreline area for fishing and recreation, and allow more frequent and severe erosion and inundation of inland areas. Without beach restoration, infrastructure improvements, such as parking areas, pedestrian pathways, and transit stops would be undermined by continued shoreline loss. *See* DEIS, Appendix K (Traffic Impact Analysis Report).

Nearshore waters and the marine environment would also be impacted by an additional 20,000 cubic yards of sedimentation as a result of chronic erosion under the No Action alternative over fifty years (DEIS Application, Ch. 4). This level of discharge would have devastating consequences for reef health, fish habitat, and water quality, directly undermining public trust obligations. The Constitution requires that these waters be safeguarded for the benefit of present and future generations, and *Waiāhole Ditch* made clear that water resources must be managed with

a presumption in favor of trust purposes. Sediment degradation on this scale cannot be reconciled with those constitutional requirements.

Moreover, the ability of Native Hawaiians to exercise and practice their traditional and customary rights would be compromised by the erosion of Honokōwai Beach. Narrowed beaches limit safe access to fishing grounds and gathering areas. Sediment discharges would reduce the abundance and health of fish populations. As one practitioner noted in the CIA, the loss of clear, healthy water diminishes not only the fishery but also the cultural experience of engaging in ancestral practices.

Further, inland assets would face increasing risk, and the absence of a buffering beach would magnify hazard exposure and vulnerability and decrease resilience (DEIS, Ch. 2). From a trust perspective, allowing this trajectory to unfold unabated would contravene Article XI, Section 1's mandate to manage resources for the benefit of present and future generations. Hazard mitigation is a public good, and the State has a duty to preserve natural infrastructure that fulfills this role.

The DEIS also notes that shoreline erosion diminishes economic and social values, making West Maui less attractive to residents and visitors alike (Appendix I). The No Action scenario would accelerate these declines, removing both physical beach area and the intangible cultural value of the shoreline. The loss of Honokōwai Beach would have cascading effects on local quality of life, cultural identity, and economic vitality.

From a public trust resource perspective, the No Action alternative represents a failure to protect constitutional resources and is therefore untenable, and the erosion trajectory represents not just environmental loss but a breach of fiduciary responsibility. Article XI, Section 1 requires the State to conserve natural beauty and resources "for the benefit of present and future generations." Allowing beaches to vanish without intervention would contradict this constitutional mandate.

4.3 Clarity of the Decision

The final *Waiāhole Ditch* factor is clarity of the State or agency's decision. Agencies must articulate their reasoning in a way that is transparent, evidence-based, and reviewable by the courts. Vague assertions that a project is "necessary" or "beneficial" are insufficient. This requirement echoes *Mauna Kea*, where the Court demanded specific findings on cultural practices and alternatives, and *Ching*, which underscored the fiduciary nature of ceded lands.

The DEIS and appendices provide the factual basis for clarity. For example, the Coastal Engineering Assessment (Appendix A) documents sediment dynamics, design alternatives, and impacts. The Cultural Impact Assessment (Appendix G-1) identifies traditional and customary

practices, their locations, and mitigation measures. The Traffic Impact Analysis Report (Appendix K) details access and infrastructure. Collectively, these materials provide a comprehensive record of evidence.

For DLNR and BLNR, the task is to integrate these findings into a clear decision record. The Board must adopt findings that Honokōwai Beach and nearshore waters are trust resources under Article XI, §§ 1 and 7, and Article XII, § 4; that the Project aligns with the presumption in favor of public use; that alternatives were considered; and that beach restoration through Beach Stabilization is the most effective and practicable alternative insofar as it would best preserve and protect the public trust resource. Although, as noted in the DEIS, both the Beach Nourishment and Beach Maintenance alternatives also provide benefit and protection to the public trust resources, those benefits would have shorter lifespans and, in the case of Beach Nourishment, greater impacts and costs. The No Action alternative provides the least benefit and greatest potential risk to the public trust resources.

5.0 Conclusion

Honokōwai Beach and its nearshore waters embody the full range of Hawai‘i’s public trust resources. They are physical spaces of access and recreation, ecological systems supporting marine life, cultural landscapes sustaining Native Hawaiian practices, and protective buffers against coastal hazards and sea level rise.

The *Frankel* decision articulates a procedural roadmap, as set forth by *Waiāhole Ditch* and its progeny, for fulfilling these duties: begin with the presumption in favor of public use, consider practicable alternatives, and articulate the decision with clarity. The DEIS and appendices for the Ho‘āla Honokōwai Project provide the evidence necessary to meet each step. They document the erosion history and trajectory and its impacts, evaluate a full suite of alternatives, and detail the cultural, ecological, and social values at stake.

The Ho‘āla Honokōwai Project’s objectives of improving beach stability, preserving and enhancing cultural and shoreline access, increasing resilience to coastal hazards and human-induced sea level rise, and enabling planning for long-term adaptation to sea level rise are classic public trust purposes are quintessential trust purposes. By adopting clear findings aligned with constitutional mandates, DLNR and BLNR can authorize the Project as a fulfillment of fiduciary duty. The Ho‘āla Honokōwai Project is consistent with Hawai‘i’s constitutional trust obligations—it restores eroded lands, protects cultural and ecological resources, and strengthens resilience for future generations.

APPENDIX

I

ECONOMIC IMPACT REPORT

FINAL

Hoʻāla Honokōwai Economic Impact Report

October 2024

Prepared By:
Environment & Economics, LLC

EXECUTIVE SUMMARY

This Economic Impact Report was conducted to assess the economic impacts that the proposed Hoʻāla Honokōwai project would have on the economy of Maui County and the fiscal revenue of the State of Hawaiʻi and Maui County governments over a period of analysis from 2028 to 2078, a timeframe approximating the design life of the action alternatives. Potential economic and fiscal impacts are assessed for three action alternatives – construction projects to nourish, maintain, and stabilize natural beach features – and three no action alternative scenarios; these alternatives are briefly described below:

1. *Beach Nourishment*. A single action consisting of the placement of additional sand to increase beach width and sand volume to offset the effects of erosion. The action would start and be complete in 2028, and have a 10-year design life. Economic and fiscal impacts would be derived from construction activities and, due to the short design life, effects related to taking no action would be incurred for the latter portion of the period of analysis.
2. *Beach Maintenance*. A series of actions consisting of an initial beach nourishment project, followed by a series of successive, less extensive, beach renourishment projects on a recurring basis (i.e., every 10 years). The series of actions would be complete in 2068 and have a design life extending through the end of the period of analysis (i.e., 2078). Economic and fiscal impacts would be derived from construction activities.
3. *Beach Stabilization*. A single action consisting of beach nourishment combined with installation of new engineered structures (e.g., groins) to stabilize the sand and keep it in place. The action would be complete in 2029 and have a design life extending through the end of the period of analysis. Economic and fiscal impacts would be derived from construction activities.
4. *No Action*. Not a planned outcome, nor a certainty, but based on projections, the No Action alternative assumes that if no adaptation actions are taken, after 2053, the Kāʻanapali Beach Club would need to reduce operations or be forced to close entirely due to the eventual loss of Honokōwai Beach and the overall degradation of the shoreline area. Estimates of economic and fiscal impacts for the No Action alternative are derived from the jobs, incomes, and economic activity supported on-site at Kāʻanapali Beach Club as well as spending throughout Maui County by visitors to the Kāʻanapali Beach Club. Three No Action alternative scenarios are analyzed with these scenarios representing varying levels of reduced Kāʻanapali Beach Club operations, and associated reductions in county-wide economic activity that would be lost due to those reductions. The three scenarios are briefly described below:
    a. No Action, Low Impact – Assumes an approximate one-thirds reduction in Kāʻanapali Beach Club operations beginning after 2053 and extending through the period of analysis.
    b. No Action, Moderate Impact – Assumes an approximate two-thirds reduction in Kāʻanapali Beach Club operations beginning after 2053 and extending through the period of analysis.
    c. No Action, Maximal Impact – Assumes a full closure of Kāʻanapali Beach Club beginning after 2053 and extending through the period of analysis.

Each of the action alternatives would generate short-term benefits through construction/restoration activities. The action alternatives would also avoid or delay the projected eventual loss and the overall degradation of the Honokōwai Beach shoreline area, and extend continued full operations of Kāʻanapali Beach Club, which generates substantial economic and fiscal benefits in Maui County. With the No Action alternative scenarios, there would be substantial long-term jobs loss, loss of incomes, and a reduction in overall economic activity associated with both activities at Kāʻanapali Beach Club and the spending of Club

visitors throughout Maui County. While the period of analysis extends only to 2078, these adverse impacts would extend indefinitely.

Table ES-1 shows economic impacts associated with the three action alternatives and the No Action alternative scenarios, from 2028 to 2078, approximating the design life of the action alternatives. Due to the short design life of the Beach Nourishment alternative, effects related to degradation of the shoreline area are assumed to commence after 2063 and, for 15-years of the period of analysis, adverse effects associated with the No Action alternative would be incurred. The other action alternatives – Beach Maintenance and Beach Stabilization – would have moderate economic benefits over various timeframes, and would allow adverse impacts associated with no action to be avoided though the period of analysis. The No Action alternative scenarios would, based on projections of erosion and shoreline degradation, and associated effects on Kāʻanapali Beach Club operations, begin to be incurred after 2053 and continue through the period of analysis (i.e., 2054 to 2078), and beyond.

Economic impacts are presented in terms of jobs, labor income, and economic output. Fiscal impacts are presented in terms of State of Hawaiʻi and Maui County government revenue. Overall, the two action alternatives with extended design lives (i.e., Beach Maintenance and Beach Stabilization) would, by far, be the most economically beneficial to Maui County. These alternatives would, in addition to generating moderate beneficial impacts associated with construction, avoid the substantial consequences associated with reduced or ceased operations of the Kāʻanapali Beach Club. Conversely, the Beach Nourishment alternative and No Action alternative scenarios would lead to substantial job loss and reduced economic vitality through the period of analysis for an indefinite period of time afterward.

Table ES-1. Economic Impacts, Totals[1] by Year, 2024 $s

Alternative	Economic Variable	2028-2034	2035-2053	2054-2078	Overall Total
Beach Nourishment[2]	Jobs	65	0	-19,785	**-19,720**
	Labor Income	$4.5M	$0	-$1.10B	**-$1.09B**
	Output	$15.8M	$0	-$2.69B	**-$2.67B**
Beach Maintenance	Jobs	65	38	38	**140**
	Labor Income	$4.5M	$2.6M	$2.6M	**$9.8M**
	Output	$15.8M	$9.2M	$9.2M	**$34.3M**
Beach Stabilization	Jobs	154	0	0	**154**
	Labor Income	$10.7M	$0	$0	**$10.7M**
	Output	$31.1M	$0	$0	**$31.1M**
No Action – Low Impact	Jobs	0	0	-16,492	**-16,492**
	Labor Income	$0	$0	-$914.3M	**-$914.3M**
	Output	$0	$0	-$2.24B	**-$2.24B**
No Action – Moderate Impact	Jobs	0	0	-32,983	**-32,983**
	Labor Income	$0	$0	-$1.83B	**-$1.83B**
	Output	$0	$0	-$4.48B	**-$4.48B**
No Action – Maximal Impact	Jobs	0	0	-49,475	**-49,475**
	Labor Income	$0	$0	-$2.74B	**-$2.74B**
	Output	$0	$0	-$6.72B	**-$6.72B**

Notes: [1]Includes direct (project related), indirect (business to business spending related), and induced (related to spending of employee incomes) impacts.

[2]Due to the short design life of the Beach Nourishment alternative, effects of no action would be incurred during the period of analysis, from 2064 to 2078. This table includes effects associated with the No Action – Moderate scenario for a period of 15 years as being associated with the Beach Nourishment alternative.

Table ES-2 shows fiscal impacts associated with the three action alternatives and the three No Action alternative scenarios, from 2028 to 2078. Similar to economic impacts, the action alternatives with extended design lives (i.e., Beach Maintenance and Beach Stabilization) would have, by far, the most beneficial fiscal impacts to the State of Hawai‘i and Maui County governments. These would, in addition to the moderate beneficial impacts associated with construction, avoid the substantial consequences associated with reduced or ceased operations of the Kā‘anapali Beach Club. Conversely, the Beach Nourishment alternative and No Action alternative scenarios would lead to substantial reductions in State of Hawai‘i and Maui County government revenue through the period of analysis and for an indefinite period of time afterward.

Table ES-2. Fiscal Impacts, Totals by Year, 2024 $s

Alternative	Fiscal Variable	2028-2034	2035-2053	2054-2078	Overall Total[2]
Beach Nourishment[1]	State Revenue	$705,546	$0	-$169.1M	**-$168.4M**
	Maui Revenue	$271,087	$0	-110.1M	**-$109.8M**
Beach Maintenance	State Revenue	$705,546	$205,499	$205,499	**$1.5M**
	Maui Revenue	$271,087	$78,958	$78,958	**$586,919**
Beach Stabilization	State Revenue	$1.4M	$0	$0	**$1.4M**
	Maui Revenue	$509,310	$0	$0	**$509,310**
No Action – Low Impact	State Revenue	$0	$0	-$140.9M	**-$140.9M**
	Maui Revenue	$0	$0	-$91.7M	**-$91.7M**
No Action – Moderate Impact	State Revenue	$0	$0	-$281.8M	**-$281.8M**
	Maui Revenue	$0	$0	-$183.5M	**-$183.5M**
No Action – Maximal Impact	State Revenue	$0	$0	-$422.7M	**-$422.7M**
	Maui Revenue	$0	$0	-$275.2M	**-$275.2M**

Note: Due to the short design life of the Beach Nourishment alternative, effects of no action would be incurred during the period of analysis, from 2064 to 2078. This table includes effects associated with the No Action – Moderate scenario for a period of 15 years as being associated with the Beach Nourishment alternative.

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Abbreviations and Acronyms

Acronym	Definition
%	percent
$s	dollars
EIR	Economic Impact Report
GET	General Excise Tax
HHP	Hoʻāla Honokōwai Project
IMPLAN	Impact Analysis for Planning
KBC	Kāʻanapali Beach Club
ROI	Region of Influence
TAT	Transient Accommodations Tax

1 Introduction

Honokōwai Beach (the Project Site) is located north of Kāʻanapali and south of Kahana Bay on the west coast of the island of Maui. Honokōwai Beach is an important natural, cultural, and aesthetic resource that supports a wide variety of cultural, recreational, and economic uses. Honokōwai Beach provides a rare combination of perpendicular and lateral shoreline access, public parking, and public restrooms.

In 2016, a combination of persistent North Pacific swell and elevated water levels produced high waves, strong currents, and abnormally high tides which caused significant erosion and beach loss at Honokōwai Beach. The shoreline retreated 6 to 12 ft in just a few months, and the beach was almost entirely eroded. Engineering analyses by Sea Engineering, Inc. indicate that this deteriorated condition is expected to worsen over time. The proposed Hoʻāla Honokōwai Project (HHP) would restore and preserve Honokōwai Beach by one of three action alternatives - Beach Nourishment, Beach Maintenance, or Beach Stabilization. These methods, along with the No Action alternative, are described in more detail below.

This Economic Impact Report (EIR) was conducted to assess and report on the economic impacts that the HHP would have on the Maui County economy, where the project would take place. Additionally, fiscal impacts to both the Maui County and State of Hawaiʻi governments are presented. Economic impacts are presented in terms of jobs, labor income, and economic output. Fiscal impacts are presented in terms of State of Hawaiʻi and Maui County government revenue.

Due to varying timeframes for each of the alternatives, the period of analysis considered in this report is an approximate 50-year period beginning in 2028 and ending in 2078. This time period approximates the full implementation and the design life of the three action alternatives, which have design lives that extend as much as 50-years. The 2028 to 2078 period includes a 25-year period (from 2054 to 2078) whereby projections indicate that, if no action is taken, the Kāʻanapali Beach Club (KBC) would need to reduce operations or be forced to close entirely due to the eventual loss of Honokōwai Beach and the overall degradation of the shoreline area. While the period of analysis for this EIR only extends to 2078, the adverse economic and fiscal impacts related to reductions in, or a cessation of, KBC operations associated with taking no action would not end in 2078 but would extend indefinitely.

1.1 Beach Nourishment

Beach Nourishment refers to a single action of the placement of additional sand to increase beach width and sand volume to offset the effects of erosion. This would be a short-term response (10-year design life) that would consist of placing sand directly along the shoreline without any structures to stabilize the sand. Given the 10-year design life, the analysis assumes that KBC would be forced to reduce or cease operations 10 years later than is assumed under the No Action alternative (i.e., after 2063 rather than after 2053). Therefore, the analysis assumes that there would be a 15-year period (2064 to 2078) when effects related to not taking any action to minimize shoreline degradation would be incurred. Economic and fiscal impacts associated with the Beach Nourishment action are presented in Sections 4.1 and 5.1, respectively, and impacts for the 2064 to 2078 period in Sections 4.5 and 5.5. The cumulative effects over the 2028 to 2078 period are summarized in Sections 4.7 and 5.7.

1.2 Beach Maintenance

Beach Maintenance refers to a series of actions consisting of an initial beach nourishment project, followed by a series of successive beach renourishment projects in order to maintain beach width and volume. For purposes of analysis, it is assumed that initial beach nourishment would occur in 2028 and that follow-up renourishment efforts would occur in the years 2038, 2048, 2058, and 2068 that would be less extensive than the initial renourishment. Overall, this alternative would have a 50-year design life and would avoid economic and fiscal impacts associated with no action through the period of analysis for this EIR. Economic

and fiscal impacts associated with the Beach Maintenance action alternative are presented in Sections 4.2 and 5.2, respectively.

1.3 Beach Stabilization

Beach Stabilization refers to a single action consisting of beach nourishment combined with installation of new engineered structures (e.g., groins) to stabilize the sand and keep it in place. Though there would be overlap in the activities, for purposes of analysis, it is assumed that initial beach nourishment would occur in 2028 and that modification or installation of stabilizing structures would occur in 2029. Overall, this alternative would have a 50-year design life and would avoid economic and fiscal impacts associated with no action through the period of analysis for this EIR. Economic and fiscal impacts associated with the Beach Stabilization alternative are presented in Sections 4.3 and 5.3, respectively.

1.4 No Action Alternative Scenarios

The primary assumptions underlying the analysis for the No Action alternative are that Honokōwai Beach would continue to erode and result in a loss of Honokōwai Beach and overall degradation of the shoreline area to the extent that KBC could not feasibly operate at current levels, by mid-century or sooner. While this occurrence would affect multiple transient and other commercial establishments in the area, the analysis presented in this report, due to lack of available data on other businesses, estimates only those impacts related to KBC operations (i.e., on-site employment and spending impacts) as well as those related to visitor spending of KBC guests that occurs off-site, within Maui County. The analysis of potential impacts to KBC operations is conducted for three scenarios, which are described below:

1. No Action, Low Impact – Assumes an approximate one-thirds reduction in KBC operations beginning after 2053 and extending through the period of analysis (assessed for a total of 25-years). Economic and fiscal impacts associated with this scenario are presented in Sections 4.4 and 5.4, respectively.
2. No Action, Moderate Impact – Assumes an approximate two-thirds reduction in KBC operations beginning after 2053 and extending through the period of analysis (assessed for a total of 25-years). To provide additional details for analysis of the Beach Maintenance alternative, estimated impacts associated with the No Action – Moderate scenario are also provided on a 15-year basis. Economic and fiscal impacts associated with this scenario are presented in Sections 4.5 and 5.5, respectively.
3. No Action, Maximal Impact – Assumes a full closure of KBC beginning after 2053 and extending through the period of analysis (assessed for a total of 25-years). Economic and fiscal impacts associated with this scenario are presented in Sections 4.6 and 5.6, respectively.

2 Approach to Analysis

2.1 Region of Influence and Other Limiting Factors

The Region of Influence (ROI) considered in this EIR is Maui County, which is the location of the proposed HHP. All fiscal impacts that would accrue to the State of Hawai‘i government are those that would be generated by economic activity that would take place within Maui County. Some economic benefits may spill over into locations outside of the ROI, as workers are likely to spend portions of their income elsewhere, such as Hawai‘i, Honolulu, and Kaua‘i Counties but these potential spill-over effects would likely be minimal and are not captured in this report.

Other potential economic and fiscal impacts are not captured in this report, due either to lack of data required for estimating impacts or because the intent of this EIR is to assess economy-wide impacts rather than impacts on individual, or sets of, persons or businesses. For instance, the KBC facility, with a real property assessed value estimated to be $299,437,700 as of 2024, may incur substantial damage under the No Action alternative, but this is not presented as an impact to the Maui County economy because it is owned privately, and the value of damages would be incurred by only a small set of individuals and businesses. Also, the No Action alternative, in addition to affecting KBC operations, may lead to the potential closure of other nearby businesses; however, gathering the necessary data required to make estimates of impacts related to other businesses is outside the scope of this report. The potential economic or fiscal impacts of legal claims, such as takings, are furthermore outside the scope of this report.

All timelines and assumptions on when particular occurrences may take place are based on the best available information, but they are projections into the future and should not be taken as binding or promissory. A variety of factors may lead to changes in construction/restoration plans or in projections of sea level rise and how shorelines may be affected 50 years hence. The timelines in this EIR are meant to provide a simplifying structure upon which to base estimates given a multitude of future unknowns. The annualized estimates that are provided in Chapters 4 and 5 can be applied to any number of years and a variety of scenarios, as real-world outcomes vary from projections over time.

2.2 Input Data and Modeling Procedures

The IMPLAN model is an input-output modeling application, which provides detailed data sets at various levels of geography on an annual basis (IMPLAN, 2024); due to the consistent annual data updates and specified county-level data, it is the current industry standard for economic modeling. IMPLAN data sets that were applied in this analysis represent year 2022 (the most recent available) for Maui County.

The data that were input into the IMPLAN model are presented in the tables below. For the action alternatives, construction and maintenance expenditures developed in engineering studies by Sea Engineering, Inc. (2023) were input into the IMPLAN model, as industry expenditures (see Tables 2-1 through 2-3).

Impacts from the No Action alternative represent the effects of an eventual reduction in operations or closure of KBC, and the associated reduction in number of available guest rooms in Maui County. Therefore, estimates of annualized impacts of KBC operations were used to represent effects of the No Action alternative scenarios. Both on-site and off-site economic activity associated with KBC were estimated and then were combined to represent total impacts of the No Action alternative scenarios. Impacts related to on-site activity were calculated by applying estimates of economic activity stemming from lodging, restaurant, retail, recreation, entertainment, and personal services establishments located on-site, at KBC. Impacts related to off-site economic activity were calculated by applying estimates of spending by KBC visitors at Maui establishments that are not located at the KBC resort.

The two most important factors used to develop modeling inputs for the No Action alternative scenarios were 1) total visitor spending by economic sector and, 2) on-site (at KBC) employment by economic sector.

Total visitor spending by economic sector was estimated by first establishing the number of annual visitor days to KBC (estimated based on data provided by Hilton Grand Vacations, 2023) and then applying Hawai‘i Department of Business, Economic Development, and Tourism (DBEDT) per person/per day/by economic sector data, for Maui County, to that number of visitors.

With total visitor spending by economic sector calculated, the split of that spending between on-site and off-site was calculated utilizing data from Hilton Grand Vacations related to on-site employment. On-site employment figures were input into the IMPLAN model to yield an estimate of total sales, on-site, by economic sector and then the resulting figures were subtracted from estimates of total visitor spending by economic sector to yield estimates of off-site visitor spending by economic sector. The various spending and employment data that were input into the IMPLAN model for the No Action alternative are provided in Table 2-4 and Table 2-5.

2.2.1 Beach Nourishment Inputs

Table 2-1 shows how estimated beach nourishment expenditures were applied to the IMPLAN model, as industry expenditure, to calculate economic impacts for the alternative. Estimated expenditures and timeline were provided by Sea Engineering.

Table 2-1. Beach Nourishment Inputs, 2023 $s

IMPLAN Sector Description	Event Year	IMPLAN Code	Estimated Expenditure[1]
Maintenance and Repair Construction (nonresidential)	2028	60	$10,300,000

Source[1]: Sea Engineering Inc., 2023

2.2.2 Beach Maintenance Inputs

Table 2-2 shows how estimated beach maintenance expenditures were applied to the IMPLAN model, as industry expenditure, to calculate economic impacts for the alternative. Estimated expenditures and timeline were provided by Sea Engineering.

Table 2-2. Beach Maintenance Inputs, 2023 $s

IMPLAN Sector Description	Event Year	IMPLAN Code	Estimated Expenditure[1]
Maintenance and Repair Construction (nonresidential)	2028	60	$10,300,000
Maintenance and Repair Construction (nonresidential)	2038	60	$3,000,000
Maintenance and Repair Construction (nonresidential)	2048	60	$3,000,000
Maintenance and Repair Construction (nonresidential)	2058	60	$3,000,000
Maintenance and Repair Construction (nonresidential)	2068	60	$3,000,000

Source[1]: Sea Engineering Inc., 2023

2.2.3 Beach Stabilization Inputs

Table 2-3 shows how estimated Beach Stabilization expenditures were applied to the IMPLAN model, as industry expenditure, to calculate economic impacts for the alternative. Estimated expenditures and timeline were provided by Sea Engineering.

Table 2-3. Beach Stabilization Inputs, 2023 $s

IMPLAN Sector Description	Event Year	IMPLAN Code	Estimated Expenditure[1]
Maintenance and Repair Construction (nonresidential)	2028	60	$10,300,000
Construction of other Nonresidential Structures	2029	56	$9,527,000

Source[1]: Sea Engineering Inc., 2023

2.2.4 No Action Alternative Inputs

The No Action alternative assumes operations at the KBC would be reduced or cease after 2053. To estimate the economic and fiscal impacts of that potential occurrence, economic activity at KBC was estimated on an annualized basis. Data utilized for this estimate included information from Hilton Grand Vacations related to direct on-site employment for various aspects of the operation (e.g., hotel/timeshare, on-site retail, restaurant, and retail). On-site visitor expenditures and direct employment by industry that were input into the IMPLAN model are presented in Table 2-4. Data provided in Table 2-4 are associated with the No Action – Maximal Impact scenario, which were input into the IMPLAN model. Results for the other two No Action alternative scenarios were calculated as fractional proportions of results for the Maximal Impact scenario.

Table 2-4. No Action Alternative Inputs, On-site, 2023 $s

IMPLAN Sector Description	IMPLAN Code	Estimated Direct Jobs[1]	Estimated Expenditure
Hotels and Motels	507	298	$94,878,000
Full-service Restaurants	509	32	$3,819,697
Miscellaneous Retail	412	4	$282,484
Performing Arts Companies	496	4	$363,306
Other Amusement	504	4	$321,529
Other Personal Services	520	4	$81,348

Source[1]: Hilton Grand Vacations, 2023

Off-site impacts are generated by expenditures made by visitors to KBC that are made on Maui, but not at KBC. These impacts were estimated by calculating the number of annual KBC visitor days in conjunction with data on per person per day visitor spending by economic sector, on Maui, which were developed by DBEDT. Off-site visitor expenditures by economic sector that were input into the IMPLAN model are presented in Table 2-5. Data provided in Table 2-5 are associated with the No Action – Maximal Impact scenario, which were input into the IMPLAN model. Results for the other two No Action alternative scenarios were calculated as fractional proportions of results for the Maximal Impact scenario.

Table 2-5. No Action Alternative Inputs, Off-site, 2023 $s

IMPLAN Sector Description	IMPLAN Code	Estimated Expenditure
Full-service Restaurants	509	$30,409,053
Transportation	418	$19,665,217
Miscellaneous Retail	412	$12,924,059
Other Amusement	504	$14,286,535
Other Personal Services	520	$4,130,509

Source: Estimated based on Hilton Grand Vacations, 2023 & DBEDT, 2024.

2.3 Economic Result Variables

Economic variables that are presented as results include jobs, labor income, and economic output. Each of these variables consists of a direct, indirect, and induced element. Estimated results for the variables were calculated by the IMPLAN model using the input data described above in Section 2.2. Increases in the result variables are generally considered beneficial as they tend to be associated with higher living standards. Positive values in the result variables represent marginal increases (i.e., increases from the status quo) and negative values in the result variables represent marginal decreases (i.e., decreases from the status quo).

Direct impacts are associated with the proposed project itself and include workers directly associated with initial project-related expenditures, the incomes earned by those workers, and the economic output generated by these initial project-related expenditures.

Indirect impacts are generated by the businesses that would supply goods and services that would facilitate various aspects of the project. Indirect jobs include jobs at companies that supply goods and services that support direct activities. Indirect jobs extend to include jobs related to the manufacture of products, to the extent that activity may occur in Maui County. Indirect labor income includes the income earned by people working indirect jobs. Indirect economic output includes the total sales volume related to the supply of goods and services net intermediate purchases.

Induced impacts are the result of spending of the wages and salaries of the direct and indirect workers on items such as food, housing, transportation, and medical services. This spending creates induced employment, labor income, and economic output in nearly all sectors of the economy, especially service sectors.

Direct, indirect, and induced results are presented in data tables on an annualized and cumulative (over multiple years) basis and summed to totals. Throughout the numerous tables presented in this EIR, due to the prevalence of large numbers being rounded then summed, and then summed again over a variety of timespans to represent cumulative effects, some totals may not appear to be summed accurately; but this is due to the effects of the rounding.

2.3.1 Jobs

Job impacts represent the number of jobs that would be created or sustained within the ROI as a result of the proposed project. The IMPLAN model generates job numbers that include both full-time and part-time jobs including jobs that may be short-term. Short-term jobs may include, for example, construction trades specialists such as carpenters that may only conduct part of the construction work. When jobs impacts are presented over multiple years, these jobs should be thought of as 'job-years' meaning the same impact is recurring over multiple years rather than new or different impacts being generated over time. Specifics on the types of jobs generated for the HHP are provided below:

- *Action Alternatives*. Direct jobs would primarily be Construction Trades Workers, Other Installations, Maintenance, and Repair Workers, and Construction Supervisors. Indirect jobs would primarily be Retail Sales Workers, Material Moving Workers, and Motor Vehicle Operators. Induced jobs would primarily be Food and Beverage Service Workers, Healthcare Workers, and Retail Sales Workers.
- *No Action Alternative*. Direct jobs would primarily be Food and Beverage Service Workers, Motor Vehicle Operators, Cooks and Food Prep Workers, Retail Workers, Entertainment Industry Workers, Information and Records Clerks, and Building/Grounds Maintenance Workers. Indirect jobs would primarily be Retail Sales Workers, Material Moving Workers, and Motor Vehicle

Operators. Induced jobs would primarily be Food and Beverage Service Workers, Building Services Workers, and Retail Sales Workers.

2.3.2 Labor Income

Labor income impacts represent the income generated through the jobs that would be created or sustained as a result of the construction, operations, and other related economic activity in the ROI. Results are presented in year 2024 constant dollars.

2.3.3 Economic Output

Economic output equals the value of production by various industries in the ROI in a calendar year. It can also be described as annual revenue plus net inventory change. Results are presented in year 2024 constant dollars.

2.4 Fiscal Result Variables

Fiscal variables include State of Hawai‘i government revenue and Maui County government revenue. Each of these consists of multiple sources of revenue as described below in Section 2.4.1 and Section 2.4.2. Increases in government revenue are generally considered beneficial as revenue can be used by governments to fund public services and capital expenditures. Also, when governments spend the revenue that they receive from the project, additional jobs, labor income, and economic output would be generated; however, potential effects of government expenditures are not captured in this EIR. Conversely, when there are declines in government revenue, the level of public services may need to be reduced and capital projects become more difficult to fund.

2.4.1 State of Hawai‘i Government Revenue

Revenue that would be accrued by the State of Hawai‘i government as a result of the alternatives are presented in four categories: 1) Transient Accommodations Tax (TAT), General Excise Tax (GET) and Use Tax, 2) Corporate Profits Tax, 3) Personal Income Tax, and 4) Other. Estimates were calculated by the IMPLAN model based on incomes, spending of incomes, and industry expenditures. Results are presented in year 2024 constant dollars.

2.4.2 Maui County Revenue

Revenue that would be accrued by the Maui County government as a result of the alternatives are presented in two categories: 1) Property Tax, 2) TAT, and 3) Other. Property tax revenue to Maui County associated with the KBC site was provided by Hilton Grand Vacations and compiled from data from the Maui County Real Property Assessment Division. Estimates of TAT were calculated based on room night spending data provided by Hilton Grand Vacations. Other revenue to the Maui County government was calculated by the IMPLAN model and include, but are not limited to, sales tax revenue and revenue from licenses and fees. Results are presented in year 2024 constant dollars.

3 Economic Background

Table 3-1 provides population data for 2010, 2015, and 2022 for the State of Hawai‘i, Maui County, and each of the Census County Divisions (CCDs) on Maui, along with average annual growth rates from 2010 to 2015 and 2015 to 2022. As of 2022, the population for the State of Hawai‘i was about 1.45 million, with 164,765 of that population residing in Maui County (about 11.4% of the State population). The Lahaina CCD, where the proposed project would occur, had a 2022 population of 23,214, making up about 14.1% of the Maui County population.

Population growth rates statewide, countywide, and through most Maui CCDs were lower from 2015 to 2022 than they were from 2010 to 2015. The Lahaina CCD grew at an average annual rate of 1.9% from 2010 to 2015 exceeding the County rate, and, while growth slowed relative to the previous period, the Lahaina population growth rate also exceeded the State and Maui rates from 2015 to 2022 (0.8% per year in Lahaina compared to 0.4% statewide and 0.3% for Maui).

Table 3-1. Population Totals and Anuual Growth Rates by Area

	2010	2015	2022	Average Annual Growth Rate 2010-2015	Average Annual Growth Rate 2015-2022
State of Hawai‘i	1,333,591	1,406,299	1,450,589	1.1%	0.4%
Maui County	150,711	160,863	164,765	1.3%	0.3%
East Moloka‘i	4,903	6,300	4,827	5.7%	-3.3%
Haiku-Pauwela	9,552	9,854	11,274	0.6%	2.1%
Hana	2,351	1,841	1,164	-4.3%	-5.3%
Kahului	24,712	28,476	27,233	3.0%	-0.6%
Kīhei	23,066	24,801	25,087	1.5%	0.2%
Kula	12,135	13,212	13,111	1.8%	-0.1%
Lahaina	20,121	21,996	23,214	1.9%	0.8%
Lāna'i	3,335	3,539	3,218	1.2%	-1.3%
Makawao-Pā'ia	20,729	20,372	20,850	-0.3%	0.3%
Spreckelsville	280	457	291	12.6%	-5.2%
Wahihee-Waikapu	5,201	7,568	8,062	9.1%	0.9%
Wailuku	21,865	21,626	23,794	-0.2%	1.4%
West Moloka‘i	2,641	2,821	2,640	1.4%	-0.9%

Source: U.S. Census, 2010, 2015, 2022

Table 3-2 provides labor statistics for the State of Hawai‘i and Maui County for the years 2018 to 2023. The labor statistics include the size of the labor force, the total number of employed individuals, the total number of unemployed individuals, and the unemployment rate. Unemployment rates for both the State and Maui were generally very low from 2018 to 2019 but surged in 2020 due to business closures and travel restrictions forced by the COVID-19 pandemic. Due to the effects of wildfires, the Maui unemployment rate reached as high as 8.5% in September of 2023, and for the full year of 2023 the unemployment rate was 4.3%. As of June, 2024, the Maui unemployment rate stood at 3.6%, above the State rate of 3.3% (U.S. Bureau of Labor Statistics, 2024).

Table 3-2. State of Hawai‘i and Maui County Labor Statistics, 2018-2023

	2018	2019	2020	2021	2022	2023
State of Hawai‘i						
Labor force	692,457	686,066	665,964	670,193	672,727	676,355
Employment	675,849	668,769	588,159	630,151	650,672	656,336
Unemployment	16,608	17,297	77,805	40,042	22,055	20,019
Unemployment rate	2.4%	2.5%	11.7%	6.0%	3.3%	3.0%
Maui County						
Labor force	90,337	89,697	85,169	87,321	87,268	87,498
Employment	88,220	87,505	69,977	80,630	84,237	83,772
Unemployment	2,117	2,192	15,192	6,691	3,031	3,726
Unemployment rate	2.3%	2.4%	17.8%	7.7%	3.5%	4.3%

Source: U.S. Bureau of Labor Statistics, 2024

Table 3-3 shows data on visitor arrivals to the State of Hawai‘i and Maui County from 2010 to 2023 along with year-over-year rates of change and the proportion of total statewide visitors who visited Maui. The State and Maui saw increases in visitor arrivals every year from 2010 to 2019, with the largest year-over-year growth being experienced from 2011 to 2012 (9.7% and 6.4% increases respectively). From 2017 to 2019 there was steady growth in visitor arrivals however travel restrictions in 2020 led to a massive decline in visitor arrivals, down 73.8% statewide and 74.1% in Maui from 2019 to 2020. As of 2022, the number of visitor arrivals had recovered to similar levels as those seen prior to 2020 but not back to the pre-pandemic high reached in 2019. Maui saw another substantial decline in visitation from 2022 to 2023, due to wildfires, as the number of visitor arrivals fell by about 15% and the proportion of State visitors who visited Maui declined to a lower level than any time since 2010.

Table 3-3. Statewide & Maui County Visitor Arrivals, 2010-2023

Year	Statewide Visitor Arrivals (by Air)	Statewide Year over Year Change		Maui Visitor Arrivals (by Air)	Maui Year over Year Change	Maui % of Statewide Total
2010	6,916,894			2,122,635		30.7%
2011	7,174,397	3.7%		2,211,413	4.2%	30.8%
2012	7,867,143	9.7%		2,353,329	6.4%	29.9%
2013	8,003,474	1.7%		2,401,733	2.1%	30.0%
2014	8,196,342	2.4%		2,456,935	2.3%	30.0%
2015	8,563,018	4.5%		2,579,311	5.0%	30.1%
2016	8,821,802	3.0%		2,678,089	3.8%	30.4%
2017	9,277,613	5.2%		2,799,654	4.5%	30.2%
2018	9,761,448	5.2%		2,963,564	5.9%	30.4%
2019	10,243,165	4.9%		3,111,132	5.0%	30.4%
2020	2,686,403	-73.8%		807,308	-74.1%	30.1%
2021	6,777,761	152.3%		2,340,915	190.0%	34.5%
2022	9,138,674	34.8%		2,969,395	26.8%	32.4%
2023	9,488,477	3.8%		2,526,521	-14.9%	26.6%

Source: DBEDT, 2024

4 Economic Results

4.1 Beach Nourishment

4.1.1 Jobs

Table 4-1 shows that there would be an estimated total of 65 jobs generated or sustained from beach nourishment – 37 of the jobs would be direct, 13 indirect, and 14 induced.

Table 4-1. Beach Nourishment Jobs, Total

	2028
Direct	37
Indirect	13
Induced	14
Total	**65**

4.1.2 Labor Income

Table 4-2 shows that there would be a total increase of $4.5 million in labor income generated or sustained from beach nourishment – $2.9 million of the labor income would be direct, $0.8 million indirect, and another $0.8 million induced.

Table 4-2. Beach Nourishment Labor Income, Total (2024 $s)

	2028
Direct	$2,916,466
Indirect	$799,642
Induced	$808,052
Total	**$4,524,159**

4.1.3 Economic Output

Table 4-3 shows that there would be a total increase of $15.8 million in economic output generated or sustained from beach nourishment – $10.2 million of the economic output would be direct, $3.0 million indirect, and another $2.6 million induced.

Table 4-3. Beach Nourishment Economic Output, Total (2024 $s)

	2028
Direct	$10,186,643
Indirect	$3,040,266
Induced	$2,621,253
Total	**$15,848,162**

Due to the short design life (10 years) of the Beach Nourishment alternative, economic impacts associated with the No Action alternative would also be incurred during the period of analysis for this EIR. Given that effects of the No Action alternative are assumed to commence after 2053, the 10-year design life would avoid those effects until after 2063. Therefore, the period of time when effects related to the No Action alternative are considered in this analysis covers 15 years, between 2064 and 2078. Impacts associated with No Action alternative scenarios are detailed below but, assuming the No Action – Moderate scenario, over the 2064-2078 period, there would be a loss of 19,785 jobs, $1.1 billion in labor income, and $2.7 billion in economic output (see "15-year Total" in Sections 4.5 and 4.7) associated with Beach Nourishment.

4.2 Beach Maintenance

4.2.1 Jobs

Table 4-4 shows that there would be an estimated total of 140 jobs generated or sustained from beach maintenance – 81 of the jobs would be direct, 29 indirect, and 31 induced. Total jobs include those that would be generated from five nourishment efforts, which would occur over an approximate 40-year timespan.

Table 4-4. Beach Maintenance Jobs

	2028	2038	2048	2058	2068	Total
Direct	37	11	11	11	11	**81**
Indirect	13	4	4	4	4	**29**
Induced	14	4	4	4	4	**31**
Total	**65**	**19**	**19**	**19**	**19**	**140**

4.2.2 Labor Income

Table 4-5 shows that there would be a total increase of $9.8 million in labor income generated or sustained from beach maintenance – $6.3 million of the labor income would be direct, $1.7 million indirect, and another $1.7 million induced. Total labor income would be generated from five nourishment efforts, which would occur over an approximate 40-year timespan.

Table 4-5. Beach Maintenance Labor Income (2024 $s)

	2028	2038	2048	2058	2068	Total
Direct	$2,916,466	$849,456	$849,456	$849,456	$849,456	**$6,314,289**
Indirect	$799,642	$232,905	$232,905	$232,905	$232,905	**$1,731,263**
Induced	$808,052	$235,356	$235,356	$235,356	$235,356	**$1,749,472**
Total	**$4,524,159**	**$1,317,716**	**$1,317,716**	**$1,317,716**	**$1,317,716**	**$9,795,024**

4.2.3 Economic Output

Table 4-6 shows that there would be a total increase of $34.3 million in economic output generated or sustained from beach maintenance – $22.1 million of the economic output would be direct, $6.6 million indirect, and another $5.7 million induced. Total economic output would be generated from five nourishment efforts, which would occur over an approximate 40-year timespan.

Table 4-6. Beach Maintenance Economic Output (2024 $s)

	2028	2038	2048	2058	2068	Total
Direct	$10,186,643	$2,966,983	$2,966,983	$2,966,983	$2,966,983	**$22,054,576**
Indirect	$3,040,266	$885,514	$885,514	$885,514	$885,514	**$6,582,323**
Induced	$2,621,253	$763,472	$763,472	$763,472	$763,472	**$5,675,140**
Total	**$15,848,162**	**$4,615,969**	**$4,615,969**	**$4,615,969**	**$4,615,969**	**$34,312,039**

4.3 Beach Stabilization

4.3.1 Jobs

Table 4-7 shows that there would be an estimated total of 154 jobs generated or sustained from Beach Stabilization – 97 of the jobs would be direct, 23 indirect, and 34 induced. Total jobs include those that would be generated over an approximate two-year period by a single nourishment effort and the construction of stabilizing structures.

Table 4-7. Beach Stabilization Jobs

	2028	2029	Total
Direct	37	60	**97**
Indirect	13	10	**23**
Induced	14	20	**34**
Total	**65**	**89**	**154**

4.3.2 Labor Income

Table 4-8 shows that there would be a total increase of $10.7 million in labor income generated or sustained from Beach Stabilization – $7.4 million of the labor income would be direct, $1.4 million indirect, and another $1.9 million induced. Total labor income would be generated over an approximate two-year period by a single nourishment effort and the construction of stabilizing structures.

Table 4-8. Beach Stabilization Labor Income (2024 $s)

	2028	2029	Total
Direct	$2,916,466	$4,475,930	**$7,392,396**
Indirect	$799,642	$602,965	**$1,402,607**
Induced	$808,052	$1,107,122	**$1,915,174**
Total	**$4,524,159**	**$6,186,018**	**$10,710,177**

4.3.3 Economic Output

Table 4-9 shows that there would be a total increase of $31.1 million in economic output generated or sustained from project operations annually – $19.6 million of the economic output would be direct, $5.3 million indirect, and another $6.2 million induced. Total economic output would be generated over an approximate two-year period by a single nourishment effort and the construction of stabilizing structures.

Table 4-9. Beach Stabilization Economic Output (2024 $s)

	2028	2029	Total
Direct	$10,186,643	$9,422,150	**$19,608,793**
Indirect	$3,040,266	$2,237,435	**$5,277,701**
Induced	$2,621,253	$3,591,377	**$6,212,630**
Total	**$15,848,162**	**$15,250,961**	**$31,099,123**

4.4 No Action Alternative – Low Impact Scenario

4.4.1 On-site

4.4.1.1 Jobs

Table 4-10 shows that with no action there would be an estimated total loss of 189 jobs related to on-site economic activity annually – 111 of the jobs would be direct, 28 indirect, and 51 induced. Over the course of the 25 years, there would be an estimated overall total loss of 4,733 jobs.

Table 4-10. No Action Low, On-site Jobs, Annual & 25-Year Total

	Annual	Total
Direct	-111	-2,775
Indirect	-28	-700
Induced	-51	-1,267
Total	**-189**	**-4,733**

4.4.1.2 Labor Income

Table 4-11 shows that with no action there would be an estimated total loss of $16.5 million in labor income related to on-site economic activity annually – $12.1 million would be direct, $1.6 million indirect, and $2.9 million induced. Over the course of the 25 years, there would be an estimated overall total loss of $413.9 million in labor income.

Table 4-11. No Action Low, On-site Labor Income, Annual & 25-Year Total (2024 $s)

	Annual	Total
Direct	-$12,118,795	-$302,969,875
Indirect	-$1,561,979	-$39,049,475
Induced	-$2,874,163	-$71,854,067
Total	**-$16,554,937**	**-$413,873,425**

4.4.1.3 Economic Output

Table 4-12 shows that with no action there would be an estimated total loss of $47.5 million in economic output related to on-site economic activity annually – $33.5 million would be direct, $4.8 million indirect, and $9.3 million induced. Over the course of the 25 years, there would be an estimated overall total loss of $1.19 billion in economic output.

Table 4-12. No Action Low, On-site Economic Output, Annual & 25-Year Total (2024 $s)

	Annual	Total
Direct	-$33,457,549	-$836,438,725
Indirect	-$4,750,715	-$118,767,867
Induced	-$9,322,583	-$233,064,583
Total	**-$47,530,847**	**-$1,188,271,175**

4.4.2 Off-site

4.4.2.1 Jobs

Table 4-13 shows that with no action there would be an estimated total loss of 470 jobs related to off-site economic activity annually – 378 of the jobs would be direct, 30 indirect, and 62 induced. Over the course of the 25 years, there would be an estimated overall total loss of 11,750 jobs.

Table 4-13. No Action Low, Off-site Jobs, Annual & 25-Year Total

	Annual	Total
Direct	-378	-9,458
Indirect	-30	-742
Induced	-62	-1,550
Total	**-470**	**-11,750**

4.4.2.2 Labor Income

Table 4-14 shows that with no action there would be an estimated total loss of $20.0 million in labor income related to off-site economic activity annually – $14.9 million would be direct, $1.6 million indirect, and $3.5 million induced. Over the course of the 25 years, there would be an estimated overall total loss of $500.4 million in labor income.

Table 4-14. No Action Low, Off-site Labor Income, Annual & 25-Year Total (2024 $s)

	Annual	Total
Direct	-$14,920,607	-$373,015,167
Indirect	-$1,579,150	-$39,478,750
Induced	-$3,517,840	-$87,946,008
Total	**-$20,017,597**	**-$500,439,933**

4.4.2.3 Economic Output

Table 4-15 shows that with no action there would be an estimated total loss of $42.1 million in economic output related to off-site economic activity annually – $25.3 million would be direct, $5.4 million indirect, and $11.4 million induced. Over the course of the 25 years, there would be an estimated overall total loss of $1.05 billion in economic output.

Table 4-15. No Action Low, Off-site Economic Output, Annual & 25-Year Total (2024 $s)

	Annual	Total
Direct	-$25,287,253	-$632,181,317
Indirect	-$5,403,104	-$135,077,592
Induced	-$11,411,459	-$285,286,475
Total	**-$42,101,816**	**-$1,052,545,392**

4.4.3 Total – On-site and Off-site

4.4.3.1 Jobs

Table 4-16 shows that with no action there would be an estimated total loss of 660 jobs annually – 489 of the jobs would be direct, 58 indirect, and 113 induced. Over the course of the 25 years, there would be an estimated overall total loss of 16,492 jobs.

Table 4-16. No Action Low, Jobs, Annual & 25-Year Total

	Annual	Total
Direct	-489	-12,233
Indirect	-58	-1,442
Induced	-113	-2,817
Total	**-660**	**-16,492**

4.4.3.2 Labor Income

Table 4-17 shows that with no action there would be an estimated total loss of $36.6 million in labor income annually – $27.0 million would be direct, $3.1 million indirect, and $6.4 million induced. Over the course of the 25 years, there would be an estimated overall total loss of $914.3 million in labor income.

Table 4-17. No Action Low, Labor Income, Annual & 25-Year Total (2024 $s)

	Annual	Total
Direct	-$27,039,402	-$675,985,042
Indirect	-$3,141,129	-$78,528,225
Induced	-$6,392,003	-$159,800,083
Total	**-$36,572,534**	**-$914,313,358**

4.4.3.3 Economic Output

Table 4-18 shows that with no action there would be an estimated total loss of $89.6 million in economic output annually – $58.7 million would be direct, $10.2 million indirect, and $20.7 million induced. Over the course of the 25 years, there would be an estimated overall total loss of $2.24 billion in economic output.

Table 4-18. No Action Low, Economic Output, Annual & 25-Year Total (2024 $s)

	Annual	Total
Direct	-$58,744,802	-$1,468,620,042
Indirect	-$10,153,818	-$253,845,458
Induced	-$20,734,042	-$518,351,058
Total	**-$89,632,663**	**-$2,240,816,567**

4.5 No Action Alternative – Moderate Impact Scenario

4.5.1 On-site

Table 4-19 shows that with no action there would be an estimated total loss of 379 jobs related to on-site economic activity annually – 222 of the jobs would be direct, 56 indirect, and 101 induced. Over the course of the 25 years, there would be an estimated overall total loss of 9,467 jobs.

Table 4-19. No Action Moderate, On-site Jobs, Annual & Multi-Year Totals

	Annual	15-Year Total	25-Year Total
Direct	-222	-3,330	-5,550
Indirect	-56	-840	-1,400
Induced	-101	-1,515	-2,533
Total	**-379**	**-5,685**	**-9,467**

4.5.1.1 Labor Income

Table 4-20 shows that with no action there would be an estimated total loss of $33.1 million in labor income related to on-site economic activity annually – $24.2 million would be direct, $3.1 million indirect, and $5.7 million induced. Over the course of the 25 years, there would be an estimated overall total loss of $827.7 million in labor income.

Table 4-20. No Action Moderate, On-site Labor Income, Annual & Multi-Year Totals (2024 $s)

	Annual	15-Year Total	25-Year Total
Direct	-$24,237,590	-$363,563,850	-$605,939,750
Indirect	-$3,123,958	-$46,859,370	-$78,098,950
Induced	-$5,748,325	-$86,224,875	-$143,708,133
Total	**-$33,109,874**	**-$496,648,110**	**-$827,746,850**

4.5.1.2 Economic Output

Table 4-21 shows that with no action there would be an estimated total loss of $95.1 million in economic output related to on-site economic activity annually – $66.9 million would be direct, $9.5 million indirect, and $18.6 million induced. Over the course of the 25 years, there would be an estimated overall total loss of $2.38 billion in economic output.

Table 4-21. No Action Moderate, On-site Economic Output, Annual & Multi-Year Totals (2024 $s)

	Annual	15-Year Total	25-Year Total
Direct	-$66,915,098	-$1,003,726,470	-$1,672,877,450
Indirect	-$9,501,429	-$142,521,435	-$237,535,733
Induced	-$18,645,167	-$279,677,505	-$466,129,167
Total	**-$95,061,694**	**-$1,425,925,410**	**-$2,376,542,350**

4.5.2 Off-site

4.5.2.1 Jobs

Table 4-22 shows that with no action there would be an estimated total loss of 940 jobs related to off-site economic activity annually – 757 of the jobs would be direct, 59 indirect, and 124 induced. Over the course of the 25 years, there would be an estimated overall total loss of 23,500 jobs.

Table 4-22. No Action Moderate, Off-site Jobs, Annual & Multi-Year Totals

	Annual	15-Year Total	25-Year Total
Direct	-757	-11,355	-18,917
Indirect	-59	-885	-1,483
Induced	-124	-1,860	-3,100
Total	**-940**	**-14,100**	**-23,500**

4.5.2.2 Labor Income

Table 4-23 shows that with no action there would be an estimated total loss of $40.0 million in labor income related to off-site economic activity annually – $29.8 million would be direct, $3.2 million indirect, and $7.0 million induced. Over the course of the 25 years, there would be an estimated overall total loss of $1.00 billion in labor income.

Table 4-23. No Action Moderate, Off-site Labor Income, Annual & Multi-Year Totals (2024 $s)

	Annual	15-Year Total	25-Year Total
Direct	-$29,841,213	-$447,618,195	-$746,030,333
Indirect	-$3,158,300	-$47,374,500	-$78,957,500
Induced	-$7,035,681	-$105,535,215	-$175,892,017
Total	**-$40,035,195**	**-$600,527,925**	**-$1,000,879,867**

4.5.2.3 Economic Output

Table 4-24 shows that with no action there would be an estimated total loss of $84.2 million in economic output related to off-site economic activity annually – $50.6 million would be direct, $10.8 million indirect, and $22.8 million induced. Over the course of the 25 years, there would be an estimated overall total loss of $2.11 billion in economic output.

Table 4-24. No Action Moderate, Off-site Economic Output, Annual & Multi-Year Totals (2024 $s)

	Annual	15-Year Total	25-Year Total
Direct	-$50,574,505	-$758,617,575	-$1,264,362,633
Indirect	-$10,806,207	-$162,093,105	-$270,155,183
Induced	-$22,822,918	-$342,343,770	-$570,572,950
Total	**-$84,203,631**	**-$1,263,054,465**	**-$2,105,090,783**

4.5.3 Total – On-site and Off-site

4.5.3.1 Jobs

Table 4-25 shows that with no action there would be an estimated total loss of 1,319 jobs annually – 979 of the jobs would be direct, 115 indirect, and 225 induced. Over the course of the 25 years, there would be an estimated overall total loss of 32,983 jobs.

Table 4-25. No Action Moderate, Jobs, Annual & Multi-Year Totals

	Annual	15-Year Total	25-Year Total
Direct	-979	-14,685	-24,467
Indirect	-115	-1,725	-2,883
Induced	-225	-3,375	-5,633
Total	**-1,319**	**-19,785**	**-32,983**

4.5.3.2 Labor Income

Table 4-26 shows that with no action there would be an estimated total loss of $73.1 million in labor income annually – $54.1 million would be direct, $6.3 million indirect, and $12.8 million induced. Over the course of the 25 years, there would be an estimated overall total loss of $1.83 billion in labor income.

Table 4-26. No Action Moderate,Labor Income, Annual & Multi-Year Totals (2024 $s)

	Annual	15-Year Total	25-Year Total
Direct	-$54,078,803	-$811,182,045	-$1,351,970,083
Indirect	-$6,282,258	-$94,233,870	-$157,056,450
Induced	-$12,784,007	-$191,760,105	-$319,600,167
Total	**-$73,145,069**	**-$1,097,176,035**	**-$1,828,626,717**

4.5.3.3 Economic Output

Table 4-27 shows that with no action there would be an estimated total loss of $179.3 million in economic output annually – $117.5 million would be direct, $20.3 million indirect, and $41.5 million induced. Over the course of the 25 years, there would be an estimated overall total loss of $4.48 billion in economic output.

Table 4-27. No Action Moderate, Economic Output, & Multi-Year Totals (2024 $s)

	Annual	15-Year Total	25-Year Total
Direct	-$117,489,603	-$1,762,344,045	-$2,937,240,083
Indirect	-$20,307,637	-$304,614,555	-$507,690,917
Induced	-$41,468,085	-$622,021,275	-$1,036,702,117
Total	**-$179,265,325**	**-$2,688,979,875**	**-$4,481,633,133**

4.6 No Action Alternative – Maximal Impact Scenario

4.6.1 On-site

4.6.1.1 Jobs

Table 4-28 shows that with no action there would be an estimated total loss of 568 jobs related to on-site economic activity annually – 333 of the jobs would be direct, 84 indirect, and 152 induced. Over the course of the 25 years, there would be an estimated overall total loss of 14,200 jobs.

Table 4-28. No Action Maximal, On-site Jobs, Annual & 25-Year Total

	Annual	Total
Direct	-333	-8,325
Indirect	-84	-2,100
Induced	-152	-3,800
Total	**-568**	**-14,200**

4.6.1.2 Labor Income

Table 4-29 shows that with no action there would be an estimated total loss of $49.7 million in labor income related to on-site economic activity annually – $36.4 million would be direct, $4.7 million indirect, and $8.6 million induced. Over the course of the 25 years, there would be an estimated overall total loss of $1.24 billion in labor income.

Table 4-29. No Action Maximal, On-site Labor Income, Annual & 25-Year Total (2024 $s)

	Annual	Total
Direct	-$36,356,385	-$908,909,625
Indirect	-$4,685,937	-$117,148,425
Induced	-$8,622,488	-$215,562,200
Total	**-$49,664,811**	**-$1,241,620,275**

4.6.1.3 Economic Output

Table 4-30 shows that with no action there would be an estimated total loss of $142.6 million in economic output related to on-site economic activity annually – $100.4 million would be direct, $14.3 million indirect, and $28.0 million induced. Over the course of the 25 years, there would be an estimated overall total loss of $3.56 billion in economic output.

Table 4-30. No Action Maximal, On-site Economic Output, Annual & 25-Year Total (2024 $s)

	Annual	Total
Direct	-$100,372,647	-$2,509,316,175
Indirect	-$14,252,144	-$356,303,600
Induced	-$27,967,750	-$699,193,750
Total	**-$142,592,541**	**-$3,564,813,525**

4.6.2 Off-site

4.6.2.1 Jobs

Table 4-31 shows that with no action there would be an estimated total loss of 1,410 jobs related to off-site economic activity annually – 1,135 of the jobs would be direct, 89 indirect, and 186 induced. Over the course of the 25 years, there would be an estimated overall total loss of 35,250 jobs.

Table 4-31. No Action Maximal, Off-site Jobs, Annual & 25-Year Total

	Annual	Total
Direct	-1,135	-28,375
Indirect	-89	-2,225
Induced	-186	-4,650
Total	**-1,410**	**-35,250**

4.6.2.2 Labor Income

Table 4-32 shows that with no action there would be an estimated total loss of $60.1 million in labor income related to off-site economic activity annually – $44.8 million would be direct, $4.7 million indirect, and $10.6 million induced. Over the course of the 25 years, there would be an estimated overall total loss of $1.50 billion in labor income.

Table 4-32. No Action Maximal, Off-site Labor Income, Annual & 25-Year Total (2024 $s)

	Annual	Total
Direct	-$44,761,820	-$1,119,045,500
Indirect	-$4,737,450	-$118,436,250
Induced	-$10,553,521	-$263,838,025
Total	**-$60,052,792**	**-$1,501,319,800**

4.6.2.3 Economic Output

Table 4-33 shows that with no action there would be an estimated total loss of $126.3 million in economic output related to off-site economic activity annually – $75.9 million would be direct, $16.2 million indirect, and $34.2 million induced. Over the course of the 25 years, there would be an estimated overall total loss of $3.16 billion in economic output.

Table 4-33. No Action Maximal, Off-site Economic Output, Annual & 25-Year Total (2024 $s)

	Annual	Total
Direct	-$75,861,758	-$1,896,543,950
Indirect	-$16,209,311	-$405,232,775
Induced	-$34,234,377	-$855,859,425
Total	**-$126,305,447**	**-$3,157,636,175**

4.6.3 Total – On-site and Off-site

4.6.3.1 Jobs

Table 4-34 shows that with no action there would be an estimated total loss of 1,979 jobs annually – 1,468 of the jobs would be direct, 173 indirect, and 338 induced. Over the course of the 25 years, there would be an estimated overall total loss of 49,475 jobs.

Table 4-34. No Action Maximal, Jobs, Annual & 25-Year Total

	Annual	Total
Direct	-1,468	-36,700
Indirect	-173	-4,325
Induced	-338	-8,450
Total	**-1,979**	**-49,475**

4.6.3.2 Labor Income

Table 4-35 shows that with no action there would be an estimated total loss of $109.7 million in labor income annually – $81.1 million would be direct, $9.4 million indirect, and $19.2 million induced. Over the course of the 25 years, there would be an estimated overall total loss of $2.74 billion in labor income.

Table 4-35. No Action Maximal, Labor Income, Annual & 25-Year Total (2024 $s)

	Annual	Total
Direct	-$81,118,205	-$2,027,955,125
Indirect	-$9,423,387	-$235,584,675
Induced	-$19,176,010	-$479,400,250
Total	**-$109,717,603**	**-$2,742,940,075**

4.6.3.3 Economic Output

Table 4-36 shows that with no action there would be an estimated total loss of $268.9 million in economic output annually – $176.2 million would be direct, $30.5 million indirect, and $62.2 million induced. Over the course of the 25 years, there would be an estimated overall total loss of $6.72 billion in economic output.

Table 4-36. No Action Maximal, Economic Output, Annual & 25-Year Total (2024 $s)

	Annual	Total
Direct	-$176,234,405	-$4,405,860,125
Indirect	-$30,461,455	-$761,536,375
Induced	-$62,202,127	-$1,555,053,175
Total	**-$268,897,988**	**-$6,722,449,700**

4.7 Economic Results Summary

Table 4-37 provides a summary of economic impact results for each of the action alternatives and the three No Action alternative scenarios. Each of the action alternatives would generate short-term benefits through construction/restoration activities. The action alternatives with extended design lives (Beach Maintenance and Beach Stabilization) would substantially extend continued full operations of KBC, which generates substantial economic benefits in Maui County. The Beach Nourishment alternative would have a brief design life and would be followed by substantial adverse impacts during the period of analysis. With the No Action alternative scenarios, there would be substantial long-term jobs loss, loss of incomes, and a reduction in overall economic activity associated with both activities at KBC and the spending of Club visitors throughout Maui County. While the period of analysis extends only to 2078, these adverse impacts associated with no action would extend indefinitely.

Table 4-37. Economic Impact Summary, Period of Analysis Totals for Each Alternative (2024 $s)

	Beach Nourishment			Beach Maintenance	Beach Stabilization	No Action - Low	No Action - Moderate	No Action - Maximal
	Action	No Action – Moderate 15-Years	Total					
Jobs								
Direct	37	-14,685	-14,648	81	97	-12,233	-24,467	-36,700
Indirect	13	-1,725	-1,712	29	23	-1,442	-2,883	-4,325
Induced	14	-3,375	-3,361	31	34	-2,817	-5,633	-8,450
Total	**65**	**-19,785**	**-19,720**	**140**	**154**	**-16,492**	**-32,983**	**-49,475**
Labor Income								
Direct	$2,916,466	-$811,182,045	-$808,265,579	$6,314,289	$7,392,396	-$675,985,042	-$1,351,970,083	-$2,027,955,125
Indirect	$799,642	-$94,233,870	-$93,434,228	$1,731,263	$1,402,607	-$78,528,225	-$157,056,450	-$235,584,675
Induced	$808,052	-$191,760,105	-$190,952,053	$1,749,472	$1,915,174	-$159,800,083	-$319,600,167	-$479,400,250
Total	**$4,524,159**	**-$1,097,176,035**	**-$1,092,651,876**	**$9,795,024**	**$10,710,177**	**-$914,313,358**	**-$1,828,626,717**	**-$2,742,940,075**
Economic Output								
Direct	$10,186,643	-$1,762,344,045	-$1,752,157,402	$22,054,576	$19,608,793	-$1,468,620,042	-$2,937,240,083	-$4,405,860,125
Indirect	$3,040,266	-$304,614,555	-$301,574,289	$6,582,323	$5,277,701	-$253,845,458	-$507,690,917	-$761,536,375
Induced	$2,621,253	-$622,021,275	-$619,400,022	$5,675,140	$6,212,630	-$518,351,058	-$1,036,702,117	-$1,555,053,175
Total	**$15,848,162**	**-$2,688,979,875**	**-$2,673,131,713**	**$34,312,039**	**$31,099,123**	**-$2,240,816,567**	**-$4,481,633,133**	**-$6,722,449,700**

5 Fiscal Results

5.1 Beach Nourishment

Table 5-1 shows that there would be a total of approximately $0.7 million in State of Hawai‘i government revenue generated or sustained from beach nourishment. The majority of this revenue ($0.5 million) would be generated through TAT, GET and Use taxes.

Table 5-1. Beach Nourishment State of Hawai‘i Government Revenue (2024 $s)

Tax Category	Total
TAT, GET & Use	$499,209
Corporate Profit	$32,456
Personal Income	$168,268
Other	$5,613
Total	**$705,546**

Table 5-2 shows that there would be a total of approximately $0.27 million in Maui County government revenue generated or sustained from beach nourishment. The majority of this revenue ($0.23 million) would be generated through property taxes.

Table 5-2. Beach Nourishment Maui County Government Revenue (2024 $s)

Tax Category	Total
Property	$234,306
Other	$36,781
Total	**$271,087**

Due to the short design life (10 years) of the Beach Nourishment alternative, fiscal impacts associated with the No Action alternative would also be incurred during the period of analysis for this EIR. Given that effects of the No Action alternative are assumed to commence after 2053, the 10-year design life would avoid those effects until after 2063. Therefore, the period of time when effects related to the No Action alternative are considered in this analysis covers 15 years, between 2064 and 2078. Impacts associated with No Action alternative scenarios are detailed below but, assuming the No Action – Moderate scenario, over the 2064 to 2078 period, there would be a of loss of $169.1 million in State of Hawai‘i government revenue and $110.1 million in Maui County revenue (see “15 Year Total” in Sections 5.5 and 5.7) associated with Beach Nourishment.

5.2 Beach Maintenance

Table 5-3 shows that there would be a total of approximately $1.5 million in State of Hawai‘i government revenue generated or sustained from beach maintenance. The majority of this revenue ($1.1 million) would be generated through TAT, GET and Use taxes. Total revenue would be generated from five nourishment efforts, which would occur over an approximate 40-year timespan.

Table 5-3. Beach Maintenance State of Hawai‘i Government Revenue (2024 $s)

Tax Category	2028	2038	2048	2058	2068	Total
TAT, GET & Use	$499,209	$145,401	$145,401	$145,401	$145,401	**$1,080,813**
Corporate Profit	$32,456	$9,453	$9,453	$9,453	$9,453	**$70,268**
Personal Income	$168,268	$49,010	$49,010	$49,010	$49,010	**$364,308**
Other	$5,613	$1,635	$1,635	$1,635	$1,635	**$12,153**
Total	**$705,546**	**$205,499**	**$205,499**	**$205,499**	**$205,499**	**$1,527,542**

Table 5-4 shows that there would be a total of approximately $0.59 million in Maui County government revenue generated or sustained from beach maintenance. The majority of this revenue ($0.5 million) would be generated through property taxes. Total revenue would be generated from five nourishment efforts, which would occur over an approximate 40-year timespan.

Table 5-4. Beach Maintenance Maui County Government Revenue, Annual (2024 $s)

Tax Category	2028	2038	2048	2058	2068	Total
Property	$234,306	$68,244	$68,244	$68,244	$68,244	**$507,282**
Other	$36,781	$10,714	$10,714	$10,714	$10,714	**$79,637**
Total	**$271,087**	**$78,958**	**$78,958**	**$78,958**	**$78,958**	**$586,919**

5.3 Beach Stabilization

Table 5-5 shows that there would be a total of approximately $1.4 million in State of Hawai‘i government revenue generated or sustained from Beach Stabilization. The majority of this revenue ($0.93 million) would be generated through TAT, GET and Use taxes. Total revenue would be generated over an approximate two-year period by a single nourishment effort and the construction of stabilizing structures.

Table 5-5. Beach Stabilization State of Hawai‘i Government Revenue (2024 $s)

Tax Category	2028	2029	Total
TAT, GET & Use	$499,209	$433,281	**$932,490**
Corporate Profit	$32,456	$16,500	**$48,956**
Personal Income	$168,268	$229,809	**$398,077**
Other	$5,613	$7,699	**$13,312**
Total	**$705,546**	**$687,289**	**$1,392,835**

Table 5-6 shows that there would be a total of approximately $0.51 million in Maui County government revenue generated or sustained project operations, annually. The majority of this revenue ($0.44 million) would be generated through property taxes. Total revenue would be generated over an approximate two-year period by a single nourishment effort and the construction of stabilizing structures.

Table 5-6. Beach Stabilization Maui County Government Revenue (2024 $s)

Tax Category	2028	2029	Total
Property	$234,306	$203,362	**$437,668**
Other	$36,781	$34,861	**$71,642**
Total	**$271,087**	**$238,223**	**$509,310**

5.4 No Action Alternative – Low Impact Scenario

Table 5-7 shows that there would be an annual loss of approximately $5.6 million in State of Hawai‘i government revenue associated with the low impact scenario. The majority of the lost revenue ($4.1 million) would be associated with TAT, GET and Use taxes. Over the course of the 25 years, there would be an estimated overall total loss of $140.9 million in revenue.

Table 5-7. No Action Low, State of Hawai‘i Government Revenue, Annual & 25-Year Total (2024 $s)

Tax Category	Annual	Total
TAT, GET & Use	-$4,084,043	-$102,101,083
Corporate Profit	-$199,180	-$4,979,492
Personal Income	-$1,308,394	-$32,709,858
Other	-$44,661	-$1,116,533
Total	**-$5,636,279**	**-$140,906,967**

Table 5-8 shows that there would be an annual loss of approximately $3.7 million in Maui County government revenue associated with the low impact scenario. The majority of the lost revenue ($2.4 million) would be associated with property taxes, including annual payments of approximately $1.2 million associated with the site itself. Revenue from TAT would decline by approximately $1.0 million per year. Over the course of the 25 years, there would be an estimated overall total loss of $91.7 million in revenue.

Table 5-8. No Action Low, Maui County Government Revenue, Annual & 25-Year Total (2024 $s)

Tax Category	Annual	Total
Property[1]	-$2,362,175	-$59,054,367
TAT	-$948,780	-$23,719,500
Other	-$358,498	-$8,962,450
Total	**-$3,669,453**	**-$91,736,317**

Note: [1]Includes estimated annual on-site property tax payments of $1,176,467.

5.5 No Action Alternative – Moderate Impact Scenario

Table 5-9 shows that there would be an annual loss of approximately $11.3 million in State of Hawai‘i government revenue associated with the moderate impact scenario. The majority of the lost revenue ($8.2 million) would be associated with TAT, GET and Use taxes. Over the course of the 25 years, there would be an estimated overall total loss of $281.8 million in revenue.

Table 5-9. No Action Moderate, State of Hawai‘i Government Revenue, Annual & Multi-Year Totals (2024 $s)

Tax Category	Annual	15-Year Total	25-Year Total
TAT, GET & Use	-$8,168,087	-$122,521,305	-$204,202,167
Corporate Profit	-$398,359	-$5,975,385	-$9,958,983
Personal Income	-$2,616,789	-$39,251,835	-$65,419,717
Other	-$89,323	-$1,339,845	-$2,233,067
Total	**-$11,272,557**	**-$169,088,355**	**-$281,813,933**

Table 5-10 shows that there would be an annual loss of approximately $7.3 million in Maui County government revenue associated with the moderate impact scenario. The majority of the lost revenue ($4.7 million) would be associated with property taxes, including annual payments of approximately $2.4 million associated with the site itself. Revenue from TAT would decline by approximately $1.9 million per year. Over the course of the 25 years, there would be an estimated overall total loss of $183.5 million in revenue.

Table 5-10. No Action Moderate, Maui County Government Revenue, Annual & Multi-Year Totals (2024 $s)

Tax Category	Annual	15-Year Total	25-Year Total
Property[1]	-$4,724,349	-$70,865,235	-$118,108,733
TAT	-$1,897,560	-$28,463,400	-$47,439,000
Other	-$716,996	-$10,754,940	-$17,924,900
Total	**-$7,338,905**	**-$110,083,575**	**-$183,472,633**

Note: [1]Includes estimated annual on-site property tax payments of $2,352,935.

5.6 No Action Alternative – Maximal Impact Scenario

Table 5-11 shows that there would be an annual loss of approximately $16.9 million in State of Hawai‘i government revenue associated with the maximal impact scenario. The majority of the lost revenue ($12.3 million) would be associated with TAT, GET and Use taxes. Over the course of the 25 years, there would be an estimated overall total loss of $422.7 million in revenue.

Table 5-11. No Action Maximal, State of Hawai‘i Government Revenue, Annual & 25-Year Total (2024 $s)

Tax Category	Annual	Total
TAT, GET & Use	-$12,252,130	-$306,303,250
Corporate Profit	-$597,539	-$14,938,475
Personal Income	-$3,925,183	-$98,129,575
Other	-$133,984	-$3,349,600
Total	**-$16,908,836**	**-$422,720,900**

Table 5-12 shows that there would be an annual loss of approximately $11.0 million in Maui County government revenue associated with the maximal impact scenario. The majority of the lost revenue ($7.1 million) would be associated with property taxes, including annual payments of approximately $3.5 million associated with the site itself. Revenue from TAT would decline by approximately $2.8 million per year. Over the course of the 25 years, there would be an estimated overall total loss of $275.2 million in revenue.

Table 5-12. No Action Maximal, Maui County Government Revenue, Annual & 25-Year Total (2024 $s)

Tax Category	Annual	Total
Property[1]	-$7,086,524	-$177,163,100
TAT	-$2,846,340	-$71,158,500
Other	-$1,075,494	-$26,887,350
Total	**-$11,008,358**	**-$275,208,950**

Note: [1]Includes estimated annual on-site property tax payments of $3,529,402.

5.7 Fiscal Results Summary

Table 4-37 provides a summary of fiscal impact results for each of the action alternatives and the three No Action alternative scenarios. Each of the action alternatives would generate short-term benefits through construction/restoration activities. The action alternatives with extended design lives (Beach Maintenance and Beach Stabilization) would substantially extend continued full operations of KBC, which generates substantial fiscal benefits for the State of Hawai‘i and Maui County governments. The Beach Nourishment alternative would have a brief design life and lead to substantial adverse impacts during the latter portion of the period of analysis. With the No Action alternative scenarios, there would be substantial long-term loss of revenue associated with both activities at KBC and the spending of Club visitors throughout Maui County. While the period of analysis extends only to 2078, these adverse impacts associated with no action would extend indefinitely.

Table 5-13. Fiscal Impact Summary, Period Of Analysis Totals for Each Alternative (2024 $s)

	Beach Nourishment			Beach Maintenance	Beach Stabilization	No Action - Low	No Action - Moderate	No Action - Maximal
	Action	No Action – Moderate 15-Years	Total					
State of Hawai‘i Government Revenue								
TAT, GET & Use	$499,209	-$122,521,305	-$122,022,096	$1,080,813	$932,490	-$102,101,083	-$204,202,167	-$306,303,250
Corporate Profit	$32,456	-$5,975,385	-$5,942,929	$70,268	$48,956	-$4,979,492	-$9,958,983	-$14,938,475
Personal Income	$168,268	-$39,251,835	-$39,083,567	$364,308	$398,077	-$32,709,858	-$65,419,717	-$98,129,575
Other	$5,613	-$1,339,845	-$1,334,232	$12,153	$13,312	-$1,116,533	-$2,233,067	-$3,349,600
Total	**$705,546**	**-$169,088,355**	**-$168,382,809**	**$1,527,542**	**$1,392,835**	**-$140,906,967**	**-$281,813,933**	**-$422,720,900**
Maui County Government Revenue								
Property	$234,306	-$70,865,235	-$70,630,929	$507,282	$437,668	-$59,054,367	-$118,108,733	-$177,163,100
TAT	N/A	-$28,463,400	-$28,463,400	N/A	N/A	-$23,719,500	-$47,439,000	-$71,158,500
Other	$36,781	-$10,754,940	-$10,718,159	$79,637	$71,642	-$8,962,450	-$17,924,900	-$26,887,350
Total	**$271,087**	**-$110,083,575**	**-$109,812,488**	**$586,919**	**$509,310**	**-$91,736,317**	**-$183,472,633**	**-$275,208,950**

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APPENDIX J

COASTAL AND MARINE USES REPORT

Coastal and Marine Uses Report for the Hōʻala Honokōwai Beach Restoration Project

Honokōwai, Maui, Hawaiʻi



Prepared for:

Sea Engineering, Inc.
Makai Research Pier
Waimānalo, Hawaiʻi 96795

Ian ʻAkahi Masterson

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Coastal and Marine Uses Report for the Hōʻala Honokōwai Beach Restoration Project

1.0 EXECUTIVE SUMMARY

This Coastal and Marine Uses report is intended to provide information to Sea Engineering, Inc. [SE] concerning the Hōʻala Honokōwai Project, regarding ocean safety and recreational activities. Honokōwai Beach is located on the west shore of the island of Maui, in the district of Kāʻanapali within the ahupuaʻa of Honokōwai. The Project Site at Honokōwai Beach, shown in Figure 1.1 and 1.2, is located north of Kāʻanapali and south of Kahana Bay. The shoreline surrounding the Project Site is characterized by engineered structures including seawalls, revetment, hybrid seawall-revetments, and drainage headwalls.

Kāʻanapali Beach Club, adjacent to the Project Site, is one of only two unarmored properties along the coast. In 2016, due to an unusual combination of persistent northerly swell, sustained elevated water levels, strong currents, and abnormally high tides, Honokōwai Beach was almost entirely lost to erosion. The erosion caused substantial beach loss, structural damage, and created risks to public health, safety, and welfare, and impeded access to and along the shoreline.

It is anticipated that beach restoration would help to preserve and enhance the fundamental character of Honokōwai Beach by maintaining shoreline access and supporting existing uses along the shore. The purpose of the project is to initiate beach restoration to mitigate the shoreline erosion and rapid beach loss that exposed the backshore area and caused turbidity plumes to form in the nearshore waters off Honokōwai Beach. The objectives of the proposed action are to restore and preserve Honokōwai Beach, increase beach stability, provide safe access to and along the shoreline, and increase resilience to coastal hazards and sea level rise.

To achieve these objectives, the following alternatives were evaluated: No Action, Beach Nourishment, Beach Maintenance (with periodic renourishment), and Beach Stabilization. The estimated time to complete the project depends on the beach restoration alternative chosen. All the beach restoration alternatives would require recovery of sand from the Sand Recovery Site, an 8.5-acre sand deposit located offshore of Puʻu Kekaʻa in 115 to 131-foot water depth. The sand would be taken by barge to Kahului Harbor and trucked to the project site, then placed on the shoreline. The beach stabilization alternative would include beach nourishment and construction of three T-head groins and one L-head groin. The project spans approximately 1,000 feet of shoreline.

Section 3 details the scope of an Ocean Recreation and Safety Impacts Survey that was accomplished for the purpose of understanding how the project alternatives might impact coastal and marine uses at Honokōwai, and to receive public comment about the project. Two site visits to Honokōwai were made to gather information, as well as to interview beach patrons, commercial operators, and local businesses, and to invite participation in the survey. On-site, coastal and marine uses were observed, as well as existing conditions, including an analysis of the surf breaks, and ocean safety considerations. These existing conditions and the coastal and marine uses observed are reported on in Sections 4 and 5 of this report, including the regulatory and management frameworks dictated by State and Federal law.

Of the email requests and site visits conducted for the Ocean Recreation and Safety Impacts Survey between March 2023 and September 2024, there were a dozen respondents to the survey,

and a total of twenty face-to-face contacts made during the site visits. The results of the survey given in Section 6 show the value that respondents place in Honokōwai Beach. They discuss the impacts of recent weather and large surf events, express concerns regarding beach loss and environmental degradation, and provide their thoughts about improving the beach and shoreline access there as well as ocean safety. In addition, respondents provided input concerning potential impacts on beach and ocean recreation that beach restoration might have. Respondents also provided additional comments, concerns, and recommendations, wherein patron safety and the environment emerged as priorities with regards to what actions are to be taken at Honokōwai.

Regarding Beach Stabilization, some survey respondents expressed concern about the aesthetic impacts of groins protruding into the sea, considering them to be too visually overwhelming of a change. On the other hand, other respondents welcomed the idea of erosion mitigation measures associated with Beach Stabilization for safety and continued recreational use. In general, their reasoning followed that a stable beach creates better access across a sandy beach to an ocean with safer nearshore waters due to the interruption of the strong currents that exist there at present. Generally speaking, many respondents felt that at least some sort of measures should be taken to halt the shoreline from eroding away at the present rate for reasons cited ranging from environmental damages relating to turbidity and sedimentation, to preservation of shoreline access for recreation, to infrastructure and property protection, to the hazardous debris and visual wasteland left behind by a managed retreat where no mitigative actions are taken beyond removal of the temporary erosion structures.

In Section 7, the report turns to an assessment of potential short-term and long-term impacts that each project alternative might have on coastal and marine uses, which are listed individually for each alternative. Existing and anticipated environmental conditions are considered for each ocean recreation activity with regards to shoreline access, safety, and the viability of continuing to practice these activities in light of the potential changes that might occur from Beach Nourishment, Beach Maintenance, Beach Stabilization, or by taking no action at all beyond removing the temporary erosion control structures that exist along the backshore at present.

In the short-term, beyond No Action being taken, all of the beach restoration project alternatives being considered have proposed operational activities that take place either in the ocean or on the beach, and are expected to directly, but temporarily impact ocean recreation and access into and around the Project Site and Sand Recovery Site. Potential long-term impacts of this project are difficult to project with absolute certainty, but survey comments and previous reports were considered in assessing potential impacts on coastal and marine uses as well as ocean safety in and around the Project Site and the Sand Recovery Site, with long-term impacts reaching closer to the project objective of maintaining a stable beach for 50-years.

In summary, beach restoration is expected to have temporary short-term impacts on coastal and marine uses. Long-term impacts will have to be observed over time, though some coral rubble and occasional turbidity from fine sand may occur during increased wave activity that moves the recovered sands. Eventually, beach loss is expected to occur over time, the rate of which depends on the alternative chosen for beach restoration with regards to this project.

As an alternative action, Beach Stabilization might be considered to have the greatest physical and aesthetic impact to the coastline at Honokōwai other than taking No Action at all, which would also significantly impact the coastline in a different way, but Beach Stabilization also offers the best chance of reaching the project objective of creating a stable beach for a period of 50 years. Having a stable beach could be a benefit in allowing coastal and marine uses to continue as they had prior to the extreme erosional events of 2016 that occurred at Honokōwai Beach.



Figure 1-1 Aerial Photograph showing the Project Site at Honokōwai Point.



Figure 1-2 Close-Up Aerial Photograph showing the Project Site.

2.0 INTRODUCTION

2.1 Purpose

This Coastal and Marine Uses report is intended to provide information to Sea Engineering, Inc. [SE], regarding the Hōʻala Honokōwai Project. SE completed a concept design report in November 2021 and submitted it to the Department of Land and Natural Resources, Office of Conservation and Coastal Lands (DLNR-OCCL). SE issued a second Coastal Engineering Assessment Report draft in March 2024, which was used for information presented in this report. This 2024 Coastal and Marine Uses Report will be included as an appendix in the Environmental Impact Statement (EIS) for the project being prepared for submission at this time.

2.2 Project Location & Site Description

Honokōwai Beach is located on the west shore of the island of Maui, in the district of Kāʻanapali within the ahupuaʻa of Honokōwai. The Project Site at Honokōwai Beach, shown in Figure 1-1 and 1-2, is located north of Kāʻanapali and south of Kahana Bay. The Project Site is situated where the shoreline transitions from predominantly sandy beaches, dunes, and unarmored shoreline south of Honokōwai Point, to predominantly rocky or armored shoreline north of Honokōwai Point and consists of 1,000 linear feet of shoreline that is fronted by a sandy beach, locally referred to as Honokōwai Beach.

Shoreline armoring begins approximately 800 ft south of the Project Site and extends north to Kahana Bay. The shoreline surrounding the Project Site is characterized by engineered structures including seawalls, revetment, hybrid seawall-revetments, and drainage headwalls. Honokōwai Beach is located at the southern end of the Honokōwai littoral cell, which extends from Honokōwai Point north to Kahana Bay and spans approximately 6,200 linear feet (lf) (1.15 miles (mi) of shoreline. Within the Honokōwai littoral cell, there are only two unarmored properties: Kāʻanapali Beach Club (adjacent to the Project Site) and Honokōwai Beach Park (0.5 mi north of the Project Site).

The notable landmark named Puʻu Kekaʻa, a cinder-and-spatter cone of the Lahaina Volcanic Series, is located to the south on the Kāʻanapali shore, where it divides Kāʻanapali Beach and North Kāʻanapali Beach. In Hawaiian lore it is known as a leina ka ʻuhane, a “leaping place of the spirits.” A historic marker on the Kāʻanapali Boardwalk includes the following information, “To this day, it [Puʻu Kekaʻa] is revered as a sacred spot known as “ka leina a ka ʻuhane”- the place where a soul leaps into eternity.” Today some people refer to Puʻu Kekaʻa as “Black Rock.”

North Kāʻanapali Beach extends north from Puʻu Kekaʻa to Kahekili Beach Park, where the sandy unarmored shoreline continues into Honokōwai, ending near the southern edge of the Maui Kai Condominium property at Honokōwai Point, about 800 ft. south of the Project Site. The Project Site does not include North Kāʻanapali Beach but begins at the northern edge of the Maui Kai Condominium property at Honokōwai Point. Puʻu Kekaʻa is not in or near the Project Site, but it is the closest landmark to the area identified for suitable sand to be obtained for this project, called the Sand Wave Deposit, and known as the Sand Recovery Site. The area is referenced in regard to the three alternatives that have a sand recovery component for project implementation. It is located west of Puʻu Kekaʻa, about a half mile offshore of this leaping place.

Figure 2-1 shows Honokōwai Point (left) and Puʻu Kekaʻa (right) in Kāʻanapali, the present Project Site and the proposed offshore Sand Recovery Site off of Puʻu Kekaʻa, respectively. The Sand Wave Deposit has an estimated area of 8.5 acres (about the area of the Lincoln Memorial Reflecting Pool), contains an estimated 629,000 cubic yards of beach quality sand, and is part of the region’s largest littoral sand system.



Figure 2-1 Honokōwai Point (left) and Puʻu Kekaʻa (right) in Kāʻanapali, showing the present Project Site and the proposed offshore Sand Recovery Site off Puʻu Kekaʻa, respectively.

2.2.1 Public Access & Amenities

Honokōwai Beach provides a unique combination of perpendicular and lateral shoreline access and public amenities that is rare along the West Maui coastline (Figure 1-6). Perpendicular access to the shoreline is available via a paved road between Kāʻanapali Beach Club and Kāʻanapali Shores Condominium (adjacent property to the north). The public beach right of way features dedicated public parking stalls and a public changing station with restroom and shower facilities.

Lateral shoreline access is available along the beach and via a coastal walkway that provides Americans with Disabilities Act (ADA)-compliant access along approximately 1,000 linear feet of shoreline from the south end of the Kāʻanapali Beach Club property to the north side of Honokōwai Stream. The beach supports a wide range of cultural and recreational uses and is a popular destination for beach goers, shoreline fisherman, spear fishers, divers, snorkelers, swimmers, surfers, and paddlers. The beach has significant natural, recreational, aesthetic, cultural, and economic value. Figure 2-2 shows the public access and amenities at Honokōwai.

The area between Honoapiʻilani Highway and the shoreline is in the Special Management Area (SMA) and Urban Land Use District. The area makai (seaward) of the shoreline consists of submerged lands that are in the Resource Subzone of the Conservation District. The area mauka (landward) of the shoreline is densely developed with resort infrastructure. There are three (3) privately-owned parcels near the Project Site, all of which are zoned (H) Hotel.



Figure 2-2 Public Access and amenities at Honokōwai Beach make it a popular location for visitors and residents to enjoy ocean recreation and cultural gathering activities there.

2.2.2 Recent Extreme Weather and Surf

In 2016, due to an unusual combination of persistent northerly swell, sustained elevated water levels, strong currents, and abnormally high tides, Honokōwai Beach was almost entirely lost to erosion. Figure 2-3 shows the extent of damage wrought from this episodic erosion event. The connection between the Honokōwai and North Kā‘anapali littoral cells was severed by this discrete event, which has inhibited the continued exchange of sediment (i.e., sand) between the two littoral cells. As a result of the 2016 beach loss event, the volume of sand in the Honokōwai littoral cell was substantially reduced, thereby inhibiting beach recovery. The reduction in sand volume and disruption of natural sediment transport have caused Honokōwai Beach to become unstable, making it more sensitive to seasonal erosional forces and less capable of natural recovery.

Figure 2-3 shows the erosion and beach loss that occurred in 2016 which caused extensive environmental damage and negatively impacted the range of beneficial uses of Honokōwai Beach. The erosion caused substantial beach loss, structural damage, and created risks to public health, safety, and welfare, and impeded access to and along the shoreline. The erosion and discharge of alluvial material (i.e., clay, dirt, and boulders) from the backshore caused the formation of large turbidity plumes that negatively impacted water quality, as shown in Figure 2-4. It is anticipated that restoring Honokōwai Beach and preventing further erosion of the backshore will have a positive net beneficial impact on the environment, including preserving the beach and improving water quality. It is also anticipated that beach restoration would help to preserve and enhance the fundamental character of Honokōwai Beach by maintaining shoreline access and supporting existing uses along the shore.



Figure 2-3 Honokōwai Beach was stable prior to the 2016 episodic erosional event.



Figure 2-4 Showing extensive turbidity plumes caused by the 2016 episodic erosional event.

2.3 Project Description

The purpose of the project is to initiate beach restoration to mitigate the shoreline erosion and rapid beach loss that exposed the backshore area and caused turbidity plumes to form in the nearshore waters off Honokōwai Beach. This erosion has exposed and damaged infrastructure including a concrete walkway that provides lateral access along the shoreline, shower pads, irrigation lines, electrical wiring, and gas lines. The erosion also threatened the north flank of the south adjacent property (Maui Kai Condominiums).

The objectives of the proposed action are to restore and preserve Honokōwai Beach, increase beach stability, provide safe access to and along the shoreline, and increase resilience to coastal hazards and sea level rise. To achieve these objectives, the following alternatives were evaluated: No Action, Beach Nourishment, Beach Maintenance (with periodic renourishment), and Beach Stabilization. These alternatives are further described below and shown in Figure 2-5.

> **No Action** would consist of not implementing any of the beach restoration alternatives and allowing Honokōwai Beach to continue to erode naturally. No Action would occur if the applicant were unable to obtain the necessary permits and approvals to implement the preferred beach restoration alternative. For the purposes of the EIS analysis, it is assumed that the No Action alternative would involve removal of the existing temporary erosion control structure. To evaluate and compare the potential impacts of No Action, it is necessary to consider the cumulative impacts that may occur over a period of 50 years, which corresponds with the design life of the Beach Stabilization and Beach Maintenance alternatives.
>
> **Beach Nourishment** refers to an individual action (Project) that involves placement of additional sand to increase beach width and sand volume to offset the effects of erosion without modifying existing structures or installing any new structures.
>
> **Beach Maintenance** refers to a series of actions (Program) that consist of periodic beach nourishment combined with sand pushing and/or sand back passing, without modifying existing structures or installing any new structures. Beach maintenance actions are typically intended to be conducted on a recurring, periodic basis over a specified period of time and are therefore considered to be programmatic in nature.
>
> **Beach Stabilization** refers to an individual action (Project) that involves placement of sand to nourish the beach and either (i) modifying existing structures, and/or (ii) installing new structures (e.g., groins) to stabilize the sand (i.e., mitigate erosion and beach loss). Beach stabilization projects are typically designed to be implemented as a single, discrete Project with a specified design life.

Restoration of a beach by placing sand in an appropriately designed manner along a shoreline can be an effective and attractive means of mitigating beach loss and providing for recreational and aesthetic enjoyment. Where erosional forces are weak, beach restoration can be accomplished by placing sand on the shoreline to nourish or enlarge the beach. Alternatively, where erosional forces are stronger, beach restoration can be accomplished by placing sand in conjunction with beach stabilizing structures such as T-head groins to avoid repeated renourishment. The erosion rate for non-stabilized beach fill could be so high that frequent renourishment would be required to maintain the desired beach width. There are limited sources of suitable beach-fill sand in Hawai‘i; thus, the resource is finite, and consequently the cost is high.

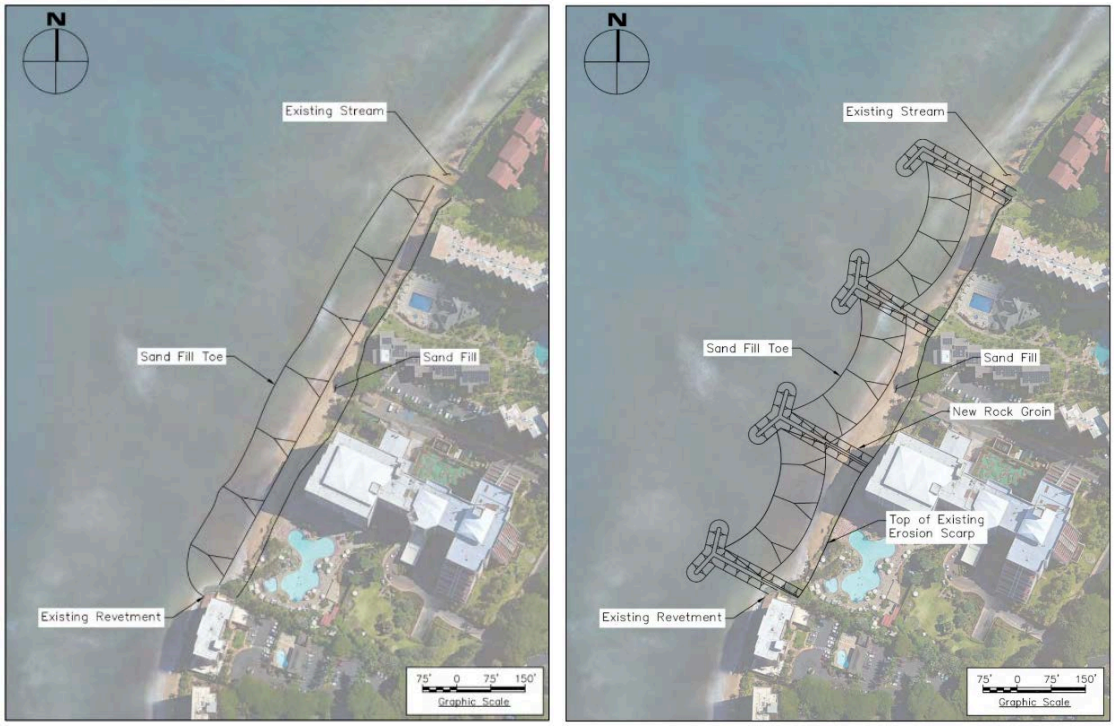


Figure 2-5 Plan View of the Beach Nourishment and Beach Maintenance Alternatives on the left, and the Beach Stabilization Alternative on the right, showing the proposed L- and T-head groins.

T-head groins are engineered structures that are constructed perpendicular to the shoreline to block the longshore transport of sediment (i.e., sand). T-head groins decrease and reorient the amount of wave energy reaching the beach and create artificial littoral cells to stabilize the sand. Rubblemound T-head groins are recommended to reduce rip currents, wave reflection, and the subsequent offshore sand losses. The beach should be nourished with sand to achieve the predicted shoreline shape. T-groins can be aligned, or "tuned," according to the prevailing wave crest orientation, to produce the desired beach configuration. This would produce a stable beach and mitigate the need for periodic renourishment and maintenance, which would reduce cumulative costs and impacts.

A beach restoration project would include recovering suitable sand from an offshore area. The Sand Recovery Site identified is called the Sand Wave Deposit, located offshore of Puʻu Kekaʻa, about 1.5 miles south of the Project Site. The Sand Recovery Site has an estimated area of 8.5 acres (about the area of the Lincoln Memorial Reflecting Pool) and contains an estimated 629,000 cubic yards of beach quality sand and is part of the region's largest littoral sand system. The sand would then be transported to Kahului Harbor and then delivered to the beach, where it would be placed along the shoreline and graded. The amount of sand required would vary, ranging from 27,000 cubic yards to 47,000 cubic yards, depending on the specific beach restoration methodology selected (i.e., Beach Nourishment, Beach Maintenance, or Beach Stabilization).

2.3.1 Beach Nourishment

The Beach Nourishment alternative would consist of placing sand at the south end of the Honokōwai littoral cell without any structures to stabilize the sand. The sand would be placed along approximately 1,000 feet of shoreline between Honokōwai Stream and Honokōwai Point. The beach would have a crest elevation of +8.5 feet MSL and a beach slope of 1V:8H. This concept would require 27,000 cy of sand and would provide a minimum beach width of 40 feet.

2.3.2 Beach Maintenance

The Beach Maintenance alternative would consist of an initial beach nourishment project with periodic renourishment at specified intervals. The initial nourishment effort would be identical to the beach nourishment alternative described above. Periodic beach maintenance would be performed after the initial nourishment and throughout the 50-year design life to maintain the desired beach width. Over a period of 50 years, four (4) renourishment efforts would be required to maintain the desired beach width of 40 feet. Each renourishment would require approximately 5,000 cy of sand, resulting in a total volume of 47,000 cy of sand to restore the beach and provide a minimum beach width of 40 feet.

2.3.3 Beach Stabilization

The beach stabilization alternative would consist of beach nourishment and construction of three T-head groins and one L-head groin. The project spans approximately 1,000 feet of shoreline. The groins would be spaced between 330 and 340 feet apart from southwest to northeast. The groins would extend between 220 and 250 feet from the existing backshore. The heads would extend between 72 and 84 feet to either side of the stem, at angles ranging from 90º to 120º in order to best orient the gaps between heads parallel to the typical wave approach. The groin crests and elevations are designed with the capability of adapting to sea level rise. The groin heads are designed with a crest elevation of +6 feet MSL. That elevation would allow some overtopping during high wave events without sacrificing beach stability.

The heads would have crest widths of 11.4 feet and side slopes of 1V:1.5H. The crest elevation is +6 feet MSL and the groin stem elevations would increase from +6 feet MSL at the heads to +7.5 feet MSL at the inshore ends on the inner groins and +8.5 feet MSL on the terminal groins. The stems would not require modification for sea level rise, so they are constructed with a three-stone crest width of 11.4 feet. Approximately 10,000 cubic yards of stone would be required to construct the groins. The southwest and northeast groins are considered terminal groins, meaning that they are at the ends of the beach system. All the other groins will have sand on either side, so they can be lower to allow for a continuous sand beach. As terminal groins, the stem elevations will have to be higher than the other stems to prevent sand from washing over them. The terminal groin stem elevations are set to +8.5 feet MSL. Sand fill would be placed between the groins to create a beach with a minimum 40-foot width, +8.5-foot MSL elevation, and a 1V:8H slope from the crest to the sea bottom. The inner groin stems are lower than the beach crest elevation, thus approximately half of the groin stem would be covered by sand, with the groins gradually emerging from the beach slope. An estimated 33,000 cubic yards of sand would be required for the alternative.

2.4 Construction Methodology

2.4.1 Sand Recovery

The estimated time to complete the project depends on the alternative chosen. All of the beach restoration alternatives would require recovery of sand from the Sand Recovery Site, an 8.5-acre sand deposit located offshore of Puʻu Kekaʻa in 115 to 131-foot water depth. The proposed sand recovery plan limits dredging depths to about six feet below the existing sand surface. This upper section of the sand deposit is the portion that was tested for sand quality, including grain size, distribution, sediment character, and color. The dredging equipment would consist of a crane barge and several deck barges. An environmental clamshell bucket would be used to dredge the sand and place it on the deck barges. The crane barge would be anchored at the offshore Sand Recovery Site. Dredging and offloading operations would be performed simultaneously, using deck barges to transport the sand. The deck barges would be equipped with concrete wear decks and containment fences.



Figure 2-5 An aerial view of the Sand Wave Deposit located offshore of Puʻu Kekaʻa and Kāʻanapali Beach, where sand recovery operations are planned for the three alternatives.

2.4.2 Sand Transport

Once a deck barge is filled, a tugboat would transport the barge to Kahului Harbor on the north coast of Maui. The sand would be offloaded at Kahului Harbor and trucked to a temporary stockpile site and then to the project site to be placed on the shoreline. Trucks and other equipment would transfer the sand to the placement area, where bulldozers and crews would spread it on the beach or between the groins according to the concept design plan chosen.

2.4.3 Sand Placement

As sand is trucked to the project site, the sand would be moved directly to the beach and placed to the design lines and grades. There is no dewatering associated with the truck hauling method. Sand movement and placement would be accomplished using standard mechanical equipment, including a front-end bucket loader, dump trucks, and bulldozers. The beach width will be increased from onshore to offshore, thus building dry substrate for machinery to operate on as it is built seaward. Proper beach shape would be verified during construction with surveys and by placing survey stakes with final beach height markings as references. Design beach profiles and volume calculations would be part of the construction drawings. A containment system will be required in the area of active sand placement to reduce the potential for turbidity impacts to coastal waters during sand placement in the water. Silt curtains and fences will be required, consistent with previous requirements of the DOH.

2.4.4 Groin Construction

The Beach Stabilization Alternative involves construction of rock rubblemound groins, which is a relatively straightforward marine project. The primary challenges are related to access – both to get equipment and material to the site and to establish a work platform to construct from. The

shallow reef flat and wave action prohibit access to the site from the ocean side. The stone will have to be transported by truck to the site, and then moved to the shoreline via available accessways between buildings. Direct access to the project site shoreline is available via a paved road between Kāʻanapali Beach Club and Kāʻanapali Shores. Access to the shoreline could also be achieved through the Maui Kai Condominium property to the south. Approximately 770 truckloads will be required to transport the 10,000 cy of stone required to construct the groins. The groin stem and head sections would be overbuilt to approximately 15 feet in width to provide for equipment access, and the groins would be completed working from the heads to shore, removing excess stone as the work proceeds landward. Groin construction would proceed one at a time, working back toward the access. Sand would be placed as each cell is completed.

3.0 SURVEY SCOPE

An Ocean Safety and Recreation Activities Impacts survey was conducted for the purpose of understanding how the project alternatives might impact coastal and marine uses at Honokōwai and to receive public comment about the project. The scope of work for this report included:

a. Identifying coastal and marine uses in the Project Site, including traditional fishing and gathering activities.
b. Identifying beach and ocean conditions in the Project Site.
c. Interviewing shoreline and ocean users.
d. Identifying possible short-term and long-term impacts of the project.
e. Identifying possible beach and ocean hazards at the project site.

3.1 Survey Methodology

Information for this report was gathered from two site visits to Honokōwai Beach, from interviews with individuals familiar with the project site, from interviews with staff members of contracted beach concession companies on and around Honokōwai Beach, and from a Google Forms-based questionnaire that was sent to commercial ocean recreation companies which conduct business at the project site, as well as other organizations and individuals on Maui that may have information about recreation in this area. A pedestrian survey accomplished while on site included visits to businesses with store fronts along Lower Honoapiʻilani Road in the Honokōwai area to invite participation in the survey questionnaire.

3.2 Survey Questionnaire

The coastal and marine use survey contains a paragraph briefly describing the purpose for the Honokōwai Beach Restoration project, an aerial photo of the Project Site and surf zone, and a graphic showing the extent of the Project Site in relation to the surf zone, followed by ten questions related to the respondents observations and recreational uses of the area as well as their comments, concerns, and recommendations in regards to the project objectives. The survey and survey responses are included as an appendix in this report.

3.3 Survey Fieldwork and Distribution

Approximately fifty individuals were approached in person, by phone, or by email, to discuss Honokōwai Beach. These individuals included ocean recreation and safety practitioners, community members, and beach patrons interviewed during the pedestrian surveys, as well as members of the following companies/organizations who were identified during the pedestrian survey or thought to have recreational interests at Honokōwai Beach.

- 808 Boards Surf Shop

- ‘Āina Solutions
- Boss Frog’s Snorkel, Bike, and Beach Rentals
- Hawaiian Style Beach Activities (at Kā‘anapali Beach Club)
- Honua Kai Watersports & Pool Service
- Maui Beach Villa Rentals
- Maui Ocean Safety
- Nalu Studies (an education & research program)
- Sabado Art Gallery
- Salty Zen Clothing
- Snorkel Bob’s Honokowai
- Sun Beach Rentals

Two different visits were made to Honokōwai in order to accomplish the survey, observe recreational activities happening there, and assess conditions relating to patron safety and the present environment. These visits occurred in June 2024 and September 2024. The survey was distributed over time, with initial contact occurring in spring 2023, then follow-up happening in summer 2023. The survey was halted in fall 2023 due to the Lahaina fires, so all survey respondents were contacted once again prior to the site visit the next year in June 2024. Final contact with respondents occurred in fall 2024, coinciding with the second site visit in September. With each survey distribution, new respondents were identified and interviewed. Section 6 details the results of the coastal and marine uses survey. The summary includes answers from all of the survey respondents over the duration of this project. The survey and raw survey results (except questions relating to personal information and identity) are listed as an appendix in this report.

4.0 EXISTING CONDITIONS

The Project Site is located just north of Honokōwai Point where the shoreline transitions from sandy unarmored shoreline (to the south) to armored/rocky shoreline (to the north). Kā‘anapali Beach Club, fronting the Project Site, is one of only two properties along 1.75 mi of shoreline that is unarmored, the other being Honokōwai Beach Park, approximately 0.35 mi north of the Project Site. The foreshore along this reach is lined by a shallow fringing reef, except for a small sand channel through the reef at the north end of the Kā‘anapali Beach Club, which is the remnant of an ancient stream that existed there.

The Project Site is located in the Honokōwai watershed, which has a total area of 9.8 square miles and a maximum elevation of 5,689 ft. The nearest perennial stream is Honokōwai Stream, which is located at the northern boundary of Honokōwai Beach. Honokōwai Stream is 16.9 mi long and passes under Honoapi‘ilani Highway via a concrete box culvert. The lower reach of the stream drainage is concrete-lined where it meets the ocean, and the stream is dry near the coast but runs when rains occur in the area. It is assumed that the remnant stream channel fronting Kā‘anapali Beach Club was created by Honokōwai Stream in the geologic past prior to being diverted during recent times as the area was being developed starting in the 1960s. Because Honokōwai stream has been diverted and channelized by the County of Maui Department of Public Works, it now empties out at the northern edge of the Project Site boundary to the north of Aston Kā‘anapali Shores. From there, currents generally run south along the shore to the remnant stream channel fronting Kā‘anapali Beach Club, where the current direction turns offshore in the deeper waters of the channel. During flood events, the discharge of terrigenous sediment and debris from Honokōwai Stream causes turbidity plumes to form in the waters offshore of the Project Site.



Figure 3-1 Two aerial views of the remnant stream channel, on the left showing the typical path of stream outflow, and on the right deeper channel waters are seen between the breaking waves.

Honokōwai Beach is a dynamic shoreline that is subject to seasonal and episodic variations in beach width and volume. As recently as 2011, beach widths ranged from 40 to 80 ft. However, the beach is experiencing both chronic and episodic erosion. The El Niño winter of 2015/2016 caused significant beach narrowing. As a result, the backshore was exposed to erosion and more than 5,600 ft^2 of land was lost. The erosion caused structural damage and threatened the existing infrastructure. In May 2018, a temporary erosion control structure (erosion protection skirt) was installed along the shoreline fronting Kā‘anapali Beach Club. The erosion protection skirt was constructed from geotextile fabric, sand-filled geotextile mattresses, and polypropylene sandbags.

Nearshore hydrodynamics (i.e., waves, currents, and water circulation) along the Honokōwai shoreline are very complex. At Honokōwai Beach, sediment (i.e., sand) is moved in multiple directions due to a complex combination of wave exposure, bathymetry, water depths, nearshore currents, and sediment availability. As a result, beach width and sand volume at Honokōwai Beach are constantly changing due to seasonal and episodic variations. Conditions in the Sand Recovery Site vary with tides, winds, swells, and storms that produce various strengths and directions of currents both on the surface and at depth. These factors also produce varying surface conditions that, depending on the intensity of each factor, may produce extremely rough seas.

4.1 Seasonal Swells and Annual Beach Migration/Sand Movement

The following is a summary of the dynamic seasonal beach sand movement at the Project Site. In their latest Coastal Engineering Assessment Report (03/05/2024), SE has conducted an in-depth analysis of wave, swell, and current models relating to the Project Site that supports the following assessment and provides visuals of current and wave-energy scenarios for the various swell directions that affect Honokōwai Beach.

Summer swells at Honokōwai Beach come from the south and wrap around Pu‘u Keka‘a, creating longshore currents that run north along the Project Site. These currents erode sand from Honokōwai Beach and transport it north, where some accretes by the present channelized stream outlet seawall, widening the beach there. Thus, the beach narrows during the summer months, when southerly swell dominates and pushes sand to the north. During periods of seasonal fluctuation, portions of the beach become narrower and flatter, which exposes the backshore to erosion. Winter surf reverses this pattern, coming from the north and creating longshore currents that run south toward Honokōwai Point, thus, the southern portion of the beach is widest during the winter months. These currents transport sand from the northern end of the Project Site, where it accumulates on the updrift side of the seawall fronting the Maui Kai Condominium. Being the southern edge of this littoral current, sand also gets transported offshore by way of the remnant stream channel fronting Kā‘anapali Beach Club, as evidenced by the sandy bottom there.

In summary, the seasonal variations in wave activity at Honokōwai Beach result in dynamic shifts of sand, resulting in dramatic differences between summer and winter beach widths. Because of the 2016 beach loss events, the volume of sand in the Honokōwai littoral cell was substantially reduced, thereby inhibiting beach recovery and severing the connection with the neighboring North Kāʻanapali littoral cell to the south. These seasonal swells also pose various hazards for beach patrons and ocean enthusiasts, described in Section 4.4.

4.2 Currents

Offshore currents tend to reverse like the nearshore currents, but they are influenced by the movement of the tides. Ebb tide currents flow to the north, while flood tide currents are inconsistent and may flow to the north and south. Strong easterly trade winds are blocked from the island and blow offshore, but northerly winds carry sand south, which usually occurs intermittently during the winter months. Seasonal swells then push that sand back towards the north at Honokōwai Beach during summer months, as explained above. A seaward moving current exists in the remnant stream channel as water exits the longshore current coming from the north. Likewise, wave energy from the south piles up inside Honokōwai Point and pushes towards the channel as well. These currents converge and flow out to sea in the deeper waters of the channel, intensifying during swell episodes and when strong trade winds blow offshore.

4.3 Island Swell Blockage

Honokōwai is at the center of the Maui Nui complex, which consists of the islands of Maui, Lānaʻi, Molokaʻi, and Kahoʻolawe. These islands shelter the Honokōwai area from direct exposure to northeast tradewind-generated waves and North Pacific swell from the northwest. However, the area is exposed to southern swell, North Pacific swell from the north, and occasional swell from the west. The island of Molokaʻi shelters Honokōwai Beach from northwest swells but swells from a more northerly direction reach the beach, creating waves along the fringing reef as well as shorebreak waves, rip currents, and strong longshore currents that also carries sand to the south. Direct exposure of the coastline occurs when the occasional Kona storm occurs from the west, with waves entering through the gap between islands.

4.4 Seasonal Swells and Surfing Breaks

The fringing reefs along and just offshore of the western edge of the Project Site create breaking waves that affect the shoreline within theProject Site and constantly reshape Honokōwai Beach. These waves also offer recreational opportunities for patrons who want to ride waves, and thus they are named surfing sites. The northern edge of the fringing reef where it meets deeper waters in the remnant stream channel provides a diagonally breaking wave that rolls in towards shore when a north swell occurs–a surfing break called “Hotels”. In addition, a southern swell will peel in towards Kāʻanapali Beach from the fringing reef fronting the Maui Kai Condominium on the southern side of Honokōwai Point, a surfing break known as “Rainbows”, but also known as “Osterizers”. These waves tend to meet at Honokōwai Point fronting the Maui Kai Condominium, refracting and focusing wave energy to a maximum between the two breaks.

This convergence often causes their crests to merge through constructive interference, close-out on the shallow reef between the breaks, and roll into the boulder revetment where the waves then reflect back into the surf zone. This wave action extends north into the Project Site to the edge of the remnant stream channel fronting the Kāʻanapali Shores building. Thus, the highest point of refraction, or peak of the wave, shifts depending on this convergence from various swell directions, or the focusing of one swell direction along the reef versus another. A north or northwest swell tends to focus at the corner of the channel where the reef front bends south at

"Hotels" while a south swell focuses on the reef that gently curves towards shore on the south side of Honokōwai Point at "Rainbows". Figure 4-1 shows on the right, the location of the surfing breaks "Rainbows" and "Hotels" (in red) offshore of and entering into the present Project Site. The aerial view on the left shows how the surf breaks and Project Site overlap. Although no west swells were observed during any site visits, these infrequent swells would tend to focus at Honokōwai Point in a similar manner as described above, while also providing a good chance of diagonally breaking waves at each respective surfing break, with "rights" at Rainbows and "lefts" at Hotels along the remnant stream channel, as shown in Figure 4-2. Of course, both waves will break both ways from either north or south swells if they are significant in size and wave period.



Figure 4-1 Showing the surfing sites "Rainbows" and "Hotels" (in red) offshore of and entering into the present Project Site. The aerial view on the left shows how the surf breaks and Project Site overlap.



Figure 4-2 Showing "Rainbows" (AKA Osterizers) on the left and "Hotels" surf break on the right. These photos were taken during a small south swell that came through in early June 2024 (top), and a small north swell that came through in September 2024 (bottom).

The fringing reef north of the remnant stream channel also supports breaking waves during these various swell directions, however, they are not of the same quality or caliber of wave as the named surfing sites due to the bathymetry of the fringing reef not supporting a diagonally-breaking wave beyond the northern edge of the remnant stream channel. Because the channel is fairly narrow, large swells tend to close-out across the channel as well, creating a hazardous situation for patrons in the water.

Regardless of swell direction, because the channel is narrow, the shorebreak waves tend to have the most energy within and directly adjacent to the remnant stream channel. Here, wave energy rushes towards shore between the fringing reefs, being refracted but not impeded by shallow waters until it hits the sloping sand berm at the shoreline, rearing up and crashing on the beach. Again, this increased wave energy poses a hazardous situation for patrons in the water, but may offer bodysurfers, bodyboarders, and skim boarders the opportunity to enjoy such activities. The following section goes into more depth about beach and ocean hazards at Honokōwai Beach and the surrounding surfing breaks, and the risks that they pose to patrons who go there.

4.5 Beach and Ocean Hazards in the Project Site

Beach and ocean hazards in and around the Project Site are numerous, including winds, waves, currents, shallow coral reefs, abrupt and irregular bathymetry, seasonally shifting sands on the beachfront, and sometimes steeply sloping sands in the shorebreak. A coral and rocky substrate is often exposed when the seasonally shifting sands migrate away from the Project Site. This substrate poses a risk for injury and damage to equipment. There is also the intermittent presence of rocky terrestrial fill and construction debris along the eroded backshore, with potential for such debris left behind or pulled into the water. All of these hazards pose some measure of risk for unsuspecting beach patrons and ocean enthusiasts.



Figure 4-3 There are many ocean hazards present along Honokōwai Beach, and no lifeguards.

There are no lifeguard towers at the Project Site. The County of Maui, Department of Fire & Public Safety operates lifeguard towers at Hanakoʻo Beach Park (over 2 miles south of the Project Site) and DT Fleming Beach Park (over 4 miles north of the Project Site) in West Maui. Ocean safety officers, or lifeguards, are on duty every day from 8:00 a.m. to 4:45 p.m. (County of Maui, Department of Fire & Public Safety, 2024).

Hazards in the Sand Recovery Site do not necessarily include the same kinds of beach and backshore hazards, but operations in the area will create hazards not normally present for boaters. Winds, currents, swells, marine mammals and other sea creatures may potentially pose a hazard to patrons offshore in this area as well. This section could not possibly list all the hazards present in and around the Project Site and Sand Recover Area, but major hazards are addressed below. Figure 4-3 shows two pictures of a local patron going to the aid of a visitor who fell out of his innertube, which then blew offshore in the wind. The boy struggled to swim to shore, and the local retrieved the tube. The picture to the top right shows snorkelers negotiating a crashing wave in the shorebreak near the channel in front of "Hotels" surf break on a south swell. Bottom left shows a surfboard that a local leaves daily for rescues.

4.5.1 Principles of Ocean Risk Management

The ocean has inherent risks as does every beach. In general, people in the presence of hazards are at some level of risk. A hazard is considered to be something in the environment that people do not have control over. Many hazards exist in an ocean environment from myriad natural and man-made sources, and it is impossible to identify every hazard and eliminate every risk posed to people. However, through a process of identifying hazards and assessing those hazards into risk, people can then put controls in place to eliminate risk where possible, and control residual risks where they exist. These hazards are assessed from the standpoint of how likely they are to occur and what the consequences are for people, equipment, and property if they do occur.

The more hazards that exist in the environment, the higher the risk there is for people in that environment to experience consequences from those risks. Such consequences range from physical injury or death, to cultural, social, legal, and financial consequences, thus negatively impacting people and subsequently, lowering the value of that place. Because risk for people cannot be entirely eliminated in an ocean environment, minimizing risk is considered to have a positive impact on people and thus raises the value of a place. It is in this framework that beach and ocean hazards are identified and assessed in and around the project areas. In no way could this report list every hazard nor every source of danger that exists in and around the project areas, but it is with the goal of identifying major hazards and minimizing risk for beach patrons and ocean recreation enthusiasts that the following risk assessment is undertaken for the present Project Site and Sand Recovery Site.

4.5.2 Winds

Predominant tradewinds blow offshore, often becoming very strong and gusty in the afternoon. This hazard poses risk to patrons not only through the potential of blowing them or their equipment offshore, or perhaps preventing them from returning to shore once they have gone out to sea, but also through causing ocean recreation equipment and other beach items to be blown into the air or down the beach and out to sea. Such hazards could hit an unsuspecting beach patron, causing injury or damage to property. For example, one local interviewed told the author that they witnessed a beach umbrella fly higher than the Maui Kai Condominium, eventually landing in the Kāʻanapali Shores pool after swirling offshore. No one was hurt, but it exemplifies the risks posed by such airborne hazards. All of the hazards relating to wind mentioned above pose some measure of risk for unsuspecting beach patrons, such as the innertube blown offshore.

4.5.3 Waves

Seasonal swells reach Honokōwai Beach through the gaps on either side of Molokai island, providing enough surf for named surfing sites to exist offshore of the Project Site. These surfing sites focus the swells from the southwest and north-northeast, with the largest long-period swells refracting in from the north, southwest, and west. A combination of southwest and northeast swells was observed during the last field study, with the observation that the swells seem to converge on the reef fronting Maui Kai Condominiums and seaward of the present Project Site. The convergence of swell crests caused constructive interference, adding to wave heights and causing even small waves to plunge on to the shallow reef below.

Because the reef borders the remnant stream channel to the north, an abrupt contour exists that focuses this wave refraction, which the author of this report experienced as well on a very small day with wave energy coming in from both directions as described above. Adding to that, the offshore winds and longshore currents are strong enough to require surfers to paddle constantly in order to hold their position in the lineup. As such, the surfing site can be challenging for surfers when these waves converge and break swiftly from the abrupt contours of the reef and adjacent sand channel. An interviewee described how their board was snapped when taking off on a wave that caused them to "pearl dive" into the reef below.

Wave reflection was also experienced by the author while surfing the site. At that time in mid-September 2024, seasonal sands had accreted within the Project Site due to several early north swells that had occurred in August and early September. This sand had a fairly steep beach slope fronting the shorebreak because the previous swell had been significant. Due to this naturally-formed berm, waves would break on the outside reef, move over the reef where the whitewash would dissipate in the slightly deeper waters near shore, then stand up and break suddenly on this steeply sloping sand berm. After washing up the beach, a significant amount of wave energy would reflect and gain momentum as the backwash pushed offshore.

Backwash poses a hazard to surfers by causing an upward thrust as the two waves meet. When riding a wave, such energy can impact a surfer, pushing the surfboard and its rider up into the air and causing a risk of injury to the person or damage to the watercraft upon falling and colliding with their equipment or with the ocean floor. When considering the assessment of mitigation alternatives, it is important to note that backwash already exists and poses a hazard to surfers at present. It can be assumed that such backwash also exists during larger surf events when the wave-runup reaches up to and reflects this stronger wave energy off of the present erosion protection skirt, thus it is a regular hazard for surfers at Honokōwai beach.

4.5.4 Beach hazards, Shoreline Armoring, and other Man-Made Structures

Beach hazards onshore comprise of shifting coral rubble in the surf zone and up on the sands, as well as flotsam-jetsam along the high tide line such as driftwood, shells, fishbones, and even the occasional marine carcass, etc. in the sand, in addition to man-made hazards such as plastic debris, manufactured glass bottles and glass products, ropes and net fragments, and other rubbish washed up from the sea or blown down to the shoreline from land. Other man-made beach hazards are more permanent such as old construction debris, as well as the present infrastructure along the backshore that may be exposed by continued erosion.

At the southern boundary of the Project Site, there is a revetment of large boulders abutting the erosion protection skirt and buttressing the end of the beach, extending out into the shorebreak, then reaching south across Maui Kai Condominiums outside the Project Site. A small drainage

point coming from the hotel causes water to run along the base of the boulders, creating unstable sands and rivulets in the sand between the two properties. In combination with extensive erosion from the 2016 high surf events, seasonal sand movement causes the stairwell leading up to Maui Kai Condominiums to be undermined and at times presents a vertical drop of several feet to the sands below. At high tide the stairwell even leads directly into the surf zone during summer months when the sand migrates north, making it very dangerous for patrons trying to access the southern end of Honokōwai Beach. People often navigate the boulders next to the stairwell attempting to stay dry and get to the sandy portion of the beach, only to confront the ever-changing rivulets of water draining from the terrain above as they step down. As mentioned, storm events transporting sand offshore have cut off the Honokōwai littoral current from the North Kāʻanapali littoral current, impeding beach patrons from accessing the shoreline altogether, and making the stairwell the only access point along the shore there, whereas sand often linked the beaches prior to the 2016 events.

Extending along the backshore, the steeply sloping erosion protection skirt has a slippery surface which is hazardous to people who might attempt to climb up or down from the terrain above. A fence running above the erosion protection skirt along the present sidewalk minimizes this risk by discouraging people from accessing along the erosion protection skirt, but nonetheless, it exists as a hazard along the backshore there. Erosion just past the northern corner of the erosion protection skirt where the public access exists has caused the terrain to become unstable at the interface of the beach, making it challenging for patrons to ingress and egress from the grass and concrete pathway above the sands. At present the beach itself is not handicap accessible, and the worn path and uneven slope down to the beach presents a danger from slipping on loose sand or miscalculating a step and falling for any beach patron attempting to reach the beach, handicapped or not.

4.5.5 Marine flora and fauna

Marine flora and fauna attract visitors to Honokōwai, but they may pose a risk to people who visit the beach and ocean waters. Beyond coral that might cause lacerations and seaweeds washing in that could cause skin irritations, the occasional Portuguese Man-O-War (Physalia physalis) has the potential to wash in when the winds turn sideshore or onshore, and box jellyfish (Carybdea alata) could be a concern during extended periods of calm wind and ocean conditions and aligned with the waning crescent moon. Both types of jellyfish have toxins creating the potential for a person to get stung, and at worse, have an anaphylactic reaction to the sting. Many sea creatures frequent the shoreline and nearshore waters, with the remnant stream channel giving easy access for larger sea creatures and marine mammals as well. NOAA urges members of the public to observe marine animals from a safe and respectful distance, and do not approach or touch them, and do not disturb their normal behavior, especially protected species, including federally listed threatened and endangered species. Various hazards are posed by marine mammals and their interactions with humans; thus, they pose a risk to patrons who visit Honokōwai Beach or the Sand Recovery Site offshore of Puʻu Kekaʻa. The site visits were not conducted during whale season, so none were observed.

During the site visits to Honokōwai sea creatures were observed, including a pair of eagle rays (Aetobatus narinari), a large barracuda (Sphyraena barracuda) estimated to be four-feet long, as well as many green sea turtles (Chelonia mydas), and at least two different monk seals (Neomonachus schauinslandi), both of whom came ashore at different times. One rested on the sands and the other swam a half mile north to the sands fronting Honokōwai Beach Park. The barracuda and monk seals all used the remnant stream channel to enter the nearshore waters, then moved along the shoreline inside the reef, as shown in Figure 4-4. A very large pod of spinner dolphins also swam by from north to south–dozens of them (Stenella longirostris), moving along

the waters from just outside the fringing reef break about 300 feet offshore, to at least 1,000 feet offshore along the same trajectory as several commercial catamarans and a 6-person paddling canoe had traversed in prior observations. Although no sharks were witnessed during the field survey, there have been at least 65 shark attacks on Maui since 1995, with 11 of them occurring in the vicinity of the Project Site between Kahana and Kāʻanapali during that period of time.



Figure 4-4 shows a barracuda and a turtle swimming very close to shore, as did this monk seal prior to coming ashore within the Project Site at Honokōwai Beach.

Again, it is with the goal of identifying major hazards and minimizing risk for beach patrons and ocean recreation enthusiasts that this risk assessment is presented, and by no means is this a complete list of hazards, associated risks, or consequences with regards to the safety of people and property within the present Project Site. This same framework will be utilized to identify beach and ocean hazards in and around the Project Site when each alternative action is considered for this project, presented in Section 7 of this report. The next section considers mitigation measures related to the hazards discussed in this section.

4.6 Mitigating Environmental Hazards to Control Risk

4.6.1 Extreme Weather Events

Extreme weather such as strong Kona (southerly) storms, hurricanes, tsunami, and extreme water level changes may result in the loss of some or all of the placed sand in a short period of time for the Beach Nourishment and Beach Maintenance alternatives. A beach restoration project such as this should be viewed as a maintenance activity that may require ongoing work and future restoration projects. The frequency of such work depends on the alternative chosen for beach restoration at Honokōwai, with Beach Stabilization being the most likely to achieve the long-term objective of this project with the least likelihood of multiple operations. If severe weather or surf occurs during operational activities, construction equipment, vehicles, and vessels should be demobilized to a protected area until the severe weather conditions subside. These precautions are detailed in the BMP report under “Severe Weather Conditions Readiness”.

4.6.2 Sand Grain Size

Sand will be recovered from the Sand Recovery Site, an 8.5-acre sand deposit located offshore of Puʻu Kekaʻa in 115 to 131-foot water depth. The proposed sand recovery plan limits dredging depths to about six feet below the existing sand surface. This upper section of the sand deposit is the portion that SE tested for sand quality, including grain size, distribution, sediment characteristics, and color. In summary, the samples tested consistently met the current DLNR guidelines for beach restoration. Ensuring the compatibility of sand being utilized to replenish the beach is important for this project because matching the sand type gives the greatest chance for

success in stabilizing the beach for a longer period of time, barring extreme weather and surf events that would transport sand offshore regardless of such efforts.

Placing incompatible sand might undermine the efforts to stabilize the beach because if the sand grains are too small, they are easily churned up by regular surf and high tide events, creating increased turbidity and getting caught in the longshore currents that would transport it away from the Project Site. Large surf pulls sand offshore, so if the sand grains are too large, one surf event could transport an increased amount of placed sand offshore that would be too heavy to return to the beach seasonally, especially due to the offshore winds and infrequency of seasonal wave energy that keeps sand in the littoral current and which would normally push compatible sand back to the beach.

In relation to the beach restoration alternatives under consideration, Beach Nourishment is likely to be more effective if compatible sand grains are used, potentially allowing beach and ocean recreation activities to more likely continue at normal levels for a longer period. Beach Maintenance activities might occur less frequently if compatible sand grains are used, thus avoiding more frequent inconveniences for beach patrons and ocean recreation enthusiasts due to a longer duration of time between beach maintenance activities that impede access to the area. Beach Stabilization efforts might last longer as the beach has the best chance of returning to seasonal norms by using sand adaptable to the natural environment there.

4.6.3 Coral Rubble

Coral rubble is defined as coral fragments up to 1 inch in diameter. SE's tests of potential sand recovery sites for the project determined that the Sand Recovery Site, while not completely free of coral rubble, has a comparatively low volume of it. One of the disadvantages of clamshell dredging is that there is no method to screen coral rubble from the recovered sand at the dredge site. The contractor, therefore, will monitor the sand as it is placed on the barge. If excessive coral rubble appears, sand recovery operations will be moved to another location within the Sand Recovery Site. While screening sand as it is offloaded at the harbor is possible, it would substantially extend the duration of the project.

Careful inspection of the sand as it is being recovered is, therefore, considered the most effective way to minimize coral rubble content. In summary, some coral rubble may be found in the sand placed onshore. Coral rubble impacts beachgoers and ocean recreation enthusiasts negatively because it makes it more difficult to walk easily or find a suitable place to lay on the beach, it increases the potential for lacerations and other foot injuries when walking the beach, and there is a high probability that any ocean recreation equipment such as a finely polished surfboard or one-person canoe could be scratched or damaged by coral rubble in the sand and along the shore.

4.6.4 Beach Slope

Beach slope, the angle of the beach, is measured by using a gradient of height to length, such as one foot of height for eight feet of length, 1:8. SE determined beach slopes for the entire length of the Honokōwai Beach and will ensure that the contractor matches them as closely as possible during the sand placement and grading operations. SE noted in its latest Coastal Engineering Assessment report that based on previous projects in Hawai‘i, there is evidence that the introduced slopes match the existing slopes in a short period of exposure to the natural elements. Thus, the slope of the placed sand will closely follow the natural slope of the beach. A beach slope that matches the existing natural slope of the beach will allow beach and ocean recreation activities to ensue at normal levels while also preserving the longevity of the coastline through normal beach processes like absorbing wave energy, a function of the natural beach slope in any given area.

Too steep a beach slope might cause increased wave reflection, negatively affecting activities such as wave riding at the surfing sites just offshore of the Project Site. A beach slope steeper than normal might also accelerate sand loss, and a steeply sloping beach makes for a hazardous plunging wave at the shorebreak. On the other hand, if the beach slope is too gentle, wave action may cut a scarp into the sand berm along the shoreline as environmental processes attempt to restore the natural slope of the beach. A wave-cut bank such as this would create a falling hazard for beachgoers because of the sudden drop-off in the shoreline that is unstable to walk along or transit across when accessing the ocean or beach. Any vertical embankment at the ocean's edge may also cause accelerated erosion as wave reflection then pushes the placed sand offshore.

4.7 Safety Considerations

4.7.1 Emergency Action Plan

An Emergency Action Plan (EAP) should be developed for the Hō‘ala Honokōwai Beach Restoration Project. The EAP should address risk assessment concerns in the Project Site and determine risk management recommendations to address them. The EAP, which should include a project notification list with contact information, should be distributed to everyone involved in the project, including the contractors conducting the onsite operations and their personnel. SE has indicated that an EAP will be included in the Best Management Practices Plan for this project.

4.7.2 Hurricanes and Tsunami

The Central Pacific Hurricane Center in Honolulu defines the annual Central Pacific hurricane season in Hawai‘i as June 1 to November 30. Tsunamis may occur at any time of year. In the event that either a hurricane or tsunami warning should occur, provisions should be made to relocate the dredge barge and support vessels offshore to deeper water. In the event that the dredge barge should be dislodged, resulting in it becoming a hazard to navigation or washing ashore and becoming a hazard to beach users, provisions should be made for recovery operations.

4.7.3 Navigation

The dredge barge is an anchored platform. HAR section 13-256-109 Kaanapali Commercial Thrill Craft Areas (far south of the Project Site) addresses anchored platforms in a way that might be considered as similar to the anchored barge. Although the regulation does not apply to the barge utilized for project operations, it should be considered as a best practice. It reads as follows: "All supporting rafts or platforms shall display an anchor light at night." With this regulation in mind, the barges should display appropriate lighting while at anchor and while navigating.

Many of the catamarans and monohulls that conduct commercial tours at Kā‘anapali Beach offer sunset cruises that proceed north past the Sand Recovery Site. Although most of them return to the beach before the sun sets, sometimes they return after dark, such as during the winter months. Anchor lights are for their safety and for the safety of other vessels operating at night. Anchor lines for the dredge barge will be in place for the duration of the sand recovery operation. Floating anchor lines at the site should also be marked with floats. SE has indicated that the Contractor will issue a Notice to Mariners about operational activities. A safety support vessel will also monitor dredging operations during active work hours to ensure vessels stay away.

4.7.4 Off-Hours

When the dredge barge is not in use and unoccupied, individuals on various types of watercraft may or may not attempt to board them, especially at night. Some type of security watch might be considered. The same goes for equipment left overnight at the Project Site, Some type of security

watch should be considered. Perhaps alerting security staff members at the various hotels when operations have ceased or posting overnight security would keep patrons from entering the site.

4.7.5 Weather and Ocean Conditions

Weather and ocean conditions that would preclude operations at the Project Site and at the dredge barge should be identified. These conditions would include high surf and high winds. Many of the catamarans and monohulls that conduct commercial tours at Kāʻanapali Beach have established their own tour cancellation guidelines, such as when a high surf warning is in effect for the Kāʻanapali coast, which would preclude beach landings, or when trade winds are in excess of 28 knots. SE has indicated that there will be a BMP plan that will include specifications for "Severe Weather Conditions of Readiness." For example, if the severity of the weather condition dictates, then large equipment (e.g., barge) will be demobilized to a protected area until weather conditions improve.

4.7.6 Beach Patron Safety

Adequate signage and barricades such as fencing should be used to ensure patron safety when accessing and recreating at Honokōwai Beach. Wherever possible, a 100-foot-wide no-entry safety zone should be implemented during construction activities, marked by buoys offshore, and barricades along the shoreline, while sand placement activities are taking place.

4.7.7 Medical Emergencies

Medical emergencies may occur anywhere in the Project Site at any time. The EAP should address how they would be reported and who would be notified. For emergencies that occur onshore, the EAP should identify the nearest sites for emergency vehicle access to the offloading and sand placement locations, such as the public access corridor north of Kāʻanapali Beach Club, or the Maui Kai Condominium access point. The lifeguards are equipped with power rescue watercraft and could assist with an ocean emergency or extrication at the Sand Recovery Site or at Honokōwai Beach, if called. For emergencies that occur offshore, the EAP should designate a safe place for an emergency vessel such as a professional rescue watercraft to dock and load any person needing assistance, and identify a shoreline location with adequate access for emergency response vehicles to receive the victim being brought ashore, whether that happens with an emergency vessel, or one associated with the Contractor or person. This information would support first responders in achieving a more rapid response time in rendering aid to the victim, which would increase the chances for survival. If high surf precludes a beach landing, an alternate site, such as Hanakaʻōʻō Beach Park for the dredging area should be designated. The beach park is the nearest site to the Project Site that has a county lifeguard on duty during the day and can accommodate emergency response vehicles.

5.0 COASTAL AND MARINE USES

5.1 Regulatory and Management Frameworks

Coastal and marine uses of Honokōwai Beach and its nearshore waters are regulated by the State of Hawaii's Department of Land and Natural Resources (DLNR) administrative rules. Uncertified copies of the rules are found online. Certified copies may be obtained from DLNR. Paragraphs cited in this report refer to the administrative rules identified in sections a, b, and c that follow, and section d refers to the Ocean Recreation Management Area (ORMA) rules fronting the Project Site:

5.1.1 Commercial Activities

Hawaii Administrative Rules Title 13, Department of Land and Natural Resources Subtitle 11, Ocean Recreation and Coastal Areas Part III, Ocean Waters, Navigable Streams and Beaches, Chapter 251, Commercial Activities On State Ocean Waters, Navigable Streams, and Beaches, Subchapters 1- 8.

5.1.2 Mooring Areas

Hawaii Administrative Rules Title 13, Department of Land and Natural Resources Subtitle 11, Ocean Recreation and Coastal Areas Part I, Small Boat Harbors, Chapter 235, Offshore Mooring Rules and Areas. Subchapter 3, Paragraph 13-235-65 Kaanapali mooring zones.

5.1.3 Ocean Recreation Management Areas

Hawaii Administrative Rules Title 13, Department of Land and Natural Resources Subtitle 11, Ocean Recreation and Coastal Areas Part III, Ocean Waters, Navigable Streams and Beaches, Chapter 256 Ocean Recreation Management Rules and Areas. Subchapter 7 West Maui Ocean Recreation Management Areas.

5.1.3.1 Designated Ocean Recreation Management Areas

Designated Ocean Recreation Management Areas (ORMAs) are established to (1) provide for increased public access; (2) reduce user conflicts; (3) promote overall public safety; and (4) avoid possible adverse impacts on humpback whales or other protected marine life (13-256-16). The designated areas also are established to control certain commercial activities to specifically designated locations and time periods as well as place limits on equipment types. Both recreational and commercial vessels may use designated areas when the permitted activity is not taking place and may cross the area at all times with caution. There are specifically designated zones assigned to qualified permittees within each ORMA. For example, commercial thrill craft may only operate in a specifically assigned location with not more than six craft in an area measuring 400 feet in diameter.

5.1.3.2 Non-designated Ocean Recreation Management Areas

Non-designated Ocean Recreation Management Areas prohibit the commercial use of controlled ocean sports. In these areas off the islands of Kauai, Oahu, Maui, and Hawaii, recreational (i.e., non-commercial) thrill craft may operate in State waters only from 500 feet from the shore line (or outer edge of a fringing reef) to two miles offshore. There are no ingress/egress corridors established in non-designated Ocean Recreation Management Areas. Thus, motorized commercial vessels may not land and/or pick up passengers in these locations.

5.1.4 Designated West Maui Ocean Recreation Management Area

The project areas are within the Designated West Maui Ocean Recreation Management Area, which allows both recreational and commercial activities that are not specifically assigned to a commercial zone. For instance, the assigned areas designated for commercial thrill craft, water sledding, parasailing activities, and mooring areas in Kāʻanapali are located south of the Project Site. However, as shown in Figure 5-1, the Sand Recovery Site is within the assigned area for commercial water sledding and parasailing off Puʻu Kekaʻa. There are no restricted areas within the Designated ORMA fronting the Project Site location at Honokōwai Beach, thus, it is open for both commercial and recreational activities as described in the sections named above in Section 2.1.c. of this report that cites Ocean Recreation Management Areas. The following paragraphs identify coastal and marine uses occurring in the West Maui ORMA, with descriptions of activities in relation to both the Project Site as well as the Sand Recovery Site.



Figure 5-1 Showing West Maui Designated ORMA, overlaying the Sand Wave Deposit on right.

5.1.5 Maui Humpback Whale Protected Waters

Both the Project Site and the Sand Recovery Site lie within the boundaries of the Maui Humpback Whale Protected Waters zone. Between December 15 and May 15 of the following year during the whale season, no person shall operate a thrill craft, or engage in parasailing, water sledding or commercial high-speed boating, or operate a motor vessel towing a person engaged in water sledding or parasailing within this area. All people and vessels must keep a minimum of 100 yards distance away from any whale, as defined by federal rules regarding marine mammals put forth by NOAA Fisheries and echoed by DLNR. Other marine mammals such as the leatherback and green sea turtles, Hawaiian monk seals, and dolphins are protected, and some are considered endangered species as well. The public is prohibited from harassing, harming, pursuing, wounding, killing, capturing, or collecting marine species protected by the Endangered Species Act and Marine Mammal Protection Act.

5.1.6 Kahekili Herbivore Fisheries Management Area

The Project Site is within the Kahekili Herbivore Fisheries Management Area, also regulated by the State of Hawaii's Department of Land and Natural Resources (DLNR) administrative rules, HAR chapter 13-60.7. This management area extends north from the highwater mark of the shoreline on Honokaʻōʻō beach at the southern edge of Puʻu Kekaʻa all the way to the southern edge of Honokōwai Beach Park and offshore for a distance of 1,292 yards. It appears that the Sand Wave deposit is located about 800 ft. offshore of the western boundary of the Kahekili Herbivore Fisheries Management Area, in alignment with the southernmost boundary at Puʻu Kekaʻa. The Sand Wave deposit extends north of Puʻu kekaʻa, but it appears to be situated just offshore of this special Management Area. It is permitted to fish for, injure, kill, possess, or remove any finfish or invertebrate, except prohibited species indicated below. It is also permitted to use bait or other attractants while fishing for permitted marine life. It is prohibited to injure, kill, possess, or remove any rudderfish (nenue), parrotfish (uhu) or surgeonfish. To injure, kill, possess, or remove any sea urchin is also prohibited. In addition, it is prohibited to feed or deliberately introduce any attractant, directly to or in the vicinity of any marine life, except while fishing for permitted marine life.

5.2 Aggregated Ocean Recreation Incident Data

5.2.1 Drownings

The Hawai‘i Injury Prevention Plan 2018-2023 states that drowning is the 5th leading cause of fatal injuries among Hawai‘i residents, with an average of nearly 40 deaths a year. The Hawaii Department of Health (DOH) reports that a total of 62 fatal ocean drownings occurred in Maui County between 2007 and 2011. About three-quarters of the ocean drowning victims on Maui County were non-residents. There were 16 drownings (including 15 non-residents) from Kā‘anapali Beach to Hanaka‘ō‘ō Beach Park. Another DOH aggregate shows that between 2005 and 2014 there were 34 drownings in Kā‘anapali, with 15 of them occurring in the vicinity of Pu‘u Keka‘a. More recent data from DOH shows that between 2009 and 2018, there were 193 drownings in Maui County, as well as 96 spinal cord injuries. Of those drownings, at least 24 happened in the vicinity of Pu‘u Keka‘a. Snorkeling and swimming had the highest activity rates resulting in fatal drownings, but other activities that resulted in a fatal drowning included surfing, bodyboarding, free diving, falling or being swept into the water, scuba diving, boating and kayaking, picking ‘opihi, and fishing from shore. With regards to snorkeling, if non-fatal incidents were included, there were a total of 298 incidents in Maui County, with a total of 45 incidents occurring along the Kā‘anapali coast surrounding Pu‘u Keka‘a. Section 5.2.2 highlights Hawai‘i drowning and spinal injury facts.

Since then, specific data is hard to come by, but at least five fatal drownings have occurred in Kā‘anapali, including two at Kā‘anapali Beach, two at Pu‘u Keka‘a, one at Honokōwai Beach Park, and one fatal drowning at Honokōwai Point potentially in or near the present Project Site. This victim was swimming at the time of the incident, though no other information was provided. Former Maui Fire Department battalion chief of ocean safety Colin Yamamoto is quoted as saying “By far, [Pu‘u Keka‘a is] the No. 1 drowning capital in Hawaii,” in an interview with SFGate.com (2017, December 11). With this data in mind, employing drowning prevention strategies are critical to the success of any coastal restoration project, from engineering erosion control structures properly to minimize the hazard of drowning, to the placement of signage and rescue tubes along the beach for education and to aid in public assistance.

5.2.2 Spinal Cord Injuries

Data from DOH shows that between 2009 and 2018, there were 96 spinal cord injuries. Twenty of the spinal cord injuries happened along Kā‘anapali Beach, resulting from being struck by a wave, or while bodyboarding, bodysurfing, surfing, or diving in the water. Again, employing spinal cord injury prevention education measures and implementing design strategies to reduce the potential for spinal cord injuries should be considered when weighing the alternative actions for this project. The more gentle the slope and contour of a shoreline, the more gentle the waves break.

5.2.3 Hawai‘i Drowning & Spinal Cord Injury Facts

Figure 5-2 shows Hawaii drowning and spinal cord injury facts as presented by the Hawai‘i Department of Health. All of the activities presented in this report are listed as having been a cause of drowning or spinal injury, with Kā‘anapali Beach listed as the third in the top ten beaches where spinal injuries occur in the State. Because Honokōwai is zoned as a hotel district that attracts and provides accommodations for visitors, it is worth noting that visitors (non-Hawai‘i residents) represent 55% of all drownings and 81% of all spinal injury incidents. The Hawai‘i Department of Health is committed to understanding the causes of drowning and ocean injuries, as shown in the above fact sheets. The aggregated data presented here is important to this project in highlighting the importance of choosing an alternative and designing beach replenishment in a way that is safe for all the people who frequent Honokōwai Beach.

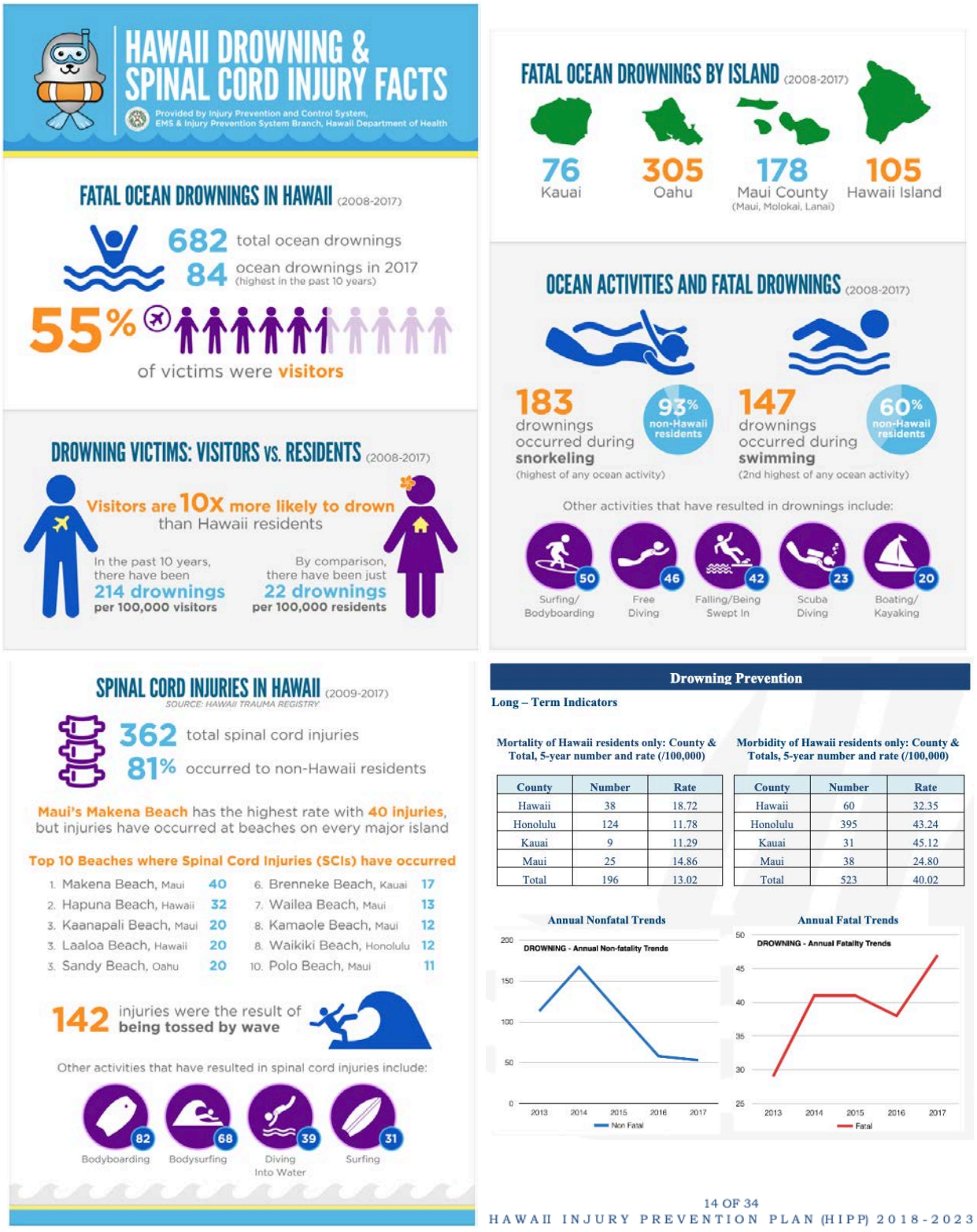


Figure 5-2 The State Department of Health shares data about drownings and spinal cord injury to raise awareness about the dangers of coastal and marine use activities that are promoted as part of Hawai‘i’s appeal as a vacation destination. That said, Hawai‘i residents are also at risk from these same hazards, especially considering the number of new residents from other places that are making Hawai‘i their home.

5.2.4 Shark Attacks

As mentioned, there have been at least 65 shark attacks on Maui since 1995, with 11 of them occurring in the vicinity of the Project Site between Kahana and Kā‘anapali during that period of time. All of those attacks happened within 100 yards of the shoreline, with two of them resulting in a fatality–including one at Honokōwai Point, potentially in or along the edge of the Project Site. Seven of these shark attacks were noted to have occurred in turbid waters. Four of the shark attacks happened before 9:00 a.m., six of them happened midday between 10:00 a.m. and 4:00 p.m., and one attack happened in the evening around 6:00 p.m.. Five people were swimming at the time they were attacked, three people were surfing, two people were snorkeling, and one person was wading in the shallow waters near the shoreline. Although it is unlikely that shark attacks can be mitigated directly through project operations or its outcome, strategies to minimize encounters with sharks can be employed. Turbid waters were cited in many instances of shark attacks on Maui, including a majority of the attacks near the present Project Site. Thus, efforts to minimize turbidity should be employed in the operational activities for this project regarding the goal of minimizing encounters with sharks during construction, if any such alternatives are chosen. The highest projected turbidity levels are associated with the No Action Alternative, which should also be acknowledged when considering the other project alternatives in relation to patron safety. Educational signage is another strategy to warn patrons about the presence of sharks and how to minimize shark encounters through making good choices about when to engage with ocean recreation activities. Admittedly, though sharks are known to be more active in the mornings and evenings, half of the attacks occurred from mid-morning to mid-afternoon. Regardless, educating the public on shark behavior and what attracts sharks becomes an important strategy for any entity along the coast with a responsibility towards patron safety.

5.3 Ocean Recreation Activities

This Coastal and Marine Uses Report completed for the Project Site and Sand Recovery Site identifies existing recreational uses of the Project Site and nearshore waters through a survey and site visits. Honokōwai Beach, including the nearshore and offshore waters, and the Sand Recovery Site support a variety of shoreline and ocean-based recreational activities, listed and described below. It is important to recognize that there are many coastal and ocean recreation activities that exist, and the list that follows only represents major ocean recreation activities engaged in by visitors and locals alike; there is a potential for patrons to enjoy other ocean activities not mentioned here.

5.3.1 Sunbathing, Beach Walking, Ocean Wading, Beachcombing, & Gathering

Sunbathing takes place along the entire length of Honokōwai Beach. Families enjoy walking, wading, and beachcombing on Honokōwai Beach, as shown in Figure 5-3. Many beachgoers walk along the 1,000 feet of sandy shoreline. Seasonal sand migration and erosion impacts beach walking and wading when the rocky seafloor substrate is exposed. Longshore currents tend to run towards the remnant stream channel where they turn offshore, creating a strong rip current that is a safety hazard for unsuspecting patrons who wade into the deeper channel waters and risk getting swept off their feet and taken offshore. Several rescues of this type were noted by local patrons who responded to the survey.

No traditional gathering activities, such as picking ‘opihi (edible limpets) or harvesting limu (seaweed), were seen to take place during the field site visits. However, a few ‘opihi were observed on the breakwall fronting the Maui Kai Condominium south of the Project Site, and various types of limu were observed along the shoreline and in the shallow waters along Honokōwai Beach. As such, there is a high potential that gathering still occurs within and surrounding the Project Site. Several years prior to this project, a local family living in Honokōwai north of the Project Site had told the author of this report that their family had grown

up gathering resources along the beach in a traditional Hawaiian manner, but that it became difficult to continue practicing traditional gathering activities along the shore because of the development that has occurred there over the past several decades and the loss of sand had made it worse. Because the Sand Recovery Site is approximately 1,850 feet offshore of the beach adjacent to Puʻu Kekaʻa, no beach or shoreline gathering activities occur out there.



Figure 5-3 Families enjoy walking, wading, and beachcombing on Honokōwai Beach.

5.3.2 Swimming

Figure 5-4 highlights how swimming tends to be concentrated near the public access and in the remnant stream channel offshore of the Project Site. The shoreline is bordered by a shallow reef shelf, while the remnant stream channel has a mostly sandy seafloor. The sand bottom here is more attractive to swimmers who wade in and out of the water with bare feet. Although the Sand Recovery Site is over half a mile offshore, approximately 1,850 feet from the beach adjacent to Puʻu Kekaʻa, there is potential for swimmers to swim offshore and into this area. Swimmers and divers who go offshore more than 200 feet are required to have a dive buoy for visibility. Swimmers who make it out that far are at risk of being caught up in wind or sea-borne currents, or at risk of injury from a collision with boaters passing by. There is also the potential for an encounter with marine life that might pose a threat to an unsuspecting swimmer, such as sharks.

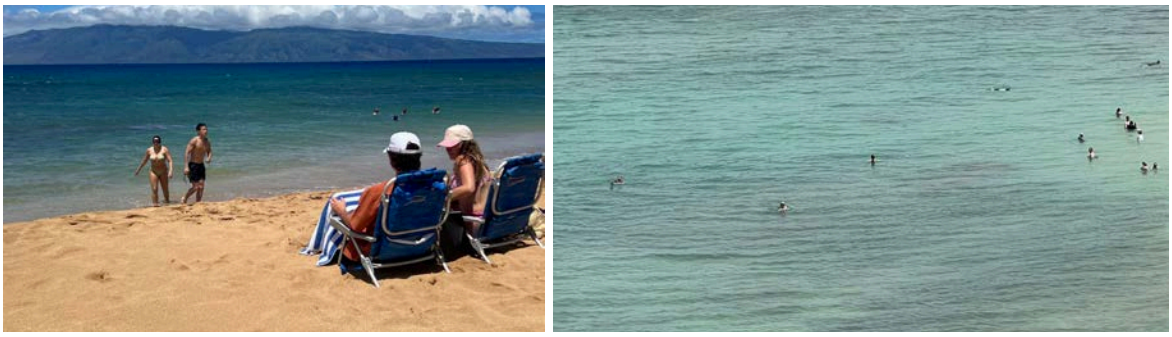


Figure 5-4 A couple gets out of the water after enjoying a swim (left), and many patrons enjoy swimming and snorkeling in and around the remnant stream channel (right).

5.3.3 Bodyboarding and Bodysurfing

The sandy bottom within the remnant stream channel and along the shoreline south of the channel provides an opportunity for bodysurfing and bodyboarding in the shorebreak, whereas the exposed reef shelf north of the channel inhibits such activities due to the potential for lacerations from the ocean floor. Bodyboarding also occurs in the breakers just offshore of the Project Site, though the shallow waters and reef shelf at the surf break are not favorable for bodysurfing. Although no bodyboarding or bodysurfing was observed during the site visits, several families had bodyboards on the beach with them, and the author of this report did enjoy bodysurfing a few

waves while on site at the beach. The rides were enjoyable, rolling in from “Hotels” surf break. As seen in Figure 4-3, the shorebreak boasts a short but fun ride up onto the beach. Because the Sand Recovery Site is approximately 1,850 feet offshore of the beach adjacent to Puʻu Kekaʻa, the water is generally too deep to cause waves to break there, so no bodysurfing or bodyboarding occurs there, only at the Project site in Honokōwai Beach and along Kāʻanapali Beach.

5.3.4 Skimboarding

The sandy shoreline fronting the remnant stream channel is also utilized for skimboarding activities. Skimboarding was observed taking place in the Project Site, along the shoreline fronting Kāʻanapali Beach Club. Seasonal sand migration as well as continued erosion inhibits skimboarding activities when the rocky seafloor substrate is exposed. Because the Sand Recovery Site is approximately 1,850 feet offshore of the beach adjacent to Puʻu Kekaʻa, no skimboarding occurs there, which requires a very thin sheet of water over a sandy beach to support the gliding board. In Figure 5-5, a skimboarder glides across the sand fronting the stream channel.

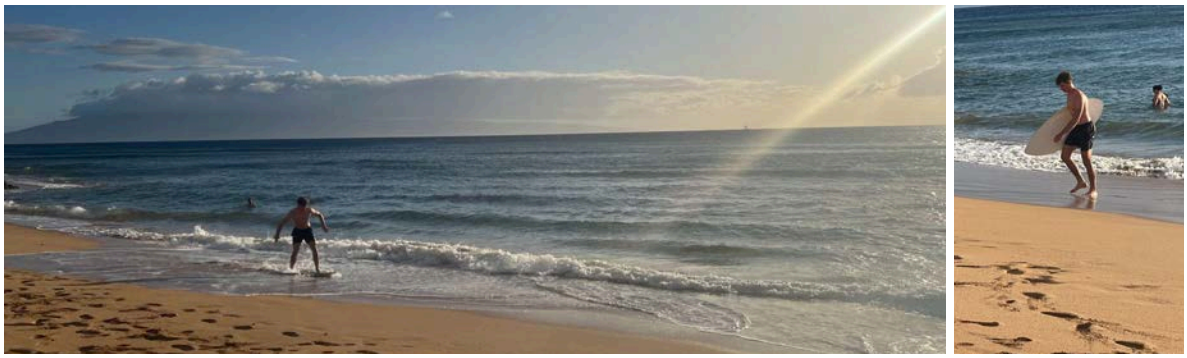


Figure 5-5 A skimboarder glides across the sand fronting the stream channel at Honokōwai Beach.

5.3.5 Snorkeling, Free Diving, and Scuba Diving

With generally good visibility and depths to 15 feet in the channel, there is a wide variety of sea life, including fish, turtles, sting rays, and crustaceans in and around the Project Site that attract snorkelers, free divers, and scuba divers. Live coral exists offshore about 450 to 600 feet offshore as well. Recreational snorkelers were observed in and around the Project Site. Freediving and spearfishing, including night diving, by individual free divers and scuba divers also occurs along the fringing reef within the Project Site and beyond. Divers access the area from the shoreline through the remnant stream channel at Honokōwai Beach, or from Kāʻanapali Beach, or by boat when accessing offshore areas. As seen in Figure 5-6, spear fishermen were observed freediving during two different site visits, both entering from North Kāʻanapali Beach and heading north, then returning to shore south of the point once again, while the other landed in the Project Site.

Taking advantage of the clear waters and remnant stream channel on Honokōwai Beach, the storefronts along Honoapiʻilani Highway have commercial shops and the hotel properties have beach concessions that offer snorkeling equipment rentals and sales, introductory snorkeling lessons, and introductory scuba lessons. Commercial operators from remote storefronts utilize the public beach access corridors between hotels to gain ocean access where they instruct on ocean recreation activities in and around the remnant stream channel in the Project Site. Other operations occur along Kāʻanapali Beach, although Kahekili Beach and Puʻu Kekaʻa are more well-known as diving sites.

Although the Sand Recovery Site is approximately 1,850 feet offshore of the beach adjacent to Puʻu Kekaʻa, there is potential for snorkelers or divers to access by boat or swim offshore and

into this area. Snorkelers and divers who go offshore more than 200 feet are required to have a dive buoy for visibility. Divers who make their way out that far or even come by boat are at risk for being caught up in wind or sea-borne currents, or at risk of injury by boaters passing by, as well as the potential for an encounter with marine life that might pose a threat to an unsuspecting snorkeler or diver such as sharks. Other risks relating to fatigue and equipment also exist.



Figure 5-6 Snorkelers clean their masks in preparation for an adventure, and spear fishermen swim along the reef with a dive buoy, required when diving over 200 feet offshore.

5.3.6 Boating

In general, commercial vessels charge a fee to take people diving or whale watching. Recreational vessels are usually smaller. Although there is no recreational launch site for boats within the Project Site, nor do commercial catamarans and monohull boats operate out of Honokōwai Beach, they transit the waters just offshore of the fringing reef within the Designated ORMA, as observed during site visits. A recreational operator with a small vessel could potentially come near or into Project Site waters through the remnant stream channel at Honokōwai Beach, though it would be quite dangerous due to the shallow coral reef on either side of the channel. It may not be accessible during a swell episode, especially if the waves are big and closing out across the channel. At least one beach concession north of Puʻu Kekaʻa advertises catamaran rides. Many of these commercial vessels originate from the Kāʻanapali mooring areas south of Hanakaʻōʻō Point, and recreational boaters utilize nearby boat ramps and harbor entrances.

In addition to the storefronts and beach concessions that offer ocean recreation equipment and lessons, a number of commercial catamarans and monohull boats seen in Figure 5-8 operate from the Kāʻanapali mooring zone off Hanakaʻōʻō Point offer snorkeling and scuba diving lessons, but not at Kāʻanapali Beach or outside of Puʻu Kekaʻa. Commercial boats use other destinations for their tours, such as Honolua Bay and Olowalu. However, they pick up their passengers from Kāʻanapali Beach, south of the Project Site but in the vicinity of the Sand Recovery Site. Catamarans land directly on Kāʻanapali Beach using ingress/egress lanes designated by DLNR, while the monohull vessels use smaller boats, such as motorized inflatable crafts, to pick up and return their passengers in the designated lanes. This activity is addressed in HAR section 13-251-76 as follows: The maximum number of Kāʻanapali commercial permits that may be issued for monohull vessels to embark and disembark passengers at Kāʻanapali Beach shall not be greater than five, but small craft used to shuttle passengers to and from a monohull vessel in the Kāʻanapali ocean waters may be included under that vessel's commercial activity permit.

Commercial vessels have a fair probability of passing through the Sand Recovery Site, especially if they pick up passengers at Kāʻanapali Beach or run commercial parasailing or water sledding operations. Recreational boaters transiting or participating in offshore ocean recreation activities

may also enter or pass through the Sand Recovery Site as well, in addition to the Project Site at Honokōwai Beach. The US Coast Guard tracks vessel traffic, as seen below in Figure 5-7. There are consistent transit routes (yellow color) going up the coast from Lahaina towards Honolua Bay, especially in the areas just offshore of Puʻu Kekaʻa and Honokōwai, most likely for whale watching and other recreational activities within the West Maui Designated ORMA.

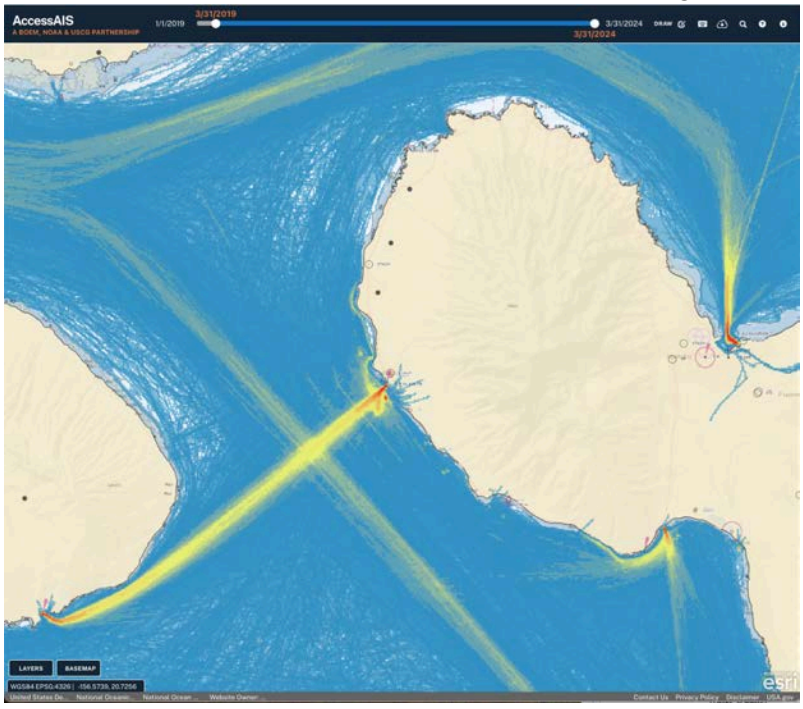


Figure 5-7 shows vessel transit routes and traffic density in Kāʻanapali, as recorded by the US Coast Guard. The yellow and red colors show frequent traffic over the years from April 2019 to April 2024.



Figure 5-8 Commercial catamaran charter boats regularly pass by the Project Site just offshore of the fringing reef. Most originate from the Kāʻanapali mooring site just inside the Sand Recovery Site.

5.3.7 Prone Paddleboarding, Standup Paddle Boarding, and Kayaking

Several beach concessions along the Honokōwai beachfront rent standup paddle boards (SUPs) and offer lessons. A few concessions also rent ocean kayaks and offer kayak tours along the beach and fringing reefs outside of the Project Site. Paddlers in both activities access into and transit to the nearshore waters of the Project Site, accessing the area from both Honokōwai Beach

as well as North Kāʻanapali Beach. Standup Paddleboarders were observed paddling around Honokōwai Point during the site visits, as seen below in Figure 5-9. A kayaker was seen entering and then exiting the water at North Kāʻanapali Beach after paddling north of the point. Several kayaks were seen on the beach at the southern edge of Maui Kai Condominiums, possibly owned by residents of that complex, or made available to visitors who stay there.



Figure 5-9 One standup paddleboarder peers into the calm waters off Honokōwai Point while another patron paddles on their knees as they attempt to catch a wave at "Hotels" surf break.

5.3.8 Surfing

The most popular surf spots along Honokōwai Beach are located off of Honokōwai Point–"Rainbows" (also known as Osterizers) skirts the southern boundary of the Project Site, and "Hotels" is just to the north of that, rolling into the Project Site along the remnant stream channel. It is the most consistent spot and offers the longest rides, which are preferable conditions for beginners and other surfers. Although surf may be somewhat inconsistent throughout the year, it breaks best during the winter months. That said, a surfer was observed at this break during a south swell that came up in June. Another potential surfing break was identified on the reef offshore to the north of the remnant stream channel, but is not the preferred surfing site due to its uneven breakers. Still, at least one respondent shared stories about surfing this site. This surfing site also rolls into the Project Site, but it remains unnamed and considered to be part of the "Hotels" break area.

Surfboard rentals and surfing lessons are offered by a number of hotels through beach concession stands on Honokōwai Beach and Kāʻanapali Beach north of Puʻu Kekaʻa. In addition to the beach concessions, several commercial operators along Honoapiʻilani Highway offer surfboard rentals and surfing lessons that transit through the public access to get to the surfing sites at Honokōwai Beach. Prior to the 2016 erosion event, surf lessons from these remote companies were given under a large tree fronting the public bathroom at Honokōwai Beach, within the present Project Site. Figure 5-10 shows two sequences of surfers riding waves at "Hotels."



Figure 5-10 A morning surfer catches a right at "Hotels" and rides it towards "Rainbows" (top). Later that afternoon, a surfer catches a right slide and then fades left towards the channel, riding the wave almost to shore, and clearly within the Project Site (bottom sequence) at Honokōwai.

5.3.9 Fishing

The traditional fishing grounds in this region have been described as being "very shallow from twenty to thirty fathoms in depth and extending from Hāwea Point at Kā'anapali to the eastern point of Lāna'i (Kahā'ulelio 2006:59). In 1839, clarity of the fishing grounds and fish of the maka'āinana (common people) and that of the konohiki (landlord) and ali'i (chief) were written down as a part of the Kingdom laws, a pattern which may be an extension of a traditional management system. The King declared that the fishing grounds without the coral reef and the lūhe'e (octopus fishing) grounds were for the people (Maly and Maly 2003:244). But the fishing grounds from the coral reefs to the sea beach are for the landlords, and for the tenants of their several lands, but not for others" (taken from SE Functional Design Concept Plan, March 2024).

Shore casting and spear fishing, including night diving, by individual free divers and scuba divers occurs along the fringing reef within the Project Site and beyond. Figure 2-2 shows a Hawaiian fisherman "throwing net" from the sands within the Project Site, which is a traditional Hawaiian cultural activity. Divers access the area from the shoreline through the remnant stream channel at Honokōwai, or by boat. A fisherman was observed fishing all night long from the corner of the

Maui Kai Condominium property, and, as shown in Figure 5-11, another person fished from the sand for several hours during the day. Figure 5-6 shows the spear fishermen who were seen diving from the sandy shoreline, out the remnant stream channel, and along the fringing reef of the entire Project Site, but an interview was not obtained. Small reef fish such as pāpio (*Caranx ignobilis*), moi (*Polydactylus sexfilis*), kūmū (*Parupeneus porphyreus*), and octopus (*Octopus cyanea*) are typically sought after by these shore casters and spear fishers, but larger catches such as ʻulua (*Caranx ignobilis*) are hoped for. The presence of larger fish is altogether probable there, as was witnessed when a large barracuda (*Sphyraena barracuda*) was observed at the same location that the fishermen had their poles on the southeastern corner of the Project Site, as seen in Figure 4-4.

Fisherman trolling or bottom fishing have the potential to transit through and fish within the Sand Recovery Site offshore of Puʻu Kekaʻa. Large species of fish such as aku (*Katsuwonus pelamis*), ahi (*Thunnus albacares*), mahimahi (*Coryphaena hippurus*), and ono (*Acanthocybium solanderi*) are usually sought after, and many different pelagic and nearshore species of fish have the potential to exist within these deeper offshore waters. Also, public comments received during the Kāʻanapali Beach Enhancement Project review period included discussion on the presence of Kona crab (*Ranina ranina*) in the region of the Sand Recovery Site. Their reported presence in the sand field is fitting, as their habitat is sand fields, typically in water depths of 30 feet to over 300 feet (SE Kāʻanapali EIS, July 2022).



Figure 5-11 A fisherman prepares his gear along the temporary erosion control structure within the Project Site (left). The northern corner of Maui Kai Condominium is a popular place to fish, as evidenced by poles left overnight during the June site visit, and a shorecaster fishing from that location in September 2024. There were no fishermen there when the barracuda passed through.

5.3.10 Kitesurfing & Wingfoiling

Recreational Wing Foiling was observed occurring along the remnant stream channel within the Project Site and out into the nearshore waters. The sandy beach and deeper waters of the channel allow for access to and from shore for surfboards with a foil fin on the bottom. These boards require at least two feet of clearance because of the long shaft or “mast” on the foil board. Although no kitesurfing was observed during the site visits, one respondent indicated that they participate in kitesurfing at Honokōwai Beach. The strong and gusty tradewinds blowing side-offshore at times, coupled with the deeper waters of the channel and the sandy beach for an access point have the potential to create favorable conditions for kitesurfing at Honokōwai Beach. The channel provides clear passage through to the offshore waters where kite surfers and wing foilers have access to a more expansive area with deeper water and stronger winds, as seen in Figure 5-12. Although windsurfing was very popular in decades past, no windsurfers were

observed, nor was windsurfing mentioned by any of the informants, and no equipment rental for windsurfers was found among the shops renting ocean recreation equipment in Honokōwai or Kāʻanapali.

Nothing prevents a kitesurfer or wingfoiler from operating in the West Maui Designated ORMA, so although the Sand Recovery Site is approximately 1,850 feet offshore of the beach adjacent to Puʻu Kekaʻa, there is potential for kitesurfers or wingfoilers to access or transit through this area, especially since winds blow stronger and more consistently further offshore along this coastline.



Figure 5-12 A wingfoiler sails out of the remnant stream channel next to "Hotels" surfing break (left) and wingfoilers negotiate offshore winds while sailing in and out of the channel (right).

5.3.11 Cliff Diving/Jumping

This activity takes place on the low seacliff on the south side of Puʻu Kekaʻa, or Black Rock, south of the Project Site. As shown in Figure 5-13, the dive/jump site is approximately 30 feet above sea level. Most divers swim to the base of the cliff from Kāʻanapali Beach and then climb to the top of the jump site. The Sheraton Maui Resort and Spa offers a nightly torch lighting ceremony on Puʻu Kekaʻa, which concludes with a cliff dive by a single diver. Cliff diving/jumping does not occur at the Project Site or within the Sand Recovery Site, one because of the shallow waters and low-lying coastal features at the Project Site, the other because of the distance offshore, and both because there are no leaping points to enter the water from at either location.



Figure 5-13 Several people stand atop the bluff at Puʻu Kekaʻa, a popular place for cliff jumping. The potential Sand Recovery Site can be seen in the background some 1,800 feet offshore.

5.3.12 One-person and Six-person Outrigger Canoe Paddling

One-person and six-person outrigger canoe paddling was observed within and just offshore of the Project Site, as seen in Figure 5-14. During the first site visit, a one-person outrigger transited from offshore, into the remnant stream channel, and up onto the sandy beach, where the person then continued up through the access to the parking lot behind the public restrooms. The paddler pictured below paddled into Project Site waters over the shallow reef inside the "Rainbows" surf break, then went out the channel and followed a similar transit line back towards the south that the six-person canoe had paddled. The channel and sandy bottom make this site a decent place to end a long-distance paddle or launch and land there, but seasonally when the sand migrates away from the area, the rocky substrate would not be ideal. A six-person canoe team was observed transiting the coastline from north to south, outside of the fringing reef, approximately 900 feet offshore of the Project Site.

The shallow reef, unpredictable waves, and seasonal sand migration does not make this area suitable for regular launching, landing, or storage of these larger 6-person outrigger canoes. Hanakaʻōʻō Beach Park is the most popular launch, recovery, and storage area for outrigger canoes, south of the Project Site and Sand Recovery Site. Other launch areas are situated north of the Project Site around Kahana. Although the Sand Recovery Site is approximately 1,850 feet offshore of the beach adjacent to Puʻu Kekaʻa, there is potential for one-person and six-person outrigger canoe paddlers to access or transit through this area.



Figure 5-14 One-person and six-person outrigger canoe paddling was observed within and just offshore of the Project Site. The one-person canoe entered the Project Site fifty feet off the beach.

5.3.13 Parasailing

Parasailing takes place in an assigned area about 1,000 feet west of the Sand Recovery Site outside the Designated ORMA boundary line of 3,000 feet. This activity is not permitted during the whale season from December 15th to May 15th of the following year, the time of year when whales are wintering in Hawaiʻi. Commercial vessels have a fair probability of passing through the Sand Recovery Site, especially if they pick up passengers at Kāʻanapali Beach or run commercial parasailing operations. Recreational boaters transiting or participating in offshore ocean recreation activities such as parasailing may also enter or pass through the area. Parasailing does not take place in or near the Project Site since the northern extent of the assigned area ends at Puʻu Kekaʻa, and is just offshore of the Sand Recovery Site, as shown earlier in Figure 5-1.

5.3.14 Thrill Craft

The use of recreational Thrill Craft is not permitted in or near the Project Site. Thrill craft must remain in undesignated State Waters, operating at least 3,000 feet offshore while transiting along the coastline to and from their launching point and an area designated for thrill craft use. There is no assigned area for recreational Thrill Craft in the West Maui Designated ORMA, as shown in Figure 5-1. Commercial Thrill Craft operations, which includes using personal watercraft such as jet skis, takes place in two designated areas south of Hanakaʻōʻō Point, but is not permitted during the winter and spring from December 15th to May 15th of the following year, the season when whales are wintering in Hawaiʻi. Because the Kāʻanapali Commercial Thrill Craft areas and launching points are all situated south of the Sand Recovery Site, it is unlikely that Thrill Craft operations would occur there. Likewise, any recreational operators passing by should be transiting at least 1,000 feet west of the Sand Recovery Site, outside the Designated ORMA boundary line.

5.3.15 Water Sledding

This activity, which includes using a motorized vessel to tow one or more persons on a water sled, such as an inflatable raft or tube, takes place in an assign area in the Designated ORMA far south of the Project Site, but is not permitted during the winter and spring, the season when whales are wintering in Hawaiʻi. Water sledding does not take place in or near the Project Site at Honokōwai, but it appears that the Sand Recovery Site lies within the designated Water Sledding Zone at its northeastern boundary off Puʻu Kekaʻa. Commercial vessels have a fair probability of passing through the Sand Recovery Site, especially if they pick up passengers at Kāʻanapali Beach or run commercial water sledding operations. Recreational boaters transiting or participating in offshore ocean recreation activities such as water sledding may also enter or pass through the area. Water Sledding does not take place in or near the Project Site since the northern extent of the assigned area ends at Puʻu Kekaʻa, as shown earlier in Figure 5-1.

6.0 SURVEY RESULTS

6.1 General Overview

Individuals, companies, and organizations who have a coastal or marine use interest at Honokōwai Beach were contacted for this report. Of the email requests and site visits conducted for the recreation and ocean impacts survey, there were a dozen respondents to the survey, and a total of twenty face-to-face contacts made during the site visits. A summary of information gathered from both respondents and interviewees is presented in the section below. There were only a few people who did not want to participate. The companies and organizations are listed in Section 3.3 Survey Fieldwork and Distribution. Individual respondents remain anonymous for the purposes of this report, but their answers are included herein.

The following is a list showing uses of Honokōwai Beach from survey respondents that either participated in or observed activities taking place there. The number of respondents that mentioned each activity is listed in parentheses:

- (1) Beachcombing
- (3) Bodyboarding
- (1) Bodysurfing
- (3) Diving/Freediving
- (1) Diving at night
- (5) Fishing

- (1) Fishing Overnight for Ulua
- (1) Flying Drones
- (1) Kayaking
- (1) Kite Surfing
- (1) Marine Science Education Activities & Coral Reef Analysis
- (2) None–Respondents indicated they did not frequent Honokōwai Beach
- (1) Paddleboarding
- (1) Paddling
- (1) Picnicking
- (1) Relaxing
- (1) Rescue Turtles
- (1) Skimboarding
- (2) Scuba Diving
- (5) Snorkeling
- (1) Spearfishing
- (1) Sun Bathing
- (6) Surfing
- (2) Swimming
- (1) Walking on the Beach

6.2 The Value of Honokōwai Beach to Survey Respondents

Beyond the actual recreational activities that respondents mention are the reasons respondents value the beach and shoreline access at Honokōwai. Reasons given are that respondents value:

- Safe and easy accessibility to all public beachgoers;
- Adequate public parking;
- Handicap access to the ocean;
- Less crowded than other beaches nearby;
- Natural beauty;
- Offshore reefs and healthy coral;
- Cleanliness of the beach and water; and
- "All ocean and sand life that resides on and in Honokōwai Beach."

As one respondent expressed, this beach "acts like a catalyst of connection to the past, present, and future," in reference to "the hindsight of living through past mistakes leading us to the current predicaments with hope of future restoration."

6.3 Impacts of Weather and Surf Conditions on Recreational Uses

Respondents indicated the type of weather and surf conditions that impact their activities at Honokōwai Beach. Several respondents indicated that tides, wind, rain, large storms, and high surf affect their activities there. Often, the results of high tides, large surf, and heavy rains from large storms include coastal erosion that causes murky waters and stream runoff containing pollutants. Both the appearance of pollutants and the high turbidity of the nearshore waters, when these occur, impacts or prevents patrons from participating in their normal recreational activities until clear weather returns and ocean currents flush the nearshore waters clean.

6.4 Concerns Regarding Beach Loss at Honokōwai Beach

Respondents had a broad range of responses regarding beach loss, citing the proximity of seawalls to the ocean that increase coastal erosion, along with the uncertainty of changes in the area as coastal erosion continues. Respondents mentioned that such further environmental

degradation would impact marine life and coral health, and increase turbidity of the waters there. Safe access to the shoreline and nearshore waters was a concern with regards to collapsing walkways, sudden drop offs, and sinkholes from erosion. Public safety was also a concern with regards to increasing debris along the shoreline and in the shallows from collapsing structures and pipes. One respondent mentioned concern that operational activities might impact educational activities such as recurring coral reef analysis. For example, a program at the University of Hawai‘i at Maui College conducts regular surveys evaluating the health of the reefs along the Honokōwai and Kā‘anapali coastlines. A few respondents cited the impacts on recreational activities taking place at Honokōwai due to the erosion and turbidity. These comments were summed up by one respondent who said, “nowhere for locals to go fish, surf, and dive.”

6.5 Improving Beach and Shoreline Access at Honokōwai Beach

When asked what can or should be done to improve beach and shoreline access at Honokōwai Beach, some respondents answered specifically towards daily use, saying that more public parking should be added. Other respondents answered in a variety of ways, including:

- Restoring sand from offshore that was washed away in recent storm events;
- Bringing back sand mined and taken away in the past;
- Moving the hotels inland to (1) allow for the natural processes to restore the beach, and (2) provide additional parking and beach access;
- Hardening the shoreline and constructing a safe access point to the beach for all users;
- Actively restore the natural ecology offshore;
- Doing nothing, citing that any action would negatively impact sea life, incur high costs for a short-term fix, and have unintended consequences.

One respondent who suggested moving the structures inland indicated that doing nothing and allowing the structures to collapse would create a hazardous environment for sea life and people accessing the coastline and ocean at Honokōwai.

A majority of respondents and interviewees felt that some sort of sand replenishment should be done to save the beach, though most recognized that the ocean would eventually take it away again over time. One interviewee stated that groins were “taking it too far,” that “this coastline is not ready [for a visually buttressed coastline like Waikiki],” but insisted that replenishing the sand was a necessity since the beach is disappearing. This person also cited impacts of erosion on safe access to the beach occurring already, pointing out the sudden drop off inhibiting people’s ability to access the sand safely at the time of the interview in June 2024.

Another interviewee stated that beach restoration which included the proposed groins (being privy to public information about this project) was necessary to re-establish safe access, and to save the beach and surfing sites offshore from erosion-borne pollution, turbidity, and backwash that is already impacting wave quality. This person also discussed ocean safety for beach patrons, saying how the proposed beach restoration actions would decrease longshore currents fronting the public access point and thus increase public safety in the area. A second interviewee who is a regular to the area mentioned the dangerous currents that run along shore as well, stating that, during a north swell, these currents have increased as the beach has diminished, exposing the rocky seafloor substrate as well. Most of the people interviewed on site felt that something should be done to save Honokōwai Beach, although there was a difference of opinion on how that might be accomplished. No one wanted to see building debris left behind along the shore.

6.6 Timing for Beach Restoration

Input regarding the timing for any beach restoration project is important to obtain from regular Honokōwai Beach patrons because of their local knowledge of seasonal weather and surf that cause changes in the shoreline. Respondents gave various responses which related to different aspects of the present situation at Honokōwai Beach, including weather, surf, and the urgency of protecting the existing access and structures. Those citing weather and surf were mostly in agreement, indicating that there is typically less surf in the summer, so the project should occur during the summer months.

One respondent suggested that the project should occur when erosion is at its worst, which would be at the end of summer when coastal sands have migrated to the north end of the Honokōwai Littoral Cell, thereby increasing erosion at the south end by the Maui Kai Condominium. This timing does not consider an extreme weather or surf event, which may cause erosion regardless of the time of year. Respondents who did not favor beach restoration in previous answers reiterated that here, again citing the impact of beach restoration on living coral and sea life there. To note, living coral was found about 150 to 200 meters offshore of the Project Site.

6.7 Concerning Potential Impacts on Beach and Ocean Recreation

Several interviewees hoped that the beach restoration alternative chosen might alleviate longshore currents which presently poses a danger to beach patrons swimming along the shoreline, reestablish safe public access to the remnant stream channel where surfers access the surf breaks, and protect the shoreline from erosion that causes high turbidity in the nearshore waters–all considered to be positive impacts. On the other hand, one respondent was concerned that beach restoration might increase recreational activities there, which, in the respondent's opinion, could negatively impact personal marine uses there.

6.8 Additional Comments, Concerns, and Recommendations from Respondents

Public input is an important part of this restoration process, as is reporting on comments made by respondents. Such input may or may not reflect the greater public sentiment, but the input is recognized here as part of the reporting process. Several respondents gave suggestions relating to the alternatives being considered, while others reiterated concerns already stated, including personal opinion. One respondent cited that project actions should reflect what the "experts" deemed best for restoring the beach, while another suggested planting plants rather than replenishing sand. One respondent questioned the effectiveness of sand replenishment based on past observations of another project where beach restoration turned out to be a short-term fix, ultimately exposing construction debris that was not removed prior to sand replenishment in that case.

Safety for beach patrons emerged as a theme, regardless of whether they want beach restoration to occur or not. One respondent suggested that "clear and obvious safety and science and cultural education signage should be visible along with historical information on the area." This kind of suggestion shows how the people who enjoy Honokōwai are also deeply connected with this place on every level.

7.0 POTENTIAL IMPACTS ON COASTAL AND MARINE USES

Survey respondents were asked to discuss possible short-term impacts of the proposed project on their coastal and ocean recreation activities. Several potential impacts mentioned above were identified by individuals, companies, and organizations who have a coastal or marine use interest

at Honokōwai Beach that were contacted for this report. In addition, the Coastal Engineering Assessment report prepared by SE is considered, along with other similar project reports that have been completed along the Kāʻanapali coastline. In the short-term, SE notes that beyond No Action being taken, all of the project alternatives being considered have proposed operational activities that take place either in the ocean or on the beach, and are expected to directly, but temporarily impact ocean recreation and access near the Project Site and Sand Recovery Site. Potential long-term impacts of this project are difficult to project with absolute certainty, but survey comments and previous reports are considered in this section that assesses potential short-term and long-term impacts on coastal and marine uses in and around the Project Site.

7.1 Summary of Potential Impacts Anticipated in General

In this section the discussion is focused on potential impacts of the project alternatives to the beach, nearshore ocean environment, and access corridors in general. These potential impacts are considered as short-term or long-term, with long-term impacts reaching closer to the project objective of maintaining a stable beach for 50-years. Short-term impacts generally consist of the period of time during which operational activities relating to the alternatives occur, and for a period of time immediately following these activities when a settling of sediments relating to operations and distribution of placed sand by natural processes occur (i.e. sand odor diminishes on the beach over time, reduced water clarity from fine sediments improves as waves and currents wash it away, etc.).

In regards to the three beach restoration alternatives with operational activities that include sand recovery, there are a few similar impacts relating to all of them. For instance, the short-term impacts related to sand recovery, transportation, and placement at Honokōwai Beach are similar with each alternative being evaluated. Here, the difference in the alternatives relates mostly to the volume of sand needing to be recovered, which increases from Beach Nourishment to Beach Stabilization to Beach Maintenance. Of course, other short-term impacts remain unique to the alternative, such as Beach Stabilization, which includes the placement of rubble mound groins along the shoreline to compartmentalize and stabilize the placed sands. Table 1 in Section 7.3 lists the potential short-term and long-term impacts relating to the beach, ocean, and access corridors for each alternative, while Section 7.1 highlights the general impacts of the various alternatives, including environmental and recreational considerations relative to one or more of the alternatives, and 7.2 details how each alternative might impact each coastal and marine use.

7.1.1 Water Quality

During sand recovery operations, minor turbidity is expected from the clamshell dredging operation as sand is brought from the seafloor to the barge. Depending on ocean conditions, such as wind and currents, the turbidity plume may extend inshore and impact water clarity in the snorkeling and scuba diving areas around Puʻu Kekaʻa, including its north side, all of which is far outside of the Project Site. Once placed in the Project Site, sand from the Sand Recovery Site, though compatible with the dry beach sand, will still have fine sand grains that will separate out of the beach system and move offshore during the initial seaward merging of the introduced sand to the existing beach sand. The fine sand grains may create nearshore turbidity plumes and temporarily impact the water clarity in the nearshore waters of Honokōwai Beach until currents flush them offshore.

However, while sand placement operations are occurring, silt curtains and containment barriers will be deployed along the shoreline to help reduce turbidity. Results of turbidity analysis by SE of the sand in the Sand Recovery Site indicate that following the placement of recovered sand, turbidity in the nearshore waters at the project site are expected to be elevated but are also

expected to approach natural levels as the waves and currents carry away fine sand grains. In the case of the Beach Maintenance alternative, additional episodes of increased turbidity may occur over time as newly recovered sand is exposed and washed by waves after recurring beach nourishment activities have occurred. The same disbursement of these plumes is expected after these activities.

7.1.2 Sedimentation on Live Corals

Sedimentation occurs when fine sediment particles suspended in turbid water dissipate and settle on the ocean floor, so sedimentation is a normal process that follows turbidity. Turbidity generated from dredging operations at the Sand Recovery Site is expected to have a net transport to the south by currents moving parallel to shore. The nearest live corals down-current from the Sand Recovery Site are located approximately 3,000 feet to the south of Hanakaʻōʻō Point. Sand sized particles will fall out of the water column rapidly and return to the sand field. While some turbidity may remain in the water column long enough to be transported to the coral reef's northern end, this material is expected to be widely distributed and to be quickly dispersed by wind, waves, and currents, eliminating sedimentation on live coral reefs. The same expectation of eliminating sedimentation on live coral reefs is anticipated for turbid waters that will be generated following the sand placement, distribution, and grading operations onshore.

7.1.3 Sand Quality

When sand is recovered from anoxic environments, such as portions of the Sand Recovery Site, it may have a gray color and scent. These characteristics may be temporarily evident offshore of Kāʻanapali Beach while sand recovery takes place, in Kahului Harbor while the sand is being offloaded, and on Honokōwai Beach when sand placement initially occurs, but will diminish over time due to exposure to the elements.

7.1.4 Marine Use Considerations

Sand from the Sand Recovery Site will be placed on a barge and towed by a tugboat to the offloading location at Kahului Harbor. There may be several barges alternating between the Sand Recovery Site and the offloading location, but for the majority of the time they will be moored at the offshore Sand Recovery Site. While the barges are in transit, other marine vessels and ocean recreation activities may need to adjust to their movements. As the barges exit the area, barge routes may change according to weather conditions, but they are expected to transit in a well-established vessel transit corridor approximately 2,000 feet offshore in over 150 feet of water, well offshore of swimming, snorkeling, scuba diving, and surfing sites. Table 1 includes the potential short-term impacts on specific ocean recreation activities for each alternative.

7.1.5 Coastal Use Considerations

Sand placement operations on the beach in the Project Site will require them to be cordoned off to all beach activities during trucking, placement, and grading operations. Onshore and nearshore hazards will be marked with signage and/or marker floats. Security personnel on the beach will advise the public when and where they can safely cross the beach to enter and exit the ocean.

7.1.6 Access Considerations

Access to the public parking area, restrooms, and handicap lateral shoreline pathway may be impacted by construction activities relating to the transfer, stockpiling, and placement of sand processes. Access to the public parking and traffic on the roadways where trucks are accessing the Project Site to deliver sand may also be impacted. Several respondents expressed concern towards

the impacts of the project on public safety and emergency services at Honokōwai Beach during the construction, so it is important that controls are put in place to minimize risk for patrons and emergency services who might need to respond to the area during any such incident.

7.2 Summary of Potential Impacts from Each Alternative Action

The following summary of potential impacts from each alternative action is meant to assess the potential scenarios that each alternative action may pose to various ocean recreation activities. In this way, no assessment of impacts is complete, both in potential outcomes as well as ocean recreation activities being considered. Rather, the assessment is based on past scenarios as well as ocean recreation expertise applied to brainstorming how activities may be affected by each action alternative being considered at the Project Site and Sand Recovery Site in this case. Each section below begins with a fairly detailed summary of potential impacts followed by a short description of how each ocean recreation activity mentioned in the Honokōwai Coastal and Marine Uses survey and observed on site may be impacted by that alternative.

Considering the principles and practices behind ocean safety risk management, it should be acknowledged here that there is a potential for unanticipated hazards, impacts, and situations to arise with all of the alternatives being considered. Each ocean recreation activity is unique and has limitations and situations that may arise due to equipment, intent, and operator experience. With this fact in mind, the following assessment highlights the major hazards that might impact ocean recreation enthusiasts for each alternative, but there may be other impacts not listed here.

7.2.1 No Action Taken

No Action would consist of not implementing any of the beach restoration alternatives and allowing Honokōwai Beach to continue to erode naturally. It would also include removal of the existing temporary erosion control structure. When seasonal sand migration exposes the rocky seafloor substrate in and around the Project Site, there are considered to be negative impacts to most all of the beach and ocean recreation activities that are enjoyed by locals and visitors alike, namely through an increase in exposed natural and man-made hazards that might injure people or damage equipment, and perhaps inhibit or halt people from engaging in these activities at that location altogether due to hazardous conditions there.

The armored shoreline on either side of the Project Site contributes to sand loss within the present Project Site in that, there is continued sand loss inherent in a coastal circulation (littoral) cell process where shoreline alterations tend to interrupt the source materials from remaining in the littoral cell and thus replenishing the beach. Also, there are singular and recurring weather events such as extreme high tides and large swell events that have the capability to transport an increased amount of sand offshore, exposing the rocky seafloor substrate for an extended period of time–longer than the normal seasonal variation and perhaps for more than one season as was the case of the 2016 El Niño large surf events.

Although partial beach recovery has occurred since the temporary measures were put in place, the beach width and volume has not recovered itself to the same extent as before the extreme surf events that happened over the past decade. Removing the existing temporary erosion control

structure has the potential to accelerate erosion by disturbing the sands that have replenished the beach and upsetting the adaptations made by the littoral cell following the placement of the existing temporary erosion control structure. If No Action is taken, it is possible that eventually, the beach could potentially disappear entirely, thus having a negative impact on patrons and diminishing the value of this place for such people. It would also create many hazards for patrons who do attempt to engage in their normal beach and ocean activities there.

In such cases where erosion has exposed the underlying substrate, the rocky shoreline has the potential to impede beach patrons traversing through the access to the ocean as well as those walking along the water's edge. Furthermore, once the sand has been transported offshore, it is highly likely that ensuing tidal extremes and large swell events may cause erosion of the terrestrial backshore, even to the point of displacing the large sandbags that form the existing temporary erosion control structure, if it were to be left in place. If the temporary erosion control structure was removed or compromised by wave-action, it would expose terrestrial materials and construction debris from underground infrastructure behind that embankment that might fall into the sea, creating more hazards and lowering water quality significantly.

The volume of terrestrial sediment (alluvium) that could potentially be discharged would likely greatly exceed the volume of marine sediment (sand) relating to the alternatives where sand is placed, which does discharge some amount of marine sediment (sand) into the water column as described above. Turbidity plumes relating to extensive erosion in the recent past prior to the temporary erosion structures being put in place were observed to be substantial, extending far offshore, with large volumes of sediment being carried for some distance in the currents, as seen in Figure 2-4. These kinds of turbidity plumes would not only discourage patrons from engaging in their normal activities there, but also the sediment is potentially detrimental to corals and sea life as well.

In a case where the sandbags might have been displaced, it is likely that a wave-cut vertical scarp would form along the backshore as the land erodes. Both the fallen debris and unstable nature of such a bank would add to the hazards for beachgoers, and potentially cause accelerated erosion from an increase in wave reflection against the vertical scarp that carries terrestrial sediment and beach sand out to sea more rapidly than where sloping sands exist. There would also be concern that, if any were present in the wave-cut bank, cultural deposits or materials may be exposed or washed into the sea as well. In general, there is a significant concern among community members regarding potential impacts to cultural resources due to both operational activities and erosion. Thus, any exposure of cultural deposits or materials may negatively affect public perceptions of this project. Just being aware of the presence of inadvertent cultural finds might potentially discourage people from visiting Honokōwai Beach due to their concerns and cultural sensitivity. These concerns will be addressed in a Cultural Impact Assessment that will be included in the Draft EIS.

As one of only two unarmored areas along this coast, the south end of Honokōwai Beach and Honokōwai Park to the north would likely incur the most degradation of the shoreline in the shortest amount of time. In a case where No Action is taken, it is the author's opinion that for a managed retreat to be successful, an extensive effort beyond the scope of this project might be necessary to remove all shoreline armory and all structures for some distance beyond the backshore along the entire Honokōwai littoral cell, and then perhaps the remaining backshore would still have to be reshaped in such a way as to encourage the natural processes to once again deposit sand along this coastline.

This strategy could potentially materialize as a success over the long-term, if at all, but the reshaped, unprotected shoreline would be subject to storms, extreme high tides, and even sea level rise over time, which might cause erosion that would most likely negate the work accomplished towards a managed retreat. It would also involve the collaboration of the entire community and all the property owners along this coastline who might have to be willing to retreat so that the whole coastline could be restored to a state similar to what it was prior to the development of West Maui. It is difficult to assess how much sand was removed to level the land during this early period of development. Again, in the author's opinion, it is also unfortunate that no one seemed to understand that the sand protects the land. High sand dunes could shift during extreme surf without impacting terrestrial sediment and soils behind the storm berms. Now, without excessive mechanical sand recovery efforts, accumulated sands may potentially not be enough to curtail continued erosion and associated turbidity along the coast. At the same time, with higher ocean waters approaching the level of coastal drowning in many areas of the islands, it is questionable as to whether the coastline would recover at all. Even a strategy to manage retreat might require some operational or restorative effort to stabilize the sands over time.

Within the Project Site, continued erosion might cause the longshore currents that tend to run towards the remnant stream channel to increase due to the absence of sand that absorbs current and wave energy. In such a case, the unforgiving rocky seafloor substrate and vertical embankment could potentially cause an increase in the rip currents that run along the shore and then turn offshore there. The currents would also be a mechanism that carries suspended terrestrial materials further offshore and down-current, increasing the potential for negative impacts to coral, sea life, and water quality, and reducing visibility for ocean patrons attempting to go diving.

If such impacts occur, choosing the No Action Alternative would significantly decrease water quality, increase hazards, and potentially expose any cultural materials present. Therefore, this situation poses additional risk for unsuspecting patrons due to the absence of a beach, the sharp and abrupt changes in the exposed rocky seafloor substrate, the rocky terrestrial fill and sediments that would most likely decrease water quality, and inevitably, the construction debris fallen into the water and along the eroded shoreline. Predominantly offshore winds already add to the offshore pull of the current, and the lack of sand and hard substrate has the potential to cause the current running offshore to intensify as well, increasing further the potential for hazardous situations to occur with swimmers and even people wading in the shallows who might get swept off their feet by currents or blown offshore by the strong winds there, as highlighted by the State Department of Health in Figure 5-2. Table 1 below highlights the potential short-term and long-term impacts to specific beach and ocean recreation activities for each alternative.

7.2.1.1 *Sunbathing, Beach Walking, Gathering & Beachcombing*

Short-Term: At the Project Site, erosion would likely continue at a similar or more rapid rate than at present if No Action were taken. Where erosion has exposed the underlying seafloor substrate, patrons may have increasing difficulty traversing from the public access to the ocean and along the water's edge. If No Action is taken, there will be an increase in hazards for patrons who attempt to walk the beach there.

Long-Term: If there is little to no sand, patrons will have increasingly less space to sunbathe or sit on the sand, and eventually they would no longer be able to sunbathe there if a total loss of beach were to occur. As the beach disappears, a vertical wave-cut bank could form there in the backshore that drops down to a rocky substrate, making it very dangerous for patrons to traverse, or cutting off safe passage from the showers and handicap pathway altogether. Beachcombing and

traditional gathering practices would also be impacted negatively as the beach gets smaller, with less area for limu (seaweed), shells, and other items to collect on the sand. Eventually, with no beach, the limu and other items would not be able to collect, getting pushed back offshore by wave reflection and floating away in the current. It would mark the end of a long cultural tradition at Honokōwai Beach if limu and other native resources could no longer be gathered there because there is no beach for it to land upon.

7.2.1.2 *Swimming*

Short-Term: At the Project Site, erosion would likely continue at a similar or more rapid rate than at present if No Action were taken. Patrons would have increasing difficulty traversing through the public access to the ocean and along the water's edge. The hardened shoreline has the potential to increase current flow, which would create a more hazardous environment for swimmers. Turbidity plumes may occur in the ocean if waves reach the backshore and it begins to erode, discouraging patrons from swimming there at all.

Long-Term: Swimming tends to be concentrated near the public access and in the remnant stream channel offshore of the Project Site. As the beach disappears, a vertical wave-cut bank could form there in the backshore that drops down to a rocky substrate, making it very dangerous for patrons to traverse, or cutting off safe passage to the ocean altogether. The hardened shoreline has the potential to increase current flow, which would create a more hazardous environment for swimmers who are at increased risk for being pulled offshore. If erosion of the backshore continues there is likely to be an increased number of turbidity plume events; it may even cause sustained turbidity in the nearshore waters, lowering water quality and visibility over the long-term. These kinds of turbidity plumes and murky waters would not only discourage patrons from swimming there, but also the sediment is potentially detrimental to coral and sea life as well. The turbidity might also increase the risk of a shark attack. Eventually, patrons would no longer be able to access the ocean to enjoy going swimming there if a total loss of beach were to occur and the waters were always turbid.

7.2.1.3 *Bodyboarding & Bodysurfing*

Short-Term: At the Project Site, erosion would likely continue at a similar or more rapid rate than at present if No Action were taken. Patrons would have increasing difficulty traversing through the public access to the ocean and along the water's edge. The hardened shoreline has the potential to expose the rocky substrate and increase current flow along the shoreline. Turbidity plumes may occur in the ocean if waves reach the backshore and it begins to erode. If No Action is taken, there will be an increase in hazards for patrons who attempt to bodyboard or bodysurf the shorebreak there.

Long-Term: As the beach disappears, a vertical wave-cut bank could form there in the backshore that drops down to a rocky substrate, making it very dangerous for patrons to traverse, or cutting off safe passage to the ocean altogether. If there is little to no sand, patrons will have increasingly less space to bodyboard or bodysurf safely unless they go further offshore to ride waves. However, the surfing breaks out there are shallow, so it would be difficult and more dangerous to ride waves due to the risk of impacting the coral reef resulting in lacerations or other injuries.

Backwash in the waves offshore would also increase due to wave reflection, lowering the quality of the ride and increasing risk of injury for those enthusiasts who do go further offshore to ride waves. In addition, the hardened shoreline has the potential to increase current flow, which would

create a more hazardous environment for bodyboarders and bodysurfers there. If erosion of the backshore continues there is likely to be increased turbidity that may even cause lower water quality and visibility over the long-term. The turbidity might also increase the risk of a shark attack. Eventually, patrons would no longer be able to bodyboard or bodysurf the shorebreak there if a total loss of sand were to occur.

7.2.1.4 *Skimboarding*

Short-Term: At the Project Site, erosion would likely continue at a similar or more rapid rate than at present if No Action were taken. In such cases where erosion has exposed the underlying substrate, the rocky shoreline has the potential to impede beachgoers traversing through the public access to the ocean as well as those walking along the water's edge. If there is little to no sand, patrons will have increasingly less space to skimboard and ride waves in the shorebreak.

Long-Term: If there is little to no sand, patrons will have increasingly less space to skimboard on the sand and ride waves in the shorebreak. If No Action is taken, it is possible that the sand could disappear entirely, thus having a negative impact on patrons because a skimboard requires sand for the rider to glide smoothly across the thin film of water along the beach. Eventually they would no longer be able to skimboard at Honokōwai Beach if a total loss of sand were to occur.

7.2.1.5 *Snorkeling, Free Diving, and Scuba Diving*

Short-Term: At the Project Site, erosion would likely continue at a similar or more rapid rate than at present if No Action were taken. Where erosion has exposed the underlying seafloor substrate, patrons may have increasing difficulty traversing from the public access to the ocean and along the water's edge. If No Action is taken, there will be an increase in hazards for patrons who attempt to snorkel or dive there.

Long-Term: Snorkeling and diving tend to be concentrated near the public access and in the remnant stream channel offshore of the Project Site. If there is little to no sand, patrons will have an increasingly difficult time accessing the ocean over the rocky seafloor substrate until they get in deeper waters further offshore. The hardened shoreline has the potential to increase current flow, which would create a more hazardous environment for snorkelers and divers. If erosion of the backshore continues there is likely to be increased turbidity that may even cause lower water quality and visibility over the long-term, which might discourage patrons from snorkeling or diving there. Also, the sediment is potentially detrimental to coral and sea life as well. The turbidity might also increase the risk of a shark attack. Eventually, patrons would no longer be able to access the ocean to enjoy snorkeling or diving if a total loss of beach were to occur and the waters were always turbid.

7.2.1.6 *Boating*

Short-Term: A recreational operator with a small vessel could potentially come near or into Project Site waters through the remnant stream channel, and larger recreational vessels are known to pass by offshore, which means they may be impacted by turbidity. Wave reflection and more turbulent waters within the channel might impact a small vessel if they get near the shoreline. Turbidity plumes may occur in the ocean if waves reach the backshore and it begins to erode. If No Action is taken, there will be an increase in hazards for patrons who attempt to access a small recreational boating vessel near shore there.

Long-Term: If erosion continues, the hardened shoreline has the potential to increase current flow, which would create a more hazardous environment for boaters attempting to come near the shoreline in the channel. Turbidity plumes relating to extensive erosion in the past were observed to be substantial, extending far offshore, with large volumes of sediment being carried for some distance in the currents. If erosion of the backshore continues there is likely to be increased turbidity that may even cause lower water quality and visibility over the long-term, which might make it difficult and more dangerous to navigate a vessel in the nearshore waters of Honokōwai and downwind towards Kā‘anapali.

7.2.1.7 *Standup Paddleboarding (SUP) & Kayaking*

Short-Term: At the Project Site, erosion would likely continue at a similar or more rapid rate than at present if No Action were taken. Where erosion has exposed the underlying seafloor substrate, patrons may have increasing difficulty traversing from the public access to the ocean and along the water's edge. If No Action is taken, there will be an increase in hazards for patrons who attempt to standup paddle or kayak at Honokōwai Beach.

Long-Term: Kayaking and SUP tend to be concentrated near the public access and in the remnant stream channel offshore of the Project Site. The hardened shoreline has the potential to increase current flow, which would create a more hazardous environment for kayakers or stand-up paddlers trying to launch and land in the channel. If erosion of the backshore continues there is likely to be increased turbidity that may cause lower water quality and visibility over the long-term, which might discourage patrons from kayaking or stand-up paddling there. The turbidity might also increase the risk of a shark attack. Eventually, patrons would no longer be able to access the ocean to enjoy kayaking or stand-up paddling if a total loss of beach were to occur and the waters were always turbid.

7.2.1.8 *Surfing*

Short-Term: At the Project Site, erosion would likely continue at a similar or more rapid rate than at present if No Action were taken. Patrons would have increasing difficulty traversing through the public access to the ocean and along the water's edge. The hardened shoreline has the potential to expose the rocky substrate, making it difficult to enter and exit the ocean. Turbidity plumes may occur in the ocean if waves reach the backshore and it begins to erode. If No Action is taken, there will be an increase in hazards for patrons who attempt to surf the breaks offshore or ride waves into the shorebreak.

Long-Term: As the beach disappears, a vertical wave-cut bank could form there in the backshore that drops down to a rocky substrate, making it very dangerous for patrons to traverse, or cutting off safe passage to the ocean altogether. If there is little to no sand, patrons will have an increasingly difficult time accessing the water and paddling out until they go further offshore to ride waves. However, the hardened shoreline would be difficult and more dangerous to ride waves to shore due to the risk of impacting the rocky seafloor substrate resulting in lacerations or other injuries.

Backwash in the waves offshore would also increase due to wave reflection, lowering the quality of the ride and increasing risk of injury for those enthusiasts who do ride waves there. In addition, the hardened shoreline has the potential to increase current flow along the shore and out the channel, which would create a more hazardous environment for surfers. Also, if erosion of the backshore continues there is likely to be increased turbidity that may even cause lower water

quality and visibility over the long-term, and it might increase the risk of a shark attack. Eventually, patrons would have a very difficult time accessing the ocean and surfing "Hotels" or "Rainbows" if a total loss of sand were to occur and the waters remained murky.

7.2.1.9 *Fishing*

Short-Term: At the Project Site, erosion would likely continue at a similar or more rapid rate than at present if No Action were taken. Where erosion has exposed the underlying seafloor substrate, patrons may have increasing difficulty traversing from the public access to the ocean and along the water's edge. If No Action is taken, there will be an increase in hazards for patrons who attempt to fish there. It may also create sudden waves breaking along the shoreline and reflecting off the hardened backshore, again increasing hazards to shoreline fishermen along Honokōwai who could get swept into the ocean. Shore casting and spear fishing, including night diving, by individual free divers and scuba divers who catch fish would be negatively impacted by decreased water clarity due to turbidity plumes, and the turbid waters may impact the presence of fish in that area.

Long-Term: If there is little to no sand, patrons will have increasingly less space to set up pole holders on the beach or sit on the sand, and eventually they would no longer be able to set poles there if a total loss of beach were to occur. As the beach disappears, a vertical wave-cut bank could form there in the backshore that drops down to a rocky substrate, making it very dangerous for patrons to traverse, or cutting off safe passage to the ocean altogether. Also, if erosion of the backshore continues there is likely to be increased turbidity that may even cause lower water quality and visibility over the long-term, which might discourage patrons from shore casting, spear fishing, and night diving. The turbidity might diminish the chances of fish biting while potentially increasing the risk of a shark attack for fishermen and spear divers in the water.

7.2.1.10 *Kite Foiling & Kite Surfing*

Short-Term: At the Project Site, erosion would likely continue at a similar or more rapid rate than at present if No Action were taken. Patrons would have increasing difficulty traversing through the public access to the ocean and along the water's edge. The hardened shoreline has the potential to expose the rocky substrate, making it difficult to enter and exit the ocean. If there is little to no sand, foilers and kitesurfers will have an increasingly difficult time accessing the water and paddling out on their equipment until they go further offshore. Turbidity plumes may occur in the ocean if waves reach the backshore and it begins to erode. If No Action is taken, there will be an increase in hazards for patrons who attempt to kite foil or kite surf there.

Long-Term: As the beach disappears, a vertical wave-cut bank could form there in the backshore that drops down to a rocky substrate, making it very dangerous for patrons to traverse, or cutting off safe passage to the ocean altogether. In addition, the hardened shoreline has the potential to increase current flow, which would generally increase the hazardous environment for kite foiling and kite surfing there. Also, if erosion of the backshore continues there is likely to be increased turbidity that may even cause lower water quality and visibility over the long-term, and it might increase the risk of a shark attack. Eventually, patrons would no longer be able to kitefoil or kitesurf without undue risk in the nearshore waters due to the rocky seafloor substrate if a total loss of sand were to occur.

7.2.1.11 Cliff Diving & Jumping

Short-Term: This activity takes place on the low seacliff on the south side of Puʻu Kekaʻa, or Black Rock, about a mile and a half south of the Project Site, so it is anticipated that there will be little or no impacts from taking No Action to halt erosion at Honokōwai Beach in the short-term.

Long-Term: Turbidity plumes relating to extensive erosion in the past were observed to be substantial, extending far offshore, with large volumes of sediment being carried for some distance in the currents. If erosion of the backshore continues there is likely to be increased turbidity that may even cause lower water quality and visibility over the long-term. That said, turbidity plumes from the Project Site have the slight chance of entering into the longshore currents and even perhaps drifting down towards Puʻu Kekaʻa, which may impact water quality along Kaʻanapali Beach as well.

7.2.1.12 One-person & 6-person Outrigger Canoe Paddling

Short-Term: At the Project Site, erosion would likely continue at a similar or more rapid rate than at present if No Action were taken. In such cases where erosion has exposed the underlying substrate, the rocky shoreline has the potential to impede beachgoers traversing through the public access to the ocean as well as those walking along the water's edge. If No Action is taken, there will be an increase in hazards for patrons who attempt to launch or land their canoe at this location.

Long-Term: One-person outrigger canoe paddling tends to be concentrated near the public access and in the remnant stream channel offshore of the Project Site. If there is little to no sand, patrons will have an increasingly difficult time accessing the ocean over the rocky substrate while carrying their vessel until they get in deeper waters further offshore. The hardened shoreline has the potential to increase current flow, which would create a more hazardous environment for paddlers who are at increased risk of being pushed over the reef while entering or exiting the ocean and while negotiating the nearshore waters. Also, if erosion of the backshore continues there is likely to be increased turbidity that may even cause lower water quality and visibility over the long-term, and it might increase the risk of a shark attack. Eventually, patrons would no longer be able to access the ocean safely to enjoy paddling if a total loss of beach were to occur and the waters were always murky.

7.2.1.13 Parasailing

Short-Term: This activity takes place in a designated location south of Puʻu Kekaʻa, or Black Rock, about a mile and a half south of the Project Site, so it is anticipated that there will be little or no impacts from taking No Action to halt erosion at Honokōwai Beach in the short-term.

Long-Term: Turbidity plumes relating to extensive erosion in the past were observed to be substantial, extending far offshore, with large volumes of sediment being carried for some distance in the currents. If erosion of the backshore continues there is likely to be increased turbidity that may even cause lower water quality and visibility over the long-term, which might make it difficult and more dangerous to navigate a vessel in the nearshore waters of Honokōwai and downwind towards Kāʻanapali. That said, turbidity plumes from the Project Site have the slight chance of entering into the longshore currents and even perhaps drifting down towards Puʻu Kekaʻa, which may impact water quality along Kaʻanapali Beach as well. In that event, murky waters might impact parasailing activities downwind of the Project Site.

7.2.1.14 Thrill craft

Short-Term: This activity takes place in a designated location south of Puʻu Kekaʻa, or Black Rock, about a mile and a half south of the Project Site, so it is anticipated that there will be little or no impacts from taking No Action to halt erosion at Honokōwai Beach in the short-term.

Long-Term: Turbidity plumes relating to extensive erosion in the past were observed to be substantial, extending far offshore, with large volumes of sediment being carried for some distance in the currents. If erosion of the backshore continues there is likely to be increased turbidity that may even cause lower water quality and visibility over the long-term, which might make it difficult and more dangerous to navigate a vessel in the nearshore waters of Honokōwai and downwind towards Kāʻanapali. That said, turbidity plumes from the Project Site have the slight chance of entering into the longshore currents and even perhaps drifting down towards Puʻu Kekaʻa, which may impact water quality along Kaʻanapali Beach as well. In that event, murky waters might impact thrill craft activities downwind of the Project Site. However, it is unlikely that the murky water would encroach upon the designated commercial thrill craft areas just off of the shoreline south of Hanakaʻōʻō Point, several miles to the south of the Project Site.

7.2.1.15 Water Sledding

Short-Term: This activity takes place in a designated location south of Puʻu Kekaʻa, or Black Rock, about a mile and a half south of the Project Site, so it is anticipated that there will be little or no impacts from taking No Action to halt erosion at Honokōwai Beach in the short-term.

Long-Term: Turbidity plumes relating to extensive erosion in the past were observed to be substantial, extending far offshore, with large volumes of sediment being carried for some distance in the currents. If erosion of the backshore continues there is likely to be increased turbidity that may even cause lower water quality and visibility over the long-term, which might make it difficult and more dangerous to navigate a vessel in the nearshore waters of Honokōwai and downwind towards Kāʻanapali. That said, turbidity plumes from the Project Site have the slight chance of entering into the longshore currents and even perhaps drifting down towards Puʻu Kekaʻa, which may impact water quality along Kaʻanapali Beach as well. In that event, murky waters might impact water sledding activities downwind of the Project Site.

7.2.2 Beach Nourishment

The Beach Nourishment alternative would consist of placing sand at the south end of the Honokōwai littoral cell without any structures to stabilize the sand. The sand would be placed along approximately 1,000 feet of shoreline between Honokōwai Stream and Honokōwai Point. The beach would have a crest elevation of +8.5 feet MSL and a beach slope of 1V:8H. This concept would require 27,000 cy of sand and would provide a minimum beach width of 40 feet.

Restoration of a beach by placing sand in an appropriately designed manner along a shoreline can be an effective and attractive means of mitigating beach loss and providing for recreational and aesthetic enjoyment. Choosing Beach Nourishment as an Alternative would likely have the result of slowing the erosion processes that would be expected to occur if the No Action Alternative were chosen. The added sands have the potential to increase the beach width and volume and perhaps temporarily slow the sand loss that occurs seasonally. A beach width of 40 feet or more would positively impact access from the southern boundary of the Project Site where the Maui Kai Condominium stairwell meets the beach. A crest elevation of +8.5 feet would have a positive

impact on beach access from the public access and sidewalk pathways fronting the public restrooms and parking area. The presence of sand has positive impacts for beachgoers in that they could continue to enjoy the aesthetics of the beach while engaging in their normal ocean recreation activities in and around the present Project Site.

However, how long the sand would remain is uncertain due to the unpredictable nature of singular extreme weather and large surf events that transport sand offshore. The erosion rate for non-stabilized beach fill could be very high. Worse, if large surf were to coincide with an extreme high tide, sand loss could occur rapidly as has been observed during former coinciding large surf and high tide events, and thus the long-term impacts of Beach Nourishment may be negligent because just one such event could transport a majority of the replenished sand offshore, negating the efforts, aesthetics, and positive impacts of this alternative.

Following one such catastrophic event, erosion might ensue in a similar manner as described in the No Action Alternative. Beach loss negatively impacts beach and ocean recreation activities, and along with the aesthetic loss of the beach, the value of the place is diminished as access becomes more dangerous. Even if no such large surf events occurred, over time, the seasonal push and pull of materials in the longshore currents would be exacerbated by the wave-cut banks, likely eroding the deposited sands by transporting a majority of it alongshore and offshore towards a place of deposition where it has likely exited the coastal circulation cell altogether. Indeed, it is possible that eventually, the beach could potentially disappear entirely, even if the beach sands were replenished at this time.

The short-term impacts of Beach Nourishment would be related to the processes of extracting sands from the Sand Recovery Site, delivering those sands by barge and then by truck, and placing the recovered sands within the present Project Site utilizing a bulldozer and other heavy construction equipment. Construction activities would limit access for beach and ocean patrons in both the Project Site as well as the Sand Recovery Site.

During sand recovery operations, minor turbidity is expected from the clamshell dredging operation as sand is brought from the seafloor to the barge. Depending on ocean conditions, such as wind and currents, the turbidity plume may extend inshore and impact water clarity in the snorkeling and diving areas around Puʻu Kekaʻa, including its north side, all of which is far outside of the Project Site.

Sand from the Sand Recovery Site, though compatible with the dry beach sand, will still have fine sand grains that will separate out of the beach system and move offshore during the initial seaward merging of the introduced sand to the existing beach sand. The fine sand grains may create nearshore turbidity plumes and impact the water clarity in the nearshore waters of Honokōwai Beach until currents flush them offshore.

However, while sand placement operations are occurring, silt curtains and containment barriers will be deployed along the shoreline to help reduce turbidity. Results of turbidity analysis by SE of the sand in the Sand Recovery Site indicate that following the placement of recovered sand, turbidity in the nearshore waters at the project site are expected to be elevated but are also expected to approach natural levels as the waves and currents carry away fine sand grains. Additional episodes of increased turbidity may occur over time as more placed sand is exposed and washed by waves.

Thus, designed properly, the impacts of Beach Nourishment would be positive in that the recovered sands placed on the beach would allow patrons safer passage from the beach access to

the shoreline and along the beach within and adjacent to the Project Site. Seasonal sand migration and associated erosion may still impact beach and ocean activities when the rocky seafloor substrate is exposed by natural processes such as waves and longshore currents, but perhaps not to the extent that taking No Action has, which would allow the erosion to continue unabated. The long-term impacts also have the potential to be positive, as described above, but a singular weather or surf event could take away all of the recovered sand at once, negating those positive impacts by exposing the hard substrate and backshore terrestrial materials. Again, when the sand is gone there are negative impacts because patrons are considered to be at higher risk through increased hazards which might cause injury to people and damage to equipment. It may even inhibit or halt people from accessing and engaging in these activities at all, lowering the value of Honokōwai beach to both beach patrons and residents fronting the shoreline there. Table 1 below highlights impacts to specific beach and ocean recreation activities.

7.2.2.1 *Sunbathing, Beach Walking, Gathering & Beachcombing*

Short-Term: At the Project Site, operational activities would directly but temporarily impact sunbathing, beach walking, beachcombing, and gathering activities and limit access for these patrons. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect wading as well as traditional gathering practices until the water clears. These activities do not occur within or near the Sand Recovery Site. Minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect gathering and beachcombing activities there.

Long-Term: Beach Nourishment has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, which has positive impacts for beachgoers. Beach Nourishment would also allow patrons safer passage from the public access to the shoreline and along the beach. However, one large surf and weather event could transport replenished sand offshore, causing erosion rates to increase. As the beach gets smaller, patrons will have increasingly less space to sunbathe or walk on the sand, and eventually they would potentially no longer be able to sit, walk, or even access the ocean if a total loss of beach were to occur. Beachcombing and traditional gathering practices would also be impacted negatively as the beach gets smaller, with less area for limu (seaweed), shells, and other items to collect on the sand. Eventually, with no beach, the limu and other items would not be able to collect, getting pushed back offshore by wave reflection and floating away in the current. It would mark the end of a long cultural tradition at Honokōwai Beach if limu and other ocean resources could no longer be gathered there because a beach no longer exists there.

7.2.2.2 *Swimming*

Short-Term: At the Project Site, operational activities would directly but temporarily impact swimming and affect access for these patrons. Recovered sands may create nearshore turbidity plumes that might affect swimmers until the water clears. Although the Sand Recovery Site is over half a mile offshore of Puʻu Kekaʻa, there is potential for swimmers to swim far offshore and into this area. Swimmers who make it out that far would have to alter their course to avoid operational activities. Minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect swimmers there.

Long-Term: Beach Nourishment has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, which has positive impacts for swimmers. Beach Nourishment would also allow patrons safer passage from the public access to the shoreline and

along the beach. However, one large surf and weather event could transport replenished sand offshore, causing erosion rates to increase. As the beach gets smaller, patrons will have an increasingly difficult time accessing the ocean over the rocky substrate. The hardened shoreline has the potential to increase current flow, which would create a more hazardous environment for swimmers. If erosion of the backshore continues there is likely to be increased turbidity that may even cause lower water quality and visibility over the long-term, which might discourage patrons from swimming there altogether. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to swimmers in or around the Sand Recovery Site.

7.2.2.3 Bodyboarding & Bodysurfing

Short-Term: At the Project Site, operational activities would directly but temporarily impact bodysurfing and bodyboarding and limit access for these patrons. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect bodysurfers and bodyboarders until the water clears. While bodysurfing and bodyboarding do not occur within or near the Sand Recovery Site, minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect bodysurfers and bodyboarders there.

Long-Term: Beach Nourishment has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, which has positive impacts for bodysurfers and bodyboarders. Beach Nourishment would also allow patrons safer passage from the public access to the shoreline and along the beach. However, one large surf and weather event could transport replenished sand offshore, causing erosion rates to increase. As the beach gets smaller, patrons will have increasingly less space to bodyboard or bodysurf unless they go further offshore. That said, the surfing breaks out there are shallow, so it would be difficult and more dangerous to ride waves, especially bodysurfing, due to the increased risk of impacting the coral reef resulting in lacerations or other injuries.

Backwash in the waves offshore would also increase due to wave reflection, lowering the quality of the ride and increasing risk of injury for those enthusiasts who do go further offshore to ride waves. Eventually, patrons would no longer be able to bodyboard or bodysurf the shorebreak there if a total loss of beach were to occur. If erosion of the backshore continues, turbidity plumes and murky waters associated with erosion might discourage patrons from bodyboarding or bodysurfing there altogether. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be no long-term impacts to bodysurfers and bodyboarders in or around the Sand Recovery Site.

7.2.2.4 Skimboarding

Short-Term: At the Project Site, operational activities would directly but temporarily impact skimboarding and limit access for these patrons. Recovered sands may create nearshore turbidity plumes that might affect skimboarders until the water clears. While skimboarding does not occur within or near the Sand Recovery Site, minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect skimboarders there.

Long-Term: Beach Nourishment has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, which has positive impacts for skimboarders.

Beach Nourishment would also allow patrons safer passage from the public access to the shoreline and along the beach. However, one large surf and weather event could transport replenished sand offshore, causing erosion rates to increase. As the beach gets smaller, patrons will have increasingly less space to skimboard on the sand, and eventually they would no longer be able to skimboard there if a total loss of beach were to occur. After sand recovery is completed and the turbidity from operational activities subsides, there is anticipated to be no long-term impacts to skimboarders in or around the Sand Recovery Site.

7.2.2.5 *Snorkeling, Free Diving and Scuba Diving*

Short-Term: At the Project Site, operational activities would directly but temporarily impact snorkeling and diving and limit access for these patrons. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect snorkelers and divers until the water clears. There is potential for snorkelers and divers to go by boat or swim far offshore and into the Sand Recovery Site. If so, they would have to alter their course to avoid operational activities. Minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect snorkeling and diving there.

Long-Term: Beach Nourishment has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, which has positive impacts for snorkelers and divers. Beach Nourishment would also allow patrons safer passage from the public access to the shoreline and along the beach. However, one large surf and weather event could transport replenished sand offshore, causing erosion rates to increase. As the beach gets smaller, patrons will have an increasingly difficult time accessing the ocean over the rocky seafloor substrate. The hardened shoreline has the potential to increase current flow, which would create a more hazardous environment for snorkelers and divers. If erosion of the backshore continues there is likely to be increased turbidity that may even cause lower water quality and visibility over the long-term, which might discourage patrons from snorkeling and diving there altogether. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to snorkeling and diving in or around the Sand Recovery Site.

7.2.2.6 *Boating*

Short-Term: Although there is no recreational launch site for boats within the Project Site, nor do commercial catamarans and monohull boats operate out of Honokōwai Beach, they transit the waters just offshore of the fringing reef within the Designated ORMA, as observed while on site visits. A recreational operator with a small vessel could potentially come near or into Project Site waters through the remnant stream channel at Honokōwai Beach, so sand placement operations are expected to temporarily impact boaters in and around the Project site. Recovered sands might create nearshore turbidity plumes and impact water clarity that might affect boating operations until the water clears.

A number of commercial catamarans and monohull boats pick up their passengers from Kāʻanapali Beach, south of the Project Site but in the vicinity of the Sand Recovery Site, so sand recovery operations are expected to temporarily impact this activity. Commercial vessels have a fair probability of passing through the Sand Recovery Site, especially if they pick up passengers at Kāʻanapali Beach or run commercial parasailing or water sledding operations. Recreational boaters transiting or participating in offshore ocean recreation activities may also enter or pass through the Sand Recovery Site as well, in addition to the Project Site in Honokōwai. If so, these operators would have to alter their course to avoid operational activities. Minor turbidity from the

dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect operational activities relating to commercial or recreational boating in the area.

Long-Term: Beach Nourishment has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, which has positive impacts for boaters who come close to shore. However, one large surf and weather event could transport replenished sand offshore, causing erosion rates to increase. If erosion of the backshore occurs, there is likely to be increased turbidity, and may lower water quality and visibility for nearshore boaters over the long-term. Turbidity and increased current would make nearshore boating operations more hazardous. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to boating operations in or around the Sand Recovery Site.

7.2.2.7 Standup Paddleboarding (SUP) & Kayaking

Short-Term: At the Project Site, operational activities would directly but temporarily impact standup paddleboarding (SUP) and kayaking and affect access for these patrons. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect standup paddleboarders and kayakers until the water clears. There is potential for standup paddleboarders and kayakers to go far offshore and into the Sand Recovery Site. If so, they would have to alter their course to avoid operational activities. Minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect standup paddleboarders and kayakers there.

Long-Term: Beach Nourishment has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, which has positive impacts for standup paddleboarders and kayakers. Beach Nourishment would also allow patrons safer passage from the public access to the shoreline and along the beach. However, one large surf and weather event could transport replenished sand offshore, causing erosion rates to increase. As the beach gets smaller, patrons will have an increasingly difficult time accessing the ocean over the rocky seafloor substrate. The hardened shoreline has the potential to increase current flow, which would create a more hazardous environment for standup paddleboarders and kayakers. If erosion of the backshore continues there is likely to be increased turbidity that may even cause lower water quality and visibility over the long-term, which might discourage patrons from standup paddleboarding or kayaking there altogether. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to standup paddleboarding or kayaking in or around the Sand Recovery Site.

7.2.2.8 Surfing

Short-Term: At the Project Site, operational activities would directly but temporarily impact surfing and affect access for these patrons. Recovered sands may create nearshore turbidity plumes and impact the water clarity that has the potential to affect surfers until the water clears. While surfing does not occur within or near the Sand Recovery Site, minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect surfers there.

Long-Term: Beach Nourishment has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, which has positive impacts for surfers. Beach

Nourishment would also allow patrons safer passage from the public access to the shoreline and along the beach. However, one large surf and weather event could transport replenished sand offshore, causing erosion rates to increase and potentially affect access to the surf breaks. If the sand recedes in front of the channel, surfers will have to walk out across the rocky seafloor substrate to reach deeper waters where they can paddle, so there is a higher risk of lacerations or other injuries for surfers accessing the surf.

Backwash in the waves offshore would also increase due to wave reflection, lowering the quality of the ride and increasing risk of injury for those surfers. Eventually, patrons would no longer be able to surf into the shorebreak or ride a wave to the beach if a total loss of beach were to occur. If erosion of the backshore continues there is likely to be increased turbidity that may even lower water quality and visibility over the long-term, which might discourage all but the most avid patrons from surfing there altogether, especially considering how many shark attacks have occurred here–even in clear water conditions. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be no long-term impacts to surfers in or around the Sand Recovery Site.

7.2.2.9 *Fishing*

Short-Term: At the Project Site, operational activities would directly but temporarily impact fishing and affect access for these patrons. People would most likely not be able to fish in the area while operations were occurring, they would need to move up or down the shoreline and fish elsewhere. Even then, recovered sands may create nearshore turbidity plumes that might impact fishermen until the water clears. There is potential for fishermen to go by boat, kayak, or other vessel offshore and into the Sand Recovery Site. If so, they would have to alter their course to avoid operational activities. Short-term impacts are anticipated to the Kona crab community at the Sand Recovery Site. Minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect fishermen there.

Long-Term: Beach Nourishment has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, which has positive impacts for fishermen. Beach Nourishment would also allow patrons safer passage from the public access to the shoreline and along the beach. However, one large surf and weather event could transport replenished sand offshore, causing erosion rates to increase. As the beach gets smaller, patrons will have increasingly less space to fish on the sand, and eventually, fishermen will have to retreat to the nearest shoreline if a total loss of beach were to occur, most likely onto the handicap pathway or into the private property behind the former beach. The hardened shoreline has the potential to increase current flow and allow waves to crash against the backshore in an unexpected manner as well, which, along with an unstable rocky shoreline, would create a more hazardous environment for fishermen attempting to set poles and tend to them while fishing–especially at night.

If erosion of the backshore continues there is likely to be increased turbidity that may even cause lower water quality and visibility over the long-term, which might discourage patrons from fishing there altogether. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to fishing in or around the Sand Recovery Site. Also, based on previous studies, long-term, secondary, and cumulative impacts on Kona crab populations are not anticipated either.

7.2.2.10 Kitesurfing & Wingfoiling

Short-Term: At the Project Site, operational activities would directly but temporarily impact kitesurfing and wingfoiling and affect access for these patrons. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect kitesurfers and wingfoilers until the water clears. There is potential for kitesurfers or wingfoilers to sail offshore and into the Sand Recovery Site. If so, they would have to alter their course to avoid operational activities. Minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect kitesurfers and wingfoilers there.

Long-Term: Beach Nourishment has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, which has positive impacts for kitesurfers and wingfoilers. Beach Nourishment would also allow patrons safer passage from the public access to the shoreline and along the beach. However, one large surf and weather event could transport replenished sand offshore, causing increased erosion and more difficulty accessing the deeper waters further offshore that are necessary for foilers to avoid collision with a shallow seafloor. If the sand recedes in front of the channel, kitesurfers and wingfoilers will have to walk out across the rocky seafloor substrate to reach deeper waters where they can paddle or launch, so there is a higher risk of lacerations or other injuries for them. If erosion of the backshore continues there is likely to be increased turbidity that may even cause lower water quality and visibility over the long-term, which might discourage patrons from kitesurfing or wingfoiling there altogether. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to kitesurfing or wingfoiling in or around the Sand Recovery Site.

7.2.2.11 Cliff Diving & Jumping

Short-Term: Cliff diving/jumping does not occur at the Project Site or within the Sand Recovery Site because there are no leaping points to enter the water from at either location. Cliff diving and jumping takes place on the low seacliff on the south side of Puʻu Kekaʻa, or Black Rock, south of the Project Site. Minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect cliff divers and people jumping there.

Long-Term: Again, cliff diving or jumping does not occur in or adjacent to the Project Site at Honokōwai. However, if erosion of the backshore eventually occurs, turbidity plumes from the Project Site have the slight chance of entering into the longshore currents and even perhaps drifting down towards Puʻu Kekaʻa, which may impact water quality along Kaʻanapali Beach as well. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to cliff divers and people jumping off Puʻu Kekaʻa.

7.2.2.12 One-person & six-person Outrigger Canoe Paddling

Short-Term: At the Project Site, operational activities would directly but temporarily impact outrigger canoe paddling and affect access for those patrons wanting to launch their canoes there. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect canoe paddlers until the water clears. There is potential for canoe paddlers to paddle offshore and into the Sand Recovery Site. In fact, because Hanakaʻōʻō Beach Park is where many canoe clubs launch and land, it is likely that various types of outrigger canoes might pass near or through the area. If so, these paddlers would have to alter their course to avoid operational

activities. Minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect paddlers in the area.

Long-Term: Beach Nourishment has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, which has positive impacts for canoe paddlers. Beach Nourishment would also allow patrons safer passage from the public access to the shoreline and along the beach. However, one large surf and weather event could transport replenished sand offshore, causing erosion rates to increase. As the beach gets smaller, patrons will have increasing difficulty accessing the deeper waters offshore, necessary for paddlers to avoid collision with the seafloor depending on the draft of their canoe. If the sand recedes in front of the channel, paddlers will have to walk their vessels out across the rocky seafloor substrate to reach deeper waters where they can launch and paddle, so there is a higher risk of lacerations or other injuries for them. If erosion of the backshore continues there is likely to be increased turbidity that may even cause lower water quality and visibility over the long-term, which might discourage patrons from launching or landing there altogether. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to canoe paddling in or around the Sand Recovery Site.

7.2.2.13 Parasailing

Short-Term: Parasailing does not take place in or near the Project Site at Honokōwai, but it it does take place in an assigned area about 1,000 feet west of the Sand Recovery Site outside the Designated ORMA boundary line of 3,000 feet, so sand recovery operations are expected to impact this activity. Commercial vessels offering parasailing have a fair probability of passing through the Sand Recovery Site, especially if they pick up passengers at Kāʻanapali Beach or run commercial parasailing operations within the assigned area offshore. Recreational boaters transiting or participating in offshore ocean recreation activities such as parasailing may also enter or pass through the area. If so, these vessel operators would potentially have to alter their course to avoid sand recovery operational activities. Minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect operational activities relating to parasailing in the area.

Long-Term: Again, parasailing does not occur in or adjacent to the Project Site at Honokōwai. However, if erosion of the backshore eventually occurs, turbidity plumes from the Project Site have the slight chance of entering into the longshore currents and even perhaps drifting down towards Puʻu Kekaʻa, which may impact water quality offshore from Kaʻanapali Beach as well. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to parasailing activities in the areas surrounding Puʻu Kekaʻa and the Sand Recovery Site.

7.2.2.14 Thrill Craft

Short-Term: Thrill craft operations do not take place in or near the Project Site at Honokōwai, but thrill craft operations are allowed to take place about 1,000 feet west of the Sand Recovery Site outside the Designated ORMA boundary line of 3,000 feet, so sand recovery operations are expected to impact this activity. Commercial vessels offering thrill craft will most likely not be passing through the Sand Recovery Site because the assigned commercial thrill craft zones are located south of Hanakaʻōʻō Point closer to shore. Recreational thrill craft operators transiting or participating in offshore ocean recreation activities with a thrill craft may enter or pass through the area. If so, these operators would have to alter their course to avoid sand recovery operational

activities. Minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect operational activities relating to thrill craft in the area.

Long-Term: Again, thrill craft operations do not occur in or adjacent to the Project Site at Honokōwai. However, if erosion of the backshore eventually occurs, turbidity plumes from the Project Site have the slight chance of entering into the longshore currents and even perhaps drifting down towards Puʻu Kekaʻa, which may impact water quality offshore of Kaʻanapali Beach as well. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to thrill craft operations in the areas offshore of Puʻu Kekaʻa and around the Sand Recovery Site.

7.2.2.15 Water Sledding

Short-Term: Water sledding does not take place in or near the Project Site at Honokōwai, but it appears that the Sand Recovery Site lies within the designated Water Sledding Zone at its northeastern boundary off of Puʻu Kekaʻa, so sand recovery operations are expected to impact this activity. Commercial vessels offering water sledding have a fair probability of passing through the Sand Recovery Site, especially if they pick up passengers at Kāʻanapali Beach or run commercial water sledding operations within the assigned area. Recreational boaters transiting or participating in offshore ocean recreation activities such as water sledding may also enter or pass through the area. If so, these operators would have to alter their course to avoid operational activities. Minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect operational activities relating to water sledding in the area.

Long-Term: Again, water sledding does not take place in or near the Project Site at Honokōwai Beach. However, if erosion of the backshore eventually occurs, turbidity plumes from the Project Site have the slight chance of entering into the longshore currents and even perhaps drifting down towards Puʻu Kekaʻa, which may impact water quality offshore of Kaʻanapali Beach as well. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to water sledding activities in the areas offshore of Puʻu Kekaʻa and around the Sand Recovery Site.

7.2.3 Beach Maintenance

Beach Maintenance involves recurring projects for the placement of additional sand to increase beach width and sand volume, and to offset the effects of erosion without modifying existing structures or installing any new structures. Choosing Beach Maintenance as an option would likely have the result of mitigating sand loss over time by slowing the erosion processes that would occur if No Action were taken, and replenishing sand as necessitated by the rate of sand loss. As with Beach Nourishment, the added sands have the potential to increase beach width and volume and perhaps even slow the sand loss that occurs seasonally, but would also be subject to rapid sand loss during extreme surf events. As a recurring project, Beach Maintenance has the potential to meet the project objective to maintain a stable beach for a period of 50 years, with renourishment being required approximately every 10 years, which would require a larger volume of sand than beach stabilization and beach nourishment and recurring sand recovery activities associated with beach renourishment. However, beach maintenance does not increase beach stability, nor does not improve lateral access between Honokōwai and North Kāʻanapali littoral cells. The erosion rate for non-stabilized beach fill could be so high that frequent renourishment

more often than every ten years might be required to maintain the desired beach width, or patrons will be impacted by beach erosion between each scheduled renourishment.

