FILE COPY
SEP 23 2017

DAVID Y. IGE
GOVERNOR

CRAIG K. HIRAI
EXECUTIVE DIRECTOR

In reply, refer to:

17: DEV/083

STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
HAWAII HOUSING FINANCE AND DEVELOPMENT CORPORATION
677 QUEEN STREET, SUITE 300
HONOLULU, HAWAII 96813
FAX: (808) 587-0600

September 13, 2017

Mr. Scott Glenn, Director
Office of Environmental Quality Control
Department of Health, State of Hawaii
235 South Beretania Street, Room 702
Honolulu, Hawaii 96813

RECEIVED
'17 SEP 13 A11:53
OFC. OF ENVIRONMENTAL QUALITY CONTROL

Dear Mr. Glenn:

SUBJECT: PROPOSED WAILUKU APARTMENT RENTAL HOUSING PROJECT LOCATED AT WAIALE ROAD, WAILUKU, ISLAND OF MAUI, HAWAII, TMK: (2) 3-5-001:064

With this letter, Hawaii Housing Finance and Development Corporation ("HHFDC"), hereby transmits the Draft Environmental Assessment (EA) and Anticipated Findings of No Significant Impact (DEA-AFONSI) for the proposed Wailuku Apartment Rental Housing Project situated at TMK (2)3-5-001:064, in the Wailuku District on the island of Maui for publication in the next available edition of the Environmental Notice.

Enclosed is a completed OEQC Publication Form, two copies of the DEA-AFONSI, an Adobe Acrobat PDF file of the same, and an electronic copy of the publication form in MS WORD. Simultaneous with this letter, we have submitted the summary of the action in a text file by electronic mail to your office.

Thank you for your cooperation. If there are any questions, please contact Ken Takahashi, Project Manager at 587-0527.

Sincerely,

CRAIG HIRAI
Director

Attachments
xc: Linda Schatz
Vince G. Bagoyo, Jr., Bagoyo Development Group
Legacy Wailuku, LLC

18.155

APPLICANT
PUBLICATION FORM

Project Name:	Wailuku Apartment Rental Housing Project
Project Short Name:	Wailuku Apartment Renal Housing Project Draft EA
HRS §343-5 Trigger(s):	Propose any amendments to existing county general plans where the amendment would result in designations other than agriculture, conservation, or preservation
Island(s):	Maui
Judicial District(s):	Wailuku
TMK(s):	(2) 3-5-001:064
Permit(s)/Approval(s):	201H-38, HRS
Proposing/Determining Agency:	Hawaii Housing Finance Development Corporation (HHFDC)
Contact Name, Email, Telephone, Address	Mr. Ken Takahashi, ken.t.takahashi@hawaii.gov Tel. No. (808) 587-0547; Address: 677 Queen St., Room 300, Honolulu, HI 96813
Accepting Authority:	(for EIS submittals only)
Contact Name, Email, Telephone, Address	
Consultant:	V. Bagoyo Development Consulting Group, LLC
Contact Name, Email, Telephone, Address	Vince Bagoyo; Email: vbagoyo-devgroup@hawaii.rr.com Tel. No. (808) 357-3842; Address: 1500 Kilinoe Pl., Wailuku, HI 96793

Status (select one)	**Submittal Requirements**
__x__ DEA-AFNSI	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEA, and 4) a searchable PDF of the DEA; a 30-day comment period follows from the date of publication in the Notice.
____ FEA-FONSI	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; no comment period follows from publication in the Notice.
____ FEA-EISPN	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; a 30-day comment period follows from the date of publication in the Notice.
____ Act 172-12 EISPN ("Direct to EIS")	Submit 1) the proposing agency notice of determination letter on agency letterhead and 2) this completed OEQC publication form as a Word file; no EA is required and a 30-day comment period follows from the date of publication in the Notice.
____ DEIS	Submit 1) a transmittal letter to the OEQC and to the accepting authority, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEIS, 4) a searchable PDF of the DEIS, and 5) a searchable PDF of the distribution list; a 45-day comment period follows from the date of publication in the Notice.
____ FEIS	Submit 1) a transmittal letter to the OEQC and to the accepting authority, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEIS, 4) a searchable PDF of the FEIS, and 5) a searchable PDF of the distribution list; no comment period follows from publication in the Notice.
____ FEIS Acceptance Determination	The accepting authority simultaneously transmits to both the OEQC and the proposing agency a letter of its determination of acceptance or nonacceptance (pursuant to Section 11-200-23, HAR) of the FEIS; no comment period ensues upon publication in the Notice.
FEIS Statutory Acceptance	Timely statutory acceptance of the FEIS under Section 343-5(c), HRS, is not applicable to agency actions.
____ Supplemental EIS Determination	The accepting authority simultaneously transmits its notice to both the proposing agency and the OEQC that it has reviewed (pursuant to Section 11-200-27, HAR) the previously accepted FEIS and determines that a supplemental EIS is or is not required; no EA is required and no comment period ensues upon publication in the Notice.

____ Withdrawal Identify the specific document(s) to withdraw and explain in the project summary section.

____ Other Contact the OEQC if your action is not one of the above items.

Project Summary
Provide a description of the proposed action and purpose and need in 200 words or less.

The applicant is requesting approval of its 201H, HRS application for its proposed affordable workforce housing project consisting of 324 apartment rental units on approximately 14.416 acres located in the State Ag district along Waiale Road, Wailuku, Island of Maui, Hawaii. The proposed workforce apartment rental housing project application will be processed pursuant to 201H-38, Hawaii Revised Statutes (HRS). 60 percent of the total project units will be made available to qualified individuals earning within the 80% to 140% of Maui's Area Median Income (AMI) per Hawaii Housing Finance and Development Corporation's affordable housing rent guidelines. The remaining 40% of the total project units will be unrestricted. The proposed project consists of 9 apartment buildings, with maximum height of 38'. The project also includes related improvements such as grading, construction of internal roadways, utilities, and resident amenities such as a recreation center with swimming pool and children's play areas..

Draft Environmental Assessment

WAILUKU APARTMENT RENTAL HOUSING PROJECT & RELATED IMPROVEMENTS

Pursuant to Section 201H-38, Hawaii Revised Statutes (HRS)
Located at Waiale Road, Wailuku, Hawaii, Island of Maui
TMK: (2) 3-5-001:064

Prepared for: Legacy Wailuku, LLC
Prepared by: Bagoyo Development Consulting Group
1500 Kilinoe Place, Wailuku, Maui, Hawaii 96793
(808) 357-3842 | vbagoyo-devgroup@hawaii.rr.com

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I. Preface

The proposed project is located at **Waiale Road, Wailuku, Maui, Hawaii** identified as **TMK: (2) 3-5-001:064**. The subject property consists of approximately 14.416 acres and falls just outside of the Kehalani Master Plan.

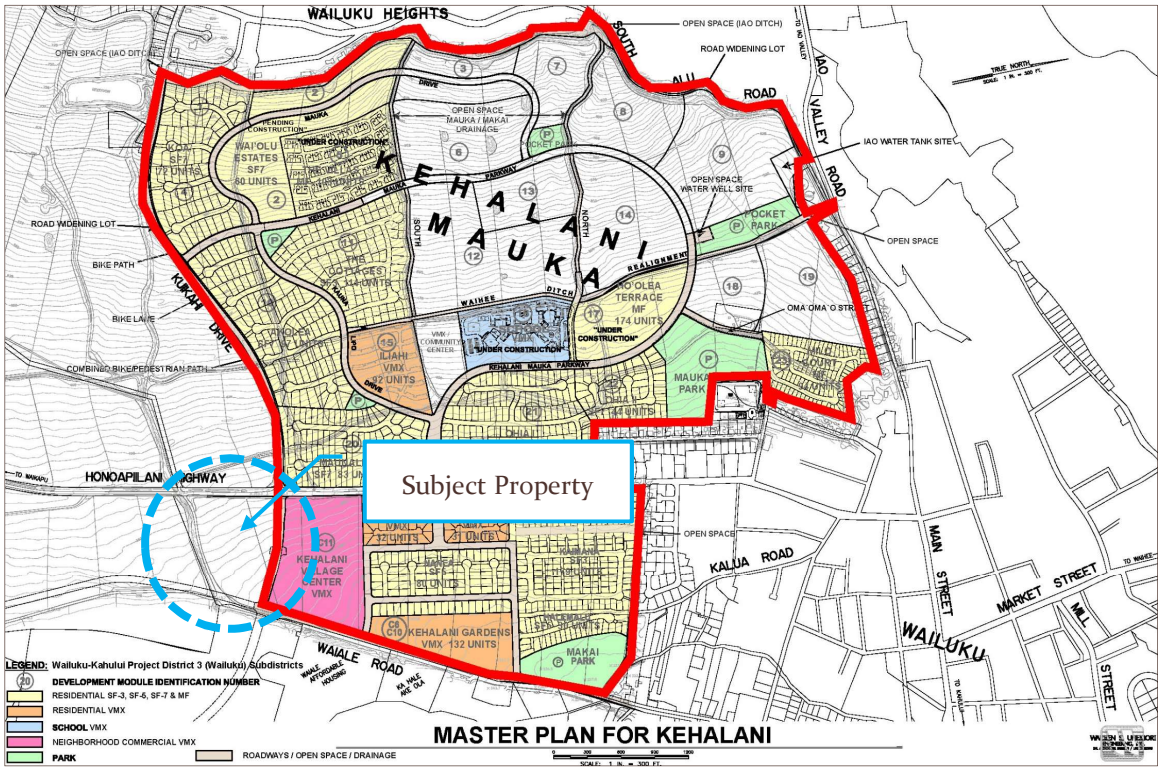

Figure 1: Map showing location of subject property just outside the Kehalani Master Plan boarded by Honoapiilani Highway, Kuikahi Drive, and Waiale Road.

Legacy Wailuku LLC ("Applicant") is proposing to develop 324 affordable and market rate apartment units pursuant to Section 201H-38, Hawaii Revised Statutes (HRS). The proposed development will consist of 60% affordable apartment units (195 units) and 40% unrestricted units (129 units) priced to the market. This ratio of 60% affordable units that are restricted and 40% unrestricted units allows the developer to cross subsidize the affordable rentals without direct government subsidies to ensure the project is financeable.

The affordability breakdown of the affordable units also meets Maui County Codes' 2.96 requirements for income group distribution.[1]

Area Median Income (AMI) Level*	Income Group	Units	% of Units
80% to 100% AMI	Low Income	55	17%
101% to 120% AMI	Below-moderate Income	55	17%
121% to 140%	Moderate Income	85	26%
Total		**195**	**60%**

*Based on HHFDC's Maui median income levels

The Applicant envisions a rental community that meets Maui's housing needs with safe, attractive, quality housing for its essential workers and families. The rental community will provide residential amenities such as a recreation center with swimming pool and four children's play areas to provide a safe and fulfilling environment. Roughly about 40% of Maui's population are renters and the need for quality rentals are in great demand often with many rental communities with a long wait lists of applicants. Legacy Wailuku LLC hopes to answer this need in the Wailuku area. Census data shows that the population growth for Maui from 2010 to 2015 was 9.5% which is higher than the overall state at 7.35%. DBEDT projects a steady growth for Maui of 7.7% for each 5-year period from 2015-2040.

The project will be developed under the Section 201H-38, HRS and 195 affordable apartment units will be priced to families making 80% to 140% of Maui County's median family income pursuant to Hawaii Housing Finance and Development Corporation's (HHFDC) Affordable Rent Guidelines. The Applicant, in coordination with the HHFDC, will seek exemptions from certain statutes, ordinances, charter provisions, and rules relating to planning, zoning, construction standards for subdivisions, development and improvement of land, and the construction of dwelling units thereon as provided by Section 201H-38, Hawaii Revised Statutes. These exemptions requested by the Applicant will be processed through HHFDC with approval to be granted by the Maui County Council.

Since the property is within the State Land Use Agricultural District, with this Section 201H-38, HRS application Legacy Wailuku, LLC ("Applicant") is also requesting that the Maui County Council approve a State Land Use District Boundary Amendment pursuant to Section 205-3.1, HRS and Section 19.68.040, Maui County Code (MCC) to reclassify the approximately 14.416 acres of the subject property for the proposed workforce apartment rental project from the State Agricultural District to the State Land Use Urban District.

[1] Maui County Code 2.96.040 - https://library.municode.com/hi/county_of_maui/codes/code_of_ordinances?nodeId=TIT2ADPE_CH2.96REWOHOPO_2.96.040REWOHORE

This environmental assessment (EA) is prepared pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and in compliance with the requirement by HHFDC for the processing of Applicant's Section 201H-38, HRS application for the proposed Wailuku Apartment Rental housing project and related improvements. Accordingly, this report documents the proposed action and addresses potential impacts and mitigation measures anticipated in connection with the implementation of the proposed workforce apartment housing project.

This draft Environmental Assessments provides a basis for review and comment by agencies and the public on the proposed Wailuku Workforce Apartment project.

II. Project Profile

Project Name:	Wailuku Workforce Apartments
Type of Document:	Draft Environmental Assessment (EA) and Section 201H-38, HRS Application
Accepting Agency for Environmental Assessment:	Hawaii Housing Finance & Development Corporation 677 Queen Street Honolulu, Hawaii 96813 Contact: Mr. Craig Hirai, Executive Director Phone: (808) 586-0620
Approving Authority for Section 201H-38, HRS:	Maui County Council
Location:	TMK: (2) 3-5-001:064 Waiale Road, Wailuku Island of Maui, Hawaii
Recorded Fee Owner:	Kehalani Agricultural Investors, LLC c/o PCCP, LLC 555 California St., Suite 3450 San Francisco, CA 94104 Attn: Phil Russick Phone: (916) 952-5600
Developer/Applicant:	Legacy Wailuku LLC 1111 Third Avenue, #2850 Seattle, WA 98101 Contact: Ms. Linda Schatz Phone: (808) 428-8717
Agent/Preparer:	V. Bagoyo Development Consulting Group, LLC 1500 Kilinoe Place Wailuku, Hawaii 96793 Contact: Vince G Bagoyo, Jr. Phone: (808) 357-3842
Existing Land Use Designations:	State Land Use District – *Agriculture* County Zoning – *Agriculture* Community Plan – *Agriculture* Maui Island Plan – *Urban Growth Boundary and Outside Protected Area* Special Management Area (SMA) - *Not in SMA*

Compliance with State of Hawaii Environmental Laws:	The proposed project will be filed pursuant to Section 201H-38, Hawaii Revised Statutes (HRS). This environmental assessment is prepared in compliance with HHFDC's requirement and in compliance with the provisions of Hawaii Administrative Rules (HAR), Title 11, Department of Health, Chapter 200, Environmental Impact Statement Rules.

III. Project Description

A. PROJECT LOCATION, EXISTING USE AND LAND OWNERSHIP

Legacy Wailuku LLC is proposing the development of 324 affordable and market rate apartment units and related improvements including resident amenities such as recreation center with swimming pool and four children's play areas. The subject project site consists of approximately 14.416 acres of land, identified as Tax Map Key (2) 3-5-001:064. The subject parcel for the proposed development is located at Waiale Road, Wailuku Area, Island of Maui, Hawaii. (See Appendix A - Location Map).

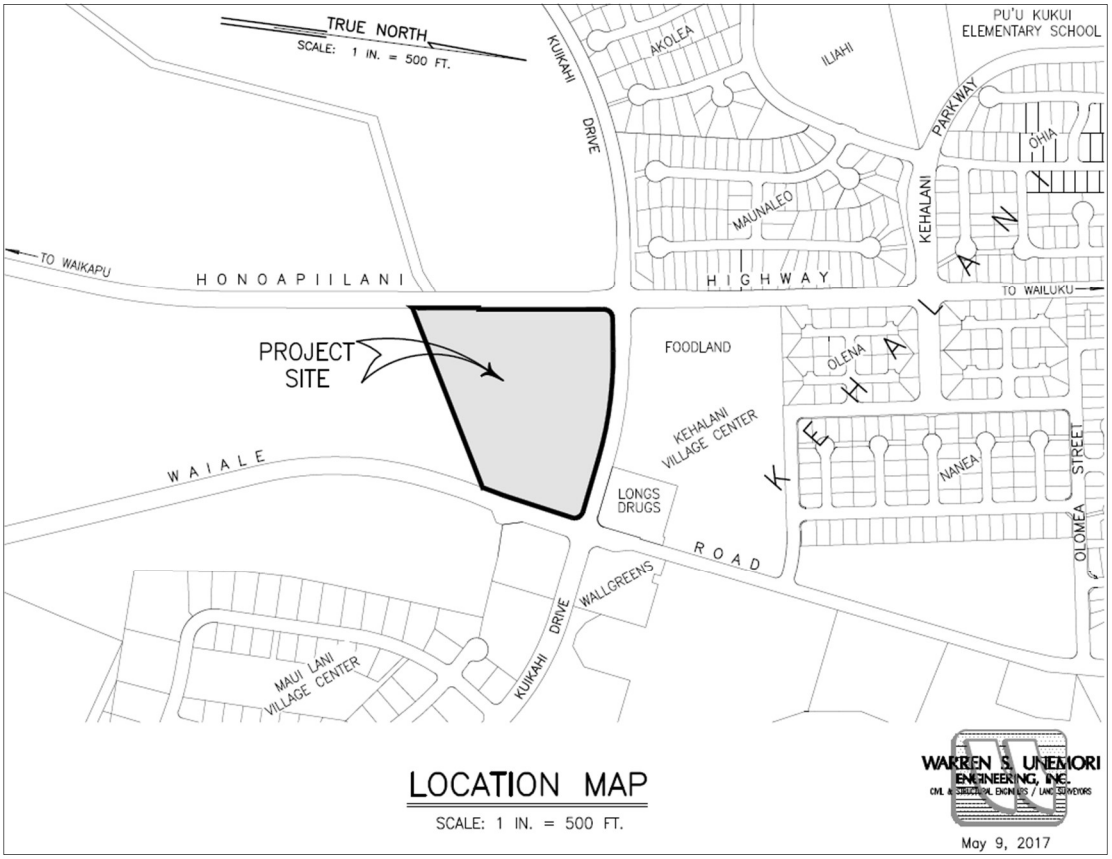

Figure 2: Location map of project site (See Appendix A)

The subject property is located on the east side of Kehalani and Wailuku Heights residential subdivisions and on the north and east side of the subject property are the Kehalani Village Center and Maui Lani commercial center. The property is bounded by Honoapiilani Highway to the west; Kuikahi Drive to the north; and Waiale Road to the east. On the south side of the project site is a recently-developed 467 affordable housing subdivision known as Waikapu Gardens Subdivision Phases 1 and 2. Also, located south of the proposed project is a recently approved 70-lot affordable fee simple housing project. The proposed project site is within the major urban growth boundary and sits next to the two

major planned communities in Central Maui, Maui Lani and Kehalani. There are two existing affordable housing projects in Waikapu, with another planned affordable housing project also planned in the same area. The proposed project is an ideal location for workforce apartments due to its proximity to existing commercial centers, schools, medical facilities, and other government agencies and services, and public transportation.

The site is currently vacant and a small portion of the property is presently used as a temporary trailer office site for Kehalani Community Association.

B. PROPOSED ACTION

The Applicant is requesting approval of its proposed project pursuant to Section 201H-38, Hawaii Revised Statutes, for the use of the subject property for a workforce apartment rental project. Upon receipt of applicant's Section 201H-38, HRS application approval and approval of the State Land Use District boundary amendment, the applicant proposes to develop approximately 324 affordable and market rate apartment units (See Appendix B, Preliminary Site Plan).

As mentioned earlier in this report, the proposed development will consist of 60% affordable apartment units which will be priced to qualified individuals earning within the 80% to 140% of Maui median income as set forth by the Hawaii Housing Finance & Development Corporation's Affordable Rent Guidelines. The proposed rental units consist of studio, 1, 2, and 3-bedroom units with floor area ranging from approximately 400 square feet to 950 square feet (See Appendix I - Preliminary Floor Models). There will be a minimum of 486 parking stalls (1.5 parking stall per unit) for the project. The project will also include residential amenities such as recreation center, leasing offices, swimming pool, bar-b-que areas and four children play areas.

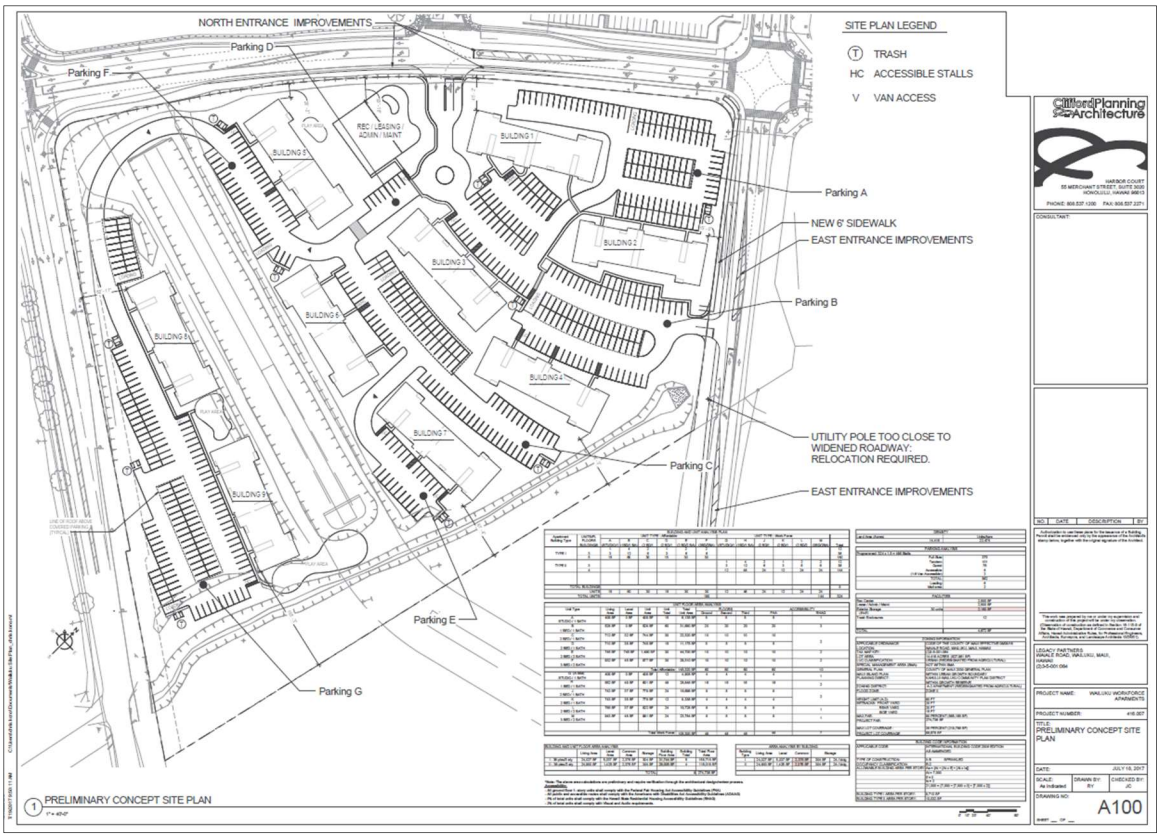

Figure 3: Preliminary concept site plan (See Appendix B)

<u>Proposed Project Unit Mix</u>

No. of Buildings	Studios	1 Bedroom	2 Bedroom	3 Bedroom
9	27	108	135	54

Paul Cassiday Real Estate Market Research was secured by the Applicant to study the market demand for workforce rentals on Maui. The study, dated January 14, 2017, provides essential information that formulated the unit mix, density, and conceptual site plan (See Appendix H). The report notes a strong demand for workforce apartment rentals in Central Maui, especially households earning 80% to 140% of the area median income. Maui's housing prices continue to trend upward, putting pressure on housing rental rates. The proposed Wailuku apartment project will help meet the demand for workforce rental units in the Island of Maui.

In addition to increasing housing prices, Maui's visitor industry continues to expand. There have been record breaking numbers of visitors and increased spending which also creates additional jobs. As the Maui economy increases the

number of jobs, housing pressure also increases and therefore rental rates rise to unaffordable levels.

The report states there are two significant sources of housing demand – local long-time residents and recent immigrants. In the first case of existing long-term rental demand, there is a significant portion of the local population that is "under housed." They are unable to find housing shelter at a price affordable to their incomes. This condition has existed for decades, according to the report since the boom of the visitor industry in the 1970's, followed by the second resort home industry, in the 1980's. The report states that Maui has not produced many private large-scale rental projects since the early 90's. Small-scale rental projects have been built but with major government subsidies. This project aims to serve local working households.

The rental rates for the affordable (restricted) units being proposed by the applicant will meet those earning 80% to 140% of Maui's median income families pursuant to HHFDC's Affordable Rent Guidelines. The estimated cost for the site work is approximately $10.2 million and the estimated cost for the construction of the apartment units and project amenities is approximately $60 million, totaling approximately $70 million. Construction of the proposed project and related infrastructure improvements is anticipated to begin as soon as all permitting approvals have been received. The applicant anticipates that the completion of the project is expected to take approximately 36 months to complete baring no unanticipated delays.

Proposed project amenities:

- Recreation, leasing, and community center (approximately 2,500 square feet)
- Swimming Pool
- Four children's play areas
- Close proximity to bus stop
- Close proximity to commercial centers at Kehalani and Maui Lani

C. REASONS FOR JUSTIFYING REQUEST

The proposed project will provide 195 workforce affordable apartment rental units to those earning 80% to 140% of Maui's median income families pursuant to HHFDC's Affordable Rent Guidelines. It will also provide 129 market-priced (unrestricted) apartment units. The proposed project is within close proximity to commercial uses, schools, medical facilities, the Maui Bus and other existing services and amenities. North of the project site is the Kehalani Village Center, a

commercial retail and office development, grocer, coffee shops, fast food restaurants, and pharmacies. To the South are lands owned by religious organizations, with the Waikapu Gardens single-family residential subdivisions and the recently approved 70-lot affordable fee simple single-family subdivision. West of the project, across Honoapiilani Highway is the existing Kehalani and Wailuku Heights residential subdivisions.

Hawaii Housing Planning Study states that Maui County needs 13,949 housing units by 2025 to meet demand as reported by SMS Research and Marketing Services, Inc., which was a study prepared for the County of Maui, Department of Housing and Human Concerns in December 2016.[2] Of the 13,949 units of demand, 3,119 units are needed that fall within the 80% to 140% area median income levels.[3] Approximately half, or 48% of the 13,949 units of demand are rentals.[4] There is a great need for affordable rental units that fall at 140%AMI and below.

Rentals also serve those households who only have a single member. Rentals provide a housing product that allows un-related individuals to room together thereby bringing their individual housing costs down. According the Bureau of Labor Statistics, Maui's rental households are 40% single individuals. In the case of two individuals renting a two-bedroom unit, one roommate can be at 70%AMI and the second individual at 50%AMI to meet the affordability requirements for a 120%AMI restricted unit. Workforce rentals at 80% to 140% AMI in this scenario can house people are lower AMI levels. This project with 324-units will have a ripple effect in the regional area to provide opportunities for those at lower median incomes. It will relieve pressure in homes that are currently doubling up and free up older rental stock in the area for other households.

According to the Wailuku-Kahului Community Plan the development of affordable housing within the region is encouraged. Under the community plan, its housing policy goal specifically states that ***"a sufficient supply and choice of attractive, sanitary, and affordable housing accommodations for the broad section of residents, including the elderly".*** Similarly, the Maui Countywide Policy Plan adopted by Ordinance No. 3732 took effect on March 24, 2010, states in its goals, objectives, policies, and action to ***"expand housing opportunities for residents"*** **in order to** ***"reduce the affordable housing deficit for residents".*** The applicant's proposed workforce housing project at the proposed site will meet a significant community need within the Wailuku-Kahului Community Plan District and in the Maui Countywide Policy Plan.

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[2] Hawaii Housing Planning Study, 2016, SMS Research & Marketing Services, Inc. December 2016, Page 33, Table 27a.
[3] Page 33
[4] Page 34

D. ENTITLEMENT APPROVALS REQUIRED

The proposed Wailuku Apartment project will consist of 60% affordable and 40% market-priced rental units. The affordable workforce units will be priced targeting families earning 80% to 140% of Maui's median income as set forth by the Hawaii Housing Finance and Development Corporation's Rent Guidelines. This application is filed and processed by HHFDC and approved by Maui County Council pursuant to Section 201H-38, HRS. This statute promotes the development of affordable housing project by providing exemptions from ***"all statutes, ordinances, charter provisions, and rules of any government agency relating to planning, zoning, construction standards for subdivisions, development and improvement of land, and the construction of dwelling units thereon"*** provided that the proposed housing project is consistent with the purpose and intent of Section 201H-38, HRS, and the project's design meets all health and life safety requirements per the building code and Maui County Code. This proposed project will be consistent and in compliance with the requirements of Section 201H-38, HRS.

According to the Wailuku-Kahului Community Plan District, the subject property is designated "Agriculture," hence, the Applicant is requesting exemptions from the process for Community Plan (CPA) and Change-In-Zoning (CIZ) amendments to expedite the implementation and delivery of the proposed workforce apartment rental project to Maui's residents without compromising health and safety considerations. This project meets the intent of Maui Countywide Policy Plan and the Wailuku-Kahului Community Plan District goals and objectives relating to providing and expanding affordable housing opportunities for Maui's residents.

This environmental assessment is prepared in compliance with the provisions of Chapter 343, HRS and in compliance with HHFDC's requirements for the processing of the applicant's Section 201H-38, HRS application for its proposed project.

Below is a list of permits required for review and approval for the implementation of the proposed Wailuku Apartment workforce rental project:

Permit or Approval	Responsible Agency
Section 201H-38, HRS	Hawaii Housing Finance and Development Corporation (HHFDC) and Maui County Council
Chapter 343, HRS	HHFDC and State of Hawaii Office of Environmental Quality Control (OEQC)
State Land Use "Urban" District Boundary Amendment	Maui County Council

Construction Permits (building, electrical, plumbing, and site improvements)	Maui County Dept. of Public Works
Grubbing and Grading	Maui County Dept. of Public Works
Landscape Plans	Maui County Dept. of Planning
Wastewater Connection Permits	Maui County Dept. of Environmental Management
Water Connection Permits	Maui County Dept. of Water Supply
NPDES Permit	State Dept. of Health
Noise Permit	State Dept. of Health

E. ANTICIPATED DEVELOPMENT SCHEDULE

Approval of Section 201H-38, HRS Application:	January 2018
Projected Building Permit Date:	February 2019
Construction Start Date:	March 2019
Projected Completion Date:	July 2021

F. PRELIMINARY RENT DISTRIBUTION OF AFFORDABLE UNITS

Estimated rental rates and unit type distribution are provided below based on HHFDC's 2017 rent guidelines. Each year new rent guidelines are issued by HHFDC. Upon completion of the first building ready for occupancy, rents will be determined based on the rent guidelines issued within that year. Affordable units will be provided first to households prior to the release of market rate units.

Unit Type	Unit Count	Living Area	Affordable Rent Ranges for 195 Restricted Units (60% of total unit count)* (80%-140% AMI)
Studio	27	424 sf	$1,007-$1,911
1 Bedroom	108	552 sf	$1,072-$2,041
2 Bedroom	135	741-812 sf	$1,271-$2,433
3 Bedroom	54	934-956 sf	$1,443-$2,786
TOTAL	**324**		

*Note: Rents are based on 2017 HHFDC Rent Guidelines minus utility allowance. These are subject to changed based on annually published rent guidelines and utility allowances by State and County agencies.

Affordable Unit Distribution

Area Median Income (AMI) Level*	Income Group	Units	% of Units
80% to 100% AMI	Low Income	55	17%
101% to 120% AMI	Below-moderate Income	55	17%
121% to 140%	Moderate Income	85	26%
Total		**195**	**60%**

*Based on HHFDC's Maui median income levels

IV. Existing Environment, Potential Impacts, and Mitigative Measures

This section of the EA documents existing environmental conditions and any project-related impacts that may occur. Through the Applicant and consultants' due diligence and studies of the development project, mitigative measures are being recommended where necessary.

A. PHYSICAL SETTING

1. Project Site History

Historically, during the mid-1800s this area was cleared for sugar cane agriculture and the area was plowed, planted, burned, and harvested in continuous cycles for over 100 years, according to the Biological Resource Survey by Mr. Robert Hobdy (See Appendix F). This subject area has been previously disturbed by prior grubbing, grading, and stockpiling of material from sugarcane cultivation and the construction of retention ditch in the western half of the subject property which continues south outside the project area. When sugar production ended at this site in the 1990s this area became fallow and has remain vacant since the closure of the sugar cane operation by Wailuku Sugar Company. The subject property is currently being used as a temporary trailer office, construction equipment and material storage yard.

2. Surrounding Land Uses

West of the subject property are existing Kehalani and Wailuku Heights residential subdivisions. Immediately north of the project site is Kehalani commercial center, and immediately east (makai) of the property is Maui Lani commercial center and Maui Lani residential subdivision. The property is bounded by Honoapiilani Highway on the west and Waiale Road on the east of the property. The Waikapu village town community is located approximately a little over a mile south of the subject property. Waikapu town is an old plantation community originally developed as a sugar plantation village. Today, Waikapu is primarily a residential community with limited lands allocated for commercial use along Honoapiilani Highway. Located south of the property are church-owned properties, and the existing recently-developed Waikapu Gardens Phases 1 and 2 affordable workforce housing subdivisions.

The Maui Tropical Plantation is located at the southern extent of Waikapu, approximately 2 miles south of the subject property. Approximately a mile east of the subject property is A&B Properties, Inc.'s proposed 545-acre

Waiale master planned community project consisting of approximately 2,500 residential units (currently going through entitlement process), and the existing Maui Lani residential subdivisions.

Honoapiilani Highway located west or mauka of the subject property provides access to Wailuku town, Waiehu and Waihee communities and West Maui. The general area is considered a highly desireable area to live on Maui due to its proximity to commercial amenities, schools, and parks.

It is within the major urban growth boundary, with roughly a third of the population in the immediate area. It sits next to the two-major master planned communities in Central Maui, Maui Lani and Kehalani, with another one planned in Waikapu. The project site is within close proximity to the Wailuku Town – the center of government and professional business services. It is worth noting that less than half a mile south from the project site is the 411-units Waikapu Gardens affordable housing project. Immediately north of the project is the Kehalani Village Center, and east of the project is the Maui Lani Parkway Commercial complex. About 2 miles southeast of the proposed project is A&B Properties Hawaii, Inc.'s proposed 540-acre Waiale Master Planned Residential Project. A&B's planned project will be a village concept with mixed uses including single-family and multi-family, and commercial.

Waikapu Town located approximately 2 miles southwest of the project site contains primarily single-family residential uses, although there are neighborhood commercial uses along Honoapiilani Highway.

The proposed action will result with a project that is compatible with surrounding residential uses. The site location is an ideal extension of the Kehalani and Maui Lani residential housing projects. The proposed Wailuku Workforce Apartment project undoubtedly meets and is consistent with the workforce housing policy as stated in the County of Maui 2030 General Plan-Countywide Policy Plan.

3. Climate

Maui's climate is relatively consistent throughout the year. The island's climate varies as the terrain changes. Characteristic of Maui's climate, the proposed project site experiences mild and uniform temperatures year-round, moderate humidity and consistent northeasterly trade winds.

Average temperatures at the project site (based on temperatures recorded at Kahului Airport) range from low 60 to high 80 degrees Fahrenheit. August is historically the warmest month, while January and February are

the coolest. Based on rainfall data from the Maui County Data Book 2015, annual precipitation rainfall average is 20 to 30 inches per year. Winds blow predominantly out of the north-northeasterly direction.

4. Topography and Soil Characteristics

Elevations across the project site range from approximately 360 feet at its southwest corner, to roughly 306 feet at its northeast corner. The existing terrain slopes steadily downward from southwest to northeast across the project site and has an average slope of approximately 5 percent.

According to the "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii (August, 1972)", prepared by the United States Department of Agriculture Soil Conservation Service, identifies Iao clay (IcB) and Iao silty clay (IaA) as the predominant soil types found on the project site. These soils are characterized as presenting a slight to moderate erosion hazard.

The State Department of Agriculture has established three categories of Agricultural Lands of Importance to the State of Hawaii (ALISH). These are: "Prime" agricultural lands which have soil quality, growing season, and moisture supply needed to produce sustained high yield of crops economically when treated and managed according to farming methods; "Unique" agricultural lands which have the special combination of soil quality, location, growing season, moisture supply, and is used to produce sustained high quality and of high yields of specific crop when treated and managed according to modern farming methods; and, "Other" important agricultural lands are lands other than Prime or Unique agricultural lands that are also of statewide or local importance for agricultural use.

As indicated by the ALISH map (See Appendix L) the subject property falls within the "Prime" agricultural land category. According to the former landowner, Wailuku Sugar Company, this portion of the property was used for sugar cane cultivation and it ceased operation in the early 1980s and it has remained vacant since the closure of its sugar cane operation. The subject property is undeveloped and is not presently used in any agricultural cultivation.

<u>Potential Impacts and Mitigative Measures</u>

The project site will be generally graded to maintain the natural form of the mountainside and the drainage pattern that now exists. A storm drainage system consisting of drainage inlets and underground pipes will be installed throughout the development too collect the runoff shed by

rooftops and pavements and convey it to the northeast corner of the site where it will be discharged into the pre-designated connection point at the storm drain mainline on Kuikahi Drive (See Appendix D – Preliminary Engineer Report for more detailed information of proposed drainage improvements). This drainline will, in turn, convey the runoff to Kehalani's Waiale Drainage Basin for disposal. The entire increase in peak storm runoff attributable to development of the project site will be directed to the Waiale Detention basin which, having already been designed and constructed to accommodate the post-development runoff from the project site,[5] will fully mitigate this increase in peak flow.

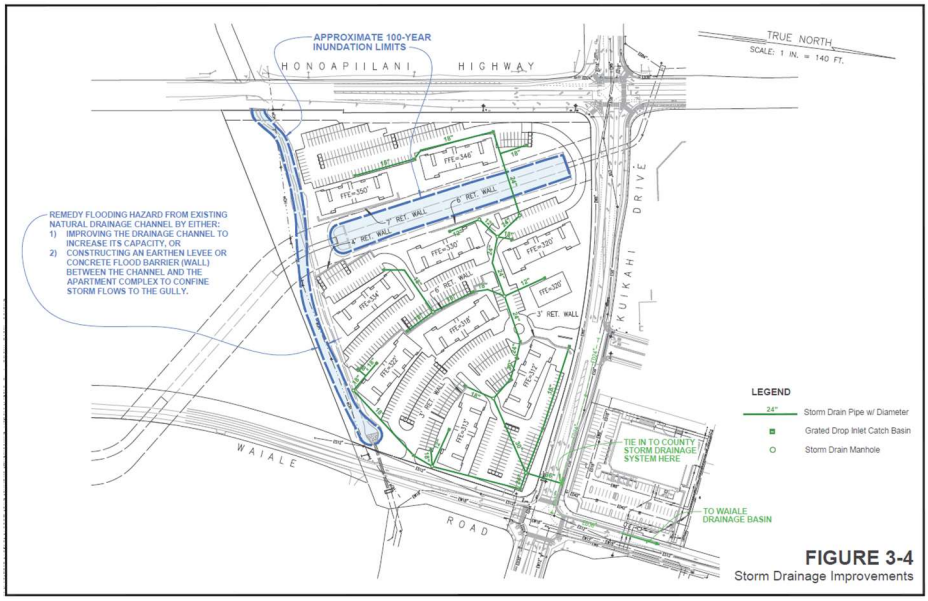


Figure 4: Storm Drainage Improvements, Figure 3-4, Preliminary Engineering Report, Wailuku Apartments, Warren S. Unemori Engineering, Inc.

[5] *Ref. Warren S. Unemori Engineering, Inc., "Wailuku Project District Drainage Master Plan," February 1998.*

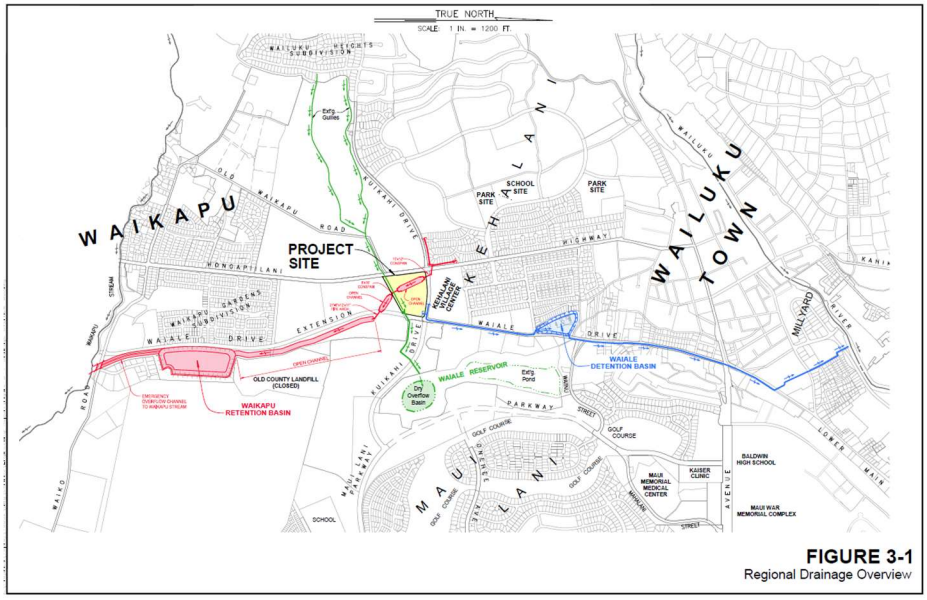


Figure 5: Regional Drainage Overview, Figure 3-1, Preliminary Engineering Report, Wailuku Apartments, Warren S. Unemori Engineering, Inc.

The project's drainage system will be designed to accommodate the increase in runoff generated by the proposed development of the entire project site. Drainage patterns of proposed improvements will be maintained to ensure impacts to downstream properties are minimized. With the proposed drainage improvements, adverse impacts to topography and landforms resulting from minimum grading activities are not expected. The adjoining and downstream properties will not have any additional increase of runoff due to this proposed development. Development of the project site will also include best management practices (BMPs) during construction to provide erosion control and minimize any potential impacts to downstream properties. There are no anticipated adverse impacts to topography and landforms from grading activities of the project site.

5. Flood and Tsunami Hazard

The proposed project site is located near the base of the West Maui Mountains. According to the Flood Insurance Rate Map (FIRM), prepared by the United States Federal Emergency Management Agency (FEMA) for the Maui County, the project site is situated in Flood Zone X, outside both the floodplain and tsunami zone. Flood Zone X represents areas outside of the 0.2% annual chance flood plain.

Potential Impacts and Mitigative Measures

The classification of the subject property as Flood Zone X is further confirmed by the Maui County Planning Department's Zoning and Flood Confirmation Form (refer to Appendix L) and no flood development permit is required. Best Management Practices (BMPs) will be implemented to mitigate any future or potential flooding on the site. Furthermore, the subject site is not located within the tsunami inundation zone.

6. Flora and Fauna

Flora and fauna survey was conducted at the property by Robert W. Hobdy (Environmental Consultant) on February 2017 (See Appendix F). The objectives of the flora and fauna survey were to:

- Document plant and animal species that occur on the property or may likely occur in the existing habitat;
- Document the status and abundance of each species;
- Determine the presence or likely occurrence of any native flora and fauna, particularly any that are federally listed as Threatened or Endangered;
- Determine if the project area contains any special habitats which if lost or altered might result in significant negative impact on the flora and fauna in this part of the island.

According to the flora and fauna field survey, the vegetation across the proposed project area is dominated by two non-native species, Guinea grass and glycine. These two species form a tall dense grassland that is smothered by vines. Also common are koa haole and castor bean. The vegetation throughout the project area is dominated by non-native species that are of no particular environmental interest or concern. The report further confirms that no listed Endangered or Threatened plant species (USFWS, 2017) were found, nor do any plants that are candidates for such status occur on the project site. No special plant habitats occur on or near the project and no potential wetlands occur in this dry upland site. According to the Mr. Hobdy's report, the proposed project is not expected to have any significant negative impacts on these botanical resources in this part of Central Maui. No special plant habitats were identified during field inspection of the project site.

With respect to fauna survey, a walk-through survey method was conducted by the environmental consultant in conjunction with the botanical survey. According to the environmental consultant, all parts of the project site were covered. Field observations were made with the aid of

binoculars and by listening to vocalizations. In addition, an evening visit was made to the area to record crepuscular activities and vocalizations to see if there was any evidence of occurrence of the Hawaiian hoary bat in the area. Just two non-native mammals, the mongoose and axis deer were observed during two site visits. No evidence of the Hawaiian hoary bat was observed.

Birdlife was somewhat sparse within the project area due to the lack of habitat diversity. Just six species of non-native birds were recorded during the two site visits by the environmental consultant. The report confirms that the wildlife within the project area were all non-native species. No Endangered Blackburn's sphinx moths or eggs or larvae were found during the survey and none of their specific obligate host plants were found growing in the project area. The development of the proposed project is not expected to have a significant negative effect on the native animal resources in this part of Central Maui.

As a result of the flora and fauna inventory field survey, the report confirmed that *"no federally Endangered or Threatened species (USFWS 2017) were found on the project site."* Because of the above described environmental conditions, the proposed project will not have a significant negative impact on the flora and fauna resources in this part of Maui.

Potential Impacts and Mitigative Measures

There are no known significant habitats or rare, endangered, or threatened species of flora and fauna located or in the vicinity of the project site. The proposed improvements on the property are not anticipated to impact wetland areas and wildlife habitats. It has been determined removal of vegetation from the project site is not considered an adverse impact on these components of the natural environs. The proposed project does not anticipate any impacts on the flora and fauna resources. (See Appendix F – Biological Resources Survey)

7. Streams and Reservoirs

Waikapu stream is located approximately 1.5 miles south (across Waiko Road) of the proposed project site. Waikapu stream is perennial stream which originates in the upper reaches of Waikapu Valley, ultimately discharging into Kealia pond, in the Maalaea flats. According to the Hawaii Stream Assessment, the Waikapu Stream has no listed tributaries and flows to the sea year-round. The assessment also found that the Waikapu Stream was important for taro cultivation in the past and that Waikapu Valley may contain valuable cultural and historical sites (Hawaii Cooperative Park

Service, 1990). It is important to note that some families at Waikapu Village (located about 2 miles southwest upstream or mauka of the proposed project site) began to rehabilitate old taro patches.

There is a plantation reservoir located west or mauka of the project site and across Honoapiilani Highway and below the existing Wailuku Heights residential subdivision. This reservoir was formerly used for sugar cane irrigation, and currently owned and maintained by Wailuku Water Company.

According to the project's biological resources survey report, there are no identified wetlands on the project site. Nothing remotely approaching the three essential criteria that define a federally recognized wetland, namely: hydrophytic vegetation; hydric soils; and, wetland hydrology occurs within this dry project site.

Potential Impacts and Mitigative Measures

There are no wetlands on the subject property or in the immediate vicinity of the property. Waikapu Stream located approximately 2 miles south of the project site will not be affected by the proposed project. Drainage generated from the subject property will not be discharged into Waikapu Stream. The entire increase in peak storm runoff attributable to development of the project site will directed to the Waiale Detention basin which has already been designed and constructed to accommodate the post-development runoff from the subject property, will fully mitigate this increase in peak flow. The proposed project is not expected to have an anticipated impact on Waikapu Stream and wetlands.

8. Air Quality

There are no point sources of airborne emissions within close proximity of the project site. Air quality in the vicinity of the project site may be affected by a variety of sources, including dust from construction activities mauka of the project site. Vehicular traffic on nearby roadways including, Honoapiilani Highway, Waiale Road, and Kuikahi Road are the primary sources of pollutants. Occasionally, dust from construction activities at Maui Lani Parkway are sources of airborne emission. However, these sources are intermittent and prevailing winds quickly disperse the particulates generated by these temporary sources. These activities do not result in adverse regional air quality impacts. Overall, air quality is the Central Maui region is considered excellent.

Potential Impacts and Mitigative Measures

Based on the existing and surrounding residential and commercial operations within close proximity of the project site, the following assessment was made with regards to potential impacts, if any, of air quality.

Emissions from construction equipment and vehicles used during construction activities may temporarily affect the ambient air quality within the immediate vicinity of the project site. However, these temporary air quality affects can be minimized by instituting Best Management Practices (BMPs) during project construction. In addition, dust control will be instituted such as dust barriers, watering graded areas, and/or sprinklers to control dust during construction of the project.

On a long-term basis, upon completion of the proposed Wailuku Apartment project, it is not anticipated to generate adverse impact on air quality on or in close proximity of the project site.

9. Noise

Traffic noise from Waiale Road located east of the subject project, Kuikahi Road on north of the project and Honoapiilani Highway located west of the subject property are the predominant sources of noise in the vicinity of the project site. However, this activity is temporary in nature. Also, on intermittent basis, noise from construction activities at Maui Lani Parkway and at Kehalani subdivision located mauka of the subject property are secondary sources of background noise, as well as natural conditions such as wind and rain.

Potential Impacts and Mitigative Measures

Ambient noise conditions may be temporarily affected during construction activities at project site. Construction equipment machinery will likely be the dominant noise-generating source during construction period. Best Management Practices (BMPs) will be instituted, including equipment maintenance and vehicle maintenance, are anticipated to reduce noise levels. Construction activities will be limited to daytime working hours.

Construction-period noise will be mitigated in accordance and strict adherence with Title 11, Administrative Rules, Chapter 46, Community Noise Control of the State Department of Health. All construction equipment and onsite vehicles will be equipped with mufflers as required in Section 11-46 (b)(1)(A). Required permit conditions for construction activities may include, where appropriate:

"No permit shall allow construction activities creating excessive noise before 7:00 A.M. and after 6:00 P.M. of the same day"

"No permit shall allow construction activities which emits noise in excess of ninety-five dB(A) except between 9:00 A.M. and 5:30 P.M. of the same day"

Once project is completed, the proposed workforce apartment rental project is not anticipated to generate significant long term adverse noise conditions. These conclusions were drawn based on the existing and surrounding residential and commercial uses in the area.

10. Scenic and Open Space Resources

West Maui Mountain, including Haleakala Mountain to the east define the scenic resources of the project site. Immediately south boundary of the project site is presently an open space, which is a church-owned property. It is also bordered by Kehalani Village Center to the north and the Maui Lani Parkway Commercial complex to the east with building structures taller than 35 feet in some cases. The subject property has partial views of East Maui and Haleakala. The project site is not part of a scenic corridor.

Potential Impacts and Mitigative Measures

To minimize and mitigate potential visual impact resulting from the proposed project, the project will utilize the existing elevations of the site and limit the height of the buildings to 38-40 feet (three story building). (See to Appendix I – Unit Plans & Elevation) The project is not part of a scenic corridor and will not affect views from inland vantage points. As such, the proposed project is not anticipated to have an adverse impact upon the visual character of the surrounding areas.

The project's site at its highest point on Honoapiilani Highway is at 360' elevation. The buildings on the highest point on the site sits on 350' elevation and 346' elevation creating a scenario where the building is lowered approximately 10' from the highest point on Honoapiilani Highway, which helps to mitigate views from Mauka to Makai (East to West). Landscaping will also border the properties' boundaries helping to screen the buildings for those who live further Mauka of the property.

11. Hazardous Materials

An Environmental Site Assessment – Phase I Investigation was conducted for the subject property by Bureau Veritas North America, Inc. in March 7,

2016. Both site reconnaissance and records review for the subject property, as well as the surrounding areas, were completed. The Phase I Environmental Site Assessment (ESA) was conducted to determine if the site may be contaminated with hazardous or toxic substances or wastes resulting from current or past site activities. The goal of the environmental site assessment is to identify *recognized environmental conditions* on the property that indicate an existing release, a past release, or a material threat of release of any hazardous substances or petroleum products.

According to the report by the environmental consultant, the assessment survey report revealed no evidence of recognized environmental conditions, as defined by ASTM, in connection with the subject property. With regard to past agricultural use of pesticides and/or herbicides formerly used on agricultural crops, the report noted that this historical recognized environmental condition is not considered a current recognized environmental condition because the subject property has received a *"No Further Action Determination"* letter from the DOH HEER Office with regards to elevated agricultural chemicals in the soil.

Potential Impacts and Mitigative Measures

The subject project site was not listed on any hazardous database listings. There was no evidence of any historic misuse or significant spills of hazardous or regulated substances on the subject property. According to the environmental site assessment report, the assessment has revealed no evidence of recognized environmental conditions, as defined by ASTM, in connection with the subject property. Also, no sensitive ecological areas were observed on the subject property, according to the Phase I environmental assessment report. Considering the past agricultural use of the property, the report noted that agricultural chemicals were not detected at or above regulatory levels. It was further pointed out in the report that the subject property has received a "No Further Action Determination" letter from the DOH HEER Office with regards to elevated agricultural chemicals in the soil. Based on its findings as a result of the Phase I environmental site investigation, there are no hazardous or regulated substances found on the property site. BMPs will be instituted during the construction of the subject project. No adverse impacts are anticipated per environmental consultant's findings. The subject property is not in any state or federal data listings.

12. Archaeological Resources

An archaeological assessment survey was conducted by Archaeological Services Hawaii, LLC on May 2017 of the 14.416-acre of land located along

Waiale Road within Wailuku *Ahupua`a.* The Archaeological Assessment Survey report for the project site was prepared in compliance with the Department of Land and Natural Resources (DLNR), State Historic Preservation Division (SHPD) Hawaii Administrative Rules (HAR 13-275-276-5); in compliance with Maui County guidelines, rules, and regulations. The information in the said assessment survey report was compiled through a combination of background research by the archaeological consultant and archaeological investigative field results.

As noted earlier in this report, the archaeological assessment was comprised of a 100 percent pedestrian survey with mechanical test excavations and these procedures were performed by archaeologists from Archaeological Services Hawaii. A total of 40 field hours were expended during the course of this project. A total of 11 backhoe trenches were excavated across the parcel and were negative for buried cultural remains.

An archaeological inventory survey was conducted on the subject property by Archaeological Services Hawaii, LLC (ASH) ("Consultant"). The archaeological inventory survey was conducted by the Consultant on May 2017. The purpose of the archaeological survey was to determine the presence/absence, nature, and extent and significance of any cultural and archaeological resources in the proposed project area. A total of 11 backhoe trenches were excavated across the parcel, and according to the report were negative for buried cultural remains (See Appendix C - Archaeological Assessment Report). The archaeological assessment was comprised of a 100% pedestrian survey with mechanical test excavations and these procedures were performed by ASH's archaeologists.

<u>Potential Impacts and Mitigative Measures</u>

Based on the negative findings by the archaeological consultant, coupled with the compounded disturbances across the subject property, the probability of encountering *in situ* cultural remains is low (See Appendix C - Archaeological Assessment Survey Report).

No further archaeological work beyond the inventory level is recommended for the subject area. However, as a precautionary measure recommended by the consultant, archaeological monitoring plan (AMP) is recommended for any development or future earth moving activities on the subject parcel and an AMP is currently being prepared by ASH and will be submitted to SHPD for review and approval prior to the commencement of construction activities.

Further discussions and details on the result of the archaeological assessment survey can be found in Archaeological Services Hawaii, LLC's attached report identified as Appendix C.

13. Cultural Impact Assessment

A draft cultural impact assessment (CIA) was conducted by Scientific Consultant Services, Inc. (SCS) on August 2017 (See Appendix M). The primary purpose of the CIA is to identify the possibility of "on-going cultural activities and resources within the project area, or its vicinity, and then assessing the potential for impacts on these cultural resources." According to SCS, the cultural impact assessment was prepared in accordance with the suggested methodology and content protocol in the Guidelines for Assessing Cultural Impacts (OEQC 1997:11-13), which specifically states that,

> *"information may be obtained through scoping community meetings, ethnographic interviews and oral histories…"*

The CIA report contains archival and documentary research, as well as communication with organizations and individuals having knowledge of the project area, its cultural resources, and its practices and beliefs.

The project area is located in the Wailuku and Waikapu Ahupua`a, Wailuku District, Maui Island, Hawaii. According to the draft CIA report, Wailuku and Waikapu Ahupua`a are located in the land division (`*okana*) which was once known as "Na Wai Eha". This area was comprised the four great alleys of Waihe`e, Waiehu, Wailuku, and Waikapu which cut far back into the slopes of West Maui and drain the eastward watershed of Pu`u Kukui. Kuikahi Drive forms the northern project area boundary, Honoapiilani Highway and Waiale Road form the west and east boundaries, respectively. The southern boundary is formed by an irrigation ditch, which appears to be a portion of Kama Ditch, State 50-50-04-5474. The proposed project area is situated on the base of West Maui Mountains.

<u>Potential Impacts and Mitigation Measures</u>

Historic utilization of the Waikapu-Wailuku landscape near the project area focused on industrial-levels of cultivating sugar cane and pineapple. Water was channeled from traditional sources through plantation lands. These former sugar cane and pineapple lands are now being reclaimed through residential developments and industrial baseyards. In the SCS' CIA report, there have been a number of archaeological inventory survey

within close proximity of the project area. More recently, Archaeological Surveys of Hawaii, LLC (ASH) conducted an archaeological Inventory Survey of a 50-acre parcel of land in Wailuku and Waikapu ahupua`a, Wailuku district, Maui Island, located adjacent and south of the proposed project area. During the survey, Kama Ditch was documented. The Kama Ditch was constructed around 1905, provided water to the sugarcane and subsequent pineapple fields. Use of the irrigation ditch was terminated approximately 30 years ago. Chris Hart and Partners conducted a cultural impact analysis for the same 50-acre parcel noted above for State land Use Urban Boundary designation of said property and found that there's no anticipated adverse affect on Native Hawaiian traditional and customary rights which would require protection under Article XII, Section 7, of the Hawaii State Constitution. Similarly, the proposed project does not anticipate adverse impact on the cultural resources within the Wailuku-Waikapu area.

B. SOCIO-ECONOMIC ENVIRONMENT

1. Population

The population of the Island of Maui has increased dramatically over the last two (2) decades. The 2000 population was estimated at 117,644, an increase from 1990 of 91,361 (County of Maui 2030 General Plan - Countywide Policy Plan). According to the Maui Countywide Policy Plan, Maui's resident population is expected to grow from 129,471 in 2005, 157,087 in 2015, 169,540 in 2020, and 194,630 in 2030. These projections, according to the Maui Island Plan indicate a dramatic population growth.

According to the *Socio-Economic Forecast* as noted in the Maui Island Plan, the total population is not expected to increase equally throughout the island, rather, there are specific regions where population growth in more likely to occur at higher rate than others. To further illustrate the population growth that will likely occur, there are four community plan regions that are in close proximity of the proposed project site, namely: Kihei-Makena, Makawao-Pukalani-Kula, and Paia-Haiku, and West Maui regions. The combined population growth within these regions including Kahului-Wailuku is: population in 2005 is 127,473; in 2010 is 142,153, and in 2020 is expected to grow at 166,797, and in 2030 the combined population in these regions will reach at a staggering 191,481 (according to Maui Countywide Policy Plan). Within Wailuku-Kahului Community Plan District (location of the project site), the projected population growth will increase dramatically from 2010 population of 54,433 to a projected

population of 64,853 in 2030, according to the Maui County General Plan 2030.

Because of the proposed project unique central location between Wailuku-Kahului Community Plan District and Kihei-Makena Community Plan District, the proposed project will help meet the demand for workforce rental housing units in these Maui community plan districts.

Potential Impact and Mitigation Measures

The proposed project will create immediate construction employment during the development of the project. Combined estimated construction costs both for site work and vertical construction cost for the apartment buildings will be approximately $70 million, and not including soft costs. As noted above, the proposed project will create construction jobs for local residents during the development of the project. This projected employment will have a multiplier effect on local material suppliers and retail businesses that can be expected to benefit from the proposed project. Also, in the long-term, apartment tenants will require services related to home improvements and maintenance which will further support local businesses, thereby creating more employment opportunities.

Both long and short-term basis, the proposed action should not affect population parameters. The proposed project is not considered population generator from a long-term perspective. The project is anticipated to meet existing demands for workforce housing by current Maui residents that are waiting for affordably-priced rental housing project. According to the market demand report, there are many families doubling up in small rental unit due to lack of workforce housing units. This project does not significantly (if any) affect/increase population parameters within the Kahului-Wailuku Community Plan District since the target market is the current population who are looking for suitable affordably-priced rental units.

No mitigative measures are necessary in response to the anticipated increased short-term as well as long-term employment and no additional mitigative measures are required regarding population since the proposed project is not a population generator.

2. Agriculture

The approximately 14.416-acre project site is situated in a region of existing and ongoing urban development. As noted earlier in this report, the subject property based on the ALISH map, the project site falls within the

"Prime" agricultural land category. The property site is situated within the growth urban boundary and surrounded with existing residential subdivisions and commercial centers. The sugar operation and any agricultural activity have ceased operation in the early 1980s and the subject property has been vacant and remained fallow and presently used as a temporary field office for the Kehalani Community Association. Since the closure of HC&S sugar company – it left approximately 36,000 acres of agricultural lands that can be used for agricultural cultivations. The 14.416-acre project site does not impact the availability of agricultural lands on Maui.

Potential Impacts and Mitigation Measures

Use of the property for the proposed workforce apartment rental project is not anticipated to adversely impact agricultural productivity on the island. The subject property is designated as growth reserve in the Kahului-Wailuku Community Plan, and residential urban growth boundary designation within the approved Maui Island Plan. Since proposed action will not affect agricultural production on the island, no mitigative measures are expected to be required.

3. Housing

According to the SMS Hawaii Housing Planning Study, 2011 prepared for the County of Maui, among Maui's 53,621 households in 2011, about 56 percent were homeowners and 93 percent of them owned their property fee simple. The report further stated that a significant number of Maui households live in overcrowded conditions or are 'doubled-up" with other families. According to the SMS report, in the past four years, crowding has begun to increase and is presently over 11 percent. Since 2003, doubling up has increased to 10 percent in 2006 and 13 percent in 2011.

In the County of Maui 2030 General Plan – Countywide Policy Plan rightfully notes that *"shelter is among the most basic of human needs."* The affordability, quality, and location of housing – including the degree of crowding within the home and within the neighborhood – play an enormous role in the quality of life of Maui County's residents.

The SMS Socio-Economic Forecast for Maui County notes that the island of Maui's housing supply in the year 2000 is estimated at 40,041 units of which 32 percent or 12,852 were located in the Wailuku-Kahului Community Plan District. This region accounts for the largest percentage of housing units on the island. Demand for housing in this community plan region in the year 2000 was estimated at 13,528 units. Housing

demand in the Wailuku-Kahului district is projected to grow to 16,826 units in the year 2010 while the expected number of households is estimated at 15,985 units. By the year 2020, the projected housing demand will reach 20,054 units compared to household count of 19,051, according to SMS findings.

A Market Demand Study for the proposed 324 Wailuku Apartment workforce rental project was prepared by Paul Cassiday Real Estate Market Research (See Appendix H). The market demand study analyzed the residential real estate market as it relates to the proposed workforce rental project. The report assessed the residential rental market and projected the rate of absorption and the level of rents that the proposed project could capture. This was done, according to the report, by updating the Rental Housing Study done for the County in 2014, using 2016 instead of 2013 data, and targets it for the Central Maui project site on the demand side by reviewing economic trends, in terms of population, jobs, income, and housing. On the supply side, the market report describes and analyzes the housing stock in the area, as it relates to rental demand, and on the capacity of the housing in the core area and future population in Central Maui. It also analyzed the supply pipeline for all housing on the island as it relates to project and the target market.

The report notes the following summary findings:

a) The housing market on Maui continues to show more sales and higher prices, thus putting upward pressure on the rental market;

b) The stock of housing on Maui continues to grow more slowly than the population, or the number of households living on Maui. This makes housing more scarce, and puts pressure upward on the rental market;

c) The rejuvenation of two major resorts on Maui continues, with the expectation that this will cause both higher in migration of workforces to rebuild Kaanapali and Makena resorts, and lead to higher visitor counts ultimately; and

d) As the market conditions continue to improve, the proposed rental housing project can expect to see heightened demand, due to its Central Maui location.

4. Economy

The Wailuku region is the island's center of governmental activities, as well as a focal point for professional and business services. Combined with

neighboring Kahului, the region's economic character includes a wide range of commercial, service, and governmental activities. Another important economic engine in Kahului region is the harbor and airport transportation systems critical to Maui's economy. Also, within the Kahului region is the University of Hawaii Maui College and the Maui Center for Cultural Arts that contributes significantly to our economy in the region.

The Kihei-Makena Community Plan region is one of the island's well-planned visitor resort destination, which is the primary economic engine for the island of Maui. In the same region is the home of the research and technology park which contributes significantly to the island's economy.

Monsanto Seed Farm, a major employer in the area, is located approximately 6 miles south east of the project area, which currently employs approximately 500 Maui residents. HC&S closed last year in 2016, with approximately 36,000 acres that could be available for future agricultural use potentially adding to Maui's economy.

Another important economic engine within the region are tourism-related activities such as the popular Maui Ocean Center located at Maalaea (located south of the project area) and the Maui Tropical Plantation located at the base of Waikapu Valley at West Maui Mountain. These two tourism-related activities are located within 2 to 3 miles south and southwest of the proposed project site.

Maui Medical Group, Kaiser Permanente, and the 200+ beds at Maui Medical Center Hospital (now being managed by Kaiser effective July 1, 2017) are also located in the regional area within a 5-minute drive from the proposed project. There are also elderly long-term residential facilities in the region that substantially contribute to the region's economy such as Hale Makua, Hale Mahaolu and Roselani residential complexes. These facilities are located within a mile to 2 miles from the subject project site. It is estimated that these health-care related facilities have a combined number of direct employees of approximately 2,000.

The proposed project targets this essential workforce that addresses Maui County's government and health needs. It also provide quality housing for these major employers to retain and attract talent in the regional area.

5. Employment

The Island of Maui recorded a 2.9 percent unemployment rate in April 2017, up from the 2.8 percent rate recorded in March, and unchanged from the 2.9 percent ate reported in April of last year. According to recent

report, Maui County's economic picture is marked by impressive tourism industry rebound, which is the major economic drivers for Maui's economy.

According to the Maui County data Book, in 2015, total wage and salary jobs in Maui County is approximately 73,230, and by 2020 to 2030, it is projected to be approximately 77,140 and 84,170, respectively. Most of the jobs are in accommodations and food services; trade; government; and other services. It is anticipated according to recent report by First Hawaiian Bank – Economic Forecast that robust tourism propels Maui's economy in 2016. The report further confirms that visitor sector has led the way and looks promising as more capacity comes on line. County's labor market is strong; and construction, which has been bolstered by public infrastructure continues to stay steady.

C. PUBLIC SERVICE

1. Police and Fire Protection

Police protection for the Wailuku-Kahului region is provided by the Maui Police Department (MPD) located at Wailuku Station headquartered at its main station at Kaahumanu Avenue in Wailuku located approximately 2 miles north of the project area. The Maui Police Department provides investigative services, uniform patrol services, technical support, and traffic services as stated in its mission to protect the residents on Maui County. Both main and sub-stations are located in very close proximity of the project site.

Fire prevention, protection, rescue, and emergency services for the Wailuku-Kahului region are provided by the Maui County Department of Fire and Public Safety. The department has 2 stations to service the Wailuku-Kahului region that is in close proximity of the project site. The Wailuku station is located in Wailuku town approximately 2 miles north of the project site and the Kahului station is located at Dairy Road, Kahului located approximately 2.5 miles east of the project site.

<u>Potential Impacts and Mitigative Measures</u>

The proposed action is not anticipated to impact the service capacity and capability of police, fire, and emergency medical operations. The project will not expand nor extend the existing service area limit for emergency medical services. There are existing police, fire, and medical facilities in very close proximity of the project site. Fire protection system will be constructed with the proposed project in accordance with Maui Fire

Department standards. No further mitigative measures are expected to be required.

2. Medical Facilities

State-owned Maui Memorial Medical Center (MMMC) and now managed by Kaiser Permanente effective July 1, 2017, the only major medical facility on the island, services the Wailuku-Kahului region. Acute, general, and emergency care services are provided by the 200+ beds MMMC facility located in Mahalani Street, Wailuku, about 2 miles north of the subject property. Also, state owned Kula Hospital (also managed by Kaiser effective July 1, 2017) located approximately 20 miles east of the subject property provides emergency and long-term care services.

In addition, Kaiser, Maui Medical Group, Maui Medical Clinic, and Liberty Dialysis Clinic serve health care needs for the Island of Maui, all located in Wailuku and Kahului, about 2 miles north of the subject property. Dental and other medical offices are also located within Wailuku-Kahului region to serve its residents and visitors, and are within 2 miles or less from the proposed project site.

3. Schools

The State Department of Education (DOE) operates 8 schools in the Wailuku-Kahului region. There area is also served by several privately-operated schools providing education for elementary, intermediate, and high school students. Public school facilities within the Wailuku-Kahului District area include: H. Perrine Baldwin High (grades 9-12), Iao Intermediate (grades 6-8), Wailuku Elementary (K-5), Waihee Elementary (K-5), Maui High (9-12), Pomaikai Elementary (K-5), Kahului Elementary (K-5), Lihikai Elementary (K-5), Maui Waena Intermediate (6-8), and Puu Kukui Elementary School (K-5) area located in Wailuku.

Privately-operated schools serving Wailuku-Kahului region include St. Anthony School (grades K-12), Kaahumanu Hou Christian School (grades K-12), Emmanuel Lutheran School (K-6), and Maui Adventist School (grades 1-8).

University of Hawaii Maui College (part of University of Hawaii system) located in Kaahumanu Avenue, Kahului serves the college needs of Maui residents recently becoming a four-year university.

According to the Maui County Data Book, 2015, the following public and privately-operated schools 2015 enrollment within the Wailuku-Kahului region is shown in the following table.

Schools	Enrollment	Grades
Baldwin High School	1,398	9-12
Maui High School	1,906	9-12
Iao Intermediate	918	6-8
Wailuku Elementary	694	K-5
Puu Kukui Elementary	692	K-5
Waihee Elementary	752	K-5
Kahului Elementary	954	K-5
Lihikai Elementary	901	K-5
Maui Waena Intermediate	1043	6-8
Pomaikai Elementary	574	K-5
St. Anthony School	272	K-12
Kaahumanu Hou Christian	112	K-12
Emmanuel Lutheran	179	K-6
Maui Adventist	20	1-8
Source: Maui County Data Book, 2015		

As noted earlier in this report, the proposed action is not a population generator that will increase population parameters within the Kahului-

Potential Impacts and Mitigative Measures

There are no anticipated impacts to existing educational facilities or resources. The applicant will work closely with the State Department of Education (DOE) to ensure that the proposed project meets with all DOE's applicable rules and regulations concerning appropriate assessment policy. No further mitigative measures are expected to be required.

4. Recreation Facilities (Parks)

Within the Wailuku-Kahului Community Plan District, there are many recreational activities, including shoreline and boating activities at the Kahului Harbor and adjoining beach parks, and organized recreational

activities provided/offered at County Parks. Within close proximity of the project site is the Waikapu Community Center located about half a mile west of the project area. Other Maui County owned parks within the Wailuku-Kahului region are the Papohaku Park and Wailuku Community Center, War Memorial Athletic complex, Wailuku Little League baseball fields, 65-acre Maui Regional Park, Maui Lani Parkway Park, Sakamoto Swimming Pool, and Keopuolani Regional Park. All these county-owned recreational facilities located within approximately 2 to 3 miles north and east of the project site. A nearby park adjacent to the Hale Makana O Waiale Affordable Housing complex contains a baseball field, basketball court, and playground equipment. This park is located about 1 mile north of the project site. Other recreational facilities in the Wailuku area include Iao Park, Wells Park, Wailuku Pool, Wailuku Gym, and Wailuku Elementary School Park. In addition, there are several golf courses in the Wailuku-Kahului region located within close proximity of the project site, namely: Kahili and Kamehameha golf courses, The Dunes at Maui Lani Golf Course, and Maui County-owned Waiehu Golf course. These golf courses are within 1 to 3 miles of the project site. According to a recent report during a meeting with the Waikapu Community Association, it was reported that the County of Maui has purchase an approximately 242-acre parcel for a proposed Central Maui Regional Park.

Potential Impacts and Mitigative Measures

As noted earlier in this report, the proposed action is not a population generator that will increase population parameters within the Kahului-Wailuku Community Plan district, hence, the proposed project is not expected to generate the need for recreational facilities or services. Park facilities are currently available within close proximity of the project site. The County is proposing to develop approximately 242-acre parcel for its proposed central Maui regional park located a mile southeast of the project site. The recently completed 65-acre regional park is located about less than a mile from east of the project site. Also, The Maui Parkway county park located about half a mile from the project site is available for community use. There are many other County parks and recreational facilities within the Kahului-Wailuku Community Plan District that are located within 2 to 4 miles from the project site. No further mitigative measures are expected to be required.

The project also proposed to provide four distinct play areas for families on the property totaling 16,823 sf.

5. Solid Waste Disposal

Solid waste collection services for the project will be provided by a privately-managed company and disposed of at the Maui County's 55-acre Central Maui Landfill. This landfill is located approximately 4 miles east of the subject property. This county-owned landfill is managed and operated by Maui County Department of Environmental Management.

Potential Impacts and Mitigative Measures

A solid waste management plan will be developed for the disposal of any construction materials during the development of the proposed project. Once construction is completed, it is anticipated that the project solid waste collection and disposal will be provided for and disposed to the County of Maui's Department of Environmental Management's 55-acre Central Maui Landfill located approximately 5 miles east of the project site.

After the project is completed, residents will be encouraged to implement waste recycling programs to reduce the amount of waste to the County's Central Maui Landfill site.

D. EXISTING INFRASTRUCTURE, POTENTIAL IMPACTS, AND ANTICIPATED IMPROVEMENTS

1. Roadways

Honoapiilani Highway is under the jurisdiction of the State of Hawaii Department of Transportation and is the main artery linking Wailuku to Central, South, and West Maui. Honoapiilani Highway is located west of the project site. It is a two-lane undivided State Highway which runs in the north-south direction into Wailuku town. No vehicular access is allowed directly from the project site onto Honoapiilani Highway. The proposed Wailuku Apartment project site is accessible from both Waiale Road and Kuikahi Drive, which is controlled by the County of Maui. The Waiale/Kuikahi Road and Honoapiilani Highway/Kuikahi intersections are signalized.

A detailed Traffic Impact Assessment Report (TIAR) was completed on May 15, 2017 for the proposed project by Austin Tsutsumi &Associates. Refer to Appendix E, for detailed traffic assessment for the project. The TIAR study methodology address the following:

- Assess existing traffic operating conditions during the weekday AM and PM peak hours of traffic within the study area;

- Provide traffic projections for Base Year 2020 (without the project);
- Estimate the vehicular trips that will be generated by the project;
- Provide traffic projections for the Project for Future Year 2020 (with project);
- Conduct a signal warrant analysis at the Project's proposed Kuikahi Drive access; and
- Provide recommendations for roadway improvements, or other mitigative measures.

The following existing roadways were studied within the vicinity of the proposed project:

- Honoapiilani Highway
- Kuikahi Drive
- Waiale Road
- East Waiko Road
- Kehalani Parkway
- Nokekula Loop, Haawi Street, and Kokololio Street
- Ohana Hana Loop

Potential Impacts and Mitigation Measures

Access to the proposed project will be from both Waiale Road and Kuikahi Drive, which are controlled by the County of Maui. No vehicular access is allowed from the project site onto Honoapiilani Highway, which is controlled by the State of Hawaii Department of Transportation's Highway Division.

According to the project's TIAR, traffic growth in the study area was estimated for Year 2020, resulted in an anticipated growth rate of approximately 1.9 percent per year. The project anticipated to increase traffic at the Honoapiilani Highway/Kehalani Parkway intersection by approximately 1.5 percent. Based on the forecast trips at Waiale Road/Kuikahi Drive intersection in the AM peak hour, the project will increase traffic at the intersection by approximately 2.8 percent. Based on the slight projected traffic increase from the proposed project, the following improvements are being recommended per TIAR:

- *Optimize the WaialeRoad/Kuikahi Drive signalized intersection signal timing;*
- *<u>Kuikahi Drive/Project Access:</u> Provide a new northbound leg with a shared left-turn/through lane and exclusive right-turn lane; Restripe the southbound leg to provide a shared left-turn/through lane and exclusive right-turn lane; and provide a new westbound left-turn lane with a minimum storage length of at least 5 feet or as long as feasibly possible, given the constraints from the existing eastbound left-turn lane at the Waiale Road/Kuikahi Drive intersection. (See Page 96-97 – Figure 2-1, 202)*
- *<u>Waiale Road/Project Access</u>: Provide a new northbound left-turn lane with a minimum storage length of at least 50 feet. (See Page 96-97 – Figure 2-1, 202)*

2. Drainage

A Preliminary Engineering Report (PER) report was prepared by Warren S. Unemori Engineering, Inc. for the proposed project (See Appendix D). The project site is currently vacant and formerly used for sugar cane cultivation until Wailuku sugar Company ceased its operation in the early 1980s. A small portion of the subject property is currently used as a temporary trailer office. According to the PER, the existing terrain slopes downward from the southwest to northwest across the project site is approximately 5 percent. Elevations across the project site range from approximately 360 feet above mean sea level at its southwest corner, to approximately 306 feet at its northeast corner.