Each time operational activities occur to replenish beach sands, similar short-term impacts as described during Beach Nourishment would occur, though the volume of sand needing to be placed will vary on the rate of erosion between recurring operational activities. The short-term impacts of Beach Maintenance are similar to those of Beach Nourishment in relating to the processes of extracting sands from the Sand Recovery Site, delivering those sands by barge and then by truck, and placing the recovered sands within the present Project Site utilizing a bulldozer and other construction equipment. Construction activities would limit access for beach and ocean patrons in the Project Site, and may impact vessel operations and ocean recreation activities at the Sand Recovery Site as well.

During sand recovery operations, minor turbidity is expected from the clamshell dredging operation as sand is brought from the seafloor to the barge. Depending on ocean conditions, such as wind and currents, the turbidity plume may extend inshore and impact water clarity in the swimming, snorkeling, and scuba diving areas around Puʻu Kekaʻa, including its north side, all of which is far outside of the Project Site. Sand from the Sand Recovery Site, though compatible with the dry beach sand, will still have fine sand grains that will separate out of the beach system and move offshore during the initial seaward merging of the introduced sand to the existing beach sand. The fine sand grains may create nearshore turbidity plumes and impact the water clarity in the nearshore waters of Honokōwai Beach until currents flush them offshore.

Results of turbidity analysis by SE of the sand in the Sand Recovery Site indicate that following the placement of recovered sand, turbidity in the nearshore waters at the project site are expected to be elevated but are also expected to approach natural levels as the waves and currents carry away fine sand grains. Additional episodes of increased turbidity may occur over time as more placed sand is exposed and washed by waves. Again, the presence of sand has positive impacts for patrons and ocean recreation enthusiasts in that they could continue to engage in their beach and ocean recreation activities at normal levels in and around the Project Site except during and immediately after operations to replenish the beach. During these times, patrons may have to alter their normal beach and ocean recreation practices as necessary until conditions at the beach and in the ocean return to normal. Over the long-term, Beach Maintenance has a higher potential to maintain a stable beach for a longer period of time, thus, this alternative is considered to increase safety and offer more sustained positive impacts for beach and ocean patrons than Beach Nourishment as an alternative.

7.2.3.1 *Sunbathing, Beach Walking, Gathering & Beachcombing*

Short-Term: Each time operational activities occur at the Project Site, they would directly but temporarily impact sunbathing, beach walking, gathering and beachcombing activities and affect access for these patrons. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect wading as well as traditional gathering practices until the water clears. These activities do not occur within or near the Sand Recovery Site. Minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect gathering and beachcombing activities that occur along the shoreline of Kāʻanapali Beach.

Long-Term: Beach Maintenance has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss between each sand replenishment episode, which has positive impacts for beachgoers. Beach Maintenance would also allow patrons safer passage

from the public access to the shoreline and along the beach in the long term. However, one large surf and weather event could transport replenished sand offshore, causing erosion rates to increase. As the beach gets smaller between sand replenishment episodes, patrons will have increasingly less space to recreate on the sand, and at certain points they might potentially no longer be able to sit, walk, or even access the ocean if a total loss of beach were to occur.

Beachcombing and traditional gathering practices would also be impacted negatively as the beach gets smaller, with less area for limu (seaweed), shells, and other items to collect on the sand. If the beach does disappear between beach replenishment episodes, the limu and other items would not be able to collect, getting pushed back offshore by wave reflection and floating away in the current, at least until the beach is replenished once again at the end of the 10-year period or with emergency mitigation efforts occurring sooner than that following a large surf and weather event, or due to other unexpected weather and climate factors over time.

7.2.3.2 *Swimming*

Short-Term: Each time operational activities occur at the Project Site, they would directly but temporarily impact swimming and affect access for these patrons. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect swimmers until the water clears. Although the Sand Recovery Site is over half a mile offshore of Puʻu Kekaʻa, there is potential for swimmers to swim far offshore and into the Sand Recovery Site. If so, they would have to alter their course to avoid operational activities. Minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect swimmers there.

Long-Term: Beach Maintenance has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss between each sand replenishment episode, which has positive impacts for swimmers. Beach Maintenance would also allow patrons safer passage from the public access to the shoreline and along the beach in the long term. However, one large surf and weather event could transport replenished sand offshore, causing erosion rates to increase. As the beach gets smaller between sand replenishment episodes, patrons will have an increasingly difficult time accessing the ocean over the rocky substrate.

The hardened shoreline has the potential to increase current flow, which would create a more hazardous environment for swimmers. If erosion of the backshore continues there is likely to be increased turbidity that may lower water quality and visibility until the next sand replenishment occurs, which might discourage patrons from swimming there until the sand is replenished. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to swimmers in or around the Sand Recovery Site until the next sand recovery operation takes place.

7.2.3.3 *Bodyboarding & Bodysurfing*

Short-Term: Each time operational activities occur at the Project Site, they would directly but temporarily impact bodysurfing and bodyboarding and affect access for these patrons. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect bodysurfers and bodyboarders until the water clears. While bodysurfing and bodyboarding do not occur within or near the Sand Recovery Site, minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect bodysurfers and bodyboarders there.

Long-Term: Beach Maintenance has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss between each sand replenishment episode, which has positive impacts for bodysurfers and bodyboarders. Beach Maintenance would also allow patrons safer passage from the public access to the shoreline and along the beach in the long term. However, one large surf and weather event could transport replenished sand offshore, causing erosion rates to increase. As the beach gets smaller, patrons will have increasingly less space to bodyboard or bodysurf unless they go further offshore. However, the surfing breaks out there are shallow, so it would be difficult and more dangerous to ride waves due to the risk of impacting the coral reef resulting in lacerations or other injuries until the next sand replenishment occurs.

Backwash in the waves offshore would also increase due to wave reflection, lowering the quality of the ride and increasing risk of injury for those enthusiasts who do go further offshore to ride waves. If erosion of the backshore continues there is likely to be increased turbidity that may even cause lower water quality and visibility over the long-term, which might discourage patrons from bodyboarding or bodysurfing there altogether. Eventually, patrons would no longer be able to bodyboard or bodysurf the shorebreak there if a total loss of beach were to occur. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be no long-term impacts to bodysurfers and bodyboarders in or around the Sand Recovery Site until the next sand recovery operation takes place.

7.2.3.4 *Skimboarding*

Short-Term: Each time operational activities occur at the Project Site, they would directly but temporarily impact skimboarding and affect access for these patrons. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect skimboarders until the water clears. While skimboarding does not occur within or near the Sand Recovery Site, minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect skimboarders there.

Long-Term: Beach Maintenance has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss between each sand replenishment episode, which has positive impacts for skimboarders. Beach Maintenance would also allow patrons safer passage from the public access to the shoreline and along the beach unless replenished sand gets pulled offshore, causing erosion rates to increase until the next sand replenishment occurs. As the beach gets smaller, patrons will have increasingly less space to skimboard on the sand, and eventually they would not be able to skimboard there if a total loss of beach were to occur. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to skimboarders on Kaʻanapali Beach until the next sand recovery operation takes place.

7.2.3.5 *Snorkeling, Free Diving, and Scuba Diving*

Short-Term: Each time operational activities occur at the Project Site, they would directly but temporarily impact snorkeling and diving and affect access for these patrons. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect snorkelers and divers until the water clears. There is potential for snorkelers and divers to go by boat or swim offshore and into the Sand Recovery Site. If so, they would have to alter their course to avoid operational activities. Minor turbidity from the dredging process may extend inshore and

impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect snorkelers and divers there.

Long-Term: Beach Maintenance has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss between each sand replenishment episode, which has positive impacts for snorkelers and divers. Beach Maintenance would also allow patrons safer passage from the public access to the shoreline and along the beach unless replenished sand gets pulled offshore, causing erosion rates to increase until the next sand replenishment occurs. As the beach gets smaller, patrons will have an increasingly difficult time accessing the ocean over the rocky seafloor substrate, and the hardened shoreline has the potential to increase current flow, which would create a more hazardous environment for snorkelers and divers. If erosion of the backshore continues there is likely to be increased turbidity, which might discourage patrons from snorkeling and diving there until the sand is replenished. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to snorkeling and diving in or around the Sand Recovery Site until the next sand recovery operation takes place.

7.2.3.6 *Boating*

Short-Term: Although there is no recreational launch site for boats within the Project Site, nor do commercial catamarans and monohull boats operate out of Honokōwai Beach, they transit the waters just offshore of the fringing reef within the Designated ORMA, as observed during site visits. A recreational operator with a small vessel could potentially come near or into Project Site waters through the remnant stream channel at Honokōwai Beach, so Beach Maintenance operations are expected to impact boaters in and around the Project site. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect boating operations each time sand placement activities occur at the Project Site.

A number of commercial catamarans and monohull boats pick up their passengers from Kāʻanapali Beach in the vicinity of the Sand Recovery Site, so sand recovery operations are expected to impact this activity. Commercial vessels have a fair probability of passing through the Sand Recovery Site, especially if they pick up passengers at Kāʻanapali Beach or run commercial ocean recreation operations. Recreational boaters transiting or participating in offshore ocean recreation activities may also enter or pass through the Sand Recovery Site as well. If so, these operators would have to alter their course to avoid operational activities. Minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect operational activities relating to commercial or recreational boating in the area each time sand recovery operations occur.

Long-Term: Beach Maintenance has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss between each sand replenishment episode, which has positive impacts for boaters who approach the shoreline. However, one large surf and weather event could transport replenished sand offshore, causing erosion rates to increase until the next sand replenishment occurs. If erosion of the backshore continues there is likely to be increased turbidity that may temporarily lower water quality and visibility for nearshore boaters. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to boating operations in the areas offshore of Puʻu Kekaʻa or near the Sand Recovery Site until the next sand recovery operation takes place.

7.2.3.7 Standup Paddleboarding (SUP) & Kayaking

Short-Term: Each time operational activities occur at the Project Site, they would directly but temporarily impact standup paddleboarding (SUP) and kayaking and affect access for these patrons. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect standup paddleboarders and kayakers until the water clears. There is potential for standup paddleboarders and kayakers to paddle far offshore and into the Sand Recovery Site. If so, they would have to alter their course to avoid operational activities. Minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect standup paddleboarders and kayakers there.

Long-Term: Beach Maintenance has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss between each sand replenishment episode, which has positive impacts for standup paddleboarders and kayakers. Beach Maintenance would also allow patrons safer passage from the public access to the shoreline and along the beach unless replenished sand gets pulled offshore, causing erosion rates to increase until the next sand replenishment occurs. As the beach gets smaller, patrons will have an increasingly difficult time accessing the ocean over the rocky seafloor substrate, and the hardened shoreline has the potential to increase current flow, which would create a more hazardous environment for standup paddleboarders and kayakers until the sand is replenished. If erosion of the backshore continues there is likely to be increased turbidity, which might discourage patrons from standup paddleboarding or kayaking there until the sand is replenished. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to standup paddleboarding or kayaking in or around the Sand Recovery Site until the next sand recovery operation takes place.

7.2.3.8 Surfing

Short-Term: Each time operational activities occur at the Project Site, they would directly but temporarily impact surfing and affect access for these patrons. Recovered sands may create nearshore turbidity plumes and impact the water clarity in the nearshore waters off Honokōwai Beach that has the potential to affect surfers until the water clears. These activities do not occur within or near the Sand Recovery Site, but during sand recovery operations offshore of Puʻu Kekaʻa, minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect surfers there.

Long-Term: Beach Maintenance has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss between each sand replenishment episode, which has positive impacts for surfers. Beach Maintenance would also allow patrons safer passage from the public access to the shoreline and along the beach. However, one large surf and weather event could transport replenished sand offshore, causing erosion rates to increase until the next sand replenishment occurs. As the beach gets smaller, patrons will have increasinging difficulty accessing the surf breaks offshore. If the sand recedes in front of the channel, surfers will have to walk out across the rocky seafloor substrate to reach deeper waters where they can paddle, so there is an increased risk of lacerations or other injuries for surfers until the sand is replenished.

If the sand disappears between sand replenishment episodes, backwash in the waves offshore would also increase due to wave reflection, lowering the quality of the ride and increasing risk of injury for those enthusiasts who go offshore to ride waves. Eventually, patrons would no longer be able to surf into the shorebreak or ride a wave to the beach if a total loss of beach were to occur. If erosion of the backshore continues there is likely to be an increased turbidity that may

temporarily lower water quality and visibility. These kinds of turbidity plumes and murky waters would most likely discourage all but the most avid patrons from surfing there altogether, especially considering how many shark attacks have occurred in even the clear waters normally present there. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be no long-term impacts to surfers in the waters around Puʻu Kekaʻa until the next sand recovery operation takes place.

7.2.3.9 *Fishing*

Short-Term: Each time operational activities occur at the Project Site, they would directly but temporarily impact fishing and affect access for these patrons. People would most likely not be able to fish in the area while operations were occurring, they would need to move up or down the shoreline and fish elsewhere. Even then, recovered sands may create nearshore turbidity plumes and impact the water clarity in the nearshore waters of Honokōwai Beach. This might impact fishermen until the water clears. There is potential for fishermen to go by boat, kayak, or other vessels offshore and into the Sand Recovery Site. If so, they would have to alter their course to avoid operational activities.

Minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect fishermen in the area. Short-term impacts are anticipated to the Kona crab community at the Sand Recovery Site; fishermen might have to alter their location to avoid operations, but they would still be able to fish for Kona crab in the surrounding area.

Long-Term: Beach Maintenance has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss between each sand replenishment episode, which has positive impacts for fishermen. Beach Maintenance would also allow patrons safer passage from the public access to the shoreline and along the beach. However, one large surf and weather event could transport replenished sand offshore, causing erosion rates to increase. As the beach gets smaller, patrons will have increasingly less space to fish on the sand, and eventually, fishermen will have to retreat to the nearest shoreline if a total loss of beach were to occur, most likely onto the handicap pathway or into the private property behind the former beach. The hardened shoreline has the potential to increase current flow and allow waves to crash against the backshore in an unexpected manner as well, which, along with an unstable rocky shoreline, would create a more hazardous environment for fishermen attempting to set poles and tend to them while fishing–especially at night, at least until the next sand replenishment occurs.

If erosion of the backshore continues there is likely to be increased turbidity that may temporarily lower water quality and visibility, which might discourage patrons from fishing there until the sand is replenished again. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to fishing in or around the Sand Recovery Site until the next sand recovery operation takes place. Also, based on previous studies, long-term, secondary, and cumulative impacts on Kona crab populations are not anticipated either.

7.2.3.10 *Kitesurfing & Wingfoiling*

Short-Term: Each time operational activities occur at the Project Site, they would directly but temporarily impact kitesurfing and wingfoiling, and affect access for these patrons. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect

kitesurfers and wingfoilers until the water clears. There is potential for kitesurfers or wingfoilers to sail offshore and into the Sand Recovery Site. If so, they would have to alter their course to avoid operational activities. Minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect kitesurfers and wingfoilers there.

Long-Term: Beach Maintenance has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss between each sand replenishment episode, which has positive impacts for kitesurfers and wingfoilers. Beach Maintenance would also allow patrons safer passage from the public access to the shoreline and along the beach unless replenished sand gets pulled offshore, causing erosion rates to increase until the next sand replenishment occurs. As the beach gets smaller between sand replenishment episodes, patrons will have an increasingly difficult time accessing the ocean over the rocky seafloor substrate, and the hardened shoreline has the potential to increase current flow, which would create a more hazardous environment for foilers. If the sand recedes in front of the channel, kitesurfers and wingfoilers will have to walk out across the rocky seafloor substrate to reach deeper waters where they can paddle or launch, so there is a higher risk of lacerations or other injuries for them. If erosion of the backshore continues there is likely to be increased turbidity that may temporarily lower water quality and visibility, which might discourage patrons from kitesurfing or wingfoiling there altogether until the sand is replenished. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to kitesurfing or wingfoiling in or around the Sand Recovery Site until the next sand recovery operation takes place.

7.2.3.11 Cliff Diving & Jumping

Short-Term: Cliff diving and jumping does not occur at the Project Site or within the Sand Recovery Site because there are no leaping points to enter the water from at either location. Cliff diving and jumping takes place on the low seacliff on the south side of Puʻu Kekaʻa, or Black Rock, south of the Project Site. During sand recovery operations offshore of Puʻu Kekaʻa, minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect cliff divers and people jumping there.

Long-Term: Again, parasailing does not occur at the Project Site or within the Sand Recovery Site, so there are no long term impacts anticipated unless erosion at the Project Site between sand replenishments was extensive and sustained, causing a slight chance that turbidity plumes drift downwind into the Kaʻanapali area until the next beach replenishment operation has occurred. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to cliff divers or people jumping off Puʻu Kekaʻa until the next sand recovery operation takes place.

7.2.3.12 One-person & six-person Outrigger Canoe Paddling

Short-Term: Each time operational activities occur at the Project Site, they would directly but temporarily impact outrigger canoe paddling and limit access for patrons wanting to launch their canoes there. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect canoe paddlers until the water clears. Because Hanakaʻōʻō Beach Park is where many canoe clubs launch and land, it is likely that various types of outrigger canoes might pass near or through the Sand Recovery Site. If so, these paddlers would have to alter their course to avoid operational activities. Minor turbidity expected from the dredging process may extend

inshore and impact water clarity in the waters around Puʻu Kekaʻa and downwind to the south, which could temporarily affect paddlers there.

Long-Term: Beach Maintenance has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss between each sand replenishment episode, which has positive impacts for canoe paddlers. Beach Maintenance would also allow patrons safer passage from the public access to the shoreline and along the beach. However, one large surf and weather event could transport replenished sand offshore, causing erosion rates to increase until the next sand replenishment occurs. As the beach gets smaller, patrons will have increasingly less space to access the deeper waters further offshore, necessary for paddlers to avoid collision with the seafloor depending on the draft of their canoe.

If the sand recedes in front of the channel, paddlers will have to walk their vessels out across the rocky seafloor substrate to reach deeper waters where they can launch and paddle, so there is a higher risk of lacerations or other injuries for them until the sand is replenished. If erosion of the backshore continues there is likely to be increased turbidity that may lower water quality and visibility until the sand is replenished which may discourage patrons from launching or landing there altogether. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to canoe paddling in or around the Sand Recovery Site.

7.2.3.13 Parasailing

Short-Term: Parasailing does not take place in or near the Project Site at Honokōwai, but it does take place in an assigned area about 1,000 feet west of the Sand Recovery Site outside the Designated ORMA boundary line of 3,000 feet, so sand recovery operations are expected to impact this activity. Commercial vessels offering parasailing have a fair probability of passing through the Sand Recovery Site, especially if they pick up passengers at Kāʻanapali Beach or run commercial parasailing operations within the assigned area offshore. Recreational boaters transiting or participating in offshore ocean recreation activities such as parasailing may also enter or pass through the area. If so, these vessel operators would have to alter their course to avoid sand recovery operational activities. Minor turbidity is expected from the dredging process. Depending on ocean conditions, such as wind and currents, the turbidity plume may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa and to the south, which could temporarily affect operational activities relating to parasailing in the area.

Long-Term: Again, parasailing does not occur at the Project Site or within the Sand Recovery Site, so there are no long term impacts anticipated unless erosion at the Project Site between sand replenishments was extensive and sustained, causing a slight chance that turbidity plumes drift downwind into the Kaʻanapali area until the next beach replenishment operation has occurred. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to parasailing activities in the areas surrounding Puʻu Kekaʻa until the next sand recovery operation takes place.

7.2.3.14 Thrill craft

Short-Term: Thrill craft operations do not take place in or near the Project Site at Honokōwai, but thrill craft operations are allowed to take place about 1,000 feet west of the Sand Recovery Site outside the Designated ORMA boundary line of 3,000 feet, so sand recovery operations are expected to impact this activity. Commercial vessels offering thrill craft will most likely not be

passing through the Sand Recovery Site because the assigned commercial thrill craft zones are located south of Hanakaʻōʻō Point closer to shore. Recreational thrill craft operators transiting or participating in offshore ocean recreation activities with a thrill craft may enter or pass through the area. If so, these operators would have to alter their course to avoid sand recovery operational activities. Minor turbidity expected from the dredging process may extend inshore and temporarily impact water clarity in the waters around Puʻu Kekaʻa and downwind towards the south, which could temporarily affect operational activities relating to thrill craft in the area.

Long-Term: Again, parasailing does not occur at the Project Site or within the Sand Recovery Site, so there are no long term impacts anticipated unless erosion at the Project Site between sand replenishments was extensive and sustained, causing a slight chance that turbidity plumes drift downwind into the Kaʻanapali area until the next beach replenishment operation has occurred. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to thrill craft operations in the areas offshore of Puʻu Kekaʻa or downwind towards Hanakaʻōʻō Beach Park until the next sand recovery operation takes place.

7.2.3.15 Water Sledding

Short-Term: Water sledding does not take place in or near the Project Site at Honokōwai, but it appears that the Sand Recovery Site lies within the designated Water Sledding Zone at its northeastern boundary off of Puʻu Kekaʻa, so sand recovery operations are expected to impact this activity. Commercial vessels offering water sledding have a fair probability of passing through the Sand Recovery Site, especially if they pick up passengers at Kāʻanapali Beach or run commercial water sledding operations within the assigned area. Recreational boaters transiting or participating in offshore ocean recreation activities such as water sledding may also enter or pass through the area. If so, these operators would have to alter their course to avoid operational activities. Minor turbidity expected from the dredging process may extend inshore and impact water clarity in the waters offshore of Puʻu Kekaʻa, which could temporarily affect operational activities relating to water sledding in the area.

Long-Term: Again, parasailing does not occur at the Project Site or within the Sand Recovery Site, so there are no long term impacts anticipated unless erosion at the Project Site between sand replenishments was extensive and sustained, causing a slight chance that turbidity plumes drift downwind into the Kaʻanapali area until the next beach replenishment operation has occurred. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to water sledding activities in the areas offshore of Puʻu Kekaʻa until the next sand recovery operation takes place.

7.2.4 Beach Stabilization

For the Beach Stabilization Alternative, the use of rock rubble mound groins to compartmentalize the beach and stabilize the sand is being recommended. The beach stabilization alternative would consist of beach nourishment and construction of three T-head groins and one L-head groin. The project spans approximately 1,000 feet of shoreline. The beach and groin layout is shown earlier in Figure 2-5 of this report. The groins would be spaced between 330 and 340 feet apart from southwest to northeast. The groins would extend between 220 and 250 feet from the existing backshore. The heads would extend between 72 and 84 feet to either side of the stem, at angles ranging from 90˚ to 120˚ in order to best orient the gaps between heads parallel to the typical wave approach. This alternative would require approximately 33,000 cy of sand. The volume of sand required will depend on the condition of the beach at the time of construction.

It is important to note that this particular alternative is intended to restore the shoreline to a similar state as prior to the erosion events that have occurred in the last decade, and thus such action is considered by some to be restorative towards the recreational uses that beach erosion has interrupted there in the past decade. The most recent Coastal Engineering Assessment report prepared by SE indicates that Beach Stabilization meets the project objective to maintain a stable beach for a period of 50 years. Because the beach would be stable, future erosion rates would be significantly reduced. The beach would be less vulnerable to episodic erosion events as well. Also, the cumulative impacts are less than Beach Maintenance as an alternative because a stable beach would require less sand recovery over the long term, and the impacts of operational activities to stabilize the beach would not be recurring.

In the short-term, Beach Stabilization has a greater impact on the area and its uses than Beach Nourishment or Beach Maintenance due to the longer duration of the operational activities as well as the construction of beach stabilization measures extending over 200 feet offshore, thus impacting a greater area of the coastline as well as the surfing breaks offshore during operational activities.

Some of the short-term impacts are similar to the other alternatives, such as those relating to the processes of extracting sands from the Sand Recovery Site, delivering those sands by barge and then by truck, and placing the recovered sands within the present Project Site utilizing a bulldozer and other heavy construction equipment. Of those alternatives, Beach Stabilization would require the most sand extracted from the Sand Recovery Site, and would likewise place and distribute the most sand on the beach at one time. The erosion rate for stabilized beach fill is likely to be much lower than that of a non-stabilized beach, and renourishment would most likely not be required to maintain the desired beach width because of the T-head groins. In the case of Beach Maintenance, more sand would have to be recovered over the long-term due to the need to periodically place more sand on the non-stabilized beach over that 50 year period.

During sand recovery operations, minor turbidity is expected from the clamshell dredging operation as sand is brought from the seafloor to the barge. Depending on ocean conditions, such as wind and currents, the turbidity plume may extend inshore and impact water clarity in the snorkeling and scuba diving areas around Puʻu Kekaʻa, including its north side, all of which is far outside of the Project Site. More sand being extracted will likely take a longer amount of time as well, create more turbidity, and cause more sedimentation over time, which has the potential to impact marine uses in the Sand Recovery Site for that longer duration of time.

Sand from the Sand Recovery Site, though compatible with the dry beach sand, will still have fine sand grains that will separate out of the beach system and move offshore during the initial seaward merging of the introduced sand to the existing beach sand. The fine sand grains may create nearshore turbidity plumes and impact the water clarity in the nearshore waters of Honokōwai Beach until currents flush them offshore. In the Project Site, the higher volume of placed sand associated with this alternative, as well as sediments relating to building the rubble mound groins, may cause turbidity for a longer duration as this introduced sediment and the larger volume of sand is exposed to natural processes that wash the land and clean the sand.

In all of the alternatives assessed in this report, operational activities would limit access for beach and ocean patrons in both the Project Site as well as the Sand Recovery Site for the duration of the project activities. During these times, patrons might have to alter their normal beach and

ocean recreation practices as necessary until construction activities are completed and environmental conditions at the beach and in the ocean return to normal.

As an alternative, Beach Stabilization has the longest duration as a one-time project, and the short-term impacts would last at least the duration of the operational activities. However, SE has indicated that while groin construction and sand placement operations are occurring, silt curtains and containment barriers will be deployed along the shoreline to help reduce turbidity. Results of turbidity analysis by SE of the sand in the Sand Recovery Site indicate that following the placement of recovered sand, turbidity in the nearshore waters at the project site are expected to be elevated but are also expected to approach natural levels as the waves and currents carry away fine sand grains.

Over the long-term, Beach Stabilization has the highest potential to maintain a stable beach for a longer period of time–perhaps meeting the project objective of 50 years, thus, this alternative is considered to increase safety overall and offer more sustained positive impacts for beach and ocean patrons than Beach Nourishment or Beach Stabilization as alternatives. Again, the presence of sand has positive impacts for beachgoers and ocean recreation enthusiasts in that they can continue to engage in their beach and ocean recreation activities at normal levels in and around the Project Site. Beach Stabilization may even offer improved environmental conditions and increased opportunities for some ocean recreation activities as well. Noting that fishermen often take advantage of constructed groins and piers to get as far offshore as possible for casting purposes, there may be an added advantage for shorecasting activities, though it should be noted that there are hazards associated with unexpected surf events that could endanger any such patrons who are sitting or standing at or near the end of one or another groin.

A stable beach with a naturalized slope provides a more sandy access for patrons entering and exiting the water with less risk of injury or damage to equipment from exposed rocks or rocky seafloor substrate. It is also expected to reduce the intensity of the dangerous rip currents that presently run along shore and out the remnant stream channel fronting the Project Site. It is thought that there will also potentially be less current flow between the groins where the sand is compartmentalized, making it safer for patrons who decide to go into the ocean there.

Wave reflection moving back out into the offshore surfing breaks exists at present, even with beach sands accumulated towards the south end of the Project Site. A notably steeper beach berm slope existed after the first north swell this season in September of 2024. Engineered correctly, some of that wave reflection would be dissipated by the rubblemound groins placed to compartmentalize and stabilize the beach, although any hardened shoreline would cause some amount of reflection. It would also dissipate some wave action in the shorebreak between the groins as wave energy is deflected by the outermost tip of these T-groins and L-groins.

Based on observations, this alternative being considered would extend into the shoreward edge of the surfing breaks offshore, but only near the end of the surfing course where the waves dissipate or rear up and close-out across the beach. In that way, Beach Stabilization could be considered to have the greatest potential impact on surfers in the long-term, causing a surfer to have to end the riding of a wave in proximity to the T-head groins, or navigate between the T-groins to get to shore. This assessment is difficult to make with any surety because it wholly depends on swell size and direction; patrons should always be aware of wave energy surging in and out of the nearshore waters and onto the beachfront, especially where groins might cause unexpected wave refraction, reflection, and convergence.

It is important to note that even with the groins, this Beach Stabilization alternative does not facilitate sand exchange between Honokōwai and North Kāʻanapali littoral cells. That would require additional beach stabilization measures fronting Maui Kai Condominiums, which are adjacent to but south of the present Project Site. Likewise, Beach Stabilization for this project would not improve lateral access between Honokōwai and North Kāʻanapali littoral cells beyond possibly supporting the northern stairwell of the Maui Kai Condominium through the placement of sand within the southernmost rubble mound groin adjacent to that property.

7.2.4.1 *Sunbathing, Beach Walking, Gathering & Beachcombing*

Short-Term: At the Project Site, operational activities would directly but temporarily impact sunbathing, beach walking, gathering and beachcombing activities and affect access for these patrons. Beach Stabilization would impact the gathering and beachcombing activities in the shorebreak and just offshore as well. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect gathering and beachcombing activities until the water clears. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect wading as well as traditional gathering practices until the water clears. While sunbathing, beach walking, gathering and beachcombing activities do not occur within or near the Sand Recovery Site, minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect sunbathing, beach walking, gathering and beachcombing activities there.

Long-Term: A stabilized beach is anticipated to offer similar opportunities for sunbathing, beach walking, beachcombing, and gathering activities as before the episodic erosion events of the past decade. With sand present between the groins, the compartmentalized beach would allow beachgoers to continue to engage in sunbathing, beach walking, beachcombing, and gathering activities on a stabilized beach. The groins also have the potential to interrupt longshore current flow in a manner that lowers the risk of people wading in the shallows. After sand recovery is completed and the turbidity from operational activities subsides, there is anticipated to be no long-term impacts to sunbathing, beach walking, beachcombing, and gathering activities in or around the Sand Recovery Site.

7.2.4.2 *Swimming*

Short-Term: At the Project Site, operational activities would temporarily impact swimming and affect access for these patrons. Beach Stabilization would impact the swimming areas in the shorebreak and just offshore. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect swimmers until the water clears. Although the Sand Recovery Site is over half a mile offshore of Puʻu Kekaʻa, there is potential for swimmers to swim far offshore and into this area. If so, they would have to alter their course to avoid operational activities. Minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect swimmers there.

Long-Term: A stabilized beach is anticipated to offer similar opportunities for swimming activities as before the episodic erosion events of the past decade. The compartmentalized beach would allow swimmers safer access to the ocean, and the groins have the potential to interrupt longshore current flow that may lower the risk for swimmers. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to swimmers in or around the Sand Recovery Site.

7.2.4.3 Bodyboarding & Bodysurfing

Short-Term: At the Project Site, operational activities would temporarily impact bodysurfing and bodyboarding and affect access for patrons. Beach Stabilization would impact the bodyboarding and bodysurfing areas in the shorebreak and just offshore. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect bodysurfers and bodyboarders until the water clears. While bodysurfing and bodyboarding do not occur within or near the Sand Recovery Site, minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect bodysurfers and bodyboarders there.

Long-Term: A stabilized beach is anticipated to offer similar opportunities for bodyboarding and bodysurfing activities as before the episodic erosion events of the past decade. The compartmentalized beach would allow bodyboarders and bodysurfers safer access to the ocean to catch waves in the shorebreak or access the offshore surfing breaks. The distance between each groin will likely allow wave energy to reach shore, and with sand present between the groins, there is the potential for those waves to rise up and break in a suitable manner for bodysurfing and bodyboarding, ultimately landing the rider on a stabilized beach. The groins also have the potential to interrupt longshore current flow, which may lower the risk for bodyboarders and bodysurfers. After sand recovery is completed and the turbidity from operational activities subsides, there is anticipated to be no long-term impacts to bodysurfers and bodyboarders in or around the Sand Recovery Site.

7.2.4.4 Skimboarding

Short-Term: At the Project Site, operational activities would temporarily impact skimboarding and affect access for these patrons. Beach Stabilization would impact the skimboarding areas in the shorebreak. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect skimboarders until the water clears. While skimboarding does not occur within or near the Sand Recovery Site, minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect skimboarders there.

Long-Term: A stabilized beach is anticipated to offer similar opportunities for skimboarding activities as before the episodic erosion events of the past decade. The compartmentalized beach would allow skimboarders safer access to the ocean. The distance between each groin will likely allow wave energy to reach shore, and with sand present between the groins, there is the potential for those waves to rise up and break in a suitable manner for skimboarding, ultimately landing the rider on a stabilized beach. After sand recovery is completed and the turbidity from operational activities subsides, there is anticipated to be no long-term impacts to skimboarders in or around the Sand Recovery Site.

7.2.4.5 Snorkeling, Free Diving, and Scuba Diving

Short-Term: At the Project Site, operational activities would temporarily impact snorkeling and diving and affect access for these patrons. Beach Stabilization would impact the snorkeling and diving areas along the shoreline and just offshore. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect snorkelers and divers until the water clears. There is potential for snorkelers and divers to go by boat or swim offshore and into the Sand Recovery Site. If so, they would have to alter their course to avoid operational activities.

Minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect snorkeling and diving there.

Long-Term: A stabilized beach is anticipated to offer similar opportunities for snorkeling and diving activities as before the episodic erosion events of the past decade. The compartmentalized beach would allow snorkelers and divers safer access to the ocean and back to shore. The groins also have the potential to interrupt longshore current flow that may lower the risk for snorkelers and divers. After sand recovery is completed and the turbidity from operational activities subsides, there is anticipated to be no long-term impacts to snorkelers and divers in or around the Sand Recovery Site.

7.2.4.6 *Boating*

Short-Term: Although there is no recreational launch site for boats within the Project Site, nor do commercial catamarans and monohull boats operate out of Honokōwai Beach, they transit the waters just offshore of the fringing reef within the Designated ORMA, as observed while on site visits. A recreational operator with a small vessel could potentially come near or into Project Site waters through the remnant stream channel at Honokōwai Beach, so sand placement operations are expected to impact boaters in and around the Project site. Beach Stabilization has the longest duration of operational activities among the alternatives, as well as the largest scope of construction, thus impacting a greater area of the coastline as well as the boating areas just offshore during operational activities. Recovered sands may create nearshore turbidity plumes and temporarily impact the water clarity in the nearshore waters of Honokōwai Beach that might affect boating operations until the water clears.

A number of commercial catamarans and monohull boats pick up their passengers from Kāʻanapali Beach, south of the Project Site but in the vicinity of the Sand Recovery Site, so sand recovery operations are expected to impact this activity. Commercial vessels have a fair probability of passing through the Sand Recovery Site, especially if they pick up passengers at Kāʻanapali Beach or run commercial parasailing or water sledding operations. Recreational boaters transiting or participating in offshore ocean recreation activities may also enter or pass through the Sand Recovery Site as well, in addition to the Project Site in Honokōwai. If so, these operators would temporarily have to alter their course to avoid operational activities. During sand recovery operations, minor turbidity expected from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa and downwind towards the south, which could temporarily affect activities relating to commercial or recreational boating in the area.

Long-Term: A stabilized beach would be less vulnerable to episodic erosion events, thus allowing boating activities as before the episodic erosion events of the past decade. The compartmentalized beach would allow patrons safer access to the ocean, for instance if a person were to meet a boater just offshore of the beach, most likely in the channel. After sand recovery is completed and the turbidity from operational activities subsides, there is anticipated to be little to no long-term impacts to boating operations in the areas in and around the Sand Recovery Site.

7.2.4.7 *Standup Paddleboarding (SUP) & Kayaking*

Short-Term: At the Project Site, operational activities would temporarily impact standup paddleboarding and kayaking and affect access for these patrons. Beach Stabilization would impact the standup paddleboarding and kayaking areas in the shorebreak and just offshore. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might

affect standup paddleboarders and kayakers until the water clears. There is potential for standup paddleboarders and kayakers to go by boat or swim offshore and into the Sand Recovery Site. If so, they would have to alter their course to avoid operational activities. Minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect standup paddleboarders and kayakers there.

Long-Term: A stabilized beach is anticipated to offer similar opportunities for standup paddleboarding and kayaking activities as before the episodic erosion events of the past decade. The compartmentalized beach would allow standup paddleboarders and kayakers safer access to the ocean. The distance between each groin will allow wave energy to reach shore, and with sand present between the groins, there is the potential for those waves to rise up and break in a suitable manner for standup paddleboarding and kayaking in the surf, ultimately landing the rider on a stabilized beach. The groins also have the potential to interrupt longshore current flow that may lower the risk for standup paddleboarders and kayakers near shore. After sand recovery is completed and the turbidity from operational activities subsides, there is anticipated to be no long-term impacts to standup paddleboarders and kayakers in or around the Sand Recovery Site.

7.2.4.8 *Surfing*

Short-Term: At the Project Site, operational activities would temporarily impact surfing and affect access for these patrons. Beach Stabilization would impact the surfing areas in the shorebreak and just offshore. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect surfers until the water clears. While surfing does not occur within or near the Sand Recovery Site, minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect surfers there.

Long-Term: A stabilized beach is anticipated to offer similar opportunities for surfing activities as before the episodic erosion events of the past decade. The compartmentalized beach would allow surfers safer access to the ocean to catch waves in the shorebreak or access the offshore surfing breaks. It is worth noting that surfers now may ride a longer wave to reach the receded shoreline, but it fades in the extended shallows with exposed rocky seafloor beneath the rider, which poses extra risk of equipment damage, laceration, or injury if the surfer falls close to the present shoreline. Prior to the erosion events this inside area was for the most part covered by sand, though seasonal variations did occur then and now. The distance between each groin will likely allow wave energy to reach shore, and with sand present between the groins, there is the potential for those waves to rise up and break in a suitable manner for surfing, ultimately landing the rider on a stabilized beach. The groins also have the potential to interrupt longshore current flow that may lower risk for surfers near shore. After sand recovery is completed and the turbidity from operational activities subsides, there is anticipated to be no long-term impacts to surfers in or around the Sand Recovery Site.

7.2.4.9 *Fishing*

Short-Term: At the Project Site, operational activities would temporarily impact fishing and affect access for these patrons. Beach Stabilization would impact the fishing areas in the shorebreak and just offshore. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect fishermen until the water clears. There is potential for fishermen to go by boat, kayak, or other vessel offshore and into the Sand Recovery Site. If so, they would have to alter their course to avoid operational activities. Short-term impacts are

anticipated to the Kona crab community at the sand recovery site. Fishermen might have to alter their location to avoid sand recovery operations, but they would still be able to fish for Kona crab in the surrounding area. During operations, minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect fishermen there and around the Sand Recovery Site.

Long-Term: A stabilized beach is anticipated to offer similar opportunities for fishing activities as before the episodic erosion events of the past decade. The compartmentalized beach would allow fishermen safer access to the ocean where they could set up poles on a stabilized beach. The groins also have the potential to allow fishermen to cast their lines from a point further offshore, although any groin has the potential to create a more hazardous environment for fishermen attempting to set poles at the head of the groin and tend to them while fishing during large swell episodes, especially at night. After sand recovery is completed and the turbidity from operational activities subsides, there is anticipated to be no long-term impacts to fishermen in or around the Sand Recovery Site.

7.2.4.10 Kitesurfing & Wingfoiling

Short-Term: At the Project Site, operational activities would temporarily impact kitesurfing and wingfoiling and affect access for these patrons. Beach Stabilization would impact the kitesurfing and wingfoiling areas in the shorebreak and just offshore. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect kitesurfers and wingfoilers until the water clears. There is potential for kitesurfers or wingfoilers to sail offshore and into the Sand Recovery Site. If so, they would have to alter their course to avoid operational activities. During operations, minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect kitesurfers and wingfoilers there.

Long-Term: A stabilized beach is anticipated to offer similar opportunities for kitesurfing and wingfoiling as before the episodic erosion events of the past decade. The compartmentalized beach would allow kitesurfers and wingfoilers safer access to the ocean to catch waves in the shorebreak or access the offshore surfing breaks. The distance between each groin will likely allow wave energy to reach shore, and with sand present between the groins, there is the potential for those waves to rise up and break in a suitable manner for kitesurfers and wingfoilers to ride them, ultimately landing the rider on a stabilized beach. The groins also have the potential to interrupt longshore current flow, lowering the risk of kitesurfers and wingfoilers near shore. After sand recovery is completed and the turbidity from operational activities subsides, there is anticipated to be no long-term impacts to kitesurfers and wingfoilers in or around the Sand Recovery Site.

7.2.4.11 Cliff Diving & Jumping

Short-Term: Cliff diving/jumping does not occur at the Project Site or within the Sand Recovery Site because there are no leaping points to enter the water from at either location. Cliff diving and jumping takes place on the low seacliff on the south side of Puʻu Kekaʻa, or Black Rock, south of the Project Site. During sand recovery operations offshore of Puʻu Kekaʻa, minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect cliff divers and people jumping there.

Long-Term: Again, cliff diving and jumping does not occur at the Project Site or within the Sand Recovery Site, so there are no long-term impacts anticipated for these activities there. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to cliff divers and people jumping off Puʻu Kekaʻa.

7.2.4.12 One-person & six-person Outrigger Canoe Paddling

Short-Term: At the Project Site, operational activities would temporarily impact outrigger canoe paddling and affect access for these patrons. Beach Stabilization would impact the outrigger canoe paddling areas in the shorebreak and just offshore. Recovered sands may create nearshore turbidity plumes and impact the water clarity that might affect canoe paddlers until the water clears. There is potential for canoe paddlers to paddle offshore and into the Sand Recovery Site. In fact, because Hanakaʻōʻō Beach Park is where many canoe clubs launch and land, it is likely that various types of outrigger canoes might pass near or through the area. If so, these paddlers would have to alter their course to avoid operational activities. Minor turbidity from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa, which could temporarily affect canoe paddlers there.

Long-Term: A stabilized beach is anticipated to offer similar opportunities for outrigger canoe paddling activities as before the episodic erosion events of the past decade. The compartmentalized beach would allow paddlers safer access to the ocean, and back to shore. The groins have the potential to interrupt longshore current flow in a way that may lower the risk for paddlers near shore. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to canoe paddling in or around the Sand Recovery Site.

7.2.4.13 Parasailing

Short-Term: Parasailing does not take place in or near the Project Site at Honokōwai, so there are no long-term impacts anticipated for these activities there. Parasailing takes place in an assigned area about 1,000 feet west of the Sand Recovery Site outside the Designated ORMA boundary line of 3,000 feet, so sand recovery operations are expected to impact this activity. Commercial vessels offering parasailing have a fair probability of passing through the Sand Recovery Site, especially if they pick up passengers at Kāʻanapali Beach or run commercial parasailing operations within the assigned area offshore. Recreational boaters transiting or participating in offshore ocean recreation activities such as parasailing may also enter or pass through the area. If so, these vessel operators would have to alter their course to avoid sand recovery operational activities. During sand recovery operations offshore of Puʻu Kekaʻa, minor turbidity expected from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa and to the south, which could temporarily affect operational activities relating to parasailing in the area.

Long-Term: Again, parasailing does not occur at the Project Site or within the Sand Recovery Site, so there are no long-term impacts anticipated for these activities there. After sand recovery is completed and the turbidity from operational activities subsides, there is anticipated to be little to no long-term impacts to parasailing activities in the areas surrounding Puʻu Kekaʻa and the Sand Recovery Site.

7.2.4.14 Thrill craft

Short-Term: Thrill craft operations do not take place in or near the Project Site at Honokōwai, but thrill craft operations are allowed to take place about 1,000 feet west of the Sand Recovery Site outside the Designated ORMA boundary line of 3,000 feet, so sand recovery operations are expected to impact this activity. Commercial vessels offering thrill craft will most likely not be passing through the Sand Recovery Site because the assigned commercial thrill craft zones are located south of Hanakaʻōʻō Point closer to shore. Recreational thrill craft operators transiting or participating in offshore ocean recreation activities with a thrill craft may enter or pass through the area. If so, these operators would potentially have to alter their course to avoid sand recovery operational activities. Minor turbidity expected from the dredging process may extend inshore and impact water clarity in the waters around Puʻu Kekaʻa and downwind towards the south, which could temporarily affect operational activities relating to thrill craft in the area.

Long-Term: Again, thrill craft operations do not occur at the Project Site or within the Sand Recovery Site. After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to thrill craft operations in the areas offshore of Puʻu Kekaʻa or downwind towards Hanakaʻōʻō Beach Park.

7.2.4.15 Water Sledding

Short-Term: Water sledding does not take place in or near the Project Site at Honokōwai, but it appears that the Sand Recovery Site lies within the designated Water Sledding Zone at its northeastern boundary off of Puʻu Kekaʻa, so sand recovery operations are expected to impact this activity. Commercial vessels offering water sledding have a fair probability of passing through the Sand Recovery Site, especially if they pick up passengers at Kāʻanapali Beach or run commercial water sledding operations within the assigned area. Recreational boaters transiting or participating in offshore ocean recreation activities such as water sledding may also enter or pass through the area. If so, these operators would potentially have to alter their course to avoid operational activities. Minor turbidity expected from the dredging process may extend inshore and impact water clarity in the waters offshore of Puʻu Kekaʻa, which could temporarily affect operational activities relating to water sledding in the area as well.

Long-Term: After sand recovery is completed and the turbidity from operational activities subsides, there is anticipated to be little to no long-term impacts to water sledding activities in the areas offshore of Puʻu Kekaʻa or downwind towards Hanakaʻōʻō Beach Park.

7.3 Conclusion

7.3.1 Summary of Ocean Recreation and Safety Impacts Survey Results

In relation to the Coastal and Marine Uses Survey, multiple respondents stated that at least some sort of measures should be taken to halt the shoreline from eroding away at the present rate for reasons cited above, ranging from environmental damages relating to turbidity and sedimentation, to preservation of shoreline access for recreation, to infrastructure and property protection, to the hazardous debris and visual change left behind by a managed retreat where no mitigative actions are taken beyond removal of the temporary erosion structures.

Regarding Beach Stabilization in particular, some respondents welcomed the idea of erosion mitigation measures associated with Beach Stabilization for safety and continued recreational and

commercial use. In general, their reasoning followed that a stable beach creates better access across a sandy beach to an ocean with safer nearshore waters due to the interruption of the strong currents that exist there at present. Other respondents were concerned about the aesthetic impacts of Beach Stabilization and thought it might be visually too overwhelming of a change.

7.3.2 Summary of Potential Impacts on Coastal and Marine Uses

In summary, Beach Nourishment, Beach Maintenance, or Beach Stabilization is expected to have temporary short-term impacts on coastal and marine uses. Long-term impacts from these three alternatives to beach restoration will have to be observed over time, though some coral rubble and occasional turbidity from fine sand may occur when increased wave activity moves the recovered sands. No matter what, beach loss is expected to occur over time, the rate of which depends on the alternative chosen for beach restoration with regards to this project. If No Action is chosen as an alternative, erosion could potentially continue at its present rate, or even accelerate after each episode of extreme weather or surf. As one of only two unarmored areas along this coast, the south end of Honokōwai Beach and Honokōwai Park to the north would likely incur the most degradation of the shoreline in the shortest amount of time.

In a case where No Action is taken, for managed retreat to be successful, an extensive effort beyond the scope of this project might be necessary to remove all shoreline armory and all structures for some distance beyond the backshore along the entire Honokōwai littoral cell, and then perhaps the remaining backshore would still need to be reshaped in such a way as to encourage the natural processes to once again deposit sand along this coastline. This extensive strategy might potentially materialize as a success over the long-term, if at all, but the reshaped, unprotected shoreline would be subject to storms, extreme high tides, and even sea level rise over time, which might displace the accumulated sands and cause further erosion that could negate the work accomplished towards a managed retreat. With higher ocean waters approaching the level of coastal drowning in many areas of the islands, it is questionable as to whether any sands will return or whether the coastline would recover at all. Even a strategy that adopts managed retreat might require some level of operational or restorative effort to stabilize safely accumulated sands over time.

Beach Nourishment would offer a short-term fix, but eventually the sand would most likely be reclaimed by the ocean due to the degraded state of the Honokōwai and Kāʻanapali coastal circulation cells. Erosion would most likely ensue along the backshore, causing turbidity blooms. Beach Maintenance would repeat the same short-term fix as Beach Nourishment every 10 years and require the most sand over time. It would still be subject to extreme weather and surf events that could require repeated maintenance efforts more frequent than the 10-year period proposed, which might be more costly than other alternatives, but it would arguably better sustain the value of Honokōwai Beach to ocean recreation enthusiasts with the recurring sand replenishment efforts. That said, each time sand replenishment operational activities occur under Beach Nourishment, patrons' abilities to access the area would be inhibited, as would any recreational or commercial activities near the Sand Recovery Site, where patrons would need to alter course to avoid the operational activities there.

Beach Stabilization offers the best chances of reaching the project objective of creating a stable beach for a period of 50 years, but as an alternative action it might be considered to have the greatest physical and aesthetic impact to the coastline at Honokōwai other than taking no action at all beyond removal of the temporary erosion structures. Other long-term impacts of Beach Stabilization may include environmental changes that benefit patrons, including safer ocean access and more sand that allows for more ocean recreation opportunities along the shoreline.

Alterations to the present coastline may also create safer ocean conditions for patrons shortly after completion of construction if longshore currents are dissipated and diverted away from the channel by the work accomplished for this project.

By dissipating wave energy and longshore currents prior to reaching the remnant stream channel, Beach Stabilization would lessen the risk of beach patrons being swept offshore during episodes of surf that increase longshore currents, or being struck by a wave rearing up and breaking on the steep slope of an unarmored beach. Of course, any oceanic swell will cause waves to rise up along a shoreline, compartmentalized or not, so patrons should always be made aware of hazards at a beach through signage, education, and stewardship of Hawai‘i’s coastlines. In this way, the value of Honokōwai Beach to ocean recreation enthusiasts might be better sustained by the Beach Stabilization alternative.

7.4 Table 1: Summary of Potential Impacts from Each Alternative Action

Alternatives & Activities	No Action Taken	Beach Nourishment	Beach Maintenance	Beach Stabilization
Definitions of Alternative Actions	**No Action** would consist of not implementing any of the beach restoration alternatives and allowing Honokōwai Beach to continue to erode naturally. It is necessary to consider the cumulative impacts that may occur over a period of 50 years, which corresponds with the design life of the Beach Stabilization and Beach Maintenance alternatives.	**Beach Nourishment** refers to an individual action (Project) that involves placement of additional sand to increase beach width and sand volume to offset the effects of erosion without modifying existing structures or installing any new structures.	**Beach Maintenance** refers to a series of actions (Program) that consist of periodic beach nourishment combined with sand pushing and/or sand back passing, without modifying existing structures or installing any new structures. Beach maintenance actions are intended to be conducted on a recurring, periodic basis.	**Beach Stabilization** refers to an individual action (Project) that involves placement of sand to nourish the beach and either (i) modifying existing structures, and/or (ii) installing new structures (e.g., groins) to stabilize the sand, with a specified design life span considered as 50 years.
Sunbathing, Beach Walking, Ocean Wading, & Beachcombing	**Short-Term:** - Erosion would likely continue at a similar rate, negatively impacting beachgoers, sunbathers, beachcombers, and traditional gathering activities. - The rocky shoreline has the potential to impede beachgoers traversing through the public access. - Patrons will have increasingly less space to sunbathe or sit on the sand as the beach gets smaller.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact sunbathing, beach walking, gathering and beachcombing activities and limit access for beach and ocean patrons. - Recovered sands may create nearshore turbidity plumes and impact the water clarity. - In the Sand Recovery Area turbidity in the water is expected during sand recovery operations. - The impacts are unlikely to affect sunbathing, beach walking, gathering and beachcombing activities that occur along the shoreline of Kā'anapali Beach.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact sunbathing, beach walking, gathering and beachcombing activities and limit access for beach and ocean patrons at the Project Site. - Recovered sands may create nearshore turbidity plumes and impact the water clarity.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact sunbathing, beach walking, gathering and beachcombing activities and limit access for beach and ocean patrons. - Beach Stabilization has the longest duration of operational activities among the alternatives, as well as the largest scope of construction, thus impacting a greater area of the coastline as well as the shorebreak and surfing breaks offshore during operational activities. Patrons might have to go elsewhere to recreate. - Recovered sands may create nearshore turbidity plumes and impact the water clarity. - In the Sand Recovery Area turbidity in the water is expected during sand recovery operations. - The operations in the Sand Recovery Area and the Project Site are unlikely to affect sunbathing, beach walking, gathering and beachcombing activities that occur along the shoreline of Kā'anapali Beach.
Sunbathing, Beach Walking, Ocean Wading, & Beachcombing	**Long-Term:** - The beach could potentially disappear, negatively impacting patrons who attempt to walk the beach. - The shoreline might become inaccessible without sand, cutting off safe passage from the backshore. -With little to no beach, there would be less area for limu, shells, and other items to collect on the sand. - If the beach were to disappear, the limu and other items would most likely not be able to collect, getting pushed back offshore by wave reflection.	**Long-Term:** - Beach Nourishment has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, but the sand would be unstable and vulnerable to erosion. - There are positive impacts for beachgoers in that they could continue to engage in sunbathing, beach walking, beachcombing, and gathering activities in and around the present Project Site. - Beach Nourishment would also allow patrons safer passage from the public access to the shoreline and along the beach within and adjacent to the project area until replenished sands get pulled offshore. - Patrons will have increasingly less space to sunbathe or sit on the sand as the beach gets smaller. - The beach could potentially disappear, negatively impacting patrons who attempt to walk the beach. -With little to no beach, there would be less area for limu, shells, and other items to collect on the sand. - If the beach were to disappear, the limu and other items would most likely not be able to collect, getting pushed back offshore by wave reflection.	**Long-Term:** - Beach Maintenance has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, but the sand would be unstable and vulnerable to erosion. - There are positive impacts for beachgoers in that they could continue to engage in sunbathing, beach walking, beachcombing, and gathering activities in and around the present Project Site until replenished sands get pulled offshore between replenishment operations. - Beach Maintenance would also allow patrons safer passage from the public access to the shoreline and along the beach within and adjacent to the project area until replenished sands get pulled offshore. - Patrons will have to alter their course and activities each time sand replenishment operations occur. - The beach could become smaller and potentially disappear between sand replenishment episodes, negatively impacting patrons who attempt to walk the beach or gather along the shoreline. -With little to no beach, there would be less area for limu, shells, and other items to collect on the sand. - If the beach were to disappear, the limu and other items would most likely not be able to collect, getting pushed back offshore by wave reflection until the sand is replenished.	**Long-Term:** - Beach Stabilization has positive impacts for beachgoers in that the compartmentalized beach would allow them to continue sunbathing, beach walking, beachcombing, and practicing traditional gathering activities in and around the Project Site in a similar manner as before the past erosional events. - Beach Stabilization would also allow patrons safer passage from the public access to the shoreline and along the beach within and around the Project Site, though the groins may prompt an initial adjustment. - Future erosion rates would be significantly reduced, and the beach would be less vulnerable to episodic erosion events, creating long-term benefits for the coastline that allow for ocean recreation to continue. - The groins also have the potential to interrupt waves and longshore current flow in a manner that lowers the risk for people wading in the shallows getting knocked off their feet and pulled out in the rip currents. - Sunbathing, beach walking, gathering and beachcombing activities do not occur within or near the Sand Recovery Area, so there are little to no long-term impacts that are likely to affect these activities that occur along the shoreline of Kā'anapali Beach.
Swimming	**Short-Term:** - Erosion would likely continue at a similar rate, negatively impacting swimmers. - The rocky shoreline has the potential to impede beachgoers traversing to and from the backshore. - Turbidity plumes may occur in the ocean if waves or high tide reaches the backshore. - Patrons will have increasingly less space to access the ocean for swimming as the beach gets smaller.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact swimming activities and limit access for beach and ocean patrons who will have to go elsewhere. - Recovered sands may create nearshore turbidity plumes and impact the water clarity. - In the Sand Recovery Area turbidity in the water is expected during sand recovery operations. - Swimmers who enter the sand recovery area would have to alter their course to avoid operational activities.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact swimming activities and limit access for beach and ocean patrons who will have to go elsewhere each time sand replenishment operations occur at the Project Site. - Recovered sands may create nearshore turbidity plumes and impact the water clarity. - In the Sand Recovery Area turbidity in the water is expected each time sand recovery operations occur. - Swimmers who enter the sand recovery area would have to alter their course to avoid operational activities each time sand recovery operations occur.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact swimming activities and limit access for beach and ocean patrons, even for those patrons approaching from the water on a vessel. - Beach Stabilization has the longest duration of operational activities among the alternatives, as well as the largest scope of construction, thus impacting a greater area of the coastline as well as the shorebreak and surfing breaks offshore during operational activities. Patrons might have to go elsewhere to recreate. - Recovered sands may create nearshore turbidity plumes and impact the water clarity at the Project Site. - In the Sand Recovery Area turbidity in the water is expected during sand recovery operations. - Swimmers who enter the Sand Recovery Area would have to alter their course to avoid operational activities for sand recovery.
Swimming	**Long-Term:** - The shoreline might potentially become inaccessible, cutting off safe passage from the backshore. - The beach will likely get smaller, and could potentially disappear entirely, thus having a negative impact for swimmers by exposing many hazards for patrons who do attempt to swim at Honokōwai Beach. - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and visibility.	**Long-Term:** - Beach Nourishment has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, but the sand would be unstable and vulnerable to erosion. - There are positive impacts for beachgoers in that they could continue to engage in swimming activities in and around the present Project Site until the replenished sand gets pulled offshore. - Beach Nourishment would also allow patrons safer passage from the public access to the shoreline and along the beach within and adjacent to the project area until replenished sands get pulled offshore. - Patrons will have increasingly less space to access the ocean for swimming as the beach gets smaller. - The beach will likely get smaller, and could potentially disappear entirely, thus having a negative impact for swimmers by exposing many hazards for patrons who do attempt to swim at Honokōwai Beach. - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and visibility. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to swimmers in or around the Sand Recovery Area.	**Long-Term:** - Beach Maintenance has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, but the sand would be unstable and vulnerable to erosion between recurring replenishment operations. - There are positive impacts for beachgoers in that they could continue to engage in swimming activities in and around the present Project Site until the replenished sand gets pulled offshore between sand replenishment operations. - Beach Maintenance would also allow patrons safer passage from the public access to the shoreline and along the beach within and adjacent to the project area until replenished sands get pulled offshore. - The beach will likely get smaller between sand replenishment operations, and could potentially disappear entirely, thus having a negative impact for swimmers by exposing many hazards for patrons who do attempt to swim at Honokōwai Beach, until the next sand replenishment operation occurs. - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and visibility until the next sand replenishment operation occurs. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to swimmers in or around the Sand Recovery Area until the next time sand recovery operations occur.	**Long-Term:** - Beach Stabilization has positive impacts for beachgoers in that the compartmentalized beach would allow them to continue swimming in and around the Project Site in a similar manner as before the past erosional events. - Beach Stabilization would also allow patrons safer passage from the public access to the shoreline and along the beach within and around the Project Site, though the groins may prompt an initial adjustment. - Future erosion rates would be significantly reduced, and the beach would be less vulnerable to episodic erosion events, creating long-term benefits for the coastline that allow for ocean recreation to continue. - The groins also have the potential to interrupt waves and longshore current flow in a manner that lowers the risk for people swimming getting pulled out in the rip currents. - Beach Stabilization poses the biggest aesthetic change in the vessel composition of the shoreline, it may also change ocean entry points and alter ocean routes for swimmers who will have to adjust their course. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to swimmers in or around the Sand Recovery Area, or along the shoreline of Kā'anapali Beach.
Bodyboarding & Bodysurfing	**Short-Term:** - Erosion would likely continue at a similar rate, negatively impacting bodyboarders and bodysurfers. - The rocky shoreline has the potential to impede beachgoers traversing to and from the backshore. - Turbidity plumes may occur in the ocean if waves or high tide reaches the backshore. - Patrons will have increasingly less space to access the ocean for swimming as the beach gets smaller.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact bodysurfing and bodyboarding activities and limit access for beach and ocean patrons who will have to go elsewhere. - Recovered sands may create nearshore turbidity plumes and impact the water clarity. - In the Sand Recovery Area turbidity in the water is expected during sand recovery operations.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact bodysurfing and bodyboarding activities and limit access for beach and ocean patrons who will have to go elsewhere each time sand replenishment operations occur. - Recovered sands may create nearshore turbidity plumes and impact the water clarity. - In the Sand Recovery Area turbidity in the water is expected each time sand recovery operations occur.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact bodysurfing and bodyboarding activities and limit access for beach and ocean patrons. - Beach Stabilization has the longest duration of operational activities among the alternatives, as well as the largest scope of construction, thus impacting a greater area of the coastline as well as the shorebreak and surfing breaks offshore during operational activities. Patrons might have to go elsewhere to recreate. - Recovered sands may create nearshore turbidity plumes and impact the water clarity at the Project Site. - In the Sand Recovery Area turbidity in the water is expected during sand recovery operations.

Alternatives & Activities	No Action Taken	Beach Nourishment	Beach Maintenance	Beach Stabilization
Bodyboarding & Bodysurfing	**Long-Term:** - The shoreline might potentially become inaccessible, cutting off safe passage from the backshore - The beach will likely get smaller, and could potentially disappear entirely, thus having a negative impact by exposing many hazards for patrons who do attempt to bodyboard or bodysurf at Honokōwai Beach. - If there is little to no sand, patrons will have increasingly less space to bodyboard or bodysurf. - Backwash will likely increase due to wave reflection, lowering wave quality and increasing risk. - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and viability.	**Long-Term:** - Beach Nourishment has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, but the sand would be unstable and vulnerable to erosion. - There are positive impacts for beachgoers in that they could continue to engage in bodyboarding and bodysurfing activities in and around the present Project Site. - Beach Nourishment would also allow patrons safer passage from the public access to the shoreline and along the beach within and adjacent to the project area until replenished sands get pulled offshore. - The beach will likely get smaller, and could potentially disappear entirely, thus having a negative impact for patrons by exposing many hazards for patrons who do attempt to bodysurf or bodyboard at Honokōwai Beach. - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and viability. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to bodyboarding or bodysurfing in or around the Sand Recovery Area.	**Long-Term:** - Beach Maintenance has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, but the sand would be unstable and vulnerable to erosion between recurring sand replenishment operations. - There are positive impacts for beachgoers in that they could continue to engage in bodyboarding and bodysurfing activities in and around the Project Site until the replenished sand gets pulled offshore. - Beach Maintenance would also allow patrons safer passage from the public access to the shoreline and along the beach within and adjacent to the project area until replenished sands get pulled offshore. - The beach will likely get smaller, and could potentially disappear entirely, thus having a negative impact for patrons by exposing many hazards for patrons who do attempt to bodysurf or bodyboard at Honokōwai Beach until the next sand replenishment operation occurs. - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and viability until the next sand recovery operation occurs. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to bodyboarding or bodysurfing in or around the Sand Recovery Area until the next sand recovery operation occurs.	**Long-Term:** - Beach Stabilization has positive impacts for beachgoers in that the compartmentalized beach would allow them to continue bodysurfing and bodyboarding in and around the Project Site. - Beach Stabilization would also allow patrons safer passage from the public access to the shoreline and along the beach within and around the Project Site, though the groins may prompt an initial adjustment. - Future erosion rates would be significantly reduced, and the beach would be less vulnerable to episodic erosion events, creating long-term benefits for the coastline that allow for ocean recreation to continue. - The groins also have the potential to interrupt waves and longshore current flow in a manner that lowers the risk for people bodysurfing and bodyboarding getting pulled out in the rip currents. - Beach Stabilization poses the biggest aesthetic change in the visual composition of the shoreline, it may also change ocean entry points and alter the course of the wave for bodyboarders and bodysurfers who will have to adjust their ride. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to bodysurfing and bodyboarding activities along the shoreline of Kā'anapali Beach.
Skimboarding	**Short-Term:** - Erosion would likely continue at a similar rate, negatively impacting skimboarders. - The rocky shoreline has the potential to impede beachgoers traversing to and from the backshore. - Turbidity plumes may occur in the ocean if waves or high tide reaches the backshore. - There would be a negative impact on patrons by creating many hazards for patrons who do attempt to skimboard there.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact skimboarding activities and limit access for beach and ocean patrons who will have to go elsewhere. - Recovered sands may create nearshore turbidity plumes and impact the water clarity. - In the Sand Recovery Area turbidity in the water is expected during sand recovery operations.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact skimboarding activities and limit access for beach and ocean patrons who will have to go elsewhere each time sand replenishment operations occur. - Recovered sands may create nearshore turbidity plumes and impact the water clarity. - In the Sand Recovery Area turbidity in the water is expected each time sand recovery operations occur.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact skimboarding activities and limit access for beach and ocean patrons. - Beach Stabilization has the longest duration of operational activities among the alternatives, as well as the largest scope of construction, thus impacting a greater area of the coastline as well as the shorebreak and surfing breaks offshore during operational activities. Patrons might have to go elsewhere to recreate. - Recovered sands may create nearshore turbidity plumes and impact the water clarity at the Project Site. - In the Sand Recovery Area turbidity in the water is expected during sand recovery operations.
Skimboarding	**Long-Term:** - If there is little to no sand, patrons will have increasingly less space to skimboard the shorebreak. - There is likely to be an increased number of turbidity plume events, lowering water quality and viability. - It is possible that all the sand could disappear entirely, thus having a negative impact on patrons because they would no longer be able to engage in skimboarding as an activity at Honokōwai Beach.	**Long-Term:** - Beach Nourishment has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, but the sand would be unstable and vulnerable to erosion. - There are positive impacts for beachgoers in that they could continue to engage in skimboarding activities in and around the present Project Site. - Beach Nourishment would also allow patrons safer passage from the public access to the shoreline and along the beach within and adjacent to the project area until replenished sands get pulled offshore. - The beach will likely get smaller, and could potentially disappear entirely, thus having a negative impact for patrons by exposing many hazards for patrons who do attempt to skimboard at Honokōwai Beach. - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and viability. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to skimboarders around the Sand Recovery Area.	**Long-Term:** - Beach Maintenance has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, but the sand would be unstable and vulnerable to erosion between recurring sand replenishment operations. - There are positive impacts for beachgoers in that they could continue to engage in skimboarding activities in and around the present Project Site until the replenished sands get pulled offshore. - Beach Maintenance would also allow patrons safer passage from the public access to the shoreline and along the beach within and adjacent to the project area until replenished sands get pulled offshore. - The beach will likely get smaller, and could potentially disappear entirely, thus having a negative impact for patrons by exposing many hazards for patrons who do attempt to skimboard at Honokōwai Beach until the next sand replenishment operation occurs. - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and viability until the next sand replenishment operation occurs. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to skimboarders around the Sand Recovery Area until the next sand recovery operation occurs.	**Long-Term:** - Beach Stabilization has positive impacts for beachgoers in that the compartmentalized beach would allow them to continue skimboarding in and around the Project Site. - Beach Stabilization would also allow patrons safer passage from the public access to the shoreline and along the beach within and around the Project Site, though the groins may prompt an initial adjustment. - Future erosion rates would be significantly reduced, and the beach would be less vulnerable to episodic erosion events, creating long-term benefits for the coastline that allow for ocean recreation to continue. - The groins also have the potential to interrupt waves and longshore current flow in a manner that lowers the risk for people skimboarding and falling in the shorebreak, then getting pulled out in the rip currents. - Beach Stabilization poses the biggest aesthetic change in the visual composition of the shoreline, it may also change ocean entry points for skimboarders as the shoreface adjusts to the groins. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to skimboarding activities in or around the Sand Recovery Area, or along the shoreline of Kā'anapali Beach.
Snorkeling & Scuba Diving	**Short-Term:** - Erosion would likely continue at a similar rate, negatively impacting snorkelers and scuba divers. - The rocky shoreline has the potential to impede beachgoers traversing to and from the backshore. - Turbidity plumes may occur in the ocean if waves or high tide reaches the backshore. - Patrons will have increasingly less space to access the ocean for snorkeling or scuba diving.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact snorkeling and scuba diving activities and limit access for beach and ocean patrons who will have to go elsewhere. - Recovered sands may create nearshore turbidity plumes and impact the water clarity. - In the Sand Recovery Area turbidity in the water is expected during sand recovery operations. - snorkelers and scuba divers who enter the sand recovery area would have to alter their course to avoid operational activities.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact snorkeling and scuba diving activities and limit access for beach and ocean patrons who will have to go elsewhere each time sand replenishment operations occur at the Project Site. - Recovered sands may create nearshore turbidity plumes and impact the water clarity. - In the Sand Recovery Area turbidity in the water is expected each time sand recovery operations occur. - Snorkelers and scuba divers who enter the sand recovery area would have to alter their course to avoid operational activities each time sand recovery operations occur.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact snorkeling and scuba diving activities and limit access for beach and ocean patrons, even for those patrons approaching from the water or on a vessel. - Beach Stabilization has the longest duration of operational activities among the alternatives, as well as the largest scope of construction, thus impacting a greater area of the coastline as well as the shorebreak and surfing breaks offshore during operational activities. Patrons might have to go elsewhere to recreate. - Recovered sands may create nearshore turbidity plumes and impact the water clarity at the Project Site. - In the Sand Recovery Area turbidity in the water is expected during sand recovery operations. - Snorkelers and scuba divers who enter the sand recovery area would have to alter their course to avoid operational activities.

Alternatives & Activities	No Action Taken	Beach Nourishment	Beach Maintenance	Beach Stabilization
Snorkeling & Scuba Diving	**Long-Term:** - The shoreline might potentially become inaccessible, cutting off safe passage from the backshore. - The beach will likely get smaller, and could potentially disappear entirely, thus having a negative impact by creating many hazards for patrons who do attempt to snorkel or scuba dive at Honokōwai Beach. - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and visibility.	**Long-Term:** - Beach Nourishment has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, but the sand would be less stable and vulnerable to erosion. - There are positive impacts for beachgoers in that they could continue to engage in snorkeling and scuba diving activities in and around the present Project Site. - Beach Nourishment would also allow patrons safer passage from the public access to the shoreline and along the beach within and adjacent to the project area until replenished sands get pulled offshore. - The beach will likely get smaller, and could potentially disappear entirely, thus having a negative impact for patrons by exposing many hazards for patrons who do attempt snorkeling or scuba diving there. - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and visibility. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to snorkeling or scuba diving in or around the Sand Recovery Area.	**Long-Term:** - Beach Maintenance has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, but the sand would be unstable and vulnerable to erosion between recurring replenishment operations. - There are positive impacts for beachgoers in that they could continue to engage in snorkeling and scuba diving activities in and around the present Project Site until the replenished sand gets pulled offshore between sand replenishment operations. - Beach Maintenance would also allow patrons safer passage from the public access to the shoreline and along the beach within and adjacent to the project area until replenished sands get pulled offshore. - The beach will likely get smaller between sand replenishment operations, and could potentially disappear entirely, thus having a negative impact for snorkeling and scuba diving by exposing many hazards for patrons who do attempt to snorkel or scuba dive at Honokōwai Beach, until the next sand replenishment operation occurs. - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and visibility until the next sand replenishment operation occurs. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to snorkeling and scuba diving activities in or around the Sand Recovery Area until the next time sand recovery operations occur.	**Long-Term:** - Beach Stabilization has positive impacts for beachgoers in that the compartmentalized beach would allow them to continue snorkeling and scuba diving in and around the Project Site. - Beach Stabilization would also allow patrons safer passage from the public access to the shoreline and along the beach within and around the Project Site, though the groins may prompt an initial adjustment. - Future erosion rates would be significantly reduced, and the beach would be less vulnerable to episodic erosion events, creating long-term benefits for the coastline that allow for ocean recreation to continue. - The groins also have the potential to interrupt waves and longshore current flow in a manner that lowers the risk for people snorkeling and scuba diving getting pulled out in the rip currents. - Beach Stabilization poses the biggest aesthetic change in the visual composition of the shoreline, it may also change ocean entry points and alter ocean routes for snorkelers and scuba divers who will have to adjust their course around the groins and through the gaps between them. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to snorkeling and scuba diving activities in or around the Sand Recovery Area, or along the shoreline of Kā'anapali Beach.
Boating	**Short-Term:** - Erosion would likely continue at a similar rate, negatively impacting coastal boaters. - Turbidity plumes may occur in the ocean if waves or high tide reaches the backshore.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact boating activities in the nearshore waters for ocean patrons who will have to go elsewhere. - Recovered sands may create nearshore turbidity plumes and impact the water clarity. - In the Sand Recovery Area turbidity in the water is expected during sand recovery operations. - Commercial or recreational boaters who enter the sand recovery area would have to alter their course to avoid operational activities.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact boating activities and limit access for beach and ocean patrons who will have to go elsewhere each time sand replenishment operations occur at the Project Site. - Recovered sands may create nearshore turbidity plumes and impact the water clarity. - In the Sand Recovery Area turbidity in the water is expected each time sand recovery operations occur. - Boaters who enter the sand recovery area would have to alter their course to avoid operational activities each time sand recovery operations occur there.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact boating activities and limit access for beach and ocean patrons, even for those patrons approaching from the water on a vessel. - Beach Stabilization has the longest duration of operational activities among the alternatives, as well as the largest scope of construction, thus impacting a greater area of the coastline as well as the shorebreak and surfing breaks offshore during operational activities. Patrons might have to go elsewhere to recreate. - Recovered sands may create nearshore turbidity plumes and impact the water clarity in and around the Project Site, even offshore. - In the Sand Recovery Area turbidity in the water is expected during sand recovery operations. - Commercial or recreational boaters who enter the sand recovery area would have to alter their course to avoid operational activities.
Boating	**Long-Term:** - The shoreline might potentially become inaccessible, cutting off safe passage from the backshore. - The beach will likely get smaller, and could potentially disappear entirely, thus having a negative impact by creating many hazards for patrons who do attempt to meet a boat at Honokōwai Beach. - The hardened shoreline has potential to increase current flow, making it dangerous for nearshore boaters. - There is likely to be an increased number of turbidity plume events, lowering water quality and visibility.	**Long-Term:** - Beach Nourishment has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, but the sand would be less stable and vulnerable to erosion. - There are positive impacts for nearshore boaters in that they could continue to engage in their boating activities in and around the present Project Site. - The hardened shoreline has potential to increase current flow, increasing risk for boaters in the channel. - There is likely to be an increased number of turbidity plume events, lowering water quality and visibility. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to boaters in or around the Sand Recovery Area.	**Long-Term:** - Beach Maintenance has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, but the sand would be unstable and vulnerable to erosion between recurring replenishment operations. - There are positive impacts for boaters in that they could continue to engage in boating activities in and around the present Project Site until the replenished sand gets pulled offshore between recurring sand replenishment operations. - The hardened shoreline has potential to increase current flow, increasing risk for boaters in the channel. - There is likely to be an increased number of turbidity plume events, lowering water quality and visibility until the next sand replenishment operation occurs. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to boating activities in or around the Sand Recovery Area until the next time sand recovery operations occur.	**Long-Term:** - Beach Stabilization has positive impacts for beachgoers in that the compartmentalized beach would allow them to continue boating activities in and around the Project Site. - Future erosion rates would be significantly reduced, and the beach would be less vulnerable to episodic erosion events, creating long-term benefits for the coastline that allow for ocean recreation to continue. - The groins also have the potential to interrupt waves and longshore current flow in a manner that lowers the risk for boaters being affected by strong currents near shore and in the channel. - Beach Stabilization poses the biggest aesthetic change in the visual composition of the shoreline, it may also change ocean entry points and alter ocean routes for boaters who will have to adjust their course. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to boating activities in or around the Sand Recovery Area.
Standup Paddling & Kayaking	**Short-Term:** - Erosion would likely continue at a similar rate, negatively impacting kayakers or stand-up paddlers. - The rocky shoreline has the potential to impede beachgoers traversing to and from the backshore. - Turbidity plumes may occur in the ocean if waves or high tide reaches the backshore. - Patrons will have increasingly less space to access the ocean for kayaking or stand-up paddling.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact standup paddleboarding and kayaking activities and limit access for beach and ocean patrons who will have to go elsewhere. - Recovered sands may create nearshore turbidity plumes and impact the water clarity. - In the Sand Recovery Area turbidity in the water is expected during sand recovery operations. - Standup paddleboarders or kayakers who paddle out to the sand recovery area would have to alter their course to avoid operational activities.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact standup paddleboarding and kayaking activities and limit access for beach and ocean patrons who will have to go elsewhere each time sand replenishment operations occur at the Project Site. - Recovered sands may create nearshore turbidity plumes and impact the water clarity. - In the Sand Recovery Area turbidity in the water is expected each time sand recovery operations occur. - Standup paddleboarders and kayakers who enter the sand recovery area would have to alter their course to avoid operational activities each time sand recovery operations occur.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact standup paddleboarding and kayaking activities and limit access for beach and ocean patrons, even for those patrons approaching from the water or on a vessel. - Beach Stabilization has the longest duration of operational activities among the alternatives, as well as the largest scope of construction, thus impacting a greater area of the coastline as well as the shorebreak and surfing breaks offshore during operational activities. Patrons might have to go elsewhere to recreate. - Recovered sands may create nearshore turbidity plumes and impact the water clarity at the Project Site. - In the Sand Recovery Area turbidity in the water is expected during sand recovery operations. - Standup paddleboarders and kayakers who enter the sand recovery area would have to alter their course to avoid operational activities.

Alternatives & Activities	No Action Taken	Beach Nourishment	Beach Maintenance	Beach Stabilization
Standup Paddling & Kayaking	**Long-Term:** - The shoreline might potentially become inaccessible, cutting off safe passage from the backshore - The beach will likely get smaller, and could potentially disappear entirely, thus having a negative impact by creating many hazards for patrons who do attempt to kayak or stand-up paddle at Honokōwai Beach. - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore - There is likely to be an increased number of turbidity plume events, lowering water quality and visibility	**Long-Term:** - Beach Nourishment has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, but the sand would be less stable and vulnerable to erosion. - There are positive impacts for beachgoers in that they could continue to engage in standup paddleboarding and kayaking activities in and around the present Project Site. - Beach Nourishment would also allow patrons safer passage from the public access to the shoreline and along the beach within and adjacent to the project area until replenished sands get pulled offshore. - The beach will likely get smaller, and could potentially disappear entirely, thus having a negative impact for patrons by exposing many hazards for patrons who do attempt snorkeling or scuba diving there. - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and visibility. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to standup paddling or kayaking in or around the Sand Recovery Area.	**Long-Term:** - Beach Maintenance has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, but the sand would be unstable and vulnerable to erosion between recurring replenishment operations. - There are positive impacts for beachgoers in that they could continue to engage in standup paddleboarding and kayaking activities in and around the present Project Site until the replenished sand gets pulled offshore between recurring sand replenishment operations. - Beach Maintenance would also allow patrons safer passage from the public access to the shoreline and along the beach within and adjacent to the project area until replenished sands get pulled offshore. - The beach will likely get smaller between sand replenishment operations, and could potentially disappear entirely, thus having a negative impact for standup paddleboarding and kayaking by exposing many hazards for patrons who do attempt to snorkel or scuba dive at Honokōwai Beach, until the next sand replenishment operation occurs. - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and visibility until the next sand replenishment operation occurs. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to standup paddleboarding and kayaking activities in or around the Sand Recovery Area until the next time sand recovery operations occur.	**Long-Term:** - Beach Stabilization has positive impacts for beachgoers in that the compartmentalized beach would allow them to continue standup paddleboarding and kayaking in and around the Project Site. - Beach Stabilization would also allow patrons safer passage from the public access to the shoreline and along the beach within and around the Project Site, though the groins may prompt an initial adjustment. - Future erosion rates would be significantly reduced, and the beach would be less vulnerable to episodic erosion events, creating long-term benefits for the coastline that allow for ocean recreation to continue. - The groins also have the potential to interrupt waves and longshore current flow in a manner that lowers the risk for people standup paddleboarders and kayakers getting pulled out in the rip currents. - Beach Stabilization poses the biggest aesthetic change in the visual composition of the shoreline, it may also change ocean entry points and alter ocean routes for standup paddleboarders and kayakers who will have to adjust their course around the groins and through the gaps between them. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to standup paddleboarding and kayaking activities in or around the Sand Recovery Area, or along the shoreline of Kā'anapali Beach.
Surfing	**Short-Term:** - Erosion would likely continue at a similar rate, negatively impacting surfers - The rocky shoreline has the potential to impede beachgoers traversing to and from the backshore - Turbidity plumes may occur in the ocean if waves or high tide reaches the backshore - Patrons will have increasingly less space to access the ocean for swimming as the beach gets smaller	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact surfing activities and limit access for beach and ocean patrons who will have to go elsewhere. - Recovered sands may create nearshore turbidity plumes and impact the water clarity. - In the Sand Recovery Area turbidity in the water is expected during sand recovery operations.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact surfing activities and limit access for beach and ocean patrons who will have to go elsewhere each time sand replenishment operations occur. - Recovered sands may create nearshore turbidity plumes and impact the water clarity. - In the Sand Recovery Area, turbidity in the water is expected each time sand recovery operations occur.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact surfing activities and limit access for beach and ocean patrons. - Beach Stabilization has the longest duration of operational activities among the alternatives, as well as the largest scope of construction, thus impacting a greater area of the coastline as well as the shorebreak and surfing breaks offshore during operational activities. Patrons might have to go elsewhere to recreate. - Recovered sands may create nearshore turbidity plumes and impact the water clarity at the Project Site. - In the Sand Recovery Area turbidity in the water is expected during sand recovery operations.
Surfing	**Long-Term:** - The shoreline might potentially become inaccessible, cutting off safe passage from the backshore - The beach will likely get smaller, and could potentially disappear entirely, thus having a negative impact by exposing many hazards for patrons who do attempt to bodyboard or bodysurf at Honokōwai Beach. - If there is little to no sand, patrons will have increasingly less space to access the surf breaks offshore - Backwash will likely increase due to wave reflection, lowering wave quality and increasing risk - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and visibility	**Long-Term:** - Beach Nourishment has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, but the sand would be less stable and vulnerable to erosion. - There are positive impacts for beachgoers in that they could continue to engage in surfing activities in and around the present Project Site. - Beach Nourishment would also allow patrons safer passage from the public access to the shoreline and along the beach within and adjacent to the project area until replenished sands get pulled offshore. - The beach will likely get smaller, and could potentially disappear entirely, thus having a negative impact for patrons by exposing many hazards for patrons who do attempt to surf at Rainbows or Hotels. - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and visibility. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to surfing around the Sand Recovery Area.	**Long-Term:** - Beach Maintenance has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, but the sand would be unstable and vulnerable to erosion between recurring sand replenishment operations. - There are positive impacts for beachgoers in that they could continue to engage in surfing activities in and around the Project Site until the replenished sand gets pulled offshore between recurring sand replenishment operations. - Beach Maintenance would also allow patrons safer passage from the public access to the shoreline and along the beach within and adjacent to the project area until replenished sands get pulled offshore. - The beach will likely get smaller, and could potentially disappear entirely, thus having a negative impact for patrons by exposing many hazards for patrons who do attempt to surf at Honokōwai Beach until the next sand replenishment operation occurs. - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and visibility until the next sand recovery operation occurs. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to surfing around the Sand Recovery Area until the next sand recovery operation occurs.	**Long-Term:** - Beach Stabilization has positive impacts for beachgoers in that the compartmentalized beach would allow them to continue surfing in and around the Project Site. - Beach Stabilization would also allow patrons safer passage from the public access to the shoreline and along the beach within and around the Project Site, though the groins may prompt an initial adjustment. - Future erosion rates would be significantly reduced, and the beach would be less vulnerable to episodic erosion events, creating long-term benefits for the coastline that allow for ocean recreation to continue. - The groins also have the potential to interrupt waves and longshore current flow in a manner that lowers the risk for people who are surfing getting pulled out in the rip currents. - Beach Stabilization poses the biggest aesthetic change in the visual composition of the shoreline, it may also change ocean entry points and alter the course of the wave for surfers who will have to adjust their ride. The ride may become shorter than the rides at present, but it might be similar to the rides before the erosional episodes of the last decade occurred. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to surfing activities along the shoreline of Kā'anapali Beach.
Fishing	**Short-Term:** - Erosion would likely continue at a similar rate, negatively impacting beachgoers and fishermen. - The rocky shoreline has the potential to impede fishermen traversing through the public access. - Patrons will have increasingly less space to sunbathe or sit on the sand as the beach gets smaller.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact fishing activities and limit access for beach and ocean patrons who will have to go elsewhere. - Recovered sands may create nearshore turbidity plumes and impact the water clarity. - In the Sand Recovery Area turbidity in the water is expected during sand recovery operations. - Fishermen who boat out to the sand recovery area would have to alter their course to avoid operational activities.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact fishing activities and limit access for beach and ocean patrons who will have to go elsewhere each time sand replenishment operations occur. - Recovered sands may create nearshore turbidity plumes and impact the water clarity. - In the Sand Recovery Area, turbidity in the water is expected each time sand recovery operations occur. - Fishermen who enter the sand recovery area with a vessel would have to alter their course to avoid operational activities each time sand recovery operations occur.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact fishing activities and limit access for beach and ocean patrons. - Beach Stabilization has the longest duration of operational activities among the alternatives, as well as the largest scope of construction, thus impacting a greater area of the coastline as well as the shorebreak and surfing breaks offshore during operational activities. Patrons might have to go elsewhere to fish. - Recovered sands may create nearshore turbidity plumes and impact the water clarity at the Project Site. - In the Sand Recovery Area turbidity in the water is expected during sand recovery operations. - Fishermen who boat out to the sand recovery area would have to alter their course to avoid operational activities.

Alternatives & Activities	No Action Taken	Beach Nourishment	Beach Maintenance	Beach Stabilization
Fishing	**Long-Term:** - The beach could potentially disappear, negatively impacting patrons who attempt to fish from the beach. - The shoreline might become inaccessible without sand, cutting off safe passage from the backshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and viability. - Murky waters would not only discourage patrons from shore casting, spear fishing, and night diving, but also the turbidity might diminish the chances of fish biting the hook.	**Long-Term:** - Beach Nourishment has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, but the sand would be less stable and vulnerable to erosion. - There are positive impacts for beachgoers in that they could continue to engage in shoreline fishing activities in and around the present Project Site. - Beach Nourishment would also allow patrons safer passage from the public access to the shoreline and along the beach within and adjacent to the project area until replenished sands get pulled offshore.	**Long-Term:** - Beach Maintenance has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, but the sand would be unstable and vulnerable to erosion between recurring sand replenishment operations. - There are positive impacts for beachgoers in that they could continue to engage in fishing activities in and around the Project Site until the replenished sand gets pulled offshore between recurring replenishment operations. - Beach Maintenance would also allow patrons safer passage from the public access to the shoreline and along the beach within and adjacent to the project area until replenished sands get pulled offshore. - The beach will likely get smaller, and could potentially disappear entirely, thus having a negative impact for patrons by exposing many hazards for patrons who do attempt to fish at Honokōhau Beach until the next sand replenishment operation occurs. - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and viability until the next sand recovery operation occurs. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to fishing in or around the Sand Recovery Area until the next sand recovery operation occurs.	**Long-Term:** - Beach Stabilization has positive impacts for beachgoers in that the compartmentalized beach would allow them to continue fishing in and around the Project Site. - Beach Stabilization would also allow patrons safer passage from the public access to the shoreline and along the beach within and around the Project Site, though the groins may prompt an initial adjustment. - Future erosion rates would be significantly reduced, and the beach would be less vulnerable to episodic erosion events, creating long-term benefits for the coastline that allow for ocean recreation to continue. - The groins also have the potential to interrupt waves and longshore current flow in a manner that lowers the risk for people wading in the shallows getting knocked off their feet and pulled out in the rip currents. The compartmentalized beach would allow fishermen good access to the ocean and the groins have the potential to allow fishermen to cast their lines from a point further offshore. - Beach Stabilization poses the biggest aesthetic change in the visual composition of the shoreline; it may also change ocean entry points and alter ocean routes for spear fishermen who will have to adjust their course around the groins and through the gaps between them. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to fishing activities in or around the Sand Recovery Area, or along the shoreline of Kā'anapali Beach. - Also, based on previous studies, long-term, secondary, and cumulative impacts on Kona crab populations around the Sand Recovery Area are not anticipated.
Wingfoiling & Kitesurfing	**Short-Term:** - Erosion would likely continue at a similar rate, negatively impacting wingfoilers and kitesurfers. - The rocky shoreline has the potential to impede beachgoers traversing to and from the backshore. - Turbidity plumes may occur in the ocean if waves or high tide reaches the backshore. - Patrons will have increasingly less space to access the ocean for wingfoiling or kitesurfing.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact kitesurfing and wingfoiling activities and limit access for beach and ocean patrons who will have to go elsewhere. - Recovered sands may create nearshore turbidity plumes and impact the water clarity. - In the Sand Recovery Area turbidity in the water is expected during sand recovery operations. - kitesurfers and wingfoilers who paddle out to the sand recovery area would have to alter their course to avoid operational activities.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact kitesurfing and wingfoiling activities and limit access for beach and ocean patrons who will have to go elsewhere each time sand replenishment operations occur at the Project Site. - Recovered sands may create nearshore turbidity plumes and impact the water clarity. - In the Sand Recovery Area turbidity in the water is expected each time sand recovery operations occur. - Kitesurfers and wingfoilers who enter the sand recovery area would have to alter their course to avoid operational activities each time sand recovery operations occur.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact standup paddleboarding and kayaking activities and limit access for beach and ocean patrons, even for those patrons approaching from the water or on a vessel. - Beach Stabilization has the longest duration of operational activities among the alternatives, as well as the largest scope of construction, thus impacting a greater area of the coastline as well as the shorebreak and surfing breaks offshore during operational activities. Patrons might have to go elsewhere to recreate. - Recovered sands may create nearshore turbidity plumes and impact the water clarity at the Project Site. - In the Sand Recovery Area turbidity in the water is expected during sand recovery operations. - Standup paddleboarders and kayakers who enter the sand recovery area would have to alter their course to avoid operational activities.
Wingfoiling & Kitesurfing	**Long-Term:** - The shoreline might potentially become inaccessible, cutting off safe passage from the backshore. - The beach will likely get smaller, and could potentially disappear entirely, thus having a negative impact by creating many hazards for patrons who do attempt to wingfoil or kitesurf at Honokōhau Beach. - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and viability.	**Long-Term:** - Beach Nourishment has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, but the sand would be less stable and vulnerable to erosion. - There are positive impacts for beachgoers in that they could continue to engage in kitesurfing and wingfoiling activities in and around the present Project Site. - Beach Nourishment would also allow patrons safer passage from the public access to the shoreline and along the beach within and adjacent to the project area until replenished sands get pulled offshore. - The beach will likely get smaller, and could potentially disappear entirely, thus having a negative impact for patrons by exposing many hazards for patrons who do attempt kitesurfing and wingfoiling there. - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and viability. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to kitesurfing and wingfoiling in or around the Sand Recovery Area.	**Long-Term:** - Beach Maintenance has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, but the sand would be unstable and vulnerable to erosion between recurring replenishment operations. - There are positive impacts for beachgoers in that they could continue to engage in kitesurfing and wingfoiling activities in and around the present Project Site until the replenished sand gets pulled offshore between sand replenishment operations. - Beach Maintenance would also allow patrons safer passage from the public access to the shoreline and along the beach within and adjacent to the project area until replenished sands get pulled offshore. - The beach will likely get smaller between sand replenishment operations, and could potentially disappear entirely, thus having a negative impact for kitesurfing and wingfoiling activities by exposing many hazards for patrons who do attempt to kitesurf or wingfoil at Honokōhau Beach, until the next sand replenishment operation occurs. - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and viability until the next sand replenishment operation occurs.	**Long-Term:** - Beach Stabilization has positive impacts for beachgoers in that the compartmentalized beach would allow them to continue standup paddleboarding and kayaking in and around the Project Site. - Beach Stabilization would also allow patrons safer passage from the public access to the shoreline and along the beach within and around the Project Site, though the groins may prompt an initial adjustment. - Future erosion rates would be significantly reduced, and the beach would be less vulnerable to episodic erosion events, creating long-term benefits for the coastline that allow for ocean recreation to continue. - The groins also have the potential to interrupt waves and longshore current flow in a manner that lowers the risk for people standup paddleboarders and kayakers getting pulled out in the rip currents. - Beach Stabilization poses the biggest aesthetic change in the visual composition of the shoreline; it may also change ocean entry points and alter ocean routes for standup paddleboarders and kayakers who will have to adjust their course around the groins and through the gaps between them. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to standup paddleboarding and kayaking activities in or around the Sand Recovery Area, or along the shoreline of Kā'anapali Beach.
Cliff Diving & Jumping	**Short-Term:** - Cliff diving and jumping activities take place at Pu'u Keka'a, Black Rock, about a mile and a half south of the Project Site. - It is anticipated that there will be little or no short-term impacts on cliff diving or jumping at Pu'u Keka'a.	**Short-Term:** - Cliff diving and jumping activities take place at Pu'u Keka'a, Black Rock, about a mile and a half south of the Project Site, where sand is being placed. - In the Sand Recovery Area, turbidity in the water is expected during sand recovery operations. - Turbidity plumes may potentially drift in towards Pu'u Keka'a, where they would then impact water clarity there until operations are completed and the water clears or the currents shift back offshore.	**Short-Term:** - Cliff diving and jumping activities take place at Pu'u Keka'a, Black Rock, about a mile and a half south of the Project Site, where sand is being placed. - In the Sand Recovery Area turbidity in the water is expected each time sand recovery operations occur. - Turbidity plumes may potentially drift in towards Pu'u Keka'a, where they would then impact water clarity there until operations are completed and the water clears or the currents shift back offshore.	**Short-Term:** - Cliff diving and jumping activities take place at Pu'u Keka'a, Black Rock, about a mile and a half south of the Project Site, where sand is being placed. - In the Sand Recovery Area, turbidity in the water is expected during sand recovery operations. - Turbidity plumes may potentially drift in towards Pu'u Keka'a, where they would then impact water clarity there until operations are completed and the water clears or the currents shift back offshore.
Cliff Diving & Jumping	**Long-Term:** - Erosion would likely continue at a similar rate, with potentially an increased number of turbidity plume events, and it may lower water quality and viability over the long-term. - Turbidity plumes from erosion at the Project Site have the slight chance of entering into the longshore currents within the North Kā'anapali Littoral Cell and even perhaps drifting down to Pu'u Keka'a where they would then impact water quality there and along the coast.	**Long-Term:** - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to cliff diving or cliff jumping activities in or around the sand recovery site. - Turbidity plumes from erosion at the Project Site have the slight chance of entering into the longshore currents within the North Kā'anapali Littoral Cell and even perhaps drifting down to Pu'u Keka'a where the murky water would then impact water quality there.	**Long-Term:** - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to cliff diving or cliff jumping activities in or around the sand recovery site. - Turbidity plumes from erosion at the Project Site have the slight chance of entering into the longshore currents within the North Kā'anapali Littoral Cell and even perhaps drifting down to Pu'u Keka'a where the murky water would then impact water quality there.	**Long-Term:** - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to cliff diving or cliff jumping activities in or around the sand recovery site. - Turbidity plumes from erosion at the Project Site have the slight chance of entering into the longshore currents within the North Kā'anapali Littoral Cell and even perhaps drifting down to Pu'u Keka'a where the murky water would then impact water quality there.

Alternatives & Activities	No Action Taken	Beach Nourishment	Beach Maintenance	Beach Stabilization
One-person & Six-person Outrigger Canoe Paddling	**Short-Term:** - Erosion would likely continue at a similar rate, negatively impacting outrigger canoe paddlers. - The rocky shoreline has the potential to impede beachgoers traversing to and from the backshore. - Turbidity plumes may occur in the ocean if waves or high tide reaches the backshore. - Patrons needing sand will have increasingly less space to access the ocean with an outrigger canoe.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact canoe paddling activities and limit access for beach and ocean patrons who will have to go elsewhere. - Recovered sands may create nearshore turbidity plumes and impact the water clarity. - In the Sand Recovery Area, turbidity in the water is expected during sand recovery operations. - Canoe paddlers who paddle out to the sand recovery area would have to alter their course to avoid operational activities.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact outrigger canoe paddling activities and limit access for beach and ocean patrons who will have to go elsewhere each time sand replenishment operations occur at the Project Site. - Recovered sands may create nearshore turbidity plumes and impact the water clarity. - In the Sand Recovery Area turbidity in the water is expected each time sand recovery operations occur. - Outrigger canoe paddlers who enter the sand recovery area would have to alter their course to avoid operational activities each time sand recovery operations occur.	**Short-Term:** - At the Project Site, operational activities would directly but temporarily impact canoe paddlers and limit access for beach and ocean patrons, even for those patrons approaching from the water on a vessel. - Beach Stabilization has the longest duration of operational activities among the alternatives, as well as the largest scope of construction, thus impacting a greater area of the coastline as well as the shorebreak and surfing breaks offshore during operational activities. Patrons might have to go elsewhere to recreate. - Recovered sands may create nearshore turbidity plumes and impact the water clarity at the Project Site. - In the Sand Recovery Area turbidity in the water is expected during sand recovery operations. - Canoe paddlers who enter the sand recovery area would have to alter their course to avoid operational activities.
One-person & Six-person Outrigger Canoe Paddling	**Long-Term:** - The shoreline might potentially become inaccessible, cutting off safe passage from the backshore. - The beach will likely get smaller, and could potentially disappear entirely, thus having a negative impact by creating many hazards for patrons who do attempt to paddle a canoe at Honokōwai Beach. - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and viability.	**Long-Term:** - Beach Nourishment has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, but the sand would be less stable and vulnerable to erosion. - There are positive impacts for beachgoers in that they could continue to engage in canoe paddling activities in and around the present Project Site. - Beach Nourishment would also allow patrons safer passage from the public access to the shoreline and along the beach within and adjacent to the project area until replenished sands get pulled offshore. - The beach will likely get smaller, and could potentially disappear entirely, thus having a negative impact for patrons by exposing many hazards for patrons who do attempt canoe paddling there. - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and visibility. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to canoe paddling in or around the Sand Recovery Area.	**Long-Term:** - Beach Maintenance has the potential to increase the beach width and volume and perhaps temporarily slow the rate of sand loss, but the sand would be unstable and vulnerable to erosion between recurring replenishment operations. - There are positive impacts for beachgoers in that they could continue to engage in outrigger canoe paddling activities in and around the present Project Site until the replenished sand gets pulled offshore between sand replenishment operations. - Beach Maintenance would also allow patrons safer passage from the public access to the shoreline and along the beach within and adjacent to the project area until replenished sands get pulled offshore. - The beach will likely get smaller between sand replenishment operations, and could potentially disappear entirely, thus having a negative impact for outrigger canoe paddling activities by exposing many hazards for patrons who do attempt to paddle outrigger canoes at Honokōwai Beach, until the next sand replenishment operation occurs. - The hardened shoreline has potential to increase current flow, increasing risk of being pulled offshore. - There is likely to be an increased number of turbidity plume events, lowering water quality and viability until the next sand replenishment operation occurs. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to outrigger canoe paddling activities in or around the Sand Recovery Area until the next time sand recovery operation occurs.	**Long-Term:** - Beach Stabilization has positive impacts for beachgoers in that the compartmentalized beach would allow them to continue launching one-person canoes and canoe paddling in and around the Project Site. - Beach Stabilization would also allow patrons safer passage from the public access to the shoreline and along the beach within and around the Project Site, though the groins may prompt an initial adjustment. - Future erosion rates would be significantly reduced, and the beach would be less vulnerable to episodic erosion events, creating long-term benefits for the coastline that allow for ocean recreation to continue. - The groins also have the potential to interrupt waves and longshore current flow in a manner that lowers the risk for canoe paddlers getting affected by currents along shore or in the channel. - Beach Stabilization poses the biggest aesthetic change in the visual composition of the shoreline; it may also change ocean entry points and alter ocean routes for canoe paddlers who will have to adjust their course around the groins and through the gaps between them. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to canoe paddling activities in or around the Sand Recovery Area, or along the shoreline of Kā'anapali Beach.
Parasailing	**Short-Term:** - This activity takes place south of Pu'u Keka'a, about a mile and a half south of the Project Site. - It is anticipated that there will be little or no short-term impacts on parasailing activities.	**Short-Term:** - This activity takes place south of Pu'u Keka'a, about a mile and a half south of the Project Site, or outside 3000 feet offshore in undesignated State Waters. - In the Sand Recovery Area, turbidity in the water is expected during sand recovery operations. - Parasailing vessel operators transiting through the sand recovery area would have to alter their course to avoid operational activities.	**Short-Term:** - This activity takes place south of Pu'u Keka'a, about a mile and a half south of the Project Site. - In the Sand Recovery Area, turbidity in the water is expected each time sand recovery operations occur. - Parasailing vessel operators transiting through the sand recovery area would have to alter their course to avoid operational activities each time sand recovery operations occur.	**Short-Term:** - This activity takes place south of Pu'u Keka'a, about a mile and a half south of the Project Site. - In the Sand Recovery Area, turbidity in the water is expected during sand recovery operations. - Parasailing vessel operators transiting through the sand recovery area would have to alter their course to avoid operational activities.
Parasailing	**Long-Term:** - Turbidity plumes from erosion at the Project Site have a slight chance of entering into the longshore currents within the North Kā'anapali Littoral Cell and even perhaps drifting down to Pu'u Keka'a or outside the 3000-foot ORMA boundary where they would then impact water quality there.	**Long-Term:** - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to parasailing activities in or around the sand recovery site. - Turbidity plumes from erosion at the Project Site have the slight chance of entering into the longshore currents within the North Kā'anapali Littoral Cell and even perhaps drifting down to Pu'u Keka'a where the murky water would then impact water quality there.	**Long-Term:** - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to parasailing activities in or around the sand recovery site until the next sand recovery operation occurs. - Turbidity plumes from erosion at the Project Site have the slight chance of entering into the longshore currents within the North Kā'anapali Littoral Cell and even perhaps drifting down to Pu'u Keka'a where the murky water would then impact water quality there until the next sand replenishment operation occurs. - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to parasailing activities in or around the Sand Recovery Area until the next time sand recovery operation occurs.	**Long-Term:** - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to parasailing activities in or around the sand recovery site.
Thrill Craft	**Short-Term:** - This activity takes place south of Hanaka'ō'ō Point, over two miles south of the Project Site, or outside 3000 feet offshore in undesignated State Waters. - It is anticipated that there will be little or no short-term impacts on thrill craft operations.	**Short-Term:** - This activity takes place south of Hanaka'ō'ō Point, over two miles south of the Project Site, or outside 3000 feet offshore in undesignated State Waters. - In the Sand Recovery Area, turbidity in the water is expected during sand recovery operations. - Thrill craft operators transiting through the sand recovery area would have to alter their course to avoid operational activities.	**Short-Term:** - This activity takes place south of Pu'u Keka'a, about a mile and a half south of the Project Site. - In the Sand Recovery Area, turbidity in the water is expected each time sand recovery operations occur. - Thrill craft operators transiting through the sand recovery area would have to alter their course to avoid operational activities each time sand recovery operations occur.	**Short-Term:** - This activity takes place south of Hanaka'ō'ō Point, over two miles south of the Project Site, or outside 3000 feet offshore in undesignated State Waters. - In the Sand Recovery Area, turbidity in the water is expected during sand recovery operations. - Thrillcraft operators transiting through the sand recovery area would have to alter their course to avoid operational activities.
Thrill Craft	**Long-Term:** - Turbidity plumes from erosion at the Project Site have a slight chance of entering into the longshore currents within the North Kā'anapali Littoral Cell and even perhaps drifting down to Pu'u Keka'a or outside the 3000-foot ORMA boundary where they would then impact water quality there.	**Long-Term:** - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to thrill craft operations in or around the sand recovery site. - Turbidity plumes from erosion at the Project Site have a slight chance of entering into the longshore currents within the North Kā'anapali Littoral Cell and even perhaps drifting down to Pu'u Keka'a or outside the 3000-foot ORMA boundary where they would then impact water quality there.	**Long-Term:** - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to thrillcraft operations in or around the sand recovery site until the next sand recovery operation occurs. - Turbidity plumes from erosion at the Project Site have the slight chance of entering into the longshore currents within the North Kā'anapali Littoral Cell and even perhaps drifting down to Pu'u Keka'a where the murky water would then impact water quality there until the next sand replenishment operation occurs.	**Long-Term:** - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to thrill craft activities in or around the sand recovery site.
Water Sledding	**Short-Term:** - This activity takes place at Pu'u Keka'a, about a mile and a half south of the Project Site. - It is anticipated that there will be little or no short-term impacts on water sledding activities.	**Short-Term:** - This activity takes place south of Pu'u Keka'a, about a mile and a half south of the Project Site, or outside 3000 feet offshore in undesignated State Waters. - In the Sand Recovery Area, turbidity in the water is expected during sand recovery operations. - Water sledding vessel operators transiting through or operating within the sand recovery area would have to alter their course to avoid operational activities.	**Short-Term:** - This activity takes place south of Pu'u Keka'a, about a mile and a half south of the Project Site. - In the Sand Recovery Area, turbidity in the water is expected each time sand recovery operations occur. - Water sledding vessel operators transiting through or operating within the sand recovery area would have to alter their course to avoid operational activities each time sand recovery operations occur.	**Short-Term:** - This activity takes place south of Hanaka'ō'ō Point, over two miles south of the Project Site, or outside 3000 feet offshore in undesignated State Waters. - This activity takes place south of Pu'u Keka'a, about a mile and a half south of the Project Site. - In the Sand Recovery Area, turbidity in the water is expected during sand recovery operations. - Waterstedding vessel operators transiting through or operating within the sand recovery area would have to alter their course to avoid operational activities.

Alternatives & Activities	No Action Taken	Beach Nourishment	Beach Maintenance	Beach Stabilization
Water Sledding	Long-Term: - Turbidity plumes from erosion at the Project Site have a slight chance of entering into the longshore currents within the North Kā'anapali Littoral Cell and even perhaps drifting down to Pu'u Keka'a or outside the 3000-foot ORMA boundary where they would then impact water quality there.	Long-Term: - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to water sledding activities in or around the sand recovery site. - Turbidity plumes from erosion at the Project Site have a slight chance of entering into the longshore currents within the North Kā'anapali Littoral Cell and even perhaps drifting down to Pu'u Keka'a or outside the 3000-foot ORMA boundary where they would then impact water quality there.	Long-Term: - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to water sledding activities in or around the sand recovery site until the next sand recovery operation occurs. - Turbidity plumes from erosion at the Project Site have the slight chance of entering into the longshore currents within the North Kā'anapali Littoral Cell and even perhaps drifting down to Pu'u Keka'a where the murky water would then impact water quality there until the next sand replenishment operation occurs.	Long-Term: - After sand recovery is completed and the turbidity from operational activities subsides, there is thought to be little to no long-term impacts to water sledding activities in or around the sand recovery site. - Turbidity plumes from erosion at the Project Site have a slight chance of entering into the longshore currents within the North Kā'anapali Littoral Cell and even perhaps drifting down to Pu'u Keka'a or outside the 3000-foot ORMA boundary where they would then impact water quality there.

8.0 APPENDIX

8.1 Survey

8.0 Appendix ~ Hoʻāla Honokōwai Beach Restoration Project Recreation and Ocean Safety Impacts Activities Survey

Hoʻāla Honokōwai Beach Restoration Project Recreation and Ocean Safety Impacts Activities Survey

Aloha! Mahalo for your interest in being a survey respondent and providing feedback regarding the Honokōwai Beach restoration efforts. Here is a summary of the project:

West Maui Resorts Partners, L.P. is proposing to restore and preserve Honokōwai Beach in Honokōwai, Maui, Hawai'i. Honokōwai Beach is a dynamic shoreline that is experiencing both chronic and episodic erosion. An episodic erosion event occurred during the winter of 2015/2016. The beach was almost entirely eroded and approximately 5,600 square feet of land was permanently lost to erosion. The erosion caused structural damage and negatively impacted water quality and shoreline access.

The objectives of the Proposed Action are to restore and preserve Honokōwai Beach to:

- Improve beach stability
- Preserve and enhance cultural and shoreline access
- Increase resilience to coastal hazards and sea level rise
- Enable planning for long-term adaptation to sea level rise.

Please find the attached pictures to help you visualize the area and contents of the executive summary.

In preparation for drafting an Environmental Impact Statement (EIS), Sea Engineering, Inc. asked me to prepare a report on the recreational activities that take place in the vicinity of the project area, including the beach, nearshore, and offshore.

I am an independent consultant. To begin my part of the project I have attached a survey to gather your comments, concerns, and recommendations. Please fill it out and submit this form at your earliest convenience. Feel free to leave blank any response or information that you do not want to share. All information will be included in a summary report and activities analysis for the contractor to review and consider with regards to erosion and beach loss mitigation at Honokōwai. Your feedback is appreciated.

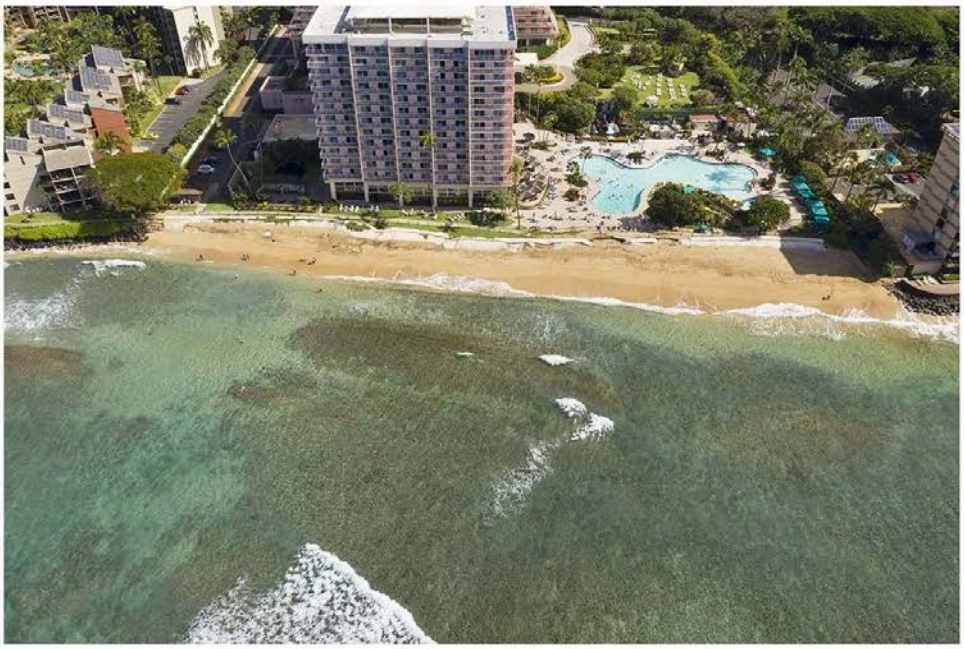
Please feel free to contact me if you have any questions about the survey and/or the project in general.

Sincerely with aloha,

Ian ʻAkahi Masterson

1. Email *

Hoʻāla Honokōwai Beach Restoration Project Area (general arial view)



Ho'āla Honokōwai Beach Restoration Project Area shown within the gray outline, and with associated surf break zone outlined in red. The surf zone begins seaward of the project area, and continues into the project area mitigation zone along the shoreline fronting the park and resort property.



2. Please click on the **Date** tab to choose the date:

_____

Example: January 7, 2019

3. Please share **your Name,** if you choose to do so:

_____

4. Please share **your email address and/or phone number,** if you choose to do so.

   That way we can follow-up with you if you have any further questions or concerns that you would like to share with us. Mahalo!

5. Please share the **Name of your Business/Organization/Group** (if you are associated with any and choose to share this information):

6. Please share the **Address of your Business/Organization/Group** (if you are associated with any and choose to share this information):

7. **SURVEY QUESTION #1:**
   What ocean-based recreation activities do you do in the project area, including activities that you do at night?

8. **SURVEY QUESTION #2:**

   What other ocean-based recreation activities do you see in the project area, including activities that are done at night?

9. **SURVEY QUESTION #3:**
What types of weather conditions, including surf, impact your activities?

_____

10. **SURVEY QUESTION #4:**
What do you value about the beach and shoreline access at Honokōwai Beach?

_____

11. **SURVEY QUESTION #5:** What are your concerns regarding beach loss at Honokōwai Beach?

_____

12. **SURVEY QUESTION #6:**

What do you think can/should be done to improve beach and shoreline access at Honokōwai Beach?

_____

13. **SURVEY QUESTION #7:**
What would be the best time of year to do the project and why?

_____

14. **SURVEY QUESTION #8:**

What would be the short-term impacts of the project on your activities?

_____

15. **SURVEY QUESTION #9:**
Do you have any additional comments, concerns, or recommendations in regard to the project?

_____

16. **SURVEY QUESTION #10:** Would you like us to contact you for a follow-up conversation about this matter?

If so, please leave your email address or phone number in the box above. Mahalo!

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Other: _____

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Google Forms

8.2 Survey Responses

Timestamp	SURVEY QUESTION #1: What ocean-based recreation activities do you do in the project area, including activities that you do at night?	SURVEY QUESTION #2: What other ocean-based recreation activities do you see in the project area, including activities that are done at night?
6/14/2023 16:40:51	Surfing, relaxing	Kitesurfing
6/16/2023 13:06:24	Surf	Fishing, diving, paddling
6/21/2023 15:03:46	My family and I do not frequent the area	Swimming, Snorkeling, Sun Bathing, Boogie Boarding and Picnicking
6/26/2023 12:22:29	surfing/fishing/freediving/spearfishing/swimming	snorkeling/ swimming/ beach combing
6/30/2023 15:04:44	surf, dive, swim	
7/4/2023 8:21:35	Marine science education activities and coral reef health analysis with students using quadrants and transects. We also have students connect to the ocean through surfing, boogie boarding. We have safety personnel on our team. We do not go out at night.	Snorkeling, surfing, boogie boarding, and body surfing. I have not seen people out at night.
7/6/2023 13:41:41	Surfing, snorkeling, free diving, scuba diving, fishing	fishing
6/2/2024 11:15:18	Walking on the beach	Skim boarding boogie boarding surfing night diving overnight fishing -Ulua
6/9/2024 8:25:49	Snorkeling	
7/1/2024 13:07:09	Snorkel, rescue turtles,surf,fly drone	
7/1/2024 13:16:03	Surf	Fishing, swimming
7/2/2024 19:44:55	None	Swimming, kayaking, fishing , surfing, paddle board

Timestamp	SURVEY QUESTION #3: What types of weather conditions, including surf, impact your activities?	SURVEY QUESTION #4: What do you value about the beach and shoreline access at Honokōwai Beach?
6/14/2023 16:40:51	Tides and wind	It's my home beach
6/16/2023 13:06:24	Wind, water quality	Reefs
6/21/2023 15:03:46	Surf and Tides	I value it's natural beauty and all ocean and sand life that resides on and in Honokowai Beach
6/26/2023 12:22:29	Hi surf/ rain / stream-runoff	it is always accessible to all public beach goers
6/30/2023 15:04:44	waves, wind, tides	handicap access to the ocean, adequate parking
7/4/2023 8:21:35	Large surf and swells, heavy runoff after flooding and heavy rains, pollution, heavy rains, lightning and large storms.	Everyone (cultural practitioners, educators, scientists, tourists, and locals, should have safe access to the ocean to engage with the ocean environment
7/6/2023 13:41:41	Visibility, surf	Healthy coral, lots of marine life, easy access
6/2/2024 11:15:18	Wind and rain	Less crowded than other beaches
6/9/2024 8:25:49	Low surf is preferred.	The cleanliness of the the beach and water.
7/1/2024 13:07:09	wind and surf and turbid water	Reasonable parking and easy access into the water
7/1/2024 13:16:03	flooding/runoff and swell size	It's ability to act like a catalyst of connection to the past, present, and future. The hindsight of living through past mistakes leading us to the current predicaments with the hope of future restoration.
7/2/2024 19:44:55	Clear weather	Availability

Timestamp	**SURVEY QUESTION #5:** What are your concerns regarding beach loss at Honokōwai Beach?	**SURVEY QUESTION #6:** What do you think can/should be done to improve beach and shoreline access at Honokōwai Beach?
6/14/2023 16:40:51	It would be tragic	Replace the children's playground
6/16/2023 13:06:24	Uncertainty of changes to area	Don't know
6/21/2023 15:03:46	My only two concerns is that the locals who frequent the area will have to find somewhere else to enjoy their day- which shouldn't be a problem as we are a rock surrounded by beautiful beaches and ocean. My main concern is the man made structures that will be negatively impacting Honokowai Beach as beach loss leads straight to erosion. With erosion comes significant damage to structures that could end up in the ocean THAT WOULD DAMAGE OUR WATER QUALITY, REEFS, OCEAN AND MARINE LIFE.	Absolutely nothing. If Honokowai Project takes place, there are multiple negative impacts that could happen... 1.When new sediments are added to the beach, it may bury marine life. 2.The public does not have access to the beach during the restoration project. 3.This project will require a repeated renourishment application for the work to be effective. 4. It's expensive 5. Adding sand to the beach does not solve the problem of erosion. 6.The work must be completed within a specific time for it to be effective (another storm could take out the whole project as soon as it's completed or months away) 7.There is a high energy cost to pay in addition to the capital cost 8. Unintended consequences can be unpredictable with projects such as this one
6/26/2023 12:22:29		
6/30/2023 15:04:44	the walls that are too close to the water that create excessive erosion	more parking for the public
7/4/2023 8:21:35	Coastal degradation, marine life impacts and coral health, public safety, danger to the public. Public safety may be compromised	Discussions with stakeholders followed by design and construction of an access that allows for safe travel to and from the water by the public, educators, scientists, and first responders.
7/6/2023 13:41:41	I do not have concerns about the beach loss. The Hawaiian Islands are subsiding and sea level is rising. Beach loss is an expected outcome of such processes and inevitable. I welcome the changing beaches.	We should allow for the natural evolution of the islands to continue and not interfere with nature. If anything, the hotels should be moved across the highway and more parking should be added to improve beach and shoreline accessibility. Moving the hotels now will ensure safety of visitors who stay in those hotels and their house reefs. Collapse of the hotels could cause significant loss of life and irreparable damage to the animals and healthy reef systems.
6/2/2024 11:15:18	No where for locals to go fish surf and dive	Bring the sand back from Ko'olina and Aulani Disney and wherever else the Maui county sand was sent off to
6/9/2024 8:25:49	Not sure how to restore the beach front as the resorts front the majority of it.	
7/1/2024 13:07:09	Ingress and egress and red clay ablation	I believe the shoreline should be hardened just beyond where the sand reaches and down below the sand strata
7/1/2024 13:16:03	Further environmental degradation of the area and a loss of access with our residents.	Restoration of traditional ecology (reef, ocean, beach, etc.). Move building from the shoreline and prevent further development within projected areas of sea rise.
7/2/2024 19:44:55	Shoreline access	Leave it to experts

Timestamp	SURVEY QUESTION #7: What would be the best time of year to do the project and why?	SURVEY QUESTION #8: What would be the short-term impacts of the project on your activities?
6/14/2023 16:40:51	Now	
6/16/2023 13:06:24	Summer months. Winter swells, specifically N/NE swells highly impact area	
6/21/2023 15:03:46	Project shouldn't be done at all	I feel that the locals who spend their time in this area will be able to adapt to change and find somewhere else to enjoy. Also, the less human traffic that is there- the more replenishment there will be of ocean/ marine life and reef.
6/26/2023 12:22:29		The project would impede all beach/ocean access to residents and visitors who plan to use the area.
6/30/2023 15:04:44	when erosion is at its worst	none, I rarely go there
7/4/2023 8:21:35	During the season when surf swells and waves would not be an issue and safety can be optimized.	We might not have access during the construction phase for educational purposes.
7/6/2023 13:41:41	Never. If sand is added, the current LIVING coral and animals will be suffocated and destroyed.	Short-term impact include the destruction of current near-shore reefs and ecosystem, which wou
6/2/2024 11:15:18	August/September because it's quiet during that time	It doesn't matter to me I just believe the sand should be returned let the ocean take care of the rest
6/9/2024 8:25:49	Anytime would suit me.	I could enjoy the beach at another location.
7/1/2024 13:07:09	Summer time because there is typically less surf	limited access
7/1/2024 13:16:03	May/June: reduced large swell events	
7/2/2024 19:44:55	The time of year best for the work regardless of tourism.	None

Timestamp	SURVEY QUESTION #9: Do you have any additional comments, concerns, or recommendations in regard to the project?
6/14/2023 16:40:51	
6/16/2023 13:06:24	Didn't know there was a project happening. Is this related to project in Kahana? Or 2 different projects?
6/21/2023 15:03:46	I personally feel that this whole project isn't about the improvements and saving of our island, ocean or beaches. It's all about money and those who want to protect the public and private structures they own behind the beach. And in those public and private structures- are people who will heavily use the new widened beach that this project will bring..... Usage that includes more recreational activities that will negatively impact this area.
6/26/2023 12:22:29	I have worked on a sand restoration project before and it did not work. All the sand that was moved to the new area was gone within the year. The project left nothing but issues for the area.. Issues such as rubbish and debris left by contractors.
6/30/2023 15:04:44	wondering what is planned and how you plan on keeping it a beach without removing walls and structures that are too close to the shoreline
7/4/2023 8:21:35	The coral reef and ocean environment should be safely accessible to everyone including educators, researchers, scientists, cultural practitioners, locals, tourists, first responders, and the general public. Clear and obvious safety and science and cultural education signage should be visible along with historical information on the area.
7/6/2023 13:41:41	This project is a terrible idea. The hotels at Honokowai should be demoed and moved across the main highway. Not only is sea level rising, but the island is subsiding. Erosion of the coastline is inevitable. In order to best protect the shoreline we love so much, we should let natural evolution take its course and protect the shoreline from future hotel collapses from the shoreline getting undercut by the waves.
6/2/2024 11:15:18	Ian was very knowledgeable and kind his explanation made a lot of sense hope and pray they this idea works for West side of Maui and possibly beyond
6/9/2024 8:25:49	
7/1/2024 13:07:09	If T-groins or any off the beach structres or break walls wee determined to be a best choice by the experts then I believe they should be allowed
7/1/2024 13:16:03	Don't pump sand. Plant plants.
7/2/2024 19:44:55	

8.3 Email Responses

In the initial stages of this project, prior to the ocean recreation survey being distributed, local knowledge was sought after by the Contractor, who passed on this email reply for the purposes of this report. The respondent is a local who also provided aerial view pictures of the surf breaks, which were overlaid and roughly labeled with red markings and lettering. Those pictures can be found in this report as Figure 4-1. The following is this unedited response in its totality, just like the survey responses presented above. The response given does not represent the opinions or judgements of the Contractor nor the author of this report, but rather, it is the answer given in response to a basic email prompt inquiring about Project Site options:

1) The rip current there between Kaanapali Beach Club and Kaanapali Shores has claimed a number of lives over the years and involved hundreds of rescues. There is a deep (relative) channel of sand where the additional water from waves on both sides of the channel returns to the sea. I imagine T-groins in the area will alter this return and possibly help alleviate the problem or change its course.
2) Rainbows and Hotels surf breaks are south of your project area so probably not significantly effected but this is my guess and I am no expert.
3) A surf break that I have really enjoyed over the last 14 years and where I spend 90% of my time riding waves is right in your project area but this break is no where as popular or used as Rainbows and Hotels. That is, used by surfers. "My" spot is to the north of the rip channel and in front of the southern building of Kaanapali Shores. I realize my spot could be altered and possibly ruined by the project but I also realize that a new break might emerge and ultimately the benefit to the properties and majority of people involved can easily outweigh my personal loss.
4) There is a group of kite surfers and wing surfers who do use the surf and water in your project area both for riding the waves and ingress and egress to the ocean further out. This is partly due to the fun waves but more important, one of the few decent and accessible launch sites in the area.I can imagine that the T-groins could both benefit and hinder their activities.
5) as far as safety goes, there is no lifeguard on duty and this has been a dangerous spot for visitors and locals due to strong currents and deceptive areas appearing to be safe. I don't know what the height of the T-groins will be but can imagine that they can inhibit view of the ocean at large and might add risk to the unwary.
6) The project area falls within the Kahekili Herbivore Fish Management area where herbivores are protected. I assume permits will clear any possible unintentional take. I do wonder if the T-groins are "friendly' to fishermen who will no doubt see them as an opportunity to reach new fishing areas.
7) In the past, both KBC and Kaanapali Shores have had in house scuba activities and instructors and the ingress and egress for the divers has been through the deep rip channel when viable which was typically when there is small waves and the rip not so strong.
8) If not common knowledge, Rainbows is a west or north swell break so modeling should consider the wave angles that come from those directions.
9) personally I am of the impression that the most important consideration is keeping the waves from accessing the red dirt, clay rock or what ever one calls the substrate there. I suspect a hardened shoreline that went deep enough to avoid undermining would serve well and some form of beach seems to cycle in and out with the seasons as is.
10) I marked the typical flow path of the stream when it runs and I imagine this would be altered if any T-groin were placed between the stream exit and the deep rip channel. I should qualify that this may be the typical path when the rip is also running due to surf and that is when I am more apt to be present.

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APPENDIX

K

TRAFFIC IMPACT ANALYSIS REPORT

TRAFFIC IMPACT ANALYSIS REPORT
HONOKOWAI BEACH RESTORATION PROJECT
HONOKOWAI, MAUI, HAWAII

FINAL

January 28, 2025

Prepared for:

Munekiyo Hiraga
735 Bishop Street, Suite 412
Honolulu, Hawaii 96813

Austin, Tsutsumi & Associates, Inc.
Civil Engineers • Surveyors
501 Sumner Street, Suite 521
Honolulu, Hawaii 96817-5031
Telephone: (808) 533-3646
Facsimile: (808) 526-1267
E-mail: atahnl@atahawaii.com
Honolulu • Wailuku, Hawaii

TRAFFIC IMPACT ANALYSIS REPORT
HONOKOWAI BEACH RESTORATION PROJECT

Honokowai, Maui, Hawaii

FINAL

Prepared for

Munekiyo Hiraga
735 Bishop Street, Suite 412
Honolulu, Hawaii 96813

Prepared by
Austin, Tsutsumi & Associates, Inc.
Civil Engineers • Surveyors
Honolulu • Wailuku, Hawaii

January 28, 2025

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A. LOS CRITERIA

B. TRAFFIC COUNT DATA

C. 2018 COUNT DATA

D. LOS WORKSHEETS

AUSTIN, TSUTSUMI & ASSOCIATES, INC. CIVIL ENGINEERS • SURVEYORS
CONTINUING THE ENGINEERING PRACTICE FOUNDED BY H. A. R. AUSTIN IN 1934

TERRANCE S. ARASHIRO, P.E.
ADRIENNE W.L.H. WONG, P.E., LEED AP
DEANNA M.R. HAYASHI, P.E.
PAUL K. ARITA, P.E.
ERIK S. KANESHIRO, L.P.L.S, LEED AP
MATT K. NAKAMOTO, P.E.
GARRETT K. TOKUOKA, P.E.

ADRIENNE W.L.H. WONG, P.E., LEED AP
Maui Branch Manager

TRAFFIC IMPACT ANALYSIS REPORT

Honokowai Beach Restoration Project

Honokowai, Maui, Hawaii

1. INTRODUCTION

This report documents the findings of a traffic study conducted by Austin, Tsutsumi, and Associates, Inc. (ATA) to evaluate the traffic impacts resulting from the proposed Hoala Honokowai Beach Restoration Project (hereinafter referred to as the "Project") at Honokowai Beach located in Honokowai, Maui, Hawaii.

1.1 Project Description

West Maui Resort Partners, L.P. (WMRP) is proposing beach restoration to restore and preserve Honokowai Beach. The restoration is proposed along the beach segment fronting Kaanapali Beach Club and Kaanapali Shores. The Project considers three (3) restoration alternatives, listed below. The TIAR will assess these three (3) methods and a "No Action" alternative for a total of four (4) Alternatives scenarios.

- **Alternative 1 – No Action**: Natural erosion of Honokowai Beach. This alternative assumes the existing erosion skirt will be removed, and Honokowai Beach continues to erode naturally, experiencing chronic, seasonal, and episodic erosion. Trips generated by the "No Action" Alternative will be associated with the removal of the erosion skirt. For the purpose of this report, the erosion skirt is anticipated to be removed by Year 2028.

- **Alternative 2 – Beach Nourishment**: An individual action (project) involving the placement of additional sand to temporarily increase beach width and sand volume to offset the effects of erosion without modifying existing structures or installing new structures. This alternative is anticipated to be completed by Year 2028 and has an estimated design life of 10 years.

- **Alternative 3 – Beach Maintenance**: A series of actions (program) including periodic beach nourishment combined with sand pushing and/or sand back passing without modifying existing structures or installing new structures. This alternative is anticipated to be completed by Year 2028 and has an estimated design life of 50 years. Five (5)

benchmark years are studied, beginning with Year 2028 and continuing at 10-year increments thereafter up to the 40-year forecast.

- **Alternative 4 – Beach Stabilization**: An individual action (project) involving the placement of sand to nourish the beach and modifying existing structures and/or installing new structures (e.g., groins). This alternative is anticipated to be completed by Year 2028 and has an estimated design life of 50 years.

The sand is proposed to be barged to Kahului Harbor, offloaded, and temporarily stockpiled on-site, or transported to a temporary stockpile site in Puunene. The sand will then be trucked to the project site to be placed on the shoreline.

See Figure 1.1 for the Project location. See Figure 1.2 for diagrams of the proposed alternatives.

1.2 Study Methodology

This study will address the following:

- Existing traffic operating conditions during the weekday morning (AM), weekday afternoon (PM), and Saturday midday (MD) peak hours of traffic within the study area.
- Traffic Projections for Base Year scenarios (without the Project).
- Vehicular trips that will be generated by the Project.
- Traffic projections for the Project for Future Year scenarios (with Project).
- Recommendations for roadway improvements or other mitigative measures, as appropriate, to reduce or eliminate the adverse impacts resulting from traffic generated by the Project.

1.2.1 Analysis Methodology

Level of Service (LOS) is a qualitative measure used to describe the conditions of traffic flow at intersections, with values ranging from free-flow conditions at LOS A to congested conditions at LOS F. The Highway Capacity Manual (HCM), 7th Edition includes methods for calculating volume-to-capacity (v/c) ratios, delays, and corresponding LOS that were used in this study. See Appendix A for LOS Criteria.

Analyses for the study intersections were performed using the traffic analysis software Synchro, which is able to prepare reports based on the methodologies described in the HCM. These reports contain control delay results based on intersection lane geometry, signal timing, and hourly traffic volumes. Based on the vehicular delay at each intersection, a LOS is assigned to each approach and intersection movement as a qualitative measure of performance. These results, as confirmed or refined by field observations, constitute the technical analysis that will form the basis of the recommendations outlined in this report.

HONOKOWAI BEACH RESTORATION

AustinTsutsumi & ASSOCIATES, INC.
Engineers & Surveyors

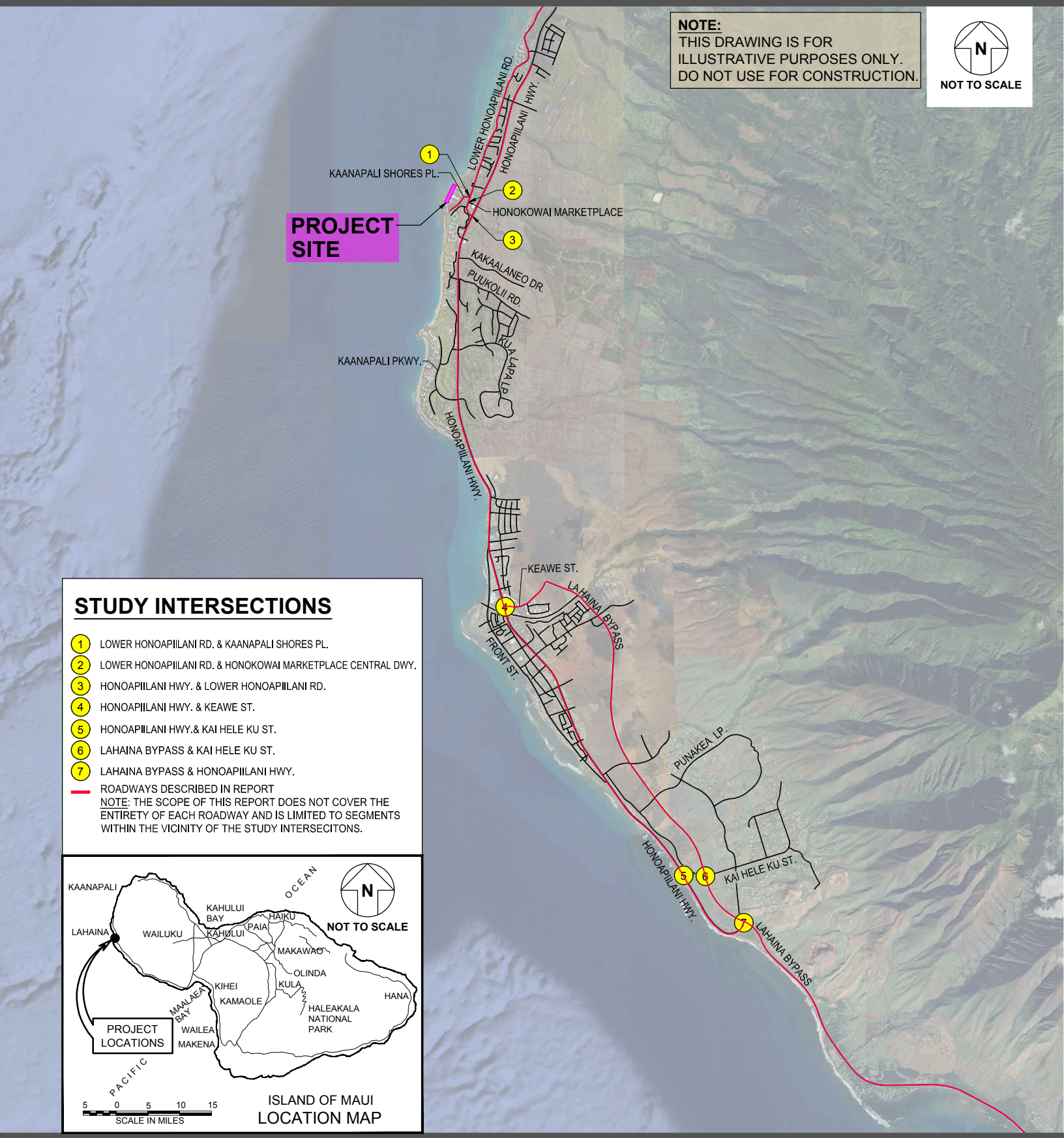


FIGURE 1.1

PROJECT LOCATION

AustinTsutsumi & ASSOCIATES, INC.
Engineers & Surveyors

NOTE:
THIS DRAWING IS FOR
ILLUSTRATIVE PURPOSES ONLY.
DO NOT USE FOR CONSTRUCTION.

N
NOT TO SCALE



PLAN VIEW OF THE BEACH STABILIZATION ALTERNATIVE



PLAN VIEW OF THE BEACH NOURISHMENT AND BEACH MAINTENANCE ALTERNATIVES

2. EXISTING CONDITIONS

2.1 Pedestrian Facilities

In the vicinity of the Project, sidewalks are provided along Kaanapali Shores Place, Lower Honoapiilani Road, and Keawe Street. Crosswalks are also provided at all study intersections. There is also a pathway between Kaanapali Beach Club and Kaanapali Shores that provides beach access from Kaanapali Shores Place.

The West Maui Greenway is a proposed 25-mile, multi-use trail connecting Lipoa Point to Ukumehame. According to the Maui Metropolitan Planning Organization (MPO)'s Transportation Improvement Plan (TIP) published in August 2024, this project is expected to be constructed in 2029.

See Figure 2.1 for the existing pedestrian facilities in the study area.

2.2 Bicycle Facilities

Within the study area, Honoapiilani Highway and part of Lahaina Bypass are designated as shared roadways.

According to the Bike Plan Hawaii Refresh, published in 2022 by the Hawaii Department of Transportation (HDOT), expansion of facilities in Lahaina is identified as a public priority. Within the study area, a signed shared roadway is proposed along the entirety of Lahaina Bypass, including future extensions. The previously mentioned West Maui Greenway will also be open to bicycle use.

See Figure 2.1 for the existing bicycle facilities in the study area.

2.3 Transit Facilities

The Maui Bus system offers several routes that connect the major areas in Maui. As of August 2024, a one-way fare costs $2.00, a daily pass costs $4.00, and a monthly pass costs $45.00. The Project area is served by the Lahaina Villager (Route 23) and the West Maui Express (Route 29). The nearest existing stop to the Project is along Lower Honoapiilani Road at the Honokowai Shopping Center.

See Figure 2.1 for the existing transit facilities in the study area.

2.4 Roadway System

The following are brief descriptions of the existing roadways studied within the vicinity of the Project:

Honoapiilani Highway is a State highway that provides regional connectivity for West Maui. Honoapiilani Highway begins in Wailuku where it transitions from South High Street near Keanu Street and continues southward toward Maalaea. The highway borders the coastline as it curves back around West Maui and northward again toward Kapalua, where it transitions into Kahekili Highway near Honokohau Bay. In the vicinity of the Project, Honoapiilani Highway is generally a two-way, four-lane undivided road with a speed limit of 35 miles per hour (mph).

Lower Honoapiilani Road is a two-way, two-lane roadway that begins to the north at its intersection with Office Road and extends south at its intersection with Honoapiilani Highway. It is generally parallel to the makai side of Honoapiilani Highway and provides access to beach-front properties. In the vicinity of the Project, Lower Honoapiilani Road has a posted speed limit of 20 mph.

Kaanapali Shores Place is a two-way, two-lane roadway that begins at its intersection with Lower Honoapiilani Road and heads makai towards various hotels and beach facilities. A paved auxiliary roadway connects from Kaanapali Shores Place to the shoreline. It has a posted speed limit of 5 mph.

Keawe Street is a two-way, four-lane divided roadway connecting Honoapiilani Highway and Lahaina Bypass Road (LBR) and currently serves as the northernmost terminus of LBR until the construction of the future LBR Phase 1C and 1D. Keawe Street also serves Lahaina Gateway and Lahaina Business Park. It has a posted speed limit of 25 mph within the study area.

Lahaina Bypass Road (LBR) is generally a two-way, two-lane highway that begins to the north at its intersection with Keawe Street and extends southward until it transitions into Honoapiilani Highway near Olowalu. LBR generally travels parallel to Honoapiilani Highway and provides access to Lahaina and Launiupoko. It has a posted speed limit of 45 mph within the study area.

Kai Hele Ku Street is a two-way, two-lane roadway that begins to the west at its intersection with Honoapiilani Highway and terminates to the east after its intersection with Kumu Niu Place. Kai Hele Ku Street facilitates traffic through Launiupoko and provides connectivity between Honoapiilani Highway and LBR. It has a posted speed limit of 25 mph within the study area.

The roadways discussed above are identified in Figure 1.1. The scope of this report does not cover the entirety of each roadway and is limited to segments within the vicinity of study intersections.

2.5 Existing Traffic Volumes

The following intersections in the vicinity of the Project were evaluated as a part of this study:

1. Lower Honoapiilani Road/Kaanapali Shores Place (Unsignalized)
2. Lower Honoapiilani Road/Honokowai Marketplace Central Driveway (Unsignalized)
3. Honoapiilani Highway/Lower Honoapiilani Road (Signalized)
4. Honoapiilani Highway/Keawe Street (Signalized)
5. Honoapiilani Highway/Kai Hele Ku Street (Signalized)
6. Lahaina Bypass/Kai Hele Ku Street (Signalized)
7. Lahaina Bypass (South Terminus)/Honoapiilani Highway (Unsignalized)

Traffic count data at the above intersections was collected on Thursday, May 9, 2024, and Saturday, May 11, 2024. Based on the traffic count data, the AM, PM, and MD peak hours of traffic occur between 7:30 AM to 8:30 AM, 3:30 PM to 4:30 PM, and 12:15 PM to 1:15 PM, respectively. Traffic count data is provided in Appendix B.

Due to the Lahaina wildfires in August 2023, traffic volumes in the study area are significantly lower than volumes recorded in years prior. At the time of this report, restoration efforts are currently ongoing, and the timeline for Lahaina's full recovery remains uncertain. A supplementary growth factor is applied to simulate the increase in traffic volumes attributed to the rebuilding. This growth is discussed further in Section 3. The 2018 traffic count data is provided in Appendix C.

2.6 Existing Intersection Analysis

Below are descriptions of the intersection operations during the AM, PM, and MD peak hours of traffic at the time of data collection.

[1] Lower Honoapiilani Road/Kaanapali Shores Place

All movements at this stop-controlled T-intersection operated at LOS C or better during all studied peak hours of traffic. The intersection experienced high pedestrian volumes in the resort area. No persistent congestion was observed at this intersection during any of the peak hours.

[2] Lower Honoapiilani Road/Honokowai Market Place

This stop-controlled T-intersection operated at LOS C or better during all studied traffic peaks. No persistent congestion was observed at this intersection during any of the peak hours.

[3] Honoapiilani Highway/Lower Honoapiilani Road

Most movements at this signalized intersection operated at LOS D or better during all studied peak hours of traffic. Although the southbound left-turn operated at LOS E(F) during the AM(PM) peaks, volume at this movement was observed to be relatively low at less than 5 vehicles per hour and is due to long cycles which prioritize progression of the mainline Honoapiilani Highway traffic. No persistent congestion was observed at this intersection during any of the peak hours.

[4] Honoapiilani Highway/Keawe Street

At the time of data collection, Honoapiilani Highway was temporarily closed due to ongoing restoration efforts in Lahaina but was reopened to through traffic in August 2024. This closure forced all southbound traffic to turn left onto Keawe Street, resulting in unusually high turning volumes. The absence of northbound traffic allowed the southbound left-turn to utilize a larger share of the traffic signal's cycle length, leading to mauka-bound congestion and spillback along Keawe Street, which was further worsened by a temporary traffic signal at the Keawe Street/Kupuohi Street intersection.

During the AM and MD peak hours, the observed traffic flow across all movements was generally smooth. However, during the PM peak hour, heavy volumes bound for LBR spillback along Keawe Street, slowing the progression of the southbound left-turn movement at the Honoapiilani Highway/Keawe Street intersection. This condition persisted through the end of the peak hour at 4:30 PM but was alleviated around 5:00 PM. Traffic conditions are expected to improve following the reopening of Honoapiilani Highway.

[5] Honoapiilani Highway/Kai Hele Ku Street

Similar to Keawe Street, traffic was redistributed due to the temporary closure along Honoapiilani Highway. With the redistribution, all movements at this signalized intersection operated at LOS B or better regardless of redistribution during all peak hours of traffic. Pedestrian volumes on the

east crosswalk were high as a result of crossings between Launiupoko Beach Park and its overflow parking lot across Honoapiilani Highway. No persistent congestion was observed at this intersection during any of the peak hours.

[6] Lahaina Bypass/Kai Hele Ku Street

Like the previous intersections, traffic volumes were adjusted to match historical distributions to account for the temporary closure along Honoapiilani Highway. With the redistribution, all movements at this signalized intersection operated at LOS C or better for all peak hours of traffic.

Approximately 30 minutes after the end of the PM peak hour, at about 5:00 PM, the spillback in the southbound direction along LBR was observed to affect progression at the LBR/Kai Hele Ku intersection and beyond. This congestion persisted at varying levels until about 7:00 PM and is similar to the conditions observed in 2018.

[7] Lahaina Bypass (South Terminus)/Honoapiilani Highway

At this intersection, the northbound traffic from Honoapiilani Highway can freely turn right into their own lane along LBR, which later merges into LBR about 1,300 feet south of the intersection. Throughout the AM and MD peak hours, traffic was generally able to quickly find gaps to seamlessly merge into LBR traffic.

During the PM peak hour, reduced speed limits and slowdowns in Olowalu and Ukumehame resulted in congestion in the southbound direction which spilled back through the merge and LBR Southern Terminus intersection and beyond. This congestion persisted at varying levels until about 7:15 PM.

Existing laneage, volumes, and LOS can be found in Figure 2.2 and a LOS summary can be found in Table 2.1.

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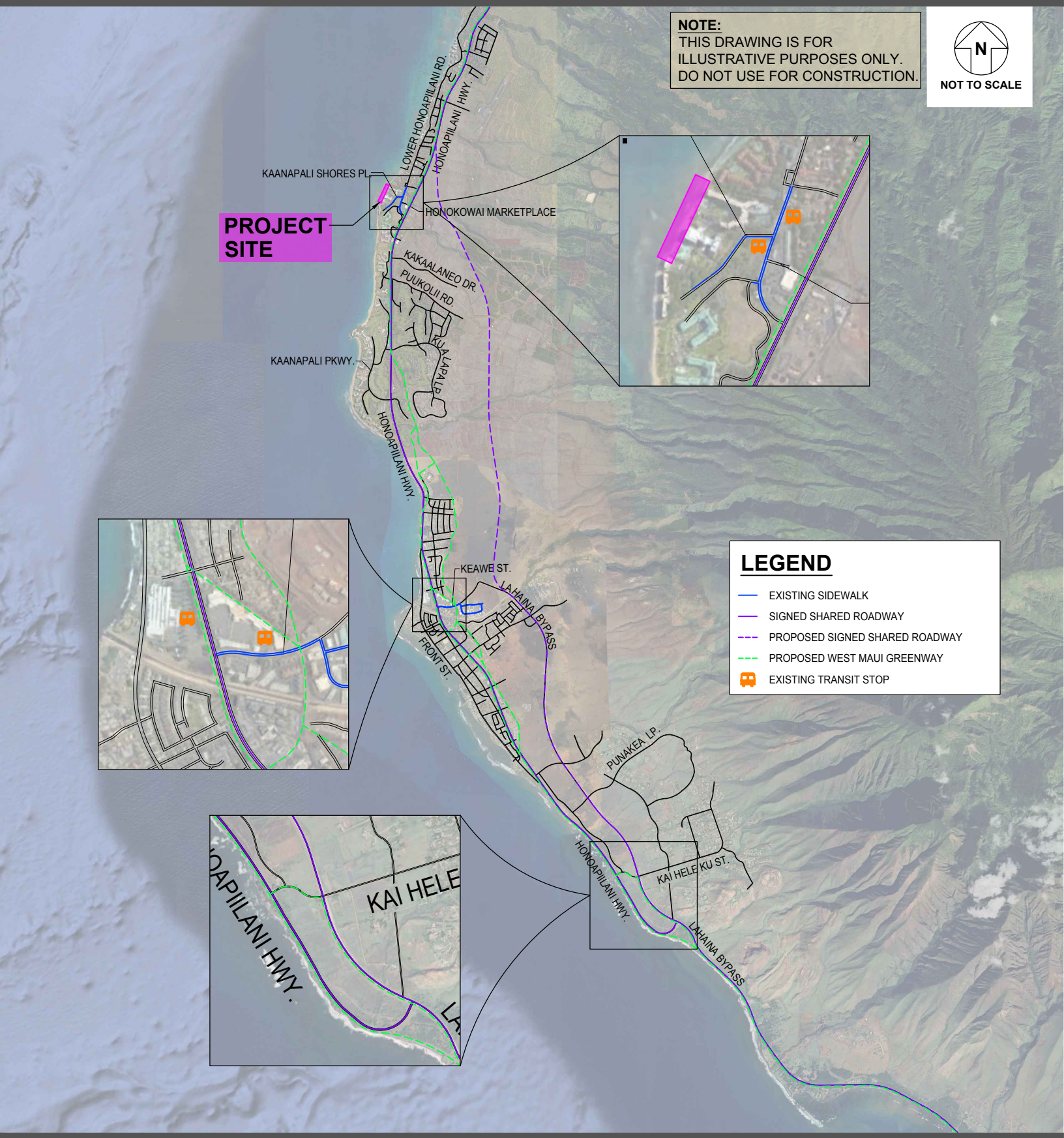


FIGURE 2.1

EXISTING PEDESTRIAN, BICYCLE, AND TRANSIT FACILITIES

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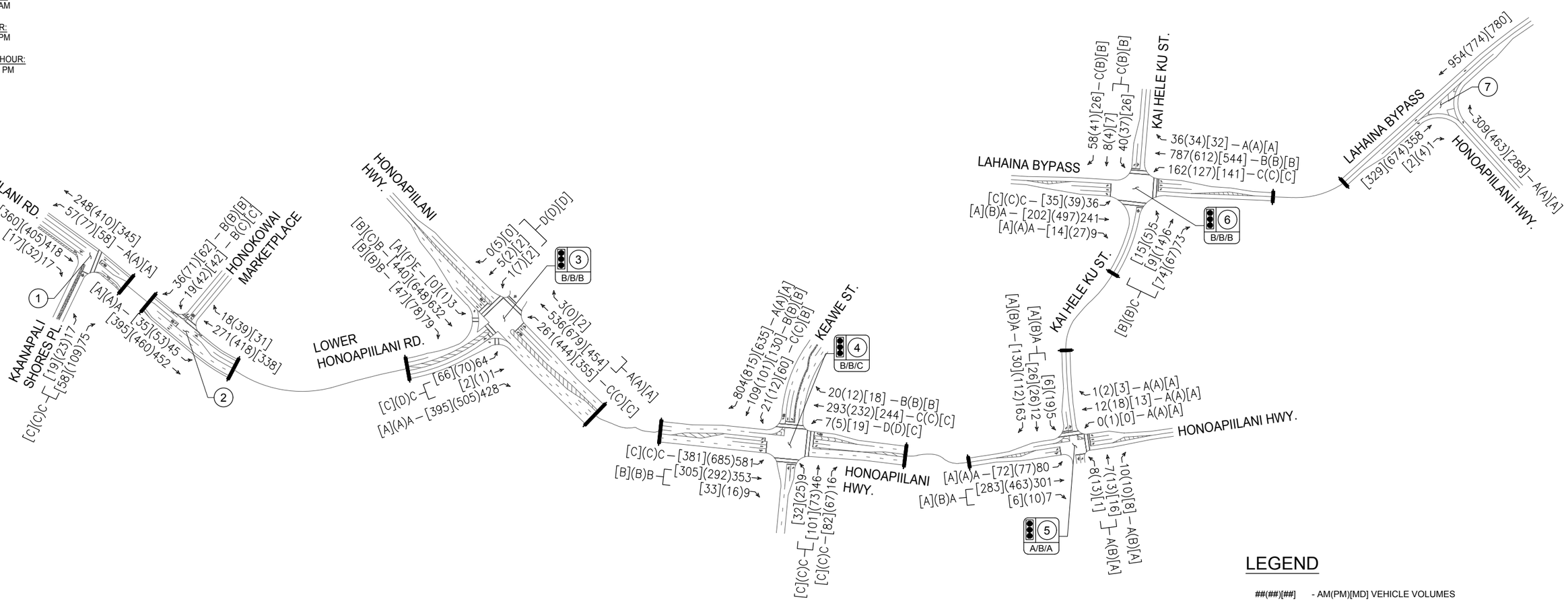
DATE OF COUNTS:
THURSDAY, MAY 9, 2024
SATURDAY, MAY 11, 2024

AM PEAK HOUR:
7:30 AM - 8:30 AM

PM PEAK HOUR:
3:30 PM - 4:30 PM

SAT MD PEAK HOUR:
12:15 PM - 1:15 PM

N
NOT TO SCALE



LEGEND

##(##)[##]	- AM(PM)[MD] VEHICLE VOLUMES
X	- UNSIGNALIZED INTERSECTION X
Y, X/X/X	- SIGNALIZED INTERSECTION Y, OVERALL AM/PM/MD LOS
X(X)[X]	- AM(PM)[MD] LOS *DENOTES V/C ≥ 1

FIGURE 2.2

EXISTING CONDITIONS
LANE CONFIGURATIONS, VOLUMES, AND LOS

TABLE 2.1: LOS SUMMARY
EXISTING CONDITIONS

Intersection	Existing Conditions								
	AM			PM			MD		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Lower Honoapiilani Road & Kaanapali Shores Place									
NB LT	9.3	0.07	A	9.4	0.09	A	9.0	0.07	A
EB LT/RT	18.5	0.27	C	23.7	0.43	C	18.2	0.24	C
OVERALL	2.7	-	-	3.7	-	-	2.2	-	-
2: Lower Honoapiilani Road & Honokowai Marketplace Driveway									
WB LT	14.6	0.05	B	19.4	0.16	C	15.7	0.12	C
WB RT	10.2	0.05	B	12.1	0.13	B	11.1	0.10	B
SB LT	8.0	0.04	A	8.6	0.05	A	8.2	0.03	A
OVERALL	1.2	-	-	2.0	-	-	1.8	-	-
3: Honoapiilani Highway & Lower Honoapiilani Road									
NB LT	25.6	0.80	C	28.5	0.88	C	22.6	0.82	C
NB TH/RT	8.5	0.32	A	7.6	0.35	A	5.1	0.23	A
EB LT/TH	33.1	0.67	C	43.2	0.74	D	31.8	0.67	C
WB LT/TH/RT	44.8	0.41	D	47.8	0.45	D	51.7	0.41	D
SB LT	61.6	0.41	E	118.2	0.41	F	0.0	0.00	A
SB TH	17.4	0.63	B	23.7	0.69	C	19.4	0.59	B
SB RT	13.8	0.05	B	18.6	0.05	B	16.3	0.03	B
OVERALL	16.4	-	B	19.9	-	B	16.0	-	B
4: Honoapiilani Highway & Keawe Street									
NB LT	43.7	0.43	D	51.9	0.42	D	34.5	0.47	C
NB TH	23.6	0.75	C	24.9	0.69	C	23.4	0.71	C
NB RT	17.5	0.01	B	19.6	0.01	B	18.0	0.01	B
EB LT/TH	25.6	0.26	C	26.3	0.40	C	23.5	0.45	C
EB RT	24.4	0.02	C	24.3	0.07	C	20.9	0.05	C
WB LT	21.7	0.09	C	21.8	0.06	C	17.8	0.21	B
WB TH	19.4	0.29	B	19.6	0.26	B	14.9	0.25	B
SB LT	21.6	0.74	C	21.2	0.77	C	23.0	0.68	C
SB TH/RT	11.0	0.46	B	10.6	0.38	B	15.5	0.57	B
OVERALL	19.4	-	B	19.9	-	B	20.3	-	C
5: Honoapiilani Highway & Kai Hele Ku Street									
NB LT	0.0	0.00	A	8.7	0.00	A	0.0	0.00	A
NB TH	9.0	0.04	A	8.4	0.03	A	9.1	0.04	A
NB RT	9.0	0.00	A	8.3	0.00	A	9.0	0.00	A
EB LT/TH	9.4	0.04	A	12.1	0.06	B	9.2	0.04	A
EB RT	9.3	0.00	A	11.9	0.00	B	9.1	0.00	A
WB LT/TH	9.5	0.04	A	12.3	0.11	B	9.4	0.07	A
WB RT	9.6	0.08	A	12.0	0.05	B	9.3	0.06	A
SB LT	6.2	0.13	A	6.9	0.11	A	6.3	0.12	A
SB TH/RT	5.1	0.39	A	10.2	0.70	B	5.2	0.37	A
OVERALL	5.9	-	A	10.0	-	B	6.1	-	A
6: Lahaina Bypass & Kai Hele Ku Street									
NB LT	28.5	0.78	C	24.6	0.74	C	22.1	0.74	C
NB TH	11.1	0.81	B	10.9	0.76	B	10.7	0.73	B
NB RT	5.2	0.03	A	6.2	0.03	A	6.5	0.03	A
EB LT/TH/RT	24.2	0.09	C	19.2	0.11	B	18.1	0.14	B
WB LT/TH	25.0	0.23	C	19.5	0.17	B	17.7	0.13	B
WB RT	23.9	0.02	C	18.8	0.02	B	17.2	0.02	B
SB LT	31.5	0.53	C	25.2	0.52	C	23.5	0.50	C
SB TH	8.8	0.29	A	11.8	0.70	B	9.6	0.33	A
SB RT	7.4	0.01	A	7.6	0.02	A	8.2	0.01	A
OVERALL	13.9	-	B	13.2	-	B	12.9	-	B

3. BASE YEAR TRAFFIC CONDITIONS

The Base Year scenarios represent the traffic conditions within the study area without the Project. Traffic projections were formulated by applying a de facto growth rate to the traffic count volumes as well as trips generated by known future developments in the vicinity of the Project. The benchmark year for Alternative 1 – No Action, Alternative 2 – Beach Nourishment, and Alternative 4 – Beach Stabilization is year 2028. The benchmark years for Alternative 3, which includes a total of five (5) nourishment actions, are 2028, 2038, 2048, 2058, and 2068.

3.1 Background Projection Methodology

The Maui MPO's Maui Travel Demand Model (MTDM) provides traffic projections across the island of Maui up to Year 2045. The forecasting model compiles socio-economic data from various sources to distribute households and vehicular trips across predetermined Traffic Analysis Zones (TAZs) based on existing TAZ household distributions. Traffic projections from the MTDM are used to calculate a "de facto" annual growth rate to determine Base Year conditions.

Because the study area covers a relatively large area, annual growth rates along Honoapiilani Highway and Lahaina Bypass vary by location. However, these rates generally range between 0.4% and 0.5%. These growth rates are assumed to remain constant for Base Years beyond Year 2045.

Since the completion of the MTDM, several projects have either stalled or have not been substantially completed in line with initial development plans. In addition, several known developments are not accounted for in the model since plans were not known while creating the MTDM. Trips are generated independently for known background developments and added to the study network based on the available information.

As previously noted, existing traffic volumes are significantly lower than volumes recorded in years prior, due to the Lahaina fires in 2023. At the time of this report, the timeline and extent to which Lahaina will be rebuilt is unknown. To account for the growth attributed to rebuilding in Lahaina, a supplementary growth rate is applied to existing data in addition to MTDM growth to simulate the increase in traffic volumes attributed to the rebuilding. This supplementary growth uses traffic data collected in 2018 before the wildfires as a basis and assumes that Lahaina will return to pre-fire conditions by 2038.

3.2 Background Developments

In addition to the de facto growth rate, background projects that are anticipated to generate traffic within the Project study area are added to the existing roadway network. Because these projections are generally conservative, the growth may not materialize if background projects are not constructed, especially in the longer horizons in which project may change. The known developments and their expected completion year are listed below based on available information at the time of this report.

- Mahana Estates – This project is located in Kapalua, mauka of Honoapiilani Highway within the larger Kapalua Mauka Residential development. The project proposes to develop 51 single-family luxury homes. At the time of this report, this project is partially constructed, and completion is this project is assumed to occur by 2028.
- Wailele Ridge – Previously known as West Maui Village, this project is located south of Honoapiilani Highway and just east of Maui Preparatory Academy. The project proposes

to develop 158 single-family units in 25 buildings. Construction of the project is ongoing with completion expected by 2028.

- Pulelehua Development – This project currently proposes to develop approximately 310 acres of land to provide 100 single-family residential units with an ohana unit allowed on each lot, 800 multi-family residential units, an elementary school, a 10-acre park and three (3) retail centers, totaling 70,000 square feet. In addition, a new roadway will be constructed just east and parallel to Honoapiilani Highway that will provide vehicular, bike and pedestrian access to link the Project's development north and south of Mahinahina Gulch. Construction is anticipated to occur in seven (7) phases, with all aforementioned uses assumed to be constructed by 2028. In addition, the elementary school that will be planned and developed by the Department of Education (DOE) is conservatively assumed to be constructed by 2038. King Kamehameha III Elementary school is currently operating here temporarily and these volumes were included in Existing conditions.

- DHHL Honokowai Development – This project currently proposes to develop approximately 800 acres of land to provide up to 250 homestead subsistence agriculture lots, 335 homestead residential single-family lots, 543 homestead multi-family residential units, 14 acres of supplemental agriculture, 17 acres of community use agriculture, 30 acres of community park space, 25 acres of community commercial use and 16 acres of industrial use. An updated TIAR was prepared for DHHL Honokowai by Fehr & Peers, dated January 4, 2022. Based on this TIAR, the DHHL Honokowai development would generate a total net new vehicular trips of 1,035 AM peak hour trips and 1,552 PM peak hour trips, with full build-out by Year 2028.

- West Maui Hospital and Medical Center – This project is located east of Honoapiilani Highway in the Kaanapali region. The project proposes to develop a critical access hospital, a skilled nursing facility, an assisted living facility, medical office buildings and a rehabilitation facility. At the time of this report, the project is currently on hold. However, as a conservative estimate, all components of the project would be completed by 2028.

- Lanikeha Kaanapali – This project is located east of Honoapiiliani Highway and across from Kaanapali Parkway. The project consists of 132 lots in a gated community, with Honoapiilani Highway access provided via Kekaa Drive and Kualapa Loop. At the time of this report, several lots were completed or under construction with additional lots still available for purchase.

- Lahaina Cannery Mall Expansion – This project is an expansion of the existing Lahaina Cannery Mall located at the northwest corner of Honoapiilani Highway and Keawe Street. The expansion is proposed between the existing access across Keawe Street and the Kahoma Stream Flood Control Channel. The project proposes to develop an 18-pump gas station, a First Hawaiian Bank Branch, and a restaurant. The project is expected to be completed by 2028.

- Kaiaulu o Kukuia (Keawe Street Apartments) – This project is located across from Lahaina Business Park on the north side of Keawe Street. The project proposes to develop 200 affordable rental apartment units through the Hawaiian Housing Finance and Development Corporation (HHFDC). This project is expected to be completed by 2028.

- Villages of Leialii, Village 1-B – This project is located mauka of Honoapiilani Highway and bounded by Lahaina Civic Center to the north and Leialii Parkway to the south. The project proposes to develop up to 250 dwelling units. This project is expected to be completed by 2038.

- Makila Farms is expected to consist of a combination of workforce residential dwelling units and market lots for a total of 34 dwelling units with access to be provided via Haniu Street and Punakea Street. At the time of this report, this project is currently on hold. However, as a conservative estimate, this project is estimated to be completed by 2028.

The following developments were also considered but were not included in Base Year projections or were assumed to be accounted for in the previously described growth rates.

- Ka Lai Ola – This project is located on 57 acres of HHFDC land to the east of Honoapiilani Highway between Leialii Parkway and Wahiukuli Road. The project proposes to construct 450 temporary housing units for survivors of the Lahaina wildfires who were not eligible for FEMA assistance. This temporary housing is expected to last for five (5) years. Trips generated by this project were assumed to be included in the Lahaina recovery growth.
- FEMA Kilohana – This project is located on 36 acres of land to the east of Honoapiilani Highway between Wahiukuli Road and Keawe Street. This FEMA project is led by the Army Corps of Engineers and proposes to construct 169 temporary housing units. Trips associated with this project were assumed to be included in the Lahaina recovery growth.
- Kamehameha Lahaina Revitalization – This project encompasses 2,500 acres in Lahaina owned by Kamehameha Schools. The project is expected to include agricultural, residential, and commercial land uses. However, there are no exact plans for the completion of this project; and therefore this project was not included in Base Year scenarios.
- Kahana Bay Erosion Mitigation – This project proposes erosion mitigation measures to treat 3,700 feet of beach from Kahana Stream to Pohaku Park. Trips generated by this project are assumed to be included within Base Year growth and normal fluctuations.
- Kaanapali Beach Restoration and Berm Enhancement – This project proposes beach nourishment within the Kaanapali Resort area between Hanakaoo Beach Park and Hanakaoo Point. Berm enhancement is also included between Hanakaoo Point and Puu Kekaa. Trips generated by this project are assumed to be included within Base Year growth and normal fluctuations.

See Figure 3.1 for the known developments included in the Base Year scenarios.

3.2.1 Trip Generation

The Institute of Transportation Engineers (ITE) publishes a book based on empirical data compiled from a body of more than 4,250 studies submitted by public agencies, developers, consulting firms, and associations. This publication, titled Trip Generation Manual, 11th Edition, provides trip rates and/or formulae based on graphs that correlate vehicular trips with independent variables. The independent variables can range from Dwelling Units (DU) for single-family attached homes to Gross Floor Area (GFA) for commercial or office development.

Trip generation for background projects are assumed based on previously accepted TIARs when available. If a TIAR did not generate traffic for the development or if a TIAR was never completed, trips were manually generated using trip generation rates contained in the Trip Generation Manual, 11th Edition as described above.

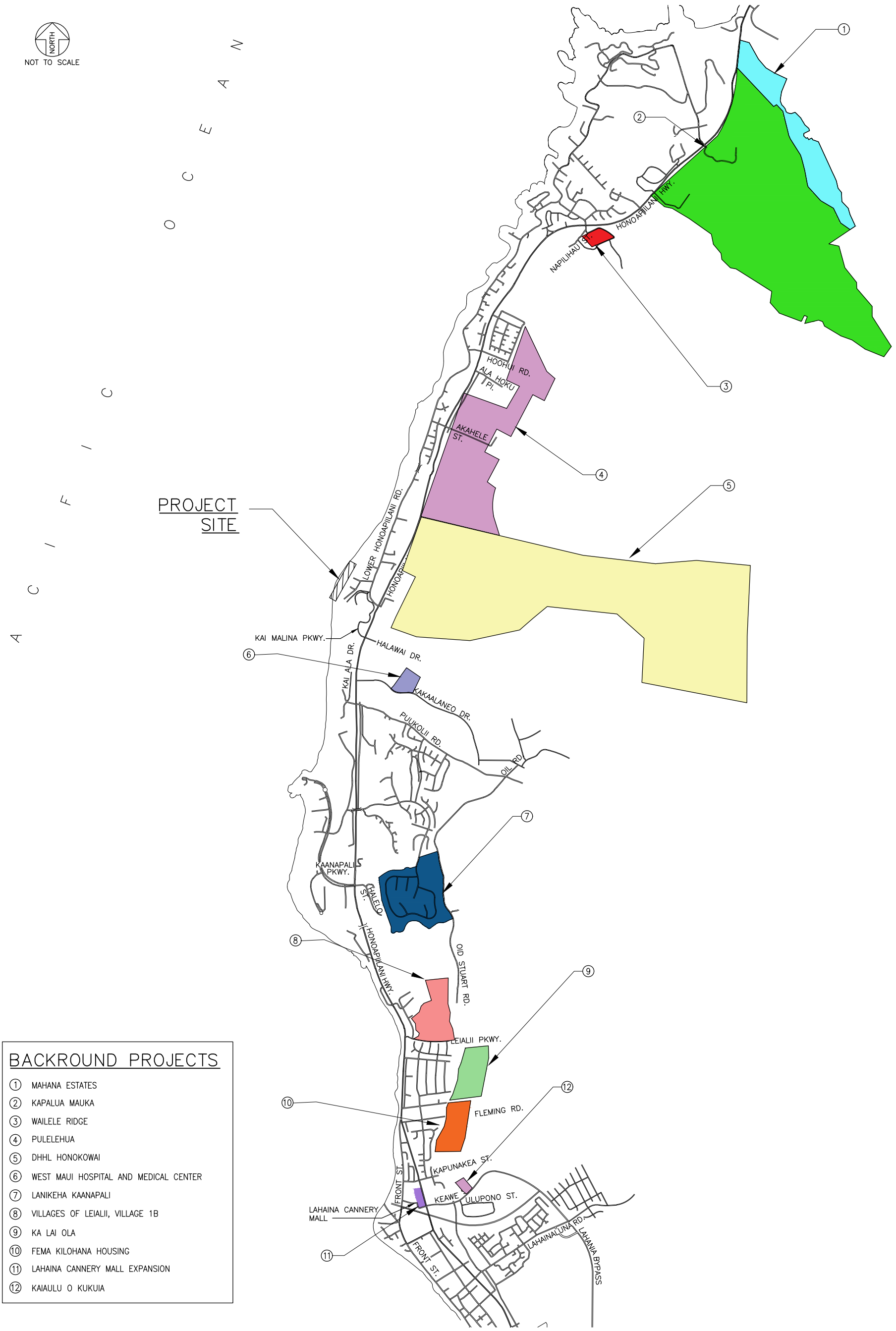
3.2.2 Trip Distribution & Assignment

Trips generated by the background developments were assigned throughout the study area generally based upon previous traffic studies and/or existing traffic patterns.

3.3 Planned Roadway Improvements

The following roadway improvements have been considered in the study area:

- Lahaina Bypass Extension: According to the Maui MPO's Long Range Transportation Plan 2038, Phase 1C will extend LBR north from its current terminus at Keawe Street to Kakaalaneo Drive. Phase 1D may extend LBR even further north, but there are currently no plans for its construction. Although the project currently lacks funding, Phases 1C and 1D were assumed to be constructed by Year 2038 and 2048, respectively.



BACKROUND PROJECTS

1. MAHANA ESTATES
2. KAPALUA MAUKA
3. WAILELE RIDGE
4. PULELEHUA
5. DHHL HONOKOWAI
6. WEST MAUI HOSPITAL AND MEDICAL CENTER
7. LANIKEHA KAANAPALI
8. VILLAGES OF LEIALII, VILLAGE 1B
9. KA LAI OLA
10. FEMA KILOHANA HOUSING
11. LAHAINA CANNERY MALL EXPANSION
12. KAIAULU O KUKUIA

FIGURE 3.1

BACKGROUND DEVELOPMENTS
LAHAINA AND KAANAPALI

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BACKROUND PROJECTS

① MAKILA FARMS

FIGURE 3.2

BACKGROUND DEVELOPMENTS
LAUNIUPOKO

Table 3.1: Background Project Trip Generation

Land Use	Independent Variable	AM Peak Hour			PM Peak Hour			MD Peak Hour		
		Enter (vph)	Exit (vph)	Total (vph)	Enter (vph)	Exit (vph)	Total (vph)	Enter (vph)	Exit (vph)	Total (vph)
Known Developments in Lahaina										
Kapalua Mauka[2]	390 Recreational SF DU 300 Recreational MF DU	118	48	166	106	141	247	106	141	247
Mahana Estates	51 SF DU	8	4	12	6	9	15	10	10	20
Wailele Ridge	158 SF DU	13	51	64	54	31	85	50	42	92
Pulelehua Development[1]	1000 SF/MF DU 70,000 Sq. Ft. Shopping Center 2 Field Soccer Complex 750 Student Elementary School	448	608	1056	528	397	928	553	490	1043
DHHL Honokowai[1,2]	250 Agriculture Lots 335 SF Lots 543 MF DU 31 Acres Agricultural Use 30 Acres Park Space 25 Acres Commercial 16 Acres Industrial	495	564	1057	832	760	1592	832	760	1592
West Maui Hospital and Medical Center	25 Bed Hospital 40 Bed Skilled Nursing Facility 40 Bed Assisted Living Facility 40 Bed Rehabilitation Facility 60,000 Sq. Ft. Medical Office Bldg.	184	62	246	86	201	287	188	155	341
Lanikeha Kaanapali	132 SF DU	16	8	24	12	18	30	19	22	41
Lahaina Cannery Mall Expansion[1]	18 Fueling Positions 5000 Sq. Ft. Walk-in Bank 3000 Sq. Ft Fast Casual Restaurant	105	98	202	177	174	351	291	281	572
Kaiaulu o Kukuia	200 MF DU	16	63	79	67	40	107	60	52	112
Villages of Leialii, Village 1-B[1,2]	86 SF DU	17	48	65	55	32	87	55	32	87
	164 MF DU	17	57	74	58	34	92	58	34	92
Makila Farms[1,2]	34 SF DU	7	22	29	23	14	37	23	14	37
Total Background External Trips		**1444**	**1633**	**3074**	**2004**	**1851**	**3858**	**2245**	**2033**	**4276**

Notes

- SF DU = Single-Family Dwelling Unit
- MF DU = Multi-Family Dwelling Unit
- Forecast trips are either derived from available TIAR's for each Project, ITE Trip Generation and/or updated to reflect current status.
- Table 3.1 shows total external trips generated by known developments in the vicinity of the Project.

1. Includes pass-by trip reductions based on the project TIAR.
2. To stay consistent with accepted TIAR, MD is assumed to be equal to PM

3.4 Base Year Analysis

3.4.1 Base Year 2028 Conditions

By Year 2028, volumes throughout the study area are expected to increase by roughly 37-53% compared to existing conditions. This is due to various developments as well as the anticipated restoration efforts in Lahaina. Most study intersections are expected to operate similarly to existing conditions with movements at LOS D or better. Intersections with movements at LOS E or F are discussed below:

[1] Lower Honoapiilani Road/Kaanapali Shores Place

All movements at this intersection are anticipated to operate at LOS C or better across all peak hours, with the exception of the eastbound minor street approach which is anticipated to operate at LOS E during the peak PM hour of traffic. All movements are anticipated to operate under capacity across all peak hours.

[3] Honoapiilani Highway/Lower Honoapiilani Road

Various minor movements are anticipated to operate at LOS E/F during all peak hours as a result of long cycle lengths which prioritize throughput mainline Honoapiilani Highway traffic. The mainline northbound and southbound through movements are anticipated to operate at LOS D or better and all movements are anticipated to operate under capacity across all peak hours.

[4] Honoapiilani Highway/Keawe Street

Traffic volume is expected to increase at this intersection as Lahaina recovers. Most movements are expected to operate at LOS D or better for all studied peak hours of traffic. During the PM and MD peaks, the northbound left-turn is expected to operate at LOS E, but is anticipated to continue to operate under capacity.

Base Year 2028 laneage, volumes, and LOS can be found in Figure 3.3. Table 3.2 shows a LOS Summary for Base Year 2028 conditions.

3.4.2 Base Year 2038 Conditions

By Year 2038, Phase 1C of the Lahaina Bypass Extension is assumed to be constructed. This roadway improvement aims to decrease traffic demand along Honoapiilani Highway by providing a more direct route to Kaanapali. As such, traffic operations at the Keawe Street intersection are expected to improve. In addition, several large developments are expected to be completed. While the study area is anticipated to operate similarly to Base Year 2028 conditions, the following intersections have movements that worsen to LOS E or F:

[3] Honoapiilani Highway/Lower Honoapiilani Road

With the increase in volumes, delay on turning movements at this intersection are anticipated to increase, with more movements operating at LOS E/F compared to Base Year 2028 due to long cycle lengths which prioritize throughput of the mainline Honoapiilani Highway traffic. However, all movements are anticipated to continue to operate under capacity.

[6] Lahaina Bypass/Kai Hele Ku Street

Some traffic along Honoapiilani Highway is expected to be diverted to Lahaina Bypass. In conjunction with de facto growth, the increased volume causes the southbound left-turn to worsen from LOS D to LOS E during the AM traffic peak. However, the left-turn volume is relatively low at less than 50 vehicles per hour and the movement will continue to operate under capacity.

Base Year 2038 laneage, volumes, and LOS can be found in Figure 3.4. Table 3.2 shows a LOS Summary for Base Year 2038 conditions.

3.4.3 Base Year 2048 Conditions

By Year 2048, Phase 1D of the Lahaina Bypass Extension is assumed to be constructed, decreasing volumes on Honoapiilani Highway and improving traffic operations at the Honoapiilani Highway/Lower Honoapiilani Road intersection. Study intersections are anticipated to generally operate similarly to Base Year 2038 conditions.

Base Year 2048 laneage, volumes, and LOS can be found in Figure 3.5. Table 3.3 shows a LOS Summary for Base Year 2048 conditions.

3.4.4 Base Year 2058 Conditions

Under Base Year 2058 conditions, no additional roadway changes are anticipated within the study area. If traffic growth remains consistent, most study intersections are expected to operate similarly to Base Year 2048 conditions. Although all movements are expected to remain under capacity, operations are anticipated to worsen at the following intersections:

[1] Lower Honoapiilani Road/Kaanapali Shores Place

As volume along Lower Honoapiilani Road increases from the de facto growth, the eastbound approach is expected to worsen from LOS from E to F during the PM peak hour; though this movement will continue to operate under capacity.

[2] Lower Honoapiilani Road/Honokowai Marketplace Central Driveway

As volume along Lower Honoapiilani Road increases from the de facto growth, the westbound left-turn is expected to worsen from LOS D to E during the PM peak hour; though this movement will continue to operate under capacity.

[3] Honoapiilani Highway/Lower Honoapiilani Highway

The eastbound left-turn/through movement is anticipated to experience an increase in delay of about three (3) seconds, which results in the movement lowering from LOS D to E during the MD peak.

[6] Lahaina Bypass/Kai Hele Ku Street

The northbound left-turn is expected to lower from LOS D to E during the PM traffic peak and the westbound left-turn/through movement is anticipated to lower from LOS D to LOS E during the AM peak hour.

Base Year 2058 laneage, volumes, and LOS can be found in Figure 3.6. Table 3.3 shows a LOS Summary for Base Year 2058 conditions.

3.4.5 Base Year 2068 Conditions

Under Base Year 2068 conditions, most study intersections are expected to operate similarly to Base Year 2058 conditions. Although all movements are expected to remain under capacity, operations are anticipated to worsen at the following intersections:

[4] Honoapiilani Highway/Keawe Street

The northbound through movement is anticipated to lower from LOS D to LOS E during the MD peak hour; however the movement will remain under capacity.

[6] Lahaina Bypass/Kai Hele Ku Street

Due to an increase in volumes, minor street movements are anticipated to lower from LOS D to LOS E due to long cycle lengths which favor progression along Lahaina Bypass; however all movements are anticipated to operate under capacity.

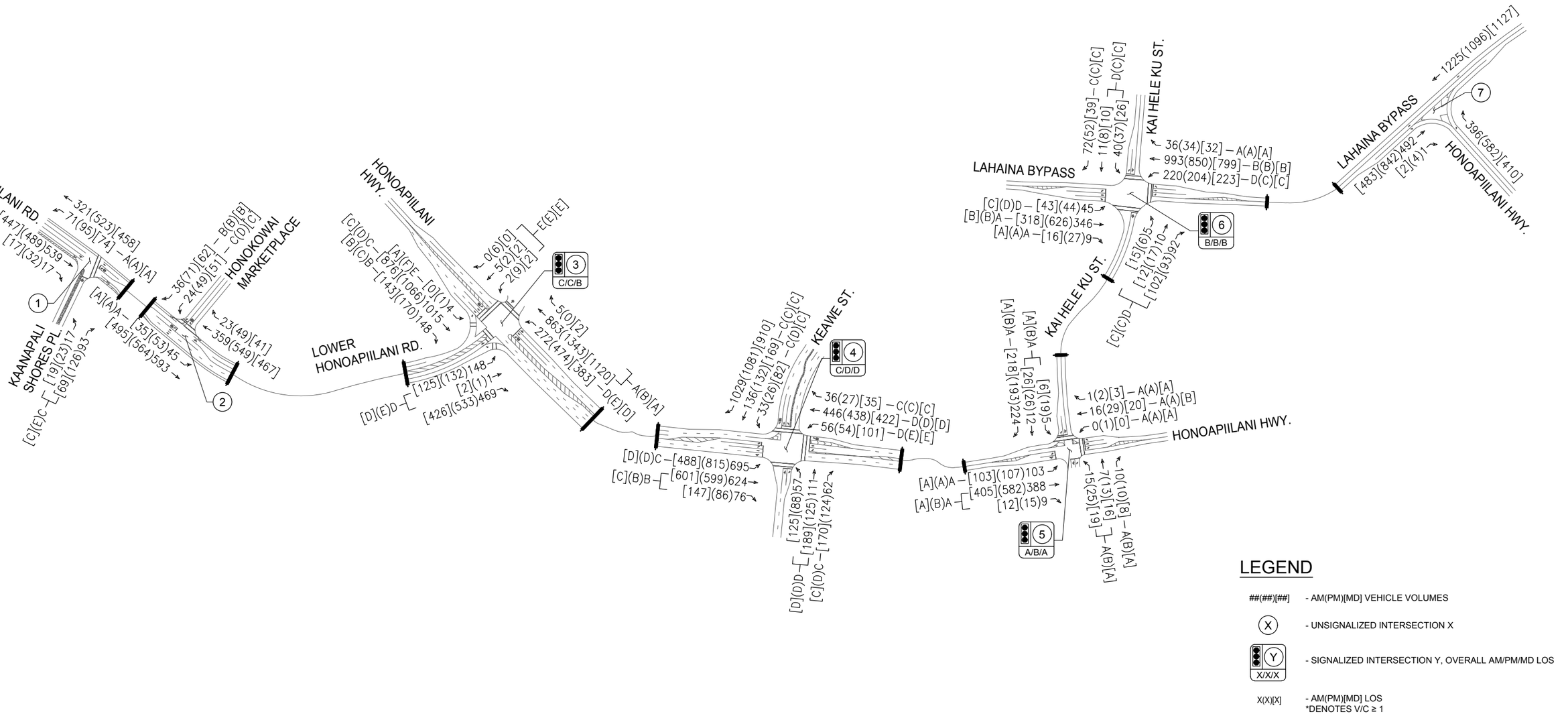
Base Year 2068 laneage, volumes, and LOS can be found in Figure 3.7. Table 3.3 shows a LOS Summary for Base Year 2068 conditions.

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N
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LEGEND

##(##)[##]	- AM(PM)[MD] VEHICLE VOLUMES
X	- UNSIGNALIZED INTERSECTION X
Y, X/X/X	- SIGNALIZED INTERSECTION Y, OVERALL AM/PM/MD LOS
X(X)[X]	- AM(PM)[MD] LOS *DENOTES V/C ≥ 1

FIGURE 3.3

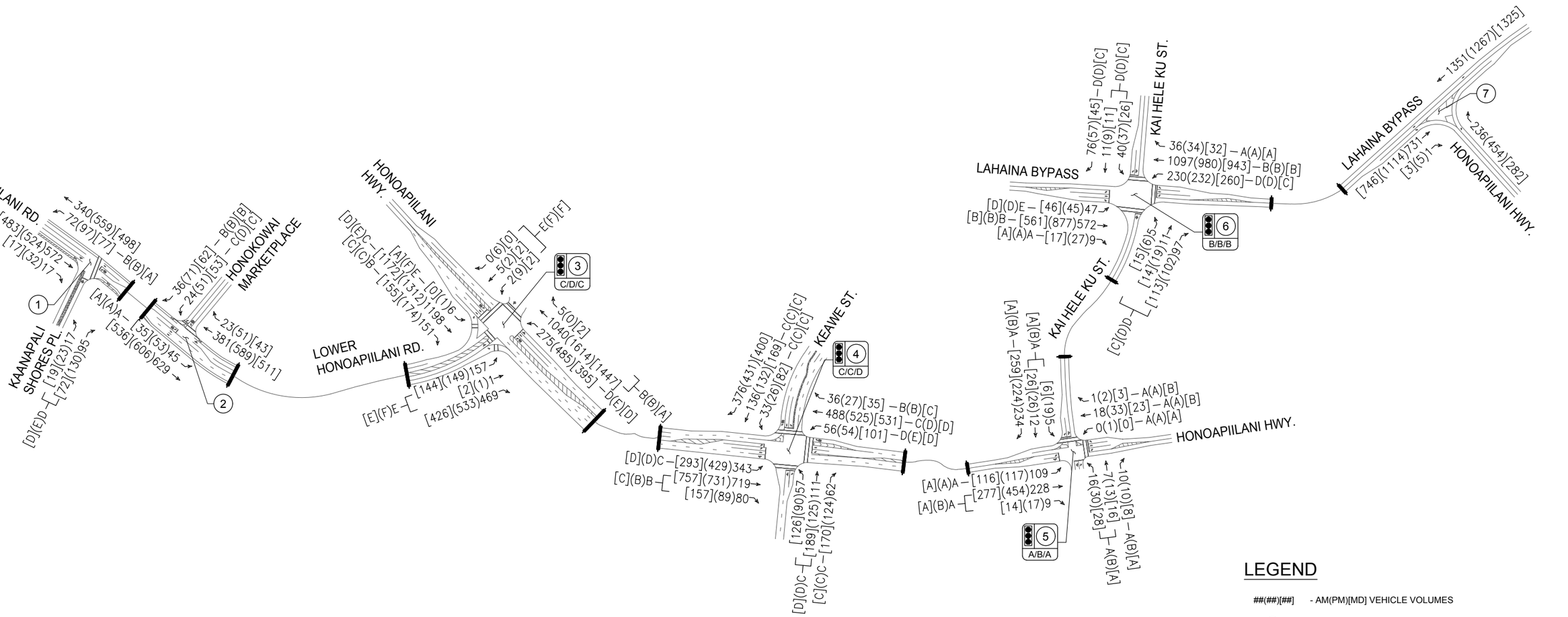
BASE YEAR 2028
LANE CONFIGURATIONS, VOLUMES, AND LOS

HONOKOWAI BEACH RESTORATION

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N
NOT TO SCALE



LEGEND

##(##)[##]	- AM(PM)[MD] VEHICLE VOLUMES
X	- UNSIGNALIZED INTERSECTION X
Y, X/X/X	- SIGNALIZED INTERSECTION Y, OVERALL AM/PM/MD LOS
X(X)[X]	- AM(PM)[MD] LOS *DENOTES V/C ≥ 1

FIGURE 3.4

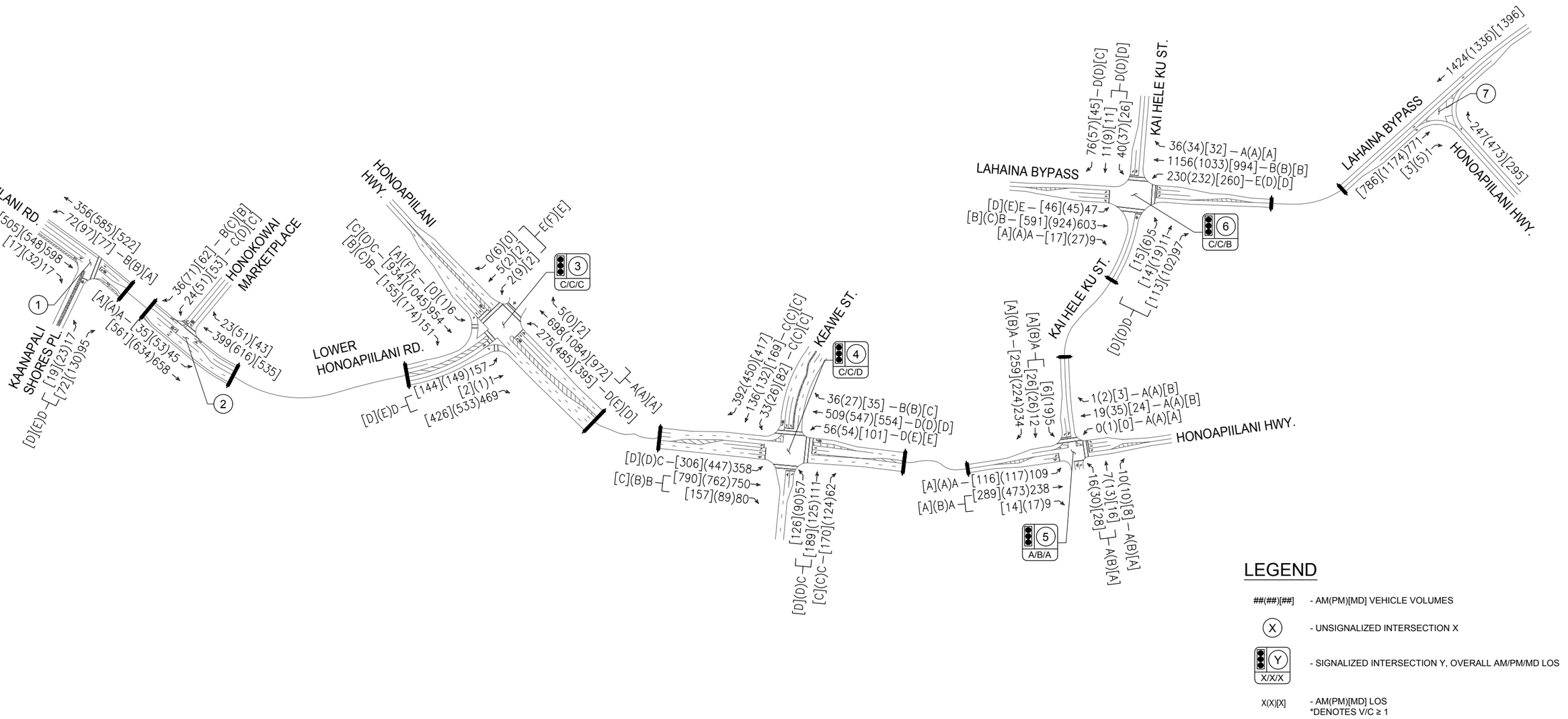
BASE YEAR 2038
LANE CONFIGURATIONS, VOLUMES, AND LOS

HONOKOWAI BEACH RESTORATION

AustinTsutsumi & ASSOCIATES, INC.
Engineers & Surveyors

NOTE:
THIS DRAWING IS FOR
ILLUSTRATIVE PURPOSES ONLY.
DO NOT USE FOR CONSTRUCTION.

N
NOT TO SCALE



LEGEND

##(##)[##]	- AM(PM)[MD] VEHICLE VOLUMES
X	- UNSIGNALIZED INTERSECTION X
Y X/X/X	- SIGNALIZED INTERSECTION Y, OVERALL AM/PM/MD LOS
X(X)[X]	- AM(PM)[MD] LOS *DENOTES V/C ≥ 1

FIGURE 3.5

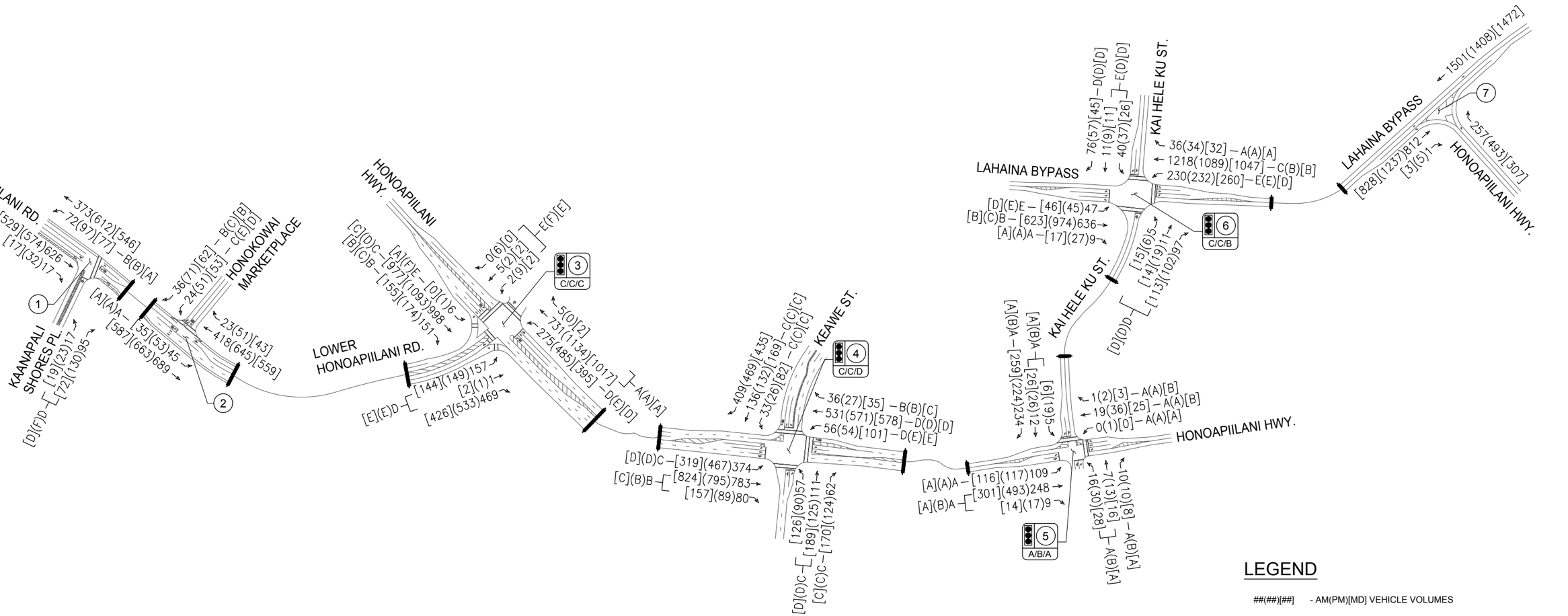
BASE YEAR 2048
LANE CONFIGURATIONS, VOLUMES, AND LOS

HONOKOWAI BEACH RESTORATION

AustinTsutsumi & ASSOCIATES, INC.
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N
NOT TO SCALE



LEGEND

##(##)[##]	- AM(PM)[MD] VEHICLE VOLUMES
X	- UNSIGNALIZED INTERSECTION X
Y, X/X/X	- SIGNALIZED INTERSECTION Y, OVERALL AM/PM/MD LOS
X(X)[X]	- AM(PM)[MD] LOS *DENOTES V/C ≥ 1

FIGURE 3.6

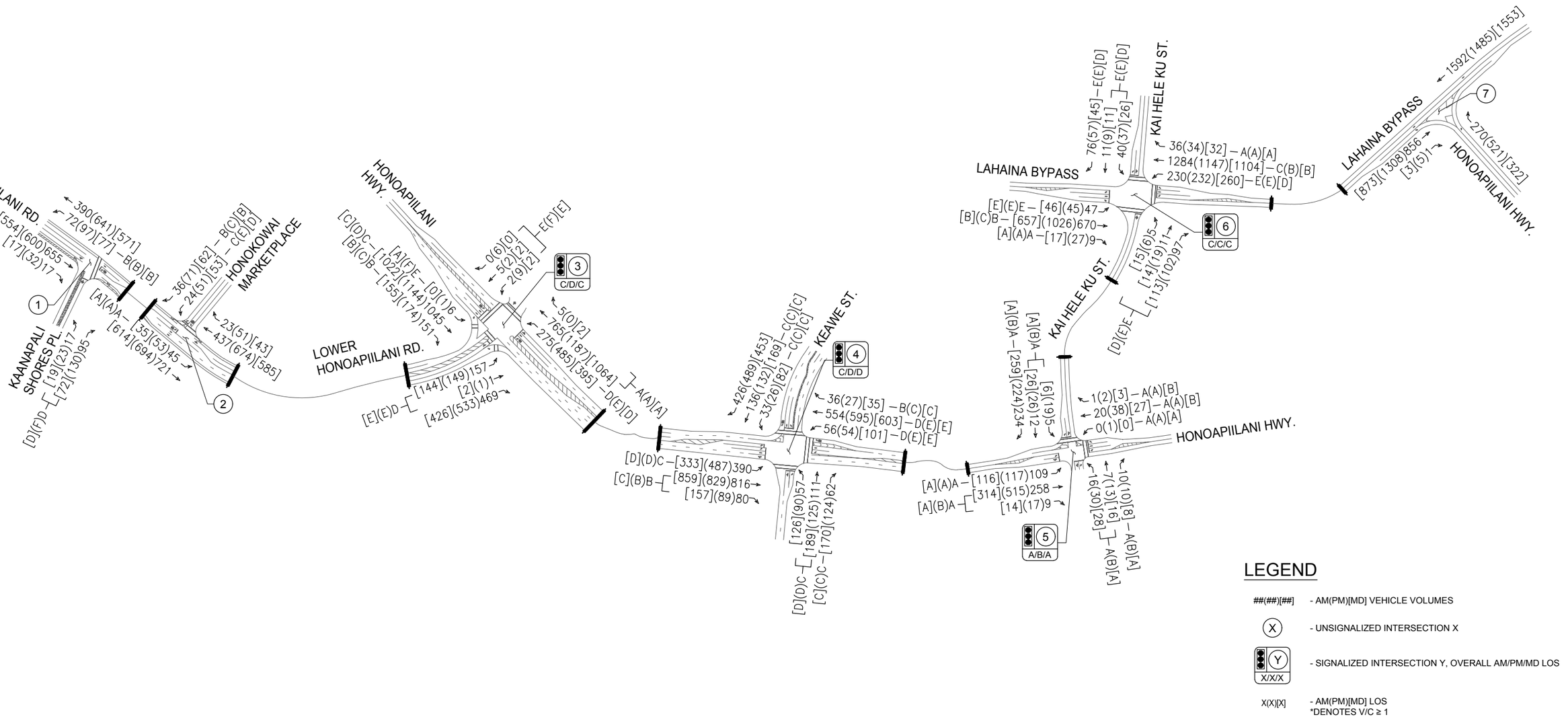
BASE YEAR 2058
LANE CONFIGURATIONS, VOLUMES, AND LOS

HONOKOWAI BEACH RESTORATION

AustinTsutsumi & ASSOCIATES, INC.
Engineers & Surveyors

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DO NOT USE FOR CONSTRUCTION.

N
NOT TO SCALE



LEGEND

##(##)[##]	- AM(PM)[MD] VEHICLE VOLUMES
X	- UNSIGNALIZED INTERSECTION X
Y, X/X/X	- SIGNALIZED INTERSECTION Y, OVERALL AM/PM/MD LOS
X(X)[X]	- AM(PM)[MD] LOS *DENOTES V/C ≥ 1

FIGURE 3.7

BASE YEAR 2068
LANE CONFIGURATIONS, VOLUMES, AND LOS

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

TABLE 3.2: LOS SUMMARY
EXISTING, BY 2028, AND BY 2038

	Existing Conditions									Base Year 2028									Base Year 2038								
	AM			PM			MD			AM			PM			MD			AM			PM			MD		
Intersection	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Lower Honoapiilani Road & Kaanapali Shores Place																											
NB LT	9.3	0.07	A	9.4	0.09	A	9.0	0.07	A	9.9	0.10	A	9.9	0.12	A	9.5	0.09	A	10.1	0.10	B	10.1	0.13	B	9.7	0.10	A
EB LT/RT	18.5	0.27	C	23.7	0.43	C	18.2	0.24	C	24.9	0.40	C	35.2	0.59	E	23.2	0.33	C	27.1	0.43	D	41.8	0.65	E	25.8	0.37	D
OVERALL	2.7	-	-	3.7	-	-	2.2	-	-	3.3	-	-	4.8	-	-	2.5	-	-	3.4	-	-	5.4	-	-	2.7	-	-
2: Lower Honoapiilani Road & Honokowai Marketplace Driveway																											
WB LT	14.6	0.05	B	19.4	0.16	C	15.7	0.12	C	17.8	0.09	C	26.7	0.24	D	20.6	0.19	C	18.8	0.09	C	30.1	0.28	D	22.9	0.22	C
WB RT	10.2	0.05	B	12.1	0.13	B	11.1	0.10	B	11.0	0.06	B	13.9	0.16	B	12.6	0.12	B	11.2	0.06	B	14.6	0.17	B	13.1	0.13	B
SB LT	8.0	0.04	A	8.6	0.05	A	8.2	0.03	A	8.3	0.04	A	9.1	0.06	A	8.7	0.04	A	8.4	0.04	A	9.3	0.07	A	8.9	0.04	A
OVERALL	1.2	-	-	2.0	-	-	1.8	-	-	1.1	-	-	2.1	-	-	1.9	-	-	1.1	-	-	2.2	-	-	1.9	-	-
3: Honoapiilani Highway & Lower Honoapiilani Road																											
NB LT	25.6	0.80	C	28.5	0.88	C	22.6	0.82	C	41.0	0.86	D	57.2	0.94	E	36.1	0.89	D	49.8	0.88	D	77.0	0.95	E	48.7	0.91	D
NB TH/RT	8.5	0.32	A	7.6	0.35	A	5.1	0.23	A	9.7	0.43	A	10.1	0.59	B	6.6	0.49	A	10.2	0.48	B	12.3	0.68	B	8.1	0.60	A
EB LT/TH	33.1	0.67	C	43.2	0.74	D	31.8	0.67	C	47.7	0.81	D	66.6	0.82	E	45.3	0.79	D	65.7	0.84	E	90.3	0.87	F	69.1	0.84	E
WB LT/TH/RT	44.8	0.41	D	47.8	0.45	D	51.7	0.41	D	60.2	0.43	E	78.0	0.52	E	68.3	0.41	E	70.1	0.43	E	96.3	0.55	F	81.5	0.42	F
SB LT	61.6	0.41	E	118.2	0.41	F	0.0	0.00	A	71.6	0.42	E	149.4	0.41	F	0.0	0.00	A	71.7	0.45	E	166.1	0.41	F	0.0	0.00	A
SB TH	17.4	0.63	B	23.7	0.69	C	19.4	0.59	B	22.8	0.75	C	38.0	0.83	D	25.5	0.76	C	25.3	0.79	C	58.6	0.95	E	36.0	0.88	D
SB RT	13.8	0.05	B	18.6	0.05	B	16.3	0.03	B	16.2	0.13	B	25.7	0.17	C	18.5	0.08	B	16.5	0.13	B	29.2	0.17	C	20.2	0.09	C
OVERALL	16.4	-	B	19.9	-	B	16.0	-	B	21.7	-	C	30.0	-	C	19.7	-	B	24.3	-	C	41.3	-	D	26.3	-	C
4: Honoapiilani Highway & Keawe Street																											
NB LT	43.7	0.43	D	51.9	0.42	D	34.5	0.47	C	55.0	0.77	D	67.4	0.77	E	55.3	0.79	E	41.7	0.69	D	55.6	0.76	E	53.6	0.78	D
NB TH	23.6	0.75	C	24.9	0.69	C	23.4	0.71	C	48.8	0.91	D	42.5	0.88	D	49.3	0.89	D	33.7	0.88	C	40.9	0.90	D	54.7	0.94	D
NB RT	17.5	0.01	B	19.6	0.01	B	18.0	0.01	B	22.2	0.02	C	27.9	0.01	C	26.8	0.02	C	16.2	0.02	B	19.3	0.01	B	22.4	0.02	C
EB LT/TH	25.6	0.26	C	26.3	0.40	C	23.5	0.45	C	38.2	0.64	D	46.6	0.72	D	43.1	0.78	D	30.2	0.59	C	36.1	0.66	D	39.8	0.77	D
EB RT	24.4	0.02	C	24.3	0.07	C	20.9	0.05	C	32.6	0.11	C	38.6	0.17	D	30.3	0.21	C	25.9	0.09	C	29.8	0.13	C	28.8	0.19	C
WB LT	21.7	0.09	C	21.8	0.06	C	17.8	0.21	B	29.7	0.20	C	35.9	0.18	D	29.0	0.44	C	23.1	0.16	C	27.4	0.15	C	27.6	0.42	C
WB TH	19.4	0.29	B	19.6	0.26	B	14.9	0.25	B	27.2	0.33	C	33.1	0.30	C	23.2	0.27	C	20.6	0.29	C	24.6	0.27	C	21.9	0.27	C
SB LT	21.6	0.74	C	21.2	0.77	C	23.0	0.68	C	31.7	0.83	C	44.8	0.89	D	42.4	0.82	D	30.0	0.71	C	37.0	0.78	D	44.7	0.76	D
SB TH/RT	11.0	0.46	B	10.6	0.38	B	15.5	0.57	B	13.7	0.42	B	15.2	0.39	B	25.9	0.59	C	15.9	0.57	B	17.0	0.53	B	28.8	0.75	C
OVERALL	19.4	-	B	19.9	-	B	20.3	-	C	30.3	-	C	35.8	-	D	36.9	-	D	24.9	-	C	30.0	-	C	38.1	-	D
5: Honoapiilani Highway & Kai Hele Ku Street																											
NB LT	0.0	0.00	A	8.7	0.00	A	0.0	0.00	A	0.0	0.00	A	9.1	0.00	A	0.0	0.00	A	0.0	0.00	A	9.4	0.00	A	0.0	0.00	A
NB TH	9.0	0.04	A	8.4	0.03	A	9.1	0.04	A	9.7	0.05	A	8.5	0.05	A	10.0	0.06	B	10.0	0.06	A	9.4	0.07	A	10.4	0.08	B
NB RT	9.0	0.00	A	8.3	0.00	A	9.0	0.00	A	9.6	0.00	A	8.3	0.00	A	9.9	0.00	A	9.8	0.00	A	9.2	0.00	A	10.2	0.00	B
EB LT/TH	9.4	0.04	A	12.1	0.06	B	9.2	0.04	A	9.6	0.05	A	14.5	0.10	B	9.5	0.07	A	9.4	0.05	A	12.1	0.10	B	9.5	0.09	A
EB RT	9.3	0.00	A	11.9	0.00	B	9.1	0.00	A	9.4	0.01	A	14.1	0.00	B	9.3	0.00	A	9.2	0.01	A	11.7	0.00	B	9.2	0.00	A
WB LT/TH	9.5	0.04	A	12.3	0.11	B	9.4	0.07	A	9.5	0.04	A	14.6	0.11	B	9.5	0.07	A	9.3	0.04	A	12.1	0.10	B	9.4	0.07	A
WB RT	9.6	0.08	A	12.0	0.05	B	9.3	0.06	A	10.0	0.16	A	14.6	0.12	B	9.8	0.16	A	9.9	0.19	A	12.3	0.16	B	9.9	0.21	A
SB LT	6.2	0.13	A	6.9	0.11	A	6.3	0.12	A	6.5	0.16	A	6.3	0.14	A	6.8	0.17	A	6.7	0.18	A	7.1	0.17	A	7.1	0.19	A
SB TH/RT	5.1	0.39	A	10.2	0.70	B	5.2	0.37	A	5.9	0.50	A	10.8	0.76	B	6.3	0.54	A	5.2	0.31	A	10.7	0.71	B	5.7	0.38	A
OVERALL	5.9	-	A	10.0	-	B	6.1	-	A	6.6	-	A	10.7	-	B	7.1	-	A	6.7	-	A	10.3	-	B	7.2	-	A
6: Lahaina Bypass & Kai Hele Ku Street																											
NB LT	28.5	0.78	C	24.6	0.74	C	22.1	0.74	C	49.0	0.85	D	29.9	0.79	C	27.3	0.79	C	47.7	0.86	D	45.0	0.86	D	34.0	0.84	C
NB TH	11.1	0.81	B	10.9	0.76	B	10.7	0.73	B	12.0	0.86	B	11.7	0.83	B	11.7	0.82	B	12.9	0.89	B	10.4	0.81	B	12.3	0.86	B
NB RT	5.2	0.03	A	6.2	0.03	A	6.5	0.03	A	4.3	0.02	A	5.1	0.02	A	5.5	0.02	A	3.8	0.02	A	4.0	0.02	A	4.8	0.02	A
EB LT/TH/RT	24.2	0.09	C	19.2	0.11	B	18.1	0.14	B	35.2	0.15	D	27.6	0.17	C	26.2	0.27	C	43.5	0.21	D	42.8	0.35	D	34.3	0.38	C
WB LT/TH	25.0	0.23	C	19.5	0.17	B	17.7	0.13	B	36.3	0.31	D	28.0	0.23	C	25.5	0.17	C	44.8	0.36	D	42.2	0.30	D	32.7	0.20	C
WB RT	23.9	0.02	C	18.8	0.02	B	17.2	0.02	B	34.7	0.07	C	27.0	0.05	C	24.8	0.03	C	42.8	0.10	D	40.4	0.06	D	31.8	0.06	C
SB LT	31.5	0.53	C	25.2	0.52	C	23.5	0.50	C	45.6	0.65	D	35.4	0.59	D	32.9	0.57	C	57.9	0.73	E	54.6	0.70	D	42.6	0.64	D
SB TH	8.8	0.29	A	11.8	0.70	B	9.6	0.33	A	9.9	0.36	A	14.2	0.75	B	11.3	0.42	B	12.0	0.56	B	18.9	0.88	B	14.5	0.66	B
SB RT	7.4	0.01	A	7.6	0.02	A	8.2	0.01	A	7.8	0.01	A	8.3	0.02	A	9.0	0.01	A	7.8	0.01	A	8.1	0.02	A	9.3	0.01	A
OVERALL	13.9	-	B	13.2	-	B	12.9	-	B	18.2	-	B	15.7	-	B	15.3	-	B	18.7	-	B	19.3	-	B	17.6	-	B

TABLE 3.3: LOS SUMMARY
BY 2048, BY 2058, AND BY 2068

	Base Year 2048									Base Year 2058									Base Year 2068								
	AM			PM			MD			AM			PM			MD			AM			PM			MD		
Intersection	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Lower Honoapiilani Road & Kaanapali Shores Place																											
NB LT	10.3	0.10	B	10.3	0.13	B	9.8	0.10	A	10.4	0.11	B	10.4	0.14	B	9.9	0.10	A	10.6	0.11	B	10.6	0.14	B	10.1	0.11	B
EB LT/RT	28.9	0.45	D	46.8	0.69	E	27.6	0.39	D	31.1	0.48	D	53.5	0.73	F	29.6	0.41	D	33.7	0.50	D	61.9	0.77	F	32.0	0.43	D
OVERALL	3.4	-	-	5.8	-	-	2.7	-	-	3.5	-	-	6.3	-	-	2.7	-	-	3.6	-	-	6.9	-	-	2.8	-	-
2: Lower Honoapiilani Road & Honokowai Marketplace Driveway																											
WB LT	19.5	0.10	C	32.5	0.30	D	24.3	0.24	C	20.4	0.10	C	35.4	0.32	E	25.8	0.25	D	21.4	0.11	C	38.7	0.35	E	27.6	0.27	D
WB RT	11.4	0.07	B	15.0	0.18	C	13.5	0.14	B	11.5	0.07	B	15.5	0.19	C	13.8	0.14	B	11.7	0.07	B	16.1	0.19	C	14.2	0.15	B
SB LT	8.4	0.05	A	9.4	0.07	A	9.0	0.04	A	8.5	0.05	A	9.6	0.07	A	9.1	0.04	A	8.6	0.05	A	9.7	0.07	A	9.2	0.04	A
OVERALL	1.1	-	-	2.2	-	-	1.9	-	-	1.0	-	-	2.2	-	-	1.9	-	-	1.0	-	-	2.3	-	-	1.9	-	-
3: Honoapiilani Highway & Lower Honoapiilani Road																											
NB LT	39.3	0.86	D	60.0	0.94	E	39.6	0.90	D	41.0	0.86	D	63.9	0.94	E	41.0	0.90	D	42.9	0.87	D	67.8	0.95	E	42.5	0.91	D
NB TH/RT	9.7	0.36	A	9.4	0.48	A	6.4	0.42	A	9.6	0.37	A	9.5	0.49	A	6.5	0.43	A	9.6	0.38	A	9.6	0.51	A	6.6	0.45	A
EB LT/TH	46.2	0.81	D	68.8	0.84	E	54.1	0.82	D	49.2	0.81	D	73.7	0.85	E	57.0	0.82	E	52.6	0.82	D	78.7	0.86	E	60.0	0.83	E
WB LT/TH/RT	58.5	0.42	E	80.6	0.52	F	72.8	0.42	E	60.4	0.43	E	84.2	0.53	F	74.5	0.42	E	62.5	0.43	E	87.8	0.54	F	76.3	0.42	E
SB LT	60.0	0.44	E	151.8	0.41	F	0.0	0.00	A	61.9	0.44	E	155.1	0.41	F	0.0	0.00	A	64.0	0.44	E	158.4	0.41	F	0.0	0.00	A
SB TH	22.9	0.74	C	40.3	0.84	D	28.3	0.79	C	23.2	0.75	C	42.5	0.85	D	29.3	0.80	C	23.7	0.76	C	45.1	0.87	D	30.5	0.82	C
SB RT	16.7	0.14	B	27.6	0.18	C	19.9	0.09	B	16.6	0.13	B	27.9	0.17	C	19.9	0.09	B	16.5	0.13	B	28.3	0.17	C	19.9	0.09	B
OVERALL	22.4	-	C	33.3	-	C	23.0	-	C	22.8	-	C	34.7	-	C	23.6	-	C	23.2	-	C	36.3	-	D	24.2	-	C
4: Honoapiilani Highway & Keawe Street																											
NB LT	43.2	0.70	D	58.4	0.78	E	58.2	0.79	E	44.8	0.71	D	60.0	0.78	E	60.5	0.80	E	46.4	0.72	D	61.0	0.77	E	62.8	0.80	E
NB TH	37.1	0.90	D	45.6	0.92	D	48.5	0.92	D	41.4	0.92	D	51.9	0.95	D	53.7	0.94	D	47.1	0.94	D	61.7	0.98	E	60.5	0.96	E
NB RT	16.3	0.02	B	19.6	0.01	B	22.8	0.02	C	16.5	0.02	B	20.0	0.01	B	23.2	0.02	C	16.6	0.02	B	20.4	0.01	C	23.6	0.02	C
EB LT/TH	31.2	0.60	C	37.6	0.67	D	45.5	0.79	D	32.2	0.61	C	39.2	0.68	D	48.5	0.80	D	33.2	0.61	C	40.2	0.69	D	51.5	0.81	D
EB RT	26.7	0.09	C	31.1	0.13	C	31.8	0.19	C	27.6	0.09	C	32.3	0.13	C	33.3	0.19	C	28.4	0.09	C	33.2	0.13	C	34.8	0.19	C
WB LT	23.9	0.17	C	28.6	0.15	C	30.8	0.45	C	24.8	0.17	C	29.9	0.16	C	32.4	0.46	C	25.6	0.18	C	30.7	0.16	C	33.9	0.48	C
WB TH	21.4	0.30	C	25.8	0.27	C	24.7	0.27	C	22.2	0.30	C	27.1	0.28	C	26.1	0.28	C	23.1	0.31	C	27.9	0.28	C	27.4	0.28	C
SB LT	30.7	0.72	C	38.2	0.79	D	48.8	0.78	D	31.5	0.74	C	39.4	0.80	D	50.7	0.79	D	32.2	0.75	C	40.1	0.81	D	52.4	0.81	D
SB TH/RT	15.9	0.57	B	17.1	0.53	B	28.9	0.73	C	15.9	0.58	B	17.2	0.54	B	29.7	0.73	C	16.0	0.59	B	17.4	0.56	B	30.6	0.74	C
OVERALL	26.0	-	C	31.7	-	C	38.6	-	D	27.4	-	C	33.7	-	C	41.0	-	D	29.1	-	C	36.5	-	D	43.7	-	D
5: Honoapiilani Highway & Kai Hele Ku Street																											
NB LT	0.0	0.00	A	9.4	0.00	A	0.0	0.00	A	0.0	0.00	A	9.4	0.00	A	0.0	0.00	A	0.0	0.00	A	9.3	0.00	A	0.0	0.00	A
NB TH	10.0	0.06	A	9.3	0.07	A	10.4	0.08	B	10.0	0.06	A	9.2	0.07	A	10.4	0.08	B	10.0	0.07	A	9.1	0.07	A	10.5	0.09	B
NB RT	9.8	0.00	A	9.1	0.00	A	10.2	0.00	B	9.8	0.00	A	9.0	0.00	A	10.2	0.00	B	9.8	0.00	A	8.8	0.00	A	10.2	0.00	B
EB LT/TH	9.4	0.05	A	12.4	0.10	B	9.5	0.09	A	9.4	0.05	A	12.8	0.10	B	9.5	0.09	A	9.4	0.05	A	13.2	0.11	B	9.5	0.09	A
EB RT	9.3	0.01	A	12.1	0.00	B	9.2	0.00	A	9.3	0.01	A	12.4	0.00	B	9.2	0.00	A	9.3	0.01	A	12.8	0.00	B	9.2	0.00	A
WB LT/TH	9.4	0.04	A	12.5	0.10	B	9.4	0.07	A	9.4	0.04	A	12.8	0.11	B	9.4	0.07	A	9.4	0.04	A	13.2	0.11	B	9.5	0.07	A
WB RT	9.9	0.19	A	12.7	0.15	B	9.9	0.20	A	9.9	0.19	A	13.0	0.16	B	9.9	0.20	A	9.9	0.19	A	13.4	0.16	B	10.0	0.20	A
SB LT	6.7	0.18	A	6.9	0.17	A	7.0	0.19	A	6.7	0.18	A	6.8	0.16	A	7.0	0.19	A	6.7	0.18	A	6.7	0.16	A	7.0	0.19	A
SB TH/RT	5.2	0.32	A	10.7	0.71	B	5.8	0.39	A	5.2	0.33	A	10.7	0.72	B	5.9	0.41	A	5.3	0.34	A	10.8	0.73	B	5.9	0.42	A
OVERALL	6.7	-	A	10.4	-	B	7.2	-	A	6.6	-	A	10.5	-	B	7.2	-	A	6.6	-	A	10.5	-	B	7.2	-	A
6: Lahaina Bypass & Kai Hele Ku Street																											
NB LT	56.0	0.87	E	52.5	0.87	D	38.6	0.85	D	66.9	0.89	E	62.1	0.88	E	45.5	0.87	D	77.6	0.90	E	73.4	0.90	E	54.5	0.88	D
NB TH	16.2	0.91	B	10.9	0.83	B	12.5	0.87	B	20.5	0.93	C	12.3	0.85	B	12.9	0.88	B	28.2	0.96	C	14.6	0.87	B	14.3	0.90	B
NB RT	3.6	0.02	A	3.8	0.02	A	4.5	0.02	A	3.4	0.02	A	3.6	0.02	A	4.3	0.02	A	3.4	0.02	A	3.4	0.02	A	4.0	0.02	A
EB LT/TH/RT	48.5	0.22	D	47.4	0.37	D	37.7	0.39	D	54.8	0.24	D	53.2	0.39	D	41.9	0.41	D	60.5	0.24	E	59.7	0.41	E	47.2	0.43	D
WB LT/TH	50.0	0.38	D	46.7	0.32	D	35.9	0.21	D	56.5	0.41	E	52.3	0.34	D	40.0	0.22	D	62.6	0.43	E	58.9	0.36	E	45.0	0.24	D
WB RT	47.7	0.10	D	44.7	0.06	D	35.0	0.06	C	53.7	0.11	D	50.0	0.06	D	38.9	0.06	D	59.3	0.10	E	56.1	0.06	E	43.7	0.06	D
SB LT	66.3	0.77	E	61.8	0.74	E	47.3	0.67	D	72.4	0.77	E	70.9	0.78	E	53.4	0.70	D	78.4	0.77	E	77.2	0.77	E	61.8	0.74	E
SB TH	12.2	0.57	B	20.4	0.89	C	14.6	0.66	B	12.4	0.58	B	23.7	0.91	C	14.9	0.66	B	13.0	0.59	B	28.0	0.92	C	15.2	0.66	B
SB RT	7.7	0.01	A	8.0	0.02	A	9.2	0.01	A	7.6	0.01	A	7.9	0.02	A	9.1	0.01	A	7.7	0.01	A	7.9	0.01	A	9.0	0.01	A
OVERALL	21.5	-	C	21.0	-	C	18.4	-	B	25.1	-	C	23.9	-	C	19.6	-	B	30.5	-	C	27.8	-	C	21.7	-	C

4. FUTURE YEAR TRAFFIC CONDITIONS

The Future Year scenarios represent the traffic conditions within the Project study area with the full build-out and occupancy of the Project.

4.1 Project Description

The Project proposes to restore and preserve the section of Honokowai Beach fronting Kaanapali Beach Club and Kaanapali Shores. The following four (4) Alternatives scenarios are considered:

- **Alternative 1 – No Action**: Natural erosion of Honokowai Beach. This alternative assumes the existing erosion skirt will be removed, and Honokowai Beach continues to erode naturally, experiencing chronic, seasonal, and episodic erosion. Trips generated by the "No Action" Alternative will be associated with the removal of the erosion skirt. The erosion skirt is anticipated to be removed by Year 2028.

- **Alternative 2 – Beach Nourishment**: An individual action (project) involving the placement of additional sand to temporarily increase beach width and sand volume to offset the effects of erosion without modifying existing structures or installing new structures. This alternative is anticipated to be completed by Year 2028 and has an estimated design life of 10 years.

- **Alternative 3 – Beach Maintenance**: A series of actions (program) including periodic beach nourishment combined with sand pushing and/or sand back passing without modifying existing structures or installing new structures. This alternative is anticipated to be completed by Year 2028 and has an estimated design life of 50 years. Five (5) benchmark years are studied, beginning with Year 2028 and continuing at 10-year increments thereafter up to the 40-year forecast.

- **Alternative 4 – Beach Stabilization**: An individual action (Project) involving the placement of sand to nourish the beach and modifying existing structures and/or installing new structures (e.g., groins). This alternative is anticipated to be completed by Year 2028 and has an estimated design life of 50 years.

The sand is proposed to be barged to Kahului Harbor, offloaded, and temporarily stockpiled on-site, or transported to a temporary stockpile site in Puunene. The sand will then be trucked to the project site to be placed on the shoreline.

4.2 Travel Demand Estimations

4.2.1 Trip Generation

To determine the Project's trip generation, each alternative was separated into individual tasks. Using worker information provided by Sea Engineering, Inc. (SE), a daily trip rate was estimated for each task. The total trip generation for each alternative was obtained by summing these daily trip rates. Construction work is expected to only occur during standard weekday work hours. To be conservative for the purpose of this study, work was assumed to be completed through the weekend.

"Removal of the erosion skirt" refers to the staff on-site working on the removal of the erosion skirt and does not include the trips generated by material removal from the site. Workers are assumed

to enter the site in the AM peak and leave the site during the PM peak. As a result, no trips are generated during the Saturday midday peak by this staff.

"Sand Placement" refers to the staff on-site working on the placement of the sand being transported to the site and does not include the trips generated by the sand transport itself. Workers are assumed to enter the site in the AM peak and leave the site during the PM peak. As a result, no trips are generated during the Saturday midday peak by this staff.

"Groin Construction" refers to the staff on-site working construction of the groins and does not include the trips generated by the stone transport to construct the groins. Workers are assumed to enter the site in the AM peak and leave the site during the PM peak. As a result, no trips are generated during the Saturday midday peak by this staff.

"Material Transport" refers to the trucks arriving carrying the stone for the groin construction or sand for placement. These trucks were assumed to arrive and depart the site at a rate of two (2) trucks per hour throughout the workday. If multiple tasks requiring material transport are required, as in Alternative 4, which requires the delivery of sand and stone, two (2) trucks per hour are assumed to be generated by each of these tasks. Waste material from the removal of the erosion skirt is assumed to be transported off-site by trucks after unloading sand/stone, and therefore additional material transport trips were not generated for the removal of the erosion skirt; however for Alternative 1 specifically, which does not include any delivery of sand, material transport trips will be generated for removal of these materials from the site at a rate of two (2) trucks per hour.

See Table 4.1 for a summary of the project tasks and the corresponding trip generation.

Table 4.1: Project Task Trip Generation

Task	AM Peak Hour			PM Peak Hour			MD Peak Hour		
	Enter (vph)	Exit (vph)	Total (vph)	Enter (vph)	Exit (vph)	Total (vph)	Enter (vph)	Exit (vph)	Total (vph)
Removal of Erosion Skirt	6	0	6	0	6	6	0	0	0
Sand Placement	5	0	5	0	5	5	0	0	0
Groin Construction	12	0	12	0	12	12	0	0	0
Material Transport	2	2	4	2	2	4	2	2	4

4.2.2 Trip Distribution & Assignment

Worker trips generated by the Project were assigned throughout the study area generally based on existing and projected Base Year travel patterns. Sand-delivery trucks were assumed to follow the same route for each alternative. The truck routes that were assessed are as follows:

- Sand Offload Site → Lahaina Bypass Road → Kai Hele Ku Street → Honoapiilani Highway → Lower Honoapiilani Road → Kaanapali Shores Place → Project Site

- Project Site → Kaanapali Shores Place → Lower Honoapiilani Road → Honoapiilani Highway → Lahaina Bypass Road (South Terminus) → Sand Offload Site

The traffic generated by the Project was added to the Base Year traffic volumes to constitute Future Year traffic conditions.

Figures 4.1, 4.2, 4.3, and 4.4 illustrate the Project-generated trip distribution for each alternative.

4.3 Future Year Analysis

Intersection operations with the Project trips are compared to the corresponding Base Years conditions to assess the Project's impact to the study area.

4.3.1 Alternative 1 – No Action

Alternative 1 includes the removal of the existing erosion skirt. Alternative 1 is anticipated to be completed in 2028. Trips generated by Alternative 1 are shown in Table 4.2 below.

Table 4.2: Alternative 1 Trip Generation

Task	AM Peak Hour			PM Peak Hour			MD Peak Hour		
	Enter (vph)	Exit (vph)	Total (vph)	Enter (vph)	Exit (vph)	Total (vph)	Enter (vph)	Exit (vph)	Total (vph)
Removal of Erosion Skirt	6	0	6	0	6	6	0	0	0
Material Transport	2	2	4	2	2	4	2	2	4
Total	**8**	**2**	**10**	**2**	**8**	**10**	**2**	**2**	**4**

As shown in Table 4.2, a total of 10(10)[4] trips are anticipated to be generated with the AM(PM)[MD] peak hours. This results in a peak volume increase of roughly 0.4% compared to Base Year conditions.

Because this trip generation is relatively low, Alternative 1 is not anticipated to significantly impact the traffic environment within the study area. Intersection operations are expected to remain similar to Base Year conditions.

Alternative 1 Future Year 2028 laneage, volumes, and LOS can be found in Figure 4.5. Table 4.6 shows a LOS Summary for Alternative 1.

4.3.2 Alternative 2 – Beach Nourishment

Alternative 2 includes the removal of the existing erosion skirt and a single placement event of additional sand on the Project site to offset erosion without modifying existing structures or adding new installations. Alternative 2 is anticipated to be completed in 2028. Trips generated by Alternative 2 are shown in Table 4.3 below.

Table 4.3: Alternative 2 Trip Generation

Task	AM Peak Hour			PM Peak Hour			MD Peak Hour		
	Enter (vph)	Exit (vph)	Total (vph)	Enter (vph)	Exit (vph)	Total (vph)	Enter (vph)	Exit (vph)	Total (vph)
Removal of Erosion Skirt	6	0	6	0	6	6	0	0	0
Sand Placement	5	0	5	0	5	5	0	0	0
Material Transport	2	2	4	2	2	4	2	2	4
Total	**13**	**2**	**15**	**3**	**13**	**15**	**2**	**2**	**4**

As shown in Table 4.3, a total of 15(15)[4] trips are anticipated to be generated with the AM(PM)[MD] peak hours. This results in a peak volume increase of roughly 0.6% compared to Base Year conditions.

Although greater than Alternative 1, this trip generation is still relatively low. Thus, Alternative 2 is not anticipated to significantly impact the traffic environment within the study area. Intersection operations are expected to remain similar to Base Year conditions.

Alternative 2 Future Year 2028 laneage, volumes, and LOS can be found in Figure 4.6. Table 4.7 shows a LOS Summary for Alternative 2.

4.3.3 Alternative 3 – Beach Maintenance

Alternative 3 includes the removal of the existing erosion skirt and the periodic placement of sand without modifying existing structures or installing new structures. The sand placement is planned to occur a total of five (5) times in 10-year intervals; therefore years 2028, 2038, 2048, 2058, and 2068 were studied. Trips generated by the initial placement of sand and erosion skirt in 2028 are shown in Table 4.4 below. Subsequent intervals in 2038, 2048, and 2058 will not generate trips associated with the removal of the erosion skirt.

Table 4.4: Alternative 3 Trip Generation - Year 2028 (Initial Placement)

Task	AM Peak Hour			PM Peak Hour			MD Peak Hour		
	Enter (vph)	Exit (vph)	Total (vph)	Enter (vph)	Exit (vph)	Total (vph)	Enter (vph)	Exit (vph)	Total (vph)
Removal of Erosion Skirt	6	0	6	0	6	6	0	0	0
Sand Placement	5	0	5	0	5	5	0	0	0
Material Transport	2	2	4	2	2	4	2	2	4
Total	**13**	**2**	**15**	**3**	**13**	**15**	**2**	**2**	**4**

4.3.3.1 Future Year 2028

As shown in Table 4.4, a total of 15(15)[4] trips are anticipated to be generated with the AM(PM)[MD] peak hours. This results in a peak volume increase of roughly 0.6% compared to Base Year conditions.

In Future Year 2028, all study intersections are expected to remain similar to Base Year 2028 conditions. Because this trip generation is relatively low, Alternative 3 is not anticipated to significantly impact the traffic environment within the study area.

Alternative 3 Future Year 2028 laneage, volumes, and LOS can be found in Figure 4.7. Table 4.8 shows a LOS Summary for Alternative 3 in 2028.

4.3.3.2 Future Year 2038

As previously mentioned in Section 3.4, Phase 1C of the Lahaina Bypass Extension is expected to be constructed by Year 2038. Because the timeline, alignment, and roadway geometry of the extension are unknown, the material transport routes are assumed to remain the same throughout all sand placement intervals.

Under Future Year 2038 conditions, all movements are expected to operate similarly to Base Year conditions.

Alternative 3 Future Year 2038 laneage, volumes, and LOS can be found in Figure 4.8. Table 4.9 shows a LOS Summary for Alternative 3 in 2038.

4.3.3.3 Future Year 2048

By 2048, Phase 1D of the Lahaina Bypass Extension is assumed to be constructed. For similar reasons as above, project-generated trips are conservatively assumed to use the same distributions as previous scenarios. Although most intersections continue operating similarly to Base Year 2048 conditions, the following intersections have movements that change to LOS E/F:

[1] Lower Honoapiilani Road/Kaanapali Shores Place

During the PM peak hour of traffic, the eastbound approach is expected to change from LOS E to F. However, the delay for this movement only increases by roughly seven (7) seconds and is expected to remain under capacity.

Alternative 3 Future Year 2048 laneage, volumes, and LOS can be found in Figure 4.9. Table 4.10 shows a LOS Summary for Alternative 3 in 2048.

4.3.3.4 Future Year 2058

Under Future Year 2058 conditions, all study intersections are expected to continue operating similarly to Base Year 2058 conditions.

Alternative 3 Future Year 2058 laneage, volumes, and LOS can be found in Figure 4.11. Table 4.10 shows a LOS Summary for Alternative 3 in 2058.

4.3.3.5 Future Year 2068

Under Future Year 2068 conditions, intersections within the study area are expected to operate similarly to Base Year 2068 conditions. The following intersections have movements that change to LOS E/F:

[1] Lower Honoapiilani Road/Kaanapali Shores Place

The eastbound approach is expected to change from LOS D to E during the AM peak hour of traffic. However, the delay only increases by roughly two (2) seconds, so the movement is still expected to operate similarly to Base Year conditions.

Alternative 3 Future Year 2068 laneage, volumes, and LOS can be found in Figure 4.11. Table 4.12 shows a LOS Summary for Alternative 3 in 2068.

4.3.4 Alternative 4 – Beach Stabilization

Alternative 4 includes the removal of the existing erosion skirt, placement of sand to nourish the beach, and the installation of groins to mitigate beach erosion. Groin construction will require stone to be delivered and additional workers on-site. Alternative 4 is anticipated to be completed in 2028. Trips generated by Alternative 4 are shown in Table 4.5 below.

Table 4.5: Alternative 4 Trip Generation

Task	AM Peak Hour			PM Peak Hour			MD Peak Hour		
	Enter (vph)	Exit (vph)	Total (vph)	Enter (vph)	Exit (vph)	Total (vph)	Enter (vph)	Exit (vph)	Total (vph)
Removal of Erosion Skirt	6	0	6	0	6	6	0	0	0
Sand Placement	5	0	5	0	5	5	0	0	0
Groin Construction	12	0	12	0	12	12	0	0	0
Material Transport (Sand)	2	2	4	2	2	4	2	2	4
Material Transport (Stone)	2	2	4	2	2	4	2	2	4
Total	**27**	**4**	**31**	**4**	**27**	**31**	**4**	**4**	**8**

As shown in Table 4.5, a total of 15(15)[4] trips are anticipated to be generated with the AM(PM)[MD] peak hours. This results in a peak volume increase of roughly 1.2% compared to Base Year conditions.

Under these conditions, all study intersections are expected to remain similar to Base Year 2028 conditions. Although delays generally increase slightly overall, the operational LOS for each movement is anticipated to remain the same. Alternative 4 is therefore not anticipated to significantly impact intersection operations.

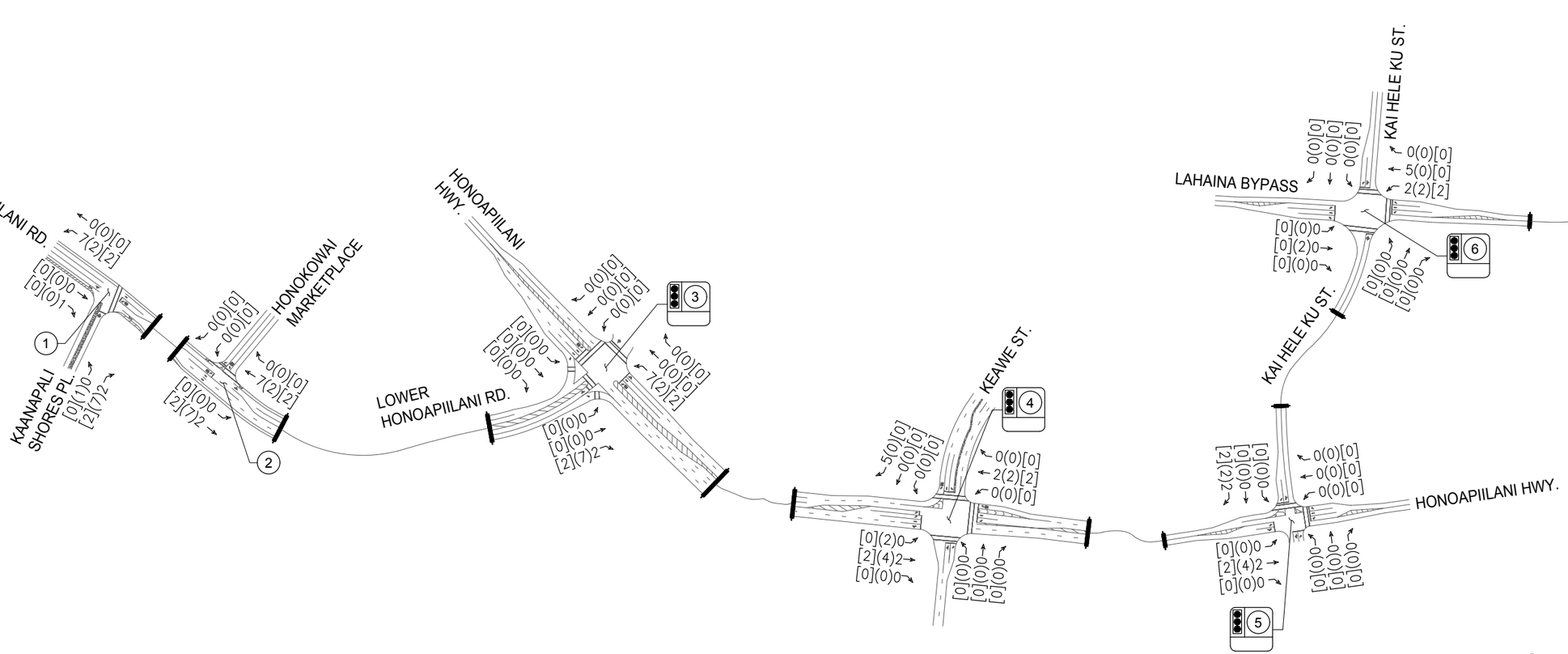
Alternative 4 Future Year 2028 laneage, volumes, and LOS can be found in Figure 4.12. Table 4.13 shows a LOS Summary for Alternative 4.

HONOKOWAI BEACH RESTORATION

AustinTsutsumi & ASSOCIATES, INC.
Engineers & Surveyors

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NOT TO SCALE



LEGEND

##(##)[##]	- AM(PM)[MD] VEHICLE VOLUMES
X	- UNSIGNALIZED INTERSECTION X
Y	- SIGNALIZED INTERSECTION Y

FIGURE 4.1

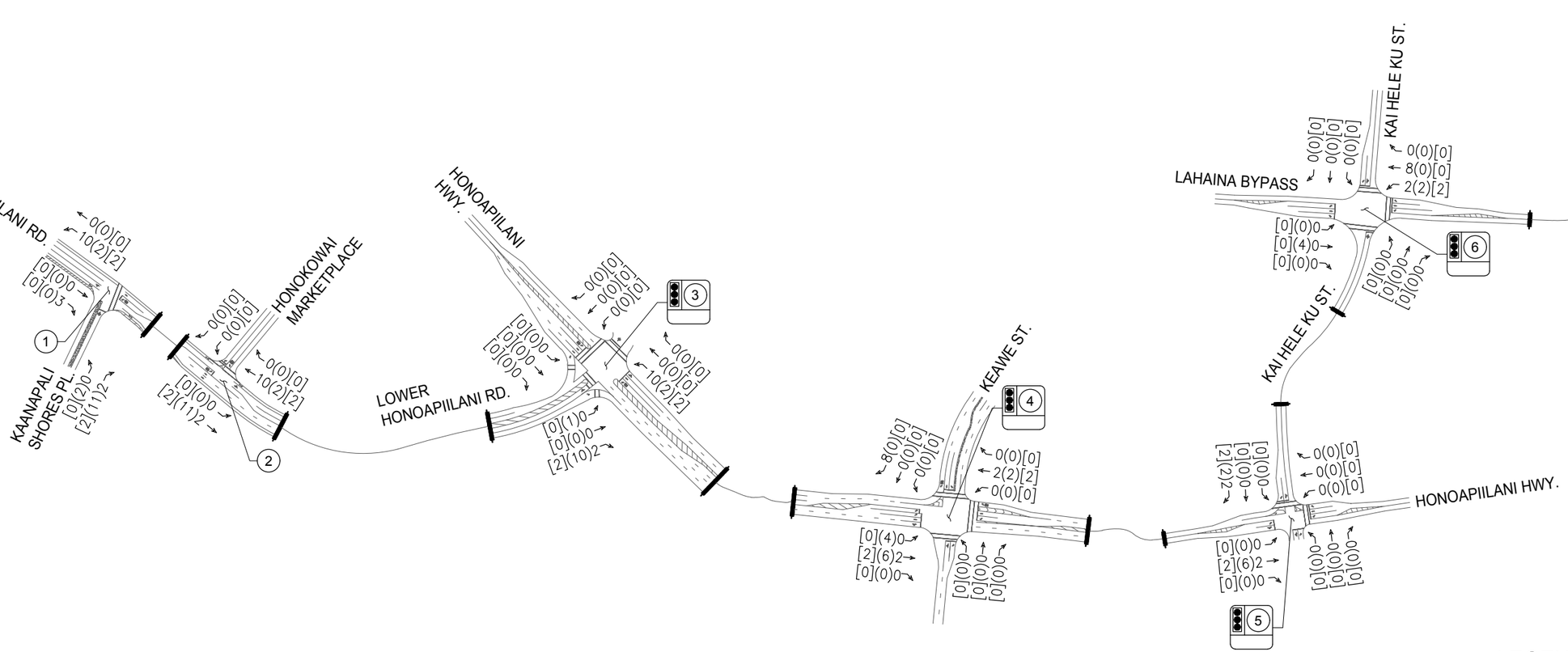
ALTERNATIVE 1
PROJECT GENERATED TRIPS

HONOKOWAI BEACH RESTORATION

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LEGEND

##(##)[##]	- AM(PM)[MD] VEHICLE VOLUMES
(X)	- UNSIGNALIZED INTERSECTION X
(Y)	- SIGNALIZED INTERSECTION Y

FIGURE 4.2

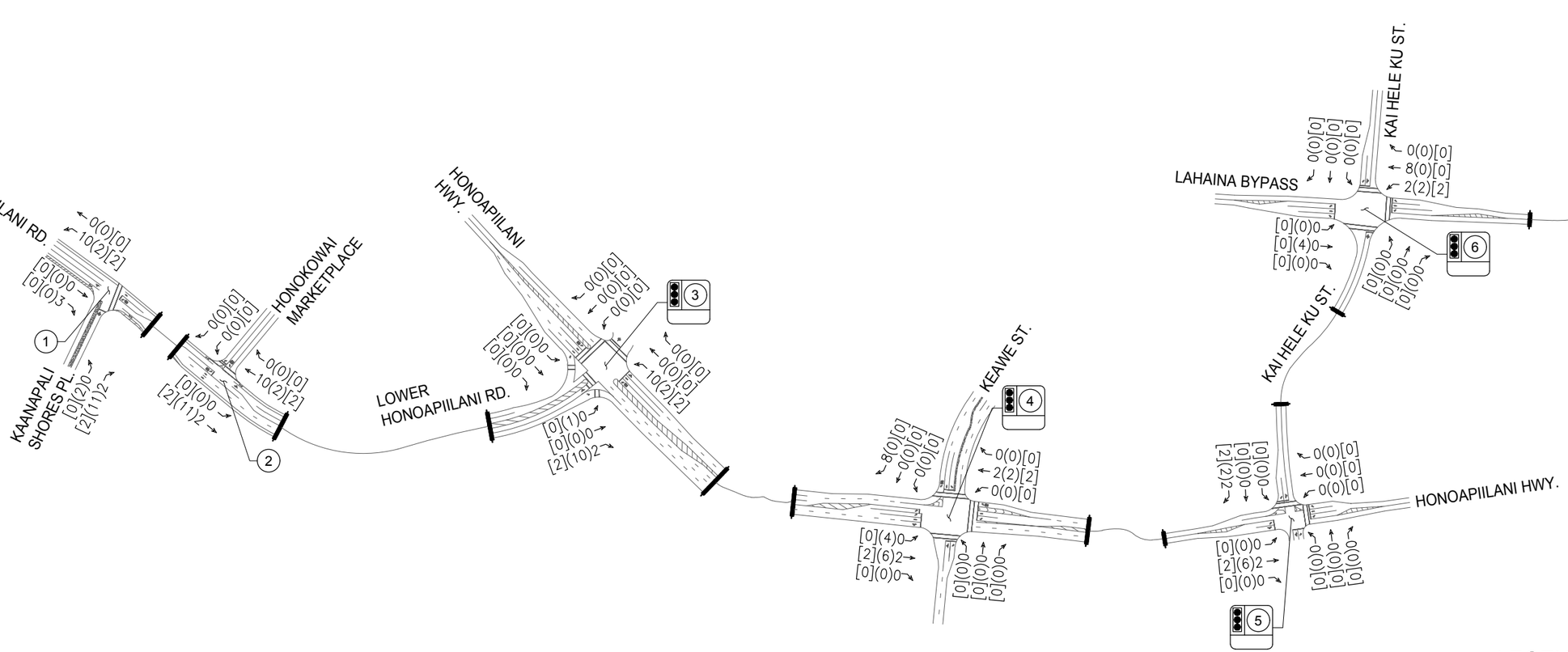
ALTERNATIVE 2
PROJECT GENERATED TRIPS

HONOKOWAI BEACH RESTORATION

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LEGEND

##(##)[##]	- AM(PM)[MD] VEHICLE VOLUMES
X	- UNSIGNALIZED INTERSECTION X
Y	- SIGNALIZED INTERSECTION Y

FIGURE 4.3

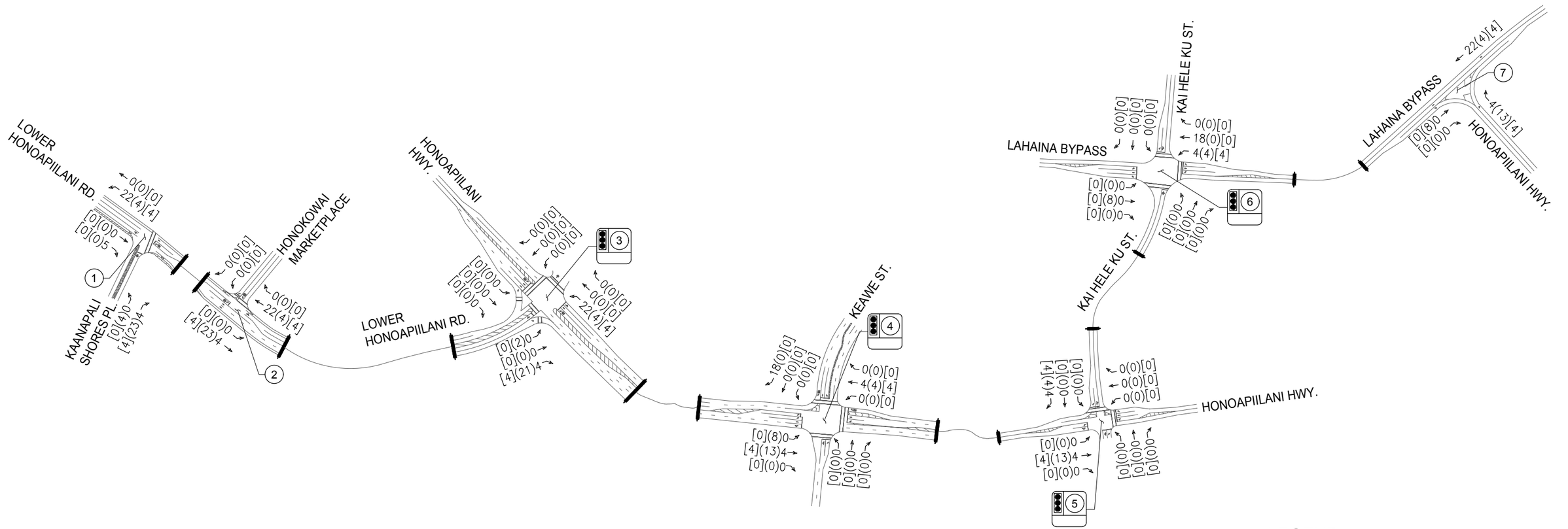
ALTERNATIVE 3
PROJECT GENERATED TRIPS

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LEGEND

##(##)[##]	- AM(PM)[MD] VEHICLE VOLUMES
X	- UNSIGNALIZED INTERSECTION X
Y	- SIGNALIZED INTERSECTION Y

FIGURE 4.4

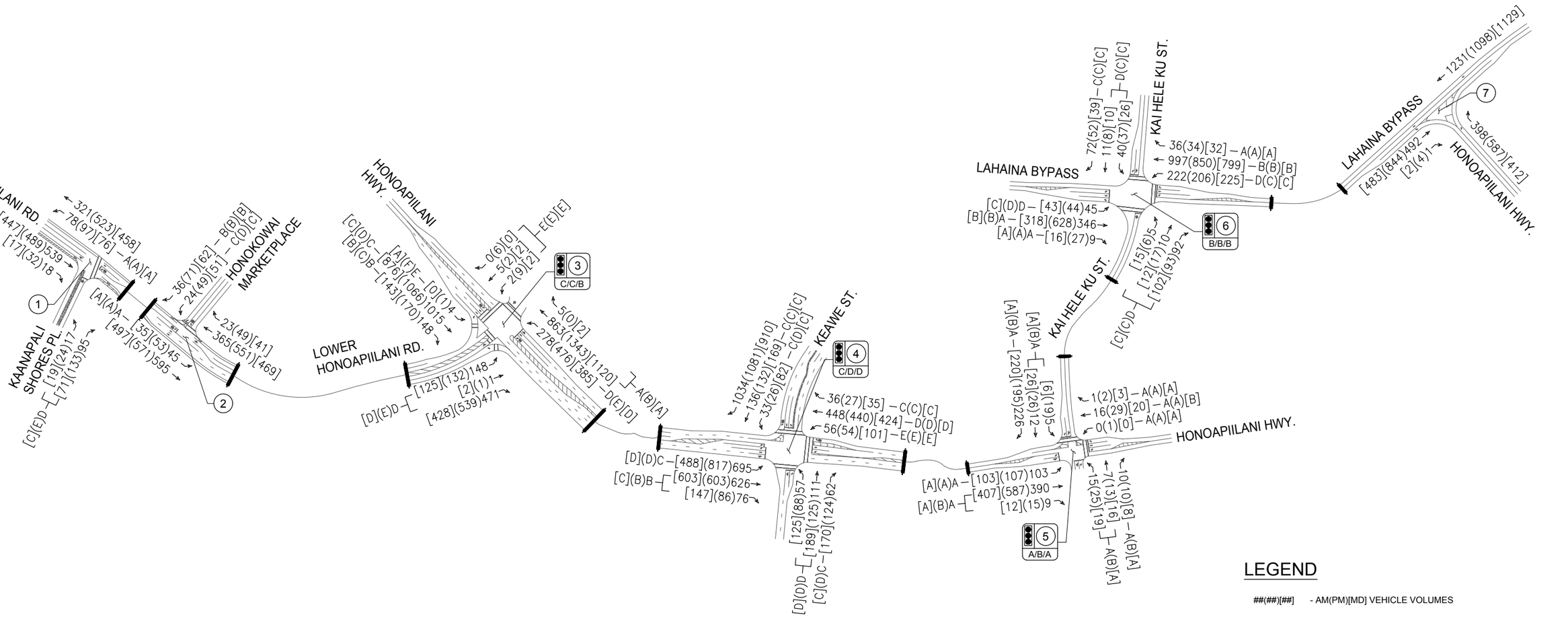
ALTERNATIVE 4
PROJECT GENERATED TRIPS

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LEGEND

##(##)[##]	- AM(PM)[MD] VEHICLE VOLUMES
X	- UNSIGNALIZED INTERSECTION X
Y / X/X/X	- SIGNALIZED INTERSECTION Y, OVERALL AM/PM/MD LOS
X(X)[X]	- AM(PM)[MD] LOS *DENOTES V/C ≥ 1

FIGURE 4.5

ALTERNATIVE 1
FUTURE YEAR 2028
LANE CONFIGURATIONS, VOLUMES, AND LOS

TABLE 4.6: LOS SUMMARY
EXISTING, BY 2028, AND FY 2028 ALTERNATIVE 1

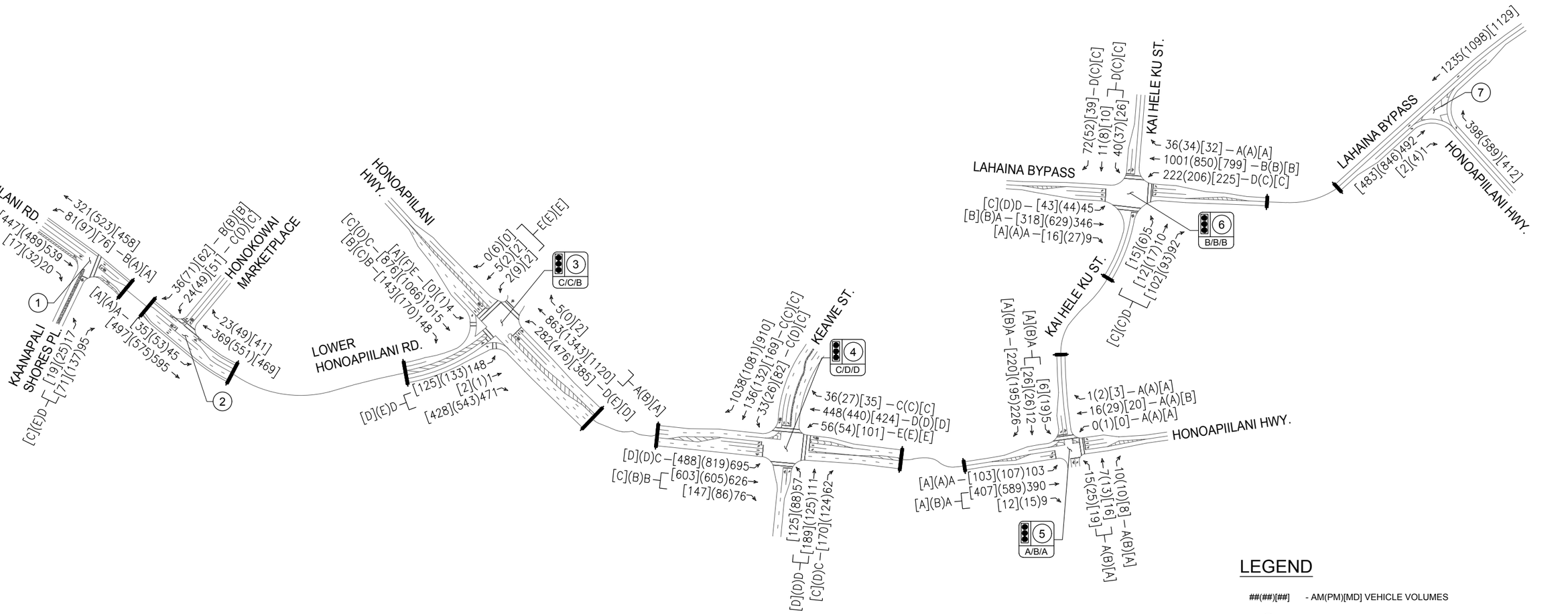
	Existing Conditions									Base Year 2028									Future Year 2028 Alternative 1								
	AM			PM			MD			AM			PM			MD			AM			PM			MD		
Intersection	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Lower Honoapiilani Road & Kaanapali Shores Place																											
NB LT	9.3	0.07	A	9.4	0.09	A	9.0	0.07	A	9.9	0.10	A	9.9	0.12	A	9.5	0.09	A	10.0	0.11	A	9.9	0.13	A	9.5	0.09	A
EB LT/RT	18.5	0.27	C	23.7	0.43	C	18.2	0.24	C	24.9	0.40	C	35.2	0.59	E	23.2	0.33	C	25.4	0.41	D	37.3	0.62	E	23.4	0.33	C
OVERALL	2.7	-	-	3.7	-	-	2.2	-	-	3.3	-	-	4.8	-	-	2.5	-	-	3.4	-	-	5.3	-	-	2.6	-	-
2: Lower Honoapiilani Road & Honokowai Marketplace Driveway																											
WB LT	14.6	0.05	B	19.4	0.16	C	15.7	0.12	C	17.8	0.09	C	26.7	0.24	D	20.6	0.19	C	18.0	0.09	C	26.9	0.25	D	20.7	0.20	C
WB RT	10.2	0.05	B	12.1	0.13	B	11.1	0.10	B	11.0	0.06	B	13.9	0.16	B	12.6	0.12	B	11.0	0.06	B	14.0	0.16	B	12.6	0.12	B
SB LT	8.0	0.04	A	8.6	0.05	A	8.2	0.03	A	8.3	0.04	A	9.1	0.06	A	8.7	0.04	A	8.3	0.04	A	9.1	0.06	A	8.7	0.04	A
OVERALL	1.2	-	-	2.0	-	-	1.8	-	-	1.1	-	-	2.1	-	-	1.9	-	-	1.1	-	-	2.1	-	-	1.9	-	-
3: Honoapiilani Highway & Lower Honoapiilani Road																											
NB LT	25.6	0.80	C	28.5	0.88	C	22.6	0.82	C	41.0	0.86	D	57.2	0.94	E	36.1	0.89	D	41.2	0.86	D	57.5	0.94	E	36.2	0.89	D
NB TH/RT	8.5	0.32	A	7.6	0.35	A	5.1	0.23	A	9.7	0.43	A	10.1	0.59	B	6.6	0.49	A	9.7	0.43	A	10.1	0.59	B	6.6	0.49	A
EB LT/TH	33.1	0.67	C	43.2	0.74	D	31.8	0.67	C	47.7	0.81	D	66.6	0.82	E	45.3	0.79	D	48.3	0.81	D	66.8	0.82	E	45.4	0.79	D
WB LT/TH/RT	44.8	0.41	D	47.8	0.45	D	51.7	0.41	D	60.2	0.43	E	78.0	0.52	E	68.3	0.41	E	60.6	0.43	E	78.3	0.52	E	68.4	0.41	E
SB LT	61.6	0.41	E	118.2	0.41	F	0.0	0.00	A	71.6	0.42	E	149.4	0.41	F	0.0	0.00	A	72.0	0.42	E	149.7	0.41	F	0.0	0.00	A
SB TH	17.4	0.63	B	23.7	0.69	C	19.4	0.59	B	22.8	0.75	C	38.0	0.83	D	25.5	0.76	C	23.1	0.75	C	38.2	0.83	D	25.6	0.76	C
SB RT	13.8	0.05	B	18.6	0.05	B	16.3	0.03	B	16.2	0.13	B	25.7	0.17	C	18.5	0.08	B	16.3	0.13	B	25.9	0.17	C	18.6	0.08	B
OVERALL	16.4	-	B	19.9	-	B	16.0	-	B	21.7	-	C	30.0	-	C	19.7	-	B	21.9	-	C	30.1	-	C	19.8	-	B
4: Honoapiilani Highway & Keawe Street																											
NB LT	43.7	0.43	D	51.9	0.42	D	34.5	0.47	C	55.0	0.77	D	67.4	0.77	E	55.3	0.79	E	55.1	0.77	E	67.7	0.77	E	55.4	0.79	E
NB TH	23.6	0.75	C	24.9	0.69	C	23.4	0.71	C	48.8	0.91	D	42.5	0.88	D	49.3	0.89	D	49.1	0.92	D	42.8	0.88	D	49.6	0.89	D
NB RT	17.5	0.01	B	19.6	0.01	B	18.0	0.01	B	22.2	0.02	C	27.9	0.01	C	26.8	0.02	C	22.2	0.02	C	27.9	0.01	C	26.8	0.02	C
EB LT/TH	25.6	0.26	C	26.3	0.40	C	23.5	0.45	C	38.2	0.64	D	46.6	0.72	D	43.1	0.78	D	38.3	0.65	D	46.8	0.72	D	43.3	0.79	D
EB RT	24.4	0.02	C	24.3	0.07	C	20.9	0.05	C	32.6	0.11	C	38.6	0.17	D	30.3	0.21	C	32.7	0.11	C	38.8	0.17	D	30.4	0.21	C
WB LT	21.7	0.09	C	21.8	0.06	C	17.8	0.21	B	29.7	0.20	C	35.9	0.18	D	29.0	0.44	C	29.7	0.20	C	36.1	0.18	D	29.1	0.44	C
WB TH	19.4	0.29	B	19.6	0.26	B	14.9	0.25	B	27.2	0.33	C	33.1	0.30	C	23.2	0.27	C	27.3	0.33	C	33.3	0.30	C	23.2	0.27	C
SB LT	21.6	0.74	C	21.2	0.77	C	23.0	0.68	C	31.7	0.83	C	44.8	0.89	D	42.4	0.82	D	31.8	0.83	C	45.1	0.89	D	42.5	0.82	D
SB TH/RT	11.0	0.46	B	10.6	0.38	B	15.5	0.57	B	13.7	0.42	B	15.2	0.39	B	25.9	0.59	C	13.7	0.42	B	15.2	0.39	B	25.9	0.59	C
OVERALL	19.4	-	B	19.9	-	B	20.3	-	C	30.3	-	C	35.8	-	D	36.9	-	D	30.4	-	C	36.0	-	D	37.1	-	D
5: Honoapiilani Highway & Kai Hele Ku Street																											
NB LT	0.0	0.00	A	8.7	0.00	A	0.0	0.00	A	0.0	0.00	A	9.1	0.00	A	0.0	0.00	A	0.0	0.00	A	9.1	0.00	A	0.0	0.00	A
NB TH	9.0	0.04	A	8.4	0.03	A	9.1	0.04	A	9.7	0.05	A	8.5	0.05	A	10.0	0.06	B	9.7	0.05	A	8.4	0.05	A	10.1	0.06	B
NB RT	9.0	0.00	A	8.3	0.00	A	9.0	0.00	A	9.6	0.00	A	8.3	0.00	A	9.9	0.00	A	9.6	0.00	A	8.3	0.00	A	9.9	0.00	A
EB LT/TH	9.4	0.04	A	12.1	0.06	B	9.2	0.04	A	9.6	0.05	A	14.5	0.10	B	9.5	0.07	A	9.6	0.05	A	14.6	0.10	B	9.5	0.07	A
EB RT	9.3	0.00	A	11.9	0.00	B	9.1	0.00	A	9.4	0.01	A	14.1	0.00	B	9.3	0.00	A	9.4	0.01	A	14.2	0.00	B	9.3	0.00	A
WB LT/TH	9.5	0.04	A	12.3	0.11	B	9.4	0.07	A	9.5	0.04	A	14.6	0.11	B	9.5	0.07	A	9.5	0.04	A	14.7	0.11	B	9.5	0.07	A
WB RT	9.6	0.08	A	12.0	0.05	B	9.3	0.06	A	10.0	0.16	A	14.6	0.12	B	9.8	0.16	A	10.0	0.17	A	14.7	0.13	B	9.8	0.16	A
SB LT	6.2	0.13	A	6.9	0.11	A	6.3	0.12	A	6.5	0.16	A	6.3	0.14	A	6.8	0.17	A	6.6	0.16	A	6.3	0.14	A	6.8	0.17	A
SB TH/RT	5.1	0.39	A	10.2	0.70	B	5.2	0.37	A	5.9	0.50	A	10.8	0.76	B	6.3	0.54	A	5.9	0.51	A	10.9	0.76	B	6.4	0.54	A
OVERALL	5.9	-	A	10.0	-	B	6.1	-	A	6.6	-	A	10.7	-	B	7.1	-	A	6.7	-	A	10.7	-	B	7.1	-	A
6: Lahaina Bypass & Kai Hele Ku Street																											
NB LT	28.5	0.78	C	24.6	0.74	C	22.1	0.74	C	49.0	0.85	D	29.9	0.79	C	27.3	0.79	C	49.9	0.86	D	29.8	0.79	C	27.2	0.79	C
NB TH	11.1	0.81	B	10.9	0.76	B	10.7	0.73	B	12.0	0.86	B	11.7	0.83	B	11.7	0.82	B	12.0	0.87	B	11.7	0.83	B	11.7	0.82	B
NB RT	5.2	0.03	A	6.2	0.03	A	6.5	0.03	A	4.3	0.02	A	5.1	0.02	A	5.5	0.02	A	4.3	0.02	A	5.1	0.02	A	5.5	0.02	A
EB LT/TH/RT	24.2	0.09	C	19.2	0.11	B	18.1	0.14	B	35.2	0.15	D	27.6	0.17	C	26.2	0.27	C	35.5	0.15	D	27.6	0.17	C	26.2	0.27	C
WB LT/TH	25.0	0.23	C	19.5	0.17	B	17.7	0.13	B	36.3	0.31	D	28.0	0.23	C	25.5	0.17	C	36.7	0.31	D	28.0	0.23	C	25.5	0.17	C
WB RT	23.9	0.02	C	18.8	0.02	B	17.2	0.02	B	34.7	0.07	C	27.0	0.05	C	24.8	0.03	C	35.0	0.07	C	27.0	0.05	C	24.8	0.03	C
SB LT	31.5	0.53	C	25.2	0.52	C	23.5	0.50	C	45.6	0.65	D	35.4	0.59	D	32.9	0.57	C	46.0	0.66	D	35.4	0.59	D	32.9	0.57	C
SB TH	8.8	0.29	A	11.8	0.70	B	9.6	0.33	A	9.9	0.36	A	14.2	0.75	B	11.3	0.42	B	9.9	0.36	A	14.4	0.76	B	11.4	0.42	B
SB RT	7.4	0.01	A	7.6	0.02	A	8.2	0.01	A	7.8	0.01	A	8.3	0.02	A	9.0	0.01	A	7.8	0.01	A	8.3	0.02	A	9.1	0.01	A
OVERALL	13.9	-	B	13.2	-	B	12.9	-	B	18.2	-	B	15.7	-	B	15.3	-	B	18.4	-	B	15.8	-	B	15.3	-	B

HONOKOWAI BEACH RESTORATION

AustinTsutsumi & ASSOCIATES, INC.
Engineers & Surveyors

NOTE:
THIS DRAWING IS FOR
ILLUSTRATIVE PURPOSES ONLY.
DO NOT USE FOR CONSTRUCTION.

N
NOT TO SCALE



LEGEND

##(##)[##]	- AM(PM)[MD] VEHICLE VOLUMES
X	- UNSIGNALIZED INTERSECTION X
Y / X/X/X	- SIGNALIZED INTERSECTION Y, OVERALL AM/PM/MD LOS
X(X)[X]	- AM(PM)[MD] LOS *DENOTES V/C ≥ 1

FIGURE 4.6

ALTERNATIVE 2
FUTURE YEAR 2028
LANE CONFIGURATIONS, VOLUMES, AND LOS

TABLE 4.7: LOS SUMMARY
EXISTING, BY 2028, AND FY 2028 ALTERNATIVE 2

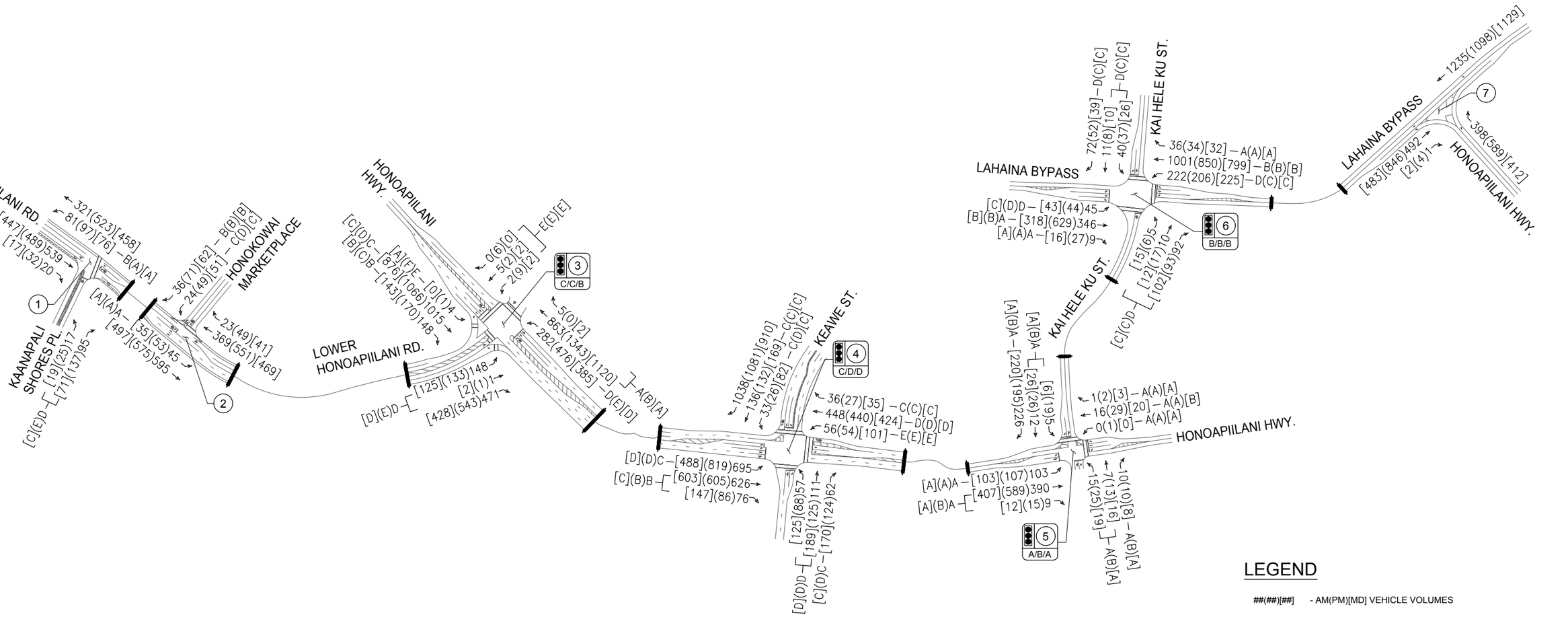
	Existing Conditions									Base Year 2028									Future Year 2028 Alternatative 2								
	AM			PM			MD			AM			PM			MD			AM			PM			MD		
Intersection	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Lower Honoapiilani Road & Kaanapali Shores Place																											
NB LT	9.3	0.07	A	9.4	0.09	A	9.0	0.07	A	9.9	0.10	A	9.9	0.12	A	9.5	0.09	A	10.0	0.11	B	9.9	0.13	A	9.5	0.09	A
EB LT/RT	18.5	0.27	C	23.7	0.43	C	18.2	0.24	C	24.9	0.40	C	35.2	0.59	E	23.2	0.33	C	25.5	0.41	D	39.0	0.64	E	23.4	0.33	C
OVERALL	2.7	-	-	3.7	-	-	2.2	-	-	3.3	-	-	4.8	-	-	2.5	-	-	3.4	-	-	5.6	-	-	2.6	-	-
2: Lower Honoapiilani Road & Honokowai Marketplace Driveway																											
WB LT	14.6	0.05	B	19.4	0.16	C	15.7	0.12	C	17.8	0.09	C	26.7	0.24	D	20.6	0.19	C	18.1	0.09	C	27.0	0.25	D	20.7	0.20	C
WB RT	10.2	0.05	B	12.1	0.13	B	11.1	0.10	B	11.0	0.06	B	13.9	0.16	B	12.6	0.12	B	11.1	0.06	B	14.0	0.16	B	12.6	0.12	B
SB LT	8.0	0.04	A	8.6	0.05	A	8.2	0.03	A	8.3	0.04	A	9.1	0.06	A	8.7	0.04	A	8.4	0.04	A	9.1	0.06	A	8.7	0.04	A
OVERALL	1.2	-	-	2.0	-	-	1.8	-	-	1.1	-	-	2.1	-	-	1.9	-	-	1.1	-	-	2.1	-	-	1.9	-	-
3: Honoapiilani Highway & Lower Honoapiilani Road																											
NB LT	25.6	0.80	C	28.5	0.88	C	22.6	0.82	C	41.0	0.86	D	57.2	0.94	E	36.1	0.89	D	41.3	0.87	D	57.8	0.94	E	36.2	0.89	D
NB TH/RT	8.5	0.32	A	7.6	0.35	A	5.1	0.23	A	9.7	0.43	A	10.1	0.59	B	6.6	0.49	A	9.7	0.43	A	10.2	0.59	B	6.6	0.49	A
EB LT/TH	33.1	0.67	C	43.2	0.74	D	31.8	0.67	C	47.7	0.81	D	66.6	0.82	E	45.3	0.79	D	48.9	0.81	D	67.0	0.83	E	45.4	0.79	D
WB LT/TH/RT	44.8	0.41	D	47.8	0.45	D	51.7	0.41	D	60.2	0.43	E	78.0	0.52	E	68.3	0.41	E	60.9	0.43	E	78.5	0.52	E	68.4	0.41	E
SB LT	61.6	0.41	E	118.2	0.41	F	0.0	0.00	A	71.6	0.42	E	149.4	0.41	F	0.0	0.00	A	72.3	0.42	E	149.9	0.41	F	0.0	0.00	A
SB TH	17.4	0.63	B	23.7	0.69	C	19.4	0.59	B	22.8	0.75	C	38.0	0.83	D	25.5	0.76	C	23.3	0.75	C	38.4	0.83	D	25.6	0.76	C
SB RT	13.8	0.05	B	18.6	0.05	B	16.3	0.03	B	16.2	0.13	B	25.7	0.17	C	18.5	0.08	B	16.5	0.13	B	26.0	0.17	C	18.6	0.08	B
OVERALL	16.4	-	B	19.9	-	B	16.0	-	B	21.7	-	C	30.0	-	C	19.7	-	B	22.0	-	C	30.3	-	C	19.8	-	B
4: Honoapiilani Highway & Keawe Street																											
NB LT	43.7	0.43	D	51.9	0.42	D	34.5	0.47	C	55.0	0.77	D	67.4	0.77	E	55.3	0.79	E	55.1	0.77	E	67.7	0.77	E	55.4	0.79	E
NB TH	23.6	0.75	C	24.9	0.69	C	23.4	0.71	C	48.8	0.91	D	42.5	0.88	D	49.3	0.89	D	49.1	0.92	D	42.9	0.88	D	49.6	0.89	D
NB RT	17.5	0.01	B	19.6	0.01	B	18.0	0.01	B	22.2	0.02	C	27.9	0.01	C	26.8	0.02	C	22.2	0.02	C	28.0	0.01	C	26.8	0.02	C
EB LT/TH	25.6	0.26	C	26.3	0.40	C	23.5	0.45	C	38.2	0.64	D	46.6	0.72	D	43.1	0.78	D	38.3	0.65	D	46.9	0.72	D	43.3	0.79	D
EB RT	24.4	0.02	C	24.3	0.07	C	20.9	0.05	C	32.6	0.11	C	38.6	0.17	D	30.3	0.21	C	32.7	0.11	C	38.9	0.17	D	30.4	0.21	C
WB LT	21.7	0.09	C	21.8	0.06	C	17.8	0.21	B	29.7	0.20	C	35.9	0.18	D	29.0	0.44	C	29.7	0.20	C	36.1	0.18	D	29.1	0.44	C
WB TH	19.4	0.29	B	19.6	0.26	B	14.9	0.25	B	27.2	0.33	C	33.1	0.30	C	23.2	0.27	C	27.3	0.33	C	33.4	0.30	C	23.2	0.27	C
SB LT	21.6	0.74	C	21.2	0.77	C	23.0	0.68	C	31.7	0.83	C	44.8	0.89	D	42.4	0.82	D	31.8	0.83	C	45.2	0.89	D	42.5	0.82	D
SB TH/RT	11.0	0.46	B	10.6	0.38	B	15.5	0.57	B	13.7	0.42	B	15.2	0.39	B	25.9	0.59	C	13.7	0.42	B	15.3	0.39	B	25.9	0.59	C
OVERALL	19.4	-	B	19.9	-	B	20.3	-	C	30.3	-	C	35.8	-	D	36.9	-	D	30.4	-	C	36.1	-	D	37.1	-	D
5: Honoapiilani Highway & Kai Hele Ku Street																											
NB LT	0.0	0.00	A	8.7	0.00	A	0.0	0.00	A	0.0	0.00	A	9.1	0.00	A	0.0	0.00	A	0.0	0.00	A	9.1	0.00	A	0.0	0.00	A
NB TH	9.0	0.04	A	8.4	0.03	A	9.1	0.04	A	9.7	0.05	A	8.5	0.05	A	10.0	0.06	B	9.7	0.05	A	8.4	0.05	A	10.1	0.06	B
NB RT	9.0	0.00	A	8.3	0.00	A	9.0	0.00	A	9.6	0.00	A	8.3	0.00	A	9.9	0.00	A	9.6	0.00	A	8.3	0.00	A	9.9	0.00	A
EB LT/TH	9.4	0.04	A	12.1	0.06	B	9.2	0.04	A	9.6	0.05	A	14.5	0.10	B	9.5	0.07	A	9.6	0.05	A	14.6	0.10	B	9.5	0.07	A
EB RT	9.3	0.00	A	11.9	0.00	B	9.1	0.00	A	9.4	0.01	A	14.1	0.00	B	9.3	0.00	A	9.4	0.01	A	14.2	0.00	B	9.3	0.00	A
WB LT/TH	9.5	0.04	A	12.3	0.11	B	9.4	0.07	A	9.5	0.04	A	14.6	0.11	B	9.5	0.07	A	9.5	0.04	A	14.7	0.11	B	9.5	0.07	A
WB RT	9.6	0.08	A	12.0	0.05	B	9.3	0.06	A	10.0	0.16	A	14.6	0.12	B	9.8	0.16	A	10.0	0.17	A	14.7	0.13	B	9.8	0.16	A
SB LT	6.2	0.13	A	6.9	0.11	A	6.3	0.12	A	6.5	0.16	A	6.3	0.14	A	6.8	0.17	A	6.6	0.16	A	6.2	0.14	A	6.8	0.17	A
SB TH/RT	5.1	0.39	A	10.2	0.70	B	5.2	0.37	A	5.9	0.50	A	10.8	0.76	B	6.3	0.54	A	5.9	0.51	A	10.9	0.76	B	6.4	0.54	A
OVERALL	5.9	-	A	10.0	-	B	6.1	-	A	6.6	-	A	10.7	-	B	7.1	-	A	6.7	-	A	10.7	-	B	7.1	-	A
6: Lahaina Bypass & Kai Hele Ku Street																											
NB LT	28.5	0.78	C	24.6	0.74	C	22.1	0.74	C	49.0	0.85	D	29.9	0.79	C	27.3	0.79	C	50.4	0.86	D	29.8	0.79	C	27.2	0.79	C
NB TH	11.1	0.81	B	10.9	0.76	B	10.7	0.73	B	12.0	0.86	B	11.7	0.83	B	11.7	0.82	B	12.1	0.87	B	11.7	0.83	B	11.7	0.82	B
NB RT	5.2	0.03	A	6.2	0.03	A	6.5	0.03	A	4.3	0.02	A	5.1	0.02	A	5.5	0.02	A	4.3	0.02	A	5.1	0.02	A	5.5	0.02	A
EB LT/TH/RT	24.2	0.09	C	19.2	0.11	B	18.1	0.14	B	35.2	0.15	D	27.6	0.17	C	26.2	0.27	C	35.7	0.15	D	27.6	0.17	C	26.2	0.27	C
WB LT/TH	25.0	0.23	C	19.5	0.17	B	17.7	0.13	B	36.3	0.31	D	28.0	0.23	C	25.5	0.17	C	36.9	0.31	D	28.0	0.23	C	25.5	0.17	C
WB RT	23.9	0.02	C	18.8	0.02	B	17.2	0.02	B	34.7	0.07	C	27.0	0.05	C	24.8	0.03	C	35.2	0.07	D	27.0	0.05	C	24.8	0.03	C
SB LT	31.5	0.53	C	25.2	0.52	C	23.5	0.50	C	45.6	0.65	D	35.4	0.59	D	32.9	0.57	C	46.3	0.66	D	35.4	0.59	D	32.9	0.57	C
SB TH	8.8	0.29	A	11.8	0.70	B	9.6	0.33	A	9.9	0.36	A	14.2	0.75	B	11.3	0.42	B	9.9	0.36	A	14.4	0.76	B	11.4	0.42	B
SB RT	7.4	0.01	A	7.6	0.02	A	8.2	0.01	A	7.8	0.01	A	8.3	0.02	A	9.0	0.01	A	7.8	0.01	A	8.3	0.02	A	9.1	0.01	A
OVERALL	13.9	-	B	13.2	-	B	12.9	-	B	18.2	-	B	15.7	-	B	15.3	-	B	18.4	-	B	15.8	-	B	15.3	-	B

HONOKOWAI BEACH RESTORATION

AustinTsutsumi & ASSOCIATES, INC.
Engineers & Surveyors

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NOT TO SCALE



LEGEND

##(##)[##]	- AM(PM)[MD] VEHICLE VOLUMES
X	- UNSIGNALIZED INTERSECTION X
Y, X/X/X	- SIGNALIZED INTERSECTION Y, OVERALL AM/PM/MD LOS
X(X)[X]	- AM(PM)[MD] LOS *DENOTES V/C ≥ 1

FIGURE 4.7

ALTERNATIVE 3
FUTURE YEAR 2028
LANE CONFIGURATIONS, VOLUMES, AND LOS

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

TABLE 4.8: LOS SUMMARY
EXISTING, BY 2028, AND FY 2028 ALTERNATIVE 3

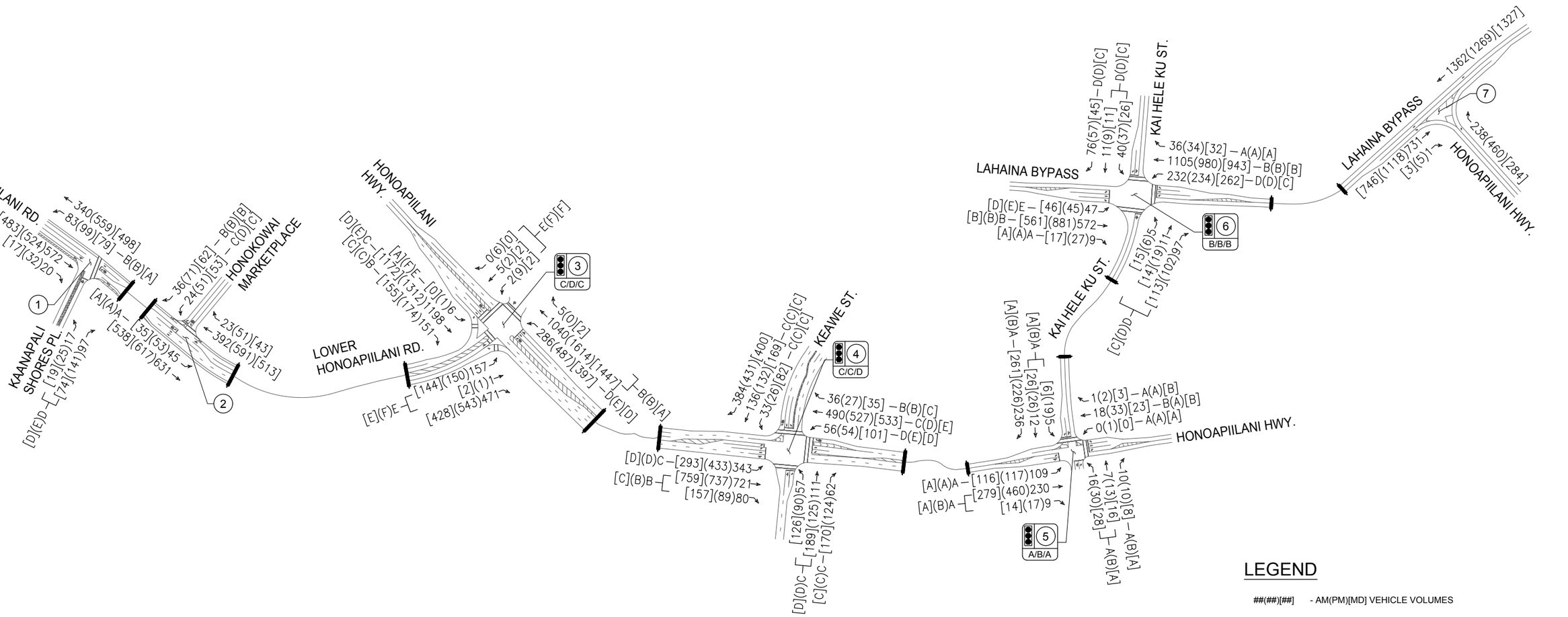
	Existing Conditions									Base Year 2028									Future Year 2028 Alternatative 3								
	AM			PM			MD			AM			PM			MD			AM			PM			MD		
Intersection	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Lower Honoapiilani Road & Kaanapali Shores Place																											
NB LT	9.3	0.07	A	9.4	0.09	A	9.0	0.07	A	9.9	0.10	A	9.9	0.12	A	9.5	0.09	A	10.0	0.11	B	9.9	0.13	A	9.5	0.09	A
EB LT/RT	18.5	0.27	C	23.7	0.43	C	18.2	0.24	C	24.9	0.40	C	35.2	0.59	E	23.2	0.33	C	25.5	0.41	D	39.0	0.64	E	23.4	0.33	C
OVERALL	2.7	-	-	3.7	-	-	2.2	-	-	3.3	-	-	4.8	-	-	2.5	-	-	3.4	-	-	5.6	-	-	2.6	-	-
2: Lower Honoapiilani Road & Honokowai Marketplace Driveway																											
WB LT	14.6	0.05	B	19.4	0.16	C	15.7	0.12	C	17.8	0.09	C	26.7	0.24	D	20.6	0.19	C	18.1	0.09	C	27.0	0.25	D	20.7	0.20	C
WB RT	10.2	0.05	B	12.1	0.13	B	11.1	0.10	B	11.0	0.06	B	13.9	0.16	B	12.6	0.12	B	11.1	0.06	B	14.0	0.16	B	12.6	0.12	B
SB LT	8.0	0.04	A	8.6	0.05	A	8.2	0.03	A	8.3	0.04	A	9.1	0.06	A	8.7	0.04	A	8.4	0.04	A	9.1	0.06	A	8.7	0.04	A
OVERALL	1.2	-	-	2.0	-	-	1.8	-	-	1.1	-	-	2.1	-	-	1.9	-	-	1.1	-	-	2.1	-	-	1.9	-	-
3: Honoapiilani Highway & Lower Honoapiilani Road																											
NB LT	25.6	0.80	C	28.5	0.88	C	22.6	0.82	C	41.0	0.86	D	57.2	0.94	E	36.1	0.89	D	41.3	0.87	D	57.8	0.94	E	36.2	0.89	D
NB TH/RT	8.5	0.32	A	7.6	0.35	A	5.1	0.23	A	9.7	0.43	A	10.1	0.59	B	6.6	0.49	A	9.7	0.43	A	10.2	0.59	B	6.6	0.49	A
EB LT/TH	33.1	0.67	C	43.2	0.74	D	31.8	0.67	C	47.7	0.81	D	66.6	0.82	E	45.3	0.79	D	48.9	0.81	D	67.0	0.83	E	45.4	0.79	D
WB LT/TH/RT	44.8	0.41	D	47.8	0.45	D	51.7	0.41	D	60.2	0.43	E	78.0	0.52	E	68.3	0.41	E	60.9	0.43	E	78.5	0.52	E	68.4	0.41	E
SB LT	61.6	0.41	E	118.2	0.41	F	0.0	0.00	A	71.6	0.42	E	149.4	0.41	F	0.0	0.00	A	72.3	0.42	E	149.9	0.41	F	0.0	0.00	A
SB TH	17.4	0.63	B	23.7	0.69	C	19.4	0.59	B	22.8	0.75	C	38.0	0.83	D	25.5	0.76	C	23.3	0.75	C	38.4	0.83	D	25.6	0.76	C
SB RT	13.8	0.05	B	18.6	0.05	B	16.3	0.03	B	16.2	0.13	B	25.7	0.17	C	18.5	0.08	B	16.5	0.13	B	26.0	0.17	C	18.6	0.08	B
OVERALL	16.4	-	B	19.9	-	B	16.0	-	B	21.7	-	C	30.0	-	C	19.7	-	B	22.0	-	C	30.3	-	C	19.8	-	B
4: Honoapiilani Highway & Keawe Street																											
NB LT	43.7	0.43	D	51.9	0.42	D	34.5	0.47	C	55.0	0.77	D	67.4	0.77	E	55.3	0.79	E	55.1	0.77	E	67.7	0.77	E	55.4	0.79	E
NB TH	23.6	0.75	C	24.9	0.69	C	23.4	0.71	C	48.8	0.91	D	42.5	0.88	D	49.3	0.89	D	49.1	0.92	D	42.9	0.88	D	49.6	0.89	D
NB RT	17.5	0.01	B	19.6	0.01	B	18.0	0.01	B	22.2	0.02	C	27.9	0.01	C	26.8	0.02	C	22.2	0.02	C	28.0	0.01	C	26.8	0.02	C
EB LT/TH	25.6	0.26	C	26.3	0.40	C	23.5	0.45	C	38.2	0.64	D	46.6	0.72	D	43.1	0.78	D	38.3	0.65	D	46.9	0.72	D	43.3	0.79	D
EB RT	24.4	0.02	C	24.3	0.07	C	20.9	0.05	C	32.6	0.11	C	38.6	0.17	D	30.3	0.21	C	32.7	0.11	C	38.9	0.17	D	30.4	0.21	C
WB LT	21.7	0.09	C	21.8	0.06	C	17.8	0.21	B	29.7	0.20	C	35.9	0.18	D	29.0	0.44	C	29.7	0.20	C	36.1	0.18	D	29.1	0.44	C
WB TH	19.4	0.29	B	19.6	0.26	B	14.9	0.25	B	27.2	0.33	C	33.1	0.30	C	23.2	0.27	C	27.3	0.33	C	33.4	0.30	C	23.2	0.27	C
SB LT	21.6	0.74	C	21.2	0.77	C	23.0	0.68	C	31.7	0.83	C	44.8	0.89	D	42.4	0.82	D	31.8	0.83	C	45.2	0.89	D	42.5	0.82	D
SB TH/RT	11.0	0.46	B	10.6	0.38	B	15.5	0.57	B	13.7	0.42	B	15.2	0.39	B	25.9	0.59	C	13.7	0.42	B	15.3	0.39	B	25.9	0.59	C
OVERALL	19.4	-	B	19.9	-	B	20.3	-	C	30.3	-	C	35.8	-	D	36.9	-	D	30.4	-	C	36.1	-	D	37.1	-	D
5: Honoapiilani Highway & Kai Hele Ku Street																											
NB LT	0.0	0.00	A	8.7	0.00	A	0.0	0.00	A	0.0	0.00	A	9.1	0.00	A	0.0	0.00	A	0.0	0.00	A	9.1	0.00	A	0.0	0.00	A
NB TH	9.0	0.04	A	8.4	0.03	A	9.1	0.04	A	9.7	0.05	A	8.5	0.05	A	10.0	0.06	B	9.7	0.05	A	8.4	0.05	A	10.1	0.06	B
NB RT	9.0	0.00	A	8.3	0.00	A	9.0	0.00	A	9.6	0.00	A	8.3	0.00	A	9.9	0.00	A	9.6	0.00	A	8.3	0.00	A	9.9	0.00	A
EB LT/TH	9.4	0.04	A	12.1	0.06	B	9.2	0.04	A	9.6	0.05	A	14.5	0.10	B	9.5	0.07	A	9.6	0.05	A	14.6	0.10	B	9.5	0.07	A
EB RT	9.3	0.00	A	11.9	0.00	B	9.1	0.00	A	9.4	0.01	A	14.1	0.00	B	9.3	0.00	A	9.4	0.01	A	14.2	0.00	B	9.3	0.00	A
WB LT/TH	9.5	0.04	A	12.3	0.11	B	9.4	0.07	A	9.5	0.04	A	14.6	0.11	B	9.5	0.07	A	9.5	0.04	A	14.7	0.11	B	9.5	0.07	A
WB RT	9.6	0.08	A	12.0	0.05	B	9.3	0.06	A	10.0	0.16	A	14.6	0.12	B	9.8	0.16	A	10.0	0.17	A	14.7	0.13	B	9.8	0.16	A
SB LT	6.2	0.13	A	6.9	0.11	A	6.3	0.12	A	6.5	0.16	A	6.3	0.14	A	6.8	0.17	A	6.6	0.16	A	6.2	0.14	A	6.8	0.17	A
SB TH/RT	5.1	0.39	A	10.2	0.70	B	5.2	0.37	A	5.9	0.50	A	10.8	0.76	B	6.3	0.54	A	5.9	0.51	A	10.9	0.76	B	6.4	0.54	A
OVERALL	5.9	-	A	10.0	-	B	6.1	-	A	6.6	-	A	10.7	-	B	7.1	-	A	6.7	-	A	10.7	-	B	7.1	-	A
6: Lahaina Bypass & Kai Hele Ku Street																											
NB LT	28.5	0.78	C	24.6	0.74	C	22.1	0.74	C	49.0	0.85	D	29.9	0.79	C	27.3	0.79	C	50.4	0.86	D	29.8	0.79	C	27.2	0.79	C
NB TH	11.1	0.81	B	10.9	0.76	B	10.7	0.73	B	12.0	0.86	B	11.7	0.83	B	11.7	0.82	B	12.1	0.87	B	11.7	0.83	B	11.7	0.82	B
NB RT	5.2	0.03	A	6.2	0.03	A	6.5	0.03	A	4.3	0.02	A	5.1	0.02	A	5.5	0.02	A	4.3	0.02	A	5.1	0.02	A	5.5	0.02	A
EB LT/TH/RT	24.2	0.09	C	19.2	0.11	B	18.1	0.14	B	35.2	0.15	D	27.6	0.17	C	26.2	0.27	C	35.7	0.15	D	27.6	0.17	C	26.2	0.27	C
WB LT/TH	25.0	0.23	C	19.5	0.17	B	17.7	0.13	B	36.3	0.31	D	28.0	0.23	C	25.5	0.17	C	36.9	0.31	D	28.0	0.23	C	25.5	0.17	C
WB RT	23.9	0.02	C	18.8	0.02	B	17.2	0.02	B	34.7	0.07	C	27.0	0.05	C	24.8	0.03	C	35.2	0.07	D	27.0	0.05	C	24.8	0.03	C
SB LT	31.5	0.53	C	25.2	0.52	C	23.5	0.50	C	45.6	0.65	D	35.4	0.59	D	32.9	0.57	C	46.3	0.66	D	35.4	0.59	D	32.9	0.57	C
SB TH	8.8	0.29	A	11.8	0.70	B	9.6	0.33	A	9.9	0.36	A	14.2	0.75	B	11.3	0.42	B	9.9	0.36	A	14.4	0.76	B	11.4	0.42	B
SB RT	7.4	0.01	A	7.6	0.02	A	8.2	0.01	A	7.8	0.01	A	8.3	0.02	A	9.0	0.01	A	7.8	0.01	A	8.3	0.02	A	9.1	0.01	A
OVERALL	13.9	-	B	13.2	-	B	12.9	-	B	18.2	-	B	15.7	-	B	15.3	-	B	18.4	-	B	15.8	-	B	15.3	-	B

HONOKOWAI BEACH RESTORATION

AustinTsutsumi & ASSOCIATES, INC.
Engineers & Surveyors

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NOT TO SCALE



LEGEND

##(##)[##]	- AM(PM)[MD] VEHICLE VOLUMES
X	- UNSIGNALIZED INTERSECTION X
Y, X/X/X	- SIGNALIZED INTERSECTION Y, OVERALL AM/PM/MD LOS
X(X)[X]	- AM(PM)[MD] LOS *DENOTES V/C ≥ 1

FIGURE 4.8

ALTERNATIVE 3
FUTURE YEAR 2038
LANE CONFIGURATIONS, VOLUMES, AND LOS

TABLE 4.9: LOS SUMMARY
EXISTING, BY 2038, AND FY 2038 ALTERNATIVE 3

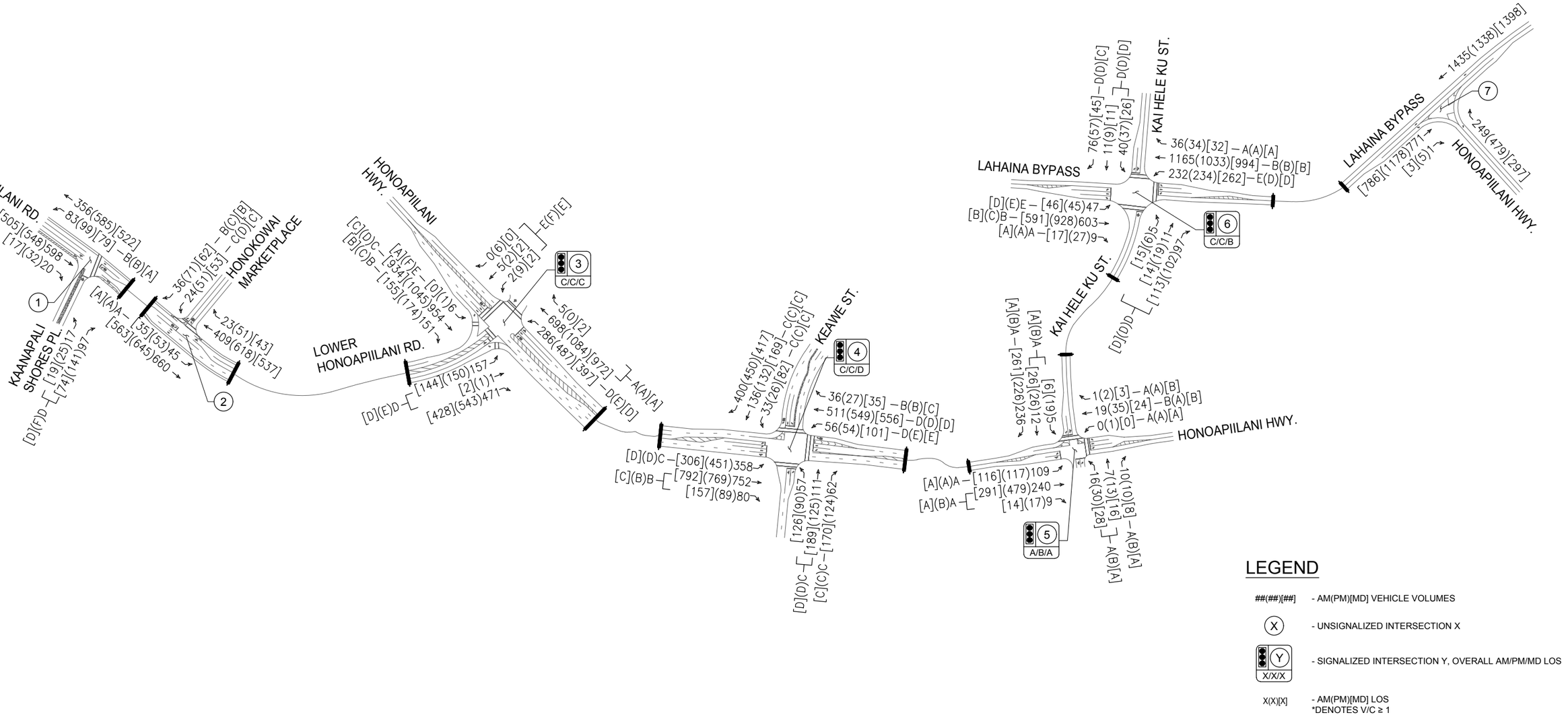
	Existing Conditions									Base Year 2038									Future Year 2038 Alternative 3								
	AM			PM			MD			AM			PM			MD			AM			PM			MD		
Intersection	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Lower Honoapiilani Road & Kaanapali Shores Place																											
NB LT	9.3	0.07	A	9.4	0.09	A	9.0	0.07	A	10.1	0.10	B	10.1	0.13	B	9.7	0.10	A	10.2	0.12	B	10.1	0.13	B	9.7	0.10	A
EB LT/RT	18.5	0.27	C	23.7	0.43	C	18.2	0.24	C	27.1	0.43	D	41.8	0.65	E	25.8	0.37	D	27.9	0.45	D	47.2	0.71	E	26.0	0.37	D
OVERALL	2.7	-	-	3.7	-	-	2.2	-	-	3.4	-	-	5.4	-	-	2.7	-	-	3.6	-	-	6.4	-	-	2.7	-	-
2: Lower Honoapiilani Road & Honokowai Marketplace Driveway																											
WB LT	14.6	0.05	B	19.4	0.16	C	15.7	0.12	C	18.8	0.09	C	30.1	0.28	D	22.9	0.22	C	19.0	0.09	C	30.5	0.28	D	23.0	0.22	C
WB RT	10.2	0.05	B	12.1	0.13	B	11.1	0.10	B	11.2	0.06	B	14.6	0.17	B	13.1	0.13	B	11.3	0.06	B	14.6	0.17	B	13.2	0.13	B
SB LT	8.0	0.04	A	8.6	0.05	A	8.2	0.03	A	8.4	0.04	A	9.3	0.07	A	8.9	0.04	A	8.4	0.04	A	9.3	0.07	A	8.9	0.04	A
OVERALL	1.2	-	-	2.0	-	-	1.8	-	-	1.1	-	-	2.2	-	-	1.9	-	-	1.1	-	-	2.2	-	-	1.9	-	-
3: Honoapiilani Highway & Lower Honoapiilani Road																											
NB LT	25.6	0.80	C	28.5	0.88	C	22.6	0.82	C	49.8	0.88	D	77.0	0.95	E	48.7	0.91	D	50.4	0.89	D	77.3	0.95	E	49.0	0.91	D
NB TH/RT	8.5	0.32	A	7.6	0.35	A	5.1	0.23	A	10.2	0.48	B	12.3	0.68	B	8.1	0.60	A	10.1	0.48	B	12.3	0.68	B	8.1	0.59	A
EB LT/TH	33.1	0.67	C	43.2	0.74	D	31.8	0.67	C	65.7	0.84	E	90.3	0.87	F	69.1	0.84	E	67.5	0.85	E	91.0	0.87	F	69.5	0.84	E
WB LT/TH/RT	44.8	0.41	D	47.8	0.45	D	51.7	0.41	D	70.1	0.43	E	96.3	0.55	F	81.5	0.42	F	71.1	0.43	E	96.6	0.55	F	81.7	0.42	F
SB LT	61.6	0.41	E	118.2	0.41	F	0.0	0.00	A	71.7	0.45	E	166.1	0.41	F	0.0	0.00	A	72.7	0.45	E	166.4	0.41	F	0.0	0.00	A
SB TH	17.4	0.63	B	23.7	0.69	C	19.4	0.59	B	25.3	0.79	C	58.6	0.95	E	36.0	0.88	D	26.0	0.80	C	59.3	0.95	E	36.3	0.88	D
SB RT	13.8	0.05	B	18.6	0.05	B	16.3	0.03	B	16.5	0.13	B	29.2	0.17	C	20.2	0.09	C	17.0	0.13	B	29.4	0.17	C	20.3	0.09	C
OVERALL	16.4	-	B	19.9	-	B	16.0	-	B	24.3	-	C	41.3	-	D	26.3	-	C	24.8	-	C	41.7	-	D	26.4	-	C
4: Honoapiilani Highway & Keawe Street																											
NB LT	43.7	0.43	D	51.9	0.42	D	34.5	0.47	C	41.7	0.69	D	55.6	0.76	E	53.6	0.78	D	41.9	0.69	D	56.1	0.76	E	53.7	0.78	D
NB TH	23.6	0.75	C	24.9	0.69	C	23.4	0.71	C	33.7	0.88	C	40.9	0.90	D	54.7	0.94	D	34.0	0.88	C	41.5	0.90	D	55.2	0.94	E
NB RT	17.5	0.01	B	19.6	0.01	B	18.0	0.01	B	16.2	0.02	B	19.3	0.01	B	22.4	0.02	C	16.2	0.02	B	19.4	0.01	B	22.4	0.02	C
EB LT/TH	25.6	0.26	C	26.3	0.40	C	23.5	0.45	C	30.2	0.59	C	36.1	0.66	D	39.8	0.77	D	30.3	0.59	C	36.3	0.67	D	39.9	0.77	D
EB RT	24.4	0.02	C	24.3	0.07	C	20.9	0.05	C	25.9	0.09	C	29.8	0.13	C	28.8	0.19	C	26.0	0.09	C	30.0	0.13	C	28.9	0.19	C
WB LT	21.7	0.09	C	21.8	0.06	C	17.8	0.21	B	23.1	0.16	C	27.4	0.15	C	27.6	0.42	C	23.2	0.17	C	27.6	0.15	C	27.6	0.42	C
WB TH	19.4	0.29	B	19.6	0.26	B	14.9	0.25	B	20.6	0.29	C	24.6	0.27	C	21.9	0.27	C	20.6	0.29	C	24.8	0.27	C	22.0	0.27	C
SB LT	21.6	0.74	C	21.2	0.77	C	23.0	0.68	C	30.0	0.71	C	37.0	0.78	D	44.7	0.76	D	30.1	0.71	C	37.2	0.79	D	44.7	0.76	D
SB TH/RT	11.0	0.46	B	10.6	0.38	B	15.5	0.57	B	15.9	0.57	B	17.0	0.53	B	28.8	0.75	C	15.9	0.57	B	17.1	0.53	B	28.8	0.75	C
OVERALL	19.4	-	B	19.9	-	B	20.3	-	C	24.9	-	C	30.0	-	C	38.1	-	D	25.0	-	C	30.2	-	C	38.3	-	D
5: Honoapiilani Highway & Kai Hele Ku Street																											
NB LT	0.0	0.00	A	8.7	0.00	A	0.0	0.00	A	0.0	0.00	A	9.4	0.00	A	0.0	0.00	A	0.0	0.00	A	9.4	0.00	A	0.0	0.00	A
NB TH	9.0	0.04	A	8.4	0.03	A	9.1	0.04	A	10.0	0.06	A	9.4	0.07	A	10.4	0.08	B	10.0	0.06	B	9.4	0.07	A	10.5	0.08	B
NB RT	9.0	0.00	A	8.3	0.00	A	9.0	0.00	A	9.8	0.00	A	9.2	0.00	A	10.2	0.00	B	9.8	0.00	A	9.2	0.00	A	10.2	0.00	B
EB LT/TH	9.4	0.04	A	12.1	0.06	B	9.2	0.04	A	9.4	0.05	A	12.1	0.10	B	9.5	0.09	A	9.4	0.05	A	12.2	0.10	B	9.5	0.09	A
EB RT	9.3	0.00	A	11.9	0.00	B	9.1	0.00	A	9.2	0.01	A	11.7	0.00	B	9.2	0.00	A	9.2	0.01	A	11.8	0.00	B	9.2	0.00	A
WB LT/TH	9.5	0.04	A	12.3	0.11	B	9.4	0.07	A	9.3	0.04	A	12.1	0.10	B	9.4	0.07	A	9.3	0.03	A	12.2	0.10	B	9.4	0.07	A
WB RT	9.6	0.08	A	12.0	0.05	B	9.3	0.06	A	9.9	0.19	A	12.3	0.16	B	9.9	0.21	A	9.9	0.20	A	12.5	0.17	B	9.9	0.21	A
SB LT	6.2	0.13	A	6.9	0.11	A	6.3	0.12	A	6.7	0.18	A	7.1	0.17	A	7.1	0.19	A	6.8	0.18	A	7.0	0.17	A	7.1	0.19	A
SB TH/RT	5.1	0.39	A	10.2	0.70	B	5.2	0.37	A	5.2	0.31	A	10.7	0.71	B	5.7	0.38	A	5.2	0.31	A	10.7	0.71	B	5.8	0.38	A
OVERALL	5.9	-	A	10.0	-	B	6.1	-	A	6.7	-	A	10.3	-	B	7.2	-	A	6.7	-	A	10.4	-	B	7.2	-	A
6: Lahaina Bypass & Kai Hele Ku Street																											
NB LT	28.5	0.78	C	24.6	0.74	C	22.1	0.74	C	47.7	0.86	D	45.0	0.86	D	34.0	0.84	C	49.1	0.86	D	46.1	0.86	D	34.0	0.84	C
NB TH	11.1	0.81	B	10.9	0.76	B	10.7	0.73	B	12.9	0.89	B	10.4	0.81	B	12.3	0.86	B	13.1	0.89	B	10.3	0.81	B	12.3	0.86	B
NB RT	5.2	0.03	A	6.2	0.03	A	6.5	0.03	A	3.8	0.02	A	4.0	0.02	A	4.8	0.02	A	3.8	0.02	A	4.0	0.02	A	4.8	0.02	A
EB LT/TH/RT	24.2	0.09	C	19.2	0.11	B	18.1	0.14	B	43.5	0.21	D	42.8	0.35	D	34.3	0.38	C	44.3	0.21	D	43.4	0.36	D	34.3	0.38	C
WB LT/TH	25.0	0.23	C	19.5	0.17	B	17.7	0.13	B	44.8	0.36	D	42.2	0.30	D	32.7	0.20	C	45.6	0.36	D	42.8	0.30	D	32.7	0.20	C
WB RT	23.9	0.02	C	18.8	0.02	B	17.2	0.02	B	42.8	0.10	D	40.4	0.06	D	31.8	0.06	C	43.5	0.10	D	40.9	0.06	D	31.8	0.06	C
SB LT	31.5	0.53	C	25.2	0.52	C	23.5	0.50	C	57.9	0.73	E	54.6	0.70	D	42.6	0.64	D	59.1	0.74	E	55.5	0.71	E	42.6	0.64	D
SB TH	8.8	0.29	A	11.8	0.70	B	9.6	0.33	A	12.0	0.56	B	18.9	0.88	B	14.5	0.66	B	12.1	0.56	B	19.0	0.88	B	14.6	0.66	B
SB RT	7.4	0.01	A	7.6	0.02	A	8.2	0.01	A	7.8	0.01	A	8.1	0.02	A	9.3	0.01	A	7.8	0.01	A	8.1	0.02	A	9.3	0.01	A
OVERALL	13.9	-	B	13.2	-	B	12.9	-	B	18.7	-	B	19.3	-	B	17.6	-	B	19.0	-	B	19.5	-	B	17.6	-	B

HONOKOWAI BEACH RESTORATION

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Engineers & Surveyors

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LEGEND

##(##)[##]	- AM(PM)[MD] VEHICLE VOLUMES
X	- UNSIGNALIZED INTERSECTION X
Y, X/X/X	- SIGNALIZED INTERSECTION Y, OVERALL AM/PM/MD LOS
X(X)[X]	- AM(PM)[MD] LOS *DENOTES V/C ≥ 1

FIGURE 4.9

ALTERNATIVE 3
FUTURE YEAR 2048
LANE CONFIGURATIONS, VOLUMES, AND LOS

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

TABLE 4.10: LOS SUMMARY
EXISTING, BY 2048, AND FY 2048 ALTERNATIVE 3

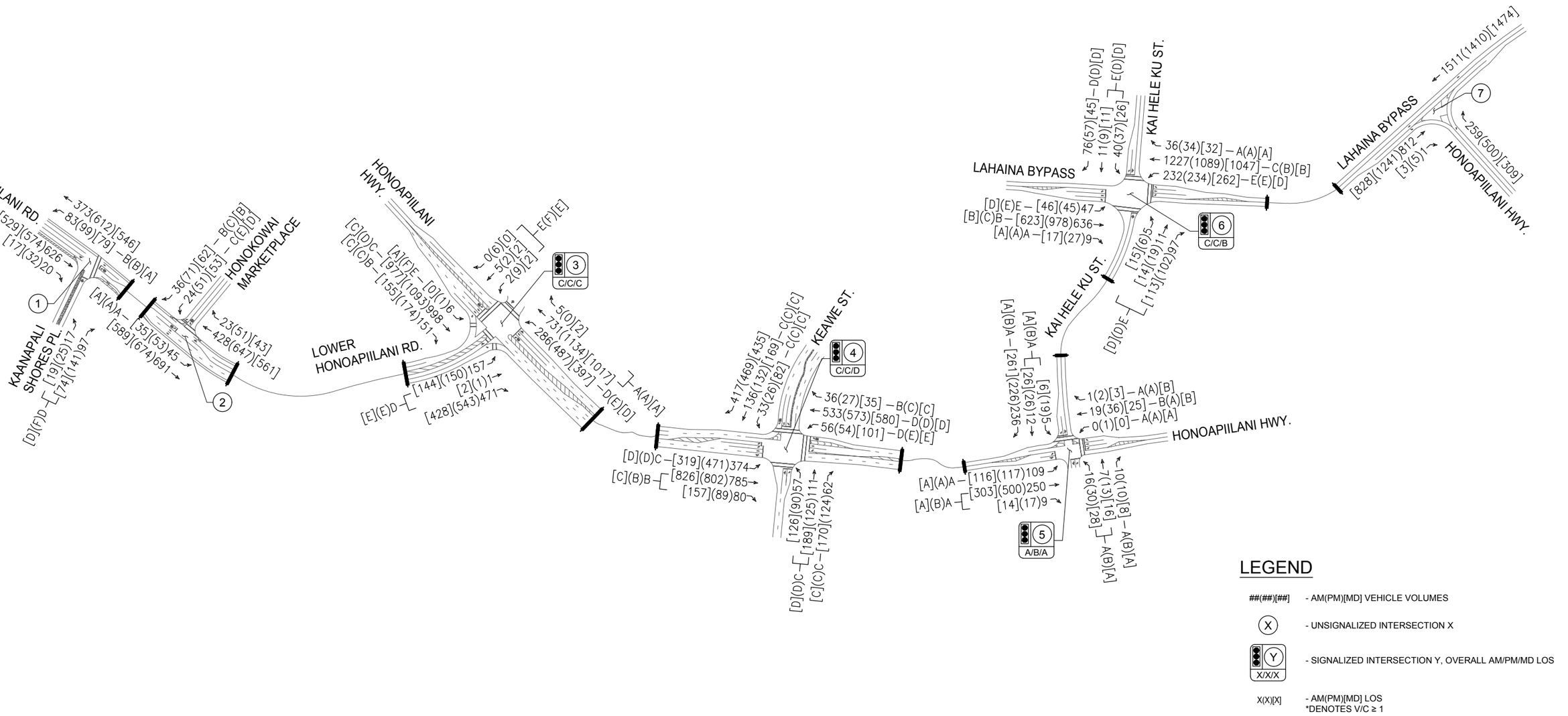
	Existing Conditions									Base Year 2048									Future Year 2048 Alternative 3								
	AM			PM			MD			AM			PM			MD			AM			PM			MD		
Intersection	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Lower Honoapiilani Road & Kaanapali Shores Place																											
NB LT	9.3	0.07	A	9.4	0.09	A	9.0	0.07	A	10.3	0.10	B	10.3	0.13	B	9.8	0.10	A	10.4	0.12	B	10.3	0.14	B	9.8	0.10	A
EB LT/RT	18.5	0.27	C	23.7	0.43	C	18.2	0.24	C	28.9	0.45	D	46.8	0.69	E	27.6	0.39	D	29.9	0.47	D	53.7	0.75	F	27.7	0.39	D
OVERALL	2.7	-	-	3.7	-	-	2.2	-	-	3.4	-	-	5.8	-	-	2.7	-	-	3.6	-	-	6.9	-	-	2.8	-	-
2: Lower Honoapiilani Road & Honokowai Marketplace Driveway																											
WB LT	14.6	0.05	B	19.4	0.16	C	15.7	0.12	C	19.5	0.10	C	32.5	0.30	D	24.3	0.24	C	19.8	0.10	C	33.0	0.30	D	24.4	0.24	C
WB RT	10.2	0.05	B	12.1	0.13	B	11.1	0.10	B	11.4	0.07	B	15.0	0.18	C	13.5	0.14	B	11.4	0.07	B	15.1	0.18	C	13.5	0.14	B
SB LT	8.0	0.04	A	8.6	0.05	A	8.2	0.03	A	8.4	0.05	A	9.4	0.07	A	9.0	0.04	A	8.5	0.05	A	9.4	0.07	A	9.0	0.04	A
OVERALL	1.2	-	-	2.0	-	-	1.8	-	-	1.1	-	-	2.2	-	-	1.9	-	-	1.1	-	-	2.2	-	-	1.9	-	-
3: Honoapiilani Highway & Lower Honoapiilani Road																											
NB LT	25.6	0.80	C	28.5	0.88	C	22.6	0.82	C	39.3	0.86	D	60.0	0.94	E	39.6	0.90	D	39.7	0.86	D	60.5	0.94	E	39.6	0.90	D
NB TH/RT	8.5	0.32	A	7.6	0.35	A	5.1	0.23	A	9.7	0.36	A	9.4	0.48	A	6.4	0.42	A	9.6	0.36	A	9.4	0.48	A	6.4	0.42	A
EB LT/TH	33.1	0.67	C	43.2	0.74	D	31.8	0.67	C	46.2	0.81	D	68.8	0.84	E	54.1	0.82	D	47.3	0.81	D	69.5	0.84	E	54.4	0.82	D
WB LT/TH/RT	44.8	0.41	D	47.8	0.45	D	51.7	0.41	D	58.5	0.42	E	80.6	0.52	F	72.8	0.42	E	59.2	0.42	E	81.0	0.53	F	73.0	0.42	E
SB LT	61.6	0.41	E	118.2	0.41	F	0.0	0.00	A	60.0	0.44	E	151.8	0.41	F	0.0	0.00	A	60.7	0.44	E	152.2	0.41	F	0.0	0.00	A
SB TH	17.4	0.63	B	23.7	0.69	C	19.4	0.59	B	22.9	0.74	C	40.3	0.84	D	28.3	0.79	C	23.4	0.74	C	40.6	0.84	D	28.5	0.79	C
SB RT	13.8	0.05	B	18.6	0.05	B	16.3	0.03	B	16.7	0.14	B	27.6	0.18	C	19.9	0.09	B	17.0	0.14	B	27.8	0.18	C	20.0	0.09	B
OVERALL	16.4	-	B	19.9	-	B	16.0	-	B	22.4	-	C	33.3	-	C	23.0	-	C	22.8	-	C	33.5	-	C	23.1	-	C
4: Honoapiilani Highway & Keawe Street																											
NB LT	43.7	0.43	D	51.9	0.42	D	34.5	0.47	C	43.2	0.70	D	58.4	0.78	E	58.2	0.79	E	43.3	0.70	D	58.6	0.78	E	58.4	0.79	E
NB TH	23.6	0.75	C	24.9	0.69	C	23.4	0.71	C	37.1	0.90	D	45.6	0.92	D	48.5	0.92	D	37.3	0.90	D	46.1	0.92	D	48.8	0.92	D
NB RT	17.5	0.01	B	19.6	0.01	B	18.0	0.01	B	16.3	0.02	B	19.6	0.01	B	22.8	0.02	C	16.3	0.02	B	19.7	0.01	B	22.8	0.02	C
EB LT/TH	25.6	0.26	C	26.3	0.40	C	23.5	0.45	C	31.2	0.60	C	37.6	0.67	D	45.5	0.79	D	31.2	0.60	C	37.8	0.67	D	45.7	0.79	D
EB RT	24.4	0.02	C	24.3	0.07	C	20.9	0.05	C	26.7	0.09	C	31.1	0.13	C	31.8	0.19	C	26.8	0.09	C	31.2	0.13	C	31.9	0.19	C
WB LT	21.7	0.09	C	21.8	0.06	C	17.8	0.21	B	23.9	0.17	C	28.6	0.15	C	30.8	0.45	C	24.0	0.17	C	28.8	0.15	C	30.8	0.45	C
WB TH	19.4	0.29	B	19.6	0.26	B	14.9	0.25	B	21.4	0.30	C	25.8	0.27	C	24.7	0.27	C	21.4	0.30	C	26.0	0.27	C	24.8	0.27	C
SB LT	21.6	0.74	C	21.2	0.77	C	23.0	0.68	C	30.7	0.72	C	38.2	0.79	D	48.8	0.78	D	30.8	0.72	C	38.3	0.80	D	48.9	0.78	D
SB TH/RT	11.0	0.46	B	10.6	0.38	B	15.5	0.57	B	15.9	0.57	B	17.1	0.53	B	28.9	0.73	C	15.9	0.57	B	17.1	0.54	B	29.0	0.73	C
OVERALL	19.4	-	B	19.9	-	B	20.3	-	C	26.0	-	C	31.7	-	C	38.6	-	D	26.1	-	C	31.8	-	C	38.8	-	D
5: Honoapiilani Highway & Kai Hele Ku Street																											
NB LT	0.0	0.00	A	8.7	0.00	A	0.0	0.00	A	0.0	0.00	A	9.4	0.00	A	0.0	0.00	A	0.0	0.00	A	9.4	0.00	A	0.0	0.00	A
NB TH	9.0	0.04	A	8.4	0.03	A	9.1	0.04	A	10.0	0.06	A	9.3	0.07	A	10.4	0.08	B	10.0	0.06	B	9.3	0.07	A	10.5	0.08	B
NB RT	9.0	0.00	A	8.3	0.00	A	9.0	0.00	A	9.8	0.00	A	9.1	0.00	A	10.2	0.00	B	9.8	0.00	A	9.0	0.00	A	10.2	0.00	B
EB LT/TH	9.4	0.04	A	12.1	0.06	B	9.2	0.04	A	9.4	0.05	A	12.4	0.10	B	9.5	0.09	A	9.4	0.05	A	12.6	0.10	B	9.5	0.09	A
EB RT	9.3	0.00	A	11.9	0.00	B	9.1	0.00	A	9.3	0.01	A	12.1	0.00	B	9.2	0.00	A	9.3	0.01	A	12.2	0.00	B	9.2	0.00	A
WB LT/TH	9.5	0.04	A	12.3	0.11	B	9.4	0.07	A	9.4	0.04	A	12.5	0.10	B	9.4	0.07	A	9.3	0.03	A	12.6	0.10	B	9.4	0.07	A
WB RT	9.6	0.08	A	12.0	0.05	B	9.3	0.06	A	9.9	0.19	A	12.7	0.15	B	9.9	0.20	A	9.9	0.20	A	12.8	0.16	B	9.9	0.21	A
SB LT	6.2	0.13	A	6.9	0.11	A	6.3	0.12	A	6.7	0.18	A	6.9	0.17	A	7.0	0.19	A	6.7	0.18	A	6.9	0.17	A	7.1	0.19	A
SB TH/RT	5.1	0.39	A	10.2	0.70	B	5.2	0.37	A	5.2	0.32	A	10.7	0.71	B	5.8	0.39	A	5.2	0.32	A	10.7	0.72	B	5.8	0.40	A
OVERALL	5.9	-	A	10.0	-	B	6.1	-	A	6.7	-	A	10.4	-	B	7.2	-	A	6.7	-	A	10.4	-	B	7.2	-	A
6: Lahaina Bypass & Kai Hele Ku Street																											
NB LT	28.5	0.78	C	24.6	0.74	C	22.1	0.74	C	56.0	0.87	E	52.5	0.87	D	38.6	0.85	D	57.6	0.88	E	53.8	0.87	D	38.7	0.85	D
NB TH	11.1	0.81	B	10.9	0.76	B	10.7	0.73	B	16.2	0.91	B	10.9	0.83	B	12.5	0.87	B	16.7	0.91	B	10.8	0.82	B	12.5	0.87	B
NB RT	5.2	0.03	A	6.2	0.03	A	6.5	0.03	A	3.6	0.02	A	3.8	0.02	A	4.5	0.02	A	3.6	0.02	A	3.8	0.02	A	4.5	0.02	A
EB LT/TH/RT	24.2	0.09	C	19.2	0.11	B	18.1	0.14	B	48.5	0.22	D	47.4	0.37	D	37.7	0.39	D	49.4	0.23	D	48.1	0.37	D	37.7	0.39	D
WB LT/TH	25.0	0.23	C	19.5	0.17	B	17.7	0.13	B	50.0	0.38	D	46.7	0.32	D	35.9	0.21	D	50.9	0.39	D	47.4	0.32	D	35.9	0.21	D
WB RT	23.9	0.02	C	18.8	0.02	B	17.2	0.02	B	47.7	0.10	D	44.7	0.06	D	35.0	0.06	C	48.5	0.10	D	45.3	0.06	D	35.0	0.06	C
SB LT	31.5	0.53	C	25.2	0.52	C	23.5	0.50	C	66.3	0.77	E	61.8	0.74	E	47.3	0.67	D	67.1	0.77	E	62.9	0.74	E	47.3	0.67	D
SB TH	8.8	0.29	A	11.8	0.70	B	9.6	0.33	A	12.2	0.57	B	20.4	0.89	C	14.6	0.66	B	12.2	0.57	B	20.8	0.90	C	14.7	0.66	B
SB RT	7.4	0.01	A	7.6	0.02	A	8.2	0.01	A	7.7	0.01	A	8.0	0.02	A	9.2	0.01	A	7.7	0.01	A	8.0	0.02	A	9.2	0.01	A
OVERALL	13.9	-	B	13.2	-	B	12.9	-	B	21.5	-	C	21.0	-	C	18.4	-	B	22.0	-	C	21.3	-	C	18.5	-	B

HONOKOWAI BEACH RESTORATION

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N
NOT TO SCALE



LEGEND

##(##)[##]	- AM(PM)[MD] VEHICLE VOLUMES
X	- UNSIGNALIZED INTERSECTION X
Y, X/X/X	- SIGNALIZED INTERSECTION Y, OVERALL AM/PM/MD LOS
X(X)[X]	- AM(PM)[MD] LOS *DENOTES V/C ≥ 1

FIGURE 4.10

ALTERNATIVE 3
FUTURE YEAR 2058
LANE CONFIGURATIONS, VOLUMES, AND LOS

TABLE 4.11: LOS SUMMARY
EXISTING, BY 2058, AND FY 2058 ALTERNATIVE 3

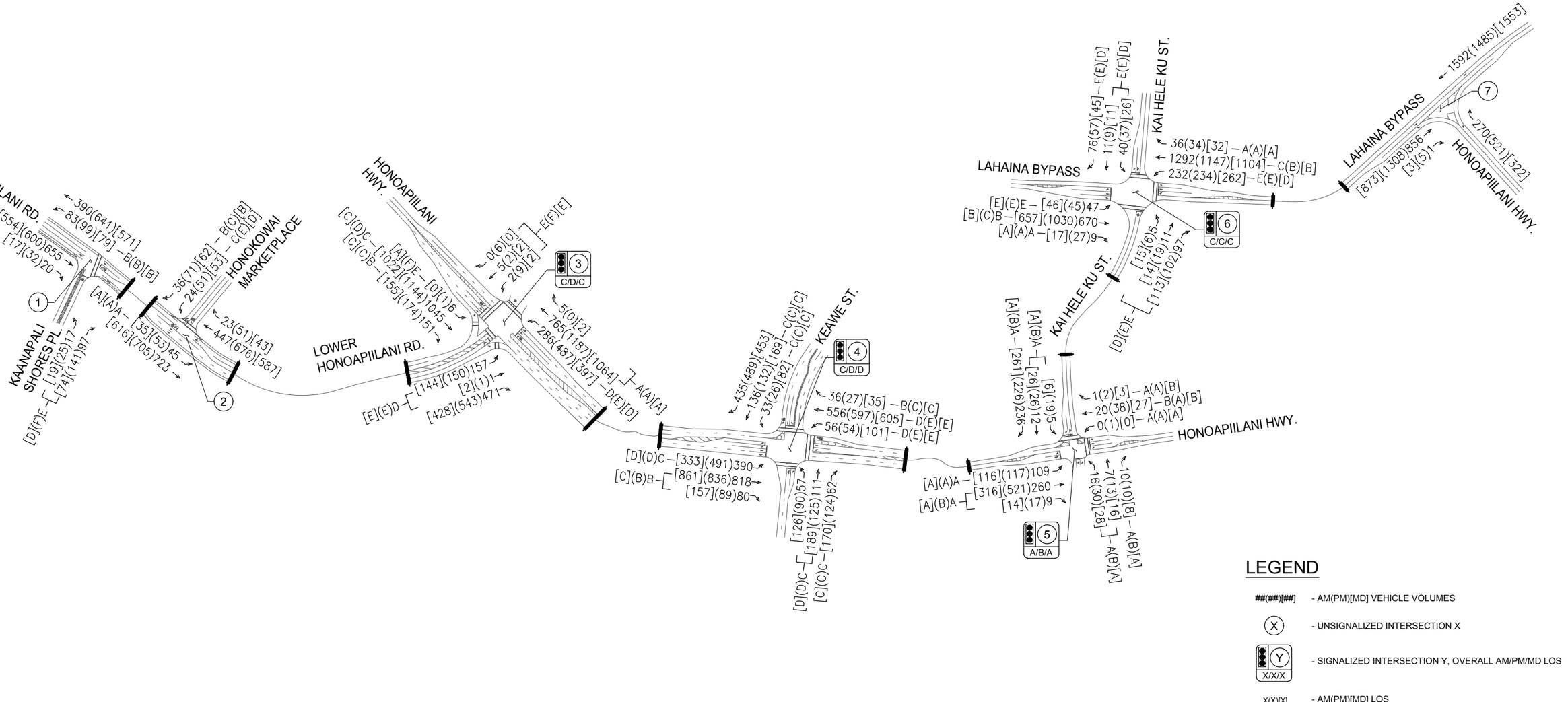
	Existing Conditions									Base Year 2058									Future Year 2058 Alternative 3								
	AM			PM			MD			AM			PM			MD			AM			PM			MD		
Intersection	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Lower Honoapiilani Road & Kaanapali Shores Place																											
NB LT	9.3	0.07	A	9.4	0.09	A	9.0	0.07	A	10.4	0.11	B	10.4	0.14	B	9.9	0.10	A	10.5	0.12	B	10.4	0.14	B	9.9	0.11	A
EB LT/RT	18.5	0.27	C	23.7	0.43	C	18.2	0.24	C	31.1	0.48	D	53.5	0.73	F	29.6	0.41	D	32.3	0.49	D	62.2	0.79	F	29.8	0.41	D
OVERALL	2.7	-	-	3.7	-	-	2.2	-	-	3.5	-	-	6.3	-	-	2.7	-	-	3.7	-	-	7.7	-	-	2.8	-	-
2: Lower Honoapiilani Road & Honokowai Marketplace Driveway																											
WB LT	14.6	0.05	B	19.4	0.16	C	15.7	0.12	C	20.4	0.10	C	35.4	0.32	E	25.8	0.25	D	20.8	0.10	C	35.9	0.33	E	26.0	0.25	D
WB RT	10.2	0.05	B	12.1	0.13	B	11.1	0.10	B	11.5	0.07	B	15.5	0.19	C	13.8	0.14	B	11.6	0.07	B	15.6	0.19	C	13.8	0.14	B
SB LT	8.0	0.04	A	8.6	0.05	A	8.2	0.03	A	8.5	0.05	A	9.6	0.07	A	9.1	0.04	A	8.5	0.05	A	9.6	0.07	A	9.1	0.04	A
OVERALL	1.2	-	-	2.0	-	-	1.8	-	-	1.0	-	-	2.2	-	-	1.9	-	-	1.0	-	-	2.2	-	-	1.9	-	-
3: Honoapiilani Highway & Lower Honoapiilani Road																											
NB LT	25.6	0.80	C	28.5	0.88	C	22.6	0.82	C	41.0	0.86	D	63.9	0.94	E	41.0	0.90	D	41.4	0.87	D	64.4	0.94	E	41.1	0.90	D
NB TH/RT	8.5	0.32	A	7.6	0.35	A	5.1	0.23	A	9.6	0.37	A	9.5	0.49	A	6.5	0.43	A	9.5	0.37	A	9.5	0.49	A	6.5	0.43	A
EB LT/TH	33.1	0.67	C	43.2	0.74	D	31.8	0.67	C	49.2	0.81	D	73.7	0.85	E	57.0	0.82	E	50.5	0.82	D	74.4	0.85	E	57.4	0.82	E
WB LT/TH/RT	44.8	0.41	D	47.8	0.45	D	51.7	0.41	D	60.4	0.43	E	84.2	0.53	F	74.5	0.42	E	61.1	0.43	E	84.6	0.53	F	74.7	0.42	E
SB LT	61.6	0.41	E	118.2	0.41	F	0.0	0.00	A	61.9	0.44	E	155.1	0.41	F	0.0	0.00	A	62.7	0.44	E	155.5	0.41	F	0.0	0.00	A
SB TH	17.4	0.63	B	23.7	0.69	C	19.4	0.59	B	23.2	0.75	C	42.5	0.85	D	29.3	0.80	C	23.8	0.75	C	42.8	0.85	D	29.5	0.80	C
SB RT	13.8	0.05	B	18.6	0.05	B	16.3	0.03	B	16.6	0.13	B	27.9	0.17	C	19.9	0.09	B	17.0	0.13	B	28.1	0.17	C	20.0	0.09	C
OVERALL	16.4	-	B	19.9	-	B	16.0	-	B	22.8	-	C	34.7	-	C	23.6	-	C	23.2	-	C	35.0	-	C	23.7	-	C
4: Honoapiilani Highway & Keawe Street																											
NB LT	43.7	0.43	D	51.9	0.42	D	34.5	0.47	C	44.8	0.71	D	60.0	0.78	E	60.5	0.80	E	44.9	0.71	D	60.2	0.77	E	60.7	0.80	E
NB TH	23.6	0.75	C	24.9	0.69	C	23.4	0.71	C	41.4	0.92	D	51.9	0.95	D	53.7	0.94	D	41.8	0.92	D	52.7	0.95	D	54.0	0.94	D
NB RT	17.5	0.01	B	19.6	0.01	B	18.0	0.01	B	16.5	0.02	B	20.0	0.01	B	23.2	0.02	C	16.4	0.02	B	20.1	0.01	C	23.2	0.02	C
EB LT/TH	25.6	0.26	C	26.3	0.40	C	23.5	0.45	C	32.2	0.61	C	39.2	0.68	D	48.5	0.80	D	32.3	0.61	C	39.4	0.68	D	48.7	0.80	D
EB RT	24.4	0.02	C	24.3	0.07	C	20.9	0.05	C	27.6	0.09	C	32.3	0.13	C	33.3	0.19	C	27.6	0.09	C	32.5	0.13	C	33.4	0.19	C
WB LT	21.7	0.09	C	21.8	0.06	C	17.8	0.21	B	24.8	0.17	C	29.9	0.16	C	32.4	0.46	C	24.8	0.17	C	30.0	0.16	C	32.5	0.46	C
WB TH	19.4	0.29	B	19.6	0.26	B	14.9	0.25	B	22.2	0.30	C	27.1	0.28	C	26.1	0.28	C	22.3	0.30	C	27.2	0.28	C	26.1	0.28	C
SB LT	21.6	0.74	C	21.2	0.77	C	23.0	0.68	C	31.5	0.74	C	39.4	0.80	D	50.7	0.79	D	31.5	0.74	C	39.5	0.81	D	50.8	0.79	D
SB TH/RT	11.0	0.46	B	10.6	0.38	B	15.5	0.57	B	15.9	0.58	B	17.2	0.54	B	29.7	0.73	C	15.9	0.58	B	17.2	0.55	B	29.8	0.73	C
OVERALL	19.4	-	B	19.9	-	B	20.3	-	C	27.4	-	C	33.7	-	C	41.0	-	D	27.5	-	C	34.0	-	C	41.1	-	D
5: Honoapiilani Highway & Kai Hele Ku Street																											
NB LT	0.0	0.00	A	8.7	0.00	A	0.0	0.00	A	0.0	0.00	A	9.4	0.00	A	0.0	0.00	A	0.0	0.00	A	9.4	0.00	A	0.0	0.00	A
NB TH	9.0	0.04	A	8.4	0.03	A	9.1	0.04	A	10.0	0.06	A	9.2	0.07	A	10.4	0.08	B	10.0	0.06	B	9.2	0.07	A	10.5	0.08	B
NB RT	9.0	0.00	A	8.3	0.00	A	9.0	0.00	A	9.8	0.00	A	9.0	0.00	A	10.2	0.00	B	9.8	0.00	A	8.9	0.00	A	10.2	0.00	B
EB LT/TH	9.4	0.04	A	12.1	0.06	B	9.2	0.04	A	9.4	0.05	A	12.8	0.10	B	9.5	0.09	A	9.4	0.05	A	12.9	0.11	B	9.5	0.09	A
EB RT	9.3	0.00	A	11.9	0.00	B	9.1	0.00	A	9.3	0.01	A	12.4	0.00	B	9.2	0.00	A	9.3	0.01	A	12.5	0.00	B	9.2	0.00	A
WB LT/TH	9.5	0.04	A	12.3	0.11	B	9.4	0.07	A	9.4	0.04	A	12.8	0.11	B	9.4	0.07	A	9.4	0.03	A	12.9	0.11	B	9.4	0.07	A
WB RT	9.6	0.08	A	12.0	0.05	B	9.3	0.06	A	9.9	0.19	A	13.0	0.16	B	9.9	0.20	A	9.9	0.20	A	13.2	0.17	B	10.0	0.21	A
SB LT	6.2	0.13	A	6.9	0.11	A	6.3	0.12	A	6.7	0.18	A	6.8	0.16	A	7.0	0.19	A	6.7	0.18	A	6.8	0.16	A	7.1	0.19	A
SB TH/RT	5.1	0.39	A	10.2	0.70	B	5.2	0.37	A	5.2	0.33	A	10.7	0.72	B	5.9	0.41	A	5.3	0.33	A	10.8	0.73	B	5.9	0.41	A
OVERALL	5.9	-	A	10.0	-	B	6.1	-	A	6.6	-	A	10.5	-	B	7.2	-	A	6.7	-	A	10.5	-	B	7.2	-	A
6: Lahaina Bypass & Kai Hele Ku Street																											
NB LT	28.5	0.78	C	24.6	0.74	C	22.1	0.74	C	66.9	0.89	E	62.1	0.88	E	45.5	0.87	D	68.7	0.89	E	63.4	0.89	E	45.7	0.87	D
NB TH	11.1	0.81	B	10.9	0.76	B	10.7	0.73	B	20.5	0.93	C	12.3	0.85	B	12.9	0.88	B	21.3	0.94	C	12.2	0.84	B	12.9	0.88	B
NB RT	5.2	0.03	A	6.2	0.03	A	6.5	0.03	A	3.4	0.02	A	3.6	0.02	A	4.3	0.02	A	3.4	0.02	A	3.6	0.02	A	4.3	0.02	A
EB LT/TH/RT	24.2	0.09	C	19.2	0.11	B	18.1	0.14	B	54.8	0.24	D	53.2	0.39	D	41.9	0.41	D	55.7	0.24	E	53.8	0.39	D	41.9	0.41	D
WB LT/TH	25.0	0.23	C	19.5	0.17	B	17.7	0.13	B	56.5	0.41	E	52.3	0.34	D	40.0	0.22	D	57.4	0.41	E	53.0	0.34	D	40.0	0.22	D
WB RT	23.9	0.02	C	18.8	0.02	B	17.2	0.02	B	53.7	0.11	D	50.0	0.06	D	38.9	0.06	D	54.6	0.11	D	50.6	0.06	D	38.9	0.06	D
SB LT	31.5	0.53	C	25.2	0.52	C	23.5	0.50	C	72.4	0.77	E	70.9	0.78	E	53.4	0.70	D	73.2	0.77	E	71.6	0.77	E	53.4	0.70	D
SB TH	8.8	0.29	A	11.8	0.70	B	9.6	0.33	A	12.4	0.58	B	23.7	0.91	C	14.9	0.66	B	12.5	0.58	B	24.1	0.91	C	14.9	0.66	B
SB RT	7.4	0.01	A	7.6	0.02	A	8.2	0.01	A	7.6	0.01	A	7.9	0.02	A	9.1	0.01	A	7.6	0.01	A	8.0	0.02	A	9.1	0.01	A
OVERALL	13.9	-	B	13.2	-	B	12.9	-	B	25.1	-	C	23.9	-	C	19.6	-	B	25.8	-	C	24.3	-	C	19.7	-	B

HONOKOWAI BEACH RESTORATION

AustinTsutsumi & ASSOCIATES, INC.
Engineers & Surveyors

NOTE:
THIS DRAWING IS FOR
ILLUSTRATIVE PURPOSES ONLY.
DO NOT USE FOR CONSTRUCTION.

N
NOT TO SCALE



LEGEND

##(##)[##]	- AM(PM)[MD] VEHICLE VOLUMES
X	- UNSIGNALIZED INTERSECTION X
Y, X/X/X	- SIGNALIZED INTERSECTION Y, OVERALL AM/PM/MD LOS
X(X)[X]	- AM(PM)[MD] LOS *DENOTES V/C ≥ 1

FIGURE 4.11

ALTERNATIVE 3
FUTURE YEAR 2068
LANE CONFIGURATIONS, VOLUMES, AND LOS

TABLE 4.12: LOS SUMMARY
EXISTING, BY 2068, AND FY 2068 ALTERNATIVE 3

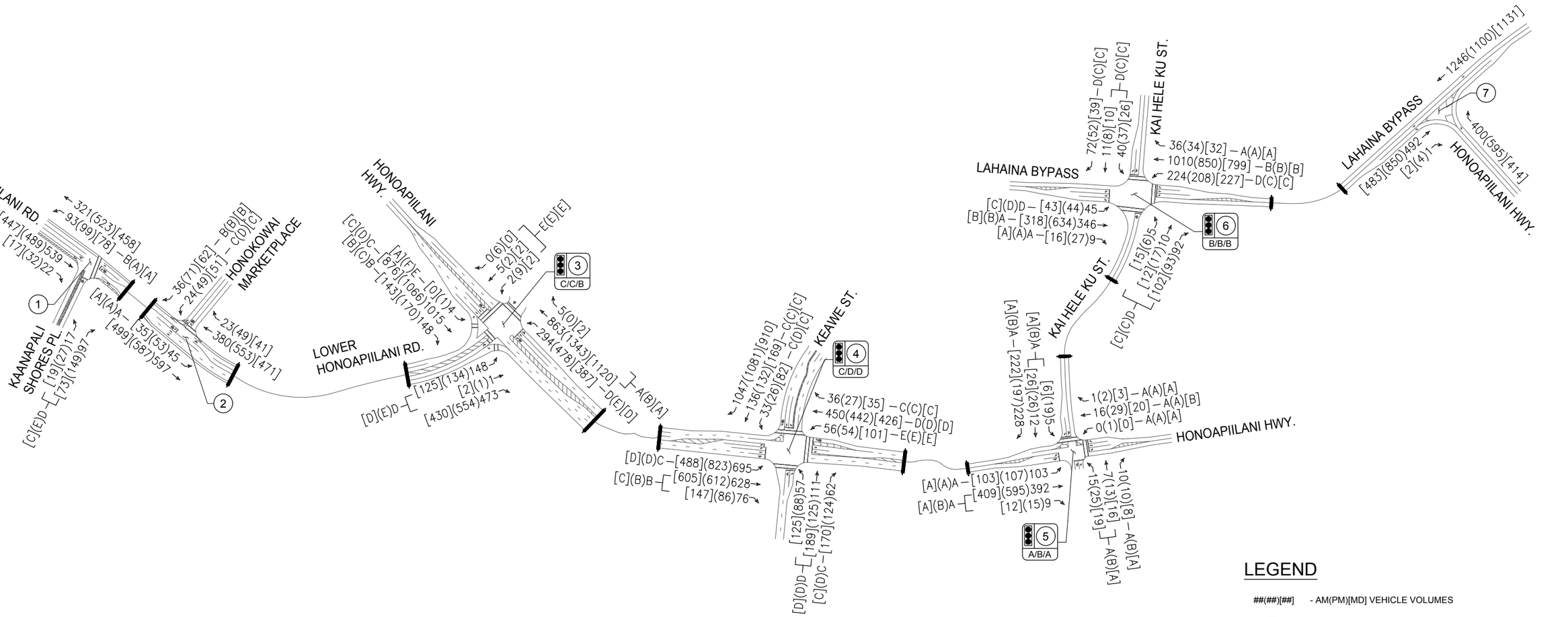
	Existing Conditions									Base Year 2068									Future Year 2068 Alternative 3								
	AM			PM			MD			AM			PM			MD			AM			PM			MD		
Intersection	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Lower Honoapiilani Road & Kaanapali Shores Place																											
NB LT	9.3	0.07	A	9.4	0.09	A	9.0	0.07	A	10.6	0.11	B	10.6	0.14	B	10.1	0.11	B	10.7	0.13	B	10.6	0.14	B	10.1	0.11	B
EB LT/RT	18.5	0.27	C	23.7	0.43	C	18.2	0.24	C	33.7	0.50	D	61.9	0.77	F	32.0	0.43	D	35.1	0.52	E	73.0	0.84	F	32.3	0.44	D
OVERALL	2.7	-	-	3.7	-	-	2.2	-	-	3.6	-	-	6.9	-	-	2.8	-	-	3.9	-	-	8.6	-	-	2.9	-	-
2: Lower Honoapiilani Road & Honokowai Marketplace Driveway																											
WB LT	14.6	0.05	B	19.4	0.16	C	15.7	0.12	C	21.4	0.11	C	38.7	0.35	E	27.6	0.27	D	21.8	0.11	C	39.4	0.35	E	27.8	0.27	D
WB RT	10.2	0.05	B	12.1	0.13	B	11.1	0.10	B	11.7	0.07	B	16.1	0.19	C	14.2	0.15	B	11.8	0.07	B	16.1	0.19	C	14.2	0.15	B
SB LT	8.0	0.04	A	8.6	0.05	A	8.2	0.03	A	8.6	0.05	A	9.7	0.07	A	9.2	0.04	A	8.6	0.05	A	9.7	0.07	A	9.2	0.04	A
OVERALL	1.2	-	-	2.0	-	-	1.8	-	-	1.0	-	-	2.3	-	-	1.9	-	-	1.0	-	-	2.3	-	-	1.9	-	-
3: Honoapiilani Highway & Lower Honoapiilani Road																											
NB LT	25.6	0.80	C	28.5	0.88	C	22.6	0.82	C	42.9	0.87	D	67.8	0.95	E	42.5	0.91	D	43.3	0.87	D	68.3	0.95	E	42.6	0.91	D
NB TH/RT	8.5	0.32	A	7.6	0.35	A	5.1	0.23	A	9.6	0.38	A	9.6	0.51	A	6.6	0.45	A	9.5	0.38	A	9.7	0.51	A	6.5	0.45	A
EB LT/TH	33.1	0.67	C	43.2	0.74	D	31.8	0.67	C	52.6	0.82	D	78.7	0.86	E	60.0	0.83	E	54.0	0.82	D	79.4	0.86	E	60.4	0.83	E
WB LT/TH/RT	44.8	0.41	D	47.8	0.45	D	51.7	0.41	D	62.5	0.43	E	87.8	0.54	F	76.3	0.42	E	63.3	0.43	E	88.2	0.54	F	76.5	0.42	E
SB LT	61.6	0.41	E	118.2	0.41	F	0.0	0.00	A	64.0	0.44	E	158.4	0.41	F	0.0	0.00	A	64.8	0.44	E	158.8	0.41	F	0.0	0.00	A
SB TH	17.4	0.63	B	23.7	0.69	C	19.4	0.59	B	23.7	0.76	C	45.1	0.87	D	30.5	0.82	C	24.2	0.76	C	45.5	0.87	D	30.7	0.82	C
SB RT	13.8	0.05	B	18.6	0.05	B	16.3	0.03	B	16.5	0.13	B	28.3	0.17	C	19.9	0.09	B	16.9	0.13	B	28.5	0.17	C	20.0	0.09	C
OVERALL	16.4	-	B	19.9	-	B	16.0	-	B	23.2	-	C	36.3	-	D	24.2	-	C	23.7	-	C	36.6	-	D	24.3	-	C
4: Honoapiilani Highway & Keawe Street																											
NB LT	43.7	0.43	D	51.9	0.42	D	34.5	0.47	C	46.4	0.72	D	61.0	0.77	E	62.8	0.80	E	46.5	0.72	D	61.1	0.77	E	62.9	0.80	E
NB TH	23.6	0.75	C	24.9	0.69	C	23.4	0.71	C	47.1	0.94	D	61.7	0.98	E	60.5	0.96	E	47.5	0.95	D	63.2	0.99	E	61.2	0.96	E
NB RT	17.5	0.01	B	19.6	0.01	B	18.0	0.01	B	16.6	0.02	B	20.4	0.01	C	23.6	0.02	C	16.6	0.02	B	20.5	0.01	C	23.6	0.02	C
EB LT/TH	25.6	0.26	C	26.3	0.40	C	23.5	0.45	C	33.2	0.61	C	40.2	0.69	D	51.5	0.81	D	33.3	0.61	C	40.3	0.69	D	51.7	0.81	D
EB RT	24.4	0.02	C	24.3	0.07	C	20.9	0.05	C	28.4	0.09	C	33.2	0.13	C	34.8	0.19	C	28.4	0.09	C	33.2	0.13	C	34.9	0.19	C
WB LT	21.7	0.09	C	21.8	0.06	C	17.8	0.21	B	25.6	0.18	C	30.7	0.16	C	33.9	0.48	C	25.6	0.18	C	30.8	0.16	C	34.0	0.48	C
WB TH	19.4	0.29	B	19.6	0.26	B	14.9	0.25	B	23.1	0.31	C	27.9	0.28	C	27.4	0.28	C	23.1	0.31	C	28.0	0.28	C	27.5	0.28	C
SB LT	21.6	0.74	C	21.2	0.77	C	23.0	0.68	C	32.2	0.75	C	40.1	0.81	D	52.4	0.81	D	32.2	0.75	C	40.1	0.81	D	52.6	0.81	D
SB TH/RT	11.0	0.46	B	10.6	0.38	B	15.5	0.57	B	16.0	0.59	B	17.4	0.56	B	30.6	0.74	C	16.0	0.59	B	17.4	0.56	B	30.7	0.74	C
OVERALL	19.4	-	B	19.9	-	B	20.3	-	C	29.1	-	C	36.5	-	D	43.7	-	D	29.2	-	C	36.8	-	D	43.9	-	D
5: Honoapiilani Highway & Kai Hele Ku Street																											
NB LT	0.0	0.00	A	8.7	0.00	A	0.0	0.00	A	0.0	0.00	A	9.3	0.00	A	0.0	0.00	A	0.0	0.00	A	9.3	0.00	A	0.0	0.00	A
NB TH	9.0	0.04	A	8.4	0.03	A	9.1	0.04	A	10.0	0.07	A	9.1	0.07	A	10.5	0.09	B	10.0	0.07	B	9.1	0.07	A	10.5	0.09	B
NB RT	9.0	0.00	A	8.3	0.00	A	9.0	0.00	A	9.8	0.00	A	8.8	0.00	A	10.2	0.00	B	9.8	0.00	A	8.8	0.00	A	10.2	0.00	B
EB LT/TH	9.4	0.04	A	12.1	0.06	B	9.2	0.04	A	9.4	0.05	A	13.2	0.11	B	9.5	0.09	A	9.4	0.05	A	13.3	0.11	B	9.5	0.09	A
EB RT	9.3	0.00	A	11.9	0.00	B	9.1	0.00	A	9.3	0.01	A	12.8	0.00	B	9.2	0.00	A	9.3	0.01	A	12.9	0.00	B	9.2	0.00	A
WB LT/TH	9.5	0.04	A	12.3	0.11	B	9.4	0.07	A	9.4	0.04	A	13.2	0.11	B	9.5	0.07	A	9.4	0.04	A	13.3	0.11	B	9.5	0.07	A
WB RT	9.6	0.08	A	12.0	0.05	B	9.3	0.06	A	9.9	0.19	A	13.4	0.16	B	10.0	0.20	A	10.0	0.20	A	13.6	0.17	B	10.0	0.21	A
SB LT	6.2	0.13	A	6.9	0.11	A	6.3	0.12	A	6.7	0.18	A	6.7	0.16	A	7.0	0.19	A	6.7	0.18	A	6.7	0.16	A	7.0	0.19	A
SB TH/RT	5.1	0.39	A	10.2	0.70	B	5.2	0.37	A	5.3	0.34	A	10.8	0.73	B	5.9	0.42	A	5.3	0.35	A	10.8	0.74	B	5.9	0.43	A
OVERALL	5.9	-	A	10.0	-	B	6.1	-	A	6.6	-	A	10.5	-	B	7.2	-	A	6.7	-	A	10.6	-	B	7.2	-	A
6: Lahaina Bypass & Kai Hele Ku Street																											
NB LT	28.5	0.78	C	24.6	0.74	C	22.1	0.74	C	77.6	0.90	E	73.4	0.90	E	54.5	0.88	D	79.5	0.91	E	75.1	0.90	E	54.7	0.88	D
NB TH	11.1	0.81	B	10.9	0.76	B	10.7	0.73	B	28.2	0.96	C	14.6	0.87	B	14.3	0.90	B	29.3	0.97	C	14.6	0.87	B	14.3	0.90	B
NB RT	5.2	0.03	A	6.2	0.03	A	6.5	0.03	A	3.4	0.02	A	3.4	0.02	A	4.0	0.02	A	3.4	0.02	A	3.4	0.02	A	4.0	0.02	A
EB LT/TH/RT	24.2	0.09	C	19.2	0.11	B	18.1	0.14	B	60.5	0.24	E	59.7	0.41	E	47.2	0.43	D	61.3	0.24	E	60.6	0.42	E	47.2	0.43	D
WB LT/TH	25.0	0.23	C	19.5	0.17	B	17.7	0.13	B	62.6	0.43	E	58.9	0.36	E	45.0	0.24	D	63.6	0.43	E	59.8	0.37	E	45.0	0.24	D
WB RT	23.9	0.02	C	18.8	0.02	B	17.2	0.02	B	59.3	0.10	E	56.1	0.06	E	43.7	0.06	D	60.1	0.10	E	56.9	0.06	E	43.7	0.06	D
SB LT	31.5	0.53	C	25.2	0.52	C	23.5	0.50	C	78.4	0.77	E	77.2	0.77	E	61.8	0.74	E	79.4	0.77	E	78.0	0.77	E	61.8	0.74	E
SB TH	8.8	0.29	A	11.8	0.70	B	9.6	0.33	A	13.0	0.59	B	28.0	0.92	C	15.2	0.66	B	13.2	0.59	B	28.8	0.93	C	15.3	0.67	B
SB RT	7.4	0.01	A	7.6	0.02	A	8.2	0.01	A	7.7	0.01	A	7.9	0.01	A	9.0	0.01	A	7.8	0.01	A	8.0	0.01	A	9.0	0.01	A
OVERALL	13.9	-	B	13.2	-	B	12.9	-	B	30.5	-	C	27.8	-	C	21.7	-	C	31.5	-	C	28.3	-	C	21.7	-	C

HONOKOWAI BEACH RESTORATION

AustinTsutsumi & ASSOCIATES, INC.
Engineers & Surveyors

NOTE:
THIS DRAWING IS FOR
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NOT TO SCALE



LEGEND

##(##)[##]	- AM(PM)[MD] VEHICLE VOLUMES
X	- UNSIGNALIZED INTERSECTION X
Y, X/X/X	- SIGNALIZED INTERSECTION Y, OVERALL AM/PM/MD LOS
X(X)[X]	- AM(PM)[MD] LOS *DENOTES V/C ≥ 1

FIGURE 4.12

ALTERNATIVE 4
FUTURE YEAR 2028
LANE CONFIGURATIONS, VOLUMES, AND LOS

TABLE 4.13: LOS SUMMARY
EXISTING, BY 2028, AND FY 2028 ALTERNATIVE 4

Intersection	Existing Conditions									Base Year 2028									Future Year 2028 Alternative 4								
	AM			PM			MD			AM			PM			MD			AM			PM			MD		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Lower Honoapiilani Road & Kaanapali Shores Place																											
NB LT	9.3	0.07	A	9.4	0.09	A	9.0	0.07	A	9.9	0.10	A	9.9	0.12	A	9.5	0.09	A	10.1	0.13	B	10.0	0.13	A	9.5	0.10	A
EB LT/RT	18.5	0.27	C	23.7	0.43	C	18.2	0.24	C	24.9	0.40	C	35.2	0.59	E	23.2	0.33	C	26.3	0.43	D	43.8	0.70	E	23.5	0.34	C
OVERALL	2.7	-	-	3.7	-	-	2.2	-	-	3.3	-	-	4.8	-	-	2.5	-	-	3.6	-	-	6.6	-	-	2.7	-	-
2: Lower Honoapiilani Road & Honokowai Marketplace Driveway																											
WB LT	14.6	0.05	B	19.4	0.16	C	15.7	0.12	C	17.8	0.09	C	26.7	0.24	D	20.6	0.19	C	18.4	0.09	C	27.4	0.25	D	20.8	0.20	C
WB RT	10.2	0.05	B	12.1	0.13	B	11.1	0.10	B	11.0	0.06	B	13.9	0.16	B	12.6	0.12	B	11.2	0.06	B	14.0	0.16	B	12.6	0.13	B
SB LT	8.0	0.04	A	8.6	0.05	A	8.2	0.03	A	8.3	0.04	A	9.1	0.06	A	8.7	0.04	A	8.4	0.04	A	9.2	0.06	A	8.7	0.04	A
OVERALL	1.2	-	-	2.0	-	-	1.8	-	-	1.1	-	-	2.1	-	-	1.9	-	-	1.1	-	-	2.1	-	-	1.9	-	-
3: Honoapiilani Highway & Lower Honoapiilani Road																											
NB LT	25.6	0.80	C	28.5	0.88	C	22.6	0.82	C	41.0	0.86	D	57.2	0.94	E	36.1	0.89	D	41.7	0.87	D	58.4	0.94	E	36.2	0.89	D
NB TH/RT	8.5	0.32	A	7.6	0.35	A	5.1	0.23	A	9.7	0.43	A	10.1	0.59	B	6.6	0.49	A	9.6	0.42	A	10.2	0.59	B	6.6	0.49	A
EB LT/TH	33.1	0.67	C	43.2	0.74	D	31.8	0.67	C	47.7	0.81	D	66.6	0.82	E	45.3	0.79	D	50.2	0.81	D	67.4	0.83	E	45.6	0.79	D
WB LT/TH/RT	44.8	0.41	D	47.8	0.45	D	51.7	0.41	D	60.2	0.43	E	78.0	0.52	E	68.3	0.41	E	61.8	0.43	E	79.0	0.52	E	68.6	0.41	E
SB LT	61.6	0.41	E	118.2	0.41	F	0.0	0.00	A	71.6	0.42	E	149.4	0.41	F	0.0	0.00	A	73.1	0.43	E	150.4	0.41	F	0.0	0.00	A
SB TH	17.4	0.63	B	23.7	0.69	C	19.4	0.59	B	22.8	0.75	C	38.0	0.83	D	25.5	0.76	C	23.9	0.75	C	38.8	0.83	D	25.7	0.76	C
SB RT	13.8	0.05	B	18.6	0.05	B	16.3	0.03	B	16.2	0.13	B	25.7	0.17	C	18.5	0.08	B	16.9	0.13	B	26.2	0.17	C	18.7	0.08	B
OVERALL	16.4	-	B	19.9	-	B	16.0	-	B	21.7	-	C	30.0	-	C	19.7	-	B	22.5	-	C	30.6	-	C	19.9	-	B
4: Honoapiilani Highway & Keawe Street																											
NB LT	43.7	0.43	D	51.9	0.42	D	34.5	0.47	C	55.0	0.77	D	67.4	0.77	E	55.3	0.79	E	55.2	0.77	E	68.1	0.77	E	55.5	0.79	E
NB TH	23.6	0.75	C	24.9	0.69	C	23.4	0.71	C	48.8	0.91	D	42.5	0.88	D	49.3	0.89	D	49.5	0.92	D	43.4	0.88	D	49.9	0.90	D
NB RT	17.5	0.01	B	19.6	0.01	B	18.0	0.01	B	22.2	0.02	C	27.9	0.01	C	26.8	0.02	C	22.2	0.02	C	28.1	0.01	C	26.9	0.02	C
EB LT/TH	25.6	0.26	C	26.3	0.40	C	23.5	0.45	C	38.2	0.64	D	46.6	0.72	D	43.1	0.78	D	38.4	0.65	D	47.2	0.72	D	43.4	0.79	D
EB RT	24.4	0.02	C	24.3	0.07	C	20.9	0.05	C	32.6	0.11	C	38.6	0.17	D	30.3	0.21	C	32.7	0.11	C	39.1	0.17	D	30.5	0.21	C
WB LT	21.7	0.09	C	21.8	0.06	C	17.8	0.21	B	29.7	0.20	C	35.9	0.18	D	29.0	0.44	C	29.8	0.20	C	36.4	0.18	D	29.2	0.44	C
WB TH	19.4	0.29	B	19.6	0.26	B	14.9	0.25	B	27.2	0.33	C	33.1	0.30	C	23.2	0.27	C	27.4	0.33	C	33.6	0.30	C	23.3	0.27	C
SB LT	21.6	0.74	C	21.2	0.77	C	23.0	0.68	C	31.7	0.83	C	44.8	0.89	D	42.4	0.82	D	31.9	0.83	C	45.7	0.89	D	42.6	0.82	D
SB TH/RT	11.0	0.46	B	10.6	0.38	B	15.5	0.57	B	13.7	0.42	B	15.2	0.39	B	25.9	0.59	C	13.7	0.42	B	15.3	0.39	B	25.9	0.59	C
OVERALL	19.4	-	B	19.9	-	B	20.3	-	C	30.3	-	C	35.8	-	D	36.9	-	D	30.5	-	C	36.3	-	D	37.2	-	D
5: Honoapiilani Highway & Kai Hele Ku Street																											
NB LT	0.0	0.00	A	8.7	0.00	A	0.0	0.00	A	0.0	0.00	A	9.1	0.00	A	0.0	0.00	A	0.0	0.00	A	9.1	0.00	A	0.0	0.00	A
NB TH	9.0	0.04	A	8.4	0.03	A	9.1	0.04	A	9.7	0.05	A	8.5	0.05	A	10.0	0.06	B	9.7	0.05	A	8.4	0.04	A	10.1	0.06	B
NB RT	9.0	0.00	A	8.3	0.00	A	9.0	0.00	A	9.6	0.00	A	8.3	0.00	A	9.9	0.00	A	9.6	0.00	A	8.3	0.00	A	9.9	0.00	A
EB LT/TH	9.4	0.04	A	12.1	0.06	B	9.2	0.04	A	9.6	0.05	A	14.5	0.10	B	9.5	0.07	A	9.6	0.05	A	14.8	0.10	B	9.5	0.07	A
EB RT	9.3	0.00	A	11.9	0.00	B	9.1	0.00	A	9.4	0.01	A	14.1	0.00	B	9.3	0.00	A	9.4	0.01	A	14.3	0.00	B	9.3	0.00	A
WB LT/TH	9.5	0.04	A	12.3	0.11	B	9.4	0.07	A	9.5	0.04	A	14.6	0.11	B	9.5	0.07	A	9.5	0.04	A	14.8	0.11	B	9.5	0.07	A
WB RT	9.6	0.08	A	12.0	0.05	B	9.3	0.06	A	10.0	0.16	A	14.6	0.12	B	9.8	0.16	A	10.0	0.17	A	14.9	0.13	B	9.8	0.17	A
SB LT	6.2	0.13	A	6.9	0.11	A	6.3	0.12	A	6.5	0.16	A	6.3	0.14	A	6.8	0.17	A	6.6	0.17	A	6.2	0.14	A	6.8	0.17	A
SB TH/RT	5.1	0.39	A	10.2	0.70	B	5.2	0.37	A	5.9	0.50	A	10.8	0.76	B	6.3	0.54	A	5.9	0.51	A	10.9	0.76	B	6.4	0.54	A
OVERALL	5.9	-	A	10.0	-	B	6.1	-	A	6.6	-	A	10.7	-	B	7.1	-	A	6.7	-	A	10.8	-	B	7.2	-	A
6: Lahaina Bypass & Kai Hele Ku Street																											
NB LT	28.5	0.78	C	24.6	0.74	C	22.1	0.74	C	49.0	0.85	D	29.9	0.79	C	27.3	0.79	C	51.9	0.86	D	29.8	0.79	C	27.2	0.79	C
NB TH	11.1	0.81	B	10.9	0.76	B	10.7	0.73	B	12.0	0.86	B	11.7	0.83	B	11.7	0.82	B	12.1	0.87	B	11.7	0.83	B	11.7	0.82	B
NB RT	5.2	0.03	A	6.2	0.03	A	6.5	0.03	A	4.3	0.02	A	5.1	0.02	A	5.5	0.02	A	4.3	0.02	A	5.1	0.02	A	5.5	0.02	A
EB LT/TH/RT	24.2	0.09	C	19.2	0.11	B	18.1	0.14	B	35.2	0.15	D	27.6	0.17	C	26.2	0.27	C	36.4	0.15	D	27.6	0.17	C	26.2	0.27	C
WB LT/TH	25.0	0.23	C	19.5	0.17	B	17.7	0.13	B	36.3	0.31	D	28.0	0.23	C	25.5	0.17	C	37.6	0.32	D	28.0	0.23	C	25.5	0.17	C
WB RT	23.9	0.02	C	18.8	0.02	B	17.2	0.02	B	34.7	0.07	C	27.0	0.05	C	24.8	0.03	C	35.9	0.07	D	27.0	0.05	C	24.8	0.03	C
SB LT	31.5	0.53	C	25.2	0.52	C	23.5	0.50	C	45.6	0.65	D	35.4	0.59	D	32.9	0.57	C	47.2	0.66	D	35.4	0.59	D	32.9	0.57	C
SB TH	8.8	0.29	A	11.8	0.70	B	9.6	0.33	A	9.9	0.36	A	14.2	0.75	B	11.3	0.42	B	9.9	0.36	A	14.6	0.77	B	11.5	0.42	B
SB RT	7.4	0.01	A	7.6	0.02	A	8.2	0.01	A	7.8	0.01	A	8.3	0.02	A	9.0	0.01	A	7.8	0.01	A	8.4	0.02	A	9.1	0.01	A
OVERALL	13.9	-	B	13.2	-	B	12.9	-	B	18.2	-	B	15.7	-	B	15.3	-	B	18.7	-	B	15.9	-	B	15.4	-	B

5. CONCLUSION

The Project proposes to restore and preserve the section of Honokowai Beach fronting Kaanapali Beach Club and Kaanapali Shores. The following four (4) alternative methodologies are considered for restoration:

- **Alternative 1 – No Action**: Natural erosion of Honokowai Beach. This alternative assumes the existing erosion skirt will be removed, and Honokowai Beach continues to erode naturally, experiencing chronic, seasonal, and episodic erosion. Trips generated by the "No Action" Alternative will be associated with the removal of the erosion skirt. The erosion skirt is anticipated to be removed by Year 2028.

- **Alternative 2 – Beach Nourishment**: An individual action (project) involving the placement of additional sand to temporarily increase beach width and sand volume to offset the effects of erosion without modifying existing structures or installing new structures. This alternative is anticipated to be completed by Year 2028 and has an estimated design life of 10 years.

- **Alternative 3 – Beach Maintenance**: A series of actions (program) including periodic beach nourishment combined with sand pushing and/or sand back passing without modifying existing structures or installing new structures. This alternative is anticipated to be completed by Year 2028 and has an estimated design life of 50 years. Five (5) benchmark years are studied, beginning with Year 2028 and continuing at 10-year increments thereafter up to the 40-year forecast.

- **Alternative 4 – Beach Stabilization**: An individual action (project) involving the placement of sand to nourish the beach and modifying existing structures and/or installing new structures (e.g., groins). This alternative is anticipated to be completed by Year 2028 and has an estimated design life of 50 years.

The sand is proposed to be barged to Kahului Harbor, offloaded, and temporarily stockpiled on-site, or transported to a temporary stockpile site in Puunene. The sand will then be trucked to the project site to be placed on the shoreline.

5.1 Existing Conditions

Sidewalks are available along Kaanapali Shores Place, Lower Honoapiilani Road, and Keawe Street. There is also a pathway between Kaanapali Beach Club and Kaanapali Shores that provides beach access from Kaanapali Shores Place. There are no dedicated bicycle lanes within the study area, but there are signed shared roadways along Honoapiilani Highway and a section of Lahaina Bypass Road. The study area is served by the Maui Bus Lahaina Villager Route and the West Maui Express, with the nearest existing stops adjacent to the Honokowai Marketplace.

Traffic count data at the above intersections was collected on Thursday, May 9, 2024, and Saturday, May 11, 2024. Based on the traffic count data, the AM, PM, and MD peak hours of traffic occur between 7:30 AM – 8:30 AM, 3:30 PM – 4:30 PM, and 12:15 PM – 1:15 PM, respectively.

Traffic volumes within the study area are significantly lower than counts taken before the Lahaina wildfires. A supplementary growth rate is applied to existing data in addition to MTDM growth to simulate the increase in traffic volumes attributed to the rebuilding. During all peak hours, all

movements at all study intersections operate at LOS D or better across all peak hours, with the exception of the southbound left-turn at Honoapiilani Highway/Lower Honoapiilani Road, which operates at LOS E(F) during the AM(PM) peak hours.

5.2 Base Year Conditions

The Maui Metropolitan Planning Organization's (MPO) Maui Travel Demand Model (MTDM) projects traffic patterns across Maui up to 2045 by using socio-economic data to distribute households and vehicular trips within specific Traffic Analysis Zones (TAZs). Traffic projections help calculate an annual growth rate for base year conditions, generally ranging between 0.4% and 0.5% along Honoapiilani Highway and Lahaina Bypass. This rate was applied to all base year scenarios.

Trips are generated independently for known background developments that were not included in the MTDM and added to the study network based on the available information. At the time of this report, the timeline and extent to which Lahaina will be rebuilt is unknown. To account for the growth attributed to rebuilding in Lahaina, a supplementary growth rate is applied to existing data in addition to MTDM growth to simulate the increase in traffic volumes attributed to the rebuilding.

The Lahaina Bypass Extension is also planned within the study area. Phase 1C will extend Lahaina Bypass Road (LBR) north from its current terminus at Keawe Street to Kakaalaneo Drive. Phase 1D will extend LBR even further north with a direct connection to Honoapiilani Highway. Although the project currently lacks funding, Phase 1C and Phase 1D were conservatively assumed to be constructed by Year 2038 and Year 2048, respectively.

By 2028, several large developments and restoration efforts in Lahaina are expected to increase traffic volumes in the study area by 37-53% compared to existing conditions. Most movements at study intersections are expected to operate LOS D or better across all peak hours, but a few movements at signalized intersections are anticipated to operate at LOS E/F due to long cycles which prioritize mainline movements; however all movements are anticipated to operate under capacity.

By 2038, with the assumed completion of Phase 1C of the Lahaina Bypass Extension, traffic conditions at the Keawe Street intersection are expected to improve. Various turning movements at the Honoapiilani Highway/Lower Honoapiilani Road intersection are expected to operate at LOS E/F due to long cycle lengths, while all other intersections are anticipated to perform similarly to 2028 conditions.

By 2048, Phase 1D of the Lahaina Bypass Extension is expected to further reduce congestion along Honoapiilani Highway. Study intersections are anticipated to generally operate similarly to Base Year 2038 conditions.

By 2058 and 2068, regional growth is expected to continue increasing volumes throughout the study area. While most movements are anticipated to continue operating within acceptable levels, various turning movements at the study intersections worsen to LOS E or F mainly due to long cycle lengths at signalized intersections. All movements are anticipated to continue to operate under capacity.

5.3 Future Year Conditions

The Project's trip generation varies by alternative; however, it only increases peak traffic volumes by 1.2% at most compared to Base Year conditions. Worker trips are distributed according to

existing and expected travel patterns throughout the study area, while sand-delivery trucks are expected to follow specific routes. Impacts to the study area are as follows:

- **Alternative 1 – No Action**: The number of trips generated by the Project is negligible and temporary, and the Project is not anticipated to have a significant impact on operations at study intersections.

- **Alternative 2 – Beach Nourishment**: The number of trips generated by the Project is negligible and temporary, and the Project is not anticipated to have a significant impact on operations at study intersections.

- **Alternative 3 – Beach Maintenance**: For the initial placement of sand, the number of trips generated by the Project is negligible and temporary, and the Project is not anticipated to have a significant impact on operations at study intersections. For subsequent intervals which occur on a longer horizon, operations are expected to generally be similar to Base Year operations of the respective benchmark year.

- **Alternative 4 – Beach Stabilization**: The number of trips generated by the Project is negligible and temporary, and the Project is not anticipated to have a significant impact on operations at study intersections.

6. RECOMMENDATIONS

With each alternative, the Project will only add a relatively small number of trips during the construction and is not expected to generate additional trips upon completion. Although traffic volumes will slightly increase temporarily, these additional trips are not expected to cause major congestion or significantly impact the study intersections. Therefore, no mitigative measures are recommended as a result of the Project.

7. REFERENCES

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APPENDICES

APPENDIX A

LEVEL OF SERVICE CRITERIA

APPENDIX A – LEVEL OF SERVICE (LOS) CRITERIA

VEHICULAR LEVEL OF SERVICE FOR SIGNALIZED INTERSECTIONS (HCM 7th EDITION)

Level of service for vehicles at signalized intersections is directly related to delay values and is assigned on that basis. Level of Service is a measure of the acceptability of delay values to motorists at a given intersection. The criteria are given in the table below.

Level-of Service Criteria for Signalized Intersections

Level of Service	Control Delay per Vehicle (sec./veh.)
A	< 10.0
B	>10.0 and ≤ 20.0
C	>20.0 and ≤ 35.0
D	>35.0 and ≤ 55.0
E	>55.0 and ≤ 80.0
F	> 80.0

Delay is a complex measure, and is dependent on a number of variables, including the quality of progression, the cycle length, the green ratio, and the v/c ratio for the lane group or approach in question.

VEHICULAR LEVEL OF SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS (HCM 7th EDITION)

The level of service criteria for vehicles at unsignalized intersections is defined as the average control delay, in seconds per vehicle.

LOS delay threshold values are lower for two-way stop-controlled (TWSC) and all-way stop-controlled (AWSC) intersections than those of signalized intersections. This is because more vehicles pass through signalized intersections, and therefore, drivers expect and tolerate greater delays. While the criteria for level of service for TWSC and AWSC intersections are the same, procedures to calculate the average total delay may differ.

Level of Service Criteria for Two-Way Stop-Controlled Intersections

Level of Service	Average Control Delay (sec/veh)
A	≤ 10
B	>10 and ≤15
C	>15 and ≤25
D	>25 and ≤35
E	>35 and ≤50
F	> 50

APPENDIX B

TRAFFIC COUNT DATA

Austin Tsutsumi & Associates

501 Sumner St, Suite 521
Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : Lower Honoapiilani Rd - Kaanapali Shores Pl
Site Code : 24-515 Honokowai Beach Restoration
Start Date : 5/9/2024
Page No : 1

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

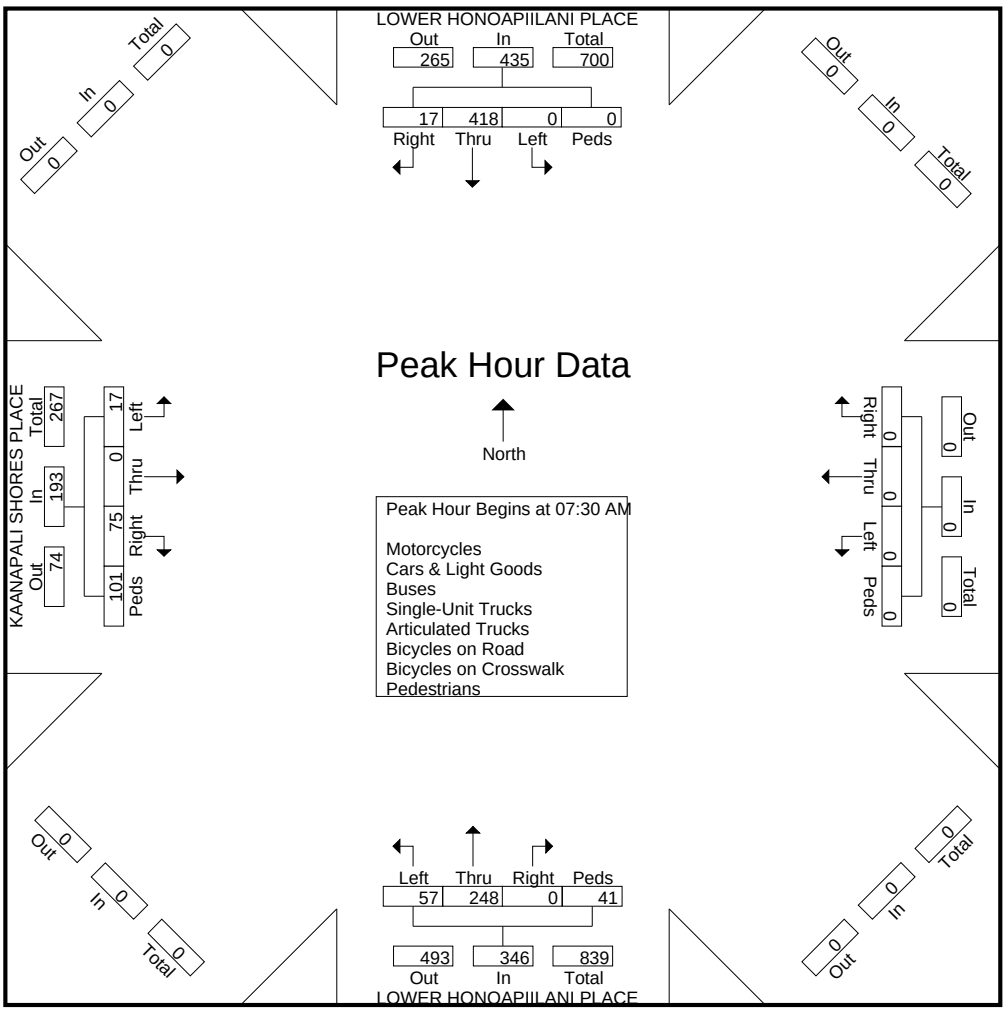
	LOWER HONOAPIILANI PLACE SOUTHBOUND				WESTBOUND				LOWER HONOAPIILANI PLACE NORTHBOUND				KAANAPALI SHORES PLACE EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:30 AM	0	65	3	0	0	0	0	0	12	38	0	0	2	0	11	19	150
06:45 AM	0	100	4	0	0	0	0	0	17	42	0	3	3	0	8	25	202
Total	0	165	7	0	0	0	0	0	29	80	0	3	5	0	19	44	352
07:00 AM	0	90	2	0	0	0	0	0	13	57	0	2	5	0	22	21	212
07:15 AM	0	113	2	0	0	0	0	0	16	53	0	6	4	0	12	22	228
07:30 AM	0	103	5	0	0	0	0	0	14	52	0	7	3	0	21	25	230
07:45 AM	0	117	3	0	0	0	0	0	17	61	0	18	6	0	15	20	257
Total	0	423	12	0	0	0	0	0	60	223	0	33	18	0	70	88	927
08:00 AM	0	111	6	0	0	0	0	0	12	62	0	4	3	0	21	30	249
08:15 AM	0	87	3	0	0	0	0	0	14	73	0	12	5	0	18	26	238
08:30 AM	0	85	2	1	0	0	0	0	14	52	0	8	4	0	23	21	210
08:45 AM	0	87	1	0	0	0	0	0	9	59	0	8	2	0	24	15	205
Total	0	370	12	1	0	0	0	0	49	246	0	32	14	0	86	92	902
09:00 AM	0	98	4	0	0	0	0	0	8	56	0	5	4	0	18	20	213
09:15 AM	0	83	3	0	0	0	0	0	7	69	0	4	5	0	15	12	198
Grand Total	0	1139	38	1	0	0	0	0	153	674	0	77	46	0	208	256	2592
Apprch %	0	96.7	3.2	0.1	0	0	0	0	16.9	74.6	0	8.5	9	0	40.8	50.2	
Total %	0	43.9	1.5	0	0	0	0	0	5.9	26	0	3	1.8	0	8	9.9	
Motorcycles	0	18	0	0	0	0	0	0	0	6	0	0	0	0	0	0	24
% Motorcycles	0	1.6	0	0	0	0	0	0	0	0.9	0	0	0	0	0	0	0.9
Cars & Light Goods	0	1094	36	0	0	0	0	0	143	653	0	0	40	0	202	0	2168
% Cars & Light Goods	0	96	94.7	0	0	0	0	0	93.5	96.9	0	0	87	0	97.1	0	83.6
Buses	0	5	0	0	0	0	0	0	5	4	0	0	3	0	2	0	19
% Buses	0	0.4	0	0	0	0	0	0	3.3	0.6	0	0	6.5	0	1	0	0.7
Single-Unit Trucks	0	12	2	0	0	0	0	0	5	9	0	0	2	0	4	0	34
% Single-Unit Trucks	0	1.1	5.3	0	0	0	0	0	3.3	1.3	0	0	4.3	0	1.9	0	1.3
Articulated Trucks	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
% Articulated Trucks	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	9	0	0	0	0	0	0	0	2	0	0	1	0	0	0	12
% Bicycles on Road	0	0.8	0	0	0	0	0	0	0	0.3	0	0	2.2	0	0	0	0.5
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	1	0	0	0	0	0	0	0	77	0	0	0	256	334
% Pedestrians	0	0	0	100	0	0	0	0	0	0	0	100	0	0	0	100	12.9

Austin Tsutsumi & Associates

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Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : Lower Honoapiilani Rd - Kaanapali Shores Pl
Site Code : 24-515 Honokowai Beach Restoration
Start Date : 5/9/2024

	LOWER HONOAPIILANI PLACE SOUTHBOUND					WESTBOUND					LOWER HONOAPIILANI PLACE NORTHBOUND					KAANAPALI SHORES PLACE EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:30 AM to 09:15 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	0	103	5	0	108	0	0	0	0	0	14	52	0	7	73	3	0	**21**	25	49	230
07:45 AM	0	**117**	3	0	**120**	0	0	0	0	0	**17**	61	0	**18**	96	**6**	0	15	20	41	**257**
08:00 AM	0	111	**6**	0	117	0	0	0	0	0	12	62	0	4	78	3	0	21	**30**	**54**	249
08:15 AM	0	87	3	0	90	0	0	0	0	0	14	**73**	0	12	**99**	5	0	18	26	49	238
Total Volume	0	418	17	0	435	0	0	0	0	0	57	248	0	41	346	17	0	75	101	193	974
% App. Total	0	96.1	3.9	0		0	0	0	0		16.5	71.7	0	11.8		8.8	0	38.9	52.3		
PHF	.000	.893	.708	.000	.906	.000	.000	.000	.000	.000	.838	.849	.000	.569	.874	.708	.000	.893	.842	.894	.947



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Site Code : 24-515 Honokowai Beach Restoration
Start Date : 5/9/2024
Page No : 1

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

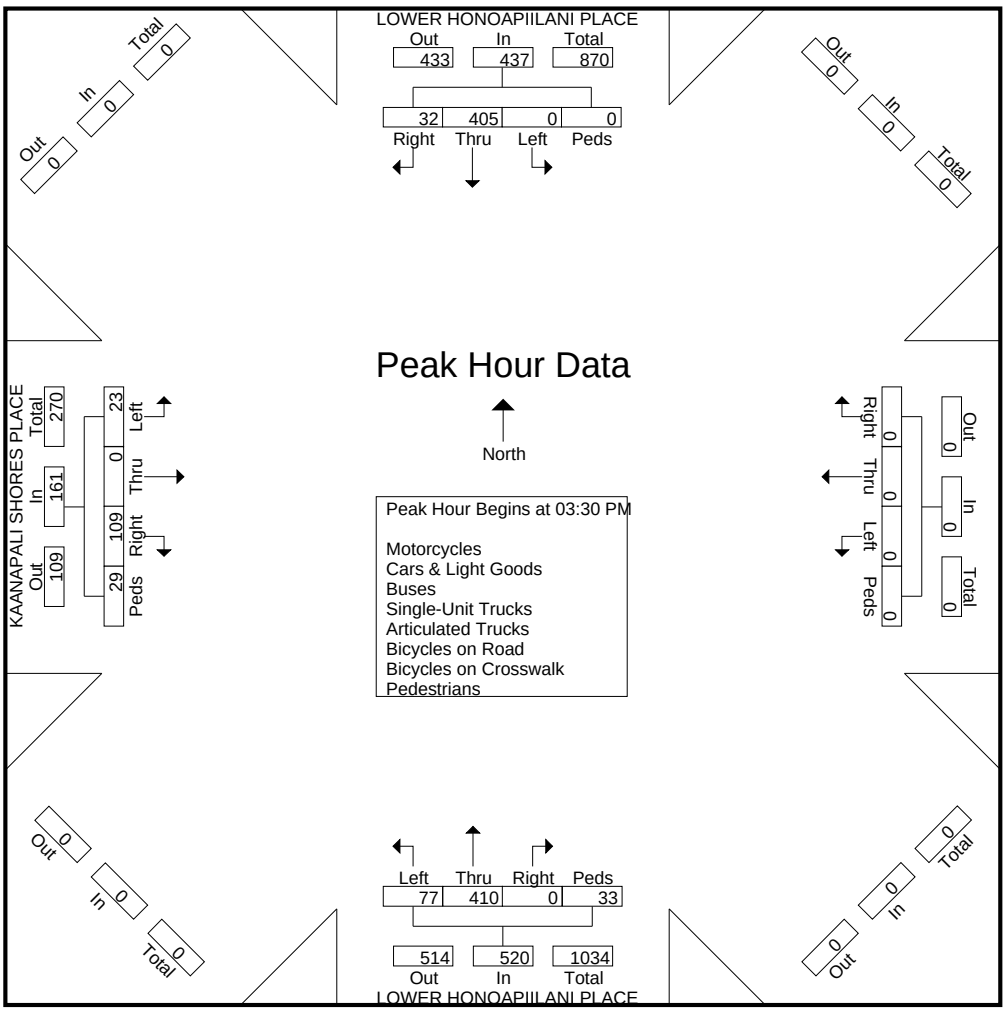
	LOWER HONOAPIILANI PLACE SOUTHBOUND				WESTBOUND				LOWER HONOAPIILANI PLACE NORTHBOUND				KAANAPALI SHORES PLACE EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
03:00 PM	0	91	7	0	0	0	0	0	21	121	0	2	7	0	19	6	274
03:15 PM	0	110	7	0	0	0	0	0	19	84	0	2	7	0	21	5	255
03:30 PM	0	105	7	0	0	0	0	0	19	100	0	14	6	0	23	8	282
03:45 PM	0	104	9	0	0	0	0	0	19	107	0	3	5	0	20	13	280
Total	0	410	30	0	0	0	0	0	78	412	0	21	25	0	83	32	1091
04:00 PM	0	112	4	0	0	0	0	0	24	114	0	7	8	0	35	4	308
04:15 PM	0	84	12	0	0	0	0	0	15	89	0	9	4	0	31	4	248
04:30 PM	0	93	4	0	0	0	0	0	19	127	0	12	4	0	16	4	279
04:45 PM	0	69	9	0	0	0	0	0	22	106	0	9	6	0	20	12	253
Total	0	358	29	0	0	0	0	0	80	436	0	37	22	0	102	24	1088
05:00 PM	0	101	6	0	0	0	0	0	15	107	0	15	7	0	23	9	283
05:15 PM	0	90	5	0	0	0	0	0	19	99	0	18	7	0	18	18	274
05:30 PM	0	72	4	0	0	0	0	0	15	134	0	16	6	0	16	29	292
05:45 PM	0	80	5	0	0	0	0	0	21	111	0	15	6	0	19	13	270
Total	0	343	20	0	0	0	0	0	70	451	0	64	26	0	76	69	1119
Grand Total	0	1111	79	0	0	0	0	0	228	1299	0	122	73	0	261	125	3298
Apprch %	0	93.4	6.6	0	0	0	0	0	13.8	78.8	0	7.4	15.9	0	56.9	27.2	
Total %	0	33.7	2.4	0	0	0	0	0	6.9	39.4	0	3.7	2.2	0	7.9	3.8	
Motorcycles	0	10	0	0	0	0	0	0	0	7	0	0	0	0	0	0	17
% Motorcycles	0	0.9	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0.5
Cars & Light Goods	0	1089	71	0	0	0	0	0	226	1276	0	0	72	0	255	0	2989
% Cars & Light Goods	0	98	89.9	0	0	0	0	0	99.1	98.2	0	0	98.6	0	97.7	0	90.6
Buses	0	3	5	0	0	0	0	0	0	4	0	0	0	0	5	0	17
% Buses	0	0.3	6.3	0	0	0	0	0	0	0.3	0	0	0	0	1.9	0	0.5
Single-Unit Trucks	0	3	1	0	0	0	0	0	1	4	0	0	1	0	1	0	11
% Single-Unit Trucks	0	0.3	1.3	0	0	0	0	0	0.4	0.3	0	0	1.4	0	0.4	0	0.3
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	6	2	0	0	0	0	0	1	8	0	0	0	0	0	0	17
% Bicycles on Road	0	0.5	2.5	0	0	0	0	0	0.4	0.6	0	0	0	0	0	0	0.5
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.2	0.1
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	122	0	0	0	121	243
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	96.8	7.4

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Site Code : 24-515 Honokowai Beach Restoration
Start Date : 5/9/2024
Page No : 2

	LOWER HONOAPIILANI PLACE SOUTHBOUND					WESTBOUND					LOWER HONOAPIILANI PLACE NORTHBOUND					KAANAPALI SHORES PLACE EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:30 PM to 04:15 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:30 PM																					
03:30 PM	0	105	7	0	112	0	0	0	0	0	19	100	0	**14**	133	6	0	23	8	37	282
03:45 PM	0	104	9	0	113	0	0	0	0	0	19	107	0	3	129	5	0	20	**13**	38	280
04:00 PM	0	**112**	4	0	**116**	0	0	0	0	0	**24**	**114**	0	7	**145**	**8**	0	**35**	4	**47**	**308**
04:15 PM	0	84	**12**	0	96	0	0	0	0	0	15	89	0	9	113	4	0	31	4	39	248
Total Volume	0	405	32	0	437	0	0	0	0	0	77	410	0	33	520	23	0	109	29	161	1118
% App. Total	0	92.7	7.3	0		0	0	0	0		14.8	78.8	0	6.3		14.3	0	67.7	18		
PHF	.000	.904	.667	.000	.942	.000	.000	.000	.000	.000	.802	.899	.000	.589	.897	.719	.000	.779	.558	.856	.907



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File Name : SAT_Lower Honoapiilani Rd - Kaanapali Shores Pl
Site Code : 24-515 Honokowai Beach Restoration
Start Date : 5/11/2024

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

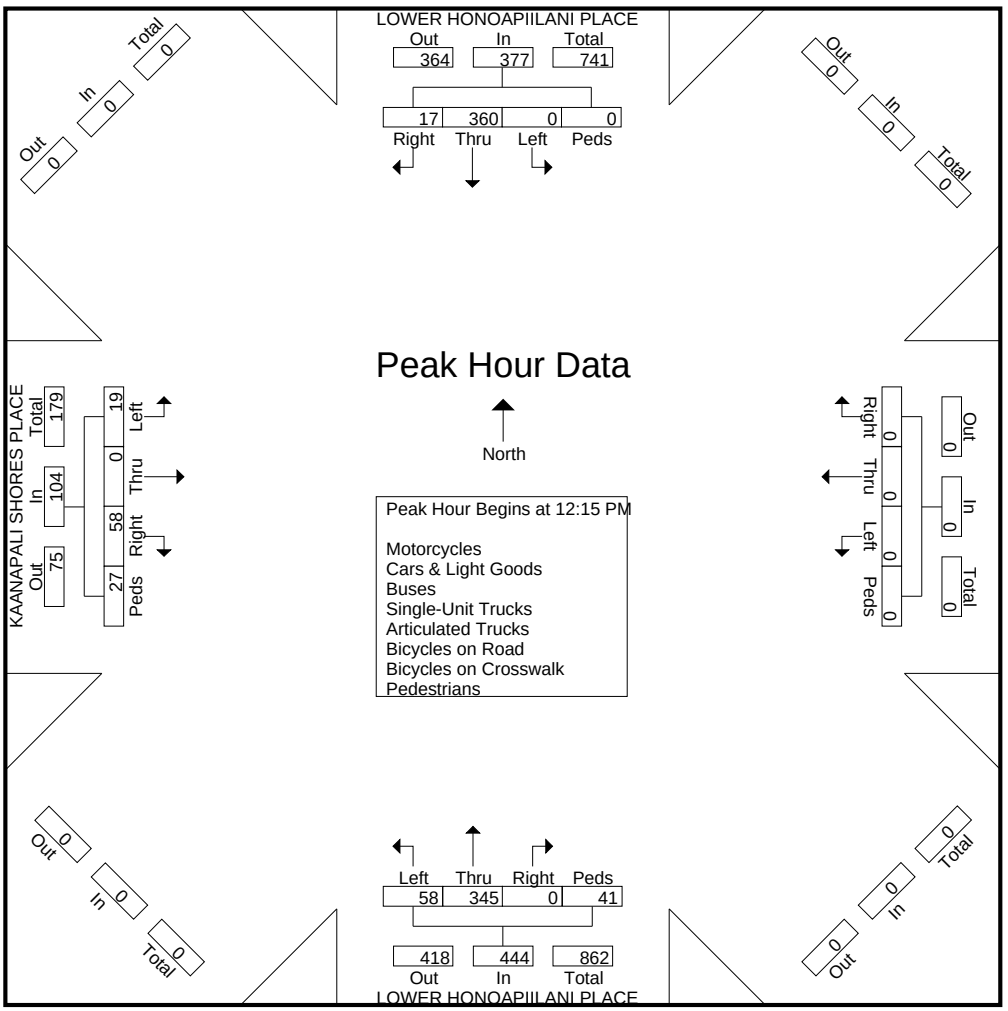
	LOWER HONOAPIILANI PLACE SOUTHBOUND				WESTBOUND				LOWER HONOAPIILANI PLACE NORTHBOUND				KAANAPALI SHORES PLACE EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
11:00 AM	0	83	4	0	0	0	0	0	11	66	0	9	5	0	13	7	198
11:15 AM	0	73	0	0	0	0	0	0	9	76	0	2	3	0	8	7	178
11:30 AM	0	80	8	0	0	0	0	0	12	85	0	13	2	0	8	12	220
11:45 AM	0	78	5	0	0	0	0	0	14	89	0	10	9	0	13	11	229
Total	0	314	17	0	0	0	0	0	46	316	0	34	19	0	42	37	825
12:00 PM	0	86	7	0	0	0	0	0	13	76	0	15	6	0	8	8	219
12:15 PM	0	105	2	0	0	0	0	0	21	90	0	13	5	0	12	9	257
12:30 PM	0	88	10	0	0	0	0	0	13	91	0	12	2	0	17	4	237
12:45 PM	0	93	3	0	0	0	0	0	15	83	0	6	8	0	13	9	230
Total	0	372	22	0	0	0	0	0	62	340	0	46	21	0	50	30	943
01:00 PM	0	74	2	0	0	0	0	0	9	81	0	10	4	0	16	5	201
01:15 PM	0	63	6	0	0	0	0	0	16	76	0	5	7	0	11	3	187
01:30 PM	0	79	8	0	0	0	0	0	17	90	0	4	9	0	9	4	220
01:45 PM	0	93	8	0	0	0	0	0	20	81	0	5	5	0	14	2	228
Total	0	309	24	0	0	0	0	0	62	328	0	24	25	0	50	14	836
Grand Total	0	995	63	0	0	0	0	0	170	984	0	104	65	0	142	81	2604
Apprch %	0	94	6	0	0	0	0	0	13.5	78.2	0	8.3	22.6	0	49.3	28.1	
Total %	0	38.2	2.4	0	0	0	0	0	6.5	37.8	0	4	2.5	0	5.5	3.1	
Motorcycles	0	7	3	0	0	0	0	0	1	9	0	0	2	0	3	0	25
% Motorcycles	0	0.7	4.8	0	0	0	0	0	0.6	0.9	0	0	3.1	0	2.1	0	1
Cars & Light Goods	0	971	58	0	0	0	0	0	168	967	0	0	62	0	137	0	2363
% Cars & Light Goods	0	97.6	92.1	0	0	0	0	0	98.8	98.3	0	0	95.4	0	96.5	0	90.7
Buses	0	5	0	0	0	0	0	0	0	5	0	0	0	0	1	0	11
% Buses	0	0.5	0	0	0	0	0	0	0	0.5	0	0	0	0	0.7	0	0.4
Single-Unit Trucks	0	3	2	0	0	0	0	0	0	3	0	0	1	0	1	0	10
% Single-Unit Trucks	0	0.3	3.2	0	0	0	0	0	0	0.3	0	0	1.5	0	0.7	0	0.4
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	10
% Bicycles on Road	0	0.9	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0.4
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.2	0
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	104	0	0	0	80	184
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	98.8	7.1

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File Name : SAT_Lower Honoapiilani Rd - Kaanapali Shores Pl
Site Code : 24-515 Honokowai Beach Restoration
Start Date : 5/11/2024
Page No : 2

	LOWER HONOAPIILANI PLACE SOUTHBOUND					WESTBOUND					LOWER HONOAPIILANI PLACE NORTHBOUND					KAANAPALI SHORES PLACE EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:15 PM to 01:00 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 12:15 PM																					
12:15 PM	0	**105**	2	0	**107**	0	0	0	0	0	**21**	90	0	**13**	**124**	5	0	12	**9**	26	**257**
12:30 PM	0	88	**10**	0	98	0	0	0	0	0	13	**91**	0	12	116	2	0	**17**	4	23	237
12:45 PM	0	93	3	0	96	0	0	0	0	0	15	83	0	6	104	**8**	0	13	9	**30**	230
01:00 PM	0	74	2	0	76	0	0	0	0	0	9	81	0	10	100	4	0	16	5	25	201
Total Volume	0	360	17	0	377	0	0	0	0	0	58	345	0	41	444	19	0	58	27	104	925
% App. Total	0	95.5	4.5	0		0	0	0	0		13.1	77.7	0	9.2		18.3	0	55.8	26		
PHF	.000	.857	.425	.000	.881	.000	.000	.000	.000	.000	.690	.948	.000	.788	.895	.594	.000	.853	.750	.867	.900



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501 Sumner St, Suite 521
Honolulu, Hawaii 96817
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File Name : Lower Honoapiilani Rd - Honokowai Marketplace Central Dwy
Site Code : 24-515 Honokowai Beach Restoration
Start Date : 5/9/2024

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

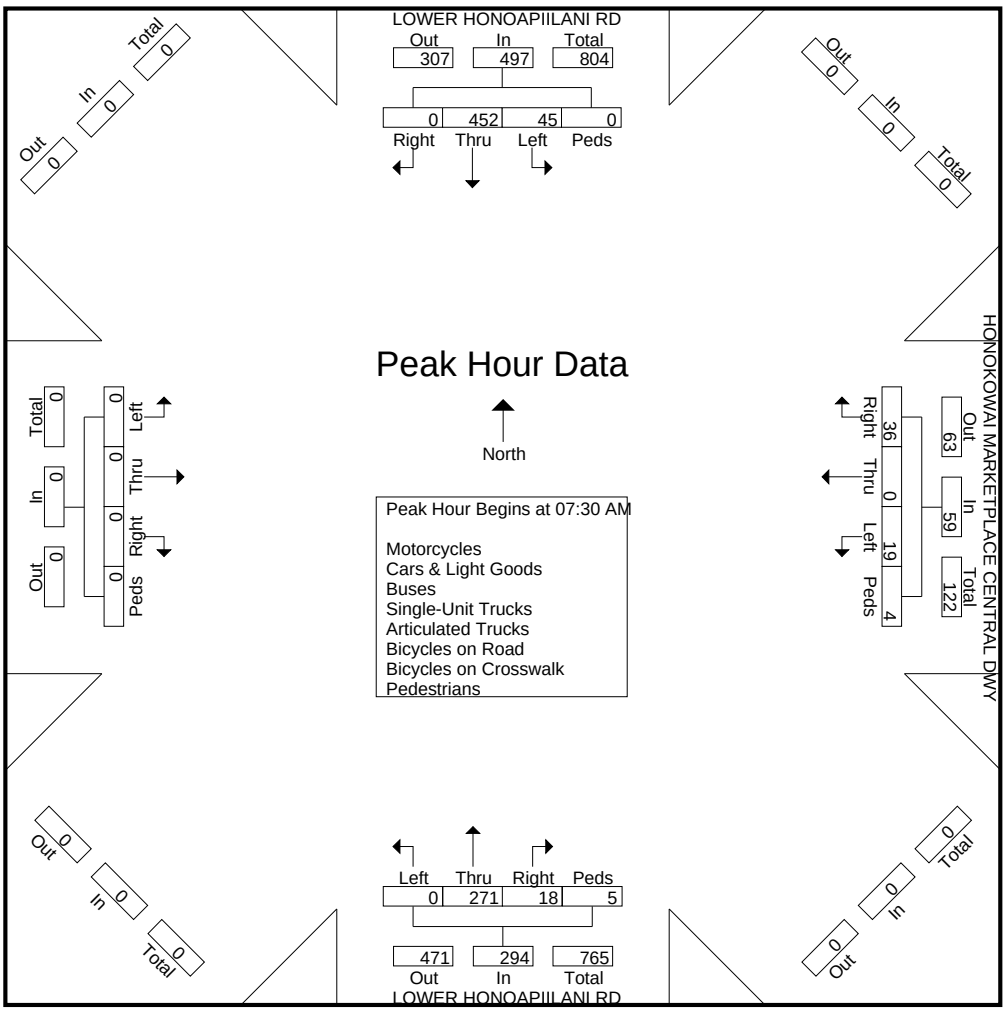
	LOWER HONOAPIILANI RD SOUTHBOUND				HONOKOWAI MARKETPLACE CENTRAL DWY WESTBOUND				LOWER HONOAPIILANI RD NORTHBOUND				EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:30 AM	7	68	0	0	2	0	5	1	0	45	6	0	0	0	0	0	134
06:45 AM	6	103	0	2	5	0	11	2	0	48	2	2	0	0	0	0	181
Total	13	171	0	2	7	0	16	3	0	93	8	2	0	0	0	0	315
07:00 AM	2	114	0	0	1	0	9	0	0	62	1	0	0	0	0	0	189
07:15 AM	8	122	0	0	5	0	6	0	0	67	3	0	0	0	0	0	211
07:30 AM	9	112	0	0	5	0	7	2	0	60	8	3	0	0	0	0	206
07:45 AM	16	117	0	0	6	0	9	2	0	68	2	1	0	0	0	0	221
Total	35	465	0	0	17	0	31	4	0	257	14	4	0	0	0	0	827
08:00 AM	8	128	0	0	4	0	9	0	0	66	6	0	0	0	0	0	221
08:15 AM	12	95	0	0	4	0	11	0	0	77	2	1	0	0	0	0	202
08:30 AM	10	95	0	0	4	0	9	3	0	56	7	1	0	0	0	0	185
08:45 AM	10	104	0	0	4	0	5	0	0	63	4	0	0	0	0	0	190
Total	40	422	0	0	16	0	34	3	0	262	19	2	0	0	0	0	798
09:00 AM	11	102	0	0	11	0	10	2	0	60	4	0	0	0	0	0	200
09:15 AM	7	91	0	3	3	0	12	3	0	60	5	2	0	0	0	0	186
Grand Total	106	1251	0	5	54	0	103	15	0	732	50	10	0	0	0	0	2326
Apprch %	7.8	91.9	0	0.4	31.4	0	59.9	8.7	0	92.4	6.3	1.3	0	0	0	0	
Total %	4.6	53.8	0	0.2	2.3	0	4.4	0.6	0	31.5	2.1	0.4	0	0	0	0	
Motorcycles	1	16	0	0	0	0	1	0	0	7	0	0	0	0	0	0	25
% Motorcycles	0.9	1.3	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1.1
Cars & Light Goods	105	1199	0	0	54	0	100	0	0	702	49	0	0	0	0	0	2209
% Cars & Light Goods	99.1	95.8	0	0	100	0	97.1	0	0	95.9	98	0	0	0	0	0	95
Buses	0	7	0	0	0	0	0	0	0	9	0	0	0	0	0	0	16
% Buses	0	0.6	0	0	0	0	0	0	0	1.2	0	0	0	0	0	0	0.7
Single-Unit Trucks	0	14	0	0	0	0	2	0	0	12	1	0	0	0	0	0	29
% Single-Unit Trucks	0	1.1	0	0	0	0	1.9	0	0	1.6	2	0	0	0	0	0	1.2
Articulated Trucks	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
% Articulated Trucks	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Bicycles on Road	0	13	0	0	0	0	0	0	0	2	0	0	0	0	0	0	15
% Bicycles on Road	0	1	0	0	0	0	0	0	0	0.3	0	0	0	0	0	0	0.6
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	5	0	0	0	15	0	0	0	10	0	0	0	0	30
% Pedestrians	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	0	1.3

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501 Sumner St, Suite 521
Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : Lower Honoapiilani Rd - Honokowai Marketplace Central Dwy
Site Code : 24-515 Honokowai Beach Restoration
Start Date : 5/9/2024

	LOWER HONOAPIILANI RD SOUTHBOUND					HONOKOWAI MARKETPLACE CENTRAL DWY WESTBOUND					LOWER HONOAPIILANI RD NORTHBOUND					EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:30 AM to 08:15 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	9	112	0	0	121	5	0	7	**2**	14	0	60	**8**	**3**	71	0	0	0	0	0	206
07:45 AM	**16**	117	0	0	133	**6**	0	9	2	**17**	0	68	2	1	71	0	0	0	0	0	**221**
08:00 AM	8	**128**	0	0	**136**	4	0	9	0	13	0	66	6	0	72	0	0	0	0	0	221
08:15 AM	12	95	0	0	107	4	0	**11**	0	15	0	**77**	2	1	**80**	0	0	0	0	0	202
Total Volume	45	452	0	0	497	19	0	36	4	59	0	271	18	5	294	0	0	0	0	0	850
% App. Total	9.1	90.9	0	0		32.2	0	61	6.8		0	92.2	6.1	1.7		0	0	0	0		
PHF	.703	.883	.000	.000	.914	.792	.000	.818	.500	.868	.000	.880	.563	.417	.919	.000	.000	.000	.000	.000	.962



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501 Sumner St, Suite 521
Honolulu, Hawaii 96817
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File Name : Lower Honoapiilani Rd - Honokowai Marketplace Central Dwy
Site Code : 24-515 Honokowai Beach Restoration
Start Date : 5/9/2024

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

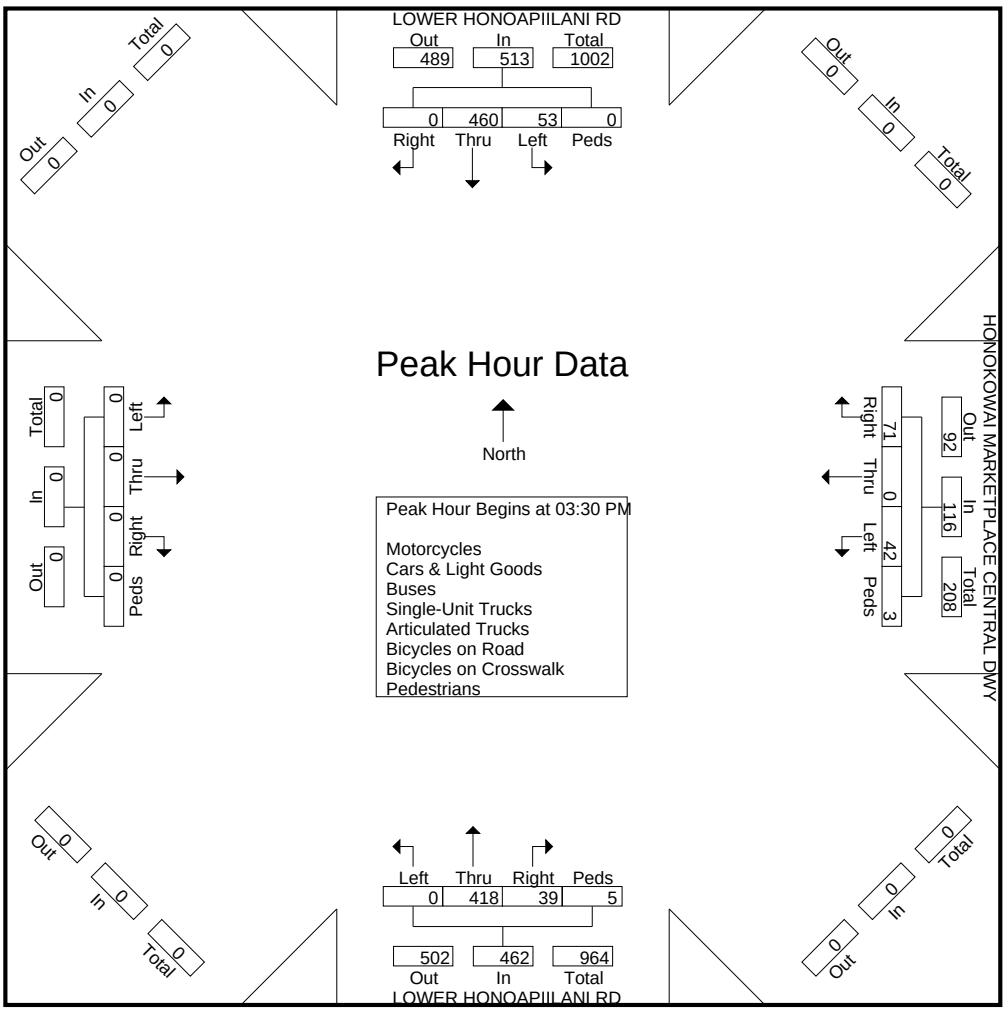
	LOWER HONOAPIILANI RD SOUTHBOUND				HONOKOWAI MARKETPLACE CENTRAL DWY WESTBOUND				LOWER HONOAPIILANI RD NORTHBOUND				EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
03:00 PM	11	98	0	0	10	0	21	0	0	121	3	1	0	0	0	0	265
03:15 PM	17	110	0	0	4	0	9	1	0	94	4	5	0	0	0	0	244
03:30 PM	7	122	0	0	8	0	21	3	0	96	8	2	0	0	0	0	267
03:45 PM	11	116	0	0	8	0	16	0	0	107	14	3	0	0	0	0	275
Total	46	446	0	0	30	0	67	4	0	418	29	11	0	0	0	0	1051
04:00 PM	24	119	0	0	11	0	22	0	0	120	10	0	0	0	0	0	306
04:15 PM	11	103	0	0	15	0	12	0	0	95	7	0	0	0	0	0	243
04:30 PM	16	97	0	2	12	0	22	2	0	118	4	0	0	0	0	0	273
04:45 PM	11	79	0	0	9	0	24	1	0	104	10	0	0	0	0	0	238
Total	62	398	0	2	47	0	80	3	0	437	31	0	0	0	0	0	1060
05:00 PM	14	112	0	0	11	0	20	2	0	101	8	4	0	0	0	0	272
05:15 PM	11	98	0	0	5	0	21	1	0	95	12	0	0	0	0	0	243
05:30 PM	17	72	0	1	8	0	11	10	0	139	13	0	0	0	0	0	271
05:45 PM	10	89	0	4	4	0	25	0	0	109	9	0	0	0	0	0	250
Total	52	371	0	5	28	0	77	13	0	444	42	4	0	0	0	0	1036
Grand Total	160	1215	0	7	105	0	224	20	0	1299	102	15	0	0	0	0	3147
Apprch %	11.6	87.9	0	0.5	30.1	0	64.2	5.7	0	91.7	7.2	1.1	0	0	0	0	
Total %	5.1	38.6	0	0.2	3.3	0	7.1	0.6	0	41.3	3.2	0.5	0	0	0	0	
Motorcycles	1	8	0	0	1	0	2	0	0	11	1	0	0	0	0	0	24
% Motorcycles	0.6	0.7	0	0	1	0	0.9	0	0	0.8	1	0	0	0	0	0	0.8
Cars & Light Goods	159	1189	0	0	103	0	221	0	0	1273	100	0	0	0	0	0	3045
% Cars & Light Goods	99.4	97.9	0	0	98.1	0	98.7	0	0	98	98	0	0	0	0	0	96.8
Buses	0	8	0	0	0	0	0	0	0	4	0	0	0	0	0	0	12
% Buses	0	0.7	0	0	0	0	0	0	0	0.3	0	0	0	0	0	0	0.4
Single-Unit Trucks	0	2	0	0	1	0	1	0	0	4	1	0	0	0	0	0	9
% Single-Unit Trucks	0	0.2	0	0	1	0	0.4	0	0	0.3	1	0	0	0	0	0	0.3
Articulated Trucks	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
% Articulated Trucks	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	7	0	0	0	0	0	0	0	7	0	0	0	0	0	0	14
% Bicycles on Road	0	0.6	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0.4
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	7	0	0	0	20	0	0	0	15	0	0	0	0	42
% Pedestrians	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	0	1.3

Austin Tsutsumi & Associates

501 Sumner St, Suite 521
Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : Lower Honoapiilani Rd - Honokowai Marketplace Central Dwy
Site Code : 24-515 Honokowai Beach Restoration
Start Date : 5/9/2024

	LOWER HONOAPIILANI RD SOUTHBOUND					HONOKOWAI MARKETPLACE CENTRAL DWY WESTBOUND					LOWER HONOAPIILANI RD NORTHBOUND					EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:30 PM to 04:15 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:30 PM																					
03:30 PM	7	**122**	0	0	129	8	0	21	**3**	32	0	96	8	2	106	0	0	0	0	0	267
03:45 PM	11	116	0	0	127	8	0	16	0	24	0	107	**14**	**3**	124	0	0	0	0	0	275
04:00 PM	**24**	119	0	0	**143**	11	0	**22**	0	**33**	0	**120**	10	0	**130**	0	0	0	0	0	**306**
04:15 PM	11	103	0	0	114	**15**	0	12	0	27	0	95	7	0	102	0	0	0	0	0	243
Total Volume	53	460	0	0	513	42	0	71	3	116	0	418	39	5	462	0	0	0	0	0	1091
% App. Total	10.3	89.7	0	0		36.2	0	61.2	2.6		0	90.5	8.4	1.1		0	0	0	0		
PHF	.552	.943	.000	.000	.897	.700	.000	.807	.250	.879	.000	.871	.696	.417	.888	.000	.000	.000	.000	.000	.891



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501 Sumner St, Suite 521
Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : SAT_Lower Honoapiilani Rd - Honokowai Marketplace Central Dwy
Site Code : 24-515 Honokowai Beach Restoration
Start Date : 5/11/2024

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

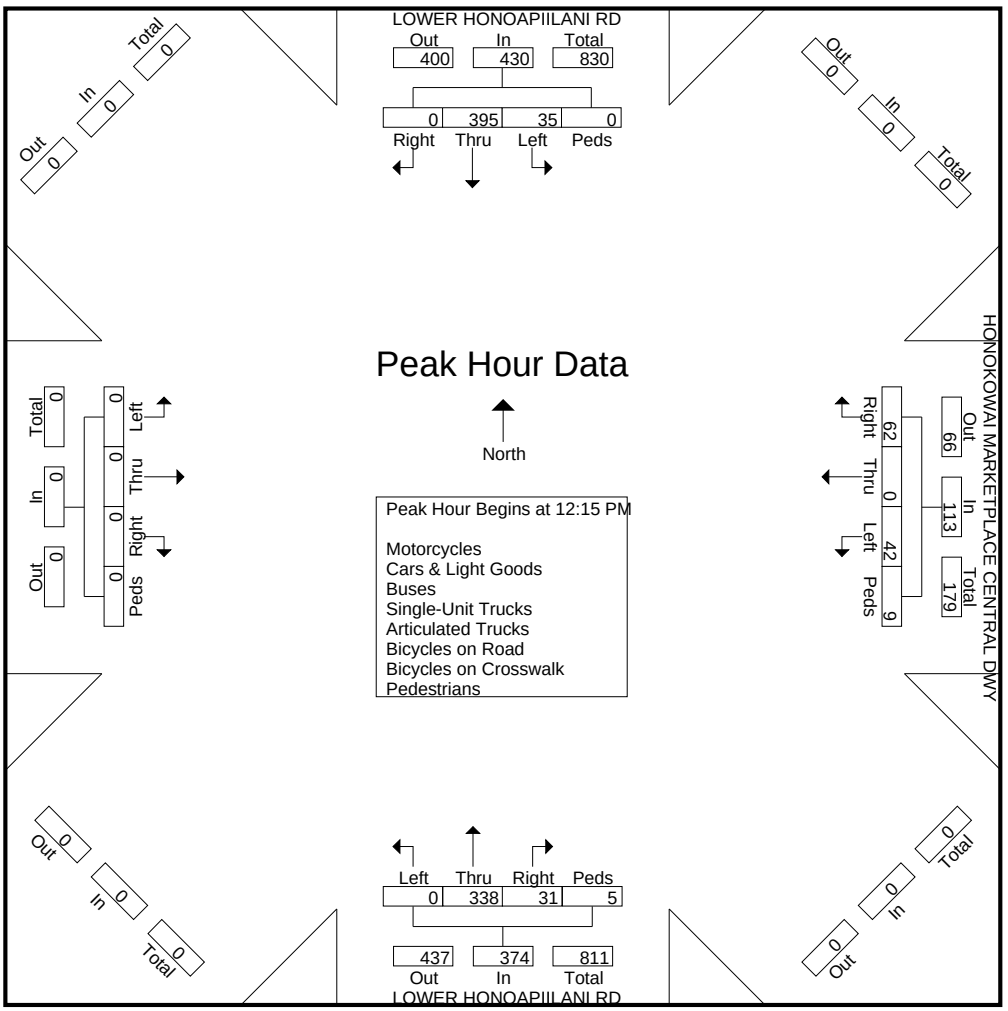
	LOWER HONOAPIILANI RD SOUTHBOUND				HONOKOWAI MARKETPLACE CENTRAL DWY WESTBOUND				LOWER HONOAPIILANI RD NORTHBOUND				EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
11:00 AM	11	83	0	0	7	0	12	0	0	65	8	1	0	0	0	0	187
11:15 AM	8	73	0	2	7	0	9	1	0	77	5	2	0	0	0	0	184
11:30 AM	7	83	0	0	4	0	14	0	0	80	8	0	0	0	0	0	196
11:45 AM	7	82	0	0	7	0	20	1	0	83	5	0	0	0	0	0	205
Total	33	321	0	2	25	0	55	2	0	305	26	3	0	0	0	0	772
12:00 PM	9	85	0	0	10	0	17	0	0	75	9	3	0	0	0	0	208
12:15 PM	12	115	0	0	13	0	19	3	0	89	6	0	0	0	0	0	257
12:30 PM	5	102	0	0	8	0	17	1	0	87	12	0	0	0	0	0	232
12:45 PM	13	94	0	0	9	0	15	1	0	83	8	0	0	0	0	0	223
Total	39	396	0	0	40	0	68	5	0	334	35	3	0	0	0	0	920
01:00 PM	5	84	0	0	12	0	11	4	0	79	5	5	0	0	0	0	205
01:15 PM	6	69	0	0	2	0	8	0	0	84	5	1	0	0	0	0	175
01:30 PM	13	79	0	0	10	0	14	0	0	96	5	0	0	0	0	0	217
01:45 PM	18	89	0	0	8	0	14	1	0	94	5	0	0	0	0	0	229
Total	42	321	0	0	32	0	47	5	0	353	20	6	0	0	0	0	826
Grand Total	114	1038	0	2	97	0	170	12	0	992	81	12	0	0	0	0	2518
Apprch %	9.9	89.9	0	0.2	34.8	0	60.9	4.3	0	91.4	7.5	1.1	0	0	0	0	
Total %	4.5	41.2	0	0.1	3.9	0	6.8	0.5	0	39.4	3.2	0.5	0	0	0	0	
Motorcycles	1	6	0	0	2	0	2	0	0	9	2	0	0	0	0	0	22
% Motorcycles	0.9	0.6	0	0	2.1	0	1.2	0	0	0.9	2.5	0	0	0	0	0	0.9
Cars & Light Goods	113	1010	0	0	93	0	167	0	0	973	78	0	0	0	0	0	2434
% Cars & Light Goods	99.1	97.3	0	0	95.9	0	98.2	0	0	98.1	96.3	0	0	0	0	0	96.7
Buses	0	5	0	0	0	0	0	0	0	5	0	0	0	0	0	0	10
% Buses	0	0.5	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0.4
Single-Unit Trucks	0	4	0	0	2	0	0	0	0	3	0	0	0	0	0	0	9
% Single-Unit Trucks	0	0.4	0	0	2.1	0	0	0	0	0.3	0	0	0	0	0	0	0.4
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	13	0	0	0	0	1	0	0	2	1	0	0	0	0	0	17
% Bicycles on Road	0	1.3	0	0	0	0	0.6	0	0	0.2	1.2	0	0	0	0	0	0.7
Bicycles on Crosswalk	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	4
% Bicycles on Crosswalk	0	0	0	0	0	0	0	33.3	0	0	0	0	0	0	0	0	0.2
Pedestrians	0	0	0	2	0	0	0	8	0	0	0	12	0	0	0	0	22
% Pedestrians	0	0	0	100	0	0	0	66.7	0	0	0	100	0	0	0	0	0.9

Austin Tsutsumi & Associates

501 Sumner St, Suite 521
Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : SAT_Lower Honoapiilani Rd - Honokowai Marketplace Central Dwy
Site Code : 24-515 Honokowai Beach Restoration
Start Date : 5/11/2024
Page No : 2

	LOWER HONOAPIILANI RD SOUTHBOUND					HONOKOWAI MARKETPLACE CENTRAL DWY WESTBOUND					LOWER HONOAPIILANI RD NORTHBOUND					EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:15 PM to 01:00 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 12:15 PM																					
12:15 PM	12	**115**	0	0	**127**	**13**	0	**19**	3	**35**	0	**89**	6	0	95	0	0	0	0	0	**257**
12:30 PM	5	102	0	0	107	8	0	17	1	26	0	87	**12**	0	**99**	0	0	0	0	0	232
12:45 PM	**13**	94	0	0	107	9	0	15	1	25	0	83	8	0	91	0	0	0	0	0	223
01:00 PM	5	84	0	0	89	12	0	11	**4**	27	0	79	5	**5**	89	0	0	0	0	0	205
Total Volume	35	395	0	0	430	42	0	62	9	113	0	338	31	5	374	0	0	0	0	0	917
% App. Total	8.1	91.9	0	0		37.2	0	54.9	8		0	90.4	8.3	1.3		0	0	0	0		
PHF	.673	.859	.000	.000	.846	.808	.000	.816	.563	.807	.000	.949	.646	.250	.944	.000	.000	.000	.000	.000	.892



Austin Tsutsumi & Associates

501 Sumner St, Suite 521
Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : Honoapiilani Hwy - Lower Honoapiilani Rd
Site Code : 24-515 Honokowai Beach TA
Start Date : 5/9/2024

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

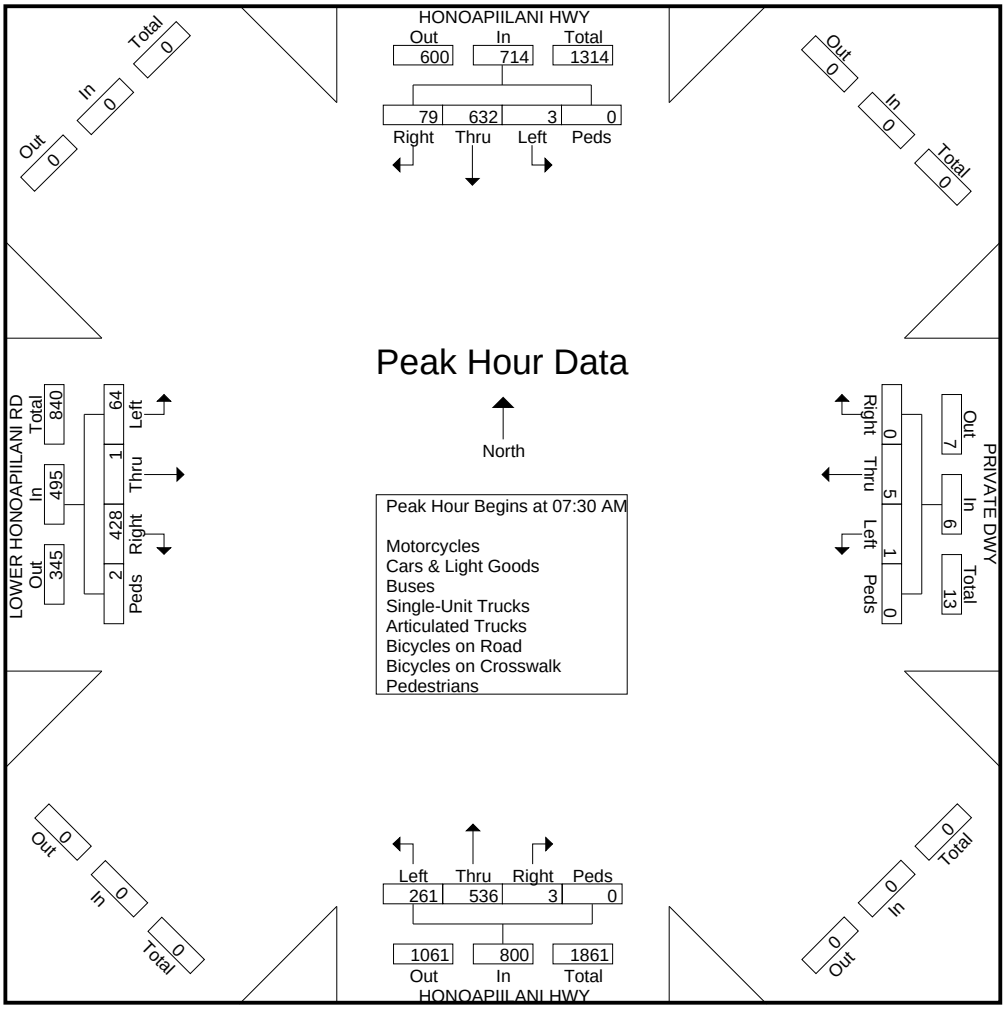
	HONOAPIILANI HWY SOUTHBOUND				PRIVATE DWY WESTBOUND				HONOAPIILANI HWY NORTHBOUND				LOWER HONOAPIILANI RD EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:30 AM	2	110	13	0	0	0	0	0	42	77	2	0	6	1	78	0	331
06:45 AM	1	137	6	0	1	0	17	0	50	58	3	0	6	2	95	1	377
Total	3	247	19	0	1	0	17	0	92	135	5	0	12	3	173	1	708
07:00 AM	1	130	12	0	2	1	1	0	60	132	0	0	22	0	103	0	464
07:15 AM	0	178	17	0	3	0	4	0	58	136	0	0	22	0	123	0	541
07:30 AM	2	163	24	0	1	0	0	0	61	154	0	0	24	0	105	0	534
07:45 AM	1	157	16	0	0	4	0	0	67	136	3	0	11	0	118	1	514
Total	4	628	69	0	6	5	5	0	246	558	3	0	79	0	449	1	2053
08:00 AM	0	153	19	0	0	1	0	0	66	131	0	0	20	1	118	1	510
08:15 AM	0	159	20	0	0	0	0	0	67	115	0	0	9	0	87	0	457
08:30 AM	0	127	15	0	1	1	0	0	64	138	0	0	12	1	95	0	454
08:45 AM	1	136	16	2	0	0	0	0	61	131	1	0	16	2	90	0	456
Total	1	575	70	2	1	2	0	0	258	515	1	0	57	4	390	1	1877
09:00 AM	0	141	18	0	0	1	0	0	69	164	2	0	11	0	111	0	517
09:15 AM	2	125	12	2	1	0	0	0	74	128	0	0	16	0	94	2	456
Grand Total	10	1716	188	4	9	8	22	0	739	1500	11	0	175	7	1217	5	5611
Apprch %	0.5	89.5	9.8	0.2	23.1	20.5	56.4	0	32.8	66.7	0.5	0	12.5	0.5	86.7	0.4	
Total %	0.2	30.6	3.4	0.1	0.2	0.1	0.4	0	13.2	26.7	0.2	0	3.1	0.1	21.7	0.1	
Motorcycles	0	8	0	0	0	0	0	0	7	3	0	0	1	0	7	0	26
% Motorcycles	0	0.5	0	0	0	0	0	0	0.9	0.2	0	0	0.6	0	0.6	0	0.5
Cars & Light Goods	7	1678	186	0	6	7	20	0	703	1457	7	0	171	7	1189	0	5438
% Cars & Light Goods	70	97.8	98.9	0	66.7	87.5	90.9	0	95.1	97.1	63.6	0	97.7	100	97.7	0	96.9
Buses	0	13	1	0	0	0	0	0	8	5	0	0	2	0	7	0	36
% Buses	0	0.8	0.5	0	0	0	0	0	1.1	0.3	0	0	1.1	0	0.6	0	0.6
Single-Unit Trucks	2	14	1	0	2	1	2	0	19	21	3	0	1	0	13	0	79
% Single-Unit Trucks	20	0.8	0.5	0	22.2	12.5	9.1	0	2.6	1.4	27.3	0	0.6	0	1.1	0	1.4
Articulated Trucks	0	3	0	0	1	0	0	0	0	12	1	0	0	0	1	0	18
% Articulated Trucks	0	0.2	0	0	11.1	0	0	0	0	0.8	9.1	0	0	0	0.1	0	0.3
Bicycles on Road	1	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	5
% Bicycles on Road	10	0	0	0	0	0	0	0	0.3	0.1	0	0	0	0	0	0	0.1
Bicycles on Crosswalk	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	1	4
% Bicycles on Crosswalk	0	0	0	75	0	0	0	0	0	0	0	0	0	0	0	20	0.1
Pedestrians	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4	5
% Pedestrians	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	80	0.1

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Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : Honoapiilani Hwy - Lower Honoapiilani Rd
Site Code : 24-515 Honokowai Beach TA
Start Date : 5/9/2024
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	HONOAPIILANI HWY SOUTHBOUND					PRIVATE DWY WESTBOUND					HONOAPIILANI HWY NORTHBOUND					LOWER HONOAPIILANI RD EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:30 AM to 08:15 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	**2**	**163**	**24**	0	**189**	**1**	0	0	0	1	61	**154**	0	0	**215**	**24**	0	105	0	129	**534**
07:45 AM	1	157	16	0	174	0	**4**	0	0	**4**	**67**	136	**3**	0	206	11	0	**118**	**1**	130	514
08:00 AM	0	153	19	0	172	0	1	0	0	1	66	131	0	0	197	20	**1**	118	1	**140**	510
08:15 AM	0	159	20	0	179	0	0	0	0	0	67	115	0	0	182	9	0	87	0	96	457
Total Volume	3	632	79	0	714	1	5	0	0	6	261	536	3	0	800	64	1	428	2	495	2015
% App. Total	0.4	88.5	11.1	0		16.7	83.3	0	0		32.6	67	0.4	0		12.9	0.2	86.5	0.4		
PHF	.375	.969	.823	.000	.944	.250	.313	.000	.000	.375	.974	.870	.250	.000	.930	.667	.250	.907	.500	.884	.943



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Honolulu, Hawaii 96817
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Site Code : 24-515 Honokowai Beach TA
Start Date : 5/9/2024

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

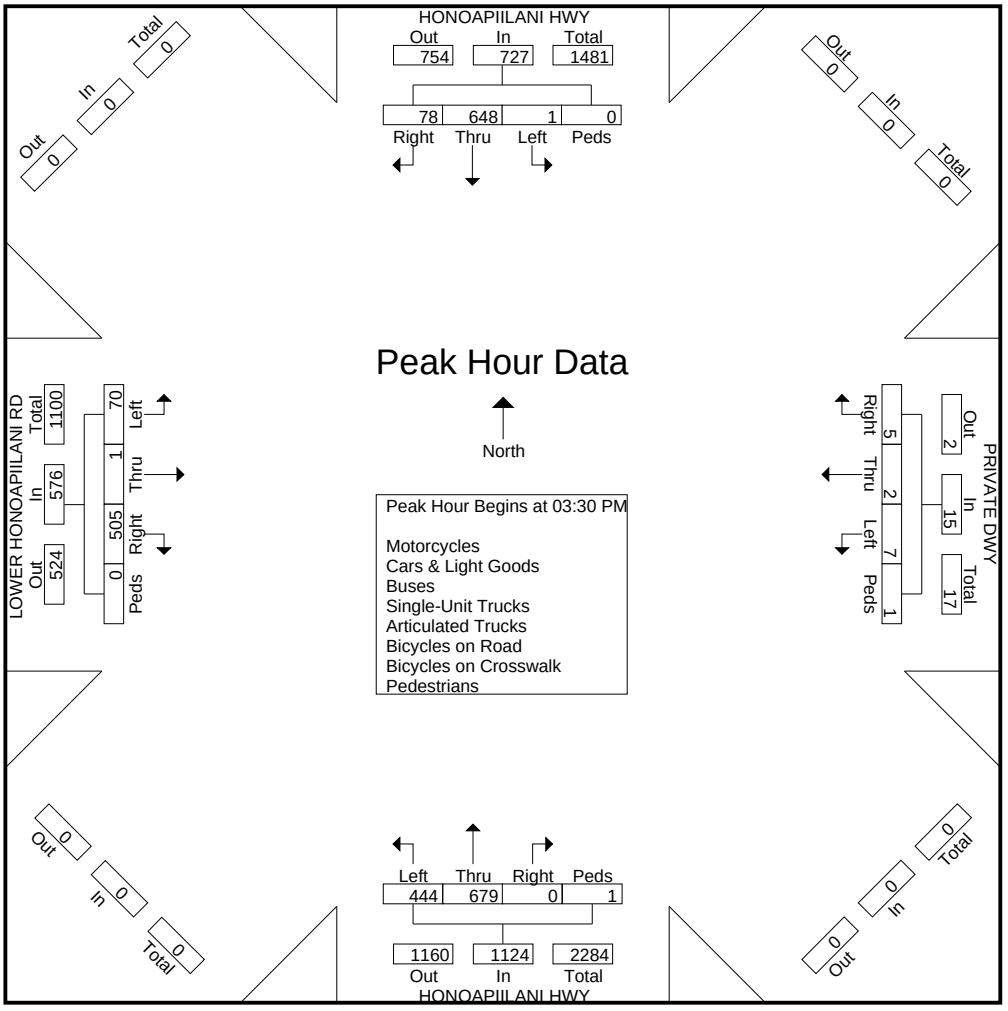
	HONOAPIILANI HWY SOUTHBOUND				PRIVATE DWY WESTBOUND				HONOAPIILANI HWY NORTHBOUND				LOWER HONOAPIILANI RD EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
03:00 PM	1	217	16	0	2	1	0	0	115	145	1	0	8	0	121	0	627
03:15 PM	1	186	19	1	2	0	2	0	112	154	0	0	11	0	126	1	615
03:30 PM	0	165	16	0	3	0	2	0	113	163	0	0	20	0	130	0	612
03:45 PM	0	151	29	0	3	0	2	0	111	201	0	0	16	0	123	0	636
Total	2	719	80	1	10	1	6	0	451	663	1	0	55	0	500	1	2490
04:00 PM	1	151	15	0	0	2	1	1	117	164	0	1	19	0	128	0	600
04:15 PM	0	181	18	0	1	0	0	0	103	151	0	0	15	1	124	0	594
04:30 PM	0	139	18	1	1	1	0	1	121	151	1	0	13	0	115	0	562
04:45 PM	0	135	22	0	0	0	0	0	111	164	0	0	13	0	81	0	526
Total	1	606	73	1	2	3	1	2	452	630	1	1	60	1	448	0	2282
05:00 PM	0	135	14	0	0	0	0	0	102	160	0	0	20	0	109	2	542
05:15 PM	0	101	17	0	0	1	0	0	108	150	0	0	9	0	107	0	493
05:30 PM	0	90	13	0	1	0	1	0	144	148	1	0	13	0	84	0	495
05:45 PM	0	74	12	0	0	1	0	0	129	164	1	0	15	0	82	0	478
Total	0	400	56	0	1	2	1	0	483	622	2	0	57	0	382	2	2008
Grand Total	3	1725	209	2	13	6	8	2	1386	1915	4	1	172	1	1330	3	6780
Apprch %	0.2	89	10.8	0.1	44.8	20.7	27.6	6.9	41.9	57.9	0.1	0	11.4	0.1	88.3	0.2	
Total %	0	25.4	3.1	0	0.2	0.1	0.1	0	20.4	28.2	0.1	0	2.5	0	19.6	0	
Motorcycles	0	2	0	0	0	0	0	0	16	3	0	0	0	0	3	0	24
% Motorcycles	0	0.1	0	0	0	0	0	0	1.2	0.2	0	0	0	0	0.2	0	0.4
Cars & Light Goods	3	1700	209	0	13	6	8	0	1360	1898	4	0	172	1	1311	0	6685
% Cars & Light Goods	100	98.6	100	0	100	100	100	0	98.1	99.1	100	0	100	100	98.6	0	98.6
Buses	0	6	0	0	0	0	0	0	4	5	0	0	0	0	8	0	23
% Buses	0	0.3	0	0	0	0	0	0	0.3	0.3	0	0	0	0	0.6	0	0.3
Single-Unit Trucks	0	11	0	0	0	0	0	0	3	3	0	0	0	0	7	0	24
% Single-Unit Trucks	0	0.6	0	0	0	0	0	0	0.2	0.2	0	0	0	0	0.5	0	0.4
Articulated Trucks	0	3	0	0	0	0	0	0	0	3	0	0	0	0	0	0	6
% Articulated Trucks	0	0.2	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0.1
Bicycles on Road	0	3	0	0	0	0	0	0	3	3	0	0	0	0	1	0	10
% Bicycles on Road	0	0.2	0	0	0	0	0	0	0.2	0.2	0	0	0	0	0.1	0	0.1
Bicycles on Crosswalk	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	4
% Bicycles on Crosswalk	0	0	0	50	0	0	0	50	0	0	0	100	0	0	0	33.3	0.1
Pedestrians	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	2	4
% Pedestrians	0	0	0	50	0	0	0	50	0	0	0	0	0	0	0	66.7	0.1

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Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : Honoapiilani Hwy - Lower Honoapiilani Rd
Site Code : 24-515 Honokowai Beach TA
Start Date : 5/9/2024
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	HONOAPIILANI HWY SOUTHBOUND					PRIVATE DWY WESTBOUND					HONOAPIILANI HWY NORTHBOUND					LOWER HONOAPIILANI RD EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:30 PM to 04:15 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:30 PM																					
03:30 PM	0	165	16	0	181	**3**	0	**2**	0	**5**	113	163	0	0	276	**20**	0	**130**	0	**150**	612
03:45 PM	0	151	**29**	0	180	3	0	2	0	5	111	**201**	0	0	**312**	16	0	123	0	139	**636**
04:00 PM	**1**	151	15	0	167	0	**2**	1	**1**	4	**117**	164	0	**1**	282	19	0	128	0	147	600
04:15 PM	0	**181**	18	0	**199**	1	0	0	0	1	103	151	0	0	254	15	**1**	124	0	140	594
Total Volume	1	648	78	0	727	7	2	5	1	15	444	679	0	1	1124	70	1	505	0	576	2442
% App. Total	0.1	89.1	10.7	0		46.7	13.3	33.3	6.7		39.5	60.4	0	0.1		12.2	0.2	87.7	0		
PHF	.250	.895	.672	.000	.913	.583	.250	.625	.250	.750	.949	.845	.000	.250	.901	.875	.250	.971	.000	.960	.960



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Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : SAT_Honoapiilani Hwy - Lower Honoapiilani Rd
Site Code : 24-515 Honokowai Beach TA
Start Date : 5/11/2024

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

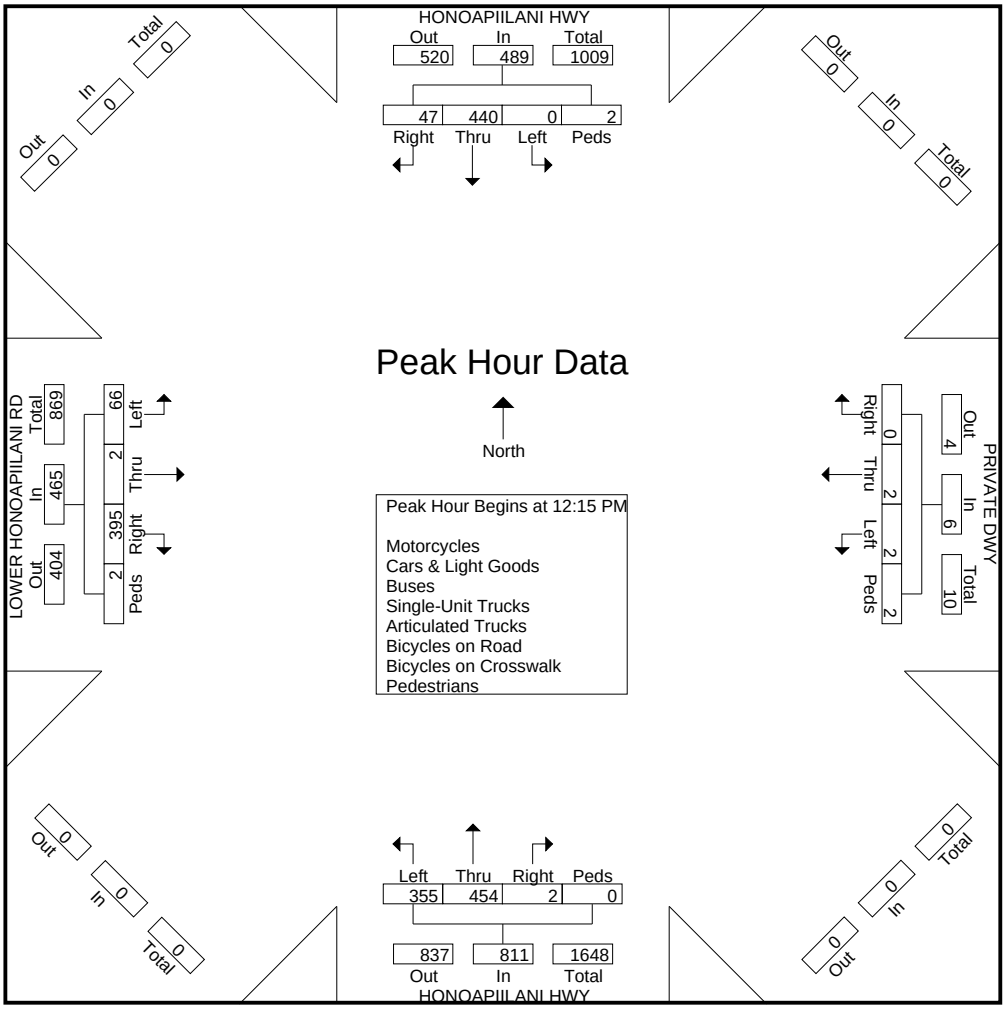
	HONOAPIILANI HWY SOUTHBOUND				PRIVATE DWY WESTBOUND				HONOAPIILANI HWY NORTHBOUND				LOWER HONOAPIILANI RD EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
11:00 AM	0	115	15	0	1	0	0	0	78	120	0	0	11	0	96	0	436
11:15 AM	0	107	22	0	1	0	0	0	74	97	0	0	15	0	89	1	406
11:30 AM	0	125	22	0	0	0	0	0	81	98	0	0	17	0	83	0	426
11:45 AM	1	112	16	0	0	1	0	0	88	107	0	0	12	0	87	0	424
Total	1	459	75	0	2	1	0	0	321	422	0	0	55	0	355	1	1692
12:00 PM	0	113	18	0	1	1	0	0	81	102	0	0	16	2	95	0	429
12:15 PM	0	123	13	2	0	0	0	2	93	114	1	0	17	1	102	2	470
12:30 PM	0	114	9	0	1	2	0	0	94	108	0	0	23	0	97	0	448
12:45 PM	0	89	15	0	0	0	0	0	79	125	0	0	11	0	98	0	417
Total	0	439	55	2	2	3	0	2	347	449	1	0	67	3	392	2	1764
01:00 PM	0	114	10	0	1	0	0	0	89	107	1	0	15	1	98	0	436
01:15 PM	0	112	17	0	0	0	0	0	88	146	0	0	6	0	79	0	448
01:30 PM	0	107	19	0	1	0	0	0	96	111	0	0	10	2	84	1	431
01:45 PM	0	115	19	0	1	0	0	0	92	126	0	0	8	0	96	0	457
Total	0	448	65	0	3	0	0	0	365	490	1	0	39	3	357	1	1772
Grand Total	1	1346	195	2	7	4	0	2	1033	1361	2	0	161	6	1104	4	5228
Apprch %	0.1	87.2	12.6	0.1	53.8	30.8	0	15.4	43.1	56.8	0.1	0	12.6	0.5	86.6	0.3	
Total %	0	25.7	3.7	0	0.1	0.1	0	0	19.8	26	0	0	3.1	0.1	21.1	0.1	
Motorcycles	0	2	0	0	0	0	0	0	3	3	0	0	4	0	3	0	15
% Motorcycles	0	0.1	0	0	0	0	0	0	0.3	0.2	0	0	2.5	0	0.3	0	0.3
Cars & Light Goods	1	1330	190	0	7	4	0	0	1020	1344	2	0	153	6	1089	0	5146
% Cars & Light Goods	100	98.8	97.4	0	100	100	0	0	98.7	98.8	100	0	95	100	98.6	0	98.4
Buses	0	1	0	0	0	0	0	0	5	0	0	0	0	0	5	0	11
% Buses	0	0.1	0	0	0	0	0	0	0.5	0	0	0	0	0	0.5	0	0.2
Single-Unit Trucks	0	13	1	0	0	0	0	0	4	12	0	0	4	0	5	0	39
% Single-Unit Trucks	0	1	0.5	0	0	0	0	0	0.4	0.9	0	0	2.5	0	0.5	0	0.7
Articulated Trucks	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
% Articulated Trucks	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0
Bicycles on Road	0	0	4	0	0	0	0	0	0	2	0	0	0	0	2	0	8
% Bicycles on Road	0	0	2.1	0	0	0	0	0	0	0.1	0	0	0	0	0.2	0	0.2
Bicycles on Crosswalk	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	2	6
% Bicycles on Crosswalk	0	0	0	100	0	0	0	100	0	0	0	0	0	0	0	50	0.1
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0

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Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

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Site Code : 24-515 Honokowai Beach TA
Start Date : 5/11/2024
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	HONOAPIILANI HWY SOUTHBOUND					PRIVATE DWY WESTBOUND					HONOAPIILANI HWY NORTHBOUND					LOWER HONOAPIILANI RD EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:15 PM to 01:00 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 12:15 PM																					
12:15 PM	0	**123**	13	**2**	**138**	0	0	0	**2**	2	93	114	**1**	0	**208**	17	**1**	**102**	**2**	**122**	**470**
12:30 PM	0	114	9	0	123	**1**	**2**	0	0	**3**	**94**	108	0	0	202	**23**	0	97	0	120	448
12:45 PM	0	89	**15**	0	104	0	0	0	0	0	79	**125**	0	0	204	11	0	98	0	109	417
01:00 PM	0	114	10	0	124	1	0	0	0	1	89	107	1	0	197	15	1	98	0	114	436
Total Volume	0	440	47	2	489	2	2	0	2	6	355	454	2	0	811	66	2	395	2	465	1771
% App. Total	0	90	9.6	0.4		33.3	33.3	0	33.3		43.8	56	0.2	0		14.2	0.4	84.9	0.4		
PHF	.000	.894	.783	.250	.886	.500	.250	.000	.250	.500	.944	.908	.500	.000	.975	.717	.500	.968	.250	.953	.942



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501 Sumner St, Suite 521
Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : Honoapiilani Hwy - Keawe St
Site Code : 24-515 Honokowai Beach TA
Start Date : 5/9/2024

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

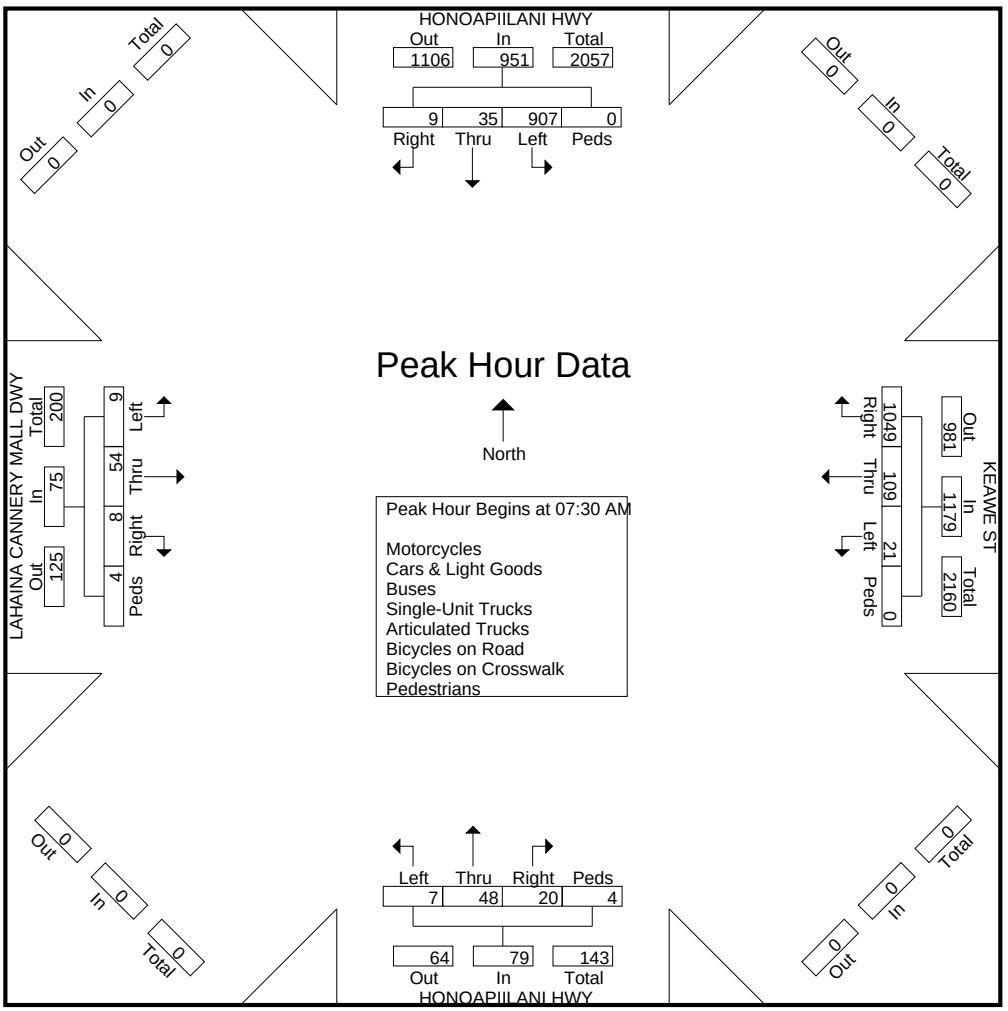
	HONOAPIILANI HWY SOUTHBOUND				KEAWE ST WESTBOUND				HONOAPIILANI HWY NORTHBOUND				LAHAINA CANNERY MALL DWY EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:30 AM	180	10	1	0	4	18	203	0	0	9	6	0	0	9	1	0	441
06:45 AM	179	23	6	0	6	24	226	0	5	29	13	0	0	17	2	1	531
Total	359	33	7	0	10	42	429	0	5	38	19	0	0	26	3	1	972
07:00 AM	222	9	6	0	10	8	263	0	4	16	14	0	1	15	4	0	572
07:15 AM	253	9	4	0	7	23	280	0	1	10	7	0	0	21	2	0	617
07:30 AM	290	5	2	0	5	27	288	0	1	11	4	4	2	22	2	4	667
07:45 AM	225	9	3	0	8	29	262	0	0	14	7	0	0	11	4	0	572
Total	990	32	15	0	30	87	1093	0	6	51	32	4	3	69	12	4	2428
08:00 AM	181	10	2	0	3	28	257	0	2	10	4	0	3	7	1	0	508
08:15 AM	211	11	2	0	5	25	242	0	4	13	5	0	4	14	1	0	537
08:30 AM	200	15	3	0	6	30	265	0	2	11	4	5	2	13	0	4	560
08:45 AM	184	11	9	0	6	29	280	0	3	17	6	1	0	22	4	0	572
Total	776	47	16	0	20	112	1044	0	11	51	19	6	9	56	6	4	2177
09:00 AM	254	11	4	0	2	23	280	0	1	14	6	0	2	17	4	0	618
09:15 AM	259	14	2	0	3	37	210	0	0	12	6	1	4	23	0	2	573
Grand Total	2638	137	44	0	65	301	3056	0	23	166	82	11	18	191	25	11	6768
Apprch %	93.6	4.9	1.6	0	1.9	8.8	89.3	0	8.2	58.9	29.1	3.9	7.3	78	10.2	4.5	
Total %	39	2	0.7	0	1	4.4	45.2	0	0.3	2.5	1.2	0.2	0.3	2.8	0.4	0.2	
Motorcycles	6	1	1	0	0	3	12	0	0	0	0	0	0	2	0	0	25
% Motorcycles	0.2	0.7	2.3	0	0	1	0.4	0	0	0	0	0	0	1	0	0	0.4
Cars & Light Goods	2576	105	42	0	55	290	2943	0	21	126	70	0	12	181	25	0	6446
% Cars & Light Goods	97.6	76.6	95.5	0	84.6	96.3	96.3	0	91.3	75.9	85.4	0	66.7	94.8	100	0	95.2
Buses	26	0	0	0	0	2	19	0	0	0	0	0	6	5	0	0	58
% Buses	1	0	0	0	0	0.7	0.6	0	0	0	0	0	33.3	2.6	0	0	0.9
Single-Unit Trucks	23	20	1	0	9	6	73	0	2	26	11	0	0	2	0	0	173
% Single-Unit Trucks	0.9	14.6	2.3	0	13.8	2	2.4	0	8.7	15.7	13.4	0	0	1	0	0	2.6
Articulated Trucks	4	10	0	0	1	0	4	0	0	14	1	0	0	0	0	0	34
% Articulated Trucks	0.2	7.3	0	0	1.5	0	0.1	0	0	8.4	1.2	0	0	0	0	0	0.5
Bicycles on Road	3	1	0	0	0	0	5	0	0	0	0	0	0	1	0	0	10
% Bicycles on Road	0.1	0.7	0	0	0	0	0.2	0	0	0	0	0	0	0.5	0	0	0.1
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	11	22
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	100	0.3

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Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : Honoapiilani Hwy - Keawe St
Site Code : 24-515 Honokowai Beach TA
Start Date : 5/9/2024
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	HONOAPIILANI HWY SOUTHBOUND					KEAWE ST WESTBOUND					HONOAPIILANI HWY NORTHBOUND					LAHAINA CANNERY MALL DWY EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:30 AM to 08:15 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	**290**	5	2	0	**297**	5	27	**288**	0	**320**	1	11	4	**4**	20	2	**22**	2	**4**	**30**	**667**
07:45 AM	225	9	**3**	0	237	**8**	**29**	262	0	299	0	**14**	**7**	0	21	0	11	**4**	0	15	572
08:00 AM	181	10	2	0	193	3	28	257	0	288	2	10	4	0	16	3	7	1	0	11	508
08:15 AM	211	**11**	2	0	224	5	25	242	0	272	**4**	13	5	0	**22**	**4**	14	1	0	19	537
Total Volume	907	35	9	0	951	21	109	1049	0	1179	7	48	20	4	79	9	54	8	4	75	2284
% App. Total	95.4	3.7	0.9	0		1.8	9.2	89	0		8.9	60.8	25.3	5.1		12	72	10.7	5.3		
PHF	.782	.795	.750	.000	.801	.656	.940	.911	.000	.921	.438	.857	.714	.250	.898	.563	.614	.500	.250	.625	.856



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Honolulu, Hawaii 96817
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Start Date : 5/9/2024
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Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

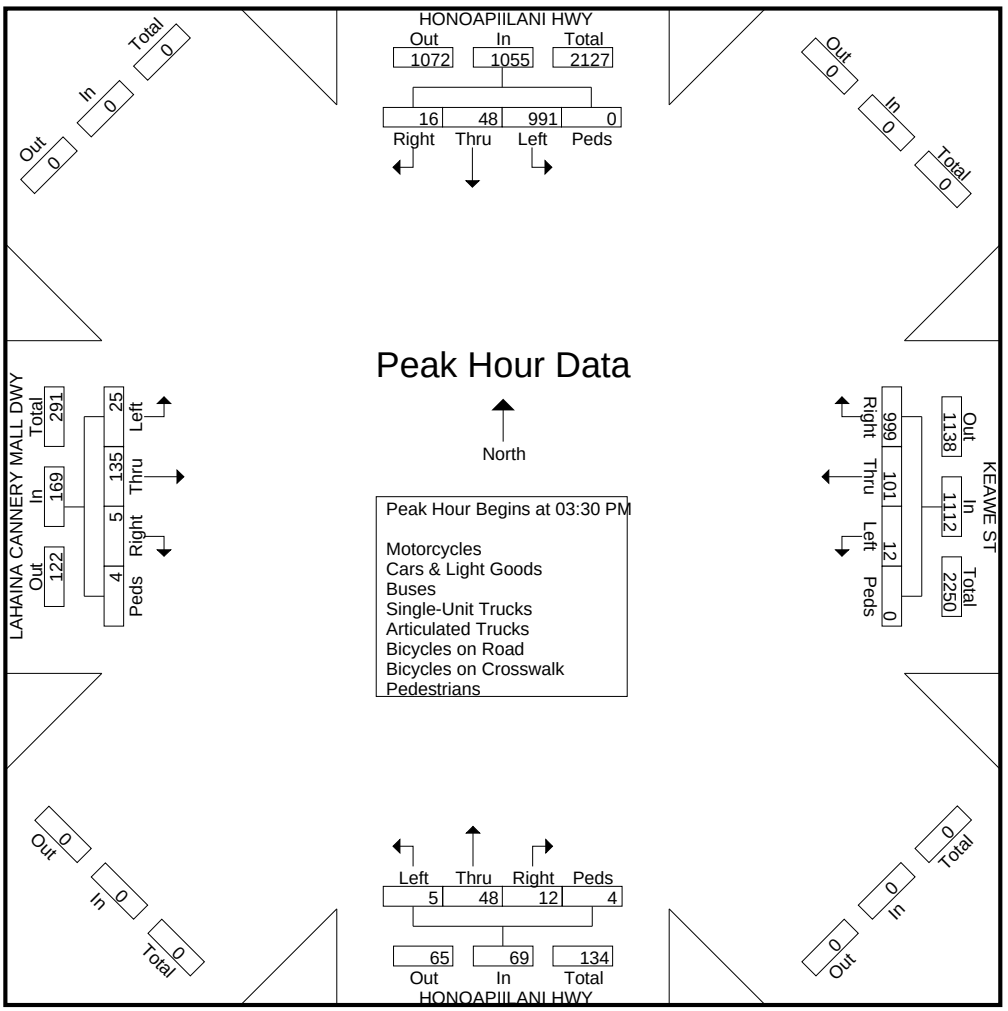
	HONOAPIILANI HWY SOUTHBOUND				KEAWE ST WESTBOUND				HONOAPIILANI HWY NORTHBOUND				LAHAINA CANNERY MALL DWY EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
03:00 PM	237	13	7	0	4	33	234	0	2	10	2	0	8	32	3	0	585
03:15 PM	222	13	5	0	2	31	227	0	3	2	4	0	7	35	0	0	551
03:30 PM	209	7	3	0	3	25	288	0	0	7	5	1	6	35	1	2	592
03:45 PM	256	12	5	0	1	28	254	0	3	8	2	0	5	27	2	0	603
Total	924	45	20	0	10	117	1003	0	8	27	13	1	26	129	6	2	2331
04:00 PM	283	15	4	0	3	19	231	0	1	21	1	3	6	29	1	2	619
04:15 PM	243	14	4	0	5	29	226	0	1	12	4	0	8	44	1	0	591
04:30 PM	260	4	3	0	2	37	209	0	1	9	0	1	5	27	0	0	558
04:45 PM	235	24	2	0	2	32	211	0	2	18	3	0	5	29	1	0	564
Total	1021	57	13	0	12	117	877	0	5	60	8	4	24	129	3	2	2332
05:00 PM	262	19	5	0	5	38	181	0	2	19	6	1	8	33	2	0	581
05:15 PM	210	15	4	0	3	24	229	0	3	45	9	2	16	55	2	1	618
05:30 PM	215	18	5	0	6	29	216	0	5	56	12	0	10	30	2	0	604
05:45 PM	177	7	2	0	5	28	202	0	6	39	7	2	7	22	0	2	506
Total	864	59	16	0	19	119	828	0	16	159	34	5	41	140	6	3	2309
Grand Total	2809	161	49	0	41	353	2708	0	29	246	55	10	91	398	15	7	6972
Apprch %	93	5.3	1.6	0	1.3	11.4	87.3	0	8.5	72.4	16.2	2.9	17.8	77.9	2.9	1.4	
Total %	40.3	2.3	0.7	0	0.6	5.1	38.8	0	0.4	3.5	0.8	0.1	1.3	5.7	0.2	0.1	
Motorcycles	12	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	15
% Motorcycles	0.4	0	0	0	0	0	0	0	0	0.4	0	0	0	0.3	0	0	0.2
Cars & Light Goods	2759	127	48	0	37	350	2672	0	28	228	53	0	81	385	14	0	6782
% Cars & Light Goods	98.2	78.9	98	0	90.2	99.2	98.7	0	96.6	92.7	96.4	0	89	96.7	93.3	0	97.3
Buses	14	0	0	0	0	0	18	0	0	0	0	0	10	7	0	0	49
% Buses	0.5	0	0	0	0	0	0.7	0	0	0	0	0	11	1.8	0	0	0.7
Single-Unit Trucks	21	26	1	0	4	3	14	0	1	12	2	0	0	5	1	0	90
% Single-Unit Trucks	0.7	16.1	2	0	9.8	0.8	0.5	0	3.4	4.9	3.6	0	0	1.3	6.7	0	1.3
Articulated Trucks	1	8	0	0	0	0	2	0	0	5	0	0	0	0	0	0	16
% Articulated Trucks	0	5	0	0	0	0	0.1	0	0	2	0	0	0	0	0	0	0.2
Bicycles on Road	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3
% Bicycles on Road	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	7	17
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	100	0.2

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Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : Honoapiilani Hwy - Keawe St
Site Code : 24-515 Honokowai Beach TA
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	HONOAPIILANI HWY SOUTHBOUND					KEAWE ST WESTBOUND					HONOAPIILANI HWY NORTHBOUND					LAHAINA CANNERY MALL DWY EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:30 PM																					
03:30 PM	209	7	3	0	219	3	25	**288**	0	**316**	0	7	**5**	1	13	6	35	1	**2**	44	592
03:45 PM	256	12	**5**	0	273	1	28	254	0	283	**3**	8	2	0	13	5	27	**2**	0	34	603
04:00 PM	**283**	**15**	4	0	**302**	3	19	231	0	253	1	**21**	1	**3**	**26**	6	29	1	2	38	**619**
04:15 PM	243	14	4	0	261	**5**	**29**	226	0	260	1	12	4	0	17	**8**	**44**	1	0	**53**	591
Total Volume	991	48	16	0	1055	12	101	999	0	1112	5	48	12	4	69	25	135	5	4	169	2405
% App. Total	93.9	4.5	1.5	0		1.1	9.1	89.8	0		7.2	69.6	17.4	5.8		14.8	79.9	3	2.4		
PHF	.875	.800	.800	.000	.873	.600	.871	.867	.000	.880	.417	.571	.600	.333	.663	.781	.767	.625	.500	.797	.971



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Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : SAT_Honoapiilani Hwy - Keawe St
Site Code : 24-515 Honokowai Beach TA
Start Date : 5/11/2024
Page No : 1

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

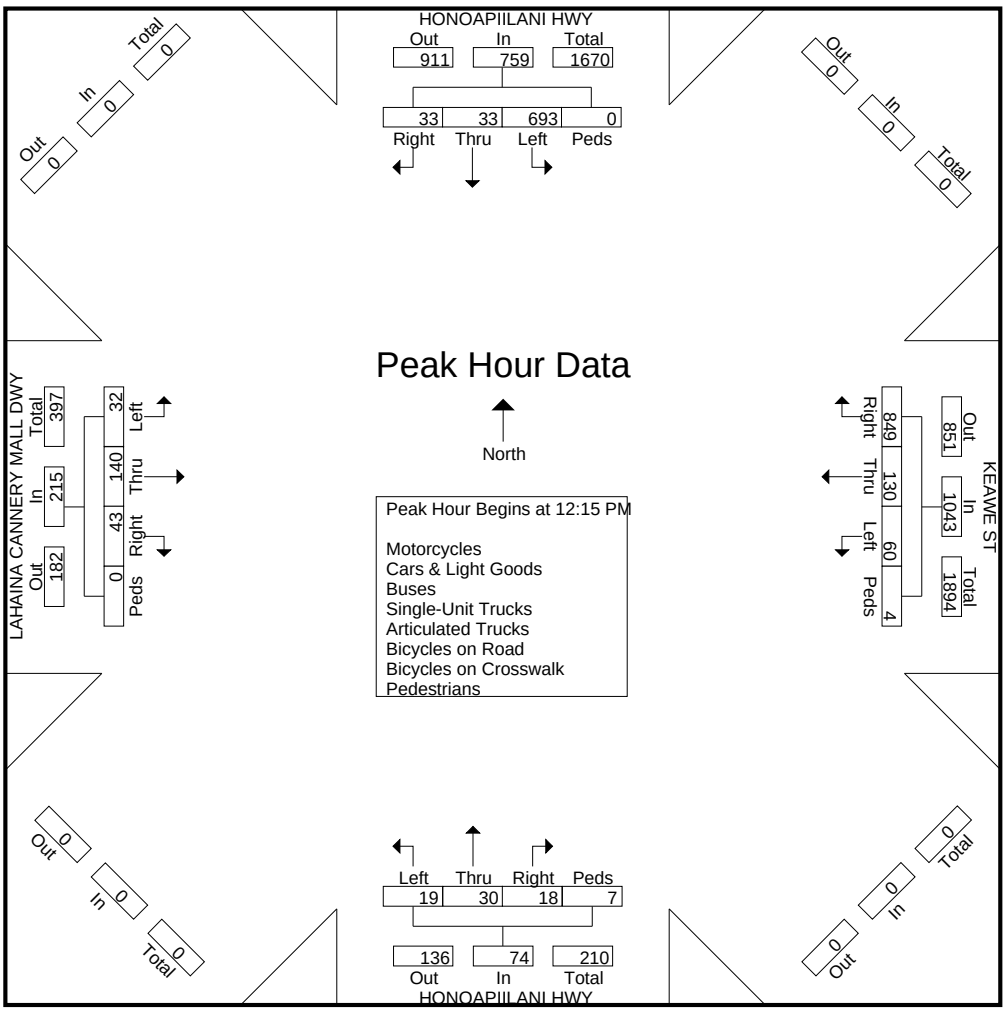
	HONOAPIILANI HWY SOUTHBOUND				KEAWE ST WESTBOUND				HONOAPIILANI HWY NORTHBOUND				LAHAINA CANNERY MALL DWY EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
11:00 AM	196	11	6	0	2	38	176	3	1	8	3	4	11	32	0	3	494
11:15 AM	187	5	4	0	3	26	172	1	3	8	4	1	11	27	0	0	452
11:30 AM	211	8	11	0	2	31	172	2	7	8	11	1	5	24	4	0	497
11:45 AM	165	9	6	0	6	39	184	2	8	16	19	2	6	26	3	2	493
Total	759	33	27	0	13	134	704	8	19	40	37	8	33	109	7	5	1936
12:00 PM	215	10	13	0	10	38	182	0	25	10	37	0	10	27	11	0	588
12:15 PM	181	3	14	0	21	46	214	1	10	9	10	1	10	32	13	0	565
12:30 PM	189	10	1	0	18	22	210	1	8	6	1	3	10	32	13	0	524
12:45 PM	161	14	9	0	12	45	217	2	1	4	4	2	5	45	15	0	536
Total	746	37	37	0	61	151	823	4	44	29	52	6	35	136	52	0	2213
01:00 PM	162	6	9	0	9	17	208	0	0	11	3	1	7	31	2	0	466
01:15 PM	156	7	5	0	3	29	272	2	3	6	6	2	10	23	4	2	530
01:30 PM	153	12	10	0	8	27	239	0	0	4	2	2	4	27	7	2	497
01:45 PM	170	8	10	0	4	21	241	2	3	4	6	4	7	30	3	5	518
Total	641	33	34	0	24	94	960	4	6	25	17	9	28	111	16	9	2011
Grand Total	2146	103	98	0	98	379	2487	16	69	94	106	23	96	356	75	14	6160
Apprch %	91.4	4.4	4.2	0	3.3	12.7	83.5	0.5	23.6	32.2	36.3	7.9	17.7	65.8	13.9	2.6	
Total %	34.8	1.7	1.6	0	1.6	6.2	40.4	0.3	1.1	1.5	1.7	0.4	1.6	5.8	1.2	0.2	
Motorcycles	4	0	0	0	1	3	5	0	0	0	1	0	0	1	0	0	15
% Motorcycles	0.2	0	0	0	1	0.8	0.2	0	0	0	0.9	0	0	0.3	0	0	0.2
Cars & Light Goods	2118	74	98	0	88	371	2453	0	63	72	90	0	83	345	67	0	5922
% Cars & Light Goods	98.7	71.8	100	0	89.8	97.9	98.6	0	91.3	76.6	84.9	0	86.5	96.9	89.3	0	96.1
Buses	1	0	0	0	0	2	9	0	0	0	0	0	13	7	0	0	32
% Buses	0	0	0	0	0	0.5	0.4	0	0	0	0	0	13.5	2	0	0	0.5
Single-Unit Trucks	23	28	0	0	8	3	17	0	6	20	11	0	0	1	8	0	125
% Single-Unit Trucks	1.1	27.2	0	0	8.2	0.8	0.7	0	8.7	21.3	10.4	0	0	0.3	10.7	0	2
Articulated Trucks	0	1	0	0	1	0	2	0	0	2	3	0	0	0	0	0	9
% Articulated Trucks	0	1	0	0	1	0	0.1	0	0	2.1	2.8	0	0	0	0	0	0.1
Bicycles on Road	0	0	0	0	0	0	1	0	0	0	1	0	0	2	0	0	4
% Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0.9	0	0	0.6	0	0	0.1
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	4.3	0	0	0	0	0
Pedestrians	0	0	0	0	0	0	0	16	0	0	0	22	0	0	0	14	52
% Pedestrians	0	0	0	0	0	0	0	100	0	0	0	95.7	0	0	0	100	0.8

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Site Code : 24-515 Honokowai Beach TA
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	HONOAPIILANI HWY SOUTHBOUND					KEAWE ST WESTBOUND					HONOAPIILANI HWY NORTHBOUND					LAHAINA CANNERY MALL DWY EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:15 PM to 01:00 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 12:15 PM																					
12:15 PM	181	3	**14**	0	198	**21**	**46**	214	1	**282**	**10**	9	**10**	1	**30**	**10**	32	13	0	55	**565**
12:30 PM	**189**	10	1	0	**200**	18	22	210	1	251	8	6	1	**3**	18	10	32	13	0	55	524
12:45 PM	161	**14**	9	0	184	12	45	**217**	**2**	276	1	4	4	2	11	5	**45**	**15**	0	**65**	536
01:00 PM	162	6	9	0	177	9	17	208	0	234	0	**11**	3	1	15	7	31	2	0	40	466
Total Volume	693	33	33	0	759	60	130	849	4	1043	19	30	18	7	74	32	140	43	0	215	2091
% App. Total	91.3	4.3	4.3	0		5.8	12.5	81.4	0.4		25.7	40.5	24.3	9.5		14.9	65.1	20	0		
PHF	.917	.589	.589	.000	.949	.714	.707	.978	.500	.925	.475	.682	.450	.583	.617	.800	.778	.717	.000	.827	.925



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501 Sumner St, Suite 521
Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : Honoapiilani Hwy - Kai Hele Ku St
Site Code : 24-515 Honokowai Beach Restoration
Start Date : 5/9/2024
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Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

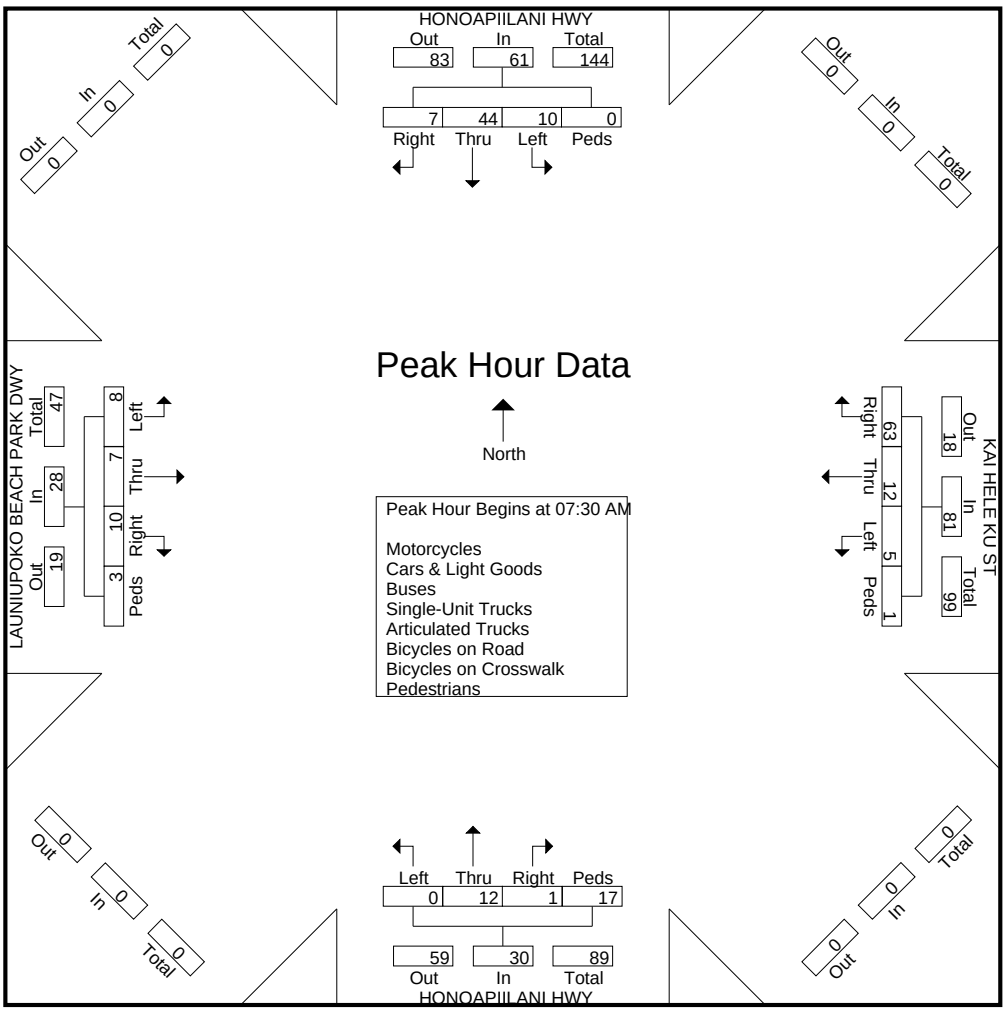
	HONOAPIILANI HWY SOUTHBOUND				KAI HELE KU ST WESTBOUND				HONOAPIILANI HWY NORTHBOUND				LAUNIUPOKO BEACH PARK DWY EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:30 AM	3	2	1	0	0	3	19	0	1	0	0	4	3	4	0	1	41
06:45 AM	3	4	2	0	0	4	17	0	0	3	0	3	5	0	2	0	43
Total	6	6	3	0	0	7	36	0	1	3	0	7	8	4	2	1	84
07:00 AM	1	5	2	0	2	3	15	0	0	2	0	3	1	3	2	0	39
07:15 AM	1	10	2	0	1	4	16	0	0	3	2	4	2	2	2	0	49
07:30 AM	1	11	1	0	2	5	15	1	0	2	0	3	2	3	3	0	49
07:45 AM	2	9	4	0	2	3	14	0	0	1	0	1	1	1	1	1	40
Total	5	35	9	0	7	15	60	1	0	8	2	11	6	9	8	1	177
08:00 AM	5	9	1	0	1	1	24	0	0	4	1	8	4	2	3	2	65
08:15 AM	2	15	1	0	0	3	10	0	0	5	0	5	1	1	3	0	46
08:30 AM	2	17	4	0	1	5	13	0	0	1	0	1	1	1	3	0	49
08:45 AM	1	17	2	0	3	4	18	0	0	4	0	2	2	2	5	1	61
Total	10	58	8	0	5	13	65	0	0	14	1	16	8	6	14	3	221
09:00 AM	5	18	2	0	1	8	19	1	0	4	0	2	5	3	1	1	70
09:15 AM	4	8	3	0	1	2	13	0	1	8	0	1	1	4	1	0	47
Grand Total	30	125	25	0	14	45	193	2	2	37	3	37	28	26	26	6	599
Apprch %	16.7	69.4	13.9	0	5.5	17.7	76	0.8	2.5	46.8	3.8	46.8	32.6	30.2	30.2	7	
Total %	5	20.9	4.2	0	2.3	7.5	32.2	0.3	0.3	6.2	0.5	6.2	4.7	4.3	4.3	1	
Motorcycles	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
% Motorcycles	0	0	0	0	0	0	0	0	0	0	0	0	3.6	0	0	0	0.2
Cars & Light Goods	29	82	25	0	13	44	144	0	2	14	2	0	27	26	25	0	433
% Cars & Light Goods	96.7	65.6	100	0	92.9	97.8	74.6	0	100	37.8	66.7	0	96.4	100	96.2	0	72.3
Buses	0	0	0	0	0	0	4	0	0	3	0	0	0	0	0	0	7
% Buses	0	0	0	0	0	0	2.1	0	0	8.1	0	0	0	0	0	0	1.2
Single-Unit Trucks	0	23	0	0	0	1	29	0	0	11	1	0	0	0	0	0	65
% Single-Unit Trucks	0	18.4	0	0	0	2.2	15	0	0	29.7	33.3	0	0	0	0	0	10.9
Articulated Trucks	1	17	0	0	1	0	15	0	0	9	0	0	0	0	0	0	43
% Articulated Trucks	3.3	13.6	0	0	7.1	0	7.8	0	0	24.3	0	0	0	0	0	0	7.2
Bicycles on Road	0	3	0	0	0	0	1	0	0	0	0	0	0	0	1	0	5
% Bicycles on Road	0	2.4	0	0	0	0	0.5	0	0	0	0	0	0	0	3.8	0	0.8
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33.3	0.3
Pedestrians	0	0	0	0	0	0	0	2	0	0	0	37	0	0	0	4	43
% Pedestrians	0	0	0	0	0	0	0	100	0	0	0	100	0	0	0	66.7	7.2