According to "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai," prepared by the U.S. Department of Agriculture Soil Conservation Service, the soils within the project site are classified as Iao clay (IcB) and Iao silty clay (IaA) as the predominant soil types found on the project site. These soils are characterized as a slight to moderate erosion hazard.

According to the Flood Insurance Rate Map (FIRM), prepared by the U.S. Federal Emergency Management Agency (FEMA), the project site is situated within Flood Zone "X" which represents areas outside of the 0.2% annual chance flood plain.

According to the project's PER, three distinct drainage systems pass through the project site:

1. a natural drainageway, which conveys storm runoff from lands mauka of Honoapiilani Highway;

2. a man-made drainageway which conveys storm runoff from the residential developments in the mauka portion of Kehalani subdivision; and
3. an underground storm drainage system which conveys runoff from the makai portion of the Kehalani subdivision.

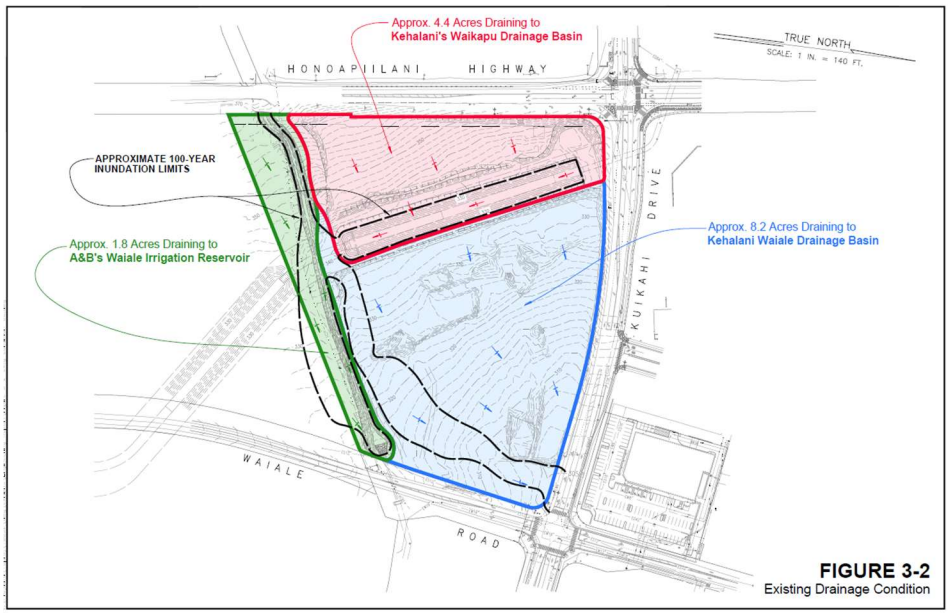


Figure 6: Existing Drainage Condition, Preliminary Engineering Report, Figure 3-2

According to the PER, the undeveloped 14.4-acre project site generates storm runoff at a 10-year peak flow rate at approximately 15 cfs. (See Appendix D - Preliminary Engineering Report).

The report estimates that the post development runoff from the project site will be 34 cfs – a 19 cfs increase over existing, undeveloped condition. As noted earlier in this report, the project's drainage system will be designed to accommodate the increase in runoff generated by the development of the entire project site. The proposed drainage system for the project consisting of drainage inlets and underground pipes will be installed throughout the development to collect the runoff sheet and will be discharged into the pre-designated connection point at the storm drain mainline on Kuikahi Drive, and in turn, convey the runoff to Kehalani Waiale Drainage Basin.

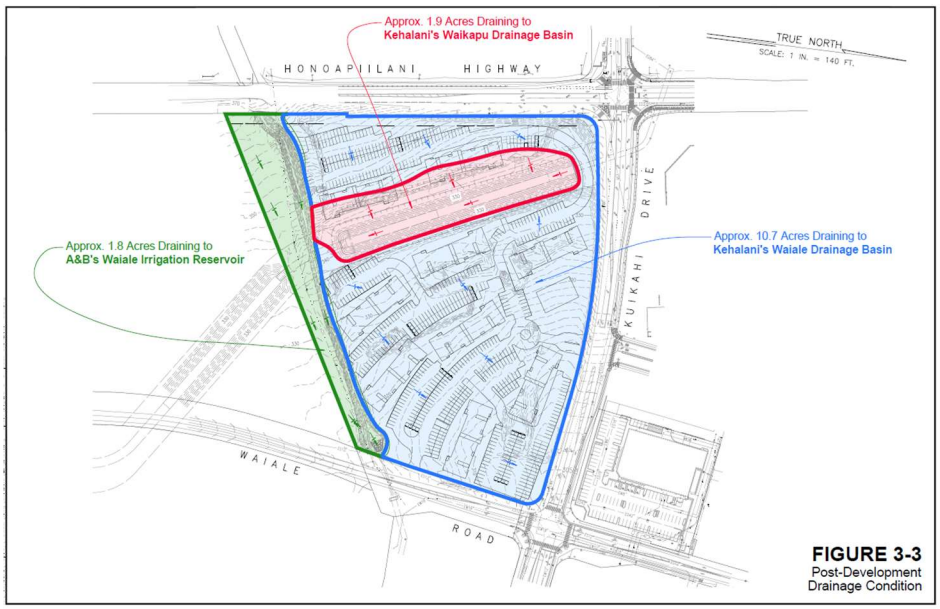


Figure 7; Post-Development Drainage Condition, Preliminary Engineering Report, Figure 3-3

<u>Potential Impacts and Mitigation Measures</u>

There will be increase in runoff sheet flowing from the project site after construction of the development. The design intent of the project will be to limit the need for extensive grading. In addition, and equally important, development of the project will also include implementation of site specific best management practices (BMPs) during construction to provide erosion control and minimize potential impacts to downstream properties. Adverse impacts on downstream properties are not anticipated with the proposed drainage improvements for the project.

The project's drainage system will be designed to accommodate the increase runoff generated by the development of the entire project site. As noted earlier in this report, once the project is developed the approximately 14.416 are project is expected to generate an onsite 10-year peak storm flow of 34 cfs - 19 cfs increase over its existing, undeveloped condition (See Appendix D – Preliminary Engineering Report).

According to project's PER, the project site will generally be graded so as to maintain the natural form of the site and maintain the drainage pattern that now exist. An urban-type storm drainage system consisting of drainage inlets and underground pipes will be installed throughout the development to collect the runoff and convey it to the northeast corner of the site where it will be discharged into the pre-designated connection point at the storm drain mainline on Kuikahi Drive. This drain line will, in turn, convey the runoff to Kehalani's Waiale Drainage Basin for disposal. The entire increase in peak storm attributable to development of the

project site will be directed to the Waiale Detention Basin which, having already been designed and constructed to accommodate the post-development runoff from the proposed project site.

The drainage improvements will be in accordance with Chapter 4, Rules for the Design of Storm Drainage Facilities in the County of Maui. Development of the proposed project will also include the implementation of site specific best management practices (BMPs) during construction to provide erosion control and minimize impacts to downstream properties.

3. Water

The proposed Wailuku Apartment project's domestic water and fire flow will be supplied by the County Department of Water Supply (DWS) from its Central Maui System. DWS' water source for the project include groundwater wells from Iao aquifer, and treated surface water from Iao Valley. The storage reservoir that will service the project site will be supplied by DWS' existing 3 million gallon Iao tank, located mauka of the project at an elevation of 506 feet. This storage tank exceeds the minimum 240,000 gallons required for the project's fire protection, and will provide ample pressure to the project site. County's water distribution system nearest to the project site consist of an existing 16-inch and 12-inch diameter mainlines. The proposed project will extend the waterlines pursuant to DWS' standards to meet the project's fire flow and domestic demand. For more detailed information and discussion regarding the water system for the proposed Wailuku Apartment project, refer to attached Preliminary Engineering Report identified as Appendix D.

<u>Potential Impacts and Mitigation Measures</u>

There will be no anticipated short-term impact to groundwater as a result of construction activities on the project site. Therefore, no mitigation measure is expected to be required. As a precautionary measure, Best Management Practices (BMPs) will be strictly enforced during the project construction.

The proposed project will be served by the Maui County Department of Water Supply (DWS) system. The domestic water demand, as determined by the Domestic Consumption Guidelines set forth by the Department of Water Supply, for the project is anticipated to be approximately 189,000 gallons per day (gpd). The proposed project will install 200-foot long, 12-inch water main extension to provide adequate fire protection and drinking water to the building apartment complex. With the installation of the 12-inch waterline for the project will meet the DWS standards with the

required 2,000 gpm with 2-hour duration fire flow for the proposed project. A single 12-inch service lateral will be extended into the project site from the 12-inch water main extension to provide both fire protection and drinking water to the building complex.

4. Wastewater

According to project's Preliminary Engineering Report prepared by Warren S. Unemori Engineering, Inc., the proposed project is expected to contribute an average 83,000 gallons per day (gpd) into the County's wastewater system. Wastewater collected from the project area is transported to the Kahului Wastewater Treatment Plant in NASKA operated by the County of Maui Department of Environmental Management.

Potential Impacts and Mitigation Measures

With approximately 83,000 gallons per day of wastewater generated by the project to the County sewerage system, wastewater from the apartment complex will be collected by an onsite gravity sewer system and convey it via 8-inch sewer service lateral connection to the existing County 12-inch diameter gravity sewer main located within Waiale Road. A 30-foot long, 8-inch diameter sewer line extension will be constructed from an existing County sewer main under Waiale Road to connect the site to the County sewer system. Wastewater generated from the project will be disposed at the Maui County's Kahului Wastewater Treatment Plant located at Naska, Kahului.

See Preliminary Engineering Report by Warren S. Unemori Engineering, Inc., dated April 28, 2017, identified as Appendix D, for more detailed information.

5. Electric, Telephone, and Cable TV

There are existing electrical transmission lines traversing along Waiale Road, Kuikahi Drive, and Honoapiilani Highway, which are in close proximity to the project site.

Maui Electric Company, Ltd., Hawaiian Telcom, and Time Warner Oceanic Cable provide electrical, telephone, and cable television services, respectively, for the proposed project.

Potential Impact and Mitigation Measures

The proposed electrical, telephone, and cable TV distribution systems to the project site will be serviced from the existing facilities along Waiale Road and Honoapiilani Highway. The project driveway entrances on Kuikahi Drive and Waiale Road will be safely illuminated using private, pole-mounted light fixtures conforming to both Maui County's Street Lighting Ordinance and Department of Public Works' lighting requirements.

The proposed electrical, telephone and cable TV distribution systems to the subject subdivision will be serviced from the existing facilities along Honoapiilani Highway and Waiale Road. Within the project complex, all distribution systems will be installed underground.

V. Consistency and Relationship to Land Use Plans, Policies, and Controls

Wailuku Workforce Apartments project is in compliance with pertinent statutory requirements of the State of Hawaii and the City and County of Honolulu. The narrative below summarizes this compliance.

A. STATE LAND USE DISTRICTS

Pursuant to Chapter 205, Hawaii Revised Statutes, all lands in the State of Hawaii have been placed into one (1) of four (4) land use districts category by the State Land Use Commission. These land use districts have been designated "Urban", "Rural", "Agricultural", and "Conservation". The proposed project site is classified "Agricultural". The proposed action involves a request for classification from "Agricultural" District to the "urban" District. Since the proposed project site is approximately 14.416-acre parcel, the Maui County Council will be the approving body as part of the project's Section 201H-38, HRS project application.

B. LAND USE COMMISSION RULES, CHAPTER 15-15, HAWAII ADMINISTRATIVE RULES

The reclassification of the subject property is in conformance with the following standards of the Urban District set forth in Chapter 15-15(18), Hawaii Administrative Rules:

Chapter 15-15(18)

- ***It shall include lands characterized by "city-like" concentrations of people, structures, streets, urban level services and other related land uses.***

  Discussion and Response:

  The proposed project is located in close proximity to the Waikapu Gardens, a 411- affordable housing subdivision. Immediately west (mauka) of the project site are existing Kehalani and Wailuku Heights residential subdivisions. Also, north boundary of the project is the Kehalani Commercial Town Center, and at east of the project is the Maui Lani Commercial Center. The project site is within the major urban growth boundary, with roughly a third of the population in the immediate area. It sits next to the two-major master planned communities in Central Maui, Maui Lani and Kehalani, with another one planned at Waikapu.

- ***It shall take into consideration the following specific factors:***

  a. ***Proximity to centers of trading and employment except where development would generate new centers of trading and employment.***

b. ***Availability of basic services such as schools, parks, wastewater systems, solid waste disposal, drainage, water, transportation systems, public utilities, and police and fire protection.***

Discussion and Response:

The project site is bounded by Kehalani Village Center, a shopping center, to the north, and Maui Lani Commercial Complex to the east. To the west of the project site is Kehalani residential subdivision. It is located approximately less than a mile from Wailuku Town which is the County seat of government and a center of trading and employment. Also, the project site is located approximately 2 miles from Kahului Town which is a major center of commercial activities, employment, and a major harbor and air transportation activities. Immediately west of the project site is the State of Hawaii's Honoapiilani Highway which serves as a major transportation route.

Basic infrastructural services such as transportation systems are available in close proximity to the project site. Both public and private schools, and public parks are in very close proximity of the project site. Drainage improvements will comply with County of Maui standards. Police, fire, and medical services also presently serve Waikapu Town and they are located in very close proximity to the project site.

- ***It shall include lands with satisfactory topography, drainage, and reasonably free from the danger of any flood, tsunami, unstable soil condition, and other adverse environmental effects.***

Discussion and Response:

Elevations cross the project site from approximately 360 feet above mean sea level at its southwest corner, to roughly 306 feet at it northeast corner. The subject site has an average slope of approximately 5 percent across the project area. Drainage improvements will be constructed in accordance to County standards.

The project site is located in Flood Zone "X" which represents areas outside of the 0.2% annual chance flood plain. The project site is not subject to tsunami inundation and unstable soil conditions.

- ***Land contiguous with existing urban areas shall be given more consideration than non-contiguous land, and particularly when indicated for future urban use on state or county general plans.***

Discussion and Response:

Lands pertaining to the subject project are in very close proximity to areas already in the Urban District, immediately adjacent to existing single-family residential developments, as well as other commercial uses in the area. The project site is also designed within the residential urban growth boundary in the Maui Island Plan.

- ***It shall include lands in appropriate locations for new urban concentration to areas of urban growth as shown on the state and county general plans.***

Discussion and Response:

The subject property is an appropriate location for an Urban District classification as it is immediately adjacent to developed lands already in the urban district classification. More importantly, the project site is within the urban growth boundary of Maui Island Plan, and growth reserve within the Kahului-Wailuku Community Plan District. The subject project is an ideal extension of the recently-developed single-family affordable residential subdivision in Waikapu, and Kehalani residential subdivision and townhomes located immediately mauka of the project site. Since the property is designated urban growth in Maui Island Plan, the property's location is considered appropriate for workforce residential housing development being bordered by housing development and commercial centers, and its close proximity to existing urban residential developments, infrastructure, and public services.

- ***It shall not include lands, the urbanization of which will contribute towards scattered spot urban development, necessitating unreasonable investment in the public infrastructure or support services.***

Discussion and Response:

The proposed reclassification and application for affordable apartment rental housing project pursuant to Section 201H-38, HRS approval does not contribute to scattered spot urban development. The project site is adjacent to existing Kehalani and Maui Lani residential subdivision and commercial centers at Kehalani and Maui Lani Parkway. The project site is designated residential urban growth boundary in the Maui Island Plan. The project site is located in close proximity of Wailuku Town – center of government services.

The proposed development will not necessitate unreasonable public investment in infrastructural facilities or public services. The applicant will comply with all applicable provisions regarding rules and regulations pertaining to infrastructure facilities.

- ***It may include lands with a general slope of twenty percent or more if the commission finds that those lands are desirable and suitable for urban purposes and that the design and construction controls, as adopted by any federal, state or county agency, are adequate to protect the public health, welfare and safety, and the public's interest in the aesthetic quality of the landscape.***

  Discussion and Response:

  The subject property is characterized as lands having an average slope of 5 percent, and is suitable for urban uses.

C. HAWAII STATE PLAN, CHAPTER 226, HAWAII REVISED STATUTES

Chapter 226, HRS, also known as the Hawaii State Plan, is a long-range comprehensive plan which serves as a guide for the future long-range development of the State by identifying goals, objectives, policies, priorities, as well as implementation mechanisms. The proposed project is consistent with the following State goals, objectives, and policies of the Hawaii State Plan:

Chapter 226-4, HRS, State Goals

(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.

Objectives and Policies of the Hawaii State Plan

The proposed reclassification and project's affordable workforce housing application pursuant to Section 201H-38, Hawaii Revised Statutes is consistent and in conformance with the following objectives and policies of the Hawaii State Plan.

Chapter 226-5, HRS, Objectives and Policies for Population

(a) It shall be the objective in planning for the State's population growth to be consistent with the achievement of physical, economic, and social objectives contained in this chapter.

(b)(1) Manage population growth statewide in a manner that provides increase opportunities for Hawaii's people to pursue their physical,

social, and economic aspirations while recognizing the unique needs of each County.

(b)(2) Encourage an increase in economic activities and employment opportunities on the neighbor islands consistent with community needs and desires.

(b)(3) Promote increased opportunities for Hawaii's people to pursue their socio-economic aspirations throughout the islands.

Chapter 226-6, HRS, Objectives and Policies for the Economy

(b)(6) Strive to achieve a level of construction activity responsive to, and consistent with, State growth objectives.

(b)(10) Stimulate the development and expansion of economic activities which will benefit areas with substantial or expected employment problems.

Discussion and Response:

The proposed project conforms with the objectives and policies of HRS 226-4, 5, and 6 for the economy, potential growth activities, and population. The proposed 14.416-acre Wailuku Apartment affordable workforce housing project will provide a wide-range of economic activities through construction of the proposed project's improvements and housing development for working families in the Kahului-Wailuku Community Plan region and for the island residents. It is anticipated that the development of this project will generate significant expenditures by the developer during the construction of the site work and construction of the apartment buildings. With the infusion of new capital expenditures on this project, these investments are expected to favorably impact the Maui economy on a broad scale. With the capital investment during the initial phase of the project development and construction of the apartment units, significant direct new construction job opportunities are expected to be created by this project. At the time of operation of the rental project will also be employing on staff leasing agents, property manager, and maintenance staff as well as outsourcing to businesses to help maintain the property is good condition.

The proposed development is intended to reflect and meet the housing needs for Maui's working families to create a livable neighborhood with amenities outside of the unit. These amenities include a recreation center, a swimming pool, and four children play areas. The architectural design of the proposed Wailuku Apartment rental units will be understated and reflect the character of its neighboring existing residential development in the surrounding area surrounded by adequate landscaping.

Chapter 226-11, HRS, Objectives and Policies for the Physical Environment - Land-Based, Shoreline, and Marine Resources

(a)(2) ***Effective protection of Hawaii's unique and fragile environmental resources.***

(b)(3) ***Take into account the physical attributes of areas when planning and designing activities and facilities.***

(b)(8) ***Pursue compatible relationships among activities, facilities, and natural resources.***

Chapter 226-12, HRS, Objectives and Policies for the Physical Environment- Scenic, Natural Beauty, and Historic Resources

(b)(5) ***Encourage the design of developments and activities that complement the natural beauty of the islands.***

Discussion and Response:

The proposed project meets with stated objective and policies of HRS 226-11 & 12 for physical environment, scenic and historic resources. The planning and design concept of the proposed project will reflect the architectural character of the neighboring residential development in Kehalani and Wailuku town, the history, location, and topography and setting of the site. View corridors and topographic features will be maintained and highlighted in the project design.

The project's design concept will embrace similar architectural design of its neighboring residential development and will meet the intent and stated objectives of HRS 226-11 & 12.

Based on thorough field assessment of the site by the applicant's consultant, no rare or endangered plant and animal species or habitats are present on site. Native habitats do not exist on the site given its history of agricultural activities of the site and equipment and material storage base yard use.

Chapter 226-13, HRS, Objectives and Policies for the Physical Environment-Land, Air, and Water Quality

(b)(2) Promote the proper management of Hawaii's land and water resources.

(b)(6) Encourage design and construction practices that enhance the physical qualities of Hawaii's communities.

(b)(7) Encourage urban developments in close proximity of existing services and facilities.

Discussion and Response:

The proposed 14.416-acre Wailuku Apartment workforce rental project is located where there is existing infrastructure ensuring proper management of Hawaii's land and resources by not expanding the infrastructure requirements in further outlying areas. The project also proposes a 3 story garden style architecture which provides a more compact development to house more people on less land but does not compromise the view planes nor over densifies the area thereby also creating efficiencies to conserve precious land and infrastructure on Maui.

The project will be designed to be complimentary to the neighboring existing residential developments in Kehalani, Maui Lani and Wailuku Town and help to meet the housing needs of Maui's working families within the Kahului-Wailuku Community Plan District. The proposed project is located along the main thorough fare to west and central Maui and in very close proximity to Kahului and Wailuku regions as well as Paia and South Maui regions. The project is inland and will not have any adverse impacts on our shoreline resources. Also, the project site is in close proximity to existing public services and facilities that are critical to the success of the project, such as the Maui Bus stop within walking distance.

Chapter 226-19, HRS, Objectives and Policies for Socio-Cultural Advancement – Housing

(a)(2) The orderly development of residential areas sensitive to community needs and other land uses.

(b)(1) Effectively accommodate the housing needs of Hawaii's people.

(b)(3) ***Increase homeownership and rental opportunities and choices in terms of quality, location, cost, densities, style, and size of housing.***

(b)(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.***

(b)(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.***

Discussion and Response:

As noted earlier in this report, the proposed workforce apartment rental housing project meets the stated objectives and policies of HRS 226-19 for the orderly development of residential areas sensitive to community needs. The proposed apartment rental project will help to meet the housing needs of Maui's residents and will increase apartment rental opportunities for Maui's workforce. It is also important to note that most residential projects are for-sale homeownership opportunities and that workforce rental projects of this scale have been minimal. About 40% of Maui's demand for housing are renters. This project will provide the opportunity for 324 households to be able to rent a quality project with amenities compared to the current rental stock which is a few decades old.

The project will also be offering a broad range of unit sizes from studios, 1-, 2-, and 3 bedrooms to accommodate small to large households. The unit size ranges approximately from 400-935sf. Since the project will also align with Maui County Code 2.96.040 income distribution requirements, 195 units will be offered at three area median income levels with the remaining 129 units at moderately priced rents.

Area Median Income (AMI) Level*	**Income Group**	**Units**	**% of Units**
80% to 100% AMI	Low Income	55	17%
101% to 120% AMI	Below-moderate Income	55	17%
121% to 140%	Moderate Income	85	26%
Total		**195**	**60%**

The design of the project will be complimentary with the surrounding residential and commercial developments in the area focusing on an architecture that keeps in tone and style familiar in Wailuku (See Appendix I – Unit Plans & Elevations). The density for the project is similar to many of the multi-family and condominium projects in the surrounding area and Wailuku Town, which helps to

create an economy of scale that lowers construction costs and is in harmony with what can be currently found in the regional area.

The proposed project is centrally located within the Wailuku-Kahului Community Plan region where a third of the housing stock is located and is conveniently accessible to public facilities, schools, transportation, and medical services making it a prime location for families who are renters.

Priority Guidelines of the Hawaii State Plan

The proposed project is consistent with the following priority guidelines of the Hawaii State Plan:

Chapter 226-103, HRS, Economic Priority Guidelines

(1) Seek 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's residents.

Discussion and Response:

The project will provide variety of economic activities for the Wailuku Town and in the Kahului-Wailuku Community Plan regions. Because of the anticipated large investment capital that will be infused in the development of the proposed apartment rental housing project, short-term construction employment opportunities will be created as a result from the development of the subdivision. Approximately $70 million dollars (exclusive of soft costs) will be invested for the construction of the proposed project, thereby creating short-term construction related jobs. The project will contribute, because of its infusion of capital investment, to the growth of Maui's economic base.

The project will also employ staff during lease-up and operations hiring a property manager, leasing agents, and maintenance staff giving economic opportunity to

those who need a job in the area. The project also intends to contract out services during operations to third party businesses on Maui who will help perform maintenance assistance such as landscaping, repairs during tenant move-outs, and other administrative services in the future which will benefit the Maui economy in the long run.

Another hidden benefit for Maui County is that the project will provide quality housing to attract the much-needed jobs that certain industries have not been able to fill such as healthcare. Having quality housing for working families and professionals will allow local small businesses to expand and grow and fill vacancies like registered nurses which are in short-supply at Maui Memorial Medical Center.

Chapter 226-104, HRS, Population Growth and Land Resources Priority Guidelines

(a)(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.

(b)(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.

(b)(2) Make available marginal or non-essential agricultural lands for appropriate urban uses while maintaining agricultural lands of importance in the agricultural district.

(b)(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.

Discussion and Response:

The proposed project is in keeping with HRS 226-104 Priority Guidelines on Population, Growth, and Land Resources. The project is located within the existing urban core of Wailuku Town where adequate public facilities and services are already available such as water and wastewater services for the proposed project. In addition, the project is located in very close proximity to parks, schools, medical facilities, fire, and police services and other public facilities that serve the

Wailuku-Kahului Community Plan District. The proposed workforce apartment rental housing project will help meet the existing and projected housing needs for Maui's working families. The project location is far inland and will not have any adverse impacts on the shoreline or conservation lands.

Chapter 226-106, HRS, Affordable Housing Priority Guidelines

(1) Seek to use marginal or nonessential agricultural land and public land to meet housing needs of low and moderate-income and gap group households.

(8) Give a higher priority to the provision of quality development of housing that is affordable for Hawaii's residents and less priority to development of housing intended primarily for individuals outside of Hawaii.

Discussion and Response:

The proposed Wailuku Apartment rental project meets the stated Affordable Housing Policy Guidelines for the provision of affordable housing pursuant to Chapter 226-106, HRS. The proposed project consists of 60% of the total apartment units will be restricted for families earning 80% to 140% of HHFDC's Maui's median income. The remaining 40% will be unrestricted units that are moderately priced apartments. The project site has been fallow and hasn't been used for agricultural purposes for decades, which sits in between a few large residential masterplans primarily providing for-sale homes. The project will add diversity to the product mix in the regional area which lacks in affordable and moderately priced rentals.

The site is currently under-utilized for a temporary office trailer. The site is centrally-located within the Wailuku-Kahului Community Plan region and surrounded with existing residential housing development, the proposed project is complementary and consistent with its neighboring residential developments.

State Functional Plans

The State Functional Plans (SFP) define actions for implementation of the Hawaii State Plan through the identification of needs, problems, and issues, and recommendations on policies and priorities, which address the identified areas of concern.

The proposed Wailuku Apartment rental housing project is consistent with the stated objectives of the following State functional plans:

a. State Agricultural Functional Plan

The proposed action to reclassify approximately 14.416 acres of land from State agricultural district to the State urban district for the proposed apartment rental project. As noted earlier in this report, the subject property has been vacant and remained fallow for decades and hasn't been used for any agricultural activities. The subject site has been used recently as a temporary storage for construction equipment and materials. The subject property is in very close proximity to existing urban uses, particularly, residential development. It is also designated as residential urban growth boundary within the approved Maui Island Plan, therefore, the proposed workforce apartment rental project at the subject site is appropriate use of the land for urban residential development. The proposed action is not anticipated to adversely impact agricultural productivity on the island.

b. State Housing Functional Plan

As noted in the Maui County's Housing Planning Study, 2011 conducted by SMS for the Maui County Department of Human Concerns and Housing, there's critical need for affordable housing especially for working families in Maui County. According to the SMS report, a significant number of Maui households live in overcrowded conditions or are "double-up" with other families. This growing public demand for affordable housing indicates a current shortage of housing inventory especially in the Wailuku-Kahului Community Plan District. With the proposed 324 apartment rental units planned within the subject property will help to address a critical community need.

County-Wide Policy Plan – County of Maui 2030 General Plan

The Countywide Policy Plan was adopted by Ordinance No. 3732 (2010) and took effect on March 24, 2010. This Policy Plan that was adopted is an update and an amendment to the Maui County's 1990 General Plan. As noted in the subject policy plan, Maui County has experienced significant changes economically, demographically, socially, and physically that must be addressed in the scope of the Countywide Policy Plan.

The purpose of the Countywide Policy Plan is to provide broad goals, objectives, policies, and implementing actions that portray the desired direction of the County's future. The Countywide Policy Plan further provides the policy framework for the development of the Maui Island Plan and the nine community plans.

The newly adopted Countywide Policy Plan advances the following core themes:

- Protect the natural environment
- Preserve local cultures and traditions
- Improve education
- Strengthen social and healthcare services
- Expand housing opportunities for residents
- Strengthen the local economy
- Improve parks and public facilities
- Diversify transportation options
- Improve physical infrastructure
- Promote sustainable land use and growth management
- Strive for good governance

According to the Countywide Policy Plan, shelter is among the most basic of human needs. The affordability, quality, and location of housing – including the degree of crowding within the home and within the neighborhood – play an enormous role in the quality of life of Maui County's residents.

The proposed Wailuku Apartment workforce rental housing project meets the following stated goals, objectives, policies, and actions of the Countywide Policy Plan – County of Maui 2030 General Plan:

E. Expand Housing Opportunities for Residents

Goal: Quality, island-appropriate housing will be available to all residents.

Objective: 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.***

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 Unites States Housing and Urban Development's median income estimates for Maui County.***

Discussion and Response:

The proposed project has a density that provides economies of scale lowering the overall cost of each unit to be able to provide a feasible workforce rental project. Maui has not seen a large-scale rental project built in over a decade that serves low-income, below-moderate income, and moderate-income households which have AMI levels between 80%-140%AMI. With the current shortage of overall housing and even a more severe rental shortage this project comes at a time of great need. Sixty percent of the project will be affordable for 30 years which is in alignment with Maui County Code 2.96.

Objective:

1. ***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:

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.***

Discussion and Response:

The project's location is ideal given its surrounding uses are mostly residential and commercial. Infrastructure is also conveniently located along Kuikahi Street and Waiale Road making it an ideal location for multi-family rentals to keep the cost of construction economical. The site is within walking distance to neighborhood serving amenities. The project site plan and unit plans assumes a broad tenant mix and household make-

up. The project is projecting a significant portion to cater to local families in the area and also roommate configurations given that 40% of Maui's renters are single individuals. In an area surrounded by for-sale homes, workforce rentals that caters to a mix of income types and age groups will provide diversity and strengthen the housing infrastructure in the Wailuku region.

Objective:

1. ***Increase and maintain the affordable housing inventory.***

Policies:

a. ***Recognize housing as basic human need, and work to fulfill that need.***

b. ***Prioritize available infrastructure capacity for affordable housing.***

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.***

Discussion and Response:

The proposed workforce apartment rental project is consistent and meets the stated goals, objectives, and policies of the Maui County's Countywide Policy Plan – 2030 General Plan. Conformance with the objectives and policies of the Maui County Policy Plan is achieved by the proposed project as it will provide needed housing for Maui's working families. As noted earlier in this report, 60% of the total units will be affordable meeting families with income of 80% to 140% of Maui's median income pursuant to Maui's HHFDC Affordable Housing Guidelines, and the remaining 40% of the units will be unrestricted and moderately priced rentals. The project designed floor plans and elevations (See Appendix I) are consistent and complimentary to the neighboring residential subdivisions in Waikapu Town.

Wailuku-Kahului Community Plan

The project site is located within the Wailuku-Kahului Community Plan region, one (1) of nine (9) community plan regions established in the County of Maui. Each region's growth and development is guided by a Community Plan. The County's Community Plan reflects current and anticipated conditions in the

Wailuku-Kahului region and advances planning goals, objectives, policies, and implementation considerations to guide decision-making in the region. The primary purpose of the Community Plan is to outline a detailed agenda for carrying out these policies and objectives. The Wailuku-Kahului Community Plan was adopted by the County of Maui through Ordinance Number 3061, Bill Number 29, and became effective on June 5, 2002. The Community Plan land use map designates the subject property as "Agricultural". As part of the project's Section 201H-38, HRS application, an exemption from the community amendment process is being sought (refer to page 78 regarding the requested exemptions, item no. 1).

The Wailuku-Kahului Community Plan identified the lack of affordable housing as one of its major problems. Similarly, the Countywide Policy Plan and the 2011 SMS report entitled "Housing Planning Study for Maui County" is one of Maui's challenges to address in order to meet this critical need and demand for affordable housing. It further recognizes that providing affordable housing opportunities for residents, specifically those earning below 80% to 140% of the Maui's median income, needs to be addressed and should be front and center of Maui's policy decision makers.

Rentals also serve those households who only have a single member. Rentals provide a housing product that allows un-related individuals to room together thereby bringing their individual housing costs down. According the Bureau of Labor Statistics, Maui's rental households are 40% single individuals. In the case of two individuals renting a two-bedroom unit, one roommate can be at 70%AMI and the second individual at 50%AMI to meet the affordability requirements for a 120%AMI restricted unit. Workforce rentals at 80% to 140% AMI in this scenario can house people are lower AMI levels. This project with 324-units will have a ripple effect in the regional area to provide opportunities for those at lower area median incomes. It will relieve pressure in homes that are currently doubling up and free up older rental stock in the area for other households.

The proposed project is consistent with the following goals, objectives, and policies of the Wailuku-Kahului Community Plan as outlined below.

Housing Goal: A sufficient supply and choice of attractive, sanitary and affordable housing accommodations for the broad cross section of residents, including the elderly.

Objectives and Policies:

> ***(1) Utilize a project district planning approach for major housing expansion areas which will allow flexibility in project planning. The will provide for flexible development standards and a mix of housing types which can result in more efficient site utilization and potential reductions in housing development costs.***

(2) Provide efficient land areas for new residential growth which relax constraints on the housing market and afford variety in type, price, and locations of units. Opportunities for the provision of housing are presently constrained by a lack of expansion areas. This condition should be relieved by a choice of housing in a variety of locations, both rural and urban in character.

(3) Seek alternative residential growth areas within the planning region, with high priority given to the Wailuku and Kahului areas. This action should recognize that crucial issues of maintaining important agricultural lands, achieving efficient patterns of growth, and providing adequate housing supply and choice of price and location must be addressed and resolved.

(8) Promote efficient housing designs in order to reduce residential home energy and water consumption.

Discussion and Response:

The proposed affordable apartment rental housing project is consistent and meets the stated goals, objectives, and policies of the Wailuku-Kahului Community Plan. As clearly noted earlier in this report, 60% of the total proposed rental units will meet in conformance with HHFDC's Affordable Housing Rent Guidelines those earning 80% to 140% of Maui's median income. The project site is centrally-located and surrounded with existing residential neighborhoods and it is in very close proximity to public facilities within community plan region. The location is ideal for multi-family residential projects given that all services and development is already located in the area creating a compact area for development versus having to sprawl development on Maui's valuable landscape. This compact development approach by concentrated residential and commercial uses in a specific area of Wailuku that already have infrastructure available to the site will not only save on infrastructure expansion requirements to outer areas but also create a more walkable environment for the local residents of Wailuku. This allows young families who may purchase a for-sale home be able to visit extended family, like grandparents, that may want to rent in the proposed project to live in the same community by providing different housing choices close to each other.

Counting Zoning

The proposed housing project site is zoned "Agricultural", according to Maui County zoning. While the current zoning does not allow for the proposed residential uses, this EA and Section 201H-38, HRS application has been prepared for submittal with the Maui County Council through the Hawaii Housing Finance & Development Corporation. Included in this draft EA and Section 201H-38, HRS filing is a request to exempt the proposed project from the County's Title 19 zoning

provisions which will allow the proposed project to be developed for workforce apartment rental housing project.

Maui Island Plan

The Maui Island Plan was adopted by Ordinance No. 4004 and took effect on December 28, 2012, provides direction for future growth, the economy, social, and environmental decisions on the island through 2030. The project site is located within the "Urban Growth Boundary" in Maui Island Plan's Kahului-Wailuku region.

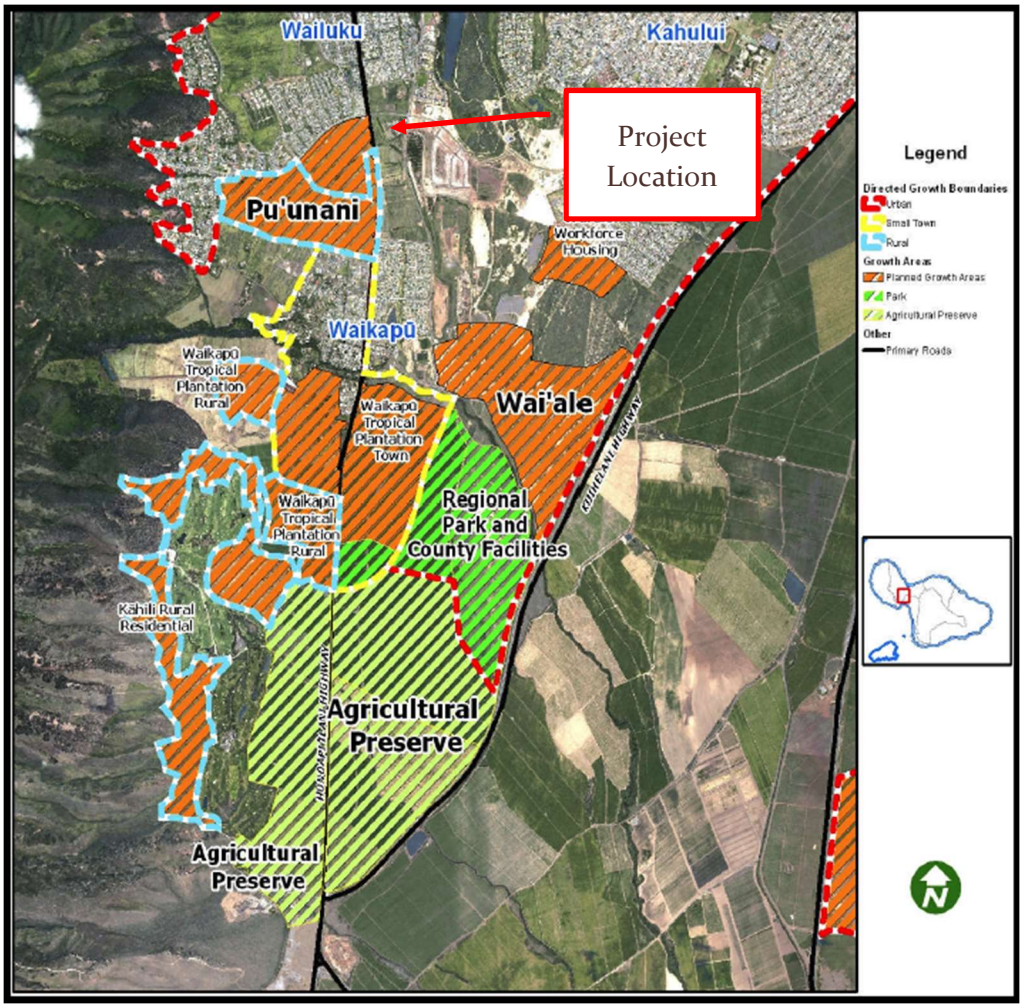


Figure 8: Maui Island Plan, 2002, Wailuku-Kahului Planned Growth Areas

It is further designated that the subject property is "Outside of Protected Areas" in Maui Island Plan (MIP). The proposed apartment rental project is consistent with the MIP's designation. The proposed Wailuku Apartment workforce housing project meets the goals, objectives, and policies as stated in Chapter 5 of the Maui Island Plan.

Coastal Zone Management Objectives and Policies

Pursuant to Chapter 205A, Hawaii Revised Statutes, projects should be evaluated with respect to Coastal Zone Management (CZM) objectives, policies and

guidelines. The subject parcel is not located within the County of Maui's Special Management Area; however, the applicability of coastal zone management considerations has been reviewed and assessed.

Recreational Resources

Objectives: Provide coastal recreational opportunities accessible to the public.

Policies:

(A) Improve coordination and funding of coastal recreational planning and management; and

(B) Provide adequate, accessible, and diverse recreational opportunities in the coastal zone management area by:

i. Protecting coastal resources uniquely suited for recreational activities that cannot be provided in other areas;

ii. Requiring replacement of coastal resources having significant recreational value, including but not limited to surfing sites, fishponds, and sand beaches, when such resources will be unavoidably damaged by development; or requiring reasonable monetary compensation to the state for recreation when replacement is not feasible or desirable;

iii. Providing and managing adequate public access, consistent with conservation of natural resources, to and along shoreline with recreational value;

iv. Providing an adequate supply of shoreline parks and other recreational facilities suitable for public recreations;

v. Ensuring public recreational use of county, state, and federally owned or controlled shoreline lands and waters having recreational value consistent with public safety standards and conservation of natural resources;

vi. Adopting water quality standards and regulating point and non-point sources of pollution to protect, and where feasible, restore the recreational value of coastal waters;

vii. Developing new shoreline recreational opportunities, where appropriate, such as artificial lagoons, artificial beaches, and artificial reefs for surfing and fishing; and

Discussion and Response:

The proposed project site is located inland, miles away from the coastline. As such, there should be no adverse impact on coastal recreational opportunities or adverse effect on existing public access to the shoreline.

Historic Resources

Objective: Protect, preserve and, where desirable, restore those natural and manmade historic and prehistoric resources in the coastal zone management area that are significant in Hawaiian and American history and culture.

Policies:

(A) Identify and analyze significant archaeological resources;

(B) Maximize information retention through preservation of remains and artifacts or salvage operations; and

(C) Support state goals for protection, restoration, interpretation, and display of historic resources.

Discussion and Response:

The proposed project does not have an adverse effect on historical or cultural resources. Archaeological Services Hawaii, LLC project's archaeological consultant for the proposed Wailuku Apartment project conducted an archaeological survey on site to assess any presence and/or absence of any historical and archaeological resources on the proposed project site. Based on the archaeological consultant's survey (refer to Appendix C) there are no archaeological and historical resources on the project site. The archaeological assessment report further noted that based on the negative findings, coupled with the compounded disturbances across the parcel, the probability of encountering in situ cultural remains is low. The report further recommends that an archaeological monitoring plan (AMP) is recommended for all future ground-altering activities. AMP is currently being prepared by ASH and will be submitted for review and approval prior to the commencement of construction activities.

Economic Uses

Objective: Provide public or private facilities and improvements important to the State's economy in suitable locations.

Policies:

(A) Concentrate coastal dependent development in appropriate areas;

(B) Ensure that coastal dependent development such as harbors and ports, and coastal related development such as visitor facilities and energy generating facilities, are located, designed, and constructed to minimize adverse social, visual, and environmental impacts in the coastal zone management area; and

(C) Direct the location and expansion of coastal dependent developments to areas presently designated and use for such developments and permit reasonable long-term growth at such areas, and permit coastal dependent development outside of presently designated areas when:

i. Use of presently designated locations is not feasible;

ii. Adverse environmental affects are minimized; and

iii. The development is important to the State's economy.

Discussion and Response:

The proposed project is not a coastal dependent development. The project site is miles inland from the shoreline. The proposed project will stimulate the economy through the generation of construction jobs and related job opportunities during the development of the proposed apartment housing project. The proposed project is consistent with the objective and policy for economic use.

Coastal Hazards

Objectives: Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, subsidence, and pollution.

Policies:

(A) Develop and communicate adequate information about storm wave, tsunami, flood, erosion, subsidence, and point and nonpoint source pollution hazards;

(B) Control development in areas subject to storm wave, tsunami, flood, erosion, hurricane, wind, subsidence, point and non-point pollution hazards;

(C) Ensure that developments comply with requirements of the Federal Flood Insurance Program;

(D) Prevent coastal flooding from inland projects; and

(E) Develop a coastal point and nonpoint source pollution control program.

Discussion and Response:

As noted earlier in this report, the project site is in Flood Zone "X", which represents areas outside of the 0.2% annual chance flood plain, according to FEMA. In addition, tsunami inundation parameters do not apply to the subject project.

Beach Protection

Objective: Protect beaches for public use and recreation.

Policies:

(A) Locate new structures inland from the shoreline setback to conserve open space ad to minimize loss of improvements due to erosion.

(B) Prohibit construction of private erosion-protection structures seaward of the shoreline, except when they result in improved aesthetic and engineering solutions to erosion at the sites and do not interfere with existing recreational and waterline activities; and

(C) Minimize the construction of public erosion-protection structures seaward of the shoreline.

Discussion and Response:

The proposed project is located miles inland, away from the shoreline and as a result, there is no anticipated adverse impact on beaches.

Marine Resources

Objective: Implement the State's ocean resources management plan.

Policies:

(A) ***Exercise an overall conservation ethic, and practice stewardship in the protection, use, and development of marine and coastal resources;***

(B) ***Assure that the use and development of marine and coastal resources are ecologically and environmentally sound and economically beneficial;***

(C) ***Coordinate the management of marine and coastal resources and activities management to improve effectiveness and efficiency;***

(D) ***Assert and articulate the interests of the State as a partner with federal agencies in the sound management of ocean resources within the United States exclusive economic zone;***

(E) ***Promote research, study, and understanding of ocean processes, marine life, and other ocean resources in order to acquire and inventory information necessary to understand how ocean development activities relate to and impact upon ocean and coastal resources; and***

(F) ***Encourage research and development of new, innovative technologies for exploring, using, or protecting marine and coastal resources.***

Discussion and Response:

As previously stated, the proposed project is located miles inland, away from the ocean and is therefore, no anticipated adverse impact on marine or coastal resources. Appropriate Best Management Practices (BMP) will be utilized to ensure that construction runoff is appropriately captured, minimizing any impact on coastal waters.

Scenic and Open Space Resources

Objective: Protect, preserve, and where desirable, restore or improve the quality of coastal scenic and open space resources.

Policies:

(A) ***Identify valued scenic resources in the coastal zone management area.***

(B) ***Ensure that new developments are compatible with their visual environment by designing and locating such developments to minimize the alteration of natural landforms and existing public views to and along the shoreline.***

(C) ***Preserve, maintain and, where desirable, improve and restore shoreline open space and scenic resources.***

(D) Encourage those developments which are not coastal dependent to locate in inland areas.

Discussion and Response:

The proposed apartment rental project will not adversely impact the scenic and open space resources. The project will involve minimum alteration of the existing topographic character of the project site and will not impact public views to and along the coastal shorelines.

Public Participation

Objective: Stimulate public awareness, education, and participation in coastal management.

Policies:

(A) Maintain a public advisory body to identify coastal management problems and to provide policy advice and assistance to the coastal zone management;

(B) Disseminate information on coastal management issues by means of educational materials, published reports, staff contact, and public workshops for persons and organizations concern with coastal-related issues, developments, and government activities; and

(C) Organize workshops, policy dialogues, and site-specific mediations to respond to coastal issues and conflicts.

Discussion and Response:

The project will meet county public awareness, education and participation objectives. Community meetings with the Waikapu Community Association Board of Directors and members were held on May 8 and June 6, 2017 to solicit input from the public regarding the proposed project. Also, a meeting was held with Kehalani Homeowners' Board of Directors on May 16, 2017. Meetings with individual local elected officials were also held to brief them and solicit comments regarding the proposed project. In addition, opportunities for agency and further public review of the proposed action are provided through the notification review and comment processes of the County.

VI. Alternatives to the Proposed Action

The following is a discussion of the various alternative options that have been considered by the Applicant as part of the planning process that will provide needed workforce housing units for Maui's working families.

A. PREFERRED ALTERNATIVE

After a series of community association meetings and in consultation with various local County officials, the proposed 324 workforce apartment rental units represents the preferred option for the project. This option will help to address the critical demand for affordably-priced apartment rental units for Maui's working families. As shared by the local officials and various stakeholders, the lack of housing on Maui has reached to a critical level that are now affecting the quality of life of the residents of Maui. As noted during the recent Maui Affordable Housing Summit, Ms. Carol Reimann, Director of Maui Department of Housing and Human Concerns, reported that the current yearly demand for housing on Maui is estimated at 1,400 units. It was also reported that the lack of workforce housing has contributed to Maui's homeless problem.

This preferred option to develop 324 workforce housing units on the approximately 14.416 acres site as shown in the preliminary site plan (Appendix B) will help meet this critical house need on the Island of Maui. The proposed project consists of 9-3 story buildings, with studio, 1-bedroom, 2-bedroom, and 3-bedroom units, ranging in size of approximately 400 square feet to 950 square feet living area.

B. AGRICULTURE SUBDIVISION

The Applicant has evaluated the use of the project site as an agricultural subdivision alternative based on project site current land use designation. Based on the sliding scale pursuant to Chapter 19.30A.030, Maui County Code, Agricultural Zoning District, this scenario only produces approximately 7 agricultural lots consisting of minimum 2-acre lot subdivision. This option will not address the current critical demand for workforce housing for Maui's residents which is estimated to be 1,400 housing units per year. The Applicant strongly believe that its proposed 324 workforce apartment rental unit that is reasonably-priced for families earning 80% to 140% of Maui's median income per HHFDC's affordable rent guidelines will help meet the housing shortage on Maui.

C. NO ACTION

Under the "no action" alternative, the project site will not be developed for workforce apartment rental housing project, and this no action option would involve the continued under-utilization of the 14.416-acre property. This

alternative option will not address the current critical demand for housing for Maui's working families.

VII. Neighborhood and County Officials Informational Meetings

As noted earlier in this report, the project's applicant held several community meetings with the Waikapu Community Association Members, consisting of members of the Waiolani subdivision and the Waikapu Gardens Phases 1 & 2 subdivisions, and Waikapu Town homeowners.

The Waikapu Association meeting was held on June 6, 2017 at the Waikapu community Center with the officers and board members of the association. At the meeting, a preliminary conceptual subdivision layout was presented by the applicant. It was also presented that the project will include a total of 324 apartment units at the property located approximately 1 mile north of Waikapu Town. Sixty percent of the total units will be for families earning 80 percent to 140 percent of Maui median income. The applicant noted that access to the proposed subdivision will be Waiale Road and Kuikahi Drive. It was also presented by the project's traffic engineer that road improvements will be constructed at Waiale Road fronting the property and Kuikahi Drive to mitigate the anticipated traffic impact of the project. The applicant also presented the preliminary floor plans as well as building plan with the elevation to ensure that the view plain impact is minimized. Also, a meeting was held with the Kehalani Homeowners' board of directors on May 16, 2017 and the applicant presented a brief overview of the project. Traffic mitigation plan was shared by the applicant and proposed crosswalk improvement was presented in response to concerns raised by the association. A meeting was also held on April 27, 2017 with Ms. Monique Yamashita, Executive Director, Ka Hale A Ke Ola and Hale Makana, located northeast of the project site.

A meeting was held with the members of the Faith Action Community Equity (F.A.C.E.) Maui – Affordable Housing Coalition on June 6, 2017 at the Christ The King Church in Kahului. There were 22 members of coalition members attended the meeting. The applicant presented brief summary and overview of the proposed Wailuku Apartment rental project. There was a general consensus the need for workforce rental housing project for Maui's working families. Some concerns raised related to affordability – project should consider rents meeting 50 percent or below of Maui's median income. It was shared by the applicant that since the project is not supported by government grants or subsidies – it will be financially difficult to develop such a rental project. The target market for the proposed project is the gap group earning 80 percent to 140 percent of Maui's median income. The members also shared traffic concerns – and the applicant presented mitigation plan to minimize the anticipated traffic impact of the project.

Common theme that was shared during the various meetings held with the community is the need for more workforce housing units for Maui's working families.

In addition, the following local elected and appointed officials were consulted for the preparation of Section 201H-38, HRS application and draft environmental assessment:

- Honorable Alan Arakawa - Mayor, County of Maui
- Honorable Michael White – Chair, Maui County Council
- Honorable Robert Carroll – Vice Chair, Maui County Council
- Honorable Alika Atay – Councilmember
- Honorable Elle Cochran – Councilmember
- Honorable Stacy Crivello - Councilmember
- Honorable Don Guzman – Councilmember
- Honorable Kelly King – Councilmember
- Honorable Yuki Lei Sugimura – Councilmember
- Ms. Carol Reimann – Director, Maui Dept. of Housing and Human Concerns
- Mr. David Goode – Director, Maui Dept. of Public Works
- Ms. Rowena Dagdag Andaya – Deputy Director, Maui Dept. of Public Works
- Mr. Clayton Yoshida – Planning Program Administrator, Maui Dept. of Planning

VIII. List of Agencies to Review and Comment on the Draft Environmental Assessment and Section 201H-38, HRS Application

The draft Environmental Assessment Section 201H-38, HRS agency and public review document will be transmitted to the following agencies for review and comment prior to finalizing the said documents:

Federal

- U.S. Fish and Wildlife Service
- U.S. Army Corp. of Engineers
- U.S. Postal Service

State of Hawaii

- Senator Gilbert Keith-Agaran
- Representative Joseph M. Souki
- Representative Justin H. Woodson
- Representative Kyle T. Yamashita
- Department of Agriculture
- Department of Business, Economic Development & Tourism (DBEDT)
- DBEDT – Office of Planning
- Department of Defense
- Department of Education
- Department of Hawaiian Homelands (DHHL)
- Department of Health (DOH)
- Department of Land and Natural Resources (DLNR)
- DLNR – Historic Preservation Division
- Department of Transportation (DOT)
- DOT – Maui Highway Division
- Hawaii Housing Finance and Development Corporation (HHFDC)

- State Land Use Commission, Commissioner Arnold Wong, Chair
- Office of Hawaiian Affairs (OHA)

Maui County

- Maui Mayor's Office
- Maui County Council Members
- Department of Housing and Human Concerns
- Department of Environmental Management
- Department of Finance
- Department of Fire and Public Safety
- Department of Parks and Recreation
- Department of Planning
- Department of Public Works
- Maui Police Department
- Department of Transportation
- Department of Water Supply
- Maui Planning Commission, Sandra Duvauchelle, Chairperson

Other

- Maui Electric Company
- Waikapu Community Association, Chair
- Kehalani Homeowners Association, Chair

IX. Requested Exemptions and Deferrals Pursuant to Section 201H-38, HRS

A. INTRODUCTION

Hawaii Revised Statutes (HRS) Section 201H-38, "Housing development; exemption from statutes, ordinances, charter provision, and rules" allows developers of eligible Section 201H-38, HRS projects to seek exemptions from all statutes, ordinances, and rules of any governmental agency relating to planning, zoning, and construction standards that do not negatively affect the health and safety of the general public in exchange for providing affordable housing.

Wailuku Workforce Apartments will be a 324-unit workforce rental project, with 60% or 195-units offered to households earning 80-140% of the Area Median Income. This project will be Maui County's first major workforce rental project of sizable scale in over 30 years. Most of Maui County's current projects in the development pipeline are affordable or workforce for-sale homes. The project serves a large unmet demand for rental housing, whereby 6,709 units are required by 2025. The median price of a home in Maui County continues to increase by 17% this year compared to last year taking the median over $700,000 which effectively prices out many from homeownership. In response to this increasing workforce rental demand pressure, high cost of construction, and limited availability of zoned land, the requested exemptions and deferrals are sought.

The exemption and deferral requests which follow are necessary to achieve and maintain the financial feasibility of the project and thereby reduce the per unit cost of the project. If the proposed exemptions and deferrals are granted, Legacy Wailuku LLC, the State of Hawaii, and Maui County will be able to offer 324-units of workforce housing with 60% restricted from 80-140% AMI.

A table of requested exemptions and deferrals are provided in this section including the rationale for each request.

B. SUMMARY TABLE OF REQUESTED EXEMPTIONS AND DEFERRALS

	Development Standard or Requirement	Relevant Sections/ Requirement	Requested Exemption	Est. Value Where Appropriate	Applicable Agency & Comments	Rationale for Request
1.	General plan and community plans	Title 2, Maui County Code, Administration and Personnel	An exemption from Chapter 2.80B, MCC, General Plan and Community Plans, shall be granted to permit the project to proceed without obtaining a community plan amendment.		Maui County Dept. of Planning	This exemption expedites the delivery of affordable workforce housing. The current site is designated as "Urban Growth" in the Maui Island Plan.
2.	Offsite Street Tree Planting	Title 12, Maui County Code: Streets, Sidewalks, and Public Places Section 12.24A.070 - Planting of Street Trees	Allow the required number, species and location of street trees along Honoapiilani Highway, Waiale Road and Kuikahi Drive to conform to the proposed concept landscape plan. *Reference Exhibit B – Preliminary Landscape Plan*	$9,600	Maui County Dept. of Planning	This exemption allows the development the flexibility to create an attractive streetscape in a cost-effective manner. It also creates flexibility in location of trees.
3.	Offsite Bike and Pedestrian Connectivity	Title 12, Maui County Code: Street, Sidewalks, and Public Places Resolution 12-34 - County "Complete Streets" Policy	Limit required bicycle and pedestrian improvements to those which appear on the proposed site plan. *Reference Exhibit A-Preliminary Concept Site Plan, Figure 2-1 (Proposed Access Improvements), Figure 2-2 (Typical Street Sections)*	$1,075,010	Maui County Dept. of Planning and Maui County Dept. of Public Works	Kuikahi Drive currently has an entry to the project site and directly across it is an entry into the Kehalani Village Center which creates an intense flow of traffic for pedestrians. Because of pedestrian life safety the project would like to limit the availability for pedestrians to traverse this area and instead redirect them an existing crosswalk located at Kuikahi Drive and Waiale Road where it is signalized. Waiale Road will have an at-grade

	Development Standard or Requirement	Relevant Sections/ Requirement	Requested Exemption	Est. Value Where Appropriate	Applicable Agency & Comments	Rationale for Request
						concrete sidewalk and also a bike lane for pedestrians. The Maui Bus stop is also located along Waiale Road, therefore providing a directed pedestrian path from the project site to the Kuikahi Drive and Waiale Road intersection, and a safe route for pedestrians to access the commercial center and the bus stop. Not only will this provide safe pedestrian access for residents in the area, but this exemption will create major savings that will help to achieve financial feasibility.
4.	Tree Planting in Onsite Parking Lots	Title 12, Maui County Code: Street, Sidewalks, and Public Places Maui County Planting Plan, Chapters 2 and 4	Allow the required number, species and location of street trees in parking lots to conform to the proposed site plan. *Reference Exhibit B – Preliminary Landscape Plan*	$8,800	Maui County Dept. of Public Works	This exemption allows the development the flexibility to create an attractively landscaped site and screen the parking lots in a cost-effective manner.
5.	Offsite Water System Infrastructure Improvements	Title 14, Maui County Code: Public Services Section 14.01.040 - Definitions; Section	Exempt the project from non-discretionary water system improvement requirements which compel the installation of offsite water system infrastructure that		Maui County Dept. of Water Supply	This exemption corrects the definition in the County Water Code which classifies an apartment complex as a "subdivision," thereby relieving it

	Development Standard or Requirement	Relevant Sections/ Requirement	Requested Exemption	Est. Value Where Appropriate	Applicable Agency & Comments	Rationale for Request
		14.05 - Subdivision Water System Requirements; and Section 14.05.090 - Fire Protection	may not be appropriate for the proposed residential apartment complex.			of offsite water system improvement requirements that are more suited to residential and commercial subdivisions. All health and safety requirements will be met.
6.	Offsite Fire Hydrants on Public Streets	Title 14, Maui County Code: Public Services Section 14.05.090.B[6] - Fire Protection	Exempt the development from having to install additional fire hydrants along Kuikahi Drive, Waiale Road, and Honoapiilani Highway where they are not needed to protect the project buildings.	$271,000	Maui County Dept. of Water Supply	The project buildings will be fully protected by onsite fire hydrants and automatic fire sprinklers. This exemption will allow the project to avoid the expense of installing additional fire hydrants along the streets that are not needed for fire protection.
7.	Water Availability for Market Apartments	Title 14, Maui County Code: Public Services Section 14.12 - Water Availability	Exempt the project from the Water Availability requirements of MCC 14.12, which typically requires a study to be done by the developer to identify the water source so that the development can be initially issued a water meter of sufficient capacity to allow all planned buildings to be occupied and avoid building	$50,000[7]	Maui County Dept. of Water Supply	This exemption to the County Water Code will ensure that the project can concurrently build workforce and market-rate units and thereby remain economically viable. This exemption waives the project from having to perform a study

[6] Ref. MCC 14.05.090.B Fire Protection:
"The spacing of fire hydrants along the streets shall be not more than two hundred fifty feet apart in business, commercial, industrial, hotel and apartment districts, not more than three hundred fifty feet apart in residential districts, and not more than five hundred feet apart in rural and agricultural districts."

[7] It is assumed that a study will cost about $50,000.

	Development Standard or Requirement	Relevant Sections/ Requirement	Requested Exemption	Est. Value Where Appropriate	Applicable Agency & Comments	Rationale for Request
			permits being withheld subject to water source considerations.			and also expedites the delivery of affordable housing.
8.	Wastewater Assessment Fees	Title 14, Maui County Code, Chapter 14.35	Exemption from Chapter 14.35, MCC, Wastewater Assessment Fees for Facility expansion for the Wailuku/Kahului Wastewater Treatment System, shall be granted to exempt the project from wastewater assessment fees.	$377,460[8]	Maui County Dept. of Water Supply	This exemption will allow the development to reduce its costs to indirectly subsidize 195 affordable workforce rental units.
9.	Offsite Public Street Frontage Improvements: Pavement Widening; Installing Curbs, Gutters and Sidewalks	Title 16, Maui County Code: Buildings and Construction Section 16.26B.3600 - Chapter 36: Improvements to Public Streets	Exempt the development from having to construct pavements, curbs, and sidewalks along Kuikahi Drive, Waiale Road, and Honoapiilani Highway when doing so will offer little or no benefit to project residents but whose cost will add significantly to their rents. Instead the project will provide a paved at-grade sidewalk, a raised asphalt curb painted white to delineate the pedestrian safety zone and also provide a bike lane along Waiale Road. *Reference Exhibit A-Preliminary Concept Site Plan, Figure 2-1*	Please see value for Exemption Item 3.	Maui County Dept. of Public Works	This exemption will allow the development to avoid the expense of constructing widened pavements, curbs and sidewalks along Kuikahi Drive, Waiale Road and Honoapiilani Highway in non-essential locations where such improvements would offer little benefit to project residents. The project intends to install an at-grade sidewalk and bike lane along Waiale Road.

[8] Water assessment fees are $1,165/unit

	Development Standard or Requirement	Relevant Sections/ Requirement	Requested Exemption	Est. Value Where Appropriate	Applicable Agency & Comments	Rationale for Request
			(Proposed Access Improvements), Figure 2-2 (Typical Street Sections)			
10.	Offsite Public Street Frontage Improvements: Undergrounding Overhead Utility Lines	Title 16, Maui County Code: Buildings and Construction Section 16.26B.3600 - Chapter 36: Improvements to Public Streets	Exempt the development from having to relocate the existing overhead utility lines underground along Waiale Road when doing so will offer little or no benefit to project residents but whose cost will add significantly to their rents. Instead the project will relocate an existing overhead utility line in a new location along Waiale Road as an overhead utility line. *Reference Exhibit A-Preliminary Concept Site Plan*	$314,200	Maui County Dept. of Public Works	This exemption will prevent the development from being compelled to pay for the relocation of existing overhead utility lines along Waiale Road underground, as this is a non-essential improvement that will not benefit project residents.
11.	Offsite Public Street Frontage Improvements: Installation of Street Lights on Public Streets	Title 16, Maui County Code: Buildings and Construction Section 16.26B.3600 - Chapter 36: Improvements to Public Streets	Exempt the development from installation of additional street lighting along Kuikahi Drive, Waiale Road and Honoapiilani Highway (except as per the surrounding Community context of lighting and improving intersections) when doing so will not comply with MCC	$84,300	Maui County Dept. of Public Works	In accordance with MCC 16.26B.3600 the intention is to provide similar lighting conditions that exist adjacent to and along Honoapilani Highway, Kuikahi Drive and Waiale Road. These public roadways are equipped with paved shoulders that allow for bike

Development Standard or Requirement	Relevant Sections/ Requirement	Requested Exemption	Est. Value Where Appropriate	Applicable Agency & Comments	Rationale for Request
		16.26B.3600 and will also offer little or no benefit to project residents but whose cost will add significantly to their rents. *Reference Exhibit C – Diagram of On-Site Lighting Locations & Specifications - for Electrical Engineer's Requirement on internal street lights and concept specifications for proposed area lights.*			access. Improved intersections with lighting occur only at roadway intersections in the immediate community surrounding the Project. It is proposed to conform to the Community standard, the two new project driveways will be lighted from on-site area light poles at the intersection with the public right-of-ways. These area lights will provide lumens similar to the existing adjacent intersections at the ground plane. The public sidewalk proposed between the Project East Entrance and the intersection of Kuikahi and Waiale Road will also be lighted from on-site area light poles. *Reference Exhibit C – Diagram of On-Site Lighting Locations & Specifications - for Electrical Engineer's Requirement on internal street lights and concept specifications for proposed area lights.*

	Development Standard or Requirement	Relevant Sections/ Requirement	Requested Exemption	Est. Value Where Appropriate	Applicable Agency & Comments	Rationale for Request
12.	Onsite Storm Water Quality Improvements	Title 16, Maui County Code: Buildings and ConstructionSection 16.26B.3900 - Chapter 39: Post-Construction Storm Water Quality Best Management Practices	Allow the development to satisfy its storm water treatment requirements offsite, at the receiving drainage basins located downstream of the project, rather than require that all treatment be done onsite. *Reference Figure 3-4 (Storm Drainage Improvements)*	$112,000	Maui County Dept. of Public Works	This exemption will exempt the project from payment of fees for installation of onsite storm water treatment facilities whose function is already provided by existing offsite drainage facilities located immediately downstream of the project which perform this same function. Permanent onsite storm water quality treatment alternatives will also be explored on site to take care of a portion of the project's storm water. The options to be explored are parking lot planter retention, hydrodynamic separators, or filter baskets at some of the drain inlets.
13.	Onsite Fire Truck Turn-arounds	Title 16, Maui County Code: Buildings and Construction Section 16.04C.010 - State Fire Code Section 18.2.3.4.4 Dead Ends	Allow the development to construct parking areas with dead-ends up to 300 feet long without a fire truck turnaround when safety is not compromised.		Maui County Dept. of Fire & Public Safety	The use of dead-end parking bays of up to 300 feet is necessary to achieve the building density that makes this project feasible. <u>To compensate for the lengthened distance between turnarounds, buildings will be fully protected with automatic fire sprinklers and onsite fire hydrants will be located so as to minimize the need for fire trucks to enter and</u>

	Development Standard or Requirement	Relevant Sections/ Requirement	Requested Exemption	Est. Value Where Appropriate	Applicable Agency & Comments	Rationale for Request
						back out of these deeper parking bays to extinguish fires.
14.	Inspection fees	Title 16, Maui County Code: Buildings and Construction Section 16.04C, 16.18B, 16.2B, 16.26B	Exemptions from MCC Chapters: • 16.04C, Fire Code, • 16.18B, Electrical Code, • 16.20B, Plumbing Code, and • 16.26B, Building Code, shall be granted to exempt the project from fire, electrical, plumbing, and building inspection fees.	• $61,110 • $58,816 • $100,737 • $611,020[9]	Maui County Dept. of Fire & Public Safety	These exemptions provide savings to ensure the project is financially feasible. The project intends to meet all inspection and code requirements.
15.	Permit fees	Title 16, Maui County Code: Buildings and Construction Section 16.04C	An exemption from MCC Chapter 16.04C, Fire Code, shall be granted to exempt the project from any permit fees required by the Fire Code.	See Exemption Item 14	Maui County Dept. of Fire & Public Safety	These exemptions provide savings to ensure the project is financially feasible.
16.	Zoning and community plan amendment	Title 18, Maui County Code	Exemptions from Section 18.04.030, MCC, Administration, and Section 18.16.020, MCC, Compliance, shall be granted to exempt the project from		Maui County Dept. of Public Works	This exemption expedites the delivery of affordable workforce housing. The current site is

[9] Includes review and permit fee based on $70million estimated cost to construct the project

	Development Standard or Requirement	Relevant Sections/ Requirement	Requested Exemption	Est. Value Where Appropriate	Applicable Agency & Comments	Rationale for Request
		Section 18.04.030, Section 18.16.020	obtaining a change in zoning and community plan amendment.			designated as "Urban Growth" in the Maui Island Plan.
17.	Offsite Public Street Frontage Improvements: curbs, gutters and sidewalks	Title 18 and 16, Maui County Code Sections 18.20.040, 18.20.070, 18.20.080, 16.26B.3600	An exemption from Sections 18.20.040, 18.20.070, 18.20.080, and 16.26B.3600, MCC, as they relate to the urban standards for curbs, gutters, and sidewalks shall be granted for the portions of the Project adjacent to Waiale Road. Instead the project will provide an at-grade sidewalk and bike path along Waiale Road with a raised asphalt curb painted white to delineate the pedestrian safety zone. *Reference Exhibit A-Preliminary Concept Site Plan, Figure 2-1 (Proposed Access Improvements), Figure 2-2 (Typical Street Sections)*	Please see value for Exemption Item 3	Maui County Dept. of Public Works	Per meeting with Maui Dept. of Public Works an "at grade" sidewalk will be constructed consistent with adjacent to recently approved affordable housing project. Figure 2-2 located on page 93 depicts a rural-style painted asphalt curb between the main pavement and the pedestrian sidewalk on Waiale Road. Note that the actual physical distance between the proposed sidewalk and the outer edge of the southbound vehicle lane on Waiale Road will actually be 9 feet or more, which is considered reasonably safe; however, the added curb would serve as a tangible gesture toward pedestrian safety as well as prevent cars from parking on the shoulder. *Reference Figure 2-2 (Typical Street Sections)*

	Development Standard or Requirement	Relevant Sections/ Requirement	Requested Exemption	Est. Value Where Appropriate	Applicable Agency & Comments	Rationale for Request
18.	Maximum Building Heights When Measured on Fill	Title 19, Maui County Code: Zoning Section 19.04.040 - Building Height Definition	Allow building heights to be measured from finish grade, rather than the lower of natural or finish grade.		Maui County Dept. of Planning	The slope of the natural terrain and presence of active drainage channels on the site require that the proposed large-footprint apartment buildings be placed either partially or fully on fill. This exemption will make it possible to construct the desired buildings on fill without violating the proposed building height restrictions.
19.	Public hearings on the State Land Use District Boundary Change	Section 205-3.1, HRS and Section 19.68.040, Maui County Code Section 19.68.020, MCC, Applications, Section 19.68.030, MCC, Procedures, and Section 8-8.4, Maui County Charter	Pursuant to Section 205-3.1, HRS and Section 19.68.040, Maui County Code (MCC), the Maui County Council shall be the decision-making authority for the requested state land use district boundary change/reclassification to reclassify the approximately 14.416 acres of the property containing 324 apartment rental units from the State Agricultural District to the State Land Use Urban District. Exemptions from Section 19.68.020, MCC, Applications, Section 19.68.030, MCC, Procedures, and Section 8-8.4, Maui County Charter, are requested to exempt the project from: a) the need to file an application for a boundary		Maui County Planning Department	Multiple public hearings would be reduced by this exemption, thereby expediting the delivery of affordable workforce housing. Since the subject property is within the State Land Use Agricultural District, with this EA and 201H, HRS application, the applicant is also requesting that the Maui County Council approve a State Land Use District Boundary Amendment pursuant to Section 205-3.1, HRS and Section 19.68.040, Maui County Code (MCC), to reclassify approximately 14.416 acres of the subject property for the proposed 324 apartment rental project from the State Agricultural District to

Development Standard or Requirement	Relevant Sections/ Requirement	Requested Exemption	Est. Value Where Appropriate	Applicable Agency & Comments	Rationale for Request
		change/reclassification of state land use district boundaries for the approximately 14.416 acres of the property for the proposed apartment rental units; and b) the procedures associated with such applications, including the requirement for the Maui Planning Commission to conduct a public hearing on the requested boundary change/reclassification. However, the Applicant is not requesting an exemption to Section 19.68.040, MCC, which provides for the Maui County Council to: a) consider the boundary change/reclassification; b) hold hearings; and c) take evidence and testimony; d) be the decision-making authority on the boundary change/reclassification; and e) impose conditions upon the proposed use of the property to prevent adverse effects upon public health and safety.			the State Land Use Urban District. According to the Wailuku-Kahului Community Plan District, the subject property is designated "Agriculture," hence, the Applicant is requesting exemptions from Community Plan (CPA) and Change-In-Zoning (CIZ) amendments to expedite the implementation and delivery of the proposed workforce apartment rental project to Maui's residents without compromising health and safety considerations. This project meets the intent of Maui Countywide Policy Plan and the Wailuku-Kahului Community Plan District goals and objectives relating to providing and expanding affordable housing opportunities for Maui's residents.

	Development Standard or Requirement	Relevant Sections/ Requirement	Requested Exemption	Est. Value Where Appropriate	Applicable Agency & Comments	Rationale for Request
20.	Agricultural District	Title 19, Maui County Code: Zoning Section 19.30A – Agricultural District	Exempt the development from County Agricultural District requirements as allowed for under MCC 19.30A.100.B[10], and including exemptions from compliance with the following recorded documents that were required for, and apply only to, land within the Agricultural District: • Subdivision Agreement (Agricultural Use) dated January 26, 1995, recorded in the Bureau of Conveyances of the State of Hawaii as Document No. 95-019375. Agreement for Allocation of Future Subdivision Potential dated November 3, 2004, recorded in the said Bureau of Conveyances as Document No. 2004-227693.		Maui County Planning Department	This exemption cleans up all title issues related the Agricultural zoning conditions placed on this property since this creates the ability for additional density to be allowed on the subject parcel.

[10] Ref. MCC 19.30A.100 - Exemptions pursuant to state law.
"B. Affordable housing projects as set forth in chapter 201E, Hawai'i Revised Statutes, shall be exempt from the requirements of this chapter."