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	HONOAPIILANI HWY SOUTHBOUND					KAI HELE KU ST WESTBOUND					HONOAPIILANI HWY NORTHBOUND					LAUNIUPOKO BEACH PARK DWY EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:30 AM to 08:15 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	1	11	1	0	13	**2**	**5**	15	**1**	23	0	2	0	3	5	2	**3**	**3**	0	8	49
07:45 AM	2	9	**4**	0	15	2	3	14	0	19	0	1	0	1	2	1	1	1	1	4	40
08:00 AM	**5**	9	1	0	15	1	1	**24**	0	**26**	0	4	**1**	**8**	**13**	**4**	2	3	**2**	**11**	**65**
08:15 AM	2	**15**	1	0	**18**	0	3	10	0	13	0	**5**	0	5	10	1	1	3	0	5	46
Total Volume	10	44	7	0	61	5	12	63	1	81	0	12	1	17	30	8	7	10	3	28	200
% App. Total	16.4	72.1	11.5	0		6.2	14.8	77.8	1.2		0	40	3.3	56.7		28.6	25	35.7	10.7		
PHF	.500	.733	.438	.000	.847	.625	.600	.656	.250	.779	.000	.600	.250	.531	.577	.500	.583	.833	.375	.636	.769



Austin Tsutsumi & Associates

501 Sumner St, Suite 521
Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : Honoapiilani Hwy - Kai Hele Ku St
Site Code : 24-515 Honokowai Beach Restoration
Start Date : 5/9/2024
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Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

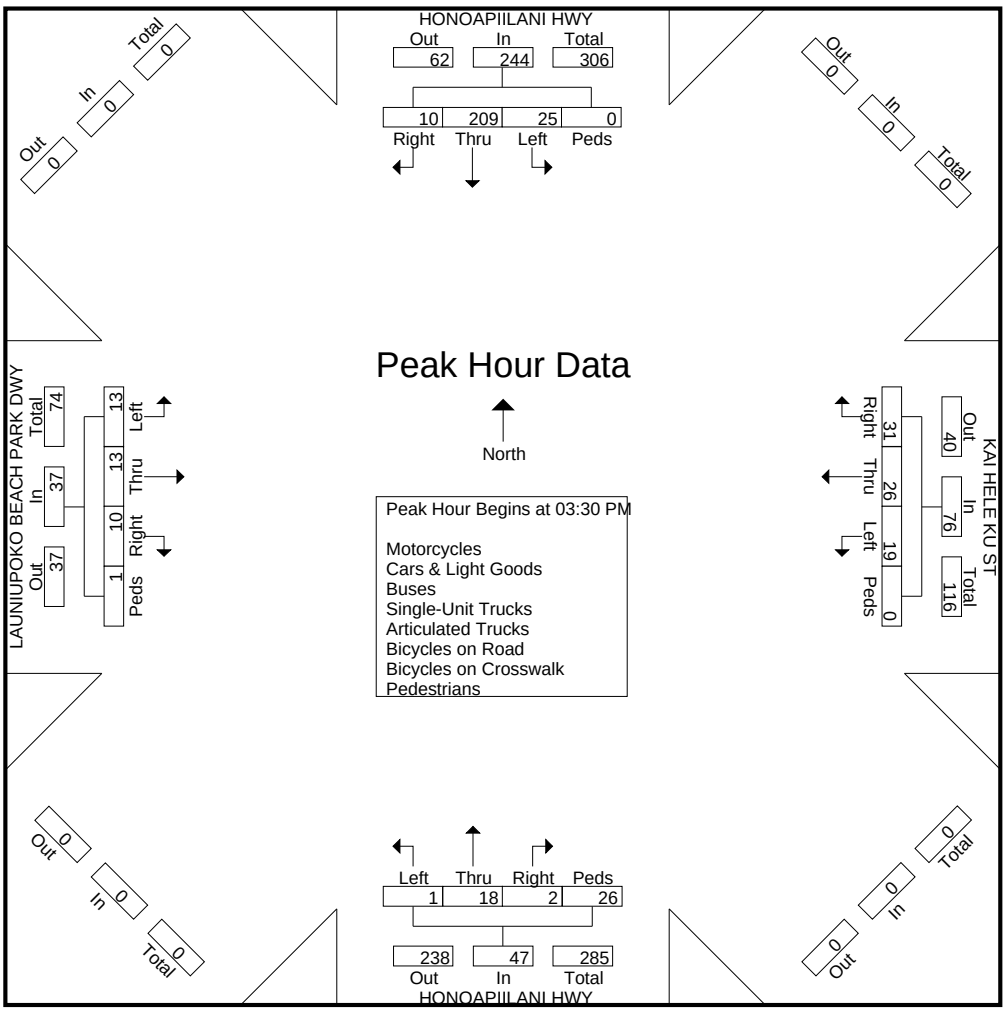
	HONOAPIILANI HWY SOUTHBOUND				KAI HELE KU ST WESTBOUND				HONOAPIILANI HWY NORTHBOUND				LAUNIUPOKO BEACH PARK DWY EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
03:30 PM	8	49	2	0	6	9	11	0	0	4	1	9	2	6	2	1	110
03:45 PM	7	49	6	0	5	6	7	0	0	5	0	6	3	3	2	0	99
Total	15	98	8	0	11	15	18	0	0	9	1	15	5	9	4	1	209
04:00 PM	4	48	1	0	5	2	5	0	0	5	1	9	6	1	3	0	90
04:15 PM	6	63	1	0	3	9	8	0	1	4	0	2	2	3	3	0	105
04:30 PM	5	62	4	0	4	11	5	1	0	3	0	9	3	8	3	0	118
04:45 PM	3	57	2	0	16	6	6	0	1	3	1	17	0	4	2	3	121
Total	18	230	8	0	28	28	24	1	2	15	2	37	11	16	11	3	434
05:00 PM	10	56	2	0	49	8	5	1	0	1	0	9	0	8	4	0	153
05:15 PM	11	98	4	0	47	3	4	0	0	0	3	29	3	4	3	0	209
05:30 PM	8	75	2	0	32	2	12	0	0	1	0	12	2	0	2	0	148
05:45 PM	8	83	1	0	27	9	5	0	1	1	0	16	0	4	3	1	159
Total	37	312	9	0	155	22	26	1	1	3	3	66	5	16	12	1	669
Grand Total	70	640	25	0	194	65	68	2	3	27	6	118	21	41	27	5	1312
Apprch %	9.5	87.1	3.4	0	59	19.8	20.7	0.6	1.9	17.5	3.9	76.6	22.3	43.6	28.7	5.3	
Total %	5.3	48.8	1.9	0	14.8	5	5.2	0.2	0.2	2.1	0.5	9	1.6	3.1	2.1	0.4	
Motorcycles	0	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0	4
% Motorcycles	0	0.3	0	0	0.5	0	0	0	0	0	16.7	0	0	0	0	0	0.3
Cars & Light Goods	65	574	24	0	191	65	65	0	3	7	5	0	21	41	27	0	1088
% Cars & Light Goods	92.9	89.7	96	0	98.5	100	95.6	0	100	25.9	83.3	0	100	100	100	0	82.9
Buses	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
% Buses	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Single-Unit Trucks	3	48	1	0	2	0	2	0	0	17	0	0	0	0	0	0	73
% Single-Unit Trucks	4.3	7.5	4	0	1	0	2.9	0	0	63	0	0	0	0	0	0	5.6
Articulated Trucks	2	15	0	0	0	0	1	0	0	3	0	0	0	0	0	0	21
% Articulated Trucks	2.9	2.3	0	0	0	0	1.5	0	0	11.1	0	0	0	0	0	0	1.6
Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	0	0	0	0	2	0	0	0	118	0	0	0	5	125
% Pedestrians	0	0	0	0	0	0	0	100	0	0	0	100	0	0	0	100	9.5

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501 Sumner St, Suite 521
Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : Honoapiilani Hwy - Kai Hele Ku St
Site Code : 24-515 Honokowai Beach Restoration
Start Date : 5/9/2024
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	HONOAPIILANI HWY SOUTHBOUND					KAI HELE KU ST WESTBOUND					HONOAPIILANI HWY NORTHBOUND					LAUNIUPOKO BEACH PARK DWY EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:30 PM to 04:15 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:30 PM																					
03:30 PM	**8**	49	2	0	59	**6**	**9**	**11**	0	**26**	0	4	**1**	**9**	14	2	**6**	2	**1**	**11**	**110**
03:45 PM	7	49	**6**	0	62	5	6	7	0	18	0	**5**	0	6	11	3	3	2	0	8	99
04:00 PM	4	48	1	0	53	5	2	5	0	12	0	5	1	9	**15**	**6**	1	**3**	0	10	90
04:15 PM	6	**63**	1	0	**70**	3	9	8	0	20	**1**	4	0	2	7	2	3	3	0	8	105
Total Volume	25	209	10	0	244	19	26	31	0	76	1	18	2	26	47	13	13	10	1	37	404
% App. Total	10.2	85.7	4.1	0		25	34.2	40.8	0		2.1	38.3	4.3	55.3		35.1	35.1	27	2.7		
PHF	.781	.829	.417	.000	.871	.792	.722	.705	.000	.731	.250	.900	.500	.722	.783	.542	.542	.833	.250	.841	.918



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501 Sumner St, Suite 521
Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : SAT_Honoapiilani Hwy - Kai Hele Ku St
Site Code : 24-515 Honokowai Beach Restoration
Start Date : 5/11/2024
Page No : 1

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

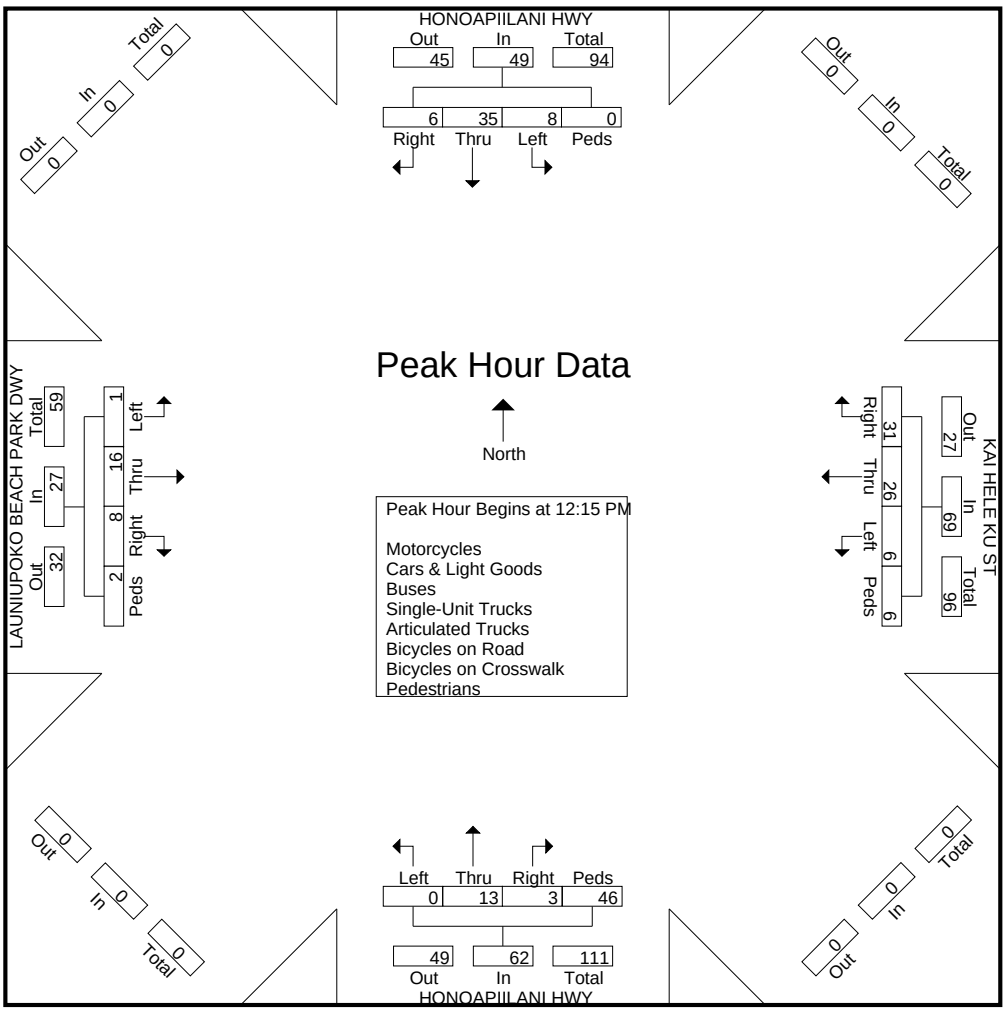
	HONOAPIILANI HWY SOUTHBOUND				KAI HELE KU ST WESTBOUND				HONOAPIILANI HWY NORTHBOUND				LAUNIUPOKO BEACH PARK DWY EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
11:00 AM	7	15	0	0	0	7	6	1	0	8	0	14	2	3	1	3	67
11:15 AM	3	19	3	0	2	0	12	1	0	5	0	9	2	3	2	2	63
11:30 AM	2	9	2	1	1	7	8	1	1	6	0	7	3	3	5	5	61
11:45 AM	3	14	3	0	1	8	9	0	0	7	0	14	1	5	2	1	68
Total	15	57	8	1	4	22	35	3	1	26	0	44	8	14	10	11	259
12:00 PM	6	8	3	0	2	7	7	0	0	2	0	17	2	8	1	3	66
12:15 PM	2	12	1	0	2	5	7	0	0	9	0	13	0	0	4	0	55
12:30 PM	2	7	2	0	0	5	6	0	0	2	2	8	0	5	3	0	42
12:45 PM	2	6	1	0	2	11	9	0	0	2	1	11	1	6	0	2	54
Total	12	33	7	0	6	28	29	0	0	15	3	49	3	19	8	5	217
01:00 PM	2	10	2	0	2	5	9	6	0	0	0	14	0	5	1	0	56
01:15 PM	3	10	2	0	6	5	8	0	1	1	0	5	0	2	5	0	48
01:30 PM	2	5	3	2	2	6	8	1	0	2	0	9	2	5	3	2	52
01:45 PM	4	17	1	0	4	5	5	0	0	3	0	17	2	4	0	2	64
Total	11	42	8	2	14	21	30	7	1	6	0	45	4	16	9	4	220
Grand Total	38	132	23	3	24	71	94	10	2	47	3	138	15	49	27	20	696
Apprch %	19.4	67.3	11.7	1.5	12.1	35.7	47.2	5	1.1	24.7	1.6	72.6	13.5	44.1	24.3	18	
Total %	5.5	19	3.3	0.4	3.4	10.2	13.5	1.4	0.3	6.8	0.4	19.8	2.2	7	3.9	2.9	
Motorcycles	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3
% Motorcycles	0	1.5	0	0	0	0	0	0	0	2.1	0	0	0	0	0	0	0.4
Cars & Light Goods	38	76	23	0	23	71	87	0	2	10	3	0	14	49	25	0	421
% Cars & Light Goods	100	57.6	100	0	95.8	100	92.6	0	100	21.3	100	0	93.3	100	92.6	0	60.5
Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Single-Unit Trucks	0	44	0	0	0	0	2	0	0	32	0	0	1	0	0	0	79
% Single-Unit Trucks	0	33.3	0	0	0	0	2.1	0	0	68.1	0	0	6.7	0	0	0	11.4
Articulated Trucks	0	10	0	0	0	0	5	0	0	3	0	0	0	0	0	0	18
% Articulated Trucks	0	7.6	0	0	0	0	5.3	0	0	6.4	0	0	0	0	0	0	2.6
Bicycles on Road	0	0	0	0	1	0	0	0	0	1	0	0	0	0	2	0	4
% Bicycles on Road	0	0	0	0	4.2	0	0	0	0	2.1	0	0	0	0	7.4	0	0.6
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0.4
Pedestrians	0	0	0	3	0	0	0	10	0	0	0	138	0	0	0	17	168
% Pedestrians	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	85	24.1

Austin Tsutsumi & Associates

501 Sumner St, Suite 521
Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

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Site Code : 24-515 Honokowai Beach Restoration
Start Date : 5/11/2024
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	HONOAPIILANI HWY SOUTHBOUND					KAI HELE KU ST WESTBOUND					HONOAPIILANI HWY NORTHBOUND					LAUNIUPOKO BEACH PARK DWY EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:15 PM to 01:00 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 12:15 PM																					
12:15 PM	**2**	**12**	1	0	**15**	**2**	5	7	0	14	0	**9**	0	13	**22**	0	0	**4**	0	4	55
12:30 PM	2	7	**2**	0	11	0	5	6	0	11	0	2	**2**	8	12	0	5	3	0	8	42
12:45 PM	2	6	1	0	9	2	**11**	**9**	0	**22**	0	2	1	11	14	**1**	**6**	0	**2**	**9**	54
01:00 PM	2	10	2	0	14	2	5	9	**6**	22	0	0	0	**14**	14	0	5	1	0	6	**56**
Total Volume	8	35	6	0	49	6	26	31	6	69	0	13	3	46	62	1	16	8	2	27	207
% App. Total	16.3	71.4	12.2	0		8.7	37.7	44.9	8.7		0	21	4.8	74.2		3.7	59.3	29.6	7.4		
PHF	1.00	.729	.750	.000	.817	.750	.591	.861	.250	.784	.000	.361	.375	.821	.705	.250	.667	.500	.250	.750	.924



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501 Sumner St, Suite 521
Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : Lahaina Bypass - Kai Hele Ku St
Site Code : 24-515 Honokowai Beach Restoration
Start Date : 5/9/2024
Page No : 1

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

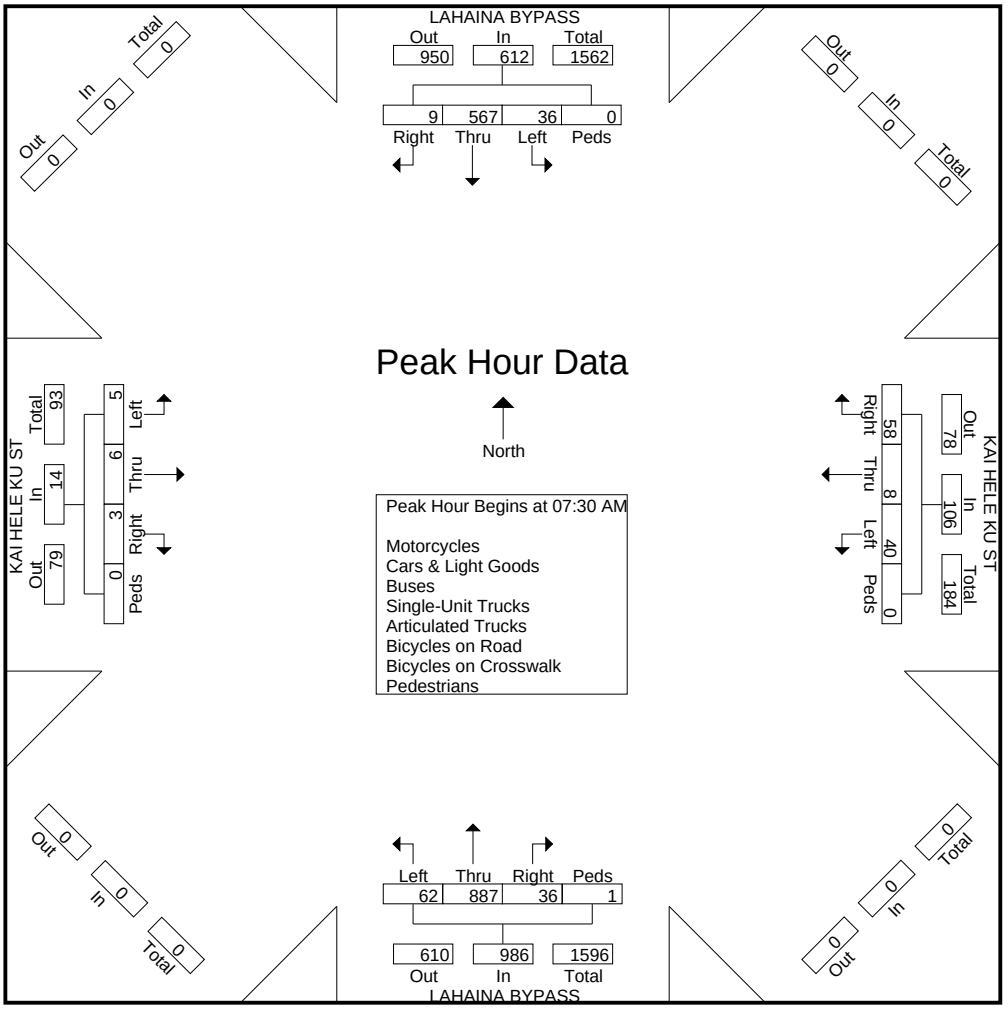
	LAHAINA BYPASS SOUTHBOUND				KAI HELE KU ST WESTBOUND				LAHAINA BYPASS NORTHBOUND				KAI HELE KU ST EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:30 AM	6	107	0	0	6	4	6	0	15	249	5	0	3	1	0	0	402
06:45 AM	8	119	0	0	5	4	6	0	18	252	10	0	0	2	2	0	426
Total	14	226	0	0	11	8	12	0	33	501	15	0	3	3	2	0	828
07:00 AM	3	120	0	0	10	1	21	0	24	268	13	0	0	0	2	0	462
07:15 AM	6	131	0	0	5	1	20	0	18	243	7	0	0	2	2	0	435
07:30 AM	10	146	4	0	9	3	16	0	14	234	7	0	2	1	2	0	448
07:45 AM	7	128	1	0	16	3	18	0	16	229	9	1	0	1	0	0	429
Total	26	525	5	0	40	8	75	0	72	974	36	1	2	4	6	0	1774
08:00 AM	9	156	1	0	8	2	10	0	24	214	11	0	0	2	1	0	438
08:15 AM	10	137	3	0	7	0	14	0	8	210	9	0	3	2	0	0	403
08:30 AM	13	160	1	0	11	1	1	0	18	198	13	0	0	3	1	0	420
08:45 AM	10	166	2	0	3	2	8	0	17	224	9	0	3	0	0	0	444
Total	42	619	7	0	29	5	33	0	67	846	42	0	6	7	2	0	1705
09:00 AM	9	148	4	0	11	3	1	0	7	157	6	0	0	3	1	0	350
09:15 AM	6	200	1	0	13	0	0	0	9	149	6	0	1	2	1	0	388
Grand Total	97	1718	17	0	104	24	121	0	188	2627	105	1	12	19	12	0	5045
Apprch %	5.3	93.8	0.9	0	41.8	9.6	48.6	0	6.4	89.9	3.6	0	27.9	44.2	27.9	0	
Total %	1.9	34.1	0.3	0	2.1	0.5	2.4	0	3.7	52.1	2.1	0	0.2	0.4	0.2	0	
Motorcycles	0	0	0	0	0	0	1	0	0	6	0	0	0	0	0	0	7
% Motorcycles	0	0	0	0	0	0	0.8	0	0	0.2	0	0	0	0	0	0	0.1
Cars & Light Goods	97	1664	15	0	99	21	116	0	142	2523	93	0	11	18	12	0	4811
% Cars & Light Goods	100	96.9	88.2	0	95.2	87.5	95.9	0	75.5	96	88.6	0	91.7	94.7	100	0	95.4
Buses	0	25	1	0	0	0	3	0	0	12	4	0	1	0	0	0	46
% Buses	0	1.5	5.9	0	0	0	2.5	0	0	0.5	3.8	0	8.3	0	0	0	0.9
Single-Unit Trucks	0	20	1	0	4	2	1	0	26	75	6	0	0	1	0	0	136
% Single-Unit Trucks	0	1.2	5.9	0	3.8	8.3	0.8	0	13.8	2.9	5.7	0	0	5.3	0	0	2.7
Articulated Trucks	0	8	0	0	1	0	0	0	20	10	2	0	0	0	0	0	41
% Articulated Trucks	0	0.5	0	0	1	0	0	0	10.6	0.4	1.9	0	0	0	0	0	0.8
Bicycles on Road	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	3
% Bicycles on Road	0	0.1	0	0	0	4.2	0	0	0	0	0	0	0	0	0	0	0.1
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Austin Tsutsumi & Associates

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	LAHAINA BYPASS SOUTHBOUND					KAI HELE KU ST WESTBOUND					LAHAINA BYPASS NORTHBOUND					KAI HELE KU ST EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:30 AM to 08:15 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	**10**	146	**4**	0	160	9	**3**	16	0	28	14	**234**	7	0	**255**	2	1	**2**	0	**5**	**448**
07:45 AM	7	128	1	0	136	**16**	3	**18**	0	**37**	16	229	9	**1**	255	0	1	0	0	1	429
08:00 AM	9	**156**	1	0	**166**	8	2	10	0	20	**24**	214	**11**	0	249	0	**2**	1	0	3	438
08:15 AM	10	137	3	0	150	7	0	14	0	21	8	210	9	0	227	**3**	2	0	0	5	403
Total Volume	36	567	9	0	612	40	8	58	0	106	62	887	36	1	986	5	6	3	0	14	1718
% App. Total	5.9	92.6	1.5	0		37.7	7.5	54.7	0		6.3	90	3.7	0.1		35.7	42.9	21.4	0		
PHF	.900	.909	.563	.000	.922	.625	.667	.806	.000	.716	.646	.948	.818	.250	.967	.417	.750	.375	.000	.700	.959



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Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : Lahaina Bypass - Kai Hele Ku St
Site Code : 24-515 Honokowai Beach Restoration
Start Date : 5/9/2024
Page No : 1

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

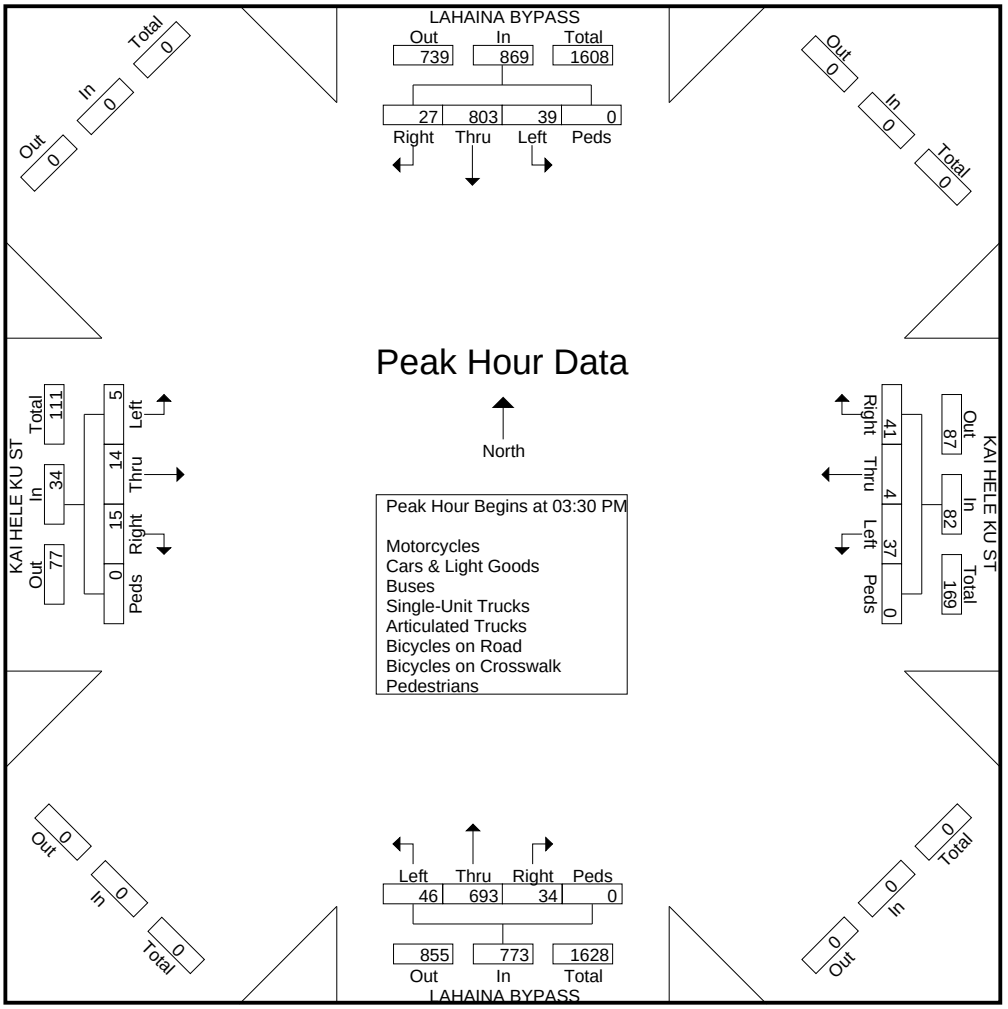
	LAHAINA BYPASS SOUTHBOUND				KAI HELE KU ST WESTBOUND				LAHAINA BYPASS NORTHBOUND				KAI HELE KU ST EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
03:00 PM	12	228	5	0	8	2	9	0	5	160	8	0	1	5	2	0	445
03:15 PM	11	213	6	0	12	1	13	0	16	210	9	0	2	1	0	0	494
03:30 PM	6	227	13	0	11	2	7	0	11	184	4	0	2	4	4	0	475
03:45 PM	15	188	6	0	9	1	15	0	13	183	11	0	0	5	3	0	449
Total	44	856	30	0	40	6	44	0	45	737	32	0	5	15	9	0	1863
04:00 PM	12	188	4	0	14	1	10	0	9	165	7	0	2	1	3	0	416
04:15 PM	6	200	4	0	3	0	9	0	13	161	12	0	1	4	5	0	418
04:30 PM	4	188	4	0	7	1	4	0	15	176	4	0	5	3	3	0	414
04:45 PM	12	153	25	0	3	4	10	0	8	171	9	0	1	1	4	0	401
Total	34	729	37	0	27	6	33	0	45	673	32	0	9	9	15	0	1649
05:00 PM	6	142	46	0	1	2	3	0	9	148	11	0	0	5	3	0	376
05:15 PM	5	93	41	0	6	2	8	0	10	189	9	0	4	6	3	0	376
05:30 PM	14	88	30	0	2	4	4	0	11	177	8	0	2	7	1	0	348
05:45 PM	7	103	26	0	2	1	7	0	11	135	9	0	2	9	1	0	313
Total	32	426	143	0	11	9	22	0	41	649	37	0	8	27	8	0	1413
Grand Total	110	2011	210	0	78	21	99	0	131	2059	101	0	22	51	32	0	4925
Apprch %	4.7	86.3	9	0	39.4	10.6	50	0	5.7	89.9	4.4	0	21	48.6	30.5	0	
Total %	2.2	40.8	4.3	0	1.6	0.4	2	0	2.7	41.8	2.1	0	0.4	1	0.6	0	
Motorcycles	0	3	1	0	0	0	0	0	0	1	0	0	1	0	0	0	6
% Motorcycles	0	0.1	0.5	0	0	0	0	0	0	0	0	0	4.5	0	0	0	0.1
Cars & Light Goods	109	1962	207	0	77	21	98	0	125	2030	99	0	21	50	28	0	4827
% Cars & Light Goods	99.1	97.6	98.6	0	98.7	100	99	0	95.4	98.6	98	0	95.5	98	87.5	0	98
Buses	0	20	0	0	0	0	0	0	0	14	0	0	0	0	0	0	34
% Buses	0	1	0	0	0	0	0	0	0	0.7	0	0	0	0	0	0	0.7
Single-Unit Trucks	0	22	2	0	1	0	1	0	2	11	2	0	0	1	2	0	44
% Single-Unit Trucks	0	1.1	1	0	1.3	0	1	0	1.5	0.5	2	0	0	2	6.2	0	0.9
Articulated Trucks	0	3	0	0	0	0	0	0	4	0	0	0	0	0	2	0	9
% Articulated Trucks	0	0.1	0	0	0	0	0	0	3.1	0	0	0	0	0	6.2	0	0.2
Bicycles on Road	1	1	0	0	0	0	0	0	0	3	0	0	0	0	0	0	5
% Bicycles on Road	0.9	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0.1
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Austin Tsutsumi & Associates

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Honolulu, Hawaii 96817
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File Name : Lahaina Bypass - Kai Hele Ku St
Site Code : 24-515 Honokowai Beach Restoration
Start Date : 5/9/2024
Page No : 2

	LAHAINA BYPASS SOUTHBOUND					KAI HELE KU ST WESTBOUND					LAHAINA BYPASS NORTHBOUND					KAI HELE KU ST EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:30 PM to 04:15 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:30 PM																					
03:30 PM	6	**227**	**13**	0	**246**	11	**2**	7	0	20	11	**184**	4	0	199	**2**	4	4	0	**10**	**475**
03:45 PM	**15**	188	6	0	209	9	1	**15**	0	**25**	**13**	183	11	0	**207**	0	**5**	3	0	8	449
04:00 PM	12	188	4	0	204	**14**	1	10	0	25	9	165	7	0	181	2	1	3	0	6	416
04:15 PM	6	200	4	0	210	3	0	9	0	12	13	161	**12**	0	186	1	4	**5**	0	10	418
Total Volume	39	803	27	0	869	37	4	41	0	82	46	693	34	0	773	5	14	15	0	34	1758
% App. Total	4.5	92.4	3.1	0		45.1	4.9	50	0		6	89.7	4.4	0		14.7	41.2	44.1	0		
PHF	.650	.884	.519	.000	.883	.661	.500	.683	.000	.820	.885	.942	.708	.000	.934	.625	.700	.750	.000	.850	.925



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Honolulu, Hawaii 96817
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File Name : SAT_Lahaina Bypass - Kai Hele Ku St
Site Code : 24-515 Honokowai Beach Restoration
Start Date : 5/11/2024

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

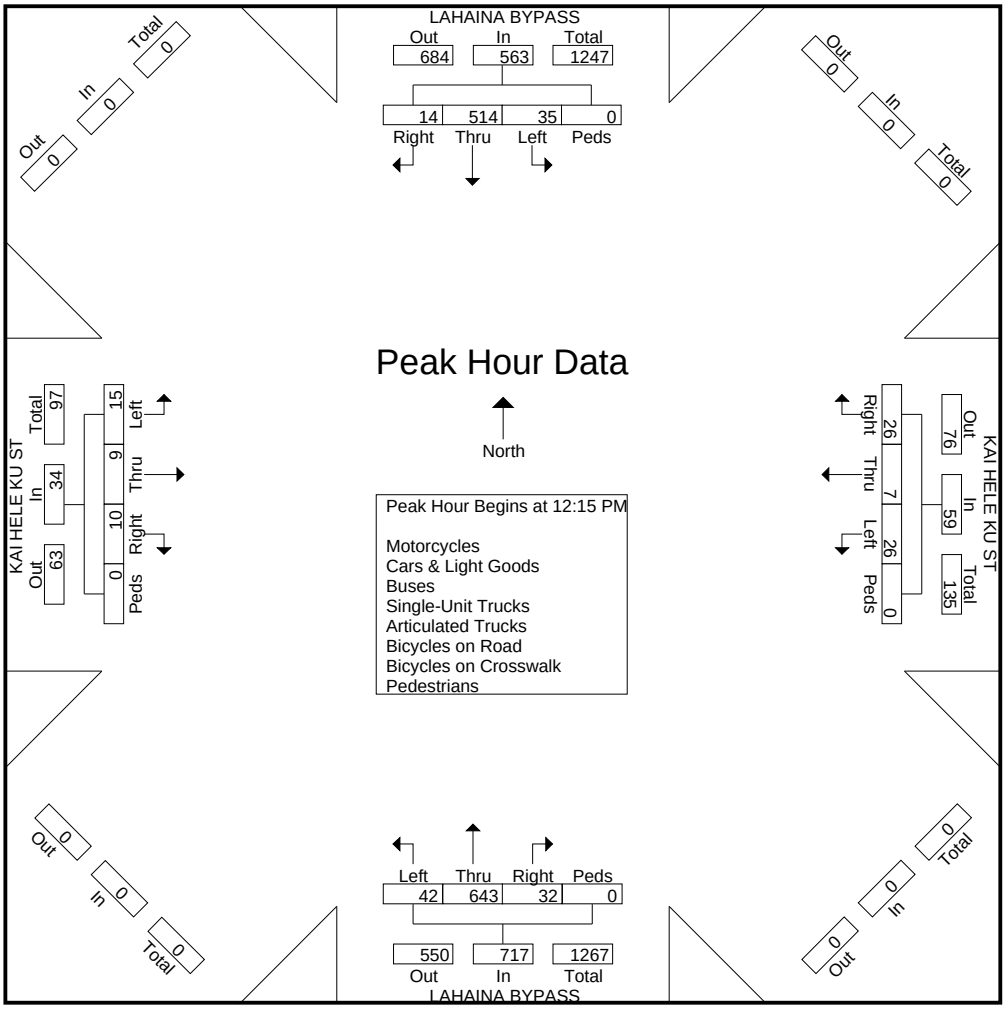
	LAHAINA BYPASS SOUTHBOUND				KAI HELE KU ST WESTBOUND				LAHAINA BYPASS NORTHBOUND				KAI HELE KU ST EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
11:00 AM	8	203	5	0	5	0	2	0	7	122	4	0	7	1	3	0	367
11:15 AM	5	160	1	0	11	0	0	0	14	119	5	0	2	1	3	0	321
11:30 AM	11	155	2	0	9	1	0	0	12	157	3	0	1	0	4	0	355
11:45 AM	11	187	3	0	13	3	0	0	10	129	9	0	4	2	2	0	373
Total	35	705	11	0	38	4	2	0	43	527	21	0	14	4	12	0	1416
12:00 PM	12	119	3	0	10	1	12	0	11	159	9	0	6	3	4	0	349
12:15 PM	4	147	7	0	12	0	9	0	9	139	2	0	6	2	4	0	341
12:30 PM	9	107	0	0	5	1	7	0	12	148	10	0	4	1	4	0	308
12:45 PM	11	141	5	0	5	4	10	0	11	149	10	0	4	3	1	0	354
Total	36	514	15	0	32	6	38	0	43	595	31	0	20	9	13	0	1352
01:00 PM	11	119	2	0	4	2	0	0	10	207	10	0	1	3	1	0	370
01:15 PM	11	138	2	0	10	3	0	0	11	194	9	0	1	0	0	0	379
01:30 PM	4	132	2	0	6	0	0	0	11	217	15	0	2	2	0	0	391
01:45 PM	5	129	6	0	7	2	0	0	4	170	12	0	1	1	3	0	340
Total	31	518	12	0	27	7	0	0	36	788	46	0	5	6	4	0	1480
Grand Total	102	1737	38	0	97	17	40	0	122	1910	98	0	39	19	29	0	4248
Apprch %	5.4	92.5	2	0	63	11	26	0	5.7	89.7	4.6	0	44.8	21.8	33.3	0	
Total %	2.4	40.9	0.9	0	2.3	0.4	0.9	0	2.9	45	2.3	0	0.9	0.4	0.7	0	
Motorcycles	0	4	0	0	0	1	0	0	0	4	1	0	0	0	0	0	10
% Motorcycles	0	0.2	0	0	0	5.9	0	0	0	0.2	1	0	0	0	0	0	0.2
Cars & Light Goods	102	1710	37	0	96	16	40	0	116	1882	97	0	39	19	29	0	4183
% Cars & Light Goods	100	98.4	97.4	0	99	94.1	100	0	95.1	98.5	99	0	100	100	100	0	98.5
Buses	0	5	0	0	0	0	0	0	0	5	0	0	0	0	0	0	10
% Buses	0	0.3	0	0	0	0	0	0	0	0.3	0	0	0	0	0	0	0.2
Single-Unit Trucks	0	13	1	0	1	0	0	0	1	17	0	0	0	0	0	0	33
% Single-Unit Trucks	0	0.7	2.6	0	1	0	0	0	0.8	0.9	0	0	0	0	0	0	0.8
Articulated Trucks	0	5	0	0	0	0	0	0	5	1	0	0	0	0	0	0	11
% Articulated Trucks	0	0.3	0	0	0	0	0	0	4.1	0.1	0	0	0	0	0	0	0.3
Bicycles on Road	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
% Bicycles on Road	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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Site Code : 24-515 Honokowai Beach Restoration
Start Date : 5/11/2024
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	LAHAINA BYPASS SOUTHBOUND					KAI HELE KU ST WESTBOUND					LAHAINA BYPASS NORTHBOUND					KAI HELE KU ST EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:15 PM to 01:00 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 12:15 PM																					
12:15 PM	4	**147**	**7**	0	**158**	**12**	0	9	0	**21**	9	139	2	0	150	**6**	2	**4**	0	**12**	341
12:30 PM	9	107	0	0	116	5	1	7	0	13	**12**	148	**10**	0	170	4	1	4	0	9	308
12:45 PM	**11**	141	5	0	157	5	**4**	**10**	0	19	11	149	10	0	170	4	**3**	1	0	8	354
01:00 PM	11	119	2	0	132	4	2	0	0	6	10	**207**	10	0	**227**	1	3	1	0	5	**370**
Total Volume	35	514	14	0	563	26	7	26	0	59	42	643	32	0	717	15	9	10	0	34	1373
% App. Total	6.2	91.3	2.5	0		44.1	11.9	44.1	0		5.9	89.7	4.5	0		44.1	26.5	29.4	0		
PHF	.795	.874	.500	.000	.891	.542	.438	.650	.000	.702	.875	.777	.800	.000	.790	.625	.750	.625	.000	.708	.928



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501 Sumner St, Suite 521
Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : Lahaina Bypass - Honoapiilani Hwy (South Terminus)
Site Code : 24-515 Honokowai Beach TA
Start Date : 5/9/2024

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

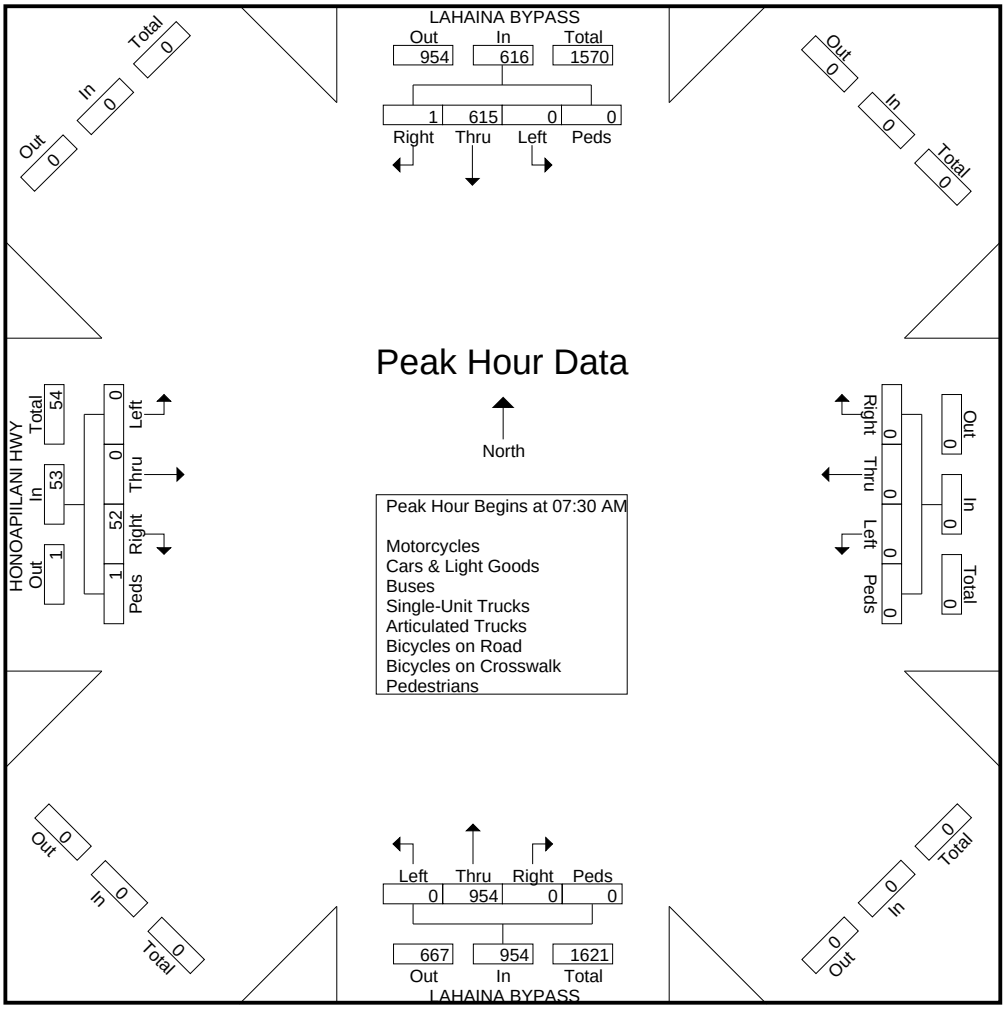
	LAHAINA BYPASS SOUTHBOUND				WESTBOUND				LAHAINA BYPASS NORTHBOUND				HONOAPIILANI HWY EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:30 AM	0	122	0	0	0	0	0	0	0	247	0	0	0	0	1	0	370
06:45 AM	0	146	0	0	0	0	0	0	0	286	0	0	0	0	7	0	439
Total	0	268	0	0	0	0	0	0	0	533	0	0	0	0	8	0	809
07:00 AM	0	129	1	0	0	0	0	0	0	281	0	0	0	0	8	0	419
07:15 AM	0	143	1	0	0	0	0	0	0	240	0	0	0	0	13	0	397
07:30 AM	0	149	1	0	0	0	0	0	0	245	0	0	0	0	12	1	408
07:45 AM	0	155	0	0	0	0	0	0	0	234	0	0	0	0	13	0	402
Total	0	576	3	0	0	0	0	0	0	1000	0	0	0	0	46	1	1626
08:00 AM	0	160	0	0	0	0	0	0	0	250	0	0	0	0	10	0	420
08:15 AM	0	151	0	0	0	0	0	0	0	225	0	0	0	0	17	0	393
08:30 AM	0	164	0	0	0	0	0	0	0	228	0	0	0	0	16	0	408
08:45 AM	0	180	0	0	0	0	0	0	0	262	0	0	0	0	16	0	458
Total	0	655	0	0	0	0	0	0	0	965	0	0	0	0	59	0	1679
09:00 AM	0	160	0	0	0	0	0	0	0	160	0	0	0	0	10	0	330
09:15 AM	0	199	0	0	0	0	0	0	0	161	0	0	0	0	6	0	366
Grand Total	0	1858	3	0	0	0	0	0	0	2819	0	0	0	0	129	1	4810
Apprch %	0	99.8	0.2	0	0	0	0	0	0	100	0	0	0	0	99.2	0.8	
Total %	0	38.6	0.1	0	0	0	0	0	0	58.6	0	0	0	0	2.7	0	
Motorcycles	0	1	0	0	0	0	0	0	0	6	0	0	0	0	0	0	7
% Motorcycles	0	0.1	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0.1
Cars & Light Goods	0	1806	2	0	0	0	0	0	0	2663	0	0	0	0	113	0	4584
% Cars & Light Goods	0	97.2	66.7	0	0	0	0	0	0	94.5	0	0	0	0	87.6	0	95.3
Buses	0	22	0	0	0	0	0	0	0	15	0	0	0	0	0	0	37
% Buses	0	1.2	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0.8
Single-Unit Trucks	0	23	0	0	0	0	0	0	0	106	0	0	0	0	4	0	133
% Single-Unit Trucks	0	1.2	0	0	0	0	0	0	0	3.8	0	0	0	0	3.1	0	2.8
Articulated Trucks	0	6	0	0	0	0	0	0	0	29	0	0	0	0	11	0	46
% Articulated Trucks	0	0.3	0	0	0	0	0	0	0	1	0	0	0	0	8.5	0	1
Bicycles on Road	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	2
% Bicycles on Road	0	0	33.3	0	0	0	0	0	0	0	0	0	0	0	0.8	0	0
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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Site Code : 24-515 Honokowai Beach TA
Start Date : 5/9/2024
Page No : 2

	LAHAINA BYPASS SOUTHBOUND					WESTBOUND					LAHAINA BYPASS NORTHBOUND					HONOAPIILANI HWY EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:30 AM to 08:15 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	0	149	**1**	0	150	0	0	0	0	0	0	245	0	0	245	0	0	12	**1**	13	408
07:45 AM	0	155	0	0	155	0	0	0	0	0	0	234	0	0	234	0	0	13	0	13	402
08:00 AM	0	**160**	0	0	**160**	0	0	0	0	0	0	**250**	0	0	**250**	0	0	10	0	10	**420**
08:15 AM	0	151	0	0	151	0	0	0	0	0	0	225	0	0	225	0	0	**17**	0	**17**	393
Total Volume	0	615	1	0	616	0	0	0	0	0	0	954	0	0	954	0	0	52	1	53	1623
% App. Total	0	99.8	0.2	0		0	0	0	0		0	100	0	0		0	0	98.1	1.9		
PHF	.000	.961	.250	.000	.963	.000	.000	.000	.000	.000	.000	.954	.000	.000	.954	.000	.000	.765	.250	.779	.966



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Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

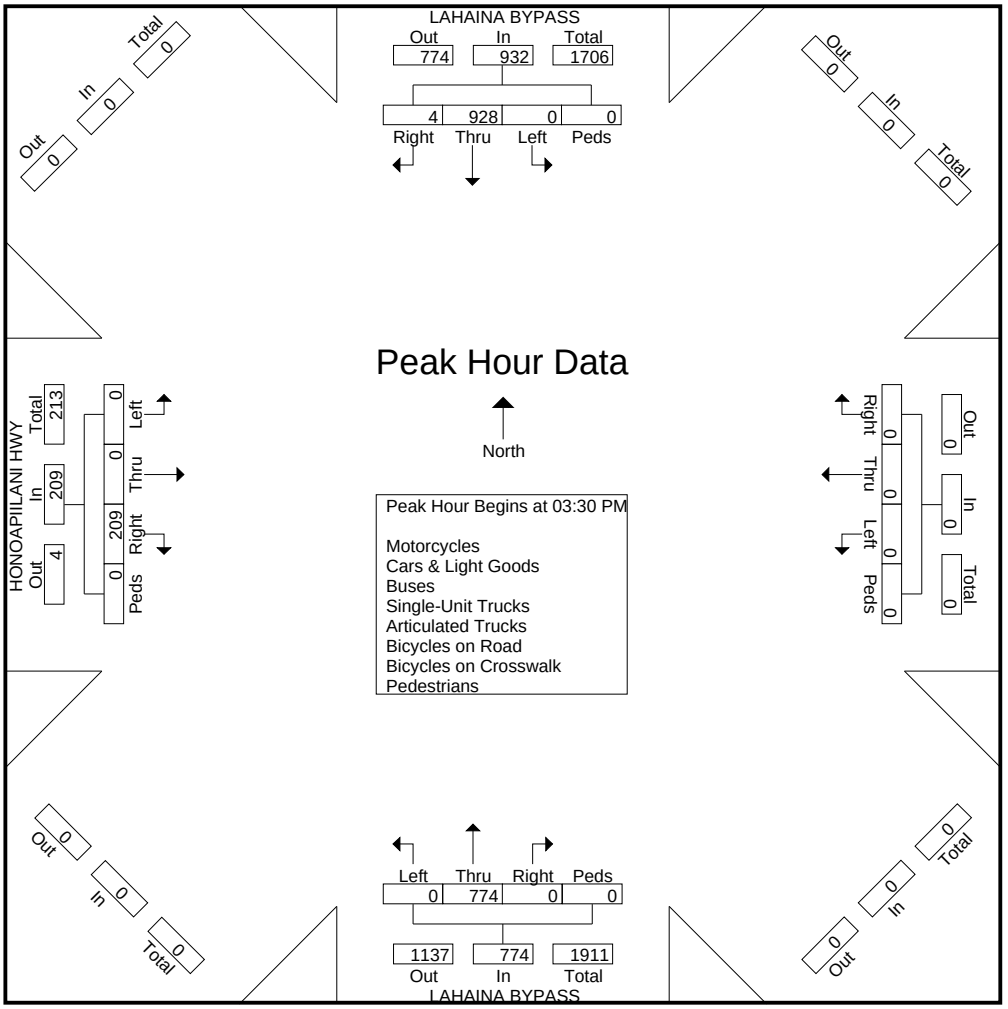
	LAHAINA BYPASS SOUTHBOUND				WESTBOUND				LAHAINA BYPASS NORTHBOUND				HONOAPIILANI HWY EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
03:00 PM	0	246	0	0	0	0	0	0	0	174	0	0	0	0	25	0	445
03:15 PM	0	239	0	0	0	0	0	0	0	250	0	0	0	0	32	0	521
03:30 PM	0	251	0	0	0	0	0	0	0	197	0	0	0	0	44	0	492
03:45 PM	0	251	1	0	0	0	0	0	0	196	0	0	0	0	54	0	502
Total	0	987	1	0	0	0	0	0	0	817	0	0	0	0	155	0	1960
04:00 PM	0	221	1	0	0	0	0	0	0	191	0	0	0	0	53	0	466
04:15 PM	0	205	2	0	0	0	0	0	0	190	0	0	0	0	58	0	455
04:30 PM	0	189	0	0	0	0	0	0	0	177	0	0	0	0	66	0	432
04:45 PM	0	104	0	0	0	0	0	0	0	181	0	0	0	0	65	0	350
Total	0	719	3	0	0	0	0	0	0	739	0	0	0	0	242	0	1703
05:00 PM	0	147	0	0	0	0	0	0	0	180	0	0	0	0	96	0	423
05:15 PM	0	86	1	0	0	0	0	0	0	205	0	0	0	0	112	0	404
05:30 PM	0	124	1	0	0	0	0	0	0	197	0	0	0	0	131	0	453
05:45 PM	0	97	0	0	0	0	0	0	0	140	0	0	0	0	111	0	348
Total	0	454	2	0	0	0	0	0	0	722	0	0	0	0	450	0	1628
Grand Total	0	2160	6	0	0	0	0	0	0	2278	0	0	0	0	847	0	5291
Apprch %	0	99.7	0.3	0	0	0	0	0	0	100	0	0	0	0	100	0	
Total %	0	40.8	0.1	0	0	0	0	0	0	43.1	0	0	0	0	16	0	
Motorcycles	0	2	0	0	0	0	0	0	0	0	0	0	0	0	4	0	6
% Motorcycles	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0.1
Cars & Light Goods	0	2111	6	0	0	0	0	0	0	2247	0	0	0	0	815	0	5179
% Cars & Light Goods	0	97.7	100	0	0	0	0	0	0	98.6	0	0	0	0	96.2	0	97.9
Buses	0	19	0	0	0	0	0	0	0	14	0	0	0	0	3	0	36
% Buses	0	0.9	0	0	0	0	0	0	0	0.6	0	0	0	0	0.4	0	0.7
Single-Unit Trucks	0	23	0	0	0	0	0	0	0	13	0	0	0	0	17	0	53
% Single-Unit Trucks	0	1.1	0	0	0	0	0	0	0	0.6	0	0	0	0	2	0	1
Articulated Trucks	0	4	0	0	0	0	0	0	0	4	0	0	0	0	8	0	16
% Articulated Trucks	0	0.2	0	0	0	0	0	0	0	0.2	0	0	0	0	0.9	0	0.3
Bicycles on Road	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
% Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : Lahaina Bypass - Honoapiilani Hwy (South Terminus)
Site Code : 24-515 Honokowai Beach TA
Start Date : 5/9/2024
Page No : 2

	LAHAINA BYPASS SOUTHBOUND					WESTBOUND					LAHAINA BYPASS NORTHBOUND					HONOAPIILANI HWY EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:30 PM to 04:15 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:30 PM																					
03:30 PM	0	**251**	0	0	251	0	0	0	0	0	0	**197**	0	0	**197**	0	0	44	0	44	492
03:45 PM	0	251	1	0	**252**	0	0	0	0	0	0	196	0	0	196	0	0	54	0	54	**502**
04:00 PM	0	221	1	0	222	0	0	0	0	0	0	191	0	0	191	0	0	53	0	53	466
04:15 PM	0	205	**2**	0	207	0	0	0	0	0	0	190	0	0	190	0	0	**58**	0	**58**	455
Total Volume	0	928	4	0	932	0	0	0	0	0	0	774	0	0	774	0	0	209	0	209	1915
% App. Total	0	99.6	0.4	0		0	0	0	0		0	100	0	0		0	0	100	0		
PHF	.000	.924	.500	.000	.925	.000	.000	.000	.000	.000	.000	.982	.000	.000	.982	.000	.000	.901	.000	.901	.954



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Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : SAT_Lahaina Bypass - Honoapiilani Hwy (South Terminus)
Site Code : 24-515 Honokowai Beach TA
Start Date : 5/11/2024

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

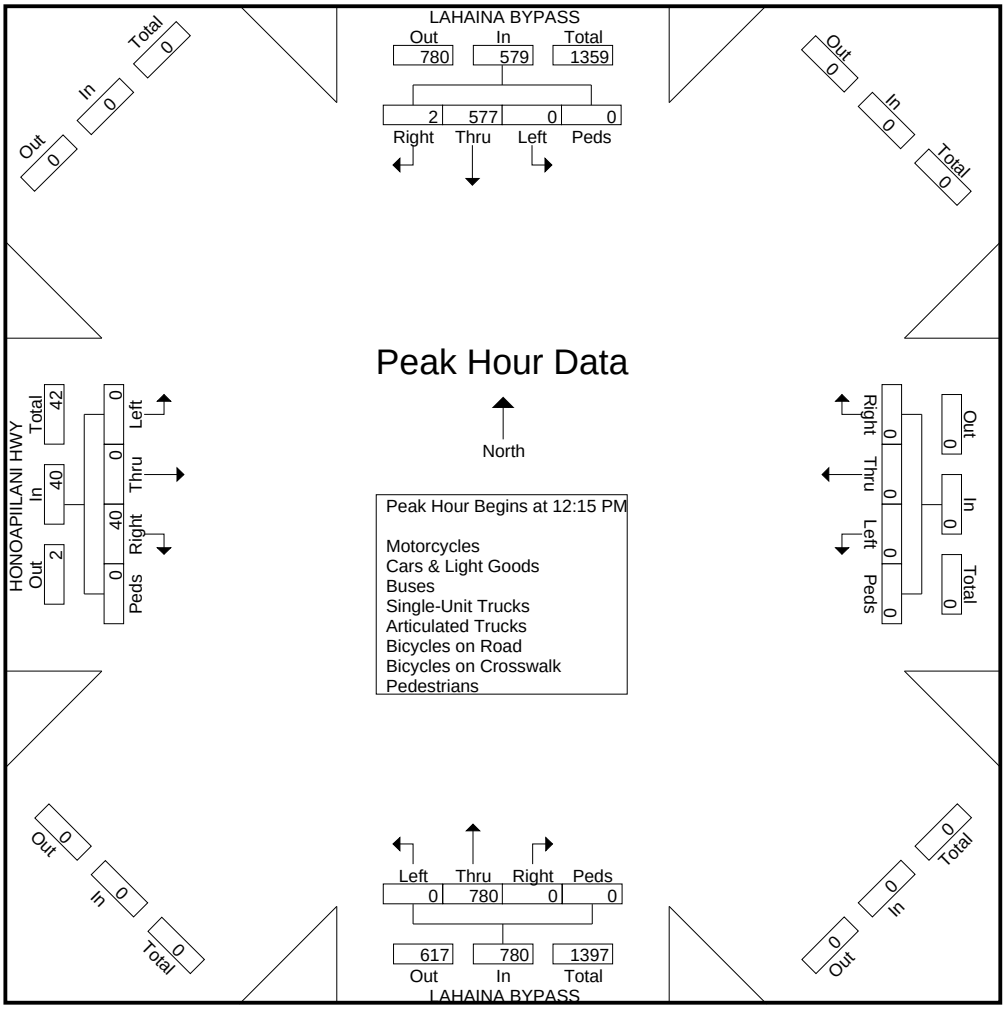
	LAHAINA BYPASS SOUTHBOUND				WESTBOUND				LAHAINA BYPASS NORTHBOUND				HONOAPIILANI HWY EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
11:00 AM	0	164	1	0	0	0	0	0	0	126	0	0	0	0	14	0	305
11:15 AM	0	186	0	0	0	0	0	0	0	147	0	0	0	0	12	0	345
11:30 AM	0	144	0	0	0	0	0	0	1	175	0	0	0	0	12	0	332
11:45 AM	0	171	0	0	0	0	0	0	0	133	0	0	0	0	7	0	311
Total	0	665	1	0	0	0	0	0	1	581	0	0	0	0	45	0	1293
12:00 PM	0	143	0	0	0	0	0	0	0	186	0	0	0	0	10	0	339
12:15 PM	0	170	1	0	0	0	0	0	0	168	0	0	0	0	14	0	353
12:30 PM	0	130	1	0	0	0	0	0	0	181	0	0	0	0	6	0	318
12:45 PM	0	156	0	0	0	0	0	0	0	194	0	0	0	0	11	0	361
Total	0	599	2	0	0	0	0	0	0	729	0	0	0	0	41	0	1371
01:00 PM	0	121	0	0	0	0	0	0	0	237	0	0	0	0	9	0	367
01:15 PM	0	151	1	0	0	0	0	0	0	197	0	0	0	0	19	0	368
01:30 PM	0	126	0	0	0	0	0	0	0	252	0	0	0	0	8	0	386
01:45 PM	0	133	0	0	0	0	0	0	0	199	0	0	0	0	8	0	340
Total	0	531	1	0	0	0	0	0	0	885	0	0	0	0	44	0	1461
Grand Total	0	1795	4	0	0	0	0	0	1	2195	0	0	0	0	130	0	4125
Apprch %	0	99.8	0.2	0	0	0	0	0	0	100	0	0	0	0	100	0	
Total %	0	43.5	0.1	0	0	0	0	0	0	53.2	0	0	0	0	3.2	0	
Motorcycles	0	3	0	0	0	0	0	0	0	5	0	0	0	0	1	0	9
% Motorcycles	0	0.2	0	0	0	0	0	0	0	0.2	0	0	0	0	0.8	0	0.2
Cars & Light Goods	0	1771	4	0	0	0	0	0	1	2161	0	0	0	0	118	0	4055
% Cars & Light Goods	0	98.7	100	0	0	0	0	0	100	98.5	0	0	0	0	90.8	0	98.3
Buses	0	4	0	0	0	0	0	0	0	5	0	0	0	0	0	0	9
% Buses	0	0.2	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0.2
Single-Unit Trucks	0	13	0	0	0	0	0	0	0	17	0	0	0	0	6	0	36
% Single-Unit Trucks	0	0.7	0	0	0	0	0	0	0	0.8	0	0	0	0	4.6	0	0.9
Articulated Trucks	0	4	0	0	0	0	0	0	0	6	0	0	0	0	5	0	15
% Articulated Trucks	0	0.2	0	0	0	0	0	0	0	0.3	0	0	0	0	3.8	0	0.4
Bicycles on Road	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
% Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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501 Sumner St, Suite 521
Honolulu, Hawaii 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : SAT_Lahaina Bypass - Honoapiilani Hwy (South Terminus)
Site Code : 24-515 Honokowai Beach TA
Start Date : 5/11/2024
Page No : 2

	LAHAINA BYPASS SOUTHBOUND					WESTBOUND					LAHAINA BYPASS NORTHBOUND					HONOAPIILANI HWY EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:15 PM to 01:00 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 12:15 PM																					
12:15 PM	0	**170**	**1**	0	**171**	0	0	0	0	0	0	168	0	0	168	0	0	**14**	0	**14**	353
12:30 PM	0	130	1	0	131	0	0	0	0	0	0	181	0	0	181	0	0	6	0	6	318
12:45 PM	0	156	0	0	156	0	0	0	0	0	0	194	0	0	194	0	0	11	0	11	361
01:00 PM	0	121	0	0	121	0	0	0	0	0	0	**237**	0	0	**237**	0	0	9	0	9	**367**
Total Volume	0	577	2	0	579	0	0	0	0	0	0	780	0	0	780	0	0	40	0	40	1399
% App. Total	0	99.7	0.3	0		0	0	0	0		0	100	0	0		0	0	100	0		
PHF	.000	.849	.500	.000	.846	.000	.000	.000	.000	.000	.000	.823	.000	.000	.823	.000	.000	.714	.000	.714	.953



APPENDIX C

2018 TRAFFIC COUNT DATA

Austin Tsutsumi & Associates

501 Sumner Street, Suite 521
Honolulu, HI 96817-5031
Phone: 533-3646 Fax: 526-1267

File Name : Honoapiilani Hwy - Lower Honoapiilani Rd
Site Code :
Start Date : 5/22/2018
Page No : 1

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

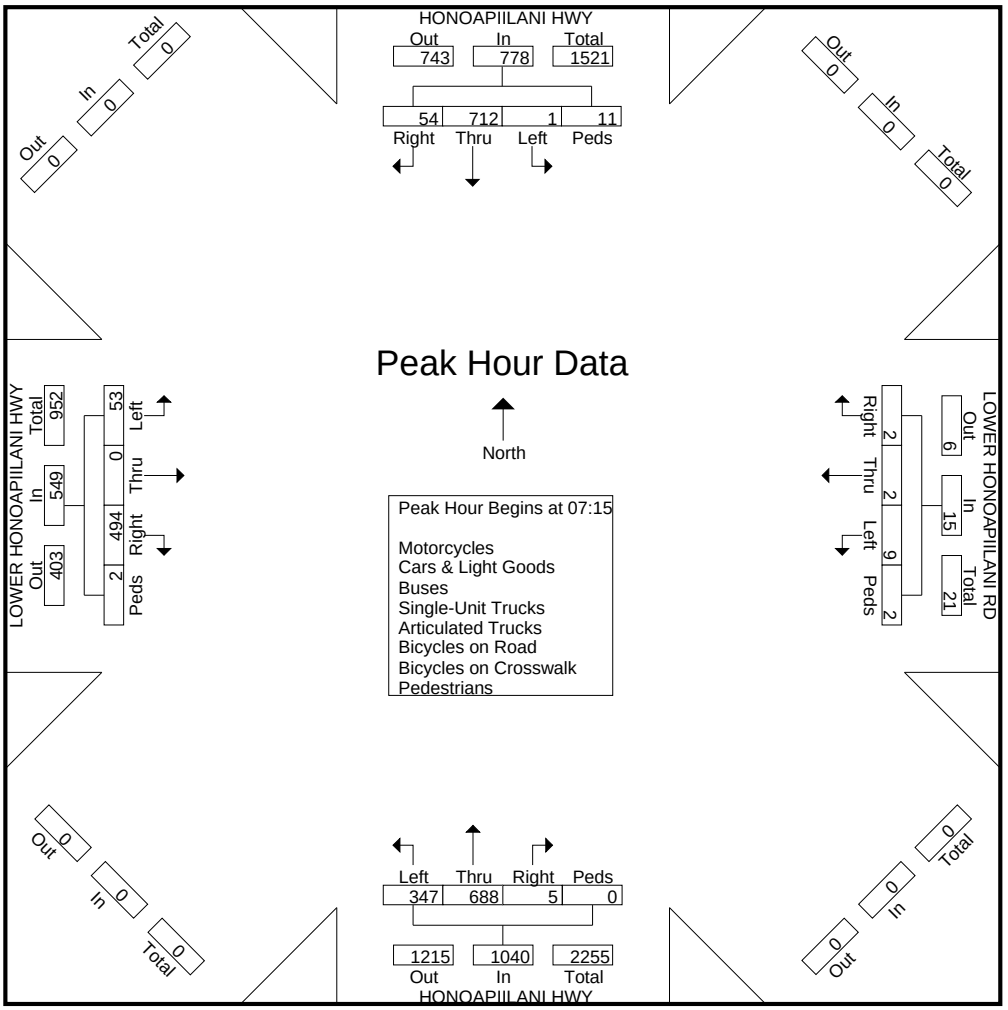
	HONOAPIILANI HWY SOUTHBOUND				LOWER HONOAPIILANI RD WESTBOUND				HONOAPIILANI HWY NORTHBOUND				LOWER HONOAPIILANI HWY EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:30	0	134	8	0	1	2	0	0	47	106	1	0	9	1	76	0	385
06:45	1	172	11	1	2	1	0	0	59	118	7	0	5	2	103	0	482
Total	1	306	19	1	3	3	0	0	106	224	8	0	14	3	179	0	867
07:00	1	191	20	0	2	0	0	0	54	99	0	0	10	0	101	0	478
07:15	0	171	16	2	1	0	0	0	71	127	3	0	16	0	139	0	546
07:30	0	192	11	0	4	1	0	0	84	170	0	0	10	0	120	0	592
07:45	0	193	11	1	4	1	0	2	96	202	0	0	16	0	114	1	641
Total	1	747	58	3	11	2	0	2	305	598	3	0	52	0	474	1	2257
08:00	1	156	16	8	0	0	2	0	96	189	2	0	11	0	121	1	603
08:15	0	144	13	1	1	3	0	0	109	147	5	0	12	1	111	0	547
Grand Total	3	1353	106	13	15	8	2	2	616	1158	18	0	89	4	885	2	4274
Apprch %	0.2	91.7	7.2	0.9	55.6	29.6	7.4	7.4	34.4	64.6	1	0	9.1	0.4	90.3	0.2	
Total %	0.1	31.7	2.5	0.3	0.4	0.2	0	0	14.4	27.1	0.4	0	2.1	0.1	20.7	0	
Motorcycles	0	1	0	0	0	0	0	0	0	4	0	0	1	0	7	0	13
% Motorcycles	0	0.1	0	0	0	0	0	0	0	0.3	0	0	1.1	0	0.8	0	0.3
Cars & Light Goods	2	1327	106	0	12	8	2	0	592	1122	16	0	84	4	853	0	4128
% Cars & Light Goods	66.7	98.1	100	0	80	100	100	0	96.1	96.9	88.9	0	94.4	100	96.4	0	96.6
Buses	0	18	0	0	0	0	0	0	8	12	0	0	1	0	15	0	54
% Buses	0	1.3	0	0	0	0	0	0	1.3	1	0	0	1.1	0	1.7	0	1.3
Single-Unit Trucks	1	7	0	0	2	0	0	0	13	16	1	0	2	0	5	0	47
% Single-Unit Trucks	33.3	0.5	0	0	13.3	0	0	0	2.1	1.4	5.6	0	2.2	0	0.6	0	1.1
Articulated Trucks	0	0	0	0	1	0	0	0	3	2	1	0	1	0	1	0	9
% Articulated Trucks	0	0	0	0	6.7	0	0	0	0.5	0.2	5.6	0	1.1	0	0.1	0	0.2
Bicycles on Road	0	0	0	0	0	0	0	0	0	2	0	0	0	0	4	0	6
% Bicycles on Road	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0.5	0	0.1
Bicycles on Crosswalk	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	2
% Bicycles on Crosswalk	0	0	0	7.7	0	0	0	50	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	12	0	0	0	1	0	0	0	0	0	0	0	2	15
% Pedestrians	0	0	0	92.3	0	0	0	50	0	0	0	0	0	0	0	100	0.4

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Honolulu, HI 96817-5031
Phone: 533-3646 Fax: 526-1267

File Name : Honoapiilani Hwy - Lower Honoapiilani Rd
Site Code :
Start Date : 5/22/2018
Page No : 2

	HONOAPIILANI HWY SOUTHBOUND					LOWER HONOAPIILANI RD WESTBOUND					HONOAPIILANI HWY NORTHBOUND					LOWER HONOAPIILANI HWY EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:15 to 08:00 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15																					
07:15	0	171	**16**	2	189	1	0	0	0	1	71	127	**3**	0	201	**16**	0	**139**	0	**155**	546
07:30	0	192	11	0	203	**4**	**1**	0	0	5	84	170	0	0	254	10	0	120	0	130	592
07:45	0	**193**	11	1	**205**	4	1	0	**2**	**7**	**96**	**202**	0	0	**298**	16	0	114	**1**	131	**641**
08:00	**1**	156	16	**8**	181	0	0	**2**	0	2	96	189	2	0	287	11	0	121	1	133	603
Total Volume	1	712	54	11	778	9	2	2	2	15	347	688	5	0	1040	53	0	494	2	549	2382
% App. Total	0.1	91.5	6.9	1.4		60	13.3	13.3	13.3		33.4	66.2	0.5	0		9.7	0	90	0.4		
PHF	.250	.922	.844	.344	.949	.563	.500	.250	.250	.536	.904	.851	.417	.000	.872	.828	.000	.888	.500	.885	.929



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Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

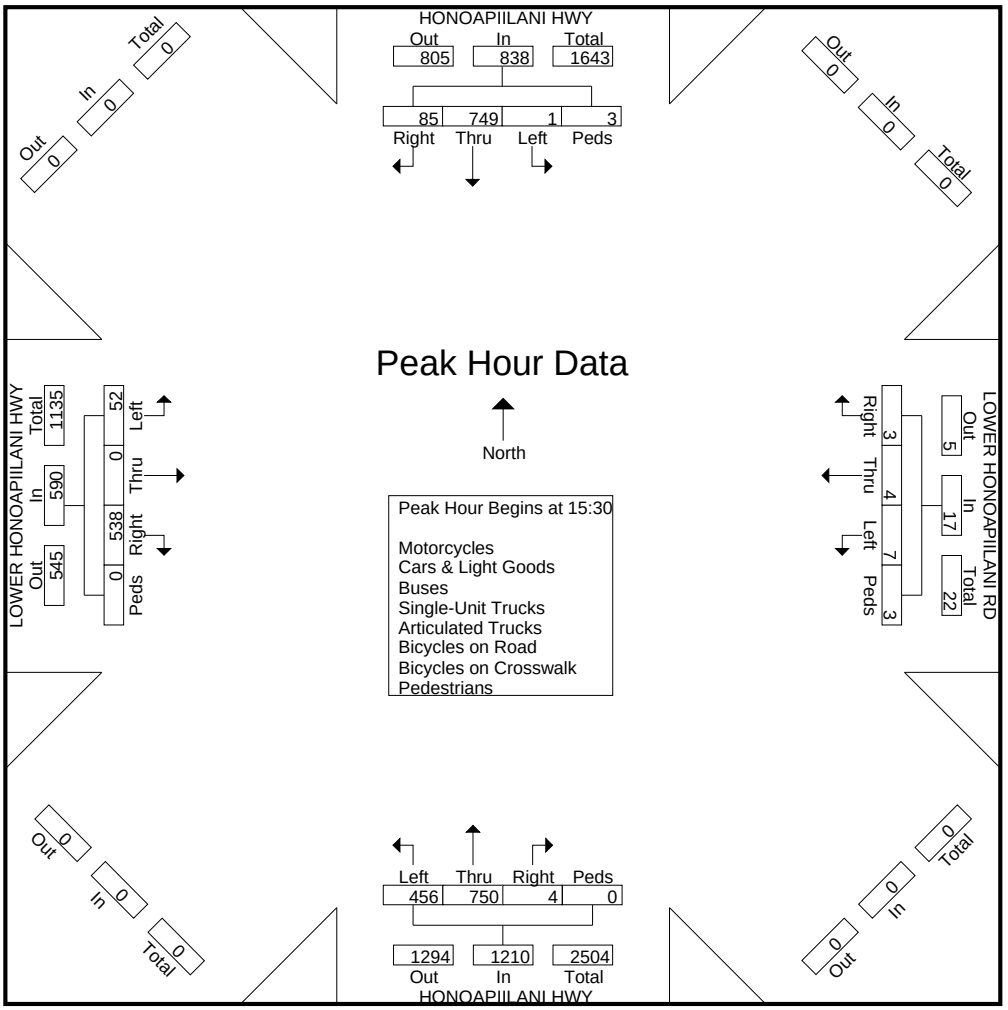
	HONOAPIILANI HWY SOUTHBOUND				LOWER HONOAPIILANI RD WESTBOUND				HONOAPIILANI HWY NORTHBOUND				LOWER HONOAPIILANI HWY EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
15:15	0	199	16	0	4	0	0	0	122	179	0	0	9	0	154	1	684
15:30	0	194	18	0	4	0	2	0	117	186	0	0	12	0	117	0	650
15:45	1	181	28	2	3	1	0	2	111	187	1	0	18	0	131	0	666
Total	1	574	62	2	11	1	2	2	350	552	1	0	39	0	402	1	2000
16:00	0	190	20	0	0	0	1	0	108	177	0	0	11	0	161	0	668
16:15	0	184	19	1	0	3	0	1	120	200	3	0	11	0	129	0	671
16:30	0	179	12	0	0	0	0	0	118	176	0	0	13	0	144	0	642
16:45	0	173	16	1	0	1	0	0	114	192	0	0	12	0	129	0	638
Total	0	726	67	2	0	4	1	1	460	745	3	0	47	0	563	0	2619
17:00	0	151	18	0	0	1	0	1	107	191	1	0	18	0	151	0	639
Grand Total	1	1451	147	4	11	6	3	4	917	1488	5	0	104	0	1116	1	5258
Apprch %	0.1	90.5	9.2	0.2	45.8	25	12.5	16.7	38	61.7	0.2	0	8.5	0	91.4	0.1	
Total %	0	27.6	2.8	0.1	0.2	0.1	0.1	0.1	17.4	28.3	0.1	0	2	0	21.2	0	
Motorcycles	0	2	0	0	0	2	0	0	23	10	2	0	0	0	6	0	45
% Motorcycles	0	0.1	0	0	0	33.3	0	0	2.5	0.7	40	0	0	0	0.5	0	0.9
Cars & Light Goods	1	1427	144	0	10	4	3	0	885	1462	3	0	104	0	1091	0	5134
% Cars & Light Goods	100	98.3	98	0	90.9	66.7	100	0	96.5	98.3	60	0	100	0	97.8	0	97.6
Buses	0	9	1	0	0	0	0	0	5	4	0	0	0	0	10	0	29
% Buses	0	0.6	0.7	0	0	0	0	0	0.5	0.3	0	0	0	0	0.9	0	0.6
Single-Unit Trucks	0	9	1	0	1	0	0	0	3	6	0	0	0	0	7	0	27
% Single-Unit Trucks	0	0.6	0.7	0	9.1	0	0	0	0.3	0.4	0	0	0	0	0.6	0	0.5
Articulated Trucks	0	0	1	0	0	0	0	0	1	2	0	0	0	0	2	0	6
% Articulated Trucks	0	0	0.7	0	0	0	0	0	0.1	0.1	0	0	0	0	0.2	0	0.1
Bicycles on Road	0	4	0	0	0	0	0	0	0	4	0	0	0	0	0	0	8
% Bicycles on Road	0	0.3	0	0	0	0	0	0	0	0.3	0	0	0	0	0	0	0.2
Bicycles on Crosswalk	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
% Bicycles on Crosswalk	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	3	0	0	0	4	0	0	0	0	0	0	0	1	8
% Pedestrians	0	0	0	75	0	0	0	100	0	0	0	0	0	0	0	100	0.2

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File Name : Honoapiilani Hwy - Lower Honoapiilani Rd
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	HONOAPIILANI HWY SOUTHBOUND					LOWER HONOAPIILANI RD WESTBOUND					HONOAPIILANI HWY NORTHBOUND					LOWER HONOAPIILANI HWY EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 15:30 to 16:15 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 15:30																					
15:30	0	**194**	18	0	**212**	**4**	0	**2**	0	**6**	117	186	0	0	303	12	0	117	0	129	650
15:45	**1**	181	**28**	**2**	212	3	1	0	**2**	6	111	187	1	0	299	**18**	0	131	0	149	666
16:00	0	190	20	0	210	0	0	1	0	1	108	177	0	0	285	11	0	**161**	0	**172**	668
16:15	0	184	19	1	204	0	**3**	0	1	4	**120**	**200**	**3**	0	**323**	11	0	129	0	140	**671**
Total Volume	1	749	85	3	838	7	4	3	3	17	456	750	4	0	1210	52	0	538	0	590	2655
% App. Total	0.1	89.4	10.1	0.4		41.2	23.5	17.6	17.6		37.7	62	0.3	0		8.8	0	91.2	0		
PHF	.250	.965	.759	.375	.988	.438	.333	.375	.375	.708	.950	.938	.333	.000	.937	.722	.000	.835	.000	.858	.989



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File Name : WE_Honoapiilani Hwy - Lower Honoapiilani Rd
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Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

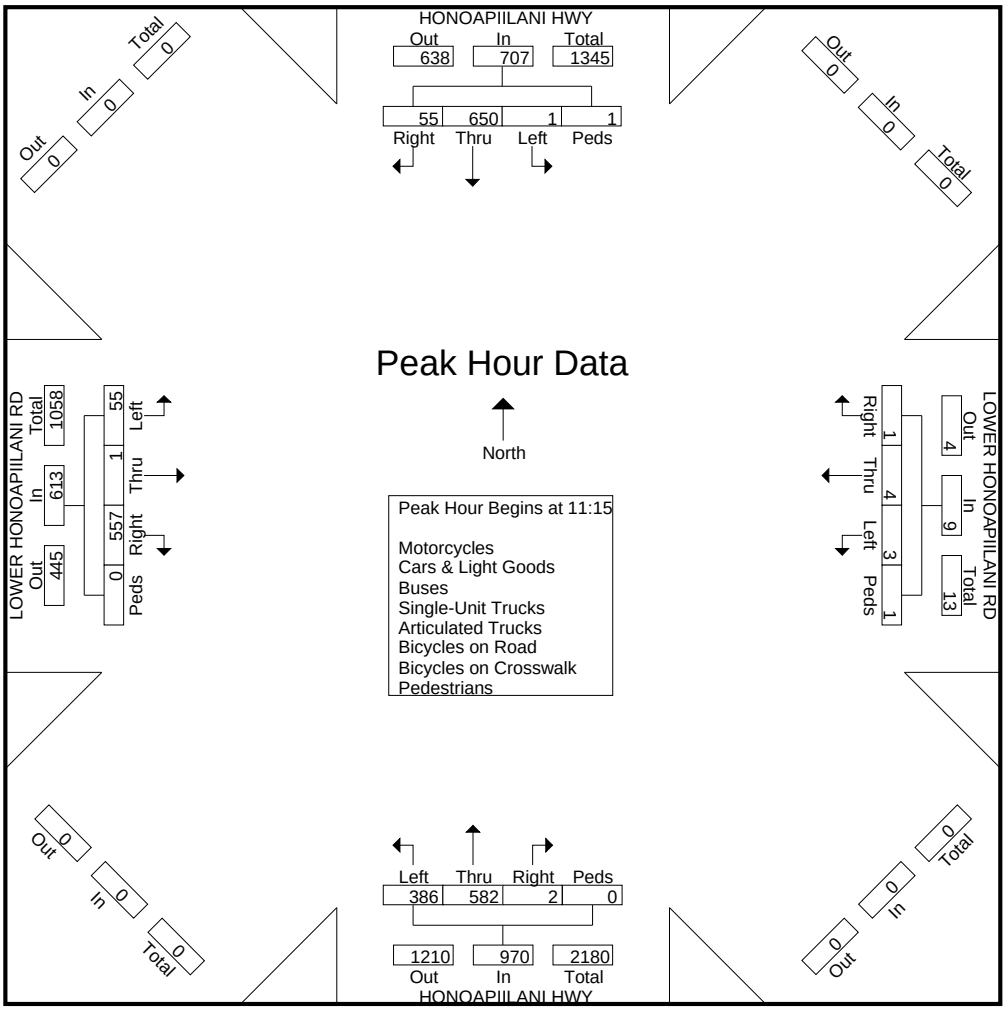
	HONOAPIILANI HWY SOUTHBOUND				LOWER HONOAPIILANI RD WESTBOUND				HONOAPIILANI HWY NORTHBOUND				LOWER HONOAPIILANI RD EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
11:00	0	207	24	0	0	0	1	0	71	131	2	0	22	1	141	0	600
11:15	1	202	17	0	1	1	0	0	82	127	1	0	12	1	181	0	626
11:30	0	158	18	0	1	1	0	0	83	146	1	0	20	0	124	0	552
11:45	0	147	8	0	1	1	0	0	99	164	0	0	13	0	115	0	548
Total	1	714	67	0	3	3	1	0	335	568	4	0	67	2	561	0	2326
12:00	0	143	12	1	0	1	1	1	122	145	0	0	10	0	137	0	573
12:15	0	147	20	4	0	1	0	4	83	156	0	0	10	0	135	0	560
12:30	0	164	14	0	0	1	1	0	101	121	1	0	14	0	127	0	544
12:45	1	126	19	0	0	0	1	0	115	153	0	0	11	0	100	0	526
Total	1	580	65	5	0	3	3	5	421	575	1	0	45	0	499	0	2203
Grand Total	2	1294	132	5	3	6	4	5	756	1143	5	0	112	2	1060	0	4529
Apprch %	0.1	90.3	9.2	0.3	16.7	33.3	22.2	27.8	39.7	60	0.3	0	9.5	0.2	90.3	0	
Total %	0	28.6	2.9	0.1	0.1	0.1	0.1	0.1	16.7	25.2	0.1	0	2.5	0	23.4	0	
Motorcycles	0	1	2	0	0	0	0	0	9	4	0	0	0	0	14	0	30
% Motorcycles	0	0.1	1.5	0	0	0	0	0	1.2	0.3	0	0	0	0	1.3	0	0.7
Cars & Light Goods	2	1273	129	0	3	5	4	0	737	1122	5	0	109	2	1034	0	4425
% Cars & Light Goods	100	98.4	97.7	0	100	83.3	100	0	97.5	98.2	100	0	97.3	100	97.5	0	97.7
Buses	0	4	0	0	0	0	0	0	6	0	0	0	1	0	5	0	16
% Buses	0	0.3	0	0	0	0	0	0	0.8	0	0	0	0.9	0	0.5	0	0.4
Single-Unit Trucks	0	12	0	0	0	0	0	0	4	9	0	0	2	0	7	0	34
% Single-Unit Trucks	0	0.9	0	0	0	0	0	0	0.5	0.8	0	0	1.8	0	0.7	0	0.8
Articulated Trucks	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
% Articulated Trucks	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	3	1	0	0	1	0	0	0	8	0	0	0	0	0	0	13
% Bicycles on Road	0	0.2	0.8	0	0	16.7	0	0	0	0.7	0	0	0	0	0	0	0.3
Bicycles on Crosswalk	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	2
% Bicycles on Crosswalk	0	0	0	20	0	0	0	20	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	4	0	0	0	4	0	0	0	0	0	0	0	0	8
% Pedestrians	0	0	0	80	0	0	0	80	0	0	0	0	0	0	0	0	0.2

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	HONOAPIILANI HWY SOUTHBOUND					LOWER HONOAPIILANI RD WESTBOUND					HONOAPIILANI HWY NORTHBOUND					LOWER HONOAPIILANI RD EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 11:15 to 12:00 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 11:15																					
11:15	**1**	**202**	17	0	**220**	**1**	**1**	0	0	2	82	127	**1**	0	210	12	**1**	**181**	0	**194**	**626**
11:30	0	158	**18**	0	176	1	1	0	0	2	83	146	1	0	230	**20**	0	124	0	144	552
11:45	0	147	8	0	155	1	1	0	0	2	99	**164**	0	0	263	13	0	115	0	128	548
12:00	0	143	12	**1**	156	0	1	**1**	**1**	**3**	**122**	145	0	0	**267**	10	0	137	0	147	573
Total Volume	1	650	55	1	707	3	4	1	1	9	386	582	2	0	970	55	1	557	0	613	2299
% App. Total	0.1	91.9	7.8	0.1		33.3	44.4	11.1	11.1		39.8	60	0.2	0		9	0.2	90.9	0		
PHF	.250	.804	.764	.250	.803	.750	1.00	.250	.250	.750	.791	.887	.500	.000	.908	.688	.250	.769	.000	.790	.918



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Groups Printed- Motorcycles - Cars - Light Goods Vehicles - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

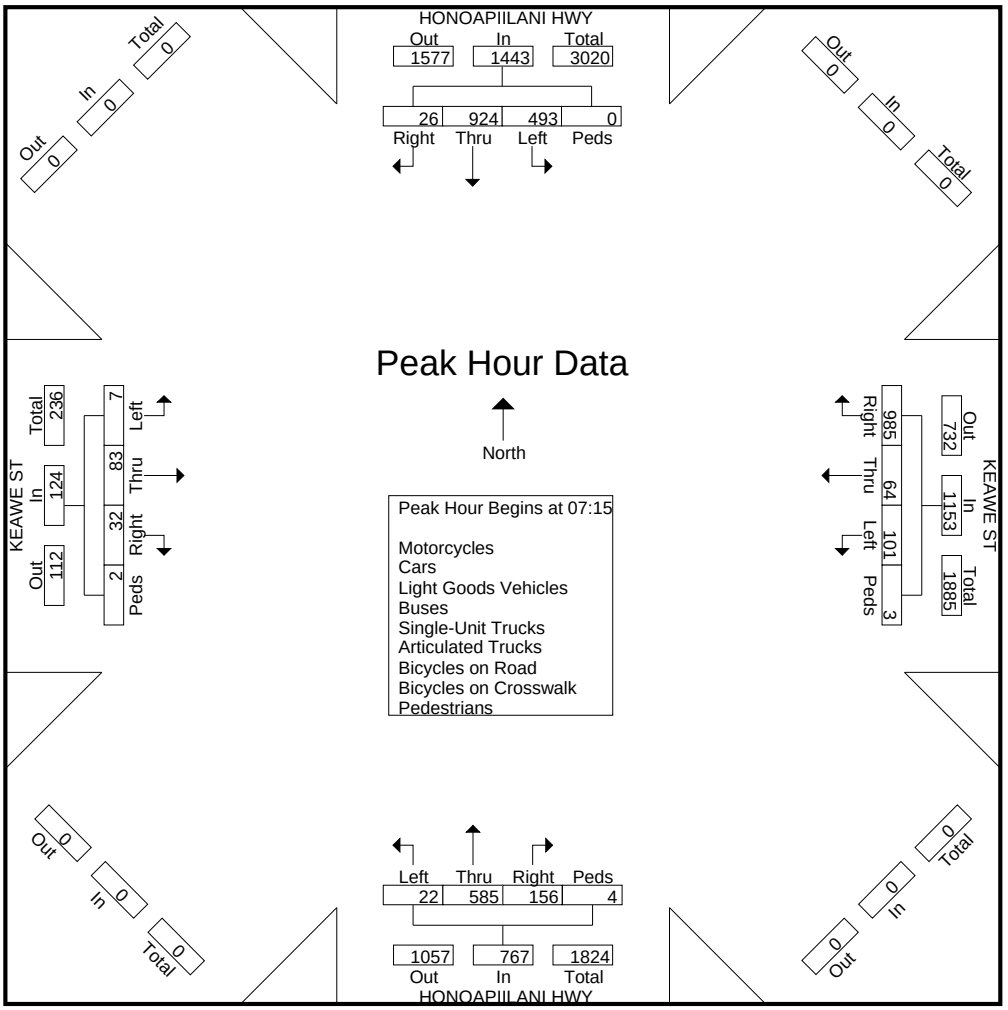
	HONOAPIILANI HWY SOUTHBOUND				KEAWE ST WESTBOUND				HONOAPIILANI HWY NORTHBOUND				KEAWE ST EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:30	76	133	1	0	15	11	186	1	2	90	18	0	0	7	5	1	546
06:45	92	199	2	0	14	15	160	1	1	78	23	0	1	15	4	0	605
Total	168	332	3	0	29	26	346	2	3	168	41	0	1	22	9	1	1151
07:00	124	232	3	0	19	9	196	1	7	98	28	2	1	16	6	0	742
07:15	147	243	5	0	24	7	246	0	7	127	25	1	2	25	9	1	869
07:30	125	253	7	0	32	19	259	0	4	141	33	0	1	26	8	0	908
07:45	130	227	8	0	17	21	267	0	7	159	56	1	2	20	7	0	922
Total	526	955	23	0	92	56	968	1	25	525	142	4	6	87	30	1	3441
08:00	91	201	6	0	28	17	213	3	4	158	42	2	2	12	8	1	788
08:15	131	208	3	0	39	11	193	0	7	101	31	5	1	25	7	0	762
Grand Total	916	1696	35	0	188	110	1720	6	39	952	256	11	10	146	54	3	6142
Apprch %	34.6	64.1	1.3	0	9.3	5.4	85	0.3	3.1	75.7	20.3	0.9	4.7	68.5	25.4	1.4	
Total %	14.9	27.6	0.6	0	3.1	1.8	28	0.1	0.6	15.5	4.2	0.2	0.2	2.4	0.9	0	
Motorcycles	2	5	1	0	4	1	6	0	1	3	2	0	0	4	0	0	29
% Motorcycles	0.2	0.3	2.9	0	2.1	0.9	0.3	0	2.6	0.3	0.8	0	0	2.7	0	0	0.5
Cars	698	1404	32	0	130	62	1156	0	23	650	197	0	6	94	43	0	4495
% Cars	76.2	82.8	91.4	0	69.1	56.4	67.2	0	59	68.3	77	0	60	64.4	79.6	0	73.2
Light Goods Vehicles	198	251	1	0	45	39	493	0	11	275	48	0	2	41	10	0	1414
% Light Goods Vehicles	21.6	14.8	2.9	0	23.9	35.5	28.7	0	28.2	28.9	18.8	0	20	28.1	18.5	0	23
Buses	12	22	0	0	5	0	19	0	1	9	4	0	2	0	0	0	74
% Buses	1.3	1.3	0	0	2.7	0	1.1	0	2.6	0.9	1.6	0	20	0	0	0	1.2
Single-Unit Trucks	5	7	0	0	4	7	40	0	3	12	5	0	0	5	1	0	89
% Single-Unit Trucks	0.5	0.4	0	0	2.1	6.4	2.3	0	7.7	1.3	2	0	0	3.4	1.9	0	1.4
Articulated Trucks	1	1	0	0	0	1	6	0	0	2	0	0	0	1	0	0	12
% Articulated Trucks	0.1	0.1	0	0	0	0.9	0.3	0	0	0.2	0	0	0	0.7	0	0	0.2
Bicycles on Road	0	6	1	0	0	0	0	0	0	1	0	0	0	1	0	0	9
% Bicycles on Road	0	0.4	2.9	0	0	0	0	0	0	0.1	0	0	0	0.7	0	0	0.1
Bicycles on Crosswalk	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	2
% Bicycles on Crosswalk	0	0	0	0	0	0	0	16.7	0	0	0	9.1	0	0	0	0	0
Pedestrians	0	0	0	0	0	0	0	5	0	0	0	10	0	0	0	3	18
% Pedestrians	0	0	0	0	0	0	0	83.3	0	0	0	90.9	0	0	0	100	0.3

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	HONOAPIILANI HWY SOUTHBOUND					KEAWE ST WESTBOUND					HONOAPIILANI HWY NORTHBOUND					KEAWE ST EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:30 to 08:15 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15																					
07:15	**147**	243	5	0	**395**	24	7	246	0	277	**7**	127	25	1	160	**2**	25	**9**	**1**	**37**	869
07:30	125	**253**	7	0	385	**32**	19	259	0	**310**	4	141	33	0	178	1	**26**	8	0	35	908
07:45	130	227	**8**	0	365	17	**21**	**267**	0	305	7	**159**	**56**	1	**223**	2	20	7	0	29	**922**
08:00	91	201	6	0	298	28	17	213	**3**	261	4	158	42	**2**	206	2	12	8	1	23	788
Total Volume	493	924	26	0	1443	101	64	985	3	1153	22	585	156	4	767	7	83	32	2	124	3487
% App. Total	34.2	64	1.8	0		8.8	5.6	85.4	0.3		2.9	76.3	20.3	0.5		5.6	66.9	25.8	1.6		
PHF	.838	.913	.813	.000	.913	.789	.762	.922	.250	.930	.786	.920	.696	.500	.860	.875	.798	.889	.500	.838	.945



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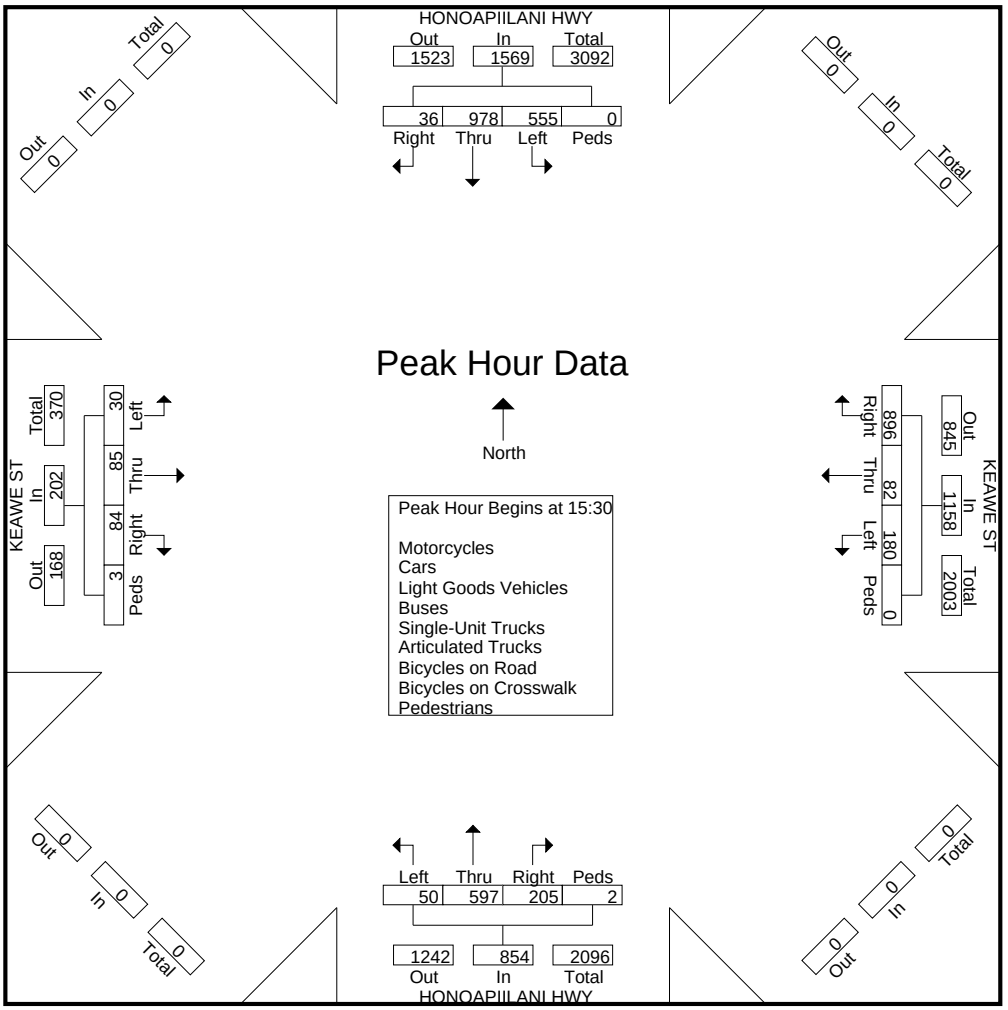
	HONOAPIILANI HWY SOUTHBOUND				KEAWE ST WESTBOUND				HONOAPIILANI HWY NORTHBOUND				KEAWE ST EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
15:15	157	255	8	0	35	29	248	0	21	145	54	4	10	31	17	3	1017
15:30	138	225	8	0	38	20	242	0	19	163	64	0	9	19	20	0	965
15:45	142	241	9	0	51	22	232	0	16	150	45	0	8	30	27	2	975
Total	437	721	25	0	124	71	722	0	56	458	163	4	27	80	64	5	2957
16:00	137	225	7	0	52	21	209	0	5	141	43	0	8	18	16	0	882
16:15	138	287	12	0	39	19	213	0	10	143	53	2	5	18	21	1	961
16:30	138	266	8	1	54	24	194	1	14	142	50	0	10	17	21	0	940
16:45	114	204	11	0	45	18	235	4	7	140	49	5	10	21	14	2	879
Total	527	982	38	1	190	82	851	5	36	566	195	7	33	74	72	3	3662
17:00	115	244	4	0	38	16	169	2	7	135	42	1	8	15	16	0	812
Grand Total	1079	1947	67	1	352	169	1742	7	99	1159	400	12	68	169	152	8	7431
Apprch %	34.9	62.9	2.2	0	15.5	7.4	76.7	0.3	5.9	69.4	24	0.7	17.1	42.6	38.3	2	
Total %	14.5	26.2	0.9	0	4.7	2.3	23.4	0.1	1.3	15.6	5.4	0.2	0.9	2.3	2	0.1	
Motorcycles	7	7	0	0	6	1	10	0	4	7	0	0	0	3	4	0	49
% Motorcycles	0.6	0.4	0	0	1.7	0.6	0.6	0	4	0.6	0	0	0	1.8	2.6	0	0.7
Cars	764	1492	61	0	297	125	1562	0	86	986	325	0	53	146	113	0	6010
% Cars	70.8	76.6	91	0	84.4	74	89.7	0	86.9	85.1	81.2	0	77.9	86.4	74.3	0	80.9
Light Goods Vehicles	286	399	4	0	47	40	151	0	9	149	68	0	11	19	30	0	1213
% Light Goods Vehicles	26.5	20.5	6	0	13.4	23.7	8.7	0	9.1	12.9	17	0	16.2	11.2	19.7	0	16.3
Buses	4	20	2	0	0	0	3	0	0	6	1	0	4	0	4	0	44
% Buses	0.4	1	3	0	0	0	0.2	0	0	0.5	0.2	0	5.9	0	2.6	0	0.6
Single-Unit Trucks	18	21	0	0	1	1	15	0	0	7	6	0	0	1	1	0	71
% Single-Unit Trucks	1.7	1.1	0	0	0.3	0.6	0.9	0	0	0.6	1.5	0	0	0.6	0.7	0	1
Articulated Trucks	0	2	0	0	0	2	0	0	0	4	0	0	0	0	0	0	8
% Articulated Trucks	0	0.1	0	0	0	1.2	0	0	0	0.3	0	0	0	0	0	0	0.1
Bicycles on Road	0	6	0	0	1	0	1	0	0	0	0	0	0	0	0	0	8
% Bicycles on Road	0	0.3	0	0	0.3	0	0.1	0	0	0	0	0	0	0	0	0	0.1
Bicycles on Crosswalk	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2
% Bicycles on Crosswalk	0	0	0	0	0	0	0	28.6	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	1	0	0	0	5	0	0	0	12	0	0	0	8	26
% Pedestrians	0	0	0	100	0	0	0	71.4	0	0	0	100	0	0	0	100	0.3

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Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 15:30 to 16:15 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 15:30																					
15:30	138	225	8	0	371	38	20	**242**	0	300	**19**	**163**	**64**	0	**246**	**9**	19	20	0	48	965
15:45	**142**	241	9	0	392	51	**22**	232	0	**305**	16	150	45	0	211	8	**30**	**27**	**2**	**67**	**975**
16:00	137	225	7	0	369	**52**	21	209	0	282	5	141	43	0	189	8	18	16	0	42	882
16:15	138	**287**	**12**	0	**437**	39	19	213	0	271	10	143	53	**2**	208	5	18	21	1	45	961
Total Volume	555	978	36	0	1569	180	82	896	0	1158	50	597	205	2	854	30	85	84	3	202	3783
% App. Total	35.4	62.3	2.3	0		15.5	7.1	77.4	0		5.9	69.9	24	0.2		14.9	42.1	41.6	1.5		
PHF	.977	.852	.750	.000	.898	.865	.932	.926	.000	.949	.658	.916	.801	.250	.868	.833	.708	.778	.375	.754	.970



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Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

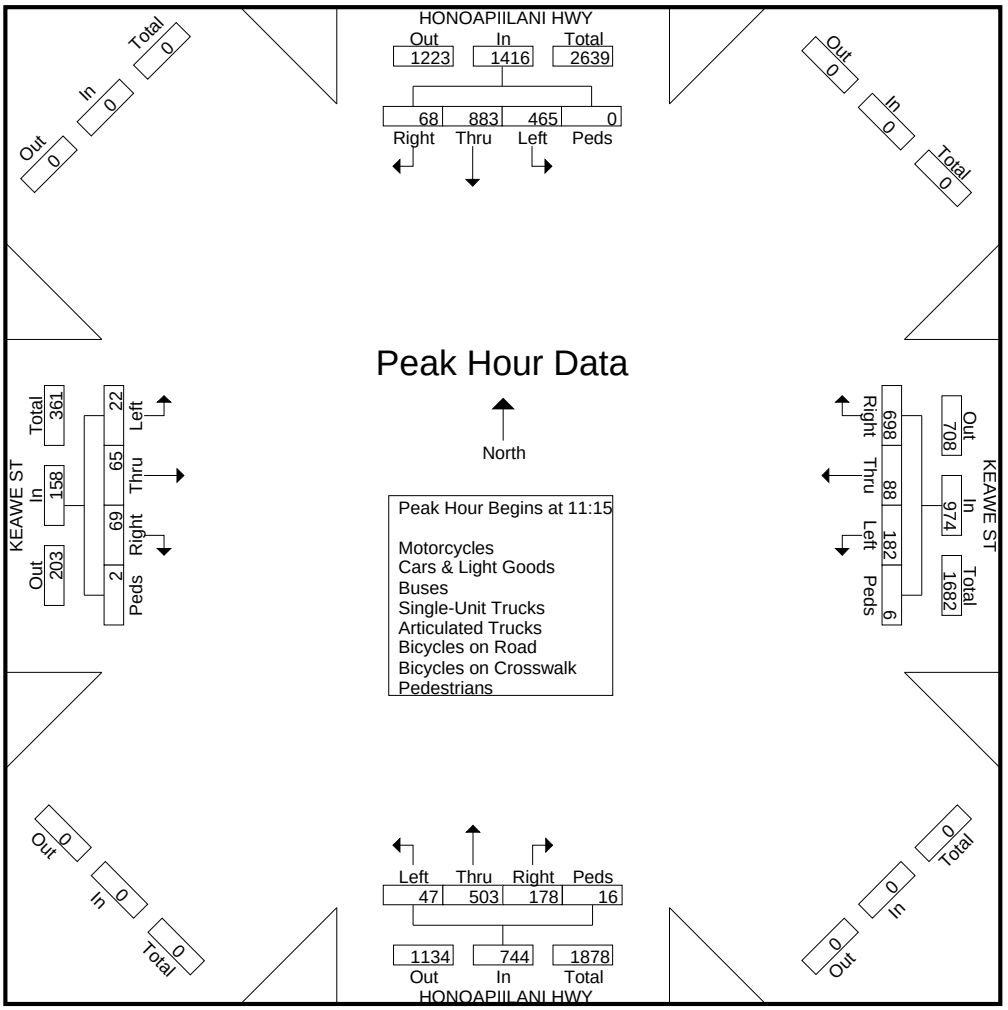
	HONOAPIILANI HWY SOUTHBOUND				KEAWE ST WESTBOUND				HONOAPIILANI HWY NORTHBOUND				KEAWE ST EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
11:00	114	209	9	1	36	18	139	0	7	123	54	1	2	25	16	1	755
11:15	142	243	16	0	51	23	153	0	9	90	44	1	4	13	17	0	806
11:30	93	229	15	0	44	21	174	2	6	131	35	9	6	19	16	2	802
11:45	115	213	23	0	43	26	179	2	13	139	42	5	7	15	14	0	836
Total	464	894	63	1	174	88	645	4	35	483	175	16	19	72	63	3	3199
12:00	115	198	14	0	44	18	192	2	19	143	57	1	5	18	22	0	848
12:15	101	222	13	0	35	31	166	1	16	138	46	4	8	25	20	0	826
12:30	111	168	10	0	42	28	165	2	11	152	41	2	7	25	16	4	784
12:45	85	169	11	0	35	20	212	0	15	140	52	3	9	26	17	2	796
Total	412	757	48	0	156	97	735	5	61	573	196	10	29	94	75	6	3254
Grand Total	876	1651	111	1	330	185	1380	9	96	1056	371	26	48	166	138	9	6453
Apprch %	33.2	62.6	4.2	0	17.3	9.7	72.5	0.5	6.2	68.2	24	1.7	13.3	46	38.2	2.5	
Total %	13.6	25.6	1.7	0	5.1	2.9	21.4	0.1	1.5	16.4	5.7	0.4	0.7	2.6	2.1	0.1	
Motorcycles	0	8	1	0	3	1	3	0	0	8	4	0	0	2	2	0	32
% Motorcycles	0	0.5	0.9	0	0.9	0.5	0.2	0	0	0.8	1.1	0	0	1.2	1.4	0	0.5
Cars & Light Goods	865	1617	110	0	322	177	1361	0	95	1027	363	0	44	162	132	0	6275
% Cars & Light Goods	98.7	97.9	99.1	0	97.6	95.7	98.6	0	99	97.3	97.8	0	91.7	97.6	95.7	0	97.2
Buses	2	13	0	0	1	1	6	0	0	11	2	0	3	0	2	0	41
% Buses	0.2	0.8	0	0	0.3	0.5	0.4	0	0	1	0.5	0	6.2	0	1.4	0	0.6
Single-Unit Trucks	9	7	0	0	3	4	9	0	0	6	2	0	1	2	0	0	43
% Single-Unit Trucks	1	0.4	0	0	0.9	2.2	0.7	0	0	0.6	0.5	0	2.1	1.2	0	0	0.7
Articulated Trucks	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
% Articulated Trucks	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	5	0	0	1	2	1	0	1	4	0	0	0	0	2	0	16
% Bicycles on Road	0	0.3	0	0	0.3	1.1	0.1	0	1	0.4	0	0	0	0	1.4	0	0.2
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	3.8	0	0	0	11.1	0
Pedestrians	0	0	0	1	0	0	0	9	0	0	0	25	0	0	0	8	43
% Pedestrians	0	0	0	100	0	0	0	100	0	0	0	96.2	0	0	0	88.9	0.7

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	HONOAPIILANI HWY SOUTHBOUND					KEAWE ST WESTBOUND					HONOAPIILANI HWY NORTHBOUND					KEAWE ST EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 11:15 to 12:00 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 11:15																					
11:15	**142**	**243**	16	0	**401**	**51**	23	153	0	227	9	90	44	1	144	4	13	17	0	34	806
11:30	93	229	15	0	337	44	21	174	**2**	241	6	131	35	**9**	181	6	**19**	16	**2**	43	802
11:45	115	213	**23**	0	351	43	**26**	179	2	250	13	139	42	5	199	**7**	15	14	0	36	836
12:00	115	198	14	0	327	44	18	**192**	2	**256**	**19**	**143**	**57**	1	**220**	5	18	**22**	0	**45**	**848**
Total Volume	465	883	68	0	1416	182	88	698	6	974	47	503	178	16	744	22	65	69	2	158	3292
% App. Total	32.8	62.4	4.8	0		18.7	9	71.7	0.6		6.3	67.6	23.9	2.2		13.9	41.1	43.7	1.3		
PHF	.819	.908	.739	.000	.883	.892	.846	.909	.750	.951	.618	.879	.781	.444	.845	.786	.855	.784	.250	.878	.971



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Phone: 533-3646 Fax: 526-1267

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Groups Printed- Motorcycles - Cars - Light Goods Vehicles - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

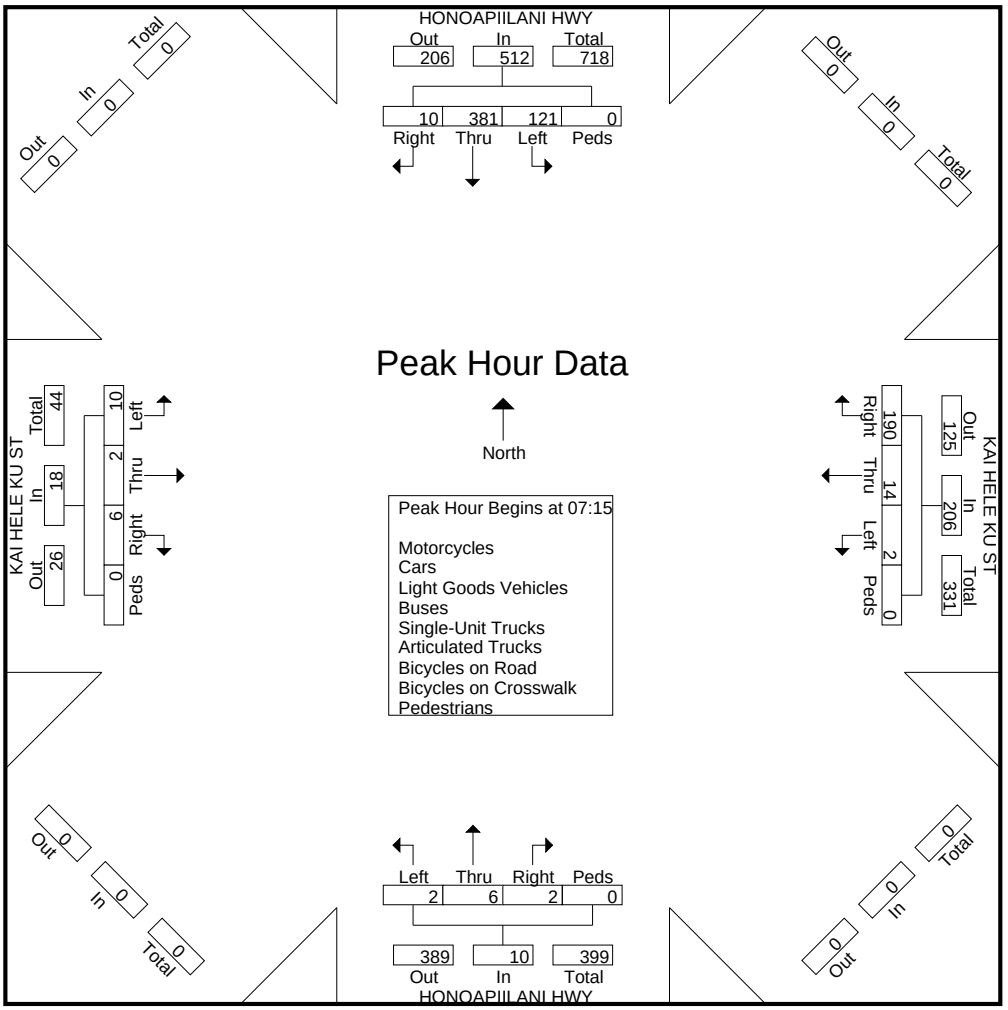
	HONOAPIILANI HWY SOUTHBOUND				KAI HELE KU ST WESTBOUND				HONOAPIILANI HWY NORTHBOUND				KAI HELE KU ST EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:30	34	68	3	0	0	6	49	0	0	0	0	0	3	0	0	0	163
06:45	35	74	4	0	1	3	39	0	0	1	0	0	2	1	1	0	161
Total	69	142	7	0	1	9	88	0	0	1	0	0	5	1	1	0	324
07:00	39	101	3	0	1	7	34	0	0	1	1	0	4	3	0	0	194
07:15	24	88	0	0	1	5	46	0	1	1	1	0	2	0	0	0	169
07:30	31	90	2	0	1	2	44	0	1	1	1	0	2	0	2	0	177
07:45	23	101	5	0	0	3	39	0	0	0	0	0	1	0	1	0	173
Total	117	380	10	0	3	17	163	0	2	3	3	0	9	3	3	0	713
08:00	43	102	3	0	0	4	61	0	0	4	0	0	5	2	3	0	227
08:15	36	104	5	0	0	7	61	0	0	3	2	0	2	4	1	1	226
Grand Total	265	728	25	0	4	37	373	0	2	11	5	0	21	10	8	1	1490
Apprch %	26	71.5	2.5	0	1	8.9	90.1	0	11.1	61.1	27.8	0	52.5	25	20	2.5	
Total %	17.8	48.9	1.7	0	0.3	2.5	25	0	0.1	0.7	0.3	0	1.4	0.7	0.5	0.1	
Motorcycles	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
% Motorcycles	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2
Cars	233	586	15	0	3	20	220	0	1	8	3	0	11	7	6	0	1113
% Cars	87.9	80.5	60	0	75	54.1	59	0	50	72.7	60	0	52.4	70	75	0	74.7
Light Goods Vehicles	27	107	9	0	1	17	124	0	0	1	2	0	10	3	1	0	302
% Light Goods Vehicles	10.2	14.7	36	0	25	45.9	33.2	0	0	9.1	40	0	47.6	30	12.5	0	20.3
Buses	3	11	1	0	0	0	2	0	0	0	0	0	0	0	1	0	18
% Buses	1.1	1.5	4	0	0	0	0.5	0	0	0	0	0	0	0	12.5	0	1.2
Single-Unit Trucks	2	15	0	0	0	0	24	0	0	1	0	0	0	0	0	0	42
% Single-Unit Trucks	0.8	2.1	0	0	0	0	6.4	0	0	9.1	0	0	0	0	0	0	2.8
Articulated Trucks	0	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	6
% Articulated Trucks	0	0.4	0	0	0	0	0.8	0	0	0	0	0	0	0	0	0	0.4
Bicycles on Road	0	3	0	0	0	0	0	0	1	1	0	0	0	0	0	0	5
% Bicycles on Road	0	0.4	0	0	0	0	0	0	50	9.1	0	0	0	0	0	0	0.3
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0.1

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	HONOAPIILANI HWY SOUTHBOUND					KAI HELE KU ST WESTBOUND					HONOAPIILANI HWY NORTHBOUND					KAI HELE KU ST EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:15 to 08:00 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15																					
07:15	24	88	0	0	112	**1**	**5**	46	0	52	**1**	1	**1**	0	3	2	0	0	0	2	169
07:30	31	90	2	0	123	1	2	44	0	47	1	1	1	0	3	2	0	2	0	4	177
07:45	23	101	**5**	0	129	0	3	39	0	42	0	0	0	0	0	1	0	1	0	2	173
08:00	**43**	**102**	3	0	**148**	0	4	**61**	0	**65**	0	**4**	0	0	**4**	**5**	**2**	**3**	0	**10**	**227**
Total Volume	121	381	10	0	512	2	14	190	0	206	2	6	2	0	10	10	2	6	0	18	746
% App. Total	23.6	74.4	2	0		1	6.8	92.2	0		20	60	20	0		55.6	11.1	33.3	0		
PHF	.703	.934	.500	.000	.865	.500	.700	.779	.000	.792	.500	.375	.500	.000	.625	.500	.250	.500	.000	.450	.822



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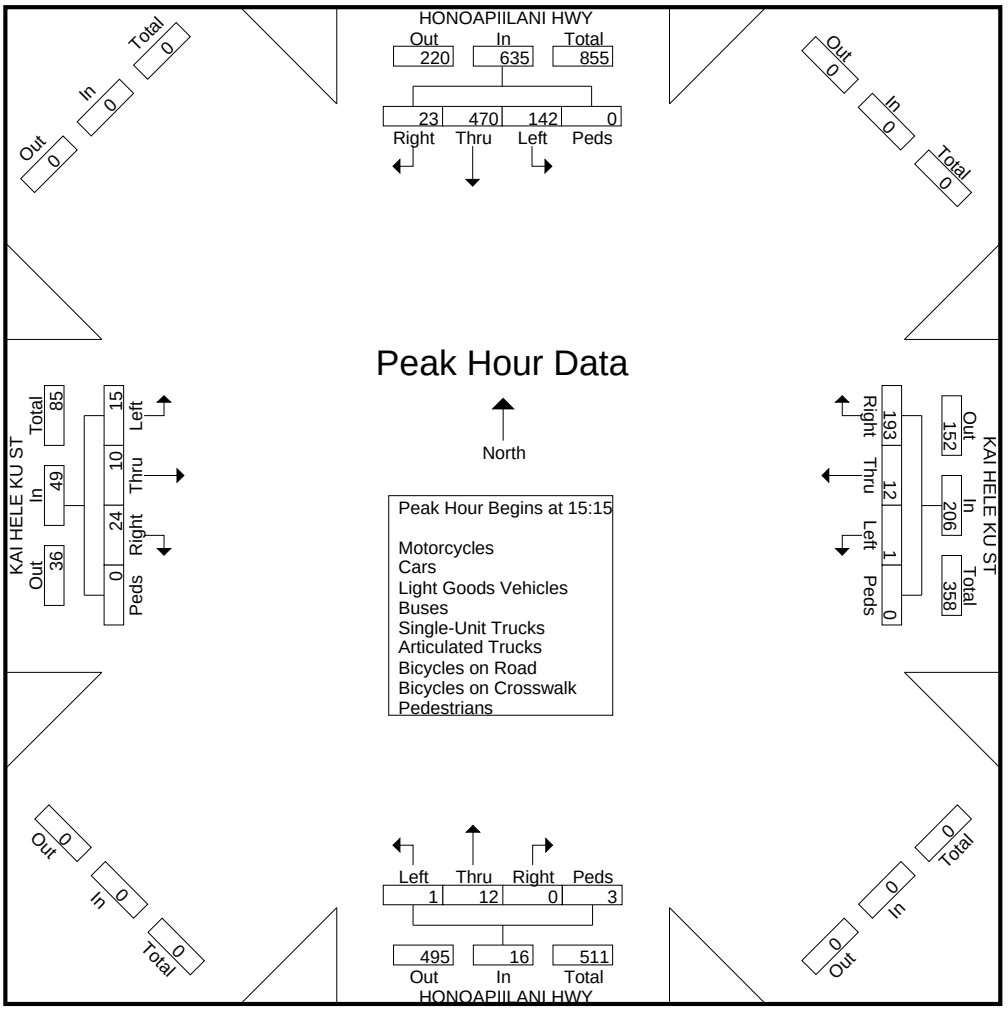
	HONOAPIILANI HWY SOUTHBOUND				KAI HELE KU ST WESTBOUND				HONOAPIILANI HWY NORTHBOUND				KAI HELE KU ST EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
15:15	31	125	9	0	0	0	44	0	0	1	0	1	8	1	10	0	230
15:30	39	122	1	0	1	6	49	0	0	3	0	2	3	0	5	0	231
15:45	36	118	7	0	0	4	45	0	0	5	0	0	3	4	2	0	224
Total	106	365	17	0	1	10	138	0	0	9	0	3	14	5	17	0	685
16:00	36	105	6	0	0	2	55	0	1	3	0	0	1	5	7	0	221
16:15	31	166	4	0	1	7	47	0	0	4	0	1	2	2	3	0	268
16:30	26	113	4	0	0	5	40	0	0	4	0	0	1	2	2	0	197
16:45	25	113	5	0	0	3	36	0	0	1	0	0	2	0	2	0	187
Total	118	497	19	0	1	17	178	0	1	12	0	1	6	9	14	0	873
17:00	17	115	5	0	1	1	44	0	0	0	0	0	6	0	4	0	193
Grand Total	241	977	41	0	3	28	360	0	1	21	0	4	26	14	35	0	1751
Apprch %	19.1	77.6	3.3	0	0.8	7.2	92.1	0	3.8	80.8	0	15.4	34.7	18.7	46.7	0	
Total %	13.8	55.8	2.3	0	0.2	1.6	20.6	0	0.1	1.2	0	0.2	1.5	0.8	2	0	
Motorcycles	1	4	0	0	0	0	2	0	0	2	0	0	0	0	0	0	9
% Motorcycles	0.4	0.4	0	0	0	0	0.6	0	0	9.5	0	0	0	0	0	0	0.5
Cars	199	721	33	0	1	17	298	0	1	14	0	0	17	10	27	0	1338
% Cars	82.6	73.8	80.5	0	33.3	60.7	82.8	0	100	66.7	0	0	65.4	71.4	77.1	0	76.4
Light Goods Vehicles	40	237	8	0	2	11	58	0	0	3	0	0	9	4	8	0	380
% Light Goods Vehicles	16.6	24.3	19.5	0	66.7	39.3	16.1	0	0	14.3	0	0	34.6	28.6	22.9	0	21.7
Buses	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
% Buses	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2
Single-Unit Trucks	1	11	0	0	0	0	1	0	0	2	0	0	0	0	0	0	15
% Single-Unit Trucks	0.4	1.1	0	0	0	0	0.3	0	0	9.5	0	0	0	0	0	0	0.9
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
% Bicycles on Road	0	0	0	0	0	0	0.3	0	0	0	0	0	0	0	0	0	0.1
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0.1
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0	75	0	0	0	0	0.2

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	HONOAPIILANI HWY SOUTHBOUND					KAI HELE KU ST WESTBOUND					HONOAPIILANI HWY NORTHBOUND					KAI HELE KU ST EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 15:15 to 16:00 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 15:15																					
15:15	31	**125**	**9**	0	**165**	0	0	44	0	44	0	1	0	1	2	**8**	1	**10**	0	**19**	230
15:30	**39**	122	1	0	162	**1**	**6**	49	0	56	0	3	0	**2**	**5**	3	0	5	0	8	**231**
15:45	36	118	7	0	161	0	4	45	0	49	0	**5**	0	0	5	3	4	2	0	9	224
16:00	36	105	6	0	147	0	2	**55**	0	**57**	**1**	3	0	0	4	1	**5**	7	0	13	221
Total Volume	142	470	23	0	635	1	12	193	0	206	1	12	0	3	16	15	10	24	0	49	906
% App. Total	22.4	74	3.6	0		0.5	5.8	93.7	0		6.2	75	0	18.8		30.6	20.4	49	0		
PHF	.910	.940	.639	.000	.962	.250	.500	.877	.000	.904	.250	.600	.000	.375	.800	.469	.500	.600	.000	.645	.981



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Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

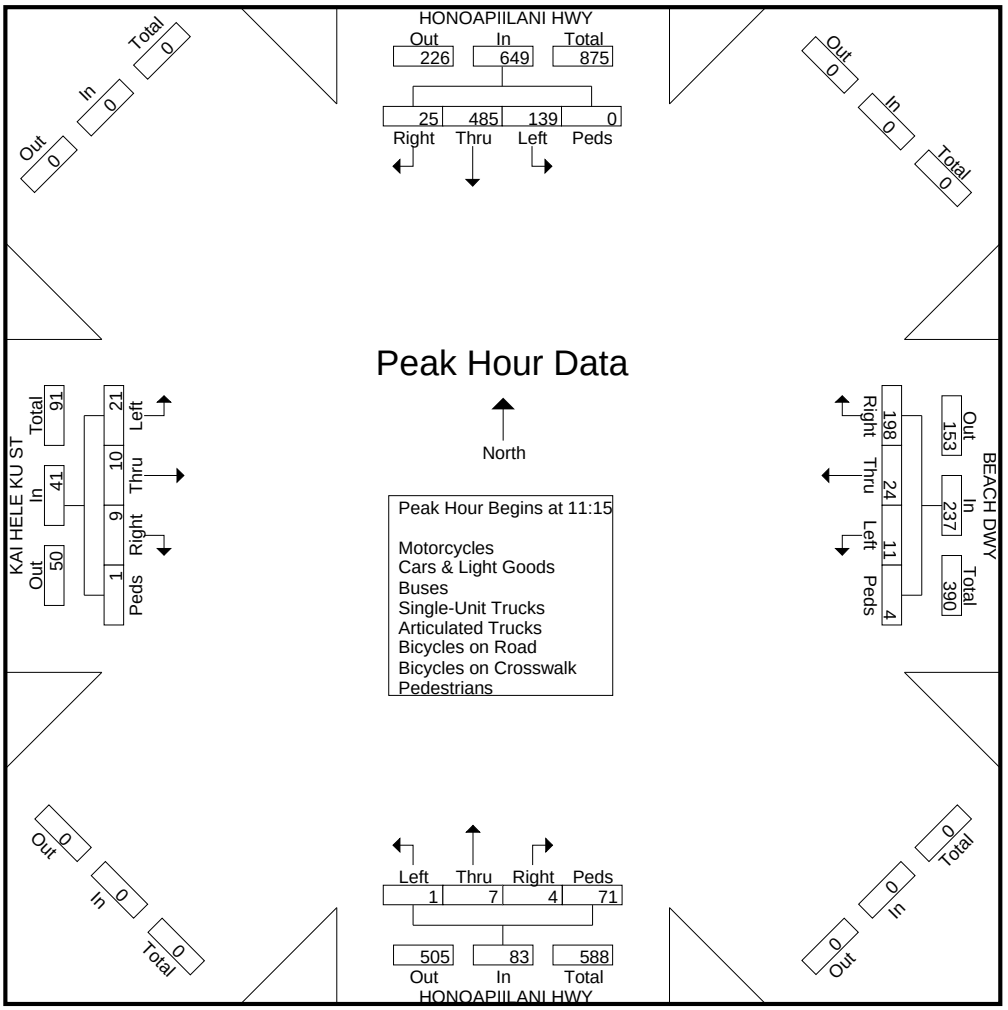
	HONOAPIILANI HWY SOUTHBOUND				BEACH DWY WESTBOUND				HONOAPIILANI HWY NORTHBOUND				KAI HELE KU ST EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
11:00	50	115	9	0	2	6	46	0	0	1	1	38	4	6	3	0	281
11:15	38	118	6	0	0	7	44	0	0	1	0	22	5	4	4	0	249
11:30	36	126	4	0	3	7	42	1	1	2	2	19	7	2	2	1	255
11:45	34	125	7	0	5	5	64	0	0	2	1	13	4	3	3	0	266
Total	158	484	26	0	10	25	196	1	1	6	4	92	20	15	12	1	1051
12:00	31	116	8	0	3	5	48	3	0	2	1	17	5	1	0	0	240
12:15	42	103	4	0	2	7	56	0	0	3	1	35	3	10	1	0	267
12:30	52	92	5	0	3	8	58	0	2	7	0	34	4	5	2	1	273
12:45	34	100	4	0	3	5	55	0	0	2	0	38	5	4	0	0	250
Total	159	411	21	0	11	25	217	3	2	14	2	124	17	20	3	1	1030
Grand Total	317	895	47	0	21	50	413	4	3	20	6	216	37	35	15	2	2081
Apprch %	25.2	71.1	3.7	0	4.3	10.2	84.6	0.8	1.2	8.2	2.4	88.2	41.6	39.3	16.9	2.2	
Total %	15.2	43	2.3	0	1	2.4	19.8	0.2	0.1	1	0.3	10.4	1.8	1.7	0.7	0.1	
Motorcycles	0	2	0	0	0	0	7	0	0	1	0	0	0	0	0	0	10
% Motorcycles	0	0.2	0	0	0	0	1.7	0	0	5	0	0	0	0	0	0	0.5
Cars & Light Goods	315	869	47	0	21	50	399	0	3	16	6	0	37	35	15	0	1813
% Cars & Light Goods	99.4	97.1	100	0	100	100	96.6	0	100	80	100	0	100	100	100	0	87.1
Buses	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	4
% Buses	0	0.3	0	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0.2
Single-Unit Trucks	2	12	0	0	0	0	3	0	0	0	0	0	0	0	0	0	17
% Single-Unit Trucks	0.6	1.3	0	0	0	0	0.7	0	0	0	0	0	0	0	0	0	0.8
Articulated Trucks	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
% Articulated Trucks	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Bicycles on Road	0	7	0	0	0	0	3	0	0	3	0	0	0	0	0	0	13
% Bicycles on Road	0	0.8	0	0	0	0	0.7	0	0	15	0	0	0	0	0	0	0.6
Bicycles on Crosswalk	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	3
% Bicycles on Crosswalk	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	100	0.1
Pedestrians	0	0	0	0	0	0	0	3	0	0	0	216	0	0	0	0	219
% Pedestrians	0	0	0	0	0	0	0	75	0	0	0	100	0	0	0	0	10.5

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	HONOAPIILANI HWY SOUTHBOUND					BEACH DWY WESTBOUND					HONOAPIILANI HWY NORTHBOUND					KAI HELE KU ST EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 11:15 to 12:00 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 11:15																					
11:15	**38**	118	6	0	162	0	**7**	44	0	51	0	1	0	**22**	23	5	**4**	**4**	0	**13**	249
11:30	36	**126**	4	0	**166**	3	7	42	1	53	**1**	**2**	**2**	19	**24**	**7**	2	2	**1**	12	255
11:45	34	125	7	0	166	**5**	5	**64**	0	**74**	0	2	1	13	16	4	3	3	0	10	**266**
12:00	31	116	**8**	0	155	3	5	48	**3**	59	0	2	1	17	20	5	1	0	0	6	240
Total Volume	139	485	25	0	649	11	24	198	4	237	1	7	4	71	83	21	10	9	1	41	1010
% App. Total	21.4	74.7	3.9	0		4.6	10.1	83.5	1.7		1.2	8.4	4.8	85.5		51.2	24.4	22	2.4		
PHF	.914	.962	.781	.000	.977	.550	.857	.773	.333	.801	.250	.875	.500	.807	.865	.750	.625	.563	.250	.788	.949



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Groups Printed- Motorcycles - Cars - Light Goods Vehicles - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

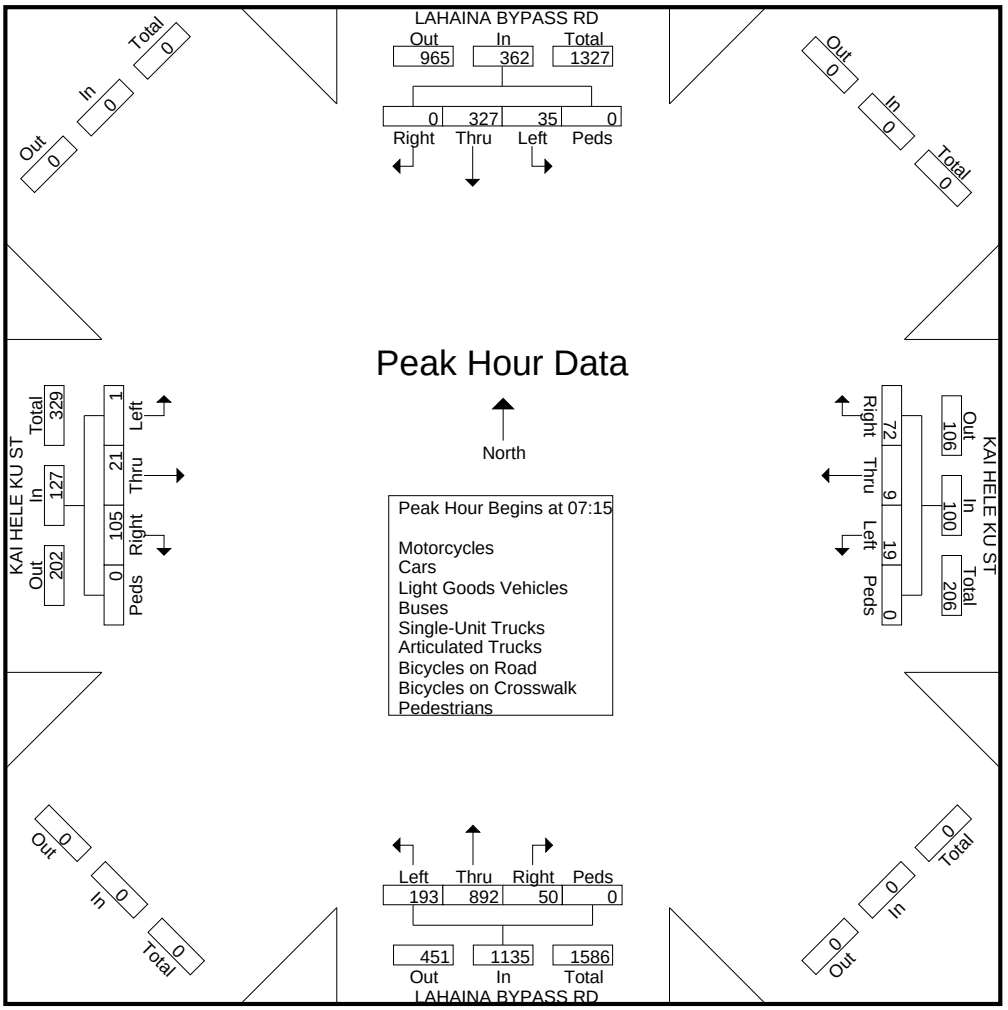
	LAHAINA BYPASS RD SOUTHBOUND				KAI HELE KU ST WESTBOUND				LAHAINA BYPASS RD NORTHBOUND				KAI HELE KU ST EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:30	3	41	1	0	6	1	10	0	45	223	8	0	1	1	32	0	372
06:45	6	59	0	0	4	2	16	0	39	223	17	0	1	7	22	0	396
Total	9	100	1	0	10	3	26	0	84	446	25	0	2	8	54	0	768
07:00	1	71	0	0	2	5	14	0	35	228	6	0	0	9	32	0	403
07:15	8	75	0	0	6	2	20	0	49	228	9	0	1	1	27	0	426
07:30	5	60	0	0	3	3	29	0	47	227	13	0	0	4	29	0	420
07:45	12	92	0	0	7	3	11	0	48	206	14	0	0	8	15	0	416
Total	26	298	0	0	18	13	74	0	179	889	42	0	1	22	103	0	1665
08:00	10	100	0	0	3	1	12	0	49	231	14	0	0	8	34	0	462
08:15	6	114	1	0	8	6	10	0	62	220	13	0	4	8	31	0	483
Grand Total	51	612	2	0	39	23	122	0	374	1786	94	0	7	46	222	0	3378
Apprch %	7.7	92	0.3	0	21.2	12.5	66.3	0	16.6	79.2	4.2	0	2.5	16.7	80.7	0	
Total %	1.5	18.1	0.1	0	1.2	0.7	3.6	0	11.1	52.9	2.8	0	0.2	1.4	6.6	0	
Motorcycles	0	4	0	0	0	0	0	0	0	9	0	0	0	0	1	0	14
% Motorcycles	0	0.7	0	0	0	0	0	0	0	0.5	0	0	0	0	0.5	0	0.4
Cars	22	470	0	0	19	15	77	0	231	1108	20	0	2	26	211	0	2201
% Cars	43.1	76.8	0	0	48.7	65.2	63.1	0	61.8	62	21.3	0	28.6	56.5	95	0	65.2
Light Goods Vehicles	27	110	1	0	16	8	44	0	122	596	68	0	5	20	5	0	1022
% Light Goods Vehicles	52.9	18	50	0	41	34.8	36.1	0	32.6	33.4	72.3	0	71.4	43.5	2.3	0	30.3
Buses	0	17	0	0	0	0	1	0	2	13	0	0	0	0	3	0	36
% Buses	0	2.8	0	0	0	0	0.8	0	0.5	0.7	0	0	0	0	1.4	0	1.1
Single-Unit Trucks	2	8	1	0	2	0	0	0	15	51	4	0	0	0	2	0	85
% Single-Unit Trucks	3.9	1.3	50	0	5.1	0	0	0	4	2.9	4.3	0	0	0	0.9	0	2.5
Articulated Trucks	0	2	0	0	1	0	0	0	4	8	2	0	0	0	0	0	17
% Articulated Trucks	0	0.3	0	0	2.6	0	0	0	1.1	0.4	2.1	0	0	0	0	0	0.5
Bicycles on Road	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	3
% Bicycles on Road	0	0.2	0	0	2.6	0	0	0	0	0.1	0	0	0	0	0	0	0.1
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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Phone: 533-3646 Fax: 526-1267

File Name : Lahaina Bypass Rd - Kai Hele Ku St
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Start Date : 5/23/2018

	LAHAINA BYPASS RD SOUTHBOUND					KAI HELE KU ST WESTBOUND					LAHAINA BYPASS RD NORTHBOUND					KAI HELE KU ST EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:15 to 08:00 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15																					
07:15	8	75	0	0	83	6	2	20	0	28	**49**	228	9	0	286	**1**	1	27	0	29	426
07:30	5	60	0	0	65	3	**3**	**29**	0	**35**	47	227	13	0	287	0	4	29	0	33	420
07:45	**12**	92	0	0	104	**7**	3	11	0	21	48	206	**14**	0	268	0	**8**	15	0	23	416
08:00	10	**100**	0	0	**110**	3	1	12	0	16	49	**231**	14	0	**294**	0	8	**34**	0	**42**	**462**
Total Volume	35	327	0	0	362	19	9	72	0	100	193	892	50	0	1135	1	21	105	0	127	1724
% App. Total	9.7	90.3	0	0		19	9	72	0		17	78.6	4.4	0		0.8	16.5	82.7	0		
PHF	.729	.818	.000	.000	.823	.679	.750	.621	.000	.714	.985	.965	.893	.000	.965	.250	.656	.772	.000	.756	.933



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Groups Printed- Motorcycles - Cars - Light Goods Vehicles - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

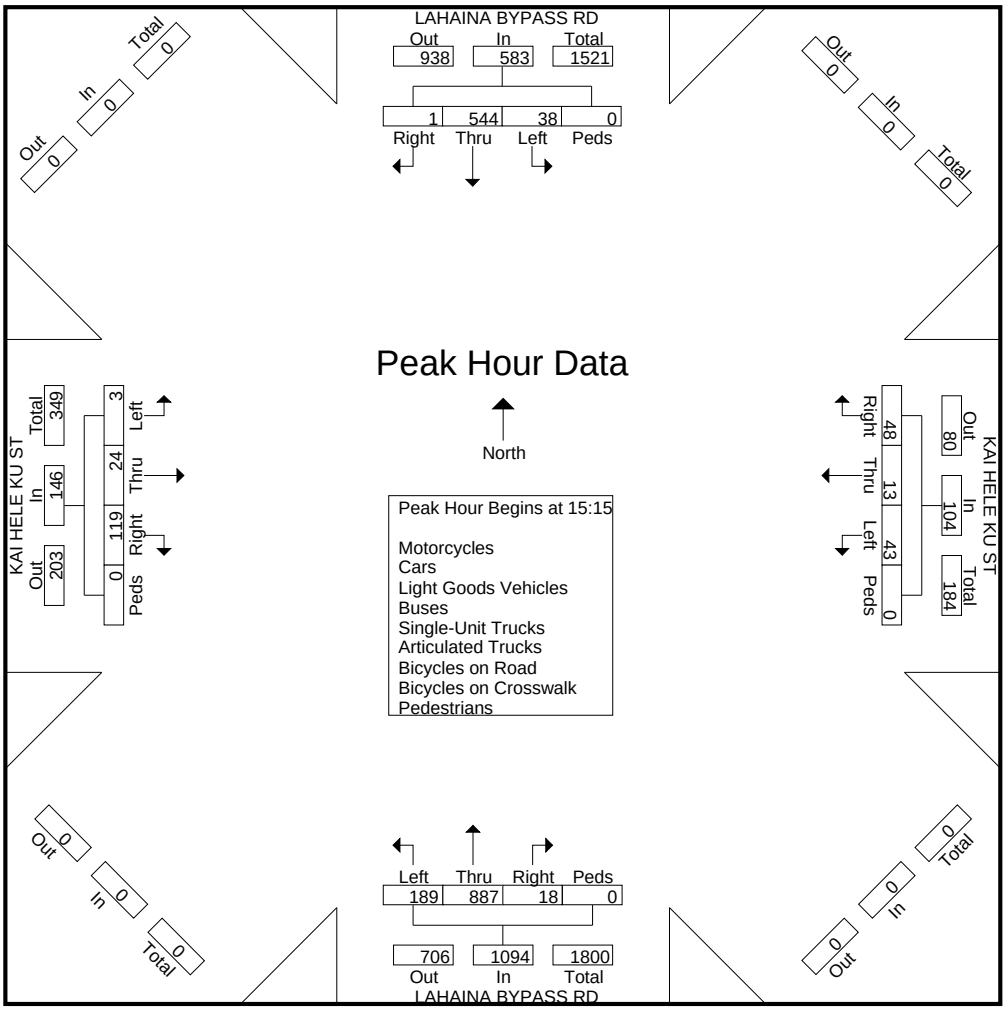
	LAHAINA BYPASS RD SOUTHBOUND				KAI HELE KU ST WESTBOUND				LAHAINA BYPASS RD NORTHBOUND				KAI HELE KU ST EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
15:15	16	136	0	0	9	3	16	0	53	234	2	0	0	12	21	0	502
15:30	7	138	1	0	15	4	7	0	37	209	7	0	0	2	36	0	463
15:45	6	134	0	0	11	3	13	0	45	242	8	0	2	7	30	0	501
Total	29	408	1	0	35	10	36	0	135	685	17	0	2	21	87	0	1466
16:00	9	136	0	0	8	3	12	0	54	202	1	0	1	3	32	0	461
16:15	7	135	1	0	13	0	14	0	56	226	7	0	1	5	32	0	497
16:30	12	140	0	0	11	3	10	0	36	230	2	0	0	3	23	0	470
16:45	5	125	1	0	9	4	7	0	43	203	5	0	1	5	23	0	431
Total	33	536	2	0	41	10	43	0	189	861	15	0	3	16	110	0	1859
17:00	10	135	1	0	6	3	8	0	40	169	9	0	0	4	13	0	398
Grand Total	72	1079	4	0	82	23	87	0	364	1715	41	0	5	41	210	0	3723
Apprch %	6.2	93.4	0.3	0	42.7	12	45.3	0	17.2	80.9	1.9	0	2	16	82	0	
Total %	1.9	29	0.1	0	2.2	0.6	2.3	0	9.8	46.1	1.1	0	0.1	1.1	5.6	0	
Motorcycles	3	1	0	0	1	0	0	0	2	7	0	0	0	1	0	0	15
% Motorcycles	4.2	0.1	0	0	1.2	0	0	0	0.5	0.4	0	0	0	2.4	0	0	0.4
Cars	43	749	4	0	25	12	51	0	307	1478	26	0	3	28	184	0	2910
% Cars	59.7	69.4	100	0	30.5	52.2	58.6	0	84.3	86.2	63.4	0	60	68.3	87.6	0	78.2
Light Goods Vehicles	25	302	0	0	54	11	36	0	53	209	15	0	2	11	26	0	744
% Light Goods Vehicles	34.7	28	0	0	65.9	47.8	41.4	0	14.6	12.2	36.6	0	40	26.8	12.4	0	20
Buses	0	7	0	0	0	0	0	0	0	7	0	0	0	0	0	0	14
% Buses	0	0.6	0	0	0	0	0	0	0	0.4	0	0	0	0	0	0	0.4
Single-Unit Trucks	1	17	0	0	2	0	0	0	2	12	0	0	0	1	0	0	35
% Single-Unit Trucks	1.4	1.6	0	0	2.4	0	0	0	0.5	0.7	0	0	0	2.4	0	0	0.9
Articulated Trucks	0	3	0	0	0	0	0	0	0	2	0	0	0	0	0	0	5
% Articulated Trucks	0	0.3	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0.1
Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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Honolulu, HI 96817-5031
Phone: 533-3646 Fax: 526-1267

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Start Date : 5/23/2018

	LAHAINA BYPASS RD SOUTHBOUND					KAI HELE KU ST WESTBOUND					LAHAINA BYPASS RD NORTHBOUND					KAI HELE KU ST EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 15:15 to 16:00 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 15:15																					
15:15	**16**	136	0	0	**152**	9	3	**16**	0	**28**	53	234	2	0	289	0	**12**	21	0	33	**502**
15:30	7	**138**	**1**	0	146	**15**	**4**	7	0	26	37	209	7	0	253	0	2	**36**	0	38	463
15:45	6	134	0	0	140	11	3	13	0	27	45	**242**	**8**	0	**295**	**2**	7	30	0	**39**	501
16:00	9	136	0	0	145	8	3	12	0	23	**54**	202	1	0	257	1	3	32	0	36	461
Total Volume	38	544	1	0	583	43	13	48	0	104	189	887	18	0	1094	3	24	119	0	146	1927
% App. Total	6.5	93.3	0.2	0		41.3	12.5	46.2	0		17.3	81.1	1.6	0		2.1	16.4	81.5	0		
PHF	.594	.986	.250	.000	.959	.717	.813	.750	.000	.929	.875	.916	.563	.000	.927	.375	.500	.826	.000	.936	.960



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Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

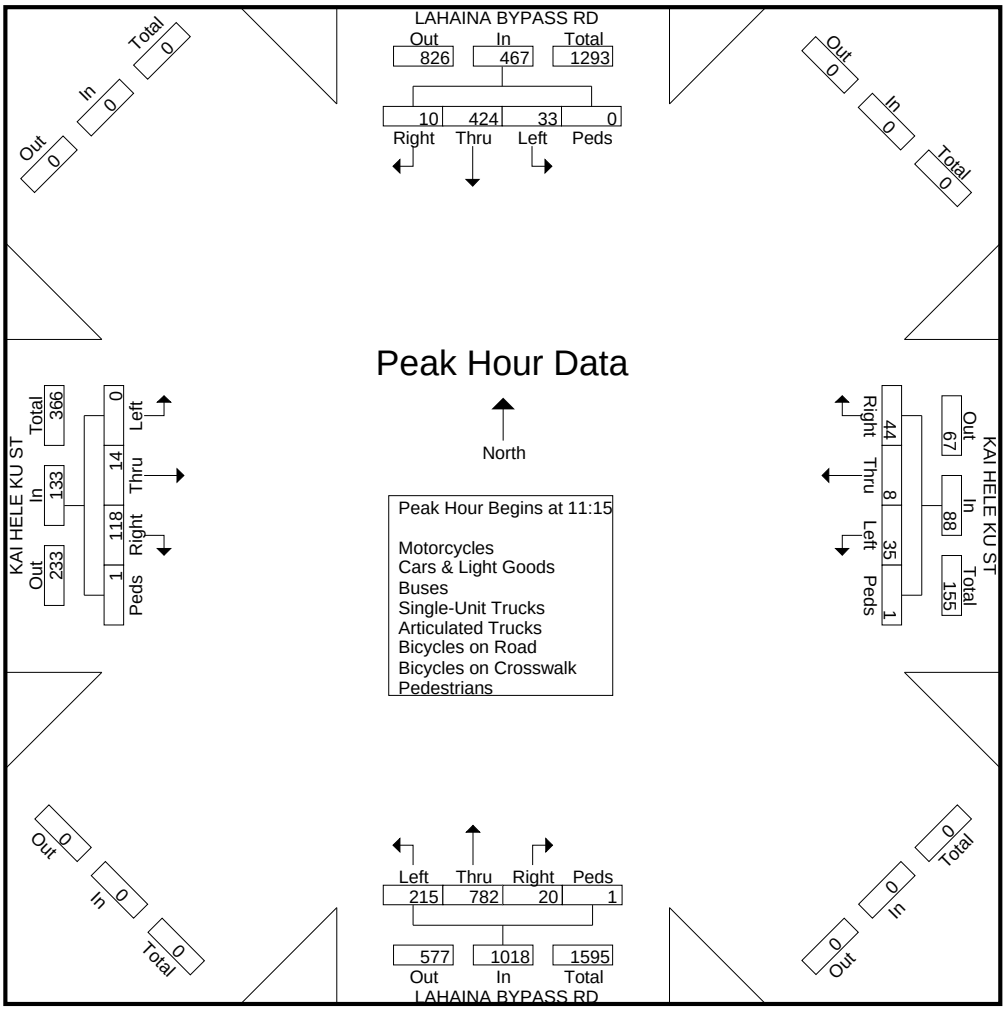
	LAHAINA BYPASS RD SOUTHBOUND				KAI HELE KU ST WESTBOUND				LAHAINA BYPASS RD NORTHBOUND				KAI HELE KU ST EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
11:00	10	100	0	0	4	4	5	0	47	155	7	0	0	4	48	0	384
11:15	9	144	1	0	12	2	18	0	49	168	2	0	0	3	34	0	442
11:30	13	100	4	0	10	3	13	0	49	199	4	1	0	4	31	0	431
11:45	4	110	4	0	5	2	6	0	61	222	7	0	0	1	28	0	450
Total	36	454	9	0	31	11	42	0	206	744	20	1	0	12	141	0	1707
12:00	7	70	1	0	8	1	7	1	56	193	7	0	0	6	25	1	383
12:15	8	89	5	0	4	2	8	0	46	191	4	0	1	3	47	0	408
12:30	8	101	3	0	5	5	4	0	54	192	5	0	0	6	46	0	429
12:45	5	80	1	0	6	2	6	0	55	245	6	0	0	5	25	0	436
Total	28	340	10	0	23	10	25	1	211	821	22	0	1	20	143	1	1656
Grand Total	64	794	19	0	54	21	67	1	417	1565	42	1	1	32	284	1	3363
Apprch %	7.3	90.5	2.2	0	37.8	14.7	46.9	0.7	20.6	77.3	2.1	0	0.3	10.1	89.3	0.3	
Total %	1.9	23.6	0.6	0	1.6	0.6	2	0	12.4	46.5	1.2	0	0	1	8.4	0	
Motorcycles	0	4	0	0	0	0	2	0	6	9	1	0	0	0	0	0	22
% Motorcycles	0	0.5	0	0	0	0	3	0	1.4	0.6	2.4	0	0	0	0	0	0.7
Cars & Light Goods	64	762	19	0	51	21	65	0	404	1532	38	0	1	31	283	0	3271
% Cars & Light Goods	100	96	100	0	94.4	100	97	0	96.9	97.9	90.5	0	100	96.9	99.6	0	97.3
Buses	0	8	0	0	0	0	0	0	1	10	0	0	0	0	0	0	19
% Buses	0	1	0	0	0	0	0	0	0.2	0.6	0	0	0	0	0	0	0.6
Single-Unit Trucks	0	19	0	0	3	0	0	0	1	10	3	0	0	1	1	0	38
% Single-Unit Trucks	0	2.4	0	0	5.6	0	0	0	0.2	0.6	7.1	0	0	3.1	0.4	0	1.1
Articulated Trucks	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	3
% Articulated Trucks	0	0.1	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0.1
Bicycles on Road	0	0	0	0	0	0	0	0	3	4	0	0	0	0	0	0	7
% Bicycles on Road	0	0	0	0	0	0	0	0	0.7	0.3	0	0	0	0	0	0	0.2
Bicycles on Crosswalk	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
% Bicycles on Crosswalk	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	100	0.1

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	LAHAINA BYPASS RD SOUTHBOUND					KAI HELE KU ST WESTBOUND					LAHAINA BYPASS RD NORTHBOUND					KAI HELE KU ST EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 11:15 to 12:00 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 11:15																					
11:15	9	**144**	1	0	**154**	**12**	2	**18**	0	**32**	49	168	2	0	219	0	3	**34**	0	**37**	442
11:30	**13**	100	**4**	0	117	10	**3**	13	0	26	49	199	4	**1**	253	0	4	31	0	35	431
11:45	4	110	4	0	118	5	2	6	0	13	**61**	**222**	**7**	0	**290**	0	1	28	0	29	**450**
12:00	7	70	1	0	78	8	1	7	**1**	17	56	193	7	0	256	0	**6**	25	**1**	32	383
Total Volume	33	424	10	0	467	35	8	44	1	88	215	782	20	1	1018	0	14	118	1	133	1706
% App. Total	7.1	90.8	2.1	0		39.8	9.1	50	1.1		21.1	76.8	2	0.1		0	10.5	88.7	0.8		
PHF	.635	.736	.625	.000	.758	.729	.667	.611	.250	.688	.881	.881	.714	.250	.878	.000	.583	.868	.250	.899	.948



APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Existing Conditions AM

Intersection	
Int Delay, s/veh	2.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	17	75	57	248	418	17
Future Vol, veh/h	17	75	57	248	418	17
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	18	82	62	270	454	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	958	606	574	0	-	0
Stage 1	565	-	-	-	-	-
Stage 2	393	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	285	497	999	-	-	-
Stage 1	569	-	-	-	-	-
Stage 2	682	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	217	432	903	-	-	-
Mov Cap-2 Maneuver	217	-	-	-	-	-
Stage 1	479	-	-	-	-	-
Stage 2	616	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	18.53	1.73	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	903	-	365	-	-
HCM Lane V/C Ratio	0.069	-	0.274	-	-
HCM Control Delay (s/veh)	9.3	-	18.5	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0.2	-	1.1	-	-

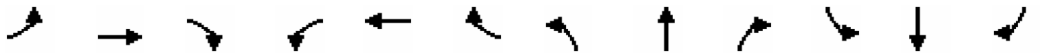
Intersection	
Int Delay, s/veh	1.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	19	36	271	18	45	452
Future Vol, veh/h	19	36	271	18	45	452
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	21	39	295	20	49	491

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	657	308	0	0	318	0
Stage 1	308	-	-	-	-	-
Stage 2	348	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	414	731	-	-	1240	-
Stage 1	744	-	-	-	-	-
Stage 2	687	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	394	728	-	-	1236	-
Mov Cap-2 Maneuver	394	-	-	-	-	-
Stage 1	741	-	-	-	-	-
Stage 2	656	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	11.75	0	0.73
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	394	728	1236	-
HCM Lane V/C Ratio	-	-	0.052	0.054	0.04	-
HCM Control Delay (s/veh)	-	-	14.6	10.2	8	-
HCM Lane LOS	-	-	B	B	A	-
HCM 95th %tile Q(veh)	-	-	0.2	0.2	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	64	1	428	1	5	0	261	536	3	3	632	79
Future Volume (veh/h)	64	1	428	1	5	0	261	536	3	3	632	79
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	70	1	0	1	5	0	284	583	3	3	687	26
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	105	1		2	12	0	357	1823	9	7	1091	485
Arrive On Green	0.06	0.06	0.00	0.01	0.01	0.00	0.20	0.50	0.50	0.00	0.31	0.31
Sat Flow, veh/h	1757	25	1585	309	1546	0	1781	3625	19	1781	3554	1580
Grp Volume(v), veh/h	71	0	0	6	0	0	284	286	300	3	687	26
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1855	0	0	1781	1777	1867	1781	1777	1580
Q Serve(g_s), s	2.2	0.0	0.0	0.2	0.0	0.0	8.6	5.4	5.4	0.1	9.4	0.7
Cycle Q Clear(g_c), s	2.2	0.0	0.0	0.2	0.0	0.0	8.6	5.4	5.4	0.1	9.4	0.7
Prop In Lane	0.99		1.00	0.17		0.00	1.00		0.01	1.00		1.00
Lane Grp Cap(c), veh/h	106	0		15	0	0	357	894	939	7	1091	485
V/C Ratio(X)	0.67	0.00		0.41	0.00	0.00	0.80	0.32	0.32	0.41	0.63	0.05
Avail Cap(c_a), veh/h	474	0		296	0	0	1390	4064	4270	284	4977	2213
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	26.0	0.0	0.0	27.8	0.0	0.0	21.5	8.3	8.3	28.0	16.8	13.8
Incr Delay (d2), s/veh	7.1	0.0	0.0	17.0	0.0	0.0	4.1	0.2	0.2	33.6	0.6	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.1	0.0	0.0	0.1	0.0	0.0	3.7	1.7	1.8	0.1	3.5	0.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	33.1	0.0	0.0	44.8	0.0	0.0	25.6	8.5	8.5	61.6	17.4	13.8
LnGrp LOS	C			D			C	A	A	E	B	B
Approach Vol, veh/h		71			6			870			716	
Approach Delay, s/veh		33.1			44.8			14.1			17.5	
Approach LOS		C			D			B			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.2	34.4		6.4	17.3	23.3		9.4				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	129.0		9.0	44.0	79.0		15.0				
Max Q Clear Time (g_c+I1), s	2.1	7.4		2.2	10.6	11.4		4.2				
Green Ext Time (p_c), s	0.0	4.1		0.0	0.9	5.8		0.2				

Intersection Summary			
HCM 7th Control Delay, s/veh		16.4	
HCM 7th LOS		B	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	9	46	16	21	109	804	7	293	20	581	353	9
Future Volume (veh/h)	9	46	16	21	109	804	7	293	20	581	353	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.98	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	10	50	3	23	118	0	8	318	5	632	384	9
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	87	142	136	248	407		19	426	361	851	843	20
Arrive On Green	0.09	0.09	0.09	0.03	0.22	0.00	0.01	0.23	0.23	0.25	0.46	0.46
Sat Flow, veh/h	174	1615	1549	1781	1870	1585	1781	1870	1585	3456	1820	43
Grp Volume(v), veh/h	60	0	3	23	118	0	8	318	5	632	0	393
Grp Sat Flow(s),veh/h/ln	1789	0	1549	1781	1870	1585	1781	1870	1585	1728	0	1862
Q Serve(g_s), s	0.0	0.0	0.1	0.6	3.1	0.0	0.3	9.2	0.1	9.8	0.0	8.4
Cycle Q Clear(g_c), s	1.8	0.0	0.1	0.6	3.1	0.0	0.3	9.2	0.1	9.8	0.0	8.4
Prop In Lane	0.17		1.00	1.00		1.00	1.00		1.00	1.00		0.02
Lane Grp Cap(c), veh/h	230	0	136	248	407		19	426	361	851	0	863
V/C Ratio(X)	0.26	0.00	0.02	0.09	0.29		0.43	0.75	0.01	0.74	0.00	0.46
Avail Cap(c_a), veh/h	583	0	452	567	995		367	834	707	3497	0	2683
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	25.0	0.0	24.3	21.5	19.0	0.0	28.7	21.0	17.5	20.3	0.0	10.6
Incr Delay (d2), s/veh	0.6	0.0	0.1	0.2	0.4	0.0	15.0	2.6	0.0	1.3	0.0	0.4
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.8	0.0	0.0	0.3	1.3	0.0	0.2	4.0	0.0	3.8	0.0	3.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	25.6	0.0	24.4	21.7	19.4	0.0	43.7	23.6	17.5	21.6	0.0	11.0
LnGrp LOS	C		C	C	B		D	C	B	C		B
Approach Vol, veh/h		63			141			331			1025	
Approach Delay, s/veh		25.6			19.8			24.0			17.5	
Approach LOS		C			B			C			B	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	20.3	19.3	7.6	11.1	6.6	33.0		18.7
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	59.0	26.0	12.0	17.0	12.0	84.0		31.0
Max Q Clear Time (g_c+I1), s	11.2	11.2	2.6	3.8	2.3	10.4		5.1
Green Ext Time (p_c), s	2.5	1.6	0.0	0.2	0.0	2.8		0.6

Intersection Summary	
HCM 7th Control Delay, s/veh	19.4
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	8	7	10	5	12	163	0	12	1	80	301	7
Future Volume (veh/h)	8	7	10	5	12	163	0	12	1	80	301	7
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.97		0.95	0.95		0.97	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	9	8	1	5	13	22	0	13	1	87	327	8
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	298	185	257	211	261	262	468	351	295	677	837	20
Arrive On Green	0.17	0.17	0.17	0.17	0.17	0.17	0.00	0.19	0.19	0.09	0.46	0.46
Sat Flow, veh/h	557	1090	1512	241	1534	1541	1781	1870	1572	1781	1818	44
Grp Volume(v), veh/h	17	0	1	18	0	22	0	13	1	87	0	335
Grp Sat Flow(s),veh/h/ln	1647	0	1512	1775	0	1541	1781	1870	1572	1781	0	1862
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.2	0.0	0.9	0.0	3.2
Cycle Q Clear(g_c), s	0.2	0.0	0.0	0.2	0.0	0.3	0.0	0.2	0.0	0.9	0.0	3.2
Prop In Lane	0.53		1.00	0.28		1.00	1.00		1.00	1.00		0.02
Lane Grp Cap(c), veh/h	484	0	257	472	0	262	468	351	295	677	0	858
V/C Ratio(X)	0.04	0.00	0.00	0.04	0.00	0.08	0.00	0.04	0.00	0.13	0.00	0.39
Avail Cap(c_a), veh/h	3353	0	3070	3605	0	3129	790	3797	3192	848	0	3781
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.4	0.0	9.3	9.4	0.0	9.5	0.0	9.0	8.9	6.1	0.0	4.8
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.2	0.0	0.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.4	0.0	9.3	9.5	0.0	9.6	0.0	9.0	9.0	6.2	0.0	5.1
LnGrp LOS	A		A	A		A		A	A	A		A
Approach Vol, veh/h		18			40			14			422	
Approach Delay, s/veh		9.4			9.5			9.0			5.3	
Approach LOS		A			A			A			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	7.4	10.1		9.6	0.0	17.5		9.6				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	2.2	2.2		2.2	0.0	5.2		2.3				
Green Ext Time (p_c), s	0.0	0.0		0.1	0.0	2.3		0.2				

Intersection Summary	
HCM 7th Control Delay, s/veh	5.9
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	6	73	40	8	58	162	787	36	36	241	9
Future Volume (veh/h)	5	6	73	40	8	58	162	787	36	36	241	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	5	7	3	43	9	2	176	855	23	39	262	5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	108	51	18	205	18	100	227	1055	894	73	893	757
Arrive On Green	0.06	0.06	0.06	0.06	0.06	0.06	0.13	0.56	0.56	0.04	0.48	0.48
Sat Flow, veh/h	302	803	276	1328	278	1580	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	15	0	0	52	0	2	176	855	23	39	262	5
Grp Sat Flow(s),veh/h/ln	1382	0	0	1605	0	1580	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.1	5.2	19.9	0.3	1.2	4.6	0.1
Cycle Q Clear(g_c), s	1.5	0.0	0.0	1.5	0.0	0.1	5.2	19.9	0.3	1.2	4.6	0.1
Prop In Lane	0.33		0.20	0.83		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	176	0	0	223	0	100	227	1055	894	73	893	757
V/C Ratio(X)	0.09	0.00	0.00	0.23	0.00	0.02	0.78	0.81	0.03	0.53	0.29	0.01
Avail Cap(c_a), veh/h	583	0	0	588	0	495	460	3929	3330	328	3791	3213
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	24.0	0.0	0.0	24.5	0.0	23.8	22.9	9.5	5.2	25.5	8.6	7.4
Incr Delay (d2), s/veh	0.2	0.0	0.0	0.5	0.0	0.1	5.6	1.6	0.0	6.0	0.2	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	0.0	0.0	0.6	0.0	0.0	2.4	6.2	0.1	0.6	1.6	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	24.2	0.0	0.0	25.0	0.0	23.9	28.5	11.1	5.2	31.5	8.8	7.4
LnGrp LOS	C			C		C	C	B	A	C	A	A
Approach Vol, veh/h		15			54			1054			306	
Approach Delay, s/veh		24.2			25.0			13.8			11.7	
Approach LOS		C			C			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.2	36.6		9.4	12.9	31.9		9.4
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		17.0	14.0	110.0		17.0
Max Q Clear Time (g_c+I1), s	3.2	21.9		3.5	7.2	6.6		3.5
Green Ext Time (p_c), s	0.0	8.7		0.0	0.2	1.7		0.1

Intersection Summary	
HCM 7th Control Delay, s/veh	13.9
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	309	0	954	358	1
Future Vol, veh/h	0	309	0	954	358	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	336	0	1037	389	1

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Existing Conditions PM

Intersection	
Int Delay, s/veh	3.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	23	109	77	410	405	32
Future Vol, veh/h	23	109	77	410	405	32
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	25	118	84	446	440	35

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1172	600	576	0	-	0
Stage 1	559	-	-	-	-	-
Stage 2	613	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	213	501	997	-	-	-
Stage 1	573	-	-	-	-	-
Stage 2	540	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	158	435	901	-	-	-
Mov Cap-2 Maneuver	158	-	-	-	-	-
Stage 1	470	-	-	-	-	-
Stage 2	488	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	23.75	1.49	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	901	-	333	-	-
HCM Lane V/C Ratio	0.093	-	0.431	-	-
HCM Control Delay (s/veh)	9.4	-	23.7	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0.3	-	2.1	-	-

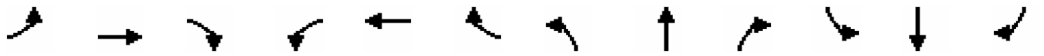
Intersection	
Int Delay, s/veh	2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	42	71	418	39	53	460
Future Vol, veh/h	42	71	418	39	53	460
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	46	77	454	42	58	500

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	850	480	0	0	501	0
Stage 1	480	-	-	-	-	-
Stage 2	370	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	315	585	-	-	1062	-
Stage 1	622	-	-	-	-	-
Stage 2	669	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	295	583	-	-	1058	-
Mov Cap-2 Maneuver	295	-	-	-	-	-
Stage 1	619	-	-	-	-	-
Stage 2	630	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	14.83	0	0.89
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	295	583	1058	-
HCM Lane V/C Ratio	-	-	0.155	0.132	0.054	-
HCM Control Delay (s/veh)	-	-	19.4	12.1	8.6	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.5	0.5	0.2	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	70	1	505	7	2	5	444	679	0	1	648	78
Future Volume (veh/h)	70	1	505	7	2	5	444	679	0	1	648	78
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	76	1	0	8	2	1	483	738	0	1	704	23
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	103	1		18	4	2	548	2111	0	2	1022	454
Arrive On Green	0.06	0.06	0.00	0.01	0.01	0.01	0.31	0.59	0.00	0.00	0.29	0.29
Sat Flow, veh/h	1759	23	1585	1292	323	162	1781	3647	0	1781	3554	1580
Grp Volume(v), veh/h	77	0	0	11	0	0	483	738	0	1	704	23
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1777	0	0	1781	1777	0	1781	1777	1580
Q Serve(g_s), s	3.1	0.0	0.0	0.4	0.0	0.0	18.6	7.7	0.0	0.0	12.7	0.8
Cycle Q Clear(g_c), s	3.1	0.0	0.0	0.4	0.0	0.0	18.6	7.7	0.0	0.0	12.7	0.8
Prop In Lane	0.99		1.00	0.73		0.09	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	104	0		24	0	0	548	2111	0	2	1022	454
V/C Ratio(X)	0.74	0.00		0.45	0.00	0.00	0.88	0.35	0.00	0.41	0.69	0.05
Avail Cap(c_a), veh/h	593	0		222	0	0	1456	5120	0	222	3397	1510
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	33.4	0.0	0.0	35.3	0.0	0.0	23.7	7.5	0.0	36.0	22.8	18.6
Incr Delay (d2), s/veh	9.7	0.0	0.0	12.5	0.0	0.0	4.8	0.1	0.0	82.1	0.8	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.6	0.0	0.0	0.3	0.0	0.0	8.0	2.5	0.0	0.1	5.1	0.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	43.2	0.0	0.0	47.8	0.0	0.0	28.5	7.6	0.0	118.2	23.7	18.6
LnGrp LOS	D			D			C	A		F	C	B
Approach Vol, veh/h		77			11			1221			728	
Approach Delay, s/veh		43.2			47.8			15.9			23.7	
Approach LOS		D			D			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.1	48.9		7.0	28.2	26.8		10.2				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	104.0		9.0	59.0	69.0		24.0				
Max Q Clear Time (g_c+I1), s	2.0	9.7		2.4	20.6	14.7		5.1				
Green Ext Time (p_c), s	0.0	6.3		0.0	1.6	5.9		0.3				

Intersection Summary	
HCM 7th Control Delay, s/veh	19.9
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	25	73	67	12	101	815	5	232	12	685	292	16
Future Volume (veh/h)	25	73	67	12	101	815	5	232	12	685	292	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.98	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	27	79	12	13	110	0	5	252	2	745	317	16
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	107	158	171	218	422		12	365	309	972	829	42
Arrive On Green	0.11	0.11	0.11	0.02	0.23	0.00	0.01	0.19	0.19	0.28	0.47	0.47
Sat Flow, veh/h	297	1438	1556	1781	1870	1585	1781	1870	1585	3456	1765	89
Grp Volume(v), veh/h	106	0	12	13	110	0	5	252	2	745	0	333
Grp Sat Flow(s),veh/h/ln	1735	0	1556	1781	1870	1585	1781	1870	1585	1728	0	1854
Q Serve(g_s), s	1.4	0.0	0.4	0.4	2.9	0.0	0.2	7.6	0.1	11.9	0.0	7.0
Cycle Q Clear(g_c), s	3.4	0.0	0.4	0.4	2.9	0.0	0.2	7.6	0.1	11.9	0.0	7.0
Prop In Lane	0.25		1.00	1.00		1.00	1.00		1.00	1.00		0.05
Lane Grp Cap(c), veh/h	265	0	171	218	422		12	365	309	972	0	871
V/C Ratio(X)	0.40	0.00	0.07	0.06	0.26		0.42	0.69	0.01	0.77	0.00	0.38
Avail Cap(c_a), veh/h	914	0	774	602	1488		266	1054	893	3379	0	1813
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	25.4	0.0	24.1	21.7	19.2	0.0	29.9	22.6	19.6	19.9	0.0	10.3
Incr Delay (d2), s/veh	1.0	0.0	0.2	0.1	0.3	0.0	22.0	2.3	0.0	1.3	0.0	0.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.4	0.0	0.2	0.2	1.2	0.0	0.1	3.3	0.0	4.5	0.0	2.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	26.3	0.0	24.3	21.8	19.6	0.0	51.9	24.9	19.6	21.2	0.0	10.6
LnGrp LOS	C		C	C	B		D	C	B	C		B
Approach Vol, veh/h		118			123			259			1078	
Approach Delay, s/veh		26.1			19.8			25.4			17.9	
Approach LOS		C			B			C			B	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	23.0	17.8	7.0	12.6	6.4	34.3		19.6
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	59.0	34.0	14.0	30.0	9.0	59.0		48.0
Max Q Clear Time (g_c+I1), s	13.9	9.6	2.4	5.4	2.2	9.0		4.9
Green Ext Time (p_c), s	3.1	1.5	0.0	0.6	0.0	2.3		0.6

Intersection Summary	
HCM 7th Control Delay, s/veh	19.9
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	13	13	10	19	26	112	1	18	2	77	463	10
Future Volume (veh/h)	13	13	10	19	26	112	1	18	2	77	463	10
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.95	0.96		0.97	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	14	14	1	21	28	13	1	20	1	84	503	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	254	196	274	226	225	279	353	590	498	771	719	14
Arrive On Green	0.18	0.18	0.18	0.18	0.18	0.18	0.00	0.32	0.32	0.08	0.39	0.39
Sat Flow, veh/h	562	1082	1511	447	1245	1540	1781	1870	1578	1781	1827	36
Grp Volume(v), veh/h	28	0	1	49	0	13	1	20	1	84	0	513
Grp Sat Flow(s),veh/h/ln	1643	0	1511	1692	0	1540	1781	1870	1578	1781	0	1864
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.3	0.0	1.1	0.0	8.2
Cycle Q Clear(g_c), s	0.4	0.0	0.0	0.8	0.0	0.2	0.0	0.3	0.0	1.1	0.0	8.2
Prop In Lane	0.50		1.00	0.43		1.00	1.00		1.00	1.00		0.02
Lane Grp Cap(c), veh/h	450	0	274	452	0	279	353	590	498	771	0	733
V/C Ratio(X)	0.06	0.00	0.00	0.11	0.00	0.05	0.00	0.03	0.00	0.11	0.00	0.70
Avail Cap(c_a), veh/h	2587	0	2348	2645	0	2395	600	2908	2452	882	0	2897
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	12.0	0.0	11.9	12.2	0.0	12.0	8.6	8.4	8.3	6.8	0.0	9.0
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.0	1.2
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	0.0	0.0	0.3	0.0	0.1	0.0	0.1	0.0	0.3	0.0	2.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	12.1	0.0	11.9	12.3	0.0	12.0	8.7	8.4	8.3	6.9	0.0	10.2
LnGrp LOS	B		B	B		B	A	A	A	A		B
Approach Vol, veh/h		29			62			22			597	
Approach Delay, s/veh		12.1			12.2			8.4			9.7	
Approach LOS		B			B			A			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	7.8	16.2		11.4	5.0	18.9		11.4				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.1	2.3		2.4	2.0	10.2		2.8				
Green Ext Time (p_c), s	0.0	0.1		0.1	0.0	3.8		0.3				

Intersection Summary	
HCM 7th Control Delay, s/veh	10.0
HCM 7th LOS	B



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	14	67	37	4	41	127	612	34	39	497	27
Future Volume (veh/h)	5	14	67	37	4	41	127	612	34	39	497	27
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	5	15	3	40	4	2	138	665	20	42	540	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	118	75	14	257	10	111	186	877	744	82	768	651
Arrive On Green	0.07	0.07	0.07	0.07	0.07	0.07	0.10	0.47	0.47	0.05	0.41	0.41
Sat Flow, veh/h	246	1067	197	1401	140	1581	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	23	0	0	44	0	2	138	665	20	42	540	13
Grp Sat Flow(s),veh/h/ln	1510	0	0	1541	0	1581	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.1	3.3	12.7	0.3	1.0	10.4	0.2
Cycle Q Clear(g_c), s	1.0	0.0	0.0	1.0	0.0	0.1	3.3	12.7	0.3	1.0	10.4	0.2
Prop In Lane	0.22		0.13	0.91		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	207	0	0	267	0	111	186	877	744	82	768	651
V/C Ratio(X)	0.11	0.00	0.00	0.17	0.00	0.02	0.74	0.76	0.03	0.52	0.70	0.02
Avail Cap(c_a), veh/h	913	0	0	854	0	765	985	4915	4165	411	4311	3654
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.0	0.0	0.0	19.2	0.0	18.8	18.9	9.5	6.2	20.2	10.6	7.6
Incr Delay (d2), s/veh	0.2	0.0	0.0	0.3	0.0	0.1	5.8	1.4	0.0	5.0	1.2	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	0.0	0.0	0.4	0.0	0.0	1.5	4.0	0.1	0.5	3.4	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	19.2	0.0	0.0	19.5	0.0	18.8	24.6	10.9	6.2	25.2	11.8	7.6
LnGrp LOS	B			B		B	C	B	A	C	B	A
Approach Vol, veh/h		23			46			823			595	
Approach Delay, s/veh		19.2			19.5			13.1			12.6	
Approach LOS		B			B			B			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.0	26.3		9.0	10.5	23.8		9.0				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0				
Max Q Clear Time (g_c+I1), s	3.0	14.7		3.0	5.3	12.4		3.0				
Green Ext Time (p_c), s	0.0	5.6		0.0	0.3	4.2		0.1				

Intersection Summary	
HCM 7th Control Delay, s/veh	13.2
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	463	0	774	674	4
Future Vol, veh/h	0	463	0	774	674	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	503	0	841	733	4

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Existing Conditions SAT

Intersection	
Int Delay, s/veh	2.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	19	58	58	345	360	17
Future Vol, veh/h	19	58	58	345	360	17
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	21	63	63	375	391	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1003	543	511	0	-	0
Stage 1	502	-	-	-	-	-
Stage 2	501	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	269	540	1054	-	-	-
Stage 1	608	-	-	-	-	-
Stage 2	609	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	205	469	953	-	-	-
Mov Cap-2 Maneuver	205	-	-	-	-	-
Stage 1	513	-	-	-	-	-
Stage 2	550	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	18.2	1.3	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	953	-	356	-	-
HCM Lane V/C Ratio	0.066	-	0.235	-	-
HCM Control Delay (s/veh)	9	-	18.2	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0.2	-	0.9	-	-

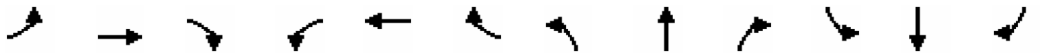
Intersection	
Int Delay, s/veh	1.8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	42	62	338	31	35	395
Future Vol, veh/h	42	62	338	31	35	395
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	46	67	367	34	38	429

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	684	388	0	0	405	0
Stage 1	388	-	-	-	-	-
Stage 2	296	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	398	659	-	-	1152	-
Stage 1	684	-	-	-	-	-
Stage 2	730	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	382	657	-	-	1147	-
Mov Cap-2 Maneuver	382	-	-	-	-	-
Stage 1	682	-	-	-	-	-
Stage 2	702	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	12.97	0	0.67
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	382	657	1147	-
HCM Lane V/C Ratio	-	-	0.12	0.103	0.033	-
HCM Control Delay (s/veh)	-	-	15.7	11.1	8.2	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.4	0.3	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	66	2	395	2	2	0	355	454	2	0	440	47
Future Volume (veh/h)	66	2	395	2	2	0	355	454	2	0	440	47
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	72	2	0	2	2	0	386	493	2	0	478	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	107	3		5	5	0	468	2182	9	3	810	359
Arrive On Green	0.06	0.06	0.00	0.01	0.01	0.00	0.26	0.60	0.60	0.00	0.23	0.23
Sat Flow, veh/h	1735	48	1585	912	912	0	1781	3630	15	1781	3554	1578
Grp Volume(v), veh/h	74	0	0	4	0	0	386	241	254	0	478	10
Grp Sat Flow(s),veh/h/ln	1784	0	1585	1825	0	0	1781	1777	1868	1781	1777	1578
Q Serve(g_s), s	2.2	0.0	0.0	0.1	0.0	0.0	11.1	3.4	3.4	0.0	6.5	0.3
Cycle Q Clear(g_c), s	2.2	0.0	0.0	0.1	0.0	0.0	11.1	3.4	3.4	0.0	6.5	0.3
Prop In Lane	0.97		1.00	0.50		0.00	1.00		0.01	1.00		1.00
Lane Grp Cap(c), veh/h	110	0		10	0	0	468	1068	1123	3	810	359
V/C Ratio(X)	0.67	0.00		0.41	0.00	0.00	0.82	0.23	0.23	0.00	0.59	0.03
Avail Cap(c_a), veh/h	460	0		168	0	0	1608	2422	2546	295	3207	1424
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	24.9	0.0	0.0	26.9	0.0	0.0	18.8	5.0	5.0	0.0	18.7	16.3
Incr Delay (d2), s/veh	6.8	0.0	0.0	24.8	0.0	0.0	3.7	0.1	0.1	0.0	0.7	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.1	0.0	0.0	0.1	0.0	0.0	4.5	0.9	0.9	0.0	2.5	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	31.8	0.0	0.0	51.7	0.0	0.0	22.6	5.1	5.1	0.0	19.4	16.3
LnGrp LOS	C			D			C	A	A		B	B
Approach Vol, veh/h		74			4			881			488	
Approach Delay, s/veh		31.8			51.7			12.8			19.3	
Approach LOS		C			D			B			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	0.0	38.6		6.3	20.3	18.4		9.4				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	74.0		5.0	49.0	49.0		14.0				
Max Q Clear Time (g_c+I1), s	0.0	5.4		2.1	13.1	8.5		4.2				
Green Ext Time (p_c), s	0.0	3.3		0.0	1.2	3.6		0.2				

Intersection Summary		
HCM 7th Control Delay, s/veh		16.0
HCM 7th LOS		B

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	32	101	82	60	130	635	19	244	18	381	305	33
Future Volume (veh/h)	32	101	82	60	130	635	19	244	18	381	305	33
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	35	110	10	65	141	0	21	265	4	414	332	34
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	119	201	217	309	567		44	373	316	606	584	60
Arrive On Green	0.14	0.14	0.14	0.06	0.30	0.00	0.02	0.20	0.20	0.18	0.35	0.35
Sat Flow, veh/h	279	1452	1562	1781	1870	1585	1781	1870	1585	3456	1668	171
Grp Volume(v), veh/h	145	0	10	65	141	0	21	265	4	414	0	366
Grp Sat Flow(s),veh/h/ln	1731	0	1562	1781	1870	1585	1781	1870	1585	1728	0	1838
Q Serve(g_s), s	1.9	0.0	0.3	1.6	3.2	0.0	0.6	7.4	0.1	6.3	0.0	9.0
Cycle Q Clear(g_c), s	4.3	0.0	0.3	1.6	3.2	0.0	0.6	7.4	0.1	6.3	0.0	9.0
Prop In Lane	0.24		1.00	1.00		1.00	1.00		1.00	1.00		0.09
Lane Grp Cap(c), veh/h	320	0	217	309	567		44	373	316	606	0	643
V/C Ratio(X)	0.45	0.00	0.05	0.21	0.25		0.47	0.71	0.01	0.68	0.00	0.57
Avail Cap(c_a), veh/h	1015	0	867	718	1674		638	837	709	2412	0	2040
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	22.5	0.0	20.9	17.5	14.7	0.0	26.9	20.9	17.9	21.6	0.0	14.7
Incr Delay (d2), s/veh	1.0	0.0	0.1	0.3	0.2	0.0	7.6	2.5	0.0	1.4	0.0	0.8
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.7	0.0	0.1	0.6	1.2	0.0	0.4	3.2	0.0	2.4	0.0	3.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	23.5	0.0	20.9	17.8	14.9	0.0	34.5	23.4	18.0	23.0	0.0	15.5
LnGrp LOS	C		C	B	B		C	C	B	C		B
Approach Vol, veh/h		155			206			290			780	
Approach Delay, s/veh		23.3			15.8			24.1			19.5	
Approach LOS		C			B			C			B	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	15.8	17.1	9.2	13.7	7.4	25.6		22.9
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	39.0	25.0	16.0	31.0	20.0	62.0		50.0
Max Q Clear Time (g_c+I1), s	8.3	9.4	3.6	6.3	2.6	11.0		5.2
Green Ext Time (p_c), s	1.5	1.3	0.1	0.8	0.0	2.5		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	20.3
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	1	16	8	6	26	130	0	13	3	72	283	6
Future Volume (veh/h)	1	16	8	6	26	130	0	13	3	72	283	6
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.97		0.95	0.96		0.97	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	1	17	1	7	28	18	0	14	1	78	308	7
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	148	327	273	191	293	278	469	346	291	660	822	19
Arrive On Green	0.18	0.18	0.18	0.18	0.18	0.18	0.00	0.19	0.19	0.08	0.45	0.45
Sat Flow, veh/h	44	1808	1512	176	1623	1541	1781	1870	1572	1781	1821	41
Grp Volume(v), veh/h	18	0	1	35	0	18	0	14	1	78	0	315
Grp Sat Flow(s),veh/h/ln	1852	0	1512	1799	0	1541	1781	1870	1572	1781	0	1863
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.2	0.0	0.8	0.0	3.0
Cycle Q Clear(g_c), s	0.2	0.0	0.0	0.4	0.0	0.3	0.0	0.2	0.0	0.8	0.0	3.0
Prop In Lane	0.06		1.00	0.20		1.00	1.00		1.00	1.00		0.02
Lane Grp Cap(c), veh/h	474	0	273	484	0	278	469	346	291	660	0	840
V/C Ratio(X)	0.04	0.00	0.00	0.07	0.00	0.06	0.00	0.04	0.00	0.12	0.00	0.37
Avail Cap(c_a), veh/h	3848	0	3062	3676	0	3121	790	3788	3184	842	0	3773
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.2	0.0	9.1	9.3	0.0	9.2	0.0	9.1	9.0	6.3	0.0	4.9
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.2	0.0	0.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.2	0.0	9.1	9.4	0.0	9.3	0.0	9.1	9.0	6.3	0.0	5.2
LnGrp LOS	A		A	A		A		A	A	A		A
Approach Vol, veh/h		19			53			15			393	
Approach Delay, s/veh		9.2			9.3			9.1			5.4	
Approach LOS		A			A			A			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	7.2	10.0		9.9	0.0	17.3		9.9				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	2.2	2.2		2.2	0.0	5.0		2.4				
Green Ext Time (p_c), s	0.0	0.1		0.1	0.0	2.1		0.2				

Intersection Summary	
HCM 7th Control Delay, s/veh	6.1
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	9	74	26	7	26	141	544	32	35	202	14
Future Volume (veh/h)	15	9	74	26	7	26	141	544	32	35	202	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	16	10	6	28	8	2	153	591	18	38	220	5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	178	32	17	253	26	115	207	808	684	77	671	568
Arrive On Green	0.07	0.07	0.07	0.07	0.07	0.07	0.12	0.43	0.43	0.04	0.36	0.36
Sat Flow, veh/h	575	446	236	1262	360	1581	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	32	0	0	36	0	2	153	591	18	38	220	5
Grp Sat Flow(s),veh/h/ln	1256	0	0	1622	0	1581	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.6	0.0	0.0	0.0	0.0	0.0	3.3	10.4	0.3	0.8	3.4	0.1
Cycle Q Clear(g_c), s	1.3	0.0	0.0	0.8	0.0	0.0	3.3	10.4	0.3	0.8	3.4	0.1
Prop In Lane	0.50		0.19	0.78		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	227	0	0	279	0	115	207	808	684	77	671	568
V/C Ratio(X)	0.14	0.00	0.00	0.13	0.00	0.02	0.74	0.73	0.03	0.50	0.33	0.01
Avail Cap(c_a), veh/h	934	0	0	949	0	834	1074	5357	4540	448	4700	3983
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	17.9	0.0	0.0	17.5	0.0	17.1	17.0	9.4	6.5	18.6	9.3	8.2
Incr Delay (d2), s/veh	0.3	0.0	0.0	0.2	0.0	0.1	5.1	1.3	0.0	4.9	0.3	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.0	0.3	0.0	0.0	1.4	3.2	0.1	0.4	1.1	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	18.1	0.0	0.0	17.7	0.0	17.2	22.1	10.7	6.5	23.5	9.6	8.2
LnGrp LOS	B			B		B	C	B	A	C	A	A
Approach Vol, veh/h		32			38			762			263	
Approach Delay, s/veh		18.1			17.6			12.9			11.5	
Approach LOS		B			B			B			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	7.7	23.2		8.9	10.6	20.3		8.9				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0				
Max Q Clear Time (g_c+I1), s	2.8	12.4		3.3	5.3	5.4		2.8				
Green Ext Time (p_c), s	0.0	4.7		0.1	0.4	1.4		0.1				

Intersection Summary	
HCM 7th Control Delay, s/veh	12.9
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	288	0	780	329	2
Future Vol, veh/h	0	288	0	780	329	2
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	313	0	848	358	2

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Base Year 2028 AM

Intersection	
Int Delay, s/veh	3.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	17	93	71	321	539	17
Future Vol, veh/h	17	93	71	321	539	17
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	18	101	77	349	586	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1199	737	705	0	-	0
Stage 1	696	-	-	-	-	-
Stage 2	503	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	205	418	893	-	-	-
Stage 1	495	-	-	-	-	-
Stage 2	607	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	151	363	807	-	-	-
Mov Cap-2 Maneuver	151	-	-	-	-	-
Stage 1	404	-	-	-	-	-
Stage 2	549	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	24.88	1.8	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	807	-	299	-	-
HCM Lane V/C Ratio	0.096	-	0.4	-	-
HCM Control Delay (s/veh)	9.9	-	24.9	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0.3	-	1.9	-	-

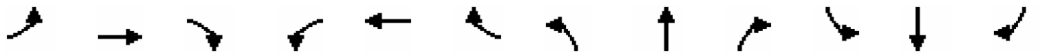
Intersection	
Int Delay, s/veh	1.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	24	36	359	23	45	593
Future Vol, veh/h	24	36	359	23	45	593
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	26	39	390	25	49	645

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	832	407	0	0	419	0
Stage 1	407	-	-	-	-	-
Stage 2	425	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	323	643	-	-	1138	-
Stage 1	671	-	-	-	-	-
Stage 2	628	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	306	641	-	-	1134	-
Mov Cap-2 Maneuver	306	-	-	-	-	-
Stage 1	669	-	-	-	-	-
Stage 2	598	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	13.72	0	0.59
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	306	641	1134	-
HCM Lane V/C Ratio	-	-	0.085	0.061	0.043	-
HCM Control Delay (s/veh)	-	-	17.8	11	8.3	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.3	0.2	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	148	1	469	2	5	0	272	863	5	4	1015	148
Future Volume (veh/h)	148	1	469	2	5	0	272	863	5	4	1015	148
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	161	1	0	2	5	0	296	938	5	4	1103	85
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	200	1		5	12	0	344	2185	12	9	1474	656
Arrive On Green	0.11	0.11	0.00	0.01	0.01	0.00	0.19	0.60	0.60	0.01	0.41	0.41
Sat Flow, veh/h	1771	11	1585	527	1317	0	1781	3624	19	1781	3554	1581
Grp Volume(v), veh/h	162	0	0	7	0	0	296	460	483	4	1103	85
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1844	0	0	1781	1777	1867	1781	1777	1581
Q Serve(g_s), s	7.9	0.0	0.0	0.3	0.0	0.0	14.3	12.3	12.3	0.2	23.4	3.0
Cycle Q Clear(g_c), s	7.9	0.0	0.0	0.3	0.0	0.0	14.3	12.3	12.3	0.2	23.4	3.0
Prop In Lane	0.99		1.00	0.29		0.00	1.00		0.01	1.00		1.00
Lane Grp Cap(c), veh/h	201	0		16	0	0	344	1071	1125	9	1474	656
V/C Ratio(X)	0.81	0.00		0.43	0.00	0.00	0.86	0.43	0.43	0.42	0.75	0.13
Avail Cap(c_a), veh/h	301	0		187	0	0	882	2580	2710	180	3160	1406
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	38.5	0.0	0.0	43.8	0.0	0.0	34.7	9.5	9.5	44.1	22.1	16.1
Incr Delay (d2), s/veh	9.3	0.0	0.0	16.4	0.0	0.0	6.3	0.3	0.3	27.5	0.8	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.9	0.0	0.0	0.2	0.0	0.0	6.6	4.4	4.6	0.2	9.4	1.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	47.7	0.0	0.0	60.2	0.0	0.0	41.0	9.7	9.7	71.6	22.8	16.2
LnGrp LOS	D			E			D	A	A	E	C	B
Approach Vol, veh/h		162			7			1239			1192	
Approach Delay, s/veh		47.7			60.2			17.2			22.5	
Approach LOS		D			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.5	59.6		6.8	23.2	42.9		16.0				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	129.0		9.0	44.0	79.0		15.0				
Max Q Clear Time (g_c+I1), s	2.2	14.3		2.3	16.3	25.4		9.9				
Green Ext Time (p_c), s	0.0	7.7		0.0	0.9	11.5		0.3				

Intersection Summary		
HCM 7th Control Delay, s/veh	21.7	
HCM 7th LOS	C	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	57	111	62	33	136	1029	56	446	36	695	624	76
Future Volume (veh/h)	57	111	62	33	136	1029	56	446	36	695	624	76
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	62	121	24	36	148	0	61	485	7	755	678	76
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	120	163	218	183	454		79	530	449	915	1622	182
Arrive On Green	0.14	0.14	0.14	0.03	0.24	0.00	0.04	0.28	0.28	0.26	0.50	0.50
Sat Flow, veh/h	463	1172	1562	1781	1870	1585	1781	1870	1585	3456	3220	361
Grp Volume(v), veh/h	183	0	24	36	148	0	61	485	7	755	374	380
Grp Sat Flow(s),veh/h/ln	1635	0	1562	1781	1870	1585	1781	1870	1585	1728	1777	1804
Q Serve(g_s), s	7.5	0.0	1.2	1.4	5.6	0.0	2.9	21.6	0.3	17.7	11.4	11.4
Cycle Q Clear(g_c), s	9.3	0.0	1.2	1.4	5.6	0.0	2.9	21.6	0.3	17.7	11.4	11.4
Prop In Lane	0.34		1.00	1.00		1.00	1.00		1.00	1.00		0.20
Lane Grp Cap(c), veh/h	284	0	218	183	454		79	530	449	915	895	909
V/C Ratio(X)	0.64	0.00	0.11	0.20	0.33		0.77	0.91	0.02	0.83	0.42	0.42
Avail Cap(c_a), veh/h	377	0	309	371	674		248	565	479	2368	1734	1760
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	35.8	0.0	32.4	29.1	26.8	0.0	40.7	29.8	22.2	29.8	13.4	13.4
Incr Delay (d2), s/veh	2.4	0.0	0.2	0.5	0.4	0.0	14.3	18.9	0.0	2.0	0.3	0.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.8	0.0	0.4	0.6	2.5	0.0	1.6	12.1	0.1	7.3	4.3	4.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	38.2	0.0	32.6	29.7	27.2	0.0	55.0	48.8	22.2	31.7	13.7	13.7
LnGrp LOS	D		C	C	C		D	D	C	C	B	B
Approach Vol, veh/h		207			184			553			1509	
Approach Delay, s/veh		37.6			27.7			49.1			22.7	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	28.8	30.4	8.9	18.0	9.8	49.4		26.9
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	22.8	26.0	12.0	17.0	12.0	84.0		31.0
Max Q Clear Time (g_c+I1), s	19.3	23.6	3.4	11.3	4.9	13.4		7.6
Green Ext Time (p_c), s	3.1	0.7	0.0	0.5	0.1	5.7		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	30.3
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	7	10	5	12	224	0	16	1	103	388	9
Future Volume (veh/h)	15	7	10	5	12	224	0	16	1	103	388	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.97	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	16	8	2	5	13	46	0	17	1	112	422	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	361	138	288	200	300	293	434	346	291	680	841	20
Arrive On Green	0.19	0.19	0.19	0.19	0.19	0.19	0.00	0.19	0.19	0.10	0.46	0.46
Sat Flow, veh/h	802	726	1514	211	1577	1543	1781	1870	1572	1781	1819	43
Grp Volume(v), veh/h	24	0	2	18	0	46	0	17	1	112	0	432
Grp Sat Flow(s),veh/h/ln	1528	0	1514	1788	0	1543	1781	1870	1572	1781	0	1862
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.2	0.0	1.2	0.0	4.7
Cycle Q Clear(g_c), s	0.3	0.0	0.0	0.2	0.0	0.7	0.0	0.2	0.0	1.2	0.0	4.7
Prop In Lane	0.67		1.00	0.28		1.00	1.00		1.00	1.00		0.02
Lane Grp Cap(c), veh/h	499	0	288	500	0	293	434	346	291	680	0	860
V/C Ratio(X)	0.05	0.00	0.01	0.04	0.00	0.16	0.00	0.05	0.00	0.16	0.00	0.50
Avail Cap(c_a), veh/h	3009	0	2897	3407	0	2952	737	3579	3008	807	0	3564
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.5	0.0	9.4	9.5	0.0	9.7	0.0	9.6	9.5	6.4	0.0	5.4
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.0	0.1	0.0	0.5
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.3	0.0	0.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.6	0.0	9.4	9.5	0.0	10.0	0.0	9.7	9.6	6.5	0.0	5.9
LnGrp LOS	A		A	A		A		A	A	A		A
Approach Vol, veh/h		26			64			18			544	
Approach Delay, s/veh		9.6			9.8			9.7			6.0	
Approach LOS		A			A			A			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.0	10.3		10.5	0.0	18.3		10.5				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.2	2.2		2.3	0.0	6.7		2.7				
Green Ext Time (p_c), s	0.0	0.1		0.1	0.0	3.1		0.2				

Intersection Summary	
HCM 7th Control Delay, s/veh	6.6
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	10	92	40	11	72	220	993	36	45	346	9
Future Volume (veh/h)	5	10	92	40	11	72	220	993	36	45	346	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	5	11	5	43	12	6	239	1079	24	49	376	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	69	52	20	157	20	90	280	1248	1057	75	1032	875
Arrive On Green	0.06	0.06	0.06	0.06	0.06	0.06	0.16	0.67	0.67	0.04	0.55	0.55
Sat Flow, veh/h	189	902	341	1281	358	1578	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	21	0	0	55	0	6	239	1079	24	49	376	6
Grp Sat Flow(s),veh/h/ln	1432	0	0	1639	0	1578	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.3	10.1	35.0	0.4	2.1	8.7	0.1
Cycle Q Clear(g_c), s	2.3	0.0	0.0	2.3	0.0	0.3	10.1	35.0	0.4	2.1	8.7	0.1
Prop In Lane	0.24		0.24	0.78		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	140	0	0	177	0	90	280	1248	1057	75	1032	875
V/C Ratio(X)	0.15	0.00	0.00	0.31	0.00	0.07	0.85	0.86	0.02	0.65	0.36	0.01
Avail Cap(c_a), veh/h	411	0	0	417	0	348	323	2765	2344	231	2668	2261
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	34.7	0.0	0.0	35.3	0.0	34.4	31.6	10.1	4.3	36.4	9.7	7.8
Incr Delay (d2), s/veh	0.5	0.0	0.0	1.0	0.0	0.3	17.4	1.9	0.0	9.2	0.2	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	0.0	0.0	1.0	0.0	0.1	5.5	11.5	0.1	1.1	3.2	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	35.2	0.0	0.0	36.3	0.0	34.7	49.0	12.0	4.3	45.6	9.9	7.8
LnGrp LOS	D			D		C	D	B	A	D	A	A
Approach Vol, veh/h		21			61			1342			431	
Approach Delay, s/veh		35.2			36.2			18.5			13.9	
Approach LOS		D			D			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	9.2	57.4		10.4	18.1	48.6		10.4
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		17.0	14.0	110.0		17.0
Max Q Clear Time (g_c+I1), s	4.1	37.0		4.3	12.1	10.7		4.3
Green Ext Time (p_c), s	0.0	14.4		0.0	0.1	2.6		0.2

Intersection Summary	
HCM 7th Control Delay, s/veh	18.2
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	384	0	1225	492	1
Future Vol, veh/h	0	384	0	1225	492	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	417	0	1332	535	1

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Base Year 2028 PM

Intersection	
Int Delay, s/veh	4.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	23	126	95	523	489	32
Future Vol, veh/h	23	126	95	523	489	32
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	25	137	103	568	532	35

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1425	691	667	0	-	0
Stage 1	650	-	-	-	-	-
Stage 2	775	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	149	445	922	-	-	-
Stage 1	520	-	-	-	-	-
Stage 2	454	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	107	386	834	-	-	-
Mov Cap-2 Maneuver	107	-	-	-	-	-
Stage 1	411	-	-	-	-	-
Stage 2	411	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	35.21	1.53	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	834	-	275	-	-
HCM Lane V/C Ratio	0.124	-	0.589	-	-
HCM Control Delay (s/veh)	9.9	-	35.2	-	-
HCM Lane LOS	A	-	E	-	-
HCM 95th %tile Q(veh)	0.4	-	3.5	-	-

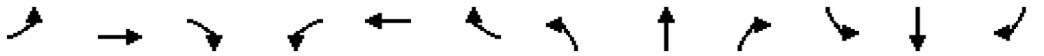
Intersection	
Int Delay, s/veh	2.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	49	71	549	49	53	564
Future Vol, veh/h	49	71	549	49	53	564
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	53	77	597	53	58	613

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1054	627	0	0	654	0
Stage 1	627	-	-	-	-	-
Stage 2	427	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	235	482	-	-	931	-
Stage 1	531	-	-	-	-	-
Stage 2	627	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	219	480	-	-	927	-
Mov Cap-2 Maneuver	219	-	-	-	-	-
Stage 1	529	-	-	-	-	-
Stage 2	585	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	19.13	0	0.79
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	219	480	927	-
HCM Lane V/C Ratio	-	-	0.244	0.161	0.062	-
HCM Control Delay (s/veh)	-	-	26.7	13.9	9.1	-
HCM Lane LOS	-	-	D	B	A	-
HCM 95th %tile Q(veh)	-	-	0.9	0.6	0.2	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	132	1	533	9	2	6	474	1343	0	1	1066	170
Future Volume (veh/h)	132	1	533	9	2	6	474	1343	0	1	1066	170
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	143	1	0	10	2	2	515	1460	0	1	1159	103
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	174	1		19	4	4	551	2488	0	2	1394	620
Arrive On Green	0.10	0.10	0.00	0.02	0.02	0.02	0.31	0.70	0.00	0.00	0.39	0.39
Sat Flow, veh/h	1770	12	1585	1259	252	252	1781	3647	0	1781	3554	1581
Grp Volume(v), veh/h	144	0	0	14	0	0	515	1460	0	1	1159	103
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1762	0	0	1781	1777	0	1781	1777	1581
Q Serve(g_s), s	10.3	0.0	0.0	1.0	0.0	0.0	36.4	27.1	0.0	0.1	38.1	5.5
Cycle Q Clear(g_c), s	10.3	0.0	0.0	1.0	0.0	0.0	36.4	27.1	0.0	0.1	38.1	5.5
Prop In Lane	0.99		1.00	0.71		0.14	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	175	0		27	0	0	551	2488	0	2	1394	620
V/C Ratio(X)	0.82	0.00		0.52	0.00	0.00	0.94	0.59	0.00	0.41	0.83	0.17
Avail Cap(c_a), veh/h	330	0		122	0	0	811	2851	0	124	1892	842
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	57.3	0.0	0.0	63.3	0.0	0.0	43.5	9.9	0.0	64.7	35.5	25.6
Incr Delay (d2), s/veh	9.3	0.0	0.0	14.7	0.0	0.0	13.7	0.2	0.0	84.8	2.4	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.1	0.0	0.0	0.6	0.0	0.0	18.0	9.9	0.0	0.1	16.8	2.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	66.6	0.0	0.0	78.0	0.0	0.0	57.2	10.1	0.0	149.4	38.0	25.7
LnGrp LOS	E			E			E	B		F	D	C
Approach Vol, veh/h		144			14			1975			1263	
Approach Delay, s/veh		66.6			78.0			22.4			37.1	
Approach LOS		E			E			C			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.2	96.7		8.0	46.1	56.8		18.7				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	104.0		9.0	59.0	69.0		24.0				
Max Q Clear Time (g_c+I1), s	2.1	29.1		3.0	38.4	40.1		12.3				
Green Ext Time (p_c), s	0.0	18.7		0.0	1.7	10.7		0.5				

Intersection Summary												
HCM 7th Control Delay, s/veh			30.0									
HCM 7th LOS			C									

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	88	125	124	26	132	1081	54	438	27	815	599	86
Future Volume (veh/h)	88	125	124	26	132	1081	54	438	27	815	599	86
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	96	136	46	28	143	0	59	476	6	886	651	86
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	155	169	279	154	483		76	543	460	996	1689	223
Arrive On Green	0.18	0.18	0.18	0.03	0.26	0.00	0.04	0.29	0.29	0.29	0.54	0.54
Sat Flow, veh/h	611	952	1567	1781	1870	1585	1781	1870	1585	3456	3154	416
Grp Volume(v), veh/h	232	0	46	28	143	0	59	476	6	886	366	371
Grp Sat Flow(s),veh/h/ln	1564	0	1567	1781	1870	1585	1781	1870	1585	1728	1777	1794
Q Serve(g_s), s	14.8	0.0	2.7	1.4	6.8	0.0	3.6	26.7	0.3	27.0	13.3	13.3
Cycle Q Clear(g_c), s	15.7	0.0	2.7	1.4	6.8	0.0	3.6	26.7	0.3	27.0	13.3	13.3
Prop In Lane	0.41		1.00	1.00		1.00	1.00		1.00	1.00		0.23
Lane Grp Cap(c), veh/h	324	0	279	154	483		76	543	460	996	951	960
V/C Ratio(X)	0.72	0.00	0.17	0.18	0.30		0.77	0.88	0.01	0.89	0.39	0.39
Avail Cap(c_a), veh/h	471	0	427	334	815		146	917	777	1224	952	961
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	43.6	0.0	38.4	35.3	32.8	0.0	52.2	37.2	27.9	37.5	15.0	15.0
Incr Delay (d2), s/veh	3.0	0.0	0.3	0.6	0.3	0.0	15.2	5.3	0.0	7.2	0.3	0.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.3	0.0	1.1	0.6	3.1	0.0	1.9	12.8	0.1	12.3	5.3	5.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	46.6	0.0	38.6	35.9	33.1	0.0	67.4	42.5	27.9	44.8	15.2	15.2
LnGrp LOS	D		D	D	C		E	D	C	D	B	B
Approach Vol, veh/h		278			171			541			1623	
Approach Delay, s/veh		45.3			33.6			45.1			31.4	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	17.7	38.0	8.9	25.6	10.7	65.0		34.5
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	39.0	54.0	14.0	30.0	9.0	59.0		48.0
Max Q Clear Time (g_c+I1), s	29.0	28.7	3.4	17.7	5.6	15.3		8.8
Green Ext Time (p_c), s	2.7	3.2	0.0	1.2	0.0	5.4		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	35.8
HCM 7th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	25	13	10	19	26	193	1	29	2	107	582	15
Future Volume (veh/h)	25	13	10	19	26	193	1	29	2	107	582	15
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.95	0.96		0.97	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	27	14	1	21	28	34	1	32	1	116	633	15
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	294	124	277	209	221	283	309	698	589	824	836	20
Arrive On Green	0.18	0.18	0.18	0.18	0.18	0.18	0.00	0.37	0.37	0.09	0.46	0.46
Sat Flow, veh/h	833	679	1512	476	1205	1541	1781	1870	1579	1781	1819	43
Grp Volume(v), veh/h	41	0	1	49	0	34	1	32	1	116	0	648
Grp Sat Flow(s),veh/h/ln	1512	0	1512	1681	0	1541	1781	1870	1579	1781	0	1862
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.5	0.0	1.5	0.0	12.2
Cycle Q Clear(g_c), s	0.8	0.0	0.0	0.9	0.0	0.8	0.0	0.5	0.0	1.5	0.0	12.2
Prop In Lane	0.66		1.00	0.43		1.00	1.00		1.00	1.00		0.02
Lane Grp Cap(c), veh/h	419	0	277	430	0	283	309	698	589	824	0	856
V/C Ratio(X)	0.10	0.00	0.00	0.11	0.00	0.12	0.00	0.05	0.00	0.14	0.00	0.76
Avail Cap(c_a), veh/h	2052	0	1971	2221	0	2009	516	2439	2058	878	0	2428
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	14.4	0.0	14.1	14.4	0.0	14.4	9.1	8.4	8.3	6.2	0.0	9.4
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.1	0.0	1.4
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.0	0.4	0.0	0.2	0.0	0.2	0.0	0.4	0.0	3.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	14.5	0.0	14.1	14.6	0.0	14.6	9.1	8.5	8.3	6.3	0.0	10.8
LnGrp LOS	B		B	B		B	A	A	A	A		B
Approach Vol, veh/h		42			83			34			764	
Approach Delay, s/veh		14.5			14.6			8.5			10.1	
Approach LOS		B			B			A			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.7	20.7		12.7	5.1	24.4		12.7				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.5	2.5		2.8	2.0	14.2		2.9				
Green Ext Time (p_c), s	0.0	0.2		0.2	0.0	5.2		0.4				

Intersection Summary	
HCM 7th Control Delay, s/veh	10.7
HCM 7th LOS	B



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	6	17	93	37	8	52	204	850	34	44	626	27
Future Volume (veh/h)	6	17	93	37	8	52	204	850	34	44	626	27
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	7	18	6	40	9	5	222	924	22	48	680	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	87	71	21	191	22	106	281	1111	941	81	902	764
Arrive On Green	0.07	0.07	0.07	0.07	0.07	0.07	0.16	0.59	0.59	0.05	0.48	0.48
Sat Flow, veh/h	231	1050	308	1253	331	1579	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	31	0	0	49	0	5	222	924	22	48	680	13
Grp Sat Flow(s),veh/h/ln	1589	0	0	1584	0	1579	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.2	7.4	24.3	0.4	1.6	18.2	0.3
Cycle Q Clear(g_c), s	1.6	0.0	0.0	1.6	0.0	0.2	7.4	24.3	0.4	1.6	18.2	0.3
Prop In Lane	0.23		0.19	0.82		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	179	0	0	213	0	106	281	1111	941	81	902	764
V/C Ratio(X)	0.17	0.00	0.00	0.23	0.00	0.05	0.79	0.83	0.02	0.59	0.75	0.02
Avail Cap(c_a), veh/h	641	0	0	611	0	540	697	3475	2945	290	3048	2583
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	27.2	0.0	0.0	27.4	0.0	26.8	24.9	10.0	5.1	28.7	12.9	8.3
Incr Delay (d2), s/veh	0.5	0.0	0.0	0.5	0.0	0.2	5.0	1.7	0.0	6.7	1.3	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	0.0	0.0	0.7	0.0	0.1	3.3	7.9	0.1	0.8	6.7	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	27.6	0.0	0.0	28.0	0.0	27.0	29.9	11.7	5.1	35.4	14.2	8.3
LnGrp LOS	C			C		C	C	B	A	D	B	A
Approach Vol, veh/h		31			54			1168			741	
Approach Delay, s/veh		27.6			27.9			15.0			15.5	
Approach LOS		C			C			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.8	42.4		10.1	15.7	35.6		10.1
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.8	114.0		21.0	24.0	100.0		21.0
Max Q Clear Time (g_c+I1), s	3.6	26.3		3.6	9.4	20.2		3.6
Green Ext Time (p_c), s	0.0	10.1		0.1	0.5	5.8		0.2

Intersection Summary	
HCM 7th Control Delay, s/veh	15.7
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	564	0	1096	842	4
Future Vol, veh/h	0	564	0	1096	842	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	613	0	1191	915	4

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Base Year 2028 SAT

Intersection	
Int Delay, s/veh	2.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	19	69	74	458	447	17
Future Vol, veh/h	19	69	74	458	447	17
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	21	75	80	498	486	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1255	637	605	0	-	0
Stage 1	596	-	-	-	-	-
Stage 2	659	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	189	477	973	-	-	-
Stage 1	550	-	-	-	-	-
Stage 2	515	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	141	414	879	-	-	-
Mov Cap-2 Maneuver	141	-	-	-	-	-
Stage 1	452	-	-	-	-	-
Stage 2	465	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	23.24	1.32	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	879	-	292	-	-
HCM Lane V/C Ratio	0.092	-	0.328	-	-
HCM Control Delay (s/veh)	9.5	-	23.2	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0.3	-	1.4	-	-

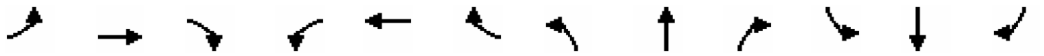
Intersection	
Int Delay, s/veh	1.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	51	62	467	41	35	495
Future Vol, veh/h	51	62	467	41	35	495
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	55	67	508	45	38	538

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	884	534	0	0	556	0
Stage 1	534	-	-	-	-	-
Stage 2	350	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	300	545	-	-	1012	-
Stage 1	587	-	-	-	-	-
Stage 2	685	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	286	543	-	-	1009	-
Mov Cap-2 Maneuver	286	-	-	-	-	-
Stage 1	585	-	-	-	-	-
Stage 2	656	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	16.18	0	0.58
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	286	543	1009	-
HCM Lane V/C Ratio	-	-	0.194	0.124	0.038	-
HCM Control Delay (s/veh)	-	-	20.6	12.6	8.7	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.7	0.4	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	125	2	426	2	2	0	383	1120	2	0	876	143
Future Volume (veh/h)	125	2	426	2	2	0	383	1120	2	0	876	143
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	136	2	0	2	2	0	416	1217	2	0	952	44
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	173	3		5	5	0	469	2497	4	2	1252	557
Arrive On Green	0.10	0.10	0.00	0.01	0.01	0.00	0.26	0.69	0.69	0.00	0.35	0.35
Sat Flow, veh/h	1757	26	1585	912	912	0	1781	3640	6	1781	3554	1581
Grp Volume(v), veh/h	138	0	0	4	0	0	416	594	625	0	952	44
Grp Sat Flow(s),veh/h/ln	1783	0	1585	1825	0	0	1781	1777	1869	1781	1777	1581
Q Serve(g_s), s	6.5	0.0	0.0	0.2	0.0	0.0	19.2	13.5	13.5	0.0	20.3	1.6
Cycle Q Clear(g_c), s	6.5	0.0	0.0	0.2	0.0	0.0	19.2	13.5	13.5	0.0	20.3	1.6
Prop In Lane	0.99		1.00	0.50		0.00	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	176	0		10	0	0	469	1219	1282	2	1252	557
V/C Ratio(X)	0.79	0.00		0.41	0.00	0.00	0.89	0.49	0.49	0.00	0.76	0.08
Avail Cap(c_a), veh/h	292	0		107	0	0	1020	1537	1616	187	2035	905
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	37.7	0.0	0.0	42.4	0.0	0.0	30.3	6.3	6.3	0.0	24.5	18.5
Incr Delay (d2), s/veh	7.6	0.0	0.0	25.8	0.0	0.0	5.8	0.3	0.3	0.0	1.0	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.1	0.0	0.0	0.2	0.0	0.0	8.7	4.2	4.4	0.0	8.3	0.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	45.3	0.0	0.0	68.3	0.0	0.0	36.1	6.6	6.6	0.0	25.5	18.5
LnGrp LOS	D			E			D	A	A		C	B
Approach Vol, veh/h		138			4			1635			996	
Approach Delay, s/veh		45.3			68.3			14.1			25.2	
Approach LOS		D			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	0.0	64.7		6.5	28.5	36.2		14.4				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	74.0		5.0	49.0	49.0		14.0				
Max Q Clear Time (g_c+I1), s	0.0	15.5		2.2	21.2	22.3		8.5				
Green Ext Time (p_c), s	0.0	11.5		0.0	1.3	7.9		0.3				

Intersection Summary		
HCM 7th Control Delay, s/veh	19.7	
HCM 7th LOS	B	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	125	189	170	82	169	910	101	422	35	488	601	147
Future Volume (veh/h)	125	189	170	82	169	910	101	422	35	488	601	147
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	136	205	81	89	184	0	110	459	8	530	653	148
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	199	235	394	204	676		140	514	436	643	1100	249
Arrive On Green	0.25	0.25	0.25	0.05	0.36	0.00	0.08	0.27	0.27	0.19	0.38	0.38
Sat Flow, veh/h	598	939	1572	1781	1870	1585	1781	1870	1585	3456	2875	651
Grp Volume(v), veh/h	341	0	81	89	184	0	110	459	8	530	403	398
Grp Sat Flow(s),veh/h/ln	1536	0	1572	1781	1870	1585	1781	1870	1585	1728	1777	1749
Q Serve(g_s), s	21.2	0.0	4.1	3.6	7.1	0.0	6.2	23.9	0.4	15.0	18.4	18.4
Cycle Q Clear(g_c), s	21.7	0.0	4.1	3.6	7.1	0.0	6.2	23.9	0.4	15.0	18.4	18.4
Prop In Lane	0.40		1.00	1.00		1.00	1.00		1.00	1.00		0.37
Lane Grp Cap(c), veh/h	435	0	394	204	676		140	514	436	643	680	669
V/C Ratio(X)	0.78	0.00	0.21	0.44	0.27		0.79	0.89	0.02	0.82	0.59	0.59
Avail Cap(c_a), veh/h	518	0	480	392	921		351	608	515	1328	1085	1068
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	36.6	0.0	30.1	27.5	22.9	0.0	45.9	35.4	26.8	39.7	25.0	25.0
Incr Delay (d2), s/veh	6.5	0.0	0.3	1.5	0.2	0.0	9.4	14.0	0.0	2.7	0.8	0.8
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	8.8	0.0	1.6	1.6	3.1	0.0	3.1	12.7	0.1	6.5	7.7	7.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	43.1	0.0	30.3	29.0	23.2	0.0	55.3	49.3	26.8	42.4	25.9	25.9
LnGrp LOS	D		C	C	C		E	D	C	D	C	C
Approach Vol, veh/h		422			273			577			1331	
Approach Delay, s/veh		40.7			25.1			50.1			32.5	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	24.9	33.9	11.3	31.4	14.0	44.8		42.7
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	39.6	33.0	16.0	31.0	20.0	62.0		50.0
Max Q Clear Time (g_c+I1), s	17.0	25.9	5.6	23.7	8.2	20.4		9.1
Green Ext Time (p_c), s	1.9	1.7	0.1	1.4	0.2	6.1		1.1

Intersection Summary	
HCM 7th Control Delay, s/veh	36.9
HCM 7th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	19	16	8	6	26	218	0	20	3	103	405	12
Future Volume (veh/h)	19	16	8	6	26	218	0	20	3	103	405	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.98	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	21	17	1	7	28	50	0	22	1	112	440	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	319	199	313	178	342	319	422	341	287	665	821	24
Arrive On Green	0.21	0.21	0.21	0.21	0.21	0.21	0.00	0.18	0.18	0.10	0.45	0.45
Sat Flow, veh/h	627	963	1520	151	1659	1546	1781	1870	1572	1781	1807	53
Grp Volume(v), veh/h	38	0	1	35	0	50	0	22	1	112	0	453
Grp Sat Flow(s),veh/h/ln	1590	0	1520	1811	0	1546	1781	1870	1572	1781	0	1861
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.3	0.0	1.3	0.0	5.2
Cycle Q Clear(g_c), s	0.5	0.0	0.0	0.4	0.0	0.8	0.0	0.3	0.0	1.3	0.0	5.2
Prop In Lane	0.55		1.00	0.20		1.00	1.00		1.00	1.00		0.03
Lane Grp Cap(c), veh/h	518	0	313	520	0	319	422	341	287	665	0	845
V/C Ratio(X)	0.07	0.00	0.00	0.07	0.00	0.16	0.00	0.06	0.00	0.17	0.00	0.54
Avail Cap(c_a), veh/h	3011	0	2839	3401	0	2888	718	3494	2937	786	0	3476
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.5	0.0	9.3	9.5	0.0	9.6	0.0	10.0	9.8	6.7	0.0	5.8
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.1	0.0	0.5
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.3	0.0	1.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.5	0.0	9.3	9.5	0.0	9.8	0.0	10.0	9.9	6.8	0.0	6.3
LnGrp LOS	A		A	A		A		B	A	A		A
Approach Vol, veh/h		39			85			23			565	
Approach Delay, s/veh		9.5			9.7			10.0			6.4	
Approach LOS		A			A			B			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.0	10.4		11.1	0.0	18.4		11.1				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.3	2.3		2.5	0.0	7.2		2.8				
Green Ext Time (p_c), s	0.0	0.1		0.2	0.0	3.3		0.4				

Intersection Summary	
HCM 7th Control Delay, s/veh	7.1
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	12	102	26	10	39	223	799	32	43	318	16
Future Volume (veh/h)	15	12	102	26	10	39	223	799	32	43	318	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	16	13	24	28	11	4	242	868	19	47	346	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	107	36	50	181	47	116	306	1059	898	82	824	698
Arrive On Green	0.07	0.07	0.07	0.07	0.07	0.07	0.17	0.57	0.57	0.05	0.44	0.44
Sat Flow, veh/h	345	485	687	1000	641	1580	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	53	0	0	39	0	4	242	868	19	47	346	6
Grp Sat Flow(s),veh/h/ln	1517	0	0	1641	0	1580	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.9	0.0	0.0	0.0	0.0	0.1	7.5	21.5	0.3	1.5	7.3	0.1
Cycle Q Clear(g_c), s	2.0	0.0	0.0	1.2	0.0	0.1	7.5	21.5	0.3	1.5	7.3	0.1
Prop In Lane	0.30		0.45	0.72		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	193	0	0	228	0	116	306	1059	898	82	824	698
V/C Ratio(X)	0.27	0.00	0.00	0.17	0.00	0.03	0.79	0.82	0.02	0.57	0.42	0.01
Avail Cap(c_a), veh/h	656	0	0	662	0	580	747	3726	3158	311	3269	2770
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	25.5	0.0	0.0	25.1	0.0	24.6	22.7	10.0	5.4	26.7	11.0	9.0
Incr Delay (d2), s/veh	0.8	0.0	0.0	0.4	0.0	0.1	4.6	1.6	0.0	6.2	0.3	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	0.0	0.0	0.5	0.0	0.1	3.3	7.0	0.1	0.7	2.6	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	26.2	0.0	0.0	25.5	0.0	24.8	27.3	11.7	5.5	32.9	11.3	9.0
LnGrp LOS	C			C		C	C	B	A	C	B	A
Approach Vol, veh/h		53			43			1129			399	
Approach Delay, s/veh		26.2			25.4			14.9			13.8	
Approach LOS		C			C			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.6	38.4		10.2	15.8	31.2		10.2
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0
Max Q Clear Time (g_c+I1), s	3.5	23.5		4.0	9.5	9.3		3.2
Green Ext Time (p_c), s	0.0	8.9		0.2	0.6	2.4		0.1

Intersection Summary	
HCM 7th Control Delay, s/veh	15.3
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	398	0	1127	483	2
Future Vol, veh/h	0	398	0	1127	483	2
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	433	0	1225	525	2

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Base Year 2038 AM

Intersection	
Int Delay, s/veh	3.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	17	95	72	340	572	17
Future Vol, veh/h	17	95	72	340	572	17
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	18	103	78	370	622	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1258	773	741	0	-	0
Stage 1	732	-	-	-	-	-
Stage 2	526	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	189	399	866	-	-	-
Stage 1	476	-	-	-	-	-
Stage 2	593	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	139	347	782	-	-	-
Mov Cap-2 Maneuver	139	-	-	-	-	-
Stage 1	387	-	-	-	-	-
Stage 2	536	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	27.08	1.77	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	782	-	282	-	-
HCM Lane V/C Ratio	0.1	-	0.431	-	-
HCM Control Delay (s/veh)	10.1	-	27.1	-	-
HCM Lane LOS	B	-	D	-	-
HCM 95th %tile Q(veh)	0.3	-	2.1	-	-

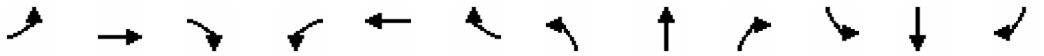
Intersection	
Int Delay, s/veh	1.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	24	36	381	23	45	629
Future Vol, veh/h	24	36	381	23	45	629
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	26	39	414	25	49	684

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	875	431	0	0	443	0
Stage 1	431	-	-	-	-	-
Stage 2	445	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	304	624	-	-	1115	-
Stage 1	655	-	-	-	-	-
Stage 2	614	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	288	621	-	-	1111	-
Mov Cap-2 Maneuver	288	-	-	-	-	-
Stage 1	652	-	-	-	-	-
Stage 2	584	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	14.21	0	0.56
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	288	621	1111	-
HCM Lane V/C Ratio	-	-	0.091	0.063	0.044	-
HCM Control Delay (s/veh)	-	-	18.8	11.2	8.4	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.3	0.2	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	157	1	469	2	5	0	275	1040	5	6	1198	151
Future Volume (veh/h)	157	1	469	2	5	0	275	1040	5	6	1198	151
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	171	1	0	2	5	0	299	1130	5	7	1302	93
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	203	1		5	12	0	339	2338	10	16	1645	732
Arrive On Green	0.11	0.11	0.00	0.01	0.01	0.00	0.19	0.64	0.64	0.01	0.46	0.46
Sat Flow, veh/h	1771	10	1585	527	1317	0	1781	3628	16	1781	3554	1582
Grp Volume(v), veh/h	172	0	0	7	0	0	299	553	582	7	1302	93
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1844	0	0	1781	1777	1867	1781	1777	1582
Q Serve(g_s), s	10.2	0.0	0.0	0.4	0.0	0.0	17.5	17.3	17.3	0.4	33.3	3.6
Cycle Q Clear(g_c), s	10.2	0.0	0.0	0.4	0.0	0.0	17.5	17.3	17.3	0.4	33.3	3.6
Prop In Lane	0.99		1.00	0.29		0.00	1.00		0.01	1.00		1.00
Lane Grp Cap(c), veh/h	204	0		16	0	0	339	1145	1203	16	1645	732
V/C Ratio(X)	0.84	0.00		0.43	0.00	0.00	0.88	0.48	0.48	0.45	0.79	0.13
Avail Cap(c_a), veh/h	249	0		155	0	0	730	2135	2244	149	2615	1164
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	46.6	0.0	0.0	52.9	0.0	0.0	42.3	9.9	9.9	52.9	24.4	16.5
Incr Delay (d2), s/veh	19.1	0.0	0.0	17.2	0.0	0.0	7.5	0.3	0.3	18.8	0.9	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.6	0.0	0.0	0.3	0.0	0.0	8.4	6.3	6.6	0.3	13.7	1.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	65.7	0.0	0.0	70.1	0.0	0.0	49.8	10.2	10.2	71.7	25.3	16.5
LnGrp LOS	E			E			D	B	B	E	C	B
Approach Vol, veh/h		172			7			1434			1402	
Approach Delay, s/veh		65.7			70.1			18.4			25.0	
Approach LOS		E			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.9	75.2		6.9	26.4	55.7		18.3				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	129.0		9.0	44.0	79.0		15.0				
Max Q Clear Time (g_c+I1), s	2.4	19.3		2.4	19.5	35.3		12.2				
Green Ext Time (p_c), s	0.0	10.4		0.0	0.9	14.3		0.2				

Intersection Summary		
HCM 7th Control Delay, s/veh		24.3
HCM 7th LOS		C

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	57	111	62	33	136	376	56	488	36	343	719	80
Future Volume (veh/h)	57	111	62	33	136	376	56	488	36	343	719	80
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	62	121	21	36	148	0	61	530	11	373	782	79
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	135	175	229	218	503		89	602	510	523	1379	139
Arrive On Green	0.15	0.15	0.15	0.04	0.27	0.00	0.05	0.32	0.32	0.15	0.42	0.42
Sat Flow, veh/h	448	1194	1563	1781	1870	1585	1781	1870	1585	3456	3257	329
Grp Volume(v), veh/h	183	0	21	36	148	0	61	530	11	373	427	434
Grp Sat Flow(s),veh/h/ln	1642	0	1563	1781	1870	1585	1781	1870	1585	1728	1777	1809
Q Serve(g_s), s	5.6	0.0	0.8	1.1	4.4	0.0	2.3	18.7	0.3	7.2	12.7	12.7
Cycle Q Clear(g_c), s	7.4	0.0	0.8	1.1	4.4	0.0	2.3	18.7	0.3	7.2	12.7	12.7
Prop In Lane	0.34		1.00	1.00		1.00	1.00		1.00	1.00		0.18
Lane Grp Cap(c), veh/h	310	0	229	218	503		89	602	510	523	752	766
V/C Ratio(X)	0.59	0.00	0.09	0.16	0.29		0.69	0.88	0.02	0.71	0.57	0.57
Avail Cap(c_a), veh/h	465	0	381	461	831		307	697	591	2924	2140	2179
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	28.4	0.0	25.7	22.8	20.2	0.0	32.6	22.4	16.1	28.2	15.3	15.3
Incr Delay (d2), s/veh	1.8	0.0	0.2	0.4	0.3	0.0	9.1	11.4	0.0	1.8	0.7	0.7
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.0	0.0	0.3	0.5	1.9	0.0	1.2	9.5	0.1	3.0	4.8	4.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	30.2	0.0	25.9	23.1	20.6	0.0	41.7	33.7	16.2	30.0	15.9	15.9
LnGrp LOS	C		C	C	C		D	C	B	C	B	B
Approach Vol, veh/h		204			184			602			1234	
Approach Delay, s/veh		29.8			21.1			34.2			20.2	
Approach LOS		C			C			C			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	16.6	28.4	8.5	16.2	9.5	35.5		24.7
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	5.6	26.0	12.0	17.0	12.0	84.0		31.0
Max Q Clear Time (g_c+I1), s	9.2	20.7	3.1	9.4	4.3	14.7		6.4
Green Ext Time (p_c), s	1.4	1.6	0.0	0.6	0.1	6.8		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	24.9
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	16	7	10	5	12	234	0	18	1	109	228	9
Future Volume (veh/h)	16	7	10	5	12	234	0	18	1	109	228	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.97	1.00		0.99	0.99		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	17	8	2	5	13	58	0	20	1	118	248	9
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	374	136	300	202	312	305	451	322	270	667	812	29
Arrive On Green	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.17	0.17	0.11	0.45	0.45
Sat Flow, veh/h	823	686	1517	210	1579	1544	1781	1870	1571	1781	1793	65
Grp Volume(v), veh/h	25	0	2	18	0	58	0	20	1	118	0	257
Grp Sat Flow(s),veh/h/ln	1508	0	1517	1789	0	1544	1781	1870	1571	1781	0	1858
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.3	0.0	1.3	0.0	2.5
Cycle Q Clear(g_c), s	0.3	0.0	0.0	0.2	0.0	0.9	0.0	0.3	0.0	1.3	0.0	2.5
Prop In Lane	0.68		1.00	0.28		1.00	1.00		1.00	1.00		0.04
Lane Grp Cap(c), veh/h	509	0	300	514	0	305	451	322	270	667	0	842
V/C Ratio(X)	0.05	0.00	0.01	0.04	0.00	0.19	0.00	0.06	0.00	0.18	0.00	0.31
Avail Cap(c_a), veh/h	2992	0	2915	3425	0	2968	756	3594	3020	788	0	3571
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.3	0.0	9.2	9.3	0.0	9.6	0.0	9.9	9.8	6.6	0.0	5.0
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1	0.0	0.1	0.0	0.2
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.3	0.0	0.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.4	0.0	9.2	9.3	0.0	9.9	0.0	10.0	9.8	6.7	0.0	5.2
LnGrp LOS	A		A	A		A		A	A	A		A
Approach Vol, veh/h		27			76			21			375	
Approach Delay, s/veh		9.4			9.7			10.0			5.7	
Approach LOS		A			A			A			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.0	9.9		10.7	0.0	18.0		10.7				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.3	2.3		2.3	0.0	4.5		2.9				
Green Ext Time (p_c), s	0.0	0.1		0.1	0.0	1.7		0.3				

Intersection Summary	
HCM 7th Control Delay, s/veh	6.7
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	11	97	40	11	76	230	1097	36	47	572	9
Future Volume (veh/h)	5	11	97	40	11	76	230	1097	36	47	572	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		0.99	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	5	12	7	43	12	8	250	1192	25	51	622	5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	54	42	20	135	19	81	290	1341	1136	70	1109	940
Arrive On Green	0.05	0.05	0.05	0.05	0.05	0.05	0.16	0.72	0.72	0.04	0.59	0.59
Sat Flow, veh/h	143	811	393	1296	362	1576	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	24	0	0	55	0	8	250	1192	25	51	622	5
Grp Sat Flow(s),veh/h/ln	1347	0	0	1657	0	1576	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.5	12.8	46.5	0.4	2.6	19.0	0.1
Cycle Q Clear(g_c), s	2.8	0.0	0.0	2.8	0.0	0.5	12.8	46.5	0.4	2.6	19.0	0.1
Prop In Lane	0.21		0.29	0.78		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	116	0	0	154	0	81	290	1341	1136	70	1109	940
V/C Ratio(X)	0.21	0.00	0.00	0.36	0.00	0.10	0.86	0.89	0.02	0.73	0.56	0.01
Avail Cap(c_a), veh/h	332	0	0	345	0	287	457	2280	1932	190	2000	1695
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	42.7	0.0	0.0	43.4	0.0	42.3	38.1	10.3	3.8	44.4	11.6	7.8
Incr Delay (d2), s/veh	0.9	0.0	0.0	1.4	0.0	0.5	9.6	2.6	0.0	13.5	0.4	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.6	0.0	0.0	1.3	0.0	0.2	6.3	15.6	0.1	1.4	7.3	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	43.5	0.0	0.0	44.8	0.0	42.8	47.7	12.9	3.8	57.9	12.0	7.8
LnGrp LOS	D			D		D	D	B	A	E	B	A
Approach Vol, veh/h		24			63			1467			678	
Approach Delay, s/veh		43.5			44.6			18.7			15.5	
Approach LOS		D			D			B			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	9.7	73.0		10.8	21.2	61.5		10.8				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	10.0	114.0		17.0	24.0	100.0		17.0				
Max Q Clear Time (g_c+I1), s	4.6	48.5		4.8	14.8	21.0		4.8				
Green Ext Time (p_c), s	0.0	18.5		0.0	0.5	5.1		0.2				

Intersection Summary	
HCM 7th Control Delay, s/veh	18.7
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	207	0	1351	731	1
Future Vol, veh/h	0	207	0	1351	731	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	225	0	1468	795	1

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Base Year 2038 PM

Intersection	
Int Delay, s/veh	5.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	23	130	97	559	524	32
Future Vol, veh/h	23	130	97	559	524	32
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	25	141	105	608	570	35

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1506	729	705	0	-	0
Stage 1	688	-	-	-	-	-
Stage 2	818	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	133	423	893	-	-	-
Stage 1	499	-	-	-	-	-
Stage 2	434	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	95	367	807	-	-	-
Mov Cap-2 Maneuver	95	-	-	-	-	-
Stage 1	392	-	-	-	-	-
Stage 2	392	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	41.77	1.5	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	807	-	256	-	-
HCM Lane V/C Ratio	0.131	-	0.649	-	-
HCM Control Delay (s/veh)	10.1	-	41.8	-	-
HCM Lane LOS	B	-	E	-	-
HCM 95th %tile Q(veh)	0.4	-	4.1	-	-

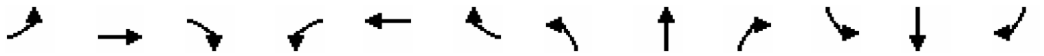
Intersection	
Int Delay, s/veh	2.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	51	71	589	51	53	606
Future Vol, veh/h	51	71	589	51	53	606
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	55	77	640	55	58	659

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1122	672	0	0	700	0
Stage 1	672	-	-	-	-	-
Stage 2	450	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	213	455	-	-	895	-
Stage 1	506	-	-	-	-	-
Stage 2	610	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	198	453	-	-	892	-
Mov Cap-2 Maneuver	198	-	-	-	-	-
Stage 1	505	-	-	-	-	-
Stage 2	568	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	21.06	0	0.75
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	198	453	892	-
HCM Lane V/C Ratio	-	-	0.28	0.17	0.065	-
HCM Control Delay (s/veh)	-	-	30.1	14.6	9.3	-
HCM Lane LOS	-	-	D	B	A	-
HCM 95th %tile Q(veh)	-	-	1.1	0.6	0.2	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	149	1	533	9	2	6	485	1614	0	1	1312	174
Future Volume (veh/h)	149	1	533	9	2	6	485	1614	0	1	1312	174
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	162	1	0	10	2	2	527	1754	0	1	1426	111
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	186	1		18	4	4	553	2596	0	2	1497	666
Arrive On Green	0.11	0.11	0.00	0.01	0.01	0.01	0.31	0.73	0.00	0.00	0.42	0.42
Sat Flow, veh/h	1771	11	1585	1259	252	252	1781	3647	0	1781	3554	1581
Grp Volume(v), veh/h	163	0	0	14	0	0	527	1754	0	1	1426	111
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1762	0	0	1781	1777	0	1781	1777	1581
Q Serve(g_s), s	14.6	0.0	0.0	1.3	0.0	0.0	46.8	42.4	0.0	0.1	62.6	7.1
Cycle Q Clear(g_c), s	14.6	0.0	0.0	1.3	0.0	0.0	46.8	42.4	0.0	0.1	62.6	7.1
Prop In Lane	0.99		1.00	0.71		0.14	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	187	0		25	0	0	553	2596	0	2	1497	666
V/C Ratio(X)	0.87	0.00		0.55	0.00	0.00	0.95	0.68	0.00	0.41	0.95	0.17
Avail Cap(c_a), veh/h	265	0		98	0	0	651	2596	0	99	1518	676
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	71.2	0.0	0.0	79.1	0.0	0.0	54.5	11.6	0.0	80.6	45.2	29.1
Incr Delay (d2), s/veh	19.2	0.0	0.0	17.2	0.0	0.0	22.4	0.7	0.0	85.5	13.4	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.7	0.0	0.0	0.7	0.0	0.0	24.4	16.2	0.0	0.1	30.3	2.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	90.3	0.0	0.0	96.3	0.0	0.0	77.0	12.3	0.0	166.1	58.6	29.2
LnGrp LOS	F			F			E	B		F	E	C
Approach Vol, veh/h		163			14			2281			1538	
Approach Delay, s/veh		90.3			96.3			27.2			56.5	
Approach LOS		F			F			C			E	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.2	124.0		8.3	56.2	74.0		23.0				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	104.0		9.0	59.0	69.0		24.0				
Max Q Clear Time (g_c+I1), s	2.1	44.4		3.3	48.8	64.6		16.6				
Green Ext Time (p_c), s	0.0	25.4		0.0	1.4	3.4		0.5				

Intersection Summary		
HCM 7th Control Delay, s/veh	41.3	
HCM 7th LOS	D	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	90	125	124	26	132	431	54	525	27	429	731	89
Future Volume (veh/h)	90	125	124	26	132	431	54	525	27	429	731	89
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	98	136	37	28	143	0	59	571	8	466	795	89
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	171	181	294	187	531		77	633	537	595	1505	168
Arrive On Green	0.19	0.19	0.19	0.03	0.28	0.00	0.04	0.34	0.34	0.17	0.47	0.47
Sat Flow, veh/h	601	967	1568	1781	1870	1585	1781	1870	1585	3456	3220	360
Grp Volume(v), veh/h	234	0	37	28	143	0	59	571	8	466	439	445
Grp Sat Flow(s),veh/h/ln	1569	0	1568	1781	1870	1585	1781	1870	1585	1728	1777	1804
Q Serve(g_s), s	11.3	0.0	1.7	1.1	5.2	0.0	2.9	25.5	0.3	11.3	15.3	15.3
Cycle Q Clear(g_c), s	12.4	0.0	1.7	1.1	5.2	0.0	2.9	25.5	0.3	11.3	15.3	15.3
Prop In Lane	0.42		1.00	1.00		1.00	1.00		1.00	1.00		0.20
Lane Grp Cap(c), veh/h	352	0	294	187	531		77	633	537	595	830	843
V/C Ratio(X)	0.66	0.00	0.13	0.15	0.27		0.76	0.90	0.01	0.78	0.53	0.53
Avail Cap(c_a), veh/h	592	0	537	422	1024		183	726	615	2326	1196	1214
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	33.9	0.0	29.6	27.0	24.3	0.0	41.5	27.6	19.3	34.7	16.5	16.5
Incr Delay (d2), s/veh	2.2	0.0	0.2	0.4	0.3	0.0	14.2	13.3	0.0	2.3	0.5	0.5
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.9	0.0	0.7	0.5	2.3	0.0	1.6	13.2	0.1	4.8	6.0	6.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	36.1	0.0	29.8	27.4	24.6	0.0	55.6	40.9	19.3	37.0	17.0	17.0
LnGrp LOS	D		C	C	C		E	D	B	D	B	B
Approach Vol, veh/h		271			171			638			1350	
Approach Delay, s/veh		35.2			25.1			42.0			23.9	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	21.1	35.7	8.5	22.4	9.8	47.0		30.9
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	59.0	34.0	14.0	30.0	9.0	59.0		48.0
Max Q Clear Time (g_c+I1), s	13.3	27.5	3.1	14.4	4.9	17.3		7.2
Green Ext Time (p_c), s	1.8	2.0	0.0	1.3	0.0	6.9		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	30.0
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	30	13	10	19	26	224	1	33	2	117	454	17
Future Volume (veh/h)	30	13	10	19	26	224	1	33	2	117	454	17
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.97	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	33	14	1	21	28	48	1	36	1	127	493	17
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	344	118	302	234	243	307	342	545	459	752	699	24
Arrive On Green	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.29	0.29	0.10	0.39	0.39
Sat Flow, veh/h	885	591	1517	467	1220	1544	1781	1870	1577	1781	1797	62
Grp Volume(v), veh/h	47	0	1	49	0	48	1	36	1	127	0	510
Grp Sat Flow(s),veh/h/ln	1477	0	1517	1687	0	1544	1781	1870	1577	1781	0	1859
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.5	0.0	1.7	0.0	8.4
Cycle Q Clear(g_c), s	0.8	0.0	0.0	0.8	0.0	0.9	0.0	0.5	0.0	1.7	0.0	8.4
Prop In Lane	0.70		1.00	0.43		1.00	1.00		1.00	1.00		0.03
Lane Grp Cap(c), veh/h	461	0	302	476	0	307	342	545	459	752	0	723
V/C Ratio(X)	0.10	0.00	0.00	0.10	0.00	0.16	0.00	0.07	0.00	0.17	0.00	0.71
Avail Cap(c_a), veh/h	2325	0	2285	2569	0	2326	581	2817	2375	819	0	2800
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	12.0	0.0	11.7	12.0	0.0	12.1	9.4	9.4	9.2	7.0	0.0	9.4
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.1	0.0	1.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.0	0.3	0.0	0.3	0.0	0.2	0.0	0.4	0.0	2.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	12.1	0.0	11.7	12.1	0.0	12.3	9.4	9.4	9.2	7.1	0.0	10.7
LnGrp LOS	B		B	B		B	A	A	A	A		B
Approach Vol, veh/h		48			97			38			637	
Approach Delay, s/veh		12.1			12.2			9.4			10.0	
Approach LOS		B			B			A			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.6	15.6		12.3	5.1	19.2		12.3				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.6	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.7	2.5		2.8	2.0	10.4		2.9				
Green Ext Time (p_c), s	0.0	0.2		0.3	0.0	3.8		0.4				

Intersection Summary	
HCM 7th Control Delay, s/veh	10.3
HCM 7th LOS	B



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	6	19	102	37	9	57	232	980	34	45	877	27
Future Volume (veh/h)	6	19	102	37	9	57	232	980	34	45	877	27
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		0.99	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	7	21	18	40	10	5	252	1065	24	49	953	14
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	54	44	33	145	20	89	294	1317	1116	70	1081	916
Arrive On Green	0.06	0.06	0.06	0.06	0.06	0.06	0.17	0.70	0.70	0.04	0.58	0.58
Sat Flow, veh/h	132	774	583	1284	361	1577	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	46	0	0	50	0	5	252	1065	24	49	953	14
Grp Sat Flow(s),veh/h/ln	1489	0	0	1644	0	1577	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.5	0.0	0.0	0.0	0.0	0.3	12.4	35.2	0.4	2.4	39.4	0.3
Cycle Q Clear(g_c), s	3.0	0.0	0.0	2.4	0.0	0.3	12.4	35.2	0.4	2.4	39.4	0.3
Prop In Lane	0.15		0.39	0.80		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	130	0	0	165	0	89	294	1317	1116	70	1081	916
V/C Ratio(X)	0.35	0.00	0.00	0.30	0.00	0.06	0.86	0.81	0.02	0.70	0.88	0.02
Avail Cap(c_a), veh/h	424	0	0	420	0	368	475	2371	2009	198	2080	1763
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	41.2	0.0	0.0	41.2	0.0	40.1	36.5	9.2	4.0	42.7	16.3	8.1
Incr Delay (d2), s/veh	1.6	0.0	0.0	1.0	0.0	0.3	8.5	1.2	0.0	12.0	2.6	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.0	0.0	0.0	1.1	0.0	0.1	6.0	11.6	0.1	1.3	15.6	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	42.8	0.0	0.0	42.2	0.0	40.4	45.0	10.4	4.0	54.6	18.9	8.1
LnGrp LOS	D			D		D	D	B	A	D	B	A
Approach Vol, veh/h		46			55			1341			1016	
Approach Delay, s/veh		42.8			42.0			16.8			20.4	
Approach LOS		D			D			B			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	9.5	69.3		11.1	20.9	58.0		11.1
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0
Max Q Clear Time (g_c+I1), s	4.4	37.2		5.0	14.4	41.4		4.4
Green Ext Time (p_c), s	0.0	14.0		0.1	0.5	10.6		0.2

Intersection Summary	
HCM 7th Control Delay, s/veh	19.3
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	410	0	1267	1114	5
Future Vol, veh/h	0	410	0	1267	1114	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	446	0	1377	1211	5

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Base Year 2038 SAT

Intersection	
Int Delay, s/veh	2.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	19	72	77	498	483	17
Future Vol, veh/h	19	72	77	498	483	17
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	21	78	84	541	525	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1344	676	644	0	-	0
Stage 1	635	-	-	-	-	-
Stage 2	709	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	167	453	941	-	-	-
Stage 1	528	-	-	-	-	-
Stage 2	488	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	123	394	850	-	-	-
Mov Cap-2 Maneuver	123	-	-	-	-	-
Stage 1	430	-	-	-	-	-
Stage 2	441	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	25.85	1.3	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	850	-	270	-	-
HCM Lane V/C Ratio	0.098	-	0.366	-	-
HCM Control Delay (s/veh)	9.7	-	25.8	-	-
HCM Lane LOS	A	-	D	-	-
HCM 95th %tile Q(veh)	0.3	-	1.6	-	-

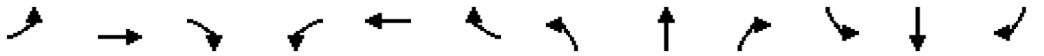
Intersection	
Int Delay, s/veh	1.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	53	62	511	43	35	536
Future Vol, veh/h	53	62	511	43	35	536
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	58	67	555	47	38	583

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	955	583	0	0	606	0
Stage 1	583	-	-	-	-	-
Stage 2	372	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	271	511	-	-	970	-
Stage 1	557	-	-	-	-	-
Stage 2	668	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	258	509	-	-	966	-
Mov Cap-2 Maneuver	258	-	-	-	-	-
Stage 1	555	-	-	-	-	-
Stage 2	638	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	17.64	0	0.54
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	258	509	966	-
HCM Lane V/C Ratio	-	-	0.223	0.132	0.039	-
HCM Control Delay (s/veh)	-	-	22.9	13.1	8.9	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.8	0.5	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	144	2	426	2	2	0	395	1447	2	0	1172	155
Future Volume (veh/h)	144	2	426	2	2	0	395	1447	2	0	1172	155
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	157	2	0	2	2	0	429	1573	2	0	1274	60
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	187	2		5	5	0	470	2642	3	2	1448	644
Arrive On Green	0.11	0.11	0.00	0.01	0.01	0.00	0.26	0.73	0.73	0.00	0.41	0.41
Sat Flow, veh/h	1760	22	1585	912	912	0	1781	3642	5	1781	3554	1581
Grp Volume(v), veh/h	159	0	0	4	0	0	429	767	808	0	1274	60
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1825	0	0	1781	1777	1870	1781	1777	1581
Q Serve(g_s), s	9.7	0.0	0.0	0.2	0.0	0.0	25.8	23.1	23.1	0.0	36.6	2.6
Cycle Q Clear(g_c), s	9.7	0.0	0.0	0.2	0.0	0.0	25.8	23.1	23.1	0.0	36.6	2.6
Prop In Lane	0.99		1.00	0.50		0.00	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	189	0		10	0	0	470	1289	1356	2	1448	644
V/C Ratio(X)	0.84	0.00		0.42	0.00	0.00	0.91	0.60	0.60	0.00	0.88	0.09
Avail Cap(c_a), veh/h	226	0		83	0	0	790	1289	1356	145	1576	701
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	48.4	0.0	0.0	54.8	0.0	0.0	39.4	7.3	7.3	0.0	30.2	20.2
Incr Delay (d2), s/veh	20.7	0.0	0.0	26.7	0.0	0.0	9.2	0.7	0.7	0.0	5.7	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.4	0.0	0.0	0.2	0.0	0.0	12.3	7.8	8.2	0.0	16.3	1.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	69.1	0.0	0.0	81.5	0.0	0.0	48.7	8.1	8.0	0.0	36.0	20.2
LnGrp LOS	E			F			D	A	A		D	C
Approach Vol, veh/h		159			4			2004			1334	
Approach Delay, s/veh		69.1			81.5			16.8			35.3	
Approach LOS		E			F			B			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	0.0	86.2		6.6	35.1	51.0		17.7				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	74.0		5.0	49.0	49.0		14.0				
Max Q Clear Time (g_c+I1), s	0.0	25.1		2.2	27.8	38.6		11.7				
Green Ext Time (p_c), s	0.0	18.0		0.0	1.3	6.4		0.2				

Intersection Summary		
HCM 7th Control Delay, s/veh	26.3	
HCM 7th LOS	C	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	126	189	170	82	169	400	101	531	35	293	757	157
Future Volume (veh/h)	126	189	170	82	169	400	101	531	35	293	757	157
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	137	205	76	89	184	0	110	577	10	318	823	159
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	204	240	402	213	689		140	612	519	418	1096	212
Arrive On Green	0.26	0.26	0.26	0.05	0.37	0.00	0.08	0.33	0.33	0.12	0.37	0.37
Sat Flow, veh/h	598	939	1573	1781	1870	1585	1781	1870	1585	3456	2967	573
Grp Volume(v), veh/h	342	0	76	89	184	0	110	577	10	318	493	489
Grp Sat Flow(s),veh/h/ln	1536	0	1573	1781	1870	1585	1781	1870	1585	1728	1777	1763
Q Serve(g_s), s	20.3	0.0	3.7	3.5	6.8	0.0	6.0	29.5	0.4	8.7	23.8	23.8
Cycle Q Clear(g_c), s	20.9	0.0	3.7	3.5	6.8	0.0	6.0	29.5	0.4	8.7	23.8	23.8
Prop In Lane	0.40		1.00	1.00		1.00	1.00		1.00	1.00		0.33
Lane Grp Cap(c), veh/h	444	0	402	213	689		140	612	519	418	656	651
V/C Ratio(X)	0.77	0.00	0.19	0.42	0.27		0.78	0.94	0.02	0.76	0.75	0.75
Avail Cap(c_a), veh/h	567	0	528	410	952		363	628	533	1372	1122	1113
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	34.9	0.0	28.6	26.3	21.7	0.0	44.4	32.2	22.4	41.8	27.0	27.0
Incr Delay (d2), s/veh	4.9	0.0	0.2	1.3	0.2	0.0	9.2	22.6	0.0	2.9	1.8	1.8
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	8.3	0.0	1.4	1.5	3.0	0.0	3.0	16.7	0.2	3.9	10.1	10.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	39.8	0.0	28.8	27.6	21.9	0.0	53.6	54.7	22.4	44.7	28.8	28.8
LnGrp LOS	D		C	C	C		D	D	C	D	C	C
Approach Vol, veh/h		418			273			697			1300	
Approach Delay, s/veh		37.8			23.8			54.1			32.7	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	17.9	38.1	11.1	31.1	13.7	42.3		42.2
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	39.6	33.0	16.0	33.0	20.0	62.0		50.0
Max Q Clear Time (g_c+I1), s	10.7	31.5	5.5	22.9	8.0	25.8		8.8
Green Ext Time (p_c), s	1.1	0.6	0.1	1.7	0.2	7.9		1.1

Intersection Summary	
HCM 7th Control Delay, s/veh	38.1
HCM 7th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	28	16	8	6	26	259	0	23	3	116	277	14
Future Volume (veh/h)	28	16	8	6	26	259	0	23	3	116	277	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.98	1.00		0.99	0.99		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	30	17	1	7	28	69	0	25	1	126	301	14
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	362	162	329	176	360	334	432	325	273	658	797	37
Arrive On Green	0.22	0.22	0.22	0.22	0.22	0.22	0.00	0.17	0.17	0.11	0.45	0.45
Sat Flow, veh/h	763	749	1523	145	1668	1548	1781	1870	1571	1781	1773	82
Grp Volume(v), veh/h	47	0	1	35	0	69	0	25	1	126	0	315
Grp Sat Flow(s),veh/h/ln	1512	0	1523	1814	0	1548	1781	1870	1571	1781	0	1855
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.3	0.0	1.5	0.0	3.4
Cycle Q Clear(g_c), s	0.6	0.0	0.0	0.4	0.0	1.1	0.0	0.3	0.0	1.5	0.0	3.4
Prop In Lane	0.64		1.00	0.20		1.00	1.00		1.00	1.00		0.04
Lane Grp Cap(c), veh/h	524	0	329	536	0	334	432	325	273	658	0	834
V/C Ratio(X)	0.09	0.00	0.00	0.07	0.00	0.21	0.00	0.08	0.00	0.19	0.00	0.38
Avail Cap(c_a), veh/h	2861	0	2802	3353	0	2848	724	3442	2892	763	0	3414
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.4	0.0	9.2	9.4	0.0	9.6	0.0	10.3	10.2	6.9	0.0	5.5
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.3	0.0	0.1	0.0	0.1	0.0	0.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	0.0	0.0	0.1	0.0	0.3	0.0	0.1	0.0	0.4	0.0	0.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.5	0.0	9.2	9.4	0.0	9.9	0.0	10.4	10.2	7.1	0.0	5.7
LnGrp LOS	A		A	A		A		B	B	A		A
Approach Vol, veh/h		48			104			26			441	
Approach Delay, s/veh		9.5			9.7			10.4			6.1	
Approach LOS		A			A			B			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.2	10.2		11.5	0.0	18.4		11.5				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.5	2.3		2.6	0.0	5.4		3.1				
Green Ext Time (p_c), s	0.0	0.1		0.3	0.0	2.1		0.4				

Intersection Summary	
HCM 7th Control Delay, s/veh	7.2
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	14	113	26	11	45	260	943	32	46	561	17
Future Volume (veh/h)	15	14	113	26	11	45	260	943	32	46	561	17
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	16	15	32	28	12	6	283	1025	22	50	610	8
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	81	32	53	151	48	108	336	1197	1014	78	925	784
Arrive On Green	0.07	0.07	0.07	0.07	0.07	0.07	0.19	0.64	0.64	0.04	0.49	0.49
Sat Flow, veh/h	279	473	776	978	704	1578	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	63	0	0	40	0	6	283	1025	22	50	610	8
Grp Sat Flow(s),veh/h/ln	1528	0	0	1682	0	1578	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	1.5	0.0	0.0	0.0	0.0	0.3	11.1	31.7	0.4	2.0	17.7	0.2
Cycle Q Clear(g_c), s	3.0	0.0	0.0	1.5	0.0	0.3	11.1	31.7	0.4	2.0	17.7	0.2
Prop In Lane	0.25		0.51	0.70		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	166	0	0	199	0	108	336	1197	1014	78	925	784
V/C Ratio(X)	0.38	0.00	0.00	0.20	0.00	0.06	0.84	0.86	0.02	0.64	0.66	0.01
Avail Cap(c_a), veh/h	516	0	0	525	0	457	589	2940	2491	246	2579	2185
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	32.9	0.0	0.0	32.2	0.0	31.6	28.4	10.4	4.8	34.1	13.7	9.3
Incr Delay (d2), s/veh	1.4	0.0	0.0	0.5	0.0	0.2	5.7	1.9	0.0	8.5	0.8	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.1	0.0	0.0	0.7	0.0	0.1	5.1	10.6	0.1	1.0	6.8	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	34.3	0.0	0.0	32.7	0.0	31.8	34.0	12.3	4.8	42.6	14.5	9.3
LnGrp LOS	C			C		C	C	B	A	D	B	A
Approach Vol, veh/h		63			46			1330			668	
Approach Delay, s/veh		34.3			32.6			16.8			16.6	
Approach LOS		C			C			B			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	9.2	52.4		10.9	19.7	41.9		10.9				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0				
Max Q Clear Time (g_c+I1), s	4.0	33.7		5.0	13.1	19.7		3.5				
Green Ext Time (p_c), s	0.0	12.7		0.2	0.6	4.9		0.1				

Intersection Summary	
HCM 7th Control Delay, s/veh	17.6
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	253	0	1325	746	3
Future Vol, veh/h	0	253	0	1325	746	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	275	0	1440	811	3

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Base Year 2048 AM

Intersection	
Int Delay, s/veh	3.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	17	95	72	356	598	17
Future Vol, veh/h	17	95	72	356	598	17
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	18	103	78	387	650	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1304	801	769	0	-	0
Stage 1	760	-	-	-	-	-
Stage 2	543	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	177	384	845	-	-	-
Stage 1	462	-	-	-	-	-
Stage 2	582	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	130	334	764	-	-	-
Mov Cap-2 Maneuver	130	-	-	-	-	-
Stage 1	374	-	-	-	-	-
Stage 2	526	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	28.91	1.72	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	764	-	269	-	-
HCM Lane V/C Ratio	0.102	-	0.452	-	-
HCM Control Delay (s/veh)	10.3	-	28.9	-	-
HCM Lane LOS	B	-	D	-	-
HCM 95th %tile Q(veh)	0.3	-	2.2	-	-

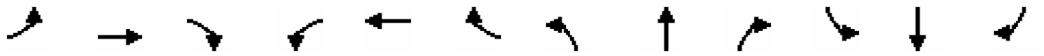
Intersection	
Int Delay, s/veh	1.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	24	36	399	23	45	658
Future Vol, veh/h	24	36	399	23	45	658
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	26	39	434	25	49	715

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	911	450	0	0	463	0
Stage 1	450	-	-	-	-	-
Stage 2	460	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	289	608	-	-	1097	-
Stage 1	641	-	-	-	-	-
Stage 2	603	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	274	606	-	-	1092	-
Mov Cap-2 Maneuver	274	-	-	-	-	-
Stage 1	639	-	-	-	-	-
Stage 2	573	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	14.63	0	0.54
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	274	606	1092	-
HCM Lane V/C Ratio	-	-	0.095	0.065	0.045	-
HCM Control Delay (s/veh)	-	-	19.5	11.4	8.4	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.3	0.2	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	157	1	469	2	5	0	275	698	5	6	954	151
Future Volume (veh/h)	157	1	469	2	5	0	275	698	5	6	954	151
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	171	1	0	2	5	0	299	759	5	7	1037	86
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	212	1		5	12	0	349	2107	14	16	1404	625
Arrive On Green	0.12	0.12	0.00	0.01	0.01	0.00	0.20	0.58	0.58	0.01	0.40	0.40
Sat Flow, veh/h	1771	10	1585	527	1317	0	1781	3619	24	1781	3554	1581
Grp Volume(v), veh/h	172	0	0	7	0	0	299	373	391	7	1037	86
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1844	0	0	1781	1777	1866	1781	1777	1581
Q Serve(g_s), s	8.1	0.0	0.0	0.3	0.0	0.0	13.9	9.5	9.5	0.3	21.3	3.0
Cycle Q Clear(g_c), s	8.1	0.0	0.0	0.3	0.0	0.0	13.9	9.5	9.5	0.3	21.3	3.0
Prop In Lane	0.99		1.00	0.29		0.00	1.00		0.01	1.00		1.00
Lane Grp Cap(c), veh/h	213	0		17	0	0	349	1034	1086	16	1404	625
V/C Ratio(X)	0.81	0.00		0.42	0.00	0.00	0.86	0.36	0.36	0.44	0.74	0.14
Avail Cap(c_a), veh/h	312	0		194	0	0	916	2679	2813	187	3281	1460
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	36.7	0.0	0.0	42.2	0.0	0.0	33.2	9.5	9.5	42.2	22.1	16.6
Incr Delay (d2), s/veh	9.5	0.0	0.0	16.3	0.0	0.0	6.1	0.2	0.2	17.8	0.8	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.0	0.0	0.0	0.2	0.0	0.0	6.4	3.4	3.6	0.2	8.6	1.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	46.2	0.0	0.0	58.5	0.0	0.0	39.3	9.7	9.7	60.0	22.9	16.7
LnGrp LOS	D			E			D	A	A	E	C	B
Approach Vol, veh/h		172			7			1063			1130	
Approach Delay, s/veh		46.2			58.5			18.0			22.6	
Approach LOS		D			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.8	55.8		6.8	22.8	39.8		16.2				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	129.0		9.0	44.0	79.0		15.0				
Max Q Clear Time (g_c+I1), s	2.3	11.5		2.3	15.9	23.3		10.1				
Green Ext Time (p_c), s	0.0	5.7		0.0	0.9	10.5		0.4				

Intersection Summary		
HCM 7th Control Delay, s/veh	22.4	
HCM 7th LOS	C	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	57	111	62	33	136	392	56	509	36	358	750	80
Future Volume (veh/h)	57	111	62	33	136	392	56	509	36	358	750	80
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	62	121	21	36	148	0	61	553	11	389	815	80
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	133	173	228	213	496		87	615	521	537	1422	140
Arrive On Green	0.15	0.15	0.15	0.04	0.26	0.00	0.05	0.33	0.33	0.16	0.44	0.44
Sat Flow, veh/h	450	1191	1563	1781	1870	1585	1781	1870	1585	3456	3267	321
Grp Volume(v), veh/h	183	0	21	36	148	0	61	553	11	389	443	452
Grp Sat Flow(s),veh/h/ln	1641	0	1563	1781	1870	1585	1781	1870	1585	1728	1777	1811
Q Serve(g_s), s	5.9	0.0	0.8	1.2	4.5	0.0	2.4	20.2	0.3	7.7	13.5	13.5
Cycle Q Clear(g_c), s	7.6	0.0	0.8	1.2	4.5	0.0	2.4	20.2	0.3	7.7	13.5	13.5
Prop In Lane	0.34		1.00	1.00		1.00	1.00		1.00	1.00		0.18
Lane Grp Cap(c), veh/h	306	0	228	213	496		87	615	521	537	773	788
V/C Ratio(X)	0.60	0.00	0.09	0.17	0.30		0.70	0.90	0.02	0.72	0.57	0.57
Avail Cap(c_a), veh/h	452	0	370	447	808		298	678	574	2842	2080	2120
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	29.3	0.0	26.5	23.6	21.0	0.0	33.6	22.9	16.3	28.8	15.2	15.3
Incr Delay (d2), s/veh	1.9	0.0	0.2	0.4	0.3	0.0	9.6	14.1	0.0	1.9	0.7	0.7
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.1	0.0	0.3	0.5	1.9	0.0	1.2	10.6	0.1	3.2	5.1	5.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	31.2	0.0	26.7	23.9	21.4	0.0	43.2	37.1	16.3	30.7	15.9	15.9
LnGrp LOS	C		C	C	C		D	D	B	C	B	B
Approach Vol, veh/h		204			184			625			1284	
Approach Delay, s/veh		30.7			21.9			37.3			20.4	
Approach LOS		C			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	17.1	29.6	8.6	16.4	9.5	37.2		25.0
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	59.0	26.0	12.0	17.0	12.0	84.0		31.0
Max Q Clear Time (g_c+I1), s	19.7	22.2	3.2	9.6	4.4	15.5		6.5
Green Ext Time (p_c), s	1.5	1.3	0.0	0.6	0.1	7.2		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	26.0
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	16	7	10	5	12	234	0	19	1	109	238	9
Future Volume (veh/h)	16	7	10	5	12	234	0	19	1	109	238	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.97	1.00		0.99	0.99		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	17	8	2	5	13	57	0	21	1	118	259	9
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	373	135	299	202	311	304	450	324	273	667	816	28
Arrive On Green	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.17	0.17	0.11	0.45	0.45
Sat Flow, veh/h	823	687	1517	209	1580	1544	1781	1870	1571	1781	1796	62
Grp Volume(v), veh/h	25	0	2	18	0	57	0	21	1	118	0	268
Grp Sat Flow(s),veh/h/ln	1509	0	1517	1789	0	1544	1781	1870	1571	1781	0	1859
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.3	0.0	1.3	0.0	2.6
Cycle Q Clear(g_c), s	0.3	0.0	0.0	0.2	0.0	0.9	0.0	0.3	0.0	1.3	0.0	2.6
Prop In Lane	0.68		1.00	0.28		1.00	1.00		1.00	1.00		0.03
Lane Grp Cap(c), veh/h	508	0	299	513	0	304	450	324	273	667	0	844
V/C Ratio(X)	0.05	0.00	0.01	0.04	0.00	0.19	0.00	0.06	0.00	0.18	0.00	0.32
Avail Cap(c_a), veh/h	2989	0	2910	3419	0	2963	755	3589	3015	789	0	3567
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.4	0.0	9.3	9.3	0.0	9.6	0.0	9.9	9.8	6.6	0.0	5.0
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1	0.0	0.1	0.0	0.2
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.3	0.0	0.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.4	0.0	9.3	9.4	0.0	9.9	0.0	10.0	9.8	6.7	0.0	5.2
LnGrp LOS	A		A	A		A		A	A	A		A
Approach Vol, veh/h		27			75			22			386	
Approach Delay, s/veh		9.4			9.8			10.0			5.7	
Approach LOS		A			A			A			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.0	10.0		10.6	0.0	18.0		10.6				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.3	2.3		2.3	0.0	4.6		2.9				
Green Ext Time (p_c), s	0.0	0.1		0.1	0.0	1.8		0.3				

Intersection Summary		
HCM 7th Control Delay, s/veh	6.7	
HCM 7th LOS	A	



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	11	97	40	11	76	230	1156	36	47	603	9
Future Volume (veh/h)	5	11	97	40	11	76	230	1156	36	47	603	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		0.99	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	5	12	7	43	12	8	250	1257	26	51	655	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	49	40	19	126	18	78	286	1384	1173	66	1153	977
Arrive On Green	0.05	0.05	0.05	0.05	0.05	0.05	0.16	0.74	0.74	0.04	0.62	0.62
Sat Flow, veh/h	134	804	386	1302	363	1575	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	24	0	0	55	0	8	250	1257	26	51	655	6
Grp Sat Flow(s),veh/h/ln	1324	0	0	1666	0	1575	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.5	14.2	55.3	0.4	2.9	21.4	0.2
Cycle Q Clear(g_c), s	3.1	0.0	0.0	3.1	0.0	0.5	14.2	55.3	0.4	2.9	21.4	0.2
Prop In Lane	0.21		0.29	0.78		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	107	0	0	144	0	78	286	1384	1173	66	1153	977
V/C Ratio(X)	0.22	0.00	0.00	0.38	0.00	0.10	0.87	0.91	0.02	0.77	0.57	0.01
Avail Cap(c_a), veh/h	297	0	0	312	0	258	412	1877	1590	344	1805	1529
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	47.5	0.0	0.0	48.3	0.0	47.1	42.5	10.7	3.6	49.5	11.7	7.6
Incr Delay (d2), s/veh	1.0	0.0	0.0	1.7	0.0	0.6	13.5	5.5	0.0	16.8	0.4	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.6	0.0	0.0	1.5	0.0	0.2	7.3	19.8	0.1	1.6	8.4	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	48.5	0.0	0.0	50.0	0.0	47.7	56.0	16.2	3.6	66.3	12.2	7.7
LnGrp LOS	D			D		D	E	B	A	E	B	A
Approach Vol, veh/h		24			63			1533			712	
Approach Delay, s/veh		48.5			49.7			22.5			16.0	
Approach LOS		D			D			C			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	9.9	82.7		11.1	22.6	69.9		11.1
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	20.0	104.0		17.0	24.0	100.0		17.0
Max Q Clear Time (g_c+I1), s	4.9	57.3		5.1	16.2	23.4		5.1
Green Ext Time (p_c), s	0.1	19.4		0.0	0.4	5.5		0.2

Intersection Summary	
HCM 7th Control Delay, s/veh	21.5
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	207	0	1424	771	1
Future Vol, veh/h	0	207	0	1424	771	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	225	0	1548	838	1

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Base Year 2048 PM

Intersection	
Int Delay, s/veh	5.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	23	130	97	585	548	32
Future Vol, veh/h	23	130	97	585	548	32
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	25	141	105	636	596	35

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1561	755	731	0	-	0
Stage 1	714	-	-	-	-	-
Stage 2	847	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	123	409	873	-	-	-
Stage 1	485	-	-	-	-	-
Stage 2	420	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	87	355	789	-	-	-
Mov Cap-2 Maneuver	87	-	-	-	-	-
Stage 1	380	-	-	-	-	-
Stage 2	380	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	46.85	1.46	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	789	-	243	-	-
HCM Lane V/C Ratio	0.134	-	0.685	-	-
HCM Control Delay (s/veh)	10.3	-	46.8	-	-
HCM Lane LOS	B	-	E	-	-
HCM 95th %tile Q(veh)	0.5	-	4.4	-	-

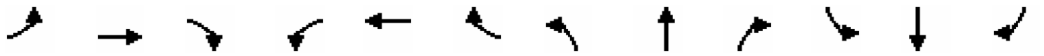
Intersection	
Int Delay, s/veh	2.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	51	71	616	51	53	634
Future Vol, veh/h	51	71	616	51	53	634
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	55	77	670	55	58	689

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1166	701	0	0	729	0
Stage 1	701	-	-	-	-	-
Stage 2	465	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	200	438	-	-	873	-
Stage 1	491	-	-	-	-	-
Stage 2	600	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	185	436	-	-	869	-
Mov Cap-2 Maneuver	185	-	-	-	-	-
Stage 1	489	-	-	-	-	-
Stage 2	557	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	22.33	0	0.73
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	185	436	869	-
HCM Lane V/C Ratio	-	-	0.299	0.177	0.066	-
HCM Control Delay (s/veh)	-	-	32.5	15	9.4	-
HCM Lane LOS	-	-	D	C	A	-
HCM 95th %tile Q(veh)	-	-	1.2	0.6	0.2	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	149	1	533	9	2	6	485	1084	0	1	1045	174
Future Volume (veh/h)	149	1	533	9	2	6	485	1084	0	1	1045	174
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	162	1	0	10	2	2	527	1178	0	1	1136	106
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	192	1		19	4	4	561	2473	0	2	1358	604
Arrive On Green	0.11	0.11	0.00	0.02	0.02	0.02	0.32	0.70	0.00	0.00	0.38	0.38
Sat Flow, veh/h	1771	11	1585	1259	252	252	1781	3647	0	1781	3554	1581
Grp Volume(v), veh/h	163	0	0	14	0	0	527	1178	0	1	1136	106
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1762	0	0	1781	1777	0	1781	1777	1581
Q Serve(g_s), s	12.0	0.0	0.0	1.1	0.0	0.0	38.6	20.2	0.0	0.1	38.9	6.0
Cycle Q Clear(g_c), s	12.0	0.0	0.0	1.1	0.0	0.0	38.6	20.2	0.0	0.1	38.9	6.0
Prop In Lane	0.99		1.00	0.71		0.14	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	193	0		27	0	0	561	2473	0	2	1358	604
V/C Ratio(X)	0.84	0.00		0.52	0.00	0.00	0.94	0.48	0.00	0.41	0.84	0.18
Avail Cap(c_a), veh/h	319	0		118	0	0	784	2755	0	120	1828	813
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	58.7	0.0	0.0	65.6	0.0	0.0	44.7	9.3	0.0	66.9	37.6	27.4
Incr Delay (d2), s/veh	10.2	0.0	0.0	15.0	0.0	0.0	15.4	0.1	0.0	84.9	2.7	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.0	0.0	0.0	0.6	0.0	0.0	19.3	7.5	0.0	0.1	17.3	2.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	68.8	0.0	0.0	80.6	0.0	0.0	60.0	9.4	0.0	151.8	40.3	27.6
LnGrp LOS	E			F			E	A		F	D	C
Approach Vol, veh/h		163			14			1705			1243	
Approach Delay, s/veh		68.8			80.6			25.1			39.3	
Approach LOS		E			F			C			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.2	99.3		8.0	48.3	57.3		20.6				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	104.0		9.0	59.0	69.0		24.0				
Max Q Clear Time (g_c+I1), s	2.1	22.2		3.1	40.6	40.9		14.0				
Green Ext Time (p_c), s	0.0	12.6		0.0	1.7	10.3		0.6				

Intersection Summary		
HCM 7th Control Delay, s/veh	33.3	
HCM 7th LOS	C	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	90	125	124	26	132	450	54	547	27	447	762	89
Future Volume (veh/h)	90	125	124	26	132	450	54	547	27	447	762	89
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	98	136	37	28	143	0	59	595	8	486	828	90
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	169	179	291	182	523		76	646	547	612	1550	168
Arrive On Green	0.19	0.19	0.19	0.03	0.28	0.00	0.04	0.35	0.35	0.18	0.48	0.48
Sat Flow, veh/h	604	963	1568	1781	1870	1585	1781	1870	1585	3456	3231	351
Grp Volume(v), veh/h	234	0	37	28	143	0	59	595	8	486	455	463
Grp Sat Flow(s),veh/h/ln	1567	0	1568	1781	1870	1585	1781	1870	1585	1728	1777	1805
Q Serve(g_s), s	11.8	0.0	1.8	1.1	5.4	0.0	3.0	27.8	0.3	12.2	16.3	16.3
Cycle Q Clear(g_c), s	12.9	0.0	1.8	1.1	5.4	0.0	3.0	27.8	0.3	12.2	16.3	16.3
Prop In Lane	0.42		1.00	1.00		1.00	1.00		1.00	1.00		0.19
Lane Grp Cap(c), veh/h	347	0	291	182	523		76	646	547	612	852	866
V/C Ratio(X)	0.67	0.00	0.13	0.15	0.27		0.78	0.92	0.01	0.79	0.53	0.53
Avail Cap(c_a), veh/h	570	0	517	406	987		176	699	593	2242	1153	1171
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	35.3	0.0	30.9	28.2	25.5	0.0	43.1	28.6	19.6	35.8	16.6	16.6
Incr Delay (d2), s/veh	2.3	0.0	0.2	0.4	0.3	0.0	15.3	17.0	0.0	2.4	0.5	0.5
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.1	0.0	0.7	0.5	2.4	0.0	1.6	15.0	0.1	5.3	6.4	6.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	37.6	0.0	31.1	28.6	25.8	0.0	58.4	45.6	19.6	38.2	17.1	17.1
LnGrp LOS	D		C	C	C		E	D	B	D	B	B
Approach Vol, veh/h		271			171			662			1404	
Approach Delay, s/veh		36.7			26.3			46.4			24.4	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	12.1	37.4	8.5	22.9	9.9	49.6		31.4
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	5.9	34.0	14.0	30.0	9.0	59.0		48.0
Max Q Clear Time (g_c+I1), s	14.3	29.8	3.1	14.9	5.0	18.3		7.4
Green Ext Time (p_c), s	1.9	1.5	0.0	1.3	0.0	7.2		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	31.7
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	30	13	10	19	26	224	1	35	2	117	473	17
Future Volume (veh/h)	30	13	10	19	26	224	1	35	2	117	473	17
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.97	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	33	14	1	21	28	47	1	38	1	127	514	17
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	339	116	299	230	240	304	337	567	478	761	720	24
Arrive On Green	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.30	0.30	0.10	0.40	0.40
Sat Flow, veh/h	887	590	1517	469	1217	1544	1781	1870	1577	1781	1800	60
Grp Volume(v), veh/h	47	0	1	49	0	47	1	38	1	127	0	531
Grp Sat Flow(s),veh/h/ln	1477	0	1517	1686	0	1544	1781	1870	1577	1781	0	1859
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.5	0.0	1.7	0.0	9.0
Cycle Q Clear(g_c), s	0.8	0.0	0.0	0.8	0.0	0.9	0.0	0.5	0.0	1.7	0.0	9.0
Prop In Lane	0.70		1.00	0.43		1.00	1.00		1.00	1.00		0.03
Lane Grp Cap(c), veh/h	455	0	299	470	0	304	337	567	478	761	0	744
V/C Ratio(X)	0.10	0.00	0.00	0.10	0.00	0.15	0.00	0.07	0.00	0.17	0.00	0.71
Avail Cap(c_a), veh/h	2275	0	2234	2512	0	2274	571	2755	2323	825	0	2739
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	12.3	0.0	12.0	12.4	0.0	12.4	9.4	9.3	9.1	6.8	0.0	9.4
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.1	0.0	1.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.0	0.3	0.0	0.3	0.0	0.2	0.0	0.4	0.0	2.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	12.4	0.0	12.1	12.5	0.0	12.7	9.4	9.3	9.1	6.9	0.0	10.7
LnGrp LOS	B		B	B		B	A	A	A	A		B
Approach Vol, veh/h		48			96			40			658	
Approach Delay, s/veh		12.4			12.6			9.3			10.0	
Approach LOS		B			B			A			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.7	16.3		12.4	5.1	19.9		12.4				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.7	2.5		2.8	2.0	11.0		2.9				
Green Ext Time (p_c), s	0.0	0.2		0.3	0.0	4.0		0.4				

Intersection Summary	
HCM 7th Control Delay, s/veh	10.4
HCM 7th LOS	B



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	6	19	102	37	9	57	232	1033	34	45	924	27
Future Volume (veh/h)	6	19	102	37	9	57	232	1033	34	45	924	27
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		0.99	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	7	21	18	40	10	5	252	1123	24	49	1004	15
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	49	43	32	136	20	87	290	1358	1151	67	1123	952
Arrive On Green	0.06	0.06	0.06	0.06	0.06	0.06	0.16	0.73	0.73	0.04	0.60	0.60
Sat Flow, veh/h	129	780	584	1284	365	1576	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	46	0	0	50	0	5	252	1123	24	49	1004	15
Grp Sat Flow(s),veh/h/ln	1492	0	0	1648	0	1576	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.6	0.0	0.0	0.0	0.0	0.3	13.7	40.8	0.4	2.7	45.9	0.4
Cycle Q Clear(g_c), s	3.2	0.0	0.0	2.7	0.0	0.3	13.7	40.8	0.4	2.7	45.9	0.4
Prop In Lane	0.15		0.39	0.80		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	124	0	0	156	0	87	290	1358	1151	67	1123	952
V/C Ratio(X)	0.37	0.00	0.00	0.32	0.00	0.06	0.87	0.83	0.02	0.74	0.89	0.02
Avail Cap(c_a), veh/h	384	0	0	382	0	334	431	2150	1822	180	1886	1598
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	45.6	0.0	0.0	45.5	0.0	44.4	40.5	9.3	3.8	47.2	17.1	8.0
Incr Delay (d2), s/veh	1.8	0.0	0.0	1.2	0.0	0.3	12.0	1.6	0.0	14.6	3.4	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.2	0.0	0.0	1.2	0.0	0.1	6.9	13.7	0.1	1.5	18.7	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	47.4	0.0	0.0	46.7	0.0	44.7	52.5	10.9	3.8	61.8	20.4	8.0
LnGrp LOS	D			D		D	D	B	A	E	C	A
Approach Vol, veh/h		46			55			1399			1068	
Approach Delay, s/veh		47.4			46.5			18.3			22.2	
Approach LOS		D			D			B			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	9.7	78.0		11.5	22.1	65.6		11.5
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0
Max Q Clear Time (g_c+I1), s	4.7	42.8		5.2	15.7	47.9		4.7
Green Ext Time (p_c), s	0.0	15.9		0.1	0.5	11.7		0.2

Intersection Summary	
HCM 7th Control Delay, s/veh	21.0
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	410	0	1336	1174	5
Future Vol, veh/h	0	410	0	1336	1174	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	446	0	1452	1276	5

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Base Year 2048 SAT

Intersection	
Int Delay, s/veh	2.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	19	72	77	522	505	17
Future Vol, veh/h	19	72	77	522	505	17
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	21	78	84	567	549	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1394	700	668	0	-	0
Stage 1	659	-	-	-	-	-
Stage 2	735	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	156	439	921	-	-	-
Stage 1	515	-	-	-	-	-
Stage 2	474	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	115	381	833	-	-	-
Mov Cap-2 Maneuver	115	-	-	-	-	-
Stage 1	418	-	-	-	-	-
Stage 2	429	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	27.55	1.26	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	833	-	257	-	-
HCM Lane V/C Ratio	0.1	-	0.385	-	-
HCM Control Delay (s/veh)	9.8	-	27.6	-	-
HCM Lane LOS	A	-	D	-	-
HCM 95th %tile Q(veh)	0.3	-	1.7	-	-

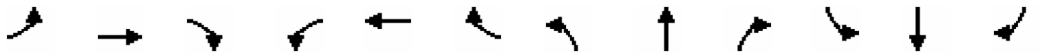
Intersection	
Int Delay, s/veh	1.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	53	62	535	43	35	561
Future Vol, veh/h	53	62	535	43	35	561
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	58	67	582	47	38	610

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	995	609	0	0	632	0
Stage 1	609	-	-	-	-	-
Stage 2	386	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	256	494	-	-	948	-
Stage 1	542	-	-	-	-	-
Stage 2	657	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	244	492	-	-	945	-
Mov Cap-2 Maneuver	244	-	-	-	-	-
Stage 1	540	-	-	-	-	-
Stage 2	628	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	18.46	0	0.53
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	244	492	945	-
HCM Lane V/C Ratio	-	-	0.236	0.137	0.04	-
HCM Control Delay (s/veh)	-	-	24.3	13.5	9	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.9	0.5	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	144	2	426	2	2	0	395	972	2	0	934	155
Future Volume (veh/h)	144	2	426	2	2	0	395	972	2	0	934	155
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	157	2	0	2	2	0	429	1057	2	0	1015	52
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	193	2		5	5	0	477	2526	5	2	1288	573
Arrive On Green	0.11	0.11	0.00	0.01	0.01	0.00	0.27	0.69	0.69	0.00	0.36	0.36
Sat Flow, veh/h	1760	22	1585	912	912	0	1781	3639	7	1781	3554	1581
Grp Volume(v), veh/h	159	0	0	4	0	0	429	516	543	0	1015	52
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1825	0	0	1781	1777	1869	1781	1777	1581
Q Serve(g_s), s	8.2	0.0	0.0	0.2	0.0	0.0	21.9	11.8	11.8	0.0	24.0	2.0
Cycle Q Clear(g_c), s	8.2	0.0	0.0	0.2	0.0	0.0	21.9	11.8	11.8	0.0	24.0	2.0
Prop In Lane	0.99		1.00	0.50		0.00	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	195	0		10	0	0	477	1233	1297	2	1288	573
V/C Ratio(X)	0.82	0.00		0.42	0.00	0.00	0.90	0.42	0.42	0.00	0.79	0.09
Avail Cap(c_a), veh/h	265	0		97	0	0	927	1397	1470	170	1850	823
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	41.0	0.0	0.0	46.7	0.0	0.0	33.2	6.2	6.2	0.0	26.8	19.8
Incr Delay (d2), s/veh	13.1	0.0	0.0	26.1	0.0	0.0	6.3	0.2	0.2	0.0	1.5	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.3	0.0	0.0	0.2	0.0	0.0	10.0	3.8	4.0	0.0	10.1	0.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	54.1	0.0	0.0	72.8	0.0	0.0	39.6	6.4	6.4	0.0	28.3	19.9
LnGrp LOS	D			E			D	A	A		C	B
Approach Vol, veh/h		159			4			1488			1067	
Approach Delay, s/veh		54.1			72.8			16.0			27.9	
Approach LOS		D			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	0.0	71.3		6.5	31.2	40.1		16.3				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	74.0		5.0	49.0	49.0		14.0				
Max Q Clear Time (g_c+I1), s	0.0	13.8		2.2	23.9	26.0		10.2				
Green Ext Time (p_c), s	0.0	9.1		0.0	1.4	8.1		0.3				

Intersection Summary		
HCM 7th Control Delay, s/veh	23.0	
HCM 7th LOS	C	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	126	189	170	82	169	417	101	554	35	306	790	157
Future Volume (veh/h)	126	189	170	82	169	417	101	554	35	306	790	157
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	137	205	75	89	184	0	110	602	11	333	859	160
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	198	234	395	199	671		139	655	555	426	1182	220
Arrive On Green	0.25	0.25	0.25	0.05	0.36	0.00	0.08	0.35	0.35	0.12	0.40	0.40
Sat Flow, veh/h	603	930	1572	1781	1870	1585	1781	1870	1585	3456	2987	556
Grp Volume(v), veh/h	342	0	75	89	184	0	110	602	11	333	511	508
Grp Sat Flow(s),veh/h/ln	1533	0	1572	1781	1870	1585	1781	1870	1585	1728	1777	1767
Q Serve(g_s), s	22.6	0.0	4.0	3.8	7.5	0.0	6.5	33.1	0.5	10.0	26.2	26.2
Cycle Q Clear(g_c), s	23.0	0.0	4.0	3.8	7.5	0.0	6.5	33.1	0.5	10.0	26.2	26.2
Prop In Lane	0.40		1.00	1.00		1.00	1.00		1.00	1.00		0.31
Lane Grp Cap(c), veh/h	432	0	395	199	671		139	655	555	426	703	699
V/C Ratio(X)	0.79	0.00	0.19	0.45	0.27		0.79	0.92	0.02	0.78	0.73	0.73
Avail Cap(c_a), veh/h	519	0	484	373	872		332	750	636	1257	1028	1022
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	38.7	0.0	31.6	29.2	24.5	0.0	48.6	33.4	22.8	45.6	27.5	27.5
Incr Delay (d2), s/veh	6.9	0.0	0.2	1.6	0.2	0.0	9.7	15.2	0.0	3.2	1.5	1.5
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	9.4	0.0	1.6	1.7	3.3	0.0	3.3	17.4	0.2	4.5	11.1	11.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	45.5	0.0	31.8	30.8	24.7	0.0	58.2	48.5	22.8	48.8	28.9	29.0
LnGrp LOS	D		C	C	C		E	D	C	D	C	C
Approach Vol, veh/h		417			273			723			1352	
Approach Delay, s/veh		43.1			26.7			49.6			33.8	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	19.2	43.6	11.5	32.9	14.4	48.4		44.4
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	39.0	43.0	16.0	33.0	20.0	62.0		50.0
Max Q Clear Time (g_c+I1), s	12.0	35.1	5.8	25.0	8.5	28.2		9.5
Green Ext Time (p_c), s	1.2	2.5	0.1	1.5	0.2	8.2		1.1

Intersection Summary	
HCM 7th Control Delay, s/veh	38.6
HCM 7th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	28	16	8	6	26	259	0	24	3	116	289	14
Future Volume (veh/h)	28	16	8	6	26	259	0	24	3	116	289	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.98	1.00		0.99	0.99		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	30	17	1	7	28	68	0	26	1	126	314	14
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	362	161	328	176	360	334	430	326	274	658	800	36
Arrive On Green	0.22	0.22	0.22	0.22	0.22	0.22	0.00	0.17	0.17	0.11	0.45	0.45
Sat Flow, veh/h	764	749	1523	145	1668	1548	1781	1870	1571	1781	1777	79
Grp Volume(v), veh/h	47	0	1	35	0	68	0	26	1	126	0	328
Grp Sat Flow(s),veh/h/ln	1513	0	1523	1813	0	1548	1781	1870	1571	1781	0	1856
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.3	0.0	1.5	0.0	3.5
Cycle Q Clear(g_c), s	0.6	0.0	0.0	0.4	0.0	1.1	0.0	0.3	0.0	1.5	0.0	3.5
Prop In Lane	0.64		1.00	0.20		1.00	1.00		1.00	1.00		0.04
Lane Grp Cap(c), veh/h	523	0	328	535	0	334	430	326	274	658	0	835
V/C Ratio(X)	0.09	0.00	0.00	0.07	0.00	0.20	0.00	0.08	0.00	0.19	0.00	0.39
Avail Cap(c_a), veh/h	2860	0	2799	3350	0	2845	722	3439	2889	763	0	3412
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.4	0.0	9.2	9.4	0.0	9.6	0.0	10.3	10.2	6.9	0.0	5.5
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.3	0.0	0.1	0.0	0.1	0.0	0.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	0.0	0.0	0.1	0.0	0.3	0.0	0.1	0.0	0.4	0.0	0.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.5	0.0	9.2	9.4	0.0	9.9	0.0	10.4	10.2	7.0	0.0	5.8
LnGrp LOS	A		A	A		A		B	B	A		A
Approach Vol, veh/h		48			103			27			454	
Approach Delay, s/veh		9.5			9.8			10.4			6.1	
Approach LOS		A			A			B			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.2	10.2		11.4	0.0	18.5		11.4				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.5	2.3		2.6	0.0	5.5		3.1				
Green Ext Time (p_c), s	0.0	0.1		0.3	0.0	2.2		0.4				

Intersection Summary	
HCM 7th Control Delay, s/veh	7.2
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	14	113	26	11	45	260	994	32	46	591	17
Future Volume (veh/h)	15	14	113	26	11	45	260	994	32	46	591	17
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	16	15	31	28	12	6	283	1080	22	50	642	8
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	76	32	51	142	47	105	331	1244	1054	75	974	826
Arrive On Green	0.07	0.07	0.07	0.07	0.07	0.07	0.19	0.66	0.66	0.04	0.52	0.52
Sat Flow, veh/h	280	485	764	975	709	1578	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	62	0	0	40	0	6	283	1080	22	50	642	8
Grp Sat Flow(s),veh/h/ln	1529	0	0	1684	0	1578	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	1.6	0.0	0.0	0.0	0.0	0.3	12.2	36.4	0.4	2.2	19.9	0.2
Cycle Q Clear(g_c), s	3.2	0.0	0.0	1.7	0.0	0.3	12.2	36.4	0.4	2.2	19.9	0.2
Prop In Lane	0.26		0.50	0.70		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	158	0	0	189	0	105	331	1244	1054	75	974	826
V/C Ratio(X)	0.39	0.00	0.00	0.21	0.00	0.06	0.85	0.87	0.02	0.67	0.66	0.01
Avail Cap(c_a), veh/h	471	0	0	481	0	417	538	2685	2275	224	2355	1996
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	36.1	0.0	0.0	35.4	0.0	34.7	31.3	10.5	4.5	37.5	13.9	9.2
Incr Delay (d2), s/veh	1.6	0.0	0.0	0.6	0.0	0.2	7.3	2.0	0.0	9.8	0.8	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.2	0.0	0.0	0.8	0.0	0.1	5.7	12.2	0.1	1.1	7.7	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	37.7	0.0	0.0	35.9	0.0	35.0	38.6	12.5	4.5	47.3	14.6	9.2
LnGrp LOS	D			D		C	D	B	A	D	B	A
Approach Vol, veh/h		62			46			1385			700	
Approach Delay, s/veh		37.7			35.8			17.7			16.9	
Approach LOS		D			D			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	9.3	58.8		11.3	20.8	47.4		11.3
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0
Max Q Clear Time (g_c+I1), s	4.2	38.4		5.2	14.2	21.9		3.7
Green Ext Time (p_c), s	0.0	14.4		0.2	0.6	5.3		0.1

Intersection Summary	
HCM 7th Control Delay, s/veh	18.4
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	253	0	1396	786	3
Future Vol, veh/h	0	253	0	1396	786	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	275	0	1517	854	3

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Base Year 2058 AM

Intersection	
Int Delay, s/veh	3.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	17	95	72	373	626	17
Future Vol, veh/h	17	95	72	373	626	17
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	18	103	78	405	680	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1353	832	800	0	-	0
Stage 1	791	-	-	-	-	-
Stage 2	562	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	165	369	823	-	-	-
Stage 1	447	-	-	-	-	-
Stage 2	571	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	121	321	744	-	-	-
Mov Cap-2 Maneuver	121	-	-	-	-	-
Stage 1	361	-	-	-	-	-
Stage 2	516	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	31.14	1.68	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	744	-	256	-	-
HCM Lane V/C Ratio	0.105	-	0.475	-	-
HCM Control Delay (s/veh)	10.4	-	31.1	-	-
HCM Lane LOS	B	-	D	-	-
HCM 95th %tile Q(veh)	0.4	-	2.4	-	-

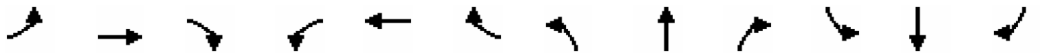
Intersection	
Int Delay, s/veh	1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	24	36	418	23	45	689
Future Vol, veh/h	24	36	418	23	45	689
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	26	39	454	25	49	749

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	948	471	0	0	483	0
Stage 1	471	-	-	-	-	-
Stage 2	477	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	274	592	-	-	1077	-
Stage 1	627	-	-	-	-	-
Stage 2	591	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	259	590	-	-	1073	-
Mov Cap-2 Maneuver	259	-	-	-	-	-
Stage 1	625	-	-	-	-	-
Stage 2	561	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	15.1	0	0.52
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	259	590	1073	-
HCM Lane V/C Ratio	-	-	0.101	0.066	0.046	-
HCM Control Delay (s/veh)	-	-	20.4	11.5	8.5	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.3	0.2	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	157	1	469	2	5	0	275	731	5	6	998	151
Future Volume (veh/h)	157	1	469	2	5	0	275	731	5	6	998	151
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	171	1	0	2	5	0	299	795	5	7	1085	86
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	210	1		5	12	0	347	2151	14	16	1451	645
Arrive On Green	0.12	0.12	0.00	0.01	0.01	0.00	0.19	0.59	0.59	0.01	0.41	0.41
Sat Flow, veh/h	1771	10	1585	527	1317	0	1781	3620	23	1781	3554	1581
Grp Volume(v), veh/h	172	0	0	7	0	0	299	390	410	7	1085	86
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1844	0	0	1781	1777	1866	1781	1777	1581
Q Serve(g_s), s	8.4	0.0	0.0	0.3	0.0	0.0	14.5	10.2	10.2	0.3	23.2	3.0
Cycle Q Clear(g_c), s	8.4	0.0	0.0	0.3	0.0	0.0	14.5	10.2	10.2	0.3	23.2	3.0
Prop In Lane	0.99		1.00	0.29		0.00	1.00		0.01	1.00		1.00
Lane Grp Cap(c), veh/h	211	0		16	0	0	347	1056	1109	16	1451	645
V/C Ratio(X)	0.81	0.00		0.43	0.00	0.00	0.86	0.37	0.37	0.44	0.75	0.13
Avail Cap(c_a), veh/h	300	0		186	0	0	880	2573	2702	180	3151	1402
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	38.3	0.0	0.0	43.9	0.0	0.0	34.7	9.4	9.4	43.9	22.5	16.5
Incr Delay (d2), s/veh	10.9	0.0	0.0	16.4	0.0	0.0	6.3	0.2	0.2	18.0	0.8	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.2	0.0	0.0	0.2	0.0	0.0	6.7	3.6	3.8	0.2	9.4	1.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	49.2	0.0	0.0	60.4	0.0	0.0	41.0	9.6	9.6	61.9	23.2	16.6
LnGrp LOS	D			E			D	A	A	E	C	B
Approach Vol, veh/h		172			7			1099			1178	
Approach Delay, s/veh		49.2			60.4			18.2			23.0	
Approach LOS		D			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.8	58.9		6.8	23.4	42.4		16.6				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	129.0		9.0	44.0	79.0		15.0				
Max Q Clear Time (g_c+I1), s	2.3	12.2		2.3	16.5	25.2		10.4				
Green Ext Time (p_c), s	0.0	6.1		0.0	0.9	11.2		0.3				

Intersection Summary		
HCM 7th Control Delay, s/veh	22.8	
HCM 7th LOS	C	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	57	111	62	33	136	409	56	531	36	374	783	80
Future Volume (veh/h)	57	111	62	33	136	409	56	531	36	374	783	80
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	62	121	21	36	148	0	61	577	11	407	851	80
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	131	172	226	208	488		86	627	531	553	1466	138
Arrive On Green	0.14	0.14	0.14	0.04	0.26	0.00	0.05	0.34	0.34	0.16	0.45	0.45
Sat Flow, veh/h	452	1188	1563	1781	1870	1585	1781	1870	1585	3456	3282	308
Grp Volume(v), veh/h	183	0	21	36	148	0	61	577	11	407	461	470
Grp Sat Flow(s),veh/h/ln	1640	0	1563	1781	1870	1585	1781	1870	1585	1728	1777	1813
Q Serve(g_s), s	6.1	0.0	0.9	1.2	4.7	0.0	2.5	21.9	0.3	8.3	14.3	14.3
Cycle Q Clear(g_c), s	7.8	0.0	0.9	1.2	4.7	0.0	2.5	21.9	0.3	8.3	14.3	14.3
Prop In Lane	0.34		1.00	1.00		1.00	1.00		1.00	1.00		0.17
Lane Grp Cap(c), veh/h	302	0	226	208	488		86	627	531	553	794	810
V/C Ratio(X)	0.61	0.00	0.09	0.17	0.30		0.71	0.92	0.02	0.74	0.58	0.58
Avail Cap(c_a), veh/h	439	0	360	434	785		289	658	558	2760	2021	2062
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	30.3	0.0	27.4	24.4	21.9	0.0	34.6	23.6	16.4	29.5	15.3	15.3
Incr Delay (d2), s/veh	1.9	0.0	0.2	0.4	0.3	0.0	10.2	17.8	0.0	1.9	0.7	0.7
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.2	0.0	0.3	0.5	2.0	0.0	1.3	12.1	0.1	3.5	5.4	5.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	32.2	0.0	27.6	24.8	22.2	0.0	44.8	41.4	16.5	31.5	15.9	15.9
LnGrp LOS	C		C	C	C		D	D	B	C	B	B
Approach Vol, veh/h		204			184			649			1338	
Approach Delay, s/veh		31.7			22.7			41.3			20.7	
Approach LOS		C			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	17.8	30.8	8.6	16.7	9.6	39.0		25.3
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	59.0	26.0	12.0	17.0	12.0	84.0		31.0
Max Q Clear Time (g_c+I1), s	10.3	23.9	3.2	9.8	4.5	16.3		6.7
Green Ext Time (p_c), s	1.5	0.8	0.0	0.6	0.1	7.6		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	27.4
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	16	7	10	5	12	234	0	19	1	109	248	9
Future Volume (veh/h)	16	7	10	5	12	234	0	19	1	109	248	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.97	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	17	8	2	5	13	57	0	21	1	118	270	9
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	373	135	299	201	311	304	449	327	274	668	819	27
Arrive On Green	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.17	0.17	0.11	0.45	0.45
Sat Flow, veh/h	823	686	1517	210	1579	1544	1781	1870	1571	1781	1799	60
Grp Volume(v), veh/h	25	0	2	18	0	57	0	21	1	118	0	279
Grp Sat Flow(s),veh/h/ln	1509	0	1517	1789	0	1544	1781	1870	1571	1781	0	1859
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.3	0.0	1.3	0.0	2.8
Cycle Q Clear(g_c), s	0.3	0.0	0.0	0.2	0.0	0.9	0.0	0.3	0.0	1.3	0.0	2.8
Prop In Lane	0.68		1.00	0.28		1.00	1.00		1.00	1.00		0.03
Lane Grp Cap(c), veh/h	508	0	299	512	0	304	449	327	274	668	0	846
V/C Ratio(X)	0.05	0.00	0.01	0.04	0.00	0.19	0.00	0.06	0.00	0.18	0.00	0.33
Avail Cap(c_a), veh/h	2983	0	2904	3413	0	2957	753	3582	3009	789	0	3561
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.4	0.0	9.3	9.4	0.0	9.6	0.0	9.9	9.8	6.6	0.0	5.0
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1	0.0	0.1	0.0	0.2
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.3	0.0	0.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.4	0.0	9.3	9.4	0.0	9.9	0.0	10.0	9.8	6.7	0.0	5.2
LnGrp LOS	A		A	A		A		A	A	A		A
Approach Vol, veh/h		27			75			22			397	
Approach Delay, s/veh		9.4			9.8			10.0			5.7	
Approach LOS		A			A			A			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.0	10.0		10.7	0.0	18.1		10.7				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.3	2.3		2.3	0.0	4.8		2.9				
Green Ext Time (p_c), s	0.0	0.1		0.1	0.0	1.8		0.3				

Intersection Summary	
HCM 7th Control Delay, s/veh	6.6
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	11	97	40	11	76	230	1218	36	47	636	9
Future Volume (veh/h)	5	11	97	40	11	76	230	1218	36	47	636	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		0.99	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	5	12	7	43	12	8	250	1324	26	51	691	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	44	39	19	118	18	76	281	1422	1205	66	1197	1014
Arrive On Green	0.05	0.05	0.05	0.05	0.05	0.05	0.16	0.76	0.76	0.04	0.64	0.64
Sat Flow, veh/h	129	818	390	1306	364	1575	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	24	0	0	55	0	8	250	1324	26	51	691	6
Grp Sat Flow(s),veh/h/ln	1337	0	0	1670	0	1575	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.6	16.0	67.8	0.5	3.3	24.6	0.2
Cycle Q Clear(g_c), s	3.5	0.0	0.0	3.5	0.0	0.6	16.0	67.8	0.5	3.3	24.6	0.2
Prop In Lane	0.21		0.29	0.78		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	102	0	0	135	0	76	281	1422	1205	66	1197	1014
V/C Ratio(X)	0.24	0.00	0.00	0.41	0.00	0.11	0.89	0.93	0.02	0.77	0.58	0.01
Avail Cap(c_a), veh/h	263	0	0	279	0	230	366	1667	1413	305	1603	1359
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	53.6	0.0	0.0	54.5	0.0	53.1	48.1	11.5	3.4	55.7	12.0	7.6
Incr Delay (d2), s/veh	1.2	0.0	0.0	1.9	0.0	0.6	18.8	9.0	0.0	16.7	0.4	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	0.0	0.0	1.7	0.0	0.2	8.6	25.7	0.1	1.8	9.8	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	54.8	0.0	0.0	56.5	0.0	53.7	66.9	20.5	3.4	72.4	12.4	7.6
LnGrp LOS	D			E		D	E	C	A	E	B	A
Approach Vol, veh/h		24			63			1600			748	
Approach Delay, s/veh		54.8			56.1			27.4			16.5	
Approach LOS		D			E			C			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	10.4	94.7		11.6	24.4	80.6		11.6
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	20.0	104.0		17.0	24.0	100.0		17.0
Max Q Clear Time (g_c+I1), s	5.5	69.8		5.5	18.0	26.6		5.5
Green Ext Time (p_c), s	0.1	18.9		0.0	0.4	5.9		0.1

Intersection Summary	
HCM 7th Control Delay, s/veh	25.1
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	207	0	1501	812	1
Future Vol, veh/h	0	207	0	1501	812	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	225	0	1632	883	1

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Base Year 2058 PM

Intersection	
Int Delay, s/veh	6.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	23	130	97	612	574	32
Future Vol, veh/h	23	130	97	612	574	32
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	25	141	105	665	624	35

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1618	783	760	0	-	0
Stage 1	742	-	-	-	-	-
Stage 2	876	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	114	394	852	-	-	-
Stage 1	471	-	-	-	-	-
Stage 2	407	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	80	342	770	-	-	-
Mov Cap-2 Maneuver	80	-	-	-	-	-
Stage 1	367	-	-	-	-	-
Stage 2	368	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	53.47	1.42	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	770	-	229	-	-
HCM Lane V/C Ratio	0.137	-	0.725	-	-
HCM Control Delay (s/veh)	10.4	-	53.5	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	0.5	-	4.9	-	-

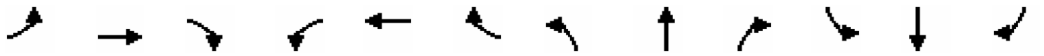
Intersection	
Int Delay, s/veh	2.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	51	71	645	51	53	663
Future Vol, veh/h	51	71	645	51	53	663
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	55	77	701	55	58	721

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1213	733	0	0	761	0
Stage 1	733	-	-	-	-	-
Stage 2	481	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	187	420	-	-	849	-
Stage 1	474	-	-	-	-	-
Stage 2	589	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	173	418	-	-	846	-
Mov Cap-2 Maneuver	173	-	-	-	-	-
Stage 1	473	-	-	-	-	-
Stage 2	546	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	23.84	0	0.71
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	173	418	846	-
HCM Lane V/C Ratio	-	-	0.321	0.185	0.068	-
HCM Control Delay (s/veh)	-	-	35.4	15.5	9.6	-
HCM Lane LOS	-	-	E	C	A	-
HCM 95th %tile Q(veh)	-	-	1.3	0.7	0.2	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	149	1	533	9	2	6	485	1134	0	1	1093	174
Future Volume (veh/h)	149	1	533	9	2	6	485	1134	0	1	1093	174
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	162	1	0	10	2	2	527	1233	0	1	1188	106
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	191	1		19	4	4	559	2506	0	2	1394	620
Arrive On Green	0.11	0.11	0.00	0.01	0.01	0.01	0.31	0.71	0.00	0.00	0.39	0.39
Sat Flow, veh/h	1771	11	1585	1259	252	252	1781	3647	0	1781	3554	1581
Grp Volume(v), veh/h	163	0	0	14	0	0	527	1233	0	1	1188	106
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1762	0	0	1781	1777	0	1781	1777	1581
Q Serve(g_s), s	12.6	0.0	0.0	1.1	0.0	0.0	40.5	22.0	0.0	0.1	42.9	6.1
Cycle Q Clear(g_c), s	12.6	0.0	0.0	1.1	0.0	0.0	40.5	22.0	0.0	0.1	42.9	6.1
Prop In Lane	0.99		1.00	0.71		0.14	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	192	0		26	0	0	559	2506	0	2	1394	620
V/C Ratio(X)	0.85	0.00		0.53	0.00	0.00	0.94	0.49	0.00	0.41	0.85	0.17
Avail Cap(c_a), veh/h	305	0		113	0	0	748	2632	0	114	1746	777
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	61.5	0.0	0.0	68.7	0.0	0.0	46.9	9.4	0.0	70.1	38.9	27.8
Incr Delay (d2), s/veh	12.2	0.0	0.0	15.5	0.0	0.0	17.0	0.2	0.0	85.0	3.5	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.4	0.0	0.0	0.6	0.0	0.0	20.5	8.2	0.0	0.1	19.3	2.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	73.7	0.0	0.0	84.2	0.0	0.0	63.9	9.5	0.0	155.1	42.5	27.9
LnGrp LOS	E			F			E	A		F	D	C
Approach Vol, veh/h		163			14			1760			1295	
Approach Delay, s/veh		73.7			84.2			25.8			41.4	
Approach LOS		E			F			C			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.2	105.0		8.1	50.1	61.1		21.1				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	104.0		9.0	59.0	69.0		24.0				
Max Q Clear Time (g_c+I1), s	2.1	24.0		3.1	42.5	44.9		14.6				
Green Ext Time (p_c), s	0.0	13.7		0.0	1.6	10.3		0.5				

Intersection Summary		
HCM 7th Control Delay, s/veh	34.7	
HCM 7th LOS	C	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	90	125	124	26	132	469	54	571	27	467	795	89
Future Volume (veh/h)	90	125	124	26	132	469	54	571	27	467	795	89
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	98	136	37	28	143	0	59	621	8	508	864	90
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	166	177	289	176	516		76	656	556	631	1594	166
Arrive On Green	0.18	0.18	0.18	0.03	0.28	0.00	0.04	0.35	0.35	0.18	0.49	0.49
Sat Flow, veh/h	607	958	1568	1781	1870	1585	1781	1870	1585	3456	3247	338
Grp Volume(v), veh/h	234	0	37	28	143	0	59	621	8	508	473	481
Grp Sat Flow(s),veh/h/ln	1566	0	1568	1781	1870	1585	1781	1870	1585	1728	1777	1808
Q Serve(g_s), s	12.4	0.0	1.9	1.2	5.7	0.0	3.1	30.5	0.3	13.3	17.4	17.4
Cycle Q Clear(g_c), s	13.5	0.0	1.9	1.2	5.7	0.0	3.1	30.5	0.3	13.3	17.4	17.4
Prop In Lane	0.42		1.00	1.00		1.00	1.00		1.00	1.00		0.19
Lane Grp Cap(c), veh/h	343	0	289	176	516		76	656	556	631	872	887
V/C Ratio(X)	0.68	0.00	0.13	0.16	0.28		0.78	0.95	0.01	0.80	0.54	0.54
Avail Cap(c_a), veh/h	549	0	498	391	951		170	674	571	2160	1111	1130
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	36.8	0.0	32.1	29.5	26.8	0.0	44.7	29.8	20.0	36.9	16.7	16.7
Incr Delay (d2), s/veh	2.4	0.0	0.2	0.4	0.3	0.0	15.3	22.1	0.0	2.5	0.5	0.5
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.3	0.0	0.7	0.5	2.5	0.0	1.7	17.2	0.1	5.7	6.9	7.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	39.2	0.0	32.3	29.9	27.1	0.0	60.0	51.9	20.0	39.4	17.2	17.2
LnGrp LOS	D		C	C	C		E	D	B	D	B	B
Approach Vol, veh/h		271			171			688			1462	
Approach Delay, s/veh		38.2			27.6			52.2			24.9	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	13.2	39.1	8.6	23.4	10.0	52.3		32.0
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	5.9.6	34.0	14.0	30.0	9.0	59.0		48.0
Max Q Clear Time (g_c+I1), s	15.3	32.5	3.2	15.5	5.1	19.4		7.7
Green Ext Time (p_c), s	2.0	0.7	0.0	1.3	0.0	7.6		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	33.7
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	30	13	10	19	26	224	1	36	2	117	493	17
Future Volume (veh/h)	30	13	10	19	26	224	1	36	2	117	493	17
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.97	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	33	14	1	21	28	47	1	39	1	127	536	17
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	334	115	296	226	237	301	331	591	498	771	741	24
Arrive On Green	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.32	0.32	0.10	0.41	0.41
Sat Flow, veh/h	888	587	1516	471	1214	1544	1781	1870	1578	1781	1803	57
Grp Volume(v), veh/h	47	0	1	49	0	47	1	39	1	127	0	553
Grp Sat Flow(s),veh/h/ln	1476	0	1516	1685	0	1544	1781	1870	1578	1781	0	1860
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.6	0.0	1.7	0.0	9.5
Cycle Q Clear(g_c), s	0.8	0.0	0.0	0.8	0.0	1.0	0.0	0.6	0.0	1.7	0.0	9.5
Prop In Lane	0.70		1.00	0.43		1.00	1.00		1.00	1.00		0.03
Lane Grp Cap(c), veh/h	448	0	296	463	0	301	331	591	498	771	0	765
V/C Ratio(X)	0.10	0.00	0.00	0.11	0.00	0.16	0.00	0.07	0.00	0.16	0.00	0.72
Avail Cap(c_a), veh/h	2220	0	2180	2452	0	2220	560	2690	2269	831	0	2675
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	12.7	0.0	12.4	12.7	0.0	12.8	9.4	9.1	9.0	6.7	0.0	9.4
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.1	0.0	1.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.0	0.3	0.0	0.3	0.0	0.2	0.0	0.4	0.0	2.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	12.8	0.0	12.4	12.8	0.0	13.0	9.4	9.2	9.0	6.8	0.0	10.7
LnGrp LOS	B		B	B		B	A	A	A	A		B
Approach Vol, veh/h		48			96			41			680	
Approach Delay, s/veh		12.8			12.9			9.2			10.0	
Approach LOS		B			B			A			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.7	17.1		12.5	5.1	20.7		12.5				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.6	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.7	2.6		2.8	2.0	11.5		3.0				
Green Ext Time (p_c), s	0.0	0.2		0.3	0.0	4.2		0.4				

Intersection Summary		
HCM 7th Control Delay, s/veh	10.5	
HCM 7th LOS	B	



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	6	19	102	37	9	57	232	1089	34	45	974	27
Future Volume (veh/h)	6	19	102	37	9	57	232	1089	34	45	974	27
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		0.99	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	7	21	18	40	10	5	252	1184	24	49	1059	15
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	44	42	31	128	20	85	285	1399	1186	63	1166	988
Arrive On Green	0.05	0.05	0.05	0.05	0.05	0.05	0.16	0.75	0.75	0.04	0.62	0.62
Sat Flow, veh/h	125	783	584	1287	366	1576	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	46	0	0	50	0	5	252	1184	24	49	1059	15
Grp Sat Flow(s),veh/h/ln	1492	0	0	1653	0	1576	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.6	0.0	0.0	0.0	0.0	0.3	15.3	48.1	0.4	3.0	54.4	0.4
Cycle Q Clear(g_c), s	3.6	0.0	0.0	3.0	0.0	0.3	15.3	48.1	0.4	3.0	54.4	0.4
Prop In Lane	0.15		0.39	0.80		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	118	0	0	147	0	85	285	1399	1186	63	1166	988
V/C Ratio(X)	0.39	0.00	0.00	0.34	0.00	0.06	0.88	0.85	0.02	0.78	0.91	0.02
Avail Cap(c_a), veh/h	343	0	0	343	0	299	386	1926	1632	161	1689	1432
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	51.0	0.0	0.0	51.0	0.0	49.7	45.5	9.6	3.6	53.0	18.1	7.9
Incr Delay (d2), s/veh	2.1	0.0	0.0	1.3	0.0	0.3	16.6	2.7	0.0	18.0	5.6	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.3	0.0	0.0	1.4	0.0	0.1	8.0	16.7	0.1	1.7	23.0	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	53.2	0.0	0.0	52.3	0.0	50.0	62.1	12.3	3.6	70.9	23.7	7.9
LnGrp LOS	D			D		D	E	B	A	E	C	A
Approach Vol, veh/h		46			55			1460			1123	
Approach Delay, s/veh		53.2			52.1			20.7			25.5	
Approach LOS		D			D			C			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	9.9	88.8		12.0	23.7	75.0		12.0
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0
Max Q Clear Time (g_c+I1), s	5.6	50.1		5.6	17.3	56.4		5.0
Green Ext Time (p_c), s	0.0	18.1		0.1	0.4	12.6		0.2

Intersection Summary	
HCM 7th Control Delay, s/veh	23.9
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	410	0	1408	1237	5
Future Vol, veh/h	0	410	0	1408	1237	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	446	0	1530	1345	5

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Base Year 2058 SAT

Intersection	
Int Delay, s/veh	2.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	19	72	77	546	529	17
Future Vol, veh/h	19	72	77	546	529	17
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	21	78	84	593	575	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1446	726	694	0	-	0
Stage 1	685	-	-	-	-	-
Stage 2	761	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	145	424	901	-	-	-
Stage 1	500	-	-	-	-	-
Stage 2	461	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	106	369	814	-	-	-
Mov Cap-2 Maneuver	106	-	-	-	-	-
Stage 1	406	-	-	-	-	-
Stage 2	417	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	29.59	1.23	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	814	-	243	-	-
HCM Lane V/C Ratio	0.103	-	0.407	-	-
HCM Control Delay (s/veh)	9.9	-	29.6	-	-
HCM Lane LOS	A	-	D	-	-
HCM 95th %tile Q(veh)	0.3	-	1.9	-	-

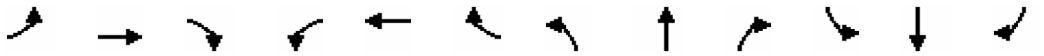
Intersection	
Int Delay, s/veh	1.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	53	62	559	43	35	587
Future Vol, veh/h	53	62	559	43	35	587
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	58	67	608	47	38	638

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1035	635	0	0	658	0
Stage 1	635	-	-	-	-	-
Stage 2	400	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	242	478	-	-	927	-
Stage 1	527	-	-	-	-	-
Stage 2	647	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	230	476	-	-	924	-
Mov Cap-2 Maneuver	230	-	-	-	-	-
Stage 1	525	-	-	-	-	-
Stage 2	617	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	19.35	0	0.51
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	230	476	924	-
HCM Lane V/C Ratio	-	-	0.251	0.142	0.041	-
HCM Control Delay (s/veh)	-	-	25.8	13.8	9.1	-
HCM Lane LOS	-	-	D	B	A	-
HCM 95th %tile Q(veh)	-	-	1	0.5	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	144	2	426	2	2	0	395	1017	2	0	977	155
Future Volume (veh/h)	144	2	426	2	2	0	395	1017	2	0	977	155
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	157	2	0	2	2	0	429	1105	2	0	1062	52
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	191	2		5	5	0	476	2551	5	2	1323	589
Arrive On Green	0.11	0.11	0.00	0.01	0.01	0.00	0.27	0.70	0.70	0.00	0.37	0.37
Sat Flow, veh/h	1760	22	1585	912	912	0	1781	3639	7	1781	3554	1581
Grp Volume(v), veh/h	159	0	0	4	0	0	429	539	568	0	1062	52
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1825	0	0	1781	1777	1869	1781	1777	1581
Q Serve(g_s), s	8.5	0.0	0.0	0.2	0.0	0.0	22.6	12.7	12.7	0.0	26.0	2.1
Cycle Q Clear(g_c), s	8.5	0.0	0.0	0.2	0.0	0.0	22.6	12.7	12.7	0.0	26.0	2.1
Prop In Lane	0.99		1.00	0.50		0.00	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	194	0		10	0	0	476	1246	1310	2	1323	589
V/C Ratio(X)	0.82	0.00		0.42	0.00	0.00	0.90	0.43	0.43	0.00	0.80	0.09
Avail Cap(c_a), veh/h	256	0		94	0	0	897	1351	1421	165	1789	796
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	42.4	0.0	0.0	48.3	0.0	0.0	34.4	6.2	6.2	0.0	27.3	19.8
Incr Delay (d2), s/veh	14.5	0.0	0.0	26.2	0.0	0.0	6.5	0.2	0.2	0.0	2.0	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.5	0.0	0.0	0.2	0.0	0.0	10.4	4.1	4.3	0.0	11.0	0.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	57.0	0.0	0.0	74.5	0.0	0.0	41.0	6.5	6.5	0.0	29.3	19.9
LnGrp LOS	E			E			D	A	A		C	B
Approach Vol, veh/h		159			4			1536			1114	
Approach Delay, s/veh		57.0			74.5			16.1			28.9	
Approach LOS		E			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	0.0	74.2		6.5	32.0	42.3		16.6				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	74.0		5.0	49.0	49.0		14.0				
Max Q Clear Time (g_c+I1), s	0.0	14.7		2.2	24.6	28.0		10.5				
Green Ext Time (p_c), s	0.0	9.8		0.0	1.4	8.2		0.2				

Intersection Summary		
HCM 7th Control Delay, s/veh		23.6
HCM 7th LOS		C

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	126	189	170	82	169	435	101	578	35	319	824	157
Future Volume (veh/h)	126	189	170	82	169	435	101	578	35	319	824	157
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	137	205	75	89	184	0	110	628	11	347	896	160
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	196	231	391	192	662		138	670	568	437	1226	219
Arrive On Green	0.25	0.25	0.25	0.05	0.35	0.00	0.08	0.36	0.36	0.13	0.41	0.41
Sat Flow, veh/h	605	927	1572	1781	1870	1585	1781	1870	1585	3456	3010	537
Grp Volume(v), veh/h	342	0	75	89	184	0	110	628	11	347	529	527
Grp Sat Flow(s),veh/h/ln	1532	0	1572	1781	1870	1585	1781	1870	1585	1728	1777	1771
Q Serve(g_s), s	23.8	0.0	4.2	4.0	7.9	0.0	6.8	36.2	0.5	10.9	28.1	28.1
Cycle Q Clear(g_c), s	24.1	0.0	4.2	4.0	7.9	0.0	6.8	36.2	0.5	10.9	28.1	28.1
Prop In Lane	0.40		1.00	1.00		1.00	1.00		1.00	1.00		0.30
Lane Grp Cap(c), veh/h	426	0	391	192	662		138	670	568	437	724	721
V/C Ratio(X)	0.80	0.00	0.19	0.46	0.28		0.80	0.94	0.02	0.79	0.73	0.73
Avail Cap(c_a), veh/h	498	0	465	356	837		319	720	610	1207	986	983
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	40.5	0.0	33.1	30.6	25.8	0.0	50.6	34.6	23.1	47.4	27.9	27.9
Incr Delay (d2), s/veh	8.0	0.0	0.2	1.7	0.2	0.0	9.9	19.1	0.0	3.3	1.8	1.8
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	9.9	0.0	1.6	1.8	3.5	0.0	3.4	19.6	0.2	4.9	12.0	12.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	48.5	0.0	33.3	32.4	26.1	0.0	60.5	53.7	23.2	50.7	29.7	29.8
LnGrp LOS	D		C	C	C		E	D	C	D	C	C
Approach Vol, veh/h		417			273			749			1403	
Approach Delay, s/veh		45.8			28.1			54.2			34.9	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	20.1	46.0	11.7	33.8	14.7	51.5		45.5
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	39.0	43.0	16.0	33.0	20.0	62.0		50.0
Max Q Clear Time (g_c+I1), s	12.9	38.2	6.0	26.1	8.8	30.1		9.9
Green Ext Time (p_c), s	1.2	1.8	0.1	1.4	0.2	8.5		1.1

Intersection Summary	
HCM 7th Control Delay, s/veh	41.0
HCM 7th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	28	16	8	6	26	259	0	25	3	116	301	14
Future Volume (veh/h)	28	16	8	6	26	259	0	25	3	116	301	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.98	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	30	17	1	7	28	68	0	27	1	126	327	14
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	361	161	328	175	360	333	429	328	276	658	802	34
Arrive On Green	0.22	0.22	0.22	0.22	0.22	0.22	0.00	0.18	0.18	0.11	0.45	0.45
Sat Flow, veh/h	764	749	1523	145	1668	1548	1781	1870	1571	1781	1780	76
Grp Volume(v), veh/h	47	0	1	35	0	68	0	27	1	126	0	341
Grp Sat Flow(s),veh/h/ln	1513	0	1523	1813	0	1548	1781	1870	1571	1781	0	1856
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.4	0.0	1.5	0.0	3.7
Cycle Q Clear(g_c), s	0.6	0.0	0.0	0.4	0.0	1.1	0.0	0.4	0.0	1.5	0.0	3.7
Prop In Lane	0.64		1.00	0.20		1.00	1.00		1.00	1.00		0.04
Lane Grp Cap(c), veh/h	523	0	328	535	0	333	429	328	276	658	0	837
V/C Ratio(X)	0.09	0.00	0.00	0.07	0.00	0.20	0.00	0.08	0.00	0.19	0.00	0.41
Avail Cap(c_a), veh/h	2856	0	2796	3346	0	2842	720	3434	2886	762	0	3409
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.5	0.0	9.2	9.4	0.0	9.6	0.0	10.3	10.2	6.9	0.0	5.5
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.3	0.0	0.1	0.0	0.1	0.0	0.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	0.0	0.0	0.1	0.0	0.3	0.0	0.1	0.0	0.4	0.0	0.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.5	0.0	9.2	9.4	0.0	9.9	0.0	10.4	10.2	7.0	0.0	5.9
LnGrp LOS	A		A	A		A		B	B	A		A
Approach Vol, veh/h		48			103			28			467	
Approach Delay, s/veh		9.5			9.8			10.4			6.2	
Approach LOS		A			A			B			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.2	10.3		11.5	0.0	18.5		11.5				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.5	2.4		2.6	0.0	5.7		3.1				
Green Ext Time (p_c), s	0.0	0.1		0.3	0.0	2.3		0.4				

Intersection Summary	
HCM 7th Control Delay, s/veh	7.2
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	14	113	26	11	45	260	1047	32	46	623	17
Future Volume (veh/h)	15	14	113	26	11	45	260	1047	32	46	623	17
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	16	15	31	28	12	6	283	1138	22	50	677	8
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	69	32	50	134	45	102	326	1291	1094	71	1024	868
Arrive On Green	0.06	0.06	0.06	0.06	0.06	0.06	0.18	0.69	0.69	0.04	0.55	0.55
Sat Flow, veh/h	277	491	767	991	696	1578	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	62	0	0	40	0	6	283	1138	22	50	677	8
Grp Sat Flow(s),veh/h/ln	1534	0	0	1687	0	1578	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	1.7	0.0	0.0	0.0	0.0	0.3	13.6	42.3	0.4	2.4	22.6	0.2
Cycle Q Clear(g_c), s	3.5	0.0	0.0	1.8	0.0	0.3	13.6	42.3	0.4	2.4	22.6	0.2
Prop In Lane	0.26		0.50	0.70		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	151	0	0	179	0	102	326	1291	1094	71	1024	868
V/C Ratio(X)	0.41	0.00	0.00	0.22	0.00	0.06	0.87	0.88	0.02	0.70	0.66	0.01
Avail Cap(c_a), veh/h	426	0	0	435	0	376	486	2423	2053	202	2125	1801
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	40.1	0.0	0.0	39.3	0.0	38.6	34.9	10.8	4.3	41.7	14.1	9.1
Incr Delay (d2), s/veh	1.8	0.0	0.0	0.6	0.0	0.2	10.6	2.1	0.0	11.7	0.7	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.4	0.0	0.0	0.8	0.0	0.1	6.7	14.4	0.1	1.3	8.9	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	41.9	0.0	0.0	40.0	0.0	38.9	45.5	12.9	4.3	53.4	14.9	9.1
LnGrp LOS	D			D		D	D	B	A	D	B	A
Approach Vol, veh/h		62			46			1443			735	
Approach Delay, s/veh		41.9			39.8			19.2			17.4	
Approach LOS		D			D			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	9.5	66.8		11.7	22.1	54.2		11.7
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0
Max Q Clear Time (g_c+I1), s	4.4	44.3		5.5	15.6	24.6		3.8
Green Ext Time (p_c), s	0.0	16.4		0.2	0.5	5.8		0.1

Intersection Summary	
HCM 7th Control Delay, s/veh	19.6
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	253	0	1472	828	3
Future Vol, veh/h	0	253	0	1472	828	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	275	0	1600	900	3

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Base Year 2068 AM

Intersection	
Int Delay, s/veh	3.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	17	95	72	390	655	17
Future Vol, veh/h	17	95	72	390	655	17
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	18	103	78	424	712	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1403	863	831	0	-	0
Stage 1	822	-	-	-	-	-
Stage 2	580	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	154	354	801	-	-	-
Stage 1	432	-	-	-	-	-
Stage 2	560	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	112	308	724	-	-	-
Mov Cap-2 Maneuver	112	-	-	-	-	-
Stage 1	348	-	-	-	-	-
Stage 2	506	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	33.75	1.65	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	724	-	243	-	-
HCM Lane V/C Ratio	0.108	-	0.5	-	-
HCM Control Delay (s/veh)	10.6	-	33.7	-	-
HCM Lane LOS	B	-	D	-	-
HCM 95th %tile Q(veh)	0.4	-	2.6	-	-

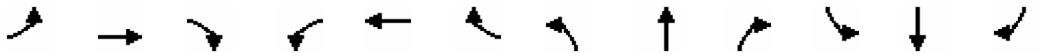
Intersection	
Int Delay, s/veh	1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	24	36	437	23	45	721
Future Vol, veh/h	24	36	437	23	45	721
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	26	39	475	25	49	784

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	986	492	0	0	504	0
Stage 1	492	-	-	-	-	-
Stage 2	495	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	259	576	-	-	1059	-
Stage 1	614	-	-	-	-	-
Stage 2	579	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	245	574	-	-	1055	-
Mov Cap-2 Maneuver	245	-	-	-	-	-
Stage 1	612	-	-	-	-	-
Stage 2	550	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	15.61	0	0.5
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	245	574	1055	-
HCM Lane V/C Ratio	-	-	0.106	0.068	0.046	-
HCM Control Delay (s/veh)	-	-	21.4	11.7	8.6	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.4	0.2	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	157	1	469	2	5	0	275	765	5	6	1045	151
Future Volume (veh/h)	157	1	469	2	5	0	275	765	5	6	1045	151
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	171	1	0	2	5	0	299	832	5	7	1136	86
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	208	1		5	12	0	345	2197	13	16	1499	667
Arrive On Green	0.12	0.12	0.00	0.01	0.01	0.00	0.19	0.61	0.61	0.01	0.42	0.42
Sat Flow, veh/h	1771	10	1585	527	1317	0	1781	3622	22	1781	3554	1581
Grp Volume(v), veh/h	172	0	0	7	0	0	299	408	429	7	1136	86
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1844	0	0	1781	1777	1866	1781	1777	1581
Q Serve(g_s), s	8.8	0.0	0.0	0.4	0.0	0.0	15.1	10.9	10.9	0.4	25.3	3.1
Cycle Q Clear(g_c), s	8.8	0.0	0.0	0.4	0.0	0.0	15.1	10.9	10.9	0.4	25.3	3.1
Prop In Lane	0.99		1.00	0.29		0.00	1.00		0.01	1.00		1.00
Lane Grp Cap(c), veh/h	210	0		16	0	0	345	1078	1132	16	1499	667
V/C Ratio(X)	0.82	0.00		0.43	0.00	0.00	0.87	0.38	0.38	0.44	0.76	0.13
Avail Cap(c_a), veh/h	287	0		178	0	0	843	2464	2588	172	3018	1343
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	40.1	0.0	0.0	45.9	0.0	0.0	36.3	9.3	9.3	45.9	22.9	16.4
Incr Delay (d2), s/veh	12.6	0.0	0.0	16.6	0.0	0.0	6.6	0.2	0.2	18.1	0.8	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.5	0.0	0.0	0.2	0.0	0.0	7.1	3.9	4.1	0.2	10.2	1.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	52.6	0.0	0.0	62.5	0.0	0.0	42.9	9.6	9.6	64.0	23.7	16.5
LnGrp LOS	D			E			D	A	A	E	C	B
Approach Vol, veh/h		172			7			1136			1229	
Approach Delay, s/veh		52.6			62.5			18.3			23.4	
Approach LOS		D			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.8	62.4		6.8	24.0	45.2		16.9				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	129.0		9.0	44.0	79.0		15.0				
Max Q Clear Time (g_c+I1), s	2.4	12.9		2.4	17.1	27.3		10.8				
Green Ext Time (p_c), s	0.0	6.4		0.0	0.9	12.0		0.3				

Intersection Summary		
HCM 7th Control Delay, s/veh	23.2	
HCM 7th LOS	C	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	57	111	62	33	136	426	56	554	36	390	816	80
Future Volume (veh/h)	57	111	62	33	136	426	56	554	36	390	816	80
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	62	121	21	36	148	0	61	602	11	424	887	80
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	129	170	224	203	482		85	637	540	568	1507	136
Arrive On Green	0.14	0.14	0.14	0.04	0.26	0.00	0.05	0.34	0.34	0.16	0.46	0.46
Sat Flow, veh/h	454	1185	1563	1781	1870	1585	1781	1870	1585	3456	3295	297
Grp Volume(v), veh/h	183	0	21	36	148	0	61	602	11	424	478	489
Grp Sat Flow(s),veh/h/ln	1639	0	1563	1781	1870	1585	1781	1870	1585	1728	1777	1815
Q Serve(g_s), s	6.3	0.0	0.9	1.2	4.8	0.0	2.6	23.7	0.3	8.9	15.2	15.2
Cycle Q Clear(g_c), s	8.1	0.0	0.9	1.2	4.8	0.0	2.6	23.7	0.3	8.9	15.2	15.2
Prop In Lane	0.34		1.00	1.00		1.00	1.00		1.00	1.00		0.16
Lane Grp Cap(c), veh/h	299	0	224	203	482		85	637	540	568	813	830
V/C Ratio(X)	0.61	0.00	0.09	0.18	0.31		0.72	0.94	0.02	0.75	0.59	0.59
Avail Cap(c_a), veh/h	427	0	350	423	764		282	641	543	2687	1967	2009
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	31.2	0.0	28.2	25.2	22.7	0.0	35.6	24.3	16.6	30.2	15.3	15.3
Incr Delay (d2), s/veh	2.0	0.0	0.2	0.4	0.4	0.0	10.8	22.8	0.0	2.0	0.7	0.7
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.3	0.0	0.3	0.5	2.1	0.0	1.3	13.8	0.1	3.7	5.7	5.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	33.2	0.0	28.4	25.6	23.1	0.0	46.4	47.1	16.6	32.2	16.0	16.0
LnGrp LOS	C		C	C	C		D	D	B	C	B	B
Approach Vol, veh/h		204			184			674			1391	
Approach Delay, s/veh		32.7			23.6			46.5			20.9	
Approach LOS		C			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	18.5	31.9	8.7	16.9	9.6	40.7		25.6
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	59.0	26.0	12.0	17.0	12.0	84.0		31.0
Max Q Clear Time (g_c+I1), s	10.9	25.7	3.2	10.1	4.6	17.2		6.8
Green Ext Time (p_c), s	1.6	0.1	0.0	0.6	0.1	8.0		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	29.1
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	16	7	10	5	12	234	0	20	1	109	258	9
Future Volume (veh/h)	16	7	10	5	12	234	0	20	1	109	258	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.97	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	17	8	2	5	13	57	0	22	1	118	280	9
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	372	135	298	201	311	304	448	329	276	668	821	26
Arrive On Green	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.18	0.18	0.11	0.46	0.46
Sat Flow, veh/h	823	686	1517	210	1579	1544	1781	1870	1572	1781	1802	58
Grp Volume(v), veh/h	25	0	2	18	0	57	0	22	1	118	0	289
Grp Sat Flow(s),veh/h/ln	1509	0	1517	1789	0	1544	1781	1870	1572	1781	0	1860
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.3	0.0	1.3	0.0	2.9
Cycle Q Clear(g_c), s	0.3	0.0	0.0	0.2	0.0	0.9	0.0	0.3	0.0	1.3	0.0	2.9
Prop In Lane	0.68		1.00	0.28		1.00	1.00		1.00	1.00		0.03
Lane Grp Cap(c), veh/h	507	0	298	512	0	304	448	329	276	668	0	847
V/C Ratio(X)	0.05	0.00	0.01	0.04	0.00	0.19	0.00	0.07	0.00	0.18	0.00	0.34
Avail Cap(c_a), veh/h	2978	0	2899	3407	0	2952	751	3576	3004	789	0	3555
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.4	0.0	9.3	9.4	0.0	9.6	0.0	9.9	9.8	6.6	0.0	5.0
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1	0.0	0.1	0.0	0.2
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.3	0.0	0.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.4	0.0	9.3	9.4	0.0	9.9	0.0	10.0	9.8	6.7	0.0	5.3
LnGrp LOS	A		A	A		A		A	A	A		A
Approach Vol, veh/h		27			75			23			407	
Approach Delay, s/veh		9.4			9.8			10.0			5.7	
Approach LOS		A			A			A			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.1	10.1		10.7	0.0	18.1		10.7				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.3	2.3		2.3	0.0	4.9		2.9				
Green Ext Time (p_c), s	0.0	0.1		0.1	0.0	1.9		0.3				

Intersection Summary	
HCM 7th Control Delay, s/veh	6.6
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	11	97	40	11	76	230	1284	36	47	670	9
Future Volume (veh/h)	5	11	97	40	11	76	230	1284	36	47	670	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		0.99	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	5	12	7	43	12	8	250	1396	26	51	728	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	39	41	19	111	17	77	277	1448	1227	66	1227	1040
Arrive On Green	0.05	0.05	0.05	0.05	0.05	0.05	0.16	0.77	0.77	0.04	0.66	0.66
Sat Flow, veh/h	118	825	388	1253	350	1575	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	24	0	0	55	0	8	250	1396	26	51	728	6
Grp Sat Flow(s),veh/h/ln	1332	0	0	1603	0	1575	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.6	17.8	85.8	0.5	3.7	28.3	0.2
Cycle Q Clear(g_c), s	4.2	0.0	0.0	4.2	0.0	0.6	17.8	85.8	0.5	3.7	28.3	0.2
Prop In Lane	0.21		0.29	0.78		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	99	0	0	128	0	77	277	1448	1227	66	1227	1040
V/C Ratio(X)	0.24	0.00	0.00	0.43	0.00	0.10	0.90	0.96	0.02	0.77	0.59	0.01
Avail Cap(c_a), veh/h	236	0	0	249	0	207	331	1506	1276	276	1448	1227
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	59.2	0.0	0.0	60.4	0.0	58.7	53.6	13.0	3.3	61.6	12.5	7.7
Incr Delay (d2), s/veh	1.2	0.0	0.0	2.2	0.0	0.6	24.0	15.2	0.0	16.7	0.5	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.8	0.0	0.0	1.9	0.0	0.3	9.8	34.9	0.1	2.0	11.4	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	60.5	0.0	0.0	62.6	0.0	59.3	77.6	28.2	3.4	78.4	13.0	7.7
LnGrp LOS	E			E		E	E	C	A	E	B	A
Approach Vol, veh/h		24			63			1672			785	
Approach Delay, s/veh		60.5			62.2			35.2			17.2	
Approach LOS		E			E			D			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	10.8	106.0		12.3	26.1	90.7		12.3				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	20.0	104.0		17.0	24.0	100.0		17.0				
Max Q Clear Time (g_c+I1), s	5.7	87.8		6.2	19.8	30.3		6.2				
Green Ext Time (p_c), s	0.1	12.2		0.0	0.3	6.4		0.1				

Intersection Summary	
HCM 7th Control Delay, s/veh	30.5
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	207	0	1582	856	1
Future Vol, veh/h	0	207	0	1582	856	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	225	0	1720	930	1

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Base Year 2068 PM

Intersection	
Int Delay, s/veh	6.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	23	130	97	641	600	32
Future Vol, veh/h	23	130	97	641	600	32
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	25	141	105	697	652	35

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1678	812	788	0	-	0
Stage 1	771	-	-	-	-	-
Stage 2	908	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	104	379	832	-	-	-
Stage 1	457	-	-	-	-	-
Stage 2	394	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	73	329	752	-	-	-
Mov Cap-2 Maneuver	73	-	-	-	-	-
Stage 1	355	-	-	-	-	-
Stage 2	356	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	61.87	1.39	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	752	-	216	-	-
HCM Lane V/C Ratio	0.14	-	0.77	-	-
HCM Control Delay (s/veh)	10.6	-	61.9	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	0.5	-	5.4	-	-

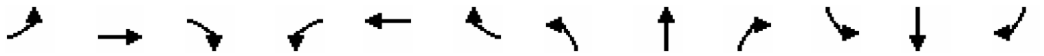
Intersection	
Int Delay, s/veh	2.3

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	51	71	674	51	53	694
Future Vol, veh/h	51	71	674	51	53	694
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	55	77	733	55	58	754

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1262	764	0	0	792	0
Stage 1	764	-	-	-	-	-
Stage 2	497	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	174	403	-	-	826	-
Stage 1	459	-	-	-	-	-
Stage 2	577	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	161	401	-	-	823	-
Mov Cap-2 Maneuver	161	-	-	-	-	-
Stage 1	457	-	-	-	-	-
Stage 2	534	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	25.57	0	0.69
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	161	401	823	-
HCM Lane V/C Ratio	-	-	0.345	0.192	0.07	-
HCM Control Delay (s/veh)	-	-	38.7	16.1	9.7	-
HCM Lane LOS	-	-	E	C	A	-
HCM 95th %tile Q(veh)	-	-	1.4	0.7	0.2	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	149	1	533	9	2	6	485	1187	0	1	1144	174
Future Volume (veh/h)	149	1	533	9	2	6	485	1187	0	1	1144	174
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	162	1	0	10	2	2	527	1290	0	1	1243	106
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	189	1		19	4	4	557	2535	0	2	1428	635
Arrive On Green	0.11	0.11	0.00	0.01	0.01	0.01	0.31	0.71	0.00	0.00	0.40	0.40
Sat Flow, veh/h	1771	11	1585	1259	252	252	1781	3647	0	1781	3554	1581
Grp Volume(v), veh/h	163	0	0	14	0	0	527	1290	0	1	1243	106
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1762	0	0	1781	1777	0	1781	1777	1581
Q Serve(g_s), s	13.2	0.0	0.0	1.2	0.0	0.0	42.4	24.0	0.0	0.1	47.2	6.3
Cycle Q Clear(g_c), s	13.2	0.0	0.0	1.2	0.0	0.0	42.4	24.0	0.0	0.1	47.2	6.3
Prop In Lane	0.99		1.00	0.71		0.14	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	190	0		26	0	0	557	2535	0	2	1428	635
V/C Ratio(X)	0.86	0.00		0.54	0.00	0.00	0.95	0.51	0.00	0.41	0.87	0.17
Avail Cap(c_a), veh/h	291	0		108	0	0	716	2535	0	109	1670	743
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	64.4	0.0	0.0	71.8	0.0	0.0	49.2	9.5	0.0	73.2	40.4	28.1
Incr Delay (d2), s/veh	14.2	0.0	0.0	16.0	0.0	0.0	18.6	0.2	0.0	85.2	4.7	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.8	0.0	0.0	0.6	0.0	0.0	21.7	9.0	0.0	0.1	21.5	2.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	78.7	0.0	0.0	87.8	0.0	0.0	67.8	9.6	0.0	158.4	45.1	28.3
LnGrp LOS	E			F			E	A		F	D	C
Approach Vol, veh/h		163			14			1817			1350	
Approach Delay, s/veh		78.7			87.8			26.5			43.8	
Approach LOS		E			F			C			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.2	110.7		8.2	51.9	65.0		21.7				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	104.0		9.0	59.0	69.0		24.0				
Max Q Clear Time (g_c+I1), s	2.1	26.0		3.2	44.4	49.2		15.2				
Green Ext Time (p_c), s	0.0	14.8		0.0	1.6	9.8		0.5				

Intersection Summary			
HCM 7th Control Delay, s/veh		36.3	
HCM 7th LOS		D	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	90	125	124	26	132	489	54	595	27	487	829	89
Future Volume (veh/h)	90	125	124	26	132	489	54	595	27	487	829	89
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	98	136	37	28	143	0	59	647	8	529	901	90
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	165	175	288	172	511		76	658	558	652	1623	162
Arrive On Green	0.18	0.18	0.18	0.03	0.27	0.00	0.04	0.35	0.35	0.19	0.50	0.50
Sat Flow, veh/h	609	955	1568	1781	1870	1585	1781	1870	1585	3456	3261	326
Grp Volume(v), veh/h	234	0	37	28	143	0	59	647	8	529	491	500
Grp Sat Flow(s),veh/h/ln	1565	0	1568	1781	1870	1585	1781	1870	1585	1728	1777	1810
Q Serve(g_s), s	12.8	0.0	1.9	1.2	5.8	0.0	3.2	33.1	0.3	14.2	18.5	18.5
Cycle Q Clear(g_c), s	13.8	0.0	1.9	1.2	5.8	0.0	3.2	33.1	0.3	14.2	18.5	18.5
Prop In Lane	0.42		1.00	1.00		1.00	1.00		1.00	1.00		0.18
Lane Grp Cap(c), veh/h	340	0	288	172	511		76	658	558	652	884	901
V/C Ratio(X)	0.69	0.00	0.13	0.16	0.28		0.77	0.98	0.01	0.81	0.56	0.56
Avail Cap(c_a), veh/h	536	0	487	382	929		166	658	558	2111	1085	1106
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	37.7	0.0	33.0	30.3	27.6	0.0	45.8	31.0	20.4	37.6	16.8	16.8
Incr Delay (d2), s/veh	2.5	0.0	0.2	0.4	0.3	0.0	15.3	30.7	0.0	2.5	0.5	0.5
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.5	0.0	0.7	0.5	2.6	0.0	1.7	19.9	0.1	6.1	7.3	7.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	40.2	0.0	33.2	30.7	27.9	0.0	61.0	61.7	20.4	40.1	17.4	17.4
LnGrp LOS	D		C	C	C		E	E	C	D	B	B
Approach Vol, veh/h		271			171			714			1520	
Approach Delay, s/veh		39.2			28.4			61.2			25.3	
Approach LOS		D			C			E			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	14.2	40.0	8.6	23.7	10.1	54.1		32.4
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	59.0	34.0	14.0	30.0	9.0	59.0		48.0
Max Q Clear Time (g_c+I1), s	16.2	35.1	3.2	15.8	5.2	20.5		7.8
Green Ext Time (p_c), s	2.0	0.0	0.0	1.2	0.0	8.0		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	36.5
HCM 7th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	30	13	10	19	26	224	1	38	2	117	515	17
Future Volume (veh/h)	30	13	10	19	26	224	1	38	2	117	515	17
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.97	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	33	14	1	21	28	47	1	41	1	127	560	17
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	328	113	293	222	234	298	325	616	520	781	765	23
Arrive On Green	0.19	0.19	0.19	0.19	0.19	0.19	0.00	0.33	0.33	0.10	0.42	0.42
Sat Flow, veh/h	888	584	1515	474	1210	1543	1781	1870	1578	1781	1805	55
Grp Volume(v), veh/h	47	0	1	49	0	47	1	41	1	127	0	577
Grp Sat Flow(s),veh/h/ln	1472	0	1515	1684	0	1543	1781	1870	1578	1781	0	1860
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.6	0.0	1.7	0.0	10.2
Cycle Q Clear(g_c), s	0.9	0.0	0.0	0.9	0.0	1.0	0.0	0.6	0.0	1.7	0.0	10.2
Prop In Lane	0.70		1.00	0.43		1.00	1.00		1.00	1.00		0.03
Lane Grp Cap(c), veh/h	440	0	293	456	0	298	325	616	520	781	0	788
V/C Ratio(X)	0.11	0.00	0.00	0.11	0.00	0.16	0.00	0.07	0.00	0.16	0.00	0.73
Avail Cap(c_a), veh/h	2162	0	2122	2388	0	2161	547	2620	2210	837	0	2605
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	13.1	0.0	12.8	13.1	0.0	13.2	9.3	9.0	8.8	6.6	0.0	9.5
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.1	0.0	1.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.0	0.3	0.0	0.3	0.0	0.2	0.0	0.5	0.0	3.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	13.2	0.0	12.8	13.2	0.0	13.4	9.3	9.1	8.8	6.7	0.0	10.8
LnGrp LOS	B		B	B		B	A	A	A	A		B
Approach Vol, veh/h		48			96			43			704	
Approach Delay, s/veh		13.2			13.3			9.1			10.1	
Approach LOS		B			B			A			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.7	17.9		12.6	5.1	21.6		12.6				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.6	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.7	2.6		2.9	2.0	12.2		3.0				
Green Ext Time (p_c), s	0.0	0.2		0.3	0.0	4.5		0.4				

Intersection Summary	
HCM 7th Control Delay, s/veh	10.5
HCM 7th LOS	B



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	6	19	102	37	9	57	232	1147	34	45	1026	27
Future Volume (veh/h)	6	19	102	37	9	57	232	1147	34	45	1026	27
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		0.99	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	7	21	18	40	10	5	252	1247	24	49	1115	15
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	40	41	30	119	19	83	281	1434	1215	63	1206	1022
Arrive On Green	0.05	0.05	0.05	0.05	0.05	0.05	0.16	0.77	0.77	0.04	0.64	0.64
Sat Flow, veh/h	119	779	577	1269	362	1576	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	46	0	0	50	0	5	252	1247	24	49	1115	15
Grp Sat Flow(s),veh/h/ln	1475	0	0	1631	0	1576	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.6	0.0	0.0	0.0	0.0	0.4	17.2	57.9	0.4	3.4	65.1	0.4
Cycle Q Clear(g_c), s	4.1	0.0	0.0	3.5	0.0	0.4	17.2	57.9	0.4	3.4	65.1	0.4
Prop In Lane	0.15		0.39	0.80		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	111	0	0	138	0	83	281	1434	1215	63	1206	1022
V/C Ratio(X)	0.41	0.00	0.00	0.36	0.00	0.06	0.90	0.87	0.02	0.77	0.92	0.01
Avail Cap(c_a), veh/h	305	0	0	306	0	267	345	1719	1457	144	1508	1278
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	57.3	0.0	0.0	57.3	0.0	55.8	51.3	10.1	3.4	59.3	19.4	7.9
Incr Delay (d2), s/veh	2.4	0.0	0.0	1.6	0.0	0.3	22.1	4.4	0.0	17.9	8.7	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.5	0.0	0.0	1.6	0.0	0.2	9.4	21.1	0.1	1.8	28.7	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	59.7	0.0	0.0	58.9	0.0	56.1	73.4	14.6	3.4	77.2	28.0	7.9
LnGrp LOS	E			E		E	E	B	A	E	C	A
Approach Vol, veh/h		46			55			1523			1179	
Approach Delay, s/veh		59.7			58.6			24.1			29.8	
Approach LOS		E			E			C			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	10.4	101.1		12.5	25.5	85.9		12.5
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0
Max Q Clear Time (g_c+I1), s	5.4	59.9		6.1	19.2	67.1		5.5
Green Ext Time (p_c), s	0.0	20.0		0.1	0.3	12.9		0.2

Intersection Summary		
HCM 7th Control Delay, s/veh	27.8	
HCM 7th LOS	C	

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	410	0	1483	1304	5
Future Vol, veh/h	0	410	0	1483	1304	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	446	0	1612	1417	5

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Base Year 2068 SAT

Intersection	
Int Delay, s/veh	2.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	19	72	77	571	554	17
Future Vol, veh/h	19	72	77	571	554	17
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	21	78	84	621	602	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1500	753	722	0	-	0
Stage 1	712	-	-	-	-	-
Stage 2	788	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	134	409	880	-	-	-
Stage 1	486	-	-	-	-	-
Stage 2	448	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	98	356	796	-	-	-
Mov Cap-2 Maneuver	98	-	-	-	-	-
Stage 1	393	-	-	-	-	-
Stage 2	405	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	32.01	1.19	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	796	-	230	-	-
HCM Lane V/C Ratio	0.105	-	0.43	-	-
HCM Control Delay (s/veh)	10.1	-	32	-	-
HCM Lane LOS	B	-	D	-	-
HCM 95th %tile Q(veh)	0.4	-	2	-	-

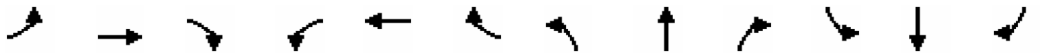
Intersection	
Int Delay, s/veh	1.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	53	62	585	43	35	614
Future Vol, veh/h	53	62	585	43	35	614
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	58	67	636	47	38	667

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1078	663	0	0	687	0
Stage 1	663	-	-	-	-	-
Stage 2	415	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	227	460	-	-	905	-
Stage 1	511	-	-	-	-	-
Stage 2	636	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	216	458	-	-	902	-
Mov Cap-2 Maneuver	216	-	-	-	-	-
Stage 1	509	-	-	-	-	-
Stage 2	606	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	20.4	0	0.49
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	216	458	902	-
HCM Lane V/C Ratio	-	-	0.267	0.147	0.042	-
HCM Control Delay (s/veh)	-	-	27.6	14.2	9.2	-
HCM Lane LOS	-	-	D	B	A	-
HCM 95th %tile Q(veh)	-	-	1	0.5	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	144	2	426	2	2	0	395	1064	2	0	1022	155
Future Volume (veh/h)	144	2	426	2	2	0	395	1064	2	0	1022	155
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	157	2	0	2	2	0	429	1157	2	0	1111	52
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	190	2		5	5	0	474	2576	4	2	1358	604
Arrive On Green	0.11	0.11	0.00	0.01	0.01	0.00	0.27	0.71	0.71	0.00	0.38	0.38
Sat Flow, veh/h	1760	22	1585	912	912	0	1781	3640	6	1781	3554	1581
Grp Volume(v), veh/h	159	0	0	4	0	0	429	565	594	0	1111	52
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1825	0	0	1781	1777	1869	1781	1777	1581
Q Serve(g_s), s	8.8	0.0	0.0	0.2	0.0	0.0	23.4	13.7	13.7	0.0	28.3	2.1
Cycle Q Clear(g_c), s	8.8	0.0	0.0	0.2	0.0	0.0	23.4	13.7	13.7	0.0	28.3	2.1
Prop In Lane	0.99		1.00	0.50		0.00	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	193	0		10	0	0	474	1258	1323	2	1358	604
V/C Ratio(X)	0.83	0.00		0.42	0.00	0.00	0.91	0.45	0.45	0.00	0.82	0.09
Avail Cap(c_a), veh/h	248	0		91	0	0	867	1306	1374	159	1730	770
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	44.0	0.0	0.0	49.9	0.0	0.0	35.7	6.3	6.3	0.0	28.0	19.9
Incr Delay (d2), s/veh	16.0	0.0	0.0	26.4	0.0	0.0	6.8	0.3	0.2	0.0	2.5	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.7	0.0	0.0	0.2	0.0	0.0	10.9	4.5	4.7	0.0	12.1	0.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	60.0	0.0	0.0	76.3	0.0	0.0	42.5	6.6	6.5	0.0	30.5	19.9
LnGrp LOS	E			E			D	A	A		C	B
Approach Vol, veh/h		159			4			1588			1163	
Approach Delay, s/veh		60.0			76.3			16.2			30.0	
Approach LOS		E			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	0.0	77.3		6.5	32.8	44.5		16.9				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	74.0		5.0	49.0	49.0		14.0				
Max Q Clear Time (g_c+I1), s	0.0	15.7		2.2	25.4	30.3		10.8				
Green Ext Time (p_c), s	0.0	10.6		0.0	1.4	8.2		0.2				

Intersection Summary		
HCM 7th Control Delay, s/veh		24.2
HCM 7th LOS		C

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	126	189	170	82	169	453	101	603	35	333	859	157
Future Volume (veh/h)	126	189	170	82	169	453	101	603	35	333	859	157
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	137	205	75	89	184	0	110	655	11	362	934	160
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	193	228	388	187	654		138	682	578	450	1266	217
Arrive On Green	0.25	0.25	0.25	0.05	0.35	0.00	0.08	0.36	0.36	0.13	0.42	0.42
Sat Flow, veh/h	607	923	1572	1781	1870	1585	1781	1870	1585	3456	3032	519
Grp Volume(v), veh/h	342	0	75	89	184	0	110	655	11	362	547	547
Grp Sat Flow(s),veh/h/ln	1531	0	1572	1781	1870	1585	1781	1870	1585	1728	1777	1774
Q Serve(g_s), s	24.9	0.0	4.4	4.2	8.2	0.0	7.0	39.7	0.5	11.8	30.0	30.1
Cycle Q Clear(g_c), s	25.1	0.0	4.4	4.2	8.2	0.0	7.0	39.7	0.5	11.8	30.0	30.1
Prop In Lane	0.40		1.00	1.00		1.00	1.00		1.00	1.00		0.29
Lane Grp Cap(c), veh/h	421	0	388	187	654		138	682	578	450	742	741
V/C Ratio(X)	0.81	0.00	0.19	0.48	0.28		0.80	0.96	0.02	0.81	0.74	0.74
Avail Cap(c_a), veh/h	479	0	448	341	807		307	694	588	1163	950	949
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	42.3	0.0	34.5	32.1	27.2	0.0	52.6	36.0	23.6	49.0	28.4	28.4
Incr Delay (d2), s/veh	9.2	0.0	0.2	1.9	0.2	0.0	10.2	24.5	0.0	3.4	2.2	2.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	10.5	0.0	1.7	1.9	3.7	0.0	3.5	22.4	0.2	5.3	13.0	13.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	51.5	0.0	34.8	33.9	27.4	0.0	62.8	60.5	23.6	52.4	30.6	30.7
LnGrp LOS	D		C	C	C		E	E	C	D	C	C
Approach Vol, veh/h		417			273			776			1456	
Approach Delay, s/veh		48.5			29.5			60.3			36.1	
Approach LOS		D			C			E			D	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	21.1	48.3	11.9	34.6	15.0	54.4		46.6
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	39.0	43.0	16.0	33.0	20.0	62.0		50.0
Max Q Clear Time (g_c+I1), s	13.8	41.7	6.2	27.1	9.0	32.1		10.2
Green Ext Time (p_c), s	1.3	0.6	0.1	1.2	0.2	8.8		1.1

Intersection Summary	
HCM 7th Control Delay, s/veh	43.7
HCM 7th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	28	16	8	6	26	259	0	27	3	116	314	14
Future Volume (veh/h)	28	16	8	6	26	259	0	27	3	116	314	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.98	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	30	17	1	7	28	68	0	29	1	126	341	14
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	361	161	328	175	359	333	427	329	277	657	805	33
Arrive On Green	0.22	0.22	0.22	0.22	0.22	0.22	0.00	0.18	0.18	0.11	0.45	0.45
Sat Flow, veh/h	764	749	1523	145	1668	1548	1781	1870	1572	1781	1784	73
Grp Volume(v), veh/h	47	0	1	35	0	68	0	29	1	126	0	355
Grp Sat Flow(s),veh/h/ln	1512	0	1523	1813	0	1548	1781	1870	1572	1781	0	1857
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.4	0.0	1.5	0.0	3.9
Cycle Q Clear(g_c), s	0.6	0.0	0.0	0.4	0.0	1.1	0.0	0.4	0.0	1.5	0.0	3.9
Prop In Lane	0.64		1.00	0.20		1.00	1.00		1.00	1.00		0.04
Lane Grp Cap(c), veh/h	522	0	328	535	0	333	427	329	277	657	0	838
V/C Ratio(X)	0.09	0.00	0.00	0.07	0.00	0.20	0.00	0.09	0.00	0.19	0.00	0.42
Avail Cap(c_a), veh/h	2853	0	2792	3342	0	2838	718	3430	2882	761	0	3405
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.5	0.0	9.2	9.4	0.0	9.7	0.0	10.3	10.2	6.9	0.0	5.6
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.3	0.0	0.1	0.0	0.1	0.0	0.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	0.0	0.0	0.1	0.0	0.3	0.0	0.1	0.0	0.4	0.0	0.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.5	0.0	9.2	9.5	0.0	10.0	0.0	10.5	10.2	7.0	0.0	5.9
LnGrp LOS	A		A	A		A		B	B	A		A
Approach Vol, veh/h		48			103			30			481	
Approach Delay, s/veh		9.5			9.8			10.4			6.2	
Approach LOS		A			A			B			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.2	10.3		11.5	0.0	18.5		11.5				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.5	2.4		2.6	0.0	5.9		3.1				
Green Ext Time (p_c), s	0.0	0.1		0.3	0.0	2.4		0.4				

Intersection Summary	
HCM 7th Control Delay, s/veh	7.2
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	14	113	26	11	45	260	1104	32	46	657	17
Future Volume (veh/h)	15	14	113	26	11	45	260	1104	32	46	657	17
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	16	15	31	28	12	6	283	1200	22	50	714	8
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	63	31	49	126	43	100	320	1340	1136	67	1074	910
Arrive On Green	0.06	0.06	0.06	0.06	0.06	0.06	0.18	0.72	0.72	0.04	0.57	0.57
Sat Flow, veh/h	273	495	768	1008	682	1578	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	62	0	0	40	0	6	283	1200	22	50	714	8
Grp Sat Flow(s),veh/h/ln	1535	0	0	1691	0	1578	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	1.9	0.0	0.0	0.0	0.0	0.4	15.3	50.1	0.4	2.7	25.9	0.2
Cycle Q Clear(g_c), s	4.0	0.0	0.0	2.1	0.0	0.4	15.3	50.1	0.4	2.7	25.9	0.2
Prop In Lane	0.26		0.50	0.70		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	143	0	0	169	0	100	320	1340	1136	67	1074	910
V/C Ratio(X)	0.43	0.00	0.00	0.24	0.00	0.06	0.88	0.90	0.02	0.74	0.66	0.01
Avail Cap(c_a), veh/h	379	0	0	389	0	336	433	2160	1830	180	1895	1606
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	45.1	0.0	0.0	44.3	0.0	43.5	39.5	11.1	4.0	47.0	14.5	9.0
Incr Delay (d2), s/veh	2.1	0.0	0.0	0.7	0.0	0.2	15.1	3.3	0.0	14.8	0.7	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.6	0.0	0.0	1.0	0.0	0.1	7.9	17.6	0.1	1.5	10.4	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	47.2	0.0	0.0	45.0	0.0	43.7	54.5	14.3	4.0	61.8	15.2	9.0
LnGrp LOS	D			D		D	D	B	A	E	B	A
Approach Vol, veh/h		62			46			1505			772	
Approach Delay, s/veh		47.2			44.8			21.7			18.1	
Approach LOS		D			D			C			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	9.7	76.7		12.3	23.8	62.7		12.3
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0
Max Q Clear Time (g_c+I1), s	4.7	52.1		6.0	17.3	27.9		4.1
Green Ext Time (p_c), s	0.0	18.6		0.2	0.5	6.3		0.1

Intersection Summary	
HCM 7th Control Delay, s/veh	21.7
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	253	0	1551	873	3
Future Vol, veh/h	0	253	0	1551	873	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	275	0	1686	949	3

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2028 AM – Alternative 1

Intersection	
Int Delay, s/veh	3.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	17	95	78	321	539	18
Future Vol, veh/h	17	95	78	321	539	18
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	18	103	85	349	586	20

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1215	738	706	0	-	0
Stage 1	697	-	-	-	-	-
Stage 2	518	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	200	418	892	-	-	-
Stage 1	494	-	-	-	-	-
Stage 2	598	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	146	363	806	-	-	-
Mov Cap-2 Maneuver	146	-	-	-	-	-
Stage 1	400	-	-	-	-	-
Stage 2	540	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	25.35	1.95	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	806	-	296	-	-
HCM Lane V/C Ratio	0.105	-	0.411	-	-
HCM Control Delay (s/veh)	10	-	25.4	-	-
HCM Lane LOS	A	-	D	-	-
HCM 95th %tile Q(veh)	0.4	-	1.9	-	-

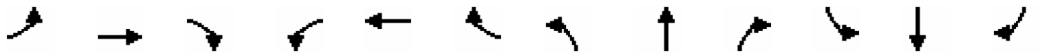
Intersection	
Int Delay, s/veh	1.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	24	36	365	23	45	595
Future Vol, veh/h	24	36	365	23	45	595
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	26	39	397	25	49	647

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	839	413	0	0	426	0
Stage 1	413	-	-	-	-	-
Stage 2	426	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	320	638	-	-	1132	-
Stage 1	667	-	-	-	-	-
Stage 2	627	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	303	636	-	-	1127	-
Mov Cap-2 Maneuver	303	-	-	-	-	-
Stage 1	664	-	-	-	-	-
Stage 2	597	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	13.82	0	0.59
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	303	636	1127	-
HCM Lane V/C Ratio	-	-	0.086	0.062	0.043	-
HCM Control Delay (s/veh)	-	-	18	11	8.3	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.3	0.2	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	148	1	471	2	5	0	278	863	5	4	1015	148
Future Volume (veh/h)	148	1	471	2	5	0	278	863	5	4	1015	148
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	161	1	0	2	5	0	302	938	5	4	1103	85
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	200	1		5	12	0	350	2193	12	9	1471	655
Arrive On Green	0.11	0.11	0.00	0.01	0.01	0.00	0.20	0.61	0.61	0.01	0.41	0.41
Sat Flow, veh/h	1771	11	1585	527	1317	0	1781	3624	19	1781	3554	1581
Grp Volume(v), veh/h	162	0	0	7	0	0	302	460	483	4	1103	85
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1844	0	0	1781	1777	1867	1781	1777	1581
Q Serve(g_s), s	7.9	0.0	0.0	0.3	0.0	0.0	14.7	12.3	12.3	0.2	23.6	3.0
Cycle Q Clear(g_c), s	7.9	0.0	0.0	0.3	0.0	0.0	14.7	12.3	12.3	0.2	23.6	3.0
Prop In Lane	0.99		1.00	0.29		0.00	1.00		0.01	1.00		1.00
Lane Grp Cap(c), veh/h	201	0		16	0	0	350	1075	1130	9	1471	655
V/C Ratio(X)	0.81	0.00		0.43	0.00	0.00	0.86	0.43	0.43	0.42	0.75	0.13
Avail Cap(c_a), veh/h	298	0		185	0	0	875	2559	2689	179	3134	1395
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	38.8	0.0	0.0	44.2	0.0	0.0	34.8	9.4	9.4	44.4	22.3	16.3
Incr Delay (d2), s/veh	9.6	0.0	0.0	16.5	0.0	0.0	6.4	0.3	0.3	27.5	0.8	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.0	0.0	0.0	0.2	0.0	0.0	6.8	4.4	4.6	0.2	9.5	1.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	48.3	0.0	0.0	60.6	0.0	0.0	41.2	9.7	9.7	72.0	23.1	16.3
LnGrp LOS	D			E			D	A	A	E	C	B
Approach Vol, veh/h		162			7			1245			1192	
Approach Delay, s/veh		48.3			60.6			17.3			22.8	
Approach LOS		D			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.5	60.2		6.8	23.6	43.1		16.1				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	129.0		9.0	44.0	79.0		15.0				
Max Q Clear Time (g_c+I1), s	2.2	14.3		2.3	16.7	25.6		9.9				
Green Ext Time (p_c), s	0.0	7.7		0.0	0.9	11.5		0.3				

Intersection Summary		
HCM 7th Control Delay, s/veh	21.9	
HCM 7th LOS	C	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	57	111	62	33	136	1034	56	448	36	695	626	76
Future Volume (veh/h)	57	111	62	33	136	1034	56	448	36	695	626	76
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	62	121	24	36	148	0	61	487	7	755	680	76
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	120	163	218	182	453		79	532	450	915	1625	181
Arrive On Green	0.14	0.14	0.14	0.03	0.24	0.00	0.04	0.28	0.28	0.26	0.50	0.50
Sat Flow, veh/h	463	1172	1562	1781	1870	1585	1781	1870	1585	3456	3221	360
Grp Volume(v), veh/h	183	0	24	36	148	0	61	487	7	755	375	381
Grp Sat Flow(s),veh/h/ln	1635	0	1562	1781	1870	1585	1781	1870	1585	1728	1777	1804
Q Serve(g_s), s	7.6	0.0	1.2	1.4	5.6	0.0	2.9	21.7	0.3	17.7	11.4	11.5
Cycle Q Clear(g_c), s	9.3	0.0	1.2	1.4	5.6	0.0	2.9	21.7	0.3	17.7	11.4	11.5
Prop In Lane	0.34		1.00	1.00		1.00	1.00		1.00	1.00		0.20
Lane Grp Cap(c), veh/h	284	0	218	182	453		79	532	450	915	896	910
V/C Ratio(X)	0.65	0.00	0.11	0.20	0.33		0.77	0.92	0.02	0.83	0.42	0.42
Avail Cap(c_a), veh/h	376	0	308	371	672		248	564	478	2364	1731	1757
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	35.8	0.0	32.4	29.2	26.9	0.0	40.8	29.9	22.2	29.8	13.4	13.4
Incr Delay (d2), s/veh	2.5	0.0	0.2	0.5	0.4	0.0	14.3	19.3	0.0	2.0	0.3	0.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.8	0.0	0.4	0.6	2.5	0.0	1.6	12.2	0.1	7.4	4.3	4.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	38.3	0.0	32.7	29.7	27.3	0.0	55.1	49.1	22.2	31.8	13.7	13.7
LnGrp LOS	D		C	C	C		E	D	C	C	B	B
Approach Vol, veh/h		207			184			555			1511	
Approach Delay, s/veh		37.6			27.8			49.4			22.8	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	28.8	30.5	8.9	18.0	9.8	49.5		26.9
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	22.8	26.0	12.0	17.0	12.0	84.0		31.0
Max Q Clear Time (g_c+I1), s	19.7	23.7	3.4	11.3	4.9	13.5		7.6
Green Ext Time (p_c), s	3.1	0.7	0.0	0.5	0.1	5.7		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	30.4
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	7	10	5	12	226	0	16	1	103	390	9
Future Volume (veh/h)	15	7	10	5	12	226	0	16	1	103	390	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.97	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	16	8	2	5	13	49	0	17	1	112	424	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	362	139	290	200	303	296	433	346	291	679	839	20
Arrive On Green	0.19	0.19	0.19	0.19	0.19	0.19	0.00	0.18	0.18	0.10	0.46	0.46
Sat Flow, veh/h	802	723	1515	209	1580	1543	1781	1870	1572	1781	1820	43
Grp Volume(v), veh/h	24	0	2	18	0	49	0	17	1	112	0	434
Grp Sat Flow(s),veh/h/ln	1526	0	1515	1789	0	1543	1781	1870	1572	1781	0	1862
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.2	0.0	1.2	0.0	4.7
Cycle Q Clear(g_c), s	0.3	0.0	0.0	0.2	0.0	0.8	0.0	0.2	0.0	1.2	0.0	4.7
Prop In Lane	0.67		1.00	0.28		1.00	1.00		1.00	1.00		0.02
Lane Grp Cap(c), veh/h	501	0	290	503	0	296	433	346	291	679	0	859
V/C Ratio(X)	0.05	0.00	0.01	0.04	0.00	0.17	0.00	0.05	0.00	0.16	0.00	0.51
Avail Cap(c_a), veh/h	2997	0	2892	3400	0	2945	736	3570	3001	805	0	3555
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.5	0.0	9.4	9.5	0.0	9.7	0.0	9.7	9.6	6.4	0.0	5.5
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1	0.0	0.1	0.0	0.5
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.3	0.0	0.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.6	0.0	9.4	9.5	0.0	10.0	0.0	9.7	9.6	6.6	0.0	5.9
LnGrp LOS	A		A	A		A		A	A	A		A
Approach Vol, veh/h		26			67			18			546	
Approach Delay, s/veh		9.6			9.9			9.7			6.0	
Approach LOS		A			A			A			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.0	10.3		10.5	0.0	18.3		10.5				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.2	2.2		2.3	0.0	6.7		2.8				
Green Ext Time (p_c), s	0.0	0.1		0.1	0.0	3.1		0.3				

Intersection Summary	
HCM 7th Control Delay, s/veh	6.7
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	10	92	40	11	72	222	997	36	45	346	9
Future Volume (veh/h)	5	10	92	40	11	72	222	997	36	45	346	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	5	11	5	43	12	6	241	1084	24	49	376	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	68	51	19	156	20	90	282	1252	1061	75	1035	877
Arrive On Green	0.06	0.06	0.06	0.06	0.06	0.06	0.16	0.67	0.67	0.04	0.55	0.55
Sat Flow, veh/h	188	901	340	1282	358	1578	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	21	0	0	55	0	6	241	1084	24	49	376	6
Grp Sat Flow(s),veh/h/ln	1429	0	0	1640	0	1578	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.3	10.2	35.4	0.4	2.1	8.7	0.1
Cycle Q Clear(g_c), s	2.3	0.0	0.0	2.3	0.0	0.3	10.2	35.4	0.4	2.1	8.7	0.1
Prop In Lane	0.24		0.24	0.78		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	139	0	0	176	0	90	282	1252	1061	75	1035	877
V/C Ratio(X)	0.15	0.00	0.00	0.31	0.00	0.07	0.86	0.87	0.02	0.66	0.36	0.01
Avail Cap(c_a), veh/h	407	0	0	414	0	345	321	2743	2325	229	2647	2243
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	35.0	0.0	0.0	35.7	0.0	34.7	31.8	10.1	4.3	36.7	9.7	7.8
Incr Delay (d2), s/veh	0.5	0.0	0.0	1.0	0.0	0.3	18.0	1.9	0.0	9.3	0.2	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	0.0	0.0	1.0	0.0	0.1	5.7	11.6	0.1	1.1	3.2	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	35.5	0.0	0.0	36.7	0.0	35.0	49.9	12.0	4.3	46.0	9.9	7.8
LnGrp LOS	D			D		C	D	B	A	D	A	A
Approach Vol, veh/h		21			61			1349			431	
Approach Delay, s/veh		35.5			36.5			18.7			14.0	
Approach LOS		D			D			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	9.3	58.0		10.4	18.3	49.0		10.4
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		17.0	14.0	110.0		17.0
Max Q Clear Time (g_c+I1), s	4.1	37.4		4.3	12.2	10.7		4.3
Green Ext Time (p_c), s	0.0	14.6		0.0	0.1	2.6		0.2

Intersection Summary	
HCM 7th Control Delay, s/veh	18.4
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	386	0	1231	492	1
Future Vol, veh/h	0	386	0	1231	492	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	420	0	1338	535	1

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2028 PM – Alternative 1

Intersection	
Int Delay, s/veh	5.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	24	133	97	523	489	32
Future Vol, veh/h	24	133	97	523	489	32
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	26	145	105	568	532	35

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1429	691	667	0	-	0
Stage 1	650	-	-	-	-	-
Stage 2	779	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	148	445	922	-	-	-
Stage 1	520	-	-	-	-	-
Stage 2	452	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	106	386	834	-	-	-
Mov Cap-2 Maneuver	106	-	-	-	-	-
Stage 1	410	-	-	-	-	-
Stage 2	409	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	37.34	1.56	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	834	-	275	-	-
HCM Lane V/C Ratio	0.126	-	0.621	-	-
HCM Control Delay (s/veh)	9.9	-	37.3	-	-
HCM Lane LOS	A	-	E	-	-
HCM 95th %tile Q(veh)	0.4	-	3.8	-	-

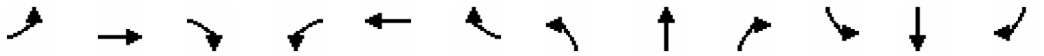
Intersection	
Int Delay, s/veh	2.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	49	71	551	49	53	571
Future Vol, veh/h	49	71	551	49	53	571
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	53	77	599	53	58	621

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1060	630	0	0	656	0
Stage 1	630	-	-	-	-	-
Stage 2	431	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	233	481	-	-	929	-
Stage 1	530	-	-	-	-	-
Stage 2	624	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	217	479	-	-	926	-
Mov Cap-2 Maneuver	217	-	-	-	-	-
Stage 1	528	-	-	-	-	-
Stage 2	582	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	19.25	0	0.78
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	217	479	926	-
HCM Lane V/C Ratio	-	-	0.246	0.161	0.062	-
HCM Control Delay (s/veh)	-	-	26.9	14	9.1	-
HCM Lane LOS	-	-	D	B	A	-
HCM 95th %tile Q(veh)	-	-	0.9	0.6	0.2	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	132	1	539	9	2	6	476	1343	0	1	1066	170
Future Volume (veh/h)	132	1	539	9	2	6	476	1343	0	1	1066	170
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	143	1	0	10	2	2	517	1460	0	1	1159	103
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	174	1		19	4	4	553	2490	0	2	1392	619
Arrive On Green	0.10	0.10	0.00	0.02	0.02	0.02	0.31	0.70	0.00	0.00	0.39	0.39
Sat Flow, veh/h	1770	12	1585	1259	252	252	1781	3647	0	1781	3554	1581
Grp Volume(v), veh/h	144	0	0	14	0	0	517	1460	0	1	1159	103
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1762	0	0	1781	1777	0	1781	1777	1581
Q Serve(g_s), s	10.3	0.0	0.0	1.0	0.0	0.0	36.7	27.1	0.0	0.1	38.3	5.5
Cycle Q Clear(g_c), s	10.3	0.0	0.0	1.0	0.0	0.0	36.7	27.1	0.0	0.1	38.3	5.5
Prop In Lane	0.99		1.00	0.71		0.14	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	175	0		27	0	0	553	2490	0	2	1392	619
V/C Ratio(X)	0.82	0.00		0.52	0.00	0.00	0.94	0.59	0.00	0.41	0.83	0.17
Avail Cap(c_a), veh/h	329	0		122	0	0	808	2842	0	123	1885	839
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	57.5	0.0	0.0	63.6	0.0	0.0	43.6	9.9	0.0	64.9	35.7	25.7
Incr Delay (d2), s/veh	9.3	0.0	0.0	14.7	0.0	0.0	13.9	0.2	0.0	84.8	2.5	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.1	0.0	0.0	0.6	0.0	0.0	18.2	9.9	0.0	0.1	16.9	2.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	66.8	0.0	0.0	78.3	0.0	0.0	57.5	10.1	0.0	149.7	38.2	25.9
LnGrp LOS	E			E			E	B		F	D	C
Approach Vol, veh/h		144			14			1977			1263	
Approach Delay, s/veh		66.8			78.3			22.5			37.2	
Approach LOS		E			E			C			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.2	97.1		8.0	46.3	57.0		18.8				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	104.0		9.0	59.0	69.0		24.0				
Max Q Clear Time (g_c+I1), s	2.1	29.1		3.0	38.7	40.3		12.3				
Green Ext Time (p_c), s	0.0	18.7		0.0	1.7	10.7		0.5				

Intersection Summary		
HCM 7th Control Delay, s/veh	30.1	
HCM 7th LOS	C	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	88	125	124	26	132	1081	54	440	27	817	603	86
Future Volume (veh/h)	88	125	124	26	132	1081	54	440	27	817	603	86
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	96	136	46	28	143	0	59	478	6	888	655	86
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	155	169	278	153	482		76	544	461	997	1694	222
Arrive On Green	0.18	0.18	0.18	0.03	0.26	0.00	0.04	0.29	0.29	0.29	0.54	0.54
Sat Flow, veh/h	612	952	1567	1781	1870	1585	1781	1870	1585	3456	3157	414
Grp Volume(v), veh/h	232	0	46	28	143	0	59	478	6	888	368	373
Grp Sat Flow(s),veh/h/ln	1563	0	1567	1781	1870	1585	1781	1870	1585	1728	1777	1794
Q Serve(g_s), s	14.9	0.0	2.8	1.4	6.8	0.0	3.6	26.9	0.3	27.2	13.4	13.4
Cycle Q Clear(g_c), s	15.8	0.0	2.8	1.4	6.8	0.0	3.6	26.9	0.3	27.2	13.4	13.4
Prop In Lane	0.41		1.00	1.00		1.00	1.00		1.00	1.00		0.23
Lane Grp Cap(c), veh/h	324	0	278	153	482		76	544	461	997	953	963
V/C Ratio(X)	0.72	0.00	0.17	0.18	0.30		0.77	0.88	0.01	0.89	0.39	0.39
Avail Cap(c_a), veh/h	469	0	425	332	812		145	913	774	1218	953	963
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	43.8	0.0	38.5	35.5	33.0	0.0	52.4	37.4	27.9	37.7	15.0	15.0
Incr Delay (d2), s/veh	3.0	0.0	0.3	0.6	0.3	0.0	15.2	5.5	0.0	7.4	0.3	0.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.4	0.0	1.1	0.6	3.1	0.0	1.9	13.0	0.1	12.4	5.3	5.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	46.8	0.0	38.8	36.1	33.3	0.0	67.7	42.8	27.9	45.1	15.2	15.2
LnGrp LOS	D		D	D	C		E	D	C	D	B	B
Approach Vol, veh/h		278			171			543			1629	
Approach Delay, s/veh		45.5			33.8			45.4			31.5	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	37.9	38.2	8.9	25.6	10.7	65.3		34.5
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	31.9	54.0	14.0	30.0	9.0	59.0		48.0
Max Q Clear Time (g_c+I1), s	29.2	28.9	3.4	17.8	5.6	15.4		8.8
Green Ext Time (p_c), s	2.7	3.2	0.0	1.2	0.0	5.5		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	36.0
HCM 7th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	25	13	10	19	26	195	1	29	2	107	587	15
Future Volume (veh/h)	25	13	10	19	26	195	1	29	2	107	587	15
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.95	0.96		0.97	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	27	14	1	21	28	36	1	32	1	116	638	15
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	293	124	277	209	221	283	307	703	593	826	841	20
Arrive On Green	0.18	0.18	0.18	0.18	0.18	0.18	0.00	0.38	0.38	0.09	0.46	0.46
Sat Flow, veh/h	833	677	1512	477	1204	1541	1781	1870	1579	1781	1820	43
Grp Volume(v), veh/h	41	0	1	49	0	36	1	32	1	116	0	653
Grp Sat Flow(s),veh/h/ln	1510	0	1512	1681	0	1541	1781	1870	1579	1781	0	1862
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.5	0.0	1.5	0.0	12.3
Cycle Q Clear(g_c), s	0.8	0.0	0.0	0.9	0.0	0.8	0.0	0.5	0.0	1.5	0.0	12.3
Prop In Lane	0.66		1.00	0.43		1.00	1.00		1.00	1.00		0.02
Lane Grp Cap(c), veh/h	418	0	277	429	0	283	307	703	593	826	0	861
V/C Ratio(X)	0.10	0.00	0.00	0.11	0.00	0.13	0.00	0.05	0.00	0.14	0.00	0.76
Avail Cap(c_a), veh/h	2036	0	1958	2206	0	1996	513	2422	2044	879	0	2412
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	14.5	0.0	14.2	14.5	0.0	14.5	9.1	8.4	8.3	6.2	0.0	9.5
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.1	0.0	1.4
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.0	0.4	0.0	0.3	0.0	0.2	0.0	0.4	0.0	3.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	14.6	0.0	14.2	14.7	0.0	14.7	9.1	8.4	8.3	6.3	0.0	10.9
LnGrp LOS	B		B	B		B	A	A	A	A		B
Approach Vol, veh/h		42			85			34			769	
Approach Delay, s/veh		14.6			14.7			8.5			10.2	
Approach LOS		B			B			A			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.7	21.0		12.8	5.1	24.6		12.8				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.5	2.5		2.8	2.0	14.3		2.9				
Green Ext Time (p_c), s	0.0	0.2		0.2	0.0	5.3		0.4				

Intersection Summary	
HCM 7th Control Delay, s/veh	10.7
HCM 7th LOS	B



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	6	17	93	37	8	52	206	850	34	44	628	27
Future Volume (veh/h)	6	17	93	37	8	52	206	850	34	44	628	27
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	7	18	6	40	9	5	224	924	22	48	683	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	87	71	21	191	22	106	283	1111	941	81	899	762
Arrive On Green	0.07	0.07	0.07	0.07	0.07	0.07	0.16	0.59	0.59	0.05	0.48	0.48
Sat Flow, veh/h	231	1050	308	1253	331	1579	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	31	0	0	49	0	5	224	924	22	48	683	13
Grp Sat Flow(s),veh/h/ln	1589	0	0	1584	0	1579	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.2	7.4	24.3	0.4	1.6	18.3	0.3
Cycle Q Clear(g_c), s	1.6	0.0	0.0	1.6	0.0	0.2	7.4	24.3	0.4	1.6	18.3	0.3
Prop In Lane	0.23		0.19	0.82		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	179	0	0	213	0	106	283	1111	941	81	899	762
V/C Ratio(X)	0.17	0.00	0.00	0.23	0.00	0.05	0.79	0.83	0.02	0.59	0.76	0.02
Avail Cap(c_a), veh/h	641	0	0	611	0	540	697	3475	2945	290	3048	2583
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	27.2	0.0	0.0	27.4	0.0	26.8	24.8	10.0	5.1	28.7	13.0	8.3
Incr Delay (d2), s/veh	0.5	0.0	0.0	0.5	0.0	0.2	5.0	1.7	0.0	6.7	1.3	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	0.0	0.0	0.7	0.0	0.1	3.3	7.9	0.1	0.8	6.7	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	27.6	0.0	0.0	28.0	0.0	27.0	29.8	11.7	5.1	35.4	14.4	8.3
LnGrp LOS	C			C		C	C	B	A	D	B	A
Approach Vol, veh/h		31			54			1170			744	
Approach Delay, s/veh		27.6			27.9			15.0			15.6	
Approach LOS		C			C			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.8	42.4		10.1	15.7	35.5		10.1
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0
Max Q Clear Time (g_c+I1), s	3.6	26.3		3.6	9.4	20.3		3.6
Green Ext Time (p_c), s	0.0	10.1		0.1	0.5	5.9		0.2

Intersection Summary	
HCM 7th Control Delay, s/veh	15.8
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	568	0	1098	844	4
Future Vol, veh/h	0	568	0	1098	844	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	617	0	1193	917	4

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2028 SAT – Alternative 1

Intersection	
Int Delay, s/veh	2.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	19	71	76	458	447	17
Future Vol, veh/h	19	71	76	458	447	17
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	21	77	83	498	486	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1259	637	605	0	-	0
Stage 1	596	-	-	-	-	-
Stage 2	663	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	188	477	973	-	-	-
Stage 1	550	-	-	-	-	-
Stage 2	512	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	139	414	879	-	-	-
Mov Cap-2 Maneuver	139	-	-	-	-	-
Stage 1	451	-	-	-	-	-
Stage 2	463	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	23.36	1.35	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	879	-	293	-	-
HCM Lane V/C Ratio	0.094	-	0.334	-	-
HCM Control Delay (s/veh)	9.5	-	23.4	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0.3	-	1.4	-	-

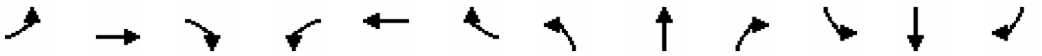
Intersection	
Int Delay, s/veh	1.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	51	62	469	41	35	497
Future Vol, veh/h	51	62	469	41	35	497
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	55	67	510	45	38	540

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	887	536	0	0	558	0
Stage 1	536	-	-	-	-	-
Stage 2	351	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	299	544	-	-	1011	-
Stage 1	586	-	-	-	-	-
Stage 2	684	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	285	542	-	-	1007	-
Mov Cap-2 Maneuver	285	-	-	-	-	-
Stage 1	583	-	-	-	-	-
Stage 2	655	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	16.24	0	0.57
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	285	542	1007	-
HCM Lane V/C Ratio	-	-	0.195	0.124	0.038	-
HCM Control Delay (s/veh)	-	-	20.7	12.6	8.7	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.7	0.4	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	125	2	428	2	2	0	385	1120	2	0	876	143
Future Volume (veh/h)	125	2	428	2	2	0	385	1120	2	0	876	143
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	136	2	0	2	2	0	418	1217	2	0	952	44
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	173	3		5	5	0	471	2499	4	2	1251	557
Arrive On Green	0.10	0.10	0.00	0.01	0.01	0.00	0.26	0.69	0.69	0.00	0.35	0.35
Sat Flow, veh/h	1757	26	1585	912	912	0	1781	3640	6	1781	3554	1581
Grp Volume(v), veh/h	138	0	0	4	0	0	418	594	625	0	952	44
Grp Sat Flow(s),veh/h/ln	1783	0	1585	1825	0	0	1781	1777	1869	1781	1777	1581
Q Serve(g_s), s	6.5	0.0	0.0	0.2	0.0	0.0	19.4	13.5	13.5	0.0	20.3	1.6
Cycle Q Clear(g_c), s	6.5	0.0	0.0	0.2	0.0	0.0	19.4	13.5	13.5	0.0	20.3	1.6
Prop In Lane	0.99		1.00	0.50		0.00	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	175	0		10	0	0	471	1220	1283	2	1251	557
V/C Ratio(X)	0.79	0.00		0.41	0.00	0.00	0.89	0.49	0.49	0.00	0.76	0.08
Avail Cap(c_a), veh/h	291	0		106	0	0	1017	1532	1612	187	2029	903
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	37.8	0.0	0.0	42.5	0.0	0.0	30.3	6.3	6.3	0.0	24.6	18.5
Incr Delay (d2), s/veh	7.6	0.0	0.0	25.8	0.0	0.0	5.8	0.3	0.3	0.0	1.0	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.2	0.0	0.0	0.2	0.0	0.0	8.8	4.2	4.4	0.0	8.3	0.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	45.4	0.0	0.0	68.4	0.0	0.0	36.2	6.6	6.6	0.0	25.6	18.6
LnGrp LOS	D			E			D	A	A		C	B
Approach Vol, veh/h		138			4			1637			996	
Approach Delay, s/veh		45.4			68.4			14.2			25.3	
Approach LOS		D			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	0.0	64.9		6.5	28.7	36.2		14.4				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	74.0		5.0	49.0	49.0		14.0				
Max Q Clear Time (g_c+I1), s	0.0	15.5		2.2	21.4	22.3		8.5				
Green Ext Time (p_c), s	0.0	11.5		0.0	1.3	7.9		0.3				

Intersection Summary	
HCM 7th Control Delay, s/veh	19.8
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	125	189	170	82	169	910	101	424	35	488	603	147
Future Volume (veh/h)	125	189	170	82	169	910	101	424	35	488	603	147
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	136	205	81	89	184	0	110	461	8	530	655	148
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	199	235	394	203	676		140	515	437	643	1102	249
Arrive On Green	0.25	0.25	0.25	0.05	0.36	0.00	0.08	0.28	0.28	0.19	0.38	0.38
Sat Flow, veh/h	598	939	1572	1781	1870	1585	1781	1870	1585	3456	2877	649
Grp Volume(v), veh/h	341	0	81	89	184	0	110	461	8	530	404	399
Grp Sat Flow(s),veh/h/ln	1536	0	1572	1781	1870	1585	1781	1870	1585	1728	1777	1749
Q Serve(g_s), s	21.2	0.0	4.1	3.6	7.1	0.0	6.2	24.1	0.4	15.0	18.5	18.5
Cycle Q Clear(g_c), s	21.7	0.0	4.1	3.6	7.1	0.0	6.2	24.1	0.4	15.0	18.5	18.5
Prop In Lane	0.40		1.00	1.00		1.00	1.00		1.00	1.00		0.37
Lane Grp Cap(c), veh/h	434	0	394	203	676		140	515	437	643	681	670
V/C Ratio(X)	0.79	0.00	0.21	0.44	0.27		0.79	0.89	0.02	0.82	0.59	0.59
Avail Cap(c_a), veh/h	517	0	479	391	919		350	607	514	1325	1083	1066
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	36.7	0.0	30.1	27.6	23.0	0.0	46.0	35.4	26.8	39.8	25.1	25.1
Incr Delay (d2), s/veh	6.6	0.0	0.3	1.5	0.2	0.0	9.4	14.2	0.0	2.7	0.8	0.8
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	8.8	0.0	1.6	1.6	3.1	0.0	3.1	12.8	0.1	6.5	7.8	7.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	43.3	0.0	30.4	29.1	23.2	0.0	55.4	49.6	26.8	42.5	25.9	25.9
LnGrp LOS	D		C	C	C		E	D	C	D	C	C
Approach Vol, veh/h		422			273			579			1333	
Approach Delay, s/veh		40.8			25.1			50.4			32.5	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	14.9	34.0	11.3	31.5	14.0	45.0		42.8
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	39.6	33.0	16.0	31.0	20.0	62.0		50.0
Max Q Clear Time (g_c+I1), s	17.0	26.1	5.6	23.7	8.2	20.5		9.1
Green Ext Time (p_c), s	1.9	1.6	0.1	1.4	0.2	6.1		1.1

Intersection Summary	
HCM 7th Control Delay, s/veh	37.1
HCM 7th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	19	16	8	6	26	220	0	20	3	103	407	12
Future Volume (veh/h)	19	16	8	6	26	220	0	20	3	103	407	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.98	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	21	17	1	7	28	52	0	22	1	112	442	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	319	199	315	178	344	320	421	341	287	664	820	24
Arrive On Green	0.21	0.21	0.21	0.21	0.21	0.21	0.00	0.18	0.18	0.10	0.45	0.45
Sat Flow, veh/h	627	961	1520	151	1660	1546	1781	1870	1572	1781	1807	53
Grp Volume(v), veh/h	38	0	1	35	0	52	0	22	1	112	0	455
Grp Sat Flow(s),veh/h/ln	1589	0	1520	1811	0	1546	1781	1870	1572	1781	0	1861
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.3	0.0	1.3	0.0	5.2
Cycle Q Clear(g_c), s	0.5	0.0	0.0	0.4	0.0	0.8	0.0	0.3	0.0	1.3	0.0	5.2
Prop In Lane	0.55		1.00	0.20		1.00	1.00		1.00	1.00		0.03
Lane Grp Cap(c), veh/h	518	0	315	521	0	320	421	341	287	664	0	844
V/C Ratio(X)	0.07	0.00	0.00	0.07	0.00	0.16	0.00	0.06	0.00	0.17	0.00	0.54
Avail Cap(c_a), veh/h	3004	0	2836	3397	0	2885	717	3490	2933	785	0	3472
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.5	0.0	9.3	9.4	0.0	9.6	0.0	10.0	9.9	6.7	0.0	5.8
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.1	0.0	0.5
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.3	0.0	1.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.5	0.0	9.3	9.5	0.0	9.8	0.0	10.1	9.9	6.8	0.0	6.4
LnGrp LOS	A		A	A		A		B	A	A		A
Approach Vol, veh/h		39			87			23			567	
Approach Delay, s/veh		9.5			9.7			10.0			6.4	
Approach LOS		A			A			B			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.0	10.4		11.1	0.0	18.4		11.1				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.3	2.3		2.5	0.0	7.2		2.8				
Green Ext Time (p_c), s	0.0	0.1		0.2	0.0	3.3		0.4				

Intersection Summary	
HCM 7th Control Delay, s/veh	7.1
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	12	102	26	10	39	225	799	32	43	318	16
Future Volume (veh/h)	15	12	102	26	10	39	225	799	32	43	318	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	16	13	24	28	11	4	245	868	19	47	346	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	107	36	50	181	47	116	309	1059	898	82	820	695
Arrive On Green	0.07	0.07	0.07	0.07	0.07	0.07	0.17	0.57	0.57	0.05	0.44	0.44
Sat Flow, veh/h	345	485	687	1000	641	1580	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	53	0	0	39	0	4	245	868	19	47	346	6
Grp Sat Flow(s),veh/h/ln	1517	0	0	1641	0	1580	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.9	0.0	0.0	0.0	0.0	0.1	7.5	21.5	0.3	1.5	7.3	0.1
Cycle Q Clear(g_c), s	2.0	0.0	0.0	1.2	0.0	0.1	7.5	21.5	0.3	1.5	7.3	0.1
Prop In Lane	0.30		0.45	0.72		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	193	0	0	228	0	116	309	1059	898	82	820	695
V/C Ratio(X)	0.27	0.00	0.00	0.17	0.00	0.03	0.79	0.82	0.02	0.57	0.42	0.01
Avail Cap(c_a), veh/h	656	0	0	662	0	580	747	3726	3158	311	3269	2770
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	25.5	0.0	0.0	25.1	0.0	24.6	22.7	10.0	5.4	26.7	11.1	9.0
Incr Delay (d2), s/veh	0.8	0.0	0.0	0.4	0.0	0.1	4.6	1.6	0.0	6.2	0.3	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	0.0	0.0	0.5	0.0	0.1	3.3	7.0	0.1	0.7	2.6	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	26.2	0.0	0.0	25.5	0.0	24.8	27.2	11.7	5.5	32.9	11.4	9.1
LnGrp LOS	C			C		C	C	B	A	C	B	A
Approach Vol, veh/h		53			43			1132			399	
Approach Delay, s/veh		26.2			25.4			14.9			13.9	
Approach LOS		C			C			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.6	38.4		10.2	15.9	31.1		10.2
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0
Max Q Clear Time (g_c+I1), s	3.5	23.5		4.0	9.5	9.3		3.2
Green Ext Time (p_c), s	0.0	8.9		0.2	0.6	2.4		0.1

Intersection Summary	
HCM 7th Control Delay, s/veh	15.3
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	400	0	1129	483	2
Future Vol, veh/h	0	400	0	1129	483	2
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	435	0	1227	525	2

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2028 AM – Alternative 2

Intersection	
Int Delay, s/veh	3.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	17	95	81	321	539	20
Future Vol, veh/h	17	95	81	321	539	20
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	18	103	88	349	586	22

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1223	739	709	0	-	0
Stage 1	698	-	-	-	-	-
Stage 2	525	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	198	417	890	-	-	-
Stage 1	494	-	-	-	-	-
Stage 2	593	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	144	363	805	-	-	-
Mov Cap-2 Maneuver	144	-	-	-	-	-
Stage 1	397	-	-	-	-	-
Stage 2	536	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	25.54	2.02	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	805	-	295	-	-
HCM Lane V/C Ratio	0.109	-	0.413	-	-
HCM Control Delay (s/veh)	10	-	25.5	-	-
HCM Lane LOS	B	-	D	-	-
HCM 95th %tile Q(veh)	0.4	-	1.9	-	-

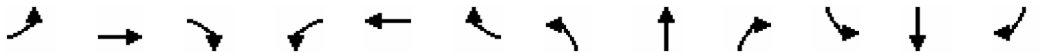
Intersection	
Int Delay, s/veh	1.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	24	36	369	23	45	595
Future Vol, veh/h	24	36	369	23	45	595
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	26	39	401	25	49	647

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	844	418	0	0	430	0
Stage 1	418	-	-	-	-	-
Stage 2	426	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	318	634	-	-	1128	-
Stage 1	664	-	-	-	-	-
Stage 2	627	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	301	632	-	-	1123	-
Mov Cap-2 Maneuver	301	-	-	-	-	-
Stage 1	661	-	-	-	-	-
Stage 2	597	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	13.88	0	0.59
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	301	632	1123	-
HCM Lane V/C Ratio	-	-	0.087	0.062	0.044	-
HCM Control Delay (s/veh)	-	-	18.1	11.1	8.4	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.3	0.2	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	148	1	471	2	5	0	282	863	5	4	1015	148
Future Volume (veh/h)	148	1	471	2	5	0	282	863	5	4	1015	148
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	161	1	0	2	5	0	307	938	5	4	1103	85
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	199	1		5	12	0	355	2200	12	9	1469	653
Arrive On Green	0.11	0.11	0.00	0.01	0.01	0.00	0.20	0.61	0.61	0.01	0.41	0.41
Sat Flow, veh/h	1771	11	1585	527	1317	0	1781	3624	19	1781	3554	1581
Grp Volume(v), veh/h	162	0	0	7	0	0	307	460	483	4	1103	85
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1844	0	0	1781	1777	1867	1781	1777	1581
Q Serve(g_s), s	8.0	0.0	0.0	0.3	0.0	0.0	15.0	12.4	12.4	0.2	23.8	3.0
Cycle Q Clear(g_c), s	8.0	0.0	0.0	0.3	0.0	0.0	15.0	12.4	12.4	0.2	23.8	3.0
Prop In Lane	0.99		1.00	0.29		0.00	1.00		0.01	1.00		1.00
Lane Grp Cap(c), veh/h	201	0		16	0	0	355	1079	1133	9	1469	653
V/C Ratio(X)	0.81	0.00		0.43	0.00	0.00	0.87	0.43	0.43	0.42	0.75	0.13
Avail Cap(c_a), veh/h	296	0		184	0	0	869	2542	2670	178	3113	1385
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	39.1	0.0	0.0	44.5	0.0	0.0	34.9	9.4	9.4	44.7	22.5	16.4
Incr Delay (d2), s/veh	9.8	0.0	0.0	16.5	0.0	0.0	6.4	0.3	0.3	27.6	0.8	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.0	0.0	0.0	0.2	0.0	0.0	7.0	4.4	4.6	0.2	9.6	1.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	48.9	0.0	0.0	60.9	0.0	0.0	41.3	9.7	9.6	72.3	23.3	16.5
LnGrp LOS	D			E			D	A	A	E	C	B
Approach Vol, veh/h		162			7			1250			1192	
Approach Delay, s/veh		48.9			60.9			17.4			23.0	
Approach LOS		D			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.5	60.8		6.8	24.0	43.3		16.2				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	129.0		9.0	44.0	79.0		15.0				
Max Q Clear Time (g_c+I1), s	2.2	14.4		2.3	17.0	25.8		10.0				
Green Ext Time (p_c), s	0.0	7.7		0.0	0.9	11.5		0.3				

Intersection Summary			
HCM 7th Control Delay, s/veh		22.0	
HCM 7th LOS		C	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	57	111	62	33	136	1038	56	448	36	695	626	76
Future Volume (veh/h)	57	111	62	33	136	1038	56	448	36	695	626	76
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	62	121	24	36	148	0	61	487	7	755	680	76
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	120	163	218	182	453		79	532	450	915	1625	181
Arrive On Green	0.14	0.14	0.14	0.03	0.24	0.00	0.04	0.28	0.28	0.26	0.50	0.50
Sat Flow, veh/h	463	1172	1562	1781	1870	1585	1781	1870	1585	3456	3221	360
Grp Volume(v), veh/h	183	0	24	36	148	0	61	487	7	755	375	381
Grp Sat Flow(s),veh/h/ln	1635	0	1562	1781	1870	1585	1781	1870	1585	1728	1777	1804
Q Serve(g_s), s	7.6	0.0	1.2	1.4	5.6	0.0	2.9	21.7	0.3	17.7	11.4	11.5
Cycle Q Clear(g_c), s	9.3	0.0	1.2	1.4	5.6	0.0	2.9	21.7	0.3	17.7	11.4	11.5
Prop In Lane	0.34		1.00	1.00		1.00	1.00		1.00	1.00		0.20
Lane Grp Cap(c), veh/h	284	0	218	182	453		79	532	450	915	896	910
V/C Ratio(X)	0.65	0.00	0.11	0.20	0.33		0.77	0.92	0.02	0.83	0.42	0.42
Avail Cap(c_a), veh/h	376	0	308	371	672		248	564	478	2364	1731	1757
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	35.8	0.0	32.4	29.2	26.9	0.0	40.8	29.9	22.2	29.8	13.4	13.4
Incr Delay (d2), s/veh	2.5	0.0	0.2	0.5	0.4	0.0	14.3	19.3	0.0	2.0	0.3	0.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.8	0.0	0.4	0.6	2.5	0.0	1.6	12.2	0.1	7.4	4.3	4.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	38.3	0.0	32.7	29.7	27.3	0.0	55.1	49.1	22.2	31.8	13.7	13.7
LnGrp LOS	D		C	C	C		E	D	C	C	B	B
Approach Vol, veh/h		207			184			555			1511	
Approach Delay, s/veh		37.6			27.8			49.4			22.8	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	28.8	30.5	8.9	18.0	9.8	49.5		26.9
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	22.8	26.0	12.0	17.0	12.0	84.0		31.0
Max Q Clear Time (g_c+I1), s	19.7	23.7	3.4	11.3	4.9	13.5		7.6
Green Ext Time (p_c), s	3.1	0.7	0.0	0.5	0.1	5.7		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	30.4
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	7	10	5	12	226	0	16	1	103	390	9
Future Volume (veh/h)	15	7	10	5	12	226	0	16	1	103	390	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.97	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	16	8	2	5	13	49	0	17	1	112	424	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	362	139	290	200	303	296	433	346	291	679	839	20
Arrive On Green	0.19	0.19	0.19	0.19	0.19	0.19	0.00	0.18	0.18	0.10	0.46	0.46
Sat Flow, veh/h	802	723	1515	209	1580	1543	1781	1870	1572	1781	1820	43
Grp Volume(v), veh/h	24	0	2	18	0	49	0	17	1	112	0	434
Grp Sat Flow(s),veh/h/ln	1526	0	1515	1789	0	1543	1781	1870	1572	1781	0	1862
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.2	0.0	1.2	0.0	4.7
Cycle Q Clear(g_c), s	0.3	0.0	0.0	0.2	0.0	0.8	0.0	0.2	0.0	1.2	0.0	4.7
Prop In Lane	0.67		1.00	0.28		1.00	1.00		1.00	1.00		0.02
Lane Grp Cap(c), veh/h	501	0	290	503	0	296	433	346	291	679	0	859
V/C Ratio(X)	0.05	0.00	0.01	0.04	0.00	0.17	0.00	0.05	0.00	0.16	0.00	0.51
Avail Cap(c_a), veh/h	2997	0	2892	3400	0	2945	736	3570	3001	805	0	3555
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.5	0.0	9.4	9.5	0.0	9.7	0.0	9.7	9.6	6.4	0.0	5.5
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1	0.0	0.1	0.0	0.5
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.3	0.0	0.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.6	0.0	9.4	9.5	0.0	10.0	0.0	9.7	9.6	6.6	0.0	5.9
LnGrp LOS	A		A	A		A		A	A	A		A
Approach Vol, veh/h		26			67			18			546	
Approach Delay, s/veh		9.6			9.9			9.7			6.0	
Approach LOS		A			A			A			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.0	10.3		10.5	0.0	18.3		10.5				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.2	2.2		2.3	0.0	6.7		2.8				
Green Ext Time (p_c), s	0.0	0.1		0.1	0.0	3.1		0.3				

Intersection Summary	
HCM 7th Control Delay, s/veh	6.7
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	10	92	40	11	72	222	1001	36	45	346	9
Future Volume (veh/h)	5	10	92	40	11	72	222	1001	36	45	346	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	5	11	5	43	12	6	241	1088	24	49	376	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	68	51	19	155	20	90	282	1255	1064	75	1038	880
Arrive On Green	0.06	0.06	0.06	0.06	0.06	0.06	0.16	0.67	0.67	0.04	0.56	0.56
Sat Flow, veh/h	187	899	339	1282	358	1578	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	21	0	0	55	0	6	241	1088	24	49	376	6
Grp Sat Flow(s),veh/h/ln	1426	0	0	1640	0	1578	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.3	10.3	35.8	0.4	2.1	8.8	0.1
Cycle Q Clear(g_c), s	2.3	0.0	0.0	2.3	0.0	0.3	10.3	35.8	0.4	2.1	8.8	0.1
Prop In Lane	0.24		0.24	0.78		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	138	0	0	175	0	90	282	1255	1064	75	1038	880
V/C Ratio(X)	0.15	0.00	0.00	0.31	0.00	0.07	0.86	0.87	0.02	0.66	0.36	0.01
Avail Cap(c_a), veh/h	404	0	0	411	0	343	319	2726	2310	228	2630	2229
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	35.2	0.0	0.0	35.9	0.0	34.9	32.1	10.1	4.3	36.9	9.7	7.8
Incr Delay (d2), s/veh	0.5	0.0	0.0	1.0	0.0	0.3	18.3	1.9	0.0	9.4	0.2	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	0.0	0.0	1.0	0.0	0.1	5.7	11.8	0.1	1.1	3.3	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	35.7	0.0	0.0	36.9	0.0	35.2	50.4	12.1	4.3	46.3	9.9	7.8
LnGrp LOS	D			D		D	D	B	A	D	A	A
Approach Vol, veh/h		21			61			1353			431	
Approach Delay, s/veh		35.7			36.8			18.7			14.0	
Approach LOS		D			D			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	9.3	58.5		10.4	18.4	49.4		10.4
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		17.0	14.0	110.0		17.0
Max Q Clear Time (g_c+I1), s	4.1	37.8		4.3	12.3	10.8		4.3
Green Ext Time (p_c), s	0.0	14.7		0.0	0.1	2.6		0.2

Intersection Summary	
HCM 7th Control Delay, s/veh	18.4
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	386	0	1235	492	1
Future Vol, veh/h	0	386	0	1235	492	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	420	0	1342	535	1

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2028 PM – Alternative 2

Intersection	
Int Delay, s/veh	5.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	25	137	97	523	489	32
Future Vol, veh/h	25	137	97	523	489	32
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	27	149	105	568	532	35

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1429	691	667	0	-	0
Stage 1	650	-	-	-	-	-
Stage 2	779	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	148	445	922	-	-	-
Stage 1	520	-	-	-	-	-
Stage 2	452	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	106	386	834	-	-	-
Mov Cap-2 Maneuver	106	-	-	-	-	-
Stage 1	410	-	-	-	-	-
Stage 2	409	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	38.99	1.56	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	834	-	274	-	-
HCM Lane V/C Ratio	0.126	-	0.642	-	-
HCM Control Delay (s/veh)	9.9	-	39	-	-
HCM Lane LOS	A	-	E	-	-
HCM 95th %tile Q(veh)	0.4	-	4	-	-

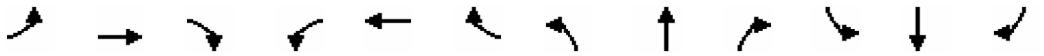
Intersection	
Int Delay, s/veh	2.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	49	71	551	49	53	575
Future Vol, veh/h	49	71	551	49	53	575
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	53	77	599	53	58	625

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1062	630	0	0	656	0
Stage 1	630	-	-	-	-	-
Stage 2	433	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	232	481	-	-	929	-
Stage 1	530	-	-	-	-	-
Stage 2	623	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	216	479	-	-	926	-
Mov Cap-2 Maneuver	216	-	-	-	-	-
Stage 1	528	-	-	-	-	-
Stage 2	581	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	19.29	0	0.77
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	216	479	926	-
HCM Lane V/C Ratio	-	-	0.246	0.161	0.062	-
HCM Control Delay (s/veh)	-	-	27	14	9.1	-
HCM Lane LOS	-	-	D	B	A	-
HCM 95th %tile Q(veh)	-	-	0.9	0.6	0.2	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	133	1	543	9	2	6	476	1343	0	1	1066	170
Future Volume (veh/h)	133	1	543	9	2	6	476	1343	0	1	1066	170
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	145	1	0	10	2	2	517	1460	0	1	1159	103
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	176	1		19	4	4	552	2489	0	2	1391	619
Arrive On Green	0.10	0.10	0.00	0.02	0.02	0.02	0.31	0.70	0.00	0.00	0.39	0.39
Sat Flow, veh/h	1770	12	1585	1259	252	252	1781	3647	0	1781	3554	1581
Grp Volume(v), veh/h	146	0	0	14	0	0	517	1460	0	1	1159	103
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1762	0	0	1781	1777	0	1781	1777	1581
Q Serve(g_s), s	10.5	0.0	0.0	1.0	0.0	0.0	36.8	27.3	0.0	0.1	38.4	5.5
Cycle Q Clear(g_c), s	10.5	0.0	0.0	1.0	0.0	0.0	36.8	27.3	0.0	0.1	38.4	5.5
Prop In Lane	0.99		1.00	0.71		0.14	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	177	0		27	0	0	552	2489	0	2	1391	619
V/C Ratio(X)	0.83	0.00		0.52	0.00	0.00	0.94	0.59	0.00	0.41	0.83	0.17
Avail Cap(c_a), veh/h	328	0		121	0	0	805	2831	0	123	1879	836
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	57.7	0.0	0.0	63.8	0.0	0.0	43.8	10.0	0.0	65.1	35.9	25.9
Incr Delay (d2), s/veh	9.3	0.0	0.0	14.7	0.0	0.0	14.0	0.2	0.0	84.8	2.5	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.2	0.0	0.0	0.6	0.0	0.0	18.3	10.0	0.0	0.1	17.0	2.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	67.0	0.0	0.0	78.5	0.0	0.0	57.8	10.2	0.0	149.9	38.4	26.0
LnGrp LOS	E			E			E	B		F	D	C
Approach Vol, veh/h		146			14			1977			1263	
Approach Delay, s/veh		67.0			78.5			22.6			37.4	
Approach LOS		E			E			C			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.2	97.4		8.0	46.5	57.1		19.0				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	104.0		9.0	59.0	69.0		24.0				
Max Q Clear Time (g_c+I1), s	2.1	29.3		3.0	38.8	40.4		12.5				
Green Ext Time (p_c), s	0.0	18.7		0.0	1.7	10.7		0.5				

Intersection Summary			
HCM 7th Control Delay, s/veh		30.3	
HCM 7th LOS		C	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	88	125	124	26	132	1081	54	440	27	819	605	86
Future Volume (veh/h)	88	125	124	26	132	1081	54	440	27	819	605	86
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	96	136	46	28	143	0	59	478	6	890	658	86
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	155	169	278	153	482		76	544	461	998	1696	221
Arrive On Green	0.18	0.18	0.18	0.03	0.26	0.00	0.04	0.29	0.29	0.29	0.54	0.54
Sat Flow, veh/h	612	951	1567	1781	1870	1585	1781	1870	1585	3456	3159	412
Grp Volume(v), veh/h	232	0	46	28	143	0	59	478	6	890	370	374
Grp Sat Flow(s),veh/h/ln	1563	0	1567	1781	1870	1585	1781	1870	1585	1728	1777	1794
Q Serve(g_s), s	14.9	0.0	2.8	1.4	6.8	0.0	3.6	27.0	0.3	27.3	13.5	13.5
Cycle Q Clear(g_c), s	15.8	0.0	2.8	1.4	6.8	0.0	3.6	27.0	0.3	27.3	13.5	13.5
Prop In Lane	0.41		1.00	1.00		1.00	1.00		1.00	1.00		0.23
Lane Grp Cap(c), veh/h	324	0	278	153	482		76	544	461	998	954	963
V/C Ratio(X)	0.72	0.00	0.17	0.18	0.30		0.77	0.88	0.01	0.89	0.39	0.39
Avail Cap(c_a), veh/h	468	0	424	332	810		145	912	773	1217	954	963
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	43.9	0.0	38.6	35.6	33.0	0.0	52.5	37.4	28.0	37.7	15.0	15.0
Incr Delay (d2), s/veh	3.0	0.0	0.3	0.6	0.3	0.0	15.2	5.5	0.0	7.5	0.3	0.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.4	0.0	1.1	0.6	3.1	0.0	1.9	13.0	0.1	12.4	5.4	5.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	46.9	0.0	38.9	36.1	33.4	0.0	67.7	42.9	28.0	45.2	15.3	15.3
LnGrp LOS	D		D	D	C		E	D	C	D	B	B
Approach Vol, veh/h		278			171			543			1634	
Approach Delay, s/veh		45.5			33.8			45.5			31.6	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	38.0	38.2	8.9	25.7	10.7	65.5		34.6
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	32.0	54.0	14.0	30.0	9.0	59.0		48.0
Max Q Clear Time (g_c+I1), s	29.3	29.0	3.4	17.8	5.6	15.5		8.8
Green Ext Time (p_c), s	2.7	3.2	0.0	1.2	0.0	5.5		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	36.1
HCM 7th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	25	13	10	19	26	195	1	29	2	107	589	15
Future Volume (veh/h)	25	13	10	19	26	195	1	29	2	107	589	15
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.95	0.96		0.97	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	27	14	1	21	28	36	1	32	1	116	640	15
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	293	124	277	208	221	282	307	705	595	827	843	20
Arrive On Green	0.18	0.18	0.18	0.18	0.18	0.18	0.00	0.38	0.38	0.09	0.46	0.46
Sat Flow, veh/h	833	677	1512	477	1203	1541	1781	1870	1579	1781	1820	43
Grp Volume(v), veh/h	41	0	1	49	0	36	1	32	1	116	0	655
Grp Sat Flow(s),veh/h/ln	1510	0	1512	1681	0	1541	1781	1870	1579	1781	0	1863
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.5	0.0	1.5	0.0	12.4
Cycle Q Clear(g_c), s	0.8	0.0	0.0	0.9	0.0	0.8	0.0	0.5	0.0	1.5	0.0	12.4
Prop In Lane	0.66		1.00	0.43		1.00	1.00		1.00	1.00		0.02
Lane Grp Cap(c), veh/h	417	0	277	429	0	282	307	705	595	827	0	862
V/C Ratio(X)	0.10	0.00	0.00	0.11	0.00	0.13	0.00	0.05	0.00	0.14	0.00	0.76
Avail Cap(c_a), veh/h	2031	0	1953	2200	0	1991	512	2416	2040	880	0	2406
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	14.5	0.0	14.2	14.6	0.0	14.5	9.1	8.4	8.3	6.2	0.0	9.5
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.1	0.0	1.4
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.0	0.4	0.0	0.3	0.0	0.2	0.0	0.4	0.0	3.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	14.6	0.0	14.2	14.7	0.0	14.7	9.1	8.4	8.3	6.2	0.0	10.9
LnGrp LOS	B		B	B		B	A	A	A	A		B
Approach Vol, veh/h		42			85			34			771	
Approach Delay, s/veh		14.6			14.7			8.5			10.2	
Approach LOS		B			B			A			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.7	21.0		12.8	5.1	24.7		12.8				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.5	2.5		2.8	2.0	14.4		2.9				
Green Ext Time (p_c), s	0.0	0.2		0.2	0.0	5.3		0.4				

Intersection Summary	
HCM 7th Control Delay, s/veh	10.7
HCM 7th LOS	B



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	6	17	93	37	8	52	206	850	34	44	629	27
Future Volume (veh/h)	6	17	93	37	8	52	206	850	34	44	629	27
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	7	18	6	40	9	5	224	924	22	48	684	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	87	71	21	191	22	106	283	1111	941	81	899	762
Arrive On Green	0.07	0.07	0.07	0.07	0.07	0.07	0.16	0.59	0.59	0.05	0.48	0.48
Sat Flow, veh/h	231	1050	308	1253	331	1579	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	31	0	0	49	0	5	224	924	22	48	684	13
Grp Sat Flow(s),veh/h/ln	1589	0	0	1584	0	1579	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.2	7.4	24.3	0.4	1.6	18.4	0.3
Cycle Q Clear(g_c), s	1.6	0.0	0.0	1.6	0.0	0.2	7.4	24.3	0.4	1.6	18.4	0.3
Prop In Lane	0.23		0.19	0.82		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	179	0	0	213	0	106	283	1111	941	81	899	762
V/C Ratio(X)	0.17	0.00	0.00	0.23	0.00	0.05	0.79	0.83	0.02	0.59	0.76	0.02
Avail Cap(c_a), veh/h	641	0	0	611	0	540	697	3475	2945	290	3048	2583
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	27.2	0.0	0.0	27.4	0.0	26.8	24.8	10.0	5.1	28.7	13.0	8.3
Incr Delay (d2), s/veh	0.5	0.0	0.0	0.5	0.0	0.2	5.0	1.7	0.0	6.7	1.4	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	0.0	0.0	0.7	0.0	0.1	3.3	7.9	0.1	0.8	6.8	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	27.6	0.0	0.0	28.0	0.0	27.0	29.8	11.7	5.1	35.4	14.4	8.3
LnGrp LOS	C			C		C	C	B	A	D	B	A
Approach Vol, veh/h		31			54			1170			745	
Approach Delay, s/veh		27.6			27.9			15.0			15.6	
Approach LOS		C			C			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.8	42.4		10.1	15.7	35.5		10.1
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.8	114.0		21.0	24.0	100.0		21.0
Max Q Clear Time (g_c+I1), s	3.6	26.3		3.6	9.4	20.4		3.6
Green Ext Time (p_c), s	0.0	10.1		0.1	0.5	5.9		0.2

Intersection Summary	
HCM 7th Control Delay, s/veh	15.8
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	570	0	1098	846	4
Future Vol, veh/h	0	570	0	1098	846	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	620	0	1193	920	4

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2028 SAT – Alternative 2

Intersection	
Int Delay, s/veh	2.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	19	71	76	458	447	17
Future Vol, veh/h	19	71	76	458	447	17
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	21	77	83	498	486	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1259	637	605	0	-	0
Stage 1	596	-	-	-	-	-
Stage 2	663	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	188	477	973	-	-	-
Stage 1	550	-	-	-	-	-
Stage 2	512	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	139	414	879	-	-	-
Mov Cap-2 Maneuver	139	-	-	-	-	-
Stage 1	451	-	-	-	-	-
Stage 2	463	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	23.36	1.35	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	879	-	293	-	-
HCM Lane V/C Ratio	0.094	-	0.334	-	-
HCM Control Delay (s/veh)	9.5	-	23.4	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0.3	-	1.4	-	-

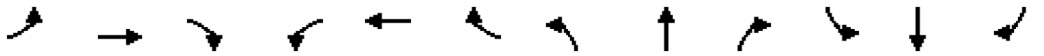
Intersection	
Int Delay, s/veh	1.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	51	62	469	41	35	497
Future Vol, veh/h	51	62	469	41	35	497
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	55	67	510	45	38	540

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	887	536	0	0	558	0
Stage 1	536	-	-	-	-	-
Stage 2	351	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	299	544	-	-	1011	-
Stage 1	586	-	-	-	-	-
Stage 2	684	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	285	542	-	-	1007	-
Mov Cap-2 Maneuver	285	-	-	-	-	-
Stage 1	583	-	-	-	-	-
Stage 2	655	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	16.24	0	0.57
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	285	542	1007	-
HCM Lane V/C Ratio	-	-	0.195	0.124	0.038	-
HCM Control Delay (s/veh)	-	-	20.7	12.6	8.7	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.7	0.4	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	125	2	428	2	2	0	385	1120	2	0	876	143
Future Volume (veh/h)	125	2	428	2	2	0	385	1120	2	0	876	143
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	136	2	0	2	2	0	418	1217	2	0	952	44
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	173	3		5	5	0	471	2499	4	2	1251	557
Arrive On Green	0.10	0.10	0.00	0.01	0.01	0.00	0.26	0.69	0.69	0.00	0.35	0.35
Sat Flow, veh/h	1757	26	1585	912	912	0	1781	3640	6	1781	3554	1581
Grp Volume(v), veh/h	138	0	0	4	0	0	418	594	625	0	952	44
Grp Sat Flow(s),veh/h/ln	1783	0	1585	1825	0	0	1781	1777	1869	1781	1777	1581
Q Serve(g_s), s	6.5	0.0	0.0	0.2	0.0	0.0	19.4	13.5	13.5	0.0	20.3	1.6
Cycle Q Clear(g_c), s	6.5	0.0	0.0	0.2	0.0	0.0	19.4	13.5	13.5	0.0	20.3	1.6
Prop In Lane	0.99		1.00	0.50		0.00	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	175	0		10	0	0	471	1220	1283	2	1251	557
V/C Ratio(X)	0.79	0.00		0.41	0.00	0.00	0.89	0.49	0.49	0.00	0.76	0.08
Avail Cap(c_a), veh/h	291	0		106	0	0	1017	1532	1612	187	2029	903
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	37.8	0.0	0.0	42.5	0.0	0.0	30.3	6.3	6.3	0.0	24.6	18.5
Incr Delay (d2), s/veh	7.6	0.0	0.0	25.8	0.0	0.0	5.8	0.3	0.3	0.0	1.0	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.2	0.0	0.0	0.2	0.0	0.0	8.8	4.2	4.4	0.0	8.3	0.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	45.4	0.0	0.0	68.4	0.0	0.0	36.2	6.6	6.6	0.0	25.6	18.6
LnGrp LOS	D			E			D	A	A		C	B
Approach Vol, veh/h		138			4			1637			996	
Approach Delay, s/veh		45.4			68.4			14.2			25.3	
Approach LOS		D			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	0.0	64.9		6.5	28.7	36.2		14.4				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	74.0		5.0	49.0	49.0		14.0				
Max Q Clear Time (g_c+I1), s	0.0	15.5		2.2	21.4	22.3		8.5				
Green Ext Time (p_c), s	0.0	11.5		0.0	1.3	7.9		0.3				

Intersection Summary	
HCM 7th Control Delay, s/veh	19.8
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	125	189	170	82	169	910	101	424	35	488	603	147
Future Volume (veh/h)	125	189	170	82	169	910	101	424	35	488	603	147
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	136	205	81	89	184	0	110	461	8	530	655	148
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	199	235	394	203	676		140	515	437	643	1102	249
Arrive On Green	0.25	0.25	0.25	0.05	0.36	0.00	0.08	0.28	0.28	0.19	0.38	0.38
Sat Flow, veh/h	598	939	1572	1781	1870	1585	1781	1870	1585	3456	2877	649
Grp Volume(v), veh/h	341	0	81	89	184	0	110	461	8	530	404	399
Grp Sat Flow(s),veh/h/ln	1536	0	1572	1781	1870	1585	1781	1870	1585	1728	1777	1749
Q Serve(g_s), s	21.2	0.0	4.1	3.6	7.1	0.0	6.2	24.1	0.4	15.0	18.5	18.5
Cycle Q Clear(g_c), s	21.7	0.0	4.1	3.6	7.1	0.0	6.2	24.1	0.4	15.0	18.5	18.5
Prop In Lane	0.40		1.00	1.00		1.00	1.00		1.00	1.00		0.37
Lane Grp Cap(c), veh/h	434	0	394	203	676		140	515	437	643	681	670
V/C Ratio(X)	0.79	0.00	0.21	0.44	0.27		0.79	0.89	0.02	0.82	0.59	0.59
Avail Cap(c_a), veh/h	517	0	479	391	919		350	607	514	1325	1083	1066
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	36.7	0.0	30.1	27.6	23.0	0.0	46.0	35.4	26.8	39.8	25.1	25.1
Incr Delay (d2), s/veh	6.6	0.0	0.3	1.5	0.2	0.0	9.4	14.2	0.0	2.7	0.8	0.8
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	8.8	0.0	1.6	1.6	3.1	0.0	3.1	12.8	0.1	6.5	7.8	7.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	43.3	0.0	30.4	29.1	23.2	0.0	55.4	49.6	26.8	42.5	25.9	25.9
LnGrp LOS	D		C	C	C		E	D	C	D	C	C
Approach Vol, veh/h		422			273			579			1333	
Approach Delay, s/veh		40.8			25.1			50.4			32.5	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	14.9	34.0	11.3	31.5	14.0	45.0		42.8
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	39.6	33.0	16.0	31.0	20.0	62.0		50.0
Max Q Clear Time (g_c+I1), s	17.0	26.1	5.6	23.7	8.2	20.5		9.1
Green Ext Time (p_c), s	1.9	1.6	0.1	1.4	0.2	6.1		1.1

Intersection Summary	
HCM 7th Control Delay, s/veh	37.1
HCM 7th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	19	16	8	6	26	220	0	20	3	103	407	12
Future Volume (veh/h)	19	16	8	6	26	220	0	20	3	103	407	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.98	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	21	17	1	7	28	52	0	22	1	112	442	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	319	199	315	178	344	320	421	341	287	664	820	24
Arrive On Green	0.21	0.21	0.21	0.21	0.21	0.21	0.00	0.18	0.18	0.10	0.45	0.45
Sat Flow, veh/h	627	961	1520	151	1660	1546	1781	1870	1572	1781	1807	53
Grp Volume(v), veh/h	38	0	1	35	0	52	0	22	1	112	0	455
Grp Sat Flow(s),veh/h/ln	1589	0	1520	1811	0	1546	1781	1870	1572	1781	0	1861
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.3	0.0	1.3	0.0	5.2
Cycle Q Clear(g_c), s	0.5	0.0	0.0	0.4	0.0	0.8	0.0	0.3	0.0	1.3	0.0	5.2
Prop In Lane	0.55		1.00	0.20		1.00	1.00		1.00	1.00		0.03
Lane Grp Cap(c), veh/h	518	0	315	521	0	320	421	341	287	664	0	844
V/C Ratio(X)	0.07	0.00	0.00	0.07	0.00	0.16	0.00	0.06	0.00	0.17	0.00	0.54
Avail Cap(c_a), veh/h	3004	0	2836	3397	0	2885	717	3490	2933	785	0	3472
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.5	0.0	9.3	9.4	0.0	9.6	0.0	10.0	9.9	6.7	0.0	5.8
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.1	0.0	0.5
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.3	0.0	1.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.5	0.0	9.3	9.5	0.0	9.8	0.0	10.1	9.9	6.8	0.0	6.4
LnGrp LOS	A		A	A		A		B	A	A		A
Approach Vol, veh/h		39			87			23			567	
Approach Delay, s/veh		9.5			9.7			10.0			6.4	
Approach LOS		A			A			B			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.0	10.4		11.1	0.0	18.4		11.1				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.3	2.3		2.5	0.0	7.2		2.8				
Green Ext Time (p_c), s	0.0	0.1		0.2	0.0	3.3		0.4				

Intersection Summary	
HCM 7th Control Delay, s/veh	7.1
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	12	102	26	10	39	225	799	32	43	318	16
Future Volume (veh/h)	15	12	102	26	10	39	225	799	32	43	318	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	16	13	24	28	11	4	245	868	19	47	346	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	107	36	50	181	47	116	309	1059	898	82	820	695
Arrive On Green	0.07	0.07	0.07	0.07	0.07	0.07	0.17	0.57	0.57	0.05	0.44	0.44
Sat Flow, veh/h	345	485	687	1000	641	1580	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	53	0	0	39	0	4	245	868	19	47	346	6
Grp Sat Flow(s),veh/h/ln	1517	0	0	1641	0	1580	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.9	0.0	0.0	0.0	0.0	0.1	7.5	21.5	0.3	1.5	7.3	0.1
Cycle Q Clear(g_c), s	2.0	0.0	0.0	1.2	0.0	0.1	7.5	21.5	0.3	1.5	7.3	0.1
Prop In Lane	0.30		0.45	0.72		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	193	0	0	228	0	116	309	1059	898	82	820	695
V/C Ratio(X)	0.27	0.00	0.00	0.17	0.00	0.03	0.79	0.82	0.02	0.57	0.42	0.01
Avail Cap(c_a), veh/h	656	0	0	662	0	580	747	3726	3158	311	3269	2770
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	25.5	0.0	0.0	25.1	0.0	24.6	22.7	10.0	5.4	26.7	11.1	9.0
Incr Delay (d2), s/veh	0.8	0.0	0.0	0.4	0.0	0.1	4.6	1.6	0.0	6.2	0.3	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	0.0	0.0	0.5	0.0	0.1	3.3	7.0	0.1	0.7	2.6	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	26.2	0.0	0.0	25.5	0.0	24.8	27.2	11.7	5.5	32.9	11.4	9.1
LnGrp LOS	C			C		C	C	B	A	C	B	A
Approach Vol, veh/h		53			43			1132			399	
Approach Delay, s/veh		26.2			25.4			14.9			13.9	
Approach LOS		C			C			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.6	38.4		10.2	15.9	31.1		10.2
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0
Max Q Clear Time (g_c+I1), s	3.5	23.5		4.0	9.5	9.3		3.2
Green Ext Time (p_c), s	0.0	8.9		0.2	0.6	2.4		0.1

Intersection Summary	
HCM 7th Control Delay, s/veh	15.3
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	400	0	1129	483	2
Future Vol, veh/h	0	400	0	1129	483	2
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	435	0	1227	525	2

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2028 AM – Alternative 3

Intersection	
Int Delay, s/veh	3.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	17	95	81	321	539	20
Future Vol, veh/h	17	95	81	321	539	20
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	18	103	88	349	586	22

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1223	739	709	0	-	0
Stage 1	698	-	-	-	-	-
Stage 2	525	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	198	417	890	-	-	-
Stage 1	494	-	-	-	-	-
Stage 2	593	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	144	363	805	-	-	-
Mov Cap-2 Maneuver	144	-	-	-	-	-
Stage 1	397	-	-	-	-	-
Stage 2	536	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	25.54	2.02	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	805	-	295	-	-
HCM Lane V/C Ratio	0.109	-	0.413	-	-
HCM Control Delay (s/veh)	10	-	25.5	-	-
HCM Lane LOS	B	-	D	-	-
HCM 95th %tile Q(veh)	0.4	-	1.9	-	-

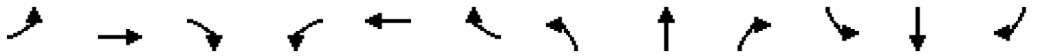
Intersection	
Int Delay, s/veh	1.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	24	36	369	23	45	595
Future Vol, veh/h	24	36	369	23	45	595
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	26	39	401	25	49	647

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	844	418	0	0	430	0
Stage 1	418	-	-	-	-	-
Stage 2	426	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	318	634	-	-	1128	-
Stage 1	664	-	-	-	-	-
Stage 2	627	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	301	632	-	-	1123	-
Mov Cap-2 Maneuver	301	-	-	-	-	-
Stage 1	661	-	-	-	-	-
Stage 2	597	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	13.88	0	0.59
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	301	632	1123	-
HCM Lane V/C Ratio	-	-	0.087	0.062	0.044	-
HCM Control Delay (s/veh)	-	-	18.1	11.1	8.4	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.3	0.2	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	148	1	471	2	5	0	282	863	5	4	1015	148
Future Volume (veh/h)	148	1	471	2	5	0	282	863	5	4	1015	148
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	161	1	0	2	5	0	307	938	5	4	1103	85
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	199	1		5	12	0	355	2200	12	9	1469	653
Arrive On Green	0.11	0.11	0.00	0.01	0.01	0.00	0.20	0.61	0.61	0.01	0.41	0.41
Sat Flow, veh/h	1771	11	1585	527	1317	0	1781	3624	19	1781	3554	1581
Grp Volume(v), veh/h	162	0	0	7	0	0	307	460	483	4	1103	85
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1844	0	0	1781	1777	1867	1781	1777	1581
Q Serve(g_s), s	8.0	0.0	0.0	0.3	0.0	0.0	15.0	12.4	12.4	0.2	23.8	3.0
Cycle Q Clear(g_c), s	8.0	0.0	0.0	0.3	0.0	0.0	15.0	12.4	12.4	0.2	23.8	3.0
Prop In Lane	0.99		1.00	0.29		0.00	1.00		0.01	1.00		1.00
Lane Grp Cap(c), veh/h	201	0		16	0	0	355	1079	1133	9	1469	653
V/C Ratio(X)	0.81	0.00		0.43	0.00	0.00	0.87	0.43	0.43	0.42	0.75	0.13
Avail Cap(c_a), veh/h	296	0		184	0	0	869	2542	2670	178	3113	1385
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	39.1	0.0	0.0	44.5	0.0	0.0	34.9	9.4	9.4	44.7	22.5	16.4
Incr Delay (d2), s/veh	9.8	0.0	0.0	16.5	0.0	0.0	6.4	0.3	0.3	27.6	0.8	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.0	0.0	0.0	0.2	0.0	0.0	7.0	4.4	4.6	0.2	9.6	1.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	48.9	0.0	0.0	60.9	0.0	0.0	41.3	9.7	9.6	72.3	23.3	16.5
LnGrp LOS	D			E			D	A	A	E	C	B
Approach Vol, veh/h		162			7			1250			1192	
Approach Delay, s/veh		48.9			60.9			17.4			23.0	
Approach LOS		D			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.5	60.8		6.8	24.0	43.3		16.2				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	129.0		9.0	44.0	79.0		15.0				
Max Q Clear Time (g_c+I1), s	2.2	14.4		2.3	17.0	25.8		10.0				
Green Ext Time (p_c), s	0.0	7.7		0.0	0.9	11.5		0.3				

Intersection Summary			
HCM 7th Control Delay, s/veh		22.0	
HCM 7th LOS		C	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	57	111	62	33	136	1038	56	448	36	695	626	76
Future Volume (veh/h)	57	111	62	33	136	1038	56	448	36	695	626	76
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	62	121	24	36	148	0	61	487	7	755	680	76
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	120	163	218	182	453		79	532	450	915	1625	181
Arrive On Green	0.14	0.14	0.14	0.03	0.24	0.00	0.04	0.28	0.28	0.26	0.50	0.50
Sat Flow, veh/h	463	1172	1562	1781	1870	1585	1781	1870	1585	3456	3221	360
Grp Volume(v), veh/h	183	0	24	36	148	0	61	487	7	755	375	381
Grp Sat Flow(s),veh/h/ln	1635	0	1562	1781	1870	1585	1781	1870	1585	1728	1777	1804
Q Serve(g_s), s	7.6	0.0	1.2	1.4	5.6	0.0	2.9	21.7	0.3	17.7	11.4	11.5
Cycle Q Clear(g_c), s	9.3	0.0	1.2	1.4	5.6	0.0	2.9	21.7	0.3	17.7	11.4	11.5
Prop In Lane	0.34		1.00	1.00		1.00	1.00		1.00	1.00		0.20
Lane Grp Cap(c), veh/h	284	0	218	182	453		79	532	450	915	896	910
V/C Ratio(X)	0.65	0.00	0.11	0.20	0.33		0.77	0.92	0.02	0.83	0.42	0.42
Avail Cap(c_a), veh/h	376	0	308	371	672		248	564	478	2364	1731	1757
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	35.8	0.0	32.4	29.2	26.9	0.0	40.8	29.9	22.2	29.8	13.4	13.4
Incr Delay (d2), s/veh	2.5	0.0	0.2	0.5	0.4	0.0	14.3	19.3	0.0	2.0	0.3	0.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.8	0.0	0.4	0.6	2.5	0.0	1.6	12.2	0.1	7.4	4.3	4.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	38.3	0.0	32.7	29.7	27.3	0.0	55.1	49.1	22.2	31.8	13.7	13.7
LnGrp LOS	D		C	C	C		E	D	C	C	B	B
Approach Vol, veh/h		207			184			555			1511	
Approach Delay, s/veh		37.6			27.8			49.4			22.8	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	28.8	30.5	8.9	18.0	9.8	49.5		26.9
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	22.8	26.0	12.0	17.0	12.0	84.0		31.0
Max Q Clear Time (g_c+I1), s	19.7	23.7	3.4	11.3	4.9	13.5		7.6
Green Ext Time (p_c), s	3.1	0.7	0.0	0.5	0.1	5.7		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	30.4
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	7	10	5	12	226	0	16	1	103	390	9
Future Volume (veh/h)	15	7	10	5	12	226	0	16	1	103	390	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.97	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	16	8	2	5	13	49	0	17	1	112	424	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	362	139	290	200	303	296	433	346	291	679	839	20
Arrive On Green	0.19	0.19	0.19	0.19	0.19	0.19	0.00	0.18	0.18	0.10	0.46	0.46
Sat Flow, veh/h	802	723	1515	209	1580	1543	1781	1870	1572	1781	1820	43
Grp Volume(v), veh/h	24	0	2	18	0	49	0	17	1	112	0	434
Grp Sat Flow(s),veh/h/ln	1526	0	1515	1789	0	1543	1781	1870	1572	1781	0	1862
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.2	0.0	1.2	0.0	4.7
Cycle Q Clear(g_c), s	0.3	0.0	0.0	0.2	0.0	0.8	0.0	0.2	0.0	1.2	0.0	4.7
Prop In Lane	0.67		1.00	0.28		1.00	1.00		1.00	1.00		0.02
Lane Grp Cap(c), veh/h	501	0	290	503	0	296	433	346	291	679	0	859
V/C Ratio(X)	0.05	0.00	0.01	0.04	0.00	0.17	0.00	0.05	0.00	0.16	0.00	0.51
Avail Cap(c_a), veh/h	2997	0	2892	3400	0	2945	736	3570	3001	805	0	3555
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.5	0.0	9.4	9.5	0.0	9.7	0.0	9.7	9.6	6.4	0.0	5.5
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1	0.0	0.1	0.0	0.5
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.3	0.0	0.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.6	0.0	9.4	9.5	0.0	10.0	0.0	9.7	9.6	6.6	0.0	5.9
LnGrp LOS	A		A	A		A		A	A	A		A
Approach Vol, veh/h		26			67			18			546	
Approach Delay, s/veh		9.6			9.9			9.7			6.0	
Approach LOS		A			A			A			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.0	10.3		10.5	0.0	18.3		10.5				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.2	2.2		2.3	0.0	6.7		2.8				
Green Ext Time (p_c), s	0.0	0.1		0.1	0.0	3.1		0.3				

Intersection Summary	
HCM 7th Control Delay, s/veh	6.7
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	10	92	40	11	72	222	1001	36	45	346	9
Future Volume (veh/h)	5	10	92	40	11	72	222	1001	36	45	346	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	5	11	5	43	12	6	241	1088	24	49	376	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	68	51	19	155	20	90	282	1255	1064	75	1038	880
Arrive On Green	0.06	0.06	0.06	0.06	0.06	0.06	0.16	0.67	0.67	0.04	0.56	0.56
Sat Flow, veh/h	187	899	339	1282	358	1578	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	21	0	0	55	0	6	241	1088	24	49	376	6
Grp Sat Flow(s),veh/h/ln	1426	0	0	1640	0	1578	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.3	10.3	35.8	0.4	2.1	8.8	0.1
Cycle Q Clear(g_c), s	2.3	0.0	0.0	2.3	0.0	0.3	10.3	35.8	0.4	2.1	8.8	0.1
Prop In Lane	0.24		0.24	0.78		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	138	0	0	175	0	90	282	1255	1064	75	1038	880
V/C Ratio(X)	0.15	0.00	0.00	0.31	0.00	0.07	0.86	0.87	0.02	0.66	0.36	0.01
Avail Cap(c_a), veh/h	404	0	0	411	0	343	319	2726	2310	228	2630	2229
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	35.2	0.0	0.0	35.9	0.0	34.9	32.1	10.1	4.3	36.9	9.7	7.8
Incr Delay (d2), s/veh	0.5	0.0	0.0	1.0	0.0	0.3	18.3	1.9	0.0	9.4	0.2	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	0.0	0.0	1.0	0.0	0.1	5.7	11.8	0.1	1.1	3.3	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	35.7	0.0	0.0	36.9	0.0	35.2	50.4	12.1	4.3	46.3	9.9	7.8
LnGrp LOS	D			D		D	D	B	A	D	A	A
Approach Vol, veh/h		21			61			1353			431	
Approach Delay, s/veh		35.7			36.8			18.7			14.0	
Approach LOS		D			D			B			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	9.3	58.5		10.4	18.4	49.4		10.4				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	10.0	114.0		17.0	14.0	110.0		17.0				
Max Q Clear Time (g_c+I1), s	4.1	37.8		4.3	12.3	10.8		4.3				
Green Ext Time (p_c), s	0.0	14.7		0.0	0.1	2.6		0.2				

Intersection Summary	
HCM 7th Control Delay, s/veh	18.4
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	386	0	1235	492	1
Future Vol, veh/h	0	386	0	1235	492	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	420	0	1342	535	1

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2028 PM – Alternative 3

Intersection	
Int Delay, s/veh	5.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	25	137	97	523	489	32
Future Vol, veh/h	25	137	97	523	489	32
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	27	149	105	568	532	35

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1429	691	667	0	-	0
Stage 1	650	-	-	-	-	-
Stage 2	779	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	148	445	922	-	-	-
Stage 1	520	-	-	-	-	-
Stage 2	452	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	106	386	834	-	-	-
Mov Cap-2 Maneuver	106	-	-	-	-	-
Stage 1	410	-	-	-	-	-
Stage 2	409	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	38.99	1.56	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	834	-	274	-	-
HCM Lane V/C Ratio	0.126	-	0.642	-	-
HCM Control Delay (s/veh)	9.9	-	39	-	-
HCM Lane LOS	A	-	E	-	-
HCM 95th %tile Q(veh)	0.4	-	4	-	-

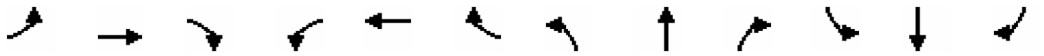
Intersection	
Int Delay, s/veh	2.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	49	71	551	49	53	575
Future Vol, veh/h	49	71	551	49	53	575
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	53	77	599	53	58	625

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1062	630	0	0	656	0
Stage 1	630	-	-	-	-	-
Stage 2	433	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	232	481	-	-	929	-
Stage 1	530	-	-	-	-	-
Stage 2	623	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	216	479	-	-	926	-
Mov Cap-2 Maneuver	216	-	-	-	-	-
Stage 1	528	-	-	-	-	-
Stage 2	581	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	19.29	0	0.77
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	216	479	926	-
HCM Lane V/C Ratio	-	-	0.246	0.161	0.062	-
HCM Control Delay (s/veh)	-	-	27	14	9.1	-
HCM Lane LOS	-	-	D	B	A	-
HCM 95th %tile Q(veh)	-	-	0.9	0.6	0.2	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	133	1	543	9	2	6	476	1343	0	1	1066	170
Future Volume (veh/h)	133	1	543	9	2	6	476	1343	0	1	1066	170
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	145	1	0	10	2	2	517	1460	0	1	1159	103
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	176	1		19	4	4	552	2489	0	2	1391	619
Arrive On Green	0.10	0.10	0.00	0.02	0.02	0.02	0.31	0.70	0.00	0.00	0.39	0.39
Sat Flow, veh/h	1770	12	1585	1259	252	252	1781	3647	0	1781	3554	1581
Grp Volume(v), veh/h	146	0	0	14	0	0	517	1460	0	1	1159	103
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1762	0	0	1781	1777	0	1781	1777	1581
Q Serve(g_s), s	10.5	0.0	0.0	1.0	0.0	0.0	36.8	27.3	0.0	0.1	38.4	5.5
Cycle Q Clear(g_c), s	10.5	0.0	0.0	1.0	0.0	0.0	36.8	27.3	0.0	0.1	38.4	5.5
Prop In Lane	0.99		1.00	0.71		0.14	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	177	0		27	0	0	552	2489	0	2	1391	619
V/C Ratio(X)	0.83	0.00		0.52	0.00	0.00	0.94	0.59	0.00	0.41	0.83	0.17
Avail Cap(c_a), veh/h	328	0		121	0	0	805	2831	0	123	1879	836
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	57.7	0.0	0.0	63.8	0.0	0.0	43.8	10.0	0.0	65.1	35.9	25.9
Incr Delay (d2), s/veh	9.3	0.0	0.0	14.7	0.0	0.0	14.0	0.2	0.0	84.8	2.5	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.2	0.0	0.0	0.6	0.0	0.0	18.3	10.0	0.0	0.1	17.0	2.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	67.0	0.0	0.0	78.5	0.0	0.0	57.8	10.2	0.0	149.9	38.4	26.0
LnGrp LOS	E			E			E	B		F	D	C
Approach Vol, veh/h		146			14			1977			1263	
Approach Delay, s/veh		67.0			78.5			22.6			37.4	
Approach LOS		E			E			C			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.2	97.4		8.0	46.5	57.1		19.0				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	104.0		9.0	59.0	69.0		24.0				
Max Q Clear Time (g_c+I1), s	2.1	29.3		3.0	38.8	40.4		12.5				
Green Ext Time (p_c), s	0.0	18.7		0.0	1.7	10.7		0.5				

Intersection Summary												
HCM 7th Control Delay, s/veh			30.3									
HCM 7th LOS			C									

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	88	125	124	26	132	1081	54	440	27	819	605	86
Future Volume (veh/h)	88	125	124	26	132	1081	54	440	27	819	605	86
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	96	136	46	28	143	0	59	478	6	890	658	86
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	155	169	278	153	482		76	544	461	998	1696	221
Arrive On Green	0.18	0.18	0.18	0.03	0.26	0.00	0.04	0.29	0.29	0.29	0.54	0.54
Sat Flow, veh/h	612	951	1567	1781	1870	1585	1781	1870	1585	3456	3159	412
Grp Volume(v), veh/h	232	0	46	28	143	0	59	478	6	890	370	374
Grp Sat Flow(s),veh/h/ln	1563	0	1567	1781	1870	1585	1781	1870	1585	1728	1777	1794
Q Serve(g_s), s	14.9	0.0	2.8	1.4	6.8	0.0	3.6	27.0	0.3	27.3	13.5	13.5
Cycle Q Clear(g_c), s	15.8	0.0	2.8	1.4	6.8	0.0	3.6	27.0	0.3	27.3	13.5	13.5
Prop In Lane	0.41		1.00	1.00		1.00	1.00		1.00	1.00		0.23
Lane Grp Cap(c), veh/h	324	0	278	153	482		76	544	461	998	954	963
V/C Ratio(X)	0.72	0.00	0.17	0.18	0.30		0.77	0.88	0.01	0.89	0.39	0.39
Avail Cap(c_a), veh/h	468	0	424	332	810		145	912	773	1217	954	963
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	43.9	0.0	38.6	35.6	33.0	0.0	52.5	37.4	28.0	37.7	15.0	15.0
Incr Delay (d2), s/veh	3.0	0.0	0.3	0.6	0.3	0.0	15.2	5.5	0.0	7.5	0.3	0.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.4	0.0	1.1	0.6	3.1	0.0	1.9	13.0	0.1	12.4	5.4	5.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	46.9	0.0	38.9	36.1	33.4	0.0	67.7	42.9	28.0	45.2	15.3	15.3
LnGrp LOS	D		D	D	C		E	D	C	D	B	B
Approach Vol, veh/h		278			171			543			1634	
Approach Delay, s/veh		45.5			33.8			45.5			31.6	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	38.0	38.2	8.9	25.7	10.7	65.5		34.6
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	32.0	54.0	14.0	30.0	9.0	59.0		48.0
Max Q Clear Time (g_c+I1), s	29.3	29.0	3.4	17.8	5.6	15.5		8.8
Green Ext Time (p_c), s	2.7	3.2	0.0	1.2	0.0	5.5		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	36.1
HCM 7th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	25	13	10	19	26	195	1	29	2	107	589	15
Future Volume (veh/h)	25	13	10	19	26	195	1	29	2	107	589	15
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.95	0.96		0.97	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	27	14	1	21	28	36	1	32	1	116	640	15
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	293	124	277	208	221	282	307	705	595	827	843	20
Arrive On Green	0.18	0.18	0.18	0.18	0.18	0.18	0.00	0.38	0.38	0.09	0.46	0.46
Sat Flow, veh/h	833	677	1512	477	1203	1541	1781	1870	1579	1781	1820	43
Grp Volume(v), veh/h	41	0	1	49	0	36	1	32	1	116	0	655
Grp Sat Flow(s),veh/h/ln	1510	0	1512	1681	0	1541	1781	1870	1579	1781	0	1863
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.5	0.0	1.5	0.0	12.4
Cycle Q Clear(g_c), s	0.8	0.0	0.0	0.9	0.0	0.8	0.0	0.5	0.0	1.5	0.0	12.4
Prop In Lane	0.66		1.00	0.43		1.00	1.00		1.00	1.00		0.02
Lane Grp Cap(c), veh/h	417	0	277	429	0	282	307	705	595	827	0	862
V/C Ratio(X)	0.10	0.00	0.00	0.11	0.00	0.13	0.00	0.05	0.00	0.14	0.00	0.76
Avail Cap(c_a), veh/h	2031	0	1953	2200	0	1991	512	2416	2040	880	0	2406
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	14.5	0.0	14.2	14.6	0.0	14.5	9.1	8.4	8.3	6.2	0.0	9.5
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.1	0.0	1.4
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.0	0.4	0.0	0.3	0.0	0.2	0.0	0.4	0.0	3.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	14.6	0.0	14.2	14.7	0.0	14.7	9.1	8.4	8.3	6.2	0.0	10.9
LnGrp LOS	B		B	B		B	A	A	A	A		B
Approach Vol, veh/h		42			85			34			771	
Approach Delay, s/veh		14.6			14.7			8.5			10.2	
Approach LOS		B			B			A			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.7	21.0		12.8	5.1	24.7		12.8				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.5	2.5		2.8	2.0	14.4		2.9				
Green Ext Time (p_c), s	0.0	0.2		0.2	0.0	5.3		0.4				

Intersection Summary	
HCM 7th Control Delay, s/veh	10.7
HCM 7th LOS	B



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	6	17	93	37	8	52	206	850	34	44	629	27
Future Volume (veh/h)	6	17	93	37	8	52	206	850	34	44	629	27
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	7	18	6	40	9	5	224	924	22	48	684	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	87	71	21	191	22	106	283	1111	941	81	899	762
Arrive On Green	0.07	0.07	0.07	0.07	0.07	0.07	0.16	0.59	0.59	0.05	0.48	0.48
Sat Flow, veh/h	231	1050	308	1253	331	1579	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	31	0	0	49	0	5	224	924	22	48	684	13
Grp Sat Flow(s),veh/h/ln	1589	0	0	1584	0	1579	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.2	7.4	24.3	0.4	1.6	18.4	0.3
Cycle Q Clear(g_c), s	1.6	0.0	0.0	1.6	0.0	0.2	7.4	24.3	0.4	1.6	18.4	0.3
Prop In Lane	0.23		0.19	0.82		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	179	0	0	213	0	106	283	1111	941	81	899	762
V/C Ratio(X)	0.17	0.00	0.00	0.23	0.00	0.05	0.79	0.83	0.02	0.59	0.76	0.02
Avail Cap(c_a), veh/h	641	0	0	611	0	540	697	3475	2945	290	3048	2583
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	27.2	0.0	0.0	27.4	0.0	26.8	24.8	10.0	5.1	28.7	13.0	8.3
Incr Delay (d2), s/veh	0.5	0.0	0.0	0.5	0.0	0.2	5.0	1.7	0.0	6.7	1.4	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	0.0	0.0	0.7	0.0	0.1	3.3	7.9	0.1	0.8	6.8	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	27.6	0.0	0.0	28.0	0.0	27.0	29.8	11.7	5.1	35.4	14.4	8.3
LnGrp LOS	C			C		C	C	B	A	D	B	A
Approach Vol, veh/h		31			54			1170			745	
Approach Delay, s/veh		27.6			27.9			15.0			15.6	
Approach LOS		C			C			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.8	42.4		10.1	15.7	35.5		10.1
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0
Max Q Clear Time (g_c+I1), s	3.6	26.3		3.6	9.4	20.4		3.6
Green Ext Time (p_c), s	0.0	10.1		0.1	0.5	5.9		0.2

Intersection Summary	
HCM 7th Control Delay, s/veh	15.8
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	570	0	1098	846	4
Future Vol, veh/h	0	570	0	1098	846	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	620	0	1193	920	4

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2028 SAT – Alternative 3

Intersection	
Int Delay, s/veh	2.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	19	71	76	458	447	17
Future Vol, veh/h	19	71	76	458	447	17
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	21	77	83	498	486	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1259	637	605	0	-	0
Stage 1	596	-	-	-	-	-
Stage 2	663	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	188	477	973	-	-	-
Stage 1	550	-	-	-	-	-
Stage 2	512	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	139	414	879	-	-	-
Mov Cap-2 Maneuver	139	-	-	-	-	-
Stage 1	451	-	-	-	-	-
Stage 2	463	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	23.36	1.35	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	879	-	293	-	-
HCM Lane V/C Ratio	0.094	-	0.334	-	-
HCM Control Delay (s/veh)	9.5	-	23.4	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0.3	-	1.4	-	-

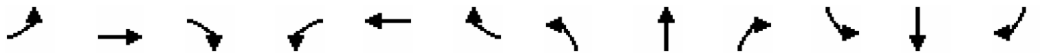
Intersection	
Int Delay, s/veh	1.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	51	62	469	41	35	497
Future Vol, veh/h	51	62	469	41	35	497
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	55	67	510	45	38	540

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	887	536	0	0	558	0
Stage 1	536	-	-	-	-	-
Stage 2	351	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	299	544	-	-	1011	-
Stage 1	586	-	-	-	-	-
Stage 2	684	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	285	542	-	-	1007	-
Mov Cap-2 Maneuver	285	-	-	-	-	-
Stage 1	583	-	-	-	-	-
Stage 2	655	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	16.24	0	0.57
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	285	542	1007	-
HCM Lane V/C Ratio	-	-	0.195	0.124	0.038	-
HCM Control Delay (s/veh)	-	-	20.7	12.6	8.7	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.7	0.4	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	125	2	428	2	2	0	385	1120	2	0	876	143
Future Volume (veh/h)	125	2	428	2	2	0	385	1120	2	0	876	143
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	136	2	0	2	2	0	418	1217	2	0	952	44
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	173	3		5	5	0	471	2499	4	2	1251	557
Arrive On Green	0.10	0.10	0.00	0.01	0.01	0.00	0.26	0.69	0.69	0.00	0.35	0.35
Sat Flow, veh/h	1757	26	1585	912	912	0	1781	3640	6	1781	3554	1581
Grp Volume(v), veh/h	138	0	0	4	0	0	418	594	625	0	952	44
Grp Sat Flow(s),veh/h/ln	1783	0	1585	1825	0	0	1781	1777	1869	1781	1777	1581
Q Serve(g_s), s	6.5	0.0	0.0	0.2	0.0	0.0	19.4	13.5	13.5	0.0	20.3	1.6
Cycle Q Clear(g_c), s	6.5	0.0	0.0	0.2	0.0	0.0	19.4	13.5	13.5	0.0	20.3	1.6
Prop In Lane	0.99		1.00	0.50		0.00	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	175	0		10	0	0	471	1220	1283	2	1251	557
V/C Ratio(X)	0.79	0.00		0.41	0.00	0.00	0.89	0.49	0.49	0.00	0.76	0.08
Avail Cap(c_a), veh/h	291	0		106	0	0	1017	1532	1612	187	2029	903
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	37.8	0.0	0.0	42.5	0.0	0.0	30.3	6.3	6.3	0.0	24.6	18.5
Incr Delay (d2), s/veh	7.6	0.0	0.0	25.8	0.0	0.0	5.8	0.3	0.3	0.0	1.0	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.2	0.0	0.0	0.2	0.0	0.0	8.8	4.2	4.4	0.0	8.3	0.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	45.4	0.0	0.0	68.4	0.0	0.0	36.2	6.6	6.6	0.0	25.6	18.6
LnGrp LOS	D			E			D	A	A		C	B
Approach Vol, veh/h		138			4			1637			996	
Approach Delay, s/veh		45.4			68.4			14.2			25.3	
Approach LOS		D			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	0.0	64.9		6.5	28.7	36.2		14.4				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	74.0		5.0	49.0	49.0		14.0				
Max Q Clear Time (g_c+I1), s	0.0	15.5		2.2	21.4	22.3		8.5				
Green Ext Time (p_c), s	0.0	11.5		0.0	1.3	7.9		0.3				

Intersection Summary	
HCM 7th Control Delay, s/veh	19.8
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	125	189	170	82	169	910	101	424	35	488	603	147
Future Volume (veh/h)	125	189	170	82	169	910	101	424	35	488	603	147
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	136	205	81	89	184	0	110	461	8	530	655	148
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	199	235	394	203	676		140	515	437	643	1102	249
Arrive On Green	0.25	0.25	0.25	0.05	0.36	0.00	0.08	0.28	0.28	0.19	0.38	0.38
Sat Flow, veh/h	598	939	1572	1781	1870	1585	1781	1870	1585	3456	2877	649
Grp Volume(v), veh/h	341	0	81	89	184	0	110	461	8	530	404	399
Grp Sat Flow(s),veh/h/ln	1536	0	1572	1781	1870	1585	1781	1870	1585	1728	1777	1749
Q Serve(g_s), s	21.2	0.0	4.1	3.6	7.1	0.0	6.2	24.1	0.4	15.0	18.5	18.5
Cycle Q Clear(g_c), s	21.7	0.0	4.1	3.6	7.1	0.0	6.2	24.1	0.4	15.0	18.5	18.5
Prop In Lane	0.40		1.00	1.00		1.00	1.00		1.00	1.00		0.37
Lane Grp Cap(c), veh/h	434	0	394	203	676		140	515	437	643	681	670
V/C Ratio(X)	0.79	0.00	0.21	0.44	0.27		0.79	0.89	0.02	0.82	0.59	0.59
Avail Cap(c_a), veh/h	517	0	479	391	919		350	607	514	1325	1083	1066
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	36.7	0.0	30.1	27.6	23.0	0.0	46.0	35.4	26.8	39.8	25.1	25.1
Incr Delay (d2), s/veh	6.6	0.0	0.3	1.5	0.2	0.0	9.4	14.2	0.0	2.7	0.8	0.8
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	8.8	0.0	1.6	1.6	3.1	0.0	3.1	12.8	0.1	6.5	7.8	7.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	43.3	0.0	30.4	29.1	23.2	0.0	55.4	49.6	26.8	42.5	25.9	25.9
LnGrp LOS	D		C	C	C		E	D	C	D	C	C
Approach Vol, veh/h		422			273			579			1333	
Approach Delay, s/veh		40.8			25.1			50.4			32.5	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	14.9	34.0	11.3	31.5	14.0	45.0		42.8
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	39.6	33.0	16.0	31.0	20.0	62.0		50.0
Max Q Clear Time (g_c+I1), s	17.0	26.1	5.6	23.7	8.2	20.5		9.1
Green Ext Time (p_c), s	1.9	1.6	0.1	1.4	0.2	6.1		1.1

Intersection Summary	
HCM 7th Control Delay, s/veh	37.1
HCM 7th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	19	16	8	6	26	220	0	20	3	103	407	12
Future Volume (veh/h)	19	16	8	6	26	220	0	20	3	103	407	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.98	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	21	17	1	7	28	52	0	22	1	112	442	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	319	199	315	178	344	320	421	341	287	664	820	24
Arrive On Green	0.21	0.21	0.21	0.21	0.21	0.21	0.00	0.18	0.18	0.10	0.45	0.45
Sat Flow, veh/h	627	961	1520	151	1660	1546	1781	1870	1572	1781	1807	53
Grp Volume(v), veh/h	38	0	1	35	0	52	0	22	1	112	0	455
Grp Sat Flow(s),veh/h/ln	1589	0	1520	1811	0	1546	1781	1870	1572	1781	0	1861
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.3	0.0	1.3	0.0	5.2
Cycle Q Clear(g_c), s	0.5	0.0	0.0	0.4	0.0	0.8	0.0	0.3	0.0	1.3	0.0	5.2
Prop In Lane	0.55		1.00	0.20		1.00	1.00		1.00	1.00		0.03
Lane Grp Cap(c), veh/h	518	0	315	521	0	320	421	341	287	664	0	844
V/C Ratio(X)	0.07	0.00	0.00	0.07	0.00	0.16	0.00	0.06	0.00	0.17	0.00	0.54
Avail Cap(c_a), veh/h	3004	0	2836	3397	0	2885	717	3490	2933	785	0	3472
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.5	0.0	9.3	9.4	0.0	9.6	0.0	10.0	9.9	6.7	0.0	5.8
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.1	0.0	0.5
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.3	0.0	1.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.5	0.0	9.3	9.5	0.0	9.8	0.0	10.1	9.9	6.8	0.0	6.4
LnGrp LOS	A		A	A		A		B	A	A		A
Approach Vol, veh/h		39			87			23			567	
Approach Delay, s/veh		9.5			9.7			10.0			6.4	
Approach LOS		A			A			B			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.0	10.4		11.1	0.0	18.4		11.1				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.3	2.3		2.5	0.0	7.2		2.8				
Green Ext Time (p_c), s	0.0	0.1		0.2	0.0	3.3		0.4				

Intersection Summary	
HCM 7th Control Delay, s/veh	7.1
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	12	102	26	10	39	225	799	32	43	318	16
Future Volume (veh/h)	15	12	102	26	10	39	225	799	32	43	318	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	16	13	24	28	11	4	245	868	19	47	346	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	107	36	50	181	47	116	309	1059	898	82	820	695
Arrive On Green	0.07	0.07	0.07	0.07	0.07	0.07	0.17	0.57	0.57	0.05	0.44	0.44
Sat Flow, veh/h	345	485	687	1000	641	1580	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	53	0	0	39	0	4	245	868	19	47	346	6
Grp Sat Flow(s),veh/h/ln	1517	0	0	1641	0	1580	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.9	0.0	0.0	0.0	0.0	0.1	7.5	21.5	0.3	1.5	7.3	0.1
Cycle Q Clear(g_c), s	2.0	0.0	0.0	1.2	0.0	0.1	7.5	21.5	0.3	1.5	7.3	0.1
Prop In Lane	0.30		0.45	0.72		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	193	0	0	228	0	116	309	1059	898	82	820	695
V/C Ratio(X)	0.27	0.00	0.00	0.17	0.00	0.03	0.79	0.82	0.02	0.57	0.42	0.01
Avail Cap(c_a), veh/h	656	0	0	662	0	580	747	3726	3158	311	3269	2770
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	25.5	0.0	0.0	25.1	0.0	24.6	22.7	10.0	5.4	26.7	11.1	9.0
Incr Delay (d2), s/veh	0.8	0.0	0.0	0.4	0.0	0.1	4.6	1.6	0.0	6.2	0.3	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	0.0	0.0	0.5	0.0	0.1	3.3	7.0	0.1	0.7	2.6	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	26.2	0.0	0.0	25.5	0.0	24.8	27.2	11.7	5.5	32.9	11.4	9.1
LnGrp LOS	C			C		C	C	B	A	C	B	A
Approach Vol, veh/h		53			43			1132			399	
Approach Delay, s/veh		26.2			25.4			14.9			13.9	
Approach LOS		C			C			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.6	38.4		10.2	15.9	31.1		10.2
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0
Max Q Clear Time (g_c+I1), s	3.5	23.5		4.0	9.5	9.3		3.2
Green Ext Time (p_c), s	0.0	8.9		0.2	0.6	2.4		0.1

Intersection Summary	
HCM 7th Control Delay, s/veh	15.3
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	400	0	1129	483	2
Future Vol, veh/h	0	400	0	1129	483	2
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	435	0	1227	525	2

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2028 AM – Alternative 4

Intersection	
Int Delay, s/veh	3.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	17	97	93	321	539	22
Future Vol, veh/h	17	97	93	321	539	22
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	18	105	101	349	586	24

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1250	740	711	0	-	0
Stage 1	699	-	-	-	-	-
Stage 2	551	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	191	417	889	-	-	-
Stage 1	493	-	-	-	-	-
Stage 2	577	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	136	362	803	-	-	-
Mov Cap-2 Maneuver	136	-	-	-	-	-
Stage 1	390	-	-	-	-	-
Stage 2	522	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	26.33	2.27	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	803	-	290	-	-
HCM Lane V/C Ratio	0.126	-	0.427	-	-
HCM Control Delay (s/veh)	10.1	-	26.3	-	-
HCM Lane LOS	B	-	D	-	-
HCM 95th %tile Q(veh)	0.4	-	2	-	-

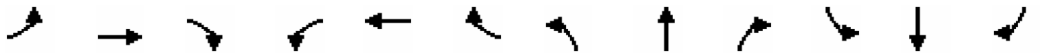
Intersection	
Int Delay, s/veh	1.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	24	36	380	23	45	597
Future Vol, veh/h	24	36	380	23	45	597
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	26	39	413	25	49	649

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	857	430	0	0	442	0
Stage 1	430	-	-	-	-	-
Stage 2	427	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	312	625	-	-	1116	-
Stage 1	655	-	-	-	-	-
Stage 2	626	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	295	622	-	-	1112	-
Mov Cap-2 Maneuver	295	-	-	-	-	-
Stage 1	653	-	-	-	-	-
Stage 2	596	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	14.05	0	0.59
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	295	622	1112	-
HCM Lane V/C Ratio	-	-	0.088	0.063	0.044	-
HCM Control Delay (s/veh)	-	-	18.4	11.2	8.4	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.3	0.2	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	148	1	473	2	5	0	294	863	5	4	1015	148
Future Volume (veh/h)	148	1	473	2	5	0	294	863	5	4	1015	148
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	161	1	0	2	5	0	320	938	5	4	1103	85
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	199	1		5	12	0	367	2219	12	9	1462	650
Arrive On Green	0.11	0.11	0.00	0.01	0.01	0.00	0.21	0.61	0.61	0.01	0.41	0.41
Sat Flow, veh/h	1771	11	1585	527	1317	0	1781	3624	19	1781	3554	1581
Grp Volume(v), veh/h	162	0	0	7	0	0	320	460	483	4	1103	85
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1844	0	0	1781	1777	1867	1781	1777	1581
Q Serve(g_s), s	8.2	0.0	0.0	0.3	0.0	0.0	16.0	12.4	12.4	0.2	24.3	3.1
Cycle Q Clear(g_c), s	8.2	0.0	0.0	0.3	0.0	0.0	16.0	12.4	12.4	0.2	24.3	3.1
Prop In Lane	0.99		1.00	0.29		0.00	1.00		0.01	1.00		1.00
Lane Grp Cap(c), veh/h	200	0		16	0	0	367	1088	1143	9	1462	650
V/C Ratio(X)	0.81	0.00		0.43	0.00	0.00	0.87	0.42	0.42	0.43	0.75	0.13
Avail Cap(c_a), veh/h	291	0		181	0	0	854	2497	2623	175	3058	1361
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	39.8	0.0	0.0	45.3	0.0	0.0	35.3	9.3	9.3	45.5	23.1	16.8
Incr Delay (d2), s/veh	10.4	0.0	0.0	16.5	0.0	0.0	6.5	0.3	0.2	27.6	0.8	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.1	0.0	0.0	0.2	0.0	0.0	7.4	4.4	4.7	0.2	9.9	1.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	50.2	0.0	0.0	61.8	0.0	0.0	41.7	9.6	9.6	73.1	23.9	16.9
LnGrp LOS	D			E			D	A	A	E	C	B
Approach Vol, veh/h		162			7			1263			1192	
Approach Delay, s/veh		50.2			61.8			17.7			23.5	
Approach LOS		D			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.5	62.2		6.8	24.9	43.8		16.3				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	129.0		9.0	44.0	79.0		15.0				
Max Q Clear Time (g_c+I1), s	2.2	14.4		2.3	18.0	26.3		10.2				
Green Ext Time (p_c), s	0.0	7.7		0.0	1.0	11.4		0.3				

Intersection Summary		
HCM 7th Control Delay, s/veh	22.5	
HCM 7th LOS	C	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	57	111	62	33	136	1047	56	450	36	695	628	76
Future Volume (veh/h)	57	111	62	33	136	1047	56	450	36	695	628	76
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	62	121	24	36	148	0	61	489	7	755	683	76
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	120	163	218	182	453		79	533	452	914	1627	181
Arrive On Green	0.14	0.14	0.14	0.03	0.24	0.00	0.04	0.28	0.28	0.26	0.50	0.50
Sat Flow, veh/h	463	1172	1562	1781	1870	1585	1781	1870	1585	3456	3223	358
Grp Volume(v), veh/h	183	0	24	36	148	0	61	489	7	755	376	383
Grp Sat Flow(s),veh/h/ln	1635	0	1562	1781	1870	1585	1781	1870	1585	1728	1777	1804
Q Serve(g_s), s	7.6	0.0	1.2	1.4	5.6	0.0	2.9	21.9	0.3	17.8	11.5	11.5
Cycle Q Clear(g_c), s	9.3	0.0	1.2	1.4	5.6	0.0	2.9	21.9	0.3	17.8	11.5	11.5
Prop In Lane	0.34		1.00	1.00		1.00	1.00		1.00	1.00		0.20
Lane Grp Cap(c), veh/h	283	0	218	182	453		79	533	452	914	897	911
V/C Ratio(X)	0.65	0.00	0.11	0.20	0.33		0.77	0.92	0.02	0.83	0.42	0.42
Avail Cap(c_a), veh/h	375	0	307	370	671		247	563	477	2360	1728	1754
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	35.9	0.0	32.5	29.3	26.9	0.0	40.8	29.9	22.2	29.9	13.4	13.4
Incr Delay (d2), s/veh	2.5	0.0	0.2	0.5	0.4	0.0	14.4	19.6	0.0	2.0	0.3	0.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.8	0.0	0.4	0.6	2.5	0.0	1.6	12.3	0.1	7.4	4.4	4.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	38.4	0.0	32.7	29.8	27.4	0.0	55.2	49.5	22.2	31.9	13.7	13.7
LnGrp LOS	D		C	C	C		E	D	C	C	B	B
Approach Vol, veh/h		207			184			557			1514	
Approach Delay, s/veh		37.7			27.8			49.8			22.8	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	8.9	30.6	8.9	18.0	9.8	49.6		26.9
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	5.0	26.0	12.0	17.0	12.0	84.0		31.0
Max Q Clear Time (g_c+I1), s	11.3	23.9	3.4	11.3	4.9	13.5		7.6
Green Ext Time (p_c), s	3.1	0.7	0.0	0.5	0.1	5.7		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	30.5
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	7	10	5	12	228	0	16	1	103	392	9
Future Volume (veh/h)	15	7	10	5	12	228	0	16	1	103	392	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.97	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	16	8	2	5	13	51	0	17	1	112	426	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	363	139	292	199	305	298	432	346	290	678	838	20
Arrive On Green	0.19	0.19	0.19	0.19	0.19	0.19	0.00	0.18	0.18	0.10	0.46	0.46
Sat Flow, veh/h	802	721	1515	208	1581	1543	1781	1870	1572	1781	1820	43
Grp Volume(v), veh/h	24	0	2	18	0	51	0	17	1	112	0	436
Grp Sat Flow(s),veh/h/ln	1524	0	1515	1789	0	1543	1781	1870	1572	1781	0	1863
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.2	0.0	1.2	0.0	4.8
Cycle Q Clear(g_c), s	0.3	0.0	0.0	0.2	0.0	0.8	0.0	0.2	0.0	1.2	0.0	4.8
Prop In Lane	0.67		1.00	0.28		1.00	1.00		1.00	1.00		0.02
Lane Grp Cap(c), veh/h	502	0	292	504	0	298	432	346	290	678	0	858
V/C Ratio(X)	0.05	0.00	0.01	0.04	0.00	0.17	0.00	0.05	0.00	0.17	0.00	0.51
Avail Cap(c_a), veh/h	2989	0	2888	3395	0	2941	734	3565	2996	804	0	3550
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.5	0.0	9.4	9.5	0.0	9.7	0.0	9.7	9.6	6.5	0.0	5.5
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1	0.0	0.1	0.0	0.5
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.3	0.0	0.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.6	0.0	9.4	9.5	0.0	10.0	0.0	9.7	9.6	6.6	0.0	5.9
LnGrp LOS	A		A	A		A		A	A	A		A
Approach Vol, veh/h		26			69			18			548	
Approach Delay, s/veh		9.6			9.9			9.7			6.1	
Approach LOS		A			A			A			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.0	10.3		10.6	0.0	18.3		10.6				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.2	2.2		2.3	0.0	6.8		2.8				
Green Ext Time (p_c), s	0.0	0.1		0.1	0.0	3.1		0.3				

Intersection Summary	
HCM 7th Control Delay, s/veh	6.7
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	10	92	40	11	72	224	1010	36	45	346	9
Future Volume (veh/h)	5	10	92	40	11	72	224	1010	36	45	346	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	5	11	5	43	12	6	243	1098	24	49	376	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	66	50	19	153	20	89	283	1264	1071	74	1045	886
Arrive On Green	0.06	0.06	0.06	0.06	0.06	0.06	0.16	0.68	0.68	0.04	0.56	0.56
Sat Flow, veh/h	185	896	338	1284	358	1577	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	21	0	0	55	0	6	243	1098	24	49	376	6
Grp Sat Flow(s),veh/h/ln	1418	0	0	1642	0	1577	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.3	10.6	36.6	0.4	2.2	8.8	0.1
Cycle Q Clear(g_c), s	2.4	0.0	0.0	2.4	0.0	0.3	10.6	36.6	0.4	2.2	8.8	0.1
Prop In Lane	0.24		0.24	0.78		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	136	0	0	173	0	89	283	1264	1071	74	1045	886
V/C Ratio(X)	0.15	0.00	0.00	0.32	0.00	0.07	0.86	0.87	0.02	0.66	0.36	0.01
Avail Cap(c_a), veh/h	397	0	0	405	0	337	314	2682	2273	224	2588	2193
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	35.8	0.0	0.0	36.5	0.0	35.5	32.6	10.1	4.2	37.5	9.7	7.8
Incr Delay (d2), s/veh	0.5	0.0	0.0	1.0	0.0	0.3	19.3	2.0	0.0	9.7	0.2	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	0.0	0.0	1.1	0.0	0.1	5.9	12.0	0.1	1.1	3.3	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	36.4	0.0	0.0	37.6	0.0	35.9	51.9	12.1	4.3	47.2	9.9	7.8
LnGrp LOS	D			D		D	D	B	A	D	A	A
Approach Vol, veh/h		21			61			1365			431	
Approach Delay, s/veh		36.4			37.4			19.0			14.1	
Approach LOS		D			D			B			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	9.3	59.7		10.5	18.6	50.4		10.5				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	10.0	114.0		17.0	14.0	110.0		17.0				
Max Q Clear Time (g_c+I1), s	4.2	38.6		4.4	12.6	10.8		4.4				
Green Ext Time (p_c), s	0.0	15.1		0.0	0.1	2.6		0.2				