	Development Standard or Requirement	Relevant Sections/ Requirement	Requested Exemption	Est. Value Where Appropriate	Applicable Agency & Comments	Rationale for Request
21.	Park Assessment Fee	Maui County Code Chapter 18.16.320 (I)(5) – Park Assessment Fee	An exemption from Chapter 18.16.320 (I)(5), MCC, Park Assessment Fee, shall be granted to exempt the project from Maui County's park assessment fee.	$1,782,000[11]	Maui County Dept. of Parks and Recreation	This exemption will allow the development to reduce its costs to indirectly subsidize 195 affordable workforce rental units. The area also includes five county parks for residents within a 2-mile radius. The project also includes four children play areas that act as internal parks within the project totaling 16,823sf of area.
22.	Onsite Water Pipes	Maui County Department of Water Dual System Policy	Allow the development to provide both drinking water and fire protection from the same onsite water main.	$200,000	Maui County Dept. of Water Supply	This exemption will allow the development to reduce its infrastructure costs by avoiding unnecessary duplication of water system piping while still providing safe drinking water and fire protection in accordance with all applicable Building Codes.
23.	Property is Zoned Agricultural District	Chapter 19.30A	Allow A-2 Apartment District Development Standards to govern the project plan approvals with exemptions listed below.		Maui County Dept. of Planning	Proposed housing development is not permitted in AG District. The land is fallow and not used for agriculture. The site is adjacent to existing urban development along Kuikahi Drive. This exemption would allow that the project to utilize A-2 Apartment District

[11] Park assessment fee for multi-family is $5,500/unit

	Development Standard or Requirement	Relevant Sections/ Requirement	Requested Exemption	Est. Value Where Appropriate	Applicable Agency & Comments	Rationale for Request
						Development Standards with a few exceptions. Following the A-2 Development Standards prevent confusion with planning and building review staff who will be reviewing design plans during permitting. A-2 Apartment District design standard was selected because it closely aligns with the proposed project in terms of building type, height, density, floor area and setbacks.
24.	A-2 Apartment District Front Yard Setback	Chapter 19.12.050	Exempt 20' front yard setback for the building perpendicular to Waiale Road. Allow 15' setback for this building and a 10' setback for a utility closet attached to the side of the building. The height of the shed roof over the utility closet is about 9'. All other buildings meet the 20' setback of A-2 Apartment District Development Standards.		Maui County Dept. of Planning	A-2 Apartment District Development Standards require a 15' front yard setback for buildings less than 35' in height. The side of the building facing Waiale Road is about 29' in height. Technically, it would meet the 15' setback requirement if it had a flat roof. However, because of the sloping roof design the height of the building to the peak of the hip roof is about 40'. The sloping roof is preferred over a flat roof design in order to be more compatible with the residential character of the surrounding neighborhood. The impact of the short side of

	Development Standard or Requirement	Relevant Sections/ Requirement	Requested Exemption	Est. Value Where Appropriate	Applicable Agency & Comments	Rationale for Request
						the building and the small utility closet on the front yard setback along Waiale Road would therefore be minimal.
25.	A-2 Apartment District requires 2 parking stalls per unit	Chapter 19.36A.010	Exempt parking requirement of 2 stalls per unit and allow 1.5 stalls per unit.		Maui County Dept. of Planning	There are 27-Studios, 108 - 1BR, 135 - 2 BR and 54 - 3BR for a total of 324 units. The Project proposes 1.5 parking ratio per unit or 486 parking stalls plus about 10% guest parking stalls or a total of 535 + 4 standard size loading stalls. In general, Studios and 1-BR would be allocated 1 stall per unit, but the property manager would have flexibility in the assignment of stalls. The reduced parking would provide more landscaped open space for the project.
26.	A-2 Apartment District – Walls, fences, and landscaping	Chapter 19.36A.070.A.1	Exempt the development from the fencing and landscape requirements of MCC 19.36A.070.A.1 beyond those fencing and landscape improvements which are specifically indicated on the proposed site plan.		Maui County Dept. of Planning	The project site is bordered on three sides with streets (Honoapiilani Hwy, Kuikahi Drive and Waiale Road) and is unique to the property by having three front yards. The fourth frontage abuts an existing Agricultural District along the east property line. Exemption from MCC Section 19.36.A.070.A.1 is requested to allow two small portions of the parking area along

Development Standard or Requirement	Relevant Sections/ Requirement	Requested Exemption	Est. Value Where Appropriate	Applicable Agency & Comments	Rationale for Request
					Kuikahi Drive and Waiale Road to encroach into the front yard setback 15' (using the A-2 District development guidelines). All the buildings, except a utility shed on the short end of one building, and the remaining parking areas comply with or exceed the 15' front yard setback along all three street frontages. The conceptual landscape plan will install ground cover and comply with the 25% front yard and the 3' wide side and rear landscape requirements. Eight (8) parking stalls on Kuikahi Drive and nine(9) parking stalls along Waiale Road will have a setback between 5' to 10' instead of the required 15'. Ground cover and/or a hedge would be provided along the parking areas fronting the streets. The frontage on Kuikahi Drive is about 920'. The encroachment of the 8 stalls is approximately 68' or 7% of the Kuikahi frontage. The frontage on Waiale Road is about 413'. The encroachment of 9 stalls is approximately 77' or 19%of the Waiale frontage. The parking encroachments are minor in

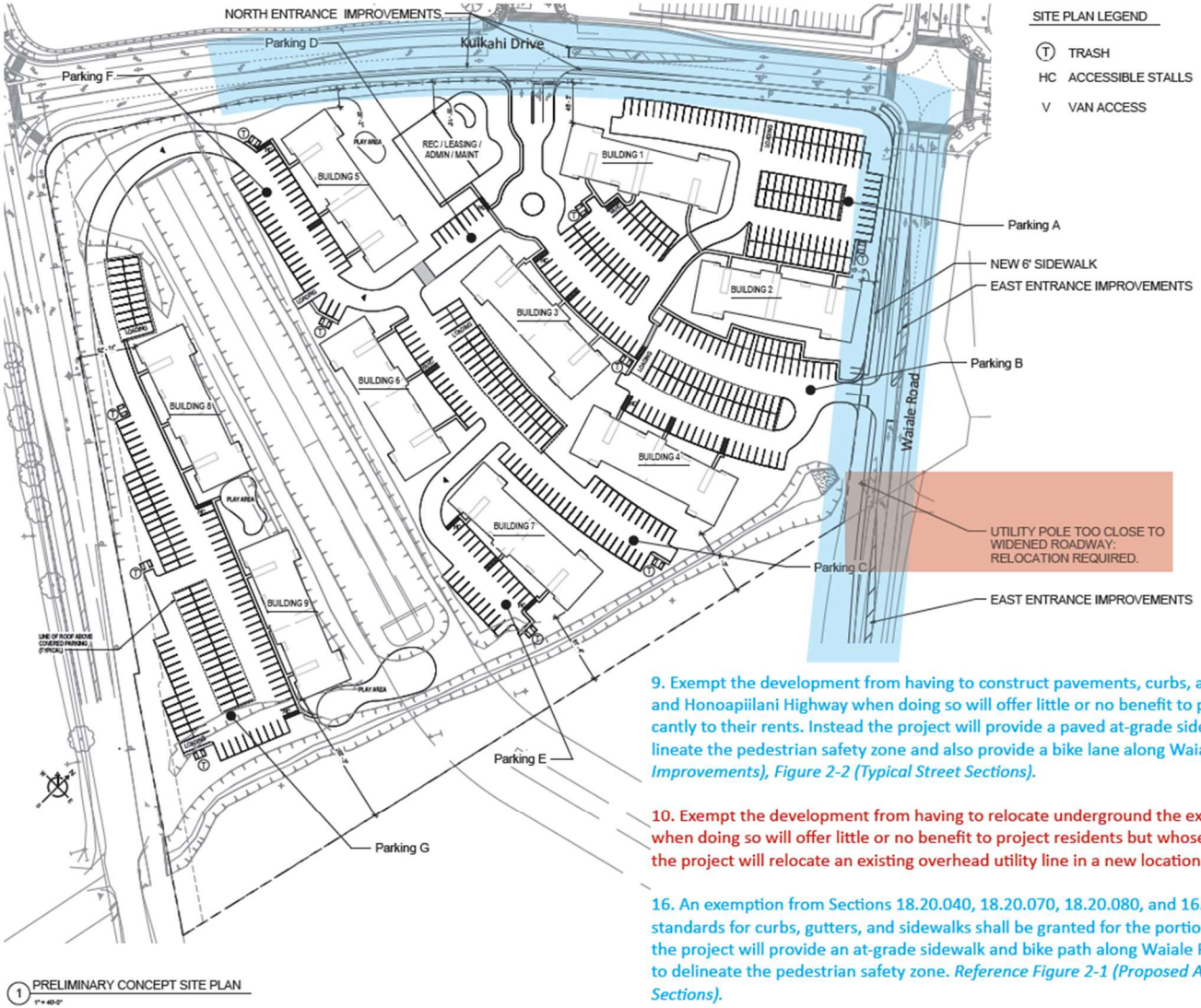
	Development Standard or Requirement	Relevant Sections/ Requirement	Requested Exemption	Est. Value Where Appropriate	Applicable Agency & Comments	Rationale for Request
						nature and would not have an adverse impact on the neighborhood.
27.	A-2 Apartment District On-site Loading	Chapter 19.36A.190	Exempt two 12'x 35' loading spaces required for each building in excess of 10,000 sf. 18 loading spaces would be required. Allow 6 - 12' x 35' loading space and 3-4 standard size spaces.		Maui County Dept. of Planning	6 -12' x 35' loading spaces are proposed. The 18 -12' x 35' stalls would be excessive for this residential development. In addition to the six 12' x 35' loading stalls, we propose to provide 3-4 standard size stalls (8'-6" x 18'-0") as designated as loading spaces. The 9 -10 loading spaces would be evenly distributed among the 9 buildings. Matson type container trucks (16 wheels) are rarely used for tenant move-in and out. Generally large "u-haul" type trucks would be used therefore the combination of 6- large and 3-4 standard size loading stalls should be adequate to service the project.
28.	A-2 Apartment District Landscape Requirements	Chapter 19.36A.070	Exempt landscape requirements to provide one tree at regular intervals for every 5 parking stalls. Allow trees to be spaced and grouped in the landscaped areas		Maui County Dept. of Planning	Exemption from 5 trees placed at regular intervals would provide flexibility in the number and placement of trees on the site plan. Trees would be placed wherever possible along designated landscape areas of the

	Development Standard or Requirement	Relevant Sections/ Requirement	Requested Exemption	Est. Value Where Appropriate	Applicable Agency & Comments	Rationale for Request
			around pkg. stalls and not at regular intervals *Reference Exhibit B – Preliminary Landscape Plan*			preliminary conceptual landscape plan.
29.	A-2 Apartment District Building Height Definition	19.04.040	Exempt definition of "height" which requires the height of building measured from finish or existing grade whichever is lower. The request is to allow building height to be measured from finish grade. A-2 Apartment District Development Standard allows a 60' height limit. The project proposes a building height of approximately 40' measured from finish grade to the peak of the sloping roof. This request would provide flexibility in grading and terracing the site.		Maui County Dept. of Planning	There are some unusual site constraints on the property. The site slopes up from the base of East Kuikahi Drive toward Honoapiilani Hwy. or about 52' from an El. 306 to El. 358. There are two natural drainage features on the site. One that is about 95' wide that bifurcates the property at the upper portion of the site running parallel to the Honoapiilani Hwy. and the other that runs parallel to the east property line. There are also some dips and valleys on the site as well Terracing the site is proposed to minimize grading. Grading would be required to comply with ADA accessibility requirements. Measuring the building height from finish grade would accommodate the desired sloping roof forms in order to be compatible with the residential character of the surrounding neighborhood.

Development Standard or Requirement	Relevant Sections/ Requirement	Requested Exemption	Est. Value Where Appropriate	Applicable Agency & Comments	Rationale for Request
		Total:	**$5,116,053** ($26,236 per affordable unit)		

Exhibits A, B, C, Figure 2-1, 2-2, and 3-4 follow this section.

PROPOSED EXEMPTIONS – EXHIBIT A – PRELIMINARY CONCEPT SITE PLAN



1 PRELIMINARY CONCEPT SITE PLAN

SITE PLAN LEGEND

- (T) TRASH
- HC ACCESSIBLE STALLS
- V VAN ACCESS

REQUESTED EXEMPTIONS

3. Kuikahi Drive currently has an entry to the project site and directly across it is an entry into the Kehalani Village Center which creates an intense flow of traffic for pedestrians. Because of pedestrian life safety the project would like to limit the availability for pedestrians to traverse this area and instead redirect them an existing crosswalk located at Kuikahi Drive and Waiale Road where it is signalized. Waiale Road will have an at-grade concrete sidewalk and also a bike lane for pedestrians. The Maui Bus stop is also locate along Waiale Road, therefore providing a directed pedestrian path from the project site to the Kuikahi Drive and Waiale Road intersection is the safest route for pedestrians to access the commercial center and the bus stop.

Not only will this encourage additional safety for our residents in the area, but this exemption will also provide us flexibility in the design to create major savings that will help to achieve financial feasibility.

Reference Figure 2-1 (Proposed Access Improvements), Figure 2-2 (Typical Street Sections).

9. Exempt the development from having to construct pavements, curbs, and sidewalks along Kuikahi Drive, Waiale Road, and Honoapiilani Highway when doing so will offer little or no benefit to project residents but whose cost will add significantly to their rents. Instead the project will provide a paved at-grade sidewalk, a raised asphalt curb painted white to delineate the pedestrian safety zone and also provide a bike lane along Waiale Road. *Reference Figure 2-1 (Proposed Access Improvements), Figure 2-2 (Typical Street Sections).*

10. Exempt the development from having to relocate underground the existing overhead utility lines along Waiale Road when doing so will offer little or no benefit to project residents but whose cost will add significantly to their rents. Instead the project will relocate an existing overhead utility line in a new location along Waiale Road as an overhead utility line.

16. An exemption from Sections 18.20.040, 18.20.070, 18.20.080, and 16.26B.3600, MCC, as they relate to the urban standards for curbs, gutters, and sidewalks shall be granted for the portions of the Project adjacent to Waiale Road. Instead the project will provide an at-grade sidewalk and bike path along Waiale Road with a raised asphalt curb painted white to delineate the pedestrian safety zone. *Reference Figure 2-1 (Proposed Access Improvements), Figure 2-2 (Typical Street Sections).*

PROPOSED EXEMPTIONS – EXHIBIT B – PRELIMINARY LANDSCAPE PLAN

REQUESTED EXEMPTIONS

2. Allow the required number, species and location of street trees along Honoapiilani Highway, Waiale Road and Kuikahi Drive to conform to the proposed concept landscape plan.

This exemption allows the development the flexibility to create an attractive streetscape in a cost-effective manner. It also creates flexibility in location of trees.

4. Allow the required number, species and location of street trees in parking lots to conform to the proposed site plan.

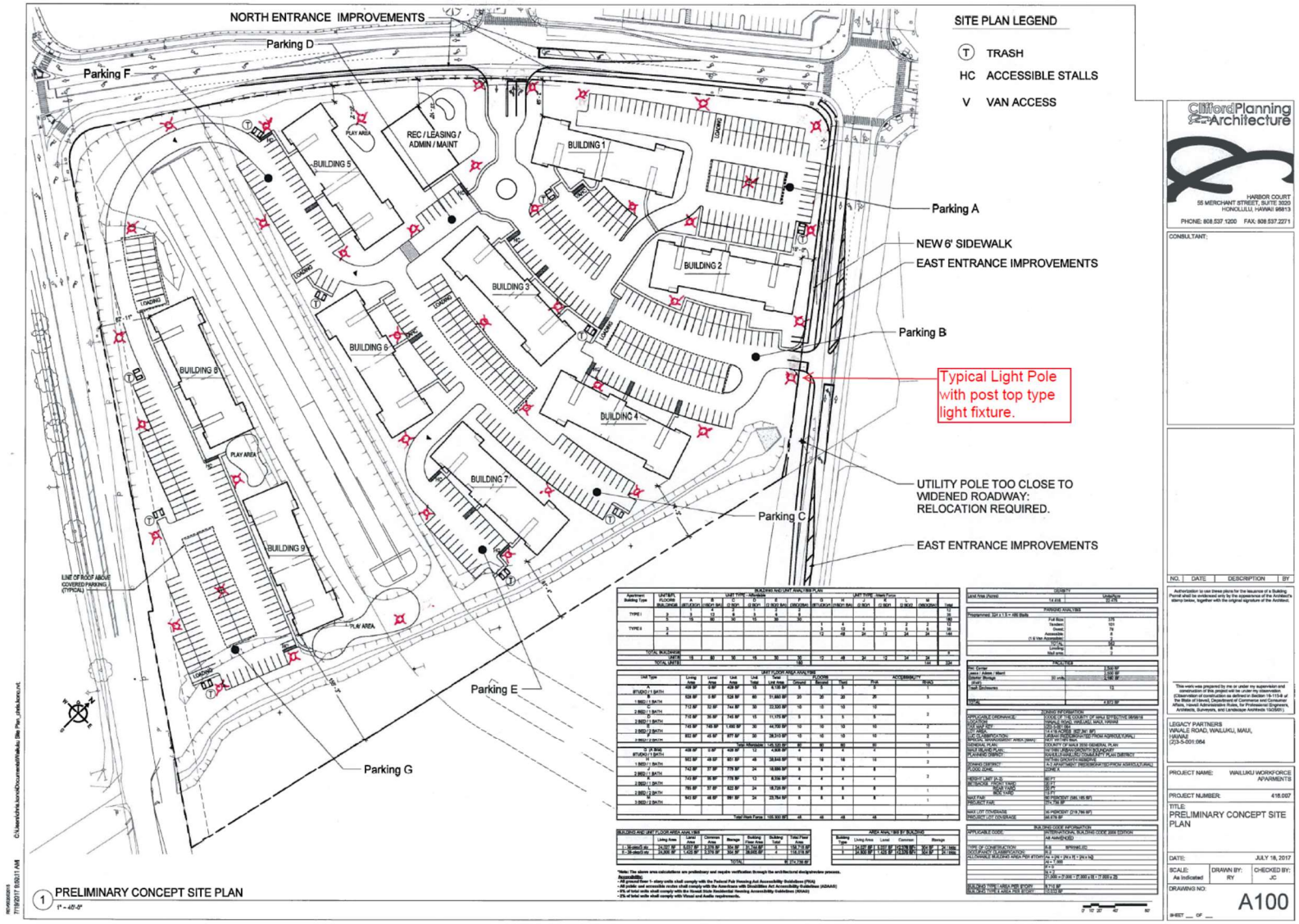
This exemption allows the development the flexibility to create an attractively landscaped site and screen the parking lots in a cost-effective manner.

27. Exempt landscape requirements to provide one tree at regular intervals for every 5 parking stalls.

Allow trees to be spaced and grouped in the landscaped areas around pkg. stalls and not at regular intervals.

Exemption from 5 trees placed at regular intervals would provide flexibility in the number and placement of trees on the site plan. Trees would be placed wherever possible along designated landscape areas of the preliminary conceptual landscape plan.

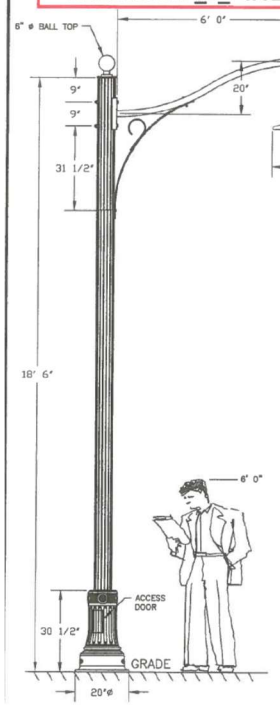
PROPOSED EXEMPTIONS – EXHIBIT C – DIAGRAM OF ON-SITE LIGHTING LOCATIONS & SPECIFICATIONS



THE PARKWAYS AT MAUI LANI
INCREMENT 3

ADDENDUM _1_ 6/02/15

REV.	ALTERATION	DATE	BY



ROADWAY LUMINAIRE SPECIFICATIONS

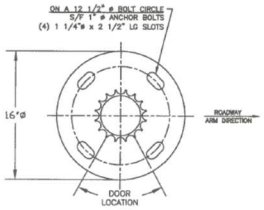
CATALOGUE NO.:	K206–FASH–II–75(SSL) –5000–120:277V–KPL10
QUANTITY:	
MOUNTING TYPE:	PENDANT
OPTICAL DESIGN:	FLAT ARRAY, SHALLOW LENS
IES DESIGNATION:	TYPE II ✓
DESIRED WATTAGE:	75W ✓
SERIES:	5000
LIGHT SOURCE:	SOLID STATE LIGHTING ✓
LINE VOLTAGE:	120:277V
PAINT:	TEXTURED CHICAGO BRONZE
OPTIONS:	KPL–10 LEVELING DEVICE

ROADWAY ARM SPECIFICATIONS

CATALOGUE NO.:	KA30–S–6'
QUANTITY:	
MATERIAL:	ALUMINUM
PAINT:	TEXTURED CHICAGO BRONZE
OPTIONS:	–

POLE SPECIFICATIONS

CATALOGUE NO.:	KSB19FE–A–18.5'
QUANTITY:	
BASE MATERIAL:	CAST ALUM. 2 PC BASE
SHAFT MATERIAL:	FLUTED EXTRUDED ALUMINUM
SHAFT DIA.:	6 1/2" ø
ANCHOR BOLTS:	(4) 1" x 36" LONG (INCLUDED)
BOLT CIRCLE:	12 1/2" ø
POLE LENGTH:	18' 6"
APPROX WEIGHT:	T.B.A.
PAINT:	TEXTURED CHICAGO BRONZE



BASEPLATE DETAIL

CUSTOMER APPROVAL & DATE:

CUSTOMER ORDER No:	249361
KMFG. ORDER No:	K05507
KING U.S. ORDER No:	A10328

King Luminaire • StressCrete • Est. 1953
STRESSCRETE GROUP

Manufacturing Locations:
Burlington, Ontario 1–800–268–7809
Northport, Alabama 1–800–435–6563
Atchison, Kansas 1–800–837–1024
Jefferson, Ohio 1–800–268–7809

PROJECT/CUSTOMER:	MAUI LANI PH6			
DRAWN BY: TASHI B.	AT: SC1	CHECKED BY:	DATE: 03/10/14	REVISION:
DRAWING TYPE: APPROVAL/MFG. DWG.			DRAWING NUMBER: 206A7764–2	

Notes:
Although rare, oscillating loads severe enough to cause damage can occasionally occur in structures of all types. Because they are influenced by many factors not provided to StressCrete, these loads are unpredictable. The users maintenance program should include observation for excessive vibration & examination for any structural damage. The StressCrete warranty specifically excludes fatigue failure or similar phenomena resulting from induced vibration, oscillation or resonance associated with the eccentric rotation of attached equipment.

DC410 LED LUMINAIRE

U.4.1.16

Description
The DC410 is a contemporary styled Luminaire that consists of a cast aluminum base, spun aluminum shade and cap, and an acrylic lens.

LED Luminaire
Multiple LED systems available with convection cooled driver, options for intensity, distribution and color. They operate with over voltage and short circuit protection and automatic voltage sensing for 120 to 277v input. (See next page for LED availability)
- 50,000+ hours of operational life
- Warm 3000K, neutral 4000K, or cool white 5000K color
- Dimmable (controller by others)
- Suitable for wet locations

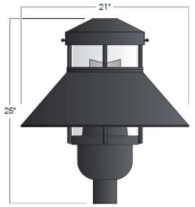
Installation
The luminaire will mount to a 3" OD post or tenon with 5/16" black oxide coated stainless steel set screws to ensure a solid connection.

Lens
Clear Acrylic

EPA
1.09

FINISH
Premium quality thermoset polyester powdercoat for a durable finish in the following:

BLK - Satin Black
CLB - Classic Bronze
GBZ - Glass Textured Bronze
GRN - Green
GTB - Glass Textured Black
TBK - Textured Black
TGR - Glass Textured Green



Ordering Information:

Model	LED System	Light Distribution	Order Code	Finish	Option
DC410	AVI LSK	AS SY	3H,4H,5H 3L,4L,5L	BLK,CLB GBZ,GRN GTB,TBK TGR Custom	PCL

See next page for more complete ordering options

DC410
LED

PROJECT:

TYPE:

Electrostatic sensitive device. observe precautions for handling

5 year limited warranty
AMERLUX LED

POWDER COATED TOUGH

Part String

Example: DC320/LSK-SY-3H/BLK

800.364.0098 • Fax: 281.997.5441 • www.amerlux.com

Amerlux reserves the right to change details that do not affect overall function and performance.

amerlux

PROPOSED EXEMPTIONS – FIGURE 2-1

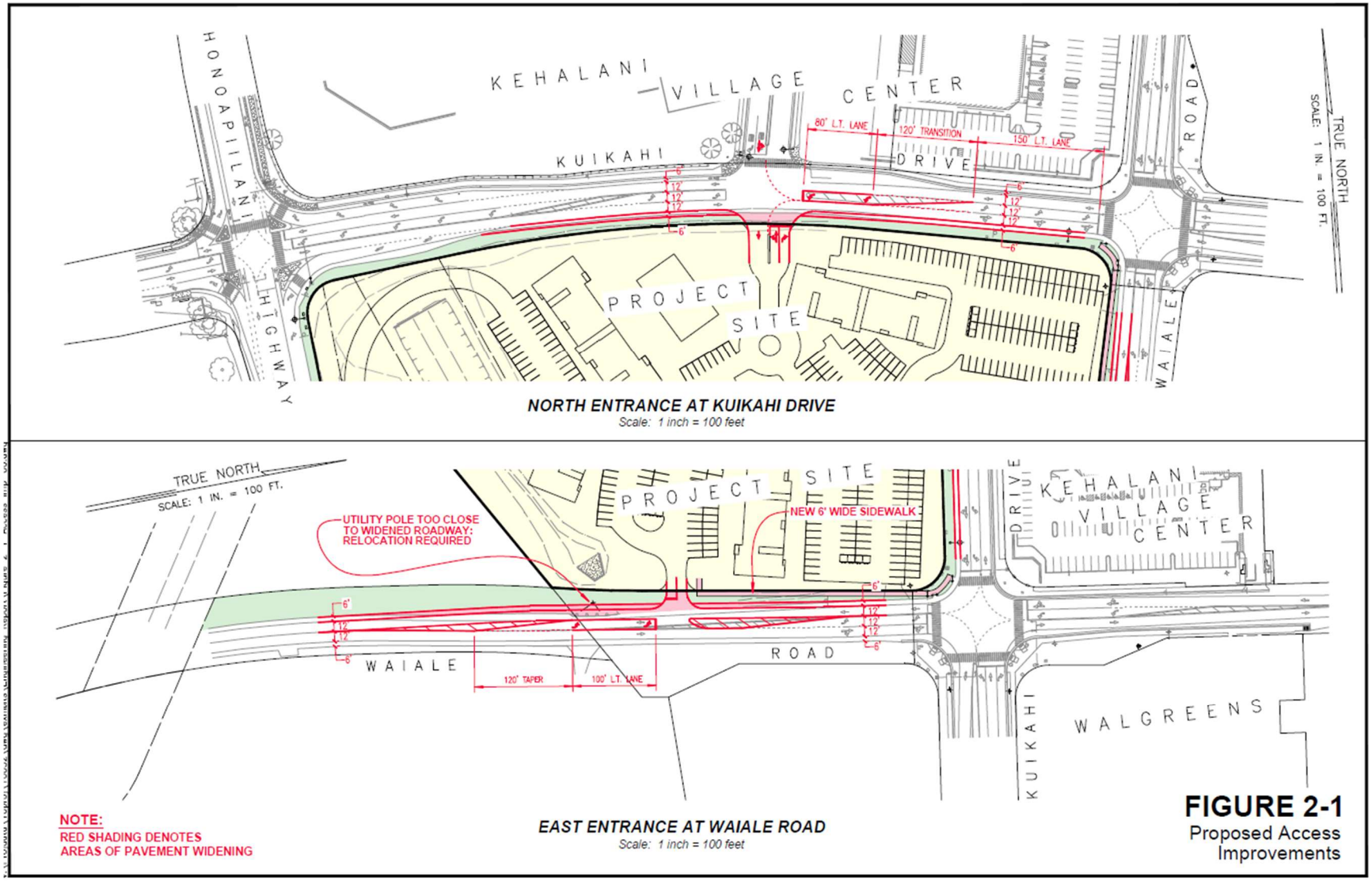


FIGURE 2-1
Proposed Access Improvements

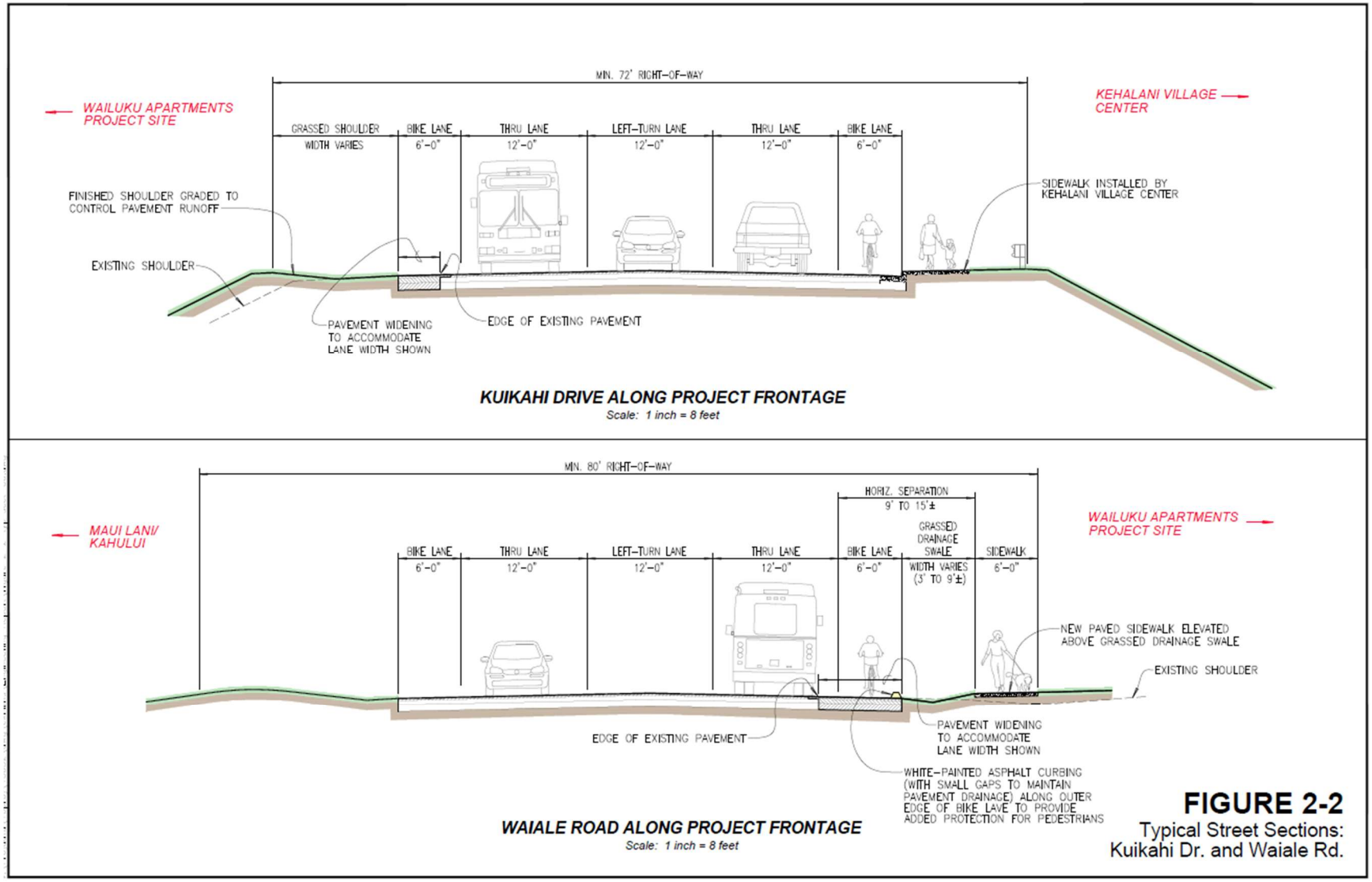


FIGURE 2-2
Typical Street Sections:
Kuikahi Dr. and Waiale Rd.

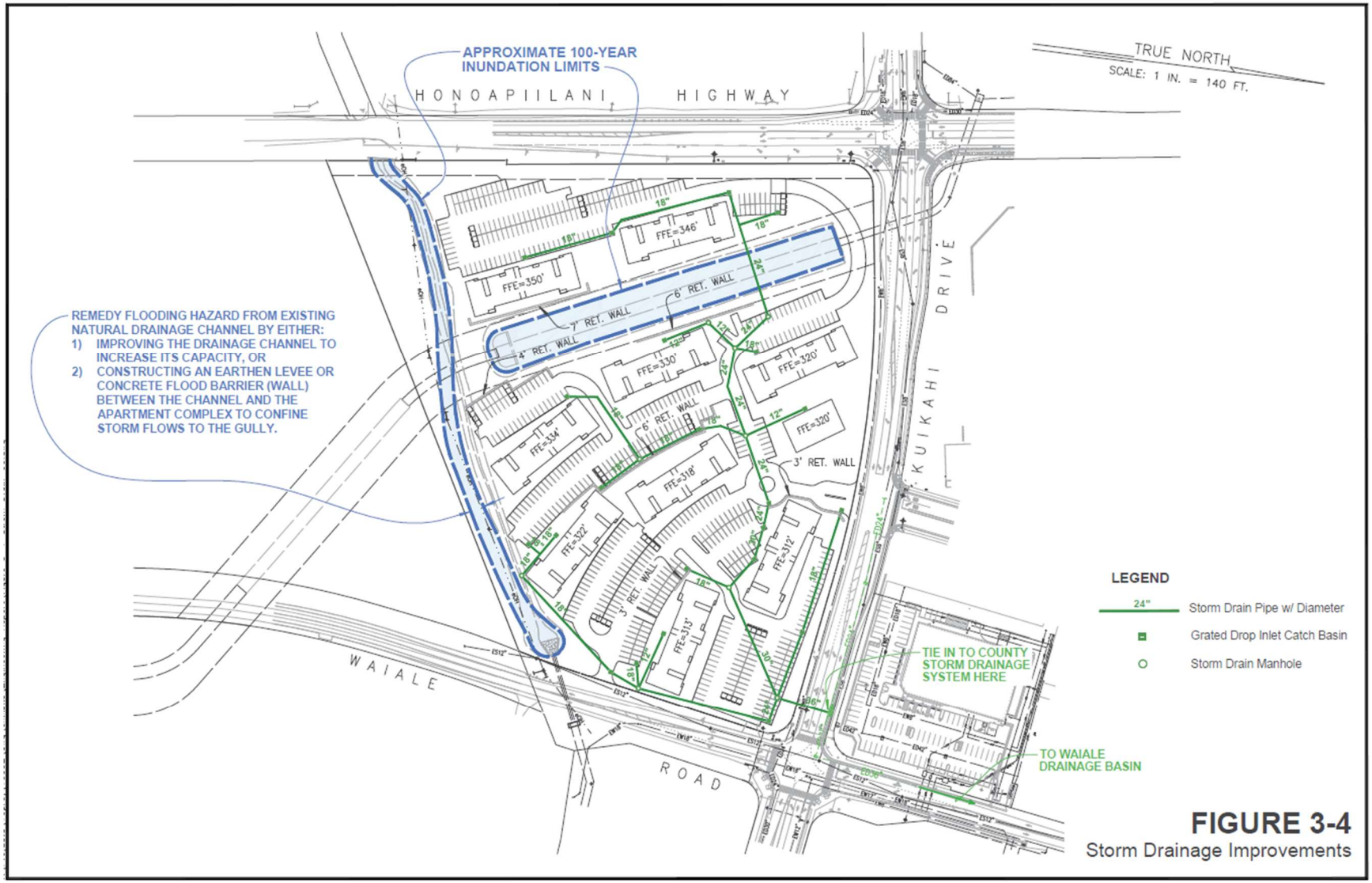


FIGURE 3-4
Storm Drainage Improvements

Draft Environmental Assessment Appendix

WAILUKU APARTMENT RENTAL HOUSING PROJECT & RELATED IMPROVEMENTS

Pursuant to Section 201H-38, Hawaii Revised Statutes (HRS)
Located at Waiale Road, Wailuku, Hawaii, Island of Maui
TMK: (2) 3-5-001:064

Prepared for: Legacy Wailuku, LLC
Prepared by: Bagoyo Development Consulting Group
1500 Kilinoe Place, Wailuku, Maui, Hawaii 96793
(808) 357-3842 | vbagoyo-devgroup@hawaii.rr.com

Appendix

A. LOCATION MAP

B. PRELIMINARY CONCEPT SITE PLAN

C. ARCHAEOLOGICAL INVENTORY SURVEY

D. PRELIMINARY ENGINEERING REPORT

E. TRAFFIC IMPACT ANALYSIS REPORT

F. FLORA & FAUNA - BIOLOGICAL RESOURCES SURVEY

G. AERIAL PHOTO AND VIEW PHOTOS OF PROJECT SITE

H. MARKET DEMAND ANALYSIS REPORT

I. UNIT PLANS & ELEVATIONS

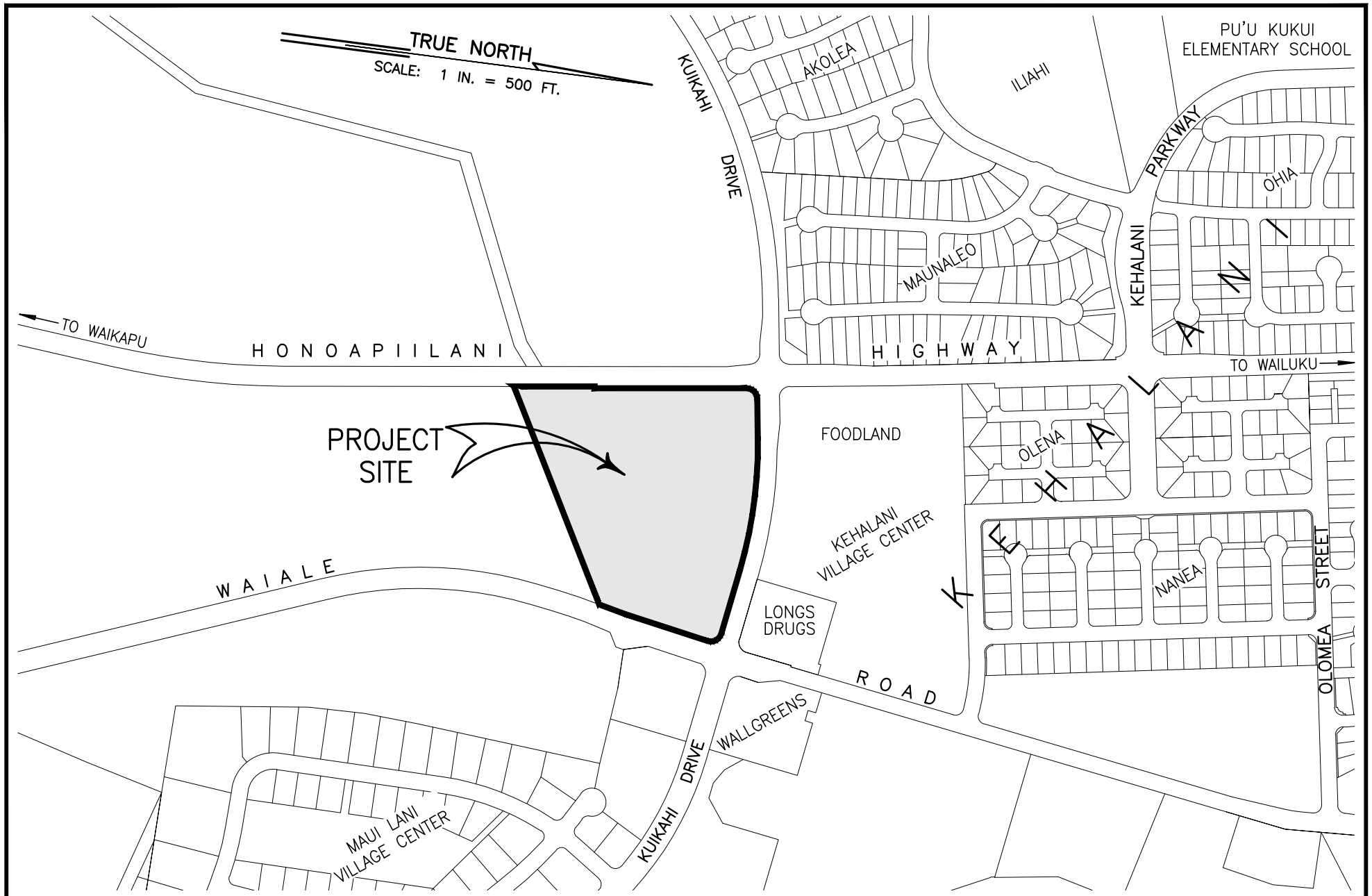
J. PRELIMINARY LANDSCAPE PLAN

K. ZONING AND FLOOD CONFIRMATION FORM

L. ALISH MAP

M. CULTURAL IMPACT ASSESSMENT

Appendix A – Location Map



LOCATION MAP

SCALE: 1 IN. = 500 FT.

WARREN S. UNEMORI ENGINEERING, INC.
CIVIL & STRUCTURAL ENGINEERS / LAND SURVEYORS

May 9, 2017

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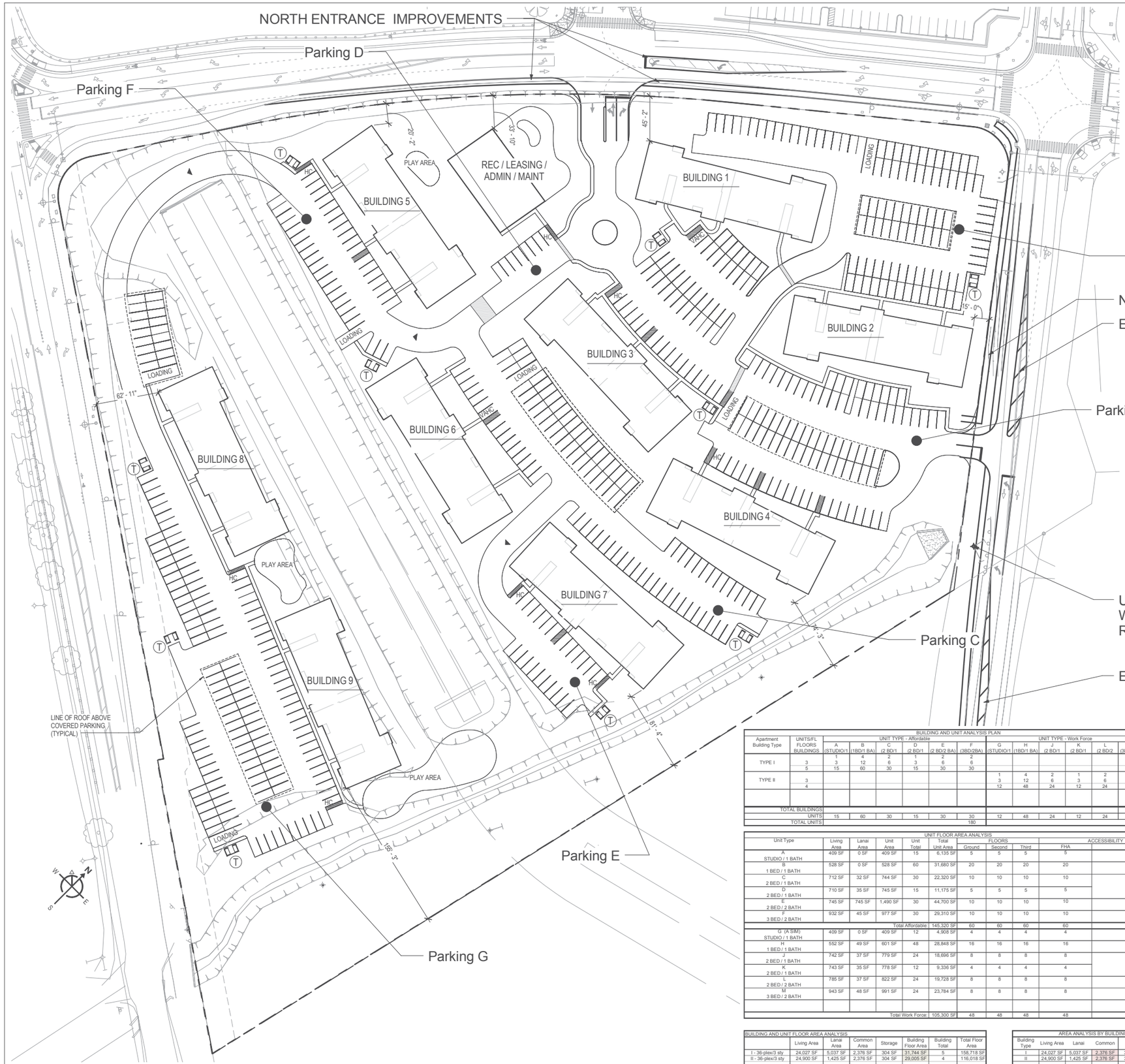
Appendix B – Preliminary Site Plan



SITE PLAN LEGEND

(T)	TRASH
HC	ACCESSIBLE STALLS
V	VAN ACCESS

1 PRELIMINARY CONCEPT SITE PLAN

1" = 40'-0"

0' 10' 20' 40' 80'

BUILDING AND UNIT ANALYSIS PLAN

Apartment Building Type	UNITS/FL FLOORS BUILDINGS	UNIT TYPE - Affordable A (STUDIO/1 BA)	B (1BD/1 BA)	C (2 BD/1 BA)	D (2 BD/1 BA)	E (2 BD/2 BA)	F (3BD/2BA)	UNIT TYPE - Work Force G (STUDIO/1 BA)	H (1BD/1 BA)	J (2 BD/1 BA)	K (2 BD/1 BA)	L (2 BD/2 BA)	M (3BD/2BA)	Total
TYPE I	3	3	12	6	3	6	6							12
	5	15	60	30	15	30	30							36
														180
TYPE II	3							1	4	2	1	2	2	12
	4							3	12	6	3	6	6	36
								12	48	24	12	24	24	144
TOTAL BUILDINGS														9
UNITS		15	60	30	15	30	30	12	48	24	12	24	24	
TOTAL UNITS							180						144	324

UNIT FLOOR AREA ANALYSIS

Unit Type	Living Area	Lanai Area	Unit Area	Unit Total	Total Unit Area	FLOORS Ground	Second	Third	ACCESSIBILITY FHA	RHAG
A STUDIO / 1 BATH	409 SF	0 SF	409 SF	15	6,135 SF	5	5	5	5	1
B 1 BED / 1 BATH	528 SF	0 SF	528 SF	60	31,680 SF	20	20	20	20	3
C 2 BED / 1 BATH	712 SF	32 SF	744 SF	30	22,320 SF	10	10	10	10	2
D 2 BED / 1 BATH	710 SF	35 SF	745 SF	15	11,175 SF	5	5	5	5	
E 2 BED / 2 BATH	745 SF	745 SF	1,490 SF	30	44,700 SF	10	10	10	10	2
F 3 BED / 2 BATH	932 SF	45 SF	977 SF	30	29,310 SF	10	10	10	10	2
Total Affordable					145,320 SF	60	60	60	60	10
G (A SIM) STUDIO / 1 BATH	409 SF	0 SF	409 SF	12	4,908 SF	4	4	4	4	1
H 1 BED / 1 BATH	552 SF	49 SF	601 SF	48	28,848 SF	16	16	16	16	2
J 2 BED / 1 BATH	742 SF	37 SF	779 SF	24	18,696 SF	8	8	8	8	2
K 2 BED / 1 BATH	743 SF	35 SF	778 SF	12	9,336 SF	4	4	4	4	
L 2 BED / 2 BATH	785 SF	37 SF	822 SF	24	19,728 SF	8	8	8	8	1
M 3 BED / 2 BATH	943 SF	48 SF	991 SF	24	23,784 SF	8	8	8	8	1
Total Work Force					105,300 SF	48	48	48	48	7

BUILDING AND UNIT FLOOR AREA ANALYSIS

	Living Area	Lanai Area	Common Area	Storage	Building Floor Area	Building Total	Total Floor Area
I - 36-plex/3 sty	24,027 SF	5,037 SF	2,376 SF	304 SF	31,744 SF	5	158,718 SF
II - 36-plex/3 sty	24,900 SF	1,425 SF	2,376 SF	304 SF	29,005 SF	4	116,018 SF
TOTAL						9	274,736 SF

AREA ANALYSIS BY BUILDING

Building Type	Living Area	Lanai	Common	Storage	
I	24,027 SF	5,037 SF	2,376 SF	304 SF	24 / bldg
II	24,900 SF	1,425 SF	2,376 SF	304 SF	24 / bldg

***Note: The above area calculations are preliminary and require verification through the architectural design/review process.**

Accessibility:

- **All ground floor 1- story units shall comply with the Federal Fair Housing Act Accessibility Guidelines (FHA)**
- **All public and accessible routes shall comply with the Americans with Disabilities Act Accessibility Guidelines (ADAAG)**
- **5% of total units shall comply with the Hawaii State Residential Housing Accessibility Guidelines (RHAG)**
- **2% of total units shall comply with Visual and Audio requirements.**

DENSITY

Land Area (Acres)	Units/Acre
14.416	22.475

PARKING ANALYSIS

Programmed: 324 x 1.5 = 486 Stalls

Full Size:	375
Tandem:	101
Guest:	76
Accessible:	8
(1:6 Van Accessible.):	2
TOTAL:	562
Loading:	6
Mail area:	2

FACILITIES

Rec Center		2,500 SF
Lease / Admin / Maint		2,500 SF
Exterior Storage (8'x9')	30 units	2,160 SF
Trash Enclosures		12
TOTAL		4,672 SF

ZONING INFORMATION

APPLICABLE ORDINANCE:	CODE OF THE COUNTY OF MAUI EFFECTIVE 08/08/16
LOCATION:	WAIALE ROAD, WAILUKU, MAUI, HAWAII
TAX MAP KEY:	(2)3-5-001:064
LOT AREA:	14.416 ACRES (627,961 SF)
LUC CLASSIFICATION:	URBAN (REDESIGNATED FROM AGRICULTURAL)
SPECIAL MANAGEMENT AREA (SMA):	NOT WITHIN SMA
GENERAL PLAN:	COUNTY OF MAUI 2030 GENERAL PLAN
MAUI ISLAND PLAN:	WITHIN URBAN GROWTH BOUNDARY
PLANNING DISRICT:	KAHULUI-WAILUKU COMMUNITY PLAN DISTRICT
	WITHIN GROWTH RESERVE
ZONING DISTRICT:	A-2 APARTMENT (REDESIGNATED FROM AGRICULTURAL)
FLOOD ZONE:	ZONE X
HEIGHT LIMIT (A-2):	60 FT
SETBACKS: FRONT YARD	20 FT
REAR YARD	20 FT
SIDE YARD	15 FT
MAX FAR:	90 PERCENT (565,165 SF)
PROJECT FAR:	274,736 SF
MAX LOT COVERAGE :	35 PERCENT (219,786 SF)
PROJECT LOT COVERAGE	88,678 SF

BUILDING CODE INFORMATION

APPLICABLE CODE:	INTERNATIONAL BUILDING CODE 2006 EDITION
	AS AMMENDED
TYPE OF CONSTRUCTION:	II-B SPRINKLED
OCCUPANCY CLASSIFICATION:	R-2
ALLOWABLE BUILDING AREA PER STORY	Aa = {At + [At x If] + [At x Is]}
	At = 7,000
	If = 0
	Is = 2
	21,000 = [7,000 + [7,000 x 0] + [7,000 x 2]]
BUILDING TYPE I AREA PER STORY:	9,710 SF
BUILDING TYPE II AREA PER STORY:	10,032 SF

CliffordPlanning Architecture
HARBOR COURT
55 MERCHANT STREET, SUITE 3020
HONOLULU, HAWAII 96813
PHONE: 808.537.1200 FAX: 808.537.2271

CONSULTANT:

NO.	DATE	DESCRIPTION	BY

Authorization to use these plans for the issuance of a Building Permit shall be evidenced only by the appearance of the Architect's stamp below, together with the original signature of the Architect.

This work was prepared by me or under my supervision and construction of this project will be under my observation. (Observation of construction as defined in Section 16-115-9 of the State of Hawaii, Department of Commerce and Consumer Affairs, Hawaii Administrative Rules, for Professional Engineers, Architects, Surveyors, and Landscape Architects 10/26/01).

LEGACY PARTNERS
WAIALE ROAD, WAILUKU, MAUI, HAWAII
(2)3-5-001:064

PROJECT NAME: WAILUKU WORKFORCE APARMENTS

PROJECT NUMBER: 416.007

TITLE: PRELIMINARY CONCEPT SITE PLAN

DATE: JULY 18, 2017

SCALE:	DRAWN BY:	CHECKED BY:
As indicated	RY	JC

DRAWING NO: A100

SHEET ___ OF ___

REV00262015
7/19/2017 9:50:11 AM
C:\Users\chris.kono\Documents\Wailuku Site Plan_chris.kono.rvt

Appendix C – Archaeological Inventory Survey

-

DRAFT ARCHAEOLOGICAL ASSESSMENT REPORT FOR A 15.0 ACRE PARCEL LOCATED ALONG WAIALE ROAD IN WAILUKU *AHUPUA'A* AND DISTRICT PŪ`ALI KOMOHANA *MOKU* ISLAND OF MAUI TMK: [2] 3-5-001:064

FOR: Pier Management-Hawaii, LLC

BY: Jenny O`Claray-Nu (B.A.), Lisa J. Rotunno-Hazuka (B.A.)

and Jeffrey Pantaleo (M.A.)

MAY 2017

ARCHAEOLOGICAL SERVICES HAWAII, LLC.

POB 1015; PU`UNĒNĒ, HI 96784

"Protecting, Preserving, Interpreting the Past, While Planning the Future"

EXECUTIVE SUMMARY

Under contract to Pier Management-Hawaii, LLC of 3401 E. Kentucky Avenue, Denver CO, 80209 and pursuant to recommendations by the State Historic Preservation Division (SHPD); Archaeological Services Hawaii, LLC (ASH) performed an archaeological assessment (archaeological inventory survey with negative findings) for a 15.0 acre parcel located along Waiale Road within Wailuku *ahupua'a* and District, Pū`ali Komohana *Moku*, Island of Maui at TMK [2] 3-5-001:064.

The current investigation was conducted to determine the presence absence, extent and significance of surface historic properties (if present) and the potential for buried cultural remains. The subject parcel is located along the culturally sensitive Waiale Road/Lower Main Corridor which is known to contain numerous traditional burials and extensive habitation sites.

The proposed development plans comprise an affordable residential housing project and will be processed according to the 201H permit process. It will include residential structures, access roads and associated infrastructural improvements. The subject area has been previously disturbed by prior grubbing, grading and stockpiling of material from sugar cane cultivation and the construction of a retention ditch in the western half of the parcel which continues south outside the project area.

The archaeological assessment was comprised of a 100% pedestrian survey with mechanical test excavations and these procedures were performed by archaeological supervisor, Ms. Jenny O'Claray-Nu (B.A.) and archaeologist, Mr. Cody Sheets (B.A.). A total of 40 field hours were expended during the course of this project. Overall coordination and supervision was undertaken by Ms. Lisa Rotunno-Hazuka (B.A.) and Mr. Jeffrey Pantaleo (M.A.) was the Principal Investigator.

A total of 11 backhoe trenches were excavated across the parcel and were negative for buried cultural remains. The trenches exemplified that the subsurface was disturbed from 0.60 m below surface (bs) to 1.85 mbs and bedrock was encountered from 1.6 mbs (TR8) to 2.30 mbs (TR3).

Based on the negative findings, coupled with the compounded disturbances across the parcel, the probability of encountering *in situ* cultural remains is low; however disturbed burial features and or remnant historic properties may be extant. Thus, an archaeological monitoring program is recommended for all future ground-altering activities. An archaeological monitoring plan (AMP) is currently being prepared by ASH and will be submitted for review and approval prior to the commencement of construction activities.

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INTRODUCTION

Under contract to Pier Management-Hawaii, LLC of 3401 E. Kentucky Avenue, Denver CO, 80209 and pursuant to recommendations by the State Historic Preservation Division (SHPD); Archaeological Services Hawaii (ASH) has prepared this Archaeological Assessment (AA) report according to the standards set forth in the Hawaii Administrative Rules (HAR) §13-284-5 (5) (A) and 276-5 (a) and (c) for a parcel located along Waiale Road within Wailuku *ahupua'a* and District, Island of Maui, TMK [2] 3-5-001:064 (Figures 1-3).

The current investigation was conducted to determine the presence absence, extent and significance of surface historic properties (if present) and the potential for buried cultural remains. The subject parcel is located along the culturally sensitive Waiale Road/Lower Main Corridor which is known to contain numerous traditional burials and extensive habitation sites.

The proposed development plans comprise an affordable residential housing project and will be processed under a 201H permit application. The planned improvements will include residential structures, access roads and associated infrastructural improvements. The subject area has been previously disturbed by prior grubbing, grading and stockpiling of material from sugar cane cultivation and the construction of a retention ditch within the western half of the parcel which extends further south outside the project area. The retention ditch extends along the *mauka* and *makai* (west and east) sides of Waiale Road to a retention basin to the south near Waiko Road. These drainage improvements underwent prior archaeological studies comprised of archaeological assessment and monitoring program (Sinoto and Titchenal 2005 and Dega 2014).

PROJECT AREA

The project area, comprised of 15.0 acres is located along the base of the West Maui Mountains within the northwestern portion of the isthmus (see Figures 1 and 2). It situated adjacent and on the west side of Waiale Road, centrally located between Waikapu and Wailuku Towns. Specifically, it is bounded to the north by Kuikahi Drive, to the south by an un-named gulch and partially developed lands of Emanuel Lutheran Church, to the east by Waiale Road and to the west by Honoa`pi`ilani Highway (Figures 1-3).

ENVIRONMENT

The parcel has undergone extensive compounded disturbances comprised of grubbing and grading for prior sugar cane cultivation, sand mining and recent construction activities for the drainage ditch, parking lot, access roads and existing drainage ditch. Due to these prior activities, the parcel is open (few trees), with stockpiles and densely covered of low grasses and weeds. Vegetation in the project area is dominated by fallow sugar cane (*saccharum officinarum)* with various *koa haole* (*Leucaena glauca*), cane

grass (*Setaria sp.)*, *`ilima* (*Sida fallax*), *`uhaloa* (*Waltheria americana*), *Ki* or *ti* (*Cordyline fruticosa*) and various grasses and weeds.

Rainfall for the area averages between 20-30 inches a year, predominantly occurring during the winter months between November and February (Giambelluca et. al. 2013) (Armstrong 1973). The subject parcel slopes west to east from 310 ft. to 360 ft. AMSL and according to the web soil survey, contains two soils from the `Ī'ao soil series; however past experience in the area has shown that the Pu`uone Sand (PZUE) is extent within the eastern portion of the parcel. The Iago silty clay (IaA) comprises 30% of the parcel along the eastern third and occurs on 0-3% slopes, is well-drained and good farmland when irrigated. The remaining portion of the parcel contains Iago clay 3 to 7% slopes and is also well drained, prime farmland if irrigated. As previously discussed, the eastern section is known to contain Pu`uone Sand, which likely overlies the Iago silty clay.

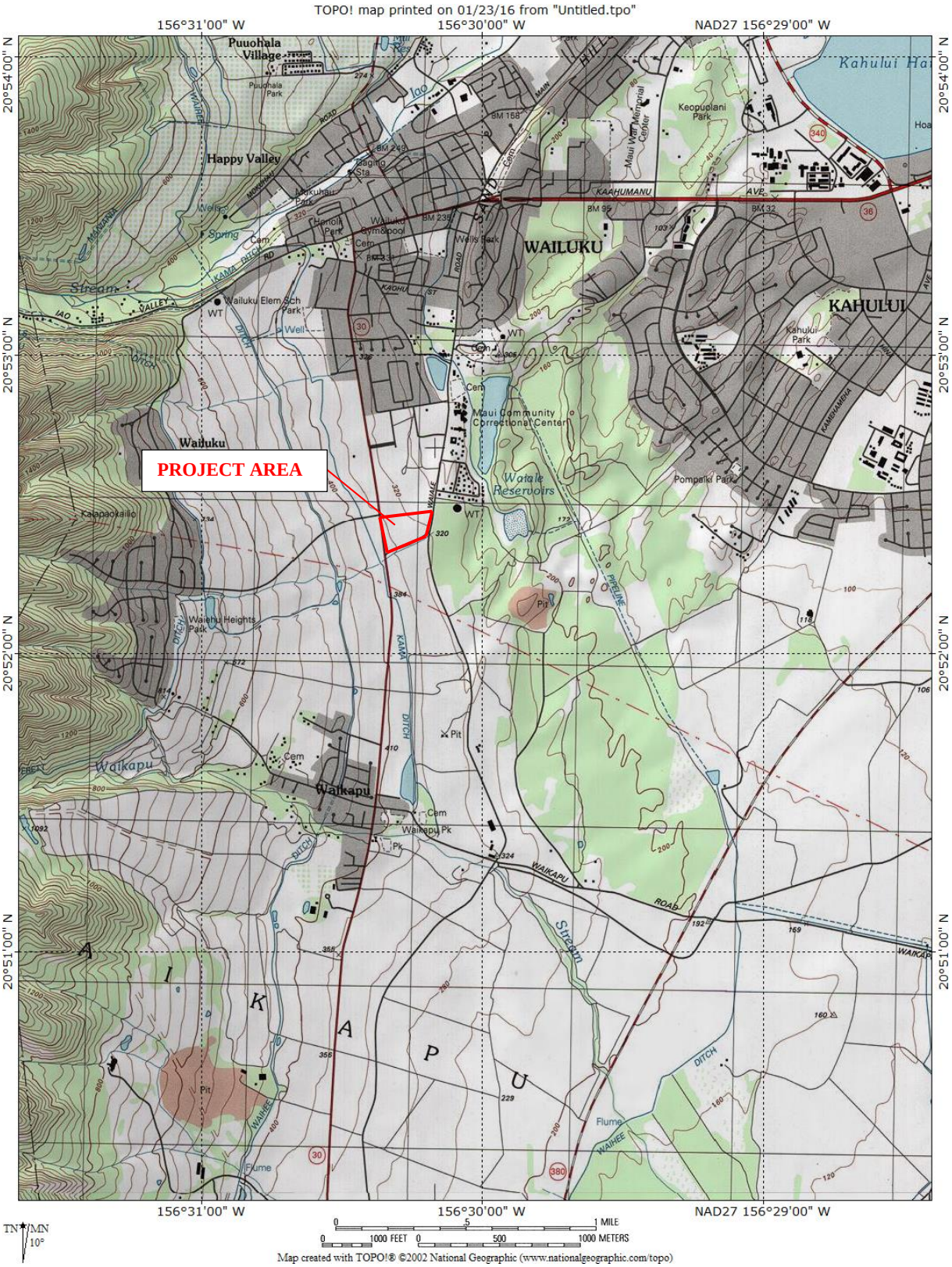

Figure 1. Map Showing Location of Project Area on USGS Quadrangle

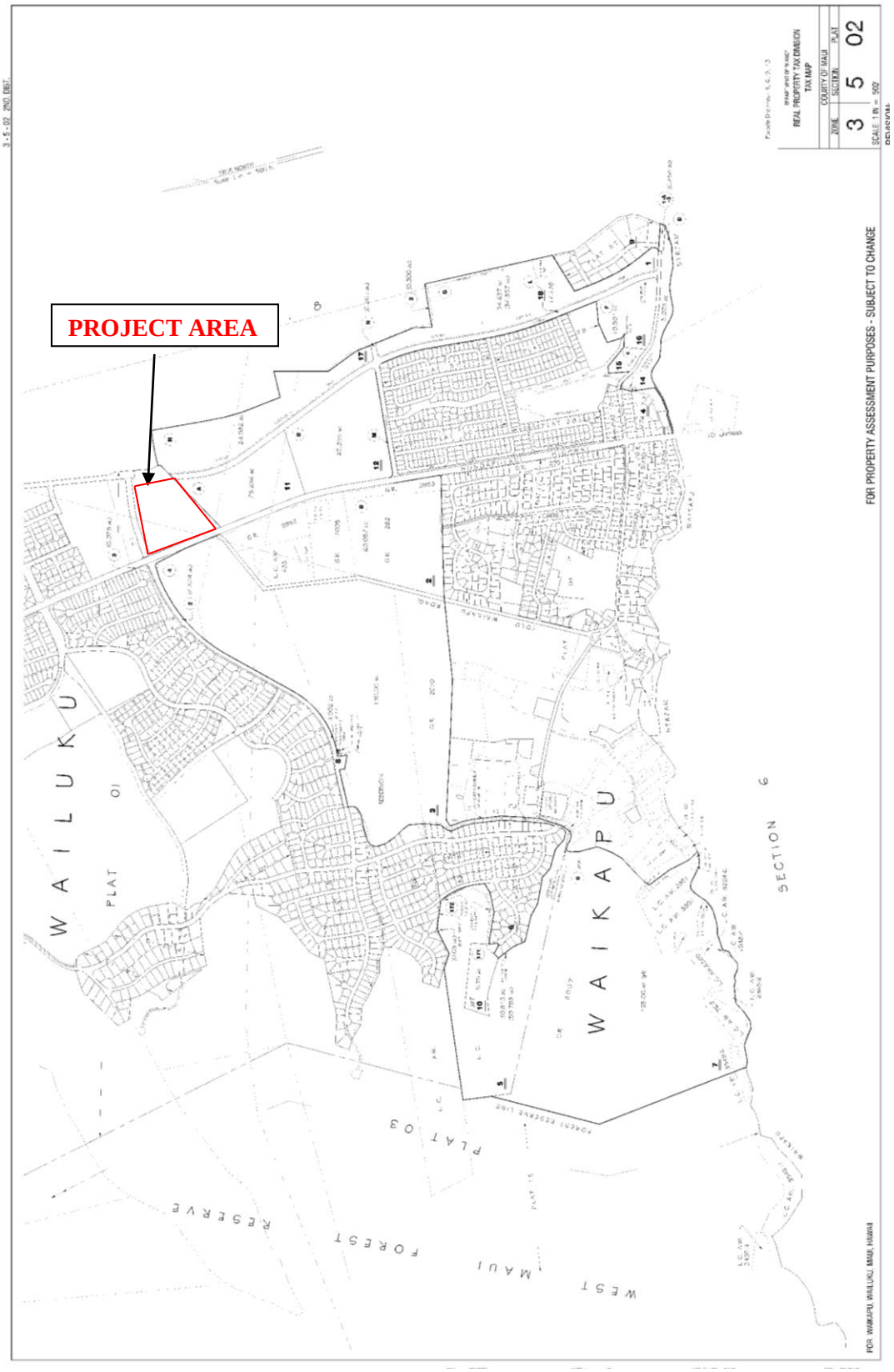

Figure 2. TMK Map Showing Location of Project Area

Figure 3. Aerial Photograph of Project Area Showing Existing Conditions

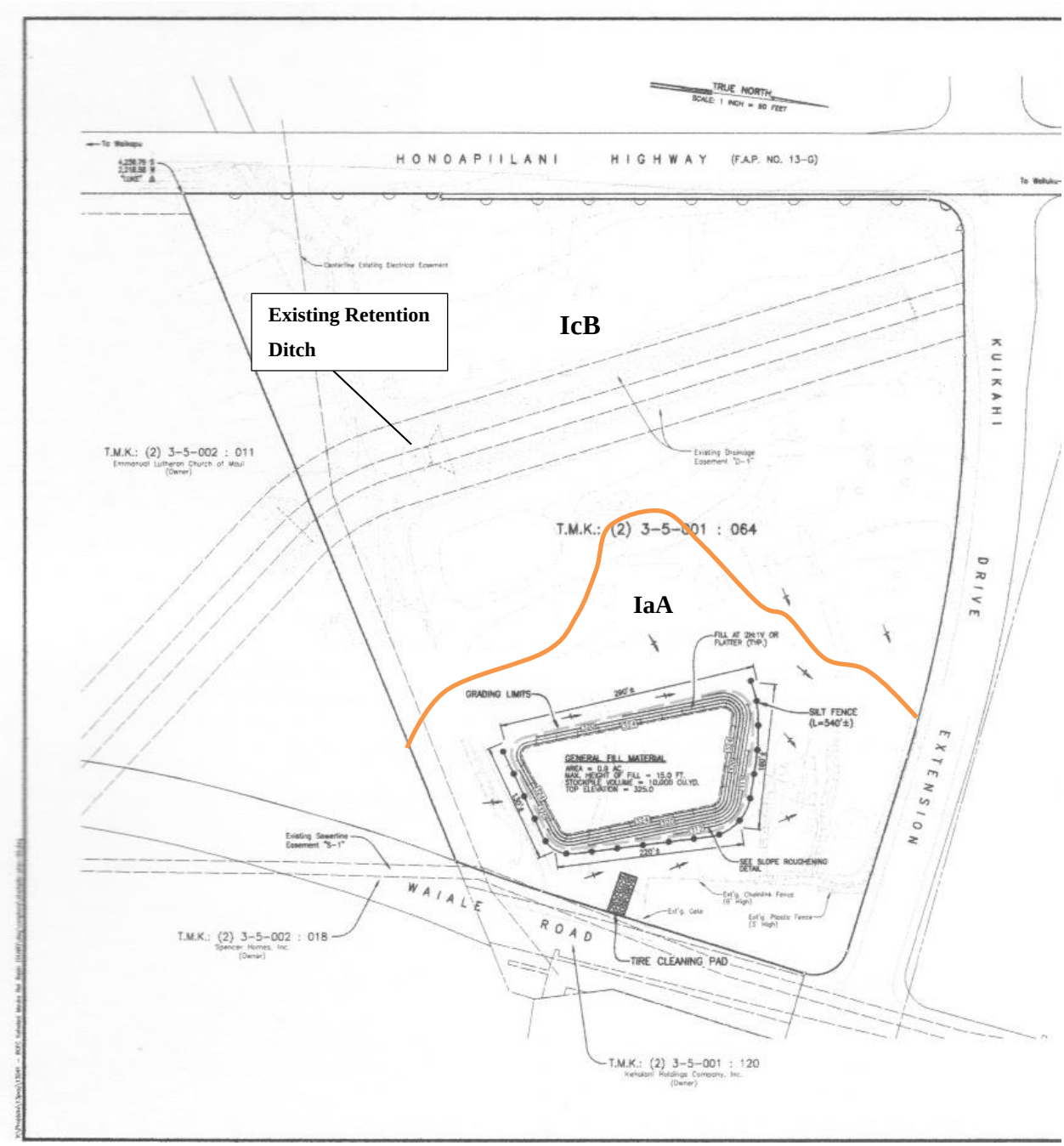

Figure 4. BMP Map of Project Area

HISTORIC BACKGROUND

Since this is an Archaeological Assessment report, only pertinent information regarding traditional and historic events, land use, previous archaeology and site expectations will be provided below as stated in Chapter §13-284-5(5)(A).

> *Chapter §13-284-5 (5) (A) an archaeological assessment shall include information on the property and the survey methods set forth in §13-276-5 (a) and (c). Chapter §13-276-5 (a) (1)-(3) includes the information on the property, and (c) (1)-(8) is the methodology section.*
>
> *Chapter §13-276-5(b) **is not** required for the Archaeological Assessment Report. This subsection provides detailed background research (archival research, previous archaeological studies, LCA and Grant research) to predict the kinds and distributions of historic properties that may be extant and to provide a context for evaluating significance of these historic properties.*

Legendary and Traditional History

The project area is located within the traditional *Moku* (district) of Pū`ali Komohana, the modern District of Wailuku and Wailuku *ahupua`a* (Figure 5). Wailuku District is comprised of the following *ahupua`a*: Waihe`e, Waiehu, Waikapū, Wailuku and Pūlehu Nui, and has been referred to as Nā Wai`ehā (the four waters) due to the four inland associated streams and valleys inland; Waihe`e, Waiehu, Wailuku (Wailuku River and `Īaō Valley), and Waikapu (Pukui and Elbert 1986: 377) (Figure 5). Due to this geologic landscape, Wailuku District was extremely fertile with an abundance of water; thus, enabling large scale cultivation of *kalo* (taro). Agricultural terraces spilled over onto the slopes at the entrances of valleys…and taro was fed by mountain rains (Handy and Handy 1940:108). Other accounts note that the coastal regions of Wailuku *ahupua`a* contained lesser areas of cultivated sweet potato and an abundance of marine resources.

As exemplified on Figure 6, Wailuku *ahupua`a* occupies almost half of Wailuku District comprising the northern portion of the isthmus closest to the coast. It extends from Paukūkalo to the west, Kahului Bay and Kapukaulua, which is where Kailua Gulch empties into the ocean and is the eastern boundary for both Wailuku District and Wailuku *ahupua`a*. Ethno-historic accounts indicate that a battle occurred in 1738 at Pu`unene between Ka`uhi and Peleio`holani (Oahu) chief against Kamehameha-nui and Alapa`i warriors. The battle at Pu`unene was considered one of the fiercest, hardest fighting wars where "Pele`io`holani was surrounded on all sides, *mauka* and *makai*, by the forces of Alapa`i led by Kalaniopu`u and Keoua. The two ruling Chiefs met there again, face to face to end the war and became friends again, so great had the slaughter been on both sides…" (Kamakau 1961:74).

A number of battles took place in the neighboring Waikapū region, including Fornander's (1969:153) account of the battle of the Waikapū Commons or the Battle of Kakanilua. The following account describes the battle on the sand hills southeast of Wailuku:

> …The detachment or regiment known as the Alapa, mustering 800 men, was selected for this hazardous expedition, and with high courage they started across the isthmus of Kamaomao, now known as the Waikapū common, as the legend says, "to drink the waters of Wailuku that day. "…Little did this gallant troop apprehend the terrible fate that awaited them…Kahekili distributed his forces in various directions on the Wailuku side of the common, and fell upon the Hawaii corps d`armee as it was entering among the sandhills southeast of Kalua, near Wailuku. After one of the most sanguinary battles recorded in Hawaiian legends,…the gallant and devoted alapa was literally annihilated; only two out of the 800 escaped alive to tell Kalaniopuu of this Hawaiian Balaclava (Fornander 1969:153).

Historic Period

In 1778, with the appearance of Captain James Cook in Kahului Bay on Maui, the post-contact documentation of the indigenous populace on Maui began. A comprehensive account of history of the Hawaiian Kingdom commencing from contact (1778) is provided in Kuykendall (1938). There were additional voyagers to Hawai`i subsequent to the arrival of Cook - including La Perouse and Vancouver. By the early 1800s, whaling ships, merchants, and missionaries had arrived. The arrival of foreigners severely impacted the life style and demographics of the Hawaiian people and caused a significant depopulation of the native people due to the introduction of Western diseases, in combination with the populace beginning to cluster around growing port towns. According to Kuykendall (1938:336), an early estimate of the population (made by missionaries) in 1823 was 142,050 and decreased to 86,593 by 1850.

In 1845, land reform legislation, which developed into 'The Great *Māhele* in 1848 was established. During the *Māhele*, crown lands were divided between the Government, Royalty, and commoners. It was during this time that the *maka`ainana* and foreigners could apply for land ownership by stating their *kuleana* claim to the Board of Commissioners to Quiet Land Titles. As part of claim process, the *maka`ainana* described the land and its contents, ownership on adjoining parcels, and discussed how the land was being utilized (i.e. house lot, taro, *lo`i*, fishpond and etc.). Once the claim was validated, a Land Claim Award (LCA) was awarded and following payment, a Royal Patent (R.P.) was issued.

Unfortunately, the *Māhele* movement and or private land ownership, like several other historic events (missionaries, whaling ships and etc.) drastically altered the Native Hawaiian way of life with deleterious effects to socio-political relationships. The concept of the traditional *ahupua'a,* a communal piece of land containing various ecosystems to be utilized, nurtured and cultivated by its inhabitants began to shift towards private ownership. The sharing of land was so interconnected with everyday life that again, it severely affected the Native Hawaiian populace.

> In 1848, there were approximately 88,000 Hawaiians, but only 14,195 applications were made…of the 14,195 *kuleana* claims, only 8,421 were actually awarded. The

> *Maka`ainana* received less than 1% of the land. Countless Native Hawaiians lost their land use rights as a result of the Great Māhele of 1848, with the establishment of a system of private land ownership. Many landless Native Hawaiians signed on as laborers in the emerging sugar industry, which began on Maui in the 1820s. Within a short time, large tracts of land were turned over to commercial agriculture, primarily sugarcane cultivation (Kame`eleihiwa 1992:295). In many cases, the purchases or leases to non-Hawaiians included entire *`ili* or *ahupua`a*.

Thus, by the end of the Māhele, naturalized foreign citizens were given the right to purchase land in Hawai`i. The ultimate result of this decision placed more land in the hands of non-Hawaiians than native Hawaiians between the years of 1850 and 1865 (Moffatt and Fitzpatrick 1995:51).

LAND USE

The project area is positioned within Grant 3343 to Claus Spreckels, which historically has been utilized for sugarcane cultivation and further discussed below (Figure 5 and Table I). In 1848, the entire Wailuku *Ahupua`a* (L. C. A. 7713:23) was designated as Government Lands and or Crown Lands. The Native Register (1846-1848) documents King Kamehameha I's great granddaughter, Ruth Ke`elikolani, and the sister of Kamehameha IV and V, Victoria Kamamalu, as the only persons of royal heritage that are designated as land owners. On September 30th, 1882, King Kalakaua signed over 24,000 acres in the Wailuku *Ahupua`a* (eastern portion) to Claus Spreckels in a fee-simple title "Grant 3343".

The earliest commercial sugar production on Maui Island began in Wailuku in 1823 when Hungtai Sugar Works was founded by Chinese merchants (Morrow n.d.:51-51). Wailuku Sugar Company was started in November of 1862 by James Robinson and company, Thomas Cumming, J. Fuller, and C. Brewer and Company. In 1865, C. Brewer and company acquired controlling interest, with Robinson and Company and Cumming as the minority stockholders.

In 1876, when the Reciprocal Trade Treaty was signed in Washington D.C., this caused an increase in the price and demand for sugar, creating a boom in the sugar cane industry. In 1878, Alexander and Baldwin purchased land east of Kahului for sugar cane production and founded the Pā`ia Plantation and incorporated the Haiku Plantation the following year (Best 1978:13). In 1882, Princess Ruth sold one-half of the Crown Lands of Hawai`i to Claus Spreckels in order to settle her debts with him. Spreckels already held a lease (purchased from Henry Cornwell) for 16,000 acres of Wailuku *ahupua`a* (Waikapū Commons), dating from 1878 (R.P. 3152) and as stated above King Kalakaua gave him (Grant 3343) in 1882, a 24,000 acre portion of the southeastern section of Wailuku *ahupua`a*, in return for the surrender of his claim to Crown Lands and established Hawaiian Commercial & Sugar (HC&S). In 1898, control of HC&S passed from Claus Spreckels to that of S.T. Alexander and H.P. Baldwin (Figure 7). In 1926,

Alexander and Baldwin bought Spreckel's Hawaiian Commercial and Sugar Company, which resulted in the intensification of the sugar industry in Wailuku.

The escalation of the sugar industry on Maui brought with it the need for water (irrigation ditches) and imported labor. Immigrants from around the world (Scandanavian, Scottish, Italian, German, Russian, Spanish, Hawaiian, Chinese, Portuguese, and Japanese) arrived on Maui to work on the sugar plantations; and hence the establishment of several plantation camps and railroad spur lines in the Wailuku and Waikapu areas. As shown on Figure 8, no plantation camps were in the vicinity of the subject parcel (Figure 8).