Intersection Summary	
HCM 7th Control Delay, s/veh	18.7
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	388	0	1246	492	1
Future Vol, veh/h	0	388	0	1246	492	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	422	0	1354	535	1

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2028 PM – Alternative 4

Intersection	
Int Delay, s/veh	6.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	27	149	99	523	489	32
Future Vol, veh/h	27	149	99	523	489	32
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	29	162	108	568	532	35

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1434	691	667	0	-	0
Stage 1	650	-	-	-	-	-
Stage 2	784	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	148	445	922	-	-	-
Stage 1	520	-	-	-	-	-
Stage 2	450	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	105	386	834	-	-	-
Mov Cap-2 Maneuver	105	-	-	-	-	-
Stage 1	409	-	-	-	-	-
Stage 2	407	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	43.83	1.58	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	834	-	274	-	-
HCM Lane V/C Ratio	0.129	-	0.699	-	-
HCM Control Delay (s/veh)	10	-	43.8	-	-
HCM Lane LOS	A	-	E	-	-
HCM 95th %tile Q(veh)	0.4	-	4.8	-	-

Intersection	
Int Delay, s/veh	2.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	49	71	553	49	53	587
Future Vol, veh/h	49	71	553	49	53	587
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	53	77	601	53	58	638

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1071	632	0	0	658	0
Stage 1	632	-	-	-	-	-
Stage 2	439	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	230	480	-	-	927	-
Stage 1	529	-	-	-	-	-
Stage 2	618	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	213	478	-	-	924	-
Mov Cap-2 Maneuver	213	-	-	-	-	-
Stage 1	527	-	-	-	-	-
Stage 2	577	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	19.45	0	0.76
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	213	478	924	-
HCM Lane V/C Ratio	-	-	0.25	0.162	0.062	-
HCM Control Delay (s/veh)	-	-	27.4	14	9.2	-
HCM Lane LOS	-	-	D	B	A	-
HCM 95th %tile Q(veh)	-	-	1	0.6	0.2	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	134	1	554	9	2	6	478	1343	0	1	1066	170
Future Volume (veh/h)	134	1	554	9	2	6	478	1343	0	1	1066	170
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	146	1	0	10	2	2	520	1460	0	1	1159	103
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	176	1		19	4	4	555	2492	0	2	1389	618
Arrive On Green	0.10	0.10	0.00	0.02	0.02	0.02	0.31	0.70	0.00	0.00	0.39	0.39
Sat Flow, veh/h	1770	12	1585	1259	252	252	1781	3647	0	1781	3554	1581
Grp Volume(v), veh/h	147	0	0	14	0	0	520	1460	0	1	1159	103
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1762	0	0	1781	1777	0	1781	1777	1581
Q Serve(g_s), s	10.6	0.0	0.0	1.0	0.0	0.0	37.3	27.4	0.0	0.1	38.8	5.6
Cycle Q Clear(g_c), s	10.6	0.0	0.0	1.0	0.0	0.0	37.3	27.4	0.0	0.1	38.8	5.6
Prop In Lane	0.99		1.00	0.71		0.14	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	178	0		27	0	0	555	2492	0	2	1389	618
V/C Ratio(X)	0.83	0.00		0.52	0.00	0.00	0.94	0.59	0.00	0.41	0.83	0.17
Avail Cap(c_a), veh/h	325	0		121	0	0	800	2812	0	122	1866	830
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	58.1	0.0	0.0	64.2	0.0	0.0	44.0	10.0	0.0	65.6	36.2	26.1
Incr Delay (d2), s/veh	9.4	0.0	0.0	14.8	0.0	0.0	14.4	0.3	0.0	84.8	2.6	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.3	0.0	0.0	0.6	0.0	0.0	18.6	10.0	0.0	0.1	17.1	2.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	67.4	0.0	0.0	79.0	0.0	0.0	58.4	10.2	0.0	150.4	38.8	26.2
LnGrp LOS	E			E			E	B		F	D	C
Approach Vol, veh/h		147			14			1980			1263	
Approach Delay, s/veh		67.4			79.0			22.9			37.8	
Approach LOS		E			E			C			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.2	98.2		8.0	47.0	57.4		19.1				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	104.0		9.0	59.0	69.0		24.0				
Max Q Clear Time (g_c+I1), s	2.1	29.4		3.0	39.3	40.8		12.6				
Green Ext Time (p_c), s	0.0	18.7		0.0	1.7	10.6		0.5				

Intersection Summary												
HCM 7th Control Delay, s/veh			30.6									
HCM 7th LOS			C									

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	88	125	124	26	132	1081	54	442	27	823	612	86
Future Volume (veh/h)	88	125	124	26	132	1081	54	442	27	823	612	86
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	96	136	46	28	143	0	59	480	6	895	665	86
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	154	169	278	152	481		76	545	462	1001	1704	220
Arrive On Green	0.18	0.18	0.18	0.03	0.26	0.00	0.04	0.29	0.29	0.29	0.54	0.54
Sat Flow, veh/h	612	951	1567	1781	1870	1585	1781	1870	1585	3456	3163	409
Grp Volume(v), veh/h	232	0	46	28	143	0	59	480	6	895	373	378
Grp Sat Flow(s),veh/h/ln	1563	0	1567	1781	1870	1585	1781	1870	1585	1728	1777	1795
Q Serve(g_s), s	15.1	0.0	2.8	1.4	6.9	0.0	3.7	27.3	0.3	27.7	13.7	13.7
Cycle Q Clear(g_c), s	15.9	0.0	2.8	1.4	6.9	0.0	3.7	27.3	0.3	27.7	13.7	13.7
Prop In Lane	0.41		1.00	1.00		1.00	1.00		1.00	1.00		0.23
Lane Grp Cap(c), veh/h	323	0	278	152	481		76	545	462	1001	957	967
V/C Ratio(X)	0.72	0.00	0.17	0.18	0.30		0.77	0.88	0.01	0.89	0.39	0.39
Avail Cap(c_a), veh/h	465	0	422	329	805		144	906	768	1209	957	967
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	44.2	0.0	38.9	35.8	33.3	0.0	52.8	37.6	28.1	37.9	15.0	15.0
Incr Delay (d2), s/veh	3.0	0.0	0.3	0.6	0.3	0.0	15.2	5.8	0.0	7.7	0.3	0.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.4	0.0	1.1	0.6	3.2	0.0	2.0	13.2	0.1	12.6	5.5	5.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	47.2	0.0	39.1	36.4	33.6	0.0	68.1	43.4	28.1	45.7	15.3	15.3
LnGrp LOS	D		D	D	C		E	D	C	D	B	B
Approach Vol, veh/h		278			171			545			1646	
Approach Delay, s/veh		45.9			34.1			45.9			31.8	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	38.3	38.5	8.9	25.8	10.8	66.0		34.7
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	32.3	54.0	14.0	30.0	9.0	59.0		48.0
Max Q Clear Time (g_c+I1), s	29.7	29.3	3.4	17.9	5.7	15.7		8.9
Green Ext Time (p_c), s	2.6	3.2	0.0	1.2	0.0	5.5		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	36.3
HCM 7th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	25	13	10	19	26	197	1	29	2	107	595	15
Future Volume (veh/h)	25	13	10	19	26	197	1	29	2	107	595	15
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.95	0.96		0.97	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	27	14	1	21	28	38	1	32	1	116	647	15
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	292	124	277	207	220	282	305	712	601	830	849	20
Arrive On Green	0.18	0.18	0.18	0.18	0.18	0.18	0.00	0.38	0.38	0.09	0.47	0.47
Sat Flow, veh/h	833	675	1511	478	1202	1541	1781	1870	1579	1781	1820	42
Grp Volume(v), veh/h	41	0	1	49	0	38	1	32	1	116	0	662
Grp Sat Flow(s),veh/h/ln	1508	0	1511	1680	0	1541	1781	1870	1579	1781	0	1863
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.5	0.0	1.5	0.0	12.6
Cycle Q Clear(g_c), s	0.8	0.0	0.0	0.9	0.0	0.9	0.0	0.5	0.0	1.5	0.0	12.6
Prop In Lane	0.66		1.00	0.43		1.00	1.00		1.00	1.00		0.02
Lane Grp Cap(c), veh/h	415	0	277	427	0	282	305	712	601	830	0	869
V/C Ratio(X)	0.10	0.00	0.00	0.11	0.00	0.13	0.00	0.04	0.00	0.14	0.00	0.76
Avail Cap(c_a), veh/h	2010	0	1935	2181	0	1973	508	2395	2021	882	0	2385
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	14.7	0.0	14.3	14.7	0.0	14.7	9.1	8.4	8.2	6.1	0.0	9.5
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.1	0.0	1.4
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.0	0.4	0.0	0.3	0.0	0.2	0.0	0.4	0.0	3.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	14.8	0.0	14.3	14.8	0.0	14.9	9.1	8.4	8.3	6.2	0.0	10.9
LnGrp LOS	B		B	B		B	A	A	A	A		B
Approach Vol, veh/h		42			87			34			778	
Approach Delay, s/veh		14.7			14.9			8.4			10.2	
Approach LOS		B			B			A			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.7	21.3		12.9	5.1	25.0		12.9				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.5	2.5		2.8	2.0	14.6		2.9				
Green Ext Time (p_c), s	0.0	0.2		0.2	0.0	5.4		0.4				

Intersection Summary	
HCM 7th Control Delay, s/veh	10.8
HCM 7th LOS	B



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	6	17	93	37	8	52	208	850	34	44	634	27
Future Volume (veh/h)	6	17	93	37	8	52	208	850	34	44	634	27
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	7	18	6	40	9	5	226	924	22	48	689	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	87	71	21	191	22	106	285	1111	941	81	897	760
Arrive On Green	0.07	0.07	0.07	0.07	0.07	0.07	0.16	0.59	0.59	0.05	0.48	0.48
Sat Flow, veh/h	231	1050	308	1253	331	1579	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	31	0	0	49	0	5	226	924	22	48	689	13
Grp Sat Flow(s),veh/h/ln	1589	0	0	1584	0	1579	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.2	7.5	24.3	0.4	1.6	18.6	0.3
Cycle Q Clear(g_c), s	1.6	0.0	0.0	1.6	0.0	0.2	7.5	24.3	0.4	1.6	18.6	0.3
Prop In Lane	0.23		0.19	0.82		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	179	0	0	213	0	106	285	1111	941	81	897	760
V/C Ratio(X)	0.17	0.00	0.00	0.23	0.00	0.05	0.79	0.83	0.02	0.59	0.77	0.02
Avail Cap(c_a), veh/h	641	0	0	611	0	540	697	3475	2945	290	3048	2583
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	27.2	0.0	0.0	27.4	0.0	26.8	24.8	10.0	5.1	28.7	13.2	8.4
Incr Delay (d2), s/veh	0.5	0.0	0.0	0.5	0.0	0.2	5.0	1.7	0.0	6.7	1.4	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	0.0	0.0	0.7	0.0	0.1	3.3	7.9	0.1	0.8	6.9	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	27.6	0.0	0.0	28.0	0.0	27.0	29.8	11.7	5.1	35.4	14.6	8.4
LnGrp LOS	C			C		C	C	B	A	D	B	A
Approach Vol, veh/h		31			54			1172			750	
Approach Delay, s/veh		27.6			27.9			15.1			15.8	
Approach LOS		C			C			B			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.8	42.4		10.1	15.8	35.4		10.1				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0				
Max Q Clear Time (g_c+I1), s	3.6	26.3		3.6	9.5	20.6		3.6				
Green Ext Time (p_c), s	0.0	10.1		0.1	0.5	5.9		0.2				

Intersection Summary		
HCM 7th Control Delay, s/veh	15.9	
HCM 7th LOS	B	

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	577	0	1100	850	4
Future Vol, veh/h	0	577	0	1100	850	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	627	0	1196	924	4

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2028 SAT – Alternative 4

Intersection	
Int Delay, s/veh	2.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	19	73	78	458	447	17
Future Vol, veh/h	19	73	78	458	447	17
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	21	79	85	498	486	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1264	637	605	0	-	0
Stage 1	596	-	-	-	-	-
Stage 2	667	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	187	477	973	-	-	-
Stage 1	550	-	-	-	-	-
Stage 2	510	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	138	414	879	-	-	-
Mov Cap-2 Maneuver	138	-	-	-	-	-
Stage 1	449	-	-	-	-	-
Stage 2	461	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	23.49	1.39	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	879	-	293	-	-
HCM Lane V/C Ratio	0.096	-	0.341	-	-
HCM Control Delay (s/veh)	9.5	-	23.5	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0.3	-	1.5	-	-

Intersection	
Int Delay, s/veh	1.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	51	62	471	41	35	499
Future Vol, veh/h	51	62	471	41	35	499
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	55	67	512	45	38	542

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	891	538	0	0	561	0
Stage 1	538	-	-	-	-	-
Stage 2	352	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	297	542	-	-	1009	-
Stage 1	584	-	-	-	-	-
Stage 2	684	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	283	540	-	-	1005	-
Mov Cap-2 Maneuver	283	-	-	-	-	-
Stage 1	582	-	-	-	-	-
Stage 2	655	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	16.29	0	0.57
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	283	540	1005	-
HCM Lane V/C Ratio	-	-	0.196	0.125	0.038	-
HCM Control Delay (s/veh)	-	-	20.8	12.6	8.7	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.7	0.4	0.1	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	125	2	430	2	2	0	387	1120	2	0	876	143
Future Volume (veh/h)	125	2	430	2	2	0	387	1120	2	0	876	143
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	136	2	0	2	2	0	421	1217	2	0	952	44
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	173	3		5	5	0	474	2502	4	2	1250	556
Arrive On Green	0.10	0.10	0.00	0.01	0.01	0.00	0.27	0.69	0.69	0.00	0.35	0.35
Sat Flow, veh/h	1757	26	1585	912	912	0	1781	3640	6	1781	3554	1581
Grp Volume(v), veh/h	138	0	0	4	0	0	421	594	625	0	952	44
Grp Sat Flow(s),veh/h/ln	1783	0	1585	1825	0	0	1781	1777	1869	1781	1777	1581
Q Serve(g_s), s	6.5	0.0	0.0	0.2	0.0	0.0	19.6	13.5	13.5	0.0	20.4	1.6
Cycle Q Clear(g_c), s	6.5	0.0	0.0	0.2	0.0	0.0	19.6	13.5	13.5	0.0	20.4	1.6
Prop In Lane	0.99		1.00	0.50		0.00	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	175	0		10	0	0	474	1221	1285	2	1250	556
V/C Ratio(X)	0.79	0.00		0.41	0.00	0.00	0.89	0.49	0.49	0.00	0.76	0.08
Avail Cap(c_a), veh/h	290	0		106	0	0	1013	1526	1606	186	2021	899
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	38.0	0.0	0.0	42.7	0.0	0.0	30.4	6.3	6.3	0.0	24.7	18.6
Incr Delay (d2), s/veh	7.6	0.0	0.0	25.9	0.0	0.0	5.9	0.3	0.3	0.0	1.0	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.2	0.0	0.0	0.2	0.0	0.0	8.9	4.2	4.4	0.0	8.4	0.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	45.6	0.0	0.0	68.6	0.0	0.0	36.2	6.6	6.6	0.0	25.7	18.7
LnGrp LOS	D			E			D	A	A		C	B
Approach Vol, veh/h		138			4			1640			996	
Approach Delay, s/veh		45.6			68.6			14.2			25.4	
Approach LOS		D			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	0.0	65.2		6.5	28.9	36.3		14.5				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	74.0		5.0	49.0	49.0		14.0				
Max Q Clear Time (g_c+I1), s	0.0	15.5		2.2	21.6	22.4		8.5				
Green Ext Time (p_c), s	0.0	11.5		0.0	1.3	7.9		0.3				

Intersection Summary	
HCM 7th Control Delay, s/veh	19.9
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	125	189	170	82	169	910	101	426	35	488	605	147
Future Volume (veh/h)	125	189	170	82	169	910	101	426	35	488	605	147
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	136	205	81	89	184	0	110	463	8	530	658	148
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	199	235	394	203	675		140	517	438	643	1106	248
Arrive On Green	0.25	0.25	0.25	0.05	0.36	0.00	0.08	0.28	0.28	0.19	0.38	0.38
Sat Flow, veh/h	598	938	1572	1781	1870	1585	1781	1870	1585	3456	2880	647
Grp Volume(v), veh/h	341	0	81	89	184	0	110	463	8	530	406	400
Grp Sat Flow(s),veh/h/ln	1536	0	1572	1781	1870	1585	1781	1870	1585	1728	1777	1750
Q Serve(g_s), s	21.3	0.0	4.2	3.6	7.1	0.0	6.2	24.3	0.4	15.0	18.6	18.6
Cycle Q Clear(g_c), s	21.8	0.0	4.2	3.6	7.1	0.0	6.2	24.3	0.4	15.0	18.6	18.6
Prop In Lane	0.40		1.00	1.00		1.00	1.00		1.00	1.00		0.37
Lane Grp Cap(c), veh/h	434	0	394	203	675		140	517	438	643	682	672
V/C Ratio(X)	0.79	0.00	0.21	0.44	0.27		0.79	0.90	0.02	0.82	0.59	0.60
Avail Cap(c_a), veh/h	516	0	478	390	917		349	605	513	1322	1080	1064
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	36.8	0.0	30.2	27.7	23.1	0.0	46.1	35.5	26.8	39.9	25.1	25.1
Incr Delay (d2), s/veh	6.7	0.0	0.3	1.5	0.2	0.0	9.4	14.5	0.0	2.7	0.8	0.8
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	8.8	0.0	1.6	1.6	3.1	0.0	3.1	12.9	0.1	6.6	7.8	7.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	43.4	0.0	30.5	29.2	23.3	0.0	55.5	49.9	26.9	42.6	25.9	25.9
LnGrp LOS	D		C	C	C		E	D	C	D	C	C
Approach Vol, veh/h		422			273			581			1336	
Approach Delay, s/veh		40.9			25.2			50.7			32.6	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	25.0	34.2	11.3	31.5	14.0	45.1		42.8
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	19.0	33.0	16.0	31.0	20.0	62.0		50.0
Max Q Clear Time (g_c+I1), s	17.0	26.3	5.6	23.8	8.2	20.6		9.1
Green Ext Time (p_c), s	1.9	1.6	0.1	1.4	0.2	6.1		1.1

Intersection Summary	
HCM 7th Control Delay, s/veh	37.2
HCM 7th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	19	16	8	6	26	222	0	20	3	103	409	12
Future Volume (veh/h)	19	16	8	6	26	222	0	20	3	103	409	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.98	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	21	17	1	7	28	54	0	22	1	112	445	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	320	199	316	178	345	321	420	341	286	664	820	24
Arrive On Green	0.21	0.21	0.21	0.21	0.21	0.21	0.00	0.18	0.18	0.10	0.45	0.45
Sat Flow, veh/h	627	960	1520	150	1661	1546	1781	1870	1572	1781	1808	53
Grp Volume(v), veh/h	38	0	1	35	0	54	0	22	1	112	0	458
Grp Sat Flow(s),veh/h/ln	1587	0	1520	1811	0	1546	1781	1870	1572	1781	0	1861
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.3	0.0	1.3	0.0	5.3
Cycle Q Clear(g_c), s	0.5	0.0	0.0	0.4	0.0	0.8	0.0	0.3	0.0	1.3	0.0	5.3
Prop In Lane	0.55		1.00	0.20		1.00	1.00		1.00	1.00		0.03
Lane Grp Cap(c), veh/h	519	0	316	523	0	321	420	341	286	664	0	844
V/C Ratio(X)	0.07	0.00	0.00	0.07	0.00	0.17	0.00	0.06	0.00	0.17	0.00	0.54
Avail Cap(c_a), veh/h	2998	0	2833	3393	0	2882	716	3486	2930	784	0	3468
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.5	0.0	9.3	9.4	0.0	9.6	0.0	10.0	9.9	6.7	0.0	5.8
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.1	0.0	0.5
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.3	0.0	1.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.5	0.0	9.3	9.5	0.0	9.8	0.0	10.1	9.9	6.8	0.0	6.4
LnGrp LOS	A		A	A		A		B	A	A		A
Approach Vol, veh/h		39			89			23			570	
Approach Delay, s/veh		9.5			9.7			10.1			6.5	
Approach LOS		A			A			B			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.0	10.4		11.1	0.0	18.4		11.1				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.3	2.3		2.5	0.0	7.3		2.8				
Green Ext Time (p_c), s	0.0	0.1		0.2	0.0	3.3		0.4				

Intersection Summary	
HCM 7th Control Delay, s/veh	7.2
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	12	102	26	10	39	227	799	32	43	318	16
Future Volume (veh/h)	15	12	102	26	10	39	227	799	32	43	318	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	16	13	24	28	11	4	247	868	19	47	346	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	107	36	50	181	47	116	311	1059	898	82	818	693
Arrive On Green	0.07	0.07	0.07	0.07	0.07	0.07	0.17	0.57	0.57	0.05	0.44	0.44
Sat Flow, veh/h	345	485	687	1000	641	1580	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	53	0	0	39	0	4	247	868	19	47	346	6
Grp Sat Flow(s),veh/h/ln	1517	0	0	1641	0	1580	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.9	0.0	0.0	0.0	0.0	0.1	7.6	21.5	0.3	1.5	7.3	0.1
Cycle Q Clear(g_c), s	2.0	0.0	0.0	1.2	0.0	0.1	7.6	21.5	0.3	1.5	7.3	0.1
Prop In Lane	0.30		0.45	0.72		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	193	0	0	228	0	116	311	1059	898	82	818	693
V/C Ratio(X)	0.27	0.00	0.00	0.17	0.00	0.03	0.79	0.82	0.02	0.57	0.42	0.01
Avail Cap(c_a), veh/h	656	0	0	662	0	580	747	3726	3158	311	3269	2770
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	25.5	0.0	0.0	25.1	0.0	24.6	22.6	10.0	5.4	26.7	11.1	9.1
Incr Delay (d2), s/veh	0.8	0.0	0.0	0.4	0.0	0.1	4.6	1.6	0.0	6.2	0.3	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	0.0	0.0	0.5	0.0	0.1	3.3	7.0	0.1	0.7	2.6	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	26.2	0.0	0.0	25.5	0.0	24.8	27.2	11.7	5.5	32.9	11.5	9.1
LnGrp LOS	C			C		C	C	B	A	C	B	A
Approach Vol, veh/h		53			43			1134			399	
Approach Delay, s/veh		26.2			25.4			15.0			14.0	
Approach LOS		C			C			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.6	38.4		10.2	16.0	31.0		10.2
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0
Max Q Clear Time (g_c+I1), s	3.5	23.5		4.0	9.6	9.3		3.2
Green Ext Time (p_c), s	0.0	8.9		0.2	0.6	2.4		0.1

Intersection Summary	
HCM 7th Control Delay, s/veh	15.4
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	402	0	1131	483	2
Future Vol, veh/h	0	402	0	1131	483	2
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	437	0	1229	525	2

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2038 AM – Alternative 3

Intersection	
Int Delay, s/veh	3.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	17	97	83	340	572	20
Future Vol, veh/h	17	97	83	340	572	20
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	18	105	90	370	622	22

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1284	775	744	0	-	0
Stage 1	734	-	-	-	-	-
Stage 2	550	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	182	398	863	-	-	-
Stage 1	475	-	-	-	-	-
Stage 2	578	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	131	346	780	-	-	-
Mov Cap-2 Maneuver	131	-	-	-	-	-
Stage 1	380	-	-	-	-	-
Stage 2	522	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	27.94	2	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	780	-	278	-	-
HCM Lane V/C Ratio	0.116	-	0.445	-	-
HCM Control Delay (s/veh)	10.2	-	27.9	-	-
HCM Lane LOS	B	-	D	-	-
HCM 95th %tile Q(veh)	0.4	-	2.2	-	-

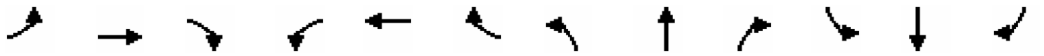
Intersection	
Int Delay, s/veh	1.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	24	36	392	23	45	631
Future Vol, veh/h	24	36	392	23	45	631
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	26	39	426	25	49	686

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	888	443	0	0	455	0
Stage 1	443	-	-	-	-	-
Stage 2	446	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	298	614	-	-	1104	-
Stage 1	646	-	-	-	-	-
Stage 2	613	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	282	612	-	-	1100	-
Mov Cap-2 Maneuver	282	-	-	-	-	-
Stage 1	644	-	-	-	-	-
Stage 2	583	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	14.39	0	0.56
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	282	612	1100	-
HCM Lane V/C Ratio	-	-	0.092	0.064	0.044	-
HCM Control Delay (s/veh)	-	-	19	11.3	8.4	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.3	0.2	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	157	1	471	2	5	0	286	1040	5	6	1198	151
Future Volume (veh/h)	157	1	471	2	5	0	286	1040	5	6	1198	151
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	171	1	0	2	5	0	311	1130	5	7	1302	93
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	202	1		5	12	0	350	2353	10	16	1637	729
Arrive On Green	0.11	0.11	0.00	0.01	0.01	0.00	0.20	0.65	0.65	0.01	0.46	0.46
Sat Flow, veh/h	1771	10	1585	527	1317	0	1781	3628	16	1781	3554	1582
Grp Volume(v), veh/h	172	0	0	7	0	0	311	553	582	7	1302	93
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1844	0	0	1781	1777	1867	1781	1777	1582
Q Serve(g_s), s	10.3	0.0	0.0	0.4	0.0	0.0	18.6	17.4	17.4	0.4	34.1	3.7
Cycle Q Clear(g_c), s	10.3	0.0	0.0	0.4	0.0	0.0	18.6	17.4	17.4	0.4	34.1	3.7
Prop In Lane	0.99		1.00	0.29		0.00	1.00		0.01	1.00		1.00
Lane Grp Cap(c), veh/h	203	0		16	0	0	350	1153	1211	16	1637	729
V/C Ratio(X)	0.85	0.00		0.43	0.00	0.00	0.89	0.48	0.48	0.45	0.80	0.13
Avail Cap(c_a), veh/h	245	0		152	0	0	717	2098	2205	147	2569	1143
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	47.5	0.0	0.0	53.9	0.0	0.0	42.7	9.8	9.8	53.9	25.1	16.9
Incr Delay (d2), s/veh	20.1	0.0	0.0	17.2	0.0	0.0	7.6	0.3	0.3	18.9	1.0	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.7	0.0	0.0	0.3	0.0	0.0	8.8	6.3	6.7	0.3	14.1	1.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	67.5	0.0	0.0	71.1	0.0	0.0	50.4	10.1	10.1	72.7	26.0	17.0
LnGrp LOS	E			E			D	B	B	E	C	B
Approach Vol, veh/h		172			7			1446			1402	
Approach Delay, s/veh		67.5			71.1			18.8			25.7	
Approach LOS		E			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	7.0	76.9		7.0	27.5	56.4		18.5				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	129.0		9.0	44.0	79.0		15.0				
Max Q Clear Time (g_c+I1), s	2.4	19.4		2.4	20.6	36.1		12.3				
Green Ext Time (p_c), s	0.0	10.4		0.0	0.9	14.3		0.2				

Intersection Summary		
HCM 7th Control Delay, s/veh	24.8	
HCM 7th LOS	C	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	57	111	62	33	136	384	56	490	36	343	721	80
Future Volume (veh/h)	57	111	62	33	136	384	56	490	36	343	721	80
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	62	121	21	36	148	0	61	533	11	373	784	79
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	135	175	229	218	502		88	604	512	523	1383	139
Arrive On Green	0.15	0.15	0.15	0.04	0.27	0.00	0.05	0.32	0.32	0.15	0.42	0.42
Sat Flow, veh/h	449	1193	1563	1781	1870	1585	1781	1870	1585	3456	3258	328
Grp Volume(v), veh/h	183	0	21	36	148	0	61	533	11	373	427	436
Grp Sat Flow(s),veh/h/ln	1642	0	1563	1781	1870	1585	1781	1870	1585	1728	1777	1809
Q Serve(g_s), s	5.6	0.0	0.8	1.1	4.4	0.0	2.4	18.9	0.3	7.2	12.7	12.8
Cycle Q Clear(g_c), s	7.4	0.0	0.8	1.1	4.4	0.0	2.4	18.9	0.3	7.2	12.7	12.8
Prop In Lane	0.34		1.00	1.00		1.00	1.00		1.00	1.00		0.18
Lane Grp Cap(c), veh/h	310	0	229	218	502		88	604	512	523	754	768
V/C Ratio(X)	0.59	0.00	0.09	0.17	0.29		0.69	0.88	0.02	0.71	0.57	0.57
Avail Cap(c_a), veh/h	464	0	380	459	829		306	696	589	2916	2135	2174
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	28.5	0.0	25.8	22.8	20.3	0.0	32.7	22.4	16.1	28.2	15.2	15.2
Incr Delay (d2), s/veh	1.8	0.0	0.2	0.4	0.3	0.0	9.2	11.6	0.0	1.8	0.7	0.7
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.0	0.0	0.3	0.5	1.9	0.0	1.2	9.6	0.1	3.0	4.8	4.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	30.3	0.0	26.0	23.2	20.6	0.0	41.9	34.0	16.2	30.1	15.9	15.9
LnGrp LOS	C		C	C	C		D	C	B	C	B	B
Approach Vol, veh/h		204			184			605			1236	
Approach Delay, s/veh		29.9			21.1			34.5			20.2	
Approach LOS		C			C			C			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	16.6	28.6	8.5	16.2	9.5	35.7		24.8
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	59.0	26.0	12.0	17.0	12.0	84.0		31.0
Max Q Clear Time (g_c+I1), s	19.2	20.9	3.1	9.4	4.4	14.8		6.4
Green Ext Time (p_c), s	1.4	1.6	0.0	0.6	0.1	6.8		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	25.0
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	16	7	10	5	12	236	0	18	1	109	230	9
Future Volume (veh/h)	16	7	10	5	12	236	0	18	1	109	230	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.97	1.00		0.99	0.99		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	17	8	2	5	13	61	0	20	1	118	250	9
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	374	136	302	202	314	307	450	322	270	666	812	29
Arrive On Green	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.17	0.17	0.11	0.45	0.45
Sat Flow, veh/h	822	683	1517	211	1578	1544	1781	1870	1571	1781	1794	65
Grp Volume(v), veh/h	25	0	2	18	0	61	0	20	1	118	0	259
Grp Sat Flow(s),veh/h/ln	1506	0	1517	1789	0	1544	1781	1870	1571	1781	0	1858
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.3	0.0	1.3	0.0	2.5
Cycle Q Clear(g_c), s	0.3	0.0	0.0	0.2	0.0	0.9	0.0	0.3	0.0	1.3	0.0	2.5
Prop In Lane	0.68		1.00	0.28		1.00	1.00		1.00	1.00		0.03
Lane Grp Cap(c), veh/h	510	0	302	516	0	307	450	322	270	666	0	841
V/C Ratio(X)	0.05	0.00	0.01	0.03	0.00	0.20	0.00	0.06	0.00	0.18	0.00	0.31
Avail Cap(c_a), veh/h	2979	0	2909	3417	0	2961	754	3585	3012	787	0	3562
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.3	0.0	9.2	9.3	0.0	9.6	0.0	9.9	9.8	6.6	0.0	5.0
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1	0.0	0.1	0.0	0.2
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.3	0.0	0.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.4	0.0	9.2	9.3	0.0	9.9	0.0	10.0	9.8	6.8	0.0	5.2
LnGrp LOS	A		A	A		A		B	A	A		A
Approach Vol, veh/h		27			79			21			377	
Approach Delay, s/veh		9.4			9.8			10.0			5.7	
Approach LOS		A			A			B			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.0	9.9		10.7	0.0	18.0		10.7				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.3	2.3		2.3	0.0	4.5		2.9				
Green Ext Time (p_c), s	0.0	0.1		0.1	0.0	1.7		0.3				

Intersection Summary	
HCM 7th Control Delay, s/veh	6.7
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	11	97	40	11	76	232	1105	36	47	572	9
Future Volume (veh/h)	5	11	97	40	11	76	232	1105	36	47	572	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		0.99	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	5	12	7	43	12	8	252	1201	25	51	622	5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	53	41	20	134	18	80	292	1348	1142	69	1115	944
Arrive On Green	0.05	0.05	0.05	0.05	0.05	0.05	0.16	0.72	0.72	0.04	0.60	0.60
Sat Flow, veh/h	141	805	390	1297	362	1576	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	24	0	0	55	0	8	252	1201	25	51	622	5
Grp Sat Flow(s),veh/h/ln	1336	0	0	1660	0	1576	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.5	13.1	47.6	0.4	2.7	19.1	0.1
Cycle Q Clear(g_c), s	2.9	0.0	0.0	2.9	0.0	0.5	13.1	47.6	0.4	2.7	19.1	0.1
Prop In Lane	0.21		0.29	0.78		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	114	0	0	152	0	80	292	1348	1142	69	1115	944
V/C Ratio(X)	0.21	0.00	0.00	0.36	0.00	0.10	0.86	0.89	0.02	0.74	0.56	0.01
Avail Cap(c_a), veh/h	326	0	0	340	0	282	450	2245	1903	188	1969	1669
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	43.4	0.0	0.0	44.1	0.0	43.0	38.7	10.4	3.8	45.2	11.6	7.8
Incr Delay (d2), s/veh	0.9	0.0	0.0	1.4	0.0	0.5	10.4	2.8	0.0	13.9	0.4	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.6	0.0	0.0	1.3	0.0	0.2	6.5	16.1	0.1	1.4	7.4	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	44.3	0.0	0.0	45.6	0.0	43.5	49.1	13.1	3.8	59.1	12.1	7.8
LnGrp LOS	D			D		D	D	B	A	E	B	A
Approach Vol, veh/h		24			63			1478			678	
Approach Delay, s/veh		44.3			45.3			19.1			15.6	
Approach LOS		D			D			B			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	9.7	74.4		10.8	21.6	62.6		10.8				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	10.0	114.0		17.0	24.0	100.0		17.0				
Max Q Clear Time (g_c+I1), s	4.7	49.6		4.9	15.1	21.1		4.9				
Green Ext Time (p_c), s	0.0	18.8		0.0	0.5	5.1		0.2				

Intersection Summary	
HCM 7th Control Delay, s/veh	19.0
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	209	0	1362	731	1
Future Vol, veh/h	0	209	0	1362	731	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	227	0	1480	795	1

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2038 PM – Alternative 3

Intersection	
Int Delay, s/veh	6.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	25	141	99	559	524	32
Future Vol, veh/h	25	141	99	559	524	32
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	27	153	108	608	570	35

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1511	729	705	0	-	0
Stage 1	688	-	-	-	-	-
Stage 2	823	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	132	423	893	-	-	-
Stage 1	499	-	-	-	-	-
Stage 2	431	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	94	367	807	-	-	-
Mov Cap-2 Maneuver	94	-	-	-	-	-
Stage 1	391	-	-	-	-	-
Stage 2	390	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	47.22	1.53	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	807	-	255	-	-
HCM Lane V/C Ratio	0.133	-	0.707	-	-
HCM Control Delay (s/veh)	10.1	-	47.2	-	-
HCM Lane LOS	B	-	E	-	-
HCM 95th %tile Q(veh)	0.5	-	4.8	-	-

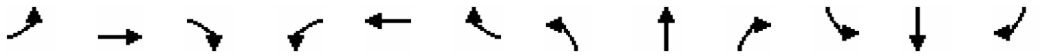
Intersection	
Int Delay, s/veh	2.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	51	71	591	51	53	617
Future Vol, veh/h	51	71	591	51	53	617
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	55	77	642	55	58	671

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1130	674	0	0	702	0
Stage 1	674	-	-	-	-	-
Stage 2	456	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	211	454	-	-	893	-
Stage 1	505	-	-	-	-	-
Stage 2	606	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	196	452	-	-	890	-
Mov Cap-2 Maneuver	196	-	-	-	-	-
Stage 1	503	-	-	-	-	-
Stage 2	564	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	21.25	0	0.74
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	196	452	890	-
HCM Lane V/C Ratio	-	-	0.283	0.171	0.065	-
HCM Control Delay (s/veh)	-	-	30.5	14.6	9.3	-
HCM Lane LOS	-	-	D	B	A	-
HCM 95th %tile Q(veh)	-	-	1.1	0.6	0.2	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	150	1	543	9	2	6	487	1614	0	1	1312	174
Future Volume (veh/h)	150	1	543	9	2	6	487	1614	0	1	1312	174
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	163	1	0	10	2	2	529	1754	0	1	1426	111
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	187	1		18	4	4	555	2596	0	2	1494	665
Arrive On Green	0.11	0.11	0.00	0.01	0.01	0.01	0.31	0.73	0.00	0.00	0.42	0.42
Sat Flow, veh/h	1771	11	1585	1259	252	252	1781	3647	0	1781	3554	1581
Grp Volume(v), veh/h	164	0	0	14	0	0	529	1754	0	1	1426	111
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1762	0	0	1781	1777	0	1781	1777	1581
Q Serve(g_s), s	14.7	0.0	0.0	1.3	0.0	0.0	47.1	42.6	0.0	0.1	63.0	7.1
Cycle Q Clear(g_c), s	14.7	0.0	0.0	1.3	0.0	0.0	47.1	42.6	0.0	0.1	63.0	7.1
Prop In Lane	0.99		1.00	0.71		0.14	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	188	0		25	0	0	555	2596	0	2	1494	665
V/C Ratio(X)	0.87	0.00		0.55	0.00	0.00	0.95	0.68	0.00	0.41	0.95	0.17
Avail Cap(c_a), veh/h	264	0		98	0	0	648	2596	0	99	1513	673
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	71.4	0.0	0.0	79.4	0.0	0.0	54.7	11.6	0.0	80.9	45.5	29.3
Incr Delay (d2), s/veh	19.6	0.0	0.0	17.3	0.0	0.0	22.7	0.7	0.0	85.5	13.8	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.8	0.0	0.0	0.7	0.0	0.0	24.7	16.3	0.0	0.1	30.5	2.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	91.0	0.0	0.0	96.6	0.0	0.0	77.3	12.3	0.0	166.4	59.3	29.4
LnGrp LOS	F			F			E	B		F	E	C
Approach Vol, veh/h		164			14			2283			1538	
Approach Delay, s/veh		91.0			96.6			27.4			57.2	
Approach LOS		F			F			C			E	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.2	124.4		8.3	56.5	74.1		23.1				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	104.0		9.0	59.0	69.0		24.0				
Max Q Clear Time (g_c+I1), s	2.1	44.6		3.3	49.1	65.0		16.7				
Green Ext Time (p_c), s	0.0	25.4		0.0	1.3	3.2		0.4				

Intersection Summary		
HCM 7th Control Delay, s/veh	41.7	
HCM 7th LOS	D	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	90	125	124	26	132	431	54	527	27	433	737	89
Future Volume (veh/h)	90	125	124	26	132	431	54	527	27	433	737	89
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	98	136	37	28	143	0	59	573	8	471	801	89
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	171	181	293	186	530		77	634	537	600	1512	168
Arrive On Green	0.19	0.19	0.19	0.03	0.28	0.00	0.04	0.34	0.34	0.17	0.47	0.47
Sat Flow, veh/h	602	967	1568	1781	1870	1585	1781	1870	1585	3456	3223	358
Grp Volume(v), veh/h	234	0	37	28	143	0	59	573	8	471	442	448
Grp Sat Flow(s),veh/h/ln	1568	0	1568	1781	1870	1585	1781	1870	1585	1728	1777	1804
Q Serve(g_s), s	11.3	0.0	1.7	1.1	5.2	0.0	2.9	25.7	0.3	11.5	15.5	15.5
Cycle Q Clear(g_c), s	12.5	0.0	1.7	1.1	5.2	0.0	2.9	25.7	0.3	11.5	15.5	15.5
Prop In Lane	0.42		1.00	1.00		1.00	1.00		1.00	1.00		0.20
Lane Grp Cap(c), veh/h	351	0	293	186	530		77	634	537	600	834	846
V/C Ratio(X)	0.67	0.00	0.13	0.15	0.27		0.76	0.90	0.01	0.79	0.53	0.53
Avail Cap(c_a), veh/h	588	0	534	419	1019		182	722	611	2313	1189	1208
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	34.1	0.0	29.8	27.2	24.5	0.0	41.7	27.8	19.4	34.9	16.5	16.5
Incr Delay (d2), s/veh	2.2	0.0	0.2	0.4	0.3	0.0	14.4	13.7	0.0	2.3	0.5	0.5
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.9	0.0	0.7	0.5	2.3	0.0	1.6	13.4	0.1	4.9	6.1	6.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	36.3	0.0	30.0	27.6	24.8	0.0	56.1	41.5	19.4	37.2	17.1	17.0
LnGrp LOS	D		C	C	C		E	D	B	D	B	B
Approach Vol, veh/h		271			171			640			1361	
Approach Delay, s/veh		35.4			25.2			42.5			24.0	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	21.3	35.9	8.5	22.5	9.8	47.3		31.0
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	59.0	34.0	14.0	30.0	9.0	59.0		48.0
Max Q Clear Time (g_c+I1), s	13.5	27.7	3.1	14.5	4.9	17.5		7.2
Green Ext Time (p_c), s	1.8	2.0	0.0	1.3	0.0	6.9		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	30.2
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	30	13	10	19	26	226	1	33	2	117	460	17
Future Volume (veh/h)	30	13	10	19	26	226	1	33	2	117	460	17
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.97	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	33	14	1	21	28	51	1	36	1	127	500	17
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	342	117	302	233	242	307	340	552	465	755	706	24
Arrive On Green	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.30	0.30	0.10	0.39	0.39
Sat Flow, veh/h	884	589	1517	469	1218	1544	1781	1870	1577	1781	1798	61
Grp Volume(v), veh/h	47	0	1	49	0	51	1	36	1	127	0	517
Grp Sat Flow(s),veh/h/ln	1474	0	1517	1686	0	1544	1781	1870	1577	1781	0	1859
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.5	0.0	1.7	0.0	8.6
Cycle Q Clear(g_c), s	0.8	0.0	0.0	0.8	0.0	1.0	0.0	0.5	0.0	1.7	0.0	8.6
Prop In Lane	0.70		1.00	0.43		1.00	1.00		1.00	1.00		0.03
Lane Grp Cap(c), veh/h	460	0	302	475	0	307	340	552	465	755	0	730
V/C Ratio(X)	0.10	0.00	0.00	0.10	0.00	0.17	0.00	0.07	0.00	0.17	0.00	0.71
Avail Cap(c_a), veh/h	2300	0	2265	2547	0	2306	577	2792	2354	821	0	2776
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	12.1	0.0	11.8	12.1	0.0	12.2	9.4	9.3	9.2	6.9	0.0	9.4
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.3	0.0	0.0	0.0	0.1	0.0	1.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.0	0.3	0.0	0.3	0.0	0.2	0.0	0.4	0.0	2.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	12.2	0.0	11.8	12.2	0.0	12.5	9.4	9.4	9.2	7.0	0.0	10.7
LnGrp LOS	B		B	B		B	A	A	A	A		B
Approach Vol, veh/h		48			100			38			644	
Approach Delay, s/veh		12.2			12.4			9.4			10.0	
Approach LOS		B			B			A			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.6	15.9		12.3	5.1	19.5		12.3				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.6	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.7	2.5		2.8	2.0	10.6		3.0				
Green Ext Time (p_c), s	0.0	0.2		0.3	0.0	3.8		0.5				

Intersection Summary	
HCM 7th Control Delay, s/veh	10.4
HCM 7th LOS	B



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	6	19	102	37	9	57	234	980	34	45	881	27
Future Volume (veh/h)	6	19	102	37	9	57	234	980	34	45	881	27
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		0.99	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	7	21	18	40	10	5	254	1065	24	49	958	14
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	53	44	33	144	20	89	296	1322	1121	69	1085	919
Arrive On Green	0.06	0.06	0.06	0.06	0.06	0.06	0.17	0.71	0.71	0.04	0.58	0.58
Sat Flow, veh/h	131	775	583	1284	361	1577	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	46	0	0	50	0	5	254	1065	24	49	958	14
Grp Sat Flow(s),veh/h/ln	1490	0	0	1645	0	1577	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.5	0.0	0.0	0.0	0.0	0.3	12.6	35.3	0.4	2.5	40.2	0.3
Cycle Q Clear(g_c), s	3.0	0.0	0.0	2.5	0.0	0.3	12.6	35.3	0.4	2.5	40.2	0.3
Prop In Lane	0.15		0.39	0.80		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	130	0	0	164	0	89	296	1322	1121	69	1085	919
V/C Ratio(X)	0.36	0.00	0.00	0.30	0.00	0.06	0.86	0.81	0.02	0.71	0.88	0.02
Avail Cap(c_a), veh/h	419	0	0	414	0	363	469	2341	1984	196	2053	1740
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	41.8	0.0	0.0	41.7	0.0	40.7	37.0	9.1	4.0	43.3	16.5	8.1
Incr Delay (d2), s/veh	1.6	0.0	0.0	1.0	0.0	0.3	9.1	1.2	0.0	12.3	2.6	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.1	0.0	0.0	1.1	0.0	0.1	6.1	11.6	0.1	1.3	16.0	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	43.4	0.0	0.0	42.8	0.0	40.9	46.1	10.3	4.0	55.5	19.0	8.1
LnGrp LOS	D			D		D	D	B	A	E	B	A
Approach Vol, veh/h		46			55			1343			1021	
Approach Delay, s/veh		43.4			42.6			16.9			20.6	
Approach LOS		D			D			B			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	9.6	70.4		11.1	21.1	58.8		11.1
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0
Max Q Clear Time (g_c+I1), s	4.5	37.3		5.0	14.6	42.2		4.5
Green Ext Time (p_c), s	0.0	14.0		0.1	0.5	10.7		0.2

Intersection Summary	
HCM 7th Control Delay, s/veh	19.5
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	416	0	1269	1118	5
Future Vol, veh/h	0	416	0	1269	1118	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	452	0	1379	1215	5

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2038 SAT – Alternative 3

Intersection	
Int Delay, s/veh	2.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	19	74	79	498	483	17
Future Vol, veh/h	19	74	79	498	483	17
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	21	80	86	541	525	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1348	676	644	0	-	0
Stage 1	635	-	-	-	-	-
Stage 2	713	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	166	453	941	-	-	-
Stage 1	528	-	-	-	-	-
Stage 2	486	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	122	394	850	-	-	-
Mov Cap-2 Maneuver	122	-	-	-	-	-
Stage 1	429	-	-	-	-	-
Stage 2	439	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	26.01	1.33	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	850	-	271	-	-
HCM Lane V/C Ratio	0.101	-	0.373	-	-
HCM Control Delay (s/veh)	9.7	-	26	-	-
HCM Lane LOS	A	-	D	-	-
HCM 95th %tile Q(veh)	0.3	-	1.7	-	-

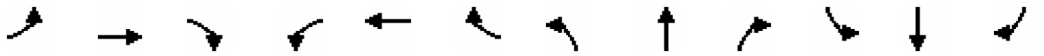
Intersection	
Int Delay, s/veh	1.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	53	62	513	43	35	538
Future Vol, veh/h	53	62	513	43	35	538
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	58	67	558	47	38	585

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	958	585	0	0	608	0
Stage 1	585	-	-	-	-	-
Stage 2	373	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	270	510	-	-	968	-
Stage 1	556	-	-	-	-	-
Stage 2	667	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	257	508	-	-	964	-
Mov Cap-2 Maneuver	257	-	-	-	-	-
Stage 1	554	-	-	-	-	-
Stage 2	638	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	17.71	0	0.54
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	257	508	964	-
HCM Lane V/C Ratio	-	-	0.224	0.133	0.039	-
HCM Control Delay (s/veh)	-	-	23	13.2	8.9	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.8	0.5	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	144	2	428	2	2	0	397	1447	2	0	1172	155
Future Volume (veh/h)	144	2	428	2	2	0	397	1447	2	0	1172	155
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	157	2	0	2	2	0	432	1573	2	0	1274	60
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	187	2		5	5	0	473	2645	3	2	1446	643
Arrive On Green	0.11	0.11	0.00	0.01	0.01	0.00	0.27	0.73	0.73	0.00	0.41	0.41
Sat Flow, veh/h	1760	22	1585	912	912	0	1781	3642	5	1781	3554	1581
Grp Volume(v), veh/h	159	0	0	4	0	0	432	767	808	0	1274	60
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1825	0	0	1781	1777	1870	1781	1777	1581
Q Serve(g_s), s	9.7	0.0	0.0	0.2	0.0	0.0	26.1	23.1	23.1	0.0	36.8	2.6
Cycle Q Clear(g_c), s	9.7	0.0	0.0	0.2	0.0	0.0	26.1	23.1	23.1	0.0	36.8	2.6
Prop In Lane	0.99		1.00	0.50		0.00	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	189	0		10	0	0	473	1290	1358	2	1446	643
V/C Ratio(X)	0.84	0.00		0.42	0.00	0.00	0.91	0.59	0.59	0.00	0.88	0.09
Avail Cap(c_a), veh/h	225	0		82	0	0	787	1290	1358	145	1570	699
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	48.6	0.0	0.0	55.0	0.0	0.0	39.5	7.3	7.3	0.0	30.4	20.3
Incr Delay (d2), s/veh	20.9	0.0	0.0	26.7	0.0	0.0	9.5	0.7	0.7	0.0	5.9	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.4	0.0	0.0	0.2	0.0	0.0	12.5	7.8	8.2	0.0	16.4	1.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	69.5	0.0	0.0	81.7	0.0	0.0	49.0	8.1	8.0	0.0	36.3	20.3
LnGrp LOS	E			F			D	A	A		D	C
Approach Vol, veh/h		159			4			2007			1334	
Approach Delay, s/veh		69.5			81.7			16.9			35.6	
Approach LOS		E			F			B			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	0.0	86.5		6.6	35.4	51.1		17.8				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	74.0		5.0	49.0	49.0		14.0				
Max Q Clear Time (g_c+I1), s	0.0	25.1		2.2	28.1	38.8		11.7				
Green Ext Time (p_c), s	0.0	18.0		0.0	1.3	6.4		0.2				

Intersection Summary		
HCM 7th Control Delay, s/veh	26.4	
HCM 7th LOS	C	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	126	189	170	82	169	400	101	533	35	293	759	157
Future Volume (veh/h)	126	189	170	82	169	400	101	533	35	293	759	157
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	137	205	76	89	184	0	110	579	10	318	825	159
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	204	240	402	212	689		140	613	519	418	1098	212
Arrive On Green	0.26	0.26	0.26	0.05	0.37	0.00	0.08	0.33	0.33	0.12	0.37	0.37
Sat Flow, veh/h	598	938	1573	1781	1870	1585	1781	1870	1585	3456	2968	572
Grp Volume(v), veh/h	342	0	76	89	184	0	110	579	10	318	494	490
Grp Sat Flow(s),veh/h/ln	1536	0	1573	1781	1870	1585	1781	1870	1585	1728	1777	1764
Q Serve(g_s), s	20.4	0.0	3.7	3.5	6.8	0.0	6.0	29.7	0.4	8.8	23.9	23.9
Cycle Q Clear(g_c), s	20.9	0.0	3.7	3.5	6.8	0.0	6.0	29.7	0.4	8.8	23.9	23.9
Prop In Lane	0.40		1.00	1.00		1.00	1.00		1.00	1.00		0.32
Lane Grp Cap(c), veh/h	444	0	402	212	689		140	613	519	418	657	652
V/C Ratio(X)	0.77	0.00	0.19	0.42	0.27		0.78	0.94	0.02	0.76	0.75	0.75
Avail Cap(c_a), veh/h	566	0	528	409	951		362	627	532	1370	1120	1112
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	35.0	0.0	28.6	26.3	21.8	0.0	44.5	32.2	22.4	41.9	27.1	27.1
Incr Delay (d2), s/veh	4.9	0.0	0.2	1.3	0.2	0.0	9.2	23.0	0.0	2.9	1.8	1.8
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	8.3	0.0	1.4	1.5	3.0	0.0	3.0	16.9	0.2	3.9	10.1	10.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	39.9	0.0	28.9	27.6	22.0	0.0	53.7	55.2	22.4	44.7	28.8	28.8
LnGrp LOS	D		C	C	C		D	E	C	D	C	C
Approach Vol, veh/h		418			273			699			1302	
Approach Delay, s/veh		37.9			23.8			54.5			32.7	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	17.9	38.2	11.1	31.1	13.7	42.4		42.2
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	39.0	33.0	16.0	33.0	20.0	62.0		50.0
Max Q Clear Time (g_c+I1), s	10.8	31.7	5.5	22.9	8.0	25.9		8.8
Green Ext Time (p_c), s	1.1	0.5	0.1	1.7	0.2	7.9		1.1

Intersection Summary	
HCM 7th Control Delay, s/veh	38.3
HCM 7th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	28	16	8	6	26	261	0	23	3	116	279	14
Future Volume (veh/h)	28	16	8	6	26	261	0	23	3	116	279	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.98	1.00		0.99	0.99		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	30	17	1	7	28	71	0	25	1	126	303	14
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	362	162	330	176	361	335	431	325	273	658	797	37
Arrive On Green	0.22	0.22	0.22	0.22	0.22	0.22	0.00	0.17	0.17	0.11	0.45	0.45
Sat Flow, veh/h	763	747	1523	145	1669	1548	1781	1870	1571	1781	1773	82
Grp Volume(v), veh/h	47	0	1	35	0	71	0	25	1	126	0	317
Grp Sat Flow(s),veh/h/ln	1510	0	1523	1814	0	1548	1781	1870	1571	1781	0	1855
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.3	0.0	1.5	0.0	3.4
Cycle Q Clear(g_c), s	0.6	0.0	0.0	0.4	0.0	1.1	0.0	0.3	0.0	1.5	0.0	3.4
Prop In Lane	0.64		1.00	0.20		1.00	1.00		1.00	1.00		0.04
Lane Grp Cap(c), veh/h	524	0	330	537	0	335	431	325	273	658	0	833
V/C Ratio(X)	0.09	0.00	0.00	0.07	0.00	0.21	0.00	0.08	0.00	0.19	0.00	0.38
Avail Cap(c_a), veh/h	2855	0	2799	3350	0	2845	723	3438	2888	762	0	3410
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.4	0.0	9.2	9.4	0.0	9.6	0.0	10.4	10.2	6.9	0.0	5.5
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.3	0.0	0.1	0.0	0.1	0.0	0.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	0.0	0.0	0.1	0.0	0.3	0.0	0.1	0.0	0.4	0.0	0.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.5	0.0	9.2	9.4	0.0	9.9	0.0	10.5	10.2	7.1	0.0	5.8
LnGrp LOS	A		A	A		A		B	B	A		A
Approach Vol, veh/h		48			106			26			443	
Approach Delay, s/veh		9.5			9.8			10.4			6.1	
Approach LOS		A			A			B			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.2	10.2		11.5	0.0	18.4		11.5				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.5	2.3		2.6	0.0	5.4		3.1				
Green Ext Time (p_c), s	0.0	0.1		0.3	0.0	2.1		0.4				

Intersection Summary		
HCM 7th Control Delay, s/veh	7.2	
HCM 7th LOS	A	



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	14	113	26	11	45	262	943	32	46	561	17
Future Volume (veh/h)	15	14	113	26	11	45	262	943	32	46	561	17
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	16	15	32	28	12	6	285	1025	22	50	610	8
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	81	32	53	151	48	108	338	1197	1014	78	923	782
Arrive On Green	0.07	0.07	0.07	0.07	0.07	0.07	0.19	0.64	0.64	0.04	0.49	0.49
Sat Flow, veh/h	279	473	776	978	704	1578	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	63	0	0	40	0	6	285	1025	22	50	610	8
Grp Sat Flow(s),veh/h/ln	1528	0	0	1682	0	1578	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	1.5	0.0	0.0	0.0	0.0	0.3	11.2	31.7	0.4	2.0	17.8	0.2
Cycle Q Clear(g_c), s	3.0	0.0	0.0	1.5	0.0	0.3	11.2	31.7	0.4	2.0	17.8	0.2
Prop In Lane	0.25		0.51	0.70		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	166	0	0	199	0	108	338	1197	1014	78	923	782
V/C Ratio(X)	0.38	0.00	0.00	0.20	0.00	0.06	0.84	0.86	0.02	0.64	0.66	0.01
Avail Cap(c_a), veh/h	516	0	0	525	0	457	589	2940	2491	246	2579	2185
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	32.9	0.0	0.0	32.2	0.0	31.6	28.3	10.4	4.8	34.1	13.8	9.3
Incr Delay (d2), s/veh	1.4	0.0	0.0	0.5	0.0	0.2	5.7	1.9	0.0	8.5	0.8	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.1	0.0	0.0	0.7	0.0	0.1	5.1	10.6	0.1	1.0	6.8	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	34.3	0.0	0.0	32.7	0.0	31.8	34.0	12.3	4.8	42.6	14.6	9.3
LnGrp LOS	C			C		C	C	B	A	D	B	A
Approach Vol, veh/h		63			46			1332			668	
Approach Delay, s/veh		34.3			32.6			16.8			16.6	
Approach LOS		C			C			B			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	9.2	52.4		10.9	19.8	41.8		10.9				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0				
Max Q Clear Time (g_c+I1), s	4.0	33.7		5.0	13.2	19.8		3.5				
Green Ext Time (p_c), s	0.0	12.7		0.2	0.6	4.9		0.1				

Intersection Summary	
HCM 7th Control Delay, s/veh	17.6
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	255	0	1327	746	3
Future Vol, veh/h	0	255	0	1327	746	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	277	0	1442	811	3

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2048 AM – Alternative 3

Intersection	
Int Delay, s/veh	3.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	17	97	83	356	598	20
Future Vol, veh/h	17	97	83	356	598	20
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	18	105	90	387	650	22

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1329	803	773	0	-	0
Stage 1	762	-	-	-	-	-
Stage 2	567	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	171	384	842	-	-	-
Stage 1	461	-	-	-	-	-
Stage 2	567	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	123	333	761	-	-	-
Mov Cap-2 Maneuver	123	-	-	-	-	-
Stage 1	367	-	-	-	-	-
Stage 2	513	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	29.9	1.96	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	761	-	265	-	-
HCM Lane V/C Ratio	0.118	-	0.467	-	-
HCM Control Delay (s/veh)	10.4	-	29.9	-	-
HCM Lane LOS	B	-	D	-	-
HCM 95th %tile Q(veh)	0.4	-	2.3	-	-

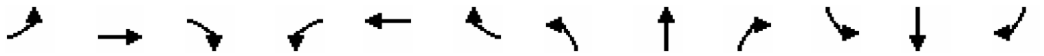
Intersection	
Int Delay, s/veh	1.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	24	36	409	23	45	660
Future Vol, veh/h	24	36	409	23	45	660
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	26	39	445	25	49	717

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	923	461	0	0	474	0
Stage 1	461	-	-	-	-	-
Stage 2	462	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	284	600	-	-	1087	-
Stage 1	634	-	-	-	-	-
Stage 2	602	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	269	597	-	-	1082	-
Mov Cap-2 Maneuver	269	-	-	-	-	-
Stage 1	632	-	-	-	-	-
Stage 2	572	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	14.8	0	0.54
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	269	597	1082	-
HCM Lane V/C Ratio	-	-	0.097	0.066	0.045	-
HCM Control Delay (s/veh)	-	-	19.8	11.4	8.5	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.3	0.2	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	157	1	471	2	5	0	286	698	5	6	954	151
Future Volume (veh/h)	157	1	471	2	5	0	286	698	5	6	954	151
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	171	1	0	2	5	0	311	759	5	7	1037	86
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	211	1		5	12	0	361	2124	14	16	1398	622
Arrive On Green	0.12	0.12	0.00	0.01	0.01	0.00	0.20	0.59	0.59	0.01	0.39	0.39
Sat Flow, veh/h	1771	10	1585	527	1317	0	1781	3619	24	1781	3554	1581
Grp Volume(v), veh/h	172	0	0	7	0	0	311	373	391	7	1037	86
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1844	0	0	1781	1777	1866	1781	1777	1581
Q Serve(g_s), s	8.2	0.0	0.0	0.3	0.0	0.0	14.7	9.5	9.5	0.3	21.7	3.0
Cycle Q Clear(g_c), s	8.2	0.0	0.0	0.3	0.0	0.0	14.7	9.5	9.5	0.3	21.7	3.0
Prop In Lane	0.99		1.00	0.29		0.00	1.00		0.01	1.00		1.00
Lane Grp Cap(c), veh/h	212	0		16	0	0	361	1043	1095	16	1398	622
V/C Ratio(X)	0.81	0.00		0.42	0.00	0.00	0.86	0.36	0.36	0.44	0.74	0.14
Avail Cap(c_a), veh/h	307	0		191	0	0	901	2636	2769	184	3229	1437
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	37.3	0.0	0.0	42.9	0.0	0.0	33.5	9.4	9.4	42.9	22.6	16.9
Incr Delay (d2), s/veh	10.0	0.0	0.0	16.4	0.0	0.0	6.2	0.2	0.2	17.9	0.8	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.1	0.0	0.0	0.2	0.0	0.0	6.8	3.4	3.6	0.2	8.8	1.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	47.3	0.0	0.0	59.2	0.0	0.0	39.7	9.6	9.6	60.7	23.4	17.0
LnGrp LOS	D			E			D	A	A	E	C	B
Approach Vol, veh/h		172			7			1075			1130	
Approach Delay, s/veh		47.3			59.2			18.3			23.1	
Approach LOS		D			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.8	57.0		6.8	23.6	40.2		16.4				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	129.0		9.0	44.0	79.0		15.0				
Max Q Clear Time (g_c+I1), s	2.3	11.5		2.3	16.7	23.7		10.2				
Green Ext Time (p_c), s	0.0	5.7		0.0	0.9	10.5		0.3				

Intersection Summary		
HCM 7th Control Delay, s/veh	22.8	
HCM 7th LOS	C	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	57	111	62	33	136	400	56	511	36	358	752	80
Future Volume (veh/h)	57	111	62	33	136	400	56	511	36	358	752	80
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	62	121	21	36	148	0	61	555	11	389	817	80
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	133	173	228	213	495		87	616	522	537	1424	139
Arrive On Green	0.15	0.15	0.15	0.04	0.26	0.00	0.05	0.33	0.33	0.16	0.44	0.44
Sat Flow, veh/h	450	1191	1563	1781	1870	1585	1781	1870	1585	3456	3268	320
Grp Volume(v), veh/h	183	0	21	36	148	0	61	555	11	389	444	453
Grp Sat Flow(s),veh/h/ln	1641	0	1563	1781	1870	1585	1781	1870	1585	1728	1777	1811
Q Serve(g_s), s	5.9	0.0	0.8	1.2	4.5	0.0	2.4	20.3	0.3	7.7	13.5	13.5
Cycle Q Clear(g_c), s	7.6	0.0	0.8	1.2	4.5	0.0	2.4	20.3	0.3	7.7	13.5	13.5
Prop In Lane	0.34		1.00	1.00		1.00	1.00		1.00	1.00		0.18
Lane Grp Cap(c), veh/h	306	0	228	213	495		87	616	522	537	774	789
V/C Ratio(X)	0.60	0.00	0.09	0.17	0.30		0.70	0.90	0.02	0.72	0.57	0.57
Avail Cap(c_a), veh/h	451	0	370	447	807		297	677	573	2837	2077	2117
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	29.4	0.0	26.6	23.6	21.1	0.0	33.7	23.0	16.3	28.9	15.3	15.3
Incr Delay (d2), s/veh	1.9	0.0	0.2	0.4	0.3	0.0	9.7	14.4	0.0	1.9	0.7	0.7
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.1	0.0	0.3	0.5	1.9	0.0	1.3	10.7	0.1	3.2	5.1	5.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	31.2	0.0	26.8	24.0	21.4	0.0	43.3	37.3	16.3	30.8	15.9	15.9
LnGrp LOS	C		C	C	C		D	D	B	C	B	B
Approach Vol, veh/h		204			184			627			1286	
Approach Delay, s/veh		30.8			21.9			37.5			20.4	
Approach LOS		C			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	17.2	29.7	8.6	16.5	9.5	37.3		25.0
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	59.6	26.0	12.0	17.0	12.0	84.0		31.0
Max Q Clear Time (g_c+I1), s	19.7	22.3	3.2	9.6	4.4	15.5		6.5
Green Ext Time (p_c), s	1.5	1.3	0.0	0.6	0.1	7.2		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	26.1
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	16	7	10	5	12	236	0	19	1	109	240	9
Future Volume (veh/h)	16	7	10	5	12	236	0	19	1	109	240	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.97	1.00		0.99	0.99		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	17	8	2	5	13	60	0	21	1	118	261	9
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	374	136	301	202	313	306	449	324	273	666	815	28
Arrive On Green	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.17	0.17	0.11	0.45	0.45
Sat Flow, veh/h	823	684	1517	210	1578	1544	1781	1870	1571	1781	1797	62
Grp Volume(v), veh/h	25	0	2	18	0	60	0	21	1	118	0	270
Grp Sat Flow(s),veh/h/ln	1506	0	1517	1789	0	1544	1781	1870	1571	1781	0	1859
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.3	0.0	1.3	0.0	2.7
Cycle Q Clear(g_c), s	0.3	0.0	0.0	0.2	0.0	0.9	0.0	0.3	0.0	1.3	0.0	2.7
Prop In Lane	0.68		1.00	0.28		1.00	1.00		1.00	1.00		0.03
Lane Grp Cap(c), veh/h	509	0	301	515	0	306	449	324	273	666	0	843
V/C Ratio(X)	0.05	0.00	0.01	0.03	0.00	0.20	0.00	0.06	0.00	0.18	0.00	0.32
Avail Cap(c_a), veh/h	2976	0	2904	3411	0	2956	753	3580	3007	787	0	3558
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.4	0.0	9.2	9.3	0.0	9.6	0.0	9.9	9.8	6.6	0.0	5.0
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1	0.0	0.1	0.0	0.2
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.3	0.0	0.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.4	0.0	9.3	9.3	0.0	9.9	0.0	10.0	9.8	6.7	0.0	5.2
LnGrp LOS	A		A	A		A		B	A	A		A
Approach Vol, veh/h		27			78			22			388	
Approach Delay, s/veh		9.4			9.8			10.0			5.7	
Approach LOS		A			A			B			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.1	10.0		10.7	0.0	18.0		10.7				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.3	2.3		2.3	0.0	4.7		2.9				
Green Ext Time (p_c), s	0.0	0.1		0.1	0.0	1.8		0.3				

Intersection Summary	
HCM 7th Control Delay, s/veh	6.7
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	11	97	40	11	76	232	1165	36	47	603	9
Future Volume (veh/h)	5	11	97	40	11	76	232	1165	36	47	603	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		0.99	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	5	12	7	43	12	8	252	1266	26	51	655	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	48	40	19	125	18	77	287	1389	1177	66	1158	981
Arrive On Green	0.05	0.05	0.05	0.05	0.05	0.05	0.16	0.74	0.74	0.04	0.62	0.62
Sat Flow, veh/h	133	806	387	1303	364	1575	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	24	0	0	55	0	8	252	1266	26	51	655	6
Grp Sat Flow(s),veh/h/ln	1327	0	0	1666	0	1575	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.5	14.6	56.8	0.5	3.0	21.6	0.2
Cycle Q Clear(g_c), s	3.2	0.0	0.0	3.2	0.0	0.5	14.6	56.8	0.5	3.0	21.6	0.2
Prop In Lane	0.21		0.29	0.78		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	106	0	0	143	0	77	287	1389	1177	66	1158	981
V/C Ratio(X)	0.23	0.00	0.00	0.39	0.00	0.10	0.88	0.91	0.02	0.77	0.57	0.01
Avail Cap(c_a), veh/h	292	0	0	307	0	254	406	1846	1564	338	1775	1504
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	48.3	0.0	0.0	49.2	0.0	47.9	43.2	10.8	3.5	50.3	11.8	7.7
Incr Delay (d2), s/veh	1.1	0.0	0.0	1.7	0.0	0.6	14.5	5.9	0.0	16.8	0.4	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.6	0.0	0.0	1.5	0.0	0.2	7.5	20.5	0.1	1.6	8.5	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	49.4	0.0	0.0	50.9	0.0	48.5	57.6	16.7	3.6	67.1	12.2	7.7
LnGrp LOS	D			D		D	E	B	A	E	B	A
Approach Vol, veh/h		24			63			1544			712	
Approach Delay, s/veh		49.4			50.6			23.1			16.1	
Approach LOS		D			D			C			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	9.9	84.3		11.2	23.0	71.2		11.2				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	20.0	104.0		17.0	24.0	100.0		17.0				
Max Q Clear Time (g_c+I1), s	5.0	58.8		5.2	16.6	23.6		5.2				
Green Ext Time (p_c), s	0.1	19.5		0.0	0.4	5.5		0.2				

Intersection Summary	
HCM 7th Control Delay, s/veh	22.0
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	209	0	1435	771	1
Future Vol, veh/h	0	209	0	1435	771	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	227	0	1560	838	1

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2048 PM – Alternative 3

Intersection	
Int Delay, s/veh	6.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	25	141	99	585	548	32
Future Vol, veh/h	25	141	99	585	548	32
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	27	153	108	636	596	35

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1565	755	731	0	-	0
Stage 1	714	-	-	-	-	-
Stage 2	851	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	123	409	873	-	-	-
Stage 1	485	-	-	-	-	-
Stage 2	418	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	86	355	789	-	-	-
Mov Cap-2 Maneuver	86	-	-	-	-	-
Stage 1	379	-	-	-	-	-
Stage 2	378	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	53.66	1.49	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	789	-	242	-	-
HCM Lane V/C Ratio	0.136	-	0.746	-	-
HCM Control Delay (s/veh)	10.3	-	53.7	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	0.5	-	5.2	-	-

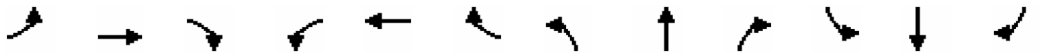
Intersection	
Int Delay, s/veh	2.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	51	71	618	51	53	645
Future Vol, veh/h	51	71	618	51	53	645
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	55	77	672	55	58	701

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1174	703	0	0	731	0
Stage 1	703	-	-	-	-	-
Stage 2	471	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	198	436	-	-	871	-
Stage 1	490	-	-	-	-	-
Stage 2	596	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	183	435	-	-	868	-
Mov Cap-2 Maneuver	183	-	-	-	-	-
Stage 1	488	-	-	-	-	-
Stage 2	553	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	22.55	0	0.72
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	183	435	868	-
HCM Lane V/C Ratio	-	-	0.303	0.178	0.066	-
HCM Control Delay (s/veh)	-	-	33	15.1	9.4	-
HCM Lane LOS	-	-	D	C	A	-
HCM 95th %tile Q(veh)	-	-	1.2	0.6	0.2	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	150	1	543	9	2	6	487	1084	0	1	1045	174
Future Volume (veh/h)	150	1	543	9	2	6	487	1084	0	1	1045	174
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	163	1	0	10	2	2	529	1178	0	1	1136	106
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	193	1		19	4	4	563	2475	0	2	1357	603
Arrive On Green	0.11	0.11	0.00	0.02	0.02	0.02	0.32	0.70	0.00	0.00	0.38	0.38
Sat Flow, veh/h	1771	11	1585	1259	252	252	1781	3647	0	1781	3554	1581
Grp Volume(v), veh/h	164	0	0	14	0	0	529	1178	0	1	1136	106
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1762	0	0	1781	1777	0	1781	1777	1581
Q Serve(g_s), s	12.2	0.0	0.0	1.1	0.0	0.0	39.0	20.3	0.0	0.1	39.2	6.0
Cycle Q Clear(g_c), s	12.2	0.0	0.0	1.1	0.0	0.0	39.0	20.3	0.0	0.1	39.2	6.0
Prop In Lane	0.99		1.00	0.71		0.14	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	194	0		27	0	0	563	2475	0	2	1357	603
V/C Ratio(X)	0.84	0.00		0.53	0.00	0.00	0.94	0.48	0.00	0.41	0.84	0.18
Avail Cap(c_a), veh/h	317	0		118	0	0	779	2741	0	119	1819	809
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	58.9	0.0	0.0	65.9	0.0	0.0	44.9	9.3	0.0	67.3	37.9	27.6
Incr Delay (d2), s/veh	10.6	0.0	0.0	15.1	0.0	0.0	15.6	0.1	0.0	84.9	2.7	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.1	0.0	0.0	0.6	0.0	0.0	19.5	7.5	0.0	0.1	17.4	2.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	69.5	0.0	0.0	81.0	0.0	0.0	60.5	9.4	0.0	152.2	40.6	27.8
LnGrp LOS	E			F			E	A		F	D	C
Approach Vol, veh/h		164			14			1707			1243	
Approach Delay, s/veh		69.5			81.0			25.3			39.6	
Approach LOS		E			F			C			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.2	99.9		8.0	48.6	57.5		20.7				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	104.0		9.0	59.0	69.0		24.0				
Max Q Clear Time (g_c+I1), s	2.1	22.3		3.1	41.0	41.2		14.2				
Green Ext Time (p_c), s	0.0	12.6		0.0	1.7	10.3		0.6				

Intersection Summary		
HCM 7th Control Delay, s/veh	33.5	
HCM 7th LOS	C	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	90	125	124	26	132	450	54	549	27	451	769	89
Future Volume (veh/h)	90	125	124	26	132	450	54	549	27	451	769	89
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	98	136	37	28	143	0	59	597	8	490	836	90
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	168	179	291	181	522		76	646	548	616	1556	167
Arrive On Green	0.19	0.19	0.19	0.03	0.28	0.00	0.04	0.35	0.35	0.18	0.48	0.48
Sat Flow, veh/h	605	962	1568	1781	1870	1585	1781	1870	1585	3456	3235	348
Grp Volume(v), veh/h	234	0	37	28	143	0	59	597	8	490	459	467
Grp Sat Flow(s),veh/h/ln	1567	0	1568	1781	1870	1585	1781	1870	1585	1728	1777	1806
Q Serve(g_s), s	11.9	0.0	1.8	1.1	5.5	0.0	3.0	28.0	0.3	12.4	16.5	16.5
Cycle Q Clear(g_c), s	13.0	0.0	1.8	1.1	5.5	0.0	3.0	28.0	0.3	12.4	16.5	16.5
Prop In Lane	0.42		1.00	1.00		1.00	1.00		1.00	1.00		0.19
Lane Grp Cap(c), veh/h	347	0	291	181	522		76	646	548	616	855	869
V/C Ratio(X)	0.67	0.00	0.13	0.15	0.27		0.78	0.92	0.01	0.80	0.54	0.54
Avail Cap(c_a), veh/h	567	0	515	404	983		175	696	590	2232	1148	1166
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	35.5	0.0	31.0	28.4	25.7	0.0	43.3	28.7	19.7	35.9	16.6	16.6
Incr Delay (d2), s/veh	2.3	0.0	0.2	0.4	0.3	0.0	15.3	17.4	0.0	2.4	0.5	0.5
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.1	0.0	0.7	0.5	2.4	0.0	1.6	15.1	0.1	5.3	6.5	6.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	37.8	0.0	31.2	28.8	26.0	0.0	58.6	46.1	19.7	38.3	17.1	17.1
LnGrp LOS	D		C	C	C		E	D	B	D	B	B
Approach Vol, veh/h		271			171			664			1416	
Approach Delay, s/veh		36.9			26.4			46.9			24.5	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	12.3	37.6	8.5	23.0	9.9	49.9		31.5
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	6.3	34.0	14.0	30.0	9.0	59.0		48.0
Max Q Clear Time (g_c+I1), s	14.4	30.0	3.1	15.0	5.0	18.5		7.5
Green Ext Time (p_c), s	1.9	1.5	0.0	1.3	0.0	7.3		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	31.8
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	30	13	10	19	26	226	1	35	2	117	479	17
Future Volume (veh/h)	30	13	10	19	26	226	1	35	2	117	479	17
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.97	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	33	14	1	21	28	50	1	38	1	127	521	17
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	337	116	299	229	239	304	335	575	485	764	726	24
Arrive On Green	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.31	0.31	0.10	0.40	0.40
Sat Flow, veh/h	886	587	1517	470	1215	1544	1781	1870	1577	1781	1801	59
Grp Volume(v), veh/h	47	0	1	49	0	50	1	38	1	127	0	538
Grp Sat Flow(s),veh/h/ln	1474	0	1517	1685	0	1544	1781	1870	1577	1781	0	1860
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.5	0.0	1.7	0.0	9.1
Cycle Q Clear(g_c), s	0.8	0.0	0.0	0.8	0.0	1.0	0.0	0.5	0.0	1.7	0.0	9.1
Prop In Lane	0.70		1.00	0.43		1.00	1.00		1.00	1.00		0.03
Lane Grp Cap(c), veh/h	453	0	299	469	0	304	335	575	485	764	0	750
V/C Ratio(X)	0.10	0.00	0.00	0.10	0.00	0.16	0.00	0.07	0.00	0.17	0.00	0.72
Avail Cap(c_a), veh/h	2250	0	2214	2490	0	2254	566	2731	2303	827	0	2715
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	12.5	0.0	12.2	12.5	0.0	12.5	9.4	9.2	9.0	6.8	0.0	9.4
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.3	0.0	0.0	0.0	0.1	0.0	1.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.0	0.3	0.0	0.3	0.0	0.2	0.0	0.4	0.0	2.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	12.6	0.0	12.2	12.6	0.0	12.8	9.4	9.3	9.0	6.9	0.0	10.7
LnGrp LOS	B		B	B		B	A	A	A	A		B
Approach Vol, veh/h		48			99			40			665	
Approach Delay, s/veh		12.5			12.7			9.3			10.0	
Approach LOS		B			B			A			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.7	16.6		12.4	5.1	20.2		12.4				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.7	2.5		2.8	2.0	11.1		3.0				
Green Ext Time (p_c), s	0.0	0.2		0.3	0.0	4.1		0.4				

Intersection Summary		
HCM 7th Control Delay, s/veh	10.4	
HCM 7th LOS	B	



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	6	19	102	37	9	57	234	1033	34	45	928	27
Future Volume (veh/h)	6	19	102	37	9	57	234	1033	34	45	928	27
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		0.99	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	7	21	18	40	10	5	254	1123	24	49	1009	15
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	48	43	32	135	20	87	291	1363	1155	66	1127	955
Arrive On Green	0.06	0.06	0.06	0.06	0.06	0.06	0.16	0.73	0.73	0.04	0.60	0.60
Sat Flow, veh/h	128	780	584	1284	365	1576	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	46	0	0	50	0	5	254	1123	24	49	1009	15
Grp Sat Flow(s),veh/h/ln	1493	0	0	1649	0	1576	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.6	0.0	0.0	0.0	0.0	0.3	14.0	41.0	0.4	2.7	46.8	0.4
Cycle Q Clear(g_c), s	3.3	0.0	0.0	2.7	0.0	0.3	14.0	41.0	0.4	2.7	46.8	0.4
Prop In Lane	0.15		0.39	0.80		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	123	0	0	155	0	87	291	1363	1155	66	1127	955
V/C Ratio(X)	0.37	0.00	0.00	0.32	0.00	0.06	0.87	0.82	0.02	0.74	0.90	0.02
Avail Cap(c_a), veh/h	379	0	0	377	0	329	425	2121	1797	177	1860	1577
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	46.2	0.0	0.0	46.2	0.0	45.0	41.0	9.3	3.8	47.9	17.3	8.0
Incr Delay (d2), s/veh	1.9	0.0	0.0	1.2	0.0	0.3	12.7	1.6	0.0	15.0	3.6	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.2	0.0	0.0	1.3	0.0	0.1	7.1	13.8	0.1	1.5	19.1	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	48.1	0.0	0.0	47.4	0.0	45.3	53.8	10.8	3.8	62.9	20.8	8.0
LnGrp LOS	D			D		D	D	B	A	E	C	A
Approach Vol, veh/h		46			55			1401			1073	
Approach Delay, s/veh		48.1			47.2			18.5			22.6	
Approach LOS		D			D			B			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	9.7	79.3		11.5	22.4	66.6		11.5
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0
Max Q Clear Time (g_c+I1), s	4.7	43.0		5.3	16.0	48.8		4.7
Green Ext Time (p_c), s	0.0	15.9		0.1	0.5	11.7		0.2

Intersection Summary	
HCM 7th Control Delay, s/veh	21.3
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	416	0	1338	1178	5
Future Vol, veh/h	0	416	0	1338	1178	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	452	0	1454	1280	5

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2048 SAT – Alternative 3

Intersection	
Int Delay, s/veh	2.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	19	74	79	522	505	17
Future Vol, veh/h	19	74	79	522	505	17
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	21	80	86	567	549	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1398	700	668	0	-	0
Stage 1	659	-	-	-	-	-
Stage 2	739	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	155	439	921	-	-	-
Stage 1	515	-	-	-	-	-
Stage 2	472	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	114	381	833	-	-	-
Mov Cap-2 Maneuver	114	-	-	-	-	-
Stage 1	417	-	-	-	-	-
Stage 2	427	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	27.74	1.29	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	833	-	257	-	-
HCM Lane V/C Ratio	0.103	-	0.393	-	-
HCM Control Delay (s/veh)	9.8	-	27.7	-	-
HCM Lane LOS	A	-	D	-	-
HCM 95th %tile Q(veh)	0.3	-	1.8	-	-

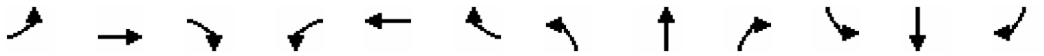
Intersection	
Int Delay, s/veh	1.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	53	62	537	43	35	563
Future Vol, veh/h	53	62	537	43	35	563
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	58	67	584	47	38	612

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	998	611	0	0	634	0
Stage 1	611	-	-	-	-	-
Stage 2	387	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	255	493	-	-	947	-
Stage 1	541	-	-	-	-	-
Stage 2	656	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	243	491	-	-	943	-
Mov Cap-2 Maneuver	243	-	-	-	-	-
Stage 1	539	-	-	-	-	-
Stage 2	627	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	18.53	0	0.53
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	243	491	943	-
HCM Lane V/C Ratio	-	-	0.238	0.137	0.04	-
HCM Control Delay (s/veh)	-	-	24.4	13.5	9	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.9	0.5	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	144	2	428	2	2	0	397	972	2	0	934	155
Future Volume (veh/h)	144	2	428	2	2	0	397	972	2	0	934	155
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	157	2	0	2	2	0	432	1057	2	0	1015	52
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	192	2		5	5	0	480	2529	5	2	1286	572
Arrive On Green	0.11	0.11	0.00	0.01	0.01	0.00	0.27	0.69	0.69	0.00	0.36	0.36
Sat Flow, veh/h	1760	22	1585	912	912	0	1781	3639	7	1781	3554	1581
Grp Volume(v), veh/h	159	0	0	4	0	0	432	516	543	0	1015	52
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1825	0	0	1781	1777	1869	1781	1777	1581
Q Serve(g_s), s	8.2	0.0	0.0	0.2	0.0	0.0	22.1	11.8	11.8	0.0	24.1	2.1
Cycle Q Clear(g_c), s	8.2	0.0	0.0	0.2	0.0	0.0	22.1	11.8	11.8	0.0	24.1	2.1
Prop In Lane	0.99		1.00	0.50		0.00	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	195	0		10	0	0	480	1235	1299	2	1286	572
V/C Ratio(X)	0.82	0.00		0.42	0.00	0.00	0.90	0.42	0.42	0.00	0.79	0.09
Avail Cap(c_a), veh/h	264	0		97	0	0	924	1391	1464	170	1843	820
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	41.2	0.0	0.0	46.9	0.0	0.0	33.3	6.2	6.2	0.0	26.9	19.9
Incr Delay (d2), s/veh	13.3	0.0	0.0	26.1	0.0	0.0	6.4	0.2	0.2	0.0	1.5	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.3	0.0	0.0	0.2	0.0	0.0	10.1	3.8	4.0	0.0	10.1	0.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	54.4	0.0	0.0	73.0	0.0	0.0	39.6	6.4	6.4	0.0	28.5	20.0
LnGrp LOS	D			E			D	A	A		C	B
Approach Vol, veh/h		159			4			1491			1067	
Approach Delay, s/veh		54.4			73.0			16.0			28.0	
Approach LOS		D			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	0.0	71.7		6.5	31.5	40.2		16.3				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	74.0		5.0	49.0	49.0		14.0				
Max Q Clear Time (g_c+I1), s	0.0	13.8		2.2	24.1	26.1		10.2				
Green Ext Time (p_c), s	0.0	9.1		0.0	1.4	8.1		0.2				

Intersection Summary		
HCM 7th Control Delay, s/veh	23.1	
HCM 7th LOS	C	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	126	189	170	82	169	417	101	556	35	306	792	157
Future Volume (veh/h)	126	189	170	82	169	417	101	556	35	306	792	157
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	137	205	75	89	184	0	110	604	11	333	861	160
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	198	233	395	198	670		139	657	556	425	1184	220
Arrive On Green	0.25	0.25	0.25	0.05	0.36	0.00	0.08	0.35	0.35	0.12	0.40	0.40
Sat Flow, veh/h	603	930	1572	1781	1870	1585	1781	1870	1585	3456	2989	555
Grp Volume(v), veh/h	342	0	75	89	184	0	110	604	11	333	512	509
Grp Sat Flow(s),veh/h/ln	1533	0	1572	1781	1870	1585	1781	1870	1585	1728	1777	1767
Q Serve(g_s), s	22.7	0.0	4.0	3.8	7.5	0.0	6.5	33.3	0.5	10.0	26.3	26.3
Cycle Q Clear(g_c), s	23.1	0.0	4.0	3.8	7.5	0.0	6.5	33.3	0.5	10.0	26.3	26.3
Prop In Lane	0.40		1.00	1.00		1.00	1.00		1.00	1.00		0.31
Lane Grp Cap(c), veh/h	432	0	395	198	670		139	657	556	425	704	700
V/C Ratio(X)	0.79	0.00	0.19	0.45	0.27		0.79	0.92	0.02	0.78	0.73	0.73
Avail Cap(c_a), veh/h	517	0	483	372	870		332	748	634	1254	1025	1020
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	38.8	0.0	31.7	29.3	24.5	0.0	48.7	33.4	22.8	45.7	27.5	27.5
Incr Delay (d2), s/veh	6.9	0.0	0.2	1.6	0.2	0.0	9.7	15.4	0.0	3.2	1.5	1.5
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	9.4	0.0	1.6	1.7	3.4	0.0	3.3	17.5	0.2	4.5	11.2	11.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	45.7	0.0	31.9	30.8	24.8	0.0	58.4	48.8	22.8	48.9	29.0	29.0
LnGrp LOS	D		C	C	C		E	D	C	D	C	C
Approach Vol, veh/h		417			273			725			1354	
Approach Delay, s/veh		43.2			26.7			49.9			33.9	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	19.2	43.7	11.5	33.0	14.4	48.6		44.5
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	39.0	43.0	16.0	33.0	20.0	62.0		50.0
Max Q Clear Time (g_c+I1), s	12.0	35.3	5.8	25.1	8.5	28.3		9.5
Green Ext Time (p_c), s	1.2	2.5	0.1	1.5	0.2	8.2		1.1

Intersection Summary	
HCM 7th Control Delay, s/veh	38.8
HCM 7th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	28	16	8	6	26	261	0	24	3	116	291	14
Future Volume (veh/h)	28	16	8	6	26	261	0	24	3	116	291	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.98	1.00		0.99	0.99		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	30	17	1	7	28	70	0	26	1	126	316	14
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	362	162	329	176	361	335	430	326	274	658	800	35
Arrive On Green	0.22	0.22	0.22	0.22	0.22	0.22	0.00	0.17	0.17	0.11	0.45	0.45
Sat Flow, veh/h	763	748	1523	145	1669	1548	1781	1870	1571	1781	1777	79
Grp Volume(v), veh/h	47	0	1	35	0	70	0	26	1	126	0	330
Grp Sat Flow(s),veh/h/ln	1511	0	1523	1814	0	1548	1781	1870	1571	1781	0	1856
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.3	0.0	1.5	0.0	3.6
Cycle Q Clear(g_c), s	0.6	0.0	0.0	0.4	0.0	1.1	0.0	0.3	0.0	1.5	0.0	3.6
Prop In Lane	0.64		1.00	0.20		1.00	1.00		1.00	1.00		0.04
Lane Grp Cap(c), veh/h	524	0	329	536	0	335	430	326	274	658	0	835
V/C Ratio(X)	0.09	0.00	0.00	0.07	0.00	0.21	0.00	0.08	0.00	0.19	0.00	0.40
Avail Cap(c_a), veh/h	2854	0	2796	3346	0	2842	721	3435	2886	762	0	3408
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.4	0.0	9.2	9.4	0.0	9.6	0.0	10.3	10.2	6.9	0.0	5.5
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.3	0.0	0.1	0.0	0.1	0.0	0.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	0.0	0.0	0.1	0.0	0.3	0.0	0.1	0.0	0.4	0.0	0.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.5	0.0	9.2	9.4	0.0	9.9	0.0	10.5	10.2	7.1	0.0	5.8
LnGrp LOS	A		A	A		A		B	B	A		A
Approach Vol, veh/h		48			105			27			456	
Approach Delay, s/veh		9.5			9.8			10.4			6.2	
Approach LOS		A			A			B			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.2	10.2		11.5	0.0	18.5		11.5				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.5	2.3		2.6	0.0	5.6		3.1				
Green Ext Time (p_c), s	0.0	0.1		0.3	0.0	2.2		0.4				

Intersection Summary	
HCM 7th Control Delay, s/veh	7.2
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	14	113	26	11	45	262	994	32	46	591	17
Future Volume (veh/h)	15	14	113	26	11	45	262	994	32	46	591	17
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	16	15	31	28	12	6	285	1080	22	50	642	8
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	76	32	51	142	47	105	333	1244	1054	75	972	824
Arrive On Green	0.07	0.07	0.07	0.07	0.07	0.07	0.19	0.66	0.66	0.04	0.52	0.52
Sat Flow, veh/h	280	485	764	975	709	1578	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	62	0	0	40	0	6	285	1080	22	50	642	8
Grp Sat Flow(s),veh/h/ln	1529	0	0	1684	0	1578	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	1.6	0.0	0.0	0.0	0.0	0.3	12.3	36.4	0.4	2.2	19.9	0.2
Cycle Q Clear(g_c), s	3.2	0.0	0.0	1.7	0.0	0.3	12.3	36.4	0.4	2.2	19.9	0.2
Prop In Lane	0.26		0.50	0.70		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	158	0	0	189	0	105	333	1244	1054	75	972	824
V/C Ratio(X)	0.39	0.00	0.00	0.21	0.00	0.06	0.85	0.87	0.02	0.67	0.66	0.01
Avail Cap(c_a), veh/h	471	0	0	481	0	417	538	2685	2275	224	2355	1996
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	36.1	0.0	0.0	35.4	0.0	34.7	31.2	10.5	4.5	37.5	13.9	9.2
Incr Delay (d2), s/veh	1.6	0.0	0.0	0.6	0.0	0.2	7.5	2.0	0.0	9.8	0.8	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.2	0.0	0.0	0.8	0.0	0.1	5.8	12.2	0.1	1.1	7.8	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	37.7	0.0	0.0	35.9	0.0	35.0	38.7	12.5	4.5	47.3	14.7	9.2
LnGrp LOS	D			D		C	D	B	A	D	B	A
Approach Vol, veh/h		62			46			1387			700	
Approach Delay, s/veh		37.7			35.8			17.8			17.0	
Approach LOS		D			D			B			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	9.3	58.8		11.3	20.9	47.3		11.3				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0				
Max Q Clear Time (g_c+I1), s	4.2	38.4		5.2	14.3	21.9		3.7				
Green Ext Time (p_c), s	0.0	14.4		0.2	0.6	5.3		0.1				

Intersection Summary	
HCM 7th Control Delay, s/veh	18.5
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	255	0	1398	786	3
Future Vol, veh/h	0	255	0	1398	786	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	277	0	1520	854	3

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2058 AM – Alternative 3

Intersection	
Int Delay, s/veh	3.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	17	97	83	373	626	20
Future Vol, veh/h	17	97	83	373	626	20
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	18	105	90	405	680	22

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1378	833	803	0	-	0
Stage 1	792	-	-	-	-	-
Stage 2	586	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	159	368	821	-	-	-
Stage 1	446	-	-	-	-	-
Stage 2	556	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	114	320	742	-	-	-
Mov Cap-2 Maneuver	114	-	-	-	-	-
Stage 1	354	-	-	-	-	-
Stage 2	503	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	32.29	1.92	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	742	-	252	-	-
HCM Lane V/C Ratio	0.122	-	0.491	-	-
HCM Control Delay (s/veh)	10.5	-	32.3	-	-
HCM Lane LOS	B	-	D	-	-
HCM 95th %tile Q(veh)	0.4	-	2.5	-	-

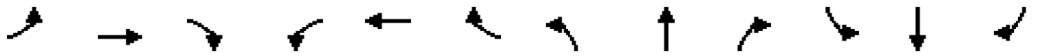
Intersection	
Int Delay, s/veh	1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	24	36	428	23	45	691
Future Vol, veh/h	24	36	428	23	45	691
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	26	39	465	25	49	751

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	960	482	0	0	494	0
Stage 1	482	-	-	-	-	-
Stage 2	478	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	269	584	-	-	1068	-
Stage 1	620	-	-	-	-	-
Stage 2	590	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	255	581	-	-	1063	-
Mov Cap-2 Maneuver	255	-	-	-	-	-
Stage 1	618	-	-	-	-	-
Stage 2	560	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	15.28	0	0.52
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	255	581	1063	-
HCM Lane V/C Ratio	-	-	0.102	0.067	0.046	-
HCM Control Delay (s/veh)	-	-	20.8	11.6	8.5	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.3	0.2	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	157	1	471	2	5	0	286	731	5	6	998	151
Future Volume (veh/h)	157	1	471	2	5	0	286	731	5	6	998	151
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	171	1	0	2	5	0	311	795	5	7	1085	86
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	210	1		5	12	0	359	2168	14	16	1444	643
Arrive On Green	0.12	0.12	0.00	0.01	0.01	0.00	0.20	0.60	0.60	0.01	0.41	0.41
Sat Flow, veh/h	1771	10	1585	527	1317	0	1781	3620	23	1781	3554	1581
Grp Volume(v), veh/h	172	0	0	7	0	0	311	390	410	7	1085	86
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1844	0	0	1781	1777	1866	1781	1777	1581
Q Serve(g_s), s	8.5	0.0	0.0	0.3	0.0	0.0	15.3	10.2	10.2	0.4	23.6	3.1
Cycle Q Clear(g_c), s	8.5	0.0	0.0	0.3	0.0	0.0	15.3	10.2	10.2	0.4	23.6	3.1
Prop In Lane	0.99		1.00	0.29		0.00	1.00		0.01	1.00		1.00
Lane Grp Cap(c), veh/h	211	0		16	0	0	359	1064	1118	16	1444	643
V/C Ratio(X)	0.82	0.00		0.43	0.00	0.00	0.87	0.37	0.37	0.44	0.75	0.13
Avail Cap(c_a), veh/h	295	0		183	0	0	866	2531	2659	177	3100	1380
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	39.0	0.0	0.0	44.6	0.0	0.0	35.0	9.3	9.3	44.6	23.0	16.9
Incr Delay (d2), s/veh	11.5	0.0	0.0	16.5	0.0	0.0	6.4	0.2	0.2	18.0	0.8	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.3	0.0	0.0	0.2	0.0	0.0	7.1	3.7	3.9	0.2	9.6	1.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	50.5	0.0	0.0	61.1	0.0	0.0	41.4	9.5	9.5	62.7	23.8	17.0
LnGrp LOS	D			E			D	A	A	E	C	B
Approach Vol, veh/h		172			7			1111			1178	
Approach Delay, s/veh		50.5			61.1			18.5			23.5	
Approach LOS		D			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.8	60.2		6.8	24.2	42.8		16.7				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	129.0		9.0	44.0	79.0		15.0				
Max Q Clear Time (g_c+I1), s	2.4	12.2		2.3	17.3	25.6		10.5				
Green Ext Time (p_c), s	0.0	6.1		0.0	0.9	11.2		0.3				

Intersection Summary			
HCM 7th Control Delay, s/veh		23.2	
HCM 7th LOS		C	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	57	111	62	33	136	417	56	533	36	374	785	80
Future Volume (veh/h)	57	111	62	33	136	417	56	533	36	374	785	80
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	62	121	21	36	148	0	61	579	11	407	853	80
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	131	172	226	208	488		86	628	532	553	1469	138
Arrive On Green	0.14	0.14	0.14	0.04	0.26	0.00	0.05	0.34	0.34	0.16	0.45	0.45
Sat Flow, veh/h	452	1188	1563	1781	1870	1585	1781	1870	1585	3456	3282	308
Grp Volume(v), veh/h	183	0	21	36	148	0	61	579	11	407	462	471
Grp Sat Flow(s),veh/h/ln	1640	0	1563	1781	1870	1585	1781	1870	1585	1728	1777	1813
Q Serve(g_s), s	6.1	0.0	0.9	1.2	4.7	0.0	2.5	22.0	0.3	8.3	14.4	14.4
Cycle Q Clear(g_c), s	7.9	0.0	0.9	1.2	4.7	0.0	2.5	22.0	0.3	8.3	14.4	14.4
Prop In Lane	0.34		1.00	1.00		1.00	1.00		1.00	1.00		0.17
Lane Grp Cap(c), veh/h	302	0	226	208	488		86	628	532	553	795	811
V/C Ratio(X)	0.61	0.00	0.09	0.17	0.30		0.71	0.92	0.02	0.74	0.58	0.58
Avail Cap(c_a), veh/h	438	0	359	434	784		289	657	557	2756	2018	2059
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	30.3	0.0	27.4	24.4	21.9	0.0	34.7	23.6	16.4	29.6	15.3	15.3
Incr Delay (d2), s/veh	2.0	0.0	0.2	0.4	0.3	0.0	10.2	18.1	0.0	1.9	0.7	0.7
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.2	0.0	0.3	0.5	2.0	0.0	1.3	12.2	0.1	3.5	5.4	5.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	32.3	0.0	27.6	24.8	22.3	0.0	44.9	41.8	16.4	31.5	15.9	15.9
LnGrp LOS	C		C	C	C		D	D	B	C	B	B
Approach Vol, veh/h		204			184			651			1340	
Approach Delay, s/veh		31.8			22.8			41.6			20.7	
Approach LOS		C			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	17.8	30.8	8.6	16.7	9.6	39.1		25.3
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	59.0	26.0	12.0	17.0	12.0	84.0		31.0
Max Q Clear Time (g_c+I1), s	10.3	24.0	3.2	9.9	4.5	16.4		6.7
Green Ext Time (p_c), s	1.5	0.8	0.0	0.6	0.1	7.6		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	27.5
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	16	7	10	5	12	236	0	19	1	109	250	9
Future Volume (veh/h)	16	7	10	5	12	236	0	19	1	109	250	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.97	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	17	8	2	5	13	60	0	21	1	118	272	9
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	373	136	301	202	313	306	448	327	274	667	818	27
Arrive On Green	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.17	0.17	0.11	0.45	0.45
Sat Flow, veh/h	823	684	1517	211	1578	1544	1781	1870	1571	1781	1800	60
Grp Volume(v), veh/h	25	0	2	18	0	60	0	21	1	118	0	281
Grp Sat Flow(s),veh/h/ln	1506	0	1517	1789	0	1544	1781	1870	1571	1781	0	1859
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.3	0.0	1.3	0.0	2.8
Cycle Q Clear(g_c), s	0.3	0.0	0.0	0.2	0.0	0.9	0.0	0.3	0.0	1.3	0.0	2.8
Prop In Lane	0.68		1.00	0.28		1.00	1.00		1.00	1.00		0.03
Lane Grp Cap(c), veh/h	509	0	301	515	0	306	448	327	274	667	0	845
V/C Ratio(X)	0.05	0.00	0.01	0.03	0.00	0.20	0.00	0.06	0.00	0.18	0.00	0.33
Avail Cap(c_a), veh/h	2970	0	2898	3405	0	2950	751	3573	3002	788	0	3552
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.4	0.0	9.3	9.3	0.0	9.6	0.0	9.9	9.8	6.6	0.0	5.0
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1	0.0	0.1	0.0	0.2
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.3	0.0	0.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.4	0.0	9.3	9.4	0.0	9.9	0.0	10.0	9.8	6.7	0.0	5.3
LnGrp LOS	A		A	A		A		B	A	A		A
Approach Vol, veh/h		27			78			22			399	
Approach Delay, s/veh		9.4			9.8			10.0			5.7	
Approach LOS		A			A			A			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.1	10.0		10.7	0.0	18.1		10.7				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.3	2.3		2.3	0.0	4.8		2.9				
Green Ext Time (p_c), s	0.0	0.1		0.1	0.0	1.8		0.3				

Intersection Summary	
HCM 7th Control Delay, s/veh	6.7
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	11	97	40	11	76	232	1227	36	47	636	9
Future Volume (veh/h)	5	11	97	40	11	76	232	1227	36	47	636	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		0.99	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	5	12	7	43	12	8	252	1334	26	51	691	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	43	39	19	117	18	76	282	1427	1209	66	1200	1017
Arrive On Green	0.05	0.05	0.05	0.05	0.05	0.05	0.16	0.76	0.76	0.04	0.64	0.64
Sat Flow, veh/h	128	819	390	1306	365	1575	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	24	0	0	55	0	8	252	1334	26	51	691	6
Grp Sat Flow(s),veh/h/ln	1338	0	0	1671	0	1575	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.6	16.4	69.9	0.5	3.4	24.9	0.2
Cycle Q Clear(g_c), s	3.6	0.0	0.0	3.6	0.0	0.6	16.4	69.9	0.5	3.4	24.9	0.2
Prop In Lane	0.21		0.29	0.78		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	101	0	0	134	0	76	282	1427	1209	66	1200	1017
V/C Ratio(X)	0.24	0.00	0.00	0.41	0.00	0.11	0.89	0.94	0.02	0.77	0.58	0.01
Avail Cap(c_a), veh/h	259	0	0	274	0	226	361	1641	1391	301	1578	1337
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	54.5	0.0	0.0	55.4	0.0	54.0	48.9	11.6	3.4	56.6	12.1	7.6
Incr Delay (d2), s/veh	1.2	0.0	0.0	2.0	0.0	0.6	19.8	9.6	0.0	16.7	0.4	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	0.0	0.0	1.7	0.0	0.2	8.8	26.8	0.1	1.8	9.9	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	55.7	0.0	0.0	57.4	0.0	54.6	68.7	21.3	3.4	73.2	12.5	7.6
LnGrp LOS	E			E		D	E	C	A	E	B	A
Approach Vol, veh/h		24			63			1612			748	
Approach Delay, s/veh		55.7			57.0			28.4			16.6	
Approach LOS		E			E			C			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	10.4	96.4		11.7	24.8	82.1		11.7
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	20.0	104.0		17.0	24.0	100.0		17.0
Max Q Clear Time (g_c+I1), s	5.4	71.9		5.6	18.4	26.9		5.6
Green Ext Time (p_c), s	0.1	18.5		0.0	0.4	5.9		0.1

Intersection Summary	
HCM 7th Control Delay, s/veh	25.8
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	209	0	1511	812	1
Future Vol, veh/h	0	209	0	1511	812	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	227	0	1642	883	1

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2058 PM – Alternative 3

Intersection	
Int Delay, s/veh	7.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	25	141	99	612	574	32
Future Vol, veh/h	25	141	99	612	574	32
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	27	153	108	665	624	35

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1623	783	760	0	-	0
Stage 1	742	-	-	-	-	-
Stage 2	880	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	113	394	852	-	-	-
Stage 1	471	-	-	-	-	-
Stage 2	405	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	79	342	770	-	-	-
Mov Cap-2 Maneuver	79	-	-	-	-	-
Stage 1	366	-	-	-	-	-
Stage 2	366	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	62.16	1.45	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	770	-	228	-	-
HCM Lane V/C Ratio	0.14	-	0.791	-	-
HCM Control Delay (s/veh)	10.4	-	62.2	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	0.5	-	5.8	-	-

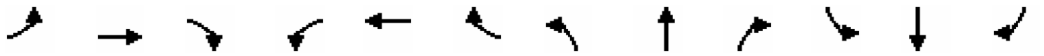
Intersection	
Int Delay, s/veh	2.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	51	71	647	51	53	674
Future Vol, veh/h	51	71	647	51	53	674
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	55	77	703	55	58	733

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1222	735	0	0	763	0
Stage 1	735	-	-	-	-	-
Stage 2	487	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	185	419	-	-	848	-
Stage 1	473	-	-	-	-	-
Stage 2	585	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	171	417	-	-	844	-
Mov Cap-2 Maneuver	171	-	-	-	-	-
Stage 1	471	-	-	-	-	-
Stage 2	542	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	24.08	0	0.7
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	171	417	844	-
HCM Lane V/C Ratio	-	-	0.325	0.185	0.068	-
HCM Control Delay (s/veh)	-	-	35.9	15.6	9.6	-
HCM Lane LOS	-	-	E	C	A	-
HCM 95th %tile Q(veh)	-	-	1.3	0.7	0.2	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	150	1	543	9	2	6	487	1134	0	1	1093	174
Future Volume (veh/h)	150	1	543	9	2	6	487	1134	0	1	1093	174
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	163	1	0	10	2	2	529	1233	0	1	1188	106
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	192	1		19	4	4	561	2507	0	2	1392	619
Arrive On Green	0.11	0.11	0.00	0.01	0.01	0.01	0.32	0.71	0.00	0.00	0.39	0.39
Sat Flow, veh/h	1771	11	1585	1259	252	252	1781	3647	0	1781	3554	1581
Grp Volume(v), veh/h	164	0	0	14	0	0	529	1233	0	1	1188	106
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1762	0	0	1781	1777	0	1781	1777	1581
Q Serve(g_s), s	12.8	0.0	0.0	1.1	0.0	0.0	40.8	22.1	0.0	0.1	43.1	6.2
Cycle Q Clear(g_c), s	12.8	0.0	0.0	1.1	0.0	0.0	40.8	22.1	0.0	0.1	43.1	6.2
Prop In Lane	0.99		1.00	0.71		0.14	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	193	0		26	0	0	561	2507	0	2	1392	619
V/C Ratio(X)	0.85	0.00		0.53	0.00	0.00	0.94	0.49	0.00	0.41	0.85	0.17
Avail Cap(c_a), veh/h	303	0		112	0	0	744	2618	0	114	1737	773
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	61.8	0.0	0.0	69.0	0.0	0.0	47.1	9.4	0.0	70.4	39.2	28.0
Incr Delay (d2), s/veh	12.6	0.0	0.0	15.6	0.0	0.0	17.3	0.2	0.0	85.0	3.6	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.5	0.0	0.0	0.6	0.0	0.0	20.7	8.2	0.0	0.1	19.4	2.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	74.4	0.0	0.0	84.6	0.0	0.0	64.4	9.5	0.0	155.5	42.8	28.1
LnGrp LOS	E			F			E	A		F	D	C
Approach Vol, veh/h		164			14			1762			1295	
Approach Delay, s/veh		74.4			84.6			26.0			41.7	
Approach LOS		E			F			C			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.2	105.6		8.1	50.5	61.3		21.3				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	104.0		9.0	59.0	69.0		24.0				
Max Q Clear Time (g_c+I1), s	2.1	24.1		3.1	42.8	45.1		14.8				
Green Ext Time (p_c), s	0.0	13.7		0.0	1.6	10.2		0.5				

Intersection Summary		
HCM 7th Control Delay, s/veh	35.0	
HCM 7th LOS	C	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	90	125	124	26	132	469	54	573	27	471	802	89
Future Volume (veh/h)	90	125	124	26	132	469	54	573	27	471	802	89
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	98	136	37	28	143	0	59	623	8	512	872	90
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	166	177	289	175	515		76	657	556	635	1599	165
Arrive On Green	0.18	0.18	0.18	0.03	0.28	0.00	0.04	0.35	0.35	0.18	0.49	0.49
Sat Flow, veh/h	608	958	1568	1781	1870	1585	1781	1870	1585	3456	3250	335
Grp Volume(v), veh/h	234	0	37	28	143	0	59	623	8	512	477	485
Grp Sat Flow(s),veh/h/ln	1565	0	1568	1781	1870	1585	1781	1870	1585	1728	1777	1808
Q Serve(g_s), s	12.5	0.0	1.9	1.2	5.7	0.0	3.1	30.7	0.3	13.5	17.7	17.7
Cycle Q Clear(g_c), s	13.5	0.0	1.9	1.2	5.7	0.0	3.1	30.7	0.3	13.5	17.7	17.7
Prop In Lane	0.42		1.00	1.00		1.00	1.00		1.00	1.00		0.19
Lane Grp Cap(c), veh/h	343	0	289	175	515		76	657	556	635	874	890
V/C Ratio(X)	0.68	0.00	0.13	0.16	0.28		0.77	0.95	0.01	0.81	0.55	0.55
Avail Cap(c_a), veh/h	547	0	496	389	947		169	671	569	2151	1106	1126
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	36.9	0.0	32.3	29.6	27.0	0.0	44.9	29.9	20.1	37.1	16.7	16.7
Incr Delay (d2), s/veh	2.4	0.0	0.2	0.4	0.3	0.0	15.3	22.7	0.0	2.5	0.5	0.5
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.3	0.0	0.7	0.5	2.6	0.0	1.7	17.4	0.1	5.8	7.0	7.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	39.4	0.0	32.5	30.0	27.2	0.0	60.2	52.7	20.1	39.5	17.2	17.2
LnGrp LOS	D		C	C	C		E	D	C	D	B	B
Approach Vol, veh/h		271			171			690			1474	
Approach Delay, s/veh		38.4			27.7			52.9			25.0	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	23.4	39.3	8.6	23.5	10.1	52.6		32.1
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	59.0	34.0	14.0	30.0	9.0	59.0		48.0
Max Q Clear Time (g_c+I1), s	15.5	32.7	3.2	15.5	5.1	19.7		7.7
Green Ext Time (p_c), s	2.0	0.6	0.0	1.3	0.0	7.7		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	34.0
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	30	13	10	19	26	226	1	36	2	117	500	17
Future Volume (veh/h)	30	13	10	19	26	226	1	36	2	117	500	17
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.97	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	33	14	1	21	28	50	1	39	1	127	543	17
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	332	114	296	226	237	301	329	598	504	774	748	23
Arrive On Green	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.32	0.32	0.10	0.41	0.41
Sat Flow, veh/h	888	585	1516	473	1212	1544	1781	1870	1578	1781	1803	56
Grp Volume(v), veh/h	47	0	1	49	0	50	1	39	1	127	0	560
Grp Sat Flow(s),veh/h/ln	1473	0	1516	1684	0	1544	1781	1870	1578	1781	0	1860
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.6	0.0	1.7	0.0	9.7
Cycle Q Clear(g_c), s	0.8	0.0	0.0	0.8	0.0	1.0	0.0	0.6	0.0	1.7	0.0	9.7
Prop In Lane	0.70		1.00	0.43		1.00	1.00		1.00	1.00		0.03
Lane Grp Cap(c), veh/h	446	0	296	462	0	301	329	598	504	774	0	771
V/C Ratio(X)	0.11	0.00	0.00	0.11	0.00	0.17	0.00	0.07	0.00	0.16	0.00	0.73
Avail Cap(c_a), veh/h	2197	0	2161	2431	0	2200	555	2666	2249	833	0	2651
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	12.8	0.0	12.5	12.8	0.0	12.9	9.4	9.1	8.9	6.7	0.0	9.5
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.3	0.0	0.0	0.0	0.1	0.0	1.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.0	0.3	0.0	0.3	0.0	0.2	0.0	0.4	0.0	3.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	12.9	0.0	12.5	12.9	0.0	13.2	9.4	9.2	8.9	6.8	0.0	10.8
LnGrp LOS	B		B	B		B	A	A	A	A		B
Approach Vol, veh/h		48			99			41			687	
Approach Delay, s/veh		12.9			13.1			9.2			10.0	
Approach LOS		B			B			A			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.7	17.3		12.5	5.1	21.0		12.5				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.7	2.6		2.8	2.0	11.7		3.0				
Green Ext Time (p_c), s	0.0	0.2		0.3	0.0	4.3		0.4				

Intersection Summary	
HCM 7th Control Delay, s/veh	10.5
HCM 7th LOS	B



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	6	19	102	37	9	57	234	1089	34	45	978	27
Future Volume (veh/h)	6	19	102	37	9	57	234	1089	34	45	978	27
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		0.99	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	7	21	18	40	10	5	254	1184	24	49	1063	15
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	44	42	31	127	20	85	287	1403	1189	63	1169	990
Arrive On Green	0.05	0.05	0.05	0.05	0.05	0.05	0.16	0.75	0.75	0.04	0.62	0.62
Sat Flow, veh/h	125	783	584	1288	366	1576	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	46	0	0	50	0	5	254	1184	24	49	1063	15
Grp Sat Flow(s),veh/h/ln	1492	0	0	1654	0	1576	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.6	0.0	0.0	0.0	0.0	0.3	15.6	48.3	0.4	3.1	55.3	0.4
Cycle Q Clear(g_c), s	3.6	0.0	0.0	3.0	0.0	0.3	15.6	48.3	0.4	3.1	55.3	0.4
Prop In Lane	0.15		0.39	0.80		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	117	0	0	146	0	85	287	1403	1189	63	1169	990
V/C Ratio(X)	0.39	0.00	0.00	0.34	0.00	0.06	0.89	0.84	0.02	0.77	0.91	0.02
Avail Cap(c_a), veh/h	339	0	0	339	0	295	382	1903	1612	159	1669	1414
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	51.7	0.0	0.0	51.6	0.0	50.3	46.0	9.5	3.5	53.6	18.3	8.0
Incr Delay (d2), s/veh	2.1	0.0	0.0	1.4	0.0	0.3	17.4	2.7	0.0	18.0	5.8	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.3	0.0	0.0	1.4	0.0	0.1	8.3	16.8	0.1	1.7	23.6	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	53.8	0.0	0.0	53.0	0.0	50.6	63.4	12.2	3.6	71.6	24.1	8.0
LnGrp LOS	D			D		D	E	B	A	E	C	A
Approach Vol, veh/h		46			55			1462			1127	
Approach Delay, s/veh		53.8			52.8			21.0			25.9	
Approach LOS		D			D			C			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	10.0	90.1		12.0	24.0	76.0		12.0
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0
Max Q Clear Time (g_c+I1), s	5.1	50.3		5.6	17.6	57.3		5.0
Green Ext Time (p_c), s	0.0	18.1		0.1	0.4	12.7		0.2

Intersection Summary		
HCM 7th Control Delay, s/veh	24.3	
HCM 7th LOS	C	

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	416	0	1410	1241	5
Future Vol, veh/h	0	416	0	1410	1241	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	452	0	1533	1349	5

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2058 SAT – Alternative 3

Intersection	
Int Delay, s/veh	2.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	19	74	79	546	529	17
Future Vol, veh/h	19	74	79	546	529	17
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	21	80	86	593	575	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1450	726	694	0	-	0
Stage 1	685	-	-	-	-	-
Stage 2	765	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	144	424	901	-	-	-
Stage 1	500	-	-	-	-	-
Stage 2	459	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	105	369	814	-	-	-
Mov Cap-2 Maneuver	105	-	-	-	-	-
Stage 1	405	-	-	-	-	-
Stage 2	415	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	29.8	1.26	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	814	-	244	-	-
HCM Lane V/C Ratio	0.105	-	0.414	-	-
HCM Control Delay (s/veh)	9.9	-	29.8	-	-
HCM Lane LOS	A	-	D	-	-
HCM 95th %tile Q(veh)	0.4	-	1.9	-	-

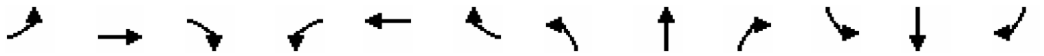
Intersection	
Int Delay, s/veh	1.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	53	62	561	43	35	589
Future Vol, veh/h	53	62	561	43	35	589
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	58	67	610	47	38	640

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1038	637	0	0	661	0
Stage 1	637	-	-	-	-	-
Stage 2	401	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	241	476	-	-	926	-
Stage 1	526	-	-	-	-	-
Stage 2	646	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	229	474	-	-	922	-
Mov Cap-2 Maneuver	229	-	-	-	-	-
Stage 1	524	-	-	-	-	-
Stage 2	616	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	19.43	0	0.51
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	229	474	922	-
HCM Lane V/C Ratio	-	-	0.252	0.142	0.041	-
HCM Control Delay (s/veh)	-	-	26	13.8	9.1	-
HCM Lane LOS	-	-	D	B	A	-
HCM 95th %tile Q(veh)	-	-	1	0.5	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	144	2	428	2	2	0	397	1017	2	0	977	155
Future Volume (veh/h)	144	2	428	2	2	0	397	1017	2	0	977	155
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	157	2	0	2	2	0	432	1105	2	0	1062	52
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	191	2		5	5	0	478	2555	5	2	1322	588
Arrive On Green	0.11	0.11	0.00	0.01	0.01	0.00	0.27	0.70	0.70	0.00	0.37	0.37
Sat Flow, veh/h	1760	22	1585	912	912	0	1781	3639	7	1781	3554	1581
Grp Volume(v), veh/h	159	0	0	4	0	0	432	539	568	0	1062	52
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1825	0	0	1781	1777	1869	1781	1777	1581
Q Serve(g_s), s	8.5	0.0	0.0	0.2	0.0	0.0	22.9	12.7	12.7	0.0	26.2	2.1
Cycle Q Clear(g_c), s	8.5	0.0	0.0	0.2	0.0	0.0	22.9	12.7	12.7	0.0	26.2	2.1
Prop In Lane	0.99		1.00	0.50		0.00	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	194	0		10	0	0	478	1247	1312	2	1322	588
V/C Ratio(X)	0.82	0.00		0.42	0.00	0.00	0.90	0.43	0.43	0.00	0.80	0.09
Avail Cap(c_a), veh/h	255	0		93	0	0	893	1345	1415	164	1781	792
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	42.6	0.0	0.0	48.5	0.0	0.0	34.5	6.2	6.2	0.0	27.5	19.9
Incr Delay (d2), s/veh	14.7	0.0	0.0	26.3	0.0	0.0	6.6	0.2	0.2	0.0	2.0	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.5	0.0	0.0	0.2	0.0	0.0	10.5	4.1	4.3	0.0	11.1	0.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	57.4	0.0	0.0	74.7	0.0	0.0	41.1	6.5	6.5	0.0	29.5	20.0
LnGrp LOS	E			E			D	A	A		C	C
Approach Vol, veh/h		159			4			1539			1114	
Approach Delay, s/veh		57.4			74.7			16.2			29.1	
Approach LOS		E			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	0.0	74.6		6.5	32.3	42.4		16.6				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	74.0		5.0	49.0	49.0		14.0				
Max Q Clear Time (g_c+I1), s	0.0	14.7		2.2	24.9	28.2		10.5				
Green Ext Time (p_c), s	0.0	9.8		0.0	1.4	8.2		0.2				

Intersection Summary		
HCM 7th Control Delay, s/veh		23.7
HCM 7th LOS		C

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	126	189	170	82	169	435	101	580	35	319	826	157
Future Volume (veh/h)	126	189	170	82	169	435	101	580	35	319	826	157
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	137	205	75	89	184	0	110	630	11	347	898	160
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	196	230	391	192	662		138	671	569	437	1228	219
Arrive On Green	0.25	0.25	0.25	0.05	0.35	0.00	0.08	0.36	0.36	0.13	0.41	0.41
Sat Flow, veh/h	606	926	1572	1781	1870	1585	1781	1870	1585	3456	3011	536
Grp Volume(v), veh/h	342	0	75	89	184	0	110	630	11	347	530	528
Grp Sat Flow(s),veh/h/ln	1532	0	1572	1781	1870	1585	1781	1870	1585	1728	1777	1771
Q Serve(g_s), s	23.8	0.0	4.2	4.0	7.9	0.0	6.8	36.4	0.5	10.9	28.2	28.2
Cycle Q Clear(g_c), s	24.2	0.0	4.2	4.0	7.9	0.0	6.8	36.4	0.5	10.9	28.2	28.2
Prop In Lane	0.40		1.00	1.00		1.00	1.00		1.00	1.00		0.30
Lane Grp Cap(c), veh/h	426	0	391	192	662		138	671	569	437	725	722
V/C Ratio(X)	0.80	0.00	0.19	0.46	0.28		0.80	0.94	0.02	0.79	0.73	0.73
Avail Cap(c_a), veh/h	497	0	464	355	836		318	719	609	1204	984	981
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	40.6	0.0	33.2	30.7	25.9	0.0	50.7	34.7	23.2	47.5	28.0	28.0
Incr Delay (d2), s/veh	8.1	0.0	0.2	1.7	0.2	0.0	9.9	19.4	0.0	3.3	1.8	1.8
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	10.0	0.0	1.6	1.8	3.6	0.0	3.4	19.8	0.2	4.9	12.1	12.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	48.7	0.0	33.4	32.5	26.1	0.0	60.7	54.0	23.2	50.8	29.8	29.8
LnGrp LOS	D		C	C	C		E	D	C	D	C	C
Approach Vol, veh/h		417			273			751			1405	
Approach Delay, s/veh		45.9			28.2			54.6			35.0	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	20.1	46.2	11.8	33.8	14.7	51.6		45.6
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	39.6	43.0	16.0	33.0	20.0	62.0		50.0
Max Q Clear Time (g_c+I1), s	12.9	38.4	6.0	26.2	8.8	30.2		9.9
Green Ext Time (p_c), s	1.2	1.7	0.1	1.4	0.2	8.5		1.1

Intersection Summary	
HCM 7th Control Delay, s/veh	41.1
HCM 7th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	28	16	8	6	26	261	0	25	3	116	303	14
Future Volume (veh/h)	28	16	8	6	26	261	0	25	3	116	303	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.98	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	30	17	1	7	28	70	0	27	1	126	329	14
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	362	162	329	175	361	334	428	328	275	658	802	34
Arrive On Green	0.22	0.22	0.22	0.22	0.22	0.22	0.00	0.18	0.18	0.11	0.45	0.45
Sat Flow, veh/h	763	748	1523	145	1669	1548	1781	1870	1571	1781	1781	76
Grp Volume(v), veh/h	47	0	1	35	0	70	0	27	1	126	0	343
Grp Sat Flow(s),veh/h/ln	1511	0	1523	1814	0	1548	1781	1870	1571	1781	0	1856
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.4	0.0	1.5	0.0	3.7
Cycle Q Clear(g_c), s	0.6	0.0	0.0	0.4	0.0	1.1	0.0	0.4	0.0	1.5	0.0	3.7
Prop In Lane	0.64		1.00	0.20		1.00	1.00		1.00	1.00		0.04
Lane Grp Cap(c), veh/h	523	0	329	536	0	334	428	328	275	658	0	836
V/C Ratio(X)	0.09	0.00	0.00	0.07	0.00	0.21	0.00	0.08	0.00	0.19	0.00	0.41
Avail Cap(c_a), veh/h	2850	0	2793	3342	0	2839	719	3431	2882	762	0	3405
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.5	0.0	9.2	9.4	0.0	9.6	0.0	10.3	10.2	6.9	0.0	5.6
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.3	0.0	0.1	0.0	0.1	0.0	0.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	0.0	0.0	0.1	0.0	0.3	0.0	0.1	0.0	0.4	0.0	0.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.5	0.0	9.2	9.4	0.0	10.0	0.0	10.5	10.2	7.1	0.0	5.9
LnGrp LOS	A		A	A		A		B	B	A		A
Approach Vol, veh/h		48			105			28			469	
Approach Delay, s/veh		9.5			9.8			10.4			6.2	
Approach LOS		A			A			B			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.2	10.3		11.5	0.0	18.5		11.5				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.5	2.4		2.6	0.0	5.7		3.1				
Green Ext Time (p_c), s	0.0	0.1		0.3	0.0	2.3		0.4				

Intersection Summary	
HCM 7th Control Delay, s/veh	7.2
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	14	113	26	11	45	262	1047	32	46	623	17
Future Volume (veh/h)	15	14	113	26	11	45	262	1047	32	46	623	17
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	16	15	31	28	12	6	285	1138	22	50	677	8
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	69	32	50	134	45	102	328	1291	1094	71	1022	866
Arrive On Green	0.06	0.06	0.06	0.06	0.06	0.06	0.18	0.69	0.69	0.04	0.55	0.55
Sat Flow, veh/h	277	491	767	991	696	1578	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	62	0	0	40	0	6	285	1138	22	50	677	8
Grp Sat Flow(s),veh/h/ln	1534	0	0	1687	0	1578	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	1.7	0.0	0.0	0.0	0.0	0.3	13.7	42.3	0.4	2.4	22.6	0.2
Cycle Q Clear(g_c), s	3.5	0.0	0.0	1.8	0.0	0.3	13.7	42.3	0.4	2.4	22.6	0.2
Prop In Lane	0.26		0.50	0.70		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	151	0	0	179	0	102	328	1291	1094	71	1022	866
V/C Ratio(X)	0.41	0.00	0.00	0.22	0.00	0.06	0.87	0.88	0.02	0.70	0.66	0.01
Avail Cap(c_a), veh/h	426	0	0	435	0	376	486	2423	2053	202	2125	1801
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	40.1	0.0	0.0	39.3	0.0	38.6	34.9	10.8	4.3	41.7	14.2	9.1
Incr Delay (d2), s/veh	1.8	0.0	0.0	0.6	0.0	0.2	10.8	2.1	0.0	11.7	0.7	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.4	0.0	0.0	0.8	0.0	0.1	6.8	14.4	0.1	1.3	8.9	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	41.9	0.0	0.0	40.0	0.0	38.9	45.7	12.9	4.3	53.4	14.9	9.1
LnGrp LOS	D			D		D	D	B	A	D	B	A
Approach Vol, veh/h		62			46			1445			735	
Approach Delay, s/veh		41.9			39.8			19.2			17.5	
Approach LOS		D			D			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	9.5	66.8		11.7	22.2	54.1		11.7
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0
Max Q Clear Time (g_c+I1), s	4.4	44.3		5.5	15.7	24.6		3.8
Green Ext Time (p_c), s	0.0	16.4		0.2	0.5	5.8		0.1

Intersection Summary	
HCM 7th Control Delay, s/veh	19.7
HCM 7th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	255	0	1474	828	3
Future Vol, veh/h	0	255	0	1474	828	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	277	0	1602	900	3

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2068 AM – Alternative 3

Intersection	
Int Delay, s/veh	3.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	17	97	83	390	655	20
Future Vol, veh/h	17	97	83	390	655	20
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	18	105	90	424	712	22

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1428	865	835	0	-	0
Stage 1	824	-	-	-	-	-
Stage 2	604	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	149	353	799	-	-	-
Stage 1	431	-	-	-	-	-
Stage 2	546	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	106	307	722	-	-	-
Mov Cap-2 Maneuver	106	-	-	-	-	-
Stage 1	341	-	-	-	-	-
Stage 2	493	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	35.11	1.88	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	722	-	239	-	-
HCM Lane V/C Ratio	0.125	-	0.517	-	-
HCM Control Delay (s/veh)	10.7	-	35.1	-	-
HCM Lane LOS	B	-	E	-	-
HCM 95th %tile Q(veh)	0.4	-	2.7	-	-

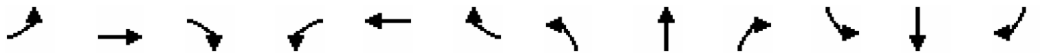
Intersection	
Int Delay, s/veh	1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	24	36	447	23	45	723
Future Vol, veh/h	24	36	447	23	45	723
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	26	39	486	25	49	786

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	998	502	0	0	515	0
Stage 1	502	-	-	-	-	-
Stage 2	496	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	255	568	-	-	1049	-
Stage 1	607	-	-	-	-	-
Stage 2	578	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	241	566	-	-	1045	-
Mov Cap-2 Maneuver	241	-	-	-	-	-
Stage 1	605	-	-	-	-	-
Stage 2	549	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	15.8	0	0.5
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	241	566	1045	-
HCM Lane V/C Ratio	-	-	0.108	0.069	0.047	-
HCM Control Delay (s/veh)	-	-	21.8	11.8	8.6	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	0.4	0.2	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	157	1	471	2	5	0	286	765	5	6	1045	151
Future Volume (veh/h)	157	1	471	2	5	0	286	765	5	6	1045	151
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	171	1	0	2	5	0	311	832	5	7	1136	86
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	208	1		5	12	0	357	2213	13	16	1492	664
Arrive On Green	0.12	0.12	0.00	0.01	0.01	0.00	0.20	0.61	0.61	0.01	0.42	0.42
Sat Flow, veh/h	1771	10	1585	527	1317	0	1781	3622	22	1781	3554	1581
Grp Volume(v), veh/h	172	0	0	7	0	0	311	408	429	7	1136	86
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1844	0	0	1781	1777	1866	1781	1777	1581
Q Serve(g_s), s	8.9	0.0	0.0	0.4	0.0	0.0	16.0	11.0	11.0	0.4	25.8	3.2
Cycle Q Clear(g_c), s	8.9	0.0	0.0	0.4	0.0	0.0	16.0	11.0	11.0	0.4	25.8	3.2
Prop In Lane	0.99		1.00	0.29		0.00	1.00		0.01	1.00		1.00
Lane Grp Cap(c), veh/h	209	0		16	0	0	357	1086	1141	16	1492	664
V/C Ratio(X)	0.82	0.00		0.43	0.00	0.00	0.87	0.38	0.38	0.44	0.76	0.13
Avail Cap(c_a), veh/h	283	0		175	0	0	829	2423	2545	169	2968	1321
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	40.8	0.0	0.0	46.6	0.0	0.0	36.7	9.3	9.3	46.6	23.4	16.8
Incr Delay (d2), s/veh	13.2	0.0	0.0	16.7	0.0	0.0	6.7	0.2	0.2	18.2	0.8	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.6	0.0	0.0	0.2	0.0	0.0	7.5	3.9	4.1	0.2	10.5	1.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	54.0	0.0	0.0	63.3	0.0	0.0	43.3	9.5	9.5	64.8	24.2	16.9
LnGrp LOS	D			E			D	A	A	E	C	B
Approach Vol, veh/h		172			7			1148			1229	
Approach Delay, s/veh		54.0			63.3			18.7			23.9	
Approach LOS		D			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.8	63.8		6.8	24.9	45.7		17.1				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	129.0		9.0	44.0	79.0		15.0				
Max Q Clear Time (g_c+I1), s	2.4	13.0		2.4	18.0	27.8		10.9				
Green Ext Time (p_c), s	0.0	6.4		0.0	0.9	11.9		0.3				

Intersection Summary		
HCM 7th Control Delay, s/veh	23.7	
HCM 7th LOS	C	

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	57	111	62	33	136	435	56	556	36	390	818	80
Future Volume (veh/h)	57	111	62	33	136	435	56	556	36	390	818	80
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	62	121	21	36	148	0	61	604	11	424	889	80
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	129	170	224	203	482		85	638	541	568	1509	136
Arrive On Green	0.14	0.14	0.14	0.04	0.26	0.00	0.05	0.34	0.34	0.16	0.46	0.46
Sat Flow, veh/h	454	1185	1563	1781	1870	1585	1781	1870	1585	3456	3296	297
Grp Volume(v), veh/h	183	0	21	36	148	0	61	604	11	424	479	490
Grp Sat Flow(s),veh/h/ln	1639	0	1563	1781	1870	1585	1781	1870	1585	1728	1777	1815
Q Serve(g_s), s	6.3	0.0	0.9	1.2	4.8	0.0	2.6	23.9	0.3	8.9	15.2	15.2
Cycle Q Clear(g_c), s	8.1	0.0	0.9	1.2	4.8	0.0	2.6	23.9	0.3	8.9	15.2	15.2
Prop In Lane	0.34		1.00	1.00		1.00	1.00		1.00	1.00		0.16
Lane Grp Cap(c), veh/h	299	0	224	203	482		85	638	541	568	814	831
V/C Ratio(X)	0.61	0.00	0.09	0.18	0.31		0.72	0.95	0.02	0.75	0.59	0.59
Avail Cap(c_a), veh/h	427	0	350	422	763		281	640	542	2683	1964	2007
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	31.2	0.0	28.2	25.2	22.7	0.0	35.7	24.3	16.6	30.2	15.3	15.3
Incr Delay (d2), s/veh	2.0	0.0	0.2	0.4	0.4	0.0	10.8	23.1	0.0	2.0	0.7	0.7
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.3	0.0	0.3	0.5	2.1	0.0	1.3	13.9	0.1	3.7	5.8	5.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	33.3	0.0	28.4	25.6	23.1	0.0	46.5	47.5	16.6	32.2	16.0	16.0
LnGrp LOS	C		C	C	C		D	D	B	C	B	B
Approach Vol, veh/h		204			184			676			1393	
Approach Delay, s/veh		32.8			23.6			46.9			20.9	
Approach LOS		C			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	18.5	31.9	8.7	16.9	9.6	40.8		25.6
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	59.0	26.0	12.0	17.0	12.0	84.0		31.0
Max Q Clear Time (g_c+I1), s	10.9	25.9	3.2	10.1	4.6	17.2		6.8
Green Ext Time (p_c), s	1.6	0.1	0.0	0.6	0.1	8.1		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	29.2
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	16	7	10	5	12	236	0	20	1	109	260	9
Future Volume (veh/h)	16	7	10	5	12	236	0	20	1	109	260	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.97	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	17	8	2	5	13	60	0	22	1	118	283	9
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	373	135	301	201	313	306	447	329	276	668	820	26
Arrive On Green	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.18	0.18	0.11	0.46	0.46
Sat Flow, veh/h	823	683	1517	211	1578	1544	1781	1870	1572	1781	1802	57
Grp Volume(v), veh/h	25	0	2	18	0	60	0	22	1	118	0	292
Grp Sat Flow(s),veh/h/ln	1506	0	1517	1789	0	1544	1781	1870	1572	1781	0	1860
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.3	0.0	1.3	0.0	2.9
Cycle Q Clear(g_c), s	0.3	0.0	0.0	0.2	0.0	0.9	0.0	0.3	0.0	1.3	0.0	2.9
Prop In Lane	0.68		1.00	0.28		1.00	1.00		1.00	1.00		0.03
Lane Grp Cap(c), veh/h	508	0	301	514	0	306	447	329	276	668	0	846
V/C Ratio(X)	0.05	0.00	0.01	0.04	0.00	0.20	0.00	0.07	0.00	0.18	0.00	0.35
Avail Cap(c_a), veh/h	2965	0	2893	3398	0	2945	749	3566	2996	788	0	3546
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.4	0.0	9.3	9.4	0.0	9.6	0.0	9.9	9.8	6.6	0.0	5.1
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1	0.0	0.1	0.0	0.2
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.3	0.0	0.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.4	0.0	9.3	9.4	0.0	10.0	0.0	10.0	9.8	6.7	0.0	5.3
LnGrp LOS	A		A	A		A		B	A	A		A
Approach Vol, veh/h		27			78			23			410	
Approach Delay, s/veh		9.4			9.8			10.0			5.7	
Approach LOS		A			A			A			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.1	10.1		10.7	0.0	18.1		10.7				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.3	2.3		2.3	0.0	4.9		2.9				
Green Ext Time (p_c), s	0.0	0.1		0.1	0.0	1.9		0.3				

Intersection Summary	
HCM 7th Control Delay, s/veh	6.7
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	11	97	40	11	76	232	1292	36	47	670	9
Future Volume (veh/h)	5	11	97	40	11	76	232	1292	36	47	670	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		0.99	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	5	12	7	43	12	8	252	1404	26	51	728	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	39	41	19	110	17	79	278	1451	1229	66	1228	1041
Arrive On Green	0.05	0.05	0.05	0.05	0.05	0.05	0.16	0.78	0.78	0.04	0.66	0.66
Sat Flow, veh/h	114	826	387	1223	341	1576	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	24	0	0	55	0	8	252	1404	26	51	728	6
Grp Sat Flow(s),veh/h/ln	1328	0	0	1565	0	1576	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.6	18.2	88.7	0.5	3.7	28.7	0.2
Cycle Q Clear(g_c), s	4.4	0.0	0.0	4.4	0.0	0.6	18.2	88.7	0.5	3.7	28.7	0.2
Prop In Lane	0.21		0.29	0.78		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	100	0	0	127	0	79	278	1451	1229	66	1228	1041
V/C Ratio(X)	0.24	0.00	0.00	0.43	0.00	0.10	0.91	0.97	0.02	0.77	0.59	0.01
Avail Cap(c_a), veh/h	231	0	0	244	0	204	326	1496	1268	258	1425	1208
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	60.0	0.0	0.0	61.3	0.0	59.5	54.4	13.3	3.4	62.6	12.7	7.8
Incr Delay (d2), s/veh	1.2	0.0	0.0	2.3	0.0	0.6	25.1	16.0	0.0	16.8	0.5	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.8	0.0	0.0	1.9	0.0	0.3	10.1	36.3	0.1	2.0	11.7	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	61.3	0.0	0.0	63.6	0.0	60.1	79.5	29.3	3.4	79.4	13.2	7.8
LnGrp LOS	E			E		E	E	C	A	E	B	A
Approach Vol, veh/h		24			63			1682			785	
Approach Delay, s/veh		61.3			63.2			36.4			17.4	
Approach LOS		E			E			D			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	10.9	107.8		12.6	26.5	92.2		12.6
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	19.0	105.0		17.0	24.0	100.0		17.0
Max Q Clear Time (g_c+I1), s	15.7	90.7		6.4	20.2	30.7		6.4
Green Ext Time (p_c), s	0.1	11.1		0.0	0.3	6.4		0.1

Intersection Summary	
HCM 7th Control Delay, s/veh	31.5
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	209	0	1592	856	1
Future Vol, veh/h	0	209	0	1592	856	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	227	0	1730	930	1

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2068 PM – Alternative 3

Intersection	
Int Delay, s/veh	8.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	25	141	99	641	600	32
Future Vol, veh/h	25	141	99	641	600	32
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	27	153	108	697	652	35

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1683	812	788	0	-	0
Stage 1	771	-	-	-	-	-
Stage 2	912	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	104	379	832	-	-	-
Stage 1	457	-	-	-	-	-
Stage 2	392	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	73	329	752	-	-	-
Mov Cap-2 Maneuver	73	-	-	-	-	-
Stage 1	354	-	-	-	-	-
Stage 2	354	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	73.01	1.42	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	752	-	215	-	-
HCM Lane V/C Ratio	0.143	-	0.84	-	-
HCM Control Delay (s/veh)	10.6	-	73	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	0.5	-	6.3	-	-

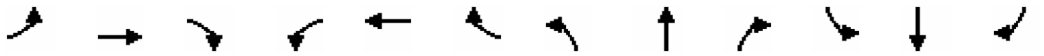
Intersection	
Int Delay, s/veh	2.3

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	51	71	676	51	53	705
Future Vol, veh/h	51	71	676	51	53	705
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	55	77	735	55	58	766

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1270	767	0	0	794	0
Stage 1	767	-	-	-	-	-
Stage 2	503	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	172	401	-	-	825	-
Stage 1	457	-	-	-	-	-
Stage 2	573	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	159	400	-	-	822	-
Mov Cap-2 Maneuver	159	-	-	-	-	-
Stage 1	456	-	-	-	-	-
Stage 2	531	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	25.84	0	0.68
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	159	400	822	-
HCM Lane V/C Ratio	-	-	0.349	0.193	0.07	-
HCM Control Delay (s/veh)	-	-	39.4	16.1	9.7	-
HCM Lane LOS	-	-	E	C	A	-
HCM 95th %tile Q(veh)	-	-	1.4	0.7	0.2	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	150	1	543	9	2	6	487	1187	0	1	1144	174
Future Volume (veh/h)	150	1	543	9	2	6	487	1187	0	1	1144	174
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	163	1	0	10	2	2	529	1290	0	1	1243	106
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	190	1		19	4	4	559	2537	0	2	1426	634
Arrive On Green	0.11	0.11	0.00	0.01	0.01	0.01	0.31	0.71	0.00	0.00	0.40	0.40
Sat Flow, veh/h	1771	11	1585	1259	252	252	1781	3647	0	1781	3554	1581
Grp Volume(v), veh/h	164	0	0	14	0	0	529	1290	0	1	1243	106
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1762	0	0	1781	1777	0	1781	1777	1581
Q Serve(g_s), s	13.4	0.0	0.0	1.2	0.0	0.0	42.8	24.1	0.0	0.1	47.5	6.3
Cycle Q Clear(g_c), s	13.4	0.0	0.0	1.2	0.0	0.0	42.8	24.1	0.0	0.1	47.5	6.3
Prop In Lane	0.99		1.00	0.71		0.14	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	191	0		26	0	0	559	2537	0	2	1426	634
V/C Ratio(X)	0.86	0.00		0.54	0.00	0.00	0.95	0.51	0.00	0.41	0.87	0.17
Avail Cap(c_a), veh/h	290	0		107	0	0	712	2537	0	109	1662	739
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	64.7	0.0	0.0	72.2	0.0	0.0	49.4	9.5	0.0	73.6	40.7	28.3
Incr Delay (d2), s/veh	14.7	0.0	0.0	16.1	0.0	0.0	18.9	0.2	0.0	85.2	4.8	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.9	0.0	0.0	0.6	0.0	0.0	21.9	9.0	0.0	0.1	21.6	2.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	79.4	0.0	0.0	88.2	0.0	0.0	68.3	9.7	0.0	158.8	45.5	28.5
LnGrp LOS	E			F			E	A		F	D	C
Approach Vol, veh/h		164			14			1819			1350	
Approach Delay, s/veh		79.4			88.2			26.7			44.2	
Approach LOS		E			F			C			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.2	111.3		8.2	52.3	65.2		21.8				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	104.0		9.0	59.0	69.0		24.0				
Max Q Clear Time (g_c+I1), s	2.1	26.1		3.2	44.8	49.5		15.4				
Green Ext Time (p_c), s	0.0	14.8		0.0	1.6	9.7		0.5				

Intersection Summary	
HCM 7th Control Delay, s/veh	36.6
HCM 7th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	90	125	124	26	132	489	54	597	27	491	836	89
Future Volume (veh/h)	90	125	124	26	132	489	54	597	27	491	836	89
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	98	136	37	28	143	0	59	649	8	534	909	90
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	165	175	288	172	510		76	657	557	657	1627	161
Arrive On Green	0.18	0.18	0.18	0.03	0.27	0.00	0.04	0.35	0.35	0.19	0.50	0.50
Sat Flow, veh/h	610	955	1568	1781	1870	1585	1781	1870	1585	3456	3264	323
Grp Volume(v), veh/h	234	0	37	28	143	0	59	649	8	534	495	504
Grp Sat Flow(s),veh/h/ln	1564	0	1568	1781	1870	1585	1781	1870	1585	1728	1777	1811
Q Serve(g_s), s	12.8	0.0	1.9	1.2	5.8	0.0	3.2	33.4	0.3	14.3	18.7	18.7
Cycle Q Clear(g_c), s	13.8	0.0	1.9	1.2	5.8	0.0	3.2	33.4	0.3	14.3	18.7	18.7
Prop In Lane	0.42		1.00	1.00		1.00	1.00		1.00	1.00		0.18
Lane Grp Cap(c), veh/h	340	0	288	172	510		76	657	557	657	886	902
V/C Ratio(X)	0.69	0.00	0.13	0.16	0.28		0.77	0.99	0.01	0.81	0.56	0.56
Avail Cap(c_a), veh/h	535	0	486	381	927		166	657	557	2106	1083	1103
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	37.8	0.0	33.0	30.4	27.7	0.0	45.9	31.2	20.5	37.6	16.9	16.9
Incr Delay (d2), s/veh	2.5	0.0	0.2	0.4	0.3	0.0	15.3	32.0	0.0	2.5	0.6	0.5
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.5	0.0	0.7	0.5	2.6	0.0	1.7	20.3	0.1	6.2	7.4	7.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	40.3	0.0	33.2	30.8	28.0	0.0	61.1	63.2	20.5	40.1	17.4	17.4
LnGrp LOS	D		C	C	C		E	E	C	D	B	B
Approach Vol, veh/h		271			171			716			1533	
Approach Delay, s/veh		39.3			28.5			62.6			25.3	
Approach LOS		D			C			E			C	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	14.4	40.0	8.6	23.8	10.1	54.3		32.4
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	9.0	34.0	14.0	30.0	9.0	59.0		48.0
Max Q Clear Time (g_c+I1), s	16.3	35.4	3.2	15.8	5.2	20.7		7.8
Green Ext Time (p_c), s	2.1	0.0	0.0	1.2	0.0	8.1		0.8

Intersection Summary	
HCM 7th Control Delay, s/veh	36.8
HCM 7th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	30	13	10	19	26	226	1	38	2	117	521	17
Future Volume (veh/h)	30	13	10	19	26	226	1	38	2	117	521	17
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.97	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	33	14	1	21	28	50	1	41	1	127	566	17
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	326	112	293	222	234	298	323	622	525	783	770	23
Arrive On Green	0.19	0.19	0.19	0.19	0.19	0.19	0.00	0.33	0.33	0.10	0.43	0.43
Sat Flow, veh/h	887	582	1515	475	1208	1543	1781	1870	1578	1781	1806	54
Grp Volume(v), veh/h	47	0	1	49	0	50	1	41	1	127	0	583
Grp Sat Flow(s),veh/h/ln	1468	0	1515	1683	0	1543	1781	1870	1578	1781	0	1860
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.6	0.0	1.7	0.0	10.4
Cycle Q Clear(g_c), s	0.9	0.0	0.0	0.9	0.0	1.1	0.0	0.6	0.0	1.7	0.0	10.4
Prop In Lane	0.70		1.00	0.43		1.00	1.00		1.00	1.00		0.03
Lane Grp Cap(c), veh/h	439	0	293	455	0	298	323	622	525	783	0	793
V/C Ratio(X)	0.11	0.00	0.00	0.11	0.00	0.17	0.00	0.07	0.00	0.16	0.00	0.74
Avail Cap(c_a), veh/h	2140	0	2106	2369	0	2144	544	2599	2193	839	0	2585
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	13.2	0.0	12.9	13.2	0.0	13.3	9.3	9.0	8.8	6.6	0.0	9.5
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.3	0.0	0.0	0.0	0.1	0.0	1.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.0	0.3	0.0	0.3	0.0	0.2	0.0	0.5	0.0	3.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	13.3	0.0	12.9	13.3	0.0	13.6	9.3	9.1	8.8	6.7	0.0	10.8
LnGrp LOS	B		B	B		B	A	A	A	A		B
Approach Vol, veh/h		48			99			43			710	
Approach Delay, s/veh		13.3			13.5			9.1			10.1	
Approach LOS		B			B			A			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.8	18.2		12.7	5.1	21.9		12.7				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.8	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.7	2.6		2.9	2.0	12.4		3.1				
Green Ext Time (p_c), s	0.0	0.2		0.3	0.0	4.5		0.5				

Intersection Summary	
HCM 7th Control Delay, s/veh	10.6
HCM 7th LOS	B



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	6	19	102	37	9	57	234	1147	34	45	1030	27
Future Volume (veh/h)	6	19	102	37	9	57	234	1147	34	45	1030	27
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		0.99	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	7	21	18	40	10	5	254	1247	24	49	1120	15
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	39	41	30	118	19	83	282	1437	1218	63	1208	1024
Arrive On Green	0.05	0.05	0.05	0.05	0.05	0.05	0.16	0.77	0.77	0.04	0.65	0.65
Sat Flow, veh/h	117	776	574	1255	361	1576	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	46	0	0	50	0	5	254	1247	24	49	1120	15
Grp Sat Flow(s),veh/h/ln	1467	0	0	1616	0	1576	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.6	0.0	0.0	0.0	0.0	0.4	17.6	58.3	0.4	3.4	66.5	0.4
Cycle Q Clear(g_c), s	4.2	0.0	0.0	3.6	0.0	0.4	17.6	58.3	0.4	3.4	66.5	0.4
Prop In Lane	0.15		0.39	0.80		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	110	0	0	137	0	83	282	1437	1218	63	1208	1024
V/C Ratio(X)	0.42	0.00	0.00	0.37	0.00	0.06	0.90	0.87	0.02	0.77	0.93	0.01
Avail Cap(c_a), veh/h	300	0	0	301	0	263	340	1694	1436	142	1486	1260
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	58.1	0.0	0.0	58.1	0.0	56.6	52.0	10.1	3.4	60.2	19.7	8.0
Incr Delay (d2), s/veh	2.5	0.0	0.0	1.6	0.0	0.3	23.1	4.5	0.0	17.9	9.1	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.5	0.0	0.0	1.6	0.0	0.2	9.7	21.3	0.1	1.9	29.6	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	60.6	0.0	0.0	59.8	0.0	56.9	75.1	14.6	3.4	78.0	28.8	8.0
LnGrp LOS	E			E		E	E	B	A	E	C	A
Approach Vol, veh/h		46			55			1525			1184	
Approach Delay, s/veh		60.6			59.5			24.5			30.6	
Approach LOS		E			E			C			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	10.5	102.7		12.7	25.9	87.3		12.7
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0
Max Q Clear Time (g_c+I1), s	5.4	60.3		6.2	19.6	68.5		5.6
Green Ext Time (p_c), s	0.0	20.0		0.1	0.3	12.8		0.2

Intersection Summary		
HCM 7th Control Delay, s/veh	28.3	
HCM 7th LOS	C	

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	416	0	1485	1308	5
Future Vol, veh/h	0	416	0	1485	1308	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	452	0	1614	1422	5

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

APPENDIX D

LEVEL OF SERVICE CALCULATIONS

Future Year 2068 SAT – Alternative 3

Intersection	
Int Delay, s/veh	2.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	19	74	79	571	554	17
Future Vol, veh/h	19	74	79	571	554	17
Conflicting Peds, #/hr	0	41	41	0	0	101
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	21	80	86	621	602	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1505	753	722	0	-	0
Stage 1	712	-	-	-	-	-
Stage 2	792	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	133	409	880	-	-	-
Stage 1	486	-	-	-	-	-
Stage 2	446	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	97	356	796	-	-	-
Mov Cap-2 Maneuver	97	-	-	-	-	-
Stage 1	392	-	-	-	-	-
Stage 2	403	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	32.28	1.22	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	796	-	231	-	-
HCM Lane V/C Ratio	0.108	-	0.439	-	-
HCM Control Delay (s/veh)	10.1	-	32.3	-	-
HCM Lane LOS	B	-	D	-	-
HCM 95th %tile Q(veh)	0.4	-	2.1	-	-

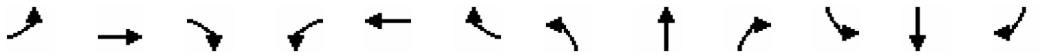
Intersection	
Int Delay, s/veh	1.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	53	62	587	43	35	616
Future Vol, veh/h	53	62	587	43	35	616
Conflicting Peds, #/hr	5	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	58	67	638	47	38	670

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1081	665	0	0	689	0
Stage 1	665	-	-	-	-	-
Stage 2	416	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	226	459	-	-	903	-
Stage 1	510	-	-	-	-	-
Stage 2	635	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	215	457	-	-	900	-
Mov Cap-2 Maneuver	215	-	-	-	-	-
Stage 1	508	-	-	-	-	-
Stage 2	605	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s/v	20.48	0	0.49
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	215	457	900	-
HCM Lane V/C Ratio	-	-	0.268	0.147	0.042	-
HCM Control Delay (s/veh)	-	-	27.8	14.2	9.2	-
HCM Lane LOS	-	-	D	B	A	-
HCM 95th %tile Q(veh)	-	-	1	0.5	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	144	2	428	2	2	0	397	1064	2	0	1022	155
Future Volume (veh/h)	144	2	428	2	2	0	397	1064	2	0	1022	155
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	157	2	0	2	2	0	432	1157	2	0	1111	52
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	190	2		5	5	0	477	2579	4	2	1356	603
Arrive On Green	0.11	0.11	0.00	0.01	0.01	0.00	0.27	0.71	0.71	0.00	0.38	0.38
Sat Flow, veh/h	1760	22	1585	912	912	0	1781	3640	6	1781	3554	1581
Grp Volume(v), veh/h	159	0	0	4	0	0	432	565	594	0	1111	52
Grp Sat Flow(s),veh/h/ln	1782	0	1585	1825	0	0	1781	1777	1869	1781	1777	1581
Q Serve(g_s), s	8.8	0.0	0.0	0.2	0.0	0.0	23.7	13.7	13.7	0.0	28.4	2.1
Cycle Q Clear(g_c), s	8.8	0.0	0.0	0.2	0.0	0.0	23.7	13.7	13.7	0.0	28.4	2.1
Prop In Lane	0.99		1.00	0.50		0.00	1.00		0.00	1.00		1.00
Lane Grp Cap(c), veh/h	193	0		10	0	0	477	1259	1325	2	1356	603
V/C Ratio(X)	0.83	0.00		0.42	0.00	0.00	0.91	0.45	0.45	0.00	0.82	0.09
Avail Cap(c_a), veh/h	247	0		90	0	0	863	1301	1368	159	1723	766
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	44.2	0.0	0.0	50.1	0.0	0.0	35.8	6.3	6.3	0.0	28.1	20.0
Incr Delay (d2), s/veh	16.2	0.0	0.0	26.4	0.0	0.0	6.8	0.3	0.2	0.0	2.6	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.7	0.0	0.0	0.2	0.0	0.0	11.0	4.5	4.7	0.0	12.2	0.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	60.4	0.0	0.0	76.5	0.0	0.0	42.6	6.5	6.5	0.0	30.7	20.0
LnGrp LOS	E			E			D	A	A		C	C
Approach Vol, veh/h		159			4			1591			1163	
Approach Delay, s/veh		60.4			76.5			16.3			30.2	
Approach LOS		E			E			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	0.0	77.6		6.5	33.1	44.6		16.9				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	9.0	74.0		5.0	49.0	49.0		14.0				
Max Q Clear Time (g_c+I1), s	0.0	15.7		2.2	25.7	30.4		10.8				
Green Ext Time (p_c), s	0.0	10.6		0.0	1.4	8.1		0.2				

Intersection Summary		
HCM 7th Control Delay, s/veh		24.3
HCM 7th LOS		C

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	126	189	170	82	169	453	101	605	35	333	861	157
Future Volume (veh/h)	126	189	170	82	169	453	101	605	35	333	861	157
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	137	205	75	89	184	0	110	658	11	362	936	160
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	193	228	388	186	654		137	684	579	449	1269	217
Arrive On Green	0.25	0.25	0.25	0.05	0.35	0.00	0.08	0.37	0.37	0.13	0.42	0.42
Sat Flow, veh/h	608	923	1572	1781	1870	1585	1781	1870	1585	3456	3033	518
Grp Volume(v), veh/h	342	0	75	89	184	0	110	658	11	362	548	548
Grp Sat Flow(s),veh/h/ln	1531	0	1572	1781	1870	1585	1781	1870	1585	1728	1777	1774
Q Serve(g_s), s	25.0	0.0	4.4	4.2	8.2	0.0	7.1	40.0	0.5	11.8	30.2	30.2
Cycle Q Clear(g_c), s	25.2	0.0	4.4	4.2	8.2	0.0	7.1	40.0	0.5	11.8	30.2	30.2
Prop In Lane	0.40		1.00	1.00		1.00	1.00		1.00	1.00		0.29
Lane Grp Cap(c), veh/h	421	0	388	186	654		137	684	579	449	743	742
V/C Ratio(X)	0.81	0.00	0.19	0.48	0.28		0.80	0.96	0.02	0.81	0.74	0.74
Avail Cap(c_a), veh/h	478	0	446	340	805		307	692	586	1160	948	946
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	42.4	0.0	34.6	32.1	27.3	0.0	52.7	36.1	23.6	49.1	28.4	28.4
Incr Delay (d2), s/veh	9.2	0.0	0.2	1.9	0.2	0.0	10.2	25.1	0.0	3.4	2.3	2.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	10.5	0.0	1.7	1.9	3.7	0.0	3.5	22.6	0.2	5.3	13.1	13.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	51.7	0.0	34.9	34.0	27.5	0.0	62.9	61.2	23.6	52.6	30.7	30.7
LnGrp LOS	D		C	C	C		E	E	C	D	C	C
Approach Vol, veh/h		417			273			779			1458	
Approach Delay, s/veh		48.6			29.6			60.9			36.1	
Approach LOS		D			C			E			D	

Timer - Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	21.1	48.5	11.9	34.7	15.0	54.6		46.6
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	39.0	43.0	16.0	33.0	20.0	62.0		50.0
Max Q Clear Time (g_c+I1), s	13.8	42.0	6.2	27.2	9.1	32.2		10.2
Green Ext Time (p_c), s	1.3	0.5	0.1	1.2	0.2	8.8		1.1

Intersection Summary	
HCM 7th Control Delay, s/veh	43.9
HCM 7th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	28	16	8	6	26	261	0	27	3	116	316	14
Future Volume (veh/h)	28	16	8	6	26	261	0	27	3	116	316	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	0.98		0.96	0.96		0.98	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	30	17	1	7	28	70	0	29	1	126	343	14
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	361	161	329	175	361	334	426	329	277	657	804	33
Arrive On Green	0.22	0.22	0.22	0.22	0.22	0.22	0.00	0.18	0.18	0.11	0.45	0.45
Sat Flow, veh/h	763	747	1523	145	1669	1548	1781	1870	1572	1781	1784	73
Grp Volume(v), veh/h	47	0	1	35	0	70	0	29	1	126	0	357
Grp Sat Flow(s),veh/h/ln	1511	0	1523	1814	0	1548	1781	1870	1572	1781	0	1857
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.4	0.0	1.5	0.0	3.9
Cycle Q Clear(g_c), s	0.6	0.0	0.0	0.4	0.0	1.1	0.0	0.4	0.0	1.5	0.0	3.9
Prop In Lane	0.64		1.00	0.20		1.00	1.00		1.00	1.00		0.04
Lane Grp Cap(c), veh/h	523	0	329	536	0	334	426	329	277	657	0	837
V/C Ratio(X)	0.09	0.00	0.00	0.07	0.00	0.21	0.00	0.09	0.00	0.19	0.00	0.43
Avail Cap(c_a), veh/h	2847	0	2790	3338	0	2835	717	3426	2879	760	0	3402
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	9.5	0.0	9.2	9.4	0.0	9.7	0.0	10.4	10.2	6.9	0.0	5.6
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.3	0.0	0.1	0.0	0.1	0.0	0.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	0.0	0.0	0.1	0.0	0.3	0.0	0.1	0.0	0.4	0.0	0.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	9.5	0.0	9.2	9.5	0.0	10.0	0.0	10.5	10.2	7.0	0.0	5.9
LnGrp LOS	A		A	A		A		B	B	A		A
Approach Vol, veh/h		48			105			30			483	
Approach Delay, s/veh		9.5			9.8			10.5			6.2	
Approach LOS		A			A			B			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.3	10.3		11.5	0.0	18.5		11.5				
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0				
Max Green Setting (Gmax), s	5.0	55.0		55.0	5.0	55.0		55.0				
Max Q Clear Time (g_c+I1), s	3.5	2.4		2.6	0.0	5.9		3.1				
Green Ext Time (p_c), s	0.0	0.1		0.3	0.0	2.4		0.4				

Intersection Summary	
HCM 7th Control Delay, s/veh	7.2
HCM 7th LOS	A



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	14	113	26	11	45	262	1104	32	46	657	17
Future Volume (veh/h)	15	14	113	26	11	45	262	1104	32	46	657	17
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	0.99		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	16	15	31	28	12	6	285	1200	22	50	714	8
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	63	31	49	126	43	100	322	1340	1136	67	1072	909
Arrive On Green	0.06	0.06	0.06	0.06	0.06	0.06	0.18	0.72	0.72	0.04	0.57	0.57
Sat Flow, veh/h	273	495	768	1008	682	1578	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	62	0	0	40	0	6	285	1200	22	50	714	8
Grp Sat Flow(s),veh/h/ln	1535	0	0	1691	0	1578	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	1.9	0.0	0.0	0.0	0.0	0.4	15.4	50.1	0.4	2.7	26.0	0.2
Cycle Q Clear(g_c), s	4.0	0.0	0.0	2.1	0.0	0.4	15.4	50.1	0.4	2.7	26.0	0.2
Prop In Lane	0.26		0.50	0.70		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	143	0	0	169	0	100	322	1340	1136	67	1072	909
V/C Ratio(X)	0.43	0.00	0.00	0.24	0.00	0.06	0.88	0.90	0.02	0.74	0.67	0.01
Avail Cap(c_a), veh/h	379	0	0	389	0	336	433	2160	1830	180	1895	1606
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	45.1	0.0	0.0	44.3	0.0	43.5	39.4	11.1	4.0	47.0	14.5	9.0
Incr Delay (d2), s/veh	2.1	0.0	0.0	0.7	0.0	0.2	15.3	3.3	0.0	14.8	0.7	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.6	0.0	0.0	1.0	0.0	0.1	8.0	17.6	0.1	1.5	10.4	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	47.2	0.0	0.0	45.0	0.0	43.7	54.7	14.3	4.0	61.8	15.3	9.0
LnGrp LOS	D			D		D	D	B	A	E	B	A
Approach Vol, veh/h		62			46			1507			772	
Approach Delay, s/veh		47.2			44.8			21.8			18.2	
Approach LOS		D			D			C			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	9.7	76.7		12.3	23.9	62.6		12.3
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	10.0	114.0		21.0	24.0	100.0		21.0
Max Q Clear Time (g_c+I1), s	4.7	52.1		6.0	17.4	28.0		4.1
Green Ext Time (p_c), s	0.0	18.6		0.2	0.5	6.3		0.1

Intersection Summary		
HCM 7th Control Delay, s/veh	21.7	
HCM 7th LOS	C	

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	255	0	1553	873	3
Future Vol, veh/h	0	255	0	1553	873	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	Yield
Storage Length	-	0	-	-	-	400
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	277	0	1688	949	3

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	-	-	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	0	-	-	-
Stage 1	0	0	0	-	-	-
Stage 2	0	0	0	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s/veh)	-	0	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

ANALYSIS OF PROJECT APPLICABILITY TO HAWAIʻI STATE PLAN

APPENDIX L-1

APPENDIX L-1

Analysis of Project Applicability to Hawai‘i State Plan

Chapter 226, HRS, also known as the Hawai‘i State Plan, is a long-range comprehensive plan which serves as a guide for the future long-term development of the State by identifying goals, objectives, policies, and priorities, as well as implementation mechanisms. The Plan consists of three (3) parts. Part I includes the Overall Theme, Goals, Objectives, and Policies; Part II includes Planning, Coordination, and Implementation; and Part III establishes Priority Guidelines. Inasmuch as Part II of the State Plan covers its administrative structure and implementation process, discussion of the proposed project's applicability to Part II is not appropriate. Below is an analysis of the project's applicability to Part I and Part III of the Hawai‘i State Plan.

The methodology for the analysis involves examining the project's applicability to the Hawai‘i State Plan's goals, objectives, and policies. "Applicability" refers to a project's need, purpose and effects, and how these advance or promote a particular set of goals, objectives and priority guidelines. In assessing the relationship between a proposed action and the Hawai‘i State Plan, an action may be categorized in one of the following groups:

1. **Directly applicable**: the action and its potential effects directly advance or promote the objective, policy or priority guideline.

   Example: A county project to develop a new water source and related transmission facilities would be directly applicable to the objectives and policies for Facility Systems-Water (HRS 226-16) which states" *(5) Support water supply services to areas experiencing critical water problems.*

2. **Indirectly applicable**: the action and its potential effects indirectly support or advance the objective, policy or priority guideline.

   Example: The county water source project cited above supports other related objectives and policies for the economy (HRS 226-6, General), which, by example, states: *(9) Strive to achieve a level of construction activity responsive to, and consistent with, state growth objectives.* In this case, the principle purpose of the project was not to create new construction activities, but nonetheless, supports this policy by creating temporary construction activity during the implementation of the project. In this instance, the proposed action may be deemed to be indirectly applicable to the objective and policy of the Hawai‘i State Plan.

3. **Not applicable**: the action and its potential effects have no direct or indirect relationship to the objectives and policies of the Hawai‘i State Plan.

   Example: That same county water source improvement project referenced above, may not have direct or indirect linkage to objectives and policies for the economy-Federal

Expenditures (HRS 226-9) which states: *(1) Encourage the sustained flow of federal expenditures in Hawaii that generates long-term government civilian employment*. From the standpoint of the agency proposing the water system improvement, and assuming no Federal Funding for the project, there is an unlikely intent that the proposed water source project would be connected to or reliant upon the foregoing policy. Hence, from the standpoint of judiciously applied policy analysis, the proposed action would be considered not applicable to the policy.

In general, a proposed action's applicability the objectives, policies and priority guidelines of the Hawai'i State Plan is judged on the basis of the action's direct or indirect relationship to the respective objectives, policies and priority directions. It is recognized that the categorization of "applicability" is subject to interpretation and should be appropriately considered in the context of local and regional conditions.

Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives and Policies **Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable**	**DA**	**IA**	**NA**
HRS 226-1: Findings and Purpose			
HRS 226-2: Definitions			
HRS 226-3: Overall Theme			
HRS 226-4: State Goals. In order to ensure, for the present and future generations, those elements of choice and mobility that ensure that individuals and groups may approach their desired levels of self-reliance and self determination, it shall be the goal of the State to achieve: (1) A strong, viable economy, characterized by stability, diversity, and growth, that enables the fulfillment of the needs and expectations of Hawaii's present and future generations. (2) A desired physical environment, characterized by beauty, cleanliness, quiet, stable natural systems, and uniqueness, that enhances the mental and physical well-being of the people. (3) Physical, social, and economic well-being, for individuals and families in Hawaii, that nourishes a sense of community responsibility, of caring, and of participation in community life.			
Analysis: **The proposed Project to restore and preserve Honokōwai Beach is directly applicable to the State's overall goal to preserve for present and future generations a desired physical environment, characterized by beauty, stable natural systems and uniqueness that enhances the mental and physical well-being of the people. The proposed Project will restore the beach face and preserve Honokōwai Beach for the enjoyment of present and future generations. The proposed Project is also indirectly applicable to the economic well-being for individuals and families since Honokōwai Beach supports a number of recreational and tourist-oriented upland commercial businesses and jobs.**			
Chapter 226-5 Objective and Policies for Population			
Objective:			
(a) It shall be the objective in planning for the State's population to guide population growth to be consistent with the achievement of physical, economic and social objectives contained in this chapter.			✓
Policies:			
(b) To achieve the population objective, it shall be the policy of this State to:			

Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
(1) Manage population growth statewide in a manner that provides increased opportunities for Hawaii's people to pursue their physical, social, and economic aspirations while recognizing the unique needs of each county.			✓
(2) Encourage an increase in economic activities and employment opportunities on the neighbor islands consistent with community needs and desires.			✓
(3) Promote increased opportunities for Hawaii's people to pursue their socio-economic aspirations throughout the islands.			✓
(4) Encourage research activities and public awareness programs to foster an understanding of Hawaii's limited capacity to accommodate population needs and to address concerns resulting from an increase in Hawaii's population.			✓
(5) Encourage federal actions and coordination among major governmental agencies to promote a more balanced distribution of immigrants among the states, provided that such actions do not prevent the reunion of immediate family members.			✓
(6) Pursue an increase in federal assistance for states with a greater proportion of foreign immigrants relative to their state's population.			✓
(7) Plan the development and availability of land and water resources in a coordinated manner so as to provide for the desired levels of growth in each geographic area.			✓
Analysis: **Not applicable.**			
Chapter 226-6 Objectives and policies for the economy – – in general			
Objectives:			
(a) Planning for the State's economy in general shall be directed toward achievement of the following objectives:			
(1) Increased and diversified employment opportunities to achieve full employment, increased income and job choice, and improved living standards for Hawaii's people, while at the same time stimulating the development and expansion of economic activities capitalizing on defense, dual-use, and science and technology assets, particularly on the neighbor islands where employment opportunities may be limited.		✓	
(2) A steadily growing and diversified economic base that is not overly dependent on a few industries, and includes the development and expansion of industries on the neighbor islands.			✓
Policies:			
(b) To achieve general economic objectives, it shall be the policy of this State to:			
(1) Promote and encourage entrepreneurship within Hawaii by residents and nonresidents of the State.			✓
(2) Expand Hawaii's national and international marketing, communication, and organizational ties, to increase the State's capacity to adjust to and capitalize upon economic changes and opportunities occurring outside the State.			✓

Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
(3) Promote Hawaii as an attractive market for environmentally and socially sound investment activities that benefit Hawaii's people.			✓
(4) Transform and maintain Hawaii as a place that welcomes and facilitates innovative activity that may lead to commercial opportunities.			✓
(5) Promote innovative activity that may pose initial risks, but ultimately contribute to the economy of Hawaii.			✓
(6) Seek broader outlets for new or expanded Hawaii business investments.			✓
(7) Expand existing markets and penetrate new markets for Hawaii's products and services.			✓
(8) Assure that the basic economic needs of Hawaii's people are maintained in the event of disruptions in overseas transportation.			✓
(9) Strive to achieve a level of construction activity responsive to, and consistent with, state growth objectives.			✓
(10) Encourage the formation of cooperatives and other favorable marketing arrangements at the local or regional level to assist Hawaii's small scale producers, manufacturers, and distributors.			✓
(11) Encourage labor-intensive activities that are economically satisfying and which offer opportunities for upward mobility.			✓
(12) Encourage innovative activities that may not be labor-intensive, but may otherwise contribute to the economy of Hawaii.			✓
(13) Foster greater cooperation and coordination between the government and private sectors in developing Hawaii's employment and economic growth opportunities.			✓
(14) Stimulate the development and expansion of economic activities which will benefit areas with substantial or expected employment problems.			✓
(15) Maintain acceptable working conditions and standards for Hawaii's workers.			✓
(16) Provide equal employment opportunities for all segments of Hawaii's population through affirmative action and nondiscrimination measures.			✓
(17) Stimulate the development and expansion of economic activities capitalizing on defense, dual-use, and science and technology assets, particularly on the neighbor islands where employment opportunities may be limited.			✓
(18) Encourage businesses that have favorable financial multiplier effects within Hawaii's economy, particularly with respect to emerging industries in science and technology.			✓
(19) Promote and protect intangible resources in Hawaii, such as scenic beauty and the aloha spirit, which are vital to a healthy economy.		✓	
(20) Increase effective communication between the educational community and the private sector to develop relevant curricula and training programs to meet future employment needs in general, and requirements of new or innovative potential growth industries in particular.			✓
(21) Foster a business climate in Hawaii--including attitudes, tax and regulatory policies, and financial and technical assistance programs-- that is conducive to the expansion of existing enterprises and the creation and attraction of new business and industry.			✓

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Analysis: **The proposed Project will support the local economy and Honokōwai Beach, which is an important natural, cultural, and aesthetic resource that supports a wide variety of cultural, recreational, and economic uses.**			
Chapter 226-7 Objectives and policies for the economy – – agriculture.			
Objectives:			
(a) Planning for the State's economy with regard to agriculture shall be directed towards achievement of the following objectives:			
(1) Viability of Hawaii's sugar and pineapple industries.			✓
(2) Growth and development of diversified agriculture throughout the State.			✓
(3) An agriculture industry that continues to constitute a dynamic and essential component of Hawaii's strategic, economic, and social well-being.			✓
Policies:			
(b) To achieve the agriculture objectives, it shall be the policy of this State to:			
(1) Establish a clear direction for Hawaii's agriculture through stakeholder commitment and advocacy.			✓
(2) Encourage agriculture by making the best use of natural resources.			✓
(3) Provide the governor and the legislature with information and options needed for prudent decision-making for the development of agriculture.			✓
(4) Establish strong relationships between the agricultural and visitor industries for mutual marketing benefits.			✓
(5) Foster increased public awareness and understanding of the contributions and benefits of agriculture as a major sector of Hawaii's economy.			✓
(6) Seek the enactment and retention of federal and state legislation that benefits Hawaii's agricultural industries.			✓
(7) Strengthen diversified agriculture by developing an effective promotion, marketing, and distribution system between Hawaii's food producers and consumers in the State, nation, and world.			✓
(8) Support research and development activities that strengthen economic productivity in agriculture, stimulate greater efficiency, and enhance the development of new products and agricultural by-products.			✓
(9) Enhance agricultural growth by providing public incentives and encouraging private initiatives.			✓
(10) Assure the availability of agriculturally suitable lands with adequate water to accommodate present and future needs.			✓
(11) Increase the attractiveness and opportunities for an agricultural education and livelihood.			✓
(12) In addition to the State's priority on food, expand Hawaii's agricultural base by promoting growth and development of flowers, tropical fruits and plants, livestock, feed grains, forestry, food crops, aquaculture, and other potential enterprises.			✓
(13) Promote economically competitive activities that increase Hawaii's			✓

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agricultural self-sufficiency, including the increased purchase and use of Hawaii-grown food and food products by residents, businesses, and governmental bodies as defined under section 103D-104.			
(14) Promote and assist in the establishment of sound financial programs for diversified agriculture.			✓
(15) Institute and support programs and activities to assist the entry of displaced agricultural workers into alternative agricultural or other employment.			✓
(16) Facilitate the transition of agricultural lands in economically nonfeasible agricultural production to economically viable agricultural uses.			✓
(17) Perpetuate, promote, and increase use of traditional Hawaiian farming systems, such as the use of loko i'a, māla, and irrigated lo'i, and growth of traditional Hawaiian crops, such as kalo, 'uala, and 'ulu.			✓
(18) Increase and develop small-scale farms.			✓
Analysis: **Not applicable.**			
Chapter 226-8 Objective and policies for the economy – – visitor industry.			
Objective:			
(a) Planning for the State's economy with regard to the visitor industry shall be directed towards the achievement of the objective of a visitor industry that constitutes a major component of steady growth for Hawaii's economy.		✓	
Policies:			
(b) To achieve the visitor industry objective, it shall be the policy of this State to:			
(1) Support and assist in the promotion of Hawaii's visitor attractions and facilities.			✓
(2) Ensure that visitor industry activities are in keeping with the social, economic, and physical needs and aspirations of Hawaii's people.			✓
(3) Improve the quality of existing visitor destination areas by utilizing Hawaii's strengths in science and technology.		✓	
(4) Encourage cooperation and coordination between the government and private sectors in developing and maintaining well-designed, adequately serviced visitor industry and related developments which are sensitive to neighboring communities and activities.		✓	
(5) Develop the industry in a manner that will continue to provide new job opportunities and steady employment for Hawaii's people.		✓	
(6) Provide opportunities for Hawaii's people to obtain job training and education that will allow for upward mobility within the visitor industry.			✓
(7) Foster a recognition of the contribution of the visitor industry to Hawaii's economy and the need to perpetuate the aloha spirit.		✓	
(8) Foster an understanding by visitors of the aloha spirit and of the unique and sensitive character of Hawaii's cultures and values.			✓

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Analysis: **The proposed Project is indirectly applicable to the objective and policies for the economy related to the visitor industry. The restoration of Honokōwai Beach, using nature-based solutions, will indirectly support local commercial establishments that rely on visitors drawn to the area by the beauty and recreational opportunities provided by Honokōwai Beach.**			
Chapter 226-9 Objective and policies for the economy – – federal expenditures.			
Objective:			
(a) Planning for the State's economy with regard to federal expenditures shall be directed towards achievement of the objective of a stable federal investment base as an integral component of Hawaii's economy.			✓
Policies:			
(b) To achieve the federal expenditures objective, it shall be the policy of this State to:			
(1) Encourage the sustained flow of federal expenditures in Hawaii that generates long-term government civilian employment;			✓
(2) Promote Hawaii's supportive role in national defense, in a manner consistent with Hawaii's social, environmental, and cultural goals by building upon dual-use and defense applications to develop thriving ocean engineering, aerospace research and development, and related dual-use technology sectors in Hawaii's economy;			✓
(3) Promote the development of federally supported activities in Hawaii that respect statewide economic concerns, are sensitive to community needs, and minimize adverse impacts on Hawaii's environment;			✓
(4) Increase opportunities for entry and advancement of Hawaii's people into federal government service;			✓
(5) Promote federal use of local commodities, services, and facilities available in Hawaii;			✓
(6) Strengthen federal-state-county communication and coordination in all federal activities that affect Hawaii; and			✓
(7) Pursue the return of federally controlled lands in Hawaii that are not required for either the defense of the nation or for other purposes of national importance, and promote the mutually beneficial exchanges of land between federal agencies, the State, and the counties.			✓
Analysis: **Not applicable.**			
Chapter 226-10 Objective and policies for the economy – – potential growth and innovative activities.			
Objective:			
(a) Planning for the State's economy with regard to potential growth and innovative activities shall be directed towards achievement of the objective of development and expansion of potential growth and innovative activities that serve to increase and diversify Hawaii's economic base.			✓
Policies:			

Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
(b) To achieve the potential growth and innovative activity objective, it shall be the policy of this State to:			
(1) Facilitate investment and employment growth in economic activities that have the potential to expand and diversify Hawaii's economy, including but not limited to diversified agriculture, aquaculture, renewable energy development, creative media, health care, and science and technology-based sectors;			✓
(2) Facilitate investment in innovative activity that may pose risks or be less labor-intensive than other traditional business activity, but if successful, will generate revenue in Hawaii through the export of services or products or substitution of imported services or products;			✓
(3) Encourage entrepreneurship in innovative activity by academic researchers and instructors who may not have the background, skill, or initial inclination to commercially exploit their discoveries or achievements;			✓
(4) Recognize that innovative activity is not exclusively dependent upon individuals with advanced formal education, but that many self-taught, motivated individuals are able, willing, sufficiently knowledgeable, and equipped with the attitude necessary to undertake innovative activity;			✓
(5) Increase the opportunities for investors in innovative activity and talent engaged in innovative activity to personally meet and interact at cultural, art, entertainment, culinary, athletic, or visitor-oriented events without a business focus;			✓
(6) Expand Hawaii's capacity to attract and service international programs and activities that generate employment for Hawaii's people;			✓
(7) Enhance and promote Hawaii's role as a center for international relations, trade, finance, services, technology, education, culture, and the arts;			✓
(8) Accelerate research and development of new energy-related industries based on wind, solar, ocean, underground resources, and solid waste;			✓
(9) Promote Hawaii's geographic, environmental, social, and technological advantages to attract new or innovative economic activities into the State;			✓
(10) Provide public incentives and encourage private initiative to attract new or innovative industries that best support Hawaii's social, economic, physical, and environmental objectives;			✓
(11) Increase research and the development of ocean-related economic activities such as mining, food production, and scientific research;			✓
(12) Develop, promote, and support research and educational and training programs that will enhance Hawaii's ability to attract and develop economic activities of benefit to Hawaii;			✓
(13) Foster a broader public recognition and understanding of the potential benefits of new or innovative growth-oriented industry in Hawaii;			✓
(14) Encourage the development and implementation of joint federal and state initiatives to attract federal programs and projects that will support Hawaii's social, economic, physical, and environmental objectives;			✓
(15) Increase research and development of businesses and services in the telecommunications and information industries;			✓

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(16) Foster the research and development of nonfossil fuel and energy efficient modes of transportation; and			✓
(17) Recognize and promote health care and health care information technology as growth industries.			✓
Analysis: **Not applicable.**			
Chapter 226-10.5 Objectives and policies for the economy – – information industry.			
Objective:			
(a) Planning for the State's economy with regard to telecommunications and information technology shall be directed toward recognizing that broadband and wireless communication capability and infrastructure are foundations for an innovative economy and positioning Hawaii as a leader in broadband and wireless communications and applications in the Pacific Region.			✓
Policies:			
(b) To achieve the information industry objective, it shall be the policy of this State to:			
(1) Promote efforts to attain the highest speeds of electronic and wireless communication within Hawaii and between Hawaii and the world, and make high speed communication available to all residents and businesses in Hawaii;			✓
(2) Encourage the continued development and expansion of the telecommunications infrastructure serving Hawaii to accommodate future growth and innovation in Hawaii's economy;			✓
(3) Facilitate the development of new or innovative business and service ventures in the information industry which will provide employment opportunities for the people of Hawaii;			✓
(4) Encourage mainland- and foreign-based companies of all sizes, whether information technology-focused or not, to allow their principals, employees, or contractors to live in and work from Hawaii, using technology to communicate with their headquarters, offices, or customers located out-of-state;			✓
(5) Encourage greater cooperation between the public and private sectors in developing and maintaining a well-designed information industry;			✓
(6) Ensure that the development of new businesses and services in the industry are in keeping with the social, economic, and physical needs and aspirations of Hawaii's people;			✓
(7) Provide opportunities for Hawaii's people to obtain job training and education that will allow for upward mobility within the information industry;			✓
(8) Foster a recognition of the contribution of the information industry to Hawaii's economy; and			✓
(9) Assist in the promotion of Hawaii as a broker, creator, and processor of information in the Pacific.			✓
Analysis: **Not applicable.**			

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Chapter 226-11 Objectives and policies for the physical environment – – land based, shoreline, and marine resources.			
Objectives:			
(a) Planning for the State's physical environment with regard to land-based, shoreline, and marine resources shall be directed towards achievement of the following objectives:			
(1) Prudent use of Hawaii's land-based, shoreline, and marine resources.	✓		
(2) Effective protection of Hawaii's unique and fragile environmental resources.	✓		
Policies:			
(b) To achieve the land-based, shoreline, and marine resources objectives, it shall be the policy of this State to:			
(1) Exercise an overall conservation ethic in the use of Hawaii's natural resources.	✓		
(2) Ensure compatibility between land-based and water-based activities and natural resources and ecological systems.	✓		
(3) Take into account the physical attributes of areas when planning and designing activities and facilities.	✓		
(4) Manage natural resources and environs to encourage their beneficial and multiple use without generating costly or irreparable environmental damage.	✓		
(5) Consider multiple uses in watershed areas, provided such uses do not detrimentally affect water quality and recharge functions.			✓
(6) Encourage the protection of rare or endangered plant and animal species and habitats native to Hawaii.	✓		
(7) Provide public incentives that encourage private actions to protect significant natural resources from degradation or unnecessary depletion.			✓
(8) Pursue compatible relationships among activities, facilities, and natural resources.	✓		
(9) Promote increased accessibility and prudent use of inland and shoreline areas for public recreational, educational, and scientific purposes.	✓		
Analysis: **The proposed Project is directly applicable to the objective and policies for the physical environment related to land based, shoreline, and marine resources. The proposed Project will restore Honokōwai Beach and reduce sedimentation within nearshore waters. The proposed Project will maintain lateral and perpendicular access to the shoreline for the present and future generations. Preserving the beach resource increases the accessibility of the shoreline area for public, recreational, educational, and scientific purposes. Furthermore, the larger sandy beach may provide an increase in the available habitat for listed species such as the Hawaiian monk seal or green sea turtle.**			
Chapter 226-12 Objective and policies for the physical environment – – scenic, natural beauty, and historic resources.			

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Objective:			
(a) Planning for the State's physical environment shall be directed towards achievement of the objective of enhancement of Hawaii's scenic assets, natural beauty, and multi-cultural/historical resources.	✓		
Policies:			
(b) To achieve the scenic, natural beauty, and historic resources objective, it shall be the policy of this State to:			
(1) Promote the preservation and restoration of significant natural and historic resources.	✓		
(2) Provide incentives to maintain and enhance historic, cultural, and scenic amenities.			✓
(3) Promote the preservation of views and vistas to enhance the visual and aesthetic enjoyment of mountains, ocean, scenic landscapes, and other natural features.	✓		
(4) Protect those special areas, structures, and elements that are an integral and functional part of Hawaii's ethnic and cultural heritage.	✓		
(5) Encourage the design of developments and activities that complement the natural beauty of the islands.	✓		
Analysis: **The proposed Project is directly applicable to the objective and policies for the physical environment related to the scenic, natural beauty, and historic resources. The proposed Project will restore Honokōwai Beach, a significant, historic and cultural resource. Groins developed as part of Beach Stabilization will change the landscape of the Project Site. These impacts to the scenic resources will be balanced by the benefits associated with stabilizing the only sandy beach in the area. If no action is taken, adverse impacts in the form of exposed escarpments and increased turbidity would occur.**			
Chapter 226-13 Objectives and policies for the physical environment – – land, air, and water quality.			
Objectives:			
(a) Planning for the State's physical environment with regard to land, air, and water quality shall be directed towards achievement of the following objectives.			
(1) Maintenance and pursuit of improved quality in Hawaii's land, air, and water resources.	✓		
(2) Greater public awareness and appreciation of Hawaii's environmental resources.	✓		
Policies:			
(b) To achieve the land, air, and water quality objectives, it shall be the policy of this State to:			
(1) Foster educational activities that promote a better understanding of Hawaii's limited environmental resources.			✓
(2) Promote the proper management of Hawaii's land and water resources.	✓		

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(3) Promote effective measures to achieve desired quality in Hawaii's surface, ground, and coastal waters.	✓		
(4) Encourage actions to maintain or improve aural and air quality levels to enhance the health and well-being of Hawaii's people.			✓
(5) Reduce the threat to life and property from erosion, flooding, tsunamis, hurricanes, earthquakes, volcanic eruptions, and other natural or man-induced hazards and disasters.	✓		
(6) Encourage design and construction practices that enhance the physical qualities of Hawaii's communities.			✓
(7) Encourage urban developments in close proximity to existing services and facilities.			✓
(8) Foster recognition of the importance and value of the land, air, and water resources to Hawaii's people, their cultures and visitors.	✓		
Analysis: **The proposed Project is directly applicable to the objective and policies for the State's physical environment with regard to land and water quality. Beach restoration will provide a stable beach that will provide a protective buffer between the ocean and the existing backshore infrastructure. The project is anticipated to reduce the vulnerability of the backshore to marine flooding, reduce turbidity, and promote nearshore water quality. BMPs will be used throughout the Project to protect the coastal water quality. In addition, an Applicable Monitoring and Assessment Plan (AMAP) will be followed to ensure that adequate measures are being taken to maintain the water quality during and after the proposed Project. Furthermore, this EIS will provide greater public awareness and appreciation of Hawai'i's environmental resources.**			
Chapter 226-14 Objective and policies for facility systems – – in general.			
Objective:			
(a) Planning for the State's facility systems in general shall be directed towards achievement of the objective of water, transportation, sustainable development, climate change adaptation, sea level rise adaptation, waste disposal, and energy and telecommunication systems that support statewide social, economic, and physical objectives.			✓
Policies:			
(b) To achieve the general facility systems objective, it shall be the policy of this State to:			
(1) Accommodate the needs of Hawaii's people through coordination of facility systems and capital improvement priorities in consonance with state and county plans.			✓
(2) Encourage flexibility in the design and development of facility systems to promote prudent use of resources and accommodate changing public demands and priorities.			✓
(3) Ensure that required facility systems can be supported within resource capacities and at reasonable cost to the user.			✓
(4) Pursue alternative methods of financing programs and projects and cost-saving techniques in the planning, construction, and maintenance of facility systems.			✓

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(5) Identify existing and planned state facilities that are vulnerable to sea level rise, flooding impacts, and natural hazards.			✓
(6) Assess a range of options to mitigate the impacts of sea level rise to existing and planned state facilities.			✓
Analysis: **Not applicable.**			
Chapter 226-15 Objectives and policies for facility systems – – solid and liquid waste.			
Objectives:			
(a) Planning for the State's facility systems with regard to solid and liquid wastes shall be directed towards the achievement of the following objectives:			
(1) Maintenance of basic public health and sanitation standards relating to treatment and disposal of solid and liquid wastes.			✓
(2) Provision of adequate sewerage facilities for physical and economic activities that alleviate problems in housing, employment, mobility, and other areas.			✓
Policies:			
(b) To achieve solid and liquid waste objectives, it shall be the policy of this State to:			
(1) Encourage the adequate development of sewerage facilities that complement planned growth.			✓
(2) Promote reuse and recycling to reduce solid and liquid wastes and employ a conservation ethic.			✓
(3) Promote research to develop more efficient and economical treatment and disposal of solid and liquid wastes.			✓
Analysis: **Not applicable.**			
Chapter 226-16 Objective and policies for facility systems – – water.			
Objective:			
(a) Planning for the State's facility systems with regard to water shall be directed towards achievement of the objective of the provision of water to adequately accommodate domestic, agricultural, commercial, industrial, recreational, and other needs within resource capacities.			✓
Policies:			
(b) To achieve the facility systems water objective, it shall be the policy of this State to:			
(1) Coordinate development of land use activities with existing and potential water supply.			✓
(2) Support research and development of alternative methods to meet future water requirements well in advance of anticipated needs.			✓
(3) Reclaim and encourage the productive use of runoff water and wastewater discharges.			✓
(4) Assist in improving the quality, efficiency, service, and storage capabilities of water systems for domestic and agricultural use.			✓

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(5) Support water supply services to areas experiencing critical water problems.			✓
(6) Promote water conservation programs and practices in government, private industry, and the general public to help ensure adequate water to meet long-term needs.			✓
Analysis: **Not applicable.**			
Chapter 226-17 Objectives and policies for facility systems – – transportation.			
Objectives:			
(a) Planning for the State's facility systems with regard to transportation shall be directed towards the achievement of the following objectives:			✓
(1) An integrated multi-modal transportation system that services statewide needs and promotes the efficient, economical, safe, and convenient movement of people and goods.			✓
(2) A statewide transportation system that is consistent with and will accommodate planned growth objectives throughout the State.			✓
Policies:			
(b) To achieve the transportation objectives, it shall be the policy of this State to:			
(1) Design, program, and develop a multi-modal system in conformance with desired growth and physical development as stated in this chapter;			✓
(2) Coordinate state, county, federal, and private transportation activities and programs toward the achievement of statewide objectives;			✓
(3) Encourage a reasonable distribution of financial responsibilities for transportation among participating governmental and private parties;			✓
(4) Provide for improved accessibility to shipping, docking, and storage facilities;			✓
(5) Promote a reasonable level and variety of mass transportation services that adequately meet statewide and community needs;			✓
(6) Encourage transportation systems that serve to accommodate present and future development needs of communities;			✓
(7) Encourage a variety of carriers to offer increased opportunities and advantages to interisland movement of people and goods;			✓
(8) Increase the capacities of airport and harbor systems and support facilities to effectively accommodate transshipment and storage needs;			✓
(9) Encourage the development of transportation systems and programs which would assist statewide economic growth and diversification;			✓
(10) Encourage the design and development of transportation systems sensitive to the needs of affected communities and the quality of Hawaii's natural environment;			✓

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(11) Encourage safe and convenient use of low-cost, energy-efficient, non-polluting means of transportation;			✓
(12) Coordinate intergovernmental land use and transportation planning activities to ensure the timely delivery of supporting transportation infrastructure in order to accommodate planned growth objectives; and			✓
(13) Encourage diversification of transportation modes and infrastructure to promote alternate fuels and energy efficiency.			✓
Analysis: **Not applicable.**			
Chapter 226-18 Objectives and policies for facility systems – – energy.			
Objectives:			
(a) Planning for the State's facility systems with regard to energy shall be directed toward the achievement of the following objectives, giving due consideration to all:			
(1) Dependable, efficient, and economical statewide energy systems capable of supporting the needs of the people;			✓
(2) Increased energy security and self-sufficiency through the reduction and ultimate elimination of Hawaii's dependence on imported fuels for electrical generation and ground transportation.			✓
(3) Greater diversification of energy generation in the face of threats to Hawaii's energy supplies and systems;			✓
(4) Reduction, avoidance, or sequestration of greenhouse gas emissions from energy supply and use; and			✓
(5) Utility models that make the social and financial interests of Hawaii's utility customers a priority.			✓
Policies:			
(b) To achieve the energy objectives, it shall be the policy of this State to ensure the short- and long-term provision of adequate, reasonably prices, and dependable energy services to accommodate demand.			✓
(c) To further achieve the energy objectives, it shall be the policy of this State to:			
(1) Support research and development as well as promote the use of renewable energy sources;			✓
(2) Ensure that the combination of energy supplies and energy-saving systems is sufficient to support the demands of growth;			✓
(3) Base decisions of least-cost supply-side and demand-side energy resource options on a comparison of their total costs and benefits when a least-cost is determined by a reasonably comprehensive, quantitative, and qualitative accounting of their long-term, direct and indirect economic, environmental, social, cultural, and public health costs and benefits;			✓
(4) Promote all cost-effective conservation of power and fuel supplies through measures, including:			

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(A) Development of cost-effective demand-side management programs;			✓
(B) Education;			✓
(C) Adoption of energy-efficient practices and technologies; and			✓
(D) Increasing energy efficiency and decreasing energy use in public infrastructure			✓
(5) Ensure, to the extent that new supply-side resources are needed, that the development or expansion of energy systems uses the least-cost energy supply option and maximizes efficient technologies; and			✓
(6) Support research, development, demonstration, and use of energy efficiency, load management, and other demand-side management programs, practices, and technologies;			✓
(7) Promote alternate fuels and transportation energy efficiency;			✓
(8) Support actions that reduce, avoid, or sequester greenhouse gases in utility, transportation, and industrial sector applications;			✓
(9) Support actions that reduce, avoid, or sequester Hawaii's greenhouse gas emissions through agriculture and forestry initiatives;			✓
(10) Provide priority handling and processing for all state and county permits required for renewable energy projects;			✓
(11) Ensure that liquefied natural gas is used only as a cost-effective transitional, limited-term replacement of petroleum for electricity generation and does not impede the development and use of other cost-effective renewable energy sources; and			✓
(12) Promote the development of indigenous geothermal energy resources that are located on public trust land as an affordable and reliable source of firm power for Hawaii.			✓
Analysis: **Not applicable.**			
Chapter 226-18.5 Objectives and policies for facility systems – – telecommunications.			
Objectives:			
(a) Planning for the State's telecommunications facility systems shall be directed towards the achievement of dependable, efficient, and economical statewide telecommunications systems capable of supporting the needs of the people.			✓
Policies:			
(b) To achieve the telecommunications objective, it shall be the policy of this State to ensure the provision of adequate, reasonably priced, and dependable telecommunications services to accommodate demand.			✓
(c) To further achieve the telecommunications objective, it shall be the policy of this State to:			

Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
(1) Facilitate research and development of telecommunications systems and resources;			✓
(2) Encourage public and private sector efforts to develop means for adequate, ongoing telecommunications planning;			✓
(3) Promote efficient management and use of existing telecommunications systems and services; and			✓
(4) Facilitate the development of education and training of telecommunications personnel.			✓
Analysis: **Not applicable.**			
Chapter 226-19 Objectives and policies for socio-cultural advancement – – housing.			
<u>Objectives</u>:			
(a) Planning for the State's socio-cultural advancement with regard to housing shall be directed toward the achievement of the following objectives:			✓
(1) Greater opportunities for Hawaii's people to secure reasonably priced, safe, sanitary, and livable homes, located in suitable environments that satisfactorily accommodate the needs and desires of families and individuals, through collaboration and cooperation between government and nonprofit and for-profit developers to ensure that more rental and for sale affordable housing is made available to very low-, very low-, lower-, moderate-, and above moderate-income segments of Hawaii's population.			✓
(2) The orderly development of residential areas sensitive to community needs and other land uses.			✓
(3) The development and provision of affordable rental housing by the State to meet the housing needs of Hawaii's people.			✓
<u>Policies</u>:			
(b) To achieve the housing objectives, it shall be the policy of this State to:			
(1) Effectively accommodate the housing needs of Hawaii's people.			✓
(2) Stimulate and promote feasible approaches that increase affordable rental and for sale housing choices for extremely low-, very low-, lower-, moderate-, and above moderate-income households.			✓
(3) Increase homeownership and rental opportunities and choices in terms of quality, location, cost, densities, style, and size of housing.			✓
(4) Promote appropriate improvement, rehabilitation, and maintenance of existing rental and for sale housing units and residential areas.			✓
(5) Promote design and location of housing developments taking into account the physical setting, accessibility to public facilities and services, and other concerns of existing communities and surrounding areas.			✓

Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
(6) Facilitate the use of available vacant, developable, and underutilized urban lands for housing.			✓
(7) Foster a variety of lifestyles traditional to Hawaii through the design and maintenance of neighborhoods that reflect the culture and values of the community.			✓
(8) Promote research and development of methods to reduce the cost of housing construction in Hawaii.			✓
Analysis: **Not applicable.**			
Chapter 226-20 Objectives and policies for socio-cultural advancement – – health.			
<u>Objectives</u>:			
(a) Planning for the State's socio-cultural advancement with regard to health shall be directed towards achievement of the following objectives:			
(1) Fulfillment of basic individual health needs of the general public.			✓
(2) Maintenance of sanitary and environmentally healthful conditions in Hawaii's communities.			✓
(3) Elimination of health disparities by identifying and addressing social determinants of health.			✓
<u>Policies</u>:			
(b) To achieve the health objectives, it shall be the policy of this State to:			
(1) Provide adequate and accessible services and facilities for prevention and treatment of physical and mental health problems, including substance abuse.			✓
(2) Encourage improved cooperation among public and private sectors in the provision of health care to accommodate the total health needs of individuals throughout the State.			✓
(3) Encourage public and private efforts to develop and promote statewide and local strategies to reduce health care and related insurance costs.			✓
(4) Foster an awareness of the need for personal health maintenance and preventive health care through education and other measures.			✓
(5) Provide programs, services, and activities that ensure environmentally healthful and sanitary conditions.			✓
(6) Improve the State's capabilities in preventing contamination by pesticides and other potentially hazardous substances through increased coordination, education, monitoring, and enforcement.			✓

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(7) Prioritize programs, services, interventions, and activities that address identified social determinants of health to improve native Hawaiian health and well-being consistent with the United States Congress' declaration of policy as codified in title 42 United States Code section 11702, and to reduce health disparities of disproportionately affected demographics, including native Hawaiians, other Pacific Islanders, and Filipinos. The prioritization of affected demographic groups other than native Hawaiians may be reviewed every ten years and revised based on the best available epidemiological and public health data.			✓
Analysis: **Not applicable.**			
Chapter 226-21 Objectives and policies for socio-cultural advancement – – education.			
<u>Objective</u>:			
(a) Planning for the State's socio-cultural advancement with regard to education shall be directed towards achievement of the objective of the provision of a variety of educational opportunities to enable individuals to fulfill their needs, responsibilities, and aspirations.			✓
<u>Policies</u>:			
(b) To achieve the education objective, it shall be the policy of this State to:			
(1) Support educational programs and activities that enhance personal development, physical fitness, recreation, and cultural pursuits of all groups.			✓
(2) Ensure the provision of adequate and accessible educational services and facilities that are designed to meet individual and community needs.			✓
(3) Provide appropriate educational opportunities for groups with special needs.			✓
(4) Promote educational programs which enhance understanding of Hawaii's cultural heritage.			✓
(5) Provide higher educational opportunities that enable Hawaii's people to adapt to changing employment demands.			✓
(6) Assist individuals, especially those experiencing critical employment problems or barriers, or undergoing employment transitions, by providing appropriate employment training programs and other related educational opportunities.			✓
(7) Promote programs and activities that facilitate the acquisition of basic skills, such as reading, writing, computing, listening, speaking, and reasoning.			✓
(8) Emphasize quality educational programs in Hawaii's institutions to promote academic excellence.			✓
(9) Support research programs and activities that enhance the education programs of the State.			✓
Analysis: **Not applicable.**			
Chapter 226-22 Objective and policies for socio-cultural advancement – – social services.			

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Objective:			
(a) Planning for the State's socio-cultural advancement with regard to social services shall be directed towards the achievement of the objective of improved public and private social services and activities that enable individuals, families, and groups to become more self-reliant and confident to improve their well-being.			✓
Policies:			
(a) To achieve the social service objective, it shall be the policy of the State to:			
(1) Assist individuals, especially those in need of attaining a minimally adequate standard of living and those confronted by social and economic hardship conditions, through social services and activities within the State's fiscal capacities.			✓
(2) Promote coordination and integrative approaches among public and private agencies and programs to jointly address social problems that will enable individuals, families, and groups to deal effectively with social problems and to enhance their participation in society.			✓
(3) Facilitate the adjustment of new residents, especially recently arrived immigrants, into Hawaii's communities.			✓
(4) Promote alternatives to institutional care in the provision of long-term care for elder and disabled populations.			✓
(5) Support public and private efforts to prevent domestic abuse and child molestation, and assist victims of abuse and neglect.			✓
(6) Promote programs which assist people in need of family planning services to enable them to meet their needs.			✓
Analysis: **Not applicable.**			
Chapter 226-23 Objective and policies for socio-cultural advancement – – leisure.			
Objective:			
(a) Planning for the State's socio-cultural advancement with regard to leisure shall be directed towards the achievement of the objective of the adequate provision of resources to accommodate diverse cultural, artistic, and recreational needs for present and future generations.	✓		
Policies:			
(b) To achieve the leisure objective, it shall be the policy of this State to:			
(1) Foster and preserve Hawaii's multi-cultural heritage through supportive cultural, artistic, recreational, and humanities-oriented programs and activities.			✓
(2) Provide a wide range of activities and facilities to fulfill the cultural, artistic, and recreational needs of all diverse and special groups effectively and efficiently.	✓		
(3) Enhance the enjoyment of recreational experiences through safety and security measures, educational opportunities, and improved facility design and maintenance.			✓

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(4) Promote the recreational and educational potential of natural resources having scenic, open space, cultural, historical, geological, or biological values while ensuring that their inherent values are preserved.	✓		
(5) Ensure opportunities for everyone to use and enjoy Hawaii's recreational resources.	✓		
(6) Assure the availability of sufficient resources to provide for future cultural, artistic, and recreational needs.	✓		
(7) Provide adequate and accessible physical fitness programs to promote the physical and mental well-being of Hawaii's people.			✓
(8) Increase opportunities for appreciation and participation in the creative arts, including the literary, theatrical, visual, musical, folk, and traditional art forms.			✓
(9) Encourage the development of creative expression in the artistic disciplines to enable all segments of Hawaii's population to participate in the creative arts.			✓
(10) Assure adequate access to significant natural and cultural resources in public ownership.	✓		
Analysis: **The proposed Project is directly applicable to objectives and policies for socio-cultural advancement regarding leisure. The proposed Project will implement a nature-based solution to create a stable beach and preserve and enhance cultural and recreational access at Honokōwai Beach.**			
Chapter 226-24 Objective and policies for socio-cultural advancement – – individual rights and personal well-being.			
Objective:			
(a) Planning for the State's socio-cultural advancement with regard to individual rights and personal well-being shall be directed towards achievement of the objective of increased opportunities and protection of individual rights to enable individuals to fulfill their socio-economic needs and aspirations.			✓
Policies:			
(b) To achieve the individual rights and personal well-being objective, it shall be the policy of this State to:			
(1) Provide effective services and activities that protect individuals from criminal acts and unfair practices and that alleviate the consequences of criminal acts in order to foster a safe and secure environment.			✓
(2) Uphold and protect the national and state constitutional rights of every individual.			✓
(3) Assure access to, and availability of, legal assistance, consumer protection, and other public services which strive to attain social justice.			✓
(4) Ensure equal opportunities for individual participation in society.			✓
Analysis: **Not applicable.**			
Chapter 226-25 Objective and policies for socio-cultural advancement – – culture.			

Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
Objective:			
(a) Planning for the State's socio-cultural advancement with regard to culture shall be directed toward the achievement of the objective of enhancement of cultural identities, traditions, values, customs, and arts of Hawaii's people.	✓		
Policies:			
(b) To achieve the culture objective, it shall be the policy of this State to:			
(1) Foster increased knowledge and understanding of Hawaii's ethnic and cultural heritages and the history of Hawaii.	✓		
(2) Support activities and conditions that promote cultural values, customs, and arts that enrich the lifestyles of Hawaii's people and which are sensitive and responsive to family and community needs.	✓		
(3) Encourage increased awareness of the effects of proposed public and private actions on the integrity and quality of cultural and community lifestyles in Hawaii.	✓		
(4) Encourage the essence of the aloha spirit in people's daily activities to promote harmonious relationships among Hawaii's people and visitors.			✓
Analysis: **The proposed Project is directly applicable to objectives and policies for socio-cultural advancement related to culture. Restoration and protection of Honokōwai Beach will maintain lateral and perpendicular shoreline access for cultural, commercial and recreational purposes. A LRFI and CIA were prepared for the proposed Project and recommendations identified by those studies and by the State Historic Preservation Division through the HRS § 6E historic review process will be implemented.**			
Chapter 226-26 Objectives and policies for socio-cultural advancement – – public safety.			
Objectives:			
(a) Planning for the State's socio-cultural advancement with regard to public safety shall be directed towards the achievement of the following objectives:			
(1) Assurance of public safety and adequate protection of life and property for all people.			✓
(2) Optimum organizational readiness and capability in all phases of emergency management to maintain the strength, resources, and social and economic well-being of the community in the event of civil disruptions, wars, natural disasters, and other major disturbances.			✓
(3) Promotion of a sense of community responsibility for the welfare and safety of Hawaii's people.			✓
Policies (Public Safety):			
(b) To achieve the public safety objectives, it shall be the policy of this State to:			
(1) Ensure that public safety programs are effective and responsive to community needs.			✓
(2) Encourage increased community awareness and participation in public safety programs.			✓
Policies (Public Safety-Criminal Justice):			

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(c) To further achieve public safety objectives related to criminal justice, it shall be the policy of this State to:			
(1) Support criminal justice programs aimed at preventing and curtailing criminal activities.			✓
(2) Develop a coordinated, systematic approach to criminal justice administration among all criminal justice agencies.			✓
(3) Provide a range of correctional resources which may include facilities and alternatives to traditional incarceration in order to address the varied security needs of the community and successfully reintegrate offenders into the community.			✓
Policies (Public Safety – Emergency Management):			
(d) To further achieve public safety objectives related to emergency management, it shall be the policy of this State to:			
(1) Ensure that responsible organizations are in a proper state of readiness to respond to major war-related, natural, or technological disasters and civil disturbances at all times.			✓
(2) Enhance the coordination between emergency management programs throughout the State.			✓
Analysis: **Not applicable.**			
Chapter 226-27 Objectives and policies for socio-cultural advancement – – government.			
Objectives:			
(a) Planning the State's socio-cultural advancement with regard to government shall be directed towards the achievement of the following objectives:			
(1) Efficient, effective, and responsive government services at all levels in the State.			✓
(2) Fiscal integrity, responsibility, and efficiency in the state government and county governments.			✓
Policies:			
(b) To achieve the government objectives, it shall be the policy of this State to:			
(1) Provide for necessary public goods and services not assumed by the private sector.			✓
(2) Pursue an openness and responsiveness in government that permits the flow of public information, interaction, and response.			✓
(3) Minimize the size of government to that necessary to be effective.			✓
(4) Stimulate the responsibility in citizens to productively participate in government for a better Hawaii.			✓
(5) Assure that government attitudes, actions, and services are sensitive to community needs and concerns.			✓

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(6) Provide for a balanced fiscal budget.			✓
(7) Improve the fiscal budgeting and management system of the State.			✓
(8) Promote the consolidation of state and county governmental functions to increase the effective and efficient delivery of government programs and services and to eliminate duplicative services wherever feasible.			✓
Analysis: **Not applicable.**			

Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	N/A
Chapter 226-101: Purpose. The purpose of this part is to establish overall priority guidelines to address areas of statewide concern.			
Chapter 226-102: Overall direction. The State shall strive to improve the quality of life for Hawaii's present and future population through the pursuit of desirable courses of action in seven major areas of statewide concern which merit priority attention: economic development, population growth and land resource management, affordable housing, crime and criminal justice, quality education, principles of sustainability, and climate change adaptation.			
Chapter 226-103: Economic priority guidelines.			
(a) Priority guidelines to stimulate economic growth and encourage business expansion and development to provide needed jobs for Hawaii's people and achieve a stable and diversified economy:	✓		
(1) Seek a variety of means to increase the availability of investment capital for new and expanding enterprises.	✓		
(A) Encourage investments which:			
(i) Reflect long term commitments to the State;	✓		
(ii) Rely on economic linkages within the local economy;	✓		
(iii) Diversify the economy;			✓
(iv) Reinvest in the local economy;	✓		
(v) Are sensitive to community needs and priorities; and	✓		
(vi) Demonstrate a commitment to provide management opportunities to Hawaii residents; and			✓
(B) Encourage investments in innovative activities that have a nexus to the State, such as:			✓
(i) Present or former residents acting as entrepreneurs or principals;			✓
(ii) Academic support from an institution of higher education in Hawaii;			✓
(iii) Investment interest from Hawaii residents;			✓
(iv) Resources unique to Hawaii that are required for innovative activity; and			✓
(v) Complementary or supportive industries or government programs or projects.			✓
(2) Encourage the expansion of technological research to assist industry development and support the development and commercialization of technological advancements.			✓
(3) Improve the quality, accessibility, and range of services provided by government to business, including data and reference services and assistance in complying with governmental regulations.			✓
(4) Seek to ensure that state business tax and labor laws and administrative policies are equitable, rational, and predictable.			✓
(5) Streamline the processes for building and development permit and review, and telecommunication infrastructure installation approval and eliminate or consolidate other burdensome or duplicative governmental requirements imposed on business, where scientific evidence indicates that public health, safety and welfare would not be adversely affected.			✓

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(6) Encourage the formation of cooperatives and other favorable marketing or distribution arrangements at the regional or local level to assist Hawaii's small-scale producers, manufacturers, and distributors.			✓
(7) Continue to seek legislation to protect Hawaii from transportation interruptions between Hawaii and the continental United States.			✓
(8) Provide public incentives and encourage private initiative to develop and attract industries which promise long-term growth potentials and which have the following characteristics:			✓
(A) An industry that can take advantage of Hawaii's unique location and available physical and human resources.			✓
(B) A clean industry that would have minimal adverse effects on Hawaii's environment.			✓
(C) An industry that is willing to hire and train Hawaii's people to meet the industry's labor needs at all levels of employment.			✓
(D) An industry that would provide reasonable income and steady employment.			✓
(9) Support and encourage, through educational and technical assistance programs and other means, expanded opportunities for employee ownership and participation in Hawaii business.			✓
(10) Enhance the quality of Hawaii's labor force and develop and maintain career opportunities for Hawaii's people through the following actions:			✓
(A) Expand vocational training in diversified agriculture, aquaculture, information industry, and other areas where growth is desired and feasible.			✓
(B) Encourage more effective career counseling and guidance in high schools and post-secondary institutions to inform students of present and future career opportunities.			✓
(C) Allocate educational resources to career areas where high employment is expected and where growth of new industries is desired.			✓
(D) Promote career opportunities in all industries for Hawaii's people by encouraging firms doing business in the State to hire residents.			✓
(E) Promote greater public and private sector cooperation in determining industrial training needs and in developing relevant curricula and on-the-job training opportunities.			✓
(F) Provide retraining programs and other support services to assist entry of displaced workers into alternative employment.			✓
(b) Priority guidelines to promote the economic health and quality of the visitor industry:		✓	
(1) Promote visitor satisfaction by fostering an environment which enhances the aloha spirit and minimizes inconveniences to Hawaii's residents and visitors.		✓	
(2) Encourage the development and maintenance of well-designed, adequately serviced hotels and resort destination areas which are sensitive to neighboring communities and activities and which provide for adequate shoreline setbacks and beach access.		✓	
(3) Support appropriate capital improvements to enhance the quality of existing resort destination areas and provide incentives to encourage investment in upgrading, repair, and maintenance of visitor facilities.		✓	

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(4) Encourage visitor industry practices and activities which respect, preserve, and enhance Hawaii's significant natural, scenic, historic, and cultural resources.		✓	
(5) Develop and maintain career opportunities in the visitor industry for Hawaii's people, with emphasis on managerial positions.			✓
(6) Support and coordinate tourism promotion abroad to enhance Hawaii's share of existing and potential visitor markets.			✓
(7) Maintain and encourage a more favorable resort investment climate consistent with the objectives of this chapter.	✓		
(8) Support law enforcement activities that provide a safer environment for both visitors and residents alike.			✓
(9) Coordinate visitor industry activities and promotions to business visitors through the state network of advanced data communication techniques.			✓
(c) Priority guidelines to promote the continued viability of the sugar and pineapple industries:			✓
(1) Provide adequate agricultural lands to support the economic viability of the sugar and pineapple industries.			✓
(2) Continue efforts to maintain federal support to provide stable sugar prices high enough to allow profitable operations in Hawaii.			✓
(3) Support research and development, as appropriate, to improve the quality and production of sugar and pineapple crops.			✓
(d) Priority guidelines to promote the growth and development of diversified agriculture and aquaculture:			✓
(1) Identify, conserve, and protect agricultural and aquacultural lands of importance and initiate affirmative and comprehensive programs to promote economically productive agricultural and aquacultural uses of such lands.			✓
(2) Assist in providing adequate, reasonably priced water for agricultural activities.			✓
(3) Encourage public and private investment to increase water supply and to improve transmission, storage, and irrigation facilities in support of diversified agriculture and aquaculture.			✓
(4) Assist in the formation and operation of production and marketing associations and cooperatives to reduce production and marketing costs.			✓
(5) Encourage and assist with the development of a waterborne and airborne freight and cargo system capable of meeting the needs of Hawaii's agricultural community.			✓
(6) Seek favorable freight rates for Hawaii's agricultural products from interisland and overseas transportation operators.			✓
(7) Encourage the development and expansion of agricultural and aquacultural activities which offer long-term economic growth potential and employment opportunities.			✓
(8) Continue the development of agricultural parks and other programs to assist small independent farmers in securing agricultural lands and loans.			✓
(9) Require agricultural uses in agricultural subdivisions and closely monitor the uses in these subdivisions.			✓
(10) Support the continuation of land currently in use for diversified agriculture.			✓

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(11) Encourage residents and visitors to support Hawaii's farmers by purchasing locally grown food and food products.			✓
(e) Priority guidelines for water use and development:			✓
(1) Maintain and improve water conservation programs to reduce the overall water consumption rate.			✓
(2) Encourage the improvement of irrigation technology and promote the use of nonpotable water for agricultural and landscaping purposes.			✓
(3) Increase the support for research and development of economically feasible alternative water sources.			✓
(4) Explore alternative funding sources and approaches to support future water development programs and water system improvements.			✓
(f) Priority guidelines for energy use and development:			✓
(1) Encourage the development, demonstration, and commercialization of renewable energy sources.			✓
(2) Initiate, maintain, and improve energy conservation programs aimed at reducing energy waste and increasing public awareness of the need to conserve energy.			✓
(3) Provide incentives to encourage the use of energy conserving technology in residential, industrial, and other buildings.			✓
(4) Encourage the development and use of energy conserving and cost-efficient transportation systems.			✓
(g) Priority guidelines to promote the development of the information industry:			✓
(1) Establish an information network, with an emphasis on broadband and wireless infrastructure and capability that will serve as the foundation of and catalyst for overall economic growth and diversification in Hawaii.			✓
(2) Encourage the development of services such as financial data processing, a products and services exchange, foreign language translations, telemarketing, teleconferencing, a twenty-four-hour international stock exchange, international banking, and a Pacific Rim management center.			✓
(3) Encourage the development of small businesses in the information field such as software development; the development of new information systems, peripherals, and applications; data conversion and data entry services; and home or cottage services such as computer programming, secretarial, and accounting services.			✓
(4) Encourage the development or expansion of educational and training opportunities for residents in the information and telecommunications fields.			✓
(5) Encourage research activities, including legal research in the information and telecommunications fields.			✓
(6) Support promotional activities to market Hawaii's information industry services.			✓
(7) Encourage the location or co-location of telecommunication or wireless information relay facilities in the community, including public areas, where scientific evidence indicates that the public health, safety, and welfare would not be adversely affected.			✓

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Analysis: **The proposed Project is directly applicable to the State economic priority guidelines. The proposed Project represents a large private investment to restore a stable beach that will improve environmental quality, nearshore water quality, and natural features that promote a healthy tourist economy. Restoration of Honokōwai Beach is a capital improvement project that will enhance the natural environment and can indirectly enhance visitor satisfaction.**			
Chapter 226-104: Population growth and land resources priority guidelines.			
(a) Priority guidelines to effect desired statewide growth and distribution:			✓
(1) Encourage planning and resource management to ensure that population growth rates throughout the State are consistent with available and planned resource capacities and reflect the needs and desires of Hawaii's people.			✓
(2) Manage a growth rate for Hawaii's economy that will parallel future employment needs for Hawaii's people.			✓
(3) Ensure that adequate support services and facilities are provided to accommodate the desired distribution of future growth throughout the State.			✓
(4) Encourage major state and federal investments and services to promote economic development and private investment to the neighbor islands, as appropriate.			✓
(5) Explore the possibility of making available urban land, low-interest loans, and housing subsidies to encourage the provision of housing to support selective economic and population growth on the neighbor islands.			✓
(6) Seek federal funds and other funding sources outside the State for research, program development, and training to provide future employment opportunities on the neighbor islands.			✓
(7) Support the development of high technology parks on the neighbor islands.			✓
(b) Priority guidelines for regional growth distribution and land resource utilization:			✓
(1) Encourage urban growth primarily to existing urban areas where adequate public facilities are already available or can be provided with reasonable public expenditures, and away from areas where other important benefits are present, such as protection of important agricultural land or preservation of lifestyles.			✓
(2) Make available marginal or nonessential agricultural lands for appropriate urban uses while maintaining agricultural lands of importance in the agricultural district.			✓
(3) Restrict development when drafting of water would result in exceeding the sustainable yield or in significantly diminishing the recharge capacity of any groundwater area.			✓
(4) Encourage restriction of new urban development in areas where water is insufficient from any source for both agricultural and domestic use.			✓
(5) In order to preserve green belts, give priority to state capital-improvement funds which encourage location of urban development within existing urban areas except where compelling public interest dictates development of a noncontiguous new urban core.			✓
(6) Seek participation from the private sector for the cost of building infrastructure and utilities, and maintaining open spaces.			✓
(7) Pursue rehabilitation of appropriate urban areas.			✓
(8) Support the redevelopment of Kakaako into a viable residential, industrial, and commercial community.			✓

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(9) Direct future urban development away from critical environmental areas or impose mitigating measures so that negative impacts on the environment would be minimized.			✓
(10) Identify critical environmental areas in Hawaii to include but not be limited to the following: watershed and recharge areas; wildlife habitats (on land and in the ocean); areas with endangered species of plants and wildlife; natural streams and water bodies; scenic and recreational shoreline resources; open space and natural areas; historic and cultural sites; areas particularly sensitive to reduction in water and air quality; and scenic resources.			✓
(11) Identify all areas where priority should be given to preserving rural character and lifestyle.			✓
(12) Utilize Hawaii's limited land resources wisely, providing adequate land to accommodate projected population and economic growth needs while ensuring the protection of the environment and the availability of the shoreline, conservation lands, and other limited resources for future generations.			✓
(13) Protect and enhance Hawaii's shoreline, open spaces, and scenic resources.			✓
Analysis: **Not applicable.**			
Chapter 226-105: Crime and criminal justice.			
Priority guidelines in the area of crime and criminal justice:			✓
(1) Support law enforcement activities and other criminal justice efforts that are directed to provide a safer environment.			✓
(2) Target state and local resources on efforts to reduce the incidence of violent crime and on programs relating to the apprehension and prosecution of repeat offenders.			✓
(3) Support community and neighborhood program initiatives that enable residents to assist law enforcement agencies in preventing criminal activities.			✓
(4) Reduce overcrowding or substandard conditions in correctional facilities through a comprehensive approach among all criminal justice agencies which may include sentencing law revisions and use of alternative sanctions other than incarceration for persons who pose no danger to their community.			✓
(5) Provide a range of appropriate sanctions for juvenile offenders, including community-based programs and other alternative sanctions.			✓
(6) Increase public and private efforts to assist witnesses and victims of crimes and to minimize the costs of victimization.			✓
Analysis: **Not applicable.**			
Chapter 226-106: Affordable housing.			
Priority guidelines for the provision of affordable housing:			✓
(1) Seek to use marginal or nonessential agricultural land and public land to meet housing needs of extremely low-, very low-, lower-, moderate-, and above and moderate-income households.			✓

Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	N/A
(2) Encourage the use of alternative construction and development methods as a means of reducing production costs.			✓
(3) Improve information and analysis relative to land availability and suitability for housing.			✓
(4) Create incentives for development which would increase home ownership and rental opportunities for Hawaii's low-, very low-, lower-, and moderate-income households and residents with special needs.			✓
(5) Encourage continued support for government or private housing programs that provide low interest mortgages to Hawaii's people for the purchase of initial owner-occupied housing.			✓
(6) Encourage public and private sector cooperation in the development of rental housing alternatives.			✓
(7) Encourage improved coordination between various agencies and levels of government to deal with housing policies and regulations.			✓
(8) Give higher priority to the provision of quality housing that is affordable for Hawaii's residents and less priority to development of housing intended primarily for individuals outside of Hawaii.			✓
Analysis: **Not applicable.**			
Chapter 226-107: Quality education.			
Priority guidelines to promote quality education:			✓
(1) Pursue effective programs which reflect the varied district, school, and student needs to strengthen basic skills achievement;			✓
(2) Continue emphasis on general education "core" requirements to provide common background to students and essential support to other university programs;			✓
(3) Initiate efforts to improve the quality of education by improving the capabilities of the education work force;			✓
(4) Promote increased opportunities for greater autonomy and flexibility of educational institutions in their decision making responsibilities;			✓
(5) Increase and improve the use of information technology in education by the availability of telecommunications equipment for:			✓
(A) The electronic exchange of information;			✓
(B) Statewide electronic mail; and			✓
(C) Access to the Internet.			✓
(6) Encourage programs that increase the public's awareness and understanding of the impact of information technologies on our lives;			✓
(7) Pursue the establishment of Hawaii's public and private universities and colleges as research and training centers of the Pacific;			✓
(8) Develop resources and programs for early childhood education;			✓
(9) Explore alternatives for funding and delivery of educational services to improve the overall quality of education; and			✓

Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	N/A
(10) Strengthen and expand educational programs and services for students with special needs.			✓
Analysis: **Not applicable.**			
CHAPTER 226-108: Sustainability			
Priority guidelines and principles to promote sustainability shall include:	✓		
(1) Encouraging balanced economic, social, community, and environmental priorities;	✓		
(2) Encouraging planning that respects and promotes living within the natural resources and limits of the State;	✓		
(3) Promoting a diversified and dynamic economy;		✓	
(4) Encouraging respect for the host culture;	✓		
(5) Promoting decisions based on meeting the needs of the present without compromising the needs of future generations;	✓		
(6) Considering the principles of the ahupuaa system; and	✓		
(7) Emphasizing that everyone, including individuals, families, communities, businesses, and government, has the responsibility for achieving a sustainable Hawaii.	✓		
Analysis: **The proposed Project is directly applicable to the priority guidelines related to sustainability. The proposed Project addresses a present need to restore and preserve Honokōwai Beach without compromising the needs of future generations. The proposed Project will restore the natural resource of Honokōwai Beach which provides important public benefit with lateral and perpendicular shoreline access as well as cultural and economic value. The proposed Project represents a private investment in promoting sustainability for Hawai'i.**			
CHAPTER 226-109: Climate change adaptation priority guidelines			
Priority guidelines to prepare the State to address the impacts of climate change, including impacts to the areas of agriculture; conservation lands; coastal and nearshore marine areas; natural and cultural resources; education; energy; higher education; health; historic preservation; water resources; the built environment, such as housing, recreation, transportation; and the economy shall:	✓		
(1) Ensure that Hawaii's people are educated, informed, and aware of the impacts climate change may have on their communities;		✓	
(2) Encourage community stewardship groups and local stakeholders to participate in planning and implementation of climate change policies;			✓
(3) Invest in continued monitoring and research of Hawaii's climate and the impacts of climate change on the State;		✓	
(4) Consider native Hawaiian traditional knowledge and practices in planning for the impacts of climate change;			✓
(5) Encourage the preservation and restoration of natural landscape features, such as coral reefs, beaches and dunes, forests, streams, floodplains, and wetlands, that have the inherent capacity to avoid, minimize, or mitigate the impacts of climate change;	✓		

Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	N/A
(6) Explore adaptation strategies that moderate harm or exploit beneficial opportunities in response to actual or expected climate change impacts to the natural and built environments;	✓		
(7) Promote sector resilience in areas such as water, roads, airports, and public health, by encouraging the identification of climate change threats, assessment of potential consequences, and evaluation of adaptation options;	✓		
(8) Foster cross-jurisdictional collaboration between county, state, and federal agencies and partnerships between government and private entities and other nongovernmental entities, including nonprofit entities;			✓
(9) Use management and implementation approaches that encourage the continual collection, evaluation, and integration of new information and strategies into new and existing practices, policies, and plans; and	✓		
(10) Encourage planning and management of the natural and built environments that effectively integrate climate change policy.	✓		
Analysis: **The proposed Project is directly applicable to the priority guidelines for climate change adaptation. The proposed Project restores and preserves Honokōwai Beach which will also provide strategies for climate change adaptation measures to protect coastal properties from the negative effects of sea level rise. The proposed Project encourages the planning and management of the natural and built environments that effectively integrates climate change policy and protects the natural marine environment and upland built features at Honokōwai Beach.**			

ANALYSIS OF PROJECT APPLICABILITY TO COUNTYWIDE POLICY PLAN

APPENDIX

L-2

APPENDIX L-2

Analysis of Project Applicability to Countywide Policy Plan

The Countywide Policy Plan was adopted in March 2010 and is a comprehensive policy document for the islands of Maui County to the year 2030. The plan provides the policy framework for the development of the Maui Island Plan as well as for the nine detailed Community Plans.

The Countywide Policy Plan provides broad goals, objectives, policies and implementing actions that portray the desired direction of the County's future. Goals are intended to describe a desirable condition of the County by the year 2030 and are intentionally general. Objectives tend to be more specific and may be regarded as milestones to achieve the larger goals. Policies are not intended as regulations, but instead provide a general guideline for County decision makers, departments, and collaborating organizations toward the attainment of goals and objectives. Implementing actions are specific tasks, procedures, programs, or techniques that carry out policy.

Discussion of the proposed project conforms to the relevant goals, objectives, policies, and implementing actions of the Countywide Policy Plan is provided below. The methodology for assessing a project's relationship to the Countywide Policy Plan involves examining the project's applicability to the Plan's goals, objectives, and policies. "Applicability" refers to a project's need, purpose and effects, and how they advance or promote a particular set of goals, objectives and policies. In assessing the relationship between a proposed action and the Countywide Policy Plan, an action may be categorized in one of the following groups:

1. **Directly applicable:** the action and its potential effects directly advance, promote or affect the relevant goal, objective, or policy.

   Example: A County project to develop a new water source and related transmission facilities would be directly applicable to improving physical infrastructure. The relevant objective states: *"Improve water systems to assure access to sustainable, clean, reliable, and affordable sources of water*" (Objective I.1). A policy within this objective category states: *Ensure that adequate supplies of water are available prior to approval of subdivision or construction documents* (Policy I.1.a).

   In this instance, the proposed action is considered to be directly applicable to the cited objective and policy.

2. **Indirectly applicable:** the action and its potential effects indirectly support, advance or affect the objective, policy or priority guideline.

   Example: The county water source project cited above supports the objective to: *"Improve land use management and implement a directed-growth strategy"* (Objective J.1). A related policy encompassed by this objective states: *"Direct new development in and around communities with existing infrastructure and service capacity, and protect natural,*

scenic, shoreline, and cultural resources" (Policy J.1.h). In this case, the principle purpose of the project is not to create a water source specifically intended to improve land use management. Nonetheless, the proposed action indirectly supports the Countywide Policy Plan's directives relating to appropriate locations for new development.

3. **Not applicable:** the action and its potential effects have no direct or indirect relationship to the objectives and policies of the Countywide Policy Plan.

Example: The county water source improvement project referenced above, may not have direct or indirect linkage to Objective D.1, which states: *"In cooperation with the Federal and State governments and nonprofit agencies, broaden access to social and healthcare services and expand options to improve the overall wellness of the people of Maui County"*. Hence, from a policy analysis and linkage standpoint, the proposed action would be considered not applicable to this set of objectives and policies.

It is recognized that policy analysis is subject to interpretation and is best considered in the context of the proposed action's local and regional conditions.

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
A. PROTECT THE NATURAL ENVIRONMENT			
Goal: Maui County's natural environment and distinctive open spaces will be preserved, managed, and cared for in perpetuity.	✓		
Objective:			
(1) Improve the opportunity to experience the natural beauty and native biodiversity of the islands for present and future generations.	✓		
Policies:			
(a) Perpetuate native Hawaiian biodiversity by preventing the introduction of invasive species, containing or eliminating existing noxious pests, and protecting critical habitat areas.			✓
(b) Preserve and reestablish indigenous and endemic species' habitats and their connectivity.	✓		
(c) Restore and protect forests, wetlands, watersheds, and stream flows, and guard against wildfires, flooding, and erosion.			✓
(d) Protect baseline stream flows for perennial streams, and support policies that ensure adequate stream flow to support Native Hawaiian aquatic species, traditional kalo cultivation, and self-sustaining ahupua'a.			✓
(e) Protect undeveloped beaches, dunes, and coastal ecosystems, and restore natural shoreline processes.			✓
(f) Protect the natural state and integrity of unique terrain, valued natural environments, and geological features.	✓		
(g) Preserve and provide ongoing care for important scenic vistas, view planes, landscapes, and open-space resources.	✓		

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
(h) Expand coordination with the State and nonprofit agencies and their volunteers to reduce invasive species, replant indigenous species, and identify critical habitat.			✓
Implementing Actions:			
(a) Develop island-wide networks of greenways, watercourses, and habitat corridors.			✓
Analysis: **The proposed Project is directly applicable to the objective and policies to protect the natural environment by restoring and preserving Honokōwai Beach, which is habitat for Hawaiian monk seals and green sea turtles. Stabilizing groins developed with Beach Stabilization will create new marine habitat with the potential to increase fish biomass and biodiversity.**			
Objective:			
(2) Improve the quality of environmentally sensitive, locally valued natural resources and native ecology of each island.	✓		
Policies:			
(a) Protect and restore nearshore reef environments and water quality.	✓		
(b) Protect marine resources and valued wildlife.	✓		
(c) Improve the connection between urban environments and the natural landscape, and incorporate natural features of the land into urban design.	✓		
(d) Utilize land-conservation tools to ensure the permanence of valued open spaces.	✓		
(e) Mitigate the negative effects of upland uses on coastal wetlands, marine life, and coral reefs.			✓
(f) Strengthen coastal-zone management, re-naturalization of shorelines, where possible, and filtration or treatment of urban and agricultural runoff.	✓		
(g) Regulate the use and maintenance of stormwater-treatment systems that incorporate the use of native vegetation and mimic natural systems.			✓
(h) Advocate for stronger regulation of fishing, boating, cruise ship, and ecotourism activities.			✓
(i) Restore watersheds and aquifer-recharge areas to healthy and productive status, and increase public knowledge about the importance of watershed stewardship, water conservation, and groundwater protection.			✓
Implementing Actions:			
(a) Develop regulations to minimize runoff of pollutants into nearshore waters and reduce nonpoint and point source pollution.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
Analysis: **The proposed Project is directly applicable to the objective and policies to improve the quality of locally valued natural resources of each island. The restoration and preservation of Honokōwai Beach will improve the quality of this valued natural resource which was severely damaged during an episodic erosion event in 2016. The proposed Project will strengthen coastal-zone management at Honokōwai Beach and re-establish the beach features, shoreline, and coastal processes in the area which were disrupted by the severe erosion in 2016. A Best Management Practices (BMP) Plan has been prepared and identifies measures to protect the marine and nearshore environment during construction.**			
Objective:			
(3) Improve the stewardship of the natural environment.	✓		
Policies:			
(a) Preserve and protect natural resources with significant scenic, economic, cultural, environmental, or recreational value.	✓		
(b) Improve communication, coordination, and collaboration among government agencies, nonprofit organizations, communities, individuals, and land owners that work for the protection of the natural environment.	✓		
(c) Evaluate development to assess potential short-term and long-term impacts on land, air, aquatic, and marine environments.	✓		
(d) Improve efforts to mitigate and plan for the impact of natural disasters, human influenced emergencies, and global warming.	✓		
(e) Regulate access to sensitive ecological sites and landscapes.			✓
(f) Reduce air, noise, light, land, and water pollution, and reduce Maui County's contribution to global climate change.			✓
(g) Plan and prepare for and educate visitors and residents about the possible effects of global warming.			✓
(h) Provide public access to beaches and shorelines for recreational and cultural purposes where appropriate.	✓		
(i) Educate the construction and landscape industries and property owners about the use of best management practices to prevent erosion and nonpoint source pollution.	✓		
(j) Support the acquisition of resources with scenic, environmental, and recreational value, and encumber their use.			✓
(k) Improve enforcement activities relating to the natural environment.			✓
(l) For each shoreline community, identify and prioritize beach-conservation objectives, and develop action plans for their implementation.	✓		
Implementing Actions:			
(a) Document, record, and monitor existing conditions, populations, and locations of flora and fauna communities.	✓		
(b) Implement Federal and State policies that require a reduction of greenhouse-gas emissions.			✓
(c) Establish a baseline inventory of available natural resources and their respective carrying capacities.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
Analysis: **The proposed Project is directly applicable to the objectives and policies to improve stewardship of the natural environment. The proposed Project will restore and preserve Honokōwai Beach as a significant cultural and recreational resource. The proposed Project is also a mid-term action to improve efforts to mitigate and plan for sea level rise caused by climate change. BMPs will be implemented during the construction of the Project to mitigate erosion and nonpoint source pollution. The proposed Project will improve water quality in the nearshore marine environment which can be impacted by turbidity caused by eroding upland soils during storm events.**			
Objective:			
(4) Educate residents and visitors about responsible stewardship practices and the interconnectedness of the natural environment and people.			✓
Policies:			
(a) Expand education about native flora, fauna, and ecosystems.			✓
(b) Align priorities to recognize that the health of the natural environment and the health of people are inextricably linked.			✓
(c) Promote programs and incentives that decrease greenhouse-gas emissions and improve environmental stewardship.			✓
Analysis: **Not applicable.**			
B. PRESERVE LOCAL CULTURES AND TRADITIONS			
Goal: Maui County will foster a spirit of pono and protect, perpetuate, and reinvigorate its residents multi-cultural values and traditions to ensure that current and future generations will enjoy the benefits of their rich island heritage.	✓		
Objective:			
(1) Perpetuate the Hawaiian culture as a vital force in the lives of residents.	✓		
Policies:			
(a) Protect and preserve access to mountain, ocean, and island resources for traditional Hawaiian cultural practices.	✓		
(b) Prohibit inappropriate development of cultural lands and sites that are important for traditional Hawaiian cultural practices, and establish mandates for the special protection of these lands in perpetuity.			✓
(c) Promote the use of ahupua‘a and moku management practices.	✓		
(d) Encourage the use of traditional Hawaiian architecture and craftsmanship.			✓
(e) Promote the use of the Hawaiian language.			✓
(f) Recognize and preserve the unique natural and cultural characteristics of each ahupua‘a or district.			✓
(g) Encourage schools to promote broader incorporation of Hawaiian and other local cultures’ history and values lessons into curriculum.			✓
(h) Ensure the protection of Native Hawaiian rights.	✓		

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
(i) Promote, encourage, and require the correct use of traditional place names, particularly in government documents, signage, and the tourism industry.			✓
Implementing Actions:			
(a) Establish alternative land use and overlay zoning designations that recognize and preserve the unique natural and cultural characteristics of each ahupua'a or district.			✓
(b) Develop requirements for all County applicants to perpetuate and use proper traditional place names in all applications submitted.			✓
Analysis: **The proposed Project is directly applicable to the objective and policies to preserve local cultures and traditions. Restoration and protection of Honokōwai Beach will maintain lateral and perpendicular shoreline access for cultural, commercial and recreational purposes. A LRFI and CIA were prepared for the proposed Project and recommendations identified by those studies and by the State Historic Preservation Division through the HRS 6E historic review process will be implemented. The restoration of the beach will maintain perpendicular shoreline access which promotes the use of ahupua'a management practices connecting the upland resources with shoreline access and resource use.**			
Objective:			
(2) Emphasize respect for our island lifestyle and our unique local cultures, family, and natural environment.	✓		
Policies:			
(a) Acknowledge the Hawaiian culture as the host culture, and foster respect and humility among residents and visitors toward the Hawaiian people and their practices.	✓		
(b) Perpetuate a respect for diversity, and recognize the historic blending of cultures and ethnicities.	✓		
(c) Encourage the perpetuation of each culture's unique cuisine, attire, dance, music, and folklore, and other unique island traditions and recreational activities.			✓
(d) Recognize the interconnectedness between the natural environment and the cultural heritage of the islands.	✓		
(e) Protect and prioritize funding for recreational activities that support local cultural practices, such as surfing, fishing, and outrigger-canoe paddling.	✓		
Analysis: **The proposed Project is directly applicable to the objective and policies that respect unique local cultures and the natural environment. The proposed Project will restore and protect Honokōwai Beach, an important island cultural and recreational resource.**			
Objective:			
(3) Preserve for present and future generations the opportunity to know and experience the arts, culture, and history of Maui County.			✓
Policies:			
(a) Foster teaching opportunities for cultural practitioners to share their knowledge and skills.			✓
(b) Support the development of cultural centers.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
(c) Broaden opportunities for public art and the display of local artwork.			✓
(d) Foster the Aloha Spirit by celebrating the Hawaiian host culture and other Maui County cultures through support of cultural-education programs, festivals, celebrations, and ceremonies.			✓
(e) Support the perpetuation of Hawaiian arts and culture.			✓
(f) Support programs and activities that record the oral and pictorial history of residents.			✓
(g) Support the development of repositories for culture, history, genealogy, oral history, film, and interactive learning.			✓
Implementing Actions:			
(a) Establish incentives for the display of public art.			✓
(b) Establish centers and programs of excellence for the perpetuation of Hawaiian arts and culture.			✓
Analysis: **Not applicable.**			
Objective:			
(4) Preserve and restore significant historic architecture, structures, cultural sites, cultural districts, and cultural landscapes.	✓		
Policies:			
(a) Support the development of island-wide historic, archaeological, and cultural resources inventories.	✓		
(b) Promote the rehabilitation and adaptive reuse of historic sites, buildings, and structures to perpetuate a traditional sense of place.	✓		
(c) Identify a sustainable rate of use and set forth specific policies to protect cultural resources.	✓		
(d) Protect and preserve lands that are culturally or historically significant.	✓		
(e) Support programs that protect, record, restore, maintain, provide education about, and interpret cultural districts, landscapes, sites, and artifacts in both natural and museum settings.	✓		
(f) Perpetuate the authentic character and historic integrity of rural communities and small towns.			✓
(g) Seek solutions that honor the traditions and practices of the host culture while recognizing the needs of the community.			✓
(h) Support the development of an Archaeological District Ordinance.			✓
(i) Protect summits, slopes, and ridgelines from inappropriate development.			✓
(j) Support the registering of important historic sites on the State and Federal historic registers.			✓
(k) Provide opportunities for public involvement with restoration and enhancement of all types of cultural resources.			✓
(l) Foster partnerships to identify and preserve or revitalize historic and cultural sites.			✓
Implementing Actions:			
(a) Identify, develop, map, and maintain an inventory of locally significant natural. cultural, and historical resources for protection.	✓		
(b) Prepare, continually update, and implement a cultural-management plan for cultural sites, districts, and landscapes, where appropriate.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
(c) Enact an Archaeological District Ordinance.			✓
(d) Nominate important historic sites to the State and Federal historic registers.	✓		
Analysis: **The proposed Project is directly applicable to the objective and policies to preserve and restore significant historic and cultural landscapes. The restoration of Honokōwai Beach will maintain important lateral and perpendicular shoreline access for recreational and cultural purposes. An archaeological Literature Review and Field Inspection and Cultural Impact Assessment were prepared as part of the EIS process.**			
C. IMPROVE EDUCATION			
Goal: Residents will have access to lifelong formal and informal educational options enabling them to realize their ambitions.			✓
Objective:			
(1) Encourage the State to attract and retain school administrators and educators of the highest quality.			✓
Policies:			
(a) Encourage the State to provide teachers with nationally competitive pay and benefit packages.			✓
(b) Encourage the State to ensure teachers will have the teaching tools and support staff needed to provide students with an excellent education.			✓
(c) Explore Maui County district- and school-based decision making in public education.			✓
Analysis: **Not applicable.**			
Objective:			
(2) Provide nurturing learning environments that build skills for the 21st century.			✓
Policies:			
(a) Expand professional-development opportunities in disciplines that support the economic-development goals of Maui County.			✓
(b) Plan for demographic, social, and technological changes in a timely manner.			✓
(c) Encourage collaborative partnerships to improve conditions of learning environments.			✓
(d) Promote development of neighborhood schools and educational centers.			✓
(e) Integrate schools, community parks, and playgrounds, and expand each community's use of these facilities.			✓
(f) Support coordination between land use and school-facility planning agencies.			✓
(g) Encourage the upgrade and ongoing maintenance of public-school facilities.			✓
(h) Encourage the State Department of Education to seek reliable, innovative, and alternative methods to support a level of per-pupil funding that places Hawai'i among the top tier of states nationally for its financial support of public schools.			✓
(i) Encourage the State to promote healthier, more productive learning environments, including by providing healthy meals, more physical activity, natural lighting, and passive cooling.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
(j) Encourage the State to support the development of benchmarks to measure the success of Hawai'i's public-education system and clarify lines of accountability.			✓
(k) Design school and park facilities in proximity to residential areas.			✓
(l) Support technology- and natural-environment-based learning.			✓
(m) Encourage the State to support lower student-teacher ratios in public schools.			✓
(n) Encourage alternative learning and educational opportunities.			✓
Implementing Actions:			
(a) Develop safe walking and bicycling programs for school children.			✓
Analysis: **Not applicable.**			
Objective:			
(3) Provide all residents with educational opportunities that can help them better understand themselves and their surroundings and allow them to realize their ambitions.			✓
Policies:			
(a) Encourage the State to improve Maui Community College as a comprehensive community college that will serve each community.			✓
(b) Broaden the use of technology and telecommunications to improve educational opportunities throughout the County.			✓
(c) Attract graduate-level research programs and institutions.			✓
(d) Promote the teaching of traditional practices, including aquaculture; subsistence agriculture; Pacific Island, Asian, and other forms of alternative health practices; and indigenous Hawaiian architecture.			✓
(e) Integrate cultural and environmental values in education, including self-sufficiency and sustainability.			✓
(f) Foster a partnership and ongoing dialogue between business organizations, formal educational institutions, and vocational training centers to tailor learning and mentoring programs to County needs.			✓
(g) Ensure teaching of the arts to all ages.			✓
(h) Expand and develop vocational learning opportunities by establishing trade schools.			✓
(i) Encourage the State to integrate financial and economic literacy in elementary, secondary, and higher-education levels.			✓
Implementing Actions:			
(a) Encourage the State to establish a four-year university, and support the development of other higher-education institutions to enable residents to obtain bachelor degrees and postgraduate degrees in Maui County.			✓
Analysis: **Not applicable.**			
Objective:			
(4) Maximize community-based educational opportunities.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
Policies:			
(a) Encourage the State and others to expand pre-school, after-school, and homebased (parent-child) learning.			✓
(b) Support public-private partnerships to develop youth-internship, -apprenticeship, and -mentoring programs.			✓
(c) Support the development of a wide range of informal educational and cultural programs for all residents.			✓
(d) Improve partnerships that utilize the skills and talents at Hawai'i's colleges and universities to benefit the County.			✓
(e) Support career-development and job-recruitment programs and centers.			✓
(f) Attract learning institutions and specialty schools to diversify and enhance educational opportunities.			✓
(g) Expand education of important life skills for the general public.			✓
(h) Support community facilities such as museums, libraries, nature centers, and open spaces that provide interactive-learning opportunities for all ages.			✓
Analysis: **Not applicable.**			
D. STRENGTHEN SOCIAL AND HEALTHCARE SERVICES			
Goal: Health and social services in Maui County will fully and comprehensively serve all segments of the population.			✓
Objective:			
(1) In cooperation with the Federal and State governments and nonprofit agencies, broaden access to social and healthcare services and expand options to improve the overall wellness of the people of Maui County.			✓
Policies:			
(a) Work with other levels of government and the nonprofit sector to expand services to address hunger, homelessness, and poverty.			✓
(b) Support the improvement of opportunities for disadvantaged youth, encourage the tradition of hanai relatives, and support expanded opportunities for foster care.			✓
(c) Support expanded long-term-care options, both in institutions and at home, for patients requiring ongoing assistance and medical attention.			✓
(d) Encourage the expansion and improvement of local hospitals, facilitate the establishment of new healthcare facilities, and facilitate prompt and high-quality emergency- and urgent-care services for all.			✓
(e) Support broadened access to affordable health insurance and health care, and recognize the unique economic challenges posed to families when healthcare services are provided off-island.			✓
(f) Encourage equal access to social and healthcare services through both technological and traditional means.			✓
Analysis: **Not applicable.**			

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
Objective:			
(2) Encourage the Federal and State governments and the private sector to improve the quality and delivery of social and healthcare services.			✓
Policies:			
(a) Strengthen partnerships with government, nonprofit, and private organizations to provide funding and to improve counseling and other assistance to address substance abuse, domestic violence, and other pressing social challenges.			✓
(b) Encourage the State to improve the quality of medical personnel, facilities, services, and equipment.			✓
(c) Encourage investment to improve the recruitment of medical professionals and the quality of medical facilities and equipment throughout Maui County.			✓
(d) Promote the development of continuum-of-care facilities that provide assisted living, hospice, home-care, and skilled-nursing options allowing the individual to be cared for in a manner congruent with his or her needs and desires.			✓
(e) Support improved social, healthcare, and governmental services for special needs populations.			✓
(f) Plan for the needs of an aging population and the resulting impacts on social services, housing, and healthcare delivery.			✓
(g) Improve coordination among the police, the courts, and the public in the administration of social and healthcare services.			✓
(h) Support programs that address needs of veterans.			✓
(i) Support programs that address the needs of immigrants.			✓
Implementing Actions:			
(a) Invest in programs designed to improve the general welfare and quality of life of Native Hawaiians.			✓
(b) Assist and facilitate the State Department of Public Safety and others in efforts to strengthen programs and facilities that will improve the mental and social health of incarcerated people and assist in prison inmates' successful transition back into Maui County communities.			✓
(c) Develop and maintain a comprehensive index that will measure the health and wellness needs of families.			✓
(d) Provide heliports countywide for emergency health and safety purposes.			✓
Analysis: **Not applicable.**			
Objective:			
(3) Strengthen public-awareness programs related to healthy lifestyles and social and medical services.			✓
Policies:			
(a) Expand public awareness about personal safety and crime prevention.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
(b) Encourage residents to pursue education and training for careers in the healthcare, social services, and community-development fields.			✓
(c) Expand public awareness and promote programs to achieve healthy eating habits and drug-free lifestyles.			✓
Analysis: **Not applicable.**			
E. EXPAND HOUSING OPPORTUNITIES FOR RESIDENTS			
Goal: Quality, island-appropriate housing will be available to all residents.			✓
Objective:			
(1) Reduce the affordable housing deficit for residents.			✓
Policies:			
(a) Ensure that an adequate and permanent supply of affordable housing, both new and existing units, is made available for purchase or rental to our resident and/or workforce population, with special emphasis on providing housing for low- to moderate-income families, and ensure that all affordable housing remains affordable in perpetuity.			✓
(b) Seek innovative ways to lower housing costs without compromising the quality of our island lifestyle.			✓
(c) Seek innovative methods to secure land for the development of low- and moderate- income housing.			✓
(d) Provide the homeless population with emergency and transitional shelter and other supportive programs.			✓
(e) Provide for a range of senior-citizen and special needs housing choices on each island that affordably facilitates a continuum of care and services.			✓
(f) Support the Department of Hawaiian Home Lands' development of homestead lands.			✓
(g) Manage property-tax burdens to protect affordable resident homeownership.			✓
(h) Explore taxation mechanisms to increase and maintain access to affordable housing.			✓
(i) Improve awareness regarding available affordable homeowner's insurance.			✓
(j) Redevelop commercial areas with a mixture of affordable residential and business uses, where appropriate.			✓
(k) Ensure residents are given priority to obtain affordable housing units developed in their communities, consistent with all applicable regulations.			✓
(l) Establish pricing for affordable housing that is more reflective of Maui County's workforce than the United States Housing and Urban Development's median-income estimates for Maui County.			✓
(m) Develop neighborhoods with a mixture of accessible and integrated community facilities and services.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
(n) Provide alternative regulatory frameworks to facilitate the use of Kuleana lands by the descendants of Native Hawaiians who received those lands pursuant to the Kuleana Act of 1850.			✓
(o) Work with lending institutions to expand housing options and safeguard the financial security of homeowners.			✓
(p) Promote the use of the community land trust model and other land-lease and land- financing options.			✓
(q) Support the opportunity to age in place by providing accessible and appropriately designed residential units.			✓
Analysis: **Not applicable.**			
Objective:			
(2) Increase the mix of housing types in towns and neighborhoods to promote sustainable land use planning, expand consumer choice, and protect the County's rural and small town character.			✓
Policies:			
(a) Seek innovative ways to develop 'ohana cottages and accessory-dwelling units as affordable housing.			✓
(b) Design neighborhoods to foster interaction among neighbors.			✓
(c) Encourage a mix of social, economic, and age groups within neighborhoods.			✓
(d) Promote infill housing in urban areas at scales that capitalize on existing infrastructure, lower development costs, and are consistent with existing or desired patterns of development.			✓
(e) Encourage the building industry to use environmentally sustainable materials, technologies, and site planning.			✓
(f) Develop workforce housing in proximity to job centers and transit facilities.			✓
(g) Provide incentives to developers and owners who incorporate green building practices and energy-efficient technologies into their housing developments.			✓
Implementing Actions:			
(a) Revise laws to support neighborhood designs that incorporate a mix of housing types that are appropriate for island living.			✓
Analysis: **Not applicable.**			
Objective:			
(3) Increase and maintain the affordable housing inventory.			✓
Policies:			
(a) Recognize housing as a basic human need, and work to fulfill that need.			✓
(b) Prioritize available infrastructure capacity for affordable housing.			✓
(c) Improve communication, collaboration, and coordination among housing providers and social-service organizations.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
(d) Study future projected housing needs, monitor economic cycles, and prepare for future conditions on each island.			✓
(e) Develop public-private and nonprofit partnerships that facilitate the construction of quality affordable housing.			✓
(f) Streamline the review process for high-quality, affordable housing developments that implement the goals, objectives, and policies of the General Plan.			✓
(g) Minimize the intrusion of housing on prime, productive, and potentially productive agricultural lands and regionally valuable agricultural lands.			✓
(h) Encourage long-term residential use of existing and future housing to meet residential needs.			✓
Implementing Actions:			
(a) Develop policies to even out the peaks and valleys in Maui County's construction-demand cycles.			✓
Analysis: **Not applicable.**			
Objective:			
(4) Expand access to education related to housing options, homeownership, financing, and residential construction.			✓
Policies:			
(a) Broaden access to information about County, State, and Federal programs that provide financial assistance to renters and home buyers.			✓
(b) Expand access to information about opportunities for homeownership and self-help housing.			✓
(c) Educate residents about making housing choices that support their individual needs, the needs of their communities, and the health of the islands' natural systems.			✓
(d) Improve home buyers' education on all aspects of homeownership.			✓
Analysis: **Not applicable.**			
F. STRENGTHEN THE LOCAL ECONOMY			
Goal: Maui County's economy will be diverse, sustainable, and supportive of community values.		✓	
Objective:			
(1) Promote an economic climate that will encourage diversification of the County's economic base and a sustainable rate of economic growth.		✓	
Policies:			
(a) Support economic decisions that create long-term benefits.		✓	
(b) Promote lifelong education, career development, and technical training for existing and emerging industries.			✓
(c) Invest in infrastructure, facilities, and programs that foster economic diversification.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
(d) Support and promote locally produced products and locally owned operations and businesses that benefit local communities and meet local demand.			✓
(e) Support programs that assist industries to retain and attract more local labor and facilitate the creation of jobs that offer a living wage.			✓
(f) Encourage work environments that are safe, rewarding, and fulfilling to employees.			✓
(g) Support home-based businesses that are appropriate for and in character with the community.			✓
(h) Encourage businesses that promote the health and well-being of the residents, produce value-added products, and support community values.			✓
(i) Foster an understanding of the role of all industries in our economy.			✓
(j) Support efforts to improve conditions that foster economic vitality in our historic small towns.			✓
(k) Support and encourage traditional host-culture businesses and indigenous agricultural practices.			✓
(l) Support public and private entities that assist entrepreneurs in establishing locally operated businesses.			✓
Implementing Actions:			
(a) Develop regulations and programs that support opportunities for local merchants, farmers, and small businesses to sell their goods and services directly to the public.			✓
(b) Monitor the carrying capacity of the islands' social, ecological, and infrastructure systems with respect to the economy.			✓
Analysis: **The proposed Project is indirectly applicable to the goal, objective, and policies to strengthen the local economy. The Economic Impact Report prepared as part of the EIS process documents the economic and fiscal benefits associated with beach restoration and the loss of jobs, revenue, and taxable income under a No Action alternative.**			
Objective:			
(2) Diversify and expand sustainable forms of agriculture and aquaculture.			✓
Policies:			
(a) Support programs that position Maui County's agricultural products as premium export products.			✓
(b) Prioritize the use of agricultural land to feed the local population, and promote the use of agricultural lands for sustainable and diversified agricultural activities.			✓
(c) Capitalize on Hawai'i's economic opportunities in the ecologically sensitive aquaculture industries.			✓
(d) Assist farmers to help make Maui County more self-sufficient in food production.			✓
(e) Support ordinances, programs, and policies that keep agricultural land and water available and affordable to farmers.			✓
(f) Support a tax structure that is conducive to the growth of the agricultural economy.			✓
(g) Enhance County efforts to monitor and regulate important agricultural issues.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
(h) Support education, research, and facilities that strengthen the agricultural industry.			✓
(i) Maintain the genetic integrity of existing food crops.			✓
(j) Encourage healthy and organic farm practices that contribute to land health and regeneration.			✓
(k) Support cooperatives and other types of nontraditional communal farming and efforts.			✓
(l) Encourage methods of monitoring and controlling genetically modified crops to prevent adverse effects.			✓
(m) Work with the State to ease the permitting process for the revitalization of traditional fish ponds.			✓
Implementing Actions:			
(a) Redirect efforts in the Office of Economic Development to further facilitate the development of the agricultural section and to monitor agricultural legislation and issues.			✓
(b) Publicly identify, with signage and other means, the field locations of all genetically modified crops.			✓
(c) Create agricultural parks in areas distant from genetically modified crops.			✓
Analysis: **Not applicable.**			
Objective:			
(3) Support a visitor industry that respects the resident culture and the environment.		✓	
Policies:			
(a) Promote traditional Hawaiian practices in visitor-related facilities and activities.		✓	
(b) Encourage and educate the visitor industry to be sensitive to island lifestyles and cultural values.			✓
(c) Encourage a spirit of welcome for residents at visitor facilities, such as by offering kama‘aina incentives and discount programs.			✓
(d) Support the renovation and enhancement of existing visitor facilities.			✓
(e) Support policies, programs, and a tax structure that redirect the benefits of the visitor industry back into the local community.			✓
(f) Encourage resident ownership of visitor-related businesses and facilities.			✓
(g) Develop partnerships to provide educational and training facilities to residents employed in the visitor industry.			✓
(h) Foster an understanding of local cultures, customs, and etiquette, and emphasize the importance of the Aloha Spirit as a common good for all.		✓	
(i) Support the diversification, development, evolution, and integration of the visitor industry in a way that is compatible with the traditional, social, economic, spiritual, and environmental values of island residents			✓
(j) Improve collaboration between the visitor industry and the other sectors of Maui County’s economy.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
(k) Perpetuate an authentic image of the Hawaiian culture and history and an appropriate recognition of the host culture.			✓
(l) Support the programs and initiatives outlined in the Maui County Tourism Strategic Plan 2006-2015.			✓
(m) Promote water conservation, beach conservation, and open-space conservation in areas providing services for visitors.		✓	
(n) Recognize the important contributions that the visitor industry makes to the County's economy, and support a healthy and vibrant visitor industry.		✓	
Analysis: **The proposed Project is indirectly applicable to the goal, objectives, and policies to support a visitor industry that respects the resident culture and the environment. Restoration and protection of Honokōwai Beach will maintain shoreline and perpendicular access to the shoreline resources for the enjoyment of present and future residents and visitors.**			
Objective:			
(4) Expand economic sectors that increase living-wage job choices and are compatible with community values.			✓
Policies:			
(a) Support emerging industries, including the following: • Health and wellness industry; • Sports and recreation industry; • Film and entertainment industry; • Arts and culture industry; • Renewable-energy industry; • Research and development industry; • High-technology and knowledge-based industries; • Education and training industry; • Ecotourism industry; and • Agritourism industry.			✓
Analysis: **Not applicable.**			
G. IMPROVE PARKS AND PUBLIC FACILITIES			
Goal: A full range of island-appropriate public facilities and recreational opportunities will be provided to improve the quality of life for residents and visitors.	✓		
Objective:			
(1) Expand access to recreational opportunities and community facilities to meet the present and future needs of residents of all ages and physical abilities.	✓		
Policies:			
(a) Protect, enhance, and expand access to public shoreline and mountain resources.	✓		
(b) Expand and enhance the network of parks, multi-use paths, and bikeways.			✓
(c) Assist communities in developing recreational facilities that promote physical fitness.			✓
(d) Expand venue options for recreation and performances that enrich the lifestyles of Maui County's people.	✓		
(e) Expand affordable recreational and after-school programs for youth.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
(f) Encourage and invest in recreational, social, and leisure activities that bring people together and build community pride.			✓
(g) Promote the development and enhancement of community centers, civic spaces, and gathering places throughout our communities.			✓
(h) Expand affordable access to recreational opportunities that support the local lifestyle.	✓		
Implementing Actions:			
(a) Identify and reserve lands for cemeteries, and preserve existing cemeteries on all islands, appropriately accommodating varying cultural and, faith-based traditions.			✓
Analysis: **The proposed Project is directly applicable to the goal, objectives, and policies to improve parks and public facilities. Restoration and protection of Honokōwai Beach will continue to provide public shoreline lateral and perpendicular access to an important cultural and recreational resource. Access to the shoreline resources will expand options for recreational outdoor activities that promote physical fitness.**			
Objective:			
(2) Improve the quality and adequacy of community facilities.			✓
Policies:			
(a) Provide an adequate supply of dedicated shelters and facilities for disaster relief.			✓
(b) Provide and maintain community facilities that are appropriately designed to reflect the traditions and customs of local cultures.			✓
(c) Ensure that parks and public facilities are safe and adequately equipped for the needs of all ages and physical abilities to the extent reasonable.			✓
(d) Maintain, enhance, expand, and provide new active and passive recreational facilities in ways that preserve the natural beauty of their locations.			✓
(e) Redesign or retrofit public facilities to adapt to major shifts in environmental or urban conditions to the extent reasonable.			✓
Analysis: **Not applicable.**			
Objective:			
(3) Enhance the funding, management, and planning of public facilities and park lands.			✓
Policies:			
(a) Identify and encourage the establishment of regulated and environmentally sound campgrounds.			✓
(b) Manage park use and control access to natural resources in order to rest sensitive places and utilize the resources in a sustainable manner.			✓
(c) Provide public-recreational facilities that are clean and well-maintained.			✓
(d) Develop partnerships to ensure proper stewardship of the islands' trails, public lands, and access systems.			✓
(e) Ensure that there is an adequate supply of public restrooms in convenient locations.			✓
Implementing Actions:			
(a) Encourage the State to allow for overnight fishing along the shoreline in accordance with management plans and regulations.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
(b) Develop and regularly update functional plans, including those relating to public facilities, parks, and campgrounds.			✓
(c) Develop and adopt local level-of service standards for public facilities and parks.			✓
(d) Identify, acquire, and develop lands for parks, civic spaces, and public uses.			✓
Analysis: **Not applicable.**			
H. DIVERSIFY TRANSPORTATION OPTIONS			
Goal: Maui County will have an efficient, economical, and environmentally sensitive means of moving people and goods.			✓
Objective:			
(1) Provide an effective, affordable, and convenient ground-transportation system that is environmentally sustainable.			✓
Policies:			
(a) Execute planning strategies to reduce traffic congestion.			✓
(b) Plan for the efficient relocation of roadways for the public benefit.			✓
(c) Support the use of alternative roadway designs, such as traffic-calming techniques and modern roundabouts.			✓
(d) Increase route and mode options in the ground-transportation network.			✓
(e) Ensure that roadway systems are safe, efficient, and maintained in good condition.			✓
(f) Preserve roadway corridors that have historic, scenic, or unique physical attributes that enhance the character and scenic resources of communities.			✓
(g) Design new roads and roadway improvements to retain and enhance the existing character and scenic resources of the communities through which they pass.			✓
(h) Promote a variety of affordable and convenient transportation services that meet countywide and community needs and expand ridership of transit systems.			✓
(i) Collaborate with transit agencies, government agencies, employers, and operators to provide planning strategies that reduce peak-hour traffic.			✓
(j) Develop and expand an attractive, island-appropriate, and efficient public transportation system.			✓
(k) Provide and encourage the development of specialized transportation options for the young, the elderly, and persons with disabilities.			✓
(l) Evaluate all alternatives to preserve quality of life before widening roads.			✓
(m) Encourage businesses in the promotion of alternative transportation options for resident and visitor use.			✓
(n) Support the development of carbon-emission standards and an incentive program aimed at achieving County carbon-emission goals.			✓
Implementing Actions:			
(a) Create incentives and implement strategies to reduce visitor dependence on rental cars.			✓
(b) Establish efficient public-transit routes between employment centers and primary workforce residential areas.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
(c) Create attractive, island-appropriate, conveniently located park-and-ride and ride- share facilities.			✓
Analysis: **Not applicable.**			
Objective:			
(2) Reduce the reliance on the automobile and fossil fuels by encouraging walking, bicycling, and other energy-efficient and safe alternative modes of transportation.			✓
Policies:			
(a) Make walking and bicycling transportation safe and easy between and within communities.			✓
(b) Require development to be designed with the pedestrian in mind.			✓
(c) Design new and retrofit existing rights-of-way with adequate sidewalks, bicycle lanes, or separated multi-use transit corridors.			✓
(d) Support the development of a countywide network of bikeways, equestrian trails, and pedestrian paths.			✓
(e) Support the reestablishment of traditional trails between communities, to the ocean, and through the mountains for public use.			✓
(f) Encourage educational programs to increase safety for pedestrians and bicyclists.			✓
Implementing Actions:			
(a) Design, build, and modify existing bikeways to improve safety and separation from automobiles.			✓
(b) Increase enforcement to reduce abuse of bicycle and pedestrian lanes by motorized vehicles.			✓
(c) Identify non-motorized transportation options as a priority for new sources of funding.			✓
Analysis: **Not applicable.**			
Objective:			
(3) Improve opportunities for affordable, efficient, safe, and reliable air transportation.			✓
Policies:			
(a) Discourage private helicopter and fixed-wing landing sites to mitigate environmental and social impacts.			✓
(b) Encourage the use of quieter aircraft and noise-abatement procedures for arrivals and departures.			✓
(c) Encourage the modernization and maintenance of air-transportation facilities for general-aviation activities.			✓
(d) Encourage a viable and competitive atmosphere for air carriers to expand service and ensure sufficient intra-County flights and affordable fares for consumers.			✓
(e) Continue to support secondary airports, and encourage the State to provide them with adequate funding.			✓
(f) During Community Plan updates, explore the use of the smaller airports.			✓
(g) Encourage the State to provide efficient, adequate, and affordable parking and transit connections within and around airports.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
Analysis: **Not applicable.**			
Objective:			
(4) Improve opportunities for affordable, efficient, safe, and reliable ocean transportation.			✓
Policies:			
(a) Support programs and regulations that reduce the disposal of maritime waste and prevent spills into the ocean.			✓
(b) Encourage the upgrading of harbors to resist damage from natural hazards and disasters.			✓
(c) Encourage the State to study the use of existing harbors and set priorities for future use.			✓
(d) Explore all options to protect the traditional recreational uses of harbors, and mitigate harbor-upgrade impacts to recreational uses where feasible.			✓
(e) Encourage the upgrading of harbors and the separation of cargo and bulk materials from passenger and recreational uses.			✓
(f) Encourage the State to provide for improved capacity at shipping, docking, and storage facilities.			✓
(g) Encourage the State to provide adequate parking facilities and transit connections within and around harbor areas.			✓
(h) Encourage the redevelopment and revitalization of harbors while preserving historic and cultural assets in harbor districts.			✓
(i) Encourage the State to provide adequate facilities for small-boat operations, including small-boat launch ramps, according to community needs.			✓
(j) Support the maintenance and cleanliness of harbor facilities.			✓
(k) Support the redevelopment of harbors as pedestrian-oriented gathering places.			✓
Analysis: **Not applicable.**			
Objective:			
(5) Improve and expand the planning and management of transportation systems.			✓
Policies:			
(a) Encourage progressive community design and development that will reduce transportation trips.			✓
(b) Require new developments to contribute their pro rata share of local and regional infrastructure costs.			✓
(c) Establish appropriate user fees for private enterprises that utilize public transportation facilities for recreational purposes.			✓
(d) Support the revision of roadway-design criteria and standards so that roads are compatible with surrounding neighborhoods and the character of rural areas.			✓
(e) Plan for multi-modal transportation and utility corridors on each island.			✓
(f) Support designing all transportation facilities, including airport, harbor, and mass- transit stations, to reflect Hawaiian architecture.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
(g) Utilize transportation-demand management as an integral part of transportation planning.			✓
(h) Accommodate the planting of street trees and other appropriate landscaping in all public rights-of-way.			✓
Analysis: **Not applicable.**			
I. IMPROVE PHYSICAL INFRASTRUCTURE			
Goal: Maui County's physical infrastructure will be maintained in optimum condition and will provide for and effectively serve the needs of the County through clean and sustainable technologies.			✓
Objective:			
(1) Improve water systems to assure access to sustainable, clean, reliable, and affordable sources of water.			✓
Policies:			
(a) Ensure that adequate supplies of water are available prior to approval of subdivision or construction documents.			✓
(b) Develop and fund improved water-delivery systems.			✓
(c) Ensure a reliable and affordable supply of water for productive agricultural uses.			✓
(d) Promote the reclamation of gray water, and enable the use of reclaimed, gray, and brackish water for activities that do not require potable water.			✓
(e) Retain and expand public control and ownership of water resources and delivery systems.			✓
(f) Improve the management of water systems so that surface-water and groundwater resources are not degraded by overuse or pollution.			✓
(g) Explore and promote alternative water-source-development methods.			✓
(h) Seek reliable long-term sources of water to serve developments that achieve consistency with the appropriate Community Plans.			✓
Implementing Actions:			
(a) Develop a process to review all applications for desalination.			✓
Analysis: **Not applicable.**			
Objective:			
(2) Improve waste-disposal practices and systems to be efficient, safe, and as environmentally sound as possible.			✓
Policies:			
(a) Provide sustainable waste-disposal systems and comprehensive, convenient recycling programs to reduce the flow of waste into landfills.			✓
(b) Support innovative and alternative practices in recycling solid waste and wastewater and disposing of hazardous waste.			✓
(c) Encourage vendors and owners of automobile, appliance, and white goods to participate in the safe disposal and recycling of such goods, and ensure greater accountability for large waste producers.			✓
(d) Develop strategies to promote public awareness to reduce pollution and litter, and encourage residents to reduce, reuse, recycle, and compost waste materials.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
(e) Pursue improvements and upgrades to existing wastewater and solid-waste systems consistent with current and future plans and the County's Capital Improvement Program.			✓
Implementing Actions:			
(a) Establish recycling, trash-separation, and materials recovery programs and facilities to reduce the flow of waste into landfills.			✓
(b) Study the feasibility of developing environmentally safe waste-to-energy facilities.			✓
(c) Utilize taxes and fees as means to encourage conservation and recycling.			✓
(d) Implement and regularly update the Integrated Solid Waste Management Plan.			✓
(e) Phase out the use of injection wells.			✓
Analysis: **Not applicable.**			
Objective:			
(3) Significantly increase the use of renewable and green technologies to promote energy efficiency and energy self-sufficiency.			✓
Policies:			
(a) Promote the use of locally renewable energy sources, and reward energy efficiency.			✓
(b) Consider tax incentives and credits for the development of sustainable- and renewable-energy sources.			✓
(c) Expand education about energy conservation and self-sufficiency.			✓
(d) Encourage small-scale energy generation that utilizes wind, sun, water, biowaste, and other renewable sources of energy.			✓
(e) Expand renewable-energy production.			✓
(f) Develop public-private partnerships to ensure the use of renewable energy and increase energy efficiency.			✓
(g) Require the incorporation of locally appropriate energy-saving and green building design concepts in all new developments by providing energy efficient urban design guidelines and amendments to the Building Code.			✓
(h) Encourage the use of sustainable energy to power vehicles.			✓
(i) Promote the retrofitting of existing buildings and new development to incorporate energy-saving design concepts and devices.			✓
(j) Encourage green footprint practices.			✓
(k) Reduce Maui County's dependence on fossil fuels and energy imports.			✓
(l) Support green building practices such as the construction of buildings that aim to minimize carbon dioxide production, produce renewable energy, and recycle water.			✓
(m) Promote and support environmentally friendly practices in all energy sectors.			✓
Implementing Actions:			
(a) Adopt an energy-efficiency policy for Maui County government as a model for other jurisdictions.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
(b) Adopt a Green Building Code, and support green building practices.			✓
Analysis: **Not applicable.**			
Objective:			
(4) Direct growth in a way that makes efficient use of existing infrastructure and to areas where there is available infrastructure capacity.			✓
Policies:			
(a) Capitalize on existing infrastructure capacity as a priority over infrastructure expansion.			✓
(b) Planning for new towns should only be considered if a region's growth is too large to be directed into infill and adjacent growth areas.			✓
(c) Utilize appropriate infrastructure technologies in the appropriate locations.			✓
(d) Promote land use patterns that can be provided with infrastructure and public facilities in a cost-effective manner.			✓
(e) Support catchment systems and on-site wastewater treatment in rural areas and aggregated water and wastewater systems in urban areas if they are appropriately located.			✓
Implementing Actions:			
(a) Develop a streamlining system for urban infill projects.			✓
(b) Identify appropriate areas for urban expansion of existing towns where infrastructure and public facilities can be provided in a cost-effective manner.			✓
Analysis: **Not applicable.**			
Objective:			
(5) Improve the planning and management of infrastructure systems.			✓
Policies:			
(a) Provide a reliable and sufficient level of funding to enhance and maintain infrastructure systems.			✓
(b) Require new developments to contribute their pro rata share of local and regional infrastructure costs.			✓
(c) Improve coordination among infrastructure providers and planning agencies to minimize construction impacts.			✓
(d) Maintain inventories of infrastructure capacity, and project future infrastructure needs.			✓
(e) Require social-justice and -equity issues to be considered during the infrastructure-planning process.			✓
(f) Discourage the development of critical infrastructure systems within hazard zones and the tsunami-inundation zone to the extent practical.			✓
(g) Ensure that infrastructure is built concurrent with or prior to development.			✓
(h) Ensure that basic infrastructure needs can be met during a disaster.			✓
(i) Locate public facilities and emergency services in appropriate locations that support the health, safety, and welfare of each community and that minimize delivery inefficiencies.			✓
(j) Promote the undergrounding of utility and other distribution lines for health safety, and aesthetic reasons.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
Implementing Actions:			
(a) Develop and regularly update functional plans for infrastructure systems.			✓
(b) Develop, adopt, and regularly update local or community-sensitive level-of service standards for infrastructure systems.			✓
Analysis: **Not applicable.**			
J. PROMOTE SUSTAINABLE LAND USE AND GROWTH MANAGEMENT			
Goal: Community character, lifestyles, economies, and natural assets will be preserved by managing growth and using land in a sustainable manner.	✓		
Objective:			
(1) Improve land use management and implement a directed-growth strategy.	✓		
Policies:			
(a) Establish, map, and enforce urban- and rural-growth limits.			✓
(b) Direct urban and rural growth to designated areas.			✓
(c) Limit the number of visitor-accommodation units and facilities in Community Plan Areas.			✓
(d) Maintain a sustainable balance between the resident, part-time resident, and visitor populations.			✓
(e) Encourage redevelopment and infill in existing communities on lands intended for urban use to protect productive farm land and open-space resources.			✓
(f) Discourage new entitlements for residential, resort, or commercial development along the shoreline.			✓
(g) Restrict development in areas that are prone to natural hazards, disasters, or sea-level rise.			✓
(h) Direct new development in and around communities with existing infrastructure and service capacity, and protect natural, scenic, shoreline, and cultural resources.	✓		
(i) Establish and maintain permanent open space between communities to protect each community's identity.			✓
(j) Support the dedication of land for public uses.			✓
(k) Preserve the public's rights of access to and continuous lateral access along all shorelines.	✓		
(l) Enable existing and future communities to be self-sufficient through sustainable land use planning and management practices.			✓
(m) Protect summits, slopes, and ridgelines from inappropriate development.			✓
Implementing Actions:			
(a) Regularly update urban- and rural-growth boundaries and their maps.			✓
(b) Establish transfer and purchase of development rights programs.			✓
(c) Develop and adopt a green infrastructure plan.			✓
(d) Develop studies to help determine a sustainable social, environmental, and economic carrying capacity for each island.			✓
(e) Identify and define resort-destination areas.	✓		

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
Analysis: **The proposed Project is directly applicable to the goals, objectives, and policies to promote sustainable land use and growth management. The beach restoration project improves land use management and restoration of a natural feature that was severely eroded in 2016. The restoration of Honokōwai Beach will ensure lateral and perpendicular shoreline access for present and future generations.**			
Objective:			
(2) Improve planning for and management of agricultural lands and rural areas.			✓
Policies:			
(a) Protect prime, productive, and potentially productive agricultural lands to maintain the islands' agricultural and rural identities and economies.			✓
(b) Provide opportunities and incentives for self-sufficient and subsistence homesteads and farms.			✓
(c) Discourage developing or subdividing agriculturally designated lands when non- agricultural activities would be primary uses.			✓
(d) Conduct agricultural-development planning to facilitate robust and sustainable agricultural activities.			✓
Implementing Actions:			
(a) Inventory and protect prime, productive, and potentially productive agricultural lands from competing non-agricultural land uses.			✓
Analysis: **Not applicable.**			
Objective:			
(3) Design all developments to be in harmony with the environment and to protect each community's sense of place.	✓		
Policies:			
(a) Support and provide incentives for green building practices.			✓
(b) Encourage the incorporation of green building practices and technologies into all government facilities to the extent practicable.			✓
(c) Protect and enhance the unique architectural and landscape characteristics of each Community Plan Area, small town, and neighborhood.			✓
(d) Ensure that adequate recreational areas, open spaces, and public-gathering places are provided and maintained in all urban centers and neighborhoods.	✓		
(e) Ensure business districts are distinctive, attractive, and pedestrian-friendly destinations.			✓
(f) Use trees and other forms of landscaping along rights-of-way and within parking lots to provide shade, beauty, urban-heat reduction, and separation of pedestrians from automobile traffic in accordance with community desires.			✓
(g) Where appropriate, integrate public-transit, equestrian, pedestrian, and bicycle facilities, and public rights-of-way as design elements in new and existing communities.			✓
(h) Ensure better connectivity and linkages between land uses.	✓		
(i) Adequately buffer and mitigate noise and air pollution in mixed-use areas to maintain residential quality of life.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
(j) Protect rural communities and traditional small towns by regulating the footprint, locations, site planning, and design of structures.			✓
(k) Support small-town revitalization and preservation.			✓
(l) Facilitate safe pedestrian access, and create linkages between destinations and within parking areas.	✓		
Implementing Actions:			
(a) Establish design guidelines and standards to enhance urban and rural environments.			✓
(b) Provide funding for civic-center and civic-space developments.			✓
(c) Establish and enhance urban forests in neighborhoods and business districts.			✓
Analysis: **The proposed Project involves beach restoration and preservation and is directly applicable to the objective and policies to design all developments to be in harmony with the environment and to protect the community's sense of place. An EIS is being prepared to assess the impacts of the project and to ensure the development will be in harmony with the environment. By preserving the beach, the proposed Project will maintain and preserve an important recreational resource in the Honokōwai area. Restoration of the beach will ensure better connectivity and linkages between upland land uses and the shoreline.**			
Objective:			
(4) Improve and increase efficiency in land use planning and management.	✓		
Policies:			
(a) Assess the cumulative impact of developments on natural ecosystems, natural resources, wildlife habitat, and surrounding uses.	✓		
(b) Ensure that new development projects requiring discretionary permits demonstrate a community need, show consistency with the General Plan, and provide an analysis of impacts.	✓		
(c) Encourage public and private partnerships to preserve lands of importance, develop housing, and meet the needs of residents.			✓
(d) Promote creative subdivision designs that implement best practices in land development, sustainable management of natural and physical resources, increased pedestrian and bicycle functionality and safety, and the principles of livable communities.			✓
(e) Coordinate with Federal, State, and County officials in order to ensure that land use decisions are consistent with County plans and the vision local populations have for their communities.			✓
(f) Enable greater public participation in the review of subdivisions.			✓
(g) Improve land use decision making through the use of land- and geographic information systems.			✓
Implementing Actions:			
(a) Institute a time limit and sunsetting stipulations on development entitlements and their implementation.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
Analysis: **The proposed Project involves beach restoration and preservation and is directly applicable to the objective and policies to improve and increase the efficiency in land use planning and management. An EIS is being prepared to assess the direct, secondary, and cumulative impacts of the proposed action and assesses consistency with the County General Plan.**			
K. STRIVE FOR GOOD GOVERNANCE			
Goal: Government services will be transparent, effective, efficient, and responsive to the needs of residents.			✓
Objective:			
(1) Strengthen governmental planning, coordination, consensus building, and decision making.			✓
Policies:			
(a) Plan and prepare for the effects of social, demographic, economic, and environmental shifts.			✓
(b) Plan for and address the possible implications of Hawaiian sovereignty.			✓
(c) Encourage collaboration among government agencies to reduce duplication of efforts and promote information availability and exchange.			✓
(d) Expand opportunities for the County to be involved in and affect State and Federal decision making.			✓
(e) Plan and prepare for large-scale emergencies and contingencies.			✓
(f) Improve public awareness about preparing for natural hazards, disasters, and evacuation plans.			✓
(g) Improve coordination among Federal, State, and County agencies.			✓
Implementing Actions:			
(a) Develop policies, regulations, and programs to protect and enhance the unique character and needs of the County's various communities.			✓
(b) Evaluate and if necessary, recommend modifications to the County Charter that could result in a possible change to the form of governance for Maui County.			✓
(c) Study and evaluate the feasibility and implications of voting in Maui County Council elections.			✓
(d) Study and evaluate the feasibility of authorizing town governments in Maui County.			✓
Analysis: **Not applicable.**			
Objective:			
(2) Promote civic engagement.		✓	
Policies:			
(a) Foster consensus building through in-depth, innovative, and accessible public participatory processes.			✓
(b) Promote and ensure public participation and equal access to government among all citizens.			✓
(c) Encourage a broad cross-section of residents to volunteer on boards and commissions.			✓
(d) Encourage the State to improve its community-involvement processes.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
(e) Support community-based decision making.			✓
(f) Expand advisory functions at the community level.			✓
(g) Expand opportunities for all members of the public to participate in public meetings and forums.		✓	
(h) Facilitate the community's ability to obtain relevant documentation.		✓	
(i) Increase voter registration and turnout.			✓
Implementing Actions:			
(a) Implement two-way communication using audio-visual technology that allows residents to participate in the County's planning processes.			✓
(b) Ensure and expand the use of online notification of County business and public meetings, and ensure the posting of all County board and commission meeting minutes.			✓
(c) Explore funding mechanisms to improve participation by volunteers on boards and commissions.			✓
(d) Develop a project-review process that mandates early and ongoing consultation in and with communities affected by planning and land use activities.			✓
Analysis: **The proposed Project involves beach restoration and preservation and is indirectly applicable to the objectives and policies to improve opportunities to promote civic engagement. The proposed Project is undergoing an EIS process and will require various land use permits. Review of the EIS and land use permits will allow for civic engagement and public comments. The Applicant has conducted a number of public and stakeholder meeting to obtain early and ongoing consultation on the proposed Project.**			
Objective:			
(3) Improve the efficiency, reliability, and transparency of County government's internal processes and decision making.			✓
Policies:			
(a) Use advanced technology to improve efficiency.			✓
(b) Simplify and clarify the permitting process to provide uniformity, reliability, efficiency, and transparency.			✓
(c) Improve communication with Lanaʻi and Molokaʻi through the expanded use of information technologies, expanded staffing, and the creation and expansion of government-service centers.			✓
(d) Ensure that laws, policies, and regulations are internally consistent and effectuate the intent of the General Plan.			✓
Implementing Actions:			
(a) Update the County Code to be consistent with the General Plan.			✓
(b) Identify and update County regulations and procedures to increase the productivity and efficiency of County government.			✓
(c) Develop local level-of-service standards for infrastructure, public facilities, and services.			✓
(d) Implement plans through programs, regulations, and capital improvements in a timely manner.			✓
(e) Expand government online services.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
Analysis: **Not applicable.**			
Objective:			
(4) Adequately fund in order to effectively administer, implement, and enforce the General Plan.		✓	
Policies:			
(a) Adequately fund, staff, and support the timely update and implementation of planning policy, programs, functional plans, and enforcement activities.			✓
(b) Ensure that the County's General Plan process provides for efficient planning at the County, island, town, and neighborhood level.			✓
(c) Encourage ongoing professional development, education, and training of County employees.			✓
(d) Encourage competitive compensation packages for County employees to attract and retain County personnel.			✓
(e) Enable the County government to be more responsive in implementing our General Plan and Community Plans.			✓
(f) Review discretionary permits for compliance with the Countywide Policy Plan.		✓	
(g) Strengthen the enforcement of County, State, and Federal land use laws.			✓
Implementing Actions:			
(a) Establish penalties to ensure compliance with County, State, and Federal land use laws.			✓
Analysis: **The proposed Project involves beach restoration and preservation and is indirectly applicable to the objectives and policies to implement and enforce the General Plan. The proposed Project has been assessed for compliance with the General Plan and Countywide Policy Plan.**			
Objective:			
(5) Strive for County government to be a role model for implementing cultural and environmental policies and practices.			✓
Policies:			
(a) Educate residents on the benefits of sustainable practices.			✓
(b) Encourage the retention and hiring of qualified professionals who can improve cultural and environmental practices.			✓
(c) Incorporate environmentally sound and culturally appropriate practices in government operations and services.			✓
(d) Encourage all vendors with County contracts to incorporate environmentally sound and culturally appropriate practices.			✓
Analysis: **Not applicable.**			
L. MITIGATE CLIMATE CHANGE AND WORK TOWARD RESILIENCE			
Goal: Minimize the causes and negative effects of climate change.	✓		
Objective:			
(1) Lower carbon emissions levels to mitigate climate change impacts and limit the rate of global warming.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
Policies:			
(a) Increase reforestation efforts by encouraging residents and visitors to plant non-invasive gardens and trees.			✓
(b) Improve communication, coordination, and collaboration among those that work to mitigate climate change impacts.	✓		
(c) Promote the teaching and use of regenerative agriculture.			✓
(d) Invest in infrastructure that is not dependent on fossil fuels and utilizes renewable energy.			✓
(e) Improve efforts to mitigate and plan for the impact of natural disasters and global warming.	✓		
(f) Encourage the building industry to use environmentally sustainable materials, technology, and site planning.			✓
(g) Reduce air, noise, light, land, and water pollution, and reduce Maui County's contribution to global climate change.			✓
(h) Plan and prepare for and educate visitors and residents about the possible effects of global warming.	✓		
(i) Promote programs and incentives that decrease greenhouse-gas emissions and improve environmental stewardship.			✓
(j) Support the development of carbon-emission standards and an incentive program aimed at achieving County carbon-emission goals.			✓
Implementing Actions:			
(a) Implement Federal and State policies that require a reduction of greenhouse-gas emissions.			✓
(b) Establish a Countywide Climate Action Plan			✓
(c) Develop programs that assist residents and businesses with obtaining access to renewable energy sources.			✓
(d) Revise laws to support neighborhood designs that incorporate the use of renewable energy sources that are appropriate for island living.			✓
(e) Incorporate planting of native and indigenous trees as a major component of Urban Design to both cool neighborhoods and reduce carbon dioxide.			✓
(f) Coordinate with State, County, and private landowners in the development of forestry and prioritizing of native and indigenous trees to reduce carbon dioxide.			✓
(g) Strongly support efforts to restore and improve Maui County's watersheds for the purpose of improving the water supply, controlling carbon dioxide levels, decreasing soil runoff, and reducing coastal flooding.			✓
Analysis: **The proposed Project involves beach restoration and preservation of Honokōwai Beach and is directly applicable to the objective and policies to minimize the negative effects of climate change. The proposed Project will increase resiliency to coastal hazards and sea level rise and enable planning for long-term adaptation to sea level rise.**			
Objective:			
(2) Reduce the impacts of sea-level rise by acknowledging climate change, adapting, mitigating, and planning accordingly.	✓		
Policies:			
(a) Evaluate development to assess potential short-term and long-term sea-level rise impacts on nearshore environments.	✓		

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
(b) Improve efforts to mitigate and plan for the impact of sea-level rise.	✓		
(c) Protect undeveloped beaches, dunes, and ecosystems, and restore natural shoreline processes.	✓		
(d) Develop an inventory of private wastewater systems (septic systems, cesspools) that may be affected by sea-level rise.			✓
(e) Strengthen coastal-zone management, re-naturalization of shorelines, where possible, and filtration or treatment of urban and agricultural runoff.	✓		
(f) Educate the construction and landscape industries and property owners about the use of best management practices to prevent erosion and nonpoint source pollution.			✓
(g) Discourage beach hardening processes such as building sea walls and revetments that block movement of the shoreline and can accelerate erosion.	✓		
(h) Discourage new entitlements for residential, resort, or commercial development along the shoreline.			✓
(i) Restrict development in areas that are prone to sea-level rise.			✓
(j) Move or rebuild public facilities away from nearshore environments to account for sea-level rise to the extent reasonable.			✓
(k) Move or rebuild roads that are in sea-level rise inundation zones to the extent reasonable.			✓
(l) Ensure that public or affordable housing projects include siting and design standards that promote equity and resilience for vulnerable populations.			✓
(m) Identify, research, and evaluate innovative and sustainable financing to support mitigation and adaptation to sea level rise.			✓
<u>Implementing Actions</u>:			
(a) Develop programs to help transition shoreline property owners out of their nearshore locations and develop a long-term plan to stay out of the way of natural beach migration.			✓
(b) Identify buildings, roads, and other infrastructure that are in sea-level rise inundation zones and assist in adaptive efforts, including nature-based solutions, elevation, or moving them away from such zones.	✓		
(c) Identify disaster redevelopment alternatives that support resilience-focused adaptation to sea level rise in the event of a catastrophic coastal event.	✓		
Analysis: **The proposed Project is directly applicable to the objective and policies to reduce the impacts of sea level rise by acknowledging climate change, adapting, mitigating, and planning accordingly. The Project will restore Honokōwai Beach and increase resiliency to climate change and sea level rise while enabling long-term adaptation solutions.**			
<u>Objective</u>:			
(3) Significantly increase the use of renewable and green technologies to. promote energy efficiency and energy self-sufficiency.			✓
<u>Policies</u>:			
(a) Promote the use of locally renewable energy sources, and reward energy efficiency.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
(b) Consider tax incentives and credits for the development of sustainable- and renewable-energy sources.			✓
(c) Expand education about energy conservation and self-sufficiency.			✓
(d) Encourage small-scale energy generation that utilizes wind, sun, water, biowaste, and other renewable sources of energy.			✓
(e) Expand renewable-energy production.			✓
(f) Develop public-private partnerships to ensure the use of renewable energy and increase energy efficiency.			✓
(g) Require the incorporation of locally appropriate energy-saving and green building design concepts in all new developments by providing energy-efficient urban design guidelines and amendments to the Building Code.			✓
(h) Encourage the use of sustainable energy to power vehicles.			✓
(i) Promote the retrofitting of existing buildings and new development to incorporate energy-saving design concepts and devices.			✓
(j) Encourage green footprint practices.			✓
(k) Reduce Maui County's dependence on fossil fuels and energy imports.			✓
(l) Support green building practices such as the construction of buildings that aim to minimize carbon dioxide production, produce renewable energy, and recycle water.			✓
(m) Promote and support environmentally friendly practices in all energy sectors.			✓
Implementing Actions:			
(a) Adopt an energy-efficiency policy for Maui County government as a model for other jurisdictions.			✓
(b) Adopt a Green Building Code and support green building practices.			✓
Analysis: **Not applicable.**			

ANALYSIS OF PROJECT APPLICABILITY TO MAUI ISLAND PLAN

APPENDIX L-3

APPENDIX L-3

Analysis of Project Applicability to Maui Island Plan

The Maui Island Plan (MIP) is applicable to the island of Maui only, providing more specific policy-based strategies for population, land use, transportation, public and community facilities, water and wastewater systems, visitor destinations, urban design, and other matters related to future growth.

As provided by Chapter 2.80B, the MIP shall include the following components:

1. *An island-wide land use strategy, including a managed and directed growth plan*

2. *A water element assessing supply, demand and quality parameters*

3. *A nearshore ecosystem element assessing nearshore waters and requirements for preservation and restoration*

4. *An implementation program which addresses the County's 20-year capital improvement requirements, financial program for implementation, and action implementation schedule*

5. *Milestone indicators designed to measure implementation progress of the MIP*

It is noted that Ordinance No. 4004 does not address the component relating to the implementation program. Chapter 2.80B of the Maui County Code, relating to the General Plan, was amended via Ordinance No. 3979, October 5, 2012, to provide that the implementation program component be adopted no later than one (1) year following the effective date of Ordinance No. 4004. In December 2013 and March 2014, the Council approved time extensions for approval and adoption of the implementation chapter of the MIP. The implementation program component of the MIP was adopted as Ordinance No. 4126 on May 29, 2014.

The MIP addresses a number of planning categories with detailed policy analysis and recommendations which are framed in terms of goals, objectives, policies and implementing actions. These planning categories address the following areas:

1. *Population*
2. *Heritage Resources*
3. *Natural Hazards*
4. *Economic Development*
5. *Housing*
6. *Infrastructure and Public Facilities*
7. *Land Use*

The proposed Project has been reviewed with respect to pertinent goals, objectives, policies and implementing actions of the MIP. The analysis is presented in the table below.

The methodology used for assessing a project's relationship to the MIP involves examining the project's applicability to the Plan's goals, objectives, and policies. "Applicability" refers to a project's need, purpose and effects, and how these advance or promote a particular set of goals, objectives and priority guidelines. In assessing the relationship between a proposed action and the MIP, an action may be categorized in one of the following groups:

1. **Directly applicable:** the action and its potential effects directly advance or promote the objective, policy or priority guideline.

   Example: Using a county project to develop a new water source and related transmission facilities as an example, a project of this nature would be directly applicable to the MIP's Objective 6.3.2, which states: *"Increase the efficiency and capacity of the water systems in striving to meet the needs and balance the island's water needs".* As well, this action would directly advance the MIP's Policy 6.3.2.f, which states: "*Acquire and develop additional sources of potable water".* The need, purpose and effects of the proposed new water source project is directly applicable to the foregoing objective and policy.

2. **Indirectly applicable:** the action's potential effects indirectly support or advance the objective, policy or priority guideline.

   Example: The county water source project cited above supports the MIP's Objective 7.3.2 which states: *"Facilitate more self-sufficient and sustainable communities".* Additionally, this kind of action is indirectly applicable to the related MIP Policy 7.3.2.f, which states: *"Facilitate the development of housing by focusing projects in locations where land and infrastructure costs facilitate the development of affordably-priced housing".* In this case, the principle purpose of the project was not to specifically facilitate the development of affordably-priced housing. However, the project's contribution to adequate infrastructure systems is supportive of the policy. In this instance, the proposed action may be deemed to be indirectly applicable to the objective and policy of the MIP.

3. **Not applicable:** The action and its potential effects have no direct or indirect relationship to the objectives and policies of the Maui Island Plan.

   Example: That same county water source improvement project referenced above, may not have direct or indirect linkage to the MIP's Objective 4.2.1, which states: *"Increase the economic contribution of the visitor industry to the island's environmental well-being for the island's residents' quality of life"*. In this case, there is no reasonably deduced direct or indirect relationship between the proposed action and Objective 4.2.1. Hence, the proposed action would be considered not applicable to the objective.

In general, a proposed action's applicability to the MIP is assessed on the basis of the action's direct or indirect relationship to the respective objectives, policies and implementing actions. It is recognized that the categorization of "applicability" is subject to interpretation and should be appropriately considered in the context of local and regional conditions.

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
CHAPTER 1 – POPULATION			
Goal:			
1.1 Maui's people, values, and lifestyles thrive through strong, healthy, and vibrant island communities.			✓
Objective:			
1.1.1 Greater retention and return of island residents by providing viable work, education, and lifestyle options.			✓
Policies:			
1.1.1.a Expand programs that enable the community to meet the education, employment, housing, and social goals of youth and young adults.			✓
1.1.1.b Expand housing, transportation, employment, and social opportunities to ensure residents are able to comfortably age within their communities.			✓
1.1.1.c Measure and track resident satisfaction through surveys and community indicators.			✓
1.1.1.d Support funding for transportation, housing, health care, recreation, and social service programs that help those with special needs (including the elderly and disabled).			✓
Analysis: **Not applicable.**			
CHAPTER 2 – HERITAGE RESOURCES			
CULTURAL, HISTORICAL, AND ARCHAEOLOGICAL RESOURCES ISSUES			
Goal:			
2.1 Our community respects and protects archaeological and cultural resources while perpetuating diverse cultural identities and traditions.	✓		
Objective:			
2.1.1 An island culture and lifestyle that is healthy and vibrant as measured by the ability of residents to live on Maui, access and enjoy the natural environment, and practice Hawaiian customs and traditions in accordance with Article XII, Section 7, Hawai'i State Constitution, and Section 7-1, Hawai`i Revised Statutes (HRS).	✓		
Policies:			
2.1.1.a Perpetuate the spirit of aloha and celebrate the host Hawaiian culture and other ethnic cultures.			✓
2.1.1.b Perpetuate a respect for diversity and recognize the broad blending of cultures and ethnicities as vital to the quality of life on Maui.			✓

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
2.1.1.c Ensure traditional public access routes, including native Hawaiian trails, are maintained for public use.	✓		
2.1.1.d Support the education of visitors and new residents about the customs and etiquette of the Hawaiian culture, as well as other cultures.			✓
Objective:			
2.1.2 A more effective and efficient planning and review process that incorporates the best available cultural resources inventory, protection techniques, and preservation strategies.	✓		
Policies:			
2.1.2.a Ensure that the island has a comprehensive and up-to-date inventory of historic and archaeological resources, and their cultural significance.		✓	
2.1.2.b Require the update of existing planning and regulatory mechanisms to protect the natural, cultural, scenic, and historic resources within designated Heritage Areas (see Cultural Resources Overlay/Scenic Corridor Protection Technical Reference Map).			✓
2.1.2.c Ensure that cultural, historic, and archaeological resources are protected for the benefit of present and future generations.	✓		
Objective:			
2.1.3 Enhance the island's historic, archaeological, and cultural resources.	✓		
Policies:			
2.1.3.a Identify and pursue a listing of the properties and sites on the State and National Register of Historic Places.			✓
2.1.3.b Support the use of easements, dedications, and other mechanisms to acquire, maintain, and protect lands with cultural, archaeological, and historic significance.			✓
2.1.3.c Support regulations to require developers, when appropriate, to prepare an Archaeological Inventory Survey, Cultural Impact Assessment, and Ethnographic Inventories that are reviewed and commented upon by the Office of Hawaiian Affairs, Native Hawaiian advisory bodies, the State Historic Preservation Division (SHPD), and the Office of Environmental Quality Control, and systematically comply with the steps listed in SHPD's administrative rules, including consultation and monitoring during construction phases of projects.	✓		
2.1.3.d Promote the rehabilitation and adaptive reuse of historic sites, buildings, and structures.			✓
2.1.3.e Encourage property owners to register historic and archaeological sites on the State and National Register.			✓
2.1.3.f Support opportunities for public involvement with the intent to facilitate the protection and restoration of historic and archeological sites, including consultation with stakeholders.	✓		
2.1.3.g Encourage the resolution of land title questions relating to Land Commission Awards and Royal patents.			✓
2.1.3.h Ensure compliance with historic preservation laws, and discourage demolition of properties that are determined to be eligible for listing on the National or State Register of Historic Places.	✓		

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
Analysis: **The proposed Project is directly applicable to the objectives and policies that incorporate the best available cultural resources inventory, protection techniques, and preservation strategies. A LRFI and CIA for the proposed Project were prepared by professionals in their field. The proposed Project will comply with HRS, Chapter 6E historic preservation laws. The restoration of Honokōwai Beach will preserve lateral and perpendicular access to the shoreline and coastal resources.**			
SHORELINE, REEFS, AND NEARSHORE WATERS			
Goal:			
2.2 An intact, ecologically functional system of reef, shoreline, and nearshore waters that are protected in perpetuity.	✓		
Objective:			
2.2.1 A more comprehensive and community-based ICZM program.	✓		
Policies:			
2.2.1.a Encourage a management system that protects and temporarily rests the reef ecosystems from overuse.			✓
2.2.1.b Support the establishment of additional MMAs and reef replenishment areas.			✓
2.2.1.c Work with appropriate agencies and community members to protect any special managed conservation areas from overuse and ensure that surrounding land uses do not contribute to the degradation of the natural resources, such as ʻAhihi-Kinaʻu Natural Area Reserve, Honolua-Mokulēʻia Bay Marine Life Conservation District, and Mākena State Park.			✓
2.2.1.d Incorporate the following into the MIP, where consistent with the MIP:			
(1) Beach Management Plan for Maui;	✓		
(2) Coastal Nonpoint Pollution Control Program Management Plan;	✓		
(3) Implementation Plan for Polluted Runoff Control; and	✓		
(4) Ocean Resource Management Plan.			✓
2.2.1.e Support greater coordination among governmental agencies involved with the protection of the island's marine resources.	✓		
Objective:			
2.2.2 Improved reef health, coastal water quality, and marine life.	✓		
Policies:			
2.2.2.a Create additional mechanisms where needed to contain and control runoff and pollution.			✓
2.2.2.b Allow extraction of high quality, Class A, low silt sands only when they will be used to protect or restore Maui's shorelines and beaches.	✓		
2.2.2.c Carefully manage beach nourishment activities to protect the coastal and marine ecosystem.	✓		

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
2.2.2.d Require, where appropriate, a buffer between landscaped areas and the shoreline, gulches, and streams to reduce the runoff of fertilizers, pesticides, herbicides, and other pollutants into coastal waters.			✓
2.2.2.e Strictly regulate shoreline armoring in accordance with adopted Shoreline Rules, with an intent to protect the coastal and marine ecosystem.	✓		
2.2.2.f Support greater protection of Keālia Pond National Wildlife Refuge through the following:			✓
(1) Enhancement of marine ecosystems;			✓
(2) Beach and sand dune restoration; and			✓
(3) Expansion of habitat for Maui's threatened or endangered sea turtles, birds, and other species.			✓
2.2.2.g Support the development of regulations to prevent the excessive depletion of fish stocks due to non-sustainable practices and gear such as SCUBA spear-fishing and lay nets, within the context of nearshore ecosystems.			✓
2.2.2.h Encourage the State to conduct a regular census of fish populations and monitor coral health.			✓
2.2.2.i Encourage the State to significantly increase the number of park rangers, enforcement officers, and marine biologists to protect coastal resources.			✓
2.2.2.j Encourage the State to prohibit the collection and exportation of fish, coral, algae, and other marine species for the ornamental and aquarium trade.			✓
Objective:			
2.2.3 Water quality that meets or exceeds State Clean Water Act standards.	✓		
Policies:			
2.2.3.a Reduce the amount of impervious surface and devise site plan standards that aim to minimize storm runoff and NPS pollution.			✓
2.2.3.b Support the revision of existing regulations to require an Erosion and Sedimentation Control Plan (ESCP) for development activities that may pose a threat to water quality.			✓
2.2.3.c Require an on-site monitoring program, where applicable, when grading may pose a threat to water quality or when recommended in the ESCP.	✓		
2.2.3.d Avoid development actions that impair Maui's reef systems and remove identified stressors.	✓		
2.2.3.e Phase out cesspools and restrict the use of septic systems in ecologically sensitive coastal areas by converting to environmentally-friendly alternative sewage treatment systems, and connecting to central sewerage systems when and where feasible.			✓
2.2.3.f Prohibit the development of new wastewater injection wells, except when unavoidable for public health and safety purposes.			✓

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
2.2.3.g Ensure that the County upholds its affirmative duty under the Clean Water Act by monitoring and reducing point and NPS pollution to help safeguard coastal waters.			✓
Objective:			
2.2.4 Acquire additional shoreline lands and shoreline access rights.			✓
Policies:			
2.2.4.a Promote the use of conservation easements, land trusts, transfer and purchase of development rights, and mitigation banking.			✓
2.2.4.b Require the dedication of public beach and rocky shoreline access ways to and along the shoreline where it serves a practical public interest as a condition of development or subdivision approval; future subdivisions and developments shall be consistent with and effectuate, to the extent practicable, the *Shoreline Access Inventory Update - Final Report* (March 2005), and its updates.			✓
2.2.4.c Incorporate the *Shoreline Access Inventory Update - Final Report* (March 2005), and its regular updates, into this plan.			✓
2.2.4.d Identify access points while further acquiring key shoreline parcels and easement rights to enhance and protect beach access and shoreline recreation.			✓
Analysis: **The proposed Project is directly applicable to the goal, objectives, and policies to protect the shoreline, reefs, and nearshore waters. The restoration of Honokōwai Beach will protect the shoreline from erosion, reduce turbidity and sedimentation, and help maintain water quality in the nearshore marine environment. The proposed Project will restore Honokōwai Beach with beach quality sand. The proposed Project will require various Federal, State, and County approvals to ensure that construction activities will be carefully managed. A Best Management Practices (BMP) Plan and Applicable Monitoring and Assessment Plan (AMAP) have been prepared and will be implemented.**			
WATERSHEDS, STREAMS, AND WETLANDS ISSUES			
Goal:			
2.3 Healthy watersheds, streams, and riparian environments.	✓		
Objective:			
2.3.1 Greater protection and enhancement of watersheds, streams, and riparian environments.	✓		
Policies:			
2.3.1.a All present and future watershed management plans shall incorporate concepts of ahupuaʻa management based on the interconnectedness of upland and coastal ecosystems/species.	✓		
2.3.1.b Continue to support and be an active member of watershed partnerships.			✓
2.3.1.c Support the establishment of regional water trusts, composed of public and private members, to manage water resources.			✓
2.3.1.d Support regulations to require developments to utilize ahupuaʻa management practices.			✓

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2.3.1.e Work with private and non-profit entities to educate the public about the connection between upland activities within the watershed and the impacts on nearshore ecosystems and coral reefs.			✓
2.3.1.f Provide adequate funding and staff to develop and implement watershed protection plans and policies, including acquisition and management of watershed resources and land.			✓
2.3.1.g Encourage the State to mandate instream assessment to provide adequate water for native species.			✓
2.3.1.h Maui will protect all watersheds and streams in a manner that guarantees a healthy, sustainable riparian environment.			✓
Objective:			
2.3.2 Decreased NPS and point source pollution.	✓		
Policies:			
2.3.2.a Enforce water pollution related standards and codes.			✓
2.3.2.b Support the use of LID Techniques such as those described in the State of Hawai'i LID Practitioner's Guide (June 2006), as amended.			✓
2.3.2.c Encourage farmers and ranchers to use agricultural BMPs to address NPS pollution.			✓
Objective:			
2.3.3 Preserve existing wetlands and improve and restore degraded wetlands.			✓
Policies:			
2.3.3.a Prohibit the destruction and degradation of existing upland, mid-elevation, and coastal wetlands.			✓
2.3.3.b Support and fund wetland protection and improvement, and restoration of degraded wetlands.			✓
2.3.3.c Where applicable, require developers to provide a wetland protection buffer and/or other protective measures around and between development and wetland resources.			✓
Objective:			
2.3.4 Greater preservation of native flora and fauna biodiversity to protect native species.	✓		
Policies:			
2.3.4.a Work with appropriate agencies to eliminate feral ungulate populations and invasive species.			✓
2.3.4.b Encourage the State to provide adequate funding to preserve biodiversity, protect native species, and contain or eliminate invasive species.			✓
2.3.4.c Support the work of conservation groups and organizations that protect, reestablish, manage, and nurture sensitive ecological areas and threatened indigenous ecosystems.			✓
Objective:			
2.3.5 Limited development in critical watershed areas.			✓

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
Policies:			
2.3.5.a Discourage development and subdivision of land within critical watersheds and in areas susceptible to high erosion and sediment loss.			✓
2.3.5.b Designate critical watershed areas as conservation lands.			✓
2.3.5.c Strongly encourage new subdivisions and developments that are proximate to environmentally sensitive watershed resources to prepare and implement CSD plans.			✓
Objective:			
2.3.6 Enhance the vitality and functioning of streams, while balancing the multiple needs of the community.			✓
Policies:			
2.3.6.a Protect and enhance natural streambeds and discourage stream alteration.			✓
2.3.6.b Work with appropriate agencies to establish minimum stream flow levels and ensure adequate stream flow to sustain riparian ecosystems, traditional kalo cultivation, and self-sustaining ahupua‘a.			✓
2.3.6.c Respect and participate in the resolution of native Hawaiian residual land and water rights issues (kuleana lands, ceded lands, and historic agricultural and gathering rights).			✓
2.3.6.d Ensure that stream flows implement laws and policies found in the State Constitution and Water Code.			✓
2.3.6.e Work with appropriate agencies and stakeholders to establish minimum stream flow levels, promote actions to support riparian habitat and the use of available lo‘i, and maintain adequate flows for the production of healthy kalo crops.			✓
Analysis: **The proposed Project is directly applicable to the goal, objectives, and policies related to watersheds, streams, and wetland issues. Preserving the lateral and perpendicular shoreline access reinforces the ahupua‘a management concept connecting the shoreline with upland uses. The proposed Project will decrease nonpoint source pollution and improve water quality in the nearshore marine environment by stabilizing the beach and eliminating turbidity plumes associated with runoff.**			
WILDLIFE AND NATURAL AREAS			
Goal:			
2.4 Maui’s natural areas and indigenous flora and fauna will be protected.	✓		
Objective:			
2.4.1 A comprehensive management strategy that includes further identification, protection, and restoration of indigenous wildlife habitats.	✓		
Policies:			
2.4.1.a Identify and inventory the following:			
(1) Natural, recreational, and open space resources;	✓		
(2) Flora and fauna with medium, high, and very high concentrations of threatened or endangered species; and	✓		

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable		DA	IA	NA
	(3) Location and extent of invasive species.	✓		
2.4.1.b	Require flora and fauna assessment and protection plans for development in areas with concentrations of indigenous flora and fauna; development shall comply with the assessment and protection plan and shall use the avoidance, minimization, and mitigation approach respectively, with an emphasis on avoidance.	✓		
2.4.1.c	Support the implementation of Hawai`i's Comprehensive Wildlife Conservation Strategy (October 2005).			✓
Objective:				
2.4.2	A decrease in invasive species through programs and partnerships that eradicate undesirable species and protect native habitat.			✓
Policies:				
2.4.2.a	Prevent the introduction of invasive species at all of Maui's airports and harbors.			✓
2.4.2.b	Encourage the State to increase funding in support of invasive species interception, control, and eradication.			✓
2.4.2.c	Encourage the State to develop programs that allow students to participate in invasive species eradication projects.			✓
Objective:				
2.4.3	Greater protection of sensitive lands, indigenous habitat, and native flora and fauna.	✓		
Policies:				
2.4.3.a	Secure an interconnected network of sensitive lands, greenways, watercourses, and habitats.	✓		
2.4.3.b	Protect Maui's sensitive lands (see Sensitive Lands on Protected Areas Diagrams).			✓
2.4.3.c	Promote innovative environmental-planning methods and site-planning standards that preserve and re-establish indigenous flora and fauna habitat, to preserve and restore connected habitat corridors and open space.	✓		
2.4.3.d	Utilize protection tools such as conservation easements, land trusts, land banks, Purchase of Developments Rights (PDRs), Transfer of Development Rights (TDRs), and other stewardship tools to acquire natural areas			✓
2.4.3.e	Encourage discussions with communities to designate heritage areas that protect recreational and cultural lifestyles and resources.			✓
2.4.3.f	Support the expansion of Haleakalā National Park, and the creation of new national parks, where appropriate and supported by local communities.			✓
2.4.3.g	Encourage reforestation efforts that increase native species' habitat.			✓
2.4.3.h	Utilize the Natural Area Partnership Program (NAPP) and other programs to protect natural lands.			✓
2.4.3.i	Support increased dedicated funding for the acquisition, protection, restoration, or preservation of important natural areas or open space through the following: grants from the Land and Water Conservation Fund; dedicated funding from real property taxes or other appropriate revenues; bond issues; real estate transfer tax; revenues from the Transient Accommodations Tax; development mitigation fees; and other appropriate funding sources.			✓

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
Analysis: **The proposed Project is directly applicable to the goal, objectives, and policies related to wildlife and natural areas. The proposed Project and EIS document established a comprehensive management strategy to restore and preserve Honokōwai Beach for present and future generations. The EIS document incorporates a Marine and Water Quality Assessment and Terrestrial Biological Survey. BMPs have been identified to ensure endangered and protected species, and their habitats are not restoring and preserving Honokōwai Beach, which is habitat for Hawaiian monk seals and green sea turtles.**			
SCENIC RESOURCES			
Goal:			
2.5 Maui will continue to be a beautiful island steeped in coastal, mountain, open space, and historically significant views that are preserved to enrich the residents' quality of life, attract visitors, provide a connection to the past, and promote a sense of place.	✓		
Objective:			
2.5.1 A greater level of protection for scenic resources.	✓		
Policies:			
2.5.1.a Protect views to include, but not be limited to, Haleakalā, ʻĪao Valley, the Mauna Kahalawai (West Maui Mountains), Puʻu Ōʻlaʻi, Kahoʻolawe, Molokini, Molokaʻi, and Lānaʻi, Mauna Kea, Mauna Loa, sea stacks, the Pacific Ocean, and significant water features, ridgelines, and landforms.	✓		
2.5.1.b Identify, preserve, and provide ongoing management of important scenic vistas and open space resources, including mauka-to-makai and makai-to-mauka view planes.	✓		
2.5.1.c Protect "night sky" resources by encouraging the implementation of ambient light ordinances and encouraging conversion of all sources that create excessive light pollution, affecting our ability to view the stars.			✓
2.5.1.d Protect ridgelines from development where practicable to facilitate the protection of public views.			✓
2.5.1.e Protect scenic resources along Maui's scenic roadway corridors.			✓
Objective:			
2.5.2. Reduce impacts of development projects and public-utility improvements on scenic resources.	✓		
Policies:			
2.5.2.a Enforce the policies and guidelines of the SMA regarding the protection of views.	✓		
2.5.2.b Require any new subdivision of land, development, or redevelopment adjacent to a "high" or "exceptional" scenic corridor to submit an impact assessment of the project's scenic impacts; this assessment shall use the avoidance, minimization, and mitigation steps respectively, with an emphasis on avoidance.			✓
2.5.2.c Require appropriate building setbacks and limits on wall heights to protect views along scenic corridors.			✓
2.5.2.d Encourage the State of Hawai`i Board of Land and Natural Resources to deny any development within the State Conservation District that interferes with a scenic landscape or disrupts important open space resources.			✓

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2.5.2.e Require Urban Design and Review Board (UDRB) review and approval of utility poles, facilities, and other visible infrastructure improvements along scenic corridors.			✓
2.5.2.f Ensure little or no effect on scenic resources from utility improvements, primarily power poles.			✓
2.5.2.g Protect scenic vistas from intrusion by power poles.			✓
Objective:			
2.5.3 Greater protection of and access to scenic vistas, access points, and scenic lookout points.	✓		
Policy:			
2.5.3.a Protect, enhance, and acquire access to Maui's scenic vistas and resources.	✓		
Analysis: **The proposed Project is directly applicable to the goal, objectives, and policies to protect scenic resources. The proposed Project restores Honokōwai Beach, a scenic, cultural, and recreational resource in West Maui. The proposed Project will not involve any outdoor lighting and will protect Maui's night sky resources. Groins developed as part of Beach Stabilization will change the landscape of the Project Site. These impacts to the scenic resources will be balanced by the benefits associated with stabilizing the only sandy beach in the area. If no action is taken, adverse impacts in the form of exposed escarpments and increased turbidity would occur.**			
CHAPTER 3 – NATURAL HAZARDS			
Goal:			
3.1 Maui will be disaster resilient.	✓		
Objective:			
3.1.1 Increased inter-agency coordination.			✓
Policy:			
3.1.1.a Reinforce the island's preparedness capacity by:			✓
(1) Applying the latest data-gathering techniques/technology;			✓
(2) Pursuing funding opportunities;			✓
(3) Improving monitoring and advance warning systems;			✓
(4) Fostering public awareness; and			✓
(5) Working with external agencies to coordinate disaster mitigation and response.			✓
Objective:			
3.1.2 Greater protection of life and property.	✓		
Policies:			
3.1.2.a Identify critical infrastructure, lifelines, roads, and populations that are vulnerable to coastal hazards, and encourage strategic retreat and relocation to safer areas.		✓	

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3.1.2.b Consider the location of dams, reservoirs, holding ponds, and other water-containing entities that are upstream of inhabited areas to anticipate, avoid, and mitigate inundation risks, and discourage new development in areas where possible inundation hazards may exist.			✓
3.1.2.c Strengthen current development standards to minimize destruction of land and property.			✓
3.1.2.d Encourage the use of construction techniques that reduce the potential for damage from natural hazards.	✓		
3.1.2.e Increase the County's resilience to drought.			✓
3.1.2.f Increase food and energy security through local production and storage.			✓
Objective:			
3.1.3 A more coordinated emergency response system that includes clearly defined and mapped evacuation routes.			✓
Policy:			
3.1.3.a Identify and expand shelter facilities and evacuation routes away from areas susceptible to natural hazards.			✓
Objective:			
3.1.4 A more educated and involved public that is aware of and prepared for natural hazards.			✓
Policies:			
3.1.4.a Promote public education and involvement related to natural hazards awareness and preparedness.			✓
3.1.4.b Coordinate a multi-agency effort to establish and promote a comprehensive public education program that will focus on practical approaches to preparedness, damage prevention, and hazard mitigation.			✓
Analysis: **The proposed Project is directly applicable to the goal, objectives, and policies related to natural hazards. Restoration of Honokōwai Beach will improve beach stability, preserve, and enhance cultural and shoreline access, increase resilience to coastal hazards and sea level rise, and enable planning for long-term adaptation to sea level rise caused by climate change.**			
CHAPTER 4 – ECONOMIC DEVELOPMENT			
ECONOMIC DIVERSIFICATION			
Goal:			
4.1 Maui will have a balanced economy composed of a variety of industries that offer employment opportunities and well-paying jobs and a business environment that is sensitive to resident needs and the island's unique natural and cultural resources.			✓
Objective:			
4.1.1 A more diversified economy.			✓

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Policies:			
4.1.1.a Encourage an economy that is driven by innovation, research and development, and human resource development, including but not limited to, increasing technology- and knowledge-based sectors to be a major component in Maui County's economic base.			✓
4.1.1.b Support the creation of new jobs and industries that provide a living wage.			✓
4.1.1.c Facilitate and expedite permits and approvals.			✓
4.1.1.d Develop linkages and partnerships among international research and development activities and Maui businesses.			✓
Objective:			
4.1.2 Increase activities that support principles of sustainability.			✓
Policies:			
4.1.2.a Support industries that are sustainable, and culturally and environmentally sensitive.			✓
4.1.2.b Encourage and support local businesses.			✓
4.1.2.c Substitute imports with locally-produced services and products where practicable.			✓
4.1.2.d Support the development of economic development clusters in targeted industry sectors.			✓
4.1.2.e Encourage all businesses to save energy, water, and other resources.			✓
Objective:			
4.1.3 Improve the island's business climate.			✓
Policies:			
4.1.3.a Upgrade, maintain the quality of, and improve access to telecommunications infrastructure.			✓
4.1.3.b Ensure an adequate supply of affordable workforce housing.			✓
4.1.3.c Develop neighborhoods and communities that are attractive to the workforce of a diversified economy.			✓
4.1.3.d Encourage, nurture, and reward entrepreneurship and innovation.			✓
4.1.3.e Encourage employers to establish incentive programs. Support flexibility in workforce policies compatible with business and quality of life goals.			✓
4.1.3.f Assist community development organizations with revitalization and development of neighborhoods and communities that are attractive to the workforce of a diversified economy.			✓
Analysis: **Not applicable.**			

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TOURISM			
Goal:			
4.2 A healthy visitor industry that provides economic well-being with stable and diverse employment opportunities.		✓	
Objective:			
4.2.1 Increase the economic contribution of the visitor industry to the island's environmental well-being for the island's residents' quality of life.		✓	
Policies:			
4.2.1.a Engage the visitor industry in the growth of emerging sectors where practicable.			✓
4.2.1.b Support the implementation of the Maui County TSP, when consistent with the MIP.			✓
4.2.1.c Focus economic growth in the visitor industry through enhanced visitor experiences and an emphasis on attracting higher-spending.		✓	
4.2.1.d Provide a rich visitor experience, while protecting the island's natural beauty, culture, lifestyles, and aloha spirit.		✓	
4.2.1.e Diversify the tourism industry by supporting appropriate niche activities such as ecotourism, cultural tourism, voluntourism, ag-tourism, health and wellness tourism, educational tourism, medical tourism, and other viable tourism-related businesses in appropriate locations.			✓
4.2.1.f Recognize the important economic contributions that the visitor industry makes and support a healthy and vibrant visitor industry.		✓	
4.2.1.g Support the increased availability of kama'āina discount programs.			✓
Objective:			
4.2.2 Comprehensively manage future visitor-unit expansion.			✓
Policies:			
4.2.2.a Mitigate the impact of tourism on the host culture, natural environment, and resident lifestyles.			✓
4.2.2.b Allow, where permitted by the community plan, the development of business hotels and small, sensitively-designed inns.			✓
4.2.2.c Manage impacts from transient vacation rentals, hotels, bed and breakfast units, timeshares, and resort condominiums on residential communities, public infrastructure, and community facilities.			✓
4.2.2.d Discourage supplanting of existing island housing to visitor accommodations that may have a negative impact on long-term rental housing, price of housing, and price of land.			✓
4.2.2.e Allow the designation of retreat/mini-conference centers in appropriate locations through the community plan process.			✓

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4.2.2.f Community plans should consider establishing standards such as limits on building size, room count, and the number of inns, if any, that will be allowed in small towns.			✓
Objective:			
4.2.3 Maximize residents' benefits from the visitor industry.			✓
Policies:			
4.2.3.a Promote a desirable island population by striving to not exceed an island-wide visitor population of roughly 33 percent of the resident population.			✓
4.2.3.b Use the required General Plan Annual Status Report to monitor trends related to residents and visitors.			✓
Analysis: **The proposed Project is indirectly applicable to the goal, objectives, and policies related to the tourism economy. The proposed Project restores and preserves Honokōwai Beach which was damaged by an episodic storm event in 2016. Honokōwai Beach is a popular attraction for both residents and tourists in West Maui. Restoration of the beach will provide a positive benefit to the tourism economy and a positive benefit for residents.**			
AGRICULTURE			
Goal:			
4.3 Maui will have a diversified agricultural industry contributing to greater economic, food, and energy security and prosperity.			✓
Objective:			
4.3.1 Strive for at least 85 percent of locally-consumed fruits and vegetables and 30 percent of all other locally-consumed foods to be grown in-State.			✓
Policies:			
4.3.1.a Strive to substitute food/agricultural product imports with a reliable supply of locally produced food and agricultural products.			✓
4.3.1.b Facilitate and support the direct marketing/sale of the island's agricultural products to local consumers, through farmers markets and similar venues.			✓
4.3.1.c Encourage growing a diverse variety of crops and livestock to ensure the stewardship of our land while safeguarding consumer safety.			✓
4.3.1.d Work with the State to regulate and monitor genetically-modified-organism (GMO) crops to ensure the safety of all crops and label all GMO products.			✓
Objective:			
4.3.2 Maintain or increase agriculture's share of the total island economy.			✓
Policies:			
4.3.2.a Encourage the export of the island's agricultural products to offshore markets.			✓

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4.3.2.b Support infrastructure investments at harbors, such as ferry service, airports, and other facilities for the rapid and cost-effective export of island-grown products.			✓
4.3.2.c Encourage the continued viability of sugar cane production, or other agricultural crops, in central Maui and all of Maui Island.			✓
4.3.2.d Work with the State to reduce excise taxes for commercial agricultural products produced within the State.			✓
4.3.2.e Coordinate with appropriate State and Federal Departments and agencies, private shipping companies, and farmers associations to assist in the rapid and cost-effective export of Maui's agricultural products to off-island markets.			✓
Objective:			
4.3.3 Expand diversified agriculture production at an average annual rate of 4 percent.			✓
Policies:			
4.3.3.a Promote the development of locally-grown and ecologically-sound biofuels, aquaculture, and forest products.			✓
4.3.3.b Support the development of farming associations/cooperatives.			✓
4.3.3.c Work with educational institutions and appropriate agencies to provide education and training for farm owners and entrepreneurs.			✓
Analysis: **Not applicable.**			
EMERGING SECTORS			
Goal:			
4.4 A diverse array of emerging economic sectors.			✓
Objective:			
4.4.1 Support increased investment and expanded activity in emerging industries.			✓
Policies:			
4.4.1.a Support the development of and access to state-of-the-art voice, video, and data telecommunications systems and high-speed Internet.			✓
4.4.1.b Attract and assist industries to compete in high technology activities such as those related to renewable energy, green technologies, diversified agriculture, ocean sciences, health sciences, space technologies, and other knowledge-based industries.			✓
4.4.1.c Support new industries that are environmentally and culturally sensitive such as health and wellness, sports and outdoor activities, cultural activities, the arts, film-making, entertainment, and digital media.			✓
4.4.1.d Support a sustainable, culturally sensitive, astronomy industry.			✓

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
4.4.1.e Support the continued development of the Maui Research and Technology Park in Kihei, as a center for research and development, education, and diversified economic development, as provided by the Maui County Code.			✓
4.4.1.f Work with appropriate organizations to support the development of high technology clusters around renewable energy, diversified agriculture, ocean sciences, health sciences, and other knowledge-based industries.			✓
Objective:			
4.4.2 Increase the development of renewable energy technologies that are supported by the local community.			✓
Policies:			
4.4.2.a Support the expansion of the renewable energy sector and the use of solar, wind, wave, and biofuel technologies.			✓
4.4.2.b Provide incentives to encourage renewable energy development, the use of green energy technologies, and energy conservation.			✓
4.4.2.c Ensure an adequate supply of land and facilitate permitting to meet the needs for renewable energy technologies such as solar, wind, wave, biofuel, and other technologies, provided that environmental, view plane, and cultural impacts are addressed.			✓
4.4.2.d Support the Maui County Energy Alliance Plan where consistent with the MIP.			✓
Analysis: **Not applicable.**			
SMALL BUSINESS DEVELOPMENT			
Goal:			
4.5 Small businesses will play a key role in Maui's economy.		✓	
Objective:			
4.5.1 Increase the number of and revenue generated by small businesses and decrease the percentage of small business failures.		✓	
Policies:			
4.5.1.a Provide incentives and support for small businesses and entrepreneurs that incorporate sustainable technologies and practices into their operations, utilize local materials, or produce and sell locally-made goods or services.			✓
4.5.1.b Assist traditional "mom and pop" business establishments.		✓	
4.5.1.c Reduce barriers to small business development.			✓
4.5.1.d Require, where feasible, the government procurement of goods and services from locally-owned, small businesses.			✓
4.5.1.e Support community markets and venues that sell locally-made produce, goods, and services.			✓

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Analysis: **The proposed Project involves the restoration of Honokōwai Beach and is indirectly applicable to the goal, objectives, and policies for the economy related to small businesses. Preservation of Hōnokowai indirectly supports the local economy in the area, providing continuing opportunities for small businesses to operate near or from Honokōwai Beach. The Economic Impact Report prepared as part of the EIS process documents the economic and fiscal benefits associated with beach restoration and the loss of jobs, revenue, and taxable income under a No Action alternative.**			
HEALTH CARE SECTOR			
Goal:			
4.6 Maui will have a health care industry and options that broaden career opportunities that are reliable, efficient, and provide social well-being.			✓
Objective:			
4.6.1 Expand the economic benefits of the health care sector.			✓
Policies:			
4.6.1.a Encourage expanded services at MMMC and at other medical facilities.			✓
4.6.1.b Support expansion of federally qualified health centers with the direct involvement of the residents of the communities served.			✓
4.6.1.c Support the use of multimedia as a means to provide healthcare information.			✓
4.6.1.d Encourage digitalization of all diagnostic equipment at all facilities on Maui to enable sharing of data and more efficient use of limited provider workforce, consistent with data protection and patient privacy.			✓
4.6.1.e Support the expansion of telemedicine.			✓
4.6.1.f Encourage expansion and improved access to emergency care in all communities.			✓
Objective:			
4.6.2 Be more efficient in the delivery of health care services and in minimizing health care costs.			✓
Policies:			
4.6.2.a Support expansion of health care providers and facilities to improve access to quality care throughout the island.			✓
4.6.2.b Encourage the expansion of veteran health care services.			✓
4.6.2.c Allow home-based out-patient medical care that does not interfere with surrounding neighborhoods.			✓
Objective:			
4.6.3. Expand Maui's alternative health care services, including spiritual practices.			✓

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Policies:			
4.6.3.a Support efforts to promote alternative medicine.			✓
4.6.3.b Allow small-scale home-alternative medicine businesses such as massage, chiropractic care, traditional Hawaiian healing, and acupuncture that do not interfere with surrounding neighborhoods.			✓
Analysis: **Not applicable.**			
EDUCATION AND WORKFORCE DEVELOPMENT			
Goal:			
4.7 Maui will have effective education and workforce development programs and initiatives that are aligned with economic development goals.			✓
Objective:			
4.7.1 Improve preschool and K-12 education to allow our youth to develop the skills needed to successfully navigate the 21st century.			✓
Objective:			
4.7.1.a Encourage the State to implement programs such as:			✓
(1) Universally available preschool for children between the ages of one and five;			✓
(2) Mandatory kindergarten;			✓
(3) Mandatory K-5th grade classroom size limits of 1 teacher to 20 students;			✓
(4) Mandatory nutrition programs; and			✓
(5) Mandatory Native Hawaiian programs at all grade levels.			✓
4.7.1.b Encourage the DOE to extend the school day by at least an hour.			✓
4.7.1.c Encourage the State to increase funding for public education so that Hawai‘i is among the top 10 states nationally as measured by investment per pupil.			✓
4.7.1.d Encourage the State to ensure teacher certifications relate to effective delivery and improved student performances, and develop an industry experience/equivalency certification to assure our DOE students have access to career technical education and training.			✓
4.7.1.e Encourage the UHMC to provide dormitory space for high school students.			✓
4.7.1.f Encourage the development and implementation of curriculum on native Hawaiian history, culture, and practices, in consultation with native Hawaiian groups and associations.			✓
Objective:			
4.7.2 Encourage an increase in the number of certificate recipients and associate, bachelors, and graduate degrees conferred.			✓

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Policies:			
4.7.2.a Encourage the State to increase the number of articulation agreements between the UHMC and four-year universities, particularly the University of Hawai'i at Manoa.			✓
4.7.2.b Encourage the State to expand accredited 2-year, 4-year, and graduate programs through the UHMC.			✓
4.7.2.c Encourage the education and training of our residents to meet the needs of a diversified economy.			✓
4.7.2.d Support education and training programs such as student internships, vocational training, and career development opportunities to ensure a highly skilled workforce			✓
4.7.2.e Work with educational institutions to improve and expand access to education and training through multiple modes, including distance learning.			✓
Objective:			
4.7.3 Strive to ensure that more of Maui's jobs are developed in STEM-related sectors by 2030.			✓
Policies:			
4.7.3.a Support the development of STEM-related certificates and degrees at the two- and four year levels.			✓
4.7.3.b Support the education initiatives of the Maui Agricultural Development Plan.			✓
4.7.3.c Expand and seek funding for internships, mentoring, job shadowing, etc. to foster interest in health and green workforce careers.			✓
4.7.3.d Work with MEDB, UHMC, and other similar organizations to expand internship/education programs to support STEM careers.			✓
4.7.3.e Continue to partner with the MEDB and other similar organizations to recruit, assist, and retain emerging industries, research and development activities, and educational/workforce opportunities.			✓
Analysis: **Not applicable.**			
CHAPTER 5 – HOUSING			
Goal:			
5.1 Maui will have safe, decent, appropriate, and affordable housing for all residents developed in a way that contributes to strong neighborhoods and a thriving island community.			✓
Objective:			
5.1.1 More livable communities that provide for a mix of housing types, land uses, income levels, and age.			✓
Policies:			
5.1.1.a Promote livable communities (compact/walkable/bikeable, access to transit) that provide for a mix of housing types and land uses, including parks, open space, and recreational areas.			✓

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5.1.1.b Promote planning approaches that provide a mix of multifamily and single-family housing units to expand housing choices.			✓
5.1.1.c Discourage gated communities.			✓
5.1.1.d Provide incentives for the rehabilitation or adaptive reuse of historic structures to facilitate more housing choices.			✓
5.1.1.e Use planning and regulatory approaches to provide higher housing densities.			✓
Objective:			
5.1.2 Better monitoring, evaluation, and refinement of affordable housing policy in conjunction with the economic cycle.			✓
Policies:			
5.1.2.a Improve data on resident and nonresident housing.			✓
5.1.2.b Utilize the following approaches to promote resident housing and to minimize offshore market impacts:			✓
(1) Ensure that the future housing stock is composed of a mix of housing types (multifamily, small lots, ohana units, co-housing, cottage houses, etc.);			✓
(2) Encourage new housing in proximity to jobs and services, in places that are conducive/affordable to island residents; and			✓
(3) Explore taxation alternatives and building fee structures.			✓
Objective:			
5.1.3 Provide affordable housing, rental or in fee, to the broad spectrum of our island community.			✓
Policies:			
5.1.3.a Consider regulations that can help keep affordable housing available at affordable rents.			✓
5.1.3.b Seek to have ownership of affordable for-sale and rental housing vested in a non-profit community land trust, or other qualified housing provider, committed to keeping such housing affordable in perpetuity.			✓
5.1.3.c Facilitate the use of public lands in urban areas that are suitable for affordable housing.			✓
5.1.3.d Develop or support partnerships and initiatives that provide housing-related education/outreach.			✓
5.1.3.e Support the continuing efforts of the County and its community partners to:			✓
(1) Disseminate information on different housing/financial assistance programs (loans, grants, etc.) including information on housing rehabilitation/restoration/adaptive reuse;			✓
(2) Provide housing-related counseling including budget, credit, and financial planning assistance; and			✓

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(3) Create and maintain a comprehensive/master list of available affordable housing to help residents secure a unit that satisfies their need.			✓
Objective:			
5.1.4 Provide infrastructure in a more timely manner to support the development of affordable housing.			✓
Policies:			
5.1.4.a Prioritize the development of infrastructure that supports the development of affordable housing.			✓
5.1.4.b Utilize appropriate financing approaches and assistance tools to encourage the development of infrastructure and public facilities.			✓
5.1.4.c Tailor infrastructure requirements to correspond with appropriate level-of-service standards to help control housing costs and to maintain safety.			✓
Objective:			
5.1.5 A wider range of affordable housing options and programs for those with special needs.			✓
Policies:			
5.1.5.a Ensure that residents with special needs have access to appropriate housing.			✓
5.1.5.b Encourage housing to be built or rehabilitated to allow the elderly and those with special needs to live in their homes.			✓
5.1.5.c Ensure and facilitate programs to assist those with special needs from becoming homeless.			✓
5.1.5.d Promote programs that stimulate the production of sustainable homeless shelters and alternative housing technologies.			✓
5.1.5.e Support programs that offer home modification counseling on low-interest retrofit loans and grants to those with special needs.			✓
Objective:			
5.1.6 Reduce the cost to developers of providing housing that is affordable to families with household incomes 160 percent and below of annual median income.			✓
Policies:			
5.1.6.a Support fast-track processing procedures for the following housing-related entitlements: affordable housing projects/units; indigenous Hawaiian housing/units; and special-needs housing units (seniors, disabled, homeless, etc.).			✓
5.1.6.b Require the construction of affordable for-sale and rental housing units as part of the construction of new housing developments.			✓
5.1.6.c Offer extra incentives in boom periods and withdraw incentives during slack periods.			✓

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Objective:			
5.1.7 Increased preservation and promotion of indigenous Hawaiian housing and architecture.			✓
Policies:			
5.1.7.a Preserve, promote, and give priority to Hawaiian housing/architecture forms to preserve Hawaiian culture.			✓
5.1.7.b Provide for indigenous architecture as an allowable structure for native Hawaiian uses to include hula and lāʻau lapaʻau.			✓
Analysis: **Not applicable.**			
CHAPTER 6 – INFRASTRUCTURE AND PUBLIC FACILITES			
SOLID WASTE			
Goal:			
6.1 Maui will have implemented the ISWMP thereby diverting waste from its landfills, extending their capacities.			✓
Objective:			
6.1.1 Meet our future solid waste needs with a more comprehensive planning and management strategy.			✓
Policies:			
6.1.1.a Update and publicize the ISWMP every ten years.			✓
6.1.1.b Strengthen inter-agency coordination including Planning and Environmental Management departments.			✓
6.1.1.c Divert waste from the landfills and educate the public about the recommendations of the ISWMP.			✓
6.1.1.d Minimize future active, unlined landfill cells to the extent feasible.			✓
Objective:			
6.1.2 Divert at least 60 percent of solid waste from the island's landfills.			✓
Policies:			
6.1.2.a Require residents and commercial enterprises that generate waste to pay a fair proportion of disposal costs.			✓
6.1.2.b Encourage environmentally safe waste-to-energy solutions.			✓
6.1.2.c Facilitate the reduction of solid waste generated by packaging, food service products, construction waste, etc.			✓
6.1.2.d Educate residents and visitors about the impacts of and methods to reduce, reuse, and recycle.			✓

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6.1.2.e Discourage the disposal of landfill leachate by diversion to wastewater treatment plants, where practicable.			✓
Analysis: **Not applicable.**			
WASTEWATER			
Goal:			
6.2 Maui will have wastewater systems that comply with or exceed State and Federal regulations; meet levels-of-service needs; provide adequate capacity to accommodate projected demand; ensure efficient, effective, and environmentally sensitive operation; and maximize wastewater reuse where feasible.			✓
Objective:			
6.2.1 A wastewater planning program capable of efficiently providing timely and adequate capacity to service projected demand where economically feasible and practicable.			✓
Policies:			
6.2.1.a Encourage the use of renewable energy in support of wastewater treatment facilities.			✓
6.2.1.b Focus the expansion of wastewater systems to accommodate planned growth consistent with the MIP Directed Growth Strategy.			✓
6.2.1.c Establish new wastewater treatment plant(s) outside the tsunami zone.			✓
Objective:			
6.2.2 Adequate levels of wastewater service with minimal environmental impacts.			✓
Policies:			
6.2.2.a Meet or exceed all State and Federal standards regulating wastewater disposal or reuse.			✓
6.2.2.b Encourage tertiary treatment for all municipal wastewater that is disposed through deep injection wells. Phase out all municipal and private injection wells in coordination with water reuse programs, where feasible, by 2020.			✓
6.2.2.c Improve and upgrade the County's existing wastewater collection, treatment, and reuse facilities consistent with current and future plans and the County's CIP.			✓
6.2.2.d Maintain an ongoing sewer inspection program for public and private multi-user systems to identify potential problems and forecast each system's residual life.			✓
6.2.2.e Require all new developments to fund system improvements in proportion to the development impact and in accordance with the County's wastewater functional plan.			✓
6.2.2.f Require appropriate funding mechanisms, such as a sinking fund, to adequately maintain or replace aging water-system components.			✓
6.2.2.g Strongly encourage the phase out of cesspools.			✓

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Objective:			
6.2.3 Increase the reuse of wastewater.			✓
Policies:			
6.2.3.a Strengthen coordination between the Department of Water Supply (DWS) and the WWRD to promote reuse/recycling of wastewater.			✓
6.2.3.b Expand the reuse of wastewater from the Central Maui, Kīhei, Lahaina, and other wastewater systems.			✓
Analysis: **Not applicable.**			
WATER			
Goal:			
6.3 Maui will have an environmentally sustainable, reliable, safe, and efficient water system.			✓
Objective:			
6.3.1 More comprehensive approach to water resources planning to effectively protect, recharge, and manage water resources including watersheds, groundwater, streams, and aquifers.			✓
Policies:			
6.3.1.a Ensure that DWS actions reflect its public trust responsibilities toward water.			✓
6.3.1.b Ensure the WUDP implements the State Water Code and MIP's goals, objectives, and policies.			✓
6.3.1.c Regularly update the WUDP, to maintain compliance with the General Plan.			✓
6.3.1.d Ensure that the County's CIP for water-source development is consistent with the WUDP and the MIP.			✓
6.3.1.e Where desirable, retain and expand public ownership and management of watersheds and fresh-water systems.			✓
6.3.1.f Encourage and improve data exchange and coordination among Federal, State, County, and private land use planning and water resource management agencies.			✓
Objective:			
6.3.2 Increase the efficiency and capacity of the water systems in striving to meet the needs and balance the island's water needs.			✓
Policies:			
6.3.2.a Ensure the efficiency of all water system elements including well and stream intakes, water catchment, transmission lines, reservoirs, and all other system infrastructure.			✓

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6.3.2.b Encourage increased education about and use of private catchment systems where practicable for nonpotable uses.			✓
6.3.2.c Maximize the efficient use of reclaimed wastewater to serve nonpotable needs.			✓
6.3.2.d Work with appropriate State and County agencies to achieve a balance in resolving the needs of water users in keeping with the water allocation priorities of the MIP.			✓
6.3.2.e Ensure water conservation through education, incentives, and regulations.			✓
6.3.2.f Acquire and develop additional sources of potable water.			✓
Objective:			
6.3 Improve water quality and the monitoring of public and private water systems.			✓
Policy:			
6.3.3.a Protect and maintain water delivery systems.			✓
Analysis: **Not applicable.**			
TRANSPORTATION			
Goal:			
6.4 An interconnected, efficient, and well-maintained, multimodal transportation system.			✓
Objective:			
6.4.1 Provide for a more integrated island-wide transportation and land use planning program that reduces congestion and promotes more efficient (transit-friendly) land use patterns.			✓
Policies:			
6.4.1.a Plan for an integrated multi-modal transportation system comprised of public transit, bicycle, pedestrian, automobile, and other transportation modes.			✓
6.4.1.b Refocus transportation investment from the construction of additional roadways only for the automobile to the expansion of a multimodal transportation system.			✓
6.4.1.c Encourage the use of “complete streets” design methods.			✓
6.4.1.d Encourage employers to implement TDM strategies.			✓
Objective:			
6.4.2 Safe, interconnected transit, roadway, bicycle, equestrian, and pedestrian network.			✓
Policies:			
6.4.2.a Ensure transit-, roadway-, and pedestrian-facilities design and level-of-service standards respect the unique character of our communities.			✓
6.4.2.b Prioritize transportation improvements list to cost-effectively meet existing and future needs consistent with the MIP.			✓

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6.4.2.c Require new development, where appropriate, to integrate sidewalks, pathways, bikeways, and transit infrastructure into new commercial and residential projects while enhancing community character.			✓
6.4.2.d Identify and improve hazardous and substandard sections of roadways, drainage infrastructure, and bridges, provided that the historical integrity of the roads and bridges are protected.			✓
6.4.2.e Consider identification, acquisition where appropriate, and utilization of abandoned right of-ways for bikeways, pedestrian pathways, and open-space networks.			✓
6.4.2.f Support the implementation of the *Central Maui Pedestrian & Bicycle Master Plan* (March 2012), when consistent with the MIP.			✓
Objective:			
6.4.3 An island-wide, multimodal transportation system that respects and enhances the natural environment, scenic views, and each community's character.			✓
Policies:			
6.4.3.a Ensure that the roadway and transit alignments respect the natural environment and scenic views.			✓
6.4.3.b Ensure that roadways and transit systems in rural areas and small towns enhance community character.			✓
6.4.3.c Design all transit systems to respect visual corridors and Maui's character.			✓
Analysis: **Not applicable.**			
TRANSIT			
Goal:			
6.5 An island-wide transit system that addresses the needs of residents and visitors and contributes to healthy and livable communities.			✓
Objective:			
6.5.1 An integrated transit system that better serves all mobility needs of Maui's residents and visitors.			✓
Policies:			
6.5.1.a Maximize access to public transit in town centers, commercial districts, and employment centers.			✓
6.5.1.b Expand regional and inter-regional transit services, where appropriate, in heavily traveled corridors and within communities			✓
6.5.1.c Increase the frequency of current service, add additional bus routes as demand requires, and transition to nonpolluting transit vehicles, as funding permits.			✓
6.5.1.d Provide adequate transit infrastructure (e.g., bus pullouts, waiting benches and shelters, signs) along existing and future transit right-of-ways.			✓
6.5.1.e Require new development where appropriate, to provide right-of-ways (ROWs) to accommodate transit circulation and support facilities.			✓
6.5.1.f Identify, protect, and preserve, or acquire corridors for future inter-community transit use, including but not limited to, rail and also multimodal use corridors.			✓

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6.5.1.g Establish transit corridors by planning for and securing right-of-way when appropriate for alternative modes of transportation (such as rail and water ferry service).			✓
6.5.1.h Pursue improvements and upgrades to the existing transit system consistent with updated MDOT planning studies/transit plans (within the framework of comprehensive island-wide multimodal transportation plans).			✓
6.5.1.i Increase inter-agency coordination between the Department of Planning, State Department of Transportation, County Department of Public Works, and other applicable agencies.			✓
Objective:			
6.5.2 Plan for a more diversified and stable funding base to support transportation goals.			✓
Policies:			
6.5.2.a Support alternative methods and sources of funding transportation improvements (including impact fees, higher taxes, fare adjustments, dedicated sources of funding, and assessments).			✓
6.5.2.b Collaborate with public-private entities or nonprofit organizations to reduce public transit operational expenses.			✓
6.5.2.c Coordinate with appropriate Federal, State, and County agencies to fund transportation projects in areas where growth is anticipated.			✓
Analysis: **Not applicable.**			
PARKS			
Goal:			
6.6 Maui will have a diverse range of active and passive recreational parks, wilderness areas, and other natural-resource areas linked, where feasible, by a network of greenways, bikeways, pathways, and roads that are accessible to all.	✓		
Objective:			
6.6.1 More effective, long-range planning of parks and recreation programs able to meet community needs.	✓		
Policies:			
6.6.1.a Support, consistent with the MIP, the implementation of open-space and recreational plans, such as the *Pali to Puamana Parkway* Master Plan and the *Upcountry Greenways Master Plan*.			✓
6.6.1.b Utilize the ahupuaʻa approach by integrating mauka-to-makai natural landscapes into an island-wide parks and recreation functional plan.	✓		
6.6.1.c Provide a balanced mix of passive and active parks, including neighborhood, community, and regional parks, in each community plan area.	✓		
6.6.1.d Support the expansion of Haleakala National Park, where supported by affected communities.			✓
6.6.1.e Support loʻi and dryland taro restoration in County, State, and Federal parks.			✓

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6.6.1.f Encourage private landowners to dedicate land to Federal, State, or County governments, or nonprofit land trusts, for parks and open-space protection consistent with the MIP.			✓
6.6.1.g Strengthen inter-agency coordination including State and County departments, such as resolving joint use of facilities and properties.			✓
6.6.1.h Work with the State to prepare and implement a master management plan for ʻĀhihi-Kīnaʻu and La Perouse-Keoneʻōʻio Bay to Kanaloa Point region.			✓
Objective:			
6.6.2 Achieve parks and recreation opportunities to meet the diverse needs of our community.			✓
Policies:			
6.6.2.a Establish appropriate level-of-service standards at the neighborhood, community, and regional levels.			✓
6.6.2.b Identify and acquire parks and recreational facilities that address existing park inadequacies and complement and enhance neighborhoods, communities, and natural land features.			✓
6.6.2.c Design park facilities to preserve and enhance natural site characteristics, maximize views, protect environmental and cultural sites, and minimize water demands.			✓
6.6.2.d Acquire lands along the shoreline, between coastal roadways and the ocean.			✓
6.6.2.e Encourage the development of regional parks, district parks, and greenways in a manner that helps to contain sprawl, provide separation between distinct communities, or offer open space within urban communities.			✓
6.6.2.f Require large master-planned communities that incorporate a mixture of park facilities pursuant to parks standards and functional plans.			✓
6.6.2.g Support appropriate areas for cultural parks (e.g., Kepaniwai) in each community plan area.			✓
6.6.2.h Incorporate community input to determine the appropriate location, design, and long-term stewardship of parks and recreation facilities.			✓
6.6.2.i Manage commercial activities at public parks to minimize impacts to residents.			✓
6.6.2.j Support public-private partnerships to implement the acquisition and development of parks when consistent with the General Plan.			✓
6.6.2.k Support a coordinated program to improve, operate, and maintain joint-use facilities and grounds.			✓
Objective:			
6.6.3 An expanded network of greenways, trails, pathways, and bikeways.	✓		
Policies:			
6.6.3.a Link existing and future park sites, natural areas, the shoreline, and residential areas with a network of bikeways, pedestrian paths, trails, and greenways.	✓		

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
6.6.3.b Support the implementation of plans and programs that facilitate pedestrian mobility and access to active and passive recreation areas and sites.			✓
6.6.3.c Collaborate with the State and private land owners to ensure perpetual access and proper stewardship of traditional trails and access systems.			✓
6.6.3.d Facilitate the development of well-managed noncommercial campgrounds throughout the island.			✓
6.6.3.e Consider requiring commercial bike rental businesses to provide funding that supports a mauka-to-makai Haleakalā bikeway improvement program.			✓
6.6.3.f Ensure ADA compliance and seek opportunities to make all parks and recreational facilities accessible to people with disabilities.	✓		
Analysis: **The proposed restoration of Honokōwai Beach is directly applicable to the goal, objectives, and policies for parks. The beach features dedicated public parking stalls and a public changing station with restroom and shower facilities. The proposed Project will preserve lateral shoreline access along the beach and repair the coastal walkway that provides Americans with Disabilities Act (ADA) compliant access along approximately 1,000 lineal feet of shoreline from the south end of the Kā‘anapali Beach Club property to the north side of Honokōwai Stream. The proposed Project will restore \land along the shoreline for recreational and cultural activities that was eroded during the episodic storm event in 2016.**			
PUBLIC FACILITIES			
Goal:			
6.7 Maui will have adequate public facilities that meet the diverse needs of residents.			✓
Objective:			
6.7.1 More effective planning for public facilities to meet community needs.			✓
Policies:			
6.7.1.a Ensure the development and update of island-wide public facilities functional plans that incorporate prioritized facilities, programs, and a financial component.			✓
6.7.1.b Establish appropriate level-of-service standards for public facilities provided by the County.			✓
6.7.1.c Pursue improvements and upgrades of County public facilities consistent with the public facilities functional plan.			✓
6.7.1.d Recognize Wailuku Town as Maui's Civic Center and support the revitalization of the Civic Center District by consolidating government office spaces, enhancing landscape beautification, and providing adequate public parking.			✓
6.7.1.e Support, with community input, the relocation of the Maui Community Correctional Center from Wailuku to an appropriate location in Pu‘unēnē.			✓
6.7.1.f Adequately plan and fund public safety facilities (fire, police, ambulance, civil defense) to meet community needs.			✓
6.7.1.g Increase joint facilities utilization and program coordination between State and County agencies such as baseyards, communication centers, recreational facilities, etc., where feasible.			✓
6.7.1.h Focus future expenditures for additional government office space, parking, and related facilities in Wailuku's Civic Center District.			✓

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
6.7.1.i Encourage continuous and safe walkways for children within one mile of each school.			✓
6.7.1.j Encourage public-private partnerships to identify and resolve public facility plan shortcomings when consistent with the General Plan.			✓
6.7.1.k Incorporate community/area residents' input to determine the appropriate location and design of public facilities.			✓
Analysis: **Not applicable.**			
SCHOOLS AND LIBRARIES			
Goal:			
6.8 Maui will have school and library facilities that meet residents' needs and goals.			✓
Objective:			
6.8.1 Assist in providing appropriate school and library facilities in a timely manner and in strategic locations.			✓
Policies:			
6.8.1.a Work in partnership with all educational institutions to meet current and future needs including appropriate location, timing, and design of future facilities.			✓
6.8.1.b Allow for the expansion and intensification of uses at the UHMC including satellite campuses operating in remote areas.			✓
6.8.1.c Encourage the DOE to build and maintain smaller, community-oriented schools.			✓
6.8.1.d Encourage better cooperation by the State and County for use of State and County facilities.			✓
6.8.1.e Encourage the State to upgrade, modernize, and expand school facilities, including those in remote communities.			✓
6.8.1.f Work with the State to develop a master plan for the expansion of UHMC in accordance with the MIP.			✓
6.8.1.g Support partnerships (public/private/nonprofit) to build and staff new schools and improve existing facilities.			✓
6.8.1.h Work with the BOE HSPLS to provide centralized library services (including telecommunications) to all areas of Maui.			✓
6.8.1.i Work with the State to expedite planning and construction of Kīhei High School, including the integration of the high school with the Maui Research and Technology Park.			✓
6.8.1.j Work with the State to identify intermediate school sites in Central Maui and other areas where needed.			✓
Objective:			
6.8.2 Provide a more expansive network of safe and convenient pedestrian-friendly streets, trails, pathways, and bikeways between neighborhoods and schools where appropriate.			✓

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
Policies:			
6.8.2.a Encourage the State to build new school facilities in appropriate locations that minimize time and distance for students to travel to and from school.			✓
6.8.2.b Encourage the State to implement the Safe Routes to School initiative with funding commitments to help the County plan and fund projects that ensure safe access routes to school.			✓
Analysis: **Not applicable.**			
HEALTH CARE			
Goal:			
6.9 All of Maui residents will have the best possible health care to include healthy living, disease prevention, as well as acute and long-term care.			✓
Objective:			
6.9.1 Greater autonomy to the Maui region in their efforts to improve medical care on the island.			✓
Policies:			
6.9.1.a Encourage the State to give greater autonomy to the Maui region in their efforts to improve medical care on the island.			✓
6.9.1.b Support innovative financial solutions, such as capital partnerships, joint ventures, and consolidations for MMMC and other health institutions.			✓
6.9.1.c Support MMMC as a major core medical center that provides a greater range of services.			✓
6.9.1.d Support the immediate development of a critical access hospital in West Maui.			✓
6.9.1.e Support the expansion of regional critical-access facilities, where allowed by Federal regulations.			✓
6.9.1.f Improve medical service to remote and outlying regions.			✓
6.9.1.g Support transportation services for dialysis patients and community dialysis programs.			✓
6.9.1.h Work with the State to determine the feasibility of appropriate medical facilities in South Maui and Hāna, including the possible reestablishment of a small community hospital in Hāna, the establishment of a hospital in South Maui, and assist the State in securing funding to meet Maui's health care needs.			✓
Objective:			
6.9.2 An expansion of long-term care facilities and long-term care alternatives to meet the needs of our aging population.			✓
Policies:			
6.9.2.a Support efforts to increase Maui's long-term care bed capacity to cover current and future needs, close to large population centers.			✓

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
6.9.2.b Recognize that facilities for low-income elders who need long-term care are a needed form of affordable and subsidized housing.			✓
6.9.2.c Evaluate the needs of the long-term disabled and provide planning support for their care, if there is a need for long-term care facilities.			✓
6.9.2.d Consider long-term care facilities as a major potential employment base and encourage the recruitment and training of potential employees.			✓
Objective:			
6.9.3 More support to home-care and community-based programs so they become alternatives to traditional nursing homes.			✓
Policies:			
6.9.3.a Support the establishment of a program to assist the elderly and people with disabilities to remain in their homes or in a home-like setting.			✓
6.9.3.b Support the establishment of senior and adult-day-care centers and senior housing.			✓
6.9.3.c Continue to support existing senior centers (e.g. Kaunoa), and establish new senior centers that will provide day-care sites and programs for the disabled and elderly.			✓
6.9.3.d Support funding alternatives for community-based services that assist home-care efforts.			✓
6.9.3.e Encourage the State to adopt the recommendations contained within the Legislative Reference Bureau's report entitled "Gimme a Break: Respite Care Services in Other States," (December 2007) where appropriate, feasible, and consistent with the MIP.			✓
Objective:			
6.9.4 Improved preventative medicine and primary health care.			✓
Policies:			
6.9.4.a Develop and utilize health-status benchmarks to measure prevention and primary health care service delivery.			✓
6.9.4.b Support programs that provide family planning assistance.			✓
Analysis: **Not applicable.**			
ENERGY			
Goal:			
6.10 Maui will meet its energy needs through local sources of clean, renewable energy, and through conservation.			✓
Objective:			
6.10.1 Reduce fossil fuel consumption. Using the 2005 electricity consumption as a baseline, reduce by 15 percent in 2015; 20 percent by 2020; and 30 percent by 2030.			✓
Policies:			
6.10.1.a Support energy efficient systems, processes, and methods in public and private operations, buildings, and facilities.			✓

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6.10.1.b Support the Maui Solar Rooftop initiative.			✓
6.10.1.c Support Hawai`i Energy and other Public Utility Commission (PUC) approved energy efficiency programs.			✓
Objective:			
6.10.2 Increase the minimum percentage of electricity obtained from clean, renewable energy sources. By 2015, more than 15 percent of Maui's electricity will be produced from locally-produced, clean, renewable energy sources, 25 percent by 2020, and 40 percent by 2030.			✓
Policies:			
6.10.2.a Evaluate available renewable energy resource sites and applicable technologies.			✓
6.10.2.b Encourage the installation of renewable energy systems, where appropriate.			✓
6.10.2.c Support the establishment of new renewable energy facilities at appropriate locations provided that environmental, view plane, and cultural impacts are addressed.			✓
6.10.2.d Encourage all new County facilities completed after January 1, 2015, to produce at least 15 percent of their projected electricity needs with onsite renewable energy.			✓
Objective:			
6.10.3 Increased use of clean, renewable energy.			✓
Policies:			
6.10.3.a Support efforts in the PUC to upgrade Maui's power grid to integrate renewable energy from multiple sources and wheeling of electricity.			✓
6.10.3.b Encourage the PUC to work with the County to implement and expedite community supported renewable energy projects.			✓
6.10.3.c Encourage efforts to produce more renewable energy using distributed generation.			✓
6.10.3.d Encourage import substitution by MECO and the broader community to become more self-sufficient in energy production.			✓
6.10.3.e Educate the public on the economic and environmental benefits from the increased use of renewable energy.			✓
6.10.3.f Encourage support from the Federal government, State, and the private sector for Maui's renewable energy objectives.			✓
6.10.3.g Encourage incentives to support the development and use of renewable energy.			✓
Objective:			
6.10.4 More efficient distribution of power throughout the island while preserving island beauty.			✓

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
Analysis: **Not applicable.**			
HARBORS AND AIRPORT			
Goal:			
6.11 Maui will have harbors and airports that will efficiently, dependably, and safely facilitate the movement of passengers and cargo.			✓
Objective:			
6.11.1 Upgraded harbor facilities to handle larger volumes of freight and passengers and additional small boat harbors.			✓
Policies:			
6.11.1.a Support the expansion and upgrade of Kahului Harbor through the following, provided that any expansion is respectful of cultural practices and existing recreational uses and supports improved water quality:			✓
(1) Accommodate increasing volumes of cargo;			✓
(2) Provide deeper pier depths and greater fuel-receiving and storing capacities; and			✓
(3) Ensure safe and efficient work areas, including separating passenger operations from fuel and cargo operations.			✓
6.11.1.b Work with public and private entities to provide adequate pier slips, utilities, repair facilities, and waste-disposal capabilities.			✓
6.11.1.c Encourage the State to safely separate passenger (cruise and ferry) operations from hazardous bulk fuels and heavy cargo transporting operations, while not decreasing harbor's capacity to safely support various recreational uses.			✓
6.11.1.d Encourage the State to develop cargo inspecting sites and facilities for efficient cargo and container processing and transportation and to prevent alien species entry.			✓
6.11.1.e Support a State and County task force to study the feasibility of a second commercial harbor on Maui.			✓
Objective:			
6.11.2 Establish more economically thriving and environmentally sensitive small boat harbors accommodating resident and business activity, including fishing, recreation, and tour boats.			✓
Policy:			
6.11.2.a Provide for needed shore-side facilities and capabilities to support small boat harbor users (e.g. repair facilities, parking, cold storage, and mass-transit connections).			✓
Objective:			
6.11.3 Upgraded airport facilities and navigation aids to serve the needs of passengers, freight movements, and general aviation.			✓
Policies:			
6.11.3.a Protect the island's airports from encroaching urbanization that may negatively impact the airport operations.			✓

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
6.11.3.b Support State efforts to improve Kahului Airport operations to better serve passenger and cargo needs.			✓
6.11.3.c Support State efforts to identify sites and plan to relocate and accommodate small and rotary wing aircraft.			✓
6.11.3.d Encourage the State to improve airport safety including lighting, fuel transmission, fuel safety, etc.			✓
6.11.3.e Consider expansion of rental car facilities in West and South Maui.			✓
6.11.3.f Consider expansion of mass transit (bus, fixed-rail, shuttle, and taxis, bicycle, and pedestrian facilities) to and from Kahului Airport and not limited to passenger movements (allowing for luggage and cargo).			✓
6.11.3.g Encourage the State to maintain airport capacity and to encourage more responsive air services to Hāna and Kapalua.			✓
Analysis: **Not applicable.**			
CHAPTER 7 – LAND USE			
AGRICULTURAL LANDS			
Goal:			
7.1 Maui will have a prosperous agricultural industry and will protect agricultural lands.			✓
Objective:			
7.1.1 Significantly reduce the loss of productive agricultural lands.			✓
Policies:			
7.1.1.a Allow, where appropriate, the clustering of development on agricultural lands when approved as a CSD plan or similar approval mechanism.			✓
7.1.1.b Require, where appropriate, the review and approval of CSD plans prior to the subdivision of agricultural land.			✓
7.1.1.c Discourage developing or subdividing productive agricultural lands for residential uses in which the residence would be the primary use and any agricultural activities would be secondary uses.			✓
7.1.1.d Consider requirements for public notification and review of the subdivision of agricultural land into four or more lots.			✓
7.1.1.e Focus urban growth, to the extent practicable, away from productive and important agricultural lands.			✓
7.1.1.f Strongly discourage the conversion of productive and important agricultural lands (such as sugar, pineapple, and other produce lands) to rural or urban use, unless justified during the General Plan update, or when other overriding factors are present.			✓
7.1.1.g Further develop the requirements for agricultural assessments found under Section 19.510, MCC.			✓
7.1.1.h Provide incentives for landowners to preserve and protect agricultural lands from development through the use of TDR/PDR, tax credits, easement programs, or similar means.			✓

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
7.1.1.i Promote the use of U.S.D.A. Farm and Ranch Lands Protection Program grants to fund the acquisition of conservation easements on eligible agricultural lands.			✓
7.1.1.j Require all major developments adjacent to agricultural lands to provide an appropriate and site-specific agricultural protection buffer as part of a required site plan.			✓
7.1.1.k Support and promote the viability of Maui's agricultural businesses through property tax incentives and other programs and subsidies.			✓
7.1.1.l Encourage future community plan efforts to identify lands within the County Agricultural zoning district that are primarily being used for large-lot residential or rural use and consider such lands for reclassification to an appropriate County Rural zone.			✓
Objective:			
7.1.2 Reduction of the island's dependence on off-island agricultural products and expansion of export capacity.			✓
Policies:			
7.1.2.a Coordinate with the agricultural community, associations/community groups, agricultural landowners, and the State to designate IALs.			✓
7.1.2.b Support an incentive package for productive Agricultural Lands which aims to ensure agricultural viability for small- and commercial-scale agricultural producers.			✓
7.1.2.c Actively look to acquire land and provide infrastructure to expand the agricultural park and establish new agricultural parks.			✓
7.1.2.d Support the designation of a research and development area within agricultural parks to help farmers stay attuned to new technology and research.			✓
7.1.2.e Support local cooperative extension services to facilitate timely technology transfer opportunities.			✓
7.1.2.f Support plans and programs to develop additional sources of water for irrigation purposes.			✓
7.1.2.g Consider appropriate subdivision requirements (gravel roads, above-ground utilities, etc.) in those subdivisions creating Agricultural Parks where lots are limited to agricultural production with no dwellings.			✓
7.1.2.h Support the recommendations, policies, and actions contained within the Maui Agricultural Development Plan, July 2009, when consistent with the MIP.			✓
7.1.2.i Allow water and tax discounts for legitimate farming operations on rural and agricultural land.			✓
7.1.2.j Give priority in delivery and use of agricultural water and agricultural land within County agricultural parks to cultivation of food crops for local consumption.			✓
7.1.2.k Support programs that control pests and diseases that affect agriculture.			✓
7.1.2.l Support the development of training and apprenticeship programs to encourage an adequate supply of agricultural workers.			✓
Objective:			
7.1.3 Support and facilitate connectivity between communities.			✓

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
Policies:			
7.1.3.a Evaluate the impact of gated communities on interconnectivity.			✓
7.1.3.b Discourage land use and urban design that impedes interconnectivity between adjacent communities.			✓
Analysis: **Not applicable.**			
RURAL AREAS			
Goal:			
7.2 Maui will have a rural landscape and lifestyle where natural systems, cultural resources and farm lands are protected and development enhances and compliments the viability and character of rural communities.			✓
Objective:			
7.2.1 Reduce the proliferation and impact of residential development outside of urban, small town, and rural growth boundaries.			✓
Policies:			
7.2.1.a Focus development to areas inside urban, small town, and rural growth boundaries to preserve natural, cultural, and agricultural resources.			✓
7.2.1.b Encourage cluster development with a mandatory buffer requirement/clear edge at the interface of country towns, agricultural uses, and surrounding rural landscapes.			✓
7.2.1.c Encourage or require, where appropriate, CSDs and the use of green spaces/natural separations to protect the character of rural landscapes.			✓
7.2.1.d Encourage basic goods/services in business country towns.			✓
7.2.1.e Allow for mixed uses, including residential uses, within Business Country Town Districts.			✓
7.2.1.f Encourage the use of alternative stormwater management techniques that minimize land disturbance and preserve natural drainage features.			✓
7.2.1.g Encourage green belts, open space buffers, and riparian zones to minimize conflicts between agriculture and residential uses.			✓
7.2.1.h Evaluate the impact of gated communities on inter-connectivity.			✓
Objective:			
7.2.2 More appropriate service/infrastructure standards to enhance and protect the island's rural character and natural systems.			✓
Policies:			
7.2.2.a Minimize impermeable surfaces within rural areas.			✓
7.2.2.b Protect and support the character, economic viability, and historic integrity of Maui's small towns.			✓

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
7.2.2.c Use infrastructure, public service, and design standards that are appropriate to rural areas.			✓
7.2.2.d Discourage land use and urban design that impede interconnectivity between adjacent communities.			✓
Analysis: **Not applicable.**			
URBAN AREAS			
Goal:			
7.3 Maui will have livable human-scale urban communities, an efficient and sustainable land use pattern, and sufficient housing and services for Maui residents.	✓		
Objective:			
7.3.1 Facilitate and support a more compact, efficient, human-scale urban development pattern.			✓
Policies:			
7.3.1.a Ensure higher-density compact urban communities, infill, and redevelopment of underutilized urban lots within Urban Growth Boundaries.			✓
7.3.1.b Maintain a distinct separation between communities, such as but not limited to, Wailuku and Waikapū; Wailuku and Waiheʻe; Pukalani and Makawao; Pukalani and Kula; Makawao and Hāliʻimaile; Lahaina and Kāʻanapali; Kīhei and Māʻalaea; and Māʻalaea and Waikapū, to protect the character and identity of Maui's communities.			✓
7.3.1.c Strengthen evaluation requirements for new urban expansion, new towns, and major urban infill projects within urban growth areas. Tailor submittal requirements to reflect the impact or scale of different projects.			✓
7.3.1.d Ensure future amendments to urban growth boundaries achieve the following: (1) provide a beneficial extension of the existing community; (2) are in areas where it is cost-effective to provide and operate infrastructure/public service facilities; and (3) do not promote automobile-oriented land use patterns.			✓
7.3.1.e Evaluate the impact of gated communities on inter-connectivity.			✓
7.3.1.f Encourage the development and implementation of neighborhood design standards that are environmentally friendly, such as LEED for Neighborhood Development (LEED – ND) standards.			✓
7.3.1.g Discourage future pyramid zoning within the industrial zoning districts, while allowing accessory commercial uses and grandfathering existing uses.			✓
7.3.1.h Promote agriculture by encouraging community gardening, community-supported agricultural programs, and farmers markets within and adjacent to urban areas.			✓
7.3.1.i Discourage land use and urban design that impedes inter-connectivity between adjacent communities.			✓
Objective:			
7.3.2 Facilitate more self-sufficient and sustainable communities.			✓

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
Policies:			
7.3.2.a When developing new communities, provide sufficient lands for commercial, appropriate industrial, educational, spiritual, and non-profit uses to serve the daily needs of community residents.			✓
7.3.2.b Site community facilities such as schools, parks, libraries, and community centers within walking and biking distance of residences.			✓
7.3.2.c Facilitate self-sufficient communities and shorten commutes by:			✓
(1) Directing residential development to job-rich areas;			✓
(2) Allowing for appropriate commercial development and community services to shorten commutes; and			✓
(3) Allowing home occupations or home-based businesses that are compatible with surrounding neighborhoods and lifestyles.			✓
7.3.2.d Ensure, where appropriate, that affordable employee housing and multi-modal transportation opportunities are located near major employment centers.			✓
7.3.2.e Discourage the establishment of bedroom communities where long commutes are required to employment centers.			✓
7.3.2.f Facilitate the development of housing by focusing projects in locations where land and infrastructure costs facilitate the development of affordably-priced housing.			✓
7.3.2.g Provide incentives to facilitate the development of multifamily housing.			✓
7.3.2.h Encourage the placement of rental housing projects in the same areas as for-sale housing to facilitate mixed-income communities.			✓
7.3.2.i Develop communities that provide sufficient parks, schools, libraries, and other essential public facilities and services to serve resident needs.			✓
7.3.2.j Promote agriculture by encouraging community gardening, edible landscaping, community-supported agricultural programs, and farmers markets within and adjacent to urban areas.			✓
Objective:			
7.3.3 Strengthen the island's sense of place.		✓	
Policies:			
7.3.3.a Protect and enhance the unique architectural and landscape characteristics of each community.			✓
7.3.3.b Encourage Hawaiian architecture and tropical building designs.			✓
7.3.3.c Support the continued revitalization of historic country towns, Wailuku Town, and Kahului's commercial core and harbor-front without displacing traditional, cultural, recreational and customary uses.			✓

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
7.3.3.d Strongly encourage the preservation of buildings, structures, and sites of historic significance.			✓
7.3.3.e Require community input through Design Workshops for major new urban expansion, new towns, and major urban infill projects.			✓
7.3.3.f Require design enhancement, landscaping, and integration of park and rides, bicycle parking areas, and mass-transit infrastructure to mitigate the effect of parking lots and structured parking on the urban landscape.			✓
7.3.3.g Ensure that safe and attractive public spaces (e.g., plazas, parks, town/village squares) are provided throughout the island's urban areas.		✓	
Objective:			
7.3.4 Strengthen planning and management for the visitor industry to protect resident quality of life and enhance the visitor experience.			✓
Policies:			
7.3.4.a Discourage the conversion of hotel units to timeshares and fractional ownership.			✓
7.3.4.b Monitor and manage the amount of, and impacts from, timeshares and fractional ownership.			✓
7.3.4.c Manage short-term rentals and bed-and-breakfast homes through a permitting and regulatory process in accordance with adopted ordinances and community plan policies.			✓
7.3.4.d Limit large-scale resort development to the four existing resort destination areas of Wailea, Mākena, Kapalua and Kā'anapali. "Large Scale Resort" is defined as complexes that include multiple accommodation facilities, activity businesses, retail complexes, and other amenities.		✓	
Objective:			
7.3.5 Ensure that Maui's planning and development review process becomes more transparent, efficient, and innovative.	✓		
Policies:			
7.3.5.a Encourage greater community involvement in land use planning and decision making.	✓		
7.3.5.b Establish a predictable and timely development review process that facilitates the approval of projects that meet planning and regulatory requirements.			✓
7.3.5.c Increase inter-agency coordination between the Department of Planning and all State and County agencies responsible for infrastructure and public facilities provision, particularly as it relates to the mitigation of long-term cumulative impacts resulting from development projects.			✓
7.3.5.d Provide greater certainty and transparency in the development review process.	✓		
7.3.5.e Expand and maintain land use and geographic information system databases for improved decisions, and make data and products available to the public.			✓

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable		DA	IA	NA
Analysis: **The proposed Project involves the restoration of Honokōwai Beach and is directly and indirectly applicable to the goal, objectives, and policies for urban areas. The proposed Project will restore an important cultural and recreational area and re-establish lateral and perpendicular shoreline access at Honokōwai Beach. Honokōwai Beach is located in an Urban Growth Area and a designated resort area in West Maui. The project will undergo a rigorous environmental review and entitlement process that will provide ongoing opportunities for public input.**				
CHAPTER 8 – DIRECTED GROWTH PLAN				
URBAN AND SMALL TOWN GROWTH AREA				
Goal:				
8.1	Maui will have well-serviced, complete, and vibrant urban communities and traditional small towns through sound planning and clearly defined development expectations.	✓		
Policies:				
8.1.a	The County, with public input, will be responsible for designating new growth areas where infrastructure and public facilities will be provided, consistent with the policies of the MIP and in accordance with State and County infrastructure plans.			✓
8.1.b	Amendments to a UGB or STB shall be reviewed as a MIP amendment. A UGB or STB shall only be expanded if the island-wide inventory (maintained by the Department of Planning) of existing land uses (residential, commercial, industrial) indicates that additional urban density land is necessary to provide for the needs of the projected population growth within ten years of that inventory; or, during the decennial update of the MIP.			✓
8.1.c	Community plans shall provide for urban density land use designations only within UGBs and Small Towns. The County may only support and approve State Urban Land Use Designations for areas within UGBs, STBs, and Rural Villages.			✓
8.1.d	The unique character and function of existing small towns shall be protected to retain and preserve their sense of place.			✓
8.1.e	New development shall be consistent with the UGBs, STBs, and all other applicable policies of the MIP. New urban-density development shall not be allowed outside of a UGB or STB.			✓
8.1.f	The County, as a condition of development approval, shall require developers of privately owned infrastructure systems to provide financial insurance (bonding, etc.) for the operation and maintenance of these systems.			✓
8.1.g	The County shall implement a zoning program to comprehensively redistrict and rezone lands within UGBs according to updated community plan policies and map designations.			✓
8.1.h	The County will seek to focus capital improvements (schools, libraries, roads, and other infrastructure and public facilities) within the UGBs and STBs in accordance with the MIP.	✓		
8.1.i	The County will promote (through incentives, financial participation, expedited project review, infrastructure/public facilities support, etc.) appropriate urban infill, redevelopment and the efficient use of buildable land within UGBs to avoid the need to expand the UGBs.			✓

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable		DA	IA	NA
8.1.j	The MIP's UGBs and STBs shall not be construed or implemented to prohibit the construction of a single-family dwelling on any existing parcel where otherwise permitted by law.			✓
Analysis: **The proposed Project involves the restoration and preservation of Honokōwai Beach and is directly applicable to the goal, objectives, and policies related to Urban and Small Town Growth Boundaries. The proposed Project is located in the Urban Growth Boundary. The restoration and preservation of Honokōwai Beach and the shoreline public walkway will preserve the unique character of Honokōwai for the enjoyment of present and future generations.**				
RURAL GROWTH AREA				
Goal:				
8.2	Maui will maintain opportunities for agriculture and rural communities through sound planning and clearly defined development expectations.			✓
Policies:				
8.2.a	Amendments to a RGB shall be reviewed as an MIP amendment. A RGB shall only be expanded if an island-wide inventory of existing land uses (residential, commercial, industrial) indicates that additional lands are necessary to provide for the needs of the projected population growth within ten years of that inventory; or, during the decennial update of the MIP.			✓
8.2.b	New development shall be consistent with RGB and all other applicable policies and requirements of the MIP. Public, quasi-public, civic, and limited commercial or industrial uses may be allowed in the RGB when the proposed uses demonstrate a public need and are consistent with the Community Plan and zoning.			✓
8.2.c	Environmental protection and compatibility will be a top priority in rural growth areas.			✓
8.2.d	All development within rural growth areas should avoid encroachment upon prime agricultural land.			✓
8.2.e	Rural growth areas include Rural Residential Areas and Rural Villages. Rural residential areas may be designated when they are located in association with or on the border of urban growth areas or Small Towns; and/or when they provide for complete, self-sufficient rural communities with a range of uses to be developed at densities that do not require urban infrastructure.			✓
8.2.f	Community plans shall provide for rural density land use designations only within RGBs; provided that limited community plan urban designations may be allowed within Rural Villages. New rural growth areas shall not be located where urban expansion may ultimately become necessary or desirable. New rural-density development shall not be allowed outside of a RGB.			✓
8.2.g	New rural growth areas intended to be complete, self-sufficient rural communities must be located a significant distance from existing urban areas, distinctly separated by agricultural or open lands.			✓
8.2.h	Urban-scale infrastructure and public facilities shall not be provided in rural areas except as described in the defined Level-of-Service (LOS) standards. There should be no expectations of urban services in rural areas.			✓
8.2.i	Urban development standards shall not be required within RGBs except in fulfillment of Federal law.			✓

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable		DA	IA	NA
8.2.j	The unique character and function of existing small towns and rural communities shall be protected to retain and preserve their sense of place.			✓
8.2.k	Preserve rural landscapes in which natural systems, cultural resources, and agricultural lands are protected and development compliments rural character and contributes to the viability of communities and small towns.			✓
8.2.l	The MIP's RGBs shall not be construed or implemented to prohibit the construction of a single family dwelling on any existing parcel where otherwise permitted by law.			✓
8.2.m	The County shall implement a zoning program to comprehensively redistrict and rezone lands within RGBs, and to implement community plan policies and map designations.			✓
8.2.n	At the time of zoning from agricultural to rural, Council will consider prohibiting restrictions on agricultural activity.			✓
Analysis:	**Not applicable. Honokōwai Beach is not located within a Rural Growth Boundary.**			
PROTECTED AREA POLICY				
8.3.a	The Protected Areas in Diagrams E-1, NW-1, N-1, NE-1, S-1, SE-1, and WC-1 should be concurrently reviewed with Table 8-2 and with any proposed land uses that may result in an adverse impact on a Protected Area. The County Council and the Administration should be notified if a Protected Area may be compromised by a development proposal.			✓
Analysis:	**Not applicable. Honokōwai Beach is not located in a Protected Area.**			

PARTIES CONSULTED DURING THE 30-DAY COMMENT PERIOD OF THE ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE; LETTERS RECEIVED; AND RESPONSES TO SUBSTANTIVE COMMENTS

APPENDIX

M

JOSH GREEN, M.D.
GOVERNOR
KE KIA'ĀINA

KEITH A. REGAN
COMPTROLLER
KA LUNA HO'OMALU HANA LAULĀ

MEOH-LENG SILLIMAN
DEPUTY COMPTROLLER
KA HOPE LUNA HO'OMALU HANA LAULĀ

STATE OF HAWAI'I | KA MOKU'ĀINA O HAWAI'I
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES | KA 'OIHANA LOIHELU A LAWELAWE LAULĀ
P.O. BOX 119, HONOLULU, HAWAII 96810-0119

(P)23.005

JAN 12 2023

MEMORANDUM

TO: Michael Cain, Administrator
Office of Conservation and Coastal Lands
Department of Land and Natural Resources

FROM: Christine L. Kinimaka
Public Works Administrator

SUBJECT: Environmental Impact Statement Preparation Notice for
Hoala Honokowai Project
Lahaina, Maui, Hawaii
TMK: (2) 4-4-001: 097, 098, and 100

Thank you for the opportunity to comment on the subject project. Although the project site is within close proximity of our Lahaina Civic Center, we believe it will not impact any of our projects or existing facilities. We offer no comments at this time but wish to be kept informed of the project as it moves forward.

If you have any questions, your staff may call Gayle Takasaki of the Planning Branch at (808) 586-0584.

GT:mo
c: Jeff Pearson, DAGS Maui District Office
Sea Engineering

https://www.hoalahonokowai.com | T: (808) 244-2015 | E: honokowai@munekiyohiraga.com

October 31, 2025

Gordon Wood, Public Works Administrator
State of Hawai'i
Department of Accounting and General Services
P. O. Box 119
Honolulu, Hawai'i 96810

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Ho'āla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawai'i

Dear Mr. Wood:

Thank you for your comment letter dated January 12, 2023 regarding the Ho'āla Honokōwai Project Environmental Impact Statement (EIS) Preparation Notice. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the comment received.

Comment:

Although the project site is within close proximity of our Lahaina Civic Center, we believe it will not impact any of our projects or existing facilities. We offer no comments at this time but wish to be kept informed of the project as it moves forward.

Response:

We note that the Lahaina Civic Center is located approximately three (3) miles to the south of the Project Site. We acknowledge your determination that the Project would not impact your Department's projects or existing facilities.

Thank you again for your participation in the Chapter 343, Hawai‘i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 244-2015.

Very truly yours,

Tessa Ng

Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Michael Cain, Office of Conservation and Coastal Lands
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JOSH GREEN, M.D.
GOVERNOR OF HAWAI'I
KE KIA'ĀINA O KA MOKU'ĀINA 'O HAWAI'I

ELIZABETH A. CHAR, M.D.
DIRECTOR OF HEALTH
KA LUNA HO'OKELE

STATE OF HAWAI'I
DEPARTMENT OF HEALTH
KA 'OIHANA OLAKINO
P. O. BOX 3378
HONOLULU, HI 96801-3378

In reply, please refer to:
File:

December 30, 2022

Mr. Michael Cain, Administrator
Office of Conservation and Coastal Lands
Department of Land and Natural Resources
State of Hawaii
1151 Punchbowl Street, Room 131
Honolulu, HI 96813

Dear Mr. Cain:

Subject: Environmental Impact Statement Preparation Notice for the Ho`ala Honokowai Project
Tax Map Keys (2) 4-4-001:097, 098 and 100
Lahaina, Maui, Hawaii

Thank you for the opportunity to comment on this project. We have no comments to offer.

It is strongly recommended that you review the department's website at https://health.hawaii.gov/epo/landuse/ and contact the appropriate program that concerns your project.

Should you have any questions, please contact me at 808 984-8230 or email me at patricia.kitkowski@doh.hawaii.gov.

Sincerely,

Patti Kitkowski

Patti Kitkowski
District Environmental Health Program Chief

c Joanna Seto, EMD Chief {Via Email}
Andy Bohlander, Sea Engineering, Inc. {honokowai@seaengineering.com}

Ho‘āla
Honokōwai

https://www.hoalahonokowai.com | T: (808) 244-2015 | E: honokowai@munekiyohiraga.com

October 31, 2025

Patti Kitkowski, District Environmental
Health Program Chief
State of Hawaii
Department of Health
Environmental Health Program
P. O. Box 3378
Honolulu, Hawai‘i 96801-3378

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Ho‘āla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawai‘i

Dear Ms. Kitkowski:

Thank you for your comment letter dated December 30, 2022 regarding the Ho‘āla Honokōwai Project Environmental Impact Statement (EIS) Preparation Notice. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the letter received.

Recommendation:

It is strongly recommended that you review the department's website at https://health.hawaii.gov/epo/landuse/ and contact the appropriate program that concerns your project.

Response:

We acknowledge that your office has no comments at this time. Thank you for the resources provided by your Department's website. The project team will review these resources and consult with the appropriate Department program, as applicable to the project. The EISPN was submitted for review to the Maui Sanitation Branch, the Clean Water Branch, and the Solid and Hazardous Waste Branch.

Thank you again for your participation in the Chapter 343, Hawai‘i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 244-2015.

Very truly yours,

Tessa Ng

Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Michael Cain, Office of Conservation and Coastal Lands
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JOSH GREEN, M.D.
GOVERNOR | KE KIA'ĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIA'ĀINA

DAWN N.S. CHANG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAI'I | KA MOKU'ĀINA 'O HAWAI'I
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

P.O. BOX 621
HONOLULU, HAWAII 96809

January 23, 2023

Sea Engineering, Inc.
Attn: Mr. Andy Bohlander via email: honokowai@seaengineering.com
Coastal Scientist & Project Manager
41-305 Kalanianaole Highway
Waimanalo, Hawaii 96795

Dear Mr. Bohlander:

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN) for the Proposed **Ho'ala Honokowai** Beach Restoration Project located at Honokowai, Island of Maui; TMK: (2) 4-4-001: 097, 098, and 100 on behalf of West Maui Resort Partners, L.P.

Thank you for the opportunity to review and comment on the subject matter. The Land Division of the Department of Land and Natural Resources (DLNR) distributed or made available a copy of your request pertaining to the subject matter to DLNR's Divisions for their review and comments.

At this time, enclosed are comments from the (a) Engineering Division and (b) Office of Conservation & Coastal Lands on the subject matter. Should you have any questions, please feel free to contact Darlene Nakamura at (808) 587-0417 or email: darlene.k.nakamura@hawaii.gov. Thank you.

Sincerely,

Russell Tsuji

Russell Y. Tsuji
Land Administrator

Enclosures
cc: Central Files

JOSH GREEN, M.D.
GOVERNOR | KE KIA'ĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIA'ĀINA

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAI'I | KA MOKU'ĀINA 'O HAWAI'I
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

P.O. BOX 621
HONOLULU, HAWAII 96809

Dec 28, 2022

MEMORANDUM

FROM: ~~TO:~~

DLNR Agencies:
_X_ Div. of Aquatic Resources (kendall.l.tucker@hawaii.gov)
___ Div. of Boating & Ocean Recreation
_X_ Engineering Division (DLNR.ENGR@hawaii.gov)
_X_ Div. of Forestry & Wildlife (rubyrosa.t.terrago@hawaii.gov)
___ Div. of State Parks
_X_ Commission on Water Resource Management (DLNR.CWRM@hawaii.gov)
_X_ Office of Conservation & Coastal Lands (sharleen.k.kuba@hawaii.gov)
_X_ Land Division – Maui District (daniel.l.ornellas@hawaii.gov)

TO: ~~FROM:~~ Russell Y. Tsuji, Land Administrator *Russell Tsuji*
SUBJECT: Environmental Impact Statement Preparation Notice (EISPN) for the Proposed **Ho'ala Honokowai** Beach Restoration Project
LOCATION: Honokowai, Island of Maui; TMK: (2) 4-4-001: 097, 098, and 100
APPLICANT: Sea Engineering, Inc. on behalf of West Maui Resort Partners, L.P.

Transmitted for your review and comment is information on the above-referenced subject matter. The EISPN was published on December 23, 2022 by the State Environmental Review Program (formerly the Office of Environmental Quality Control) at the Office of Planning and Sustainable Development in the periodic bulletin, The Environmental Notice, available at the following link:

https://files.hawaii.gov/dbedt/erp/The_Environmental_Notice/2022-12-23-TEN.pdf

Please submit any comments by **January 20, 2023**. If no response is received by this date, we will assume your agency has no comments. Should you have any questions, please contact Darlene Nakamura directly via email at darlene.k.nakamura@hawaii.gov. Thank you.

BRIEF COMMENTS:

( ) We have no objections.
( ) We have no comments.
( ) We have no additional comments.
(✓) Comments are included/attached.

Signed: *Carty S. Chang*
Print Name: Carty S. Chang, Chief Engineer
Division: Engineering Division
Date: Jan 17, 2023

Attachments
cc: Central File

DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

LD/Russell Y. Tsuji

Ref: Environmental Impact Statement Preparation Notice (EISPN) for the Proposed Hoʻala Honokowai Beach Restoration Project
Location: Honokowai, Island of Maui
TMK(s): (2) 4-4-001: 097, 098, and 100
Applicant: Sea Engineering, Inc. on behalf of West Maui Resort Partners, L.P.

COMMENTS

The rules and regulations of the National Flood Insurance Program (NFIP), Title 44 of the Code of Federal Regulations (44CFR), are in effect when development falls within a Special Flood Hazard Area (high-risk areas). Be advised that 44CFR, Chapter 1, Subchapter B, Part 60 reflects the minimum standards as set forth by the NFIP. Local community flood ordinances may stipulate higher standards that can be more restrictive and would take precedence over the minimum NFIP standards.

The owner of the project property and/or their representative is responsible to research the Flood Hazard Zone designation for the project. Flood zones subject to NFIP requirements are identified on FEMA's Flood Insurance Rate Maps (FIRM). The official FIRMs can be accessed through FEMA's Map Service Center (msc.fema.gov). Our Flood Hazard Assessment Tool (FHAT) (http://gis.hawaiinfip.org/FHAT) could also be used to research flood hazard information.

If there are questions regarding the local flood ordinances, please contact the applicable County NFIP coordinating agency below:

- Oahu: City and County of Honolulu, Department of Planning and Permitting (808) 768-8098.
- Hawaii Island: County of Hawaii, Department of Public Works (808) 961-8327.
- Maui/Molokai/Lanai County of Maui, Department of Planning (808) 270-7139.
- Kauai: County of Kauai, Department of Public Works (808) 241-4849.

Signed: _____
CARTY S. CHANG, CHIEF ENGINEER

Date: Jan 17, 2023

https://www.hoalahonokowai.com | T: (808) 244-2015 | E: honokowai@munekiyohiraga.com

October 31, 2025

Via email: dlnr@hawaii.gov and DLNR.ENGR@hawaii.gov

Dina U Lau, Acting Chief Engineer
State of Hawai'i
Department of Land and Natural Resources
Engineering Division
P. O. Box 621
Honolulu, Hawai'i 96809

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Ho'āla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawai'i

Dear Ms. Lau:

Thank you for your department's comment letter dated January 17, 2023 regarding the Ho'āla Honokōwai Project Environmental Impact Statement (EIS) Preparation Notice. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the comments received.

Comment No. 1:

The rules and regulations of the National Flood Insurance Program (NFIP), Title 44 of the Code of Federal Regulations (44CFR), are in effect when development falls within a Special Flood Hazard Area (high-risk areas). Be advised that 44CFR, Chapter 1, Subchapter B, Part 60 reflects the minimum standards as set forth by the NFIP. Local community flood ordinances may stipulate higher standards that can be more restrictive and would take precedence over the minimum NFIP standards.

Response:

The Project Site is designated as Special Flood Hazard Areas pursuant to Maui County Code Chapter 19.62. As such, the project team will consult with the Maui County Flood Plain Manager to determine compliance requirements for development within the Project Site.

Comment No. 2:

The owner of the project property and/or their representative is responsible to research the Flood Hazard Zone designation for the project. Flood zones subject to NFIP requirements are identified on FEMA's Flood Insurance Rate Maps (FIRM). The official FIRMs can be accessed through FEMA's Map Service Center (msc.fema.gov). Our Flood Hazard Assessment Tool (FHAT) (http://gis.hawaiinfip.org/FHAT) could also be used to research flood hazard information.

Response:

The Applicant notes that the project site is located within Flood Zone VE as identified by FEMA's Flood Insurance Rate Map (FIRM). The Draft EIS will include an assessment of flooding at the Project Site.

Thank you again for your participation in the Chapter 343, Hawai'i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 244-2015.

Very truly yours,

Tessa Ng

Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Michael Cain, Office of Conservation and Coastal Lands
Darlene Nakamura, DLNR Engineering Division
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JOSH GREEN, M.D.
GOVERNOR | KE KIA'ĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIA'ĀINA

DAWN N.S. CHANG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAI'I | KA MOKU'ĀINA 'O HAWAI'I
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

P.O. BOX 621
HONOLULU, HAWAII 96809

January 23, 2023

Sea Engineering, Inc.
Attn: Mr. Andy Bohlander via email: honokowai@seaengineering.com
Coastal Scientist & Project Manager
41-305 Kalanianaole Highway
Waimanalo, Hawaii 96795

Dear Mr. Bohlander:

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN) for the Proposed **Ho'ala Honokowai** Beach Restoration Project located at Honokowai, Island of Maui; TMK: (2) 4-4-001: 097, 098, and 100 on behalf of West Maui Resort Partners, L.P.

Thank you for the opportunity to review and comment on the subject matter. The Land Division of the Department of Land and Natural Resources (DLNR) distributed or made available a copy of your request pertaining to the subject matter to DLNR's Divisions for their review and comments.

At this time, enclosed are comments from the (a) Engineering Division and (b) Office of Conservation & Coastal Lands on the subject matter. Should you have any questions, please feel free to contact Darlene Nakamura at (808) 587-0417 or email: darlene.k.nakamura@hawaii.gov. Thank you.

Sincerely,

Russell Tsuji

Russell Y. Tsuji
Land Administrator

Enclosures
cc: Central Files

JOSH GREEN, M.D.
GOVERNOR | KE KIA'ĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIA'ĀINA

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RECEIVED
LAND DIVISION
2023 JAN -5 PM 1:56
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

STATE OF HAWAI'I | KA MOKU'ĀINA 'O HAWAI'I
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

P.O. BOX 621
HONOLULU, HAWAII 96809

Dec 28, 2022

MEMORANDUM

TO: **DLNR Agencies:**
X Div. of Aquatic Resources (kendall.l.tucker@hawaii.gov)
__Div. of Boating & Ocean Recreation
X Engineering Division (DLNR.ENGR@hawaii.gov)
X Div. of Forestry & Wildlife (rubyrosa.t.terrago@hawaii.gov)
__Div. of State Parks
X Commission on Water Resource Management (DLNR.CWRM@hawaii.gov)
X Office of Conservation & Coastal Lands (sharleen.k.kuba@hawaii.gov)
X Land Division – Maui District (daniel.l.ornellas@hawaii.gov)

FROM: Russell Y. Tsuji, Land Administrator *Russell Tsuji*
SUBJECT: Environmental Impact Statement Preparation Notice (EISPN) for the Proposed **Ho'ala Honokowai** Beach Restoration Project
LOCATION: Honokowai, Island of Maui; TMK: (2) 4-4-001: 097, 098, and 100
APPLICANT: Sea Engineering, Inc. on behalf of West Maui Resort Partners, L.P.

Transmitted for your review and comment is information on the above-referenced subject matter. The EISPN was published on December 23, 2022 by the State Environmental Review Program (formerly the Office of Environmental Quality Control) at the Office of Planning and Sustainable Development in the periodic bulletin, The Environmental Notice, available at the following link:

https://files.hawaii.gov/dbedt/erp/The_Environmental_Notice/2022-12-23-TEN.pdf

Please submit any comments by **January 20, 2023**. If no response is received by this date, we will assume your agency has no comments. Should you have any questions, please contact Darlene Nakamura directly via email at darlene.k.nakamura@hawaii.gov. Thank you.

BRIEF COMMENTS:

OCCL will respond directly.

( ) We have no objections.
( ) We have no comments.
( ) We have no additional comments.
( ) Comments are included/attached.

Signed: MC
Print Name: Michael Cain
Division: OCCL
Date: 12- 01-04-23

Attachments
cc: Central File

JOSH GREEN, M.D.
GOVERNOR | KE KIA'ĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIA'ĀINA

STATE OF HAWAI'I | KA MOKU'ĀINA 'O HAWAI'I
DEPARTMENT OF LAND AND NATURAL RESOURCES
Office of Conservation and Coastal Lands
P.O. BOX 621
HONOLULU, HAWAI'I 96809

DAWN N. S. CHANG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

FIRST DEPUTY

M. KALEO MANUEL
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

REF:OCCL:CM

Correspondence: MA 23-112
Jan 19, 2023

Andy Bohlander
Sea Engineering, Inc.
41-305 Kalanianaole Highway
Waimanalo, HI 96795

SUBJECT: Comments on the Environmental Impact Statement Preparation Notice (EISPN) for the Proposed Hoala Honokowai Beach Restoration Project; Honokowai, Maui; Tax Map Keys: (2) 4-4-001:seaward of 097, 098, and 100

Dear Mr. Bohlander:

The Department of Land and Natural Resources (DLNR), Office of Conservation and Coastal Lands (OCCL), has reviewed the information package you submitted regarding the subject matter. Accordingly, a 2016 episodic erosion event caused by a persistent North Pacific swell and elevated water levels resulted in significant beach loss in the vicinity. As a result of the event, the shoreline area and approximately 5,600 square feet of fast land (land mauka of the shoreline) was lost. The eroded area did not recover from the devastating erosion event.

The intent of your project is to restore and preserve Honokowai Beach fronting the subject parcels. You are proposing to accomplish this by considering three potential methods, as follows:

1. *Beach Nourishment*: A one-time, single action involving the placement of additional sand to increase the beach width and sand volume.

2. *Beach Maintenance*: A series of recurring actions over time involving the placement of additional sand, combined with sand pushing or backpassing. Maintenance would be conducted on a recurring, periodic basis.

3. *Beach Nourishment with Stabilizing Structures*: A one-time, single action involving the placement of sand, along with the modification of existing structures and/or the installation of a new structure (groin).

After reviewing the EISPN, the Department finds that:

1. The proposed land use appears to be an identified land use in the Conservation District pursuant to the Hawaii Administrative Rules (HAR), Section 13-5-22, (P-15) SHORELINE EROSION CONTROL (D-1), which states, "*Seawall, revetment, groin, or other coastal erosion control structure or device, including sand placement, to control erosion of land or inland area by coastal waters, provided that the applicant shows that (1) the applicant would be deprived of all reasonable use of the land or building without the permit; (2) the use would not adversely affect beach processes or lateral public access along the shoreline, without adequately compensating the State for its loss; or (3) public facilities (e.g., public roads) critical to public health, safety, and welfare would be severely damaged or destroyed without a shoreline erosion control structure, and there is no reasonable alternatives (e.g., relocation).* ***Requires a certified shoreline.***"

2. Further subject to HAR, Section 13-5-22, (P-16) BEACH RESTORATION (C-1), which states, "*Sand placement not to exceed 10,000 cubic yards per occasion, with minor sand retention structures, extraction of sand from submerged lands, and transportation or transmission of sand from an offshore extraction site to the replenishment site*", and (P-16) (D-1), which states, *Sand placement in excess of 10,000 cubic yards including structures necessary to retain sand, extraction of sand from submerged lands, and transportation or transmission of sand from an offshore extractions site to the replenishment site.*"

   This use requires a permit from the Board of Land and Natural Resources, who has the final authority to modify, grant, or deny any permit.

3. Pursuant to HAR, Section 13-5-40(a)(4), a public hearing is required.

4. Pursuant to the Hawaii Revised Statutes, Section 6E-8, written concurrence of "no historic properties affected" from the State Historic Preservation Division is required.

5. A discussion relating to Act 16 which prohibits the construction of private shoreline hardening structures, including seawalls and revetment, should be included.

6. Any construction of a man-made structure (e.g., groin) makai of the shoreline may require a land disposition.

7. Pursuant to HAR, Section 13-5-31, PERMIT APPLICATIONS, the permit requires that an environmental assessment or environmental impact statement be carried out.

   An EISPN has been published in the The Environmental Notice on December 23, 2022; Hoala Honokowai – (EIS Preparation Notice).

Should you have any questions regarding this correspondence, please feel free to contact Cal Miyahara of our Office at (808) 798-6147 or calen.miyahara@hawaii.gov .

Sincerely,

S Michael Cain

Michael Cain, Administrator
Office of Conservation and Coastal Lands

CC: MDLO
Maui County Planning Department

https://www.hoalahonokowai.com | T: (808) 244-2015 | E: honokowai@munekiyohiraga.com

October 31, 2025

Via email: dlnr@hawaii.gov and sharleen.k.kuba@hawaii.gov

Michael Cain
State of Hawai'i
Department of Land and Natural Resources
Office of Conservation and Coastal Lands
P. O. Box 621
Honolulu, Hawai'i 96809

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Ho'āla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawai'i (MA23-112)

Dear Mr. Cain:

Thank you for your comment letters dated January 4, 2023 and January 19, 2023 regarding the Ho'āla Honokōwai Project Environmental Impact Statement (EIS) Preparation Notice. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the comments received.

Comment No. 1:

1. *The proposed land use appears to be an identified land use in the Conservation District pursuant to the Hawaii Administrative Rules (HAR), Section 13-5-22, (P-15) SHORELINE EROSION CONTROL (D-1), which states, "Seawall, revetment, groin, or other coastal erosion control structure or device, including sand placement, to control erosion of land or inland area by coastal waters, provided that the applicant shows that (1) the applicant would be deprived of all reasonable use of the land or building without the permit; (2) the use would not adversely affect beach processes or lateral public access along the shoreline, without adequately compensating the State for its loss; or (3) public facilities (e.g., public roads) critical to public health, safety, and welfare would be severely damaged or destroyed without a shoreline erosion control structure, and there is no reasonable alternatives (e.g., relocation).* ***Requires a certified shoreline****."*

Response:

We acknowledge this comment. A Conservation District Use Permit (CDUP) application, along with a Certified Shoreline Survey, would be submitted for review by the Office of Conservation and Coastal Lands as applicable to the project. The Conservation District

Rules identify allowed uses in the various Conservation District subzones and the types of permits required (HAR § 13-5-22). The Proposed Action would be consistent with the following identified use, which would require a CDUP from the Board of Land and Natural Resources (BLNR).

P-16 Beach Restoration

(D-1) Sand placement in excess of 10,000 cy including structures necessary to retain sand, extraction of sand from submerged lands, and transportation or transmission of sand from an offshore extraction site to the replenishment site.

The Beach Stabilization alternative may also be consistent with P-15, Shoreline Erosion Control, which also requires a CDUP from the BLNR. While the proposed action is primarily a beach restoration action, the Beach Stabilization methodology would include the construction of stabilizing groins, as allowed under P-16 Beach Restoration.

The proposed Project is a nature-based solution that is intended to preserve and restore a sandy public beach. No shoreline hardening structures, such as seawalls or revetments, are proposed.

Comment No. 2:

2. *Further subject to HAR, Section 13-5-22, (P-16) BEACH RESTORATION (C-1), which states, "Sand placement not to exceed 10,000 cubic yards per occasion, with minor sand retention structures, extraction of sand from submerged lands, and transportation or transmission of sand from an offshore extraction site to the replenishment site", and (P-16) (D-1), which states, Sand placement in excess of 10,000 cubic yards including structures necessary to retain sand, extraction of sand from submerged lands, and transportation or transmission of sand from an offshore extractions site to the replenishment site."*

This use requires a permit from the Board of Land and Natural Resources, who has the final authority to modify, grant, or deny any permit.

Response:

We acknowledge that the proposed use requires a permit from the BLNR in order to extract, transport, or retain sand in excess of 10,000 cubic yards.

Comment No. 3:

3. *Pursuant to HAR, Section 13-5-40(a)(4), a public hearing is required.*

Response:

We understand that a public hearing before the BLNR or their delegated representative is required pursuant to HAR, Section 13-5-40(a)(4).

Comment No. 4:

4. Pursuant to the Hawaii Revised Statutes, Section 6E-8, written concurrence of "no historic properties affected" from the State Historic Preservation Division is required.

Response:

We acknowledge this comment. HRS Chapter 6E review would be initiated in connection with the applicable County and State permit processes.

Comment No. 5:

5. A discussion relating to Act 16 which prohibits the construction of private shoreline hardening structures, including seawalls and revetment, should be included.

Response:

The Proposed Action is beach restoration and does not involve construction of shoreline hardening structures. The term "shoreline hardening" typically refers to shore protection structures (e.g., seawalls, revetments, bulkheads) that are oriented along and parallel to the shoreline and are intended to mitigate erosion and loss of land, retain soil loads, and reduce or mitigate wave overtopping and flooding. These structures are therefore appropriately referred to as "shore protection structures".

There is a common misconception that groins are equivalent to "shoreline hardening". Groins are engineered structures that are oriented perpendicular to the shoreline. In some cases, groins may include heads with various configurations that are oblique or parallel to the shoreline but located further offshore. Groins are a nature-based solution that utilizes a combination of natural processes and human engineering to create stable beaches. Groins are therefore appropriately referred to as "beach stabilizing structures". There are fundamental differences between beach stabilizing structures and shore protection structures as their design characteristics, intended uses, and potential impacts are substantially different.

Shore protection structures are designed to mitigate erosion and loss of land by creating a hard barrier between the land and the ocean, thereby preventing erosion of fast land and loss of sediment (soil) in the cross-shore direction. While shore protection structures can be very effective in stabilizing the shoreline and protecting land and infrastructure, they are not designed to stabilize beaches. In some cases, the presence of an armored shoreline can exacerbate beach erosion, particularly along chronically eroding shorelines. In contrast, beach nourishment projects may include beach stabilizing structures, such as groins, that are designed to stabilize sandy beaches by inhibiting the movement of sand along the shoreline or the loss of sand due to erosion.

Comment No. 6:

6. Any construction of a man-made structure (e.g., groin) makai of the shoreline may require a land disposition.

Response:

We understand that a land disposition may be required for construction of structures makai of the shoreline.

Comment No. 7:

7. Pursuant to HAR, Section 13-5-31, PERMIT APPLICATIONS, the permit requires that an environmental assessment or environmental impact statement be carried out.

An EISPN has been published in the The Environmental Notice on December 23, 2022; Hoala Honokowai - (EIS Preparation Notice).

Response:

We acknowledge this comment. In accordance with HAR, Section 13-5-31, an EIS will be carried out.

Thank you again for your participation in the Chapter 343, Hawai'i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 244-2015.

Very truly yours,

Tessa Ng

Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Darlene Nakamura, DLNR Engineering Division
K:\DATA\HGV\KBC Beach Restor\Apps\EISPN\Resp Ltr\DLNR OCCL.docx

JOSH GREEN, M.D.
GOVERNOR | KE KIAʻĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIAʻĀINA

DAWN N. S. CHANG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAIʻI | KA MOKUʻĀINA ʻO HAWAIʻI
DEPARTMENT OF LAND AND NATURAL RESOURCES
KA ʻOIHANA KUMUWAIWAI ʻĀINA
LAND DIVISION

P.O. BOX 621
HONOLULU, HAWAII 96809

Feb 1, 2023

Sea Engineering, Inc.
Attn: Mr. Andy Bohlander via email: honokowai@seaengineering.com
Coastal Scientist & Project Manager
41-305 Kalanianaole Highway
Waimanalo, Hawaii 96795

Dear Mr. Bohlander:

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN) for the Proposed **Ho'ala Honokowai** Beach Restoration Project located at Honokowai, Island of Maui; TMK: (2) 4-4-001: 097, 098, and 100 on behalf of West Maui Resort Partners, L.P.

Thank you for the opportunity to review and comment on the subject matter. In addition to our previous comments dated January 23, 2023, enclosed are comments from the Division of Forestry & Wildlife on the subject matter. Should you have any questions, please feel free to contact Darlene Nakamura at (808) 587-0417 or email: darlene.k.nakamura@hawaii.gov. Thank you.

Sincerely,

Russell Tsuji

Russell Y. Tsuji
Land Administrator

Enclosures
cc: Central Files

JOSH GREEN, M.D.
GOVERNOR | KE KIAʻĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIAʻĀINA

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAIʻI | KA MOKUʻĀINA ʻO HAWAIʻI
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

P.O. BOX 621
HONOLULU, HAWAII 96809

Dec 28, 2022

MEMORANDUM

FROM: **DLNR Agencies:**
_X_ Div. of Aquatic Resources (kendall.l.tucker@hawaii.gov)
___Div. of Boating & Ocean Recreation
_X_ Engineering Division (DLNR.ENGR@hawaii.gov)
_X_ **Div. of Forestry & Wildlife** (rubyrosa.t.terrago@hawaii.gov)
___Div. of State Parks
_X_ Commission on Water Resource Management (DLNR.CWRM@hawaii.gov)
_X_ Office of Conservation & Coastal Lands (sharleen.k.kuba@hawaii.gov)
_X_ Land Division – Maui District (daniel.l.ornellas@hawaii.gov)

TO: Russell Y. Tsuji, Land Administrator *Russell Tsuji*
SUBJECT: Environmental Impact Statement Preparation Notice (EISPN) for the Proposed **Ho'ala Honokowai** Beach Restoration Project
LOCATION: Honokowai, Island of Maui; TMK: (2) 4-4-001: 097, 098, and 100
APPLICANT: Sea Engineering, Inc. on behalf of West Maui Resort Partners, L.P.

Transmitted for your review and comment is information on the above-referenced subject matter. The EISPN was published on December 23, 2022 by the State Environmental Review Program (formerly the Office of Environmental Quality Control) at the Office of Planning and Sustainable Development in the periodic bulletin, The Environmental Notice, available at the following link:

https://files.hawaii.gov/dbedt/erp/The_Environmental_Notice/2022-12-23-TEN.pdf

Please submit any comments by **January 20, 2023**. If no response is received by this date, we will assume your agency has no comments. Should you have any questions, please contact Darlene Nakamura directly via email at darlene.k.nakamura@hawaii.gov. Thank you.

BRIEF COMMENTS:

( ) We have no objections.
( ) We have no comments.
( ) We have no additional comments.
(☑) Comments are included/attached.

Signed: *Lainie Berry*
Print Name: LAINIE BERRY, Wildlife Program Mgr.
Division: Division of Forestry and Wildlife
Date: Feb 1, 2023

Attachments
cc: Central File

JOSH GREEN, M.D.
GOVERNOR | KE KIAʻĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIAʻĀINA

STATE OF HAWAIʻI | KA MOKUʻĀINA ʻO HAWAIʻI
DEPARTMENT OF LAND AND NATURAL RESOURCES
KA ʻOIHANA KUMUWAIWAI ʻĀINA

DIVISION OF FORESTRY AND WILDLIFE
1151 PUNCHBOWL STREET, ROOM 325
HONOLULU, HAWAII 96813

DAWN N.S. CHANG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

LAURA H.E. KAAKUA
FIRST DEPUTY

M. KALEO MANUEL
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

January 31, 2023

MEMORANDUM *Log no. 3958*

TO: RUSSELL Y. TSUJI, Land Administrator
Land Division

FROM: LAINIE BERRY, Wildlife Program Manager
Division of Forestry and Wildlife

SUBJECT: Division of Forestry and Wildlife Comments for the Environmental Impact Statement Preparation Notice (EISPN) for the Proposed Hoʻala Honokōwai Beach Restoration Project on Maui

The Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW) has received your request for comments for the ESIPN for the proposed Hoʻala Honokawai Beach restoration project located in Honokowai, on the island of Maui; TMKs: (2) 4-4-001:097, 4-4-001098, and 4-4-001100. The proposed project consists of restoring and preserving Honokōwai Beach through the selection of one of the following methods: beach nourishment, beach maintenance, and beach nourishment with stabilizing structures.

The State listed Hawaiian Hoary Bat or ʻŌpeʻapeʻa (*Lasiurus cinereus semotus*) could potentially occur at or in the vicinity of the project and may roost in nearby trees. Any required site clearing should be timed to avoid disturbance to bats during their birthing and pup rearing season (June 1 through September 15). During this period woody plants greater than 15 feet (4.6 meters) tall should not be disturbed, removed, or trimmed. Barbed wire should also be avoided for any construction because bats can become ensnared and killed by such fencing material during flight.

Artificial lighting can adversely impact seabirds that may pass through the area at night by causing them to become disoriented. This disorientation can result in their collision with manmade structures or the grounding of birds. For nighttime work that might be required, DOFAW recommends that all lights used be fully shielded to minimize the attraction of seabirds. Nighttime work that requires outdoor lighting should be avoided during the seabird fledging season, from September 15 through December 15, when young seabirds make their maiden voyage to sea. If nighttime construction is required during the seabird fledgling season, we recommend that a qualified biologist be present at the project site to monitor and assess the risk of seabirds being attracted or grounded due to the lighting. If seabirds are

seen circling around the area, lights should then be turned off. If a downed seabird is detected, please follow DOFAW's recommended response protocol by visiting https://dlnr.hawaii.gov/wildlife/seabird-fallout-season/#response.

Permanent lighting also poses a risk of seabird attraction, and as such should be minimized or eliminated to protect seabird flyways and preserve the night sky. For illustrations and guidance related to seabird-friendly light styles that also protect seabirds and the dark starry skies of Hawai'i please visit https://dlnr.hawaii.gov/wildlife/files/2016/03/DOC439.pdf.

The State endangered Hawaiian Monk Seal (*Monachus schauinslandi*) and threatened Green Sea Turtle (*Chelonia mydas*) could potentially occur or haul out onshore within the vicinity of the proposed project site. If either species is detected within 100 meters of the project area all nearby construction operations should cease and not continue until the focal animal has departed the area on its own accord.

The project area is within the range of the State listed Blackburn's Sphinx Moth (*Manduca blackburni*) or BSM. Larvae of BSM feed on many nonnative hostplants, which includes tree tobacco (*Nicotiana glauca*), that grow in disturbed soil. We recommend contacting the Maui Branch DOFAW office at (808) 984-8100 for further information about where BSM may be present and whether a vegetation survey should be conducted to determine the presence of plants preferred by BSM. DOFAW recommends removing plants less than one meter in height or during the dry season to avoid harm to BSM. If you intend to either remove tree tobacco over one meter in height or to disturb the ground around or within several meters of these plants, they must be thoroughly inspected by a qualified entomologist for the presence of BSM eggs and larvae.

DOFAW recommends using native plant species for landscaping that are appropriate for the area; i.e., plants for which climate conditions are suitable for them to thrive, plants that historically occurred there, etc. Please do not plant invasive species. DOFAW also recommends referring to www.plantpono.org for guidance on the selection and evaluation of landscaping plants and to determine the potential invasiveness of plants proposed for use in the project.

DOFAW recommends minimizing the movement of plant or soil material between worksites. Soil and plant material may contain detrimental fungal pathogens (e.g., Rapid 'Ōhi'a Death), vertebrate and invertebrate pests (e.g., Coqui Frogs, Little Fire Ants, etc.), or invasive plant parts (e.g., Miconia, Mullein, etc.) that could harm our native species and ecosystems. We recommend consulting the Maui Invasive Species Committee (MISC) at (808) 573-6472 to help plan, design, and construct the project, learn of any high-risk invasive species in the area, and ways to mitigate their spread. All equipment, materials, and personnel should be cleaned of excess soil and debris to minimize the risk of spreading invasive species.

We appreciate your efforts to work with our office for the conservation of our native species. These comments are general guidelines and should not be considered comprehensive for this site or project. It is the responsibility of the applicant to do their own due diligence to avoid any negative environmental impacts. Should the scope of the project change significantly, or should it become apparent that threatened or endangered species may be impacted, please contact our staff as soon as possible. If you have any questions, please contact Myrna N. Girald Pérez, Protected Species Habitat Conservation Planning Associate at (808) 265-3276 or myrna.girald-perez@hawaii.gov.

Sincerely,

Lainie Berry

LAINIE BERRY
Wildlife Program Manager

Log no. 3958 Comments- Environmental Impact Statement Preparation Notice for the Hoʻāla Honokōwai Project

Final Audit Report 2023-02-01

Created:	2023-01-31 (Hawaii-Aleutian Standard Time)
By:	Rubyrosa Terrago (rubyrosa.t.terrago@hawaii.gov)
Status:	Signed
Transaction ID:	CBJCHBCAABAAk1mXB_YCqy4BnwNtrR0vSCWHmhhdvpCH

"Log no. 3958 Comments- Environmental Impact Statement Preparation Notice for the Hoʻāla Honokōwai Project" History

Document created by Rubyrosa Terrago (rubyrosa.t.terrago@hawaii.gov)
2023-01-31 - 4:53:55 PM HST

Document emailed to Lainie Berry (lainie.berry@hawaii.gov) for signature
2023-01-31 - 4:54:41 PM HST

Document e-signed by Lainie Berry (lainie.berry@hawaii.gov)
Signature Date: 2023-02-01 - 11:49:36 AM HST - Time Source: server

Agreement completed.
2023-02-01 - 11:49:36 AM HST

https://www.hoalahonokowai.com | T: (808) 244-2015 | E: honokowai@munekiyohiraga.com

October 31, 2025

Via email: dlnr@hawaii.gov and rubyrosa.t.terrago@hawaii.gov

Jason Omick, Wildlife Program Manager
State of Hawai'i
Department of Land and Natural Resources
Division of Forestry and Wildlife
1151 Punchbowl Street, Room 325
Honolulu, Hawai'i 96813

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Ho'āla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawai'i (Log No. 3958)

Dear Mr. Omick:

Thank you for your department's comment letter February 1, 2023 and memorandum dated January 31, 2023 regarding the Ho'āla Honokōwai Project Environmental Impact Statement (EIS) Preparation Notice. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the comments received.

Comment No. 1:

The State listed Hawaiian Hoary Bat or 'Ōpe'ape'a (Lasiurus cinereus semotus) could potentially occur at or in the vicinity of the project and may roost in nearby trees. Any required site clearing should be timed to avoid disturbance to bats during their birthing and pup rearing season (June 1 through September 15). During this period woody plants greater than 15 feet (4.6 meters) tall should not be disturbed, removed, or trimmed. Barbed wire should also be avoided for any construction because bats can become ensnared and killed by such fencing material during flight.

Response:

The contractor would limit site clearing and the disturbance of any woody plants taller than 15 feet from occurring during June through September 15. Barbed wire would not be utilized during construction.

Comment No. 2:

Artificial lighting can adversely impact seabirds that may pass through the area at night by causing them to become disoriented. This disorientation can result in their

collision with manmade structures or the grounding of birds. For nighttime work that might be required, DOFAW recommends that all lights used be fully shielded to minimize the attraction of seabirds. Nighttime work that requires outdoor lighting should be avoided during the seabird fledging season, from September 15 through December 15, when young seabirds make their maiden voyage to sea. If nighttime construction is required during the seabird fledgling season, we recommend that a qualified biologist be present at the project site to monitor and assess the risk of seabirds being attracted or grounded due to the lighting. If seabirds are seen circling around the area, lights should then be turned off. If a downed seabird is detected, please follow DOFAW's recommended response protocol by visiting https://dlnr.hawaii.gov/ wildlife/seabird-fallout-season/#response.

Response:

The proposed Project would adhere to the Dark Sky Ordinance and limit nighttime work to utilizing fully shielded lights and would be avoided from September 15 through December 15, or would do so with the presence of a qualified biologist to monitor and assess risks to the seabirds.

Comment No. 3:

Permanent lighting also poses a risk of seabird attraction, and as such should be minimized or eliminated to protect seabird flyways and preserve the night sky. For illustrations and guidance related to seabird-friendly light styles that also protect seabirds and the dark starry skies of Hawai'i please visit https://dlnr.hawaii.gov/wildlife/files/2016/03/DOC439.pdf.

Response:

Permanent lighting is not anticipated to be required for the proposed Project. However, should permanent lighting be required, it would be limited to downward facing and shielded light and would comply with the Dark Sky Ordinance.

Comment No. 4:

The State endangered Hawaiian Monk Seal (Monachus schauinslandi) and threatened Green Sea Turtle (Chelonia mydas) could potentially occur or haul out onshore within the vicinity of the proposed project site. If either species is detected within 100 meters of the project area all nearby construction operations should cease and not continue until the focal animal has departed the area on its own accord.

Response:

If either a Hawaiian Monk Seal or a Green Sea Turtle is detected within 50 yards of the Project Site or Sand Recovery Site, all construction operations would cease until the animal has departed on its own accord.

Comment No. 5:

The project area is within the range of the State listed Blackburn's Sphinx Moth (Manduca blackburni) or BSM. Larvae of BSM feed on many nonnative hostplants, which includes tree tobacco (Nicotiana glauca), that grow in disturbed soil. We recommend contacting the Maui Branch DOFAW office at (808) 984-8100 for further information about where BSM may be present and whether a vegetation survey should be conducted to determine the presence of plants preferred by BSM. DOFAW recommends removing plants less than one meter in height or during the dry season to avoid harm to BSM. If you intend to either remove tree tobacco over one meter in height or to disturb the ground around or within several meters of these plants, they must be thoroughly inspected by a qualified entomologist for the presence of BSM eggs and larvae.

Response:

Thank you for the information regarding Blackburn's Sphinx Moth. The Draft EIS will include a discussion on rare, threatened, and endangered species. A terrestrial flora and fauna survey was prepared for the Project Site, and will be included and discussed in the Draft EIS.

Comment No. 6:

DOFAW recommends using native plant species for landscaping that are appropriate for the area; i.e., plants for which climate conditions are suitable for them to thrive, plants that historically occurred there, etc. Please do not plant invasive species. DOFAW also recommends referring to www.plantpono.org for guidance on the selection and evaluation of landscaping plants and to determine the potential invasiveness of plants proposed for use in the project.

Response:

The Applicant acknowledges the recommendation and would use native plant species for landscaping where appropriate. The Draft EIS will include and discuss the terrestrial flora and fauna survey that was prepared for the Project Site.

Comment No. 7:

DOFAW recommends minimizing the movement of plant or soil material between worksites. Soil and plant material may contain detrimental fungal pathogens (e.g., Rapid 'Ōhi'a Death), vertebrate and invertebrate pests (e.g., Coqui Frogs, Little Fire Ants, etc.), or invasive plant parts (e.g., Miconia, Mullein, etc.) that could harm our native species and ecosystems. We recommend consulting the Maui Invasive Species Committee (MISC) at (808) 573-6472 to help plan, design, and construct the project, learn of any high-risk invasive species in the area, and ways to mitigate their spread. All equipment, materials, and personnel should be cleaned of excess soil and debris to minimize the risk of spreading invasive species.

Response:

The Maui Invasive Species Committee will be contacted if any plant or soil material requires relocation between worksites.

Thank you again for your participation in the Chapter 343, Hawai'i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 244-2015.

Very truly yours,

Tessa Ng

Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Michael Cain, Office of Conservation and Coastal Lands
Darlene Nakamura, DLNR Engineering Division
K:\DATA\HGV\KBC Beach Restor\Apps\EISPN\Resp Ltr\DLNR DOFAW.docx

JOSH GREEN, M.D.
GOVERNOR

EDWIN H. SNIFFEN
DIRECTOR

Deputy Directors
DREANALEE K. KALILI
TAMMY L. LEE
ROBIN K. SHISHIDO
JAMES KUNANE TOKIOKA

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:

DIR 1189
STP 8.3527

January 18, 2023

VIA EMAIL: michael.cain@hawaii.gov

TO: DAWN N. S. CHANG, CHAIRPERSON
DEPARTMENT OF LAND AND NATURAL RESOURCES

ATTENTION: MICHAEL CAIN, ADMINISTRATOR
OFFICE OF CONSERVATION AND COASTAL LANDS
DEPARTMENT OF LAND AND NATURAL RESOURCES

FROM: EDWIN H. SNIFFEN
DIRECTOR OF TRANSPORTATION

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)
HOALA HONOKOWAI PROJECT
LAHAINA, MAUI, HAWAII
TAX MAP KEY: (2) 4-4-001: 097, 098, AND 100

Thank you for your letter dated December 23, 2022, requesting the Hawaii Department of Transportation's (HDOT) review and comments on the Hoala Honokowai project. HDOT understands the Proposed Action of the project is to restore and preserve an area of approximately 1,000 linear feet of the Honokowai Beach shoreline in West Maui. Beach Nourishment, Beach Maintenance, and Beach Nourishment with Stabilizing Structures are three methods being proposed to implement the Proposed Action.

The nearest roadway in the area under HDOT jurisdiction is Honoapiilani Highway (State Route 30).

HDOT has the following comments:

1. The proposed beach restoration and preservation project is located approximately 6,020 feet from the end of Runway 2 of Kapalua Airport. All projects within 5 miles from Hawaii State airports are advised to read the Technical Assistance Memorandum (TAM) for guidance with development and activities that may require further review and permits. The TAM can be viewed at the following: http://files.hawaii.gov/dbedt/op/docs/TAM-FAA-DOT-Airports_08-01-2016.pdf.

2. Federal Aviation Administration (FAA) regulation requires the submittal of FAA Form 7460-1 Notice of Proposed Construction or Alteration pursuant to the Code of Federal Regulations, Title 14, Part 77.9, if the construction or alteration is within 20,000 feet of a public use or military airport which exceeds a 100:1 surface from any point on the runway of each airport with its longest runway more than 3,200 feet. Construction equipment and staging area heights, including heights of temporary construction cranes, shall be included in the submittal. The form and criteria for submittal can be found at the following website: https://oeaaa.faa.gov/oeaaa/external/portal.jsp.

3. Based on the information provided, HDOT does not anticipate an adverse direct impact to State highways during operations; however, the Draft Environmental Impact Statement (DEIS) traffic impact assessment should include the following:

    a. Jurisdiction of roadways in the vicinity

    b. Location of existing and proposed site accesses

    c. Observations regarding existing traffic conditions in the vicinity of the site, include bicycle and pedestrian routes, and locations of transit stops

    d. Project description, including operations and construction activities, hours of operation, and estimated number of vehicle trips to/from the site during peak traffic hours. The vehicle trip assessment should include any potential increases in trips associated with possible changes in activity due to the replenished beach.

    e. Assessment of the project's potential direct, secondary, and cumulative impact to State roadways

    f. If the qualitative traffic assessment suggests a potential for adverse impact to State highways, then the DEIS should include a traffic impact assessment report prepared by a licensed Professional Engineer.

4. Determine the applicability of required HDOT, Highways Division permits and revise Page ix and Page 18, Section 3, as needed. The permit applications and instructions are available on HDOT's website at the following link: https://hidot.hawaii.gov/highways/home/doing-business/guide-to-permits

Please submit the DEIS, and any future land use entitlement related requests for review or correspondence to the HDOT Land Use Intake email address at DOT.LandUse@hawaii.gov

If there are any questions, please contact Mr. Blayne Nikaido of the HDOT Statewide Transportation Planning Office at (808) 831-7979 or via email at blayne.h.nikaido@hawaii.gov.

c: Andy Bohlander, Sea Engineering, Inc. (**VIA EMAIL**: honokowai@seaengineering.com)

https://www.hoalahonokowai.com | T: (808) 244-2015 | E: honokowai@munekiyohiraga.com

October 31, 2025

Edwin H. Sniffen, Director of Transportation
State of Hawai'i
Department of Transportation
869 Punchbowl Street
Honolulu, Hawai'i 96813

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Ho'āla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawai'i

Dear Mr. Sniffen:

Thank you for your comment letter dated January 18, 2023 regarding the Ho'āla Honokōwai Project Environmental Impact Statement (EIS) Preparation Notice. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the comments received.

Comment No. 1:

1. *The proposed beach restoration and preservation project is located approximately 6,020 feet from the end of Runway 2 of Kapalua Airport. All projects within 5 miles from Hawaii State airports are advised to read the Technical Assistance Memorandum (TAM) for guidance with development and activities that may require further review and permits. The TAM can be viewed at the following: http://files.hawaii.gov/dbedt/op/docs/TAM-FAA-DOT-Airports_08-01-2016.pdf.*

Response:

Thank you for providing this resource. The project team will review this document for guidance on further review and permitting with respect to the Project's proximity to the Kapalua Airport. Potential impacts to Kapalua Airport will be discussed in the Draft EIS.

Comment No. 2:

2. *Federal Aviation Administration (FAA) regulation requires the submittal of FAA Form 7460-1 Notice of Proposed Construction or Alteration pursuant to the Code of Federal Regulations, Title 14, Part 77.9, if the construction or alteration is within 20,000 feet of a public use or military airport which exceeds a 100:1 surface from any point on the runway of each airport with its longest runway more than 3,200 feet. Construction equipment and staging area heights, including heights of temporary construction cranes,*

shall be included in the submittal. The form and criteria for submittal can be found at the following website: https://oeaaa.faa.gov/oeaaa/external/portal.jsp.

Response:

The Applicant acknowledges this requirement.

Comment No. 3:

3. *Based on the information provided, HDOT does not anticipate an adverse direct impact to State highways during operations; however, the Draft Environmental Impact Statement (DEIS) traffic impact assessment should include the following:*

   a. *Jurisdiction of roadways in the vicinity*

   b. *Location of existing and proposed site accesses*

   c. *Observations regarding existing traffic conditions in the vicinity of the site, include bicycle and pedestrian routes, and locations of transit stops*

   d. *Project description, including operations and construction activities, hours of operation, and estimated number of vehicle trips to/from the site during peak traffic hours. The vehicle trip assessment should include any potential increases in trips associated with possible changes in activity due to the replenished beach.*

   e. *Assessment of the project's potential direct, secondary, and cumulative impact to State roadways*

   f. *If the qualitative traffic assessment suggests a potential for adverse impact to State highways, then the DEIS should include a traffic impact assessment report prepared by a licensed Professional Engineer.*

Response:

The Draft EIS will include and discuss potential impacts and mitigation measures for roadways. A Traffic Impact Assessment Report (TIAR) was conducted for the proposed Project by a licensed professional engineer and will be included and discussed within the Draft EIS.

Comment No. 4:

4. *Determine the applicability of required HDOT, Highways Division permits and revise Page ix and Page 18, Section 3, as needed. The permit applications and instructions are available on HDOT's website at the following link: https://hidot.hawaii.gov/highways/home/doing-business/guide-to-permits*

Response:

The project team will review the HDOT Highways Division site to determine if additional permits may be needed and address these requirements in the Draft EIS as applicable.

Thank you again for your participation in the Chapter 343, Hawai'i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 244-2015.

Very truly yours,

Tessa Ng

Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Michael Cain, Office of Conservation and Coastal Lands
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OSTATE OF HAWAIʻI
OFFICE OF PLANNING
& SUSTAINABLE DEVELOPMENT

JOSH GREEN, M.D.
GOVERNOR

SCOTT J. GLENN
DIRECTOR

235 South Beretania Street, 6th Floor, Honolulu, Hawaiʻi 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaiʻi 96804

Telephone: (808) 587-2846
Fax: (808) 587-2824
Web: https://planning.hawaii.gov/

Coastal Zone Management Program

Environmental Review Program

Land Use Commission

Land Use Division

Special Plans Branch

State Transit-Oriented Development

Statewide Geographic Information System

Statewide Sustainability Branch

DTS 202212270946NA

January 24, 2023

To: Dawn N. S. Chang, Chairperson
Department of Land and Natural Resources

From: Scott J. Glenn, Director
Office of Planning and Sustainable Development

Attention: Michael Cain, Administrator
Office of Conservation and Coastal Lands

Subject: Environmental Impact Statement Preparation Notice for Hoʻāla Honokōwai Project, Tax Map Keys (2) 4-4-001 :097, 098, and 100, Lahaina, Maui

Thank you for the opportunity to provide comments for the Environmental Impact Statement Preparation Notice (EISPN) for the proposed Hoʻāla Honokōwai beach restoration project. The EISPN notice and review material were received by our office via memo dated December 23, 2022.

It is our understanding that the Proposed Action seeks to restore and preserve Honokōwai Beach, Maui. According to the review material, restoration of the beach could be accomplished by one of three methods – beach nourishment, beach maintenance, or beach nourishment with stabilizing structures. The preferred method will be selected after the Draft Environmental Impact Statement (DEIS) is completed along with reviewing public comments. The project's primary objective is to restore this important natural and cultural resource for the West Maui community.

Additional objectives are to preserve and enhance cultural and shoreline access, increase resilience to coastal hazards, and enable planning for long-term adaptation to sea level rise (SLR). The review states that Honokōwai Beach experiences chronic erosion, which is projected to accelerate. We note that the EISPN identifies issues of critical importance to our office which includes impacts to the marine environment, coastal hazards, shoreline impacts, SLR threats, and environmental impairment from land-based sediment.

With that emphasis, the Office of Planning and Sustainable Development (OPSD) has the following comments to offer:

1. Coastal Zone Management Act (CZMA), Federal Consistency
   As listed in Section 3, page 18 of the EISPN, we acknowledge that this action may be subject to CZMA federal consistency, based on Section 404 Clean Water Act; and Section 10 Rivers and Harbors Act permits from the Department of the Army. The national CZMA requires that federal actions be consistent with approved state coastal programs enforceable policies.

   OPSD is the lead state agency with the authority to conduct CZMA federal consistency reviews. We recommend that you consult with our office on the applicability of CZMA federal consistency requirements as it pertains to this project.

2. Hawai‘i Coastal Zone Management (CZM) Program
   The CZM area is defined as "all lands of the State and the area extending seaward from the shoreline to the limit of the State's police power and management authority, including the U.S. territorial sea" under Hawai‘i Revised Statutes (HRS) § 205A-1.

   Pursuant to HRS § 205A-4, in implementing the objectives of the CZM program, agencies shall consider ecological, cultural, historic, esthetic, recreational, scenic, open space values, coastal hazards, and economic development. As the proposed action will require the approval of the Board of Land and Natural Resources, the DEIS should include a discussion on the project's consistency with the policies of the Hawai‘i CZM Program, HRS § 205A-2, as amended.

   Furthermore, the objectives and supporting policies of the Hawai‘i CZM Program serve as the foundation of the enforceable policies of the State of Hawai‘i, as listed in HRS § 205A-2. Disclosure of impacts on CZM objectives and supporting policies, as it relates to HRS Chapter 343 requirements, will aid the State in determining impacts to the resources of the coastal zone, and mitigation measures on the subject lands involved for this proposed action.

3. Special Management Area (SMA) Use Permit / Shoreline Setback Variance (SSV)
   As listed in Section 3, page 18 of the EISPN, we note that the project may be subject to SMA Use Permitting and SSV by the County of Maui. Related to these County approvals, the DEIS should consider the following issues related to shoreline impacts:

   a. Objectives of the Proposed Action
      Section 1.3, Page 13 the EISPN states that it is anticipated that restoring Honokōwai Beach and preventing further erosion of the backshore will have a positive net beneficial impact on the environment, including preserving the beach and improving water quality. It is also anticipated that beach restoration would help to preserve and enhance the fundamental character of Honokōwai Beach by maintaining shoreline access and supporting existing uses along the shoreline. As stated in the EISPN, the area mauka of the shoreline is densely developed with resort infrastructure. OPSD suggests that the DEIS expand the discussion on how the proposed project benefits the public interest, adjacent properties, and specifically for applicant's commercial properties.

b. Shoreline Erosion
In 2018, a temporary erosion control structure was installed along the shoreline through emergency permitting. The DEIS should address the conditions of the temporary erosion control structure from the Department of Land and Natural Resources and County of Maui Planning Department. The DEIS would benefit from the inclusion of a copy of the subject emergency permits in its appendices.

4. Cumulative Impacts
Given the definition of cumulative impact set forth in Hawaii Administrative Rules Chapter 11-200.1, OPSD suggests that the Section on Cumulative Impacts assesses potential incremental impacts that may result from the proposed action with a table and a location map of past, present and reasonably foreseeable future projects under a temporal and spatial scope.

If you have any questions, please contact Joshua Hekekia on Environmental Impact Statement issues as they relate to this OPSD response letter at (808) 587-2845; Debra Mendes on CZMA federal consistency at (808) 587-2840; or Shichao Li at (808) 587-2841 SMA Use/Shoreline Setback matters.

https://www.hoalahonokowai.com | T: (808) 244-2015 | E: honokowai@munekiyohiraga.com

October 31, 2025

Mary Alice Evans, Director
State of Hawai'i
Office of Planning & Sustainable Development
P. O. Box 2359
Honolulu, Hawai'i 96804

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Ho'āla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawai'i

Dear Ms. Evans:

Thank you for your comment letter dated January 24, 2023 regarding the Ho'āla Honokōwai Project Environmental Impact Statement (EIS) Preparation Notice. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the comments received.

Comment No. 1:

1. *Coastal Zone Management Act (CZMA), Federal Consistency*
As listed in Section 3, page 18 of the EISPN, we acknowledge that this action may be subject to CZMA federal consistency, based on Section 404 Clean Water Act; and Section 10 Rivers and Harbors Act permits from the Department of the Army. The national CZMA requires that federal actions be consistent with approved state coastal programs enforceable policies.

OPSD is the lead state agency with the authority to conduct CZMA federal consistency reviews. We recommend that you consult with our office on the applicability of CZMA federal consistency requirements as it pertains to this project.

Response:

The Project team will consult with the OPSD to determine the applicability of CZMA federal consistency requirements related to the proposed Project.

Comment No. 2:

2. *Hawai'i Coastal Zone Management (CZM) Program*
The CZM area is defined as "all lands of the State and the area extending seaward from the shoreline to the limit of the State's police power and management authority, including the U.S. territorial sea" under Hawai'i Revised Statutes (HRS) § 205A-1.

Pursuant to HRS § 205A-4, in implementing the objectives of the CZM program, agencies shall consider ecological, cultural, historic, esthetic, recreational, scenic, open space values, coastal hazards, and economic development. As the proposed action will require the approval of the Board of Land and Natural Resources, the DEIS should include a discussion on the project's consistency with the policies of the Hawai'i CZM Program, HRS § 205A-2, as amended.

Furthermore, the objectives and supporting policies of the Hawai'i CZM Program serve as the foundation of the enforceable policies of the State of Hawai'i, as listed in HRS § 205A-2. Disclosure of impacts on CZM objectives and supporting policies, as it relates to HRS Chapter 343 requirements, will aid the State in determining impacts to the resources of the coastal zone, and mitigation measures on the subject lands involved for this proposed action.

Response:

The Draft EIS will include analysis on the consistency with the CZM program as well as HRS Chapter 343.

Comment No. 3:

3. *Special Management Area (SMA) Use Permit / Shoreline Setback Variance (SSV)*
As listed in Section 3, page 18 of the EISPN, we note that the project may be subject to SMA Use Permitting and SSV by the County of Maui. Related to these County approvals, the DEIS should consider the following issues related to shoreline impacts:

   a. *Objectives of the Proposed Action*
   Section 1.3, Page 13 the EISPN states that it is anticipated that restoring Honokōwai Beach and preventing further erosion of the backshore will have a positive net beneficial impact on the environment, including preserving the beach and improving water quality. It is also anticipated that beach restoration would help to preserve and enhance the fundamental character of Honokōwai Beach by maintaining shoreline access and supporting existing uses along the shoreline. As stated in the EISPN, the area mauka of the shoreline is densely developed with resort infrastructure.

OPSD suggests that the DEIS expand the discussion on how the proposed project benefits the public interest, adjacent properties, and specifically for applicant's commercial properties.

b. Shoreline Erosion

In 2018, a temporary erosion control structure was installed along the shoreline through emergency permitting. The DEIS should address the conditions of the temporary erosion control structure from the Department of Land and Natural Resources and County of Maui Planning Department. The DEIS would benefit from the inclusion of a copy of the subject emergency permits in its appendices.

Response:

The Draft EIS will expand on the discussion on how the proposed Project benefits public interest, adjacent properties, and the existing urban uses in the area. The Draft EIS will also include information on the relevant permits for the temporary erosion control structure.

Comment No. 4:

4. Cumulative Impacts

Given the definition of cumulative impact set forth in Hawaii Administrative Rules Chapter 11-200.1, OPSD suggests that the Section on Cumulative Impacts assesses potential incremental impacts that may result from the proposed action with a table and a location map of past, present and reasonably foreseeable future projects under a temporal and spatial scope.

Response:

The Draft EIS will assess potential cumulative impacts of the Project, including identification and assessment of other beach restoration projects in the region.

Thank you again for your participation in the Chapter 343, Hawai'i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 244-2015.

Very truly yours,

Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Michael Cain, Office of Conservation and Coastal Lands
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RICHARD T. BISSEN, JR.
Mayor

KEKUHAUPIO R. AKANA
Acting Managing Director

SHANE T. DUDOIT
Acting Director



DEPARTMENT OF PARKS AND RECREATION
COUNTY OF MAUI
700 HALI'A NAKOA STREET, UNIT 2
WAILUKU, MAUI, HAWAI'I 96793
www.mauicounty.gov

January 13, 2023

Michael Cain, Administrator
Office of Conservation and Coastal Lands
Department of Land and Natural Resources
State of Hawaii
1151 Punchbowl Street, Room 131
Honolulu, Hawaii 96813

Dear Mr. Cain:

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE FOR THE HOALA HONOKOWAI PROJECT, TAX MAP KEYS (2) 4-4-001:097, 098, AND 100, LAHAINA, MAUI, HAWAII

Thank you for the opportunity to review and comment on the subject project. The Department of Parks and Recreation notes Honokowai Beach Park (TMK (2) 4-4-001:046) is located approximately 1/4 mile north of the Hoala Honokowai Project limits.

The Department requests that impacts to this County park be addressed in the environmental impact statement.

Should you have any questions, please feel free to contact me or Samual Marvel, Chief of Planning and Development, at samual.marvel@co.maui.hi.us or (808) 270-6173.

Sincerely,

SHANE T. DUDOIT
Acting Director of Parks and Recreation

c: Samual Marvel, Chief of Planning and Development
Andy Bohlander, Sea Engineering, Inc.

STD:SAM

https://www.hoalahonokowai.com | T: (808) 244-2015 | E: honokowai@munekiyohiraga.com

October 31, 2025

Patrick McCall, Director of Parks
and Recreations
County of Maui
Department of Parks and Recreation
P. O. Box 1405
Wailuku, Hawai'i 96793

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Ho'āla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawai'i

Dear Mr. McCall:

Thank you for the department's comment letter dated January 13, 2023 regarding the Ho'āla Honokōwai Project Environmental Impact Statement (EIS) Preparation Notice. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the comments received.

Comment:

The Department of Parks and Recreation notes Honokowai Beach Park (TMK (2) 4-4-001:046) is located approximately ¼-mile north of the Hoala Honokowai Project limits.

The Department requests that impacts to this County park be addressed in the environmental impact statement.

Response:

We note that the Project Site is approximately ½ mile south of Honokōwai Beach Park. The Draft EIS will discuss potential impacts to open space and recreational resources in the vicinity of the Project Site and Sand Recovery Site. No impacts are anticipated at Honokōwai Beach Park; this information will be included in the Draft EIS.

Thank you again for your participation in the Chapter 343, Hawai‘i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 244-2015.

Very truly yours,

Tessa Ng

Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Michael Cain, Office of Conservation and Coastal Lands
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RICHARD T. BISSEN JR.
Mayor

KEKUHAUPIO R. AKANA
Acting Managing Director

KATHLEEN ROSS AOKI
Acting Planning Director



DEPARTMENT OF PLANNING
COUNTY OF MAUI
ONE MAIN PLAZA
2200 MAIN STREET, SUITE 315
WAILUKU, MAUI, HAWAI'I 96793

January 23, 2023

Mr. Michael Cain
Department of Land and Natural Resources
Office of Conservation and Coastal Lands
1151 Punchbowl Street, Room 131
Honolulu, HI 96813

Dear Mr. Cain:

SUBJECT: REQUEST FOR COMMENT ON THE ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN) FOR THE PROPOSED BEACH RESTORATION FOR HONOKOWAI BEACH VIA THREE PROPOSED ALTERNATIVE RESTORATION METHODS, LOCATED AT HONOKOWAI, MAUI, HAWAII; TMKS: (2) 4-4-001:097, 098, and 100 (RFC2022-00136)

The Department of Planning (Planning Department) is in receipt of the request for comments on the EISPN for the proposed action to restore and preserve Honokowai Beach. The EISPN was published in the Office of Planning and Sustainable Development, Environmental Review Program's "The Environmental Notice" on December 23, 2022. The EISPN proposes three alternative methods to accomplish the proposed action: beach nourishment, beach maintenance, or beach nourishment with stabilizing structures. The EISPN also notes that future long-term adaptation will be explored. The EISPN states that the proposed action's objectives are to restore beach width and improve beach stability; preserve and enhance cultural and shoreline access; increase resilience to coastal hazards and sea level rise; and enable planning for long-term adaptation to sea level rise.

The project site consists of 1,000 linear feet of shoreline. The area makai of the shoreline is located in the Resource Subzone of the State Land Use Conservation District. The area mauka of the shoreline is located in the State Land Use Urban District, zoned (H) Hotel by the County of Maui, and designated as Hotel in the West Maui Community Plan.

The EISPN states that the preferred method will be selected after completing studies for the DEIS and receiving public comments. A public scoping meeting was held on January 17, 2023, at the Lahaina Civic Center Social Hall, which the Planning Department attended. The Planning Department notes that its comments are provided for the EISPN recognizing similar coastal erosion situations on the west side of Maui along other once-sandy shorelines. The Department has

conducted multiple site visits over the years to the subject parcels, is very familiar with shoreline area and the environmental setting of this proposed project. The Department notes that the area is vulnerable to future impacts from sea level rise that must be planned for through time, beginning with analysis through this EIS planning process. The Planning Department supports a final preferred alternative that will improve and minimally impact coastal ecosystems and address community concerns.

The Planning Department provides the following comments:

1. The applicant is stated as the West Maui Resort Partners, L.P., please further elaborate on who is part of this group.

2. Please further elaborate as to why this project only includes the three parcels and doesn't include additional surrounding properties such as Mahana I/II.

3. The Planning Department understands that the EIS is strictly an informational document comprised of completed assessments, analytical resources, and reports on field inspections, key informant interviews, and focus groups that inform future permits required to implement the identified preferred alternative of beach restoration, combined with berm enhancement, and stabilizing structures. Following completion and acceptance of the subject EIS, the County of Maui will be responsible for administering and processing a Special Management Area Permit and Shoreline Setback Assessment in order to implement best management practices as part of the final defined project. Other County of Maui permits may be required.

4. Develop water-quality, benthic-monitoring, and biological studies, including the Essential Fish Habitat study plans. The scope should include developing water quality and benthic monitoring plans in coordination with the University of Hawaii and/or locally-based expert groups. Previous beach restoration projects have been criticized for a perceived lack of independent or impartial monitoring. There is an opportunity to draw upon a wealth of locally based expertise from groups such as the Hui O Ka Wai Ola, West Maui Ridge-to-Reef Initiative, the Maui Nui Marine Resource Council, and the Nature Conservancy. It may even be possible for these groups to be engaged in the implementation of the pre- and post-construction monitoring.

5. For Figure 1-3 (littoral cell description) the existing shoreline description is provided for the North Kaanapali Littoral Cell and the northern portion of the Honokowai Littoral Cell. Please include the Project Site's shoreline description in this figure as well, such as any shoreline hardening or temporary emergency structures and linear feet of the project.

6. Please note any temporary emergency shoreline erosion mitigation efforts within the Project Site (since 2016): permit type/permit timeframe. Please provide the latest certified shoreline maps for the entire area and identify any shoreline encroachments and the steps to resolve any encroachments. Please describe the removal timeframe for all emergency shoreline erosion structures and the beach's return to a natural shoreline profile.

7. The Planning Department looks forward to an in-depth analysis of all proposed alternative methods. Please consider using an adaptation pathways approach to all proposed alternatives in order to provide a sequence of steps over time, to include a long-term managed relocation strategy. The EISPN notes a possible alternative for the proposed action as "long-term adaptation." As part of this long-term adaptation, the Planning Department would like to see additional mitigation measures such as consideration of managed relocation of at least non-habitable structures in the near-term along with options to vegetate and improve the coastal dune and berm area. Additionally include statements from all fronting properties acknowledging their individual and collective efforts towards longer term shoreline relocation, with projected cost ranges, to include returning of the shoreline to its natural state.

8. Moving forward with the DEIS, please work with the Planning Department to obtain comments from the Maui Planning Commission. This early planning step offers the public an additional opportunity to understand and review the project alternatives, and to provide important formal testimony.

9. Address project consistency with relevant provisions of the West Maui Community Plan. This can be accessed at: https://www.mauicounty.gov/2476/West-Maui-Community-Plan-Update-2022 .

10. Please describe how the current surrounding environment of shoreline hardening will affect the proposed alternatives for the Project Site.

11. Clearly define the public and environmental benefits and costs of allowing stabilizing structures in the ocean, or other potentially impactful alternatives. If there is an impact, define how compensatory mitigation within the project area, outside the project area, and would still clearly lead to overall net public and environmental benefits.

12. Please identify any benefits that the project will bring to the nearby and broader communities beyond the fronting properties.

13. Under 1.4 Timeframes for Addressing Erosion, Beach Loss, and Sea Level Rise, it could help to provide examples for each timeframe (short-, mid-, and long-term). Please clarify timeframes for each proposed action. Please explore in further depth long-term adaptation strategies.

14. Under 1.5 Guidance for Sea Level Rise Planning and Adaptation it states, "the design and analysis for the Proposed Action will be informed by the latest global, national, state, and local guidance on sea level rise planning and adaptation." Please elaborate on specific guidance sources and describe how they will inform the proposed project alternatives.

15. Discuss sea level rise and how it will affect each proposed alternative. Additionally discuss how sea level rise will affect the habitable and non-habitable structures that are project parcels. The online PACIOOS Hawaii Sea Level Risk Viewer https://www.pacioos.hawaii.edu/shoreline/slr-hawaii/ shows that portions of buildings immediately adjacent to the shoreline will be within the 3.2 feet of projected sea level rise.

Thank you for the opportunity to comment on this project. Should you require further clarification, please contact Staff Planner Rachel Beasley by email at rachel.beasley@co.maui.hi.us or by phone at (808) 270-7814.

Sincerely,

Kathleen Ross Aoki

KATHLEEN ROSS AOKI
Acting Planning Director

xc: Ann Cua, Planning Program Administrator (PDF)
Danny Dias, Planning Supervisor (PDF)
Rachel Beasley, Staff Planner (PDF)
Andy Bohlander, Consultant (PDF)
Honorable Tamara Paltin, Maui County Council (PDF)
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https://www.hoalahonokowai.com | T: (808) 244-2015 | E: honokowai@munekiyohiraga.com

October 31, 2025

Kate Blystone, Director of Planning
County of Maui
Department of Planning
One Main Plaza
2200 Main Street, Suite 315
Wailuku, Hawai'i 96793

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Ho'āla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawai'i

Dear Ms. Blystone:

Thank you for your comment letter dated January 23, 2023 regarding the Ho'āla Honokōwai Project Environmental Impact Statement (EIS) Preparation Notice. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the comments received.

Comment No. 1:

The Planning Department provides the following comments:

1. *The applicant is stated as the West Maui Resort Partners, L.P., please further elaborate on who is part of this group.*

Response:

West Maui Resort Partners, LP is the declarant/developer of Ka'anapali Beach Club (KBC). West Maui Resort Partners LP is a subsidiary of a Diamond Resort entity with Hilton Grand Vacations being the ultimate parent. Diamond Resorts was acquired by Hilton Grand Vacations in August 2021.

Comment No. 2:

2. *Please further elaborate as to why this project only includes the three parcels and doesn't include additional surrounding properties such as Mahana I/II.*

Response:

The geographic scope of the Project Site is primarily based on natural littoral processes and the influence of existing landscape features and shoreline armoring structures in the vicinity.

The north end of the Project Site is bounded by Honokōwai Stream, which is a natural stream drainage that was diverted and channelized by the County of Maui. Honokōwai Stream is an optimal boundary for the Project Site because the beach naturally tapers off at the stream mouth, the shoreline to the north is primarily armored with few sandy beaches, and the availability of sand in the littoral system to the north is limited. Honokōwai Stream coincidentally aligns with the north parcel boundary of the Kaanapali Shores property (Tax Map Key No. (2) 4-4-001:097).

The south end of the Project Site is bounded by Honokōwai Point, which is a natural headland that is armored by a shore protection structure. Honokōwai Point is an optimal boundary for the project site because it is the natural boundary between two littoral cells and the shoreline orientation and wave patterns are substantially different south of Honokōwai Point. Honokōwai Point coincidentally aligns with the north parcel boundary of the Maui Kai Condominium property (Tax Map Key No. (2) 4-4-001:100).

Expanding the geographic scope of the Project Site is not necessary to restore and maintain a stable beach. Furthermore, expanding the geographic scope of the Project Site would also increase the complexity, cost, and cumulative impacts of the Project.

Comment No. 3:

3. *The Planning Department understands that the EIS is strictly an informational document comprised of completed assessments, analytical resources, and reports on field inspections, key informant interviews, and focus groups that inform future permits required to implement the identified preferred alternative of beach restoration, combined with berm enhancement, and stabilizing structures. Following completion and acceptance of the subject EIS, the County of Maui will be responsible for administering and processing a Special Management Area Permit and Shoreline Setback Assessment in order to implement best management practices as part of the final defined project. Other County of Maui permits may be required.*

Response:

We understand that this Project would require a Special Management Area (SMA) Use Permit, a Shoreline Setback Assessment, and that other permits may be required. A list of anticipated permits was included in the EISPN, identifying the SMA Use Permit and Shoreline Setback Assessment, among others. This list will also be included in the Draft EIS and will be updated to reflect any additional permit requirements identified by agency comments on the EISPN. Additional information about best management practices will be provided in the Draft EIS.

Comment No. 4:

4. *Develop water-quality, benthic-monitoring, and biological studies, including the Essential Fish Habitat study plans. The scope should include developing water quality and benthic monitoring plans in coordination with the University of Hawaii and/or locally-based expert groups. Previous beach restoration projects have been criticized for a perceived lack of independent or impartial monitoring. There is an opportunity to draw upon a wealth of locally based expertise from groups such as the Hui O Ka Wai Ola, West Maui Ridge-to-Reef Initiative, the Maui Nui Marine Resource Council, and the Nature Conservancy. It may even be possible for these groups to be engaged in the implementation of the pre- and post-construction monitoring.*

Response:

The Proposed Action of beach restoration includes in-water work and potential impacts to the marine and nearshore environment. An assessment of marine water quality and biotic communities was prepared by Marine Research Consultants, Inc, (MRC). The MRC report will be included and discussed in the Draft EIS. An Applicable Monitoring and Assessment Plan (AMAP) was also prepared and details water quality monitoring before, during, and after construction. The applicant acknowledges the expertise and experience of local groups. Hui O Ka Wai Ola has been independently conducting water quality monitoring in the region, including at the Project Site, and their findings have showed an improvement in water quality since the installation of the temporary erosion protection skirt in 2018 following the erosional events of 2016. While the Project is anticipated to have short-term construction-related impacts to water quality, it is anticipated that water quality would continue to improve with the implementation of a stabilized beach and backshore.

Pursuant to Section 404 of the Clean Water Act, the proposed action would require a Section 404 Individual Permit from the Department of the Army. The Section 404 permit would include formal consultations with the NOAA National Marine Fisheries Service (NMFS) for Endangered Species Act (ESA) and Essential Fish Habitat (EFH). Additional information about the marine environment and project monitoring will be provided in the Draft EIS.

Comment No. 5:

5. *For Figure 1-3 (littoral cell description) the existing shoreline description is provided for the North Kaanapali Littoral Cell and the northern portion of the Honokowai Littoral Cell. Please include the Project Site's shoreline description in this figure as well, such as any shoreline hardening or temporary emergency structures and linear feet of the project.*

Response:

The Draft EIS will include a figure indicating the littoral cells and a description of the shoreline and the temporary emergency structures at the property and nearby shoreline hardening. Information regarding existing shoreline protection structures will be provided in the Draft EIS.

Comment No. 6:

6. *Please note any temporary emergency shoreline erosion mitigation efforts within the Project Site (since 2016): permit type/permit timeframe. Please provide the latest certified shoreline maps for the entire area and identify any shoreline encroachments and the steps to resolve any encroachments.*

   Please describe the removal timeframe for all emergency shoreline erosion structures and the beach's return to a natural shoreline profile.

Response:

A temporary erosion skirt was installed along the shoreline fronting KBC in May 2018. The structure was approved by the State of Hawai'i and the County of Maui and is authorized by the following permits and approvals:

- Emergency Conservation District Use Permit (MA-21-06)
- Revocable Permit (S-7943)
- Emergency Special Management Area Permit (SM3 2020/0014)
- Emergency Shoreline Setback Approval (SSA 2020/0062)
- Environmental Assessment Exemption (EAE 2021/0003)

The existing temporary erosion skirt is a short-term response to mitigate erosion, negative impacts to water quality, and risks to public health and safety. The structure will be removed when a mid-term solution can be approved and implemented. Information about the existing temporary erosion skirt will be provided in the Draft EIS.

Comment No. 7:

7. *The Planning Department looks forward to an in-depth analysis of all proposed alternative methods. Please consider using an adaptation pathways approach to all proposed alternatives in order to provide a sequence of steps over time, to include a long-term managed relocation strategy. The EISPN notes a possible alternative for the proposed action as "long-term adaptation." As part of this long-term adaptation, the Planning Department would like to see additional mitigation measures such as consideration of managed relocation of at least non-habitable structures in the near-term along with options to vegetate and improve the coastal dune and berm area. Additionally include statements from all fronting properties acknowledging their individual and collective efforts towards longer term shoreline relocation, with projected cost ranges, to include returning of the shoreline to its natural state.*

Response:

Because the existing structures on the property are located within the 3.2-foot Sea Level Rise Exposure Area (SLR-XA), the project team has initiated planning efforts to address short-term, mid-term, and long-term adaptation strategies, recognizing that long-term adaptation strategies will continue to develop over time. Adaptation pathways allow planners and decision-makers to map out a sequence of adaptation strategies, such as modifying structures or the environment (e.g., implementation of accommodative and/or protective actions or structures), modifying human activities (e.g., avoidance of or retreat from coastal effects), or some combination thereof in response to rising seas. These short-term, mid-term, and long-term adaptation measures will be addressed in the Draft EIS. The Draft EIS will also address collective adaptation efforts to address sea-level rise, as applicable to the Project. The Project is designed as a mid-term solution to restore and stabilize the beach to provide additional time for long-term adaptation strategies to be evaluated.

Comment No. 8:

8. *Moving forward with the DEIS, please work with the Planning Department to obtain comments from the Maui Planning Commission. This early planning step offers the public an additional opportunity to understand and review the project alternatives, and to provide important formal testimony.*

Response:

The Draft EIS will be transmitted to the Planning Department for review. The accepting authority for the EIS will be the Department of Land and Natural Resources. It is anticipated that review by the Board of Land and Natural Resources would be required prior to acceptance of the Final EIS.

Comment No. 9:

9. *Address project consistency with relevant provisions of the West Maui Community Plan. This can be accessed at: https://www.mauicounty.gov/2476/West-Maui-Community-Plan-Update-2022.*

Response:

A review of the project's consistency with the West Maui Community Plan will be included in the Draft EIS.

Comment No. 10:

10. *Please describe how the current surrounding environment of shoreline hardening will affect the proposed alternatives for the Project Site.*

Response:

The Project Site is located where the shoreline transitions from predominantly sandy beaches, dunes, and unarmored shoreline (south of Honokōwai Point) to predominantly rocky or armored shoreline (north of Honokōwai Point). Shoreline armoring begins

approximately 800 feet south of the Project Site and extends approximately 1.15 miles north to Kahana Bay. KBC (Tax Map Key No. (2) 4-4-001:098) is one of only two unarmored parcels along this stretch of coastline. The shoreline surrounding the Project Site is characterized by engineered structures including seawalls, revetments, and drainage headwalls. The Proposed Action will be designed to accommodate the existing structures.

Comment No. 11:

11. Clearly define the public and environmental benefits and costs of allowing stabilizing structures in the ocean, or other potentially impactful alternatives. If there is an impact, define how compensatory mitigation within the project area, outside the project area, and would still clearly lead to overall net public and environmental benefits

Response:

The Project involves the use of private funds to preserve and restore a public beach. Stabilizing groins, if implemented, would be located on State submerged lands, which would require compensatory mitigation in the form of an easement. The Draft EIS will include potential public and environmental impacts of the proposed action and discuss technical studies that were prepared for the Project.

Comment No. 12:

12. Please identify any benefits that the project will bring to the nearby and broader communities beyond the fronting properties.

Response:

The Project is designed as a nature-based solution, that utilizes private funds to restore and preserve a public beach. The Project is anticipated to benefit the broader community through preservation and enhancement of cultural and shoreline access. While the beach restoration action is the primary action proposed and assessed in the Draft EIS, there are potential related secondary actions (e.g., additional actions that may occur beyond the shoreline area) that may be implemented to further support the Project objectives. Secondary actions may include environmental restoration actions or public access improvements within the KBC property or the surrounding shoreline areas. Hoʻāla Honokōwai will explore and consider opportunities to perpetuate ocean recreation, enable cultural practices, and promote sustainable activities.

Comment No. 13:

13. Under 1.4 Timeframes for Addressing Erosion, Beach Loss, and Sea Level Rise, it could help to provide examples for each timeframe (short-, mid-, and long-term). Please clarify timeframes for each proposed action. Please explore in further depth long-term adaptation strategies.

Response:

Thank you for this suggestion. Section 1.4 of the EISPN includes examples of short-term, mid-term, and long-term responses, solutions, and adaptations to climate change. Additional descriptions or examples of these responses, solutions, and adaptations will be provided in the Draft EIS. The proposed alternatives assessed in the Draft EIS are classified as mid-term solutions with a design life of 10 to 50 years. Additional information about potential long-term adaptation strategies beyond the 50-year time frame will be provided in the Draft EIS.

Comment No. 14:

14. *Under 1.5 Guidance for Sea Level Rise Planning and Adaptation it states, "the design and analysis for the Proposed Action will be informed by the latest global, national, state, and local guidance on sea level rise planning and adaptation." Please elaborate on specific guidance sources and describe how they will inform the proposed project alternatives.*

Response:

The proposed alternatives assessed in the Draft EIS are classified as mid-term solutions with design lives ranging from 10 to 50 years. Mid-term solutions are intended to address existing conditions and anticipated future changes over the course of several decades while providing adequate time to conduct planning and feasibility studies to enable long-term adaptation strategies.

A Coastal Engineering Assessment (CEA) was prepared for the project and will be included and discussed in the Draft EIS. Chapter 2 of the CEA details existing guidance for sea level rise planning and also includes a detailed discussion of nature-based adaptations and adaptation timeframes. International guidance is discussed from the IPCC 6th Assessment Report and national guidance from NOAA is provided. At a State level, the CEA discussed the Coastal Zone Management Program, Hawai'i Sea level Rise Vulnerability and Adaptation Report, and a Scoping Study for a Regional Shoreline Management Strategy for the State of Hawai'i.

Additional information about specific guidance for sea level rise planning and adaptation will be provided in the Draft EIS.

Comment No. 15:

15. *Discuss sea level rise and how it will affect each proposed alternative. Additionally discuss how sea level rise will affect the habitable and non-habitable structures that are project parcels. The online PACIOOS Hawaii Sea Level Risk Viewer https://www.pacioos.hawaii.edu/shoreline/slrhawaii/ shows that portions of buildings immediately adjacent to the shoreline will be within the 3.2 feet of projected sea level rise.*

Response:

Sea level rise and coastal erosion are negatively impacting beaches and shorelines throughout Hawai‘i. Impacts include beach narrowing and beach loss, permanent loss of terrestrial land due to erosion, and infrastructure damage due to wave inundation and flooding. Anderson et al. (2015) found that, due to sea level rise, the average shoreline recession in Hawai‘i is projected to be nearly twice the historical rates by 2050, and nearly 2.5 times the historical rates by 2100. The impacts from anomalous sea level events (e.g., El Niño, king tides, mesoscale eddies, storm surge) are also likely to increase.

The Draft EIS will include a discussion of each action alternative in the context of sea level rise vulnerability and resilience. The proposed Project is intended to be a mid-term solution while long-term adaptation strategies are further evaluated. The objectives of the proposed action are to restore beach width and improve beach stability, preserve and enhance cultural and shoreline access, increase resilience to coastal hazards and sea level rise, and enable planning for long-term adaptation to sea level rise. Additional information about the potential impacts of sea level rise will be provided in the Draft EIS.

Thank you again for your participation in the Chapter 343, Hawai‘i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 244-2015.

Very truly yours,



Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Michael Cain, Office of Conservation and Coastal Lands
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POLICE DEPARTMENT
COUNTY OF MAUI
55 MAHALANI STREET
WAILUKU, MAUI, HAWAII 96793
TELEPHONE: (808) 244-6400
FAX: (808) 244-6411

RICHARD T. BISSEN, JR.
MAYOR

OUR REFERENCE

YOUR REFERENCE

JOHN PELLETIER
CHIEF OF POLICE

WADE M. MAEDA
DEPUTY CHIEF OF POLICE

February 1, 2023

Mr. Andy Bohlander
Sea Engineering, Inc.
41-305 Kalanianaole Highway
Waimanalo, Hawaii 96795

Re: Environmental Impact Statement Preparation Notice for the Hoala Honokowai Project, TMK: (2) 4-4-001:097, 098, and 100, Lahaina, Maui, Hawaii

Dear Mr. Bohlander:

This is in response to your letter dated December 23, 2022 requesting comments on the environmental impact statement preparation notice (EISPN) for the Hoala Honokowai project.

In review of the submitted documents, we have no comments or recommendations at this time. Thank you for giving us the opportunity to comment on this project.

Sincerely,

Acting Assistant Chief Keola Tom
for: JOHN PELLETIER
Chief of Police

c: Mr. Michael Cain, SOH DLNR Office of Conservation & Coastal Lands

https://www.hoalahonokowai.com | T: (808) 244-2015 | E: honokowai@munekiyohiraga.com

October 31, 2025

John Pelletier, Chief
County of Maui
Police Department
55 Mahalani Street
Wailuku, Hawai'i 96793

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Ho'āla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawai'i

Dear Chief Pelletier:

Thank you for your comment letter dated February 1, 2023 regarding the Ho'āla Honokōwai Project Environmental Impact Statement (EIS) Preparation Notice. On behalf of West Maui Resort Partners, L.P. (Applicant), we acknowledge that the Maui Police Department has no comments to offer at this time.

Thank you again for your participation in the Chapter 343, Hawai'i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 244-2015.

Very truly yours,

Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Michael Cain, DLNR Office of Conservation and Coastal Lands
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Subject: FW: Hoʻāla Honokōwai EIS Preparation Notice
Attachments: Hoʻāla Honokōwai EIS questions and comments.pdf

From: Christian K. Balagso <Christian.Balagso@mauicounty.us>
Sent: Monday, January 23, 2023 3:45 PM
To: Cain, Michael <michael.cain@hawaii.gov>
Cc: Tamara A. Paltin <Tamara.Paltin@mauicounty.us>
Subject: [EXTERNAL] Hoʻāla Honokōwai EIS Preparation Notice

Aloha,

I hope all is well. On behalf of Maui County Councilmember Tamara Paltin, I would like to submit the following document containing questions and concerns about the Hoʻāla Honokōwai EIS Preparation Notice. The questions and comments were generated by Councilmember Paltin, her office staff, and many constituents.

If there are any questions about the document or replies to any of the questions posted, please feel free to reach out. Our West Maui Residency Area Office phone number is 808-856-0123. You can also reach CM Paltin via email at tamara.paltin@mauicounty.us.

Mahalo,

Christian Balagso

West Maui Residency Area Office Staff

Councilmember Tamara Paltin

Office: (808) 856-0123

Hoʻāla Honokōwai EIS Preparation Notice

Submit comments/questions to approving agency; Email: michael.cain@hawaii.gov

Various questions generated from the Office of Councilmember Tamara Paltin and constituents:

Within the project site, there are two properties with buildings along the shoreline: Kāʻanapali Beach Club and Kāʻanapali Shores Condominium.

- Has a structural integrity assessment been done on the buildings closest to the ocean? If yes, please explain the findings. If not, why not?
- How much are each of these buildings worth?
- What would be the cost to move the buildings inland?

Where is the sand for beach nourishment going to come from? How will the sand be transported and placed onto the beach? What are the estimated costs for this method?

If the beach nourishment with stabilizing structures method is chosen, what type of structures would be used? Where would they be located? How many stabilizing structures would be needed? What are the estimated costs for stabilizing structures?

There are sandbags in front of the Kāʻanapali Beach Club serving as a temporary erosion control structure that were installed in 2018.

- How has this structure impacted the sand and beach erosion so far? Is it positive or negative?
- Did the sandbags cause any changes to the reef and/or marine life along the shoreline? If yes, please explain the changes.
- Will the sandbags be removed as part of this project?
- If the sandbags are removed, how will they be moved and what's the estimated timeframe?

What is the funding mechanism and where will/has the money for this project come from?

If the money is to be paid back, how will it be paid if the buildings become compromised and are uninhabitable?

What is the public benefit of this project that encroaches on public lands/ocean?

Why was this location chosen for this specific project?

How long is it estimated that the buildings and amenities mauka of the property will hold up if nothing is done?

Can you guarantee no marine life will be harmed in this project? Can you guarantee our Nabeta and Kona crab grounds will not be disturbed by this project?

Iroquois point, where they have implemented stabilizing structures, is littered with broken corals. Is that what will happen at Honokōwai?

Who is paying for your services?

What is the estimated timeframe for this project?

How will this project hold up to a series of large swells or tsunami? What happens if there is large swells during construction? What type of wave heights, frequency and duration will this project be able to withstand?

How will it change the nearshore currents/habitats? How will it affect free divers doing down drift sessions?

How will brown water events be flushed out of nearshore waters?

https://www.hoalahonokowai.com | T: (808) 244-2015 | E: honokowai@munekiyohiraga.com

October 31, 2025

Tamara Paltin, Councilmember
County of Maui
200 S. High Street, 8th Floor
Wailuku, Hawai'i 96793

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Ho'āla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawai'i

Dear Councilmember Paltin:

Thank you for your comment letter dated January 23, 2023 regarding the Ho'āla Honokōwai Project Environmental Impact Statement (EIS) Preparation Notice. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the comments received.

Comment No. 1:

Within the project site, there are two properties with buildings along the shoreline: Kā'anapali Beach Club and Kā'anapali Shores Condominium.

- *Has a structural integrity assessment been done on the buildings closest to the ocean? If yes, please explain the findings. If not, why not?*
- *How much are each of these buildings worth?*
- *What would be the cost to move the buildings inland?*

Response:

A Structural Assessment has been prepared by a structural engineer and will be included and discussed in the Draft EIS. The makai building of the Kā'anapali Beach Club (KBC) property is supported on concrete piles that are driven deep into the substrate. The substrate consists of sandy gravel down to a depth of approximately 92 feet. below grade, at which point hard basalt is found. The Structural Assessment indicated that erosion countermeasures such as those considered in the three beach restoration alternatives would prevent the erosion of the soil substrate, and the soil underlying the existing structure would continue to provide adequate vertical and lateral support.

According to the Economic Impact Report prepared for the project, the KBC property has a real property assessed value estimated at $299,437,700.00. The Economic Impact Report will be included and discussed within the Draft EIS. While the Economic Impact Report discusses economic and fiscal impacts for the potential forced closure of KBC if no action is taken, the cost to move the buildings has not been determined. Managed retreat could require substantial redevelopment or relocation of the resorts and condominiums that currently exist in the vicinity. Relocation at this scale would require extensive demolition and removal of existing infrastructure (e.g., buildings, parking facilities, utilities, hardscaping, landscaping, and potentially fill material) and extensive remediation to restore the area to an acceptable condition. Relocation at this scale would also require extensive new development at other locations on Maui. A project of this magnitude would fundamentally alter many aspects of the natural and built environments, and the appearance and character of the Honokōwai community as it exists today. Change of this magnitude should be addressed comprehensively and in collaboration with a broad range of stakeholders.

It is assumed that managed retreat in a heavily developed area like the Project Site would likely require a phased approach that may be implemented over the course of several decades, which could require substantial redevelopment or relocation of the resorts and condominiums that currently exist in the vicinity. Until managed retreat policies, regulations, tools, and programs at the State and County level are in place to implement managed retreat in a heavily developed community like Honokōwai, other appropriate solutions should be considered.

Comment No. 2:

Where is the sand for beach nourishment going to come from? How will the sand be transported and placed onto the beach? What are the estimated costs for this method?

Response:

The proposed sand source is an offshore sand deposit located 1.5 miles south of the Project Site. The Sand Recovery Site is approximately 1,500 to 2,000 feet seaward of the shoreline in water depths ranging from 115 to 170 feet. Additional information about the proposed sand source will be provided in the Draft EIS.

Sand would be recovered from the offshore sand deposit via a mechanical dredge system that uses an environmental clamshell bucket. The recovered sand would be transported via barge from the Sand Recovery Site to Kahului Harbor. The sand would be transported via dump trucks from Kahului Harbor to the Project Site. The sand would be placed along the shoreline using heavy equipment (e.g., excavators, dump trucks, and bulldozers). Additional information about the proposed sand recovery, transport, and placement methodology will be provided in the Draft EIS.

The estimated cost for construction would depend on the specific method of beach restoration. Additional information about estimated project costs will be provided in the Draft EIS.

Comment No. 3:

If the beach nourishment with stabilizing structures method is chosen, what type of structures would be used? Where would they be located? How many stabilizing structures would be needed? What are the estimated costs for stabilizing structures?

Response:

The Beach Stabilization alternative would involve the use of four (4) rock rubble mound groins to stabilize the beach sand. The groins would be located along the shoreline between Honokōwai Point and Honokōwai Stream. Additional information about the Beach Stabilization alternative will be provided in the Draft EIS. This alternative would have an estimated cost of $19,827,000.

Comment No. 4:

There are sandbags in front of the Kāʻanapali Beach Club serving as a temporary erosion control structure that were installed in 2018.

- *How has this structure impacted the sand and beach erosion so far? Is it positive or negative?*
- *Did the sandbags cause any changes to the reef and/or marine life along the shoreline? If yes, please explain the changes.*
- *Will the sandbags be removed as part of this project?*
- *If the sandbags are removed, how will they be moved and what's the estimated timeframe?*

Response:

The existing temporary erosion skirt has been continually monitored since it was installed in May 2018. Monthly monitoring reports are submitted to the State of Hawaiʻi and County of Maui. Since the structure was installed, the beach has experienced partial recovery as sand has been transported alongshore from the south. However, the volume of sand currently present along the shoreline within the Project Site remains substantially less than what existed prior to the episodic erosion event in 2016. Most of the observed beach recovery occurred after the temporary erosion control structure was installed.

Hui O Ka Wai Ola has been conducting water quality monitoring at Honokōwai Beach since 2016. Their monitoring results have confirmed that high levels of turbidity and nitrates are prevalent along the leeward Maui coast. Their most recent report in 2022 found that turbidity and nitrate levels at Honokōwai Beach far exceed Hawaiʻi Department of Health (DOH) water quality standards, and that turbidity is expected to increase over time in northern West Maui, as coastal erosion worsens with sea level rise. The report notes that erosion of coastal soil deposits contributes to the higher observed turbidity levels and that stabilizing the shoreline is an option to reduce soil erosion and the associated

turbidity. The report also notes that recent declines in turbidity levels at Honokōwai Beach may be attributed to the temporary erosion skirt.

There have been no observed negative impacts to the reef and/or marine life along the shoreline since the existing temporary erosion skirt was installed. In May 2021, three (3) years after installation, a baseline assessment of the marine environment was conducted by Marine Research Consultants, Inc. (MRC) that will be included and discussed in the Draft EIS. No damage or debris was observed in the nearshore or inner reef, and the outer reef was observed to be in a normal condition relative to other similar Hawaiian ecosystems with typical coral abundance and diversity and no appearance of significant stress.

Endangered species have also been observed at the Project Site since the existing temporary erosion control structure was installed. Green sea turtles have been observed foraging on the inner and outer reef, and Hawaiian monk seals have been observed hauling out on the beach. Fishermen have been observed line fishing and throw net fishing along the shoreline, and spear fishers fish the outer reef.

The existing temporary erosion skirt would be removed when a mid-term solution can be approved and implemented. The structure would be demolished and removed using heavy equipment (e.g., excavators and dump trucks). All debris material will be removed and disposed of at an approved upland disposal site.

Additional information about the existing temporary erosion skirt will be provided in the Draft EIS.

Comment No. 5:

What is the funding mechanism and where will/has the money for this project come from?

Response:

The proposed Project would be privately funded by the Applicant, the West Maui Resort Partners, L.P. and other private stakeholder partners.

Comment No. 6:

If the money is to be paid back, how will it be paid if the buildings become compromised and are uninhabitable?

Response:

As noted above, this is a privately funded project. No public monies would be allocated or loaned for project implementation.

Comment No. 7:

What is the public benefit of this project that encroaches on public lands/ocean?

Response:

The Project is intended to restore and maintain a public beach. The proposed action would provide a wide range of public benefits including but not limited to improved access to and along the shoreline, enhanced opportunities for traditional cultural practices and ocean recreation, restored habitat for endangered and protected species, improved water quality, decreased risk to public health and safety, increased resilience to coastal hazards and sea level rise, and support of Maui's visitor economy. Additional information about the public benefits of the proposed action will be provided in the Draft EIS.

Comment No. 8:

Why was this location chosen for this specific project?

Response:

Honokōwai Beach has historically been a relatively stable shoreline that experiences seasonal variations in beach width and volume. In 2016, due to an unusual combination of persistent northerly swell, sustained elevated water levels, strong currents, and abnormally high tides, Honokōwai Beach was almost entirely lost to erosion. The erosion caused extensive beach loss, structural damage, negative impacts to water quality, and risks to public health, safety, and welfare. The Hawaii Shoreline Management Study (USACE, 2018) identifies Honokōwai Beach as an erosion "hot spot".

No community or government action was taken to mitigate the erosion and beach loss; therefore, a private applicant (West Maui Resort Partners L.P.) has volunteered to restore Honokōwai Beach. Additional information about the Project Site and the Project objectives will be provided in the Draft EIS.

Comment No. 9:

How long is it estimated that the buildings and amenities mauka of the property will hold up if nothing is done?

Response:

An estimate of how long the buildings and amenities mauka of the property will remain cannot be made at this time. However, it is noted that the Draft EIS will include assessment of a No Action alternative, including cumulative impacts that may occur over a 50-year period. Coastal erosion is anticipated to accelerate around mid-century as a result of climate change. With the No Action alternative, erosion and beach loss would drastically change the shoreline. Shoreline recession, or the permanent landward migration of the shoreline, would leave a narrower shoreline that is unable to serve as an effective buffer between the ocean and the land. Shoreline recession would have significant impacts on land use at and beyond the shoreline. Projections vary for land loss and sediment discharge estimates based on project sea level rise scenarios but based on 3.2 feet of sea level rise, land loss is anticipated to be up to 60,496 square feet with up to 19,542 cubic yards of sediment discharged. While the exact timing of coastal erosion is uncertain, it is possible that total beach loss at Honokōwai Beach could occur before the end of the

century if no mitigation is done. The objectives of the Project are to restore beach width and improve beach stability, preserve and enhance cultural and shoreline access, increase resilience to coastal hazards and sea level rise, and enable planning for long-term adaptation to sea level rise. A wider and more stable beach would provide a protective buffer that would reduce the vulnerability of existing structures and land uses to coastal hazards and sea level rise.

Additional information about projected timeframes for sea level rise and erosion, and potential impacts to existing structures and land uses, will be provided in the Draft EIS.