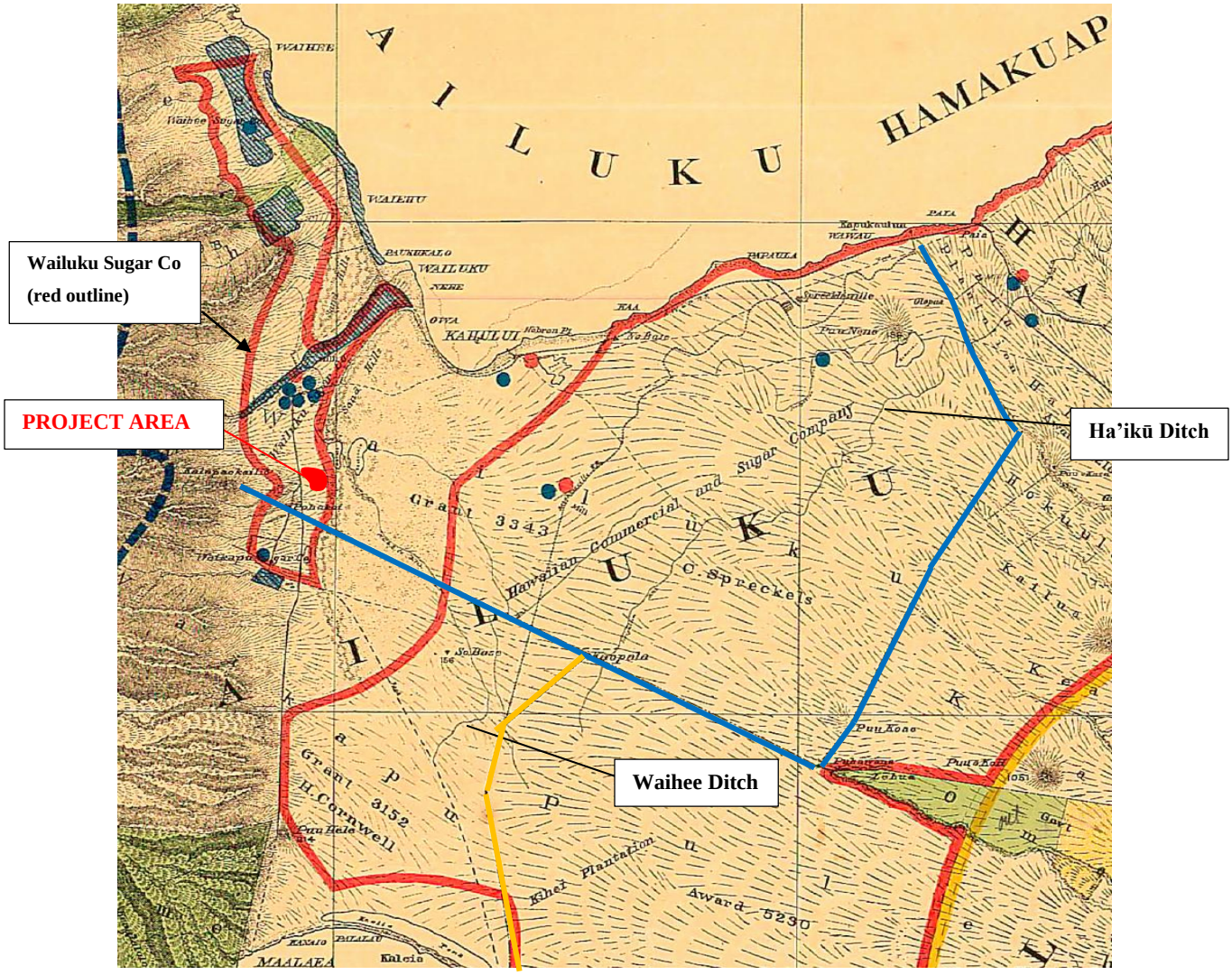

Figure 5. Portion of Hawaiian Government Survey Registered Map (1268) Showing Portions of Wailuku *Ahupua`a* (blue line), Waikapu and Pūlehu Nui *ahupua`a* (either side of gold line) Project Area within HC&S Landholdings and Grant 3343 to C. Spreckels (Dodge 1885 updated by Donn 1903)

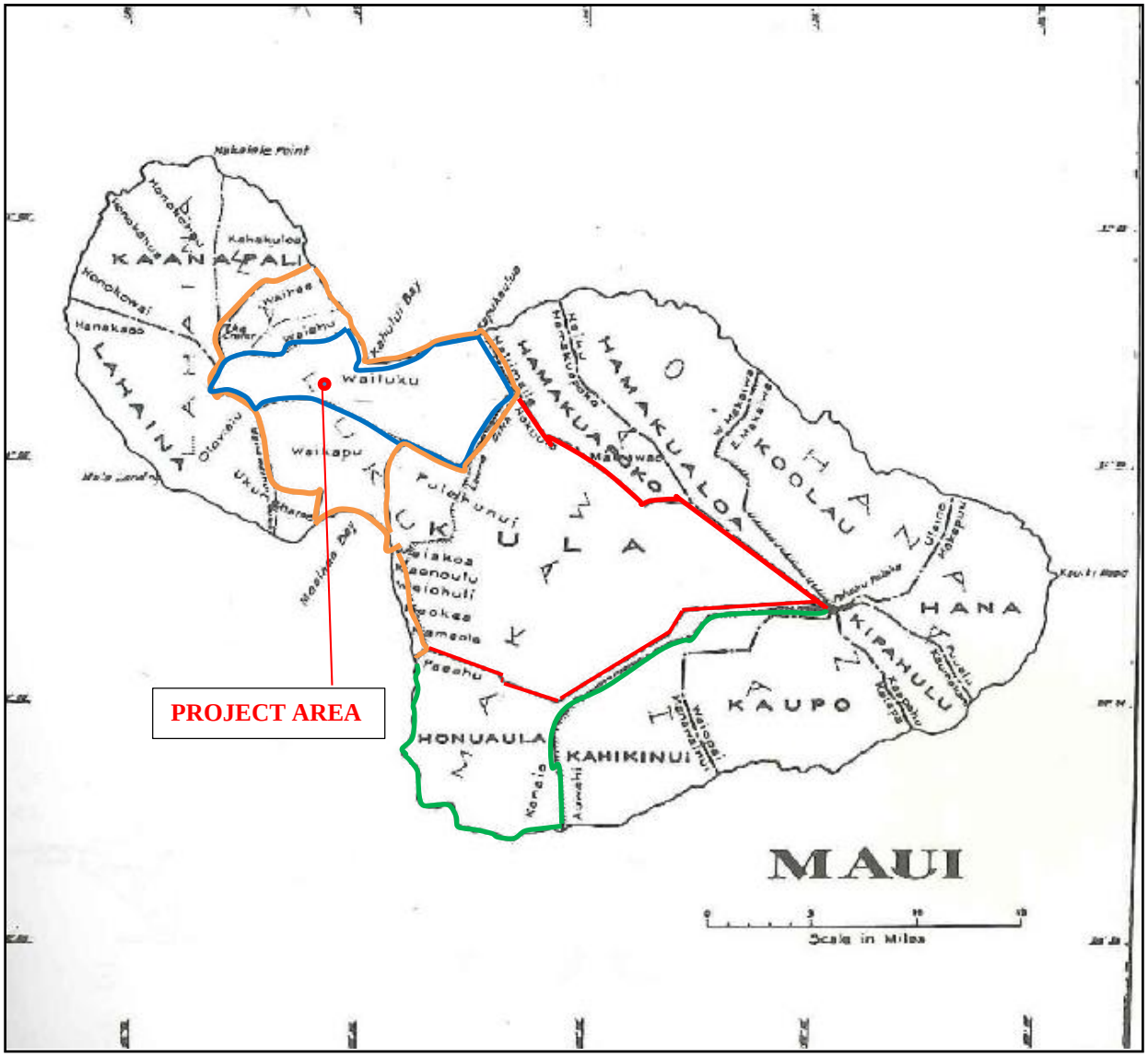

Figure 6. Island of Maui Map Showing Districts and Ahupua`a Boundaries (from a Gazetteer of Territory of Hawai`i, John Wesley Coulter-1935)

Figure 7. Approximate Location of Project Area (red) on Monserrat Map of 1882 (note name above project area exemplifies name of Alexander)

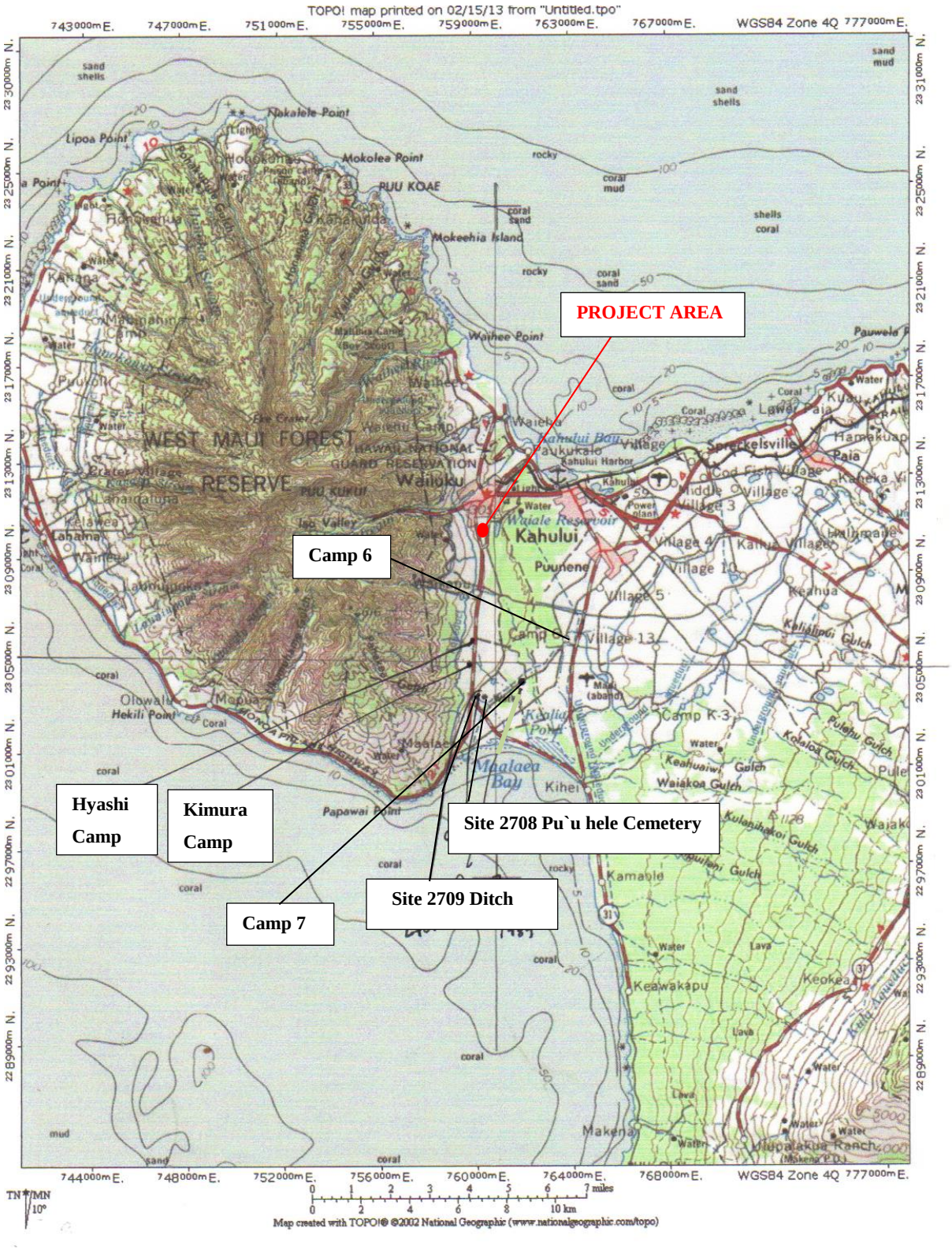

Figure 8. USGS Map Showing the Location of Closest Plantation Camps to the Subject Project Area (red)

Table I. Summary of LCA's and Grants Adjacent to Project Area (Source: Waihona `Aina Corp. 2004)

NAME	**L.C.A.**	**R.P.**	***GRANT***	***COMMENTS***	***ACREAGE***
H. Cornwell			3152	Present project area within awarded land	256.113
Wm. McLane	3201			Land given in 1822 by Puupahoehoe	3.85
Keliolelo	3525			Taro land and houselot	1.77
Wm. Crowningburg	433			Houselot; 14 patches (son-in-law of *konohiki* Puupahoehoe	5.93
C. Louzada / H. Cornwell			2951	No land use indicated	17
Spreckles		3343		Waikapū Commons PROJECT AREA	16,000

PREVIOUS ARCHAEOLOGY

As discussed in the aforementioned Historic Background section, since this is an archaeological assessment, only those studies performed in close proximity to the subject parcel will be discussed below. The early archaeological studies conducted on Maui consisted of recording *heiau* (religious structures) sites along the coastline. These studies were carried out by Thrum (1909) and Stokes (1916). An island-wide survey was executed in 1928 by Winslow Walker (1931) though the Bishop Museum, where numerous *heiau* sites were recorded primarily in the west, central portion of Wailuku District and many of these have been damaged and or destroyed. As exhibited on Figure 10, no sites were recorded in the vicinity of the subject parcel (Figure 10).

Within the project area, the western portion underwent an archaeological survey (Titchenal 1996) and monitoring procedures (Morawski et. al. 2006) for the existing retention ditch in the west, central portion (see Figures 3 and 10). Aki Sinoto Consulting conducted an archaeological inventory survey of the proposed retention basin and adjoining lands in Waikapū and Wailuku *ahupua`a*, Wailuku District, Maui Island (TMK 3-5-01:17 por: 3-5-02:1, por.), located within and south of the current project area. No surface cultural remains were located during the surface survey, and no subsurface cultural remains or deposits were identified in the thirteen backhoe trenches excavated in selected localities throughout the project area.

Site 50-50-04-2916 comprised of human skeletal remains were identified at the Maui Home Affordable Living Shelter by Donham in 1992.

Xamanek Researches (Fredericksen 2004) recently conducted an archaeological inventory survey for the Waikapū affordable housing subdivision (TMK 3-5-02:001 por and 3-8-07:101), located adjacent to; south of the present project area (see Figure 10). One previously identified historic property was noted during the inventory survey. State Site 50-50-04-5474 consists of an approximate 2000- foot portion of the Kama Ditch and a substantial reservoir (Reservoir No. 6). No other cultural remains were identified during the survey, it was estimated that approximately 40% of the project area was previously impacted by sand mining activities in the last 20 or so years and that much of the remainder of the 100-acre study area was most recently planted in pineapple. Determination by the SHPD architecture branch that sufficient information was collected at Site 5474 Kama Ditch to document the site and that the proposed demolition of the bulk of Site 5474 for proposed development was approved.

Scientific Consultants (Dega 2004) conducted an archaeological inventory survey of approximately 348 acres in Wailuku for the Kehalani Mauka Subdivision, Wailuku *ahupua`a* and District just northwest of the project area (TMK 3-5-001:001 por) (see Figure 10). Eight historic sites were documented during the

survey, two of which were recorded during a previous project. State Site 50-50-04-5473 represents Hopoi Reservoir, this reservoir predates Hopoi Camp and was present at least by 1922. Hopoi camp was not identified during the survey. State Site 50-50-04-5474, the Kama Ditch, was identified east of the Hopoi reservoir running in a north-south direction to Waikapū. State Site 50-50-04-5493 was designated for another unnamed ditch running in a north-south direction occurring along the western flank of the parcel. State Site 50-50-04-5197 represents the Waihe`e Ditch, constructed between 1905 and 1907. The four other sites consist of a combination of historic-modern roadways (Site 5489), a system of smaller historic ditches (Site 5490), a historic artifact scatter on the surface (Site 5491), and several clearing mounds likely created during the plantation era (Site 5492). Twenty-seven subsurface testing trenches revealed homogenous soil matrices across the project area.

Archaeological monitoring was implemented for the Kehalani Subdivision and off-site improvements along the Waiale Road by Scientific Consultant Services (Morawski, Shefcheck, and Dega 2006) (see Figure 10). Five sites were recorded and consisted of a historic road bed (50-50-04-5963), a sugarcane flume (50-50-04-5964), an *in situ* burial (50-50-04-5680), and two areas of isolated human remains (50-50-04-5965 and -5966). Remains associated with the isolated finds were encountered in a previously disturbed soil matrix that was most likely associated with the initial construction of the Waiale Road.

Archaeological Services Hawaii, LLC performed an archaeological inventory survey (AIS) within a 50-acre parcel of land in Wailuku and Waikapū *ahupua'a*, Wailuku District, Maui Island, TMK [2] 3-5-002:001 pors. for the proposed development of the Emmanuel Lutheran Church (ELC) adjacent and south of the subject parcel, and the Valley Isle Fellowship (VIF) (see Figure 10). The parcels were subsequently subdivided into two approximate 25.0 acre parcels and assigned TMK‘s [2] 3-5-002:011 for the north and [2] 3-5-002:012 for the south.The AIS included a pedestrian survey with subsurface backhoe testing of a total of 25 backhoe trenches (TR1-25). Results of the pedestrian survey identified one historic property, a disturbed segment of State Site 50-50-04-5474, the Kama Ditch, situated within the southwestern portion of the project area. Also noted was a metal sluice gate, designated Feature 1 of Site 5474. The ditch, also known as *kamaauwai* was constructed around 1905 to 1907 and provided water to irrigate the sugar cane fields surrounding the project area. Site 5474 was assessed as significant under Criterion “a” because of its association with the plantation era and Criterion “d” for its information content under the Federal and State historic preservation guidelines (Guerriero et. al. 2004 revised 2016).

The closest known burial sites to the project area are Site 50-50-04-5965 identified during the monitoring procedures for the retention basin and trench, as well as Sites Site 50-50-04-6573 and 6261 situated along

Kuikahi Drive at the current Walgreens Pharmacy (Site 50-50-04-6573), and along the north and south sides of Kuikahi Drive just near the entrance to Maui Lani (see Figure 10). An AIS (2005) and AMP (2007) were conducted of the Kuikahi Drive Extension and a portion of Maui Lani Parkway corridor which intersects with Kuikahi Drive (Rotunno-Hazuka et. al. 2007). Site 6573 is comprised of a primary traditional burial designated Feature 1 which was preserved in place, and disturbed human skeletal remains (Feature 2), which were reinterred adjacent to the preservation area established around Feature 1. The second Native Hawaiian burial area is Site 50-50-04-6261 comprised of primary burials and secondary deposits of human remains designated Features 1a-1c and 2-12. Site 6261 was identified during monitoring and data recovery procedures and was subsequently preserved along the north and south sides of Kuikahi Drive.

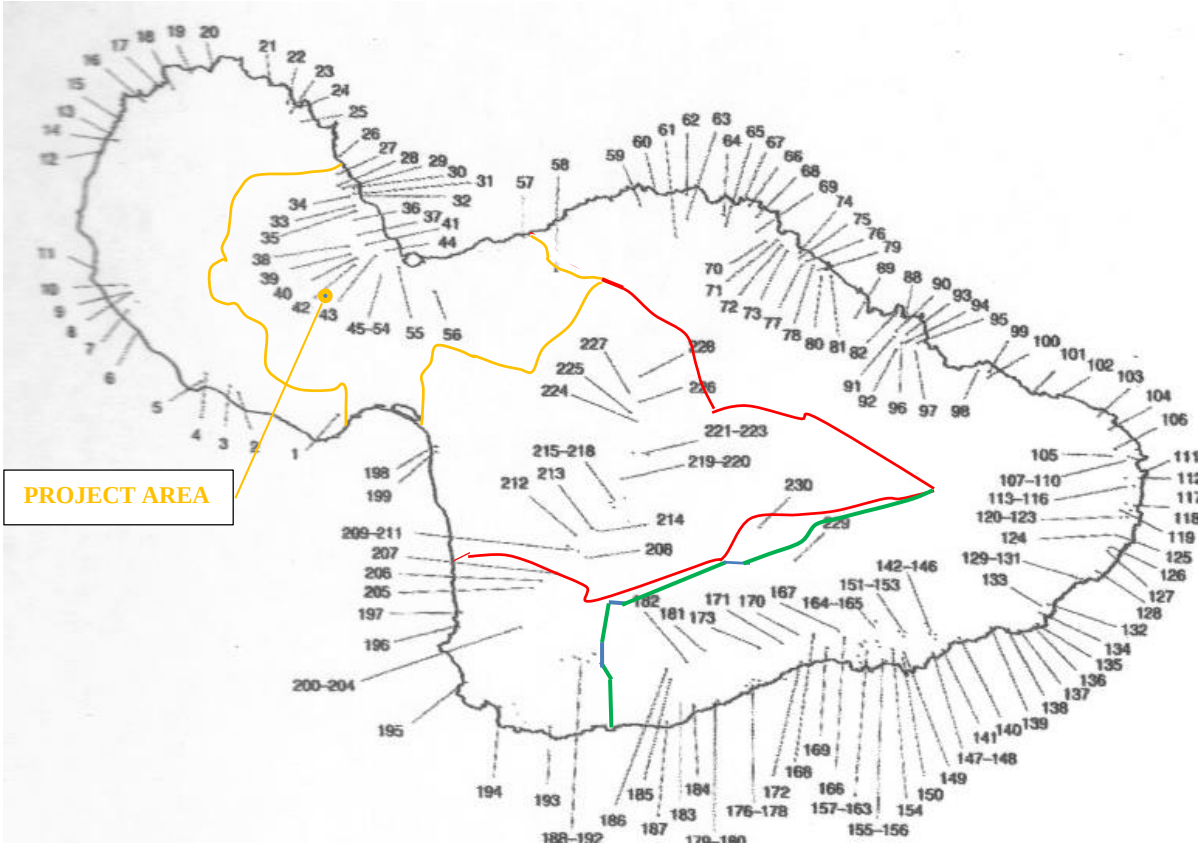

Figure 9. Walker's Site Map Showing Recorded *Heiau*, Project Area and approximate Wailuku (blue), Kula (red) and Honua`ula *Moku* (Traditional) Boundaries (green) (map adapted from Sterling 1998)

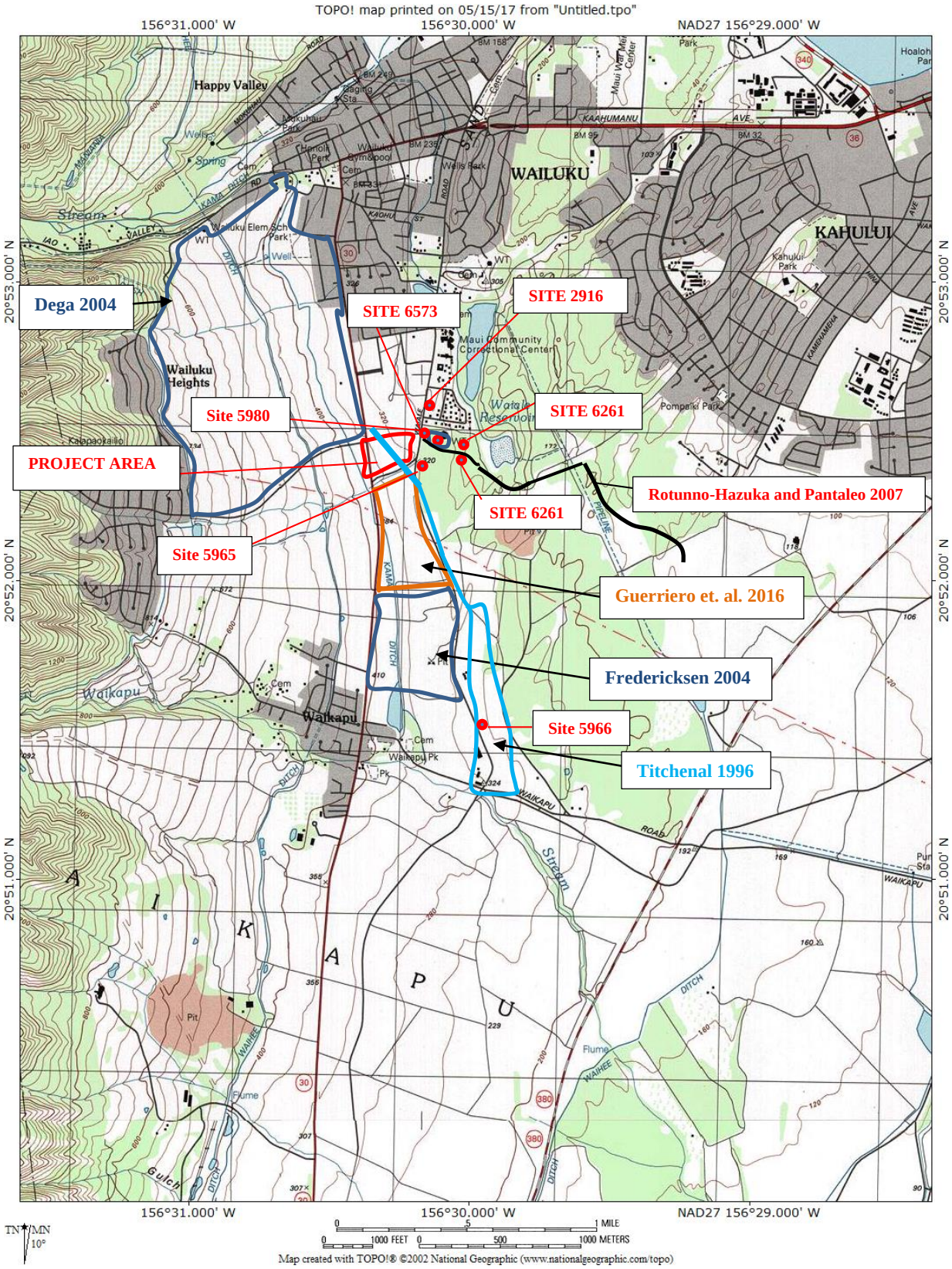

Figure 10. USGS Wailuku Quad (2002) Map Showing Previous Archaeology and Sites near Project Area

SETTLEMENT PATTERNS

The settlement patterns of an indigenous population are surmised from a variety of information and research. Previous archaeological findings and archival research (such as information retrieved during the Great Māhele and etc.) are two of the main determining factors. Another important factor is the existing geology or landforms in the area, be it a harsh or hospitable environment. The proximity to fresh water or marine resources, rain fall, the presence of basaltic ridges and or *a`a* lava flows and etc. As previously discussed, the project area is between Wailuku and Waikapū Towns along Waiale Road which was actively settled during the pre-historic and historic periods. During the pre-Contact era, permanent habitation sites with extensive agricultural complexes would be located in the lower and upper valleys due to the numerous streams and valleys of Nā Wai `Eha; however based on the close proximity of the coast and results of studies in these shoreline areas, dual permanent settlement of the uplands with a focus on agriculture and the coastline with an emphasis on marine exploitation. The Wailuku Sand Hills appear to be more intensively occupied closer to the shore, and less settled more inland but extensively utilized for the interment of Native Hawaiian burials.

SITE EXPECTABILITY

The presumed settlement patterns, coupled with the prior investigations assist in determining the types of historic properties to be expected. However due to the compounded disturbances across the project area from sugar cane cultivation, sand mining and the construction of the retention ditch, the likelihood that historic properties have survived is low but would comprise Native Hawaiian burial features with remnant agricultural (terraces) and or habitation (cultural layers) sites. Since no LCA were present within the subject parcel, historic period sites may comprise agricultural features and refuse sites and or remnant features from WWII.

METHODS AND PROCEDURES

A review of previous archaeological investigations was conducted at the ASH and SHPD libraries in Ma'alaea and Pu`unēnē prior to and during the initiation of the testing strategy. Archaeological investigations included a pedestrian survey and backhoe test trenching which were performed under the supervision of Ms. Jenny O'Claray-Nu (B.A.) and archaeologist, Mr. Cody Sheets (B.A.). A total of 40 field hours were expended during the course of this project. Mechanical excavations were undertaken with an excavator provided by T.J. Gomes. Overall coordination and supervision was performed by Ms. Lisa Rotunno-Hazuka (B.A.), drafting by Mr. Nico Fuentes (M.A.) and Mr. Jeffrey Pantaleo (M.A.) was the Principal Investigator.

FIELD METHODS

Initial investigations consisted of a pedestrian survey to determine the presence of surface historic properties, disturbances and or basalt outcrop which would aide in establishing the location of test excavations. No surface sites were noted during the survey; thus subsurface explorations were undertaken in the form of mechanical test trenches. All excavations were undertaken with the supervision of the archaeologist and terminated when sterile subsoil was reached. The testing method employed was systematic random sampling where the areas to be analyzed are chosen at random with a subsequent pre-determined strategy (Hester et. al. 2009). "Use of this sample technique guarantees more uniform coverage of an area than would likely occur with simple random sampling" (Hester et. al. 2009:29) and therefore allows the investigator to obtain information about the subsurface conditions across the project area. The backhoe trenches ranged from 4.0 m to 6.0 m long by 1.2 m wide by 1.4 to 2.3 m deep.

Each trench was recorded using scaled stratigraphic profiles, photographs, dimensions and soil descriptions. The location of the trenches was plotted utilizing known points from the aerial photographs and tape and compass from boundary corners. During the course of this project, all accepted standard archaeological procedures and practices were followed.

LABORATORY PROCEDURES

Soil samples collected during the excavations were stored in bags and labeled with provenience data and date collected. The dry soil color was recorded utilizing the Munsell color system, and soil texture using USDA soil terminology.

RESULTS OF SURVEY

A total of 11 backhoe test trenches were executed across the parcel and were negative for buried cultural remains (Figure 11 and Table II). The trenches exhibited extensive disturbances from 0.65 m (TR5) to 1.85 (TR5), where bedrock was recorded from 1.6 m (TR8) to 2.30 mbs (TR3), imported sand was noted in Layer I (TR2) and within Layer III (0.70 mbs) in TR9 and a rocky lens, possible alluvial deposition was recorded in TR6 at 1.85 mbs. Trenches 1-3 were positioned in the central portion, TR4 along the northern perimeter in the eastern half, TR's 5-8 were placed in the eastern section around the proposed detention basin for future construction activities and TR's 9-11 were situated in the western portion. The test trenches are described and presented below.

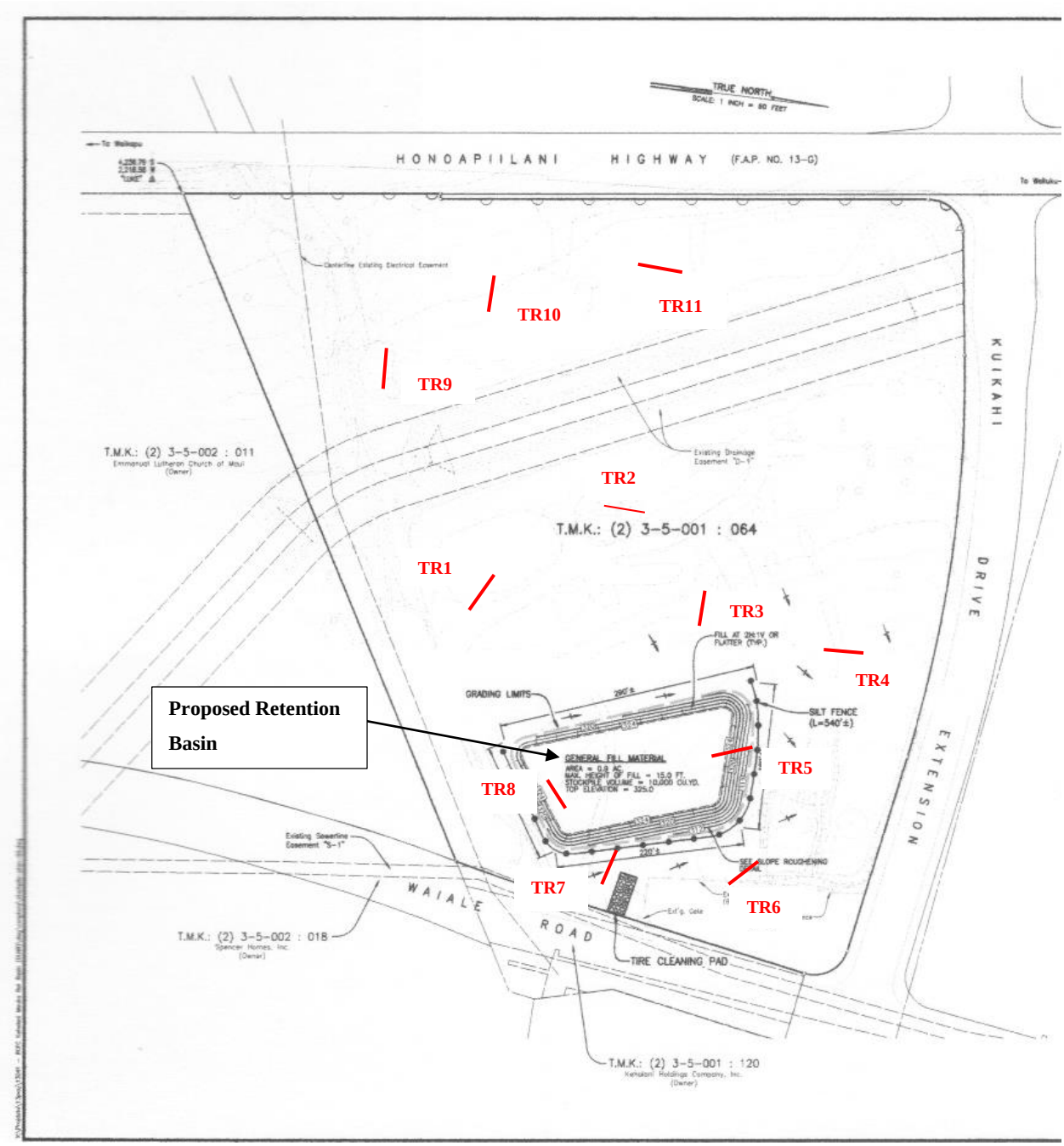

Figure 11. BMP Map Showing Location of Trenches 1-11

Table II. Summary of Trench Testing at Project area

TR	Length (m)	Width (m)	Depth (m)	Orient TN°	Disturbed	Cultural	Assessment
1	6.0	1.2	1.9/2.0	133/313	I/II	none	agricultural
2	7.0	1.2	2.0/2.2	180/360	I/II/III	none	drainage way
3	6.7	1.4	2.6	354/154	I/II	none	agricultural
4	6.5	1.2	2.5	180/360	I/II	none	agricultural
5	5.6	1.1	2.6	359/179	I/II	none	agricultural
6	6.6	1.2	2.4/2.45	349/169	I/II/III	none	ag/alluvial
7	6.2	1.2	2.3	286//106	I	none	construction
8	6.0	1.2	2.0/2.2	251/71	I/II/III	none	agricultural
9	4.3	1.3	1.7/1.8	90/270	I/II/III	none	construction
10	5.5	1.3	1.7/1.8	90/280	I	none	agricultural
11	6.0	1.1	1.7/1.8	360/160	I	none	agricultural

TRENCH 1

Trench 1 was placed in the south central portion of the project area and measured 6.0 m long by 1.2 m wide by 1.9/2.0 m deep and oriented 133/313° (see Figure 11 and Table II). The excavations revealed five stratigraphic layers which were negative for subsurface cultural remains (Figures 12-14). Layers I and II were previously disturbed by agricultural and existing drainage way development

Layer I 0 –0.15/20 mbs; (7.5YR2.5/2, 2.5/3) fill zone, dry color very dark brown gravelly very fine silty loam; common inclusions of rootlets and scattered angular pebbles and cobbles (50%); very abrupt wavy boundary, no cultural remains observed**.**
Layer II 0.15/0.20-0.80 mbs; (10YR3/2, 3/3) dry color dark grayish brown silt loam; intermix with large and small sub-angular to angular pebble and cobble scatter (30%); abrupt wavy boundary; no cultural remains observed.
Layer III 0.80-1.20/1.30 mbs; (10YR3/3,3/4) dry color very dark brown mottled dark brown stony silt clay; very few rootlet and common layers of sub-angular and angular pebble and cobble inclusions (50%); very abrupt wavy boundary. No cultural remains observed.
Layer IV 1.20/1.30-1.90/2.0 mbs; (7.5YR2.5/3) dry color very dark brown stony silt clay; prismatic of sub-angular and angular blocky inclusions intermix with common layers of sub-angular and angular boulder and cobble inclusions (50%); very abrupt wavy boundary. No cultural remains observed**.**
Layer V 1.9/2.0mbs; a basal layer; gray mottled grayish brown decomposing to hard bedrock.

Figure 12. Overview Photograph of Proposed TR1 (View to Southwest)

Figure 13. Photograph of Trench 1 (left) (View to South); Photograph of East Wall at TR1

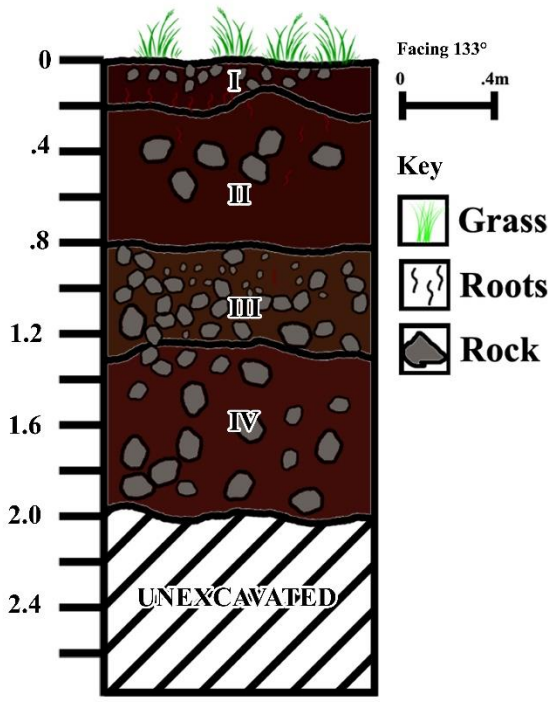

Figure 14. Stratigraphic Profile of East Wall at TR1

TRENCH 2

Trench 2 was located in the central portion of the project area east of the existing retention ditch (see Figure 11 and Table II). It measured 7.0 m long by 1.20 m wide by 2.0/2.2 m deep and oriented 180/360°. The excavations revealed three stratigraphic layers which were negative for subsurface cultural remains (Figures 15 and 16). Layers I and II observed to be previously disturbed by the drainage way development. Layer I appear to be a portion of an access road that comprised of compact gravel and pockets of sand.

> **Layer I** 0–0.22/0.30 mbs; (10YR,3/1, 3/2,5/6) gravel fill with imported sand, dry color dark grayish brown to dark brown very fine silt mottled brown fine sand pockets; intermix with common sub-angular to angular pebble (50%) very abrupt wavy boundary, no cultural remains observed**.**
> **Layer II** 0.22/0.30-0.60/0.70 mbs; (7.5YR2.5/3, 2.5/2) color very dark brown stony silt; few rootlets intermix with common sub-angular to angular pebble and cobble inclusions (40%); very abrupt wavy boundary; no cultural remains observed.
> **Layer III** 0.60/0.70-2.0/2.10 mbs; (7.5YR3/3, 2.5/3) dry color dark brown mottled very dark brown stony silt clay and few scattered of sub-angular and angular cobble inclusions (20%). No cultural remains observed.

Figure 15. Overview Photograph of TR2 (left) (View to North); Photograph of West Wall at TR2

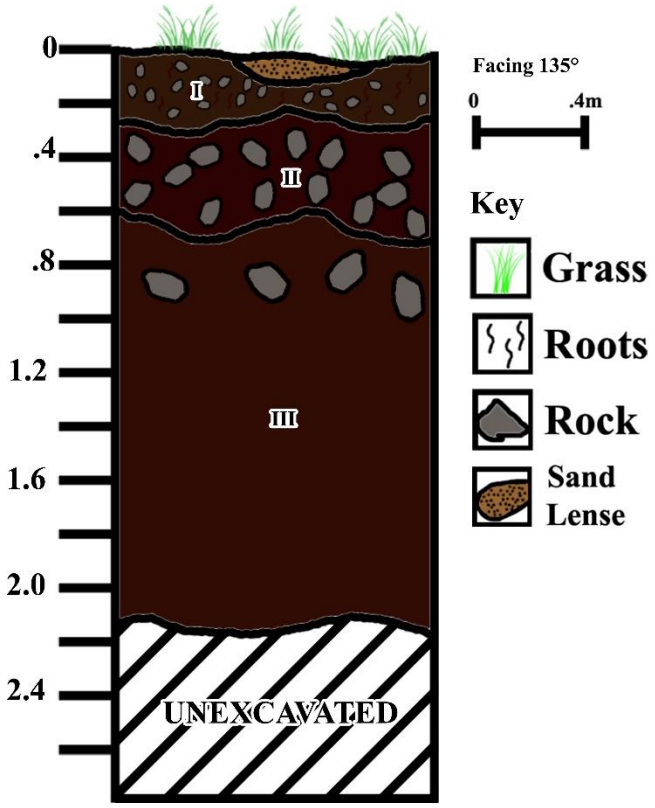

Figure 16. Stratigraphic Profile of West Wall at Trench 2

TRENCH 3

Trench 3 was placed in the east central portion of the parcel and measured 6.7 m long by 1.40 m wide by 2.5/2.6 m deep and oriented 354/174° (see Figure 11 and Table II). The excavations revealed three stratigraphic layers overlying decomposing bedrock which were negative for subsurface remains (Figures 17-19).

Layer I 0 –0.20/0.35 mbs; (7.5YR2.5/2, 2.5/3) agricultural zone, dry color very dark brown gravelly very fine silty loam; common inclusions of rootlets and scattered angular pebbles and cobbles (50%); agricultural material observed intermixed; very abrupt wavy boundary, no cultural remains observed**.**
Layer II 0.20/0.35-0.60/0.70 mbs; (10YR3/2, 3/3) dry color dark grayish brown silt loam; intermix with large and small sub-angular to angular pebble and cobble scatter(30%); abrupt wavy boundary; no cultural remains observed.
Layer III 0.60/0.70-2.30/2.40 mbs; (10YR3/3,3/4) dry color very dark brown mottled dark brown stony silt clay; very few rootlet and common layers of sub-angular and angular pebble and cobble inclusions (20%); very abrupt wavy boundary. No cultural remains observed.
Layer IV2.30/2.40 mbs; a basal layer; gray mottled grayish brown decomposing to hard bedrock.

Figure 17. Overview Photograph of the Central Portion of Project Area for TR3

Figure 18. Photograph of East Wall at Trench 3

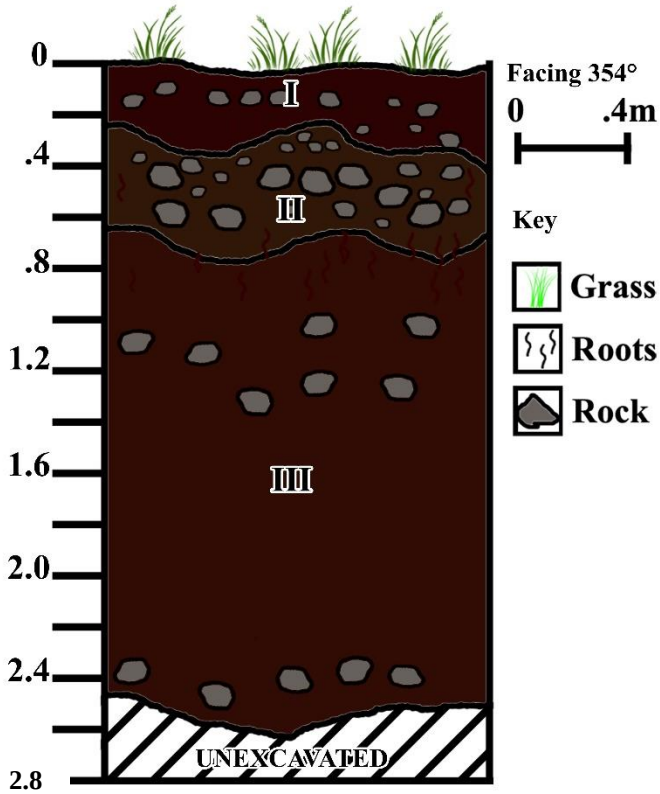

Figure 19. Stratigraphic Profile of East Wall at Trench 3

TRENCH 4

Trench 4 was located in the northeast portion of the parcel and measured 6.5 m long by 1.20 m wide by 2.50 m deep and oriented 180/360° (see Figure 11 and Table II). The excavations revealed three stratigraphic layers overlying bedrock and were negative for buried remains (Figures 20-21).

Layer I 0 –0.30/0.40 mbs; (7.5YR2.5/2, 2.5/3) agricultural zone, dry color very dark brown gravelly very fine silty loam; common inclusions of rootlets and scattered angular pebbles and cobbles (50%); very abrupt wavy boundary, agricultural black plastic and irrigation material observed intermixed; no cultural remains observed**.**
Layer II 0.30/0.40-1.30/1.40 mbs; (10YR3/2, 3/3) upper portion is disturbed and comprised of dark grayish brown silt loam; intermix with large and small sub-angular to angular pebble and cobble scatter (30%); abrupt wavy boundary; no cultural remains observed.
Layer III1.30/1.40-2.30/2.40 mbs; (10YR3/3, 3/4) dry color very dark brown mottled dark brown stony silt clay; very few rootlet and common layers of sub-angular and angular pebble and cobble inclusions (50%); very abrupt wavy boundary. No cultural remains observed.
Layer IV 2.50 mbs; a basal layer; gray mottled grayish brown decomposing to hard bedrock.

Figure 20. Overview Photograph of TR4 (left); Photograph of East wall at Trench 4

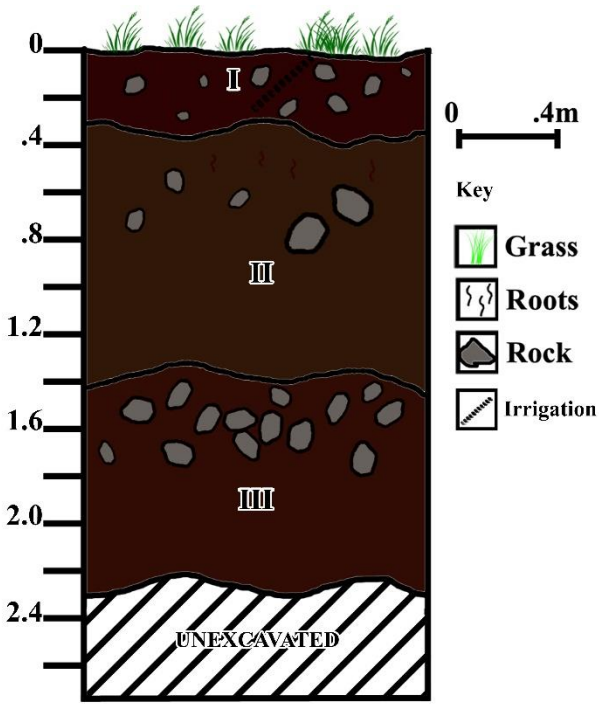

Figure 21. Stratigraphic Profile of East Wall at Trench 4

TRENCH 5

Trench 5 was positioned in the proposed retention basin in the northeast quadrant (see Figure 11 and Table II). It measured 5.6 m long by 1.10 m wide by 2.6 m deep and oriented 180/360°. The excavations revealed four negative stratigraphic layers (Figures 22-24).

Layer I 0 –0.25/0.30 mbs; (10YR,4/2, 3/2) agricultural zone, dark grayish brown gravelly fine silty loam and sand pockets; strong, medium, granular; common rootlet, sub-angular cobble and pebble inclusions (50%); very abrupt boundary, observe agricultural irrigation lines, glass and plastic fragments no; very abrupt wavy boundary.
Layer II 0.25/0.30-0.60/0.65 mbs; (7.5YR3/3, 2.5/3) dark brown mottled very dark brown stony silt loam; well formed, sub-angular blocky peds intermix with sub-angular to angular pebble and cobble inclusions (60%); very abrupt wavy boundary; no cultural remains observed.
Layer III 0.60/0.65-2.15/2.20 mbs; (10YR4/3, 3/3) very dark brown mottled dark brown silt clay; soft, massive poorly formed sub-angular blocks; sub-angular and angular cobble scatter (20%); very abrupt boundary. No cultural remains observed.
Layer IV 2.15/2.20-2.60 mbs; (10YR 3/6, 3/4) dark yellowish brown mottled brown silt clay; weakly, massive medium blocky poorly formed peds; no cultural remains observed.

Figure 22. Overview Photograph of Northeast Portion for TR's 4 and 5

Figure 23. Overview Photograph of Trench 5 (left) (View to South); Photograph of East Wall at TR5

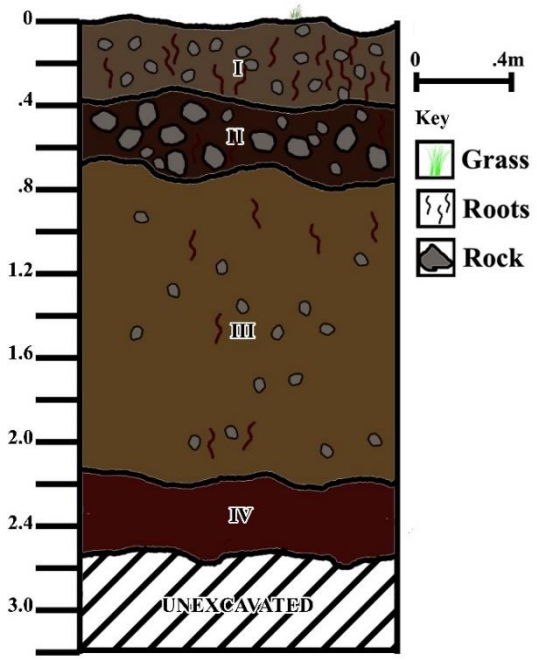

Figure 24. Stratigraphic Profile of East Wall at TR5

TRENCH 6

Trench 6 was located in the northeast corner of the subject area and measured 6.60 m long by 1.20 m wide by 2.40/2.45 m deep and oriented 349/169° (see Figure 11 and Table II). The excavations revealed five stratigraphic layers which were negative for significant subsurface cultural remains (Figures 25-26). Layers I and II revealed previously disturbed layers of agricultural activities, and Layer III appeared to contain an alluvial lens at the interface of Layers II and III.

Layer I 0 –0.60/0.75 mbs; (7.5YR,2.5/2, 2.5/3) fill zone, dry color very dark brown gravelly fine silt loam; well-formed coarse sub-angular block, peds; common rootlet, sub-angular cobble and pebble inclusions (50%); very abrupt boundary, observe agricultural irrigation lines, glass and plastic fragment; very abrupt wavy boundary.
Layer II 0.60/0.75- 1.35/1.40 mbs; (7.5YR3/3, 2.5/3) dry color dark brown mottled very dark brown stony silt loam; well formed, sub-angular blocky peds intermix with sub-angular to angular pebble and cobble inclusions (20%); very abrupt wavy boundary; 0.60 mbs PVC water line observed along southeast corner.
Layer III 1.35/1.40-2.0/2.10 mbs; (10YR4/3, 3/3) dry color very dark brown mottled dark brown silt clay; soft, sub-angular and cobble and pebble inclusions (50%); very abrupt boundary. No cultural remains observed.
Layer IV 2.15/2.20-2.40/2.45 mbs; (10YR 3/6, 3/4) dark yellowish brown mottled brown silt clay; weakly, massive medium blocky poorly formed peds; no cultural remains observed.
Layer V 2.40/2.45 mbs; a basal layer; gray hard and decomposing bedrock.

Figure 25. Overview Photograph of TR6 (left) (View to North); Photograph of East Wall at Trench 6

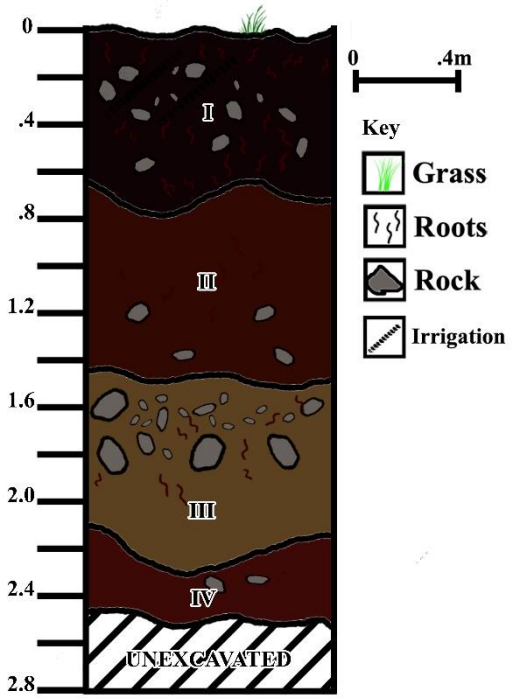

Figure 26. Stratigraphic Profile of East Wall at TR6

TRENCH 7

Trench 7 is located along the southeast portion of the project area and measured 6.2 m long by 1.20 m wide by 2.30 m deep and oriented 286/106° (see Figure 11 and Table II). The excavations revealed two stratigraphic layers which were negative for subsurface cultural remains (Figures 27-29).

> **Layer I** 0-0.30/0.34 mbs; (7.5YR3/4, 3/3) very dark brown gravelly very fine silt; durable sub-angular blocky peds; few inclusions of rootlet intermix with scattered sub-angular and angular pebbles (50%); very abrupt plane boundary, recent historic material of glass, plastic metal fragments observed**.**
> **Layer II** 0.30/0.34-2.30 mbs; (7.5YR4/1, 3/1) dark brown mottled very dark gray stony silt clay; slightly hard, poorly formed sub-angular block intermix with very few rootlet, no cultural remains observed.

Figure 27. Overview Photograph of the Southeast Corner and Proposed Trench 7

Figure 28. Photograph of North Wall at Trench 7

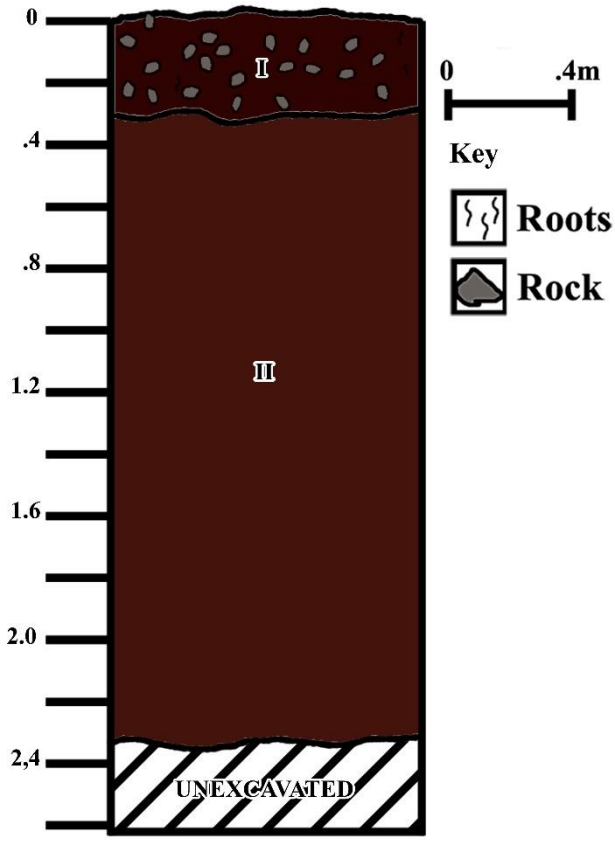

Figure 29. Stratigraphic Profile of West Wall at TR7

TRENCH 8

Trench 8 is located in the southeast corner of the parcel and measured 6.0 m long by 1.20 m wide by 2.20 m deep and oriented 251/71° (see Figure 11 and Table II). The excavations revealed four stratigraphic layers overlying bedrock (Figures 30 and 31).

Layer I 0 –0.15/0.20 mbs; (10YR/4/2, 3/2) agricultural zone, dark grayish brown gravelly fine silt loam; strong, medium, granular; common rootlet, sub-angular cobble and pebble inclusions (40%); very abrupt boundary, observe agricultural irrigation lines, glass and plastic fragments; very abrupt wavy boundary.
Layer II 0.15/0.20-0.40/0.50 mbs; (10YR5/1, 5/2) dry color gray mottled grayish brown stony silt loam; well formed, sub-angular blocky peds intermix with sub-angular to angular pebble and cobble inclusions (50%); very abrupt wavy boundary; no cultural remains observed.
Layer III 0.40/0.50-1.10/1.20 mbs; (7.5YR3/2, 2.5/3) dry color dark brown mottled very dark brown silt clay; soft, massive poorly formed sub-angular blocks; sub-angular and angular pebble scatter (15%); very abrupt boundary. No cultural remains observed.
Layer IV 1.10/1.20-2.20 mbs; (10YR 4/3, 3/3) brown mottled dark brown silt clay; weakly, massive medium blocky poorly formed peds; no cultural remains observed.
Layer V (2.10/2.20 mbs) (10YR5/1, 4/2) gray mottled grayish brown and saprolytic/decomposing bedrock.

Figure 30. Overview Photograph of TR 8 (left) (View to West); Photograph of North Wall at TR 8 (right)

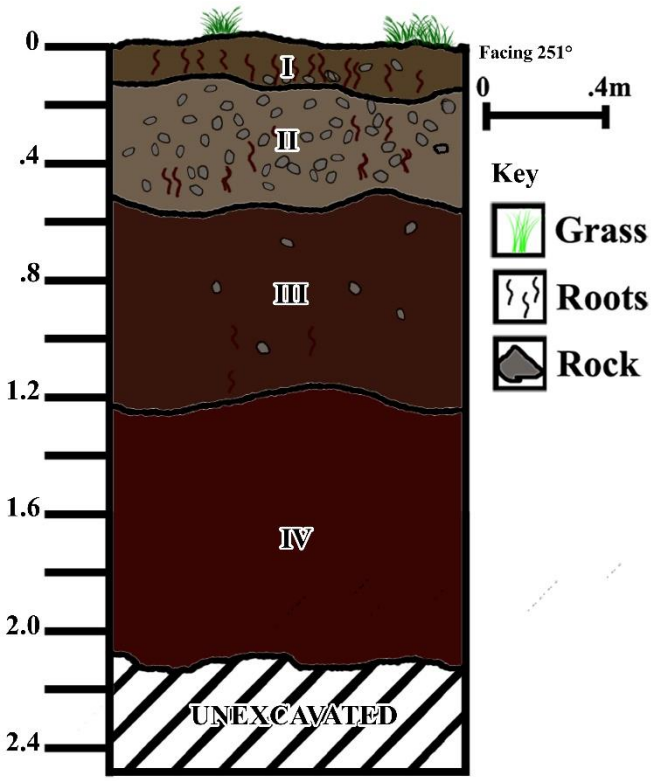

Figure 31. Stratigraphic Profile of North Wall at TR8

TRENCH 9

Trench 9 is located within the parking area of temporary offices along the northeast corner of project area (see Figure 11 and Table II). It measured 4.30 m long by 1.30 m wide by 1.55/1.80 m deep, oriented 90/270° and was negative for cultural remains. The excavations revealed four strata where Layers I and II were previously disturbed by recent developmental activities (Figures 32 and 33).

> **Layer I** 0 –0.30/0.35 mbs; (10YR/5/2) fill zone, dark grayish brown gravelly fine silt loam; strong, medium, granular; few rootlet, common sub-angular gravel and pebble inclusions (50%); very abrupt boundary, observe water and electrical lines, very abrupt wavy boundary.
> **Layer II** 0.30/0.35-0.55/0.60 mbs; (7.2YR4/3, 4/4) brown gravelly silt loam; well formed, sub-angular blocky peds few rootlet inclusions intermix with scattered sub-angular to angular pebble and gravel (30%); very abrupt wavy boundary; no cultural remains observed.
> **Layer III** 0.55/0.60-0.70/0.75 mbs; (10YR5/6, 6/6) yellowish brown mottled brown fine sand; structureless fine to coarse single grain; very abrupt wavy irregular boundary; No cultural remains observed.
> **Layer IV** 0.70/0.75-1.60/1.70 mbs; (7.5YR 4/3, 3/3) brown mottled dark brown stony silt clay; weakly, massive medium blocky well formed peds; sub-angular boulder and cobble scatter (30%); very abrupt clear boundary. no cultural remains observed.

Figure 32. Overview Photograph of TR9 (View to West) (left); Photograph of North Wall at TR9

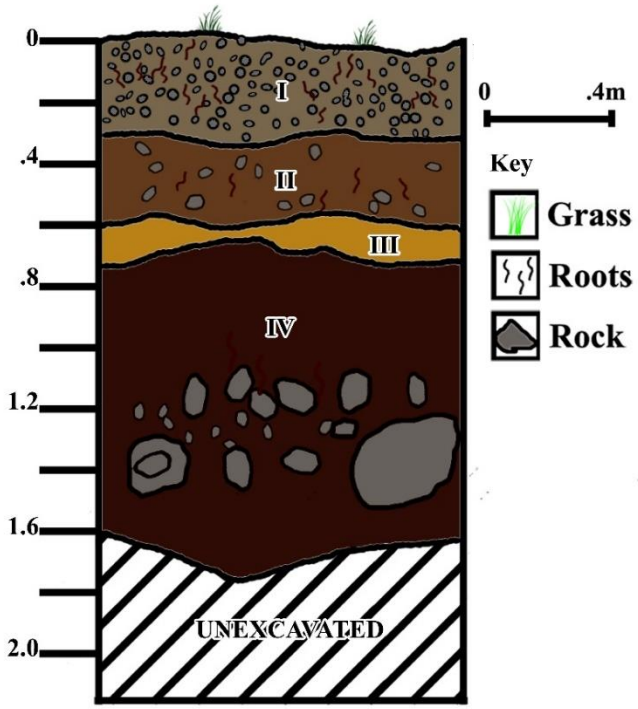

Figure 33. Stratigraphic Profile of North Wall at TR9

TRENCH 10

Trench 10 is located in the southwest quadrant of the subject parcel and measured 5.5 m long by 1.30 m wide by 1.70/1.80 m deep and oriented 90/270° (see Figure 11 and Table II). The excavations revealed three stratigraphic layers overlying saprolytic bedrock and all were negative (Figures 34-36).

Layer I 0 –0.30/0.40 mbs; (7.5YR3/2,3/3) fill zone, dry color dark brown gravelly fine silt loam; strong, medium, granular; common rootlet, common sub-angular gravel and pebble inclusions (40%); very abrupt boundary, observe irrigation lines, very abrupt wavy boundary.
Layer II 0.30/0.40-1.35/1.40 mbs; (7.2YR4/3,3/3) dry color dark brown mottled brown stony silt loam; well formed, sub-angular blocky peds few rootlet inclusions intermix with scattered sub-angular to angular pebble and gravel (40%); very abrupt wavy boundary; no cultural remains observed.
Layer III 1.35/1.40-1.71/1.75 mbs; (5YR4/4, 4/6) dry color reddish brown mottled yellowish red; prismatic sub-angular blocky peds; very abrupt boundary; No cultural remains observed.
Layer IV 1.70/1.75 mbs; (10YR5/1, 4/2) gray mottled grayish brown decomposing bedrock.

Figure 34. Overview Photograph of Southwest Area Showing Location for TR10

Figure 35. Photograph of North Wall at TR10

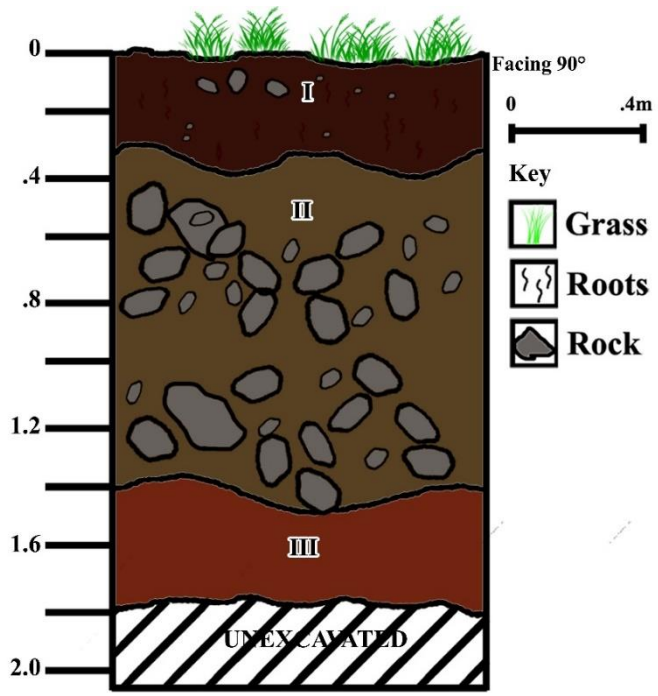

Figure 36. Stratigraphic Profile of North Wall at Trench 10

TRENCH 11

Trench 11 is located along the west, central boundary and measured 6.0 m long by 1.10 m wide by 1.70/1.80 m deep and was oriented 180/360° (see Figure 11 and Table II). The excavations revealed two stratigraphic layers that were negative for subsurface cultural remains (Figures 37 and 38).

> **Layer I** 0 –0.30/0.40 mbs; (7.5YR3/2, 3/3) fill zone, dark brown gravelly fine silt loam; strong, medium, granular; common rootlet, common sub-angular gravel and pebble inclusions (40%); very abrupt boundary, observe irrigation lines, very abrupt wavy boundary.
> **Layer II** 0.30/0.40-1.35/1.40 mbs; (7.2YR4/3, 3/3) dry color dark brown mottled brown stony silt loam; well formed, sub-angular blocky peds few rootlet inclusions intermix with scattered sub-angular to angular pebble and gravel (50%); very abrupt wavy boundary; no cultural remains observed.

Figure 37. Overview Photograph of TR11 (View to North) (left); Photograph of West Wall at Trench 11

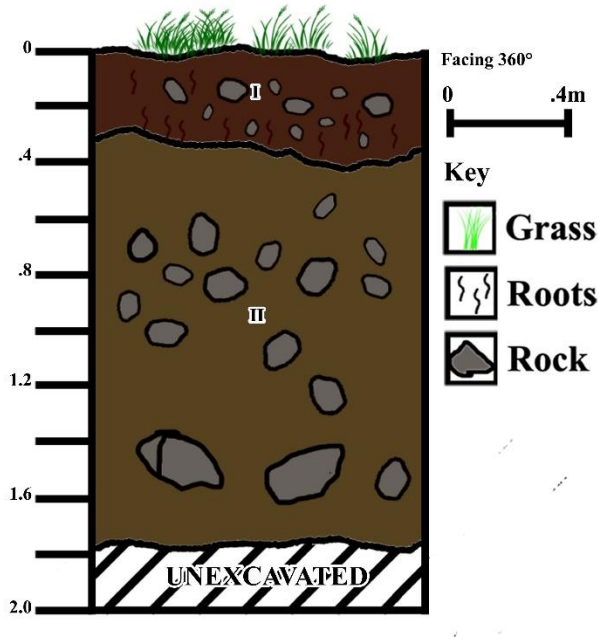

Figure 38. Stratigraphic Profile of West Wall at Trench 11

DISCUSSION AND RECOMMENDATIONS

An archaeological assessment was performed of a 15.0 acre parcel proposed for affordable residential development under the 201H permit process. The subject area has been extensively altered through drainage improvements comprised of a retention trench on the western portion, sugar cane cultivation and past sand mining activities where no inland sand dunes appear to be extant today. Despite these alterations, the subject area is positioned within a culturally sensitive area containing traditional burial features designated Sites 50-50-04-2916, 5965, 5966, 5680, 6561 and 6573; and a few historic period sites consisting of an historic road bed-Site 5963, a sugar cane flume-Site 5967 and Kama Ditch-Site 5474; thus subsurface testing was implemented. A total of 11 mechanical test trenches were excavated across the parcel and were negative for buried cultural remains and exemplified the disturbances which averaged approximately 0.60 m deep but recorded up to 1.85 mbs.

Based on the foregoing discussion, the probability of encountering *in situ* cultural remains is low; however disturbed burial features and or remnant historic properties may be extant. Thus, an archaeological monitoring program is recommended for all future ground-altering activities at the project area. An archaeological monitoring plan (AMP) is currently being prepared by ASH and will be submitted for review and approval prior to the commencement of construction activities.

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Appendix D – Preliminary Engineering Report

Established 1969

Preliminary Engineering Report

WAILUKU APARTMENTS

Wailuku, Maui, Hawaii
TMK: (2) 3-5-001: 064

Prepared For:

Pier Management – Hawaii, LLC
3401 East Kentucky Avenue
Denver, Colorado 80209

WARREN S. UNEMORI ENGINEERING, INC.
Civil and Structural Engineers – Land Surveyors
Wells Street Professional Center – Suite 403
2145 Wells Street
Wailuku, Maui, Hawaii 96793

May 1, 2017

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Preliminary Engineering Report
for
Wailuku Apartments 201H Application

1. INTRODUCTION

1.1 Purpose

This report discusses the existing infrastructure available to the Wailuku Apartments project, the improvements to be made, and the infrastructure-related exemptions that will be sought to enable implementation of the proposed development plan.

1.2 Project Description

The Wailuku Apartments project consists of a single 14.416 acre, Agricultural-zoned land parcel located in Wailuku, Maui, on which developer Pier Management - Hawaii, LLC proposes to construct nine multi-family buildings comprising 324 affordable and market-rate rental apartments. The project parcel is located on the south side of Kuikahi Drive, across the street from the Kehalani Village Center. It is bounded by Honoapiilani Highway to the west; Kuikahi Drive to the north; and Waiale Road to the east.

2. ROADWAY IMPROVEMENTS

2.1 Existing Conditions

The Wailuku Apartments project site is accessible from both Waiale Road and Kuikahi Drive, which are controlled by the County of Maui and classified as limited-access collector streets. No vehicular access is allowed from the project parcel onto Honoapiilani Highway, which is controlled by the State of Hawaii Department of Transportation's Highways Division.

2.2 Proposed Improvements

2.2.1 Vehicular Access

Vehicular access to Wailuku Apartments will be provided by two driveways constructed on Waiale Road and Kuikahi Drive. The driveway entrance on Kuikahi Drive will be located directly opposite the existing driveway into the Kehalani Village Center shopping complex. (See Figure 2-1)

Pavements on both Kuikahi Drive and Waiale Road will be widened to accommodate the left turn lanes at each driveway recommended by the Traffic Report for this project.[1] (See Figure 2-2)

[1] Austin Tsutsumi & Associates, Inc., "Traffic Impact Analysis Report for Wailuku 201H Residential Development," April 28, 2017, p.35.

2.2.2 Bike and Pedestrian Access

A 6-foot wide concrete sidewalk will be constructed along Waiale Road to connect the east driveway entrance to the signalized crosswalks at the Kuikahi Drive / Waiale Road intersection. This will offer a safe, all-weather pedestrian route from the apartment complex to the nearby Kehalani Village Center shopping area, Walgreens drug store, and businesses in the Maui Lani Village Center.

Bicycle access will be accommodated by providing the additional pavement widening needed to maintain 6-foot wide bike lanes along the project frontage and connect them to both driveway entrances.

2.3 Proposed Exemptions

The following exemptions will be sought in order to implement the proposed access plan and limit requirements for additional improvements that are not essential to the Wailuku Apartments project.

2.3.1 EXEMPTION #1: *Maui County Code Section 16.26B.3600 - Chapter 36: Improvements to Public Streets*[2]

a) Exempt the development from the requirement to dedicate land to the County of Maui to increase the width of existing rights-of-way of Kuikahi Drive, Waiale Road and Honoapiilani Highway.

b) Exempt the development from the requirement to construct pavement widening, concrete curbs, gutters and sidewalks along Kuikahi Drive, Waiale Road and Honoapiilani Highway roadway frontages beyond those improvements specifically indicated on the approved site plan.

c) Exempt the development from the requirement to relocate existing overhead power and telecom lines underground.

d) Exempt the development from the requirement to install County-standard street lighting fixtures within the public right-of-way.

---

[2] MCC 16.26B.3600 - Chapter 36: Improvements to Public Streets.

"Where public streets are adjacent to the property on which any new structures(s) will be situated ... improvements as may be required by the [Public Works] director shall be constructed on those portions of the streets adjacent to the property. Improvements may include, but shall not be limited to, pavement widening, construction of sidewalks, curbs, gutters, swales, drainage improvements, driveways, curb ramps, striping, signage, relocation of utilities, and placement of utilities underground....In determining appropriate improvement and road widening requirements, the [Public Works] director may take into consideration the Maui County General Plan, Community Plans, standards of title 18 of the Maui County Code, future roadway improvement plans, or any other development standard on file with the department. If road widening lot(s) are required, a subdivision plat shall be filed, and the director may approve the building permit should the preliminary subdivision plat generally conform to the requirements of the road widening lot(s) request. The final plat shall be approved by the director prior to the occupancy of the structure."

e) Exempt the development from the requirement to construct bus shelters, pullouts or other public transit improvements along Kuikahi Drive or Waiale Road.

2.3.2 EXEMPTION #2: *Maui County Council Resolution 12-34 - County "Complete Streets" Policy*

Exempt the development from having to provide the bicycle and pedestrian improvements necessary to fully comply with Maui County's "Complete Streets" policy. Instead, limit required improvements to only those pedestrian and bicycle improvements specifically indicated on the approved site plan.

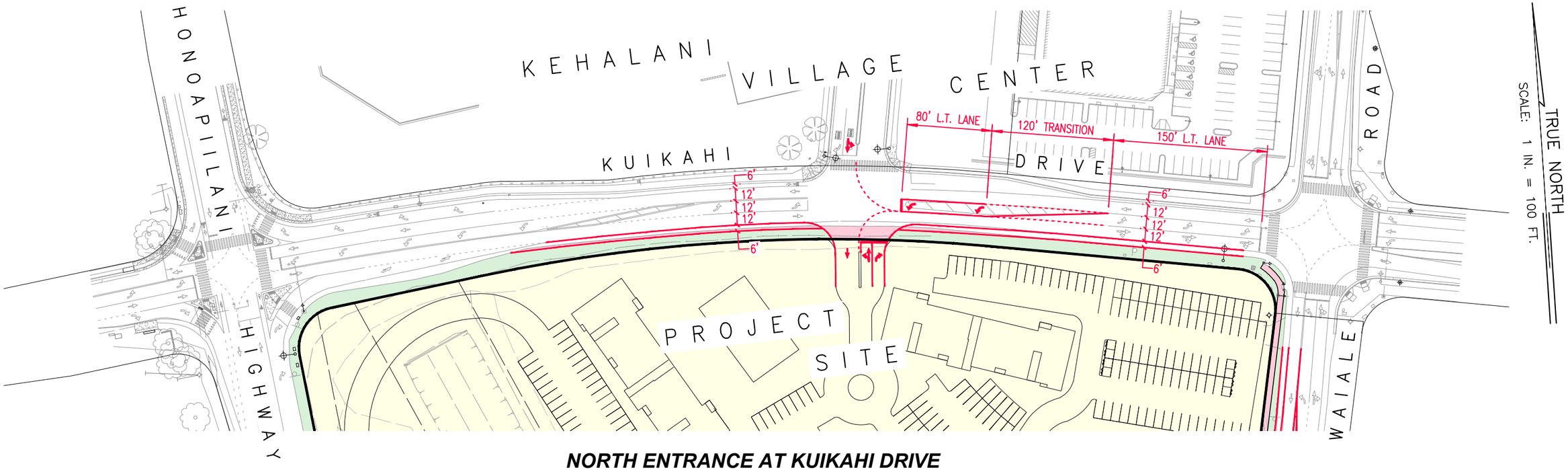
2.3.3 EXEMPTION #3: *Maui County Code Section 16.04C.010 - State Fire Code Section 18.2.3.4.4 Dead Ends*[3]

Exempt the development from the requirement to provide a fire truck turn-around when dead-end fire access lanes exceed 150 feet in length.

---

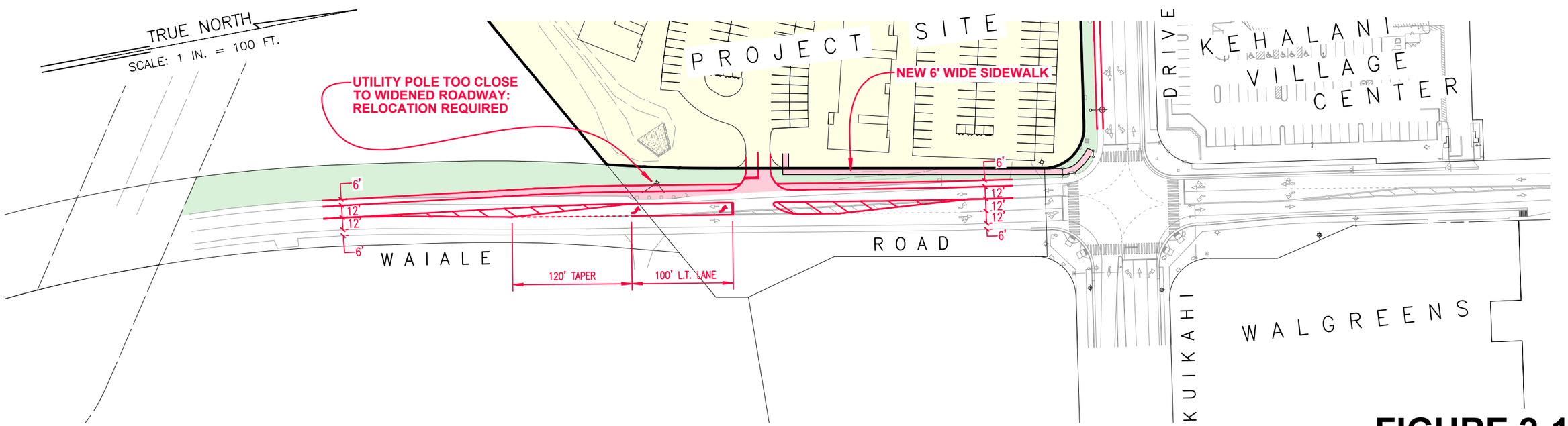
[3] Maui County Code Section 16.04C.010: NFPA 1, Section 18.2.3.4.4 Dead Ends.