Comment No. 10:

Can you guarantee no marine life will be harmed in this project? Can you guarantee our Nabeta and Kona crab grounds will not be disturbed by this project?

Response:

There may be temporary impacts to the marine environment during the sand recovery process to the marine environment, including potential turbidity and displacement of marine organisms. These impacts are expected to be temporary and not have a broader regional impact, as the Sand Recovery Site is part of a much larger sand field. After sand recovery is complete, the Sand Recovery Site is anticipated to return to its existing condition. Discussion of impacts to the marine environment will be included in the Draft EIS. There is anticipated to be a take of Kona Crab that are living within the Sand Recovery Site, but the regional impact is anticipated to be negligible as the Sand Recovery Site is part of a much larger sand field system. Any impact would be temporary, limited to the sand recovery period, and Kona Crab are anticipated to repopulate the area after sand recovery is complete. To the extent feasible, sand recovery may be scheduled outside of the Kona Crab spawning season of May to August to limit impacts to propagation. There is also anticipated to be a temporary displacement impact to fish, including the nabeta, transiting within the Sand Recovery Site. It is noted that the nabeta are solitary and the number anticipated to be displaced from sand recovery would be limited and temporary.

Comment No. 11:

Iroquois point, where they have implemented stabilizing structures, is littered with broken corals. Is that what will happen at Honokōwai?

Response:

At Iroquois Point, coral cobble was identified as a natural background condition prior to completion of the Iroquois Point Beach Restoration and Stabilization project in 2013. Large volumes of cobble were present on the seafloor adjacent to the shoreline and at the Sand Recovery Site. The beach restoration project did not change this natural background condition. Additional information about the Iroquois Point Beach Restoration and Stabilization project will be provided in the Draft EIS.

At Honokōwai Beach, coral cobble is naturally present on the seafloor in close proximity to the shoreline; however, no coral cobble has been observed at the Sand Recovery Site.

If coral cobble or other large-diameter material is encountered during dredging operations, the material can be sifted and removed prior to placement. Therefore, the Project is not anticipated to increase the volume of coral cobble that currently exists at Honokōwai Beach. Additional information about the proposed sand source will be provided in the Draft EIS.

Comment No. 12:

Who is paying for your services?

Response:

The Project would be a privately funded project. No public monies would be allocated or loaned for project implementation. All project costs would be funded by the Applicant, West Maui Resort Partners, L.P. and other private stakeholder partners.

Comment No. 13:

What is the estimated timeframe for this project?

Response:

The proposed Project is currently undergoing environmental review. Upon completion of the environmental review process, the Project can advance to final design and permitting, and eventually construction. The estimated timeframe to implement the Proposed Action is approximately four (4) years with implementation currently anticipated in the fourth quarter of 2027. Additional information about the anticipated project schedule will be provided in the Draft EIS.

Comment No. 14:

How will this project hold up to a series of large swells or tsunami? What happens if there is large swells during construction? What type of wave heights, frequency and duration will this project be able to withstand?

Response:

A Coastal Engineering Assessment (CEA) was prepared for the project and will be included and discussed in the Draft EIS. The CEA provides a detailed discussion on waves and coastal erosion events. The CEA notes that all potential beach restoration options should decrease the impacts of tsunami flooding by increasing beach width and volume, and increasing the buffer between the marine and terrestrial environments. This buffer would improve the wave dissipating capacity of the beach and potentially decrease the landward extent of wave runup. However, the proposed Project is not designed to withstand tsunamis. Beach Nourishment and Beach maintenance lack stabilizing structures and may be subject to episodic erosion events during and after construction. The Draft EIS will include a robust discussion of waves, swells, and tsunami conditions.

Comment No. 15:

How will it change the nearshore currents/habitats? How will it affect free divers doing down drift sessions?

Response:

The CEA concludes that beach restoration has the potential to impact currents, circulation, and sediment transport patterns at the Project Site, but is not expected to impact these processes at the Sand Recovery Site. The CEA includes an evaluation of potential impacts to nearshore current patterns using numerical wave modeling. The Beach Stabilization alternative is anticipated to interrupt dangerous longshore currents and rip currents and create safer swimming conditions. The footprint of the groins would be confined to the shallow nearshore scour zone, allowing free divers to down drift on the mid-reef and outer-reef without being impacted by the groins. Further discussion on the nearshore conditions are included within the Draft EIS.

Comment No. 16:

How will brown water events be flushed out of nearshore waters?

Response:

The groins would be spaced far enough to allow continued water circulation and the flushing of nearshore waters. A wider and more stable beach and backshore are anticipated to improve water quality and decrease the severity of storm water flooding and brown water events. Additionally, the terminal groin for Beach Stabilization is anticipated to reduce the accumulation of sand in the mouth of Honokōwai Stream from accumulating sand, further decreasing the severity of brown water events. Further discussion on the nearshore environment, water quality, and stormwater management will be included within the Draft EIS.

Thank you again for your participation in the Chapter 343, Hawai'i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 244-2015.

Very truly yours,

Tessa Ng

Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Michael Cain, Office of Conservation and Coastal Lands
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KAANAPALI SHORES
ASSOCIATION OF APARTMENT OWNERS
3445 L. Honoapiilani Road
Lahaina, HI 96761
Phone 808 667-2211 Fax 808 661-5474

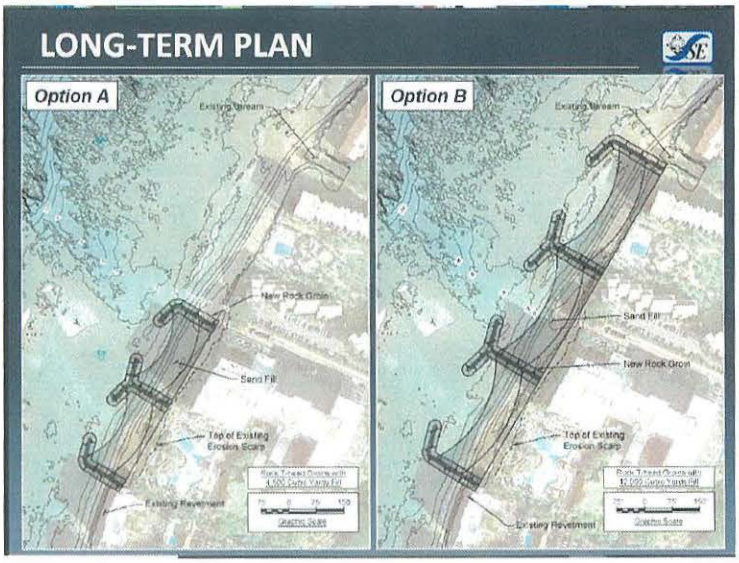
January 12, 2023

Michael Cain, Administrator
Office of Conservation and Coastal Lands
Department of Land and Natural Resources
State of Hawaii
Via Email: michael.cain@Hawaii.gov

Re: EISPN – Ho'ala Honokowai

Aloha Mr. Cain,

Below is what was communicated to us as the proposed alternatives for the subject shoreline back in May 2021, by Sea Engineering . There remain several points of concern/interest for us… I've listed them under the graphic below. We would like to ensure that our concerns are officially made a matter of record with the appropriate State/County departments in response to the EISPN.



While wanting to be a good neighbor with an interest in working together to find an optimal approach to shoreline management, the AOAO Ka'anapali Shores must object to the pursuit of "Option A" that appears on the above graphic (if it is still an option being considered), as it will clearly have an adverse impact on the natural accretion of sand fronting our property. With respect to replenishment, sand transport is primarily from south to north. The northernmost groin (proposed to be located between KS and KBC) will block that sand transport leaving us without a sand replenishment mechanism.

In addition, we have concerns about the potential liability that comes with unrestricted pedestrian access to any proposed groins (i.e. people walking/climbing/playing on them, fishing off of them, etc.). The boulders will be wet and slippery at times, creating the potential for slips and falls. We don't feel that KS should be subjected to that new and additional potential liability.

Finally, though we remain open to further discussion on reasonable alternatives for the shoreline, we would also initially object to any proposed alternative that would require the removal of our existing revetment wall.

Our board remains supportive of the concept of beach restoration assuming such restoration presents no adverse effects on the shoreline fronting our property.

We look forward to learning more detail on any proposed design concept in the months ahead.

Mahalo,

Mark D. Mrantz
General Manager
AOAO Ka'anapali Shores

CC: Andy Bohlander, Sea Engineering

https://www.hoalahonokowai.com | T: (808) 244-2015 | E: honokowai@munekiyohiraga.com

October 31, 2025

Mark D. Mrantz, General Manager
AOAO Ka‘anapali Shores
3445 L. Honoapi‘ilani Road
Lahaina, Hawai‘i 96761

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Ho‘āla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawai‘i

Dear Mr. Mrantz:

Thank you for your comment letter dated January 12, 2023 regarding the Ho‘āla Honokōwai Project Environmental Impact Statement (EIS) Preparation Notice. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the comments received.

Comment No. 1:

Below is what was communicated to us as the proposed alternatives for the subject shoreline back in May 2021, by Sea Engineering. There remain several points of concern/interest for us... I've listed them under the graphic below. We would like to ensure that our concerns are officially made a matter of record with the appropriate State/County departments in response to the EISPN.

While wanting to be a good neighbor with an interest in working together to find an optimal approach to shoreline management, the AOAO Ka'anapali Shores must object to the pursuit of "Option A" that appears on the above graphic (if it is still an option being considered), as it will clearly have an adverse impact on the natural accretion of sand fronting our property. With respect to replenishment, sand transport is primarily from south to north. The northernmost groin (proposed to be located between KS and KBC) will block that sand transport leaving us without a sand replenishment mechanism.

Response:

Thank you for your comments regarding the proposed groin design. We appreciate the opportunity for continued coordination with the AOAO Kaanapali Shores. The alternative referred to as "Option A" is one of several conceptual groin configurations that was considered in the early stages of the Project. The purpose of this alternative was to evaluate a groin configuration that would limit the geographic scope of the project to the shoreline fronting Ka‘anapali Beach Club. The three-groin alternative was not selected for

the proposed Project. The proposed Beach Stabilization alternative would involve a four-groin design as shown in Option B in your letter. Additional information about the groin design will be presented in the Draft EIS

Comment No. 2:

In addition, we have concerns about the potential liability that comes with unrestricted pedestrian access to any proposed groins (i.e. people walking/climbing/playing on them, fishing off of them, etc.). The boulders will be wet and slippery at times, creating the potential for slips and falls. We don't feel that KS should be subjected to that new and additional potential liability.

Response:

If groins are developed, a non-exclusive easement is anticipated to be required from the Department of Land and Natural Resources (DLNR). The terms of the easement would be coordinated with the DLNR and may include provisions regarding public access to the easement and related liability considerations (e.g., whether Hawai'i's recreational use statute, HRS Chapter 520, is applicable, whether mitigative measures should be required). It is not currently anticipated that the AOAO Kaanapali Shores would be party to the easement, have ownership or control over the groins, or be subjected to related liability. However, the AOAO Kaanapali Shores is encouraged to consult with its legal counsel regarding this issue.

Comment No. 3:

Finally, though we remain open to further discussion on reasonable alternatives for the shoreline, we would also initially object to any proposed alternative that would require the removal of our existing revetment wall.

Response:

The Proposed Action is beach restoration, which could be accomplished through the action alternatives of Beach Nourishment, Beach Maintenance, or Beach Stabilization. The Draft EIS will assess these methodologies and identify a preferred alternative. It is noted that neither the Proposed Action of beach restoration, nor any of the alternatives considered, would involve removal of the existing shore protection structure fronting Kaanapali Shores. Restoring and maintaining a wider and more stable beach would provide a protective buffer that would reduce the exposure of the existing shore protection structure to wave action, which may help to reduce potential for damage and costs for repair and maintenance of the structure. Additional information about the Proposed Action and action alternatives will be provided in the Draft EIS.

Comment No. 4:

Our board remains supportive of the concept of beach restoration assuming such restoration presents no adverse effects on the shoreline fronting our property.

We look forward to learning more detail on any proposed design concept in the months ahead.

Response:

We are grateful for the board's support and for your participation in the Chapter 343, Hawai'i Revised Statutes (HRS) environmental review process. The Draft EIS will assess the Proposed Action's potential impacts and identify mitigation measures to prevent adverse effects to Kaanapali Shores and other surrounding properties.

Thank you again for your participation in the Chapter 343, HRS environmental review process. A copy of your letter and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 244-2015.

Very truly yours,

Tessa Ng

Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Michael Cain, Office of Conservation and Coastal Lands
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honokowai

From: Patricia B Cadiz <pbc5@mac.com>
Sent: Monday, January 9, 2023 12:12 PM
To: michael.cain@hawaii.gov
Cc: honokowai
Subject: Support for proposed Honokowai Beach restoration and preservation project

To Whom it May Concern;

I support the goals and three proposed methods of addressing the shoreline erosion at Honokowai. My preference would be for beach restoration with shore stabilizing structures as this will offer the best long term solution to ongoing erosion in the face of projected seal level rise.

With aloha,
Patricia B Cadiz
Certified Coastal Practitioner
808-283-5070

https://www.hoalahonokowai.com | T: (808) 244-2015 | E: honokowai@munekiyohiraga.com

October 31, 2025

Via email: pbc5@mac.com

Patricia B. Cadiz
Certified Coastal Practitioner

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Hoʻāla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawaiʻi

Dear Ms. Cadiz:

Thank you for your email dated January 9, 2023 regarding the Hoʻāla Honokōwai Project Environmental Impact Statement (EIS) Preparation Notice. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the comments received.

Comment:

I support the goals and three proposed methods of addressing the shoreline erosion at Honokowai. My preference would be for beach restoration with shore stabilizing structures as this will offer the best long term solution to ongoing erosion in the face of projected seal level rise.

Response:

Thank you for your comment and support of the proposed beach restoration methodologies. Beach restoration is proposed as a mid-term solution to ongoing erosion while long-term adaptation strategies can be developed and implemented. The Draft EIS will include an analysis of how each beach restoration alternative and a No Action alternative would be impacted by projected sea level rise.

Thank you again for your participation in the Chapter 343, Hawai‘i Revised Statutes environmental review process. A copy of your email and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 244-2015.

Very truly yours,

Tessa Ng

Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Michael Cain, Office of Conservation and Coastal Lands
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honokowai

From: Harmony Colella <hcolella@gmail.com>
Sent: Monday, January 23, 2023 4:06 PM
To: michael.cain@hawaii.gov; Michael.Elliott@hgv.com; honokowai
Subject: Re: Honokowai Beach Proposal

Aloha,

As a follow up to my statement, this email is to provide specific questions regarding that need to be address in the Environmental Impact Survey:

1. What are the subsidence rates of the land? What are the subsidence rates compared to erosional rates?
2. What is the evidence that 2016 was a larger than normal episodic event? What are the erosional rates from previous years and subsequent years?
   - A statement was made about repeated north/northwest swells, which is no different than this year.
3. What are erosional rates compared to global and local sea level rise rates?
4. Have you surveyed the local community near Honokowai? Do they support that such actions would be preserving cultural practices?
5. What is the plan for all the marine life and coral reef systems that will be smothered by additional sand?
6. How much of the current coastline is currently being undercut by the ocean waves and surge activity? This could cause a much more immediate problem.
7. What is your plan to STOP Mother Nature from taking its natural course, which is continued erosion of the coastline, subsidence of the island, and sea level rise?

True concern for cultural and recreational activities is not to put a wet bandaid on a problem, it is to fix it completely. Plan for the future and move the hotels across the highway. Consider being part of the solution and not the problem on Maui!

Mahalo,
Harmony Colella, PhD.

> On Jan 16, 2023, at 7:50 PM, Harmony Colella <hcolella@gmail.com> wrote:
>
> Dear Mr. Cain,
>
> I hope this email finds you well. I am a local resident in Honokowai, a business owner who spends many of my days in teaching others about the underwater world along Maui's shoreline on the westside, and spent the first 15 years of my career as a research scientist with an advanced degree in Earth Sciences. I have published in peer-reviewed journals, received federal grants, and sat on grant review committees for the United States Geological Survey and Nationals Science Foundation. Some of my earlier research was conducted on the evolution of the Kilauea volcano and is published in a series that reviews their evolution. While most of this is not that important, it is to support my extensive knowledge of geological processes, particularly here in the Hawaiian Islands.
>
> I have read the proposal to the Honokowai Beach shoreline put forth by the resort engineers, and am frankly appalled and horrified that any actions that involve replenishing sand are being considered, and that is a solution proposed in each scenario. Adding more sand is problematic for several reasons:

- Any sand added to the beaches will be removed in subsequent storms. It has already been removed from storms, adding it back will not fix this. This is a waste of money and resources.
- The addition of sand will kill all marine life living on the shore and in along the shallow shoreline. This will further destroy cultural and recreational ocean activities - no life, no food, nothing to see.
- The addition of sand will smother already existing, actually quite healthy, reef systems and will kill marine life can coral. This will further destroy cultural and recreational ocean activities - no life, no food, nothing to see.

As a frequent Honokowai Beach Park visitor, there are always line fisherman and spear fishermen. I have spent a lot of time in the water along this shoreline and the coral is incredibly healthy and home to so much marine life. Addition of sand will destroy these resources not replenish them!

The islands (all of them) are subsiding and sea level is rising. Both of these are truths and inevitable. We CANNOT stop Mother Nature. Furthermore, the stone walls that currently exist are being undercut, which makes the land the hotels sit on in danger of collapsing into the ocean. This is, potentially, the most devastating scenario - particularly if people are in them. The collapse of the hotels and time shares will undoubtedly destroy the shoreline and underwater environment. Think Puamana but much worse. If anything Puamana should be used as a example of what is inevitable. There are several other examples of beaches, coastal cliffs/egdes, and roads that have been undercut and collapsed and that ARE being undercut and it is only a matter of time before they collapse.

If we want to preserve our shoreline, the ability to continue cultural and recreational practices in the ocean, and protect our visitors, the real solution is to move the hotels across the highway (or somewhere else). I realize this is not what West Maui Resort Partners, L.P. wants to hear, but it is true. To think that we can avoid or postpone the inevitability of coastal erosion and sea level rise is short-sided and ignorant. Mother Nature will win. Instead of trying to fight her or pretend as if she doesn't exist, why don't we do what is engrained in the Hawaiian culture - respect her and plan for her accordingly.

Thank you for your time and consideration.

Sincerely,
Harmony Colella, PhD

https://www.hoalahonokowai.com | T: (808) 244-2015 | E: honokowai@munekiyohiraga.com

October 31, 2025

Via email: hcolella@gmail.com

Harmony Colella, PhD.

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Ho'āla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawai'i

Dear Dr. Colella:

Thank you for your email comments dated January 16, 2023 and January 23, 2023 regarding the Ho'āla Honokōwai Project Environmental Impact Statement (EIS) Preparation Notice. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the comments received.

JANUARY 16, 2023 EMAIL

Comment No. 1:

I have read the proposal to the Honokowai Beach shoreline put forth by the resort engineers, and am frankly appalled and horrified that any actions that involve replenishing sand are being considered, and that is a solution proposed in each scenario. Adding more sand is problematic for several reasons:

- *Any sand added to the beaches will be removed in subsequent storms. It has already been removed from storms, adding it back will not fix this. This is a waste of money and resources.*
- *The addition of sand will kill all marine life living on the shore and in along the shallow shoreline. This will further destroy cultural and recreational ocean activities - no life, no food, nothing to see.*
- *The addition of sand will smother already existing, actually quite healthy, reef systems and will kill marine life can coral. This will further destroy cultural and recreational ocean activities - no life, no food, nothing to see.*

As a frequent Honokowai Beach Park visitor, there are always line fisherman and spear fishermen. I have spent a lot of time in the water along this shoreline and the coral is incredibly healthy and home to so much marine life. Addition of sand will destroy these resources not replenish them!

Response:

Thank you for sharing your concerns regarding beach restoration at Honokōwai Beach. Honokōwai Beach is vulnerable to chronic, seasonal, and episodic erosion. In 2016, Honokōwai Beach was almost entirely lost to erosion that was caused by an unusual combination of persistent northerly swell, sustained elevated water levels, strong currents, and abnormally high tides. The erosion caused extensive beach loss, negative impacts to water quality, and risks to public health, safety, and welfare. Erosion and beach loss are expected to continue and even accelerate with sea level rise.

The Proposed Action is beach restoration, which could be accomplished through Beach Nourishment, Beach Maintenance, or Beach Stabilization. The Draft EIS will assess these three (3) methodologies. Beach restoration is widely accepted as a nature-based approach to environmental restoration and sea level rise adaptation.

An Assessment of the Marine Environment was prepared by Marine Research Consultants Inc. (MRC) and will be included and discussed in the Draft EIS. The MRC report details the existing biotic communities in the vicinity of the Project Site. The footprint of the placed sand and stabilizing groins would be confined to a nearshore scour zone that is not a suitable habitat for coral growth. While there may be limited construction impacts to marine ecosystems, a wider and more stable beach is anticipated to positively impact water quality and the health of reef ecosystems seaward of the Project Site.

Please note that the Project Site is located approximately to ½ mile south of Honokōwai Beach Park. No action is being proposed in the immediate vicinity of Honokōwai Beach Park.

Comment No. 2:

The islands (all of them) are subsiding and sea level is rising. Both of these are truths and inevitable. We CANNOT stop Mother Nature. Furthermore, the stone walls that currently exist are being undercut, which makes the land the hotels sit on in danger of collapsing into the ocean. This is, potentially, the most devastating scenario - particularly if people are in them. The collapse of the hotels and time shares will undoubtedly destroy the shoreline and underwater environment. Think Puamana but much worse. If anything Puamana should be used as a example of what is inevitable. There are several other examples of beaches, coastal cliffs/egdes, and roads that have been undercut and collapsed and that ARE being undercut and it is only a matter of time before they collapse.

Response:

Thank you for your comments regarding sea level rise, seawalls, and shoreline areas being undercut and collapsing. The proposed Project is a mid-term solution to improve beach stability and increase resilience to coastal hazards and sea level rise while enabling planning for long-term adaptation to sea level rise.

Comment No. 3:

If we want to preserve our shoreline, the ability to continue cultural and recreational practices in the ocean, and protect our visitors, the real solution is to move the hotels across the highway (or somewhere else). I realize this is not what West Maui Resort Partners, L.P. wants to hear, but it is true.

Response:

We acknowledge your comments regarding relocation of resort development further inland. The proposed Project is designed to be a mid-term solution while long-term adaptation pathways can be determined and implemented. A goal of the Project is to preserve cultural and recreational access to the beach and nearshore.

JANUARY 23, 2023 EMAIL

Comment No. 1:

As a follow up to my statement, this email is to provide specific questions regarding that need to be address in the Environmental Impact Survey:

1. *What are the subsidence rates of the land? What are the subsidence rates compared to erosional rates?*

Response:

A Coastal Engineering Assessment (CEA) has been prepared for the Project and contains detailed information regarding subsidence. Subsidence refers to the downward vertical movement of the Earth's surface. Subsidence progressively decreased from Hawai'i Island to the west. The island of Maui is currently subsiding at an average rate of −0.1 ± 0.3 to −0.7 ± 0.3 millimeters (mm)/ year (yr.) (Pfeffer et. al., 2017). In coastal areas, subsidence leads to higher sea levels and increased flood risk, while uplifting land reduces sea level and promotes the seaward migration of coastlines. Subsidence and uplift are collectively referred to as vertical land motion, or VLM (NASA, 2024). VLM is an important component of sea level rise estimates and has been incorporated into the U.S. Task Force projections for each sea level rise scenario. VLM rates are derived from long-term tide-gauge observations and are assumed to be linear over the past record and to persist linearly into the future over the length of the projected record (Sweet et al., 2022). In Kahului, VLM rates range from 0.10 to 0.35 feet from 2030 to 2150, respectively, and account for approximately 18 percent to 3 percent of the total projected sea level rise for Kahului, respectively.

The relative sea level trend for Kahului Harbor for the period of 1947 to present is +2.22± 0.38 mm/yr., which is equivalent to a change of 0.73 feet (ft.) in 100 years (NOAA, 2023). The relative sea level trend is derived from tide station measurements, which are referenced to stable vertical points on the land and account for subsidence.

The historical shoreline change trend for the Project Site (from 1912 to 2018) has been erosion at an average rate -0.44 ft./yr. (UH-SOEST, 2022). The projected average shoreline change trend for the project site is erosion ranging from -1.07 to –1.81 ft./yr., which is 2.5 to 4 times the historical extrapolation. Based on these projections, without mitigative action, the increased erosion caused by sea level rise would likely result in total loss of Honokōwai Beach by mid-century or sooner.

More information about subsidence and erosion rates will be provided in the Draft EIS.

Comment No. 2:

2. What is the evidence that 2016 was a larger than normal episodic event? What are the erosional rates from previous years and subsequent years?

Response:

The University of Hawai'i Coastal Geology Group (CGG) conducted a historical analysis of sandy shorelines on Maui and produced shoreline change maps based on survey data and aerial imagery from 1912 to 2018. Their analysis uses the beach toe as the reference feature to measure changes in the position of the shoreline over time.

The historical shoreline change trend for the Project Site (transects 1179 to 1195) from 1912 to 2018 has been erosion at an average rate of -0.44 ft./yr. (CGG, 2022). The north end of the beach (transects 1190 to 1195) has been eroding at an average rate of -0.33 ft/yr. Erosion has historically been more pronounced along the south end of the beach (transects 1179 to 1184), which been eroding at an average rate of -0.44 ft./yr.

A comparison of shoreline positions before (2007) and after (2018) the erosion event indicates that the erosion that occurred during this time period was the largest recorded in the past century. From 2007 to 2018, the beach eroded an average of 70 ft., at an average annual rate of -5.86 ft./yr., which is over 13 times the historical average. Information about historical shoreline change will be provided in the Draft EIS.

Comment No. 3:

3. What are erosional rates compared to global and local sea level rise rates?

Response:

Sea level rise is an important factor in historical shoreline change. The CEA addresses information regarding global and local sea level rise and erosion rates. This information will be included in the Draft EIS. The CEA notes that impacts to shorelines associated with sea level rise include erosion, shoreline recession, beach narrowing, potential beach loss, and negative impacts to water quality and benthic habitat. For the proposed Project, the average of the mean projected shoreline change rates of -1.27 ft./yr. is used for planning and design purposes. This value represents the anticipated average annual shoreline change rate along Honokōwai Beach over a 50-year design life.

Comment No. 4:

4. Have you surveyed the local community near Honokowai? Do they support that such actions would be preserving cultural practices?

Response:

Local community members were surveyed and interviewed as part of the Cultural Impact Analysis (CIA), which will be included and discussed within the Draft EIS. Recreational beach and ocean users were also surveyed as part of a Coastal and Marine Uses Report that will also be included and discussed within the Draft EIS.

Comment No. 5:

5. What is the plan for all the marine life and coral reef systems that will be smothered by additional sand?

Response:

The Project is beach restoration. Potential impacts to the marine environment would depend on the specific method of beach restoration and will be discussed in the Draft EIS. A Marine and Water Quality Assessment was conducted for the proposed Project and will be included and discussed within the Draft EIS. The marine report found that the nearshore environment could be roughly divided into three zones; a nearshore scour zone, mid-reef platform, and outer reef. The placed sand and stabilizing groin footprint would be confined to the nearshore scour zone that is largely unsuitable for coral growth. While there may be limited construction impacts to marine ecosystems, a wider and more stable beach is anticipated to positively impact water quality and the health of reef ecosystems seaward of the Project Site.

Comment No. 6:

6. How much of the current coastline is currently being undercut by the ocean waves and surge activity? This could cause a much more immediate problem.

Response:

Sea level rise and coastal erosion are negatively impacting beaches and shorelines throughout Hawai‘i. Impacts include beach narrowing and beach loss, permanent loss of terrestrial land due to erosion, and infrastructure damage due to wave inundation and flooding.

Coastal erosion is anticipated to accelerate around mid-century as a result of climate change. Historical shoreline changes have been assessed at the Project Site and show an annual average recession of -0.44 ft./yr. Future sea level rise modeling at the Project Site anticipates an average recession of -1.07 ft./yr. at 1.1 ft. of sea level rise, and -1.81 ft./yr. with 3.2 ft. of sea level rise, an increase of 2.5 to 4 times historical rates, respectively.

Shoreline recession, or the permanent landward migration of the shoreline, will leave a narrower shoreline that is unable to serve as an effective buffer between the ocean and the land. Shoreline recession would have significant impacts on land use at and beyond the shoreline. While the exact timing of coastal erosion is uncertain, it is possible that total beach loss at Honokōwai Beach could occur before the end of the century if no mitigation is done. Projections vary for land loss and sediment discharge estimates based on project sea level rise scenarios but based on 3.2 ft. of sea level rise, land loss is anticipated to be up to 60,496 ft. with up to 19,542 cubic yards of sediment discharged.

The Draft EIS will include more discussion of coastal flooding, sea level rise, and land loss at the Project Site.

Comment No. 7:

7. What is your plan to STOP Mother Nature from taking its natural course, which is continued erosion of the coastline, subsidence of the island, and sea level rise?

Response:

The Project is beach restoration, which is widely accepted as a nature-based approach to environmental restoration and sea level rise adaptation. As a mid-term solution for the next 50 years, the proposed Project would enable planning and analysis for long-term adaptation strategies.

Comment No. 8:

True concern for cultural and recreational activities is not to put a wet bandaid on a problem, it is to fix it completely. Plan for the future and move the hotels across the highway.

Response:

Moving resort uses across the highway represents a potential long-term adaptation in the form of retreat. Managed retreat in a heavily developed area, like the Project Site, would likely require a phased approach that may be implemented over the course of several decades. It is noted that the State owns the majority of lands east of Honoapiʻilani Highway in the Honokōwai Area. State and local governments should be involved in retreat efforts via community-wide planning and education efforts, land use regulation, and financial assistance programs to facilitate managed retreat (vs. unmanaged retreat). Until managed retreat policies, regulations, tools, and programs are in place to implement managed retreat in a heavily developed community like Honokōwai, other appropriate solutions should be considered. The Project is an interim solution and would not preclude the implementation of other sea level rise adaptation strategies at Honokōwai in the future. Rather, the Project would help to maintain the environmental, cultural, social, recreational, and economic value of Honokōwai Beach, while providing a protective buffer to reduce impacts from erosion and flooding. The multi-decadal process of planning for and implementing managed retreat should not preclude the West Maui Resort Partners from restoring Honokōwai Beach.

Thank you again for your participation in the Chapter 343, Hawai‘i Revised Statutes environmental review process. A copy of your email and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 244-2015.

Very truly yours,

Tessa Ng

Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Michael Cain, Office of Conservation and Coastal Lands
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honokowai

From: Richard Cook <rcook.bc@gmail.com>
Sent: Tuesday, January 3, 2023 1:06 PM
To: honokowai
Subject: honokowai beach restoration

hi,
i have an accepted offer on a condo unit on the waterfront in honokowai. i was on your webpage regarding the restoration project.
i am wondering which part of the beach is affected by the proposal - is it in front of the honokowai beach park, or in front of the aston kaanapali shores and kaanapali beach club resorts, or both and everything in between?
also, if it does go ahead, do you know how it will be funded?
thanks for your assistance.
richard cook

honokowai

From: Cain, Michael <michael.cain@hawaii.gov>
Sent: Monday, January 9, 2023 4:24 PM
To: honokowai
Cc: Richard Cook
Subject: FW: [EXTERNAL] honokowai beach restoration

Forwarding, part 2

From: Richard Cook <rcook.bc@gmail.com>
Sent: Tuesday, January 3, 2023 1:12 PM
To: Cain, Michael <michael.cain@hawaii.gov>
Subject: [EXTERNAL] honokowai beach restoration

Dear Mr. Cain,
I have an accepted offer on a waterfront condo in Honokowai. I am very interested, therefore, in the beach restoration proposal. After reading the documents on their website (www.hoalahonokowai.com) it is not clear to me which part of the beach will be affected by the proposal. It looks like the proposal is for the beach in front of the Aston Kaanapali Shores, and Kaanapali Beach Club resorts. However, in the proposal, the Honokowai beach park is mentioned repeatedly.
I am wondering, therefore, if both parts of the beach are going to be improved, or if it will just be the beach in front of the resorts?
Also, can you please tell me who will be funding the beach restoration?
Thanks in advance for your assistance with this.
Sincerely,
Richard Cook

https://www.hoalahonokowai.com | T: (808) 244-2015 | E: honokowai@munekiyohiraga.com

October 31, 2025

Via email: rcook.bc@gmail.com

Richard Cook
Honokōwai Resident

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Hoʻāla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawaiʻi

Dear Mr. Cook:

Thank you for your email comments dated January 3, 2023 and January 9, 2023 regarding the Hoʻāla Honokōwai Project Environmental Impact Statement (EIS) Preparation Notice. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the comments received.

Comment No. 1:

i am wondering which part of the beach is affected by the proposal - is it in front of the honokowai beach park, or in front of the aston kaanapali shores and kaanapali beach club resorts, or both and everything in between?

it is not clear to me which part of the beach will be affected by the proposal. It looks like the proposal is for the beach in front of the Aston Kaanapali Shores, and Kaanapali Beach Club resorts. However, in the proposal, the Honokowai beach park is mentioned repeatedly.

I am wondering, therefore, if both parts of the beach are going to be improved, or if it will just be the beach in front of the resorts?

Response:

The Project Site is located where the shoreline transitions from predominantly sandy beaches and unarmored shoreline (south of Honokōwai Point) to predominantly rocky or armored shoreline (north of Honokōwai Point) and consists of 1,000 linear feet of shoreline that is fronted by a sandy beach, locally referred to as Honokōwai Beach. Private properties fronting the site include the Kaʻanapali Beach Club, the Kaanapali Shores, and the Maui Kai Condominiums. The Honokōwai Beach Park is located approximately ½ mile to the north of the Project Site.

Comment No. 2:

also, if it does go ahead, do you know how it will be funded?

Also, can you please tell me who will be funding the beach restoration?

Response:

The entire project, including beach restoration, would be privately funded by the West Maui Resort Partners, L.P. and other private stakeholder partners.

Thank you again for your participation in the Chapter 343, Hawai'i Revised Statutes environmental review process. A copy of your email and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 244-2015.

Very truly yours,

Tessa Ng

Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Michael Cain, Office of Conservation and Coastal Lands
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honokowai

From: Mark Deakos <deakos@hawaii.edu>
Sent: Sunday, January 22, 2023 11:08 PM
To: michael.cain@hawaii.gov
Cc: honokowai
Subject: EISPN Comment to 2022-12-23-MA-EISPN-Hoala-Honokowai Artificial Beach Project
Attachments: NMFS_Response_to_DLNR_FEA-Statewide-Small-Scale-Beach-Restoration-Program.pdf; Untitled attachment 00091.htm; Long_Lasting_Impacts_of_Beach_Renourishm.pdf; Untitled attachment 00094.htm

Dear Mr. Cain,

Please accept this email as my comments to the "Environmental Impact Statement Preparation Notice for the Proposed Ho'ala Honokowai Project Located at Honokowai, Lahaina, Maui Tax Map Keys: (2) 4-4-001:097, 098, and 100 (seaward)."

As a marine scientist who has worked, studied and played in West Maui's coastal waters for the past 25 years, I have witnessed severe degradation of our coastal resources including the loss of our public trust (beaches). Despite Coastal Zone Management laws enacted with the purpose of protecting, preserving, and restoring coastal resources and keeping people out of harms way, improper enforcement of these laws by the State and County have led to more than 4 miles of lost beaches in Maui alone and severely degraded coral reefs, fish populations and water quality. This is in large part due to the State and County being completely underfunded and understaffed to be expected to manage this monumental task of dealing with properties falling into public trust lands.

Living next door to Kahana Sunset for the past 20 years, I have witnessed first hand the continue attempts of property owners to hold the line, first with sand bags, then with larger and larger seawalls. Now with large surf towering over the 12 condemned condos, they wait patiently for their permits to rebuild the condos in the same location, in what appears to be complete denial of the inevitable. Managed retreat, the only viable long-term solution to preserve the public trust while keeping people out of harms way, never seems to on the table for discussion.

I see the same pattern of denial happening in Kahana, Honokawai and Kaanapali, where the right of the people to a migrating public trust is ignored and the focus remains on private property owners demanding their rights to hold the line as long as they want to. Having seen the damage of shoreline armoring, the focus has now turned to artificial beaches. Despite using terms like "beach nourishment" and "beach restoration" along with other terms of distraction, there is nothing environmentally positive about dredging thousands of cubic yards of a functioning benthic habitat and bulldozing that sand overtop of another natural habitat.

Given the grave concerns about the immediate and long-term impacts associated with artificial beach projects I have two requests:

1. The DEIS address all the concerns associated with artificial beach projects highlighted in the two attached documents (NMFS letter of concern to OCCL dated August 20, 2019; Hernandez-Delgado & Rosado-Matias, 2017). NMFS concludes that proposed beach nourishment projects will have short term, long-term to permanent, and cumulative adverse effects to Essential Fish Habitat. These are projects without T-groins in the design, which would have a much greater impact. Some items of concern at listed here and requested that they be addressed in the DEIS:
    -

- Quantitative Resource Survey Assessments: Project applicants are responsible for providing sufficient resource survey information or benthic habitat maps. Applicants should conduct preliminary, quantitative benthic marine survey assessments of the entire project footprint area within the littoral cell-hard and soft bottom, groin footprints, between groins, offshore of the groins, where sediment models predict deposition (see below), along or nearby sand pipeline pathways, and nearby the sand borrow areas-before an EFH consultation is initiated. The level of complexity of surveys will scale proportionally with the extent of habitat forming EFH resources (e.g., corals and submerged aquatic vegetation) that may suffer adverse effects (i.e., direct, indirect, and cumulative). Surveys and modeling efforts should consider the impacts of climate change, for example increased storm activity and sea level rise, on beach restoration and on the resources. Contingencies should be designed to accommodate analyses that utilize greater replication and higher statistical power to avoid the need to obtain higher resolution data Post-action monitoring plans would reduce uncertainty during potential EFH offset determinations. Assessments should be commensurate with the scale of the potential adverse effects as increasing the specificity and resolution of the scientific and natural resources information available will reduce uncertainty of adverse effects and support to EFH determinations. NMFS can provide assistance to Applicants to further refine and clarify the types and complexity of survey information that will be needed.
- Sediment Modeling: Depending on the extent of resources present within or near a beach nourishment footprint, modelling may be needed to predict how the proposed projects, including those with groins, will influence sediment transport and water motion. The modelling effort should include and consider the following areas: the groin footprints, between the groins, offshore of the groins, along or nearby sand pipeline pathways, and nearby the sand borrow areas. If there is a high probability that sediment deposition will occur over sensitive and hard-to-replace hard bottom habitat. corals. and seagrass, these areas should be prioritized survey areas both before and after construction. Completing these modelling efforts and including them in the EFH assessment would help reduce uncertainty and better inform EFH conservation recommendations and any offset determinations.
-
- Sediment Testing: Information about sediment chemistry, nutrient content, and other chemical characterization would be needed both on bulk samples (i.e.. all size fractions) and within each size fraction or sediment class (e.g., mud, silt, fine sand, sand, etc.). This is needed because smaller size fractions that include silt and mud classes typically retain higher organic carbon content and are more detrimental to habitat forming EFH than those sediment types with larger sizes. This information should also be included in the EFH assessment to inform conservation recommendations and potential offset determinations.
- Water Quality Monitoring: Robust water quality monitoring (e.g., turbidity, sedimentation rates, nutrients, dissolved oxygen, etc.) is needed to assess conditions before (i.e., baseline), during, and after beach restoration activities. These activities should be informed by the sediment modeling and daily tide and current velocity predictions (https://www.pacioos.hawaii.edu/voyagerD to select sampling. Special attention should be placed on collected turbidity and sedimentation rate information at areas where there are habitat forming EFH resources, including corals and submerged aquatic vegetation. For other criteria needed for beach restoration projects, NMFS would defer to the requirements of the Environmental Protection Agency (EPA) delegated through the state of Hawaii, Department of Health, Clean Water Branch's (DOH), 401 Water Quality Certification (WQC), Applicable Monitoring and Assessment Plans (AMAP).
- Stressor Effects: NMFS is concerned that there are a variety of adverse effects from stressors on EFH that have not been fully considered in the Draft EA. Short-term, long-term to permanent, and cumulative adverse effects to EFH are likely to occur from beach restoration projects due to physical damage, sedimentation and turbidity, and nutrients and chemical contamination.
- Physical Damage: Direct contact to habitat forming EFH resources (e.g., corals and submerged aquatic vegetation) from construction equipment and materials, as well as from installation activities, can lead to permanent and lesser adverse effects. The level of these adverse effects (i.e., short-term, long-term to permanent, and cumulative) will vary on a case-by-case basis dependent on the density and extent of

EFH resources present and the dredge and/or sediment retention design that are chosen. For example, the 2012 Waikiki Beach Nourishment and Dredging Project resulted in physical damage to the fossil limestone reef rock bordering sand borrow areas that were dredged (Draft EA, Section 4.2.2.3). In addition, recent projects in Waikiki have chosen to use a geotextile material to construct a sandbag groin. The long-term durability of this material is currently unknown and therefore carries a possibility of becoming compromised and potentially posing a risk to surrounding EFH. Due to this stressor, a variety of measures to avoid and minimize physical damage to EFH may be needed to reduce unavoidable losses.

- Sedimentation and Turbidity: Short-term, long-term to permanent, and cumulative adverse effects to habitat forming EFH may occur due to sedimentation and turbidity during proposed beach nourishment projects. Sedimentation and turbidity from hopper dredging at borrow areas may occur due to disruption from drag arms and heads and unmitigated overdredge disposal of fine sediment classes; land-based beach filling activities, after-the-fact from micritic calcium carbonate leaching from beach fill, and resuspension from groins is they alter local hydrodynamics.
-
- Nutrients and Chemical Contamination: Adverse effects may occur during dredging from borrow areas and after beach fill is placed due to release of sediment-bound nutrients and chemical contaminants; the latter may also occur from leaking construction equipment and introduction of treated materials into the marine environment, including lumber during multiple types of beach restoration projects.
-

2. One of the proposed alternative needs to include a robust analysis of managed retreat. During the project presentation by Sea Engineering, it was mentioned that the natural flow of sand between the two beach cells on either side of the Maui Kai Resort has been severed, preventing the natural seasonal flow of sand between these two beach cells. Therefore the managed retreat alternative should evaluate what portions or if the entire Maui Kai Resort should be relocated to restore the natural connection between the two beach cells. In addition, since many of the structures fronting this artificial beach project will have foundations undermined by the encroaching Erosion Hazard Line (EHL), a thorough examination of relocating these structures should be assessed. Items included in the assessment should include:
    - Certified Shoreline Survey to determine how much of the Maui Kai Resort is currently in the conservation easement (public trust)
    - How much time exists before the EHL will impact the property's foundation (for each building that is included in this DEIS)
    - The age of the building
    - What type of substrate exists below the building and to the mauka property line (substrate bores should be taken moving perpendicular to the shoreline towards the mauka property line to determine the composition of silt//sand/clay beneath
    - How much space is available mauka for relocation
    - What other alternatives exist for relocation
    - What is the estimated cost of relocation
    - What is estimated cost of repairing and remodeling the existing building
    - What revenues are generated from the existing building
    - What percentage of the units are full time residents

I recognize there is no easy solution to this complicated issue but I do believe that the sooner we begin having serious discussions and evaluations on managed retreat, the quicker we can start implementing compassionate, long-term solutions that preserve and restore coastal resources while keeping people out of harms way.

Mahalo,

Mark Deakos
Napili

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Regional Office
1845 Wasp Blvd., Bldg 176
Honolulu, Hawaii 96818
(808) 725-5000 · Fax: (808) 725-5215

Mr. Samuel Lemmo
Administrator
Office of Conservation and Coastal Lands Kalanimoku Building
1151 Punchbowl St., Room 131
Honolulu, HI 96813

August 20, 2019

Dear Mr. Lemmo:

On July 23, 2019, NMFS, Pacific Islands Regional Office (PIRO) received your request for comments and technical assistance on the Draft Programmatic Environmental Assessment for the Statewide Small Scale Beach Restoration program (SSBR). Below is our technical assistance intended to help your permit-applicants comply with the essential fish habitat (EFH) provisions of the Magnuson-Stevens Fishery Conservation and Management Act (MSA; Section 305(b)(2) as described by 50 CFR 600.920) as well as the Fish and Wildlife Coordination Act (FWCA), which will be required as part of the U.S. Army Corps of Engineers (USACE), Honolulu District, Regulatory Branch's permitting process. NMFS is concerned that while certain aspects of the proposed permitting process may be streamlined through the SSBR program, there will likely still be a need for individual EFH consultations. In general, PIRO believes that based on the Draft EA, individual projects administered through the proposed SSBR would necessitate individual EFH consultation and in many cases compensation or offset for adverse effects to habitat. This outcome is of course highly dependent on the particular details of a project including scale, location, surrounding habitat, and type of action. We describe our concerns and provide preliminary recommendations intended to help you provide your clients with the best possible compliance package to PIRO.

This technical assistance does not fulfill any federal responsibilities and does not constitute an EFH consultation as EFH consultations, which are mandatory for federal agencies (e.g, USACE) when the proposed activities could reduce the quality or quantity of designated EFH (50 CFR 600.920). Compliance with the EFH provisions of the MSA can be achieved through completing individual EFH consultations with NMFS or in conjunction with other regulatory compliance processes such as the Fish and Wildlife Coordination Act (FWCA, 16 U.S.C. 661-666c).

PIRO Habitat Mandates

Magnuson Stevens Fishery Conservation and Management Act

A consultation with NMFS is required when a federal agency works in an area that will adversely affect EFH (i.e. the federal agency is directly conducting the work, funding work, or permitting work) (MSA; Section 305(b)(2) as described by 50 CFR 600.920). The EFH consultation process entails the federal action agency contacting NMFS and providing an EFH assessment, which contains key information: a description of the proposed action, a determination from the federal agency as to how the action will affect EFH, an assessment of those adverse effects, and proposed ways to mitigate for the adverse effects, if applicable. An adverse effect to EFH is anything that reduces the quality and or quality of EFH. It may include direct, indirect, and site specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of an action. NMFS will then review the assessment and may provide conservation recommendations to avoid, minimize, or offset the listed adverse effects to EFH.

EFH consultations are scalable and commensurate to the severity and type of adverse effects to EFH. The greater the adverse effect, the greater scrutiny is needed to make a determination. As the order of effect increases, qualitative, semi-quantitative, and quantitative EFH assessments are appropriate, sequentially. Often, when EFH resources need to be quantified, PIRO will provide notice as to why an "expanded" EFH consultation is necessary (50 CFR 600.920(h)(i)), unless pre-consultation and/or sufficient avoidance and minimization has been presented along with quantification of unavoidable losses. Although we have provided you and your permit-Applicants with our most recent EFH Draft Consultation Guidance document to assist with the EFH consultation process, below we provide detail specific to your proposal that should be included within an EFH assessment for beach nourishment consultations.

In the main Hawaiian Islands, EFH has been designated in the marine water column from the surface to a depth of 1,000 meters (m), from the shoreline to the outer boundary of the Exclusive Economic Zone (5,150 kilometers/200 nautical miles/230 miles), and the seafloor from the shoreline out to a depth of 700 m. These waters and submerged lands are designated as EFH because they support various life stages for the management unit species (MUS) identified under the Western Pacific Regional Fishery Management Council's, *Pelagic and Hawai'i Archipelago Fishery Ecosystem Plan* (hereafter, Hawai'i FEP). The MUS and life stages found in these waters include: eggs, larvae, juveniles, and adults of Bottomfish MUS; eggs, larvae, juveniles, and adults of Crustacean MUS; and eggs, larvae, juveniles, and adults of Pelagic MUS. Specific types of habitat considered as EFH include coral reefs, patch reefs, hard substrate, seagrass beds, soft substrate, artificial or man-made structures, mangrove, lagoon, estuarine, surge zone, deep-slope terraces and pelagic/open ocean. In addition, the Hawai'i FEP has designated various areas within the Hawai'i Archipelago as Habitat Areas of Particular Concern[1] for providing functions of ecological importance, and being a rare habitat type that is sensitive to human-induced environmental degradation and development activities.

Federal agencies may incorporate an EFH Assessment (EFHA) into documents prepared for other purposes, such as Endangered Species Act Biological Assessments, National Environmental Policy Act documents, or public notices. If an EFHA is contained in another document, it must still include all of the mandatory contents required by the EFH guidelines. It must also be clearly

[1] https://www.habitat.noaa.gov/protection/efh/efhmapper/

identified in the table of contents and text of the document as an EFHA. Alternatively, an EFH Assessment may incorporate by reference other relevant environmental assessment documents that have already been completed. The referenced document must be provided to NMFS with the EFHA.

The EFHA process can also be combined with existing environmental consultation and review processes. The EFH guidelines at 50 CFR 600.920(f) enable Federal action agencies to use existing consultation or environmental review procedures to satisfy the MSA consultation requirements if the procedures meet the following criteria: 1) the existing process must provide NMFS with timely notification of actions that may adversely affect EFH; 2) notification must include an assessment of the proposed action's impacts on EFH that meet the requirements for EFHA discussed in section 600.920(e); and 3) NMFS must have made a finding pursuant to section 600.920(f)(3) that the existing process satisfies the requirements of section 305(b)(2) of the MSA. For the purposes of the beach nourishment programmatic process, the EFHA should be integrated with the Fish and Wildlife Coordination Act (FWCA; see below) coordination process. In situations where a Federal action may adversely designated EFH for Federally managed fisheries, EFH Conservation Recommendations can be considered within the FWCA reporting recommendations.

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (FWCA, 16 U.S.C. 661-666c) mandates that wildlife, including fish, receive equal consideration and be coordinated with other aspects of water resource development. This is accomplished through consultation with NMFS, the U.S. Fish and Wildlife Service (USFWS), and appropriate state agencies whenever any body of water is proposed to be modified in any way and a Federal permit or license is required. These agencies determine the possible harm to fish and wildlife resources, the measures needed to both prevent the damage to and loss of these resources, and the measures needed to develop and improve the resources, in connection with water resource development. NMFS, the USFWS, and state agencies submit comments to Federal licensing and permitting agencies on the potential harm to living marine resources caused by the proposed water development project, and recommendations to prevent harm (NMFS 2004). In all, the FWCA compliance process includes the following four steps: consultation (notice of initiation); reporting (e.g., field surveys and summary reports) and recommendations to protect, mitigate, and restore natural resources; Action agency consideration of recommendations, and Action agency implementation of recommendations.

Project Description

The Department of Land and Natural Resources (DLNR) wishes to re-authorize and extend the Small Scale Beach Nourishment (SSBN) program to create a Small Scale Beach Restoration (SSBR) program through a streamlined and coordinated state regulatory process. The purpose of the SSBR program is to provide an approach that will allow for the implementation of coastal erosion control projects that will result in ecosystem restoration and improved public beach access while maintaining Hawaii's visitor-based economy. The program would streamline five permits or authorizations in the permit process including those from the Office of Conservation and Coastal Lands (OCCL), State Historic Preservation Division (SHPD), U.S. Army Corps of Engineers (USACE), State of Hawaii Coastal Zone Management Office (CZM), and the Department of Health (DOH).

Projects in the proposed SSBR program are divided into three categories: 1) beach management operations include sand pushing, backpassing, and bypassing, 2) beach maintenance operations including the recovery, transport, and placement of beach compatible fill to maintain the character and functionality of the beach, and 3) beach stabilization structures (e.g., groins) used to stabilize sand within a littoral cell. Projects permitted under the program are limited to the placement of 10,000 cubic yards of beach compatible sand. It is estimated that 30 to 40 SSBR projects will be permitted over the first five years of the program, which equates to about eight projects per year.

NMFS Concerns

NMFS is concerned that while certain aspects of the proposed permitting process may be streamlined through the SSBR program, there will likely still be a need for individual EFH consultations. Considering the anticipated increase in the number and frequency of beach restoration projects, the information needs for consultation could become a bottleneck if they are not adequately addressed before NMFS involvement. Specifically, NMFS is concerned that there are several technical aspects of beach restoration projects not currently being considered: 1) increase in the need for quantitative resource survey assessments and 2) consideration of the full suite of stressors that may cause adverse effects to EFH. Below we provide details related to these concerns and guidance on how these issues can be resolved through early coordination. In addition, we provide an Enclosure at the end of this letter with specific avoidance and minimization measures that would be applicable to permit applicants.

Quantitative Resource Survey Assessments

Project applicants are responsible for providing sufficient resource survey information or benthic habitat maps. Applicants should conduct preliminary, quantitative benthic marine survey assessments of the entire project footprint area within the littoral cell—hard and soft bottom, groin footprints, between groins, offshore of the groins, where sediment models predict deposition (see below), along or nearby sand pipeline pathways, and nearby the sand borrow areas—before an EFH consultation is initiated. The level of complexity of surveys will scale proportionally with the extent of habitat forming EFH resources (e.g., corals and submerged aquatic vegetation) that may suffer adverse effects (i.e., direct, indirect, and cumulative). Surveys and modeling efforts should consider the impacts of climate change, for example increased storm activity and sea level rise, on beach restoration and on the resources.

Contingencies should be designed to accommodate analyses that utilize greater replication and higher statistical power to avoid the need to obtain higher resolution data. Post-action monitoring plans would reduce uncertainty during potential EFH offset determinations. Assessments should be commensurate with the scale of the potential adverse effects as increasing the specificity and resolution of the scientific and natural resources information available will reduce uncertainty of adverse effects and support to EFH determinations. NMFS can provide assistance to Applicants to further refine and clarify the types and complexity of survey information that will be needed.

Sediment Modeling: Depending on the extent of resources present within or near a beach nourishment footprint, modelling may be needed to predict how the proposed projects, including those with groins, will influence sediment transport and water motion. The modelling effort should include and consider the following areas: the groin footprints, between the groins, offshore of the groins, along or nearby sand pipeline pathways, and nearby the sand borrow areas. If there is a

high probability that sediment deposition will occur over sensitive and hard-to-replace hard-bottom habitat, corals, and seagrass, these areas should be prioritized survey areas both before and after construction. Completing these modelling efforts and including them in the EFH assessment would help reduce uncertainty and better inform EFH conservation recommendations and any offset determinations.

Sediment Testing: Information about sediment chemistry, nutrient content, and other chemical characterization would be needed both on bulk samples (i.e., all size fractions) and within each size fraction or sediment class (e.g., mud, silt, fine sand, sand, etc.). This is needed because smaller size fractions that include silt and mud classes typically retain higher organic carbon content and are more detrimental to habitat forming EFH than those sediment types with larger sizes. This information should also be included in the EFH assessment to inform conservation recommendations and potential offset determinations.

Water Quality Monitoring: Robust water quality monitoring (e.g., turbidity, sedimentation rates, nutrients, dissolved oxygen, etc.) is needed to assess conditions before (i.e., baseline), during, and after beach restoration activities. These activities should be informed by the sediment modeling and daily tide and current velocity predictions (https://www.pacioos.hawaii.edu/voyager/) to select sampling. Special attention should be placed on collected turbidity and sedimentation rate information at areas where there are habitat forming EFH resources, including corals and submerged aquatic vegetation. For other criteria needed for beach restoration projects, NMFS would defer to the requirements of the Environmental Protection Agency (EPA) delegated through the state of Hawaii, Department of Health, Clean Water Branch's (DOH), 401 Water Quality Certification (WQC), Applicable Monitoring and Assessment Plans (AMAP).

Stressor Effects

NMFS is concerned that there are a variety of adverse effects from stressors on EFH that have not been fully considered in the Draft EA. Short-term, long-term to permanent, and cumulative adverse effects to EFH are likely to occur from beach restoration projects due to physical damage, sedimentation and turbidity, and nutrients and chemical contamination.

Physical Damage: Direct contact to habitat forming EFH resources (e.g., corals and submerged aquatic vegetation) from construction equipment and materials, as well as from installation activities, can lead to permanent and lesser adverse effects. The level of these adverse effects (i.e., short-term, long-term to permanent, and cumulative) will vary on a case-by-case basis dependent on the density and extent of EFH resources present and the dredge and/or sediment retention design that are chosen. For example, the 2012 Waikiki Beach Nourishment and Dredging Project resulted in physical damage to the fossil limestone reef rock bordering sand borrow areas that were dredged (*Draft EA*, Section 4.2.2.3). In addition, recent projects in Waikiki have chosen to use a geotextile material to construct a sandbag groin. The long-term durability of this material is currently unknown and therefore carries a possibility of becoming compromised and potentially posing a risk to surrounding EFH. Due to this stressor, a variety of measures to avoid and minimize physical damage to EFH may be needed to reduce unavoidable losses.

Sedimentation and Turbidity: Short-term, long-term to permanent, and cumulative adverse effects to habitat forming EFH may occur due to sedimentation and turbidity during proposed

beach nourishment projects. Sedimentation and turbidity from hopper dredging at borrow areas may occur due to disruption from drag arms and heads and unmitigated overdredge disposal of fine sediment classes; land-based beach filling activities, after-the-fact from micritic calcium carbonate leaching from beach fill, and resuspension from groins is they alter local hydrodynamics.

Nutrients and Chemical Contamination: Adverse effects may occur during dredging from borrow areas and after beach fill is placed due to release of sediment-bound nutrients and chemical contaminants; the latter may also occur from leaking construction equipment and introduction of treated materials into the marine environment, including lumber during multiple types of beach restoration projects.

Conclusion

We greatly appreciate your early EFH coordination and the opportunity to provide comments on your Draft EA. In summary, we expect that proposed beach nourishment projects will have short-term, long-term to permanent, and cumulative adverse effects to EFH. Due to these anticipated effects, we anticipate some projects will entail compensation or offset through individual EFH consultation. NMFS is concerned that there are multiple aspects of the EFH consultation that are not currently addressed in the Draft EA. First that these individual EFH consultations will necessitate an increased level of information and monitoring data to be included in the EFH assessment and that there are potential stressors to EFH that have not been so far addressed. We have described the stressor impacts to EFH from your proposed activities; and provided guidance on the EFH consultation process, content to include in an EFHA, and avoidance and minimization recommendations by stressor-type (see the Enclosure).

For all questions related to consultations with us in the future, please contact us through the email address: EFHESAconsult@noaa.gov.

Sincerely,

Gerry Davis
Assistant Regional Administrator
Habitat Conservation Division

cc by e-mail:
Stuart Goldberg, NMFS
Malia Chow, NMFS

Enclosure

Recommended Avoidance and Minimization Measures
Below is a list of avoidance and minimization measures that your permit-Applicant's could anticipate to include in their potential EFH Assessments during EFH consultation.

Physical Damage

1. Restrict all physical contact with the bottom to unconsolidated sediments devoid of coral and seagrass.
2. Work platforms should be selected based on the following preferential hierarchy:
    a. conduct all work from land;
    b. use a barge with auto-positioning systems where thrusters will not cause increased turbidity;
    c. anchor barges to (1) shoreline infrastructure; (2) nearby existing moorings; (3) anchors or spuds in/on sand only (as possible, have SCUBA divers lay anchors by hand in sand areas).
3. Prior to mobilizing, ensure all construction equipment, ballast, and vessel hulls do not pose a risk of introducing new invasive species and will not increase abundance of those invasive species present at the project location.
4. Minimize physical contact by divers and construction related tools, equipment, and materials with live benthic organisms, regardless of size, especially corals and seagrass.
5. Prevent trash and debris from entering the marine environment through the use of nets or barriers.
6. Relocate infrastructure materials (e.g., riprap, piles, boulders) that are colonized with benthic communities according to an approved relocation plan[2]. If infrastructure materials (e.g. riprap, piles, boulders) that are colonized with benthic communities will be removed or destroyed as part of permitted activities, relocate these materials to an appropriate receiving site.
7. Have a qualified marine biologist identify and relocate hard corals that would be otherwise lost to project activities and which can be logistically moved according to an approved relocation plan[3].
8. Ensure that new structures minimize shading impacts to marine habitats. Incorporate measures that increase the ambient light transmission under structures. Some of these measures include: maximizing the height of the structure and minimizing the width of the structure to decrease shade footprint; grated decking material; using the fewest number of pilings necessary to support the structures to allow light into under-pier areas and minimize impacts to the substrate; and aligning the boardwalk in a north-south orientation for the path of the sun to cross perpendicular to the length of the structure and reduce the duration of shading
9. Perform pre-deployment reconnaissance (e.g., divers, drop cameras) to ensure that all anchors are set on hard or sandy bottom devoid of corals and seagrass and that chosen anchor locations

[2] Approved plans must ensure corals are moved to adjacent area(s) with similar habitat conditions, onto suitable substrates, using reliable attachment methods, in similar orientations. Monitoring is not required.
[3] Approved plans must ensure corals are moved to adjacent area(s) with similar habitat conditions, onto suitable substrates, using reliable attachment methods, in similar orientations; and corals must be monitored for success (more frequently at the beginning, and for a duration of no less than 2 years). To provide accountability reference corals or a reference reef site should also be monitored concurrently to compare observed changes.

take into consideration damage that could occur from the anchor chain if the vessel swings due to currents or tides.
10. Require a long-term maintenance plan for gear, instrumentation, and equipment to prevent failures that lead to permanent adverse effects to EFH (e.g., vessel groundings).
11. Ensure structures are properly weighted to prevent movement from currents or waves and implement a maintenance plan to ensure integrity over time.
12. Lower utility lines or cables and maneuver the placement in a controlled manner using SCUBA in order to avoid all coral resources, when practicable.
13. Develop a Wave and Storm Contingency Plan for construction materials and equipment.
14. Develop a monitoring plan to consistently assess the condition of groin materials as well as a contingency plan if the condition is endangering EFH.

Sedimentation and Turbidity

1. Conduct intertidal work at low and or slack tide.
2. Conduct work during calm sea states; stop work during high surf, winds, and currents.
3. Perform work outside of the main coral spawning period in summer (May to August) to minimize sedimentation and turbidity effects to coral eggs and larvae in the area. Peak spawning periods vary by species and geography, and are based on best available science.
4. If appropriate, consider using cofferdams to dewater the project impact site.
5. Install sediment, turbidity, and/or pneumatic curtains, and use real-time monitoring (automated or manual) for barges and dredge vessels to detect failure and implement stop-work processes if pre-determined project thresholds are reached (use standards from Clean Water Act 401 water quality certification). In areas of soft sediment, consider partial length turbidity curtains in order to reduce resuspension of sediment during high winds and currents.
6. Use soft and/or natural engineering solutions to maintain/restore natural flow volumes and velocity.
7. Minimize disturbances to stream banks, and place abutments outside of the floodplain whenever possible. Seek to maintain baseline water flow volume and velocity within the system.
8. Utilize environmental clamshell buckets for mechanical dredging.
9. Design the nourishment activities to maintain or replicate natural stream channel and flow conditions to the greatest extent practicable.
10. Revegetate shoreline areas with appropriate native species and fully stabilize disturbed upland areas prior to removing silt fences and erosion prevention measures.

Chemical Contamination

1. Conduct work during the dry season when possible; stop work during storms or heavy rains. Neutralize or treat contaminated sediments and/or waters prior to release from the project site.
2. Inspect all equipment prior to beginning work each day to ensure the equipment is in good working condition, and there are no contaminant (oil, fuel, etc.) leaks.
3. All equipment found to be leaking contaminants must be removed from service until repaired.
4. All fueling or repairs to equipment must be done in a location with the appropriate controls that prevents the introduction of contaminants to marine environment.

5. Prevent discharges of chemicals and other fluids dissimilar from seawater into the water column.
6. Use materials that are nontoxic to aquatic organisms, such as untreated wood, concrete, or steel (avoid pressure treated lumber).
7. Use diffusers on the end of subtidal discharge pipes to minimize impacts from discharges.
8. Prevent bentonite drilling fluid from contacting live benthic organisms.

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Research Article

Long-Lasting Impacts of Beach Renourishment on nearshore Urban Coral Reefs: a Glimpse of Future Impacts of Shoreline Erosion, Climate Change and Sea Level Rise

Edwin A. Hernández-Delgado[1-3]* and Bernard J. Rosado-Matías[3]

[1]*Center for Applied Tropical Ecology and Conservation, University of Puerto Rico, Puerto Rico*

[2]*Department of Environmental Sciences, University of Puerto Rico, Puerto Rico*

[3]*Sociedad Ambiente Marino, Puerto Rico*

***Corresponding author**

Edwin A. Hernández-Delgado, Center for Applied Tropical Ecology and Conservation, University of Puerto Rico, San Juan, 00931-3360, Puerto Rico, Tel: 1-787-764-0000 x188090#; Fax: 1-787-764-2610; Email: edwin.hernandezdelgado@gmail.com

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Keywords

- Beach renourishment
- Climate change
- Community trajectory
- Sediment burial
- Urban coral reef
- Water quality decline

Abstract

Urban shoreline erosion mitigation through beach renourishment has often been dismissed as environmentally insignificant. Given predicted impacts of sea level rise (SLR) and increased shoreline erosion, such activities might become a common practice in the future. But its long-term impacts on adjacent coral reefs have remained poorly documented. Benthic community trajectories were addressed during a period of twelve years across a spatial gradient of sediment burial impacts by beach renourishment on a high-energy urban coral reef at La Marginal Beach, Arecibo, Puerto Rico. Impacts associated to beach renourishment, followed by long-term, slowly-evolving impacts associated to sediment bedload, increased turbidity, increased Arecibo River streamflow, urban polluted runoff discharges, high particulate organic carbon (POC) concentration, and coral mortality following massive coral bleaching in 2005 were addressed through long-term monitoring. There was an initial catastrophic loss in coral species richness, diversity index and percent living coral cover, and a rapid regime shift favoring dominance by macroalgae and other non-reef building taxa. Long-term chronic impacts arrested high impact sites to an early successional stage, and drove moderate and low impact sites to a similar stage of very low species diversity, colony abundance and reef growth. Such chronic changes in community trajectories represent a glimpse into potential future impacts of shoreline erosion, sediment bedload, increasing turbidity and coastal water quality decline associated to SLR. The combination of chronic coral reef decline resulting from beach renourishment, coastal pollution, turbidity, and sediment bedload may have critical long-term ecological implications for urban coral reef resilience, functions and benefits.

ABBREVIATIONS

CCA: Crustose Coralline Algae; H'c: Species Diversity Index; Ha: Hectares; HI: High Impact Site; J'c: Evenness; LI: Low Impact Site; MI: Moderate Impact Site; RDC: Recently Dead Coral; S: Species Richness; SLR: Sea Level Rise; SPR: Sand + Pavement + Rubble Benthic Category

INTRODUCTION

Shoreline erosion is a natural phenomenon magnified by the combined effects of habitat destruction, the construction of artificial structures, and sea level rise (SLR), which threatens a growing number of properties built on coastal shores. SLR is a global socio-economic and environmental concern, particularly for urban coastal societies and small island nations, with significant long-term physical and socio-economic impacts resulting from environmental degradation, shoreline erosion, and coastal flooding [1-7]. Modeling suggests that, regardless of different potential climate change scenarios, there will be a significant coral reef decline and habitat loss across regional to global scales [8-12]. Coral reefs may often constitute the first line of defense against wave action, SLR, and coastal erosion. Losing coastal reef ecosystems may result in increased risks of coastal erosion. Current and forecasted global warming trends [3,13-16] could also magnify the risks of SLR in the near future, compromising the ecological benefits of coastal ecosystems [17]. SLR may cause multiple impacts to shallow coastal coral reefs. This could result from altered water quality and habitat decline, losing its multiple benefits, including buffering wave action. This could impact infrastructure adjacent to the shoreline and may affect coastal community livelihoods, risking climate change adaptation and mitigation capacity [7].

Coastal erosion threatens an increasing number of sandy beaches and the ecological, economic, social and cultural amenities they provide [18]. This may result in increased coastal vulnerability with variable impacts depending on local social

and economic conditions, built-environment, and physical characteristics [19]. Even sheltered coasts are being threatened by shoreline erosion [20]. Most mitigation measures to buffer impacts of coastal erosion have been overwhelmingly focused on engineering interventions [21], but the widespread construction of structures that alter sea surface circulation (e.g., breakwaters, spits, groins) [22], or fix the position of the shoreline undergoing retreat (e.g., seawalls, revetments) [22,23], has often resulted in increased sediment deposition in some areas and shoreline erosion rates in others. Frequent solutions for shoreline erosion mitigation have often involved sand replacement or renourishment [24,25]. However, these solutions are temporary and usually cost-prohibitive [18]. Annual expenditures and sand volumes showed an increasing trend in the U.S. even since 1990s, particularly on eastern sand bar islands [21,25,26]. Most of these activities can have long-term adverse ecological consequences, which have often been dismissed as environmentally insignificant, therefore, poorly documented in the scientific literature.

Enhanced recreational opportunities and socio-economic benefits have been commonly claimed as key justifications for beach renourishment, but rarely supported by increased numbers of visitors or by an enhanced local economy and livelihoods [27]. In contrast, beach renourishment can deteriorate coastal water quality by reducing water transparency and may not even prevent shoreline erosion [28]. Beach renourishment has also resulted in the physical disruption of macro-invertebrate and fish assemblages across shallow-water hard grounds, causing variable lethal and sub-lethal effects, and permanent benthic community regime shifts as a result of sediment bedload or burial, mechanical impacts, increased turbidity or a combination of these [29-32]. In addition, it has affected shorebird habitats on sandy beaches [33]. However, the long-term consequences of such impacts have still remained poorly studied.

Projected long-term trends of SLR suggest that coastal flooding in the near future could be more significant than previously modeled [34-36], and would require complex and expensive structural solutions to protect coastal infrastructure from erosion [37]. Under such conditions, mitigation of impacts might have magnified adverse ecological [38], environmental [39], and socio-economic consequences for societies [40]. This is particularly concerning for small tropical island nations, where socio-economic and trained human resources are often largely limited [7]. Solutions to buffer shoreline erosion may often require implementing very expensive dredge-and-fill programs to protect coastal development from shoreline erosion at the expense of adverse ecological impacts to adjacent sandy beaches [41,42], and to shallow coastal benthic ecosystems [30]. Nonetheless, mitigation has not always been successful and adverse impacts across adjacent benthic habitats are a concern which has remained poorly documented, particularly across nearshore high-energy habitats.

A regime shift can often be explained as a nonlinear system crossing a critical threshold [43], and could result from a combination of acute, chronic, press or pulse impacts. Such impacts could become more pronounced in shallow urban coral reefs under declining environmental conditions associated to periodic dredging and fill activities [44], due to long-term alterations of adjacent land use patterns [45-48], and due to long-term impacts of climate change and SLR. Dredging and sedimentation impacts can also be catastrophic for coral reef communities [49-53]. It can be argued that long-term impacts associated to beach renourishment on adjacent urban coral reefs may resemble the potential long-term impacts of shoreline erosion and sediment bedload associated to SLR and climate change. SLR impacts may include major shoreline erosion and a significant increase in chronic sediment spillover and bedload effects across shallow coral reefs adjacent to shore [54]. In this context, addressing the long-term trajectories of adjacent benthic communities following beach renourishment impacts may provide a glimpse of potential future impacts across adjacent urban coral reefs resulting from shoreline erosion, sediment bedload, and declining coastal water quality associated to SLR.

Monitoring of beach renourishment long-term ecological impacts has been frequently flawed by having poor sampling designs, failing to address natural spatial and temporal variation of ecological change, lacking proper controls, and by failing to support conclusions by statistical analyses [32]. Further, there is a major lack of available long-term assessments of ecological impacts across impacted benthic communities to determine effects on benthic community trajectories and address their natural recovery ability. This study highlights the long-term (12 years) benthic community trajectory of a high-energy urban coral reef impacted by a catastrophic beach renourishment activity at Arecibo Harbor, Puerto Rico, which strongly resembles the potential long-term predicted impacts from SLR across coastal urban coral reef ecosystems. This study investigated the immediate effects of reef burial by dredge spoil on a high-energy urban reef habitat, and addressed spatio-temporal variation in benthic community trajectory through a period of 12 years following sediment burial. Incidentally, this study also resulted in a long-term "natural" experiment to assess the impacts on coral reefs of heavy sediment bedload and water quality decline similar to what could be expected as a result of SLR and its concomitant increase in shoreline erosion and urban coastal flooding. The Arecibo Harbor case study constitutes a model to address the long-lasting impacts of beach renourishment and sediment bedload on near shore urban coral reefs. At the same time, it may provide a glimpse of potential long-term impacts of SLR and climate change in a coastal urban scenario.

MATERIALS AND METHODS

Study sites

This study was carried out at La Marginal reef, Arecibo, in the high-energy northern coast of Puerto Rico (18º28'32.29"N, 66º43'23.62"W), with a control site at Vega Baja (18º29'19.60"N, 66º25'19.70"W), 33 km east of the impact site (Figure 1). The eastern side of Arecibo Harbor has been protected from prevailing surge and northerly swells by a 366 m-long artificial breakwater built in 1944. The resulting altered local surface current patterns produce substantial accumulation of sediments within the harbor entrance that require periodic maintenance dredging. During June 2000, a total of 153,000 m^3 of shoal material were dredged from the harbor and used by the U.S. Army Corps of Engineers for a beach renourishment project at the nearby La Marginal

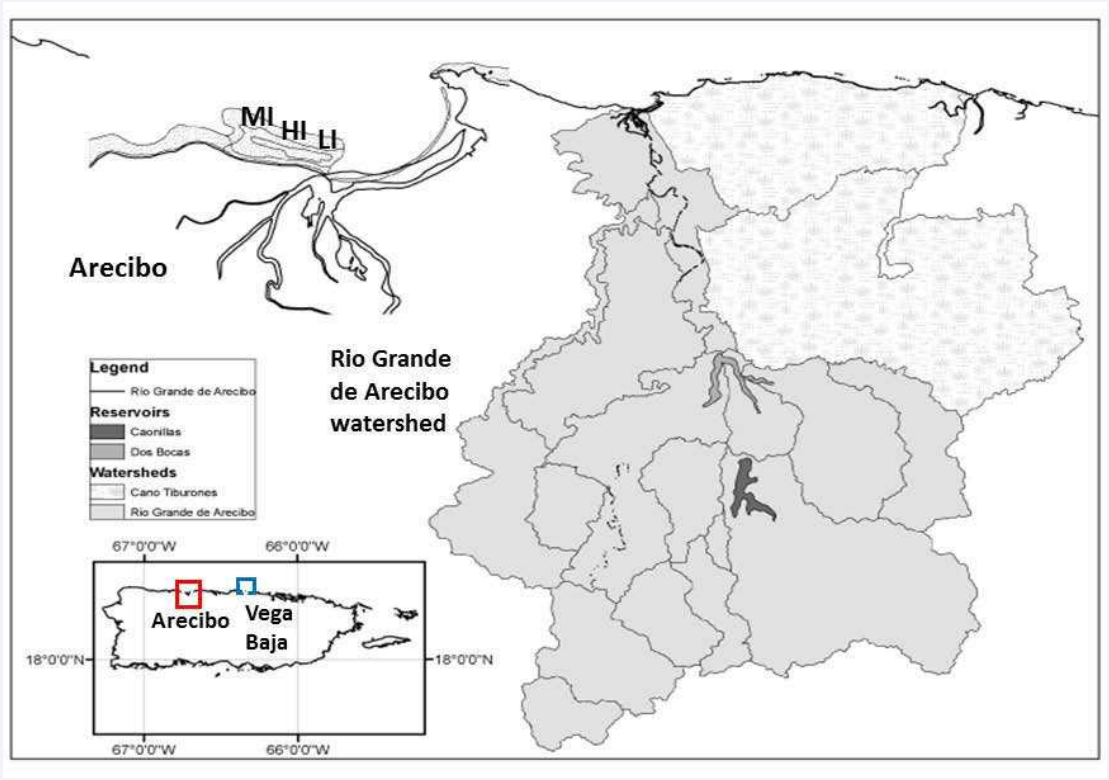


Figure 1 Study site at La Marginal reef, Arecibo, Puerto Rico (red polygon): HI= high impact site, MI= moderate impact site, LI= low impact site. Control site (CT) is located at Vega Baja (blue polygon).

Beach. Dredged sediments were hydraulically pumped out onto a colonized high-energy emergent eolianite reef platform with the objective of constructing an artificial sandy beach to increase local recreational opportunities and socio-economic benefits. But spoil material shifted away with the strong littoral drift to the sublittoral zone and completely buried or significantly smothered out 5 ha of nearshore reef habitats, causing a widespread mortality of benthic and demersal fauna. Most of the spoil material (emergent and submerged) was washed out by the strong surge and littoral drift within two months, clearing most of the reef substrate, but creating a massive sandblasting effect across approximately 25 ha downstream.

La Marginal reef is characterized by a shallow and continuous high-energy emergent eolianite reef platform ranging from 0.2 to about 6 m in depth. However, there are some areas that have developed a system of colonized pavement and channels that extend down to about 5 to 8 m. These zones supported more coral growth and higher habitat heterogeneity than shallower low-relief zones. Data were collected at the 1.7 to 2.5 m depth zone, which was the most directly impacted by the initial burial and spillover of dredged spoil material. Data from the control site were obtained from a similar habitat and depth zone that has never been impacted by beach renourishment activities.

Environmental variables

Environmental variables included the Río Grande de Arecibo mean monthly streamflow across two gauge stations at the Arecibo Observatory and at the Dos Bocas Reservoir. Data were obtained for the period of 2000 to 2012 from US Geological Survey Caribbean Field Office. Water transparency was measured in triplicates using a 51 cm-diameter Secchi disk during each visit to study sites. Remotely-sensed data of chlorophyll-*a* concentration, particulate organic carbon (POC) and particulate inorganic carbon (PIC) were obtained from satellite data for the period of 2000 to 2012, from a polygon located between 18º30.0'N, 66º44.0'W, 18º30.0'N, 66º42.0'W, 18º28.5'N, 66º44.0'W, and 18º28.5'N, 66º42.0'W (=5.14 km^2), and retrieved from NOAA's ERDDAP data set web link http://coastwatch.pfeg.noaa.gov/erddap/index.html.

Benthic community sampling design

Two main types of variables were tested in this study: temporal and spatial effects. Data were collected in 2000 (two months after sediment burial), 2003, 2005, 2007, 2009, and 2012 across areas under three different levels of sediment burial impacts. These included: high impact (HI) – sediment disposal area, moderate impact (MI) – 200 m downstream of the sediment disposal western boundary, and low impact (LI) – 200 m upstream of the sediment disposal northeastern boundary. Data were also collected from a control site (CT) at Vega Baja, 33 km east of the impacted area. No sediments were directly deposited within the LI or MI, but there was high turbidity across all impacted sites. Sediment "sandblasting" effects due to strong currents, wave action and bedload eventually impacted the MI and LI sites during spillover effects.

Benthic community data were collected using 10 m-long

point-count line transects at 0.5 m point intervals (n=20 points per transect). Strong currents and prevailing 1.5 to 2.5 m-high surge prevented the use of longer transects. A total of 6 to 8 replicate transects parallel to the shoreline were haphazardously sampled across geo-referenced reef segments per site during each time interval. Community data included coral species richness, colony abundance, species diversity index (H'c) [55], species evenness (J'c) [56], percent living coral cover, and percent cover of macroalgae, algal turf, crustose coralline algae (CCA), golden algae (*Chrysocystis* spp.), zoanthids, sponges, acronym (RDC), cyanobacteria, and sand, pavement and rubble (SPR). The percent cover or bare substrate and of bleached and size-reduced colonies were also documented. All data were collected between 0600 and 0800 hr, when wind was low and swells were still marginally safe for field work.

Statistical analyses

The null hypothesis of no significant difference in spatio-temporal patterns of coral reef benthic community structure among surveyed sites was tested using PRIMER v6.1.16 + PERMANOVA v1.0.6 statistical package (Plymouth Marine Lab, UK) [57], following a two-way permutational analysis of variance (PERMANOVA) [58]. Impact (HI, MI, LI, CT) and time (2000, 2003, 2005, 2007, 2009, 2012) were used as main variables. Also, impact x time interaction was tested. A similar approach was used to test for spatio-temporal patterns in species richness (S), H'c, J'c, and percent cover of selected benthic community components. Principal coordinate Ordination (PCO) was used to identify spatio-temporal patterns of coral reef benthic community structure clustering, temporal trajectories, and indicator taxa of such clustering patterns for each impacted site. A total of 10,000 permutations were used for multivariate tests. A combination of linear and non-linear regression models was also fit using Sigma Plot v11.0 (Systat Software, Inc.) to test the relationship of selected coral reef parameters and Rio Grande de Arecibo streamflow. Regression analyses were also performed between selected coral reef benthic parameters and mean horizontal water transparency across study sites. Multivariate routine BEST was used to test for the best environmental variable combination to explain observed temporal variability in benthic community structure through the BVSTEP method [57].

RESULTS AND DISCUSSION

Environmental variables

Mean horizontal water transparency across the impacted site during 2000 was the lowest (1.5 m), with the highest value achieved during 2005 (4.0 m) (Figure 2a). Transparency declined during subsequent surveys to 2.0 m during 2012. Mean horizontal water transparency across the control site at Vega Baja during 2000 was 10 m, with a value during 2005 of 9.5 m. Transparency declined during subsequent surveys to 6.0 m during 2012. Such declines corresponded to increasing river local and urban discharge influences associated to increasing rainfall pulse events as reflected by streamflow. Mean annual streamflow at Río Grande de Arecibo ranged from 31.12 m^3/s in 2000 to 47.56 m^3/s in 2012 (Figure 2a). Other high mean annual peaks were documented in 2003 (42.91 m^3/s), and in 2005 (46.83

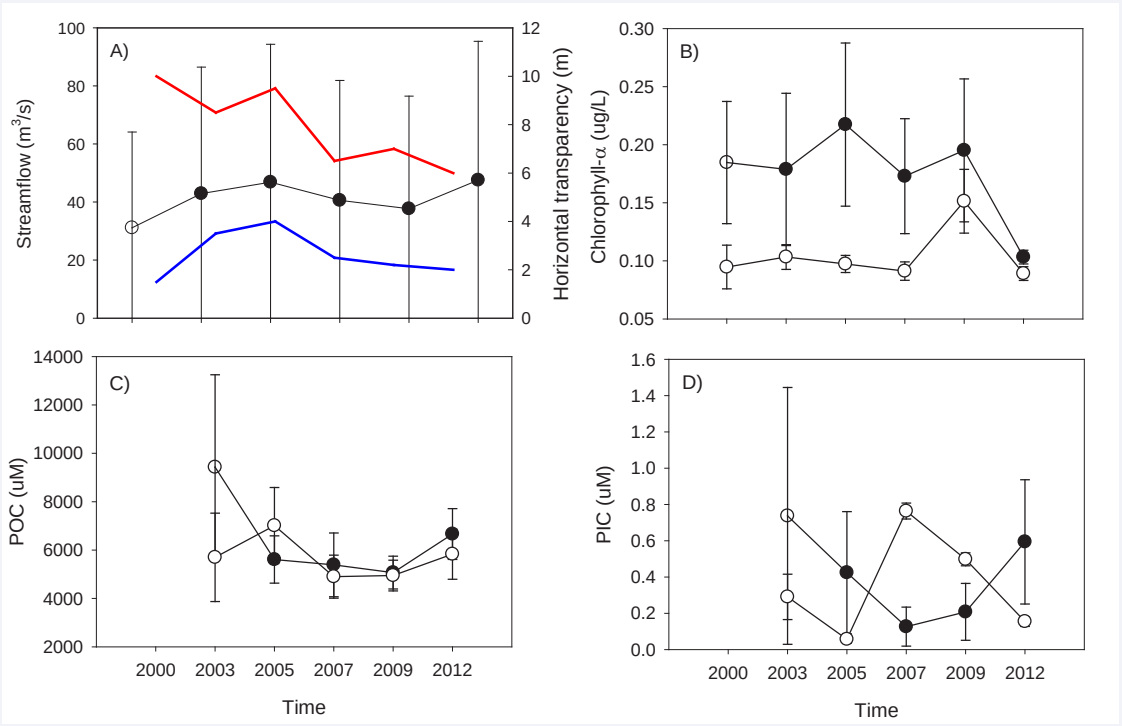


Figure 2 Environmental parameters across the study sites. (A) Río Grande de Arecibo streamflow (m3/s) and Secchi disk horizontal water transparency (m): La Marginal – blue line, Vega Baja – red line; (B) Chlorophyll-a concentration (µg/L); (C) Particulate organic carbon (POC) concentration (µM); and (D) Particulate inorganic carbon (PIC) concentration (µM). Mean ± 95% confidence intervals. La Marginal – black dots, Vega Baja – white dots. No remotely sensed data existed for these parameters during year 2000.

m^3/s). Mean annual chorophyll-*a* concentration at the impact site ranged from 0.1033µg/L in 2012 to 0.2174 µg/L in 2005 (Figure 2b). Peak chlorophyll-*a* concentration corresponded to the second highest streamflow peak. Mean annual chorophyll-*a* concentration at the control site ranged from 0.0891µg/L in 2012 to 0.1513µg/L in 2009 (Figure 2b). However, such chlorophyll-*a* concentrations were lower than those documented in previous studies in Puerto Rico [59], and were within the recommended maximum concentration of 0.3µg/L for coral reefs [60].

Mean annual particulate organic carbon (POC) concentration at the impact site ranged from 5,068.2µM in 2009 to 9,425.6µM in 2003 (Figure 2c). Highest POC concentration at the impact site corresponded to a year that showed two extreme rainfall events. Mean annual particulate organic carbon (POC) concentration at the control site ranged from 4,900.9µM in 2005 to 7,012.3 µM in 2007 (Figure 2c). Documented POC concentrations at the control site were lower than at the impact site. Nonetheless, POC concentrations at both sites were significantly higher in comparison to previous reports in the literature [61-63], and can be considered detrimental for coral reefs. Mean annual particulate inorganic carbon (PIC) concentration at the impact site ranged from 1.26 x 10^{-7}µM in 2007 to 7.37 x 10^{-7}µM in 2012 (Figure 2d). Highest PIC concentration at the impact site coincided with increasing river streamflow. Mean annual particulate inorganic carbon (PIC) concentration at the control site ranged from 6.42 x 10^{-7}µM in 2007 to 2.26 x 10^{-6} µM in 2003. PIC concentrations in coastal waters can often remain low [64].

Benthic community variables

Coral species richness showed a significant decline ($p< 0.0242$) through time and among impact levels (Table 1). Post-hoc analyses are all summarized in Table S1 in the Supplementary Material section. HI sites had no living corals in 2000 and showed only 1.67 species per transect in 2012 (Figure 3a). MI sites had 1.5 species in 2000, increased to 1.8 in 2003, but then remained at 1.5 species in 2012. LI sites had a mean of 2.0 species per transect in 2000, declining to 1.67 in 2012. CT sites supported a mean of 3.2 species in 2000, declining to 2.2 in 2012. H'c showed significant variation through time ($p=0.0032$), with two general patterns (Figure 3b). First, there was a significant increase in H'c across impact sites due to partial slow recovery of impacted coral colonies, followed by a net decline after the 2005 massive coral bleaching event and chronic water quality degradation. Secondly, H'c returned to original values by 2012 after some partial recovery of a few ephemeral coral species. No coral growth was observed at HI in 2000. Mean H'c in 2012 was 0.4527. Mean H'c at MI was 0.3269 in 2000 and 0.3277 in 2012. Mean H'c at LI was 0.4033 in 2000 and 0.4432 in 2012. Mean H'c at CT was 0.4134 in 2000 and 0.4554 in 2012. A nearly similar temporal pattern was documented in J'c ($p=0.0042$), but showing a significant increase through time (Figure 3c). No coral growth was observed at HI in 2000. Mean J'c in 2012 was 0.6530. Mean J'c at MI was 0.4716 in 2000 and 0.4728 in 2012. Mean J'c at LI was 0.4529 in 2000 and 0.6394 in 2012. Mean J'c at CT was 0.3464 in 2000 and 0.5468 in 2012.

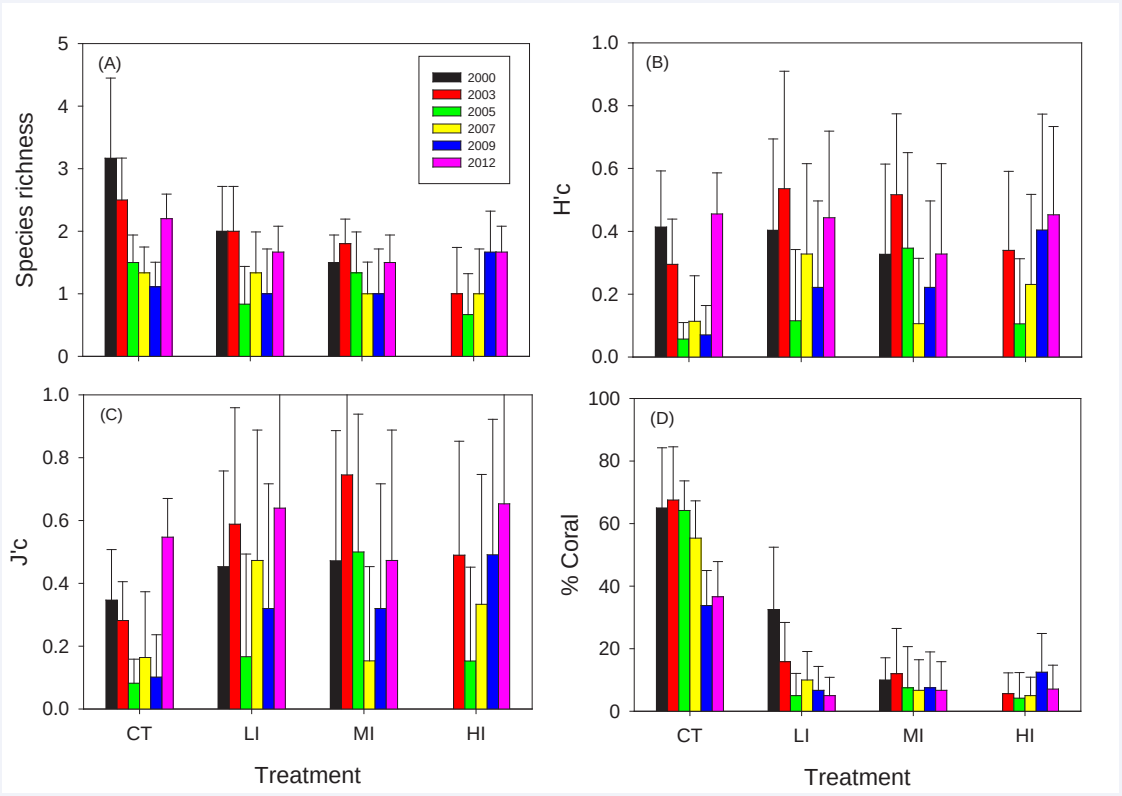


Figure 3 Benthic community parameters: (A) Coral species richness, (B) Coral species diversity index (H'n), (C) Coral species evenness (J'c), and (D) Percent live coral cover. Mean ± 95% confidence intervals. For site acronyms refer to Figure 1.

Percent living coral cover showed no temporal difference, but a highly significant difference (p<0.0001) between CT and impacted sites (Table 1 and Figure 3d). No corals were present at HI sites in 2000. Coral cover increased to 5.6% by 2003, and 12.5% by 2009, but declined to 7.1% in 2012, or a 43% loss in just three years. Coral cover at MI was 10% in 2000, and 12% in 2003, but declined to 7.5% in 2005 following the massive bleaching event and further to 6.7% in 2012, representing a 33% loss in 12 years. Coral cover at LI was 32.5% in 2000, dropping down to 15.8% in 2003 and to 5% in 2005, remaining unchanged by 2012. Living coral cover declined at LI by a factor of 51% by 2003, and by 85% after the 2005 massive bleaching event. Mean coral cover at CT was 65% in 2000, increasing to 68% in 2003. However, it showed a consistent decline to 55% in 2007, to 34% in 2009, and remaining at 37% in 2012, which represent a 44% decline within 12 years.

Spatio-temporal changes were documented in the four most important reef-building species across study sites. Elkhorn coral (*Acropora palmata*) was completely absent from impact sites, but highly abundant at CT sites (Figure 4a), with a percent relative cover of 58% during 2000, reaching up to 63% in 2005, and then declining to 31% during 2012, which represent a 51% loss. Brain coral (*Pseudodiploria strigosa*) showed a highly significant spatio-temporal fluctuation (p<0.0001) (Table 1). This species was completely absent from HI sites until 2012 (0.4%) (Figure 4b). MI sites had a mean 7.5% cover in 2000, but dropped to 1.3% in 2012, an 83% decline. LI sites had a mean 28% cover that dropped to 11% in 2003, and to 1.7% in 2005 after the massive bleaching and mass coral mortality event. It further declined to 0.8% in 2012. By 2003, *P. strigosa* loss reached 61%, 94% by 2005, and 97% by 2012. Mustard hill coral (*Porites astreoides*) showed a highly significant difference among sites (p=0.0193), but no significant temporal fluctuation (Figure 3c). HI sites had no colonies during 2000, but percent relative cover reached 6.7% in 2009, and then declined to 3.3% in 2012, a factor of 50%. MI showed a 0.8% cover in 2000, increasing to 3.3% in 2009, a 3-fold increase, but declined in 2012 to 2.5%. LI showed a 2.5% cover in 2000, increasing to 7.5% in 2007, but declined in 2012 to 2.1%, a 72% loss within only 5 years. This species remained virtually unchanged between 2000 and 2012 at CT with 2% relative cover. Fire coral (*Millepora complanata*) showed a non-significant spatio-temporal increase in percent relative cover (Figure 4d).

Macroalgal cover showed a significant increase (p<0.0001) through time, particularly across impacted sites (Table 1), shifting from 3% in 2000 to 74% in 2012 at HI, from 18 to 68% at MI, and from 10 to 71% at LI (Figure 5a). Macroalgal cover increased from 10 to only 14% across CT sites. Algal turf showed a significant decline through time across impacted sites (p<0.0001). Dynamics were also significantly different among sites (p=0.0014). Algal turf cover declined from 32% in 2000 to 10% in 2012 at HI, from 42 to 15% at MI, and from 32 to 13% at LI (Figure 5b). Algal turf just shifted from 15.7 to 16.3% across CT sites. CCA were significantly higher (p<0.0001) across CT sites than across impact sites, but showed no significant temporal trends (Figure 5c). CCA were almost absent across HI sites through 2009, and had 0.8% cover in 2012. No CCA were present at MI until 2009 (1.7%). CCA averaged 0.3% in 2000 at LI and 0.8% in 2012, while CT sites showed 2.3% in 2000 and 4.1% in 2012. Observed changes in algal communities suggest a significant regime shift through time following the sediment burial disturbance.

Golden noodle algae, *Chrysocystis* spp. showed a significant increase in percent cover through time (p<0.0001), and significantly higher cover (p=0.0017) at CT sites (Table 1). *Chrysocystis* spp. was absent at HI until 2012 (2.5%) (Figure 5d). It reached 3.3% at MI, 4.2% in LI, and 17% at CT during 2012. Cyanobacteria showed a non-significant spatio-temporal variation in percent relative cover, with mean values never exceeding 4.7% (Figure 5e). Percent cover of recently dead corals (RDC) showed a highly significant (p<0.0001) temporal variation, but no spatial variation. RDC reached 18% during 2000 at HI. There was also 1.7% of RDC during 2005 after the massive bleaching event. No other RDC were documented at HI. RDC

Table 1: Summary of the two-way PERMANOVA of selected benthic community parameters.

Variable	Time d.f.= 5,146* Pseudo-F	p	Impact level d.f.= 3,148 Pseudo-F	p	Time x Impact d.f.= 23,128 Pseudo-F	p
Species richness (S)	2.62	0.0242	7.79	0.0242	4.17	<0.0001
Species diversity (H'c)	3.72	0.0032	0.59	**	1.69	0.0348
Evenness (J'c)	3.67	0.0042	0.52	**	1.52	**
% Coral	0.99	**	24.77	<0.0001	7.31	<0.0001
% *A. palmata*	0.05	**	796.4	<0.0001	164.1	<0.0001
% *P. strigosa*	7.67	<0.0001	7.87	<0.0001	7.22	<0.0001
% *P. astreoides*	1.60	**	3.36	0.0193	1.88	0.0136
% *M. complanata*	0.50	**	0.24	**	0.97	**
% Sponges	1.78	**	6.95	<0.0001	1.62	**
% Zoanthids	1.38	**	7.19	<0.0001	1.96	0.0119
%Macroalgae	11.58	<0.0001	38.20	<0.0001	50.34	<0.0001
% Algal turf	10.55	<0.0001	5.75	0.0014	5.47	<0.0001
% CCA	1.30	**	27.86	<0.0001	4.01	<0.0001
% *Chrysocystis* spp.	43.61	<0.0001	5.46	0.0017	22.87	<0.0001
% Cyanobacteria	1.37	**	2.10	**	1.05	**
% RDC	14.75	<0.0001	2.14	**	18.90	<0.0001
% SPR	3.58	0.0035	11.78	<0.0001	8.88	<0.0001

*d.f. : degrees of freedom; **= not significant (p>0.05)

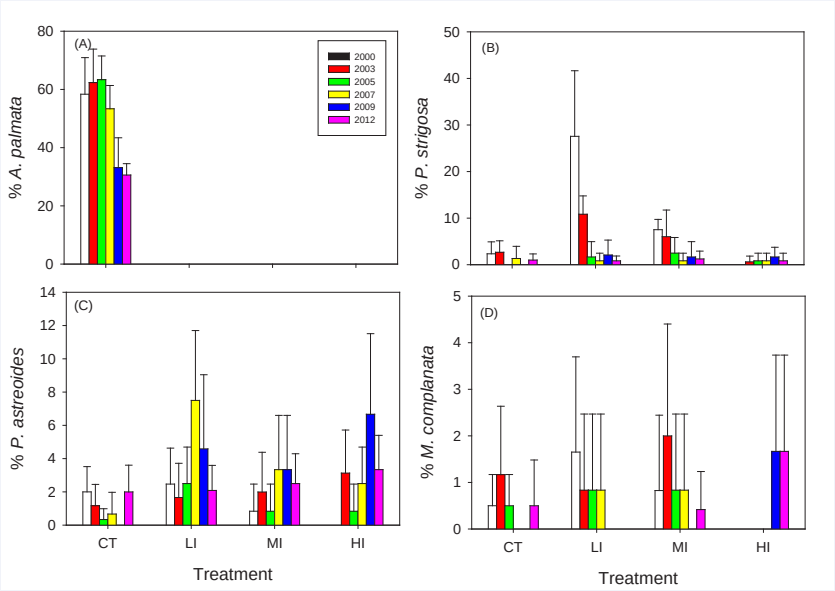


Figure 4 Percent relative cover of coral species: (A) Elkhorn coral, *Acropora palmata*, (B) Brain coral, *Pseudodiploria strigosa*, (C) Mustard hill coral, *Porites astreoides*, and (D) The word fire coral, *Millepora complanata*. Mean ± 95% confidence intervals. For site acronyms refer to Figure 1.

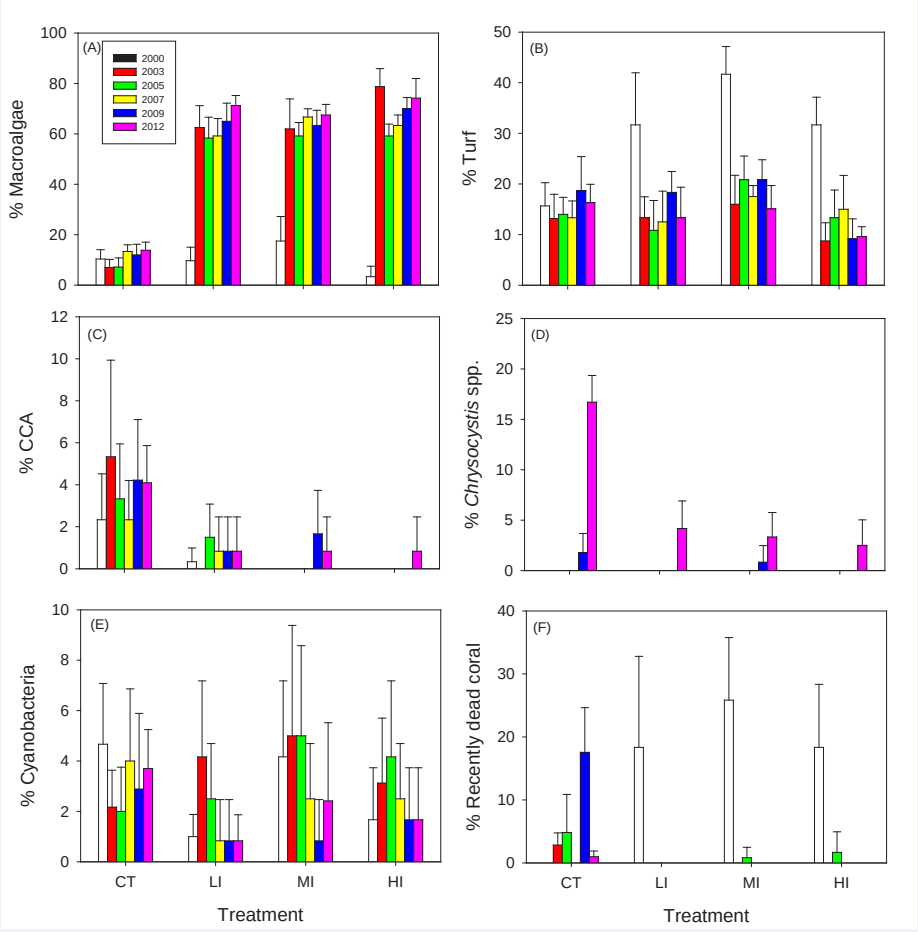


Figure 5 Benthic community parameters: (A) Percent macroalgal cover, (B) Percent filamentous algal turf cover, (C) Percent crustose coralline algal cover (CCA), (D) Percent Golden noodle algae, *Chrysocystis* spp., cover, (E) Percent cyanobacterial cover, and (F) Recently dead coral cover (RDC). Mean ± 95% confidence intervals. For site acronyms refer to Figure 1.

reached 26% during 2000 at MI. There was also 0.8% RDC during 2005, and no other RDC after that. RDC reached 18% during 2000 at LI. No other RDC were documented at LI. Sporadic pulses of RDC were documented across *Acropora palmata*-dominated bottoms at CT sites, with 3% in 2003, 5% in 2005, 18% in 2009, and 1% in 2012. The 2009 incident across CT sites was associated to the illegal spilling of raw sewage along Vega Baja beach [65].

Percent zoanthid (Figure 6a) and sponge cover (Figure 6b) showed a significantly higher cover ($p<0.0001$) across impacted sites, but no significant temporal trends (Table 1). Percent cover of SPR showed significant decline through time ($p=0.0035$), as well as higher percent cover across impact sites (Figure 6c).

Temporal trajectories of benthic community structure

There was a highly significant temporal variation in benthic community structure ($p<0.0001$), and across all combinations of pairs of years (Table 2). There was also a highly significant variation among impact levels ($p<0.0001$), including all combinations of impacts, and between impact sites and CT. Time x impact level interaction was also highly significant ($p<0.0001$). PCO analysis showed that benthic community trajectory at HI was initially dominated in 2000 by RDC, SPR and algal turf, right after reef bottom became exposed by strong surge and spoil material drifted away down current (Figure 7). Temporal changes in benthic community structure were largely explained in 2003 by the recovery of ephemeral *P. astreoides* and by a rapid increase in macroalgal growth on open reef substrates. During the sea surface warming episode in 2005 and 2007 benthic community within HI was largely explained by increasing ephemeral coral *Siderastrea radians*, zoanthids and cyanobacteria. By 2009, *P. astreoides* largely explained temporal variation, followed in 2012 by *M. complanata*, and in a lesser extent by the Encrusting gorgonian, *Erythropodium caribbaeorum* (vector not shown), a species that tend to dominate under significant disturbance. This PCO model explained 95.7% of the observed temporal trajectory.

Benthic community trajectory at MI showed that algal turf, recently dead corals (RDC) and in a lesser degree *M. complanata* explained temporal variation in 2000 (Figure 8). Macroalgae, sand, pavement and rubble (SPR), and *Siderastrea radians* explained most of the variation observed in 2003. *Erythropodium caribbaeorum* explained most of the variation following mass bleaching and partial coral colony mortality in 2005, followed by macroalgae in 2007, then again in 2009 and 2012. This PCO model explained 91.9% of the observed temporal trajectory. Variation in benthic community trajectory at LI was mostly explained by RDC, *P. strigosa*, and *Agaricia agaricites* in 2000, followed by macroalgae in 2003 after benthic community degradation by sediment spillover and bedload effects (Figure 9). Sponges and SPR explained most of the observed variation in 2005 and 2007, followed again by macroalgae in 2012. This PCO model explained 83.9% of the observed temporal trajectory.

Benthic community trajectory at CT was initially explained in 2000 by *P. strigosa* and *P. astreoides*, followed in 2003, 2005, and 2007 by the decline observed in *A. palmata*, in 2009 by RDC, and in 2012 by increasing zoanthids and Golden noodle algae, *Chrysocystis* spp. (Figure 10). This PCO model explained 84.6% of the observed temporal trajectory.

Table 2: Summary of the two-way PERMANOVA of benthic community structure.

Variable (d.f.)*	Pseudo-F	p
Time (5,146)	6.44	<0.0001
Pairwise	*t*	*p*
2000 – 2003	3.39	<0.0001
2000 – 2005	3.12	<0.0001
2000 – 2007	3.91	<0.0001
2000 – 2009	2.95	<0.0001
2000 – 2012	4.23	<0.0001
Impact level (3,148)	33.43	<0.0001
Pairwise	*t*	*p*
CT – LI	8.05	<0.0001
CT – MI	8.42	<0.0001
CT – HI	7.97	<0.0001
LI – MI	1.57	0.0460
LI – HI	2.11	0.0031
MI – HI	2.55	0.0002
Time x Impact (23,128)	14.16	<0.0001

*d.f: degrees of freedom

Impacts of environmental variables on benthic community trajectories

Cumulative rainfall across the Río Grande de Arecibo watershed resulted in a temporal increase in streamflow at the Arecibo Observatory sampling station from 2000 to 2012 through this study. However, annual variability was also becoming higher as a result from recurrent extreme rainfall events. In year 2000, maximum streamflow across the Río Grande de Arecibo watershed was 231m^3 s^{-1} in 2000, and 338 m^3 s^{-1} in 2012.A similar trend was observed at the Dos Bocas Reservoir sampling station, with 225 m3 s^{-1} during 2000 and 291 m^3/s during 2012. Increasing mean and peak rainfall coincided with increasing sediment-laden runoff impacts to coastal waters across the impact site, although a correlation between cumulative streamflow and coastal water turbidity was short of significance ($r^2=0.5938$, $p=0.0729$), probably as a result from high temporal variability in streamflow. However, increasing annual cumulative streamflow showed a significant negative regression with declining percent coral cover ($r^2=0.7255$. $p=0.0313$), and declining percent relative cover of Brain coral, *Pseudodiploria strigosa* ($r^2=0.7018$. $p=0.0374$), across LI sites, but showed no impacts across MI and HI sites. Declining water transparency resulted in a significant decline in percent *P. strigosa* cover ($r^2=0.7808$. $p=0.0178$) across LI sites, but had no effect on other parameters across any of the impact sites. High variability in streamflow only reflects the increasing recurrence of extreme rainfall events. Such pulse events can be significant drivers of impacts on adjacent reefs. BVSTEP analysis showed that the combination of river streamflow, horizontal water transparency, POC, and PIC had the strongest correlation with temporal variation in benthic community structure at the impact site (Rho= 0.743, $p=0.0110$). Horizontal water transparency, POC, and PIC had also the strongest correlation with temporal variation in benthic community structure at the control site (Rho= 0.587, $p=0.0442$). This suggests that long-term degradation in coastal water quality at both, impact and control sites became a significant factor influencing benthic coral reef community trajectory. However, long-term river influences at the

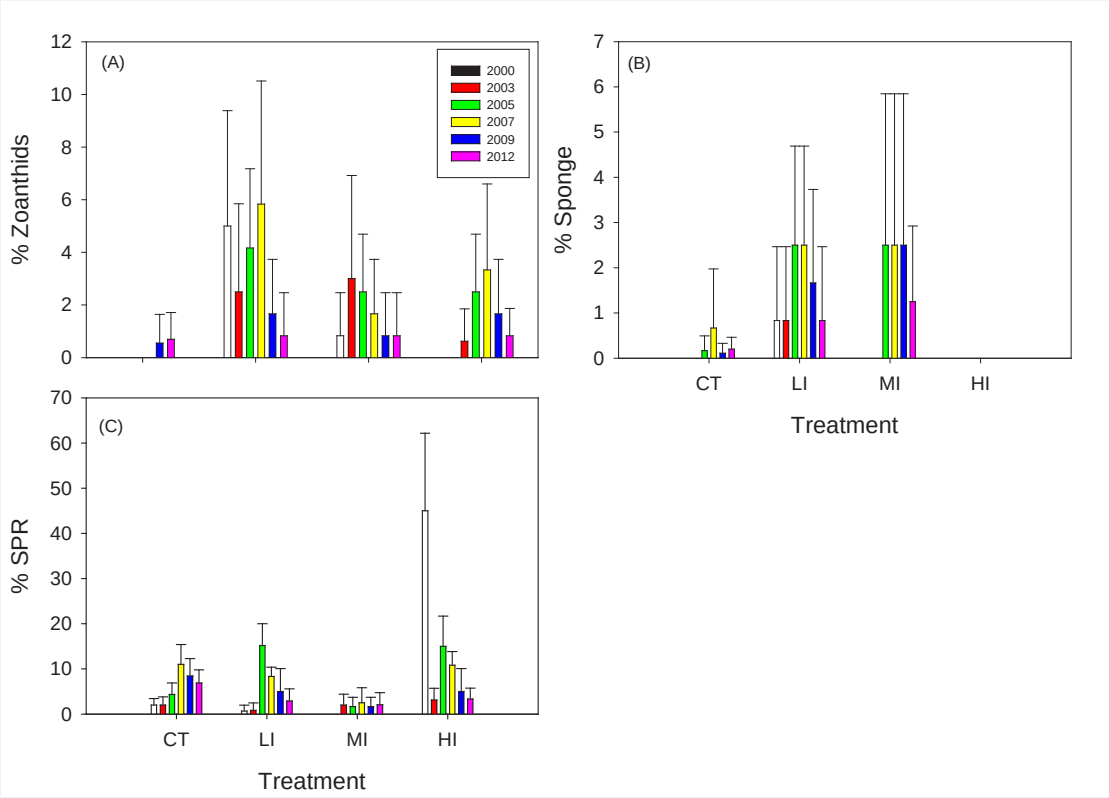


Figure 6 Benthic community parameters: (A) Percentzoanthid cover, (B) Percentsponge cover, and (C) Percentsand, pavement and rubble cover (SPR). Mean±95% confidence intervals. For site acronyms refer to Figure 1.

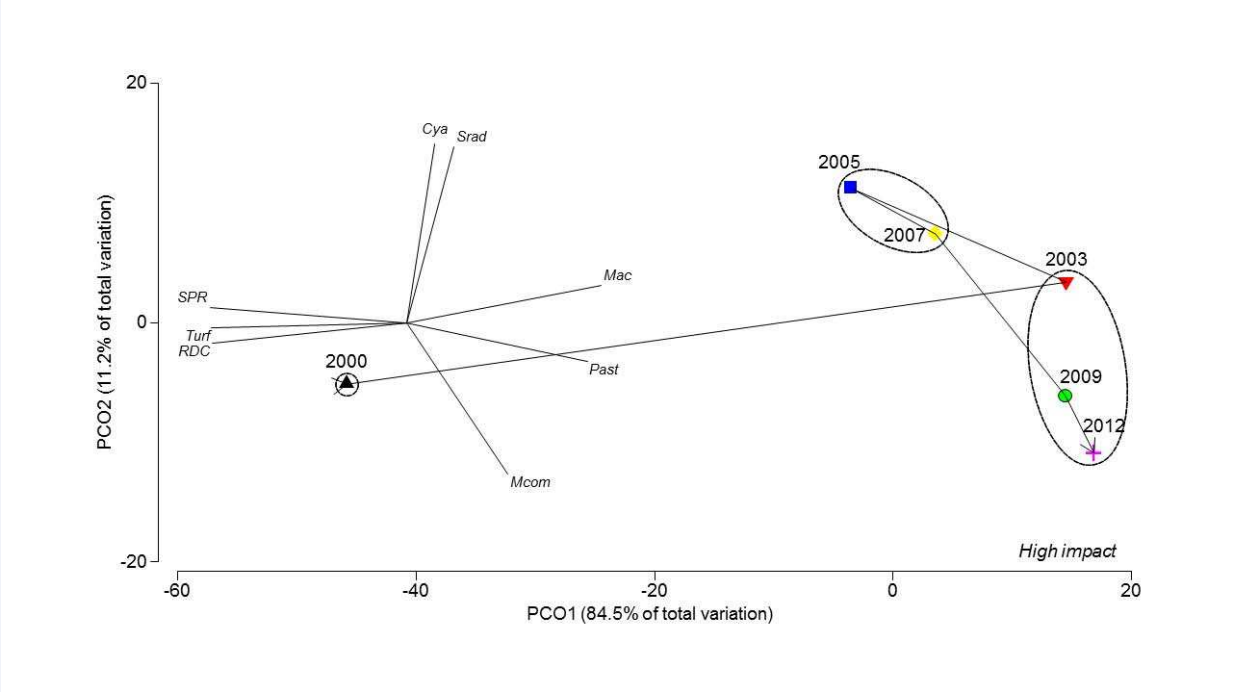


Figure 7 Principal Coordinate Ordination plot of HI benthic community trajectory. Dashed lines represent the 80% similarity cut-off level. Vectors based on a minimum correlation factor of 0.90. Model explains 95.7% of the observed variation in temporal patterns. Past= *Porites astreoides*, Srad= *Siderastrea radians*, Mcom= *Millepora complanata*, Cya= Cyanobacteria, Mac= Macroalgae, Turf= Filamentous algal turf, RDC= Recently dead coral, SPR= Sand, pavement, rubble.

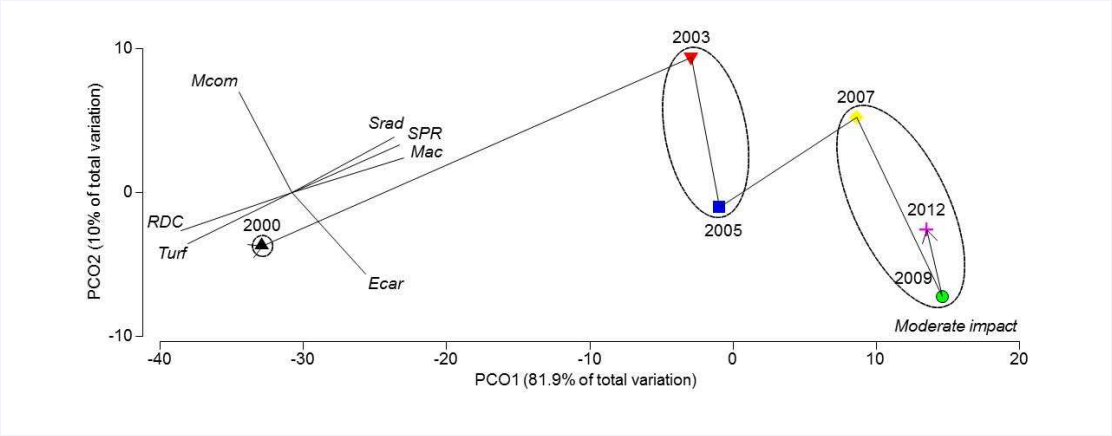


Figure 8 Principal Coordinate Ordination plot of MI benthic community trajectory. Dashed lines represent the 80% similarity cut-off level. Vectors based on a minimum correlation factor of 0.90. Model explains 91.9% of the observed variation in temporal patterns. Ecar= *Erythropodium caribbaeorum*. For other acronyms refer to Figure 7.

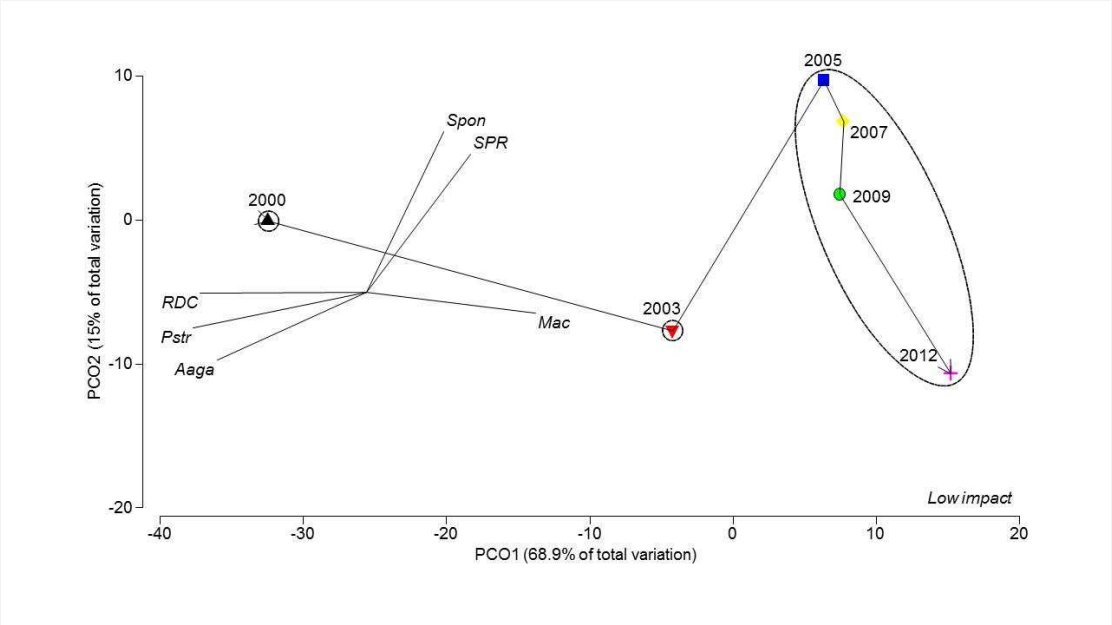


Figure 9 Principal Coordinate Ordination plot of LI benthic community trajectory. Dashed lines represent the 80% similarity cut-off level. Vectors based on a minimum correlation factor of 0.90. Model explains 83.9% of the observed variation in temporal patterns. Aaga= *Agaricia agaricites*, Pstr= *Pseudodiploria strigosa*, Spon= Sponges. For other acronyms refer to Figure 7.

impact site had a stronger impact.

Implications of beach renourishment on benthic community trajectories

Horizontal sediment transport in coral reefs can significantly alter benthic community composition [66] and affect long-term coral reef development [67-69]. Sediment transport modeling showed that under increasing SLR larger waves on shallow reefs would generate higher shear stress on benthic communities [70]. This would result in increased size and quantity of sediment being eroded and horizontally transported, in increased chronic turbidity, and in reduced light availability for photosynthesis, adversely impacting coral communities due to increased sediment-induced stress. The observed benthic community degradation persisted over a time span of at least twelve years. PCO analyses showed that although minor recovery occurred within HI sites between 2000 and 2012, major degradation across MI and LI sites caused reef community trajectories to shift towards a nearly similar state as poorly recovered HI habitats, with dominance by non-reef building ephemeral coral species and macroalgae. Such altered trajectories in benthic community assemblages favoring non-reef building taxa were consistent with previous studies following impacts in coral reefs by water quality decline, fishing, declining herbivory, or coral bleaching [71-74].

Persistence of regime shifts often depend on the reef benthic

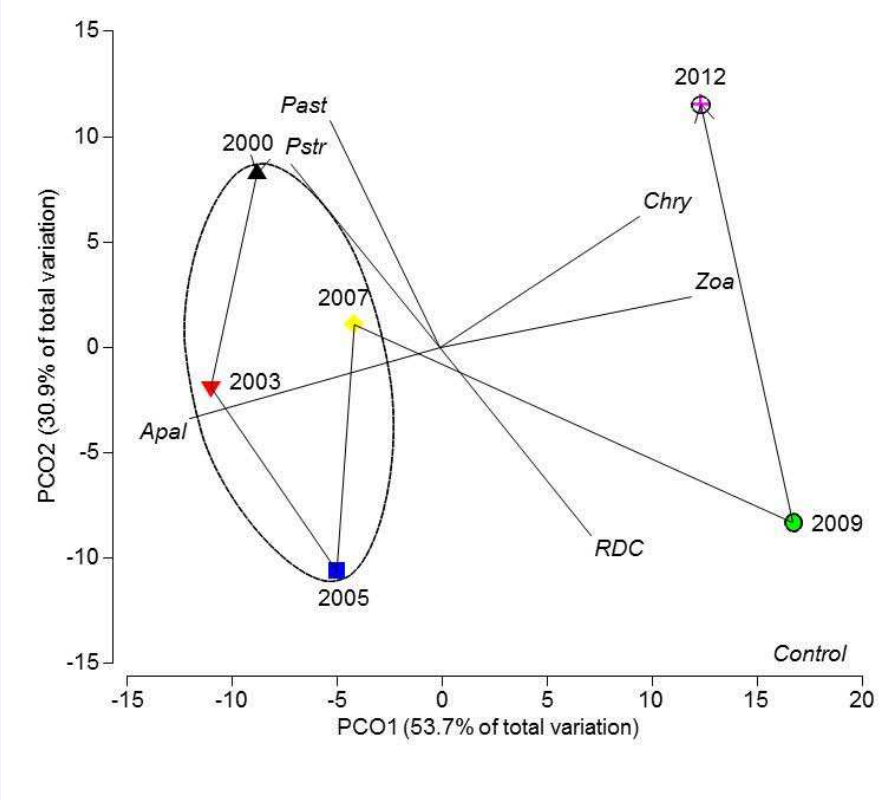


Figure 10 Principal Coordinate Ordination plot of CT benthic community trajectory. Dashed lines represent the 80% similarity cut-off level. Vectors based on a minimum correlation factor of 0.90. Model explains 84.6% of the observed variation in temporal patterns. Chryso= *Chrysocystis* sp. For other acronyms refer to Figure 7.

species composition, on coral assemblage functional redundancy, on individual species susceptibility to disturbance, on individual life history strategies of different coral species, and on the biogeographic location [75,76]. Coral reef communities recovered across a decadal scale or less following massive bleaching at the Arabian Gulf [77,78], Ryukyus Islands, Northwest Pacific [79], Lakshapweed Islands [76] and Chagos Archipelago [80], Indian Ocean, Palau, Micronesia [81], and Moorea, French Polynesia [82]. However, the wider Caribbean has mostly been characterized by a general lack of recovery following disturbance [72,73,83,84]. The Western Atlantic is characterized by low biodiversity and functional redundancy [85], a condition which can significantly impair rapid recovery of ecosystem resilience. Coral reef regime shifts favoring macroalgal dominance were suggested to be less abundant than previously considered [86]. However, this condition has been much more common across Caribbean reefs. Recovery may occur following an isolated stochastic disturbance such as a massive bleaching event or a hurricane, in the absence of other chronic disturbances. But the combined impact of chronic human-driven disturbances with acute massive bleaching events can produce cumulative or synergistic impacts on coral reef benthic community trajectories and ecosystem resilience which still remain poorly understood, and may result in slowly-evolving regime shifts which could be difficult to identify and reverse [87].

Local and regional scale impacts on regime shifts

A regime shift may not always involve a large acute change in ecosystem condition, but rather a long-term persistent shift in the trajectory and dynamics of the system, which often involves a change in its internal feedback mechanisms [88]. A regime shift favoring dominance by macroalgae and other non-reef building taxa was documented in this study across urban high-energy reefs. Initially, it involved a reef-scale, stochastic disturbance associated to sediment burial that extirpated a significant segment of benthic assemblages. It was followed by a long-term, slowly-evolving shift in the trajectory of extensive reef segments. This resulted in a permanent decline in percent coral cover, favoring dominance by macroalgae and ephemeral, disturbance-adapted, small-sized coral species. It is suggested that this change was the result of an additive combination or synergy of persistent local-scale and recurrent regional scale phenomena. Local-scale factors included the continuous sediment bedload impact that followed the original localized sediment burial incident and a persistent decline in coastal water transparency from a net temporal increase in rainfall and in sediment-laden runoff across the Río Grande de Arecibo watershed. In addition, chronic gray water and raw sewage pollution from multiple urban storm water outfalls, increasing POC and PIC, and the natural strong surge and hydrodynamic disturbance regime of local reef systems contributed to reef decline. Declining water quality associated to recurrent sewage and turbidity pulses has been shown to affect coral reefs across large spatial scales [59,89,90].Elevated POC levels were experimentally shown to induce coral mortality and to accelerate the growth rate of microbes living in the corals'

surface mucopolysaccharide layer by an order of magnitude [61]. This suggests that coral mortality may occur due to a disruption of the balance between the coral and its associated microbiota. Elevated POC levels may cause coral reefs to shift further from coral to macroalgal dominance, therefore, POC concentrations should be closely monitored as part of standard long-term coral reef monitoring protocols.

Regional-scale phenomena also impacted the study sites and included persistent sea surface warming, the 2005 massive coral bleaching event and its subsequent mass coral mortality event across the northeastern Caribbean region [91-94]. It can be argued that the additive and synergistic impacts of these factors contributed to arrest natural recovery ability of HI sites to an early successional stage characterized by non-reef building taxa and macroalgae. In the other hand, the same conditions resulted in major decline of adjacent MI and LI sites, driving benthic communities back to a similar early successional stage as in HI sites. Further, this long-term degradation affected habitat quality and availability for fish assemblages resulting from the permanent filling of multiple small channels and reef crevices by coarse sand, cobbles and small boulders, which might have further pushed observed regime shifts through a combination of indirect feedback mechanisms.

The effect of chronic and acute stressors on coral reef state can form a strong synergy that can adversely influence resilience by intensifying a regime shift [95]. Pollution and climate change may alter the magnitude, frequency and duration of regime shifts, resulting in additive and often synergistic effects that can make coral reefs more vulnerable to change that previously could be absorbed, and could foster a shift towards a less desired state in their natural capacity to recover from disturbance and generate ecosystem services [96]. Coral reefs impacted by a combination of recurrent pulse and chronic factors have undergone permanent regime shifts favoring declining percent coral cover and increasing macroalgal dominance across the Southern Pacific [97], Indian [98,99], and Western Atlantic oceans [72,83,84,100,101], with limited natural recovery. Chronic stressors can foster increased macroalgal dominance, whereas acute coral bleaching events further push the system closer to such an alternate state. This occurs because resilience can change faster and much earlier than a change in reef state [95]. In this context, loss of resilience can go unnoticed for many years, resulting in slowly-evolving regime shifts which then become disproportionately more difficult to reverse [87], and result in the emergence of a novel ecosystem.

Novel Caribbean coral reef ecosystems have been largely characterized by declining reef-building coral assemblages [91,93,94,100,101], declining coral recruitment rates [102], and recent dominance by ephemeral coral species recruits [103]. This suggests a significant alteration of benthic community trajectories, particularly compromising net reef growth in the context of projected climate change, ocean acidification and SLR. This is consistent with observations of increasing significance of coral species life histories in determining dominance by stress-tolerant coral traits [104,105]. Indirect effects of degraded benthic spatial heterogeneity on herbivore fish assemblages can also reduce herbivory and alter fish community structure and functions across affected reefs [106], further pushing benthic community regime shifts through a combination of indirect feedback mechanisms.

Disturbances that result in a state of low biotic spatial heterogeneity often precede a regime shift [107]. Chronic sediment bedload impacts can have a long-term sandblasting effect on coral assemblages which may significantly compromise net reef accretion in the future and exposing reefs to net bioerosion. Losing reef architecture may have profound long-term impacts on ecosystem processes such as nutrient recycling, fish productivity, sustaining biodiversity, and in providing multiple services [108-111], leading to net long-term declines in fish assemblages [112]. Following such disturbances, the system will shift into a state of macroalgal dominance and lower productivity, particularly under strong top-down (e.g., declining herbivory) or bottom-up (e.g., eutrophication) cascading effects. Strong persistent hydrodynamic disturbances may also affect coral species assemblages and community response to press and pulse disturbances [113], and in combination with bioerosion, may also affect reef structural complexity [110], further affecting natural recovery ability and future community trajectories. Similar combined mechanisms might have influenced benthic community trajectories after major beach renourishment stochastic impacts in this study, arresting reef natural recovery ability, resulting in a long-term slowly-evolving regime shift dominated by non-reef building taxa.

A glimpse of future impact by climate change and SLR?

Sea level is projected to significantly increase over the 21st century resulting in major coastal erosion [2,114], declining coral reefs, saltwater intrusion of groundwater [115], and displacement of human settlements from low-lying coastal areas [116]. Non-sustainable coastal development has already resulted in extensive urban and tourism construction across the coastal zone, largely affecting coastal reef systems and increasing increasing vulnerability to SLR [117]. Declining urban coral reefs are characterized by low species diversity and low percent living coral cover. High living coral cover [118], and benthic spatial heterogeneity [119], can reduce wave action by even an order of magnitude, creating calmer conditions in the backreef and fostering increased fish biodiversity. But losing percent living coral cover and spatial habitat heterogeneity, in combination with SLR, may result in long-term increased wave action. Waves are a significant destructive factor both, on exposed coral reefs and on exposed human communities [120,121]. Waves also influence sediment dynamics across coral reefs [122], and adjacent shorelines. A declining reef loses physical structure, and eventually its wave/swell buffering role. Waves, but in Puerto Rico particularly winter swells, can significantly impact coastal infrastructure, natural and cultural resources, and coastal-related economic activities. Projected SLR was modeled to generate stronger waves, increased surface currents, sediment resuspension and turbidity across shallow reefs [70]. Declining biodiversity can also increase the vulnerability of multiple coral reef functional groups and services [123], which can in turn increase the vulnerability of coastal human communities.

Under predicted SLR conditions beach renourishment could become a common shoreline stabilization management activity in the near future across many urban coastal areas, potentially

increasing impacts to adjacent shallow coral reefs. But modeling efforts to forecast potential large-scale and long-term impacts of such mitigation activities are still lacking. Spatial and temporal variation of cascade ecological effects of sediment bedload, habitat burial and turbidity associated to beach renourishment have remained largely obscure in the literature. Threshold and cross-scale effects (e.g., from physiological to ecosystem level impacts), as well as long-term coral reef benthic community trajectories following such impacts, have also remained poorly documented. This lack of information can make it difficult to predict potential long-term future impacts associated to sediment and turbidity dynamics across adjacent urban coastal reefs impacted by beach renourishment or by future shoreline erosion, increased sediment bedload, and turbidity associated to SLR.

Flooding of low-lying coastal urban and industrial areas will result in chronic unprecedented levels of pollution and eutrophication of coastal waters [124], potentially resulting in reduced water quality, hypoxia and habitat loss [7]. It can be argued that chronic shoreline erosion associated to climate change and SLR, in combination with impacts of eroded soils from flooded low-lying areas, will likely result in increased sediment spillover impacts across adjacent coastal coral reefs. If combined with increasing turbidity and urban pollution from coastal flooding and from land use change, this may produce chronic environmental impacts similar to those observed after this beach renourishment incident, potentially compromising benthic community trajectories in a nearly similar fashion.

There is evidence that some nearshore coral reefs can thrive under nearly continuous turbid conditions [125-128]. Some coral species can persist and produce an acclimatization response to high turbidity and sediment-induced stress, including the rapid replenishment of energy reserves during periods between sublethal turbidity events, shifting between phototrophy and heterotrophy, and by having rapid rates of photo-acclimation [129,130]. Nonetheless, rapid degradation of reef benthic habitat heterogeneity and the concomitant net elimination of microhabitats suitable for coral larval settlement due to sediment deposition, bedload or major algal overgrowth can be deleterious for community recovery [131,132]. Chronic impacts of horizontal sediment transport, sediment deposition, and eutrophication can be significant on scales of weeks to months [30], decadal [133], and even on century time scales [134-136]. Eutrophication has also been shown to trigger bleaching in corals [137,138], and in combination with other local stressors, can synergistically affect coral reef condition [139], and reduce its resilience to bleaching [140]. As a result, ecosystem engineer species and essential fish habitat functions for many economically valuable species can be severely eroded away or lost through slowly-evolving regime shifts. Such changes could be similar in nature to expected impacts on coastal reefs by climate change and SLR across urban scenarios, implying that slowly-evolving regime shifts could end up in a permanent alternate state which may compromise net reef accretion, ecological functions, ecosystem resilience, benefits and services.

CONCLUSION

Burial of urban nearshore reefs by beach renourishment had a variety of negative long-lasting impacts that resulted in a permanent regime shift favoring non reef-building taxa, and ephemeral, disturbance-adapted, small-sized corals. Impacts were initially characterized by a stochastic alteration in benthic community structure, followed by a slowly-evolving regime shift impacting adjacent benthic communities as a result from sediment bedload, arresting them on an early successional stage characterized by poor or none reef building activity. Beach renourishment in areas adjacent to coral reefs should not be dismissed as insignificant as many contracted environmental assessments often presume. Carry over and cross-scale effects of beach renourishment need to be addressed in the future during environmental impact evaluation prior to permitting procedures to help prevent ecological catastrophes.

This study also showed that other factors such as chronic coastal water quality decline associated to turbid river influences, polluted urban runoff, high POC, high SST, massive coral bleaching, post-bleaching coral mortality, and prevailing strong wave action could have also resulted in a combination of cumulative or synergistic effects that further contributed to the observed slowly-evolving regime shift. It arrested HI benthic community recovery trajectory to an early successional stage, but also drove MI and LI reef segments back to a nearly similar early successional stage within a period of twelve years following beach renourishment disturbance. Assessing benthic community trajectory is a critical tool to address the long-term recovery dynamics of coral reef benthic communities, can provide paramount information to managers to project and guide future reef rehabilitation and mitigation through ecosystem-based management, and should be incorporated as part of legal requirements during permitting procedures of similar projects in the future. Addressing such slowly-evolving changes in benthic community trajectories may also prove critical to address natural variability resulting from climate change-related phenomena.

Lessons learned from this glimpse of potential future climate change and SLR scenarios are also concerning as a slowly-evolving regime shift resulted in a significant change in benthic urban coral reef assemblages within only a decadal scale. Impacts on urban coral reefs can be severe and long-lasting, resulting in a benthic community trajectory leading to an arrested early successional stage, overall reef flattening, and in a permanent alteration to reef's biodiversity, ecosystem resilience, ecological functions, productivity, benefits and services. The fact that long-term persistent sediment bedload caused such broad impacts across reef segments adjacent to the sediment fill site reflects that even highly-localized beach renourishment activities can affect coral reefs across very large spatial scales, reflecting also potential future impacts by shoreline erosion, sediment bedload and chronic pollution associated to climate change and SLR. This case study represents a long-term natural experiment simulating what would be the impact of chronic sediment bedload and declining water quality on adjacent shallow urban coral reefs as a result of shoreline erosion and SLR.

Under such conditions, if impacts are similar to what was documented at La Marginal reef, net coral reef accretion would be severely compromised across very large spatial scales, losing reef's net wave action buffering function, and exposing in the

long run the shoreline and coastal infrastructure to further erosion, increasing the vulnerability of human settlements to SLR. The conservation and rehabilitation of shallow urban coral reefs have important implications for adapting and mitigating impacts by climate change and SLR on coastal human settlements. These potential effects should be taken into consideration when assessing the potential impacts and feasibility of beach renourishment activities to prevent irreversible ecological catastrophes in the future that could have unknown socio-economic and environmental consequences under projected climate change and SLR trends.

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CONFLICT OF INTEREST

All persons who meet authorship criteria are listed as authors, and both authors certify that they have participated sufficiently in the work to take public responsibility for the content, including participation in the concept, design, data collection, analysis, writing, or revision of the manuscript. Each author certifies that this material or similar material has not been and will not be submitted to or published in any other publication. The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria, grants, membership, employment, consultancies, stock ownership, or other equity interest, or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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Cite this article

Hernández-Delgado EA, Rosado-Matías BJ (2017) Long-Lasting Impacts of Beach Renourishment on nearshore Urban Coral Reefs: a Glimpse of Future Impacts of Shoreline Erosion, Climate Change and Sea Level Rise. Ann Mar Biol Res 4(1): 1021.

https://www.hoalahonokowai.com | T: (808) 244-2015 | E: honokowai@munekiyohiraga.com

October 31, 2025

Via email: deakos@hawaii.edu

Mark Deakos
Napili Resident

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Hoʻāla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawaiʻi

Dear Mr. Deakos:

Thank you for your comment email dated January 22, 2023 regarding the Hoʻāla Honokōwai Project Environmental Impact Statement (EIS) Preparation Notice. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the comments received.

Comment No. 1:

Given the grave concerns about the immediate and long-term impacts associated with artificial beach projects I have two requests:

1. *The DEIS address all the concerns associated with artificial beach projects highlighted in the two attached documents (NMFS letter of concern to OCCL dated August 20, 2019; Hernandez-Delgado & Rosado-Matias, 2017). NMFS concludes that proposed beach nourishment projects will have short term, long-term to permanent, and cumulative adverse effects to Essential Fish Habitat. These are projects without T-groins in the design, which would have a much greater impact. Some items of concern at listed here and requested that they be addressed in the DEIS:*

    - *Quantitative Resource Survey Assessments: Project applicants are responsible for providing sufficient resource survey information or benthic habitat maps. Applicants should conduct preliminary, quantitative benthic marine survey assessments of the entire project footprint area within the littoral cell-hard and soft bottom, groin footprints, between groins, offshore of the groins, where sediment models predict deposition (see below), along or nearby sand pipeline pathways, and nearby the sand borrow areas-before an EFH consultation is initiated. The level of complexity of surveys will scale proportionally with the extent of habitat forming EFH resources (e.g.,*

corals and submerged aquatic vegetation) that may suffer adverse effects (i.e., direct, indirect, and cumulative). Surveys and modeling efforts should consider the impacts of climate change, for example increased storm activity and sea level rise, on beach restoration and on the resources. Contingencies should be designed to accommodate analyses that utilize greater replication and higher statistical power to avoid the need to obtain higher resolution data Post-action monitoring plans would reduce uncertainty during potential EFH offset determinations. Assessments should be commensurate with the scale of the potential adverse effects as increasing the specificity and resolution of the scientific and natural resources information available will reduce uncertainty of adverse effects and support to EFH determinations. NMFS can provide assistance to Applicants to further refine and clarify the types and complexity of survey information that will be needed.

Response:

A Marine and Water Quality Assessment Report was prepared for the proposed Project and will be included and discussed in the Draft EIS. The report includes surveys of the marine habitat and an assessment of potential impacts for the proposed Project alternatives.

It is also noted that the proposed Project is subject to the provisions and requirements of the Magnuson Stevens Fishery Conservation and Management Act (MSA) (Section 305(b)(2) as described by 50 CFR 600.920) and the Fish and Wildlife Coordination Act (FWCA) (16 U.S.C. 661-666c). The Applicant would conduct formal consultations with the NOAA National Marine Fisheries Services (NMFS) and the U.S. Fish and Wildlife Service (USFWS) during the final design and permitting process to ensure compliance with the Essential Fish Habitat (EFH) provisions of the MSA and the FWCA.

Comment No. 2:

Sediment Modeling: Depending on the extent of resources present within or near a beach nourishment footprint, modelling may be needed to predict how the proposed projects, including those with groins, will influence sediment transport and water motion. The modelling effort should include and consider the following areas: the groin footprints, between the groins, offshore of the groins, along or nearby sand pipeline pathways, and nearby the sand borrow areas. If there is a high probability that sediment deposition will occur over sensitive and hard-to-replace hard bottom habitat. corals. and seagrass, these areas should be prioritized survey areas both before and after construction. Completing these modelling efforts and including them in the EFH assessment would help reduce uncertainty and better inform EFH conservation recommendations and any offset determinations.

Response:

A Coastal Engineering Assessment (CEA) was prepared for the proposed Project and will be included and discussed in the Draft EIS. The CEA includes an analysis of sand characteristics, sediment transport, and sedimentation.

Comment No. 3:

Sediment Testing: Information about sediment chemistry, nutrient content, and other chemical characterization would be needed both on bulk samples (i.e.. all size fractions) and within each size fraction or sediment class (e.g., mud, silt, fine sand, sand, etc.). This is needed because smaller size fractions that include silt and mud classes typically retain higher organic carbon content and are more detrimental to habitat forming EFH than those sediment types with larger sizes. This information should also be included in the EFH assessment to inform conservation recommendations and potential offset determinations.

Response:

As noted above, the CEA that was prepared included assessment of sand characteristics and sedimentation. More information about sand characteristics and suitability is included within the Draft EIS.

Comment No. 4:

Water Quality Monitoring: Robust water quality monitoring (e.g., turbidity, sedimentation rates, nutrients, dissolved oxygen, etc.) is needed to assess conditions before (i.e., baseline), during, and after beach restoration activities. These activities should be informed by the sediment modeling and daily tide and current velocity predictions (https://www.pacioos.hawaii.edu/voyagerD to select sampling. Special attention should be placed on collected turbidity and sedimentation rate information at areas where there are habitat forming EFH resources, including corals and submerged aquatic vegetation. For other criteria needed for beach restoration projects, NMFS would defer to the requirements of the Environmental Protection Agency (EPA) delegated through the state of Hawaii, Department of Health, Clean Water Branch's (DOH), 401 Water Quality Certification (WQC), Applicable Monitoring and Assessment Plans (AMAP).

Response:

An Applicable Monitoring and Assessment Program (AMAP) was prepared for the proposed Project and is included within the CEA. The AMAP details how water quality monitoring would occur before, during, and after construction. More information on water quality parameters and monitoring are provided in the Draft EIS.

Comment No. 5:

Stressor Effects: NMFS is concerned that there are a variety of adverse effects from stressors on EFH that have not been fully considered in the Draft EA. Short-term, long-term to permanent, and cumulative adverse effects to EFH are likely to

occur from beach restoration projects due to physical damage, sedimentation and turbidity, and nutrients and chemical contamination.

Response:

The 2016 episodic erosion and beach loss event resulted in large turbidity plumes that extended into nearshore waters and impacted marine biotic communities. There may be temporary impacts to water quality during construction, but it is anticipated that a wider and more stable beach and backshore would improve water quality over the long term. As previously noted, a Marine and Water Quality Assessment Report was prepared for the proposed Project and will be included and discussed in the Draft EIS. The report includes surveys of the marine habitat and an assessment of potential impacts for the proposed Project alternatives. The AMAP will also detail how water quality monitoring would occur before, during, and after construction.

Comment No. 6:

Physical Damage: Direct contact to habitat forming EFH resources (e.g., corals and submerged aquatic vegetation) from construction equipment and materials, as well as from installation activities, can lead to permanent and lesser adverse effects. The level of these adverse effects (i.e., short-term, long-term to permanent, and cumulative) will vary on a case-by-case basis dependent on the density and extent of EFH resources present and the dredge and/or sediment retention design that are chosen. For example, the 2012 Waikiki Beach Nourishment and Dredging Project resulted in physical damage to the fossil limestone reef rock bordering sand borrow areas that were dredged (Draft EA, Section 4.2.2.3). In addition, recent projects in Waikiki have chosen to use a geotextile material to construct a sandbag groin. The long-term durability of this material is currently unknown and therefore carries a possibility of becoming compromised and potentially posing a risk to surrounding EFH. Due to this stressor, a variety of measures to avoid and minimize physical damage to EFH may be needed to reduce unavoidable losses.

Response:

The proposed footprint of the groins is within a nearshore scour zone that is mostly barren of marine life. The shallow depth and concussive wave forces are not suitable for coral growth. Best Management Practices (BMPs) would be used to limit the temporary construction impacts to the marine environment.

Additionally, an AMAP is included within the CEA. The AMAP details how water quality monitoring would occur before, during, and after construction.

Comment No. 7:

Sedimentation and Turbidity: Short-term, long-term to permanent, and cumulative adverse effects to habitat forming EFH may occur due to sedimentation and turbidity during proposed beach nourishment projects. Sedimentation and turbidity from hopper dredging at borrow areas may occur due to disruption from drag arms and heads and unmitigated overdredge disposal of fine sediment classes; land-

based beach filling activities, after-the-fact from micritic calcium carbonate leaching from beach fill, and resuspension from groins is they alter local hydrodynamics.

Response:

As discussed previously, the CEA includes an analysis of sand characteristics, sediment transport, and sedimentation. This information will be included in the Draft EIS.

Comment No. 8:

Nutrients and Chemical Contamination: Adverse effects may occur during dredging from borrow areas and after beach fill is placed due to release of sediment-bound nutrients and chemical contaminants; the latter may also occur from leaking construction equipment and introduction of treated materials into the marine environment, including lumber during multiple types of beach restoration projects.

Response:

The AMAP also details how water quality monitoring would occur before, during, and after construction. The Draft EIS will discuss BMPs for minimizing impacts to water quality and the marine environment for both the Project Site and Sand Recovery Site.

Comment No. 9:

2. *One of the proposed alternative needs to include a robust analysis of managed retreat. During the project presentation by Sea Engineering, it was mentioned that the natural flow of sand between the two beach cells on either side of the Maui Kai Resort has been severed, preventing the natural seasonal flow of sand between these two beach cells. Therefore the managed retreat alternative should evaluate what portions or if the entire Maui Kai Resort should be relocated to restore the natural connection between the two beach cells. In addition, since many of the structures fronting this artificial beach project will have foundations undermined by the encroaching Erosion Hazard Line (EHL), a thorough examination of relocating these structures should be assessed. Items included in the assessment should include:*

Response:

We appreciate your comments regarding managed retreat. Managed retreat in a highly developed area, like the Project Site, would likely require a phased approach that may be implemented over the course of several decades. State and local governments should be involved in retreat efforts via community-wide planning and education efforts, land use regulation, and financial assistance programs to facilitate managed retreat (vs. unmanaged retreat). Until managed retreat policies, regulations, tools, and programs are in place to implement managed retreat in a heavily developed community like Honokōwai, other appropriate solutions should be considered. The proposed Project is an interim solution and would not preclude the implementation of other sea level rise adaptation

strategies at Honokōwai in the future. Rather, the proposed Project would help to maintain the environmental, cultural, social, recreational, and economic value of Honokōwai Beach, while providing a protective buffer to reduce impacts from erosion and flooding. The multi-decadal process of planning for and implementing managed retreat should not preclude the West Maui Resort Partners from restoring Honokōwai Beach.

Comment No. 10:

- *Certified Shoreline Survey to determine how much of the Maui Kai Resort is currently in the conservation easement (public trust)*

Response:

The Applicant for this Project is the West Maui Resort Partners, L.P., which owns the Kaʻanapali Beach Club. Shoreline certification is identified in the list of permits and approvals anticipated to be required for the Project.

Comment No. 11:

How much time exists before the EHL will impact the property's foundation (for each building that is included in this DEIS)

Response:

The Erosion Hazard Line (EHL) is the estimated exposure zone to future coastal erosion based on the Intergovernmental Panel on Climate Change (IPCC) RCP8.5 sea level rise scenario.

The EHL lines extend landward from the current shoreline up to the 80% cumulative probability contour for four scenarios representing 0.5, 1.1, 2.0, and 3.2 ft of sea level rise. The IPCC RCP 8.5 scenario projects that sea level on Maui will rise 0.5 ft by 2030, 1.0 ft by 2050, 2.1 ft by 2080, and 3.1 ft by 2100. A Structural Assessment for the Kaʻanapali Beach Club makai building was conducted in 2024 and will be included in the Draft EIS. The study found that a projected sea level rise of 3 ft will result in the ground water elevation to rise which may have a significant impact on the lateral load capacity of the Kaʻanapali Beach Club makai building if erosion processes undermine subsurface soil stiffness. However, erosion countermeasures such as those considered in the three beach restoration alternatives would prevent the erosion of the soil substrate, and the soil underlying the existing structure would continue to provide adequate vertical and lateral support.

Comment No. 12:

The age of the building

Response:

The buildings at the Kaʻanapali Beach Club were originally constructed in 1988. A Structural Assessment for the Kaʻanapali Beach Club structure was conducted in 2024 and will be included and discussed in the Draft EIS.

Comment No. 13:

What type of substrate exists below the building and to the mauka property line (substrate bores should be taken moving perpendicular to the shoreline towards the mauka property line to determine the composition of silt//sand/clay beneath

Response:

A Structural Assessment for the Kaʻanapali Beach Club makai building was conducted by KAI Hawaii, Inc. in 2024 and will be included and discussed in the Draft EIS. This report provides detailed geotechnical information for the Project Site.

Comment No. 14:

How much space is available mauka for relocation

Response:

With respect to the Kaʻanapali Beach Club parcel, approximately 248,359 square feet (5.7 acres) of the parcel is located outside of the 3.2-foot SLR-XA (the entire parcel measures approximately 7.57 acres). The areas of the property outside of the 3.2-foot SLR-XA are developed with existing buildings, parking, and related resort amenities.

Comment No. 15:

What other alternatives exist for relocation

Response:

We understand this question as asking what alternatives exist to relocate off of the current parcels (i.e., as opposed to relocating mauka on the same parcel). Challenges posed by sea level rise and climate change are not unique to the Project Site and occur throughout the County and State. As noted above, there is a lack of State and County guidance on retreat. No “receiving areas” have been identified for relocation outside of the Kaʻanapali Beach Club and Maui Kai parcels. West Maui does not have any undeveloped parcels on which resort use is currently allowed (e.g., the West Maui Community Plan does not identify any undeveloped areas for resort use, nor do current zoning maps show any undeveloped parcels zoned for resort use. It is unclear at this point if “receiving areas” even exist. If “receiving areas” do not exist, decisions need to be made whether to eliminate existing land uses (e.g., under what conditions and thresholds, whether by

condemnation or buyouts). These issues require guidance from the State and County, given their complexity and far-reaching impacts. The purpose of the Project is to enable sufficient time for these issues to be addressed and questions answered.

Comment No. 16:

What is the estimated cost of relocation

Response:

It is premature to estimate the cost of relocating structures when we are unable to determine what specifically is to be relocated and to where.

Comment No. 17:

What is estimated cost of repairing and remodeling the existing building

Response:

Given the complex nature of construction, undefined scopes of work, changes or updates in legislation that prevent or limit certain actions, supply chain constraints and the shortage of skilled labor, it is difficult to provide an estimate because there are many unknowns and cost variables that are driven by market conditions - economic, environmental, and political.

Comment No. 18:

What revenues are generated from the existing building

Response:

An Economic Impact Report was prepared for the proposed Project and will be included in the Draft EIS. Within the KBC property there are staff employed for housekeeping, guest services, management, maintenance, landscaping, security, culinary services, and vacation rental sales. Other local businesses are also supported, including a massage parlor, convenience store, Lūʻau, and valet service. These services provide a significant source of jobs for West Maui residents and the property generates significant tax revenue for the County and State, much of which is from off island and out of state. The Kaʻanapali Beach Club directly generates approximately 300 jobs. Honokōwai Beach also supports public use and businesses not affiliated with Kaʻanapali Beach Club.

Comment No. 19:

What percentage of the units are full time residents

Response:

With respect to the Kaʻanapali Beach Club parcel, the units are lawfully zoned for hotel use. As is characteristic of such use, the units do not have full time residents.

Comment No. 20:

I recognize there is no easy solution to this complicated issue but I do believe that the sooner we begin having serious discussions and evaluations on managed retreat, the quicker we can start implementing compassionate, long-term solutions that preserve and restore coastal resources while keeping people out of harms way.

Response:

We acknowledge the need to have these discussions on managed retreat and are actively involved in planning for long-term adaptations to sea level rise.

Thank you again for your participation in the Chapter 343, Hawai'i Revised Statutes environmental review process. A copy of your email and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 244-2015.

Very truly yours,

Tessa Ng

Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Michael Cain, Office of Conservation and Coastal Lands
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honokowai

From: kfish2@ptera.net
Sent: Tuesday, December 27, 2022 12:46 PM
To: michael.cain@hawaii.gov; michael.elliott@hgv.com; honokowai
Subject: Honokowai Project

Dear Approving Agency, Applicant, and Consultant,

We have visited beautiful Maui since 1984 and specifically the Kaanapali Beach Club since 2000. Our last visit we were absolutely heartbroken over the devastating beach erosion.
I am writing to encourage your hard work and planning to restore the beautiful shoreline. Reading about it at least tells us you are trying to work towards that important project and gives us hope that you will reach that necessary goal.

Thank you for your time, expertise, and allowing these public comments. We pray for your success.

Kelly and Ken Fish
kfish2@ptera.net

8908 East Honorof Lane
Spokane, Wa. 99223

https://www.hoalahonokowai.com | T: (808) 244-2015 | E: honokowai@munekiyohiraga.com

October 31, 2025

Via email: kfish2@ptera.net

Kelly and Ken Fish
8908 East Honorof Lane
Spokane, Washington 99223

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Hoʻāla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawaiʻi

Dear Mr. and Mrs. Fish:

Thank you for your email dated December 27, 2022 regarding the Hoʻāla Honokōwai Project Environmental Impact Statement (EIS) Preparation Notice. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the comments received.

Comment:

We have visited beautiful Maui since 1984 and specifically the Kaanapali Beach Club since 2000. Our last visit we were absolutely heartbroken over the devastating beach erosion.

I am writing to encourage your hard work and planning to restore the beautiful shoreline. Reading about it at least tells us you are trying to work towards that important project and gives us hope that you will reach that necessary goal.

Response:

Thank you for your comment and support of the proposed Project of beach restoration.

Thank you again for your participation in the Chapter 343, Hawai‘i Revised Statutes environmental review process. A copy of your email and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 244-2015.

Very truly yours,

Tessa Ng

Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Michael Cain, Office of Conservation and Coastal Lands
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honokowai

From: Paul Jenkins <pjenkins@horizonelectricinc.com>
Sent: Wednesday, December 28, 2022 11:21 AM
To: michael.cain@hawaii.gov; honokowai
Cc: (istravel@hawaiiantel.net)
Subject: Maui News Honokowai Article 20221227

Aloha Michael and Andy,

Happy New Year!

My name is Paul Jenkins and am 67 yrs old. My wife and I live in Pukalani, HI. I have lived on Maui since 1981.

My wife, children and I have spent a lot of time at the beaches here over the years and have seen how the sand can move around at different times. There's a few things I've noticed consistently like many other people have as well. If you build a seawall you are pretty guaranteed to lose the sand. I run on beaches fairly often and have noticed some beaches seem to always have sand even though other places have problems. The MAUI NEWS article by Dakota Grossman listed 3 possible plans of actions – beach nourishment, beach maintenance and using T-groins.

I run on the beach from Kanaha lifeguard station towards Airport Beach. Something I've noticed often is when rocks are piled perpendicular to the shoreline like "rock curbs" (fingers) going out about 100 ft and spaced about 150-200 ft apart the sand seems to not shift very much. The end of the curb at the beach is held back 5 to 10 feet sometime so people can walk around the end. I wonder who put these curbs in place and when they did it. Maybe this is what they're calling "T-groins". When I run to the end of this stretch towards airport Beach there's a couple properties with long-standing, collapsing concrete seawalls parallel to the shoreline. Where these walls are the sand has totally disappeared. Only rocks remain. Once you get past this point the beaches on the Airport Beach side again have these "rock curbs" and the sand seems to consistently stay. It makes me wonder if "curbs" were installed and the concrete walls removed if the sand wouldn't return. Some places in Hawaii have places where there are small bays with 2 points that jut on either side. I believe this type of beach seems to be protected too.

The old sugar fields have lots of large piles of big rocks that could possibly be used to create the curbs. Or maybe another material could be used. I'll try and attend the 5-7p Public Mtg 1/17/2023 at Lahaina Civic Center. I checked out the website https://www.hoalahonokowai.com/ shown in MAUI NEWS.

I'm hoping a solution can be found for Honokowai and other places here in Hawaii!

Mahalo!
Paul

Paul Jenkins
President
Horizon Systems and Design
PO Box 1078
Makawao, HI 96768
ph (808) 893-2501, fax (808) 893-2502
cell (808) 870-5865
www.horizonelectricinc.com

https://www.hoalahonokowai.com | T: (808) 244-2015 | E: honokowai@munekiyohiraga.com

October 31, 2025

Via email: pjenkins@horizonelectricinc.com

Paul Jenkins, President
Horizon Systems and Design
P. O. Box 1078
Makawao, Hawai'i 96768

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Ho'āla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawai'i

Dear Mr. Jenkins:

Thank you for your email dated December 28, 2022 regarding the Ho'āla Honokōwai Project Environmental Impact Statement (EIS) Preparation Notice. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the comment received.

Comment:

I run on the beach from Kanaha lifeguard station towards Airport Beach. Something I've noticed often is when rocks are piled perpendicular to the shoreline like "rock curbs" (fingers) going out about 100 ft and spaced about 150-200 ft apart the sand seems to not shift very much. The end of the curb at the beach is held back 5 to 10 feet sometime so people can walk around the end. I wonder who put these curbs in place and when they did it. Maybe this is what they're calling "T-groins". When I run to the end of this stretch towards airport Beach there's a couple properties with longstanding, collapsing concrete seawalls parallel to the shoreline. Where these walls are the sand has totally disappeared. Only rocks remain. Once you get past this point the beaches on the Airport Beach side again have these "rock curbs" and the sand seems to consistently stay. It makes me wonder if "curbs" were installed and the concrete walls removed if the sand wouldn't return. Some places in Hawaii have places where there are small bays with 2 points that jut on either side. I believe this type of beach seems to be protected too.

The old sugar fields have lots of large piles of big rocks that could possibly be used to create the curbs. Or maybe another material could be used.

Response:

The “rock curbs” that exist at Kanaha are similar to straight groins, which are structures that are built perpendicular to the shoreline for the purpose of interrupting longshore sand transport and stabilizing beaches. These structures are common along sandy shorelines with extensive sand transport rates. The groins work by blocking the longshore transport of sand, resulting in the groin trapping sand on its updrift side.

T-head groins are also built perpendicular to the shoreline; however, their purpose is different from straight groins. T-head groins are designed to change the wave shape as it approaches the shoreline to produce a diffracted, or curved, wave. This curved wave produces a stable beach cell between the groins. T-head groins are designed to mimic natural features (headlands) to produce curved beaches. Additional information about beach stabilizing structures will be provided in the Draft EIS.

Thank you again for your participation in the Chapter 343, Hawai‘i Revised Statutes environmental review process. A copy of your email and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 244-2015.

Very truly yours,



Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Michael Cain, Office of Conservation and Coastal Lands
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EISPN Comment Form

Name:	KAHIKILANIWAHINEMAIKA'I'OPUNA NILES
Email:	KAHIKILANI.NILES@GMAIL.COM
Affiliation (organization, company, or agency, if applicable):	
Address:	KAHOMA VALLEY
EISPN Scoping Comment:	...
Comment (attachments may be uploaded using the "upload file" function below):	AT THE MEETING ON TUESDAY 1/17/23 I ASKED A QUESTION "DID YOU FOLKS CONSULT WITH ANY FAMILIES FROM THE AREA?" I WOULD LIKE TO BE MORE SPECIFIC IN MY QUESTION... I WOULD LIKE TO KNOW HOW MANY FAMILIES DID YOU CONSULT WITH? OUT OF ALL THOSE FAMILIES, HOW MANY ARE KANAKA MAOLI/ HAWAIIAN? HOW MANY OF THEM ARE ACTUALLY OF THAT PLACE?
Upload File:	

https://www.hoalahonokowai.com | T: (808) 244-2015 | E: honokowai@munekiyohiraga.com

October 31, 2025

Via email: kahikilani.niles@gmail.com

Kahikilaniwahinemaikaʻiʻopuna Niles
Kahoma Valley

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Hoʻāla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawaiʻi

Dear Ms. Niles:

Thank you for your comment dated January 19, 2023 regarding the Hoʻāla Honokōwai Project Environmental Impact Statement (EIS) Preparation Notice. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the comments received.

Comment:

"DID YOU FOLKS CONSULT WITH ANY FAMILIES FROM THE AREA?" I WOULD LIKE TO BE MORE SPECIFIC IN MY QUESTION... I WOULD LIKE TO KNOW HOW MANY FAMILIES DID YOU CONSULT WITH? OUT OF ALL THOSE FAMILIES, HOW MANY ARE KANAKA MAOLI/ HAWAIIAN? HOW MANY OF THEM ARE ACTUALLY OF THAT PLACE?

Response:

The Applicant has consulted with various State and County agencies and community stakeholders. As part of the preparation of the Draft EIS, a Cultural Impact Assessment and Coastal and Marine Uses Report were prepared. Both reports included community outreach and surveys. These reports will be included and discussed within the Draft EIS.

Thank you again for your participation in the Chapter 343, Hawaiʻi Revised Statutes environmental review process. A copy of your comment submittal and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 244-2015.

Very truly yours,

Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Michael Cain, Office of Conservation and Coastal Lands
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honokowai

From: Kai Nishiki <kai.nishiki@gmail.com>
Sent: Monday, January 23, 2023 4:00 PM
To: Michael.Elliott@hgv.com; Michael Cain; honokowai
Subject: EISPM comment KBC Honokowai Resort & Pool Protection Proposal/ Hoala Honokowai

Please see comments and questions from Na Papa'i Waewae 'Ula'ula.

Mahalo,
Kai Nishiki

What is organizational structure of ownership/management of these properties?
Where does the funding come from to pay for these proposals?
Who has the authority to decide on proposals? Is it a board?
Who are they and do they live here?

Is the proposal a community service project to "restore" a beach for the general public? Is any public funding being applied for or utilized?

Is this project actually being proposed to protect your resort and pool? Who is paying for it? What is the projected costs for all proposals?

Public Beach Right of way and Parking

How many additional beach parking stalls will be created and set aside for kamaaina only beach access parking? Where will they be located? How will parking for kamaaina be enforced?

Will you install a beach cam for monitoring of parking and shoreline? Cost of installation and maintenance?

Dune Restoration

In order to support the landward migration of beaches, please provide design and cost of dune restoration with appropriate dune plantings in the backshore, removal of concrete walkway and installation of elevated ADA compliant movable(trex) lateral shoreline access path the length of the shoreline.

Evaluate, consult and provide information on if public beach sand is moved into the backshore, onto private property, for a dune restoration, what measures will be taken to protect and care for the public beach sand bank account.

During high wave events, when the beach will want access to the beach sand bank account, how will sand pushing be used to “feed” the beach. Design and plan for dune and movable shoreline path maintenance during emergencies, coastal erosion and high wave events.

Vegetation management up to the wall of current structures. Evaluate removal of vegetation, dirt fill, irrigation, pool patios. Provide design and cost of replacement in back shore of sand for dune restoration and movable, elevated ADA compliant lateral shoreline access path. Evaluate if this will be public infrastructure or if this area will remain private property with public use allowed?

Restroom and shower

Will these be upgraded? Is this the best location for these amenities considering SLR and coastal erosion? Evaluate relocation including new location, and costs.

Shoreline hardening

Maui Kai seawall - what are the impacts of shoreline hardening at Maui Kai and The Mahana in regards to sand transport between North Ka’anapali littoral cell and Honokowai littoral cell? Please evaluate benefits of removal of shoreline hardening in these cells to the natural coastal environment and beach processes.

What are the impacts to sand transport in the area from shoreline hardening in the Honokowai littoral cell?

If shoreline hardening was removed from both cells what would the be the impact to sand transport?

Adaptation Pathways

Will you provide funding for a comprehensive community based adaptation pathways project?

What is your long term plan? What is life expectancy of your structures? Is regular structural analysis of your buildings being done? Will you provide structural analysis to the public?

What financial considerations have been made to pay for relocation of structures and is there a proposed implementation schedule? What financial considerations/plans/savings/assessments have been made by the resort for costs associated with SLR and coastal erosion adaptation or relocation?

Beach proposal

Historically, the ocean environment in this area is very dangerous with rip currents, etc. Please research the number of rescues in this area, local knowledge from ocean safety officers, fishermen, surfers, swimmers and long time residents. If you make a pretty beach for tourists that is then more frequently used what is your plan for health and safety? Will a more attractive beach encourage more use of the area? Will you please do a projection on increase of use and by what demographic? Will there be a lifeguard on duty paid for the resort? What kind of education will be provided to guests of resorts and beach users?

How do any of the proposed solutions support the landward migration of beaches? Do you acknowledge the need to accommodate the landward migration of beaches? How do your actions demonstrate this?

Sand - where from, how much,what is process for providing sand for beach and dune restoration?

What are the impacts to surf breaks, reef, currents, etc?

Will 2018 temporary erosion control be removed? When? What timeframe is considered temporary?

We request comprehensive coring samples be done for the entire property.

Please determine where and how much dirt fill was placed on property and provide information on sand availability on the property. In reviewing photos of 2016 event, there are exposed irrigation lines in the shoreline in what appears to be dirt fill.

If permits are approved for any project, will you agree to high quality, multi angle live video monitoring available to the public for the extent of the project and for all future repairs and maintenance?

Has the shoreline been certified yearly? Has certification been done at the highest tides of the year when erosion events occurred?

Citing information below, provided in the EISPN, please provide analysis and justification for proposed beach nourishment going makai approximately 60 feet instead of supporting the landward migration of beaches through implementation of passive public infrastructure such as dunes and wetland restoration with elevated public access more resilient to coastal hazards?

“4.2 **Beach Nourishment**

Beach Nourishment refers to an individual action (Project) that involves placement of additional sand to increase beach width and sand volume to offset the effects of erosion without modifying existing structures or installing any new structures. Beach nourishment projects are typically not designed to accommodate sea level rise. The design life for beach nourishment projects is typically based on a combination of historical and projected erosion rates. When conducting beach nourishment along coastlines that are subject to chronic and/or episodic erosion, such as Honokōwai Beach, rates of pre-project beach erosion should be expected to continue following a beach nourishment project.
Beach nourishment at Honokōwai Beach is a short-term response that would consist of placing sand directly along the shoreline without any structures to stabilize the sand. The sand would be placed along 1,000 lf of shoreline with a beach crest elevation of +10 ft MSL and a beach slope of 1V:8H (vertical to horizontal). This alternative would require approximately 27,000 cy of sand and would result in approximately 50,000 sf (1.15 acres) of beach area. Average beach width would be approximately 60 feet, which aligns with the 2007 shoreline position. The estimated construction duration for the nourishment effort would be 90 to 180 days. Beach nourishment would be implemented as a single project with an anticipated design life of 8 years. The beach nourishment alternative will be further evaluated and discussed in the Draft EIS."

Historical Shoreline Change

The University of Hawai‘i Coastal Geology Group (CGG) conducted a historical analysis of sandy shorelines on Maui and produced shoreline change maps based on survey data and aerial imagery from 1912 to 2018. Their analysis uses the beach toe as the reference feature to measure changes in the position of the shoreline over time. Since 2018 (the most recent data point in the analysis), most beaches throughout West Maui appear to be experiencing an increase in erosion that appears to exceed the historical rates.

The historical shoreline change trend for Honokōwai Beach (transects 1179 to 1195) from 1912 to 2018 has been erosion at an average rate -0.44 ft/yr (CGG, 2022). The north end of the beach (transects 1190 to 1195) has been eroding at an average rate of -0.33 ft/yr. Erosion has historically been more pronounced along the south end of the beach (transects 1179 to 1184), which have been eroding at an average rate of -0.55 ft/yr.

Projected Shoreline Change

Erosion, coastal flooding, and beach loss are expected to continue and accelerate in Hawai‘i as sea levels continue to rise. Recent record high water levels and severe erosion events indicate that this acceleration may already be occurring. Anderson et al. (2015) forecasted future coastal change in Hawai‘i by combining historical shoreline trends with projected accelerations in sea level rise using the Davidson-Arnott profile model. The analysis found that, due to sea level rise, the average shoreline recession is projected to be nearly twice the historical rates by 2050, and nearly 2.5 times the historical rates by 2100 (Anderson et al. 2015).

The CGG calculated also projected future exposure to erosion and flooding to account for sea level rise (CGG, 2019). The projected shoreline change trend for Honokōwai Beach is erosion ranging from -1.66 to -3.07 ft/yr, which is 4 to 7 times the historical extrapolation. Based on the CGG erosion projections, without mitigative action, the accelerated erosion caused by sea level rise will likely result in total loss of Honokōwai Beach by mid-century or sooner. "

Sent from my iPad

https://www.hoalahonokowai.com | T: (808) 244-2015 | E: honokowai@munekiyohiraga.com

October 31, 2025

Via email: kai.nishiki@gmail.com

Kai Nishiki
Na Papa'i Waewae 'Ula'ula

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Ho'āla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawai'i

Dear Ms. Nishiki:

Thank you for your comment email dated January 23, 2023 regarding the Ho'āla Honokōwai Project Environmental Impact Statement (EIS) Preparation Notice. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the comments received.

Comment No. 1:

What is organizational structure of ownership/management of these properties?

Where does the funding come from to pay for these proposals?

Who has the authority to decide on proposals? Is it a board?

Who are they and do they live here?

Is the proposal a community service project to "restore" a beach for the general public? Is any public funding being applied for or utilized?

Is this project actually being proposed to protect your resort and pool? Who is paying for it? What is the projected costs for all proposals?

Response:

The Applicant for the proposed Project is the West Maui Resort Partners, LP. West Maui Resort Partners LP is a subsidiary of a Diamond Resort entity with Hilton Grand Vacations being the ultimate parent. Diamond Resorts was acquired by Hilton Grand Vacations in August 2021. The proposed Project would be privately funded by the Applicant. No public funding is being utilized for the project. The projected cost for the Project will be presented in the Draft EIS.

The process to approve or deny the proposed Project is a multi-step process that requires review and approval by numerous boards and commissions and would require multiple permits. Information regarding the membership and composition of each board or commission, including any applicable membership or residency requirements, may be obtained from the applicable agency overseeing the board or commission.

The objectives of the proposed Project include increasing beach stability and maintaining shoreline access for the public. The public would continue to have free and clear access to the beach, parking and restroom facilities with the goal of providing greater access whether for ADA, beach and water recreation, and cultural practices.

Comment No. 2:

Public Beach Right of way and Parking

How many additional beach parking stalls will be created and set aside for kamaaina only beach access parking? Where will they be located? How will parking for kamaaina be enforced?

Will you install a beach cam for monitoring of parking and shoreline? Cost of installation and maintenance?

Response:

An existing public beach access with dedicated public parking stalls for beach users is located between the Kaʻanapali Beach Club (KBC) and Kaanapali Shores Condominiums. Public parking is anticipated to be increased by four stalls, which would be dedicated to Kamaʻāina. The proposed Project intended to achieve the Project goals associated with beach restoration, beach stability, preserving and enhancing shoreline access, and improving overall resilience to sea level rise. The proposed Project is not anticipated to adversely affect public beach access. In addition to the proposed Project alternatives, Potential Related Secondary Actions may include further public access improvements within the KBC property or shoreline areas.

Comment No. 3:

Dune Restoration

In order to support the landward migration of beaches, please provide design and cost of dune restoration with appropriate dune plantings in the backshore, removal of concrete walkway and installation of elevated ADA compliant movable(trex) lateral shoreline access path the length of the shoreline.

Evaluate, consult and provide information on if public beach sand is moved into the backshore, onto private property, for a dune restoration, what measures will be taken to protect and care for the public beach sand bank account.

During high wave events, when the beach will want access to the beach sand bank account, how will sand pushing be used to "feed" the beach. Design and plan for dune and movable shoreline path maintenance during emergencies, coastal erosion and high wave events.

Vegetation management up to the wall of current structures. Evaluate removal of vegetation, dirt fill, irrigation, pool patios. Provide design and cost of replacement in back shore of sand for dune restoration and movable, elevated ADA compliant lateral shoreline access path. Evaluate if this will be public infrastructure or if this area will remain private property with public use allowed?

Response:

A Coastal Engineering Assessment (CEA) was prepared for the proposed Project and will be included in the Draft EIS. The CEA includes a discussion of various alternatives including dune construction.

Comment No. 4:

Restroom and shower

Will these be upgraded? Is this the best location for these amenities considering SLR and coastal erosion?

Evaluate relocation including new location, and costs.

Response:

While the beach restoration action is the primary action proposed and assessed in this EIS, there are related secondary actions (e.g., additional actions that may occur beyond the shoreline area) that may be implemented to further support the Project objectives. Potential secondary actions would be aimed at increasing resiliency and reducing exposure to or risk from climate change and coastal hazards. These secondary actions would be limited to common elements of the KBC property and may include modification or strategic relocation of existing common elements of the KBC property within the Project Site, such as walkways, landscape and hardscape features, and water features. Secondary actions may also include environmental restoration actions or public access improvements within the KBC property or shoreline areas. Secondary actions will be evaluated in the Draft EIS.

Comment No. 5:

Shoreline hardening

Maui Kai seawall - what are the impacts of shoreline hardening at Maui Kai and The Mahana in regards to sand transport between North Ka'anapali littoral cell and Honokowai littoral cell? Please evaluate benefits of removal of shoreline hardening in these cells to the natural coastal environment and beach processes.

What are the impacts to sand transport in the area from shoreline hardening in the Honokowai littoral cell?

If shoreline hardening was removed from both cells what would the be the impact to sand transport?

Response:

The Project Site is located where the shoreline transitions from predominantly sandy beaches, dunes, and unarmored shoreline (south of Honokōwai Point) to predominantly rocky or armored shoreline (north of Honokōwai Point). Shoreline armoring begins approximately 800 feet south of the Project Site and extends approximately 1.15 miles north to Kahana Bay. The shoreline surrounding the Project Site is characterized by engineered structures including seawalls, revetment, hybrid seawall-revetments, and drainage headwalls. Information about existing shore protection structures will be provided in the Draft EIS. It is noted that removal of existing shoreline hardening such as the Maui Kai seawall is beyond the scope of the proposed Project and beyond the authority of the Applicant, West Maui Resort Partners, L.P. As such, removal of these existing structures outside of the Project Site will not be evaluated within the Draft EIS.

Comment No. 6:

Adaptation Pathways

Will you provide funding for a comprehensive community based adaptation pathways project?

Response:

West Maui Resort Partners, L.P. is exploring adaptation pathways to proactively adapt to sea level rise. West Maui Resort Partners, L.P. is presently unaware of comprehensive community-based projects (public or private), but are open to considering the opportunity to participate in such a project.

Comment No. 7:

What is your long term plan? What is life expectancy of your structures? Is regular structural analysis of your buildings being done? Will you provide structural analysis to the public?

Response:

The proposed Project of beach restoration is a mid-term solution for coastal erosion and beach preservation, allowing time for long-range planning and guidance from the State and County for adaptation pathways. A Structural Assessment for the KBC structure was conducted in 2024 and will be included and discussed in the Draft EIS. This report provides detailed geotechnical information and a structural analysis for the Project Site.

Comment No. 8:

What financial considerations have been made to pay for relocation of structures and is there a proposed implementation schedule? What financial considerations/plans/ savings/assessments have been made by the resort for costs associated with SLR and coastal erosion adaptation or relocation?

Response:

As a timeshare resort, a certain percentage of annual maintenance fees are set aside for property reserves. The property maintains a healthy reserve level for regular repairs and maintenance and exploring options for beach restoration. Relocation of structures away from the shoreline, or managed retreat, is a long-term solution that requires further assessment and guidance from State and County governments. The proposed Project is a mid-term solution designed to stabilize the shoreline while long-term adaptation pathways can be assessed.

Comment No. 9:

Beach proposal

Historically, the ocean environment in this area is very dangerous with rip currents, etc. Please research the number of rescues in this area, local knowledge from ocean safety officers, fishermen, surfers, swimmers and long time residents. If you make a pretty beach for tourists that is then more frequently used what is your plan for health and safety? Will a more attractive beach encourage more use of the area? Will you please do a projection on increase of use and by what demographic? Will there be a lifeguard on duty paid for the resort? What kind of education will be provided to guests of resorts and beach users?

Response:

A Coastal and Marine Uses Report was prepared for the proposed Project and will be included and discussed in the Draft EIS. The Draft EIS will include a discussion on ocean safety and the potential impacts of the proposed Project on the nearshore environment.

Comment No. 10:

How do any of the proposed solutions support the landward migration of beaches? Do you acknowledge the need to accommodate the landward migration of beaches? How do your actions demonstrate this?

Response:

The Draft EIS will include a discussion on coastal processes and potential impacts and mitigation measures for the proposed Project. Beach restoration is proposed as a mid-term solution while long-term adaptation strategies can be developed and implemented.

Comment No. 11:

Sand - where from, how much, what is process for providing sand for beach and dune restoration?

Response:

The proposed sand source is an offshore sand deposit located 1.5 miles south of the Project Site. The Sand Recovery Site is approximately 1,500 to 2,000 feet seaward of the shoreline in water depths ranging from 120 to 170 feet. Additional information about the proposed sand source will be provided in the Draft EIS.

Sand would be recovered from the offshore sand deposit via a mechanical dredge system that uses an environmental clamshell bucket. The recovered sand would be transported via barge from the Sand Recovery Site to Kahului Harbor. The sand would be transported via dump trucks from Kahului Harbor to the Project Site. The sand would be placed along the shoreline using heavy equipment (e.g., excavators, dump trucks, and bulldozers). Additional information about the proposed sand recovery, transport, and placement methodology will be provided in the Draft EIS.

Comment No. 12:

What are the impacts to surf breaks, reef, currents, etc?

Response:

The proposed project is beach restoration, which could be accomplished through the Beach Nourishment, Beach Maintenance, or Beach Stabilization alternatives. The specific method of beach restoration has yet to be determined. Beach restoration projects have the potential to impact waves, currents, and marine habitat. Impacts to the nearby surf breaks are anticipated to be minimal per numerical wave modeling. The breaks are located well outside of the Project Site. Additional information about potential impacts to waves, currents, and marine habitat will be provided in the Draft EIS.

Comment No. 13:

Will 2018 temporary erosion control be removed? When? What timeframe is considered temporary?

Response:

The existing temporary erosion skirt is a short-term response to mitigate erosion, negative impacts to water quality, and risks to public health and safety. The structure would be demolished and removed when a mid-term solution can be approved and implemented.

Additional information about the existing temporary erosion skirt will be provided in the Draft EIS.

Comment No. 14:

We request comprehensive coring samples be done for the entire property.

Response:

A Structural Assessment for the KBC structure was conducted in 2024 and will be included and discussed in the Draft EIS. This report provides detailed geotechnical information and a structural analysis for the Project Site.

Comment No. 15:

Please determine where and how much dirt fill was placed on property and provide information on sand availability on the property. In reviewing photos of 2016 event, there are exposed irrigation lines in the shoreline in what appears to be dirt fill.

Response:

The grading plan (C2-2) for the original construction of the property as an Embassy Suites (1986) shows excavation (33,000 cubic yards (cy)) and embankment (15,000 cy). The Draft EIS will include and discuss a Structural Assessment for the KBC structure, which was conducted in 2024.

Comment No. 16:

If permits are approved for any project, will you agree to high quality, multi angle live video monitoring available to the public for the extent of the project and for all future repairs and maintenance?

Response:

For safety, security, and privacy reasons, the Applicant does not monitor active construction sites with live video available to the public. The Applicant currently provides photo monitoring of the site to the Maui Department of Planning. Shoreline conditions on the beach are documented via monthly monitoring reports for KBC pursuant to Condition No. 14 of SSA 2020/0062, which states that "the Kaanapali Beach Club monitor shoreline conditions of its property and submit a report, consisting of dated photographs, documenting such conditions to the Department on the first day of each month, starting upon commencement of the work continuing each month thereafter." The Applicant is willing to continue to provide monthly monitoring reports with photos if requested as conditions of approval for the Project. Photographic monitoring of beach conditions would be conducted at specified intervals to document environmental conditions at the Project Site.

Comment No. 17:

Has the shoreline been certified yearly? Has certification been done at the highest tides of the year when erosion events occurred?

Response:

The shoreline for KBC (Tax Map Key No. (2) 4-4-001:098) has been certified twice since the 2016 erosion event. The 2017 certified shoreline survey was conducted on April 29, 2017. The daily high tide was 3.3 feet. The 2022 certified shoreline survey was conducted on September 7, 2022. The daily high tide was 3.1 feet Tides exceeding 3 feet are statistically the highest tides of the year. The applicant would obtain a certified shoreline, as may be applicable, prior to obtaining a Conservation District Use Permit for the Project.

Comment No. 18:

Citing information below, provided in the EISPN, please provide analysis and justification for proposed beach nourishment going makai approximately 60 feet instead of supporting the landward migration of beaches through implementation of passive public infrastructure such as dunes and wetland restoration with elevated public access more resilient to coastal hazards?

"4.2 Beach Nourishment

Beach Nourishment refers to an individual action (Project) that involves placement of additional sand to increase beach width and sand volume to offset the effects of erosion without modifying existing structures or installing any new structures. Beach nourishment projects are typically not designed to accommodate sea level rise. The design life for beach nourishment projects is typically based on a combination of historical and projected erosion rates. When conducting beach nourishment along coastlines that are subject to chronic and/or episodic erosion, such as Honokōwai Beach, rates of pre-project beach erosion should be expected to continue following a beach nourishment project.

Beach nourishment at Honokōwai Beach is a short-term response that would consist of placing sand directly along the shoreline without any structures to stabilize the sand. The sand would be placed along 1,000 lf of shoreline with a beach crest elevation of +10 ft MSL and a beach slope of 1V:8H (vertical to horizontal). This alternative would require approximately 27,000 cy of sand and would result in approximately 50,000 sf (1.15 acres) of beach area. Average beach width would be approximately 60 feet, which aligns with the 2007 shoreline position. The estimated construction duration for the nourishment effort would be 90 to 180 days. Beach nourishment would be implemented as a single project with an anticipated design life of 8 years. The beach nourishment alternative will be further evaluated and discussed in the Draft EIS."

Response:

The proposed Project is to restore and stabilize the beach at the Project Site. Beach restoration is widely accepted as a nature-based approach to environmental restoration and sea level rise adaptation. Additional information about the project rationale and alternatives to the proposed Project will be provided in the Draft EIS.

Comment No. 19:

Historical Shoreline Change

The University of Hawai'i Coastal Geology Group (CGG) conducted a historical analysis of sandy shorelines on Maui and produced shoreline change maps based on survey data and aerial imagery from 1912 to 2018. Their analysis uses the beach toe as the reference feature to measure changes in the position of the shoreline over time. Since 2018 (the most recent data point in the analysis), most beaches throughout West Maui appear to be experiencing an increase in erosion that appears to exceed the historical rates.

The historical shoreline change trend for Honokōwai Beach (transects 1179 to 1195) from 1912 to 2018 has been erosion at an average rate -0.44 ft/yr (CGG, 2022). The north end of the beach (transects 1190 to 1195) has been eroding at an average rate of -0.33 ft/yr. Erosion has historically been more pronounced along the south end of the beach (transects 1179 to 1184), which have been eroding at an average rate of -0.55 ft/yr.

Response:

Thank you for the information regarding historical shoreline change at Honokōwai Beach. The CEA prepared for the proposed Project includes a discussion of historical shoreline change. The proposed Project is aimed at stabilizing the beach and backshore, to preserve and protect the sandy public beach. The Draft EIS will include a discussion on coastal processes in West Maui, including shoreline change and erosion.

Comment No. 20:

Projected Shoreline Change

Erosion, coastal flooding, and beach loss are expected to continue and accelerate in Hawai'i as sea levels continue to rise. Recent record high water levels and severe erosion events indicate that this acceleration may already be occurring. Anderson et al. (2015) forecasted future coastal change in Hawai'i by combining historical shoreline trends with projected accelerations in sea level rise using the Davidson-Arnott profile model. The analysis found that, due to sea level rise, the average shoreline recession is projected to be nearly twice the historical rates by 2050, and nearly 2.5 times the historical rates by 2100 (Anderson et al. 2015).

The CGG calculated also projected future exposure to erosion and flooding to account for sea level rise (CGG, 2019). The projected shoreline change trend for Honokōwai Beach is erosion ranging from -1.66 to -3.07 ft/yr, which is 4 to 7 times

the historical extrapolation. Based on the CGG erosion projections, without mitigative action, the accelerated erosion caused by sea level rise will likely result in total loss of Honokōwai Beach by mid-century or sooner. ”

Response:

The Draft EIS will include and discuss the CEA that was prepared for the proposed Project. The CEA includes a discussion on erosion, coastal flooding, and beach loss. Additional information on projected shoreline change will be included in the Draft EIS.

Thank you again for your participation in the Chapter 343, Hawai‘i Revised Statutes environmental review process. A copy of your email and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 244-2015.

Very truly yours,

Tessa Ng

Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Michael Cain, Office of Conservation and Coastal Lands
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honokowai

From: A.M. Quinlan <amquinlan9@hotmail.com>
Sent: Monday, December 26, 2022 12:07 PM
To: michael.cain@hawaii.gov; michael.elliott@hgv.com; honokowai
Subject: Fwd: Ho'ala Honokowai EIS Comments

...Forwarded to include additional email addresses...

From: A.M. Quinlan <amquinlan9@hotmail.com>
Sent: Monday, December 26, 2022 11:45 AM
To: michael.caine@hawaii.gov <michael.caine@hawaii.gov>
Subject: Ho'ala Honokowai EIS Comments

It's a fool's errand to battle the ocean because the ocean is always right.

Please do not allow this group to move sand around the beach in a futile effort to protect one portion of it. If taxpayer funds and other resources must be involved, please commit them to a "managed and strategic retreat" of any essential man-made structures (like power, water, and sewage lines) and leave the rest to the ocean.

Thank you for your time.

Ann Marie Quinlan
50 Puu Anoano St, Unit 3903
Lahaina, HI 96761
Phone: 808-280-5458
Email: AMQuinlan9@hotmail.com

https://www.hoalahonokowai.com | T: (808) 244-2015 | E: honokowai@munekiyohiraga.com

October 31, 2025

Via email: amquinlan9@hotmail.com

Ann Marie Quinlan
50 Puu Anoano St, Unit 3903
Lahaina, HI 96761

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Hoʻāla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawaiʻi

Dear Ms. Quinlan:

Thank you for your email dated December 26, 2022 regarding the Hoʻāla Honokōwai Project Environmental Impact Statement (EIS) Preparation Notice. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the comments received.

Comment:

Please do not allow this group to move sand around the beach in a futile effort to protect one portion of it. If taxpayer funds and other resources must be involved, please commit them to a "managed and strategic retreat" of any essential man-made structures (like power, water, and sewage lines) and leave the rest to the ocean.

Response:

We acknowledge your concerns regarding movement of sand on the beach and recognize that managed and strategic retreat considerations are among long-term adaptation pathways for consideration. The objective of the proposed Project is to restore and preserve Honokōwai Beach with a mid-term solution that enables planning for long-term adaptation to sea level rise. We would like to note that the proposed Project would not utilize taxpayer funds and is privately funded.

Thank you again for your participation in the Chapter 343, Hawai'i Revised Statutes environmental review process. A copy of your email and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 244-2015.

Very truly yours,

Tessa Ng

Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Michael Cain, Office of Conservation and Coastal Lands
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honokowai

From: Dave Williams <davewil@mc.net>
Sent: Tuesday, December 27, 2022 10:26 AM
To: honokowai
Subject: Inquiry re: Honokōwai Beach Restoration

Importance: High

Hi,
I am a 25 year owner at Aston Kaanapali Shores and a 40 year resident of Maui.
Why is this project called Honokowai Beach Restoration? I believe this area is part of Kaanapali Beach (North Kaanapali Beach).
North Kaanapali Beach runs from Kaanapali Shores south to Black Rock. South Kaanapali Shores runs from Black Rock to Hyatt Regency Maui.
Honokowai starts north of Honokowai stream which divides Kaanapali Shores and Papakea Resort.

If you believe I am incorrect, could you refer me to documentation that shows this? In 40 years, I have never found anything calling this Honokowai Beach.

Thank you,

David Williams
808 661 9216

https://www.hoalahonokowai.com | T: (808) 244-2015 | E: honokowai@munekiyohiraga.com

October 31, 2025

Via email: davewil@mc.net

David Williams, Owner
Aston Kaʻanapali Shores
Maui Resident

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Hoʻāla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawaiʻi

Dear Mr. Williams:

Thank you for your email dated December 27, 2022 regarding the Hoʻāla Honokōwai Project Environmental Impact Statement (EIS) Preparation Notice. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the comments received.

Comments:

Why is this project called Honokowai Beach Restoration? I believe this area is part of Kaanapali Beach (North Kaanapali Beach).

North Kaanapali Beach runs from Kaanapali Shores south to Black Rock. South Kaanapali Shores runs from Black Rock to Hyatt Regency Maui.

Honokowai starts north of Honokowai stream which divides Kaanapali Shores and Papakea Resort.

If you believe I am incorrect, could you refer me to documentation that shows this? In 40 years, I have never found anything calling this Honokowai Beach.

Response:

The Project Site is referred to as "Honokōwai Beach", which is consistent with the traditional naming conventions for the primary cultural and environmental features in the area. The Project is located in the Honokōwai ahupuaʻa and is bounded by Honokōwai Point (to the south) and Honokōwai Stream (to the north). Honokōwai Beach Park is located ½ mile north of the Project Site. The Project Site is also located within the Honokōwai littoral cell, which extends from Honokōwai Point north to Kahana Bay. Additional information about the Project Site will be provided in the Draft EIS.

Thank you again for your participation in the Chapter 343, Hawai‘i Revised Statutes environmental review process. A copy of your email and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 244-2015.

Very truly yours,

Tessa Ng

Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Michael Cain, Office of Conservation and Coastal Lands
K:\DATA\HGV\KBC Beach Restor\Apps\2EISPN\Resp Ltr\WILLIAMS D.docx

APPENDIX

N-1

PUBLIC SCOPING MEETING MATERIALS

INFORMATIONAL FLYER

HOʻĀLA HONOKŌWAI



Erosion and beach loss in 2016 caused extensive environmental damage and negatively impacted the range of beneficial uses of Honokōwai Beach, causing substantial beach loss, structural damage, risks to public health, safety, and welfare, and impeded access to and along the shoreline. The erosion and discharge of alluvial material (i.e., clay, dirt, and boulders) from the backshore caused the formation of large turbidity plumes that negatively impacted water quality.

West Maui Resort Partners is proposing beach restoration to restore and preserve Honokōwai Beach. The objectives of the Proposed Action are to:

- Restore beach width and improve beach stability;
- Preserve and enhance cultural and shoreline access;
- Increase resilience to coastal hazards and sea level rise; and
- Enable planning for long-term adaptation to sea level rise.

It is anticipated that restoring Honokōwai Beach and preventing further erosion of the backshore will have a positive net beneficial impact on the environment, including preserving the beach and improving water quality. It is also anticipated that beach restoration would help to preserve and enhance the fundamental character of Honokōwai Beach by maintaining shoreline access and supporting existing uses along the shoreline.

An Environmental Impact Statement Preparation Notice (EISPN) has been published in “The Environmental Notice” on December 23, 2022.

Scan QR code for EISPN
or go to link provided below
https://files.hawaii.gov/dbedt/erp/Doc_Library/2022-12-23-MA-EISPN-Hoala-Honokowai.pdf

Scan QR code for Project Website
or go to link provided below

https://www.hoalahonokowai.com/

Comments on the EISPN can be submitted until January 23, 2023 and sent to the following:

Sea Engineering, Inc.
Makai Research Pier
41-305 Kalaniana‘ole Highway
Waimānalo, Hawai‘i 96795
Attention: Ho‘āla Honokōwai

If you have any questions, please contact honokowai@seaengineering.com or call Andy Bohlander, Sea Engineering, Inc., at (808) 259-7966 extension 208.

PRESENTATION

Meeting Agenda

5:00 – 5:30 Town Hall

5:30 – 5:35 Meeting Purpose

5:35 – 6:00 Presentation

6:00 – 7:00 Public Comments

Purpose of the Public Scoping Meeting

- Provide an overview of erosion and beach loss at Honokōwai
- Provide an overview of the EISPN
- Gather feedback on the range of potential actions, alternatives, impacts, and mitigation measures to be evaluated in the Draft EIS
- Provide comments on substantive issues and concerns to be addressed in depth in the Draft EIS



Hoʻāla Honokōwai

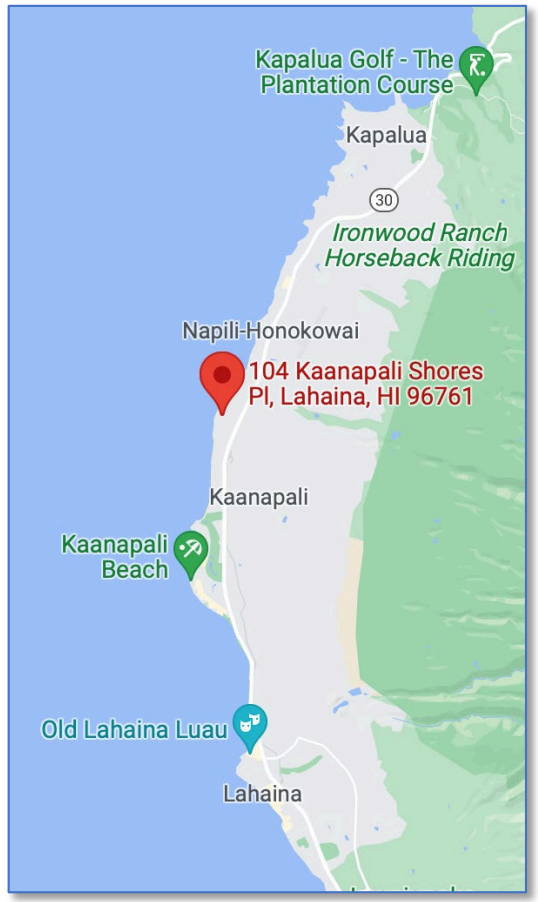
Environmental Impact Statement Preparation Notice (EISPN)

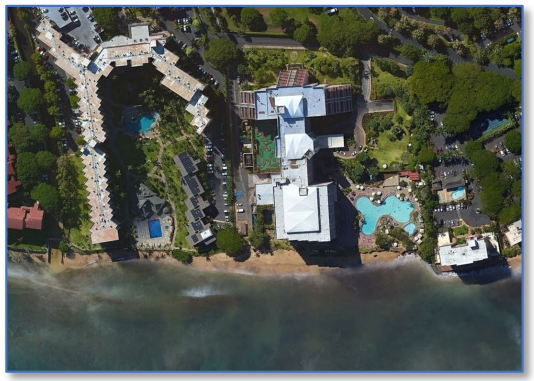
Public Scoping Meeting

January 17, 2023

Location | Honokōwai Beach, Maui, Hawai‘i

Honokōwai Beach has significant natural, social, cultural, recreational, aesthetic, and economic value.





Aerial photograph of Honokōwai Beach (Google Earth, 7/8/2016)



Oblique aerial photograph of Honokōwai Beach (4/8/2021)

Honokōwai Beach is one of the most accessible beaches in this area of West Maui.









Existing Uses| Honokōwai Beach supports various cultural and recreational uses



Public Access, Parking, Restrooms, and Showers



ADA-compliant Lateral Shoreline Access



Traditional and Cultural Practices



Beach and Ocean Recreation

Erosion and Beach Loss at Honokōwai

- Honokōwai Beach is a valuable public resource that provides a unique combination of perpendicular and lateral shoreline access, public amenities (parking, restrooms, showers), and opportunities for cultural practices and ocean-based recreation.

- Honokōwai Beach is a highly dynamic shoreline that is seasonally variable and vulnerable to chronic and episodic erosion and sea level rise.

- In 2016, a combination of persistent Northerly swells and elevated water levels caused severe erosion, beach loss, infrastructure damage, and permanent loss of land.

- In 2018, a temporary erosion control structure was installed as a short-term response to mitigate further erosion until a longer-term solution can be designed and implemented.

Historical Conditions | Until 2016, Honokōwai Beach was a wide stable beach

Stable vegetation





Walking trails

High beach crest





Expansive beach

2016 Beach Loss | Honokōwai Beach was almost entirely lost to erosion

- In 2016, a combination of persistent Northerly swells and elevated water levels produced high waves, strong currents, and abnormally high tides.

- These conditions caused severe erosion, beach loss, infrastructure damage, and permanent loss of land.

5,600 ft^2	1,000+ cy	1,500 ft
land lost permanently	terrestrial sediment (clay and silt) discharged into ocean	turbidity plumes extended offshore

- The North swell transported a large volume of sand south around Honokōwai Point.

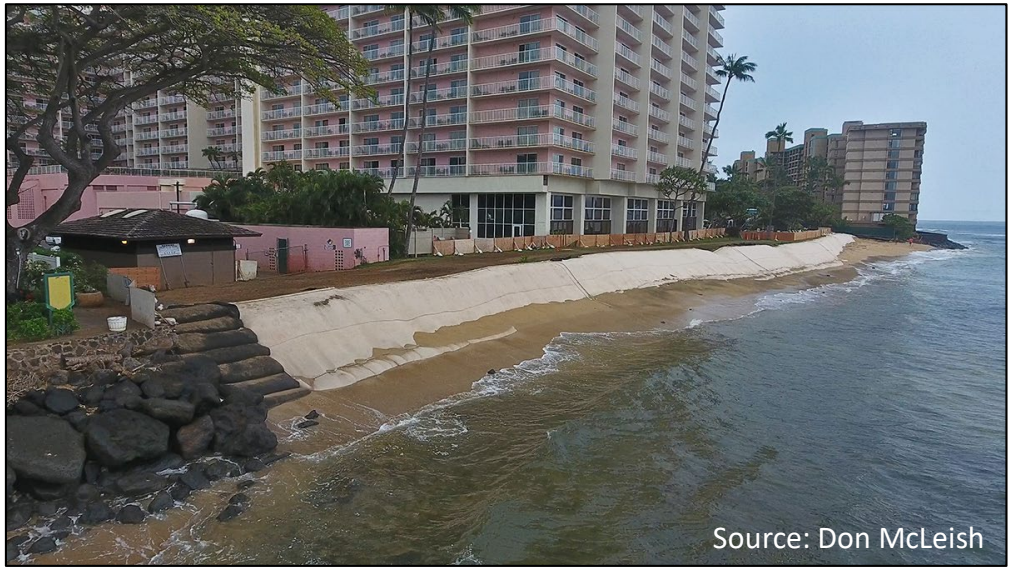
- Since then, South swell has transported some sand back onto Honokōwai Beach.

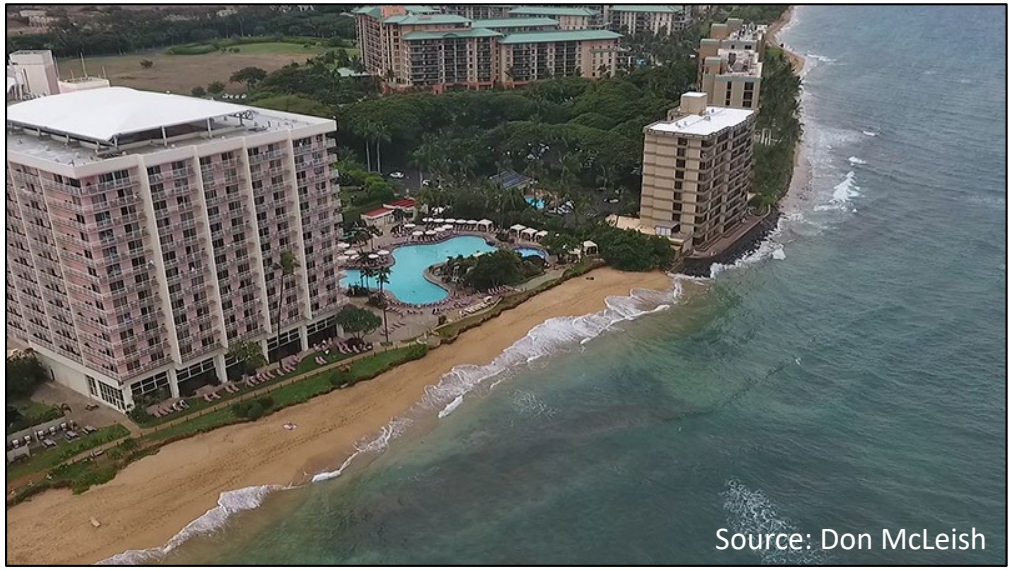
- Today, Honokōwai Beach is significantly narrower, highly unstable, and still vulnerable to erosion.

2016 Beach Loss| Unprecedented erosion and loss of public beach



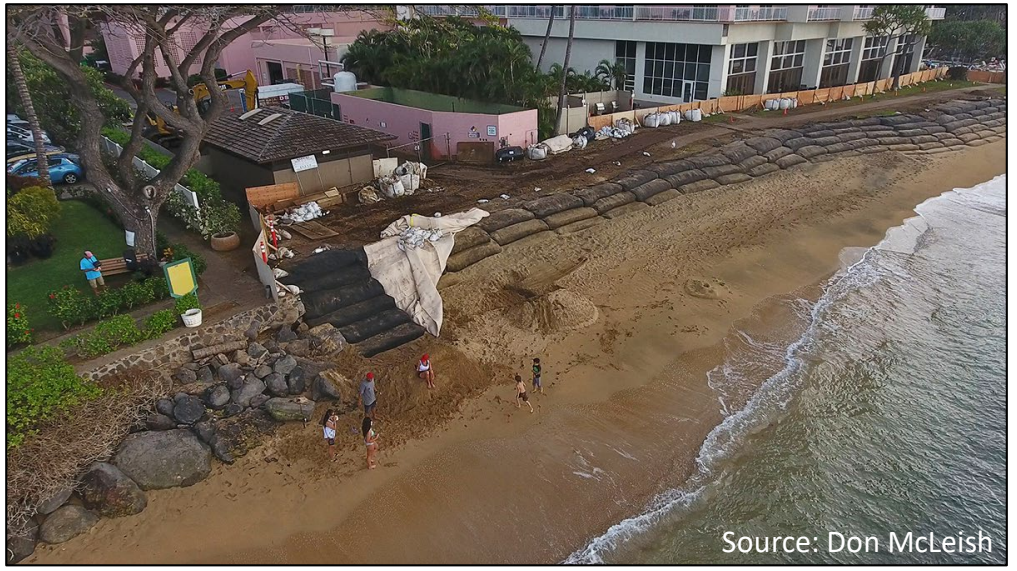






2016 Beach Loss| Loss of shoreline and beach access









2016 Beach Loss| Dangerous beach conditions and risks to public health and safety

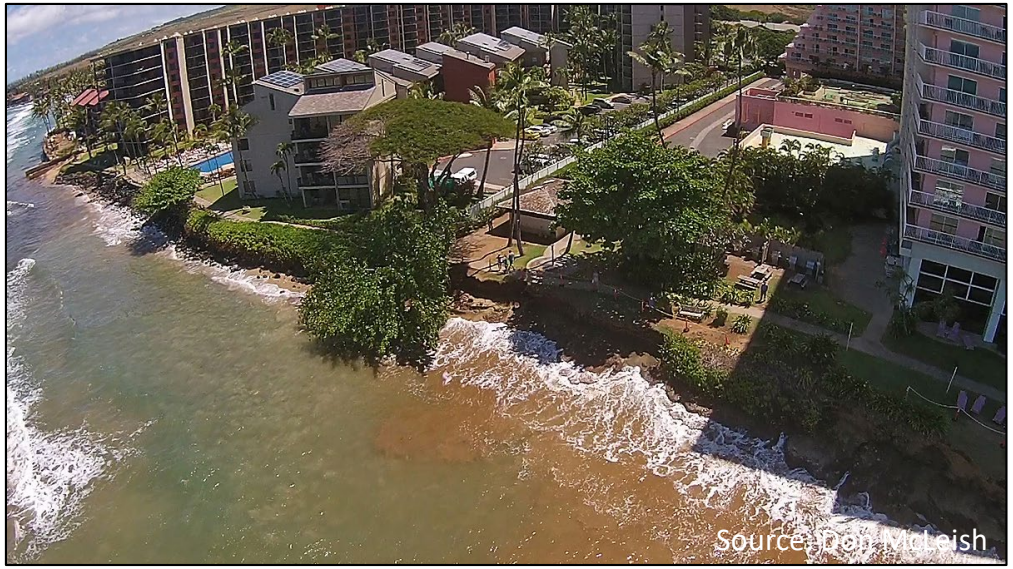




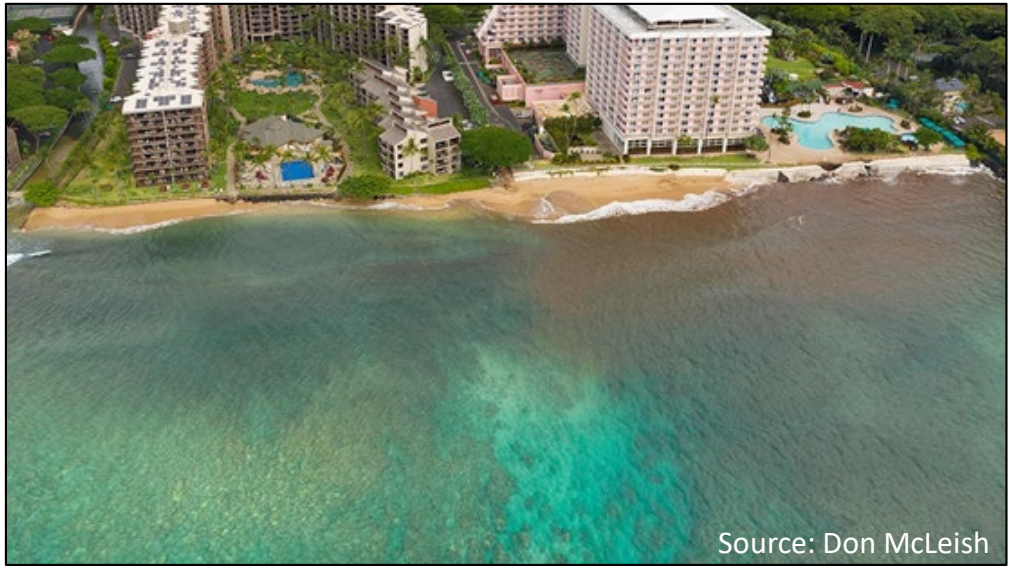




2016 Beach Loss| Turbidity plumes impacted water quality and fishing conditions

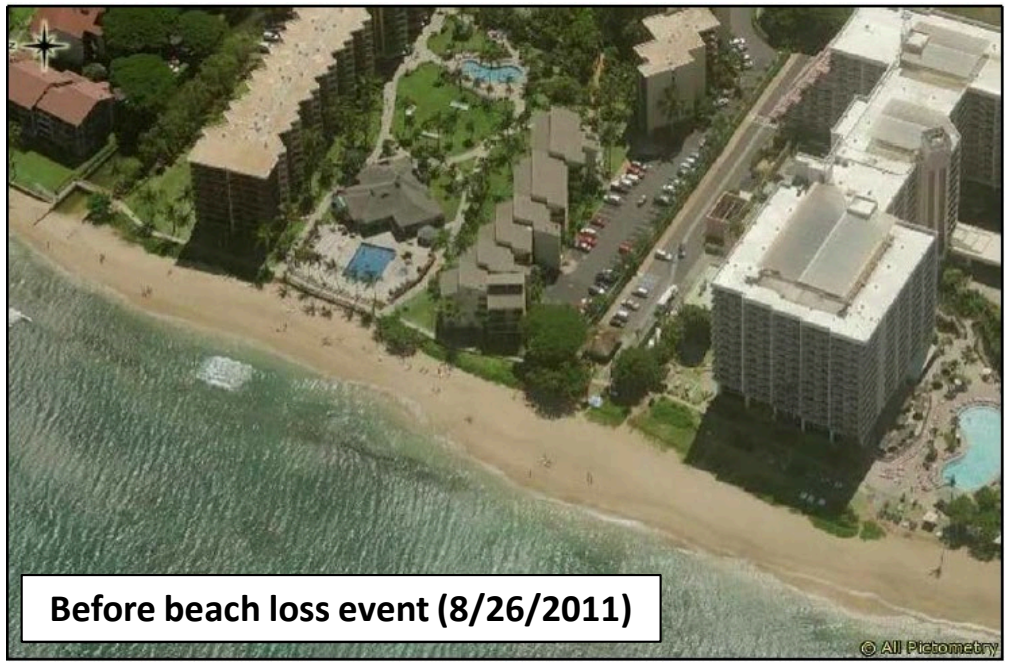








BEFORE 2016 BEACH LOSS (STABLE BEACH)





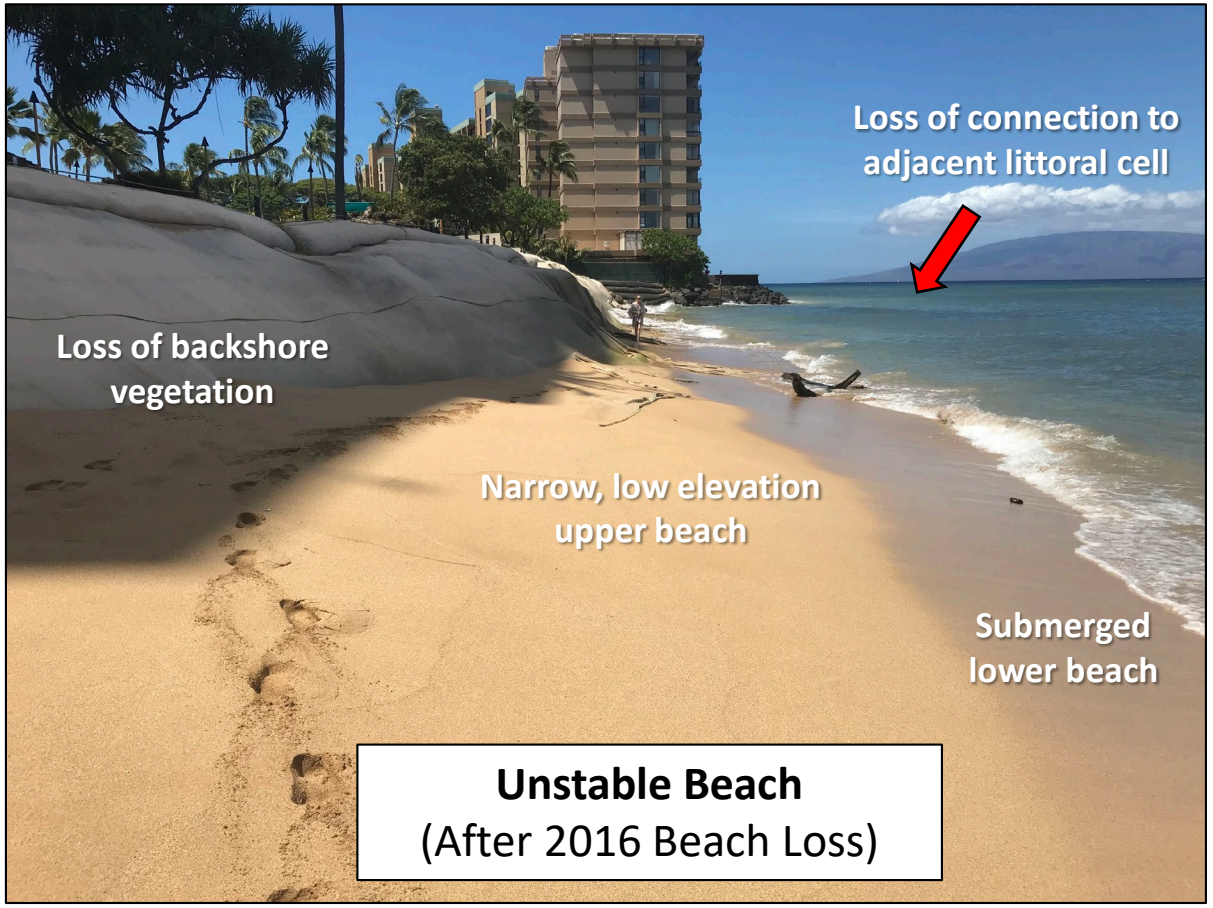
AFTER 2016 BEACH LOSS (UNSTABLE BEACH)





Honokōwai Beach is an Unstable Beach





Honokōwai Beach has limited ability to recover naturally due to loss of connection with Kahekili Beach.

Beach Instability | Honokōwai Beach is narrow, unstable, and vulnerable to erosion.

Benefits of beach stability

- Less sensitive to natural seasonal and event-driven erosional forces.
- Sand volume in the littoral system is not substantially reduced.
- More capable of recovery through natural depositional forces.
- Capable of supporting a variety of uses (access, recreational, cultural practices).

Problems of beach instability

- More sensitive to natural seasonal and event-driven erosional forces.
- Sand volume in the littoral system is substantially reduced.
- Less capable of recovery through natural depositional forces
- Shoreline access, water quality, fishing, cultural practices are negatively impacted

Goals | A balanced, nature-based solution that benefits all

1 Enhance Beach Stability

- Nature-based solution using proven design methodology
- Balanced approach to protect both public and private resources
- Maximizes environmental preservation and public benefits
- Minimizes cumulative impacts, costs, and uncertainties

2 Preserve Cultural and Shoreline Access

- Beach and shoreline access (public parking, public restrooms, showers)
- Cultural access (fishing, traditional and customary practices, etc.)
- Ocean recreation (swim, snorkel, dive, surf, SUP, kitesurf, canoes, etc.)
- ADA-compliant perpendicular and lateral shoreline access

3 Increase Hazard Resilience

- Consistent with State and County recommendations for sea level rise adaptation.
- Beach will be stable and resilient to sea level rise and future erosion
- Beach will provide a natural buffer between the ocean and infrastructure

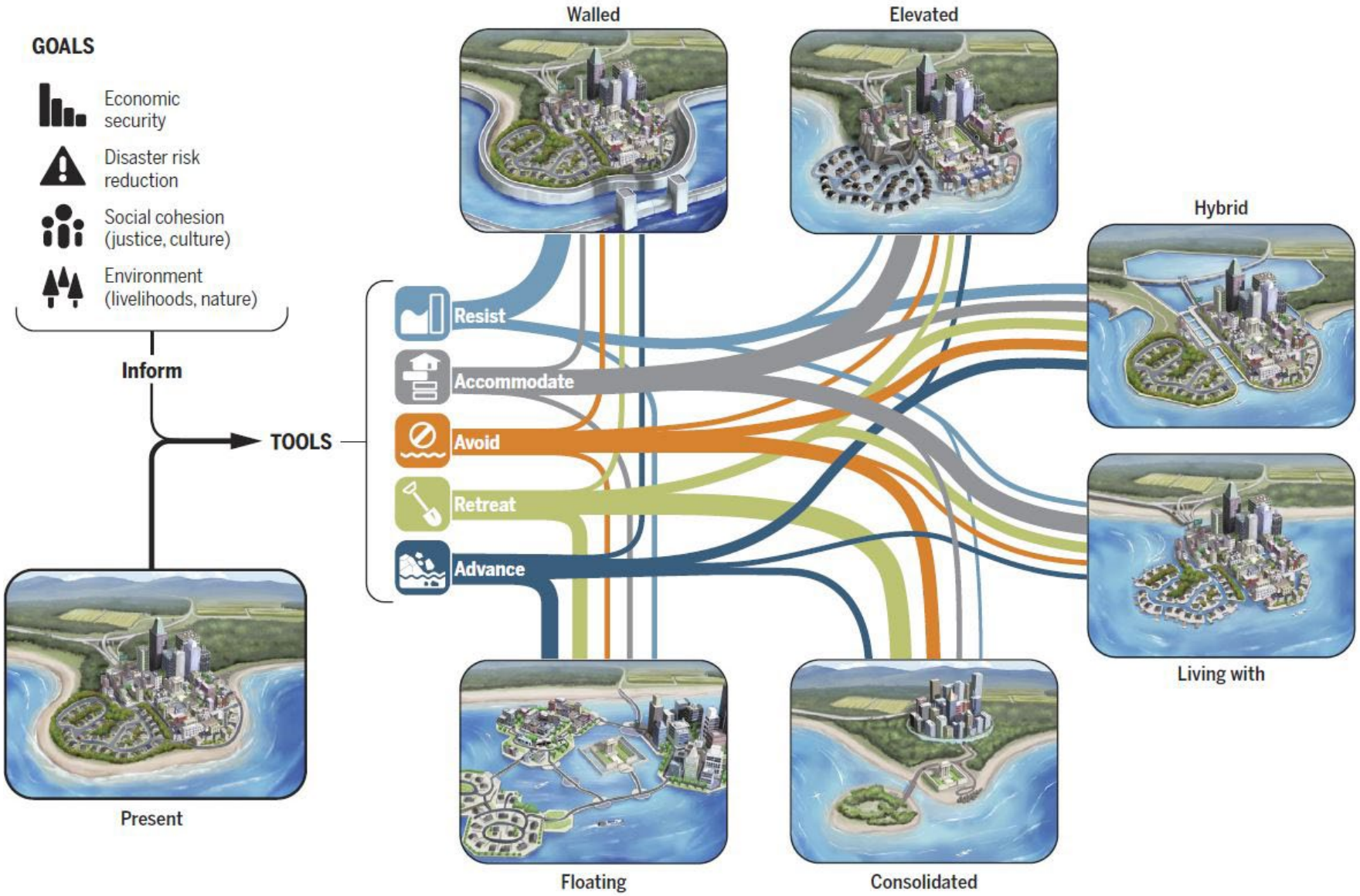
4 Enable Planning for Long-Term Adaptation Solutions Consistent with Forthcoming State and County Guidance

- Enable planning and analysis for long-term adaptation, including strategic realignment, managed retreat, or other accommodation and adaptation strategies
- Incorporate guidance from State Office of Planning and Sustainable and Development on managed retreat and other strategies for adapting to sea level rise.
- Ensure consistency with HRS 205A, Maui General Plan, West Maui Community Plan.

Evaluating Options for Mid-Term Solutions

	SHORT TERM 1-5 YRS		MID TERM OPTIONS (TO BE EVALUATED) 25-50 YRS				LONG TERM >50 YRS
	NO ACTION	**TEMPORARY EROSION CONTROL**	**SHORE PROTECTION**	**BEACH NOURISHMENT**	**BEACH MAINTENANCE**	**BEACH STABILIZATION**	**ADAPTATION PATHWAYS**
DESCRIPTION	Doing nothing will result in further erosion, beach loss, and diminished recreational and cultural access. Does not support recommendations and mandates to manage and anticipate impacts of climate change.	Stop-gap solutions to stabilize the shoreline until the beach recovers, or a long-term solution can be implemented.	Engineered structures installed parallel to the shoreline to mitigate erosion and protect backshore land and infrastructure.	Placement of sand to increase beach width and volume.	Reshapes beaches by transferring sand from lower areas of the beach profile or from adjacent portions of the beach.	Construction of structures to stabilize sand, prevent erosion and beach loss, and protect backshore land and infrastructure.	Long-term solutions may consist of a combination of multiple pathways, including moving existing structures out of the way to allow the shoreline to naturally migrate landward.
POTENTIAL SOLUTIONS	• N/A	• Erosion skirts • Sandbags • Mattresses • Geotubes	• Revetments • Seawalls • Bulkheads	• Single beach nourishment without maintenance, renourishment, or stabilizing structures	• Sand pushing • Sand pumping • Sand backpassing • Recurring beach nourishment without stabilizing structures	• Beach nourishment with stabilizing structures	• Resist / Protect • Accommodate • Avoid • Retreat / Realign • Advance

Long-term Adaptation



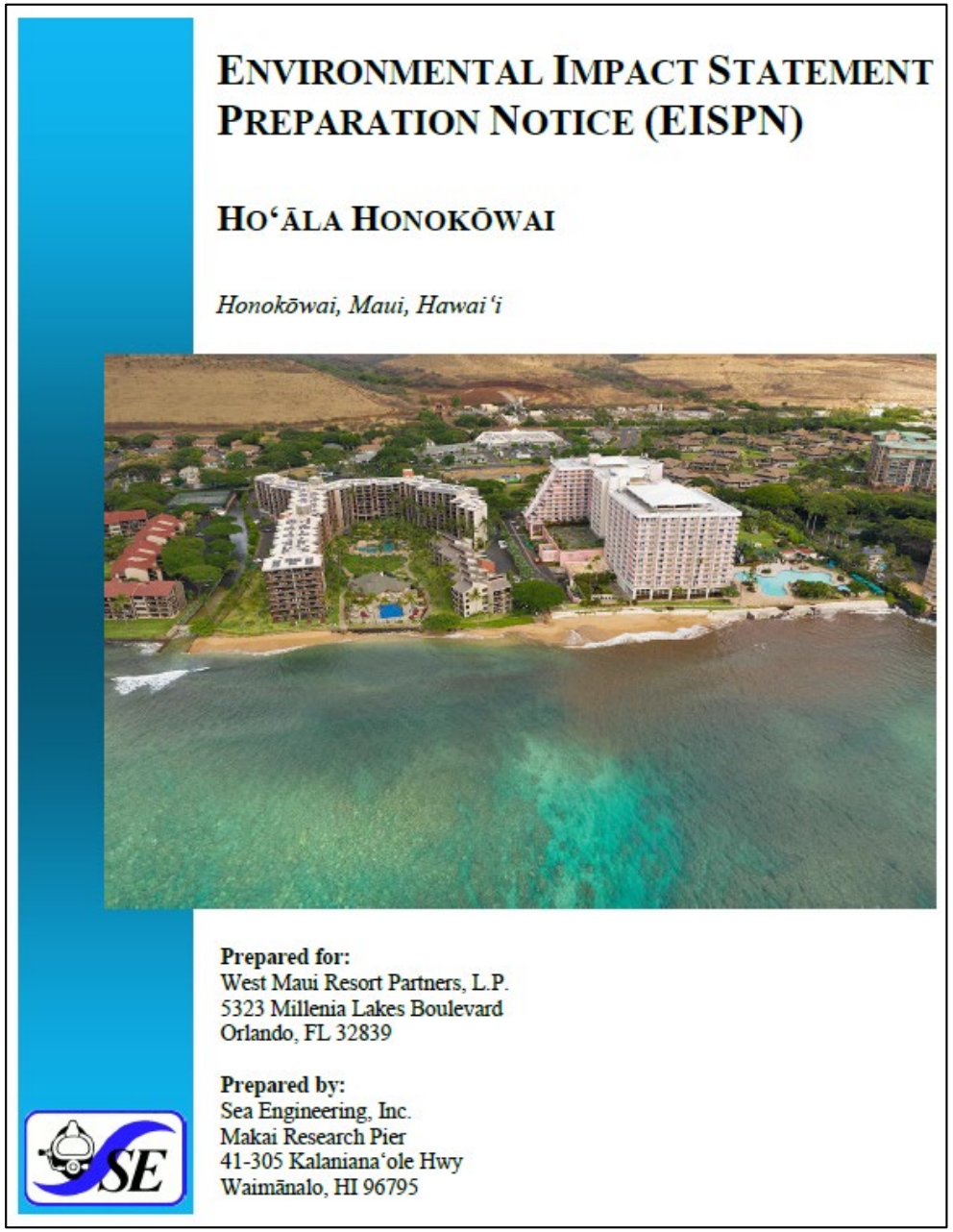

Home
Beach Loss
Beach Restoration
Planning and Public Input
Resources
FAQs
Contact
HOʻĀLA HONOKŌWAI
For additional information, please visit our website
https://www.hoalahonokowai.com/
Beach Loss in West Maui
Learn more about beach loss occurring in West Maui and its impacts.
Beach Restoration
Learn more about the efforts to restore Honokōwai for practitioners, residents, and visitors.
Planning and Public Input
Learn more about planning efforts and how to provide your valued input throughout this process.
Contact Us
Feel free to connect with us!

EISPN Publication

- The EISPN was published on 12/23/2022 in *The Environmental Notice.*

- The EISPN is available on the Environmental Review Program (ERP) website at:

https://files.hawaii.gov/dbedt/erp/Doc_Library/2022-12-23-MA-EISPN-Hoala-Honokowai.pdf


ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

HOʻĀLA HONOKŌWAI

Honokōwai, Maui, Hawaiʻi

Prepared for:
West Maui Resort Partners, L.P.
5323 Millenia Lakes Boulevard
Orlando, FL 32839

Prepared by:
Sea Engineering, Inc.
Makai Research Pier
41-305 Kalanianaʻole Hwy
Waimānalo, HI 96795

Environmental Impact Statement Process



Technical studies will be prepared and included in the EIS

- Cultural Impact Assessment (Honua Consulting, LLC)
- Archaeological Assessment ('Āina Archaeology, LLC)
- Assessment of the Marine Environment (Marine Research Consultants, Inc.)
- Economic and Fiscal Analysis (Environment & Economics, LLC)
- Recreation and Ocean Safety Study (Ian 'Akahi Masterson)

How to comment on the EIS Preparation Notice

1. Complete a comment card at this meeting.
2. Provide oral comments at this meeting.
3. Provide a comment letter to:

Sea Engineering, Inc.
Makai Research Pier
41-305 Kalaniana‘ole Hwy
Waimānalo, HI 96795
Contact: Andy Bohlander
Email: honokowai@seaengineering.com

Deadline to Submit Comments: January 23, 2023

Project Website: https://www.hoalahonokowai.com/

Guidelines for Participation in the Public Comment Portion of the Meeting

- We are here to listen and receive your comments. (We unfortunately cannot respond to questions during the comment section, but you are free to pose questions that will be responded to in the DEIS.)
- The purpose of the meeting is to identify issues to be studies in the EIS.
- No decisions or approvals are being made at this time.
- Effective comments will speak to:
  - The range of potential actions, alternatives, impacts, and mitigation measures to be evaluated in the Draft EIS
  - Substantive issues to be analyzed in depth in the Draft EIS
- Please limit comments to 3 minutes.
- If time permits, individuals may be presented with a second 3-minute comment period after everyone has had an opportunity to speak.
- Additional comments may be submitted in writing.

Scan QR code for EISPN
or go to link provided below

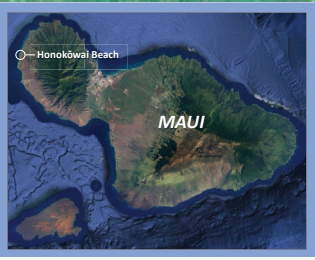
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Scan QR code for Project Website
or go to link provided below

https://www.hoalahonokowai.com/

PRESENTATION
DISPLAY BOARDS





Hoʻāla Honokōwai

2016 EROSION AND BEACH LOSS



Erosion and beach loss



Infrastructure damage and loss of shoreline access



Negative impacts to water quality



Unsafe shoreline conditions

BEFORE AND AFTER



BEACH INSTABILITY





Benefits of beach stability

- Less sensitive to natural seasonal and event-driven erosional forces.
- Sand volume in the littoral system is not substantially reduced
- More capable of recovery through natural depositional forces
- Supports a variety of uses (access, recreational, cultural practices)

Problems of beach instability

- More sensitive to natural seasonal and event-driven erosional forces.
- Sand volume in the littoral system is substantially reduced.
- Less capable of recovery through natural depositional forces
- Negative impacts to shoreline access, water quality, cultural practices

WRITTEN COMMENTS RECEIVED AT PUBLIC SCOPING MEETING AND RESPONSES TO SUBSTANTIVE COMMENTS

APPENDIX

N-2

Sea Engineering, Inc.
Makai Research Pier • 41-305 Kalaniana'ole Hwy • Waimānalo, Hawai'i 96795-1820
Phone: (808) 259-7966 • Website: www.seaengineering.com

COMMENT FORM

HO'ALA HONOKOWAI

Public Scoping Meeting

Tuesday, January 17, 2023 at 5:00 p.m.

Date 1/17/23 Phone No.: 651-587-1249

Name: James Bell

Address: 3833 L. Honoapiilani Rd

Email Address: mjtobybell@aol.com

Please write any comments you wish to share on the proposed project below:

Honokowai Park – This Park is used by many residents makai of the lower road. The beach has deteriated over the years. Sand replenishment is needed.

Please submit your comments by **January 23, 2023** via mail to:

Sea Engineering, Inc.
Makai Research Pier
41-305 Kalaniana‘ole Highway
Waimānalo, Hawai‘i 96795
Attention: Ho‘āla Honokōwai

or via email to honokowai@seaengineering.com

You may download a copy of the Environmental Impact Statement Preparation Notice at: https://files.hawaii.gov/dbedt/erp/Doc_Library/2022-12-23-MA-EISPN-Hoala-Honokowai.pdf

Should you have any questions, please contact Andy Bohlander, Sea Engineering, Inc., at (808) 259-7966 extension 208.

Sea Engineering, Inc.
Makai Research Pier • 41-305 Kalaniana'ole Hwy • Waimānalo, Hawai'i 96795-1820
Phone: (808) 259-7966 • Website: www.seaengineering.com

COMMENT FORM

HO'ĀLA HONOKŌWAI

Public Scoping Meeting

Tuesday, January 17, 2023 at 5:00 p.m.

Date: 1/17/23 Phone No.: 651-587-1249

Name: JAMES BELL

Address: 3833 L. HONOAPIILANI RD

Email Address: mjtobybell@aol.com

Please write any comments you wish to share on the proposed project below:

HONOKOWAI PARK - THIS PARK IS USED BY MANY RESIDENTS MAKAI OF THE LOWER ROAD. THE BEACH HAS DETERIATED OVER THE YEARS. SAND REPLENISHMENT IS NEEDED.

Please submit your comments by **January 23, 2023** via mail to:

Sea Engineering, Inc.
Makai Research Pier
41-305 Kalaniana'ole Highway
Waimānalo, Hawai'i 96795
Attention: Ho'āla Honokōwai

or via email to honokowai@seaengineering.com

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Should you have any questions, please contact Andy Bohlander, Sea Engineering, Inc., at (808) 259-7966 extension 208.

https://www.hoalahonokowai.com | T: (808) 536-3603 ext. 208 | E: honokowai@seaengineering.com

October 31, 2025

Via email: mjtobybell@aol.com

James Bell
3833 L. Honoapiʻilani Road
Lahaina, Hawaiʻi 96761

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Hoʻāla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawaiʻi

Dear Mr. Bell:

Thank you for your comment dated January 17, 2023 regarding the Hoʻāla Honokōwai Project. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the comments received.

Comment:

Honokowai Park – This Park is used by many residents makai of the Lower Road. The beach has deteriated over the years. Sand replenishment is needed.

Response:

We note that the Project Site is approximately half a mile south of Honokōwai Beach Park. No impacts are anticipated at Honokōwai Beach Park as this is outside the Project Site.

Thank you again for your participation in the Chapter 343, Hawaiʻi Revised Statutes environmental review process. A copy of your comment form and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 983-1233.

Very truly yours,

Tessa Ng

Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Michael Cain, Office of Conservation and Coastal Lands
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Sea Engineering, Inc.
Makai Research Pier • 41-305 Kalaniana'ole Hwy • Waimānalo, Hawai'i 96795-1820
Phone: (808) 259-7966 • Website: www.seaengineering.com

COMMENT FORM

HO'ALA HONOKOWAI

Public Scoping Meeting

Tuesday, January 17, 2023 at 5:00 p.m.

Date 1/17/2023 Phone No.: 8084190034

Name: Michelle Lelle

Address: 3666 L. Honoapiilani

Email Address: aloha@honolua.org

Please write any comments you wish to share on the proposed project below:

- Please specify if the 250 Building project is tied to the approval of this project
- Please ask if you can save the trees falling into the ocean prior to whatever plan is approved. They are going to die before the study has a chance to be approved
- Please consider Artificial Reef
- The sand moving is not good for the reef

Please submit your comments by **January 23, 2023** via mail to:

Sea Engineering, Inc.
Makai Research Pier
41-305 Kalaniana‘ole Highway
Waimānalo, Hawai‘i 96795
Attention: Ho‘āla Honokōwai

or via email to honokowai@seaengineering.com

You may download a copy of the Environmental Impact Statement Preparation Notice at: https://files.hawaii.gov/dbedt/erp/Doc_Library/2022-12-23-MA-EISPN-Hoala-Honokowai.pdf

Should you have any questions, please contact Andy Bohlander, Sea Engineering, Inc., at (808) 259-7966 extension 208.

Sea Engineering, Inc.
Makai Research Pier • 41-305 Kalaniana'ole Hwy • Waimānalo, Hawai'i 96795-1820
Phone: (808) 259-7966 • Website: www.seaengineering.com

COMMENT FORM

HO'ĀLA HONOKŌWAI

Public Scoping Meeting

Tuesday, January 17, 2023 at 5:00 p.m.

Date: 1-17-2023 Phone No.: 8084190031

Name: Michelle Lelle

Address: 3lelele L. Honoapiilani

Email Address: aloha@honolua.org

Please write any comments you wish to share on the proposed project below:

- Please Specify if the 250 Building project is tied to the approval of this Project
- Please ask if you can save the trees falling into the ocean prior to whatever Plan is approved. They are going to die before the Study has a chance to be approved
- Please consider Artificial Reef
- The Sand moving is not good for the Reef

Please submit your comments by **January 23, 2023** via mail to:

Sea Engineering, Inc.
Makai Research Pier
41-305 Kalaniana'ole Highway
Waimānalo, Hawai'i 96795
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https://www.hoalahonokowai.com | T: (808) 536-3603 ext. 208 | E: honokowai@seaengineering.com

October 31, 2025

Via email: aloha@honolua.org

Michelle Lelle
3666 L. Honoapiʻilani
Lahaina, Hawaiʻi 96761

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Hoʻāla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawaiʻi

Dear Ms. Lelle:

Thank you for your comment dated January 17, 2023 regarding the Hoʻāla Honokōwai Project. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the comments received.

Comment No. 1:

Please specify if the 250 Building project is tied to the approval of this project

Response:

The Proposed Action is beach restoration and is unrelated to any building projects.

Comment No. 2:

Please ask if you can save the trees falling into the ocean prior to whatever plan is approved. They are going to die before the study has a chance to be approved.

Response:

The trees and vegetation along the shoreline at the Project Site are currently stable and not falling into the ocean.

Comment No. 3:

Please consider Artificial Reef

Response:

The Proposed Action does not include construction of an artificial reef. A number of alternatives were evaluated for this project. These alternatives will be discussed in the Draft EIS.

Comment No. 4:

The sand moving is not good for the Reef

Response:

A Coastal Engineering Assessment (CEA) was prepared and assesses various coastal conditions, including sand transport characteristics. The CEA will be included and discussed in the Draft EIS.

Thank you again for your participation in the Chapter 343, Hawai'i Revised Statutes environmental review process. A copy of your comment form and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 983-1233.

Very truly yours,

Tessa Munekiyo Ng, AICP
Vice President
Munekiyo Hiraga

TMN:ab
cc: Michael Elliott, West Maui Resort Partners, L.P.
Tyler Middleton, Hilton Grand Vacations, Inc.
Michael Cain, Office of Conservation and Coastal Lands
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Sea Engineering, Inc.
Makai Research Pier • 41-305 Kalaniana'ole Hwy • Waimānalo, Hawai'i 96795-1820
Phone: (808) 259-7966 • Website: www.seaengineering.com

COMMENT FORM

HO'ALA HONOKOWAI

Public Scoping Meeting

Tuesday, January 17, 2023 at 5:00 p.m.

Date January 17, 2023 Phone No.: 571 330 0626

Name: Kevin Wilshere

Address: 3833 Lower Honoapiilani Road, C205

Lahaina, HI 96761

Email Address: Kwilshere@me.com

Please write any comments you wish to share on the proposed project below:

As discussed, Honokowai is a very important & interconnected area within West Maui. What happens at the south end of Honokowai has consequences up to Kuleana at least, & vice-versa. Especially with the Honokowai Master Plan, the community has a vested interest in this application, & in particular making sure that a comprehensive approach to preserving & enhancing beach shoreline throughout Honokowai is reached. I would strongly recommend that this plan be coordinated with the Master Plan to reach a holistic solution.

Please submit your comments by **January 23, 2023** via mail to:

Sea Engineering, Inc.
Makai Research Pier
41-305 Kalaniana‘ole Highway
Waimānalo, Hawai‘i 96795
Attention: Ho‘āla Honokōwai

or via email to honokowai@seaengineering.com

You may download a copy of the Environmental Impact Statement Preparation Notice at: https://files.hawaii.gov/dbedt/erp/Doc_Library/2022-12-23-MA-EISPN-Hoala-Honokowai.pdf

Should you have any questions, please contact Andy Bohlander, Sea Engineering, Inc., at (808) 259-7966 extension 208.

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https://www.hoalahonokowai.com | T: (808) 536-3603 ext. 208 | E: honokowai@seaengineering.com

October 7, 2025

Via email: kwilshere@me.com

Kevin Wilshere
3833 Lower Honoapiʻilani Road, C205
Lahaina, Hawaiʻi 96761

SUBJECT: Response to Environmental Impact Statement Preparation Notice Comments Regarding the Hoʻāla Honokōwai Project, Tax Map Keys (2) 4-4-001:097, 098, and 100, Lāhainā, Maui, Hawaiʻi

Dear Mr. Wilshere:

Thank you for your comment dated January 17, 2023 regarding the Hoʻāla Honokōwai Project. On behalf of West Maui Resort Partners, L.P. (Applicant), we offer the following information in response to the comments received.

Comment No. 1:

As discussed, Honokowai is a very important + interconnected area within West Maui. What happens at the south end of Honokowai has consequences up to Kuleana at least, + vice-versa. Especially with the Honokowai Master Plan, the community has a vested interest in the application, + enhancing beach shoreline throughout Honokowai is reached. I would strongly recommend that this plan be coordinated with the Master Plan for reach a holistic solution.

Response:

Thank you for your comments regarding Honokowai. The Honokowai Master Plan proposed by the Department of Hawaiian Home Lands is located approximately 2,000 feet from the Project Site. The DHHL was provided a copy of the EIS Preparation Notice and will receive the Draft EIS. In addition, it is noted that the Draft EIS will include an analysis of cumulative impacts associated with the proposed Project and other reasonably foreseeable actions.

Thank you again for your participation in the Chapter 343, Hawai‘i Revised Statutes environmental review process. A copy of your comment form and this response will be included in the Draft EIS for this project. If additional clarification is required, please contact me at (808) 983-1233.

Very truly yours,

Tessa Ng

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