"Dead-end fire department access roads in excess of 150 ft. in length shall be provided with approved provisions for the fire apparatus to turn around."



NORTH ENTRANCE AT KUIKAHI DRIVE

Scale: 1 inch = 100 feet



NOTE:
RED SHADING DENOTES AREAS OF PAVEMENT WIDENING

EAST ENTRANCE AT WAIALE ROAD

Scale: 1 inch = 100 feet

FIGURE 2-1
Proposed Access Improvements

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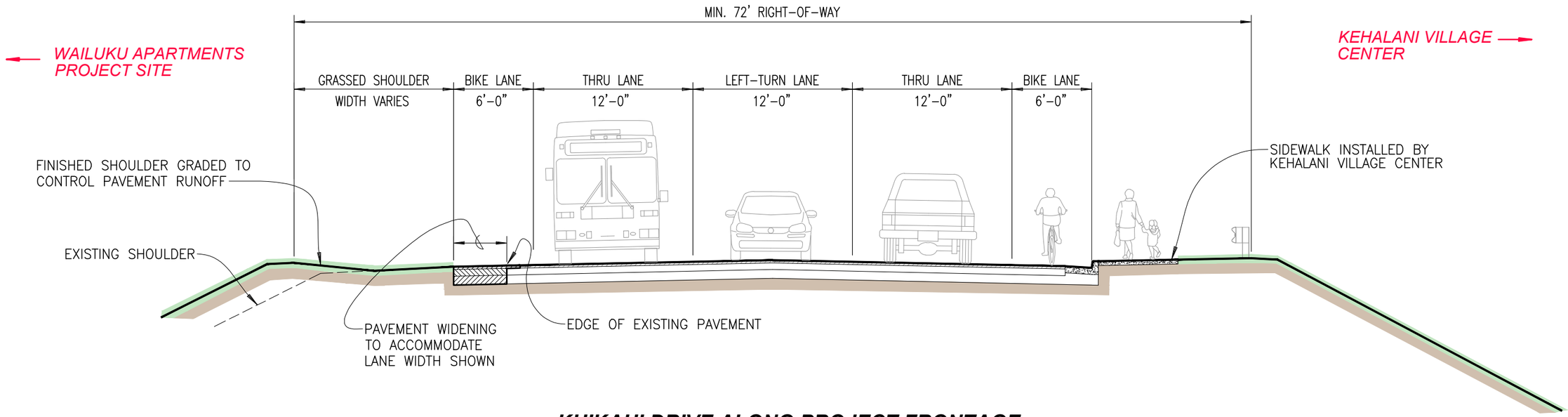
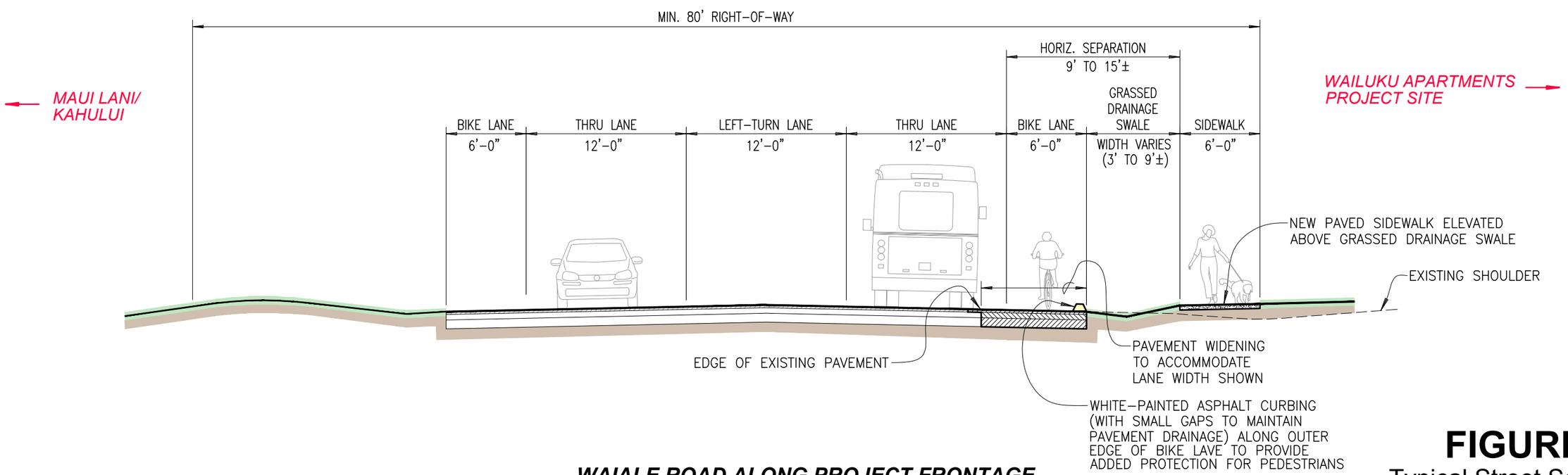


KUIKAHI DRIVE ALONG PROJECT FRONTAGE

Scale: 1 inch = 8 feet



WAIALE ROAD ALONG PROJECT FRONTAGE

Scale: 1 inch = 8 feet

FIGURE 2-2

Typical Street Sections:
Kuikahi Dr. and Waiale Rd.

V:\Projdata\16proj\16052\dwg\exhibits\Engineering Report\Figure 2-2-typ sect-00.dwg

3. STORM DRAINAGE

3.1 Existing Conditions

3.1.1 Topography and Soils

The project site was historically used for the cultivation of sugar cane by the Wailuku Sugar Company; however, in recent years it has been used as a construction equipment and material storage yard.

The existing terrain slopes steadily downward from southwest to northeast across the project area at a grade of approximately 5 percent. Elevations across the project site range from approximately 360 feet at its southwest corner, to roughly 306 feet at its northeast corner. An existing natural drainageway follows the southern boundary of the project site, connecting a drainage culvert at Honoapiilani Highway to a second culvert crossing at Waiale Road. An existing man-made drainage channel crosses the parcel in a north-to-south direction, bisecting the site.

The USDA Natural Resources Conservation Service identifies Iao clay (IcB) and Iao silty clay (IaA) as the predominant soil types found on the project site. These soils are characterized as presenting a slight to moderate erosion hazard.[4]

---

[4] United States Department of Agriculture, Soil Conservation Service, Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii, August 1972, pp. 46-47, Maps 99-100.

3.1.2 Flood and Tsunami Zone

The Federal Emergency Management Agency's Flood Insurance Rate Map for Maui County locates the project site within Zone X, outside both the 500-year floodplain and tsunami zone.[5] A current DLNR Flood Hazard Assessment Report for the parcel can be found in Appendix A-1.

3.1.3 Existing Drainage Conditions

Offsite Flows

Three distinct drainage systems pass through the project site.

1) A natural drainageway, shown in green on Figure 3-1, conveys storm runoff from lands mauka of Honoapiilani Highway[6] to the (normally dry) overflow basin at Alexander & Baldwin's Waiale irrigation reservoir. This gully conveys a 100-year storm flow of approximately 1,700 cfs across the project site in a mauka-makai (west-to-east) direction near its southern boundary.[7]

---

[5] U.S. Department of Homeland Security, Federal Emergency Management Agency, *Flood Insurance Rate Map, Maui County, Hawaii*, Community-Panel Number 150003 0391E, September 25, 2009.

[6] The lands discharging runoff to this gully include portions the Wailuku Heights Subdivision, the undeveloped mountainside above the subdivision, and the undeveloped pasturelands between the Wailuku Heights Subdivision and Honoapiilani Highway.

[7] The existing natural gully has too small a cross-section to contain the 100-year storm flow entirely within the main stem of the channel as it crosses the project site. Figure 3-2 indicates the portion of the site which is likely to be inundated should this channel overflow.

2) A man-made drainageway, shown in red on Figure 3-1, conveys storm runoff from the residential developments in the Mauka portion of the Kehalani Project District to a large stormwater retention basin in Waikapu located to the east of Waikapu Gardens Subdivision. The open drainage channel which crosses the project site in a north-to-south direction is designed to convey a 100-year storm flow of approximately 2,200 cfs.[8]

3) An underground storm drainage system, shown in blue on Figure 3-1, conveys runoff from the Makai portion of the Kehalani Project District to the Waiale Park / Detention Basin located at the corner of Olomea Street and Waiale Road. This basin, in turn, drains to the Wailuku River through a 1.2 mile long pipeline located downstream of the basin.

Onsite Flows

The undeveloped 14.4-acre project site generates storm runoff at a 10-year peak flow rate of approximately 15 cubic feet per second (cfs)[9]. Runoff drains in three directions as depicted on Figure 3-2 at the peak flow rates summarized below in Table 3-1.

---

[8] Ref. Warren S. Unemori Engineering, Inc., "Drainage Report for Kehalani Offsite Drainage System - Phase I", January 2004.

[9] See Pre-Development runoff calculation in Appendix A-2.

TABLE 3-1

Pre-Development Drainage Summary
Onsite Flows for 10 yr/1hr Storm

Receiving Facility	Approx. Area Draining to Receiving Facility	Pre-Development Peak Runoff
Kehalani Waiale Drainage Basin	8.2 Ac.	7.9 cfs
Kehalani Waikapu Drainage Basin	4.4 Ac.	5.0 cfs
A&B Waiale Irrigation Reservoir	1.8 Ac.	1.7 cfs
Total	14.4 Ac.	14.6 cfs

3.2 Drainage Plan

3.2.1 Projected Increase in Onsite Runoff Due to Development

Once developed, the 14-acre project is expected to generate an onsite 10-year peak storm flow of 34 cfs -- a 19 cfs increase over its existing, undeveloped condition.[10] Runoff will drain in three directions as indicated on Figure 3-3 at the peak flow rates noted in Table 3-2.

[10] See Post-Development runoff calculation in Appendix A-3.

TABLE 3-2

Post-Development Drainage Summary
Onsite Flows for 10 yr/1hr Storm

Receiving Facility	Approx. Area Draining to Receiving Facility	Pre-Development Peak Runoff	Post-Development Peak Runoff	Net Change from Pre-Development Condition at Project Boundary	Net Change from Pre-Development Condition Downstream of Basin
Kehalani Waiale Drainage Basin	10.7 Ac.	7.9 cfs	29.7 cfs	+21.8 cfs	0.0 cfs
Kehalani Waikapu Drainage Basin	1.9 Ac.	5.0 cfs	2.3 cfs	-2.7 cfs	0.0 cfs
A&B Waiale Irrigation Reservoir	1.8 Ac.	1.7 cfs	1.7 cfs	0.0 cfs	0.0 cfs
Total	14.4 Ac.	14.6 cfs	33.7 cfs	+19.1 cfs	0.0 cfs

3.2.2 Proposed Improvements

The project site will be generally be graded so as to maintain the natural form of the mountainside and the drainage pattern that now exists. A conventional urban-type storm drainage system consisting of drainage inlets and underground pipes will be installed throughout the development to collect the runoff shed by rooftops and pavements and convey it to the northeast corner of the site where it will be discharged into the pre-designated connection point at the storm drain

mainline on Kuikahi Drive[11]. This drainline will, in turn, convey the runoff to Kehalani's Waiale Drainage Basin for disposal. (See Figure 3-4)

The potential flooding hazard posed by the under-sized existing natural drainage channel along the southern boundary of the project site will be mitigated by either: 1) improving the drainage channel to increase its capacity, or 2) constructing an earthen levee or concrete flood barrier (wall) between the channel and the apartment complex to confine storm flows to the gully.

3.2.3 Post-Development Condition

Peak Flow Mitigation

The entire increase in peak storm runoff attributable to development of the project site will be directed to the Waiale Detention basin which, having already been designed and constructed to accommodate the post-development runoff from TMK 3-5-001: 064 (the Wailuku Apartments project site)[12], will fully mitigate this increase in peak flow. Flows to Kehalani's Waikapu Retention Basin and A&B's Waiale Reservoir will either decrease or remain unchanged and therefore require no additional action by the project.

---

[11] The portion of the Kuikahi Drive storm drainage system into which the project site discharges will be installed as part of the street frontage improvements for the Kehalani Village Center scheduled for construction later this year.

[12] Ref. Warren S. Unemori Engineering, Inc., "Wailuku Project District Drainage Master Plan," February 1998.

Stormwater Treatment

Stormwater treatment now required by the Maui County Department of Public Works[13] will be provided in the following manner.

Onsite runoff conveyed to Kehalani's Waikapu Retention Basin and A&B's Waiale Reservoir will receive "detention-based" treatment by being held in those receiving facilities for at least 48 hours.

Onsite runoff conveyed to Kehalani's Waiale Detention Basin will receive "flow-through" treatment by sheet flowing the runoff across the very gently sloping (0.4% grade) grassed basin floor for a distance of 600 feet before entering the basin's outlet structure.

3.3 Proposed Exemptions

The following code exemption will be needed to implement the drainage plan described above.

[13] Ref. Maui County Dept. of Public Works, Title MC-15, Subtitle 01, Chapter 111, "Rules for the Design of Stormwater Treatment Best Management Practices."

3.3.1 EXEMPTION #4: *Maui County Code Section 16.26B.3900 - Chapter 39: Post-Construction Stormwater Quality Best Management Practices*[14]

Exempt the development from having to provide the permanent stormwater quality treatment measures required by the Dept. of Public Works[15] *within* the project site. Instead, allow the development to satisfy its stormwater treatment requirements offsite at the receiving drainage basins as described in Section 3.2.3 of this report.

---

[14] Ref. MCC 16.26B.3900 - Chapter 39: Post-Construction Stormwater Quality Best Management Practices

> *"...Post-construction stormwater quality best management practices, as may be required by the director of public works, shall be implemented for property on which any new structure(s) will be situated..."*

[15] Ref. Maui County Dept. of Public Works, Title MC-15, Subtitle 01, Chapter 111, "Rules for the Design of Stormwater Treatment Best Management Practices."

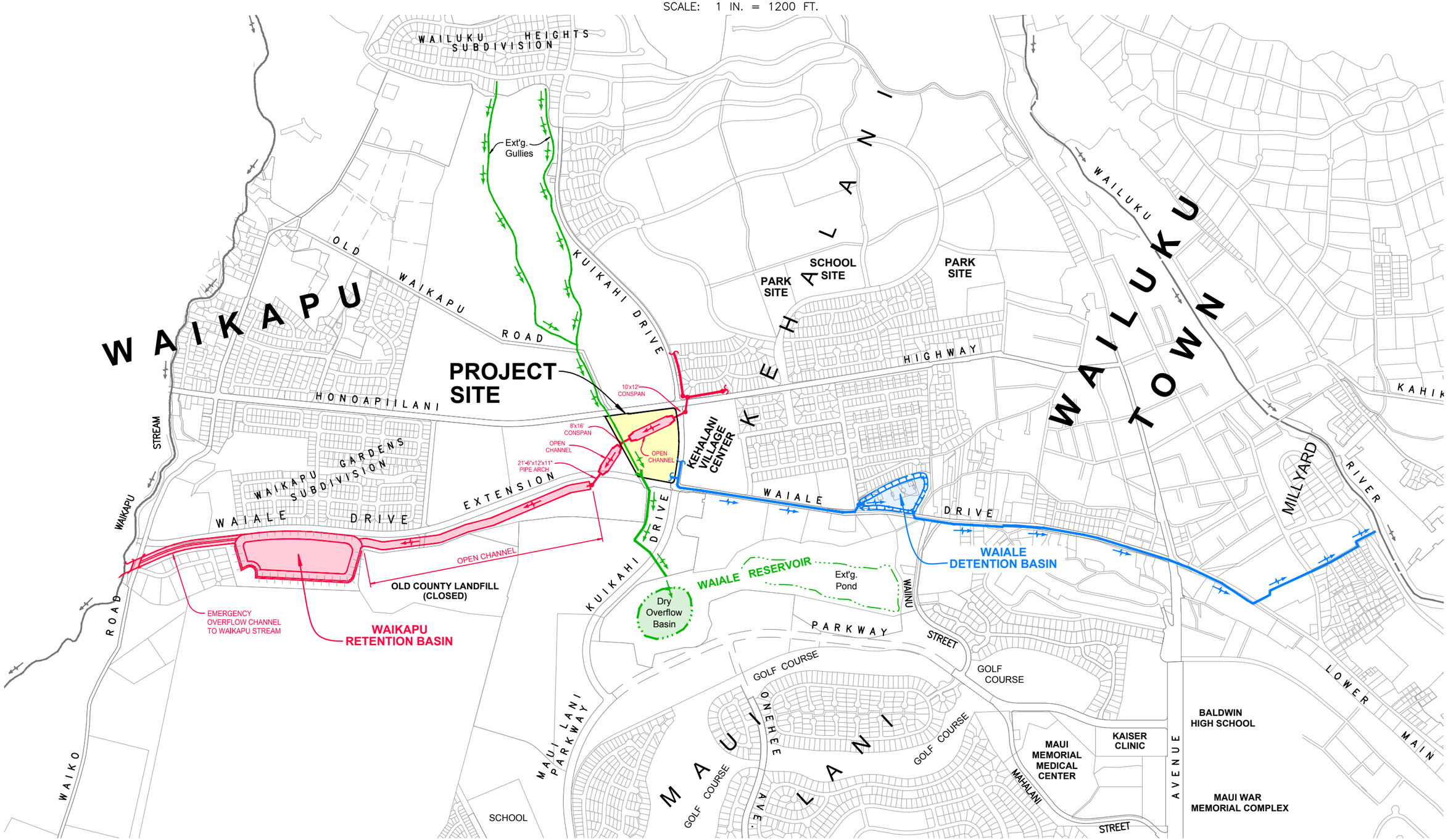


FIGURE 3-1

Regional Drainage Overview

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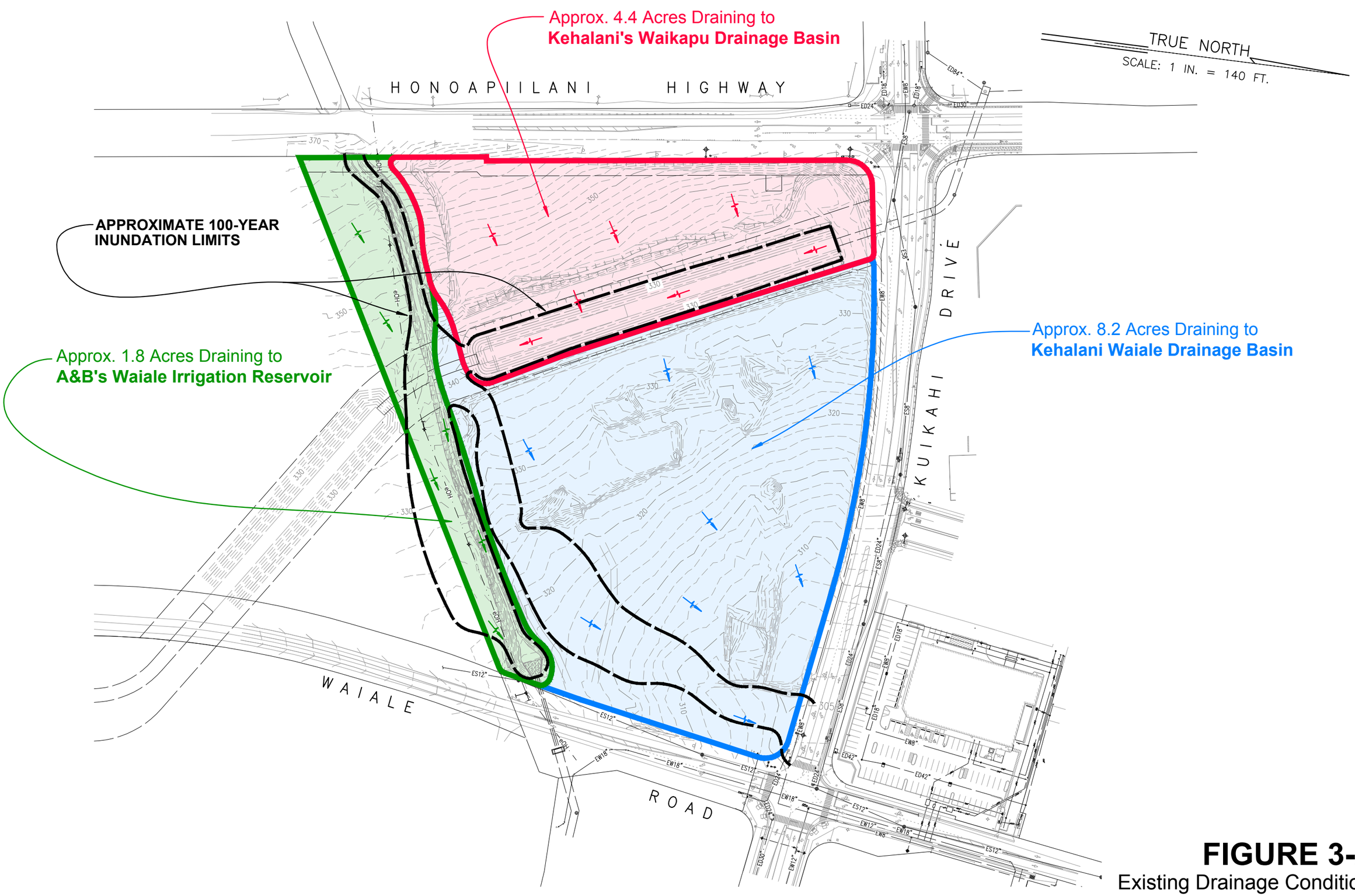

FIGURE 3-2
Existing Drainage Condition

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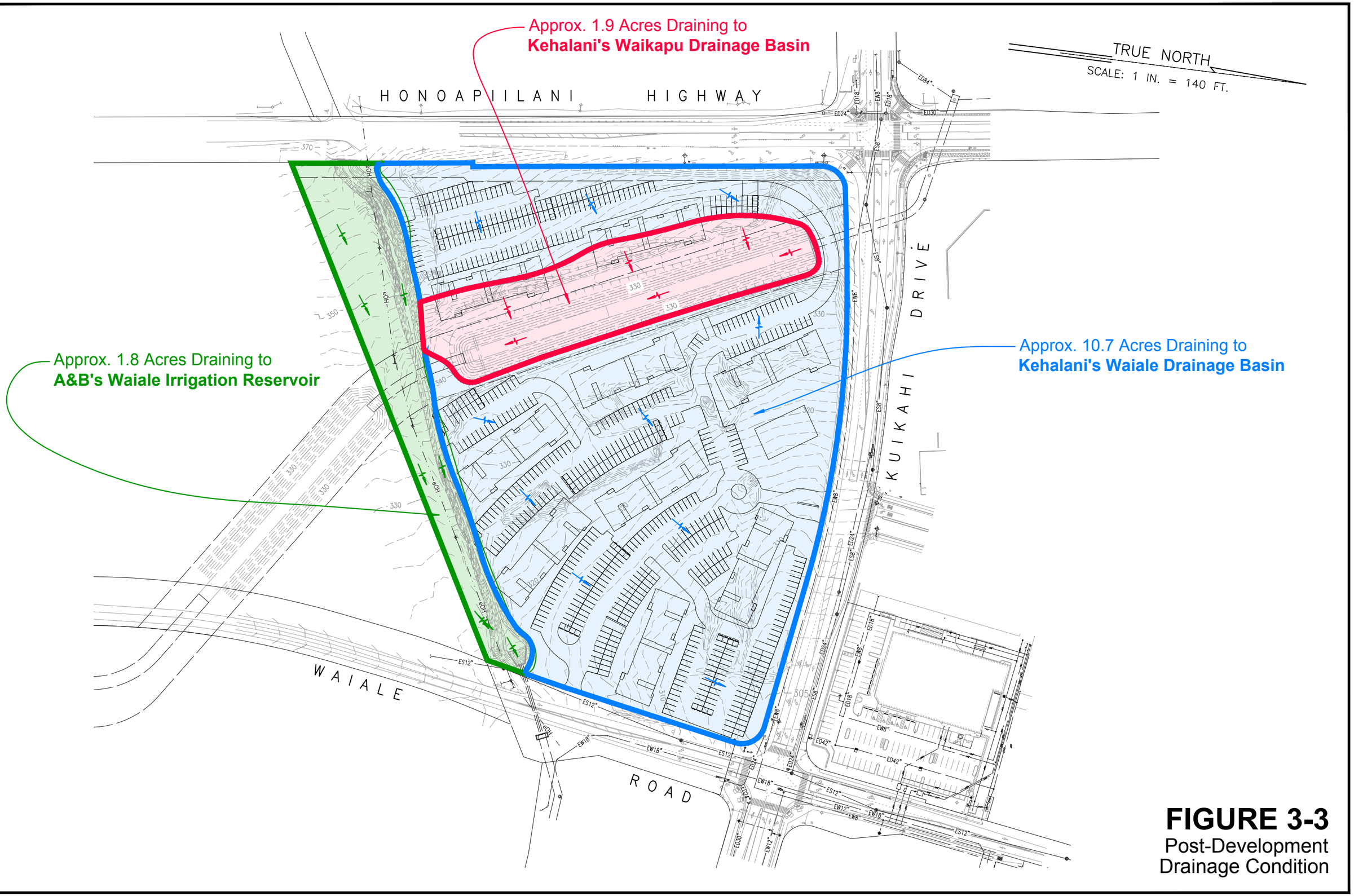


FIGURE 3-3
Post-Development
Drainage Condition

V:\Projdata\16proj\16052\dwg\exhibits\Engineering Report\Figure 3-3-post condition-00.dwg

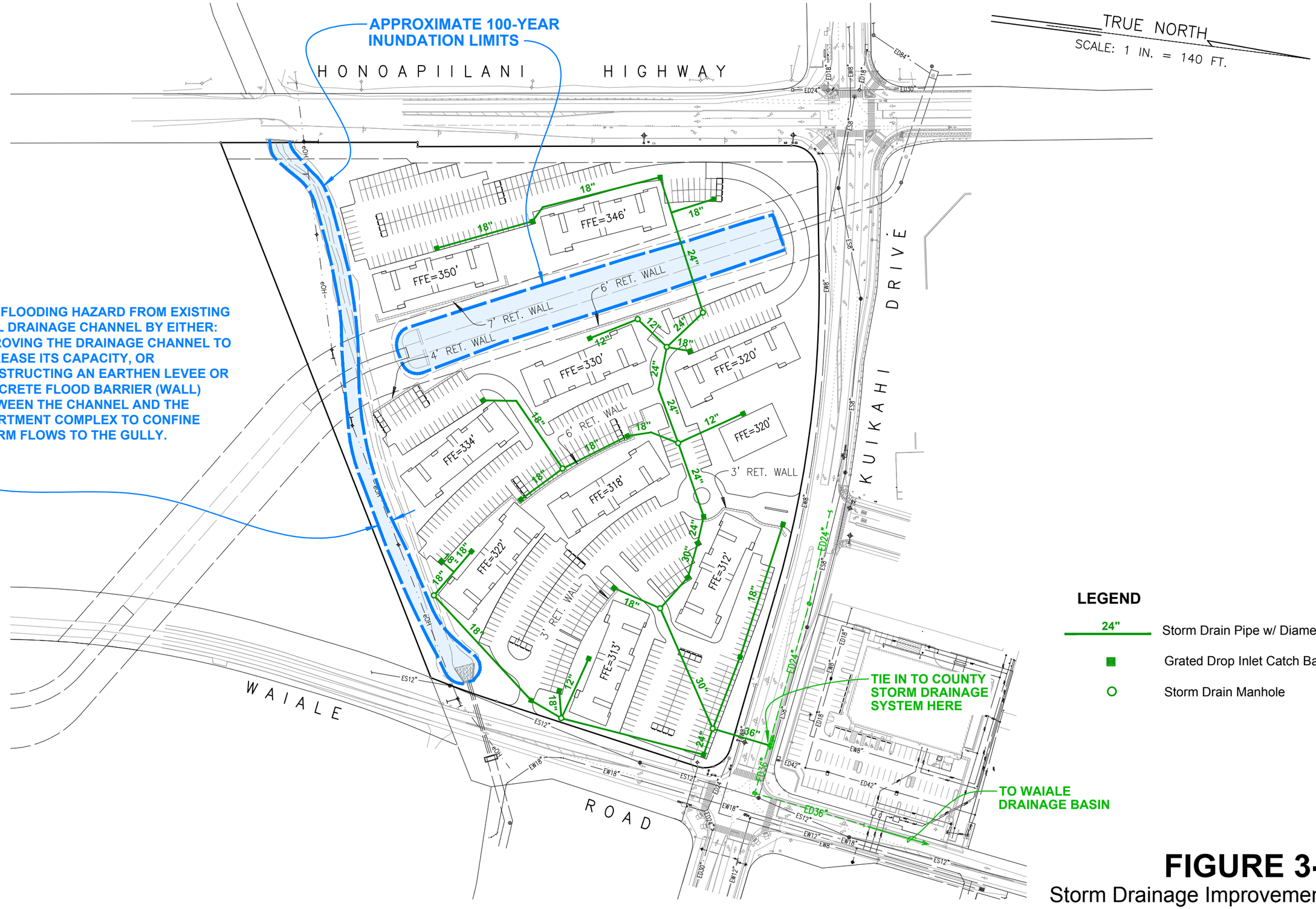


FIGURE 3-4
Storm Drainage Improvements

V:\Projdata\16proj\16052\dwg\exhibits\Engineering Report\Figure 3-4-Strom Drain-00.dwg

4. WATER

Potable water for drinking and fire protection will be supplied to the Wailuku Apartments project by the Maui County Department of Water Supply (DWS) from its Central Maui water system.

4.1 Demand

4.1.1 Domestic Consumption

The proposed apartment complex is expected to consume an average 189,000 gallons per day (gpd) of potable water.[16]

4.1.2 Fire Protection

A fire flow of 2,000 gallons per minute (gpm) sustainable for 2 hours is required to protect the apartment buildings within the development.[17]

4.2 Existing Infrastructure and Needed Improvements

4.2.1 Water Source

The water sources from which the Dept. of Water Supply will use to supply the project site include groundwater wells located in Wailuku and Waikapu that draw water from the Iao Aquifer, and treated surface water diverted from Iao

---

[16] See Appendix B for potable water demand calculation.

[17] Required fire flow specified for A-2 Apartment District by Maui County Code Section 14.05.090.D (Fire Protection) and Maui County Department of Water Supply *Water System Standards*, 2002, Table 100-19, p.111-4.

Valley. No source improvements are proposed by the Wailuku Apartments project.

4.2.2 Storage Reservoir

The project site will be supplied from the Dept. of Water Supply's existing 3.0 million gallon (MG) capacity Iao Tank, which is located along Alu Road at an elevation of 506 feet. The 3.0MG capacity of this tank exceeds the minimum 240,000 gallons required for fire protection[18] and will provide ample water pressure to the project site.[19] No storage improvements are proposed by the Wailuku Apartments project.

4.2.3 Distribution System

The County water distribution system nearest the Wailuku Apartments site is comprised of an existing pipe network whose backbone consists of 16- and 12-inch diameter mainlines.

Wailuku Apartments will install a 12-inch diameter water main extension -- the size needed to deliver the requisite 2,000 gpm fire flow -- from the end of the existing 12-inch distribution main located within the intersection of Kuikahi Drive

---

[18] Required minimum reservoir storage capacity for fire protection = 2,000 gpm fire flow x 2 hours = 240,000 gallons.

[19] Static water pressures across the site will range from 63 psi at the highest point on the site near Honoapiilani Highway to 87 psi at its lowest point near Waiale Road.

and Waiale Road to the project site. The location of the proposed connection point and main extension are depicted on Figure 4-1.

A single 12-inch diameter combined service lateral will then be extended into the project site from the 12-inch water main extension to provide both fire protection and drinking water to the building complex as shown in Figure 4-1.

4.3 Proposed Exemptions

The following code exemptions will be sought in order to implement the water system plan described above and limit requirements for additional improvements that are not essential to the Wailuku Apartments project.

4.3.1 EXEMPTION #5: *Maui County Department of Water Supply Dual System Policy*

Exempt the development from current DWS policy requiring the installation of a dual onsite water system (in which two separate and independent mains are required to supply domestic drinking water and fire protection) and allow, instead, the use of a single, combined onsite water system (in which a single main is used to provide both drinking water and fire protection).

4.3.2 EXEMPTION #6: *Maui County Code Section 14.01.040 - Definitions, Section 14.05 - Subdivision Water System Requirements and Section 14.05.090 - Fire Protection*

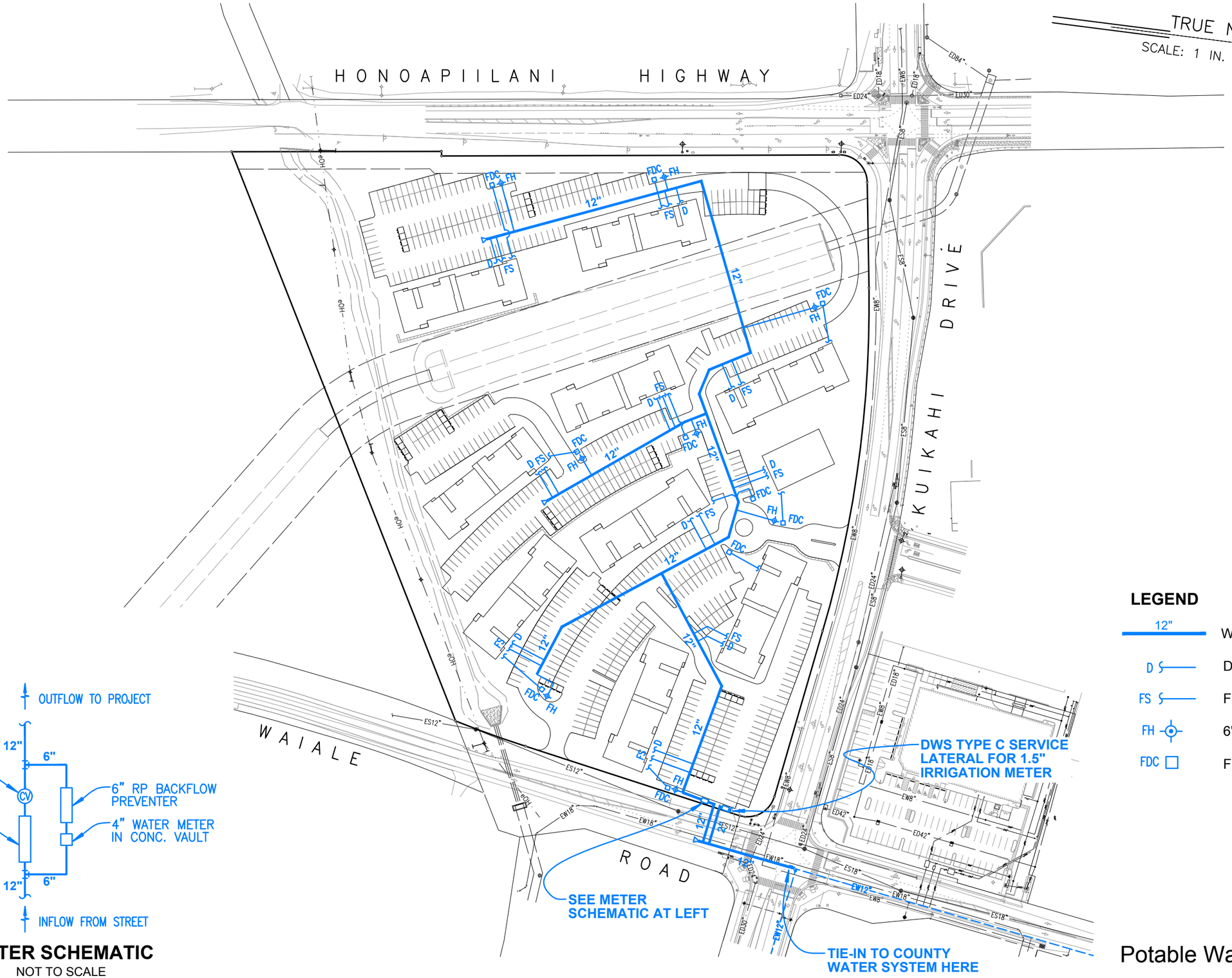
a) Narrow the definition of "subdivision" in MCC 14.01.040 so as to limit the applicability of MCC 14.05 Subdivision Water System Requirements to the project. The strikeout denotes the requested exemption from MCC 14.01.040:

"Subdivision" means improved or unimproved land or lands divided into two or more lots, parcels, sites, or other divisions of land for the purpose, whether immediate or in the future, of sale, lease, rental, transfer of title to or interest in, any or all of such parcels, and includes the process of consolidation and resubdivision, and, when appropriate to the context, shall relate to the process of subdividing land. ~~*The term also includes the construction of a building or group of buildings, other than a hotel, on a single lot, parcel, or site which will contain, result, or be divided into four or more dwelling units, including planned developments pursuant to chapter 19.32 of this code, condominium projects established pursuant to Hawaii Revised Statutes, or other forms of development, provided, that unless requested by the developer, condominium projects shall not be required to install separate water meters for each condominium unit.*~~

b) Exempt the project from the MCC 14.05.090.B[20] and the requirement to install fire hydrants on Kuikahi Drive, Waiale Road and Honoapiilani Highway.

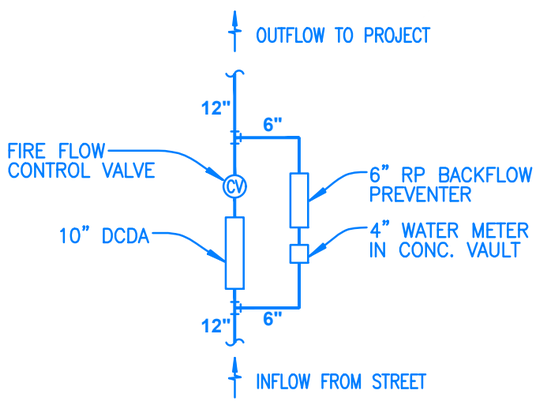
[20] Ref. MCC 14.05.090.B Fire Protection:

"The spacing of fire hydrants along the streets shall be not more than two hundred fifty feet apart in business, commercial, industrial, hotel and apartment districts, not more than three hundred fifty feet apart in residential districts, and not more than five hundred feet apart in rural and agricultural districts."



LEGEND

12"	Water Main w/ Diameter
D	Domestic Service Lateral
FS	Fire Sprinkler Lateral
FH	6" Fire Hydrant
FDC	Fire Dept. Connection Monument



METER SCHEMATIC

NOT TO SCALE

FIGURE 4-1

Potable Water Improvements

V:\Proidata\16proi\16052\dwg\exhibits\Engineering Report\Figure 4-1-Potable Water-00.dwg

5. WASTEWATER

5.1 Projected Demand

The proposed apartment complex is expected to contribute an average 83,000 gallons per day (gpd) into the County sewerage system.[21]

5.2 Existing Infrastructure and Needed Improvements

The Maui County Department of Environmental Management's Wastewater Reclamation Division operates the public sewerage system that collects wastewater from the Wailuku-Kahului area and conveys it to the County's Kahului Wastewater Treatment facility for processing and disposal.

The Wailuku Apartments project will install a conventional gravity sewer extension as shown on Figure 5-1 that will collect wastewater generated by the buildings and convey it via an 8-inch sewer service lateral connection to the existing County 12-inch diameter gravity sewer main located within Waiale Road.

5.3 Proposed Exemptions

No wastewater-related exemptions are proposed.

[21] See Appendix C for wastewater demand calculation.

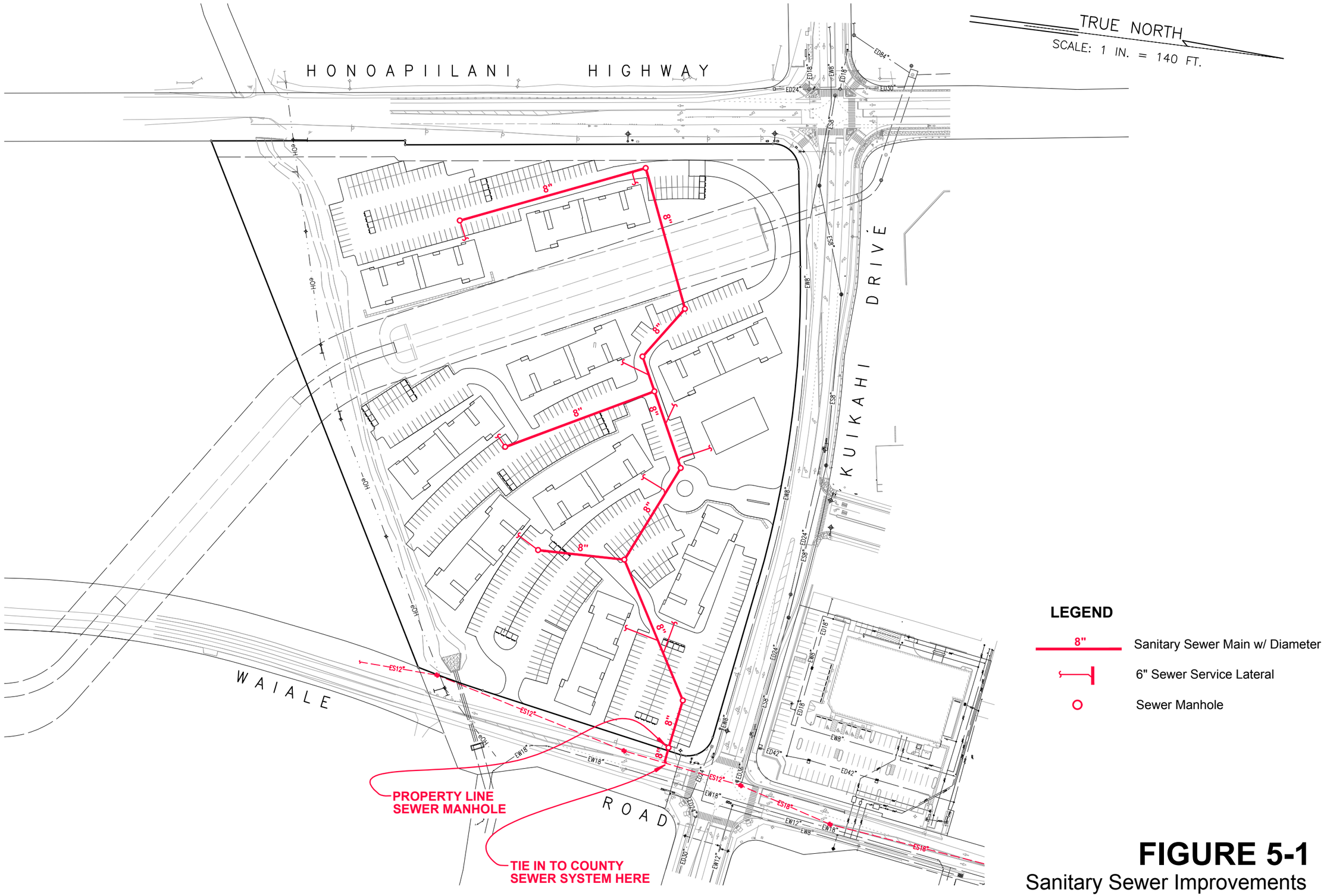


FIGURE 5-1
Sanitary Sewer Improvements

V:\Projdata\16proj\16052\dwg\exhibits\Engineering Report\Figure 5-1-Sanitary Sewer-00.dwg

6. POWER AND TELECOMMUNICATIONS

6.1 Existing Infrastructure and Needed Improvements

Regulated electric power, telephone and cable television services for the Wailuku Apartments will be provided through service arrangements with Maui Electric Company, Hawaiian Telcom and/or Oceanic Time Warner Cable which currently serve the area in which the project is located. Existing overhead utility lines are present on Honoapiilani Highway, Waiale Road and the southern edge of the project parcel.

Utility services to the individual buildings will be provided via underground service extensions from the overhead distribution system present along Waiale Road.

The project driveway entrances on Kuikahi Drive and Waiale Road will be safely illuminated using private, pole-mounted light fixtures conforming to both Maui County's Street Lighting Ordinance[22] and Dept. of Public Works' lighting requirements.[23] This will make it unnecessary to install separate underground powerlines within the Kuikahi Drive and Waiale Road rights-of-way to power standard County street lights installed at these same locations.

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[22] Maui County Code, Chapter 20.35 - Outdoor Lighting.

[23] Maui County Department of Public Works, "Street Lighting Standards", Title MC-15, Chapter 901, Effective March 23, 2000.

The existing utility pole shown in Figure 2-1 on the mauka (west) side of Waiale Road will need to be relocated out of the way of the pavement widening for the left turn lane at the East project driveway.

6.2 Proposed Exemptions

Exemptions related to under-grounding existing utilities and street lighting have been proposed as Exemptions #1.c and 1.d in Section 2.3.1 of this report.

APPENDIX A

Drainage Calculations

APPENDIX A-1

DLNR Flood Hazard Assessment Report for TMK 3-5-001: 064

Flood Hazard Assessment Report

www.hawaiinfip.org

Property Information

COUNTY:	MAUI
TMK NO:	(2) 3-5-001:064
WATERSHED:	IAO
PARCEL ADDRESS:	0 HONOAPIILANI HWY WAILUKU, HI 96793

Notes:

Flood Hazard Information

FIRM INDEX DATE:	NOVEMBER 04, 2015
LETTER OF MAP CHANGE(S):	NONE
FEMA FIRM PANEL:	1500030391E
PANEL EFFECTIVE DATE:	SEPTEMBER 25, 2009

THIS PROPERTY IS WITHIN A TSUNAMI EVACUTION ZONE: NO
FOR MORE INFO, VISIT: http://www.scd.hawaii.gov/

THIS PROPERTY IS WITHIN A DAM EVACUATION ZONE: YES (MA-0151)
FOR MORE INFO, VISIT: http://dlnreng.hawaii.gov/dam/

0 400 800 ft

Disclaimer: The Hawaii Department of Land and Natural Resources (DLNR) assumes no responsibility arising from the use, accuracy, completeness, and timeliness of any information contained in this report. Viewers/Users are responsible for verifying the accuracy of the information and agree to indemnify the DLNR, its officers, and employees from any liability which may arise from its use of its data or information.

If this map has been identified as 'PRELIMINARY', please note that it is being provided for informational purposes and is not to be used for flood insurance rating. Contact your county floodplain manager for flood zone determinations to be used for compliance with local floodplain management regulations.

FLOOD HAZARD ASSESSMENT TOOL LAYER LEGEND
(Note: legend does not correspond with NFHL)

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD - The 1% annual chance flood (100-year), also know as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. SFHAs include Zone A, AE, AH, AO, V, and VE. The Base Flood Elevation (BFE) is the water surface elevation of the 1% annual chance flood. Mandatory flood insurance purchase applies in these zones:

	Zone A: No BFE determined.
	Zone AE: BFE determined.
	Zone AH: Flood depths of 1 to 3 feet (usually areas of ponding); BFE determined.
	Zone AO: Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined.
	Zone V: Coastal flood zone with velocity hazard (wave action); no BFE determined.
	Zone VE: Coastal flood zone with velocity hazard (wave action); BFE determined.
	Zone AEF: Floodway areas in Zone AE. The floodway is the channel of stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without increasing the BFE.

NON-SPECIAL FLOOD HAZARD AREA - An area in a low-to-moderate risk flood zone. No mandatory flood insurance purchase requirements apply, but coverage is available in participating communities.

	Zone XS (X shaded): Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
	Zone X: Areas determined to be outside the 0.2% annual chance floodplain.

OTHER FLOOD AREAS

	Zone D: Unstudied areas where flood hazards are undetermined, but flooding is possible. No mandatory flood insurance purchase apply, but coverage is available in participating communities.

APPENDIX A-2

Pre-Development Storm Runoff (10-yr./1-hr.)

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Wailuku 201H Residential Development
Project No.: 16052
Engineer: Derek T. Ono
Date: 4/25/2017

Area

Description: Pre-development surface runoff draining to Kehalani Waiale Drainage Basin

Area (A): 8.2 acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Rolling]	→	0.03
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
	Composite Runoff Coefficient:		0.28

Time of Concentration

Runoff Length:	800	ft.
Start Elevation:	340	ft. M.S.L.
End Elevation:	305	ft. M.S.L.
Average Slope:	4.4	%
Time of Concentration (T_c):	18.5	minutes

Intensity

Project Location:	Wailuku, Maui, Hawaii	
Design Storm:	10-year recurrence interval, 1-hour duration	
Rainfall Depth:	2.0	in.
Intensity (I):	3.42	in./hr.

Flow Rate

$$Q = C \cdot I \cdot A$$
$$= 7.9 \quad ft.^3/sec.$$

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Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Wailuku 201H Residential Development
Project No.: 16052
Engineer: Derek T. Ono
Date: 4/25/2017

Area

Description: Pre-development surface runoff draining to Kehalani Waikapu Drainage Basin

Area (A): 4.4 acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Rolling]	→	0.03
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
	Composite Runoff Coefficient:		0.28

Time of Concentration

Runoff Length:	250	ft.
Start Elevation:	360	ft. M.S.L.
End Elevation:	340	ft. M.S.L.
Average Slope:	8.0	%
Time of Concentration (T_c):	10.5	minutes

Intensity

Project Location:	Wailuku, Maui, Hawaii	
Design Storm:	10-year recurrence interval, 1-hour duration	
Rainfall Depth:	2.0	in.
Intensity (I):	4.06	in./hr.

Flow Rate

$$Q = C \cdot I \cdot A$$
$$= 5.0 \text{ ft.}^3\text{/sec.}$$

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2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Wailuku 201H Residential Development
Project No.: 16052
Engineer: Derek T. Ono
Date: 4/25/2017

Area

Description: Pre-development surface runoff draining to A&B Waiale Irrigation Reservoir

Area (A): 1.8 acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Rolling]	→	0.03
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
	Composite Runoff Coefficient:		0.28

Time of Concentration

Runoff Length:	910	ft.
Start Elevation:	365	ft. M.S.L.
End Elevation:	312	ft. M.S.L.
Average Slope:	5.8	%
Time of Concentration (T_c):	18.5	minutes

Intensity

Project Location: Wailuku, Maui, Hawaii
Design Storm: 10-year recurrence interval, 1-hour duration
Rainfall Depth: 2.0 in.
Intensity (I): 3.42 in./hr.

Flow Rate

$$Q = C \cdot I \cdot A$$
$$= 1.7 \text{ ft.}^3\text{/sec.}$$

APPENDIX A-3

Post-Development Storm Runoff (10-yr/1-hr.)

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Wailuku 201H Residential Development
Project No.: 16052
Engineer: Derek T. Ono
Date: 4/25/2017

Area

Description: Post-development surface runoff draining to Kehalani Waiale Drainage Basin

Area (A):	10.7	acres
Impervious Area:	6.7	acres

Runoff Coefficient

Lawn Runoff Coefficient:	0.22
Impervious Runoff Coefficient:	0.95
Weighted Runoff Coefficient (C):	0.68

Time of Concentration

Time of Concentration (T_c): 10 minutes

Intensity

Project Location:	Wailuku, Maui, Hawaii	
Design Storm:	10-year recurrence interval, 1-hour duration	
Rainfall Depth:	2.0	in.
Intensity (I):	4.10	in./hr.

Flow Rate

$$Q = C \cdot I \cdot A$$
$$= 29.7 \quad ft.^3/sec.$$

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Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Wailuku 201H Residential Development
Project No.: 16052
Engineer: Derek T. Ono
Date: 4/25/2017

Area

Description: Post-development surface runoff draining to Kehalani Waikapu Drainage Basin

Area (A):	1.9	acres
Impervious Area:	0.3	acres
Channel Area:	1.1	acres

Runoff Coefficient

Lawn Runoff Coefficient:	0.22
Impervious Runoff Coefficient:	0.95
Channel Runoff Coefficient:	0.30
Composite Runoff Coefficient (C):	0.38

Time of Concentration

Runoff Length:	600	ft.
Start Elevation:	340	ft. M.S.L.
End Elevation:	322	ft. M.S.L.
Average Slope:	3.0	%
Time of Concentration (T_c):	23.5	minutes

Intensity

Project Location:	Wailuku, Maui, Hawaii	
Design Storm:	10-year recurrence interval, 1-hour duration	
Rainfall Depth:	2.0	in.
Intensity (I):	3.13	in./hr.

Flow Rate

$$Q = C \cdot I \cdot A$$
$$= 2.3 \quad ft.^3/sec.$$

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2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Wailuku 201H Residential Development
Project No.: 16052
Engineer: Derek T. Ono
Date: 4/25/2017

Area

Description: Post-development surface runoff draining to A&B Waiale Irrigation Reservoir

Area (A): 1.8 acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Rolling]	→	0.03
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
	Composite Runoff Coefficient:		0.28

Time of Concentration

Runoff Length:	910	ft.
Start Elevation:	365	ft. M.S.L.
End Elevation:	312	ft. M.S.L.
Average Slope:	5.8	%
Time of Concentration (T_c):	18.5	minutes

Intensity

Project Location:	Wailuku, Maui, Hawaii	
Design Storm:	10-year recurrence interval, 1-hour duration	
Rainfall Depth:	2.0	in.
Intensity (I):	3.42	in./hr.

Flow Rate

$$Q = C \cdot I \cdot A$$
$$= 1.7 \quad ft.^3/sec.$$

APPENDIX A-4

Minimum 48 hr. Retention Capacity Needed to Meet Maui County Stormwater Quality Requirements

Table A-4.1

Minimum 48 hr. Retention Capacity Needed to Meet Maui County Stormwater Quality Requirements

Receiving Facility	Approx. Area Draining to Receiving Facility	Minimum 48 hr. Retention Volume Development Peak Runoff
Kehalani Waiale Drainage Basin	10.7 Ac.	24,080 cu.ft.
Kehalani Waikapu Drainage Basin	1.9 Ac.	1,310 cu.ft.
A&B Waiale Irrigation Reservoir	1.8 Ac.	330 cu.ft.
Total	14.4 Ac.	25,720 cu.ft.

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Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Storm Water Treatment

Project Name: Wailuku 201H Residential Development
Project No.: 16052
Engineer: Derek T. Ono
Date: 4/26/2017

Purpose: To determine the required Kehalani Waiale Drainage Basin volume to meet the County of Maui, Department of Public Works' "Rules for the Design of Storm Water Treatment Best Management Practices"

Calculations: The required design volume for detention based control is computed by the MCC §15-111-5.a.1.C formula:

$$WQDV = C \cdot 1'' \cdot A \cdot 3630$$

where, WQDV = water quality design volume in cubic feet
C = EPA volumetric runoff coefficient
A = gross area of the site in acres = 10.7 ac.
1" = design storm for detention based water quality system
3630 = conversion factor

The EPA volumetric runoff coefficient, C, calculated from the formula given in MCC §15-111-5.a.1.A is:

$$C = 0.05 + (0.009) \cdot (IMP)$$

where, IMP = percentage of impervious area
= (impervious area) / (gross area) · 100
= (6.7 ac.) / (10.7 ac.) · 100
= 63

Since IMP = 63, the value of C is:

$$C = 0.05 + (0.009) \cdot (63)$$
$$= 0.62$$

Compute the required design volume for a 1" storm with C = 0.62:

$$WQDV = C \cdot 1'' \cdot A \cdot 3630$$
$$= 0.62 \cdot 1'' \cdot 10.7 \cdot 3630$$
$$= 24{,}080 \text{ ft}^3$$

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2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Storm Water Treatment

Project Name: Wailuku 201H Residential Development
Project No.: 16052
Engineer: Derek T. Ono
Date: 4/26/2017

Purpose: To determine the required Kehalani Waikapu Drainage Basin volume to meet the County of Maui, Department of Public Works' "Rules for the Design of Storm Water Treatment Best Management Practices"

Calculations: The required design volume for detention based control is computed by the MCC §15-111-5.a.1.C formula:

$$WQDV = C \cdot 1'' \cdot A \cdot 3630$$

where, WQDV = water quality design volume in cubic feet
C = EPA volumetric runoff coefficient
A = gross area of the site in acres = 1.9 ac.
1" = design storm for detention based water quality system
3630 = conversion factor

The EPA volumetric runoff coefficient, C, calculated from the formula given in MCC §15-111-5.a.1.A is:

$$C = 0.05 + (0.009) \cdot (IMP)$$

where, IMP = percentage of impervious area
= (impervious area) / (gross area) · 100
= (0.3 ac.) / (1.9 ac.) · 100
= 16

Since IMP = 16, the value of C is:

$$C = 0.05 + (0.009) \cdot (16)$$
$$= 0.19$$

Compute the required design volume for a 1" storm with C = 0.19:

$$WQDV = C \cdot 1'' \cdot A \cdot 3630$$
$$= 0.19 \cdot 1'' \cdot 1.9 \cdot 3630$$
$$= 1{,}310 \text{ ft}^3$$

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Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Storm Water Treatment

Project Name: Wailuku 201H Residential Development
Project No.: 16052
Engineer: Derek T. Ono
Date: 4/26/2017

Purpose: To determine the required A&B Waiale Irrigation Reservoir volume to meet the County of Maui, Department of Public Works' "Rules for the Design of Storm Water Treatment Best Management Practices"

Calculations: The required design volume for detention based control is computed by the MCC §15-111-5.a.1.C formula:

$$WQDV = C \cdot 1'' \cdot A \cdot 3630$$

where, WQDV = water quality design volume in cubic feet
C = EPA volumetric runoff coefficient
A = gross area of the site in acres = 1.8 ac.
1" = design storm for detention based water quality system
3630 = conversion factor

The EPA volumetric runoff coefficient, C, calculated from the formula given in MCC §15-111-5.a.1.A is:

$$C = 0.05 + (0.009) \cdot (IMP)$$

where, IMP = percentage of impervious area
= (impervious area) / (gross area) · 100
= (0 ac.) / (1.8 ac.) · 100
= 0

Since IMP = 0, the value of C is:

$$C = 0.05 + (0.009) \cdot (0)$$
$$= 0.05$$

Compute the required design volume for a 1" storm with C = 0.05:

$$WQDV = C \cdot 1'' \cdot A \cdot 3630$$
$$= 0.05 \cdot 1'' \cdot 1.8 \cdot 3630$$
$$= 330\ ft^3$$

APPENDIX A-5

Minimum Treated Flow Rate to Meet Maui County
Stormwater Quality Requirements

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Storm Water Treatment

Project Name: Wailuku 201H Residential Development
Project No.: 16052
Engineer: Derek T. Ono
Date: 4/26/2017

Purpose: To determine the required flow rate for treatment at the Kehalani Waiale Drainage Basin to meet the County of Maui, Department of Public Works' "Rules for the Design of Storm Water Treatment Best Management Practices"

Calculations: The required design flow rate for flow-through treatment is computed by the MCC §15-111-5.b.1.C formula:

$$WQFR = C \cdot 0.4'' \cdot A$$

where, WQFR = water quality flow rate in cubic feet per second
C = runoff coefficient
A = gross area of the site in acres = 10.7 ac.
0.4" = design storm for flow-through water quality system

Compute the required design flow rate:

$$\begin{aligned} WQFR &= C \cdot 0.4'' \cdot A \\ &= 0.68 \cdot 0.4'' \cdot 10.7 \\ &= 2.9\ ft^3/sec. \end{aligned}$$

APPENDIX B

Potable Water Demand Calculations

WAILUKU APARTMENTS
Projected Daily Water Demand

	Base Unit		Consumption Rate[1]		Average Daily Demand			Max. Daily Demand
Multi-Family Apartments	324 units	x	560 gals/unit	==>	181,440 gpd	x 1.5	==>	272,160 gpd
Leasing Office / Rec. Bldg	5,000 s.f.	x	140 gals/1000 s.f.	==>	700 gpd	x 1.5	==>	1,050 gpd
Landscape Irrigation	4 Ac.	x	1,700 gals/Ac.	==>	6,800 gpd	x 1.5	==>	10,200 gpd
Total					188,940 gpd			283,410 gpd

Notes:
[1] Consumption rates taken from Water System Standards, Department of Water Supply County of Maui, State of Hawaii, 2002, Table 100-18, p. 111-3.

APPENDIX C

Wastewater Demand Calculations

WAILUKU APARTMENTS
Projected Daily Sewer Demand

	Base Unit		Contribution Rate[1]		Average Daily Sewer Demand
Multi-Family Apartments	324 units	x	255 gals/unit/day	==>	82,620 gpd
Leasing Office / Rec. Bldg	2 employees	x	20 gals/capita/day	==>	40 gpd
Total					82,660 gpd

Note:
[1] Contribution rates taken from County of Maui, Wastewater Reclamation Division, "Wastewater Flow Standards,"

Appendix E – Traffic Impact Analysis Report

TRAFFIC IMPACT ANALYSIS REPORT
WAILUKU APARTMENTS

WAILUKU, MAUI, HAWAII

DRAFT FINAL

May 15, 2017

Prepared for:

Pier Management – Hawaii, LLC
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TRAFFIC IMPACT ANALYSIS REPORT

WAILUKU APARTMENTS

Wailuku, Maui, Hawaii

DRAFT FINAL

Prepared for

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Prepared by

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Civil Engineers • Surveyors
Honolulu • Wailuku • Hilo, Hawaii

May 15, 2017

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C. LEVEL OF SERVICE CALCULATIONS

D. TRAFFIC SIGNAL WARRANT

E. BACKGROUND PROJECT TRIPS

AUSTIN, TSUTSUMI & ASSOCIATES, INC. CIVIL ENGINEERS • SURVEYORS
CONTINUING THE ENGINEERING PRACTICE FOUNDED BY H. A. R. AUSTIN IN 1934

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WAILUKU APARTMENTS
TRAFFIC IMPACT ANALYSIS REPORT

Wailuku, Maui, Hawaii

1. INTRODUCTION

This report documents the findings of a traffic study conducted by Austin, Tsutsumi & Associates, Inc. (ATA) to evaluate the potential traffic impacts resulting from the proposed Wailuku Apartments (hereinafter referred to as the "Project") located in Wailuku, Maui, Hawaii.

1.1 Location

The Project is located in Wailuku on the island of Maui on parcels of land more specifically identified as TMK: (2) 3-5-001-064. The Project will be bounded by Honoapiilani Highway, Kuikahi Drive and Waiale Road. See Figure 1.1 for Project location.

1.2 Project Description

The Project proposes to develop approximately 14.4-acres of land to provide 324 multi-family dwelling units. Vehicular traffic to the Project will be provided by two (2) new Project accesses; one along Kuikahi Drive directly across the Kehalani Village Center driveway and another along Waiale Road towards the south frontage of the Project site. The Project is anticipated to be completed by the Year 2020. See Figure 1.2 for Project Site Plan.

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WAILUKU, MAUI, HAWAII
HILO, HAWAII

1.3 Study Methodology

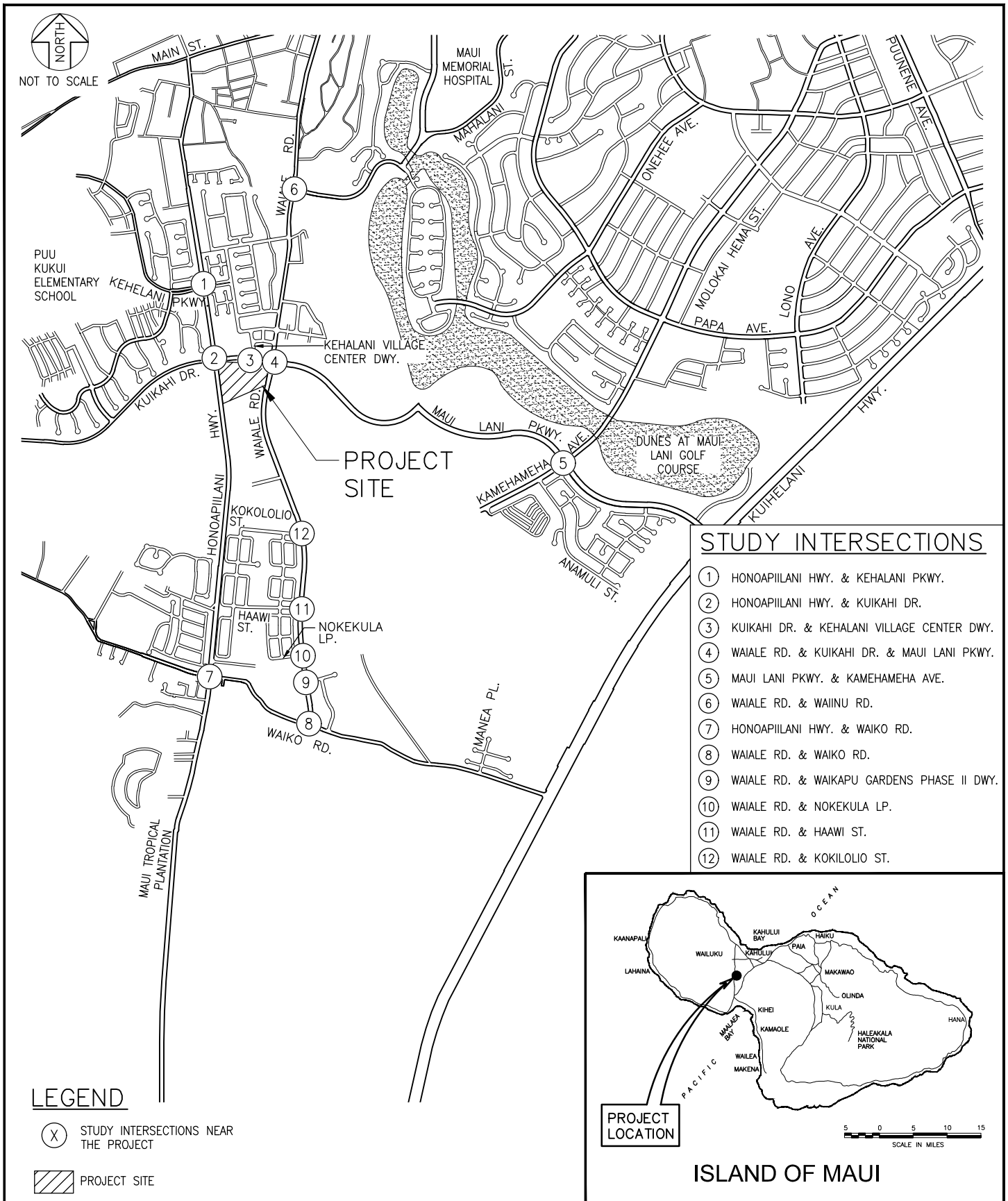
This study will address the following:

- Assess existing traffic operating conditions during the weekday AM and PM peak hours of traffic within the study area.
- Traffic Projections for Base Year 2020 (without the Project).
- Estimate the vehicular trips that will be generated by the Project.
- Traffic projections for the Project for Future Year 2020 (with Project).
- Conduct a signal warrant analysis at the Project's proposed Kuikahi Drive access.
- Recommendations for roadway improvements or other mitigative measures, as appropriate, to reduce or eliminate the adverse impacts resulting from traffic generated by the Project.

1.4 Intersection 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), dated 2010, includes methods for calculating volume to capacity ratios, delays, and corresponding Levels of Service that were utilized in this study. See Appendix B for Level of Service 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 as 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.



WAILUKU APARTMENTS

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, HAWAII

LOCATION MAP

FIGURE 1.1

NORTH

NOT TO SCALE

WAILUKU APARTMENTS

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, HAWAII

PROJECT SITE LOCATION

FIGURE

1.2

2. EXISTING TRAFFIC CONDITIONS

2.1 Roadway Network

The following are brief descriptions of the existing roadways studied within the vicinity of the Project:

Honoapiilani Highway is a north-south, two-way, two-lane, undivided arterial highway with posted speed limits ranging between 30 miles per hour (mph) and 45 mph. Honoapiilani Highway begins as the continuation of South High Street near Kahookele Street and continues southward through Waikapu, Maalaea, and wraps around the "Pali" to West Maui. Right turn channelization is provided at all of its major intersections within the study area.

Kuikahi Drive is an east-west, two-way, two-lane, undivided collector roadway with posted speed limits ranging between 25 mph and 30 mph. Kuikahi Drive begins approximately 1.2 miles west of Honoapiilani Highway within the Wailuku Heights development and extends eastward past Honoapiilani Highway, terminating near The Church of Jesus Christ of Latter Day Saints, where Kuikahi Drive becomes Maui Lani Parkway.

Waiale Road is a north-south, two-way, two-lane, undivided collector roadway with a posted speed limit of 20 mph in the Project study area. To the north, Waiale Road serves as the southern connection to Lower Main Street and extends past the Maui Community Correctional Center, Kehalani Village Center and various residential subdivisions, eventually terminating at a T-intersection with East Waiko Road.

East Waiko Road is an east-west, two-way, two-lane, undivided collector roadway with a posted speed limit of 20 mph in the Project study area. East Waiko Road extends westward from Kuihelani Highway to Honoapiilani Highway where it continues as West Waiko Road within the Waikapu residential neighborhood.

Kehalani Parkway is an east-west, two-way, four-lane, divided collector roadway with posted speed limits ranging between 20 mph and 30 mph on either side of Honoapiilani Highway. Kehalani Parkway extends east of Honoapiilani Highway from the lower Kehalani residential subdivision at Kamole Street and continues in the mauka direction, curving north past Puu Kukui Elementary School in the upper Kehalani residential subdivisions.

Nokekula Loop, Haawi Street & Kokololio Street are east-west, two-way, two lane, undivided local roadway to the west of Waiale Road with a posted speed limit of 20 mph. These three roads service the Waikapu Gardens Phase I residential neighborhood

Ohana Hana Loop is an east-west, two-way, two lane, undivided local roadway to the west of Waiale Road with a posted speed limit of 20 mph. Ohana Hana Loop extends from Waiale Road and services the Waikapu Gardens Phase II residential neighborhood.

2.2 Existing Traffic Volumes

Intersection analysis within the study area was performed on the following intersections due to their proximity to the Project. The existing traffic volumes data utilized in this report were collected on Wednesday, March 15, 2017 and Thursday, March 16, 2017 with the exception of the Waikapu Gardens Phase 1 accesses along Waiale Road, which were counted in October 2015. Since the development is fully built out, turning movements at these intersections are anticipated to remain the same.

- Honoapiilani Highway/Waiko Road (Signalized)
- Honoapiilani Highway/Kuikahi Drive (Signalized)
- Honoapiilani Highway/Kehalani Parkway (Signalized)
- Waiale Road/Waiko Road (Unsignalized)
- Waiale Road/Nokekula Loop (Unsignalized)
- Waiale Road/Haawi Street (Unsignalized)
- Waiale Road/Kokololio Street (Unsignalized)
- Waiale Road/Ohana Hana Loop (Unsignalized)
- Waiale Road/Kuikahi Drive (Signalized)
- Kuikahi Drive/Kehalani Village Center Driveway (Unsignalized)

Based on the traffic count data, the weekday AM peak hour of traffic was determined to occur between 7:00 AM and 8:00 AM, while the weekday PM peak hour of traffic was determined to occur between 4:15 PM and 5:15 PM. The traffic count data is provided in Appendix A for the existing intersections studied.

2.3 Existing Traffic Conditions Analysis and Observations

Honoapiilani Highway/Kehalani Parkway is a signalized intersection with exclusive left-turn and right-turn lanes on all approaches. The channelized northbound and southbound right-turn movements also include exclusive eastbound and westbound receiving lanes, respectively. All movements at this intersection currently operate at LOS D or better during the AM and PM peak hours of traffic, except for the eastbound left-turn movement which operates at LOS F and overcapacity conditions during the AM peak hour. For a portion of the AM peak hour, the eastbound left-turn movement operates with queues that extend to or beyond the existing left-turn storage lane and some vehicles may require two cycle lengths to clear the intersection. Heavy traffic during a short period of time is reflective of typical school traffic conditions, as these queuing conditions were observed to last about 30 minutes during the AM peak hour, generally between 7:15-7:45 AM and primarily stem from traffic generated by the Puu Kukui Elementary School.

In addition, northbound traffic queues along Honoapiilani Highway were observed to primarily stem from Wailuku Elementary School. At Aupuni Street, northbound traffic queued back to Kehalani Parkway for about 5-10 minutes during the AM peak hour due to a police officer directing traffic at Aupuni Street to service Wailuku Elementary School traffic in the morning. The police officer is observed to stop mainline northbound and southbound traffic for as much as 30-40 seconds at a time, creating lengthy mainline queues. This impacted the vehicular progression through the Honoapiilani Highway/Kehalani Parkway intersection.

Honoapiilani Highway/Kuikahi Drive is a signalized intersection with exclusive left-turn and right-turn lanes on all approaches. The channelized northbound right-turn movement also includes an exclusive eastbound acceleration lane. All movements at this intersection currently operate at LOS D or better with no significant queueing observed during the AM and PM peak hours of traffic.

Kuikahi Drive/Kehalani Village Center Access is an unsignalized T-intersection with exclusive left-turns in the eastbound and southbound directions. All movements at this intersection currently operate at LOS B or better during the AM and PM peak hours of traffic with the exception of the southbound left-turn movement which operates at LOS E(D) during the AM(PM) peak hours of traffic.

Waiale Road/Kuikahi Drive is a signalized intersection with exclusive left-turn lanes on all approaches and an exclusive right-turn lane on the westbound approach. All movements at this intersection currently operate at LOS C or better during the AM and PM peak hours of traffic. However, for about 20-30 minutes during the AM peak hour, vehicles were observed to queue beyond the length of the eastbound left-turn storage lane to the Kehalani Village Drive or as far as Honoapiilani Highway. These queues occur at variable lengths and are dependent on existing northbound queues that spill back from Waiale Road into the Waiale Road/Kuikahi Drive intersection, which limits full progression for eastbound left-turning vehicles.

Kamehameha Avenue/Maui Lani Parkway is a four-way stop controlled intersection with exclusive left-turn lanes on both approaches on Kamehameha Avenue and is located 700 feet northeast of Pomaikai Elementary School. Each approach includes flashing beacons with stop signs, and marked crosswalks are provided on the southwest leg of Kamehameha Avenue and the northwest leg of Maui Lani Parkway.

The northbound through/right-turn movement, southbound through/right-turn movement, eastbound approach, and westbound approach operate at LOS F with some overcapacity conditions during the AM and PM peak hours of traffic. This is primarily due to regional traffic between the Waikapu-Wailuku-Kahului regions. Queues were inconsistent and varied in length throughout the peak hours, with a short period of extensive southbound queuing during the AM peak hour and periodic eastbound queuing during the AM and PM peak hours of traffic.

Waiale Road/Waiinu Road is an unsignalized T-intersection the minor westbound approach of Waiinu Road stop-controlled. In both the AM and PM peak hours the westbound shared left-turn/through lane operates at LOS F and overcapacity conditions due to lengthy delays.

Traffic was generally observed to progress unimpeded along Waiale Road during the AM peak hour, except between 7:30-7:50 AM, where northbound traffic on Waiale Road was observed to slowly progress through the intersection in part due to northbound spillbacks from the Waiale Road/Kaohu Street 4-way stop controlled intersection and reduced northbound speeds generated by frequent northbound right-turning vehicles at the Waiale Road/Waiinu Road intersection. Some northbound vehicles along Waiale Road also stopped within the through travel lane to allow side street vehicles (ranging from 1-6 vehicles at a time) to turn onto or off of Waiale Road, which formed lengthy platoons. Congestion and queuing along Waiale Road generally dissipated around 7:50-7:55 AM.

During the PM peak hour, traffic along Waiale Road operated smoothly, but queues continued to be observed along the westbound leg of Waiinu Road. Queues along the westbound

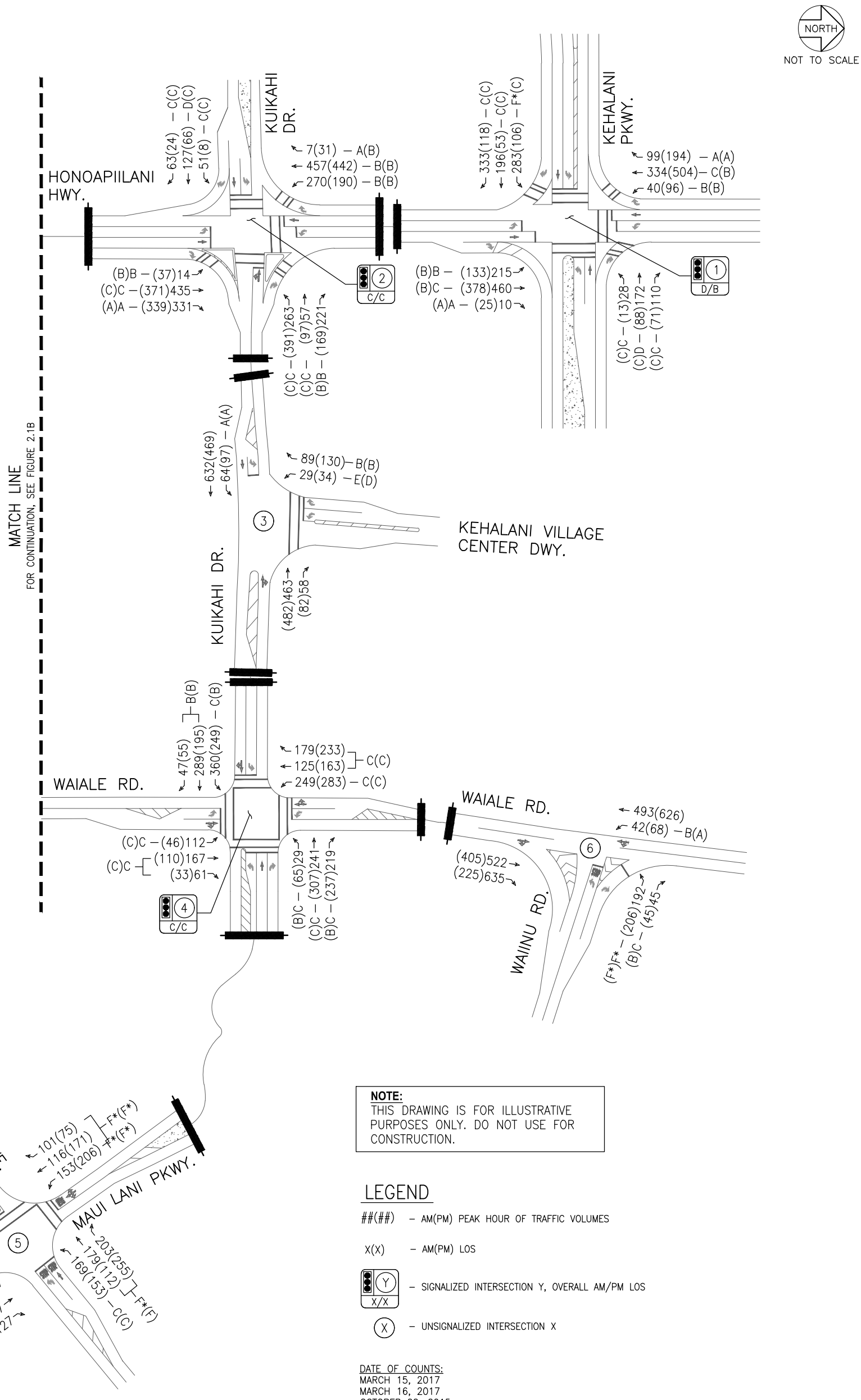
approach also varies throughout the peak period, depending on gaps in traffic and the occurrence of throughput vehicles stopping within the through lane to allow westbound vehicles to turn onto Waiale Road.

Honoapiilani Highway/Waiko Road is a signalized intersection with exclusive left-turn lanes on the northbound and southbound approaches, and exclusive right-turn lanes on the eastbound and southbound approaches. All movements at this intersection currently operate at LOS C or better with no significant delays or queuing during the AM and PM peak hours of traffic.

Waiale Road/Waiko Road is an unsignalized T-intersection with shared lanes on all approaches and the southbound approach stop-controlled. All movements at this intersection currently operate at LOS B or better with no significant delays or queues during the peak hours of traffic.

Waiale Road @ Ohana Hana Loop, Nokekula Loop, Haawi Street & Kokololio Street are unsignalized T-intersections servicing the Waikapu Gardens Phase I and II developments. All movements at these intersections currently operate at LOS B or better with no significant delays during the AM and PM peak hours of traffic.

Figure 2.1 illustrates the existing lane configuration, existing traffic volumes, and LOS for each study intersection. Table 2.1 summarizes the existing LOS at the study intersections. LOS worksheets are provided in Appendix C.



NOTE:
THIS DRAWING IS FOR ILLUSTRATIVE PURPOSES ONLY. DO NOT USE FOR CONSTRUCTION.

LEGEND

##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES

X(X) – AM(PM) LOS

(Y) X/X – SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS

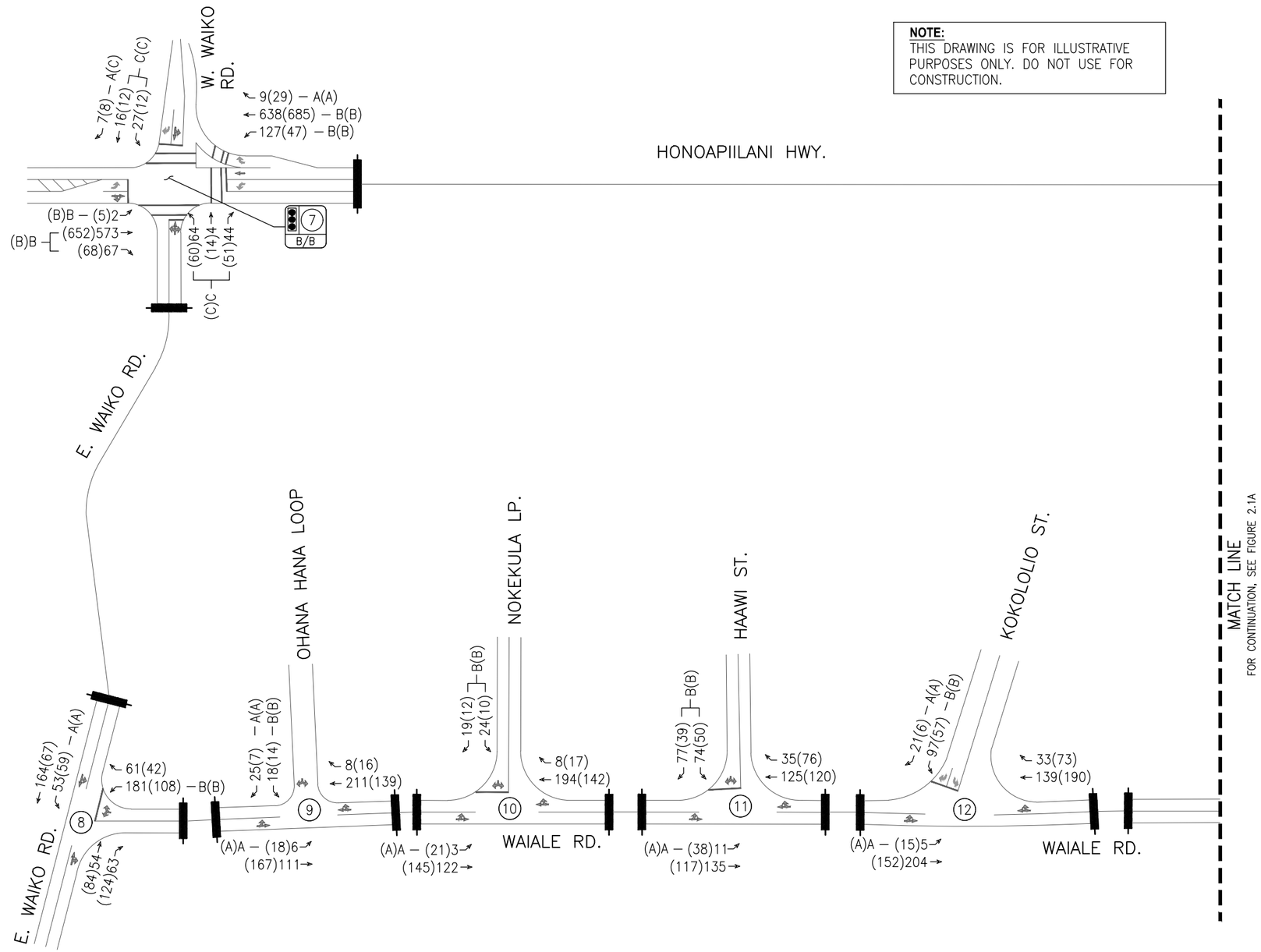
(X) – UNSIGNALIZED INTERSECTION X

DATE OF COUNTS:
MARCH 15, 2017
MARCH 16, 2017
OCTOBER 22, 2015

AM PEAK HOUR:
7:00 AM – 8:00 AM

PM PEAK HOUR:
4:15 PM – 5:15 PM

WAILUKU APARTMENTS	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS,SURVEYORS • HONOLULU,HAWAII	FIGURE
	EXISTING LANEAGE, VOLUMES AND LOS	2.1A



LEGEND

##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES

X(X) – AM(PM) LOS

Y – SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS (X/X)

X – UNSIGNALIZED INTERSECTION X

DATE OF COUNTS:
MARCH 15, 2017
MARCH 16, 2017
OCTOBER 22, 2015

AM PEAK HOUR:
7:00 AM – 8:00 AM

PM PEAK HOUR:
4:15 PM – 5:15 PM

WAILUKU APARTMENTS

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, HAWAII

EXISTING LANEAGE, VOLUMES AND LOS

FIGURE 2.1B

Table 2.1: Existing 2017 Level of Service Summary

Intersection	Existing Conditions					
	AM			PM		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Honoapiilani Hwy & Kehalani Pkwy						
NB LT	17.0	0.53	B	11.6	0.36	B
NB TH	23.8	0.68	C	14.7	0.51	B
NB RT	0.0	0.00	A	0.0	0.00	A
EB LT	91.3	1.06	F*	24.1	0.38	C
EB TH	25.2	0.41	C	24.8	0.20	C
EB RT	24.9	0.37	C	26.7	0.53	C
WB LT	30.4	0.10	C	26.6	0.05	C
WB TH	37.1	0.74	D	30.0	0.56	C
WB RT	32.8	0.15	C	29.9	0.53	C
SB LT	19.0	0.14	B	10.1	0.21	B
SB TH	26.4	0.60	C	17.7	0.69	B
SB RT	0.0	0.00	A	0.0	0.00	A
Overall	37.6	-	D	18.6	-	B
2: Honoapiilani Highway & Kuikahi Dr						
NB LT	16.0	0.04	B	16.2	0.12	B
NB TH	25.3	0.71	C	23.1	0.64	C
NB RT	0.0	0.00	A	0.0	0.00	A
EB LT	30.5	0.19	C	31.0	0.04	C
EB TH	42.2	0.74	D	33.6	0.48	C
EB RT	31.6	0.12	C	30.5	0.16	C
WB LT	27.1	0.68	C	30.5	0.79	C
WB TH	24.2	0.15	C	20.1	0.20	C
WB RT	17.4	0.15	B	16.0	0.30	B
SB LT	17.4	0.67	B	14.5	0.49	B
SB TH	16.3	0.57	B	19.0	0.63	B
SB RT	9.5	0.00	A	12.7	0.05	B
Overall	23.0	-	C	22.2	-	C
3: Kuikahi Dr & Kehalani Village Center Drwy						
EB LT	8.8	0.07	A	9.2	0.11	A
SB LT	46.3	0.27	E	33.9	0.23	D
SB RT	13.0	0.18	B	14.4	0.27	B
Overall	2.3	-	-	3.0	-	-
4: Waiale Rd & Kuikahi Dr/Maui Lani Pkwy						
NB LT	24.5	0.37	C	23.3	0.20	C
NB TH/RT	33.6	0.72	C	27.7	0.52	C
EB LT	22.7	0.81	C	16.6	0.61	B
EB TH/RT	18.2	0.49	B	17.4	0.42	B
WB LT	24.6	0.10	C	18.0	0.16	B
WB TH	32.4	0.71	C	26.1	0.75	C
WB RT	26.4	0.12	C	19.4	0.02	B
SB LT	25.5	0.67	C	20.1	0.62	C
SB TH/RT	29.4	0.67	C	27.4	0.79	C
Overall	25.9	-	C	22.4	-	C
5: Kamehameha Ave & Maui Lani Pkwy						
NB LT	24.5	0.55	C	15.9	0.20	C
NB TH/RT	53.9	0.90	F	18.2	0.38	F
EB LT/TH/RT	82.3	1.03	F*	109.2	1.11	F*
WB LT/TH/RT	57.4	0.93	F	76.9	1.05	F*
SB LT	23.0	0.52	C	19.1	0.44	C
SB TH/RT	88.0	1.06	F*	51.9	0.93	F
Overall	62.1	-	-	67.7	-	-
6: Waiale Rd & Waiinu Rd						
WB LT	486	1.86	F*	379	1.65	F*
WB RT	18	0.15	C	13	0.09	B
SB LT	12	0.08	B	9	0.08	A
Overall	49.0	-	-	50.3	-	-
7: Honoapiilani Hwy & W Waiko Rd/E Waiko Rd						
NB LT	10.1	0.01	B	10.4	0.01	B
NB TH/RT	19.6	0.71	B	20.0	0.79	B
EB LT/TH	28.6	0.12	C	26.9	0.07	C
EB RT	0.0	0.00	A	26.7	0.03	C
WB LT/TH/RT	29.4	0.24	C	29.1	0.36	C
SB LT	11.0	0.32	B	12.0	0.15	B
SB TH	12.2	0.60	B	12.9	0.66	B
SB RT	6.2	0.01	A	6.7	0.03	A
Overall	16.5	-	B	17.4	-	B

* Denotes overcapacity condition, v/c ≥ 1.

Table 2.1: Existing 2017 Level of Service Summary Cont'd

Intersection	Existing Conditions					
	AM			PM		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
8: E Waiko Rd & Waiale Rd						
EB LT	7.6	0.04	A	7.8	0.05	A
SB LT/RT	14.2	0.40	B	12.1	0.25	B
Overall	6.6	-	-	4.7	-	-
9: Waiale Rd & Ohana Hana Lp						
NB LT	7.7	0.01	A	7.6	0.01	A
EB LT	10.9	0.03	B	11.0	0.03	B
EB RT	9.6	0.03	A	9.1	0.01	A
Overall	1.3	-	-	1.0	-	-
10: Waiale Rd & Nokekula Lp						
NB LT	7.7	0.00	A	7.6	0.02	A
EB LT/RT	10.4	0.07	B	10.0	0.03	B
Overall	1.3	-	-	1.1	-	-
11: Waiale Rd & Haawi St						
NB LT	7.6	0.01	A	7.7	0.03	A
EB LT/RT	11.0	0.22	B	11.0	0.14	B
Overall	3.8	-	-	2.9	-	-
12: Waiale Rd & Kokololio St						
NB LT	7.6	0.00	A	7.9	0.01	A
EB LT	12.2	0.18	B	12.2	0.11	B
EB RT	9.2	0.03	A	9.6	0.01	A
Overall	2.9	-	-	1.8	-	-

* Denotes overcapacity condition, v/c ≥ 1.

3. TRAFFIC SIGNAL WARRANT

3.1 Traffic Signal Warrants Descriptions

The Federal Highway Administration (FHWA) Manual on Uniform Traffic Control Devices (MUTCD) 2009 Edition provides nine (9) different warrants to determine if a traffic signal is warranted at an intersection. A brief description of each warrant is provided below.

Warrant 1 – Eight-Hour Vehicular Volume: can be satisfied by either Condition A, Condition B or a combination of Conditions A or B.

- **Condition A - The Minimum Vehicular Volume:** is intended for application at locations where a large volume of intersecting traffic is the principal reason to consider installing a traffic control signal.

- **Condition B - The Interruption of Continuous Traffic:** is intended for application at locations where Condition A is not satisfied and where the traffic volume on a major street is so heavy that traffic on a minor intersecting street suffers excessive delay or conflict in entering or crossing the major street.

Warrant 1 requires that certain volume thresholds for the total of both major street approaches and the higher volume minor street approach be satisfied for each of any eight hours of a typical day.

Note: If Condition A is satisfied, then Warrant 1 is satisfied and analyses of Condition B and the combination of Conditions A and B are not needed. Similarly, if Condition B is satisfied, then Warrant 1 is satisfied and an analysis of the combination of Conditions A and B is not needed.

Warrant 2 – 4-Hour Vehicular Volume: is intended to be applied where the volume of intersecting traffic is the principal reason to consider installing a traffic control signal. Warrant 2 requires that the total of both major street approaches and the higher volume minor street approach volumes when graphed exceed a graphed threshold.

Warrant 3 – Peak Hour: is intended for use at a location where traffic conditions are such that for a minimum of 1 hour of an average day, the minor-street traffic suffers undue delay when entering or crossing the major street. This warrant is only applied in unusual cases, such as office complexes, manufacturing plants, industrial complexes, or high-occupancy vehicle facilities that attract or discharge large numbers of vehicles over a short time. No such facility is found near the Study Intersection.

Warrant 4 – Pedestrian Volume: is intended for application where the traffic volume on a major street is so heavy that pedestrians experience excessive delay in crossing the major street. Few pedestrians were observed to cross at the study intersection during the AM and PM peak hours of traffic.

Warrant 5 – School Crossing: is intended for application where the fact that schoolchildren cross the major street is the principal reason to consider installing a traffic control signal. There is a preschool located on the eastbound approach of Halekou Road.

Warrant 6 – Coordinated Signal System: is intended for application where the progressive movement in a coordinated signal system necessitates installing traffic control signals at intersections where they would not otherwise be needed in order to maintain proper platooning of vehicles. There are no signalized intersections in the vicinity of the Study Intersection.

Warrant 7 – Crash Experience: is intended for application where the severity and frequency of crashes are the principal reason to consider installing a traffic control signal.

Warrant 8 – Roadway Network: is intended for application where it is justified to encourage concentration and organization of traffic flow on a roadway network.

Warrant 9 – Intersection near a Grade Crossing: is intended for use at a location where none of the conditions described in the other eight traffic signal warrants are met, but the proximity to the intersection of a grade crossing on an intersection approach controlled by a STOP or YIELD sign is the principal reason to consider installing a traffic control signal. There are no grade crossings at Study Intersection.

3.2 Warrant Results

Based on the above descriptions and the available data, Warrants 1 and 2 will be further analyzed for the study intersection.

Warrant 1 – 8-Hour Vehicular Volume: Based on existing traffic volumes, a signal was not warranted based on Warrant 1.

Warrant 2 – 4-Hour Vehicular Volume: Based on existing traffic volumes, a signal was not warranted based on Warrant 2.

See Appendix D for existing signal warrant charts.

4. BASE YEAR 2020 TRAFFIC CONDITIONS

4.1 Defacto Growth Rate

Projections for Base Year 2020 traffic were based upon existing traffic counts performed by ATA, the Maui Regional Travel Demand Model (MRTDM) growth for forecast years of 2020 and 2035, and nearby developments in the immediate vicinity of the Project. The resulting growth rate along study roadways was approximately 1.9 percent per year.

4.2 Traffic Forecasts for Known Developments

By year 2020, the following developments shown in Figure 4.1 and Table 4.1 may be constructed. Appendix E shows the general trip distribution/assignment percentages associated with each development either based on existing traffic patterns or their respective Project TIAR's. The Kehalani Village Center and Maui Lani Village Center are currently occupied and ongoing developments with associated growth assumptions described in Table 4.1 below.

Trips generated by the master planned communities for the Kehalani and Maui Lani residential developments are accounted for in the MRTDM growth. It was assumed that the Puunani Residences, Waiale Development, and Waikapu Country Town (WCT) developments are

unlikely to be built by Year 2020, given their current statuses in the permitting process, and were therefore not explicitly included in this TIAR.

- **Waikapu Light Industrial Project** - Proposed 8.5-acre industrial development along Waiko Road. Forecast traffic growth generated by this development was obtained from the Project's TIAR dated April 2013 and was added to the roadway network.

- **Waiko Baseyard Light Industrial Development** - Proposed industrial development along Waiko Road that will include 100,000 SF of commercial space and 19.7 acres of light industrial uses. Forecast traffic growth generated by this development was obtained from the Project's TIAR dated May 2011 and was added to the roadway network.

- **Central Maui Regional Sports Complex (CMRSC)** – Proposed regional park development, located south of the Maui Lani Parkway and Kamehameha Avenue intersection. Forecast traffic growth generated by this development was obtained from the Project's TIAR dated May 2014 and was added to the roadway network.

- **Kehalani Village Center** – Existing retail center in the Kehalani subdivision. Currently occupied by Longs Drugs, Foodland, Foodland Gas, American Savings Bank, Coffee Bean Tea & Leaf and McDonalds. The forecast AM and PM peak hour trips for the remaining development was obtained from the Project's TIAR dated 2012 and was added to the roadway network.

- **Maui Lani Village Center** – Existing retail center in the Maui Lani subdivision. Currently occupied by Walgreen and a mix of various commercial, office and warehouse land uses. Based on the latest projections, approximately 20,000 SF of commercial, 20,000 SF of office and 107,000 SF of warehouse space may be completed by year 2020. The forecast AM and PM peak hour trips were generated based on the cumulative ITE Trip generation and added to the roadway network.

- **Waiale Affordable Housing** – Proposed 70-unit single-family residential subdivision and a neighborhood park. It will be located adjacent to the Valley Isle Fellowship Church along Waiale Road. An existing gated access to the project is located along Waiale Road and was assumed to be the primary access to the subdivision. The forecast AM and PM peak hour trips were obtained from the Project's TIAR dated 2015 and was added to the roadway network.

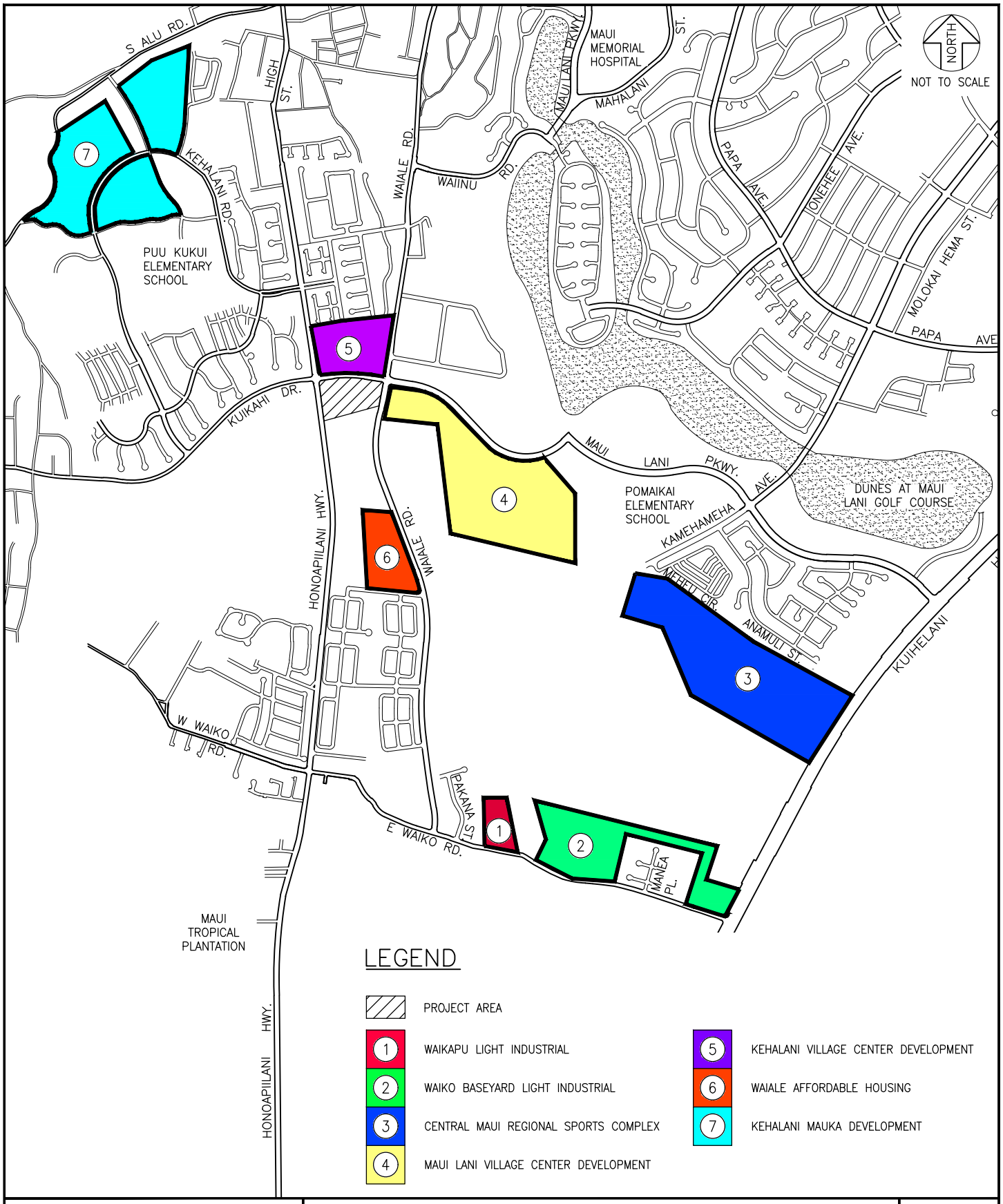
- **Kehalani Mauka** – Existing residential subdivision located north of Kuikahi Drive and west of Honoapiilani Highway. Currently partially developed with residential homes and the Puu Kukui Elementary School. Based on the latest projections, approximately 246 single-family homes and 138 duplex units may be completed by year 2020. The Kehalani Mauka Parkway Loop is also anticipated to be completed by year 2020 and was assumed in the analysis.

Table 4.1: Total Trips Generated by Known Developments in Project Vicinity [1]

Known Development	Land Use	Units	AM Peak Hour			PM Peak Hour		
			Enter	Exit	Total	Enter	Exit	Total
Waikapu Light Industrial Project	Industrial Park	8.5 Acres	74	15	89	21	79	100
Waiko Baseyard Light Industrial Development	Light Industrial, Retail	19.7 Acres, 100,000 SF	219	86	305	220	351	571
Central Maui Regional Sports Complex	County Park, Soccer Complex	13 Acres, 12 Fields	9	6	15	144	71	215
Kehalani Village Center [2]	Commercial	72,000 SF 56 MF	55	39	94	181	194	375
Maui Lani Village Center (formerly VMX) [3]	Commercial, Office, Warehouse	165,000 SF	123	26	149	65	142	207
Waiale Affordable Housing	Single-Family Residential	70 Units	15	44	59	49	28	77
Kehalani Mauka [4]	Single-Family, Multi-Family Residential	246 SF 138 MF	57	192	249	202	114	316

Note:

1. Table 4.1 shows trips generated by known developments in the vicinity of the Project. Not all traffic generated by these developments travel through the study area of this TIAR, since some traffic will be routed to various roadways and intersections that were not included in this TIAR. See Appendix E for more detailed assessment of trip distribution/assignment patterns.
2. Kehalani Village Center partially completed with Longs Drugs, Foodland, Foodland Gas and McDonalds. Trips shown, accounts for assumed 30% remaining commercial development and residential unit and is based on Kehalani Village Center TIAR dated 2012.
3. Maui Lani Village Center projections based on latest assumptions for growth. Majority of expansion (147,000 SF) attributed to lower trip generating office and warehouse land uses.
4. Kehalani Mauka projections based on latest assumptions for growth.



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BACKGROUND DEVELOPMENTS IN PROJECT VICINITY

FIGURE 4.1

4.3 Planned Roadway Projects

The Waiale Road Extension and Waiko Road Improvements are planned roadway improvements to be constructed in the future. However, since they are unlikely to be built by Year 2020 given their current status, these roadway improvements were not included in this TIAR. In addition, at the Waiale Road/Waiinu Road intersection, a traffic signal and widening improvements are listed in the Statewide Transportation Improvement Program (STIP). However, it's unknown if this development will be constructed by Year 2020 and was therefore not included in this TIAR. At the Maui Lani Parkway/Kamehameha Avenue intersection, a single-lane roundabout is planned to be constructed and was included in this TIAR.

4.4 Base Year 2020 Analysis

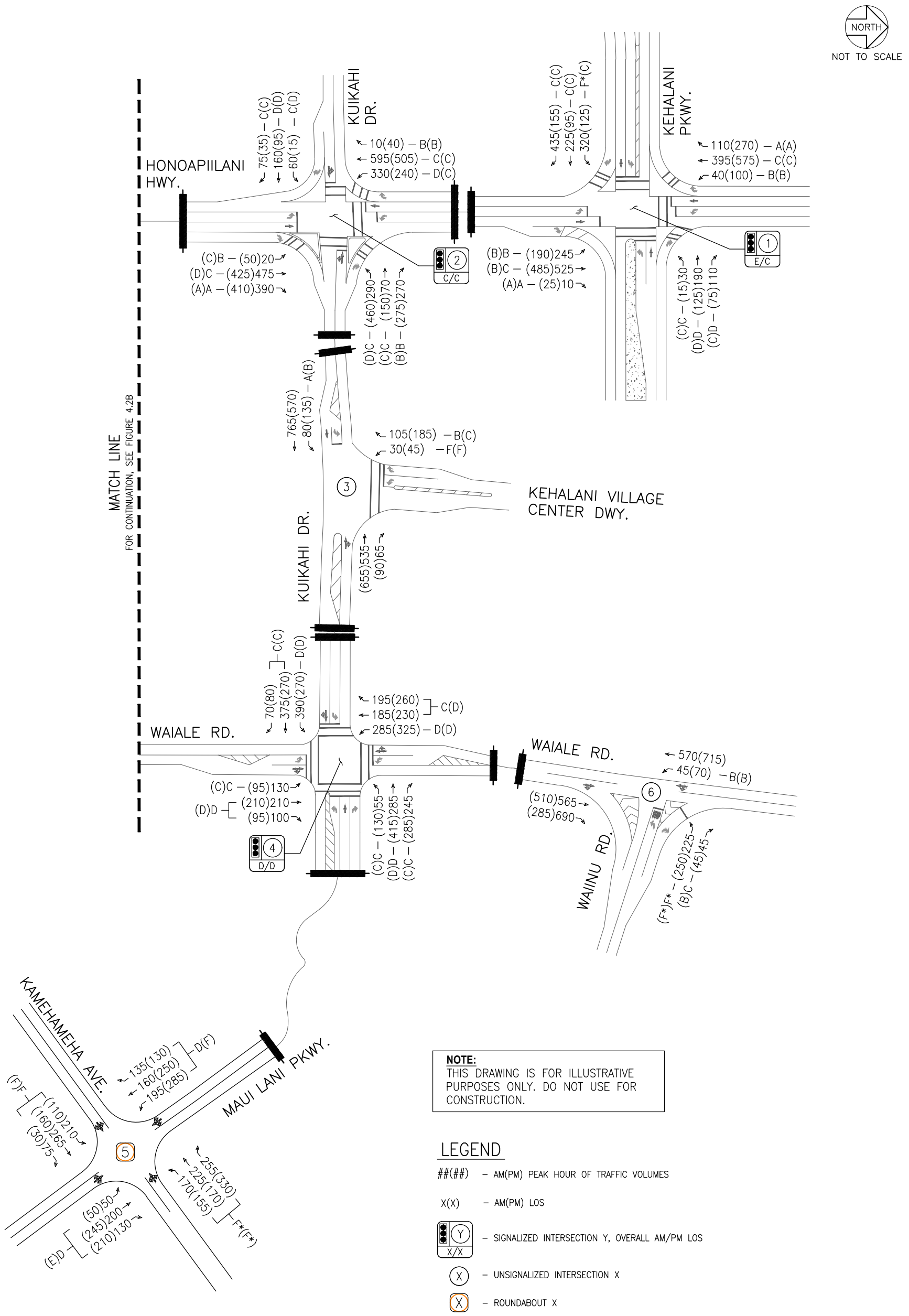
At the Honoapiilani Highway/Kehalani Parkway intersection, the eastbound left-turn movement will continue to operate at over-capacity and LOS F conditions during the AM peak hour. As noted in Section 2.3, heavy traffic during a short period of time is reflective of typical school traffic conditions, as these queuing conditions were observed to last about 30 minutes during the AM peak hour and primarily stem from traffic generated by the Puu Kukui Elementary School. There are currently no identified or planned roadway improvements likely to occur at this intersection. Signal timing may be adjusted, but northbound congestion along Honoapiilani Highway will continue to occur during the AM peak hour.

The southbound left-turn movement at the Kuikahi Drive/Kehalani Village Center Driveway will worsen to operate at LOS F during the AM and PM peak hours of traffic, however will continue to operate with relatively low volume at 30(45) vehicles in the AM(PM) peak hours of traffic.

As a roundabout, various movements at the Kamehameha Avenue/Maui Lani Parkway intersection will operate at LOS E/F during the AM and PM peak hours. However, approach delays are anticipated to improve from existing conditions.

Since no roadway improvements were assumed at the Waiale Road/Waiinu Road intersection, the westbound left-turn movement will continue operating at LOS F and overcapacity conditions during the AM and PM peak hours. Northbound through traffic on Waiale Road will continue to spill back in the AM peak hour. For future planning purposes along Waiale Road, traffic control treatment at Waiale Road/Kaohu Street intersection, intersection improvements at the Waiale Road/Waiinu Road intersection (as identified on the STIP) and median refuge lanes along Waiale Road could be considered to help mitigate Waiale Road northbound flows in the AM peak hour of traffic.

Figure 4.2 illustrates the Base Year 2020 forecast traffic volumes and LOS for the study intersection movements. Table 4.2 summarizes the Base Year 2020 LOS at the study intersections compared to existing conditions. LOS worksheets are provided in Appendix C.



NOTE:
THIS DRAWING IS FOR ILLUSTRATIVE PURPOSES ONLY. DO NOT USE FOR CONSTRUCTION.

LEGEND

##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES

X(X) – AM(PM) LOS

Y – SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS

X – UNSIGNALIZED INTERSECTION X

X – ROUNDABOUT X

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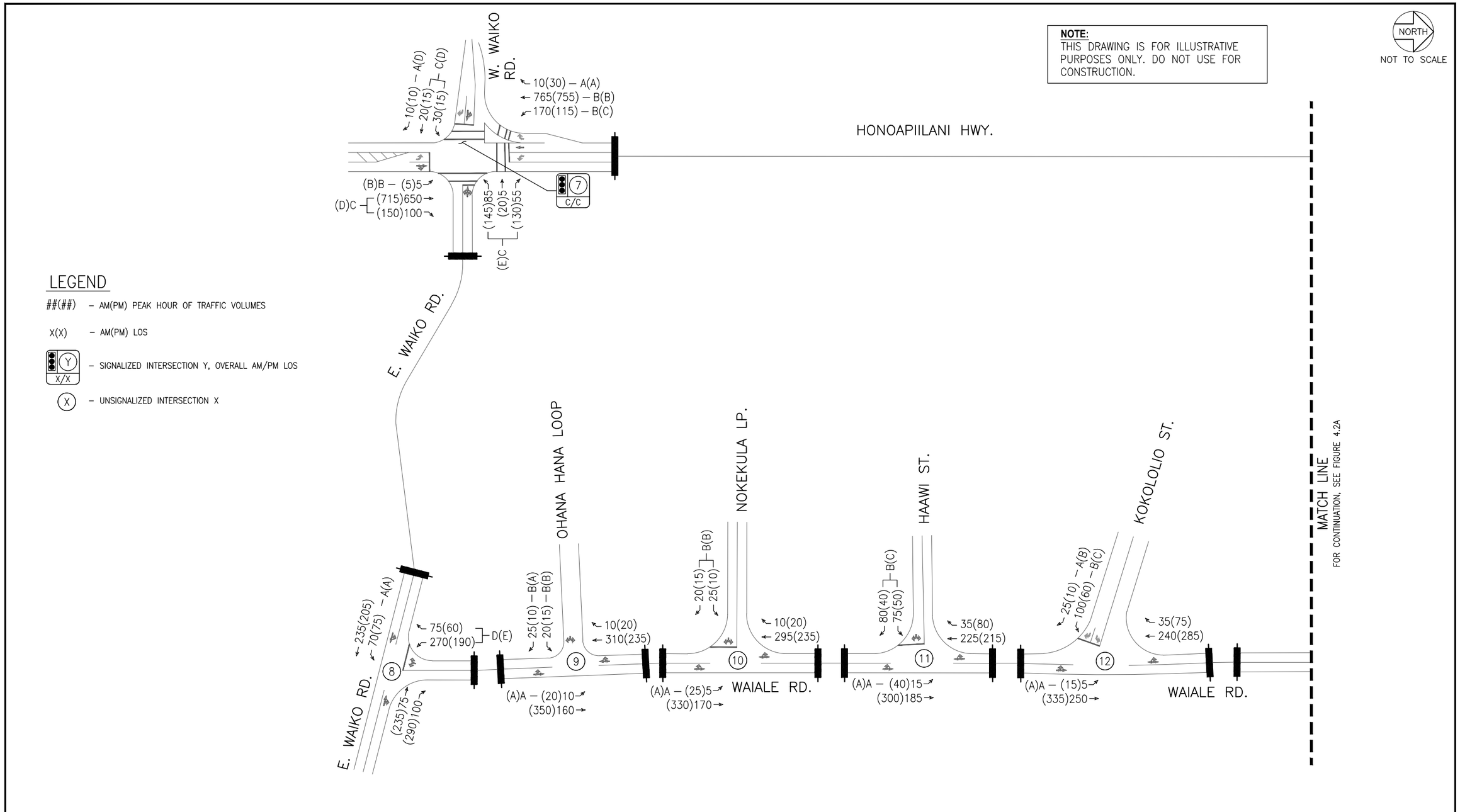
	BASE YEAR 2020 LANEAGE, VOLUMES AND LOS	4.2A



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BASE YEAR 2020 LANEAGE, VOLUMES AND LOS

FIGURE 4.2B

Table 4.2: Existing and Base Year 2020 Level of Service Summary

Intersection	Existing Conditions						Base Year 2020					
	AM			PM			AM			PM		
	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: Honoapiilani Hwy & Kehalani Pkwy												
NB LT	17.0	0.53	B	11.6	0.36	B	17.8	0.61	B	15.0	0.56	B
NB TH	23.8	0.68	C	14.7	0.51	B	24.6	0.71	C	17.4	0.61	B
NB RT	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A
EB LT	91.3	1.06	F*	24.1	0.38	C	205.9	1.35	F*	26.7	0.46	C
EB TH	25.2	0.41	C	24.8	0.20	C	29.5	0.50	C	28.4	0.31	C
EB RT	24.9	0.37	C	26.7	0.53	C	33.7	0.66	C	30.5	0.59	C
WB LT	30.4	0.10	C	26.6	0.05	C	33.3	0.12	C	30.2	0.06	C
WB TH	37.1	0.74	D	30.0	0.56	C	41.9	0.82	D	35.0	0.66	D
WB RT	32.8	0.15	C	29.9	0.53	C	35.9	0.15	D	33.6	0.47	C
SB LT	19.0	0.14	B	10.1	0.21	B	19.3	0.15	B	12.4	0.26	B
SB TH	26.4	0.60	C	17.7	0.69	B	27.6	0.65	C	23.8	0.77	C
SB RT	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A
Overall	37.6	-	D	18.6	-	B	59.8	-	E	22.9	-	C
2: Honoapiilani Highway & Kuikahi Dr												
NB LT	16.0	0.04	B	16.2	0.12	B	18.4	0.09	B	20.5	0.21	C
NB TH	25.3	0.71	C	23.1	0.64	C	30.6	0.78	C	36.0	0.81	D
NB RT	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A
EB LT	30.5	0.19	C	31.0	0.04	C	31.5	0.20	C	35.2	0.08	D
EB TH	42.2	0.74	D	33.6	0.48	C	48.9	0.79	D	40.5	0.69	D
EB RT	31.6	0.12	C	30.5	0.16	C	33.0	0.17	C	34.5	0.21	C
WB LT	27.1	0.68	C	30.5	0.79	C	34.3	0.77	C	37.0	0.86	D
WB TH	24.2	0.15	C	20.1	0.20	C	25.8	0.17	C	21.3	0.27	C
WB RT	17.4	0.15	B	16.0	0.30	B	18.6	0.23	B	16.3	0.43	B
SB LT	17.4	0.67	B	14.5	0.49	B	36.1	0.88	D	23.3	0.71	C
SB TH	16.3	0.57	B	19.0	0.63	B	22.4	0.74	C	27.2	0.75	C
SB RT	9.5	0.00	A	12.7	0.05	B	10.1	0.01	B	15.3	0.07	B
Overall	23.0	-	C	22.2	-	C	30.1	-	C	29.1	-	C
3: Kuikahi Dr & Kehalani Village Center Drwy												
EB LT	8.8	0.07	A	9.2	0.11	A	9.2	0.09	A	10.4	0.18	B
SB LT	46.3	0.27	E	33.9	0.23	D	56.1	0.32	F	91.7	0.57	F
SB RT	13.0	0.18	B	14.4	0.27	B	14.6	0.23	B	22.3	0.50	C
Overall	2.3	-	-	3.0	-	-	2.5	-	-	5.8	-	-
4: Waiale Rd & Kuikahi Dr/Maui Lani Pkwy												
NB LT	24.5	0.37	C	23.3	0.20	C	30.8	0.42	C	31.9	0.42	C
NB TH/RT	33.6	0.72	C	27.7	0.52	C	47.6	0.82	D	45.9	0.79	D
EB LT	22.7	0.81	C	16.6	0.61	B	36.6	0.91	D	35.4	0.83	D
EB TH/RT	18.2	0.49	B	17.4	0.42	B	26.9	0.65	C	29.8	0.59	C
WB LT	24.6	0.10	C	18.0	0.16	B	31.8	0.19	C	25.4	0.37	C
WB TH	32.4	0.71	C	26.1	0.75	C	48.3	0.80	D	45.2	0.85	D
WB RT	26.4	0.12	C	19.4	0.02	B	34.3	0.09	C	28.7	0.13	C
SB LT	25.5	0.67	C	20.1	0.62	C	39.3	0.81	D	35.2	0.83	D
SB TH/RT	29.4	0.67	C	27.4	0.79	C	33.1	0.62	C	37.9	0.82	D
Overall	25.9	-	C	22.4	-	C	37.0	-	D	37.2	-	D
5: Kamehameha Ave & Maui Lani Pkwy												
NB LT	24.5	0.55	C	15.9	0.20	C	-	-	-	-	-	-
NB TH/RT	53.9	0.90	F	18.2	0.38	F	-	-	-	-	-	-
NB LT/TH/RT	-	-	-	-	-	-	54.3	0.97	F	21.4	0.63	F
EB LT/TH/RT	82.3	1.03	F*	109.2	1.11	F*	26.1	0.79	D	54.0	0.99	F
WB LT/TH/RT	57.4	0.93	F	76.9	1.05	F*	31.0	0.78	D	44.8	0.92	E
SB LT	23.0	0.52	C	19.1	0.44	C	-	-	-	-	-	-
SB TH/RT	88.0	1.06	F*	51.9	0.93	F	-	-	-	-	-	-
SB LT/TH/RT	-	-	-	-	-	-	77.4	1.06	F*	59.3	1.01	F*
Overall	62.1	-	-	67.7	-	-	50.6	-	-	48.8	-	-
6: Waiale Rd & Waiinu Rd												
WB LT	485.7	1.86	F*	378.8	1.65	F*	952.7	2.88	F*	978.9	2.95	F*
WB RT	17.7	0.15	C	12.5	0.09	B	19.4	0.16	C	14.3	0.11	B
SB LT	12.1	0.08	B	9.3	0.08	A	12.9	0.10	B	10.1	0.10	B
Overall	49.0	-	-	50.3	-	-	100.8	-	-	131.2	-	-
7: Honoapiilani Hwy & W Waiko Rd/E Waiko Rd												
NB LT	10.1	0.01	B	10.4	0.01	B	11.8	0.02	B	14.8	0.02	B
NB TH/RT	19.6	0.71	B	20.0	0.79	B	27.5	0.86	C	37.6	0.92	D
EB LT/TH	28.6	0.12	C	26.9	0.07	C	28.3	0.14	C	35.8	0.09	D
EB RT	0.0	0.00	A	26.7	0.03	C	0.0	0.00	A	35.4	0.03	D
WB LT/TH/RT	29.4	0.24	C	29.1	0.36	C	30.1	0.37	C	57.3	0.83	E
SB LT	11.0	0.32	B	12.0	0.15	B	16.6	0.54	B	27.8	0.55	C
SB TH	12.2	0.60	B	12.9	0.66	B	15.9	0.73	B	17.8	0.71	B
SB RT	6.2	0.01	A	6.7	0.03	A	6.5	0.01	A	8.8	0.03	A
Overall	16.5	-	B	17.4	-	B	21.8	-	C	32.2	-	C
8: E Waiko Rd & Waiale Rd												
EB LT	7.6	0.04	A	7.8	0.05	A	7.8	0.06	A	8.9	0.08	A
SB LT/RT	14.2	0.40	B	12.1	0.25	B	27.4	0.72	D	38.4	0.74	E
Overall	6.6	-	-	4.7	-	-	12.1	-	-	9.7	-	-
9: Waiale Rd & Ohana Hana Lp												
NB LT	7.7	0.01	A	7.6	0.01	A	8.0	0.01	A	7.8	0.02	A
EB LT	10.9	0.03	B	11.0	0.03	B	12.5	0.04	B	14.3	0.04	B
EB RT	9.6	0.03	A	9.1	0.01	A	10.3	0.04	B	9.7	0.01	A
Overall	1.3	-	-	1.0	-	-	1.1	-	-	0.7	-	-

Table 4.2: Existing and Base Year 2020 Level of Service Summary Cont'd

Intersection	Existing Conditions						Base Year 2020					
	AM			PM			AM			PM		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
10: Waiale Rd & Nokekula Lp												
NB LT	7.7	0.00	A	7.6	0.02	A	7.9	0.00	A	7.9	0.02	A
EB LT/RT	10.4	0.07	B	10.0	0.03	B	11.7	0.08	B	11.7	0.05	B
Overall	1.3	-	-	1.1	-	-	1.1	-	-	0.8	-	-
11: Waiale Rd & Haawi St												
NB LT	7.6	0.01	A	7.7	0.03	A	7.9	0.01	A	8.0	0.04	A
EB LT/RT	11.0	0.22	B	11.0	0.14	B	12.8	0.27	B	15.0	0.21	C
Overall	3.8	-	-	2.9	-	-	3.4	-	-	2.3	-	-
12: Waiale Rd & Kokololio St												
NB LT	7.6	0.00	A	7.9	0.01	A	7.9	0.00	A	8.1	0.01	A
EB LT	12.2	0.18	B	12.2	0.11	B	14.6	0.22	B	16.6	0.17	C
EB RT	9.2	0.03	A	9.6	0.01	A	9.9	0.04	A	10.3	0.02	B
Overall	2.9	-	-	1.8	-	-	2.7	-	-	1.5	-	-

* Denotes overcapacity condition, v/c ≥ 1.

5. FUTURE YEAR 2020 TRAFFIC CONDITIONS

The Future Year 2020 scenario represents the traffic conditions within the Project study area with the full build-out of the Project.

5.1 Background

The Project proposes to develop approximately 14.4-acres of land to provide 324 multi-family dwelling units south of Kuikahi Drive between Honoapiilani Highway and Waiale Road. Vehicular traffic to the Project will be provided by two (2) new Project accesses; one along Kuikahi Drive directly across the Kehalani Village Center driveway and another along Waiale Road towards the south frontage of the Project site.

5.2 Travel Demand Estimations

5.2.1 Transportation Demand Management (TDM) Assumptions

The State of Hawaii Department of Transportation (HDOT) and Maui County provide various TDM programs that promote the use of transit, walking, biking and alternative modes of transportation, to reduce the use of single-occupant vehicles on roadways. TDM measures discussed in this section have only been identified, but conservatively assumed to yield no vehicular reductions for Project generated traffic.

Maui County, in partnership with Roberts Hawaii provides bus service to the major areas in Maui. In the vicinity of the Project, the Maui Bus currently provides two (2) bus stops near the Project site. The first is part of the Wailuku Loop route that stops along Waiale Road in front of the Ka Hale A Ke Ola Resource Center, about 0.3 miles north of the Kuikahi Drive/Waiale Road/Maui Lani Parkway intersection. A marked crosswalk and rectangular rapid flash beacon (RRFB) is provided at the bus stop to provide for pedestrian crossings. The second bus stop is part of the Lahaina-Wailuku route that stops at the Honoapiilani Highway/Wilikona Place intersection, about 450 feet south of the Honoapiilani Highway/East Waiko Road intersection. The nearest park and ride lots are currently located to the northeast of the Project, on the southwest corner of the Puunene Avenue/Kuihelani Highway/Dairy Road intersection and to the south of the Project, at the Honoapiilani Highway/North Kihei Road intersection.

HDOT currently provides the Bike Plan Hawaii Master Plan, which identifies proposed bicycle routes that could potentially be implemented in the future. In the vicinity of the study area, Honoapiilani Highway is proposed to be a “signed shared roadway”, which is a roadway shared by both vehicles and bicycles, which accommodate bicycles through wider vehicular travel lanes or paved shoulders. There is currently no bike improvement identified in the HDOT Bike Plan Hawaii Master Plan along Waiale Road.

5.2.2 Trip Generation

The Institute of Transportation Engineers (ITE) publishes a book based on empirical data compiled from a body of more than 4,250 trip generation studies submitted by public agencies, developers, consulting firms, and associations. This publication, titled Trip Generation Manual, 9th Edition, provides trip rates and/or formulae based on graphs that correlate vehicular trips with independent variables. The independent variable can range from Dwelling Units (DU) for single-family attached homes to Gross Floor Area (GFA) for commercial and office

development. See Tables 5.1 and 5.2 for Trip Generation formulae and projections for the Project.

Table 5.1: Project Trip Generation Rates

Land Use Type	Independent Variable	AM Peak Hour		PM Peak Hour	
		Rate	% Enter	Rate	% Enter
Residential Condo/Townhouse Housing (ITE 230)	Dwelling Units (DU)	[a]	17%	[b]	67%

Notes:
[a] Ln(T) = 0.80 * Ln(X) + 0.26
[b] Ln(T) = 0.82 * Ln(X) + 0.32

Table 5.2: New Project-Generated Trips

Land Use Type	Quantity	AM Peak Hour			PM Peak Hour		
		Enter	Exit	Total	Enter	Exit	Total
Residential Condo/Townhouse Housing (ITE 230)	324 DU	23	110	133	106	52	158

5.2.3 Trip Distribution

Trips generated by the Project were assigned throughout the study area generally based upon existing travel patterns in the study area. The traffic generated by the Project was added to the forecast Base Year 2020 traffic volumes within the vicinity of the Project to constitute the traffic volumes for the Future Year 2020 traffic conditions. Figure 5.1 illustrates the Project-generated trip volumes.

5.3 Future Year 2020 Analysis

Upon completion of the Project, all study intersections are forecast to operate with LOS similar to Base Year 2020 conditions. The eastbound left-turn movement at the Honoapiilani Highway/Kehalani Parkway intersection is forecast to continue operating at over-capacity and LOS F conditions in the AM peak hour, similar to Base Year 2020 conditions. As noted in Section 4.4, heavy traffic during a short period of time is reflective of typical school conditions, as these queuing conditions were observed to last about 30 minutes during the AM peak hour and likely primarily stem from traffic generated by the Puu Kukui Elementary School. However, the Project is only anticipated to increase traffic at the Honoapiilani Highway/Kehalani Parkway intersection by approximately 1.5%, with individual movement increases generally ranging from 1-16 vehicles. There are currently no identified or planned roadway improvements likely to occur at this intersection.

The southbound left-turn movement at the Kuikahi Drive/Kehalani Village Center Driveway intersection will continue operating at LOS F during the AM and PM peak hours of traffic. With the addition of the Project access at the intersection, the northbound left-turn movement will also operate at LOS F during the AM and PM peak hours of traffic. A signal is not anticipated to be warranted in Future Year 2020 conditions.

At the Kamehameha Avenue/Maui Lani Parkway roundabout intersection, all approaches will operate similar to Base Year 2020 conditions, with various delays operating at LOS E/F conditions during the AM and PM peak hours. The westbound left-turn movement at the Waiale Road/Waiinu Road intersection will continue operating at LOS F and overcapacity conditions during the AM and PM peak hours.

As mentioned in Section 4.4, northbound through traffic on Waiale Road will continue to spill back to the Waiale Road/Kuikahi Drive intersection in the AM peak hour.

Based on the forecast trips, the Project will increase traffic at the intersection by approximately 2.8%. Although the Project could potentially increase the eastbound left-turn movement by 24 vehicles in the AM peak hour, the Project is providing a second access on Waiale Road that can help reduce impacts to the eastbound left-turn movement by shifting more exiting Project traffic onto Waiale Road so as to not significantly impact the existing queues along Kuikahi Drive. It is recommended that the signal timing plan at the Waiale Road/Kuikahi Drive intersection be optimized to accommodate the increase in turning movement traffic generated by both the Project and various nearby developments. Optimizing the signal will not mitigate the existing regional northbound queues along Waiale Road during the AM peak hour, but it can help to optimize vehicular movements during all remaining off-peak and PM peak hours of the day.

At the Project accesses on Kuikahi Drive, the following improvements should be provided:

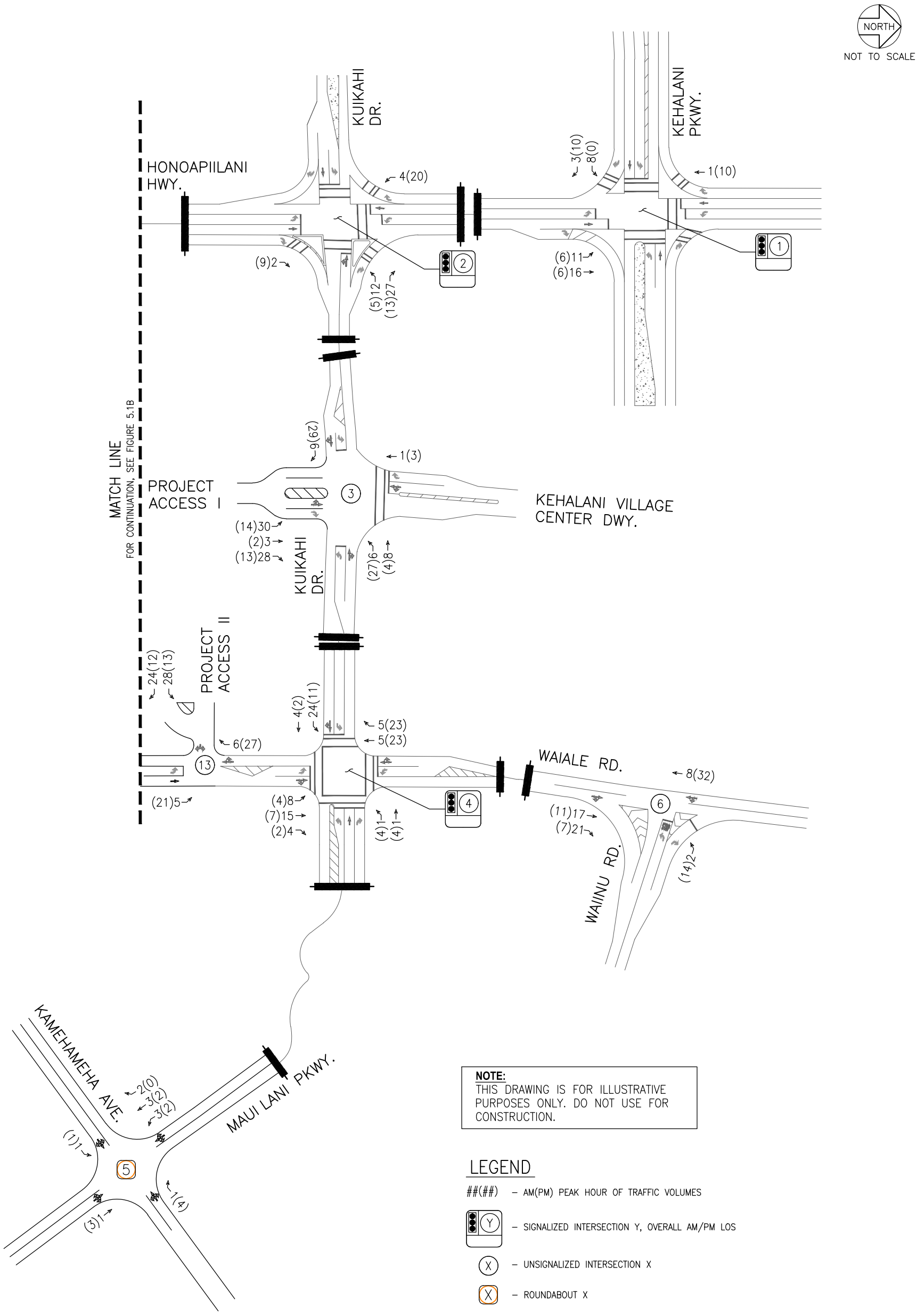
- Provide a new northbound leg with a shared left-turn/through lane and exclusive right-turn lane.
- Restripe the southbound leg to provide a shared left-turn/through lane and exclusive right-turn lane.
- Provide a new westbound left-turn lane with a minimum storage length of at least 50 feet or as long as feasibly possible, given the constraints from the existing eastbound left-turn lane at the Waiale Road/Kuikahi Drive intersection.

At the Project accesses on Waiale Road, the following improvement should be provided:

- Provide a new northbound left-turn lane with a minimum storage length of at least 50 feet.

Based on MUTCD signal warrants, a signal will likely not be met at both Project accesses at its intersections with Kuikahi Drive/Kehalani Village Center driveway and Waiale Road.

Figure 5.2 illustrates the Future Year 2020 forecast traffic volumes and LOS for the study intersection movements. Table 5.3 summarizes the Future Year 2020 LOS at the study intersections compared to Base Year 2020 conditions. LOS worksheets are provided in Appendix C.



NOTE:
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LEGEND

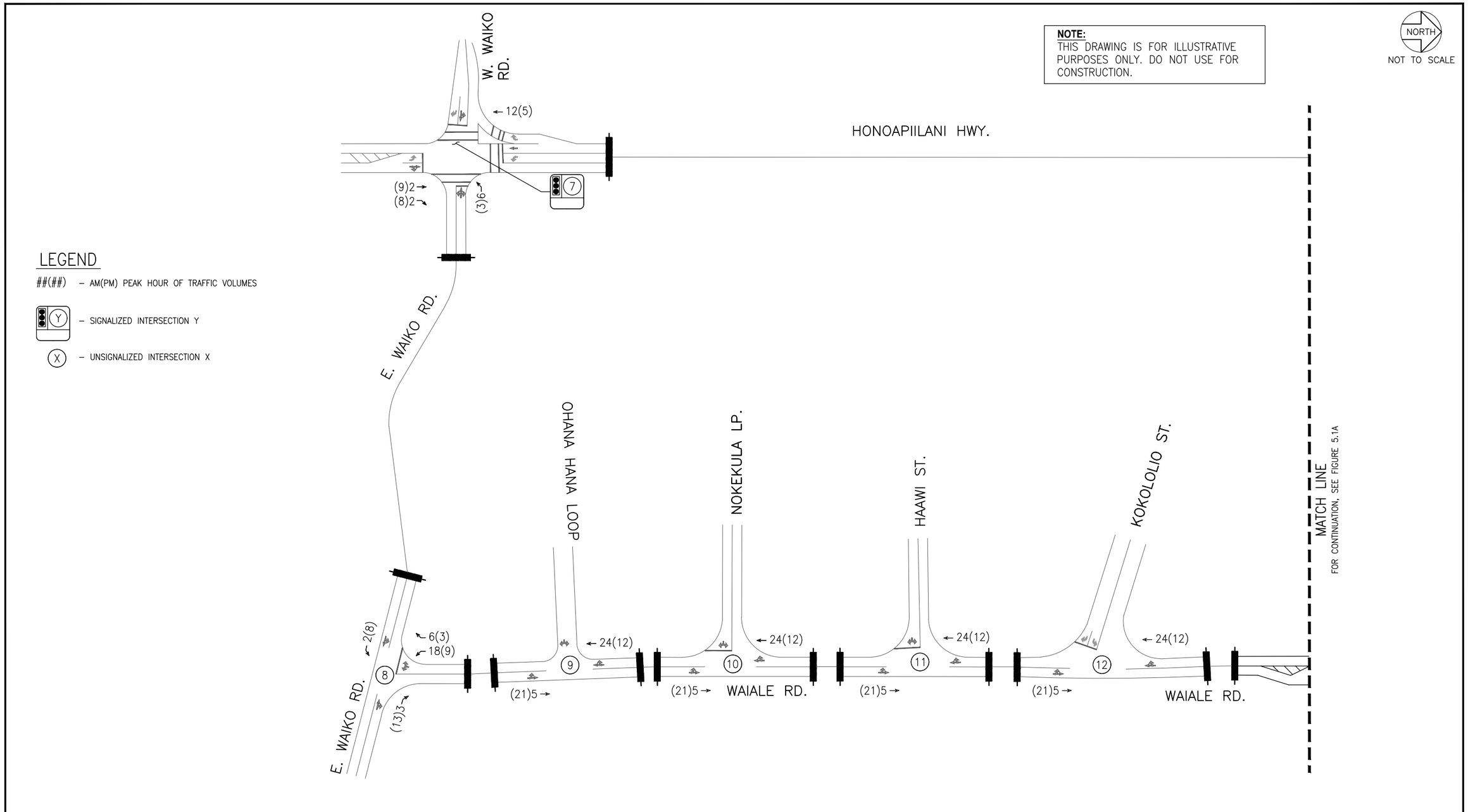
##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES

(Y) – SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS

(X) – UNSIGNALIZED INTERSECTION X

(X) – ROUNDABOUT X

WAILUKU APARTMENTS	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	FIGURE
	PROJECT TRIPS	5.1A

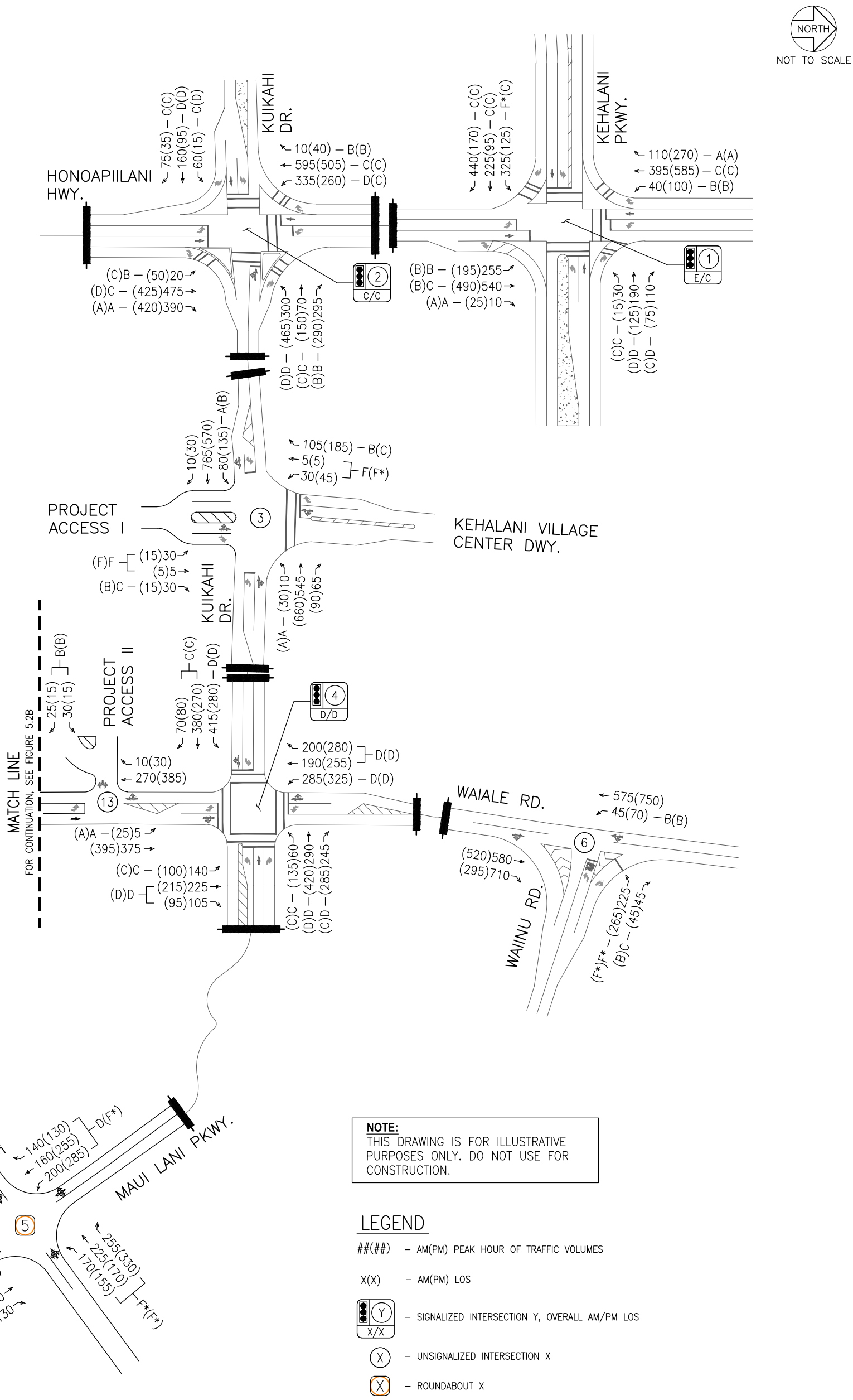


WAILUKU APARTMENTS

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS,SURVEYORS • HONOLULU,HAWAII

PROJECT TRIPS

FIGURE 5.1B



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LEGEND

##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES

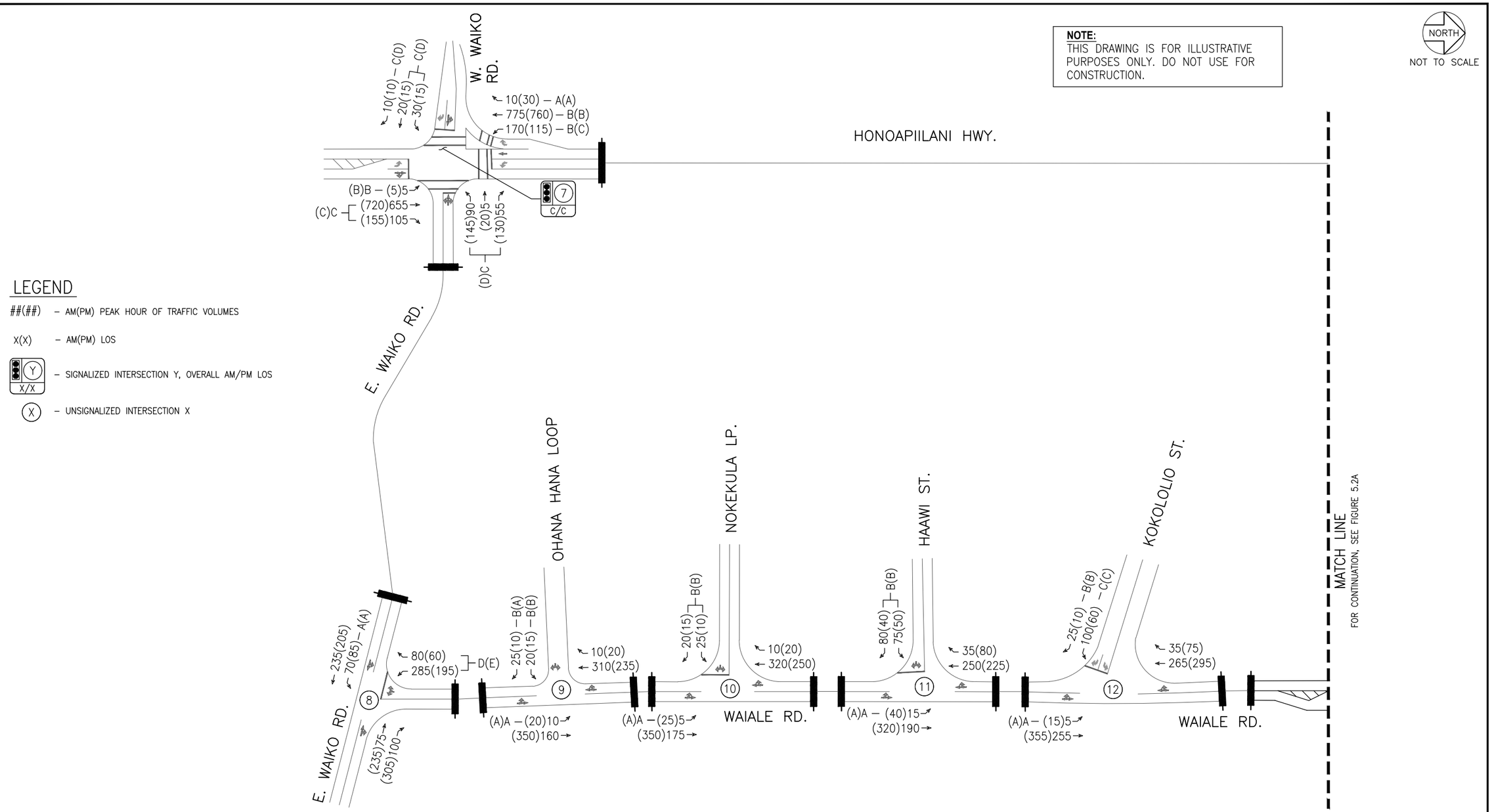
X(X) – AM(PM) LOS

Y – SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS

X – UNSIGNALIZED INTERSECTION X

X – ROUNDABOUT X

WAILUKU APARTMENTS	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	FIGURE
	FUTURE YEAR 2020 LANEAGE, VOLUMES AND LOS	5.2A



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FUTURE YEAR 2020 LANEAGE, VOLUMES AND LOS

FIGURE 5.2B

Table 5.3: Existing, Base Year 2020 and Year 2020 with Project Level of Service Summary

Intersection	Existing Conditions						Base Year 2020						Future Year 2020					
	AM			PM			AM			PM			AM			PM		
	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: Honoapiilani Hwy & Kehalani Pkwy																		
NB LT	17.0	0.53	B	11.6	0.36	B	17.8	0.61	B	15.0	0.56	B	17.9	0.63	B	15.4	0.58	B
NB TH	23.8	0.68	C	14.7	0.51	B	24.6	0.71	C	17.4	0.61	B	25.0	0.72	C	17.5	0.61	B
NB RT	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A
EB LT	91.3	1.06	F*	24.1	0.38	C	205.9	1.35	F*	26.7	0.46	C	221.0	1.38	F*	27.0	0.46	C
EB TH	25.2	0.41	C	24.8	0.20	C	29.5	0.50	C	28.4	0.31	C	29.9	0.50	C	28.7	0.31	C
EB RT	24.9	0.37	C	26.7	0.53	C	33.7	0.66	C	30.5	0.59	C	34.7	0.67	C	31.4	0.65	C
WB LT	30.4	0.10	C	26.6	0.05	C	33.3	0.12	C	30.2	0.06	C	33.6	0.12	C	30.5	0.06	C
WB TH	37.1	0.74	D	30.0	0.56	C	41.9	0.82	D	35.0	0.66	D	42.3	0.82	D	35.3	0.66	D
WB RT	32.8	0.15	C	29.9	0.53	C	35.9	0.15	D	33.6	0.47	C	36.2	0.15	D	34.0	0.47	C
SB LT	19.0	0.14	B	10.1	0.21	B	19.3	0.15	B	12.4	0.26	B	19.6	0.15	B	12.5	0.26	B
SB TH	26.4	0.60	C	17.7	0.69	B	27.6	0.65	C	23.8	0.77	C	27.8	0.65	C	24.5	0.78	C
SB RT	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A
Overall	37.6	-	D	18.6	-	B	59.8	-	E	22.9	-	C	62.8	-	E	23.3	-	C
2: Honoapiilani Highway & Kuikahi Dr																		
NB LT	16.0	0.04	B	16.2	0.12	B	18.4	0.09	B	20.5	0.21	C	18.4	0.09	B	20.8	0.20	C
NB TH	25.3	0.71	C	23.1	0.64	C	30.6	0.78	C	36.0	0.81	D	30.7	0.78	C	37.6	0.83	D
NB RT	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A
EB LT	30.5	0.19	C	31.0	0.04	C	31.5	0.20	C	35.2	0.08	D	31.5	0.20	C	35.4	0.08	D
EB TH	42.2	0.74	D	33.6	0.48	C	48.9	0.79	D	40.5	0.69	D	48.9	0.79	D	40.8	0.70	D
EB RT	31.6	0.12	C	30.5	0.16	C	33.0	0.17	C	34.5	0.21	C	33.0	0.17	C	34.7	0.21	C
WB LT	27.1	0.68	C	30.5	0.79	C	34.3	0.77	C	37.0	0.86	D	36.3	0.80	D	38.8	0.88	D
WB TH	24.2	0.15	C	20.1	0.20	C	25.8	0.17	C	21.3	0.27	C	25.8	0.17	C	21.5	0.27	C
WB RT	17.4	0.15	B	16.0	0.30	B	18.6	0.23	B	16.3	0.43	B	19.0	0.28	B	16.2	0.44	B
SB LT	17.4	0.67	B	14.5	0.49	B	36.1	0.88	D	23.3	0.71	C	38.1	0.89	D	26.4	0.75	C
SB TH	16.3	0.57	B	19.0	0.63	B	22.4	0.74	C	27.2	0.75	C	22.4	0.74	C	27.0	0.75	C
SB RT	9.5	0.00	A	12.7	0.05	B	10.1	0.01	B	15.3	0.07	B	10.1	0.01	B	15.3	0.07	B
Overall	23.0	-	C	22.2	-	C	30.1	-	C	29.1	-	C	30.6	-	C	29.9	-	C
3. Kuikahi Dr & Kehalani Village Center Drwy & Project Access I																		
NB LT/TH	-	-	-	-	-	-	-	-	-	-	-	-	165.0	0.71	F	270.3	0.73	F
NB RT	-	-	-	-	-	-	-	-	-	-	-	-	15.8	0.09	C	12.8	0.03	B
EB LT	8.8	0.07	A	9.2	0.11	A	9.2	0.09	A	10.4	0.18	B	9.3	0.09	A	10.4	0.18	B
WB LT	-	-	-	-	-	-	-	-	-	-	-	-	9.6	0.01	A	9.0	0.04	A
SB LT	46.3	0.27	E	33.9	0.23	D	56.1	0.32	F	91.7	0.57	F	-	-	-	-	-	-
SB LT/TH	-	-	-	-	-	-	-	-	-	-	-	-	122.9	0.59	F	274.9	1.07	F*
SB RT	13.0	0.18	B	14.4	0.27	B	14.6	0.23	B	22.3	0.50	C	14.7	0.24	B	22.5	0.50	C
Overall	2.3	-	-	3.0	-	-	2.5	-	-	5.8	-	-	7.7	-	-	14.1	-	-
4: Waiale Rd & Kuikahi Dr/Maui Lani Pkwy																		
NB LT	24.5	0.37	C	23.3	0.20	C	30.8	0.42	C	31.9	0.42	C	33.9	0.48	C	34.4	0.51	C
NB TH/RT	33.6	0.72	C	27.7	0.52	C	47.6	0.82	D	45.9	0.79	D	54.2	0.85	D	46.8	0.77	D
EB LT	22.7	0.81	C	16.6	0.61	B	36.6	0.91	D	35.4	0.83	D	44.9	0.94	D	41.9	0.87	D
EB TH/RT	18.2	0.49	B	17.4	0.42	B	26.9	0.65	C	29.8	0.59	C	27.9	0.64	C	31.3	0.59	C
WB LT	24.6	0.10	C	18.0	0.16	B	31.8	0.19	C	25.4	0.37	C	34.0	0.20	C	26.7	0.39	C
WB TH	32.4	0.71	C	26.1	0.75	C	48.3	0.80	D	45.2	0.85	D	54.4	0.83	D	49.6	0.87	D
WB RT	26.4	0.12	C	19.4	0.02	B	34.3	0.09	C	28.7	0.13	C	36.9	0.09	D	30.3	0.13	C
SB LT	25.5	0.67	C	20.1	0.62	C	39.3	0.81	D	35.2	0.83	D	49.8	0.87	D	36.4	0.83	D
SB TH/RT	29.4	0.67	C	27.4	0.79	C	33.1	0.62	C	37.9	0.82	D	35.8	0.63	D	44.5	0.88	D
Overall	25.9	-	C	22.4	-	C	37.0	-	D	37.2	-	D	42.5	-	D	40.7	-	D
5: Kamehameha Ave & Maui Lani Pkwy																		
NB LT	24.5	0.55	C	15.9	0.20	C	-	-	-	-	-	-	-	-	-	-	-	-
NB TH/RT	53.9	0.90	F	18.2	0.38	F	-	-	-	-	-	-	-	-	-	-	-	-
NB LT/TH/RT	-	-	-	-	-	-	54.3	0.97	F	21.4	0.63	F	57.7	0.98	F	21.7	0.64	F
EB LT/TH/RT	82.3	1.03	F*	109.2	1.11	F*	26.1	0.79	D	54.0	0.99	F	27.3	0.80	D	55.9	1.00	F*
WB LT/TH/RT	57.4	0.93	F	76.9	1.05	F*	31.0	0.78	D	44.8	0.92	E	32.1	0.79	D	44.8	0.92	E
SB LT	23.0	0.52	C	19.1	0.44	C	-	-	-	-	-	-	-	-	-	-	-	-
SB TH/RT	88.0	1.06	F*	51.9	0.93	F	-	-	-	-	-	-	-	-	-	-	-	-
SB LT/TH/RT	-	-	-	-	-	-	77.4	1.06	F*	59.3	1.01	F*	79.6	1.07	F*	59.3	1.01	F*
Overall	62.1	-	-	67.7	-	-	50.6	-	-	48.8	-	-	52.6	-	-	49.5	-	-
6: Waiale Rd & Waiinu Rd																		
WB LT	485.7	1.86	F*	378.8	1.65	F*	952.7	2.88	F*	978.9	2.95	F*	1020.3	3.02	F*	1218.0	3.47	F*
WB RT	17.7	0.15	C	12.5	0.09	B	19.4	0.16	C	14.3	0.11	B	20.0	0.17	C	14.6	0.12	B
SB LT	12.1	0.08	B	9.3	0.08	A	12.9	0.10	B	10.1	0.10	B	13.2	0.10	B	10.2	0.10	B
Overall	49.0	-	-	50.3	-	-	100.8	-	-	131.2	-	-	106.0	-	-	166.7	-	-
7: Honoapiilani Hwy & W Waiko Rd/E Waiko Rd																		
NB LT	10.1	0.01	B	10.4	0.01	B	11.8	0.02	B	14.8	0.02	B	11.9	0.02	B	13.6	0.02	B
NB TH/RT	19.6	0.71	B	20.0	0.79	B	27.5	0.86	C	37.6	0.92	D	28.2	0.87	C	34.0	0.91	C
EB LT/TH	28.6	0.12	C	26.9	0.07	C	28.3	0.14	C	35.8	0.09	D	28.3	0.14	C	36.4	0.09	D
EB RT	0.0	0.00	A	26.7	0.03	C	0.0	0.00	A	35.4	0.03	D	27.4	0.00	C	35.8	0.00	D
WB LT/TH/RT	29.4	0.24	C	29.1	0.36	C	30.1	0.37	C	57.3	0.83	E	31.4	0.40	C	53.6	0.80	D
SB LT	11.0	0.32	B	12.0	0.15	B	16.6	0.54	B	27.8	0.55	C	16.9	0.55	B	25.5	0.51	C
SB TH	12.2	0.60	B	12.9	0.66	B	15.9	0.73	B	17.8	0.71	B	16.2	0.74	B	16.3	0.70	B
SB RT	6.2	0.01	A	6.7	0.03	A	6.5	0.01	A	8.8	0.03	A	6.5	0.01	A	7.9	0.02	A
Overall	16.5	-	B	17.4	-	B	21.8	-	C	32.2	-	C	22.3	-	C	29.3	-	C
8: E Waiko Rd & Waiale Rd																		
EB LT	7.6	0.04	A	7.8	0.05	A	7.8	0.06	A	8.9	0.08	A	7.8	0.06	A	9.0	0.09	A
SB LT/RT	14.2	0.40	B	12.1	0.25	B	27.4	0.72	D	38.4	0.74	E	30.2	0.76	D	46.5	0.80	E
Overall	6.6	-	-	4.7	-	-	12.1	-	-	9.7	-	-	13.7	-	-	11.6	-	-

* Denotes overcapacity condition, v/c ≥ 1.

Table 5.3: Existing, Base Year 2020 and Year 2020 with Project Level of Service Summary Cont'd

Intersection	Existing Conditions						Base Year 2020						Future Year 2020					
	AM			PM			AM			PM			AM			PM		
	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
9: Waiale Rd & Ohana Hana Lp																		
NB LT	7.7	0.01	A	7.6	0.01	A	8.0	0.01	A	7.8	0.02	A	8.0	0.01	A	7.8	0.02	A
EB LT	10.9	0.03	B	11.0	0.03	B	12.5	0.04	B	14.3	0.04	B	12.5	0.04	B	14.3	0.04	B
EB RT	9.6	0.03	A	9.1	0.01	A	10.3	0.04	B	9.7	0.01	A	10.3	0.04	B	9.7	0.01	A
Overall	1.3	-	-	1.0	-	-	1.1	-	-	0.7	-	-	1.1	-	-	0.7	-	-
10: Waiale Rd & Nokekula Lp																		
NB LT	7.7	0.00	A	7.6	0.02	A	7.9	0.00	A	7.9	0.02	A	8.0	0.01	A	7.9	0.02	A
EB LT/RT	10.4	0.07	B	10.0	0.03	B	11.7	0.08	B	11.7	0.05	B	12.0	0.09	B	11.9	0.05	B
Overall	1.3	-	-	1.1	-	-	1.1	-	-	0.8	-	-	1.0	-	-	0.7	-	-
11: Waiale Rd & Haawi St																		
NB LT	7.6	0.01	A	7.7	0.03	A	7.9	0.01	A	8.0	0.04	A	7.9	0.01	A	8.0	0.04	A
EB LT/RT	11.0	0.22	B	11.0	0.14	B	12.8	0.27	B	15.0	0.21	C	13.2	0.28	B	14.3	0.20	B
Overall	3.8	-	-	2.9	-	-	3.4	-	-	2.3	-	-	3.4	-	-	2.1	-	-
12: Waiale Rd & Kokololio St																		
NB LT	7.6	0.00	A	7.9	0.01	A	7.9	0.00	A	8.1	0.01	A	7.9	0.00	A	8.2	0.01	A
EB LT	12.2	0.18	B	12.2	0.11	B	14.6	0.22	B	16.6	0.17	C	15.1	0.23	C	17.3	0.18	C
EB RT	9.2	0.03	A	9.6	0.01	A	9.9	0.04	A	10.3	0.02	B	10.1	0.04	B	10.3	0.02	B
Overall	2.9	-	-	1.8	-	-	2.7	-	-	1.5	-	-	2.6	-	-	1.5	-	-
13: Waiale Rd & Project Access II																		
NB LT	-	-	-	-	-	-	-	-	-	-	-	-	7.9	0.00	A	8.3	0.03	A
EB LT/RT	-	-	-	-	-	-	-	-	-	-	-	-	13.2	0.12	B	14.8	0.08	B
Overall	-	-	-	-	-	-	-	-	-	-	-	-	1.1	-	-	0.8	-	-

* Denotes overcapacity condition, v/c ≥ 1.

6. CONCLUSIONS

The Project proposes to develop approximately 14.4-acres of land to provide 324 multi-family dwelling units. Vehicular traffic to the Project will be provided by new Project access along Kuikahi Drive across from the Kehalani Village Center driveway, and a secondary vehicle access driveway along Waiale Road. The Project is anticipated to be completed by the Year 2020.

6.1 Existing Conditions

Generally, all movements at each study intersection operate at LOS D or better during the AM and PM peak hours of traffic with a few exceptions.

The eastbound left-turn movement at the Honoapiilani Highway/Kehalani Parkway intersection operates at LOS F and overcapacity conditions during the AM peak hour likely due to heavy concentrated traffic as a result of the Puu Kukui Elementary School start time. The movement experiences queues that often extend beyond the existing left-turn storage lane and a portion of vehicles require two cycle lengths to clear the intersection. However, the queuing conditions were only observed to last about 30 minutes during the AM, generally between 7:15-7:45 AM.

The southbound left-turn movement at the Kuikahi Drive/Kehalani Village Center Access operates at LOS E during the AM peak hour of traffic.

The Kamehameha Avenue/Maui Lani Parkway intersection operates with various movements at LOS F and overcapacity conditions during both AM and PM peak hours of traffic. This is primarily due to regional traffic between the Waikapu-Wailuku-Kahului regions. Queues were inconsistent and varied in length throughout the peak hours, with a short period of extensive southbound queuing during the AM peak hour and periodic eastbound queuing during the AM and PM peak hours of traffic.

The westbound approach at the Waiale Road/Waiinu Road intersection operates at LOS F and overcapacity conditions during the AM and PM peak hours of traffic due to lengthy delays. Traffic was generally observed to progress unimpeded along Waiale Road during the AM peak hour, except between 7:30-7:50 AM, where northbound traffic on Waiale Road was observed to slowly progress through the intersection in part due to northbound spillbacks from the Waiale Road/Kaohu Street 4-way stop controlled intersection and reduced northbound speeds generated by frequent northbound right-turning vehicles at the Waiale Road/Waiinu Road intersection. Some northbound vehicles along Waiale Road also stopped within the through travel lane to allow side street vehicles (ranging from 1-6 vehicles at a time) to turn onto or off of Waiale Road, which formed lengthy platoons. Congestion and queuing along Waiale Road generally dissipated around 7:50-7:55 AM.

6.2 Base Year 2020 without the Project

Traffic growth in the study area was estimated for Year 2020 by using the existing count data collected by ATA and the MRTDM, which resulted in an anticipated growth rate of approximately 1.9 percent per year. Nearby future developments that are assumed to be completed by Year 2020 include the Waikapu Light Industrial Project, Waiko Baseyard Light Industrial Development, Kehalani Village Center, Maui Lani Village Center, Central Maui Regional Sports Complex Waiale Affordable Housing and the Kehalani Mauka Residential subdivision. Other

major developments such as the Puunani Residences, Waikapu Country Town (WCT) and Waiale developments are unlikely to be built by Year 2020, and were therefore not explicitly included in this TIAR.

The Waiale Road Extension and Waiko Road Improvements are planned roadway improvements to be constructed in the future. However, since they are unlikely to be built by Year 2020 given their current status, these roadway improvements were not included in this TIAR. In addition, at the Waiale Road/Waiinu Road intersection, a traffic signal and widening improvements are listed in the Statewide Transportation Improvement Program (STIP). However, it's unknown if this development will be constructed by Year 2020 and was therefore not included in this TIAR. At the Maui Lani Parkway/Kamehameha Avenue intersection, a single-lane roundabout is planned to be constructed and was included in this TIAR.

The eastbound left-turn movement at the Honoapiilani Highway/Kehalani Parkway intersection will continue to operate at LOS F and overcapacity conditions during the AM peak hour. As noted in Section 2.3, heavy traffic during a short period of time is reflective of typical school traffic conditions, as these queuing conditions were observed to last about 30 minutes during the AM peak hour and primarily stem from traffic generated by the Puu Kukui Elementary School. There are currently no identified or planned roadway improvements likely to occur at this intersection. Signal timing may be adjusted, but northbound congestion along Honoapiilani Highway will continue to occur during the AM peak hour.

The southbound left-turn movement at the Kuikahi Drive/Kehalani Village Center Driveway will worsen to operate at LOS F during the AM and PM peak hours of traffic, however will continue to operate with relatively low volume at 30(45) vehicles in the AM(PM) peak hours of traffic.

As a roundabout, various movements at the Kamehameha Avenue/Maui Lani Parkway intersection will operate at LOS E/F during the AM and PM peak hours. However, approach delays are anticipated to improve from existing conditions.

Since no roadway improvements were assumed at the Waiale Road/Waiinu Road intersection, the westbound left-turn movement will continue operating at LOS F and overcapacity conditions during the AM and PM peak hours. Northbound through traffic on Waiale Road will continue to spill back in the AM peak hour. For future planning purposes along Waiale Road, traffic control treatment at Waiale Road/Kaohu Street intersection, intersection improvements at the Waiale Road/Waiinu Road intersection (as identified on the STIP) and median refuge lanes along Waiale Road could be considered to help mitigate Waiale Road northbound flows in the AM peak hour of traffic.

6.3 Future Year 2020 with the Project

The Project proposes to develop approximately 14.4-acres of land to provide 324 multi-family dwelling units. Vehicular traffic to the Project will be provided by two (2) new Project accesses; one along Kuikahi Drive directly across the Kehalani Village Center driveway and another along Waiale Road towards the south frontage of the Project site. The Project is anticipated to generate approximately 133 AM peak hour trips and 158 PM peak hour trips.

Upon completion of the Project, all study intersections are forecast to operate with LOS similar to Base Year 2020 conditions. The eastbound left-turn movement at the Honoapiilani Highway/Kehalani Parkway intersection is forecast to continue operating at over-capacity and

LOS F conditions in the AM peak hour, similar to Base Year 2020 conditions. The Project is only anticipated to increase traffic at the Honoapiilani Highway/Kehalani Parkway intersection by approximately 1.5%, with individual movement increases generally ranging from 1-16 vehicles. There are currently no identified or planned roadway improvements likely to occur at this intersection.

The southbound left-turn movement at the Kuikahi Drive/Kehalani Village Center Driveway intersection will continue operating at LOS F during the AM and PM peak hours of traffic. With the addition of the Project access at the intersection, the northbound left-turn movement will also operate at LOS F during the AM and PM peak hours of traffic. A signal is not anticipated to be warranted in Future Year 2020 conditions.

At the Kamehameha Avenue/Maui Lani Parkway roundabout intersection, all approaches will operate similar to Base Year 2020 conditions, with various delays operating at LOS E/F conditions during the AM and PM peak hours. The westbound left-turn movement at the Waiale Road/Waiinu Road intersection will continue operating at LOS F and overcapacity conditions during the AM and PM peak hours.

As mentioned in Section 4.4, northbound through traffic on Waiale Road will continue to spill back to the Waiale Road/Kuikahi Drive intersection in the AM peak hour. Based on the forecast trips, the Project will increase traffic at the intersection by approximately 2.8%. Although the Project could potentially increase the eastbound left-turn movement by 24 vehicles in the AM peak hour, the Project is providing a second access on Waiale Road that can help reduce impacts to the eastbound left-turn movement by shifting more exiting Project traffic onto Waiale Road so as to not significantly impact the existing queues along Kuikahi Drive. It is recommended that the signal timing plan at the Waiale Road/Kuikahi Drive intersection be optimized to accommodate the increase in turning movement traffic generated by both the Project and various nearby developments. Optimizing the signal will not mitigate the existing regional northbound queues along Waiale Road during the AM peak hour, but it can help to optimize vehicular movements during all remaining off-peak and PM peak hours of the day

7. RECOMMENDATIONS

7.1 Future Year 2020 with the Project

Waiale Road/Kuikahi Drive

- Optimize the Waiale Road/Kuikahi Drive signalized intersection signal timing.

Kuikahi Drive/Project Access

- Provide a new northbound leg with a shared left-turn/through lane and exclusive right-turn lane.
- Restripe the southbound leg to provide a shared left-turn/through lane and exclusive right-turn lane.
- Provide a new westbound left-turn lane with a minimum storage length of at least 50 feet or as long as feasibly possible, given the constraints from the existing eastbound left-turn lane at the Waiale Road/Kuikahi Drive intersection.

Waiale Road/Project Access

- Provide a new northbound left-turn lane with a minimum storage length of at least 50 feet.

8. REFERENCES

- Austin, Tsutsumi & Associates, Central Maui Regional Sports Complex TIAR, 2014.
- Austin, Tsutsumi & Associates, Waiale Affordable Housing TIAR, 2016.
- Austin, Tsutsumi & Associates, Waikapu Light Industrial Project TIAR, 2013.
- Federal Highway Administration, Manual on Uniform Traffic Control Devices, 2009.
- Institute of Transportation Engineers, Trip Generation, 9th Edition, 2012.
- Phillip Rowell & Associates, Waiko Road Light Industrial Park TIAR, 2011.
- Transportation Research Board, Highway Capacity Manual, 2010.

A P P E N D I C E S

APPENDIX A

TRAFFIC COUNT DATA

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File Name : AM_Honoapiilani Hwy - Kehalani Pkwy
Site Code : 00000000
Start Date : 3/15/2017
Page No : 1

Groups Printed- Unshifted - Bank 1

	HONOAPIILANI HWY Southbound				KEHALANI PKWY Westbound				HONOAPIILANI HWY Northbound				KEHALANI PKWY Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:30 AM	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
06:45 AM	3	75	27	0	5	18	18	0	42	81	1	0	43	14	45	0	372
Total	4	75	27	0	5	18	18	0	42	81	1	0	43	14	45	0	373
07:00 AM	6	95	30	0	5	35	21	0	41	106	0	0	77	20	67	0	503
07:15 AM	11	71	33	2	8	51	38	0	73	116	2	0	92	49	90	1	637
07:30 AM	12	79	21	1	6	63	38	1	75	121	7	0	59	78	112	0	673
07:45 AM	11	89	15	0	9	23	13	0	26	117	1	0	55	49	64	0	472
Total	40	334	99	3	28	172	110	1	215	460	10	0	283	196	333	1	2285
08:00 AM	8	74	15	2	5	10	12	0	14	85	0	0	30	15	22	0	292
08:15 AM	1	75	13	0	3	14	15	0	16	105	4	0	27	13	18	0	304
Grand Total	53	558	154	5	41	214	155	1	287	731	15	0	383	238	418	1	3254
Apprch %	6.9	72.5	20	0.6	10	52.1	37.7	0.2	27.8	70.8	1.5	0	36.8	22.9	40.2	0.1	
Total %	1.6	17.1	4.7	0.2	1.3	6.6	4.8	0	8.8	22.5	0.5	0	11.8	7.3	12.8	0	
Unshifted	53	558	154	5	41	214	155	1	287	731	15	0	383	238	418	1	3254
% Unshifted	100	100	100	100	100	100	100	100	100	100	100	0	100	100	100	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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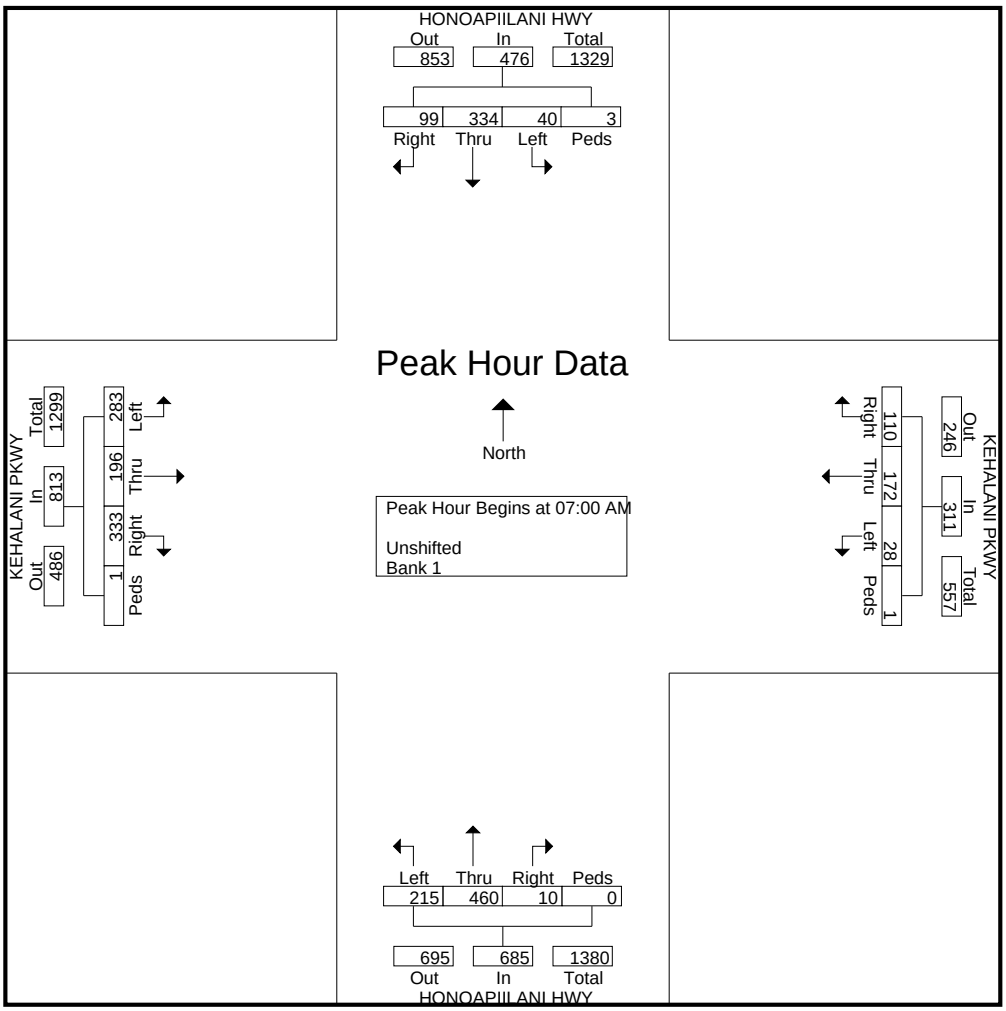
File Name : AM_Honoapiilani Hwy - Kehalani Pkwy
Site Code : 00000000
Start Date : 3/15/2017
Page No : 2

	HONOAPIILANI HWY Southbound					KEHALANI PKWY Westbound					HONOAPIILANI HWY Northbound					KEHALANI PKWY 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 08:15 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	6	**95**	30	0	**131**	5	35	21	0	61	41	106	0	0	147	77	20	67	0	164	503
07:15 AM	11	71	**33**	**2**	117	8	51	**38**	0	97	73	116	2	0	191	**92**	49	90	**1**	232	637
07:30 AM	**12**	79	21	1	113	6	**63**	38	**1**	**108**	**75**	**121**	**7**	0	**203**	59	**78**	**112**	0	**249**	**673**
07:45 AM	11	89	15	0	115	**9**	23	13	0	45	26	117	1	0	144	55	49	64	0	168	472
Total Volume	40	334	99	3	476	28	172	110	1	311	215	460	10	0	685	283	196	333	1	813	2285
% App. Total	8.4	70.2	20.8	0.6		9	55.3	35.4	0.3		31.4	67.2	1.5	0		34.8	24.1	41	0.1		
PHF	.833	.879	.750	.375	.908	.778	.683	.724	.250	.720	.717	.950	.357	.000	.844	.769	.628	.743	.250	.816	.849



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File Name : PM_Honoapiilani Hwy - Kehalani Pkwy
Site Code : 00000000
Start Date : 3/15/2017
Page No : 1

Groups Printed- Unshifted - Bank 1

	HONOAPIILANI HWY Southbound				KEHALANI PKWY Westbound				HONOAPIILANI HWY Northbound				KEHALANI PKWY 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	112	33	0	2	26	15	0	26	108	2	0	36	27	50	0	445
03:45 PM	13	99	29	0	3	12	16	0	23	128	2	0	32	13	28	0	398
Total	21	211	62	0	5	38	31	0	49	236	4	0	68	40	78	0	843
04:00 PM	12	97	25	1	0	14	25	0	31	127	3	0	28	18	18	1	400
04:15 PM	17	130	48	0	2	20	16	0	30	95	8	0	28	11	33	0	438
04:30 PM	30	133	47	0	5	23	21	0	36	103	6	0	30	15	31	0	480
04:45 PM	28	126	50	1	1	19	14	1	28	87	5	0	28	15	31	1	435
Total	87	486	170	2	8	76	76	1	125	412	22	0	114	59	113	2	1753
05:00 PM	21	115	49	1	5	26	20	1	39	93	6	0	20	12	23	0	431
05:15 PM	18	116	36	2	3	32	17	0	36	94	5	0	37	17	23	2	438
Grand Total	147	928	317	5	21	172	144	2	249	835	37	0	239	128	237	4	3465
Apprch %	10.5	66.4	22.7	0.4	6.2	50.7	42.5	0.6	22.2	74.5	3.3	0	39.3	21.1	39	0.7	
Total %	4.2	26.8	9.1	0.1	0.6	5	4.2	0.1	7.2	24.1	1.1	0	6.9	3.7	6.8	0.1	
Unshifted	147	928	317	5	21	172	144	2	249	835	37	0	239	128	237	4	3465
% Unshifted	100	100	100	100	100	100	100	100	100	100	100	0	100	100	100	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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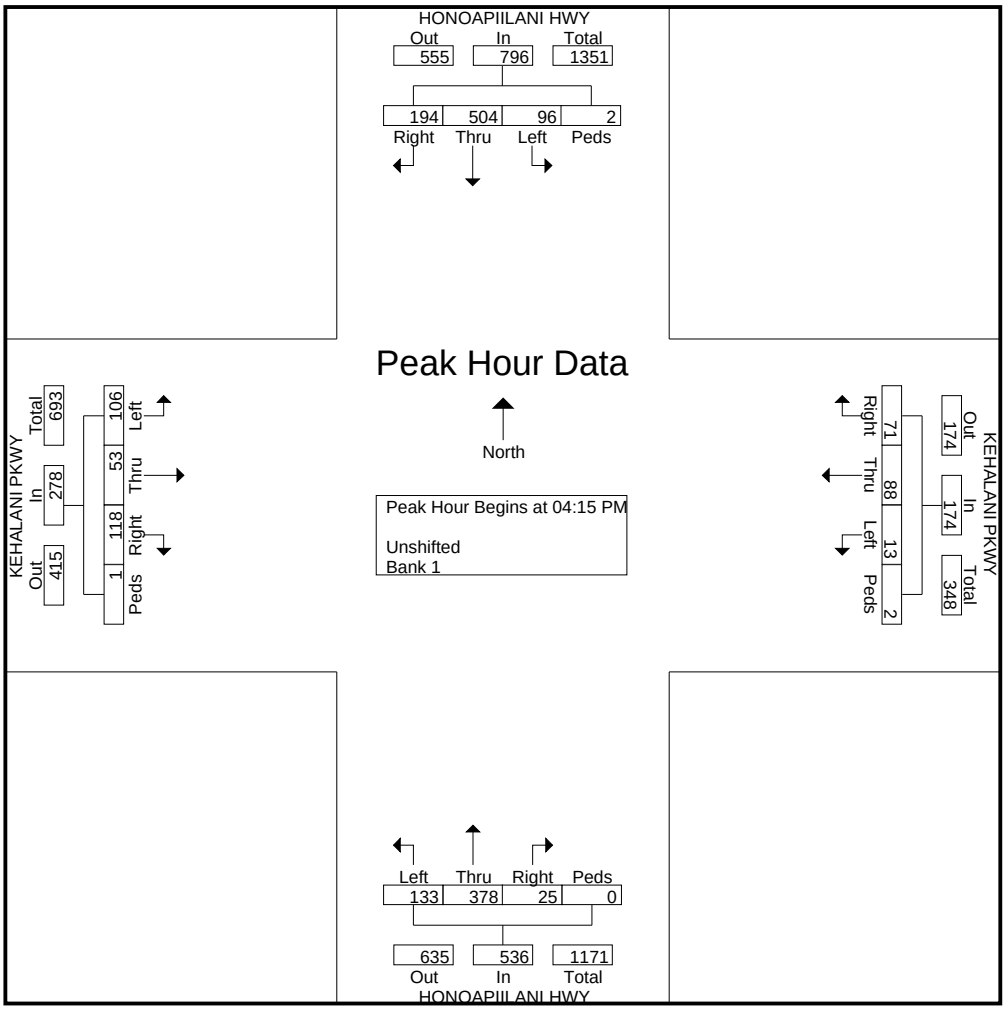
File Name : PM_Honoapiilani Hwy - Kehalani Pkwy
Site Code : 00000000
Start Date : 3/15/2017
Page No : 2

	HONOAPIILANI HWY Southbound					KEHALANI PKWY Westbound					HONOAPIILANI HWY Northbound					KEHALANI PKWY 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 05:15 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	17	130	48	0	195	2	20	16	0	38	30	95	**8**	0	133	28	11	**33**	0	72	438
04:30 PM	**30**	**133**	47	0	**210**	**5**	23	**21**	0	49	36	**103**	6	0	**145**	**30**	**15**	31	0	**76**	**480**
04:45 PM	28	126	**50**	**1**	205	1	19	14	**1**	35	28	87	5	0	120	28	15	31	**1**	75	435
05:00 PM	21	115	49	1	186	5	**26**	20	1	**52**	**39**	93	6	0	138	20	12	23	0	55	431
Total Volume	96	504	194	2	796	13	88	71	2	174	133	378	25	0	536	106	53	118	1	278	1784
% App. Total	12.1	63.3	24.4	0.3		7.5	50.6	40.8	1.1		24.8	70.5	4.7	0		38.1	19.1	42.4	0.4		
PHF	.800	.947	.970	.500	.948	.650	.846	.845	.500	.837	.853	.917	.781	.000	.924	.883	.883	.894	.250	.914	.929



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File Name : AM_Honoapiilani Hwy - Kuikahi Dr_Maui Lani Pkwy
Site Code : 00000000
Start Date : 3/15/2017
Page No : 1

Groups Printed- Unshifted - Bank 1

	HONOAPIILANI HWY Southbound				KUIKAHI DR Westbound				HONOAPIILANI HWY Northbound				KUIKAHI DR Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:45 AM	39	91	0	1	51	7	50	0	1	78	72	0	3	39	6	0	438
Total	39	91	0	1	51	7	50	0	1	78	72	0	3	39	6	0	438
07:00 AM	57	126	1	0	63	13	60	0	0	95	79	0	8	29	15	0	546
07:15 AM	61	96	1	0	55	14	70	0	3	112	86	0	20	48	9	0	575
07:30 AM	79	132	2	0	71	8	57	0	8	139	88	0	18	25	29	0	656
07:45 AM	73	103	3	0	74	22	34	0	3	89	78	0	5	25	10	0	519
Total	270	457	7	0	263	57	221	0	14	435	331	0	51	127	63	0	2296
08:00 AM	23	80	2	4	72	13	30	1	5	75	59	0	3	26	11	0	404
08:15 AM	20	79	1	0	59	17	30	0	1	91	67	0	2	25	14	0	406
Grand Total	352	707	10	5	445	94	331	1	21	679	529	0	59	217	94	0	3544
Apprch %	32.8	65.8	0.9	0.5	51.1	10.8	38	0.1	1.7	55.2	43	0	15.9	58.6	25.4	0	
Total %	9.9	19.9	0.3	0.1	12.6	2.7	9.3	0	0.6	19.2	14.9	0	1.7	6.1	2.7	0	
Unshifted	352	707	10	5	445	94	331	1	21	679	529	0	59	217	94	0	3544
% Unshifted	100	100	100	100	100	100	100	100	100	100	100	0	100	100	100	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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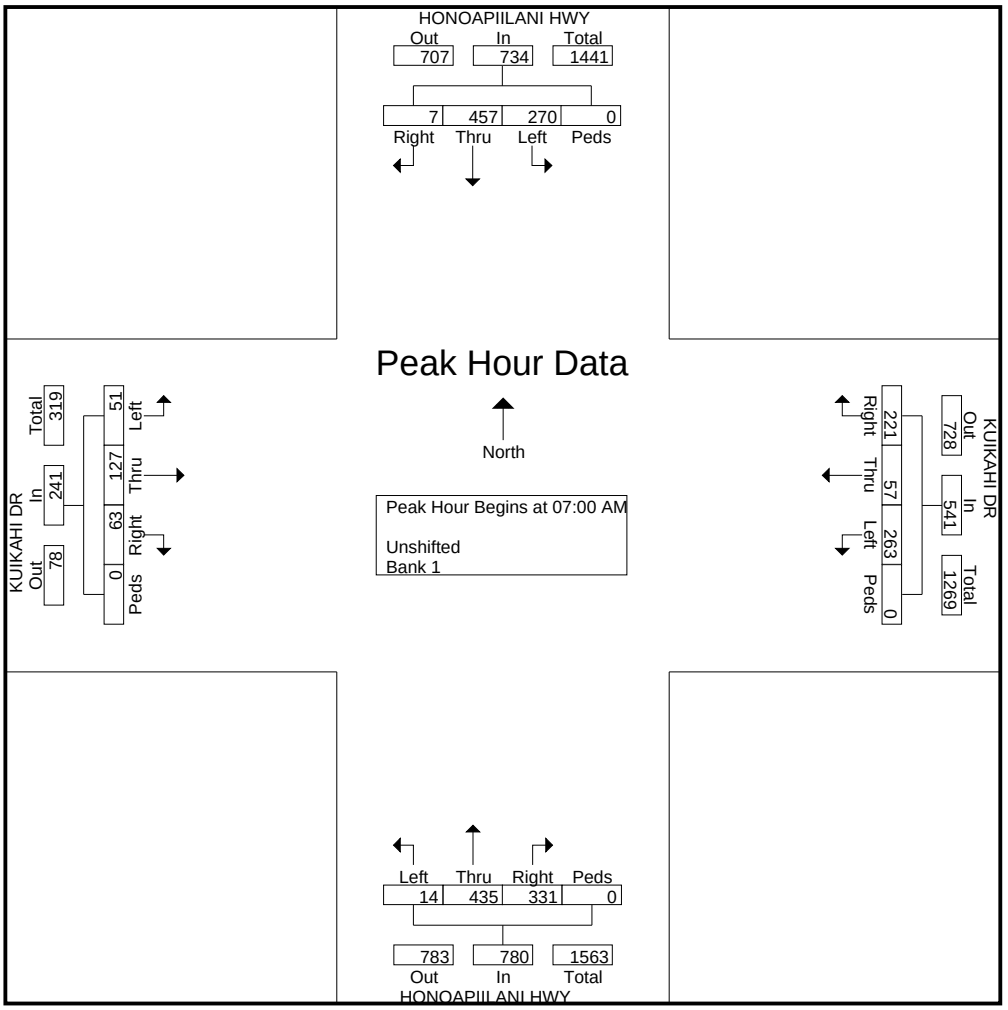
File Name : AM_Honoapiilani Hwy - Kuikahi Dr_Maui Lani Pkwy
Site Code : 00000000
Start Date : 3/15/2017
Page No : 2

	HONOAPIILANI HWY Southbound					KUIKAHI DR Westbound					HONOAPIILANI HWY Northbound					KUIKAHI DR 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 06:45 AM to 08:15 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	57	126	1	0	184	63	13	60	0	136	0	95	79	0	174	8	29	15	0	52	546
07:15 AM	61	96	1	0	158	55	14	**70**	0	**139**	3	112	86	0	201	**20**	**48**	9	0	**77**	575
07:30 AM	**79**	**132**	2	0	**213**	71	8	57	0	136	**8**	**139**	**88**	0	**235**	18	25	**29**	0	72	**656**
07:45 AM	73	103	**3**	0	179	**74**	**22**	34	0	130	3	89	78	0	170	5	25	10	0	40	519
Total Volume	270	457	7	0	734	263	57	221	0	541	14	435	331	0	780	51	127	63	0	241	2296
% App. Total	36.8	62.3	1	0		48.6	10.5	40.9	0		1.8	55.8	42.4	0		21.2	52.7	26.1	0		
PHF	.854	.866	.583	.000	.862	.889	.648	.789	.000	.973	.438	.782	.940	.000	.830	.638	.661	.543	.000	.782	.875



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File Name : PM_Honoapiilani Hwy - Kuikahi Dr_Maui Lani Pkwy
Site Code : 00000000
Start Date : 3/15/2017
Page No : 1

Groups Printed- Unshifted - Bank 1

	HONOAPIILANI HWY Southbound				KUIKAHI DR Westbound				HONOAPIILANI HWY Northbound				KUIKAHI DR Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
03:30 PM	63	94	3	0	79	23	48	0	8	86	77	0	1	19	3	0	504
03:45 PM	38	93	4	0	79	32	52	1	7	106	81	0	2	14	2	1	512
Total	101	187	7	0	158	55	100	1	15	192	158	0	3	33	5	1	1016
04:00 PM	31	88	1	2	84	26	55	0	4	102	76	0	4	14	3	1	491
04:15 PM	60	100	8	0	92	29	42	0	6	107	98	0	1	15	7	0	565
04:30 PM	47	134	8	0	97	29	41	0	7	100	88	0	2	17	8	1	579
04:45 PM	48	105	11	0	103	17	41	1	14	79	73	0	2	15	2	0	511
Total	186	427	28	2	376	101	179	1	31	388	335	0	9	61	20	2	2146
05:00 PM	35	103	4	0	99	22	45	0	10	85	80	0	3	19	7	0	512
05:15 PM	44	101	3	0	55	32	44	0	15	92	76	0	1	16	1	0	480
Grand Total	366	818	42	2	688	210	368	2	71	757	649	0	16	129	33	3	4154
Apprch %	29.8	66.6	3.4	0.2	54.3	16.6	29	0.2	4.8	51.3	43.9	0	8.8	71.3	18.2	1.7	
Total %	8.8	19.7	1	0	16.6	5.1	8.9	0	1.7	18.2	15.6	0	0.4	3.1	0.8	0.1	
Unshifted	366	818	42	2	688	210	368	2	71	757	649	0	16	129	33	3	4154
% Unshifted	100	100	100	100	100	100	100	100	100	100	100	0	100	100	100	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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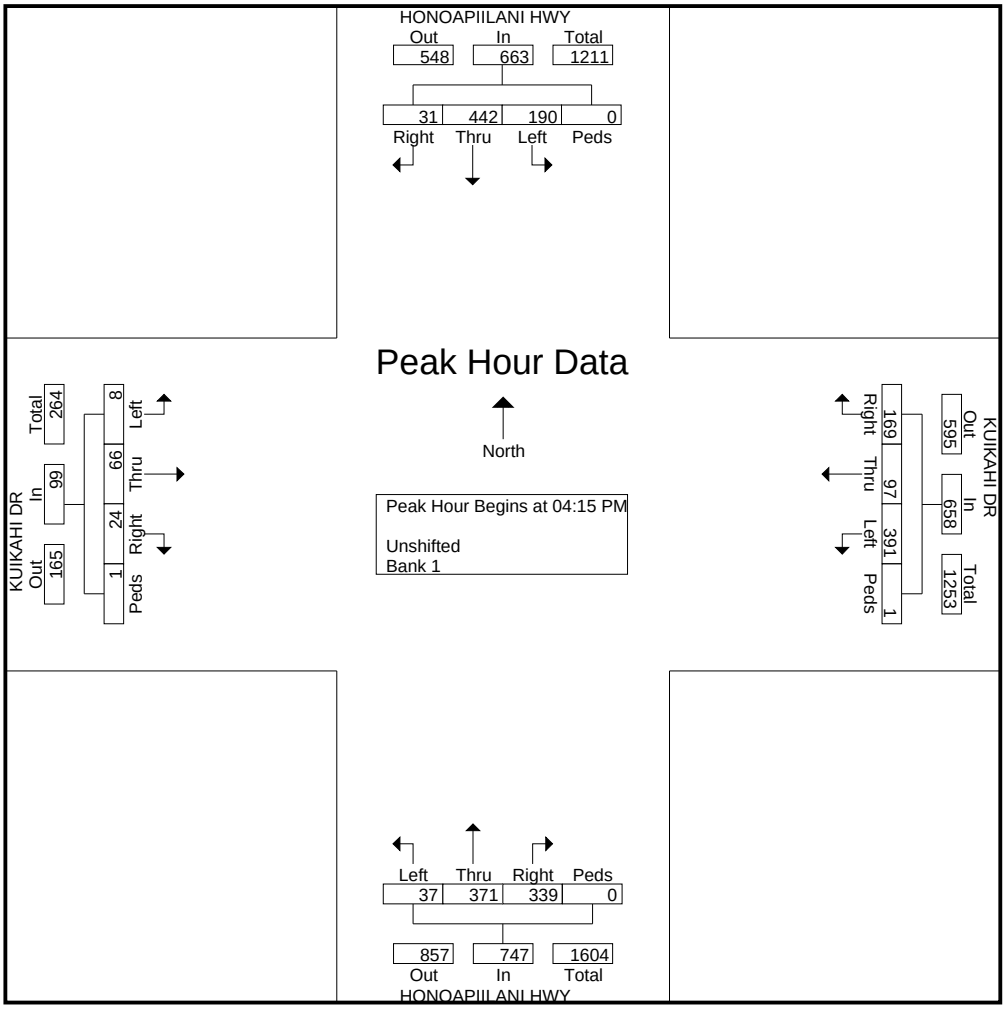
File Name : PM_Honoapiilani Hwy - Kuikahi Dr_Maui Lani Pkwy
Site Code : 00000000
Start Date : 3/15/2017
Page No : 2

	HONOAPIILANI HWY Southbound					KUIKAHI DR Westbound					HONOAPIILANI HWY Northbound					KUIKAHI DR 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 05:15 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	60	100	8	0	168	92	29	42	0	163	6	107	98	0	211	1	15	7	0	23	565
04:30 PM	47	134	8	0	189	97	29	41	0	167	7	100	88	0	195	2	17	8	1	28	579
04:45 PM	48	105	11	0	164	103	17	41	1	162	14	79	73	0	166	2	15	2	0	19	511
05:00 PM	35	103	4	0	142	99	22	45	0	166	10	85	80	0	175	3	19	7	0	29	512
Total Volume	190	442	31	0	663	391	97	169	1	658	37	371	339	0	747	8	66	24	1	99	2167
% App. Total	28.7	66.7	4.7	0		59.4	14.7	25.7	0.2		5	49.7	45.4	0		8.1	66.7	24.2	1		
PHF	.792	.825	.705	.000	.877	.949	.836	.939	.250	.985	.661	.867	.865	.000	.885	.667	.868	.750	.250	.853	.936



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File Name : AM_Kehalani Village Ctr Dwy - Kuikahi Dr
Site Code : 00000000
Start Date : 3/15/2017
Page No : 1

Groups Printed- Unshifted - Bank 1

	KEHALANI VILLAGE CTR DWY Southbound				KUIKAHI DR Westbound				Northbound				KUIKAHI DR 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	0	15	0	0	71	4	0	0	0	0	0	13	100	0	0	206
06:45 AM	7	0	16	0	0	93	7	0	0	0	0	0	14	136	0	0	273
Total	10	0	31	0	0	164	11	0	0	0	0	0	27	236	0	0	479
07:00 AM	6	0	18	0	0	119	16	0	0	0	0	0	13	164	0	0	336
07:15 AM	5	0	21	0	0	127	13	0	0	0	0	0	16	168	0	0	350
07:30 AM	6	0	27	0	0	120	13	0	0	0	0	0	22	146	0	0	334
07:45 AM	12	0	23	0	0	97	16	0	0	0	0	0	13	154	0	0	315
Total	29	0	89	0	0	463	58	0	0	0	0	0	64	632	0	0	1335
08:00 AM	9	0	21	0	0	96	13	0	0	0	0	0	16	94	0	0	249
08:15 AM	3	0	17	0	0	73	10	0	0	0	0	0	18	79	0	0	200
Grand Total	51	0	158	0	0	796	92	0	0	0	0	0	125	1041	0	0	2263
Apprch %	24.4	0	75.6	0	0	89.6	10.4	0	0	0	0	0	10.7	89.3	0	0	
Total %	2.3	0	7	0	0	35.2	4.1	0	0	0	0	0	5.5	46	0	0	
Unshifted	51	0	158	0	0	796	92	0	0	0	0	0	125	1041	0	0	2263
% Unshifted	100	0	100	0	0	100	100	0	0	0	0	0	100	100	0	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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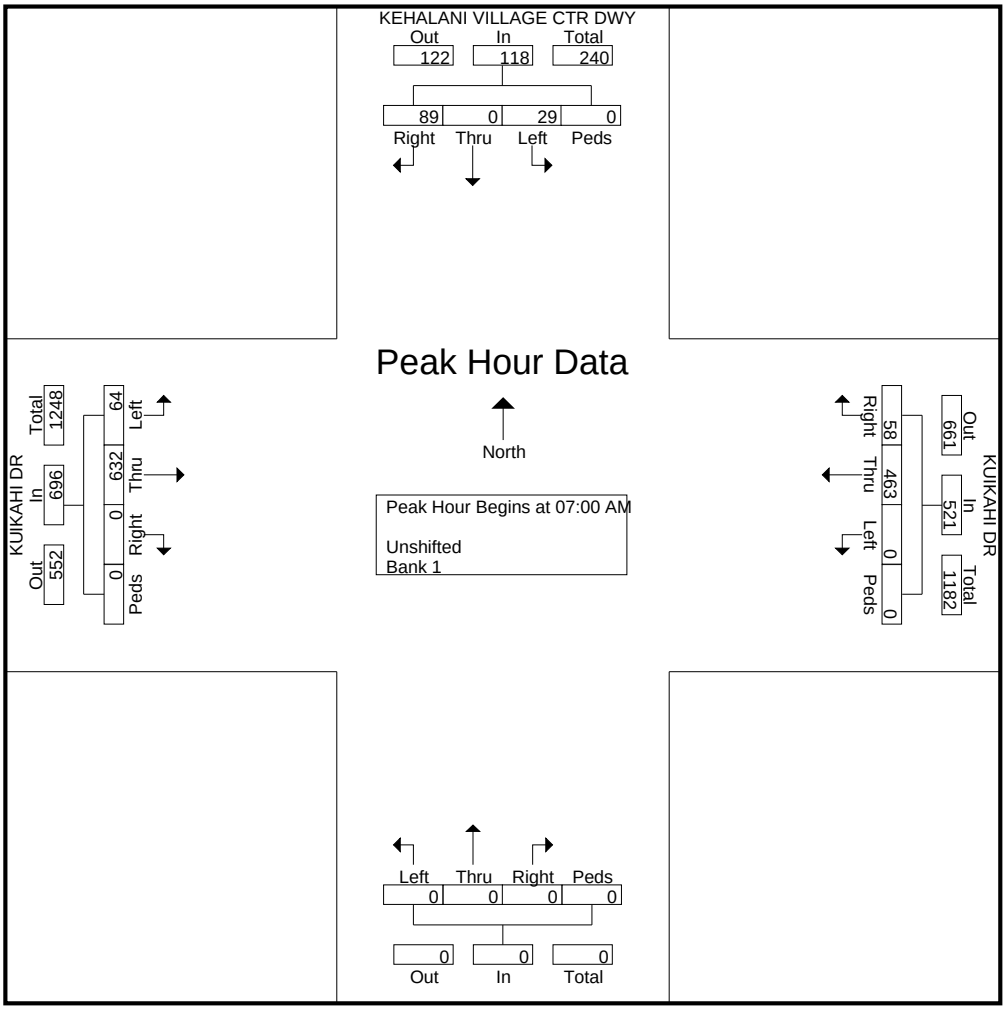
File Name : AM_Kehalani Village Ctr Dwy - Kuikahi Dr
Site Code : 00000000
Start Date : 3/15/2017
Page No : 2

	KEHALANI VILLAGE CTR DWY Southbound					KUIKAHI DR Westbound					Northbound					KUIKAHI DR 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 08:15 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	6	0	18	0	24	0	119	**16**	0	135	0	0	0	0	0	13	164	0	0	177	336
07:15 AM	5	0	21	0	26	0	**127**	13	0	**140**	0	0	0	0	0	16	**168**	0	0	**184**	**350**
07:30 AM	6	0	**27**	0	33	0	120	13	0	133	0	0	0	0	0	**22**	146	0	0	168	334
07:45 AM	**12**	0	23	0	**35**	0	97	16	0	113	0	0	0	0	0	13	154	0	0	167	315
Total Volume	29	0	89	0	118	0	463	58	0	521	0	0	0	0	0	64	632	0	0	696	1335
% App. Total	24.6	0	75.4	0		0	88.9	11.1	0		0	0	0	0		9.2	90.8	0	0		
PHF	.604	.000	.824	.000	.843	.000	.911	.906	.000	.930	.000	.000	.000	.000	.000	.727	.940	.000	.000	.946	.954



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File Name : MD_Kehalani Village Ctr Dwy - Kuikahi Dr
Site Code : 00000000
Start Date : 3/16/2017
Page No : 1

Groups Printed- Unshifted - Bank 1

	KAMEHAMEHA AVE Southbound				MAUI LANI PKWY Westbound				KAMEHAMEHA AVE Northbound				MAUI LANI PKWY Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
09:00 AM	6	0	11	0	0	94	9	0	0	0	0	0	12	93	0	0	225
09:15 AM	6	0	13	0	0	71	7	0	0	0	0	0	13	84	0	0	194
09:30 AM	4	0	5	0	0	25	6	0	0	0	0	0	11	45	0	0	96
09:45 AM	6	0	14	0	0	59	5	0	0	0	0	0	10	69	0	0	163
Total	22	0	43	0	0	249	27	0	0	0	0	0	46	291	0	0	678
10:00 AM	9	0	18	0	0	93	15	0	0	0	0	0	11	133	0	0	279
10:15 AM	8	0	13	0	0	72	23	0	0	0	0	0	12	100	0	0	228
10:30 AM	14	0	17	0	0	69	16	0	0	0	0	0	16	80	0	0	212
10:45 AM	8	0	22	0	0	59	13	0	0	0	0	0	10	85	0	0	197
Total	39	0	70	0	0	293	67	0	0	0	0	0	49	398	0	0	916
11:00 AM	8	0	16	0	0	68	9	0	0	0	0	0	19	77	0	0	197
11:15 AM	10	0	18	0	0	74	7	0	0	0	0	0	25	84	0	0	218
11:30 AM	11	0	24	0	0	82	7	0	0	0	0	0	20	74	0	0	218
11:45 AM	13	0	17	0	0	94	13	0	0	0	0	0	20	97	0	0	254
Total	42	0	75	0	0	318	36	0	0	0	0	0	84	332	0	0	887
12:00 PM	13	0	21	0	0	84	16	0	0	0	0	0	16	89	0	0	239
12:15 PM	4	0	19	0	0	73	9	0	0	0	0	0	13	67	0	0	185
12:30 PM	6	0	26	0	0	76	20	0	0	0	0	0	17	78	0	0	223
12:45 PM	5	0	14	1	0	84	15	0	0	0	0	0	17	80	0	0	216
Total	28	0	80	1	0	317	60	0	0	0	0	0	63	314	0	0	863
01:00 PM	4	0	20	0	0	79	16	0	0	0	0	0	13	81	0	0	213
01:15 PM	4	0	25	0	0	81	6	0	0	0	0	0	15	110	0	0	241
01:30 PM	5	0	30	0	0	80	7	0	0	0	0	0	12	106	0	0	240
01:45 PM	6	0	13	0	0	88	15	0	0	0	0	0	24	89	0	0	235
Total	19	0	88	0	0	328	44	0	0	0	0	0	64	386	0	0	929
02:00 PM	3	0	8	0	0	50	5	0	0	0	0	0	13	55	0	0	134
02:15 PM	11	0	20	0	0	105	16	0	0	0	0	0	19	129	0	0	300
Grand Total	164	0	384	1	0	1660	255	0	0	0	0	0	338	1905	0	0	4707
Apprch %	29.9	0	69.9	0.2	0	86.7	13.3	0	0	0	0	0	15.1	84.9	0	0	
Total %	3.5	0	8.2	0	0	35.3	5.4	0	0	0	0	0	7.2	40.5	0	0	
Unshifted	164	0	384	1	0	1660	255	0	0	0	0	0	338	1905	0	0	4707
% Unshifted	100	0	100	100	0	100	100	0	0	0	0	0	100	100	0	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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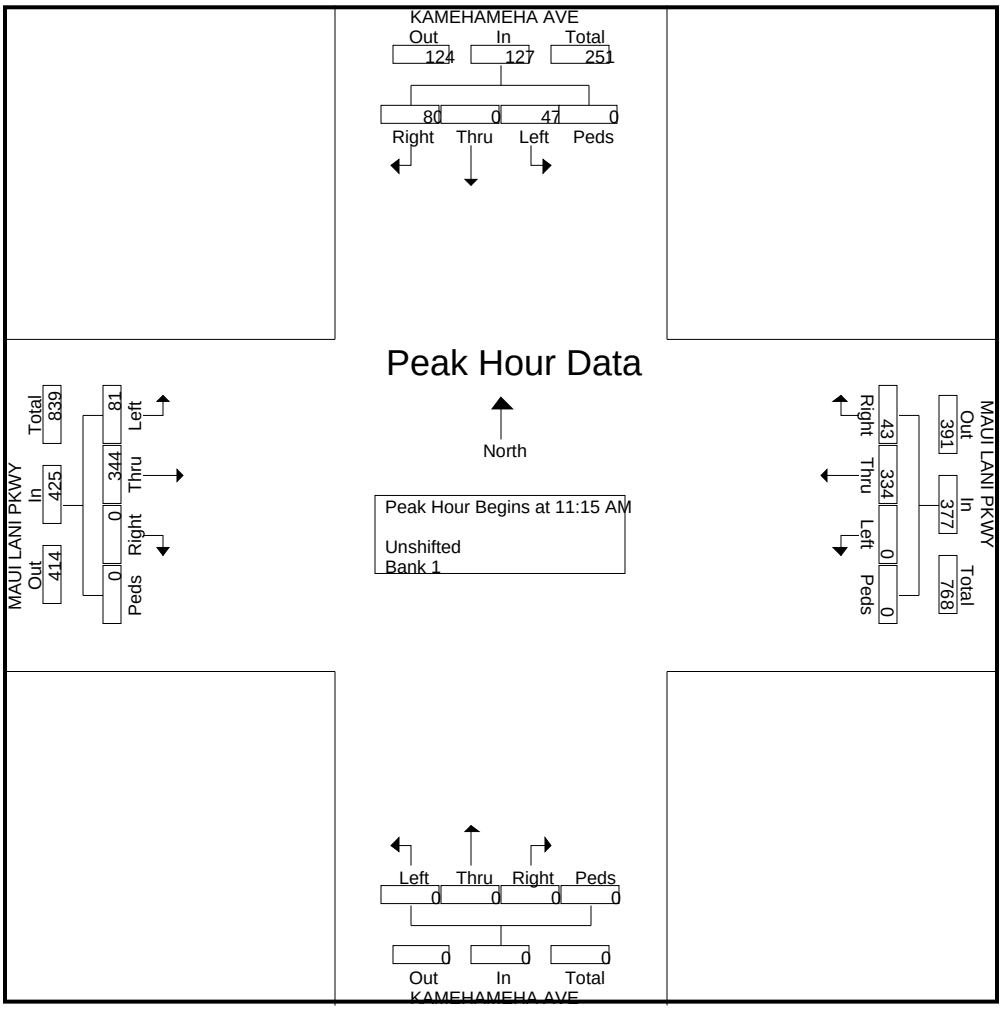
File Name : MD_Kehalani Village Ctr Dwy - Kuikahi Dr
Site Code : 00000000
Start Date : 3/16/2017
Page No : 2

	KAMEHAMEHA AVE Southbound					MAUI LANI PKWY Westbound					KAMEHAMEHA AVE Northbound					MAUI LANI PKWY 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 09:00 AM to 02:15 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 11:15 AM																					
11:15 AM	10	0	18	0	28	0	74	7	0	81	0	0	0	0	0	25	84	0	0	109	218
11:30 AM	11	0	24	0	35	0	82	7	0	89	0	0	0	0	0	20	74	0	0	94	218
11:45 AM	13	0	17	0	30	0	94	13	0	107	0	0	0	0	0	20	97	0	0	117	254
12:00 PM	13	0	21	0	34	0	84	16	0	100	0	0	0	0	0	16	89	0	0	105	239
Total Volume	47	0	80	0	127	0	334	43	0	377	0	0	0	0	0	81	344	0	0	425	929
% App. Total	37	0	63	0		0	88.6	11.4	0		0	0	0	0		19.1	80.9	0	0		
PHF	.904	.000	.833	.000	.907	.000	.888	.672	.000	.881	.000	.000	.000	.000	.000	.810	.887	.000	.000	.908	.914



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File Name : PM_Kehalani Village Ctr Dwy - Kuikahi Dr
Site Code : 00000000
Start Date : 3/15/2017
Page No : 1

Groups Printed- Unshifted - Bank 1

	KEHALANI VILLAGE CTR DWY Southbound				KUIKAHI DR Westbound				Northbound				KUIKAHI DR Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
03:30 PM	14	0	18	0	0	120	20	0	0	0	0	0	28	120	0	0	320
03:45 PM	13	0	37	0	0	110	22	0	0	0	0	0	16	111	0	0	309
Total	27	0	55	0	0	230	42	0	0	0	0	0	44	231	0	0	629
04:00 PM	6	0	24	0	0	130	15	0	0	0	0	0	20	98	0	0	293
04:15 PM	4	0	30	0	0	122	20	0	0	0	0	0	21	146	0	0	343
04:30 PM	7	0	33	0	0	115	22	0	0	0	0	0	30	113	0	0	320
04:45 PM	12	0	28	0	0	125	22	0	0	0	0	0	21	109	0	0	317
Total	29	0	115	0	0	492	79	0	0	0	0	0	92	466	0	0	1273
05:00 PM	11	0	39	0	0	120	18	0	0	0	0	0	25	101	0	0	314
05:15 PM	11	0	30	0	0	87	21	0	0	0	0	0	24	102	0	0	275
Grand Total	78	0	239	0	0	929	160	0	0	0	0	0	185	900	0	0	2491
Apprch %	24.6	0	75.4	0	0	85.3	14.7	0	0	0	0	0	17.1	82.9	0	0	
Total %	3.1	0	9.6	0	0	37.3	6.4	0	0	0	0	0	7.4	36.1	0	0	
Unshifted	78	0	239	0	0	929	160	0	0	0	0	0	185	900	0	0	2491
% Unshifted	100	0	100	0	0	100	100	0	0	0	0	0	100	100	0	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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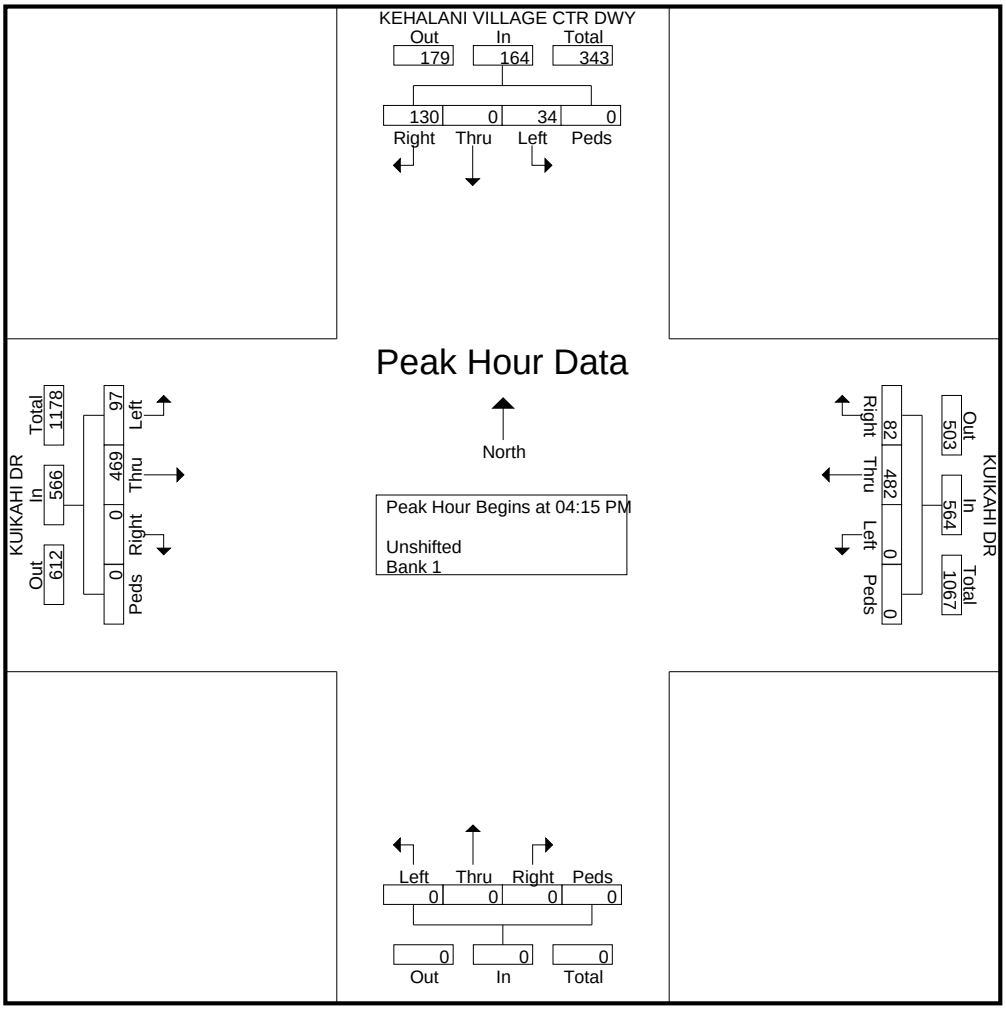
File Name : PM_Kehalani Village Ctr Dwy - Kuikahi Dr
Site Code : 00000000
Start Date : 3/15/2017
Page No : 2

	KEHALANI VILLAGE CTR DWY Southbound					KUIKAHI DR Westbound					Northbound					KUIKAHI DR 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 05:15 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	4	0	30	0	34	0	122	20	0	142	0	0	0	0	0	21	**146**	0	0	**167**	**343**
04:30 PM	7	0	33	0	40	0	115	**22**	0	137	0	0	0	0	0	**30**	113	0	0	143	320
04:45 PM	**12**	0	28	0	40	0	**125**	22	0	**147**	0	0	0	0	0	21	109	0	0	130	317
05:00 PM	11	0	**39**	0	**50**	0	120	18	0	138	0	0	0	0	0	25	101	0	0	126	314
Total Volume	34	0	130	0	164	0	482	82	0	564	0	0	0	0	0	97	469	0	0	566	1294
% App. Total	20.7	0	79.3	0		0	85.5	14.5	0		0	0	0	0		17.1	82.9	0	0		
PHF	.708	.000	.833	.000	.820	.000	.964	.932	.000	.959	.000	.000	.000	.000	.000	.808	.803	.000	.000	.847	.943



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File Name : AM_Waiale Rd - Kuikahi Dr_Maui Lani Pkwy
Site Code : 00000000
Start Date : 3/15/2017
Page No : 1

Groups Printed- Unshifted - Bank 1

	WAIALE RD Southbound				MAUI LANI PKWY Westbound				WAIALE RD Northbound				KUIKAHI DR Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:30 AM	46	24	28	0	4	37	33	0	8	28	11	0	44	42	4	0	309
06:45 AM	47	28	37	1	7	47	57	8	9	39	9	0	77	60	10	1	437
Total	93	52	65	1	11	84	90	8	17	67	20	0	121	102	14	1	746
07:00 AM	52	27	51	0	6	68	50	0	24	31	13	1	89	57	8	1	478
07:15 AM	65	35	36	0	7	55	54	0	40	61	20	0	93	63	11	0	540
07:30 AM	60	33	42	0	7	60	56	0	37	44	16	2	88	86	15	0	546
07:45 AM	72	30	50	0	9	58	59	1	11	31	12	0	90	83	13	0	519
Total	249	125	179	0	29	241	219	1	112	167	61	3	360	289	47	1	2083
08:00 AM	79	25	43	1	11	54	61	0	7	32	3	1	55	49	6	0	427
08:15 AM	35	15	28	0	1	40	41	1	10	16	9	0	46	25	2	0	269
Grand Total	456	217	315	2	52	419	411	10	146	282	93	4	582	465	69	2	3525
Apprch %	46.1	21.9	31.8	0.2	5.8	47	46.1	1.1	27.8	53.7	17.7	0.8	52.1	41.6	6.2	0.2	
Total %	12.9	6.2	8.9	0.1	1.5	11.9	11.7	0.3	4.1	8	2.6	0.1	16.5	13.2	2	0.1	
Unshifted	456	217	315	2	52	419	411	10	146	282	93	4	582	465	69	2	3525
% Unshifted	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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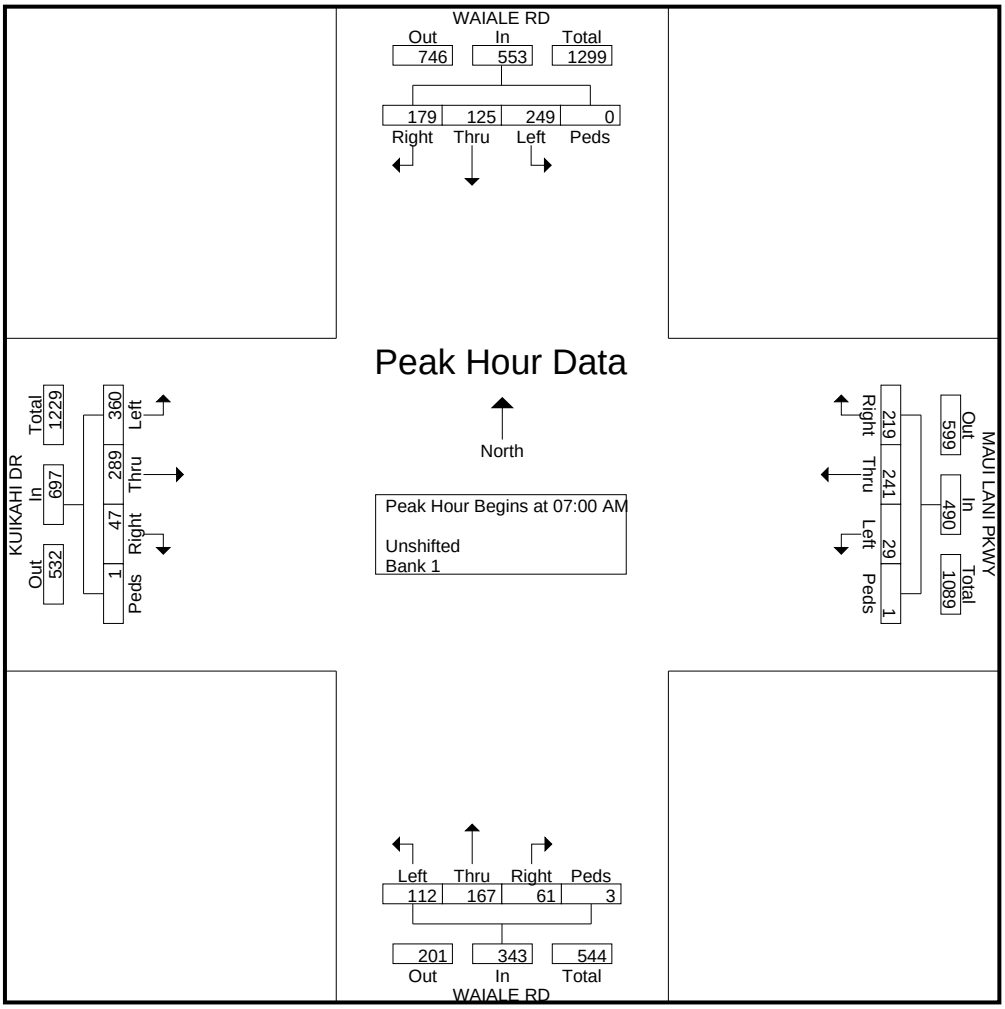
File Name : AM_Waiale Rd - Kuikahi Dr_Maui Lani Pkwy
Site Code : 00000000
Start Date : 3/15/2017
Page No : 2

	WAIALE RD Southbound					MAUI LANI PKWY Westbound					WAIALE RD Northbound					KUIKAHI DR 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 08:15 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	52	27	**51**	**0**	**130**	**6**	**68**	**50**	**0**	**124**	**24**	**31**	**13**	**1**	**69**	**89**	**57**	**8**	**1**	**155**	**478**
07:15 AM	**65**	**35**									**40**	**61**	**20**		**121**	**93**	**63**	**11**	**0**	**167**	**540**
07:30 AM	**60**	**33**	**42**	**0**	**135**	**7**	**60**	**56**	**0**	**123**	**37**	**44**	**16**	**2**	**99**	**88**	**86**	**15**	**0**	**189**	**546**
07:45 AM	**72**	**30**	**50**	**0**	**152**	**9**	58	**59**	**1**	**127**	11	31	12	0	54	90	83	13	0	186	519
Total Volume	249	125	179	0	553	29	241	219	1	490	112	167	61	3	343	360	289	47	1	697	2083
% App. Total	45	22.6	32.4	0		5.9	49.2	44.7	0.2		32.7	48.7	17.8	0.9		51.6	41.5	6.7	0.1		
PHF	.865	.893	.877	.000	.910	.806	.886	.928	.250	.965	.700	.684	.763	.375	.709	.968	.840	.783	.250	.922	.954



AUSTIN TSUTSUMI & ASSOCIATES

501 Sumner Street, Suite 521
Honolulu, HI 96817
Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : PM_Waiale Rd - Kuikahi Dr_Maui Lani Pkwy
Site Code : 00000000
Start Date : 3/15/2017
Page No : 1

Groups Printed- Unshifted - Bank 1

	WAIALE RD Southbound				MAUI LANI PKWY Westbound				WAIALE RD Northbound				KUIKAHI DR Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
03:30 PM	71	35	46	0	16	86	56	1	5	51	24	0	61	73	10	0	535
03:45 PM	75	40	52	0	8	77	57	0	12	33	7	0	64	44	12	0	481
Total	146	75	98	0	24	163	113	1	17	84	31	0	125	117	22	0	1016
04:00 PM	73	40	57	0	17	75	77	0	10	40	8	0	57	40	7	0	501
04:15 PM	64	35	44	0	20	81	48	0	10	29	10	0	67	60	9	0	477
04:30 PM	73	46	67	0	15	76	71	4	10	30	6	0	72	44	13	0	527
04:45 PM	68	45	61	0	15	82	62	1	13	28	10	0	59	53	18	0	515
Total	278	166	229	0	67	314	258	5	43	127	34	0	255	197	47	0	2020
05:00 PM	78	37	61	0	15	68	56	0	13	23	7	0	51	38	15	2	464
05:15 PM	55	32	35	0	10	62	55	0	6	28	13	0	64	35	11	2	408
Grand Total	557	310	423	0	116	607	482	6	79	262	85	0	495	387	95	4	3908
Apprch %	43.2	24	32.8	0	9.6	50.1	39.8	0.5	18.5	61.5	20	0	50.5	39.4	9.7	0.4	
Total %	14.3	7.9	10.8	0	3	15.5	12.3	0.2	2	6.7	2.2	0	12.7	9.9	2.4	0.1	
Unshifted	557	310	423	0	116	607	482	6	79	262	85	0	495	387	95	4	3908
% Unshifted	100	100	100	0	100	100	100	100	100	100	100	0	100	100	100	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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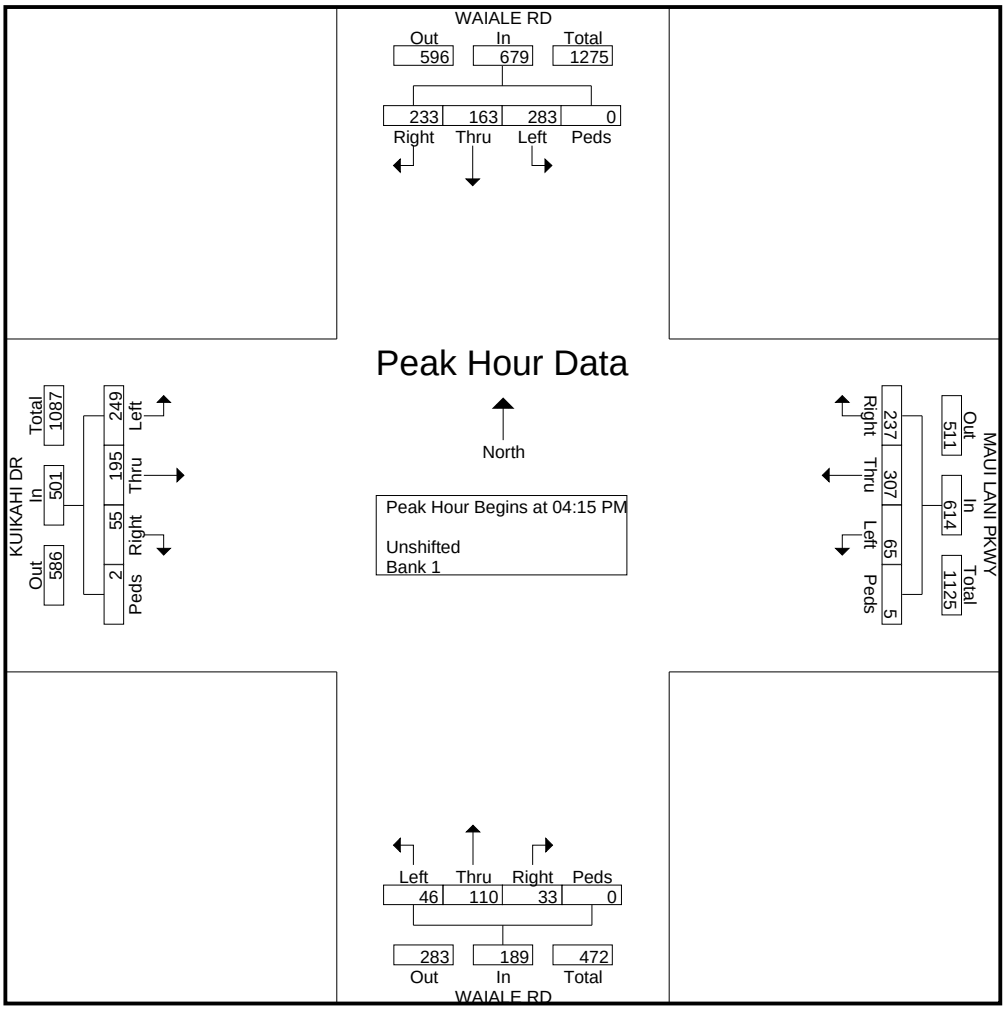
File Name : PM_Waiale Rd - Kuikahi Dr_Maui Lani Pkwy
Site Code : 00000000
Start Date : 3/15/2017
Page No : 2

	WAIALE RD Southbound					MAUI LANI PKWY Westbound					WAIALE RD Northbound					KUIKAHI DR 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 04:15 PM to 05:00 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	64	35	44	0	143	**20**	81	48	0	149	10	29	**10**	0	49	67	**60**	9	0	**136**	477
04:30 PM	73	**46**	**67**	0	**186**	15	76	**71**	**4**	**166**	10	**30**	6	0	46	**72**	44	13	0	129	**527**
04:45 PM	68	45	61	0	174	15	**82**	62	1	160	**13**	28	10	0	**51**	59	53	**18**	0	130	515
05:00 PM	**78**	37	61	0	176	15	68	56	0	139	13	23	7	0	43	51	38	15	**2**	106	464
Total Volume	283	163	233	0	679	65	307	237	5	614	46	110	33	0	189	249	195	55	2	501	1983
% App. Total	41.7	24	34.3	0		10.6	50	38.6	0.8		24.3	58.2	17.5	0		49.7	38.9	11	0.4		
PHF	.907	.886	.869	.000	.913	.813	.936	.835	.313	.925	.885	.917	.825	.000	.926	.865	.813	.764	.250	.921	.941



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File Name : AM_Kamehameha Ave – Maui Lani Pkwy
Site Code : 00000000
Start Date : 3/16/2017
Page No : 1

Groups Printed- Unshifted

	MAUI LANI PKWY Eastbound				MAUI LANI PKWY Westbound				KAMEHAMEHA AVE Northbound				KAMEHAMEHA AVE Southbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:30 AM	39	52	4	1	4	38	21	0	16	17	9	0	71	5	54	0	331
06:45 AM	49	39	11	8	12	53	25	0	19	20	11	0	53	21	51	0	372
Total	88	91	15	9	16	91	46	0	35	37	20	0	124	26	105	0	703
07:00 AM	35	30	33	4	15	34	23	0	42	38	18	1	58	44	50	0	425
07:15 AM	32	23	32	15	14	38	44	0	65	78	16	0	17	47	40	0	461
07:30 AM	41	29	28	4	16	27	29	0	38	72	22	0	31	67	32	0	436
07:45 AM	45	34	8	2	5	48	31	0	31	53	15	4	63	21	81	0	441
Total	153	116	101	25	50	147	127	0	176	241	71	5	169	179	203	0	1763
08:00 AM	43	37	4	0	3	52	22	0	14	17	8	0	47	11	45	0	303
08:15 AM	40	56	12	2	6	42	34	0	10	13	7	1	37	7	49	0	316
Grand Total	324	300	132	36	75	332	229	0	235	308	106	6	377	223	402	0	3085
Apprch %	40.9	37.9	16.7	4.5	11.8	52.2	36	0	35.9	47	16.2	0.9	37.6	22.3	40.1	0	
Total %	10.5	9.7	4.3	1.2	2.4	10.8	7.4	0	7.6	10	3.4	0.2	12.2	7.2	13	0	

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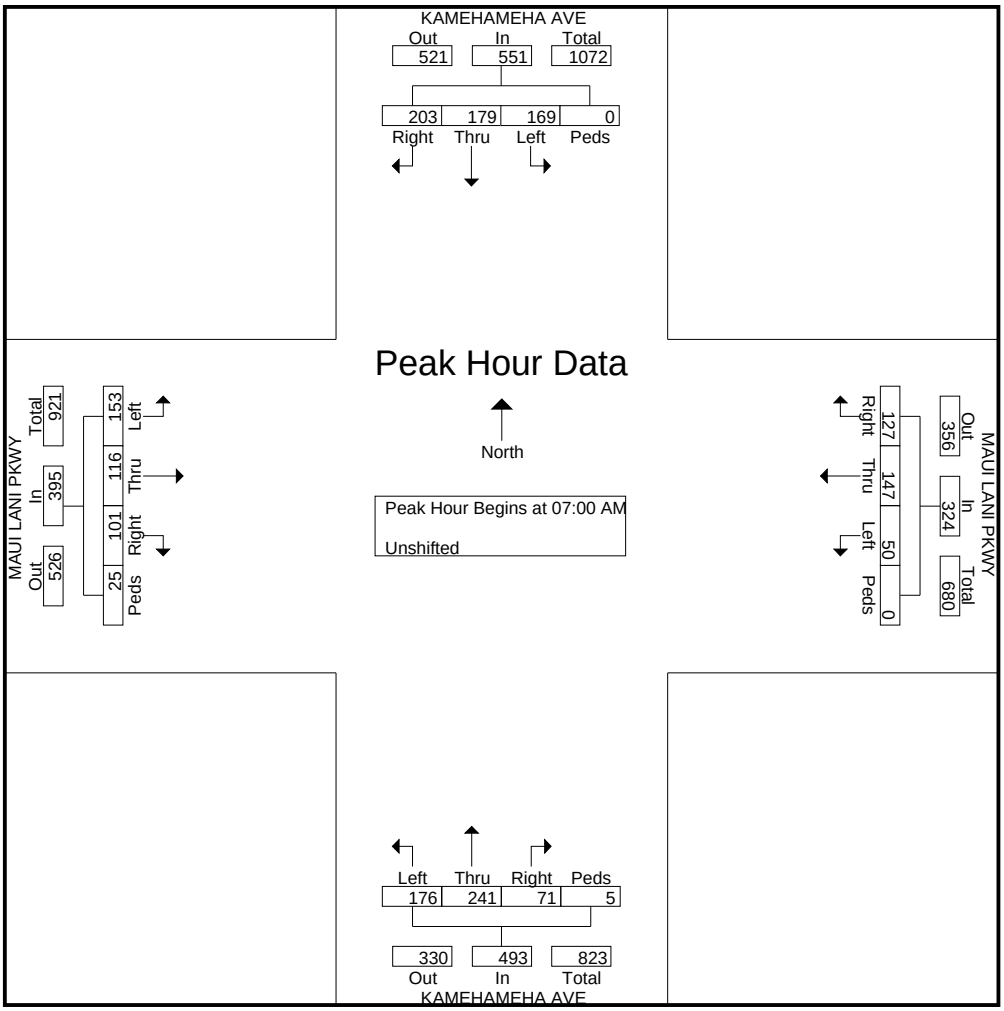
Site Code : 00000000
Start Date : 3/16/2017
Page No : 2

	MAUI LANI PKWY Eastbound					MAUI LANI PKWY Westbound					KAMEHAMEHA AVE Northbound					KAMEHAMEHA AVE Southbound					
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 08:15 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	35	30	**33**	4	**102**	15	34	23	0	72	42	38	18	1	99	58	44	50	0	152	425
07:15 AM	32	23	32	**15**	102	14	38	**44**	0	**96**	**65**	**78**	16	0	**159**	17	47	40	0	104	**461**
07:30 AM	41	29	28	4	102	**16**	27	29	0	72	38	72	**22**	0	132	31	**67**	32	0	130	436
07:45 AM	**45**	**34**	8	2	89	5	**48**	31	0	84	31	53	15	**4**	103	**63**	21	**81**	0	**165**	441
Total Volume	153	116	101	25	395	50	147	127	0	324	176	241	71	5	493	169	179	203	0	551	1763
% App. Total	38.7	29.4	25.6	6.3		15.4	45.4	39.2	0		35.7	48.9	14.4	1		30.7	32.5	36.8	0		
PHF	.850	.853	.765	.417	.968	.781	.766	.722	.000	.844	.677	.772	.807	.313	.775	.671	.668	.627	.000	.835	.956



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File Name : PM_Kamehameha Ave - Maui Lani Pkwy
Site Code : 00000000
Start Date : 3/16/2017
Page No : 1

Groups Printed- Unshifted

	MAUI LANI PKWY Eastbound				MAUI LANI PKWY Westbound				KAMEHAMEHA AVE Northbound				KAMEHAMEHA AVE Southbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
03:30 PM	47	44	13	1	6	59	40	0	23	21	10	0	40	32	58	0	394
03:45 PM	46	43	14	1	12	47	45	0	24	26	8	0	34	35	71	0	406
Total	93	87	27	2	18	106	85	0	47	47	18	0	74	67	129	0	800
04:00 PM	44	43	21	3	12	46	48	0	18	35	9	0	33	32	67	0	411
04:15 PM	51	39	26	1	10	52	55	0	15	24	13	0	27	29	60	0	402
04:30 PM	52	46	15	0	14	40	50	0	17	26	8	0	30	24	71	0	393
04:45 PM	43	44	18	0	15	37	50	0	17	22	4	0	59	32	70	0	411
Total	190	172	80	4	51	175	203	0	67	107	34	0	149	117	268	0	1617
05:00 PM	60	42	16	0	7	48	53	0	13	27	2	0	37	27	54	0	386
05:15 PM	41	52	17	1	15	51	42	0	16	13	5	1	42	24	53	0	373
Grand Total	384	353	140	7	91	380	383	0	143	194	59	1	302	235	504	0	3176
Apprch %	43.4	39.9	15.8	0.8	10.7	44.5	44.8	0	36	48.9	14.9	0.3	29	22.6	48.4	0	
Total %	12.1	11.1	4.4	0.2	2.9	12	12.1	0	4.5	6.1	1.9	0	9.5	7.4	15.9	0	

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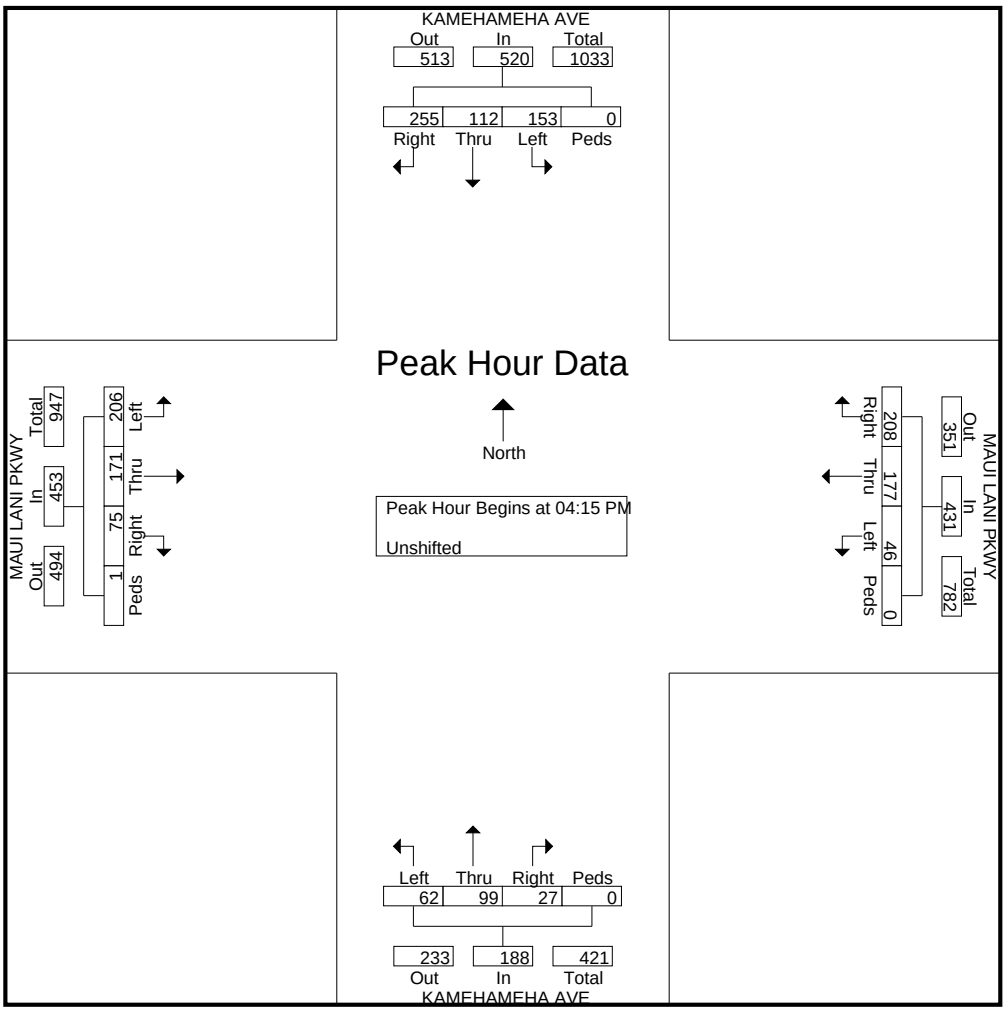
Site Code : 00000000
Start Date : 3/16/2017
Page No : 2

	MAUI LANI PKWY Eastbound					MAUI LANI PKWY Westbound					KAMEHAMEHA AVE Northbound					KAMEHAMEHA AVE Southbound					
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 04:15 PM to 05:00 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	51	39	**26**	**1**	117	10	**52**	**55**	0	**117**	15	24	**13**	0	**52**	27	29	60	0	116	402
04:30 PM	52	**46**	15	0	113	14	40	50	0	104	**17**	26	8	0	51	30	24	**71**	0	125	393
04:45 PM	43	44	18	0	105	**15**	37	50	0	102	17	22	4	0	43	**59**	**32**	70	0	**161**	**411**
05:00 PM	**60**	42	16	0	**118**	7	48	53	0	108	13	**27**	2	0	42	37	27	54	0	118	386
Total Volume	206	171	75	1	453	46	177	208	0	431	62	99	27	0	188	153	112	255	0	520	1592
% App. Total	45.5	37.7	16.6	0.2		10.7	41.1	48.3	0		33	52.7	14.4	0		29.4	21.5	49	0		
PHF	.858	.929	.721	.250	.960	.767	.851	.945	.000	.921	.912	.917	.519	.000	.904	.648	.875	.898	.000	.807	.968



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File Name : AM_Waiale Rd - Waiinu Rd
Site Code : 00000000
Start Date : 3/15/2017
Page No : 1

Groups Printed- Unshifted - Bank 1

	WAIALE RD Southbound				WAIINU RD Westbound				WAIALE 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	14	69	1	0	28	0	11	0	0	63	75	0	1	0	0	0	262
06:45 AM	8	96	0	0	55	0	6	0	1	93	162	1	0	0	0	0	422
Total	22	165	1	0	83	0	17	0	1	156	237	1	1	0	0	0	684
07:00 AM	14	100	0	0	50	0	7	0	0	117	123	0	0	0	0	0	411
07:15 AM	6	140	0	0	41	0	12	0	0	120	166	0	0	0	0	0	485
07:30 AM	13	122	0	0	53	0	19	1	0	149	182	0	0	0	0	0	539
07:45 AM	9	131	0	0	48	0	7	0	0	136	164	1	0	0	0	0	496
Total	42	493	0	0	192	0	45	1	0	522	635	1	0	0	0	0	1931
08:00 AM	17	97	0	0	54	0	12	1	0	101	80	1	0	0	0	0	363
08:15 AM	5	84	0	0	43	0	13	1	0	105	90	0	0	0	0	0	341
Grand Total	86	839	1	0	372	0	87	3	1	884	1042	3	1	0	0	0	3319
Apprch %	9.3	90.6	0.1	0	80.5	0	18.8	0.6	0.1	45.8	54	0.2	100	0	0	0	
Total %	2.6	25.3	0	0	11.2	0	2.6	0.1	0	26.6	31.4	0.1	0	0	0	0	
Unshifted	86	839	1	0	372	0	87	3	1	884	1042	3	1	0	0	0	3319
% Unshifted	100	100	100	0	100	0	100	100	100	100	100	100	100	0	0	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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Start Date : 3/15/2017
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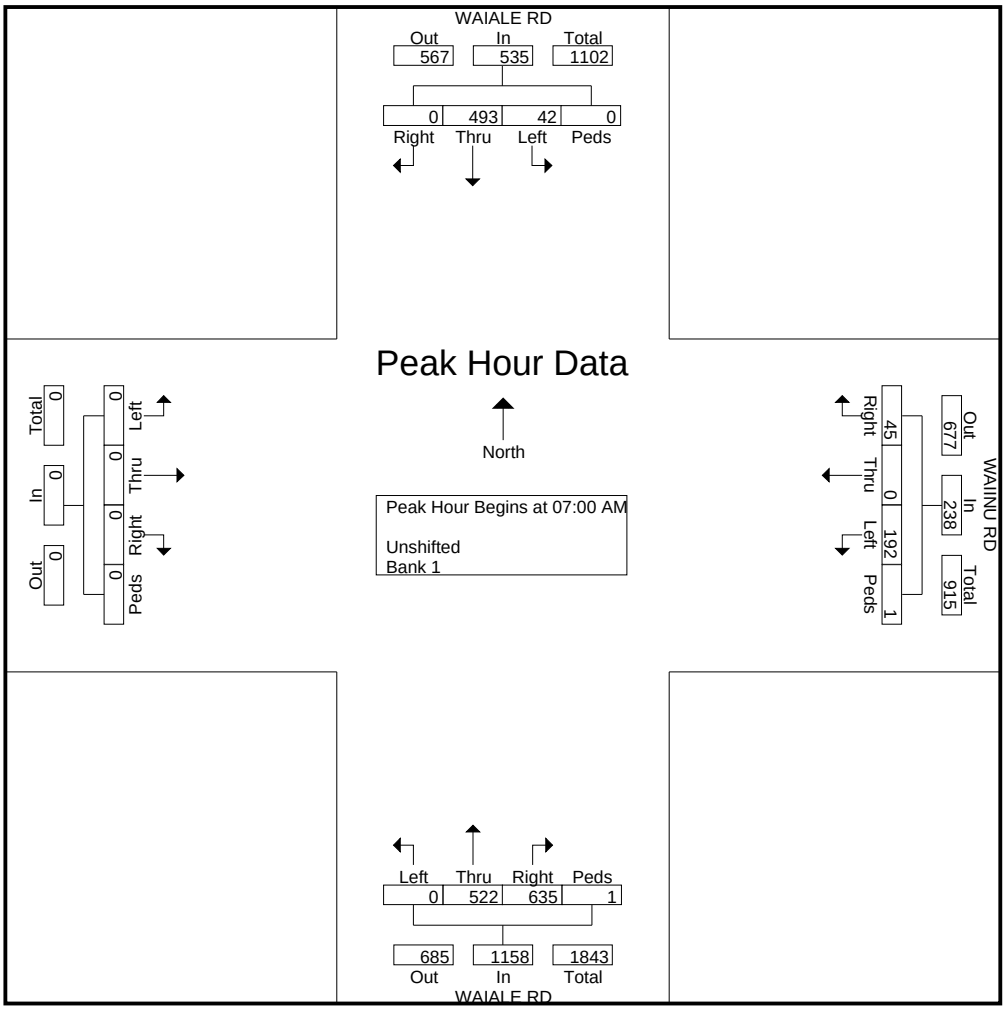
	WAIALE RD Southbound					WAIINU RD Westbound					WAIALE RD Northbound					Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:30 AM to 08:15 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	**14**	100	0	0	114	50	0	7	0	57	0	117	123	0	240	0	0	0	0	0	411
07:15 AM	6	**140**	0	0	**146**	41	0	12	0	53	0	120	166	0	286	0	0	0	0	0	485
07:30 AM	13	122	0	0	135	**53**	0	**19**	**1**	**73**	0	**149**	**182**	0	**331**	0	0	0	0	0	**539**
07:45 AM	9	131	0	0	140	48	0	7	0	55	0	136	164	**1**	301	0	0	0	0	0	496
Total Volume	42	493	0	0	535	192	0	45	1	238	0	522	635	1	1158	0	0	0	0	0	1931
% App. Total	7.9	92.1	0	0		80.7	0	18.9	0.4		0	45.1	54.8	0.1		0	0	0	0		
PHF	.750	.880	.000	.000	.916	.906	.000	.592	.250	.815	.000	.876	.872	.250	.875	.000	.000	.000	.000	.000	.896



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Groups Printed- Unshifted - Bank 1

	WAIALE RD Southbound				WAIINU RD Westbound				WAIALE RD Northbound				WAIINU RD Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
03:30 PM	15	148	0	0	47	0	2	0	0	123	44	2	0	0	0	0	381
03:45 PM	27	141	0	0	43	0	8	0	0	110	42	0	0	0	0	0	371
Total	42	289	0	0	90	0	10	0	0	233	86	2	0	0	0	0	752
04:00 PM	14	146	0	0	38	1	19	0	0	106	46	0	0	0	0	0	370
04:15 PM	13	137	0	0	54	1	14	0	6	115	51	0	0	0	0	0	391
04:30 PM	24	182	0	0	42	0	9	0	1	99	52	0	0	0	0	0	409
04:45 PM	17	143	0	0	48	2	7	1	0	109	59	0	0	0	0	0	386
Total	68	608	0	0	182	4	49	1	7	429	208	0	0	0	0	0	1556
05:00 PM	14	164	0	0	62	1	15	0	1	82	63	3	0	0	0	0	405
05:15 PM	20	147	0	0	46	1	11	0	0	92	65	3	0	0	0	0	385
Grand Total	144	1208	0	0	380	6	85	1	8	836	422	8	0	0	0	0	3098
Apprch %	10.7	89.3	0	0	80.5	1.3	18	0.2	0.6	65.6	33.1	0.6	0	0	0	0	
Total %	4.6	39	0	0	12.3	0.2	2.7	0	0.3	27	13.6	0.3	0	0	0	0	
Unshifted	144	1208	0	0	380	6	85	1	8	836	422	8	0	0	0	0	3098
% Unshifted	100	100	0	0	100	100	100	100	100	100	100	100	0	0	0	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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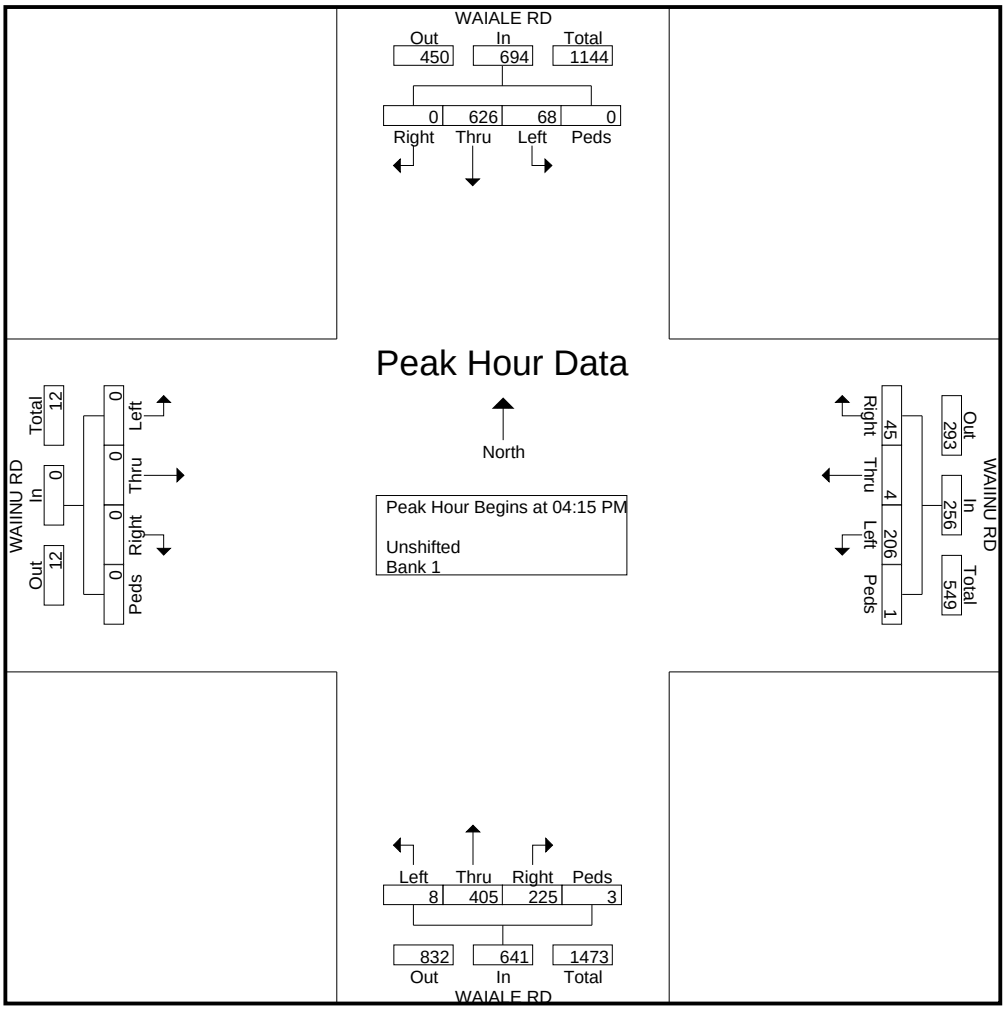
	WAIALE RD Southbound					WAIINU RD Westbound					WAIALE RD Northbound					WAIINU RD Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:30 PM to 05:15 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	13	137	0	0	150	54	1	14	0	69	**6**	**115**	51	0	**172**	0	0	0	0	0	391
04:30 PM	**24**	**182**	0	0	**206**	42	0	9	0	51	1	99	52	0	152	0	0	0	0	0	**409**
04:45 PM	17	143	0	0	160	48	**2**	7	**1**	58	0	109	59	0	168	0	0	0	0	0	386
05:00 PM	14	164	0	0	178	**62**	1	**15**	0	**78**	1	82	**63**	**3**	149	0	0	0	0	0	405
Total Volume	68	626	0	0	694	206	4	45	1	256	8	405	225	3	641	0	0	0	0	0	1591
% App. Total	9.8	90.2	0	0		80.5	1.6	17.6	0.4		1.2	63.2	35.1	0.5		0	0	0	0		
PHF	.708	.860	.000	.000	.842	.831	.500	.750	.250	.821	.333	.880	.893	.250	.932	.000	.000	.000	.000	.000	.972



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File Name : AM_Honoapiilani Hwy - Waiko Rd
Site Code : 00000000
Start Date : 3/15/2017
Page No : 1

Groups Printed- Unshifted - Bank 1

	HONOAPIILANI HWY Southbound				WAIKO RD Westbound				HONOAPIILANI HWY Northbound				WAIKO 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	7	135	0	0	12	1	3	0	0	87	9	0	5	3	1	0	263
06:45 AM	12	161	3	1	19	1	5	0	1	97	6	0	6	4	1	0	317
Total	19	296	3	1	31	2	8	0	1	184	15	0	11	7	2	0	580
07:00 AM	18	162	1	0	19	0	5	0	0	130	11	0	6	7	0	0	359
07:15 AM	32	162	2	0	16	1	17	0	2	162	15	0	10	4	1	0	424
07:30 AM	49	153	2	0	17	2	13	0	0	162	21	0	6	4	4	0	433
07:45 AM	28	161	4	0	12	1	9	0	0	119	20	0	5	1	2	0	362
Total	127	638	9	0	64	4	44	0	2	573	67	0	27	16	7	0	1578
08:00 AM	20	95	2	0	19	2	8	1	1	78	11	0	4	1	0	0	242
08:15 AM	6	97	0	0	6	0	3	0	0	91	8	0	5	4	1	0	221
Grand Total	172	1126	14	1	120	8	63	1	4	926	101	0	47	28	10	0	2621
Apprch %	13.1	85.8	1.1	0.1	62.5	4.2	32.8	0.5	0.4	89.8	9.8	0	55.3	32.9	11.8	0	
Total %	6.6	43	0.5	0	4.6	0.3	2.4	0	0.2	35.3	3.9	0	1.8	1.1	0.4	0	
Unshifted	172	1126	14	1	120	8	63	1	4	926	101	0	47	28	10	0	2621
% Unshifted	100	100	100	100	100	100	100	100	100	100	100	0	100	100	100	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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Start Date : 3/15/2017
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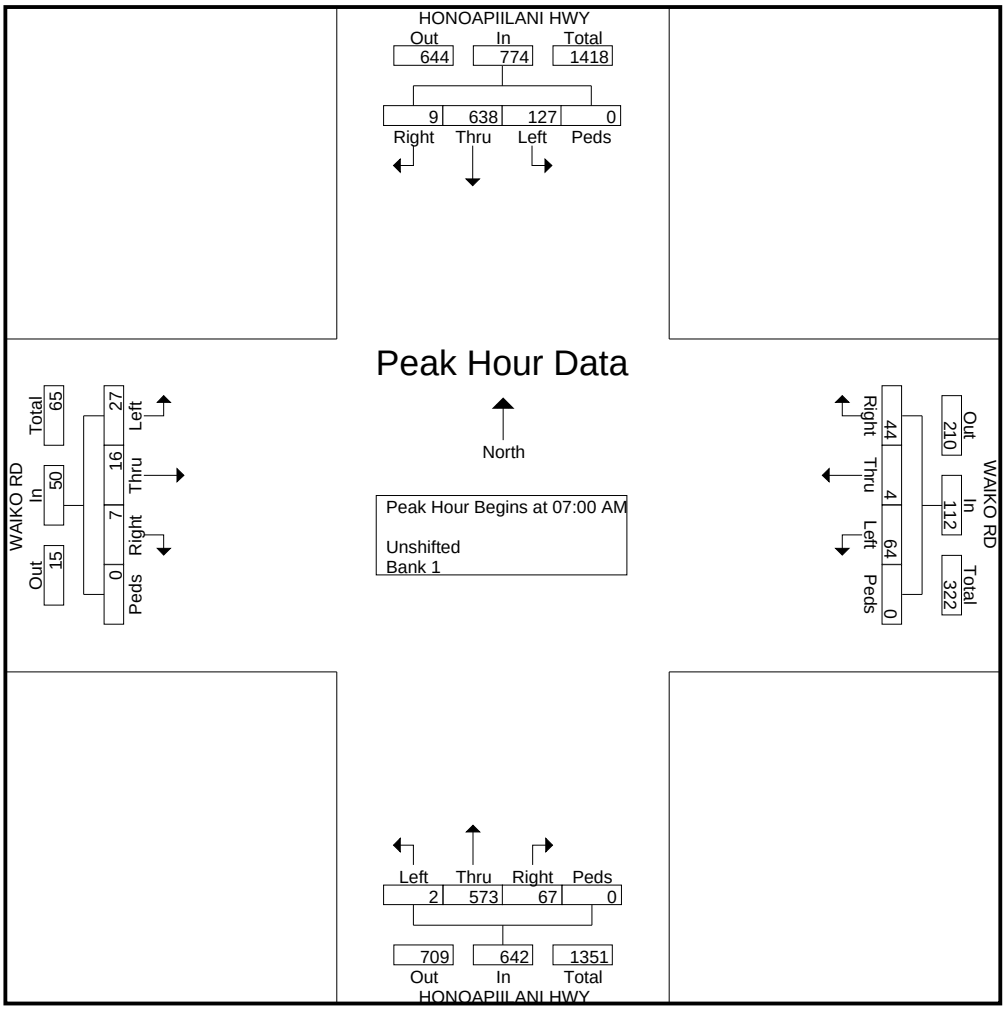
	HONOAPIILANI HWY Southbound					WAIKO RD Westbound					HONOAPIILANI HWY Northbound					WAIKO RD Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:30 AM to 08:15 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	18	**162**	1	0	181	**19**	0	5	0	24	0	130	11	0	141	6	**7**	0	0	13	359
07:15 AM	32	162	2	0	196	16	1	**17**	0	**34**	**2**	**162**	15	0	179	**10**	4	1	0	**15**	424
07:30 AM	**49**	153	2	0	**204**	17	**2**	13	0	32	0	162	**21**	0	**183**	6	4	**4**	0	14	**433**
07:45 AM	28	161	**4**	0	193	12	1	9	0	22	0	119	20	0	139	5	1	2	0	8	362
Total Volume	127	638	9	0	774	64	4	44	0	112	2	573	67	0	642	27	16	7	0	50	1578
% App. Total	16.4	82.4	1.2	0		57.1	3.6	39.3	0		0.3	89.3	10.4	0		54	32	14	0		
PHF	.648	.985	.563	.000	.949	.842	.500	.647	.000	.824	.250	.884	.798	.000	.877	.675	.571	.438	.000	.833	.911



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Site Code : 00000000
Start Date : 3/15/2017
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Groups Printed- Unshifted - Bank 1

	HONOAPIILANI HWY Southbound				WAIKO RD Westbound				HONOAPIILANI HWY Northbound				WAIKO RD Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
03:30 PM	7	143	7	0	10	3	21	0	2	132	12	0	3	1	1	0	342
03:45 PM	14	128	9	0	15	4	9	0	2	164	16	0	6	0	1	0	368
Total	21	271	16	0	25	7	30	0	4	296	28	0	9	1	2	0	710
04:00 PM	9	120	6	0	19	6	10	0	4	158	14	0	2	0	1	0	349
04:15 PM	12	135	8	0	13	3	11	1	2	194	15	0	1	4	3	0	402
04:30 PM	9	196	9	1	7	4	14	0	0	162	17	0	3	3	4	0	429
04:45 PM	13	172	6	0	23	3	14	0	1	131	17	0	4	1	0	0	385
Total	43	623	29	1	62	16	49	1	7	645	63	0	10	8	8	0	1565
05:00 PM	13	182	6	0	17	4	12	0	2	165	19	2	4	4	1	0	431
05:15 PM	9	107	4	1	10	4	20	0	1	123	9	0	12	1	0	0	301
Grand Total	86	1183	55	2	114	31	111	1	14	1229	119	2	35	14	11	0	3007
Apprch %	6.5	89.2	4.1	0.2	44.4	12.1	43.2	0.4	1	90.1	8.7	0.1	58.3	23.3	18.3	0	
Total %	2.9	39.3	1.8	0.1	3.8	1	3.7	0	0.5	40.9	4	0.1	1.2	0.5	0.4	0	
Unshifted	86	1183	55	2	114	31	111	1	14	1229	119	2	35	14	11	0	3007
% Unshifted	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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File Name : PM_Honoapiilani Hwy - Waiko Rd
Site Code : 00000000
Start Date : 3/15/2017
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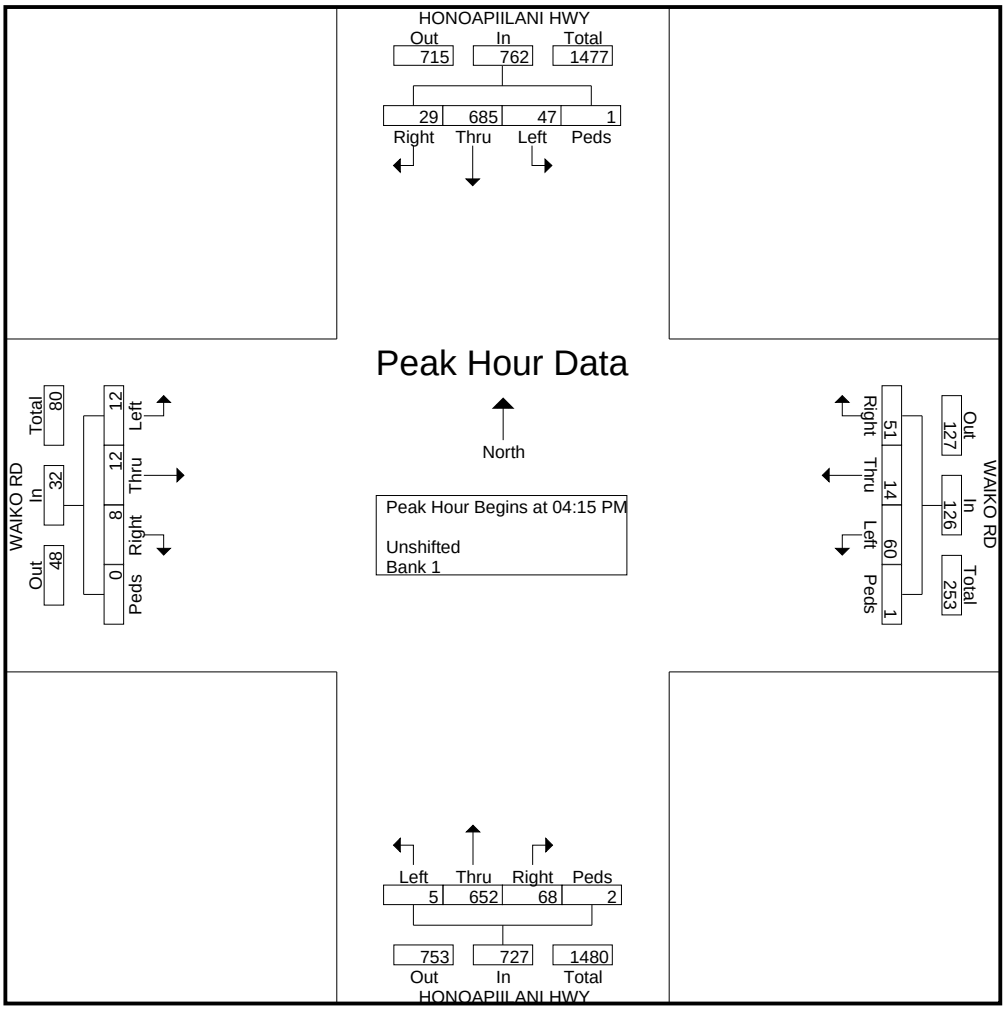
	HONOAPIILANI HWY Southbound					WAIKO RD Westbound					HONOAPIILANI HWY Northbound					WAIKO RD Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:30 PM to 05:15 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	12	135	8	0	155	13	3	11	**1**	28	**2**	**194**	15	0	**211**	1	**4**	3	0	8	402
04:30 PM	9	**196**	**9**	**1**	**215**	7	**4**	**14**	0	25	0	162	17	0	179	3	3	**4**	0	**10**	429
04:45 PM	**13**	172	6	0	191	**23**	3	14	0	**40**	1	131	17	0	149	**4**	1	0	0	5	385
05:00 PM	13	182	6	0	201	17	4	12	0	33	2	165	**19**	**2**	188	4	4	1	0	9	**431**
Total Volume	47	685	29	1	762	60	14	51	1	126	5	652	68	2	727	12	12	8	0	32	1647
% App. Total	6.2	89.9	3.8	0.1		47.6	11.1	40.5	0.8		0.7	89.7	9.4	0.3		37.5	37.5	25	0		
PHF	.904	.874	.806	.250	.886	.652	.875	.911	.250	.788	.625	.840	.895	.250	.861	.750	.750	.500	.000	.800	.955



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File Name : AM_Waiale Rd - Waiko Rd
Site Code : 00000000
Start Date : 3/15/2017
Page No : 1

Groups Printed- Unshifted - Bank 1

	WAIALE RD Southbound				WAIKO RD Westbound				WAIALE RD Northbound				WAIKO 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	29	0	15	0	0	4	7	0	0	0	0	0	4	16	0	0	75
06:45 AM	47	0	15	0	0	6	7	0	0	0	0	0	5	18	0	0	98
Total	76	0	30	0	0	10	14	0	0	0	0	0	9	34	0	0	173
07:00 AM	37	0	19	0	0	6	17	0	0	0	0	0	6	23	0	0	108
07:15 AM	58	0	13	0	0	17	15	0	0	0	0	0	15	43	0	0	161
07:30 AM	43	0	14	0	0	14	17	0	0	0	0	0	16	57	0	0	161
07:45 AM	43	0	15	0	0	17	14	0	0	0	0	0	16	41	0	0	146
Total	181	0	61	0	0	54	63	0	0	0	0	0	53	164	0	0	576
08:00 AM	22	0	15	0	0	14	23	0	0	0	0	0	11	21	0	0	106
08:15 AM	22	0	4	0	0	9	17	0	0	0	0	0	7	14	0	0	73
Grand Total	301	0	110	0	0	87	117	0	0	0	0	0	80	233	0	0	928
Apprch %	73.2	0	26.8	0	0	42.6	57.4	0	0	0	0	0	25.6	74.4	0	0	
Total %	32.4	0	11.9	0	0	9.4	12.6	0	0	0	0	0	8.6	25.1	0	0	
Unshifted	301	0	110	0	0	87	117	0	0	0	0	0	80	233	0	0	928
% Unshifted	100	0	100	0	0	100	100	0	0	0	0	0	100	100	0	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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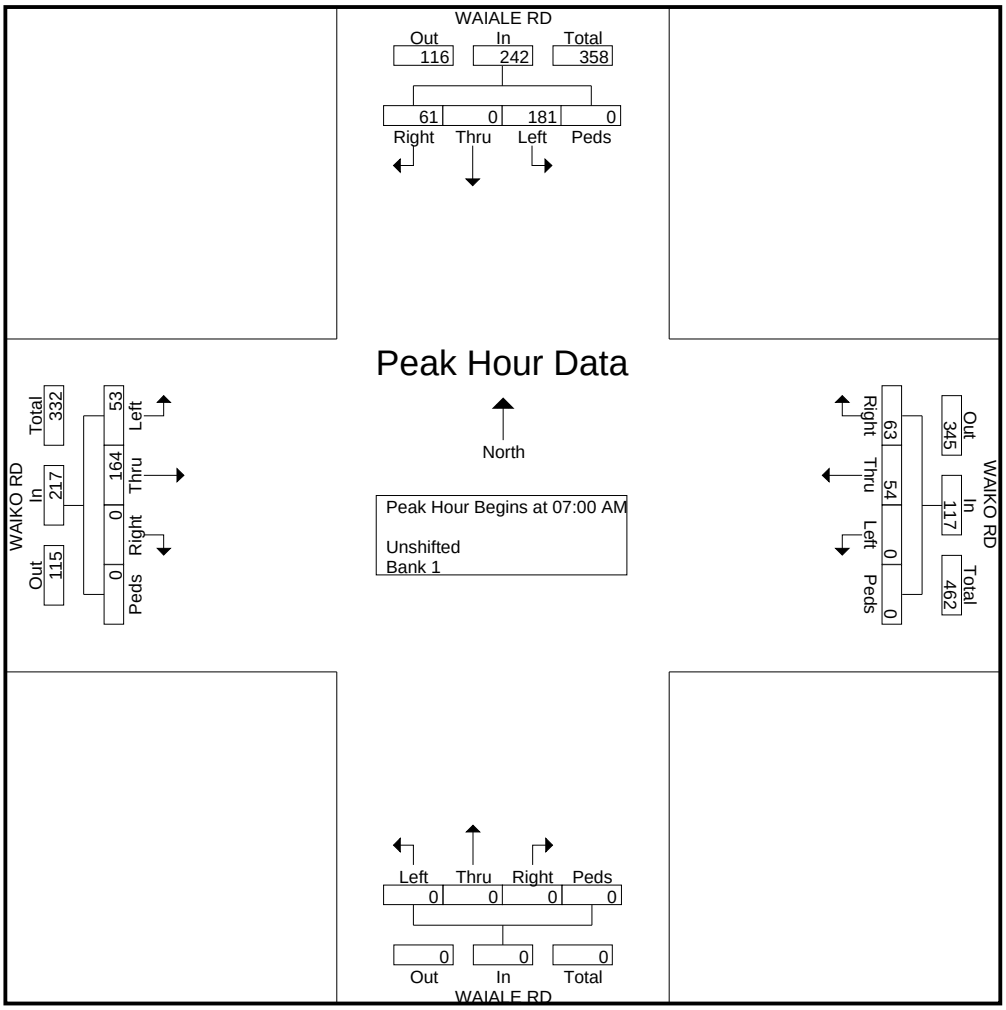
File Name : AM_Waiale Rd - Waiko Rd
Site Code : 00000000
Start Date : 3/15/2017
Page No : 2

	WAIALE RD Southbound					WAIKO RD Westbound					WAIALE RD Northbound					WAIKO 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 06:30 AM to 08:15 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	37	0	**19**	0	56	0	6	**17**	0	23	0	0	0	0	0	6	23	0	0	29	108
07:15 AM	**58**	0	13	0	**71**	0	**17**	15	0	**32**	0	0	0	0	0	15	43	0	0	58	**161**
07:30 AM	43	0	14	0	57	0	14	17	0	31	0	0	0	0	0	**16**	**57**	0	0	**73**	161
07:45 AM	43	0	15	0	58	0	17	14	0	31	0	0	0	0	0	16	41	0	0	57	146
Total Volume	181	0	61	0	242	0	54	63	0	117	0	0	0	0	0	53	164	0	0	217	576
% App. Total	74.8	0	25.2	0		0	46.2	53.8	0		0	0	0	0		24.4	75.6	0	0		
PHF	.780	.000	.803	.000	.852	.000	.794	.926	.000	.914	.000	.000	.000	.000	.000	.828	.719	.000	.000	.743	.894



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File Name : PM_Waiale Rd - Waiko Rd
Site Code : 00000000
Start Date : 3/15/2017
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Groups Printed- Unshifted - Bank 1

	WAIALE RD Southbound				WAIKO RD Westbound				WAIALE RD Northbound				WAIKO RD Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
03:30 PM	25	0	9	0	0	23	31	0	0	0	0	0	9	13	0	0	110
03:45 PM	18	0	8	0	0	17	34	0	0	0	0	0	13	17	0	0	107
Total	43	0	17	0	0	40	65	0	0	0	0	0	22	30	0	0	217
04:00 PM	22	0	8	0	0	28	30	0	0	0	0	0	8	15	0	0	111
04:15 PM	26	0	13	0	0	21	34	0	0	0	0	0	21	16	0	0	131
04:30 PM	36	0	5	0	0	15	35	0	0	0	0	0	12	14	0	0	117
04:45 PM	25	0	13	0	0	29	30	0	0	0	0	0	11	18	0	0	126
Total	109	0	39	0	0	93	129	0	0	0	0	0	52	63	0	0	485
05:00 PM	21	0	11	0	0	19	25	0	0	0	0	0	15	19	0	0	110
05:15 PM	22	0	12	0	0	30	43	0	0	0	0	0	7	20	0	0	134
Grand Total	195	0	79	0	0	182	262	0	0	0	0	0	96	132	0	0	946
Apprch %	71.2	0	28.8	0	0	41	59	0	0	0	0	0	42.1	57.9	0	0	
Total %	20.6	0	8.4	0	0	19.2	27.7	0	0	0	0	0	10.1	14	0	0	
Unshifted	195	0	79	0	0	182	262	0	0	0	0	0	96	132	0	0	946
% Unshifted	100	0	100	0	0	100	100	0	0	0	0	0	100	100	0	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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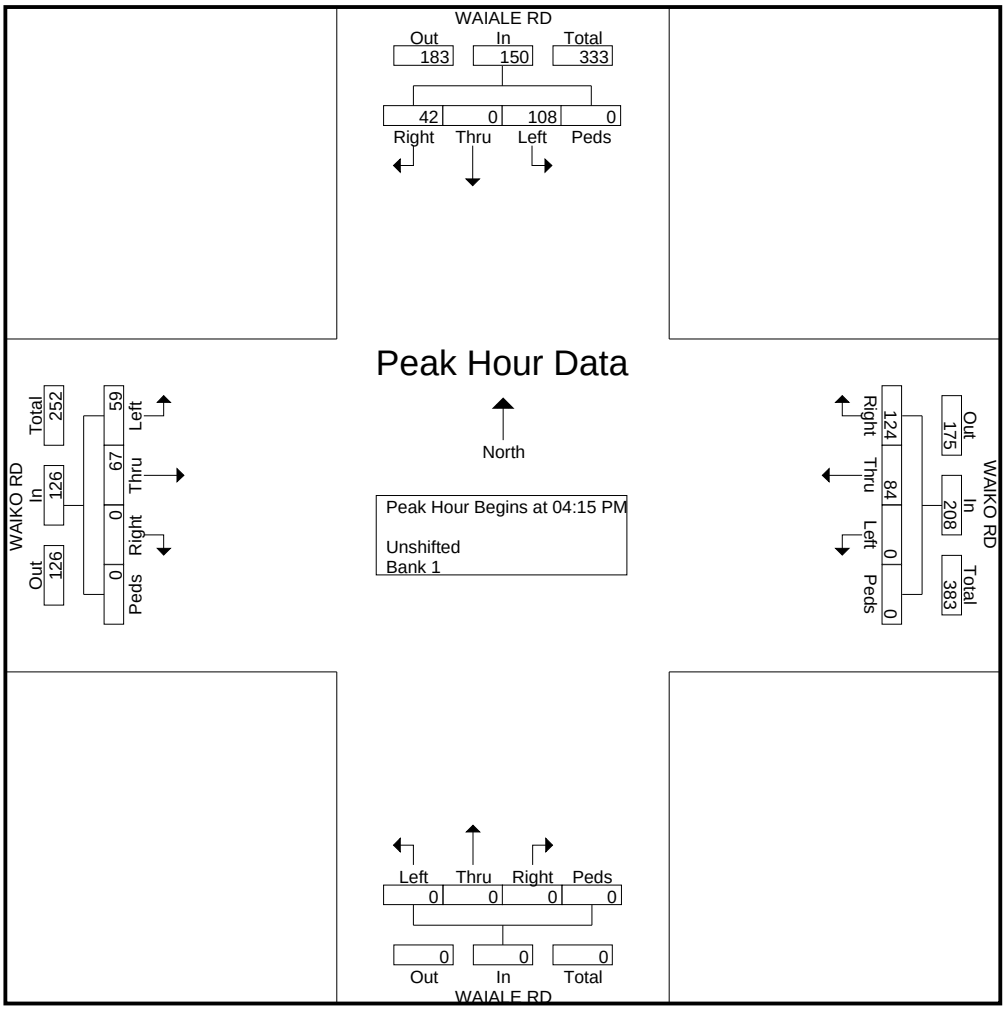
	WAIALE RD Southbound					WAIKO RD Westbound					WAIALE RD Northbound					WAIKO RD Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:15 PM to 05:00 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	26	0	**13**	0	39	0	21	34	0	55	0	0	0	0	0	**21**	16	0	0	**37**	**131**
04:30 PM	**36**	0	5	0	**41**	0	15	**35**	0	50	0	0	0	0	0	12	14	0	0	26	117
04:45 PM	25	0	13	0	38	0	**29**	30	0	**59**	0	0	0	0	0	11	18	0	0	29	126
05:00 PM	21	0	11	0	32	0	19	25	0	44	0	0	0	0	0	15	**19**	0	0	34	110
Total Volume	108	0	42	0	150	0	84	124	0	208	0	0	0	0	0	59	67	0	0	126	484
% App. Total	72	0	28	0		0	40.4	59.6	0		0	0	0	0		46.8	53.2	0	0		
PHF	.750	.000	.808	.000	.915	.000	.724	.886	.000	.881	.000	.000	.000	.000	.000	.702	.882	.000	.000	.851	.924



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File Name : AM_Waiale Rd - Waikapu Gardens Dwy
Site Code : 00000000
Start Date : 3/15/2017
Page No : 1

Groups Printed- Unshifted - Bank 1

	WAIALE RD Southbound				WAIKAPU GARDENS DWY Westbound				WAIALE RD Northbound				WAIKAPU GARDENS 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	0	36	1	0	0	0	0	0	1	11	0	0	5	0	4	0	58
06:45 AM	0	61	3	0	0	0	0	0	0	12	0	0	9	0	0	0	85
Total	0	97	4	0	0	0	0	0	1	23	0	0	14	0	4	0	143
07:00 AM	0	46	2	0	0	0	0	0	0	24	0	0	4	0	10	0	86
07:15 AM	0	66	2	0	0	0	0	0	0	29	0	0	8	0	5	0	110
07:30 AM	0	50	2	0	0	0	0	0	2	31	0	0	3	0	3	0	91
07:45 AM	0	49	2	0	0	0	0	0	4	27	0	0	3	0	7	0	92
Total	0	211	8	0	0	0	0	0	6	111	0	0	18	0	25	0	379
08:00 AM	0	32	3	0	0	0	0	0	3	32	0	0	0	0	4	0	74
08:15 AM	0	26	2	0	0	0	0	0	1	27	0	0	2	0	3	0	61
Grand Total	0	366	17	0	0	0	0	0	11	193	0	0	34	0	36	0	657
Apprch %	0	95.6	4.4	0	0	0	0	0	5.4	94.6	0	0	48.6	0	51.4	0	
Total %	0	55.7	2.6	0	0	0	0	0	1.7	29.4	0	0	5.2	0	5.5	0	
Unshifted	0	366	17	0	0	0	0	0	11	193	0	0	34	0	36	0	657
% Unshifted	0	100	100	0	0	0	0	0	100	100	0	0	100	0	100	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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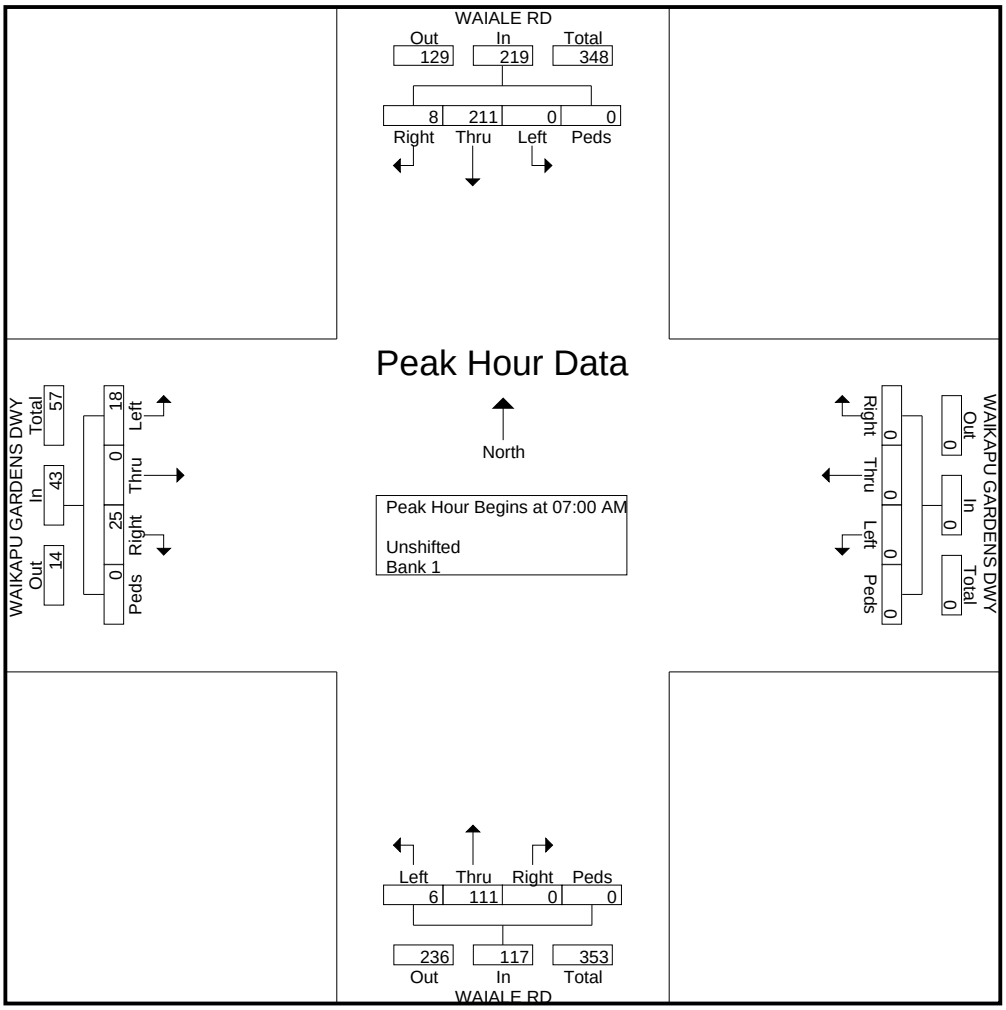
File Name : AM_Waiale Rd - Waikapu Gardens Dwy
Site Code : 00000000
Start Date : 3/15/2017
Page No : 2

	WAIALE RD Southbound					WAIKAPU GARDENS DWY Westbound					WAIALE RD Northbound					WAIKAPU GARDENS 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 06:30 AM to 08:15 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	0	46	**2**	0	48	0	0	0	0	0	0	24	0	0	24	4	0	**10**	0	**14**	86
07:15 AM	0	**66**	2	0	**68**	0	0	0	0	0	0	29	0	0	29	**8**	0	5	0	13	**110**
07:30 AM	0	50	2	0	52	0	0	0	0	0	2	**31**	0	0	**33**	3	0	3	0	6	91
07:45 AM	0	49	2	0	51	0	0	0	0	0	**4**	27	0	0	31	3	0	7	0	10	92
Total Volume	0	211	8	0	219	0	0	0	0	0	6	111	0	0	117	18	0	25	0	43	379
% App. Total	0	96.3	3.7	0		0	0	0	0		5.1	94.9	0	0		41.9	0	58.1	0		
PHF	.000	.799	1.00	.000	.805	.000	.000	.000	.000	.000	.375	.895	.000	.000	.886	.563	.000	.625	.000	.768	.861



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File Name : PM_Waiale Rd - Waikapu Gardens Dwy
Site Code : 00000000
Start Date : 3/15/2017
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Groups Printed- Unshifted - Bank 1

	WAIALE RD Southbound				WAIKAPU GARDENS DWY Westbound				WAIALE RD Northbound				WAIKAPU GARDENS 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	0	28	3	0	0	0	0	0	2	39	0	0	1	0	0	0	73
03:45 PM	0	30	5	0	0	0	0	0	1	47	0	0	2	0	1	0	86
Total	0	58	8	0	0	0	0	0	3	86	0	0	3	0	1	0	159
04:00 PM	0	33	4	0	0	0	0	0	2	40	0	0	2	0	1	0	82
04:15 PM	0	37	4	0	0	0	0	0	3	48	0	0	4	0	2	0	98
04:30 PM	0	38	5	0	0	0	0	0	7	48	0	0	3	0	2	1	104
04:45 PM	0	30	4	0	0	0	0	0	4	33	0	0	3	0	2	0	76
Total	0	138	17	0	0	0	0	0	16	169	0	0	12	0	7	1	360
05:00 PM	0	34	3	0	0	0	0	0	4	38	0	0	4	0	1	0	84
05:15 PM	0	33	2	0	0	0	0	0	6	46	0	0	1	0	2	0	90
Grand Total	0	263	30	0	0	0	0	0	29	339	0	0	20	0	11	1	693
Apprch %	0	89.8	10.2	0	0	0	0	0	7.9	92.1	0	0	62.5	0	34.4	3.1	
Total %	0	38	4.3	0	0	0	0	0	4.2	48.9	0	0	2.9	0	1.6	0.1	
Unshifted	0	263	30	0	0	0	0	0	29	339	0	0	20	0	11	1	693
% Unshifted	0	100	100	0	0	0	0	0	100	100	0	0	100	0	100	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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File Name : PM_Waiale Rd - Waikapu Gardens Dwy
Site Code : 00000000
Start Date : 3/15/2017
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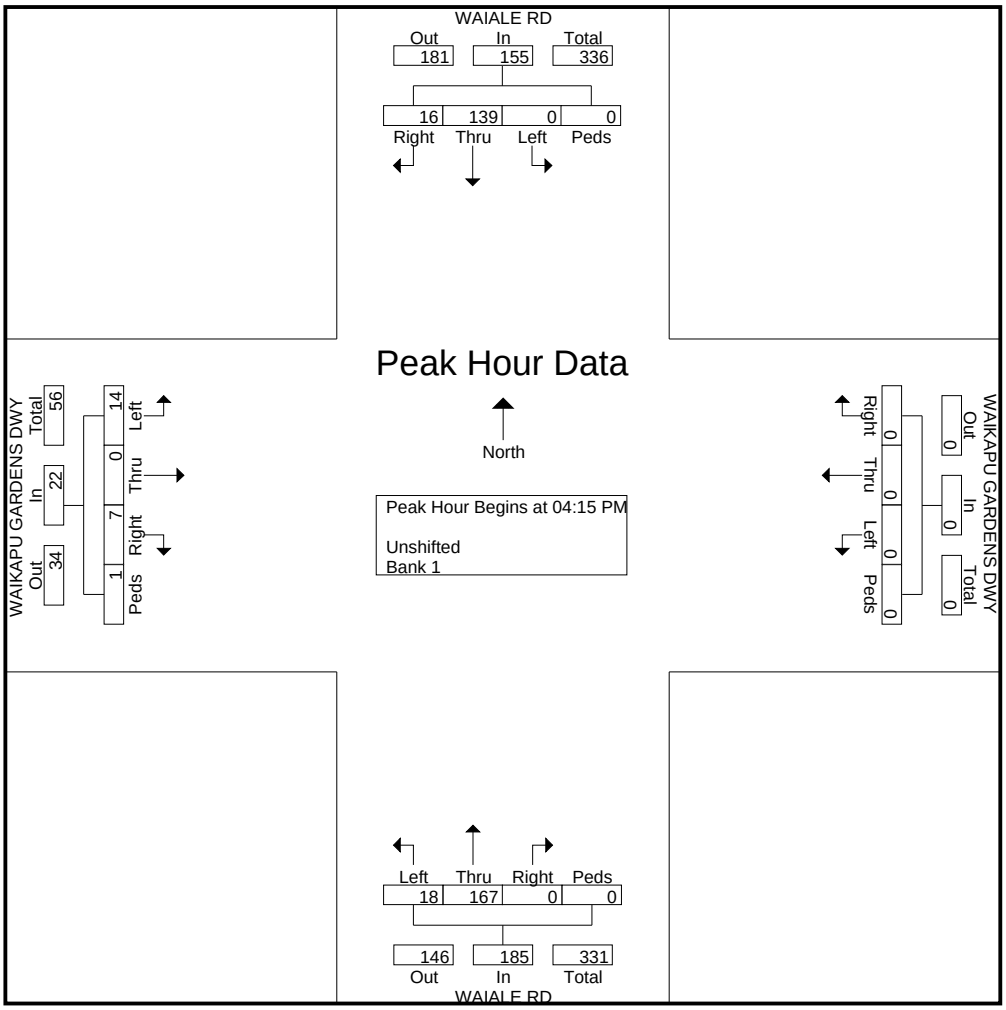
	WAIALE RD Southbound					WAIKAPU GARDENS DWY Westbound					WAIALE RD Northbound					WAIKAPU GARDENS DWY Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:15 PM to 05:00 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	0	37	4	0	41	0	0	0	0	0	3	**48**	0	0	51	**4**	0	**2**	0	**6**	98
04:30 PM	0	**38**	**5**	0	**43**	0	0	0	0	0	**7**	48	0	0	**55**	3	0	2	**1**	6	**104**
04:45 PM	0	30	4	0	34	0	0	0	0	0	4	33	0	0	37	3	0	2	0	5	76
05:00 PM	0	34	3	0	37	0	0	0	0	0	4	38	0	0	42	4	0	1	0	5	84
Total Volume	0	139	16	0	155	0	0	0	0	0	18	167	0	0	185	14	0	7	1	22	362
% App. Total	0	89.7	10.3	0		0	0	0	0		9.7	90.3	0	0		63.6	0	31.8	4.5		
PHF	.000	.914	.800	.000	.901	.000	.000	.000	.000	.000	.643	.870	.000	.000	.841	.875	.000	.875	.250	.917	.870



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File Name : AM_Waiale Rd - Nokekula Lp
Site Code : 00000000
Start Date : 10/22/2015
Page No : 1

Groups Printed- Unshifted

	NOKEKULA LP Eastbound				NOKEKULA LP Westbound				WAIALE RD Northbound				WAIALE RD Southbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:45 AM	2	0	8	0	0	0	0	0	1	10	0	0	0	58	1	0	80
Total	2	0	8	0	0	0	0	0	1	10	0	0	0	58	1	0	80
07:00 AM	11	0	8	0	0	0	0	0	1	29	0	0	0	46	1	0	96
07:15 AM	6	0	2	0	0	0	0	0	1	25	0	0	0	48	0	0	82
07:30 AM	5	0	2	0	0	0	0	0	0	47	0	0	0	52	2	0	108
07:45 AM	2	0	7	0	0	0	0	0	1	21	0	0	0	48	5	0	84
Total	24	0	19	0	0	0	0	0	3	122	0	0	0	194	8	0	370
08:00 AM	3	0	1	0	0	0	0	0	1	19	0	0	0	25	3	0	52
08:15 AM	2	0	3	0	0	0	0	0	2	32	0	0	0	20	3	0	62
Grand Total	31	0	31	0	0	0	0	0	7	183	0	0	0	297	15	0	564
Apprch %	50	0	50	0	0	0	0	0	3.7	96.3	0	0	0	95.2	4.8	0	
Total %	5.5	0	5.5	0	0	0	0	0	1.2	32.4	0	0	0	52.7	2.7	0	

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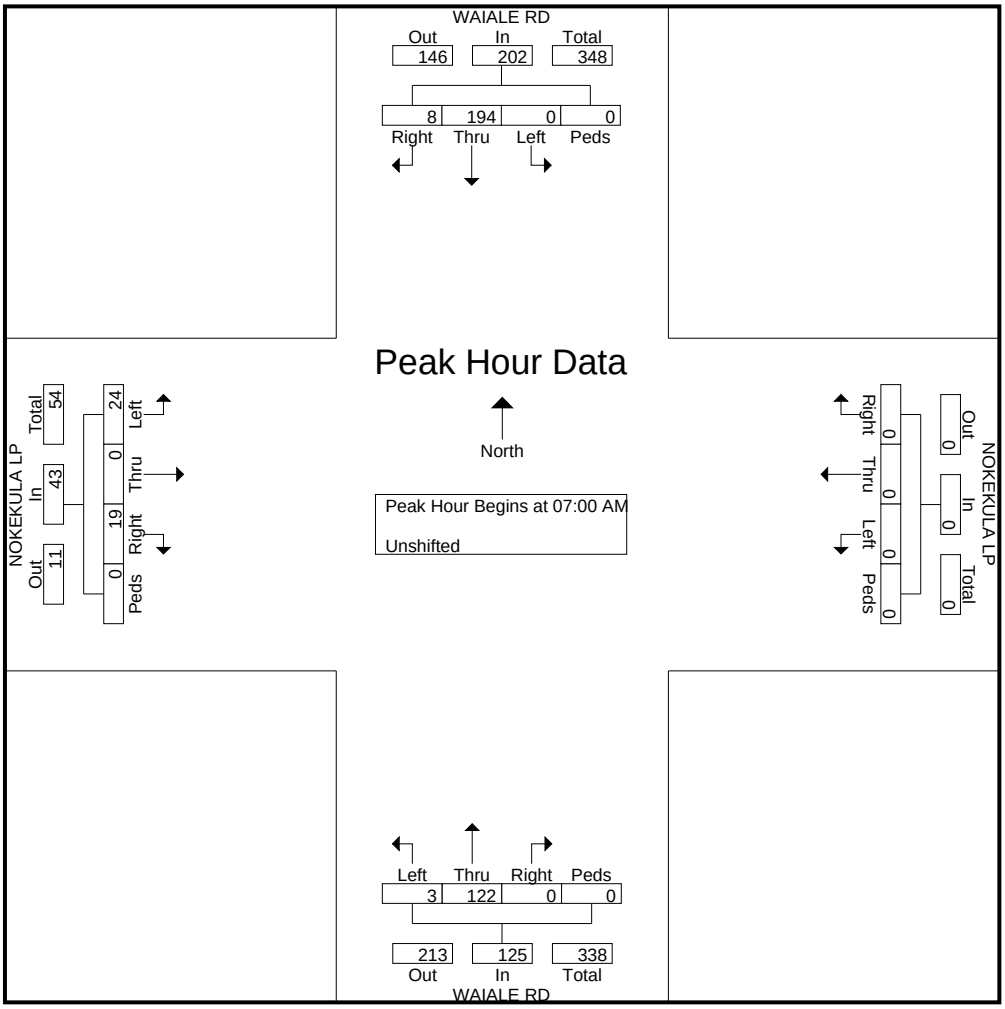
File Name : AM_Waiale Rd - Nokekula Lp
Site Code : 00000000
Start Date : 10/22/2015
Page No : 2

	NOKEKULA LP Eastbound					NOKEKULA LP Westbound					WAIALE RD Northbound					WAIALE RD Southbound					
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 08:15 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	11	0	8	0	19	0	0	0	0	0	1	29	0	0	30	0	46	1	0	47	96
07:15 AM	6	0	2	0	8	0	0	0	0	0	1	25	0	0	26	0	48	0	0	48	82
07:30 AM	5	0	2	0	7	0	0	0	0	0	0	47	0	0	47	0	52	2	0	54	108
07:45 AM	2	0	7	0	9	0	0	0	0	0	1	21	0	0	22	0	48	5	0	53	84
Total Volume	24	0	19	0	43	0	0	0	0	0	3	122	0	0	125	0	194	8	0	202	370
% App. Total	55.8	0	44.2	0		0	0	0	0		2.4	97.6	0	0		0	96	4	0		
PHF	.545	.000	.594	.000	.566	.000	.000	.000	.000	.000	.750	.649	.000	.000	.665	.000	.933	.400	.000	.935	.856



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File Name : PM_Waiale Rd - Nokekula Lp
Site Code : 00000000
Start Date : 10/22/2015
Page No : 1

Groups Printed- Unshifted

	NOKEKULA LP Eastbound				NOKEKULA LP Westbound				WAIALE RD Northbound				WAIALE RD Southbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
03:30 PM	3	0	0	0	0	0	0	0	2	27	0	0	0	23	1	0	56
03:45 PM	0	0	1	0	0	0	0	0	4	49	0	0	0	27	2	0	83
Total	3	0	1	0	0	0	0	0	6	76	0	0	0	50	3	0	139
04:00 PM	0	0	4	0	0	0	0	0	2	34	0	0	0	29	5	0	74
04:15 PM	2	0	0	0	0	0	0	0	8	26	0	0	0	30	4	0	70
04:30 PM	2	0	4	0	0	0	0	0	7	34	0	0	0	37	4	0	88
04:45 PM	2	0	3	0	0	0	0	0	3	47	0	0	0	42	4	0	101
Total	6	0	11	0	0	0	0	0	20	141	0	0	0	138	17	0	333
05:00 PM	4	0	5	0	0	0	0	0	3	38	0	0	0	33	5	0	88
05:15 PM	3	0	2	0	0	0	0	0	2	38	0	0	0	34	2	0	81
Grand Total	16	0	19	0	0	0	0	0	31	293	0	0	0	255	27	0	641
Apprch %	45.7	0	54.3	0	0	0	0	0	9.6	90.4	0	0	0	90.4	9.6	0	
Total %	2.5	0	3	0	0	0	0	0	4.8	45.7	0	0	0	39.8	4.2	0	

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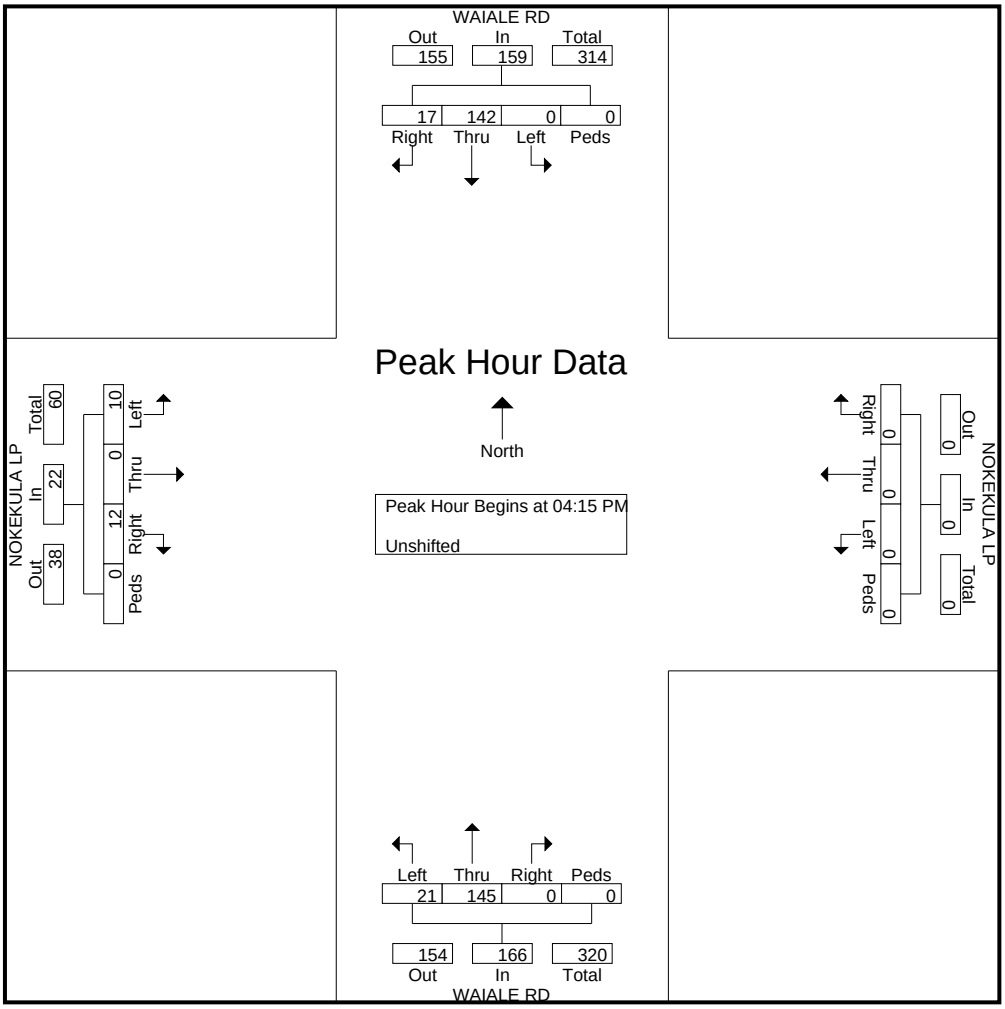
File Name : PM_Waiale Rd - Nokekula Lp
Site Code : 00000000
Start Date : 10/22/2015
Page No : 2

	NOKEKULA LP Eastbound					NOKEKULA LP Westbound					WAIALE RD Northbound					WAIALE RD Southbound					
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 04:15 PM to 05:00 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	2	0	0	0	2	0	0	0	0	0	8	26	0	0	34	0	30	4	0	34	70
04:30 PM	2	0	4	0	6	0	0	0	0	0	7	34	0	0	41	0	37	4	0	41	88
04:45 PM	2	0	3	0	5	0	0	0	0	0	3	47	0	0	50	0	42	4	0	46	101
05:00 PM	4	0	5	0	9	0	0	0	0	0	3	38	0	0	41	0	33	5	0	38	88
Total Volume	10	0	12	0	22	0	0	0	0	0	21	145	0	0	166	0	142	17	0	159	347
% App. Total	45.5	0	54.5	0		0	0	0	0		12.7	87.3	0	0		0	89.3	10.7	0		
PHF	.625	.000	.600	.000	.611	.000	.000	.000	.000	.000	.656	.771	.000	.000	.830	.000	.845	.850	.000	.864	.859



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File Name : AM_Waiale Rd - Haawi St
Site Code : 00000000
Start Date : 10/22/2015
Page No : 1

Groups Printed- Unshifted

	HAAWI ST Eastbound				HAAWI ST Westbound				WAIALE RD Northbound				WAIALE RD Southbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:45 AM	21	0	19	0	0	0	0	0	3	9	0	0	0	40	3	0	95
Total	21	0	19	0	0	0	0	0	3	9	0	0	0	40	3	0	95
07:00 AM	22	0	21	0	0	0	0	0	2	38	0	0	0	26	6	0	115
07:15 AM	30	0	20	0	0	0	0	0	2	29	0	0	0	28	10	0	119
07:30 AM	15	0	21	0	0	0	0	0	4	48	0	0	0	33	8	0	129
07:45 AM	7	0	15	0	0	0	0	0	3	20	0	0	0	38	11	0	94
Total	74	0	77	0	0	0	0	0	11	135	0	0	0	125	35	0	457
08:00 AM	5	0	3	0	0	0	0	0	1	21	0	0	0	25	11	0	66
08:15 AM	8	0	9	0	0	0	0	0	7	27	0	0	0	14	6	0	71
Grand Total	108	0	108	0	0	0	0	0	22	192	0	0	0	204	55	0	689
Apprch %	50	0	50	0	0	0	0	0	10.3	89.7	0	0	0	78.8	21.2	0	
Total %	15.7	0	15.7	0	0	0	0	0	3.2	27.9	0	0	0	29.6	8	0	

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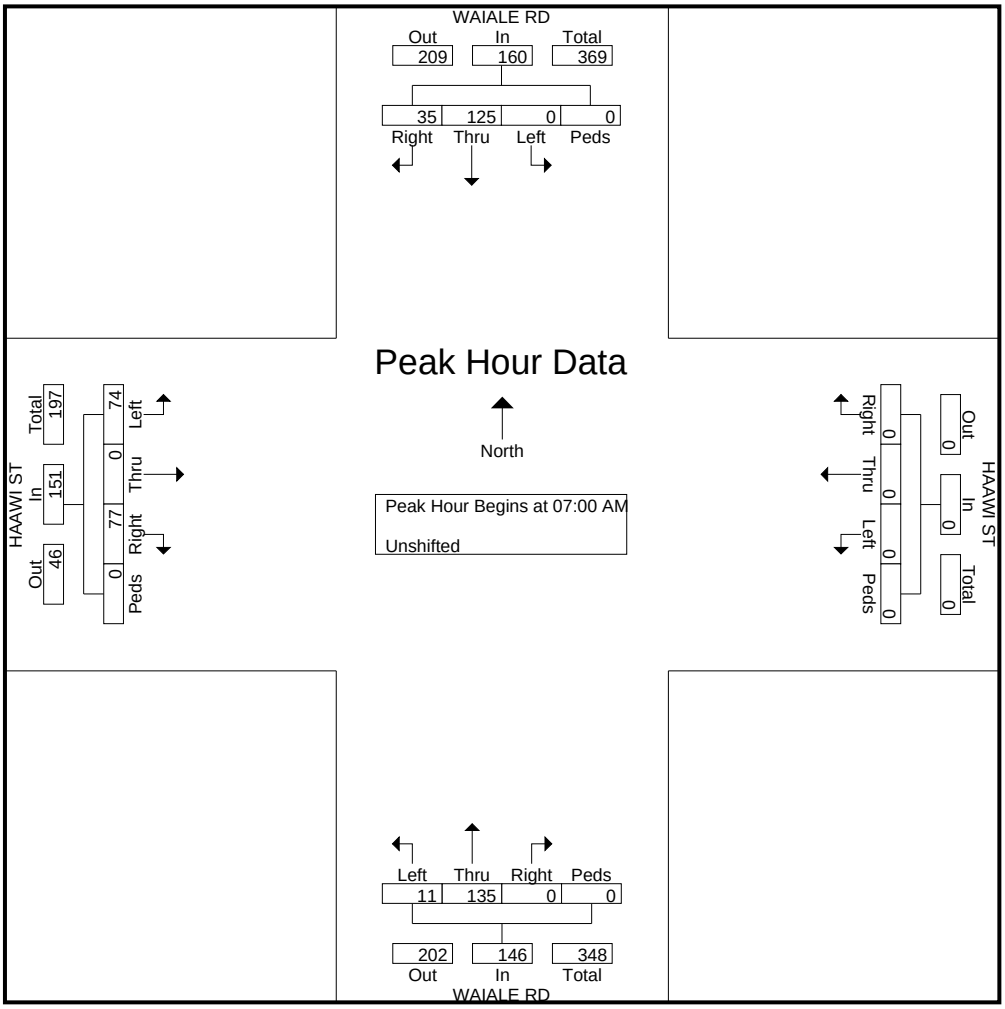
File Name : AM_Waiale Rd - Haawi St
Site Code : 00000000
Start Date : 10/22/2015
Page No : 2

	HAAWI ST Eastbound					HAAWI ST Westbound					WAIALE RD Northbound					WAIALE RD Southbound					
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 07:00 AM to 07:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	22	0	21	0	43	0	0	0	0	0	2	38	0	0	40	0	26	6	0	32	115
07:15 AM	30	0	20	0	50	0	0	0	0	0	2	29	0	0	31	0	28	10	0	38	119
07:30 AM	15	0	21	0	36	0	0	0	0	0	4	48	0	0	52	0	33	8	0	41	129
07:45 AM	7	0	15	0	22	0	0	0	0	0	3	20	0	0	23	0	38	11	0	49	94
Total Volume	74	0	77	0	151	0	0	0	0	0	11	135	0	0	146	0	125	35	0	160	457
% App. Total	49	0	51	0		0	0	0	0		7.5	92.5	0	0		0	78.1	21.9	0		
PHF	.617	.000	.917	.000	.755	.000	.000	.000	.000	.000	.688	.703	.000	.000	.702	.000	.822	.795	.000	.816	.886



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File Name : PM_Waiale Rd - Haawi St
Site Code : 00000000
Start Date : 10/22/2015
Page No : 1

Groups Printed- Unshifted

	HAAWI ST Eastbound				HAAWI ST Westbound				WAIALE RD Northbound				WAIALE RD Southbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
03:30 PM	12	0	10	0	0	0	0	0	7	23	0	0	0	14	16	0	82
03:45 PM	10	0	3	0	0	0	0	0	9	40	0	0	0	26	10	0	98
Total	22	0	13	0	0	0	0	0	16	63	0	0	0	40	26	0	180
04:00 PM	14	0	3	0	0	0	0	0	15	19	0	0	0	31	13	0	95
04:15 PM	12	0	5	0	0	0	0	0	1	27	0	0	0	29	16	0	90
04:30 PM	14	0	12	0	0	0	0	0	16	20	0	0	0	29	18	0	109
04:45 PM	14	0	15	0	0	0	0	0	11	38	0	0	0	31	20	0	129
Total	54	0	35	0	0	0	0	0	43	104	0	0	0	120	67	0	423
05:00 PM	10	0	7	0	0	0	0	0	10	32	0	0	0	31	22	0	112
05:15 PM	7	0	4	0	0	0	0	0	17	24	0	0	0	32	15	0	99
Grand Total	93	0	59	0	0	0	0	0	86	223	0	0	0	223	130	0	814
Apprch %	61.2	0	38.8	0	0	0	0	0	27.8	72.2	0	0	0	63.2	36.8	0	
Total %	11.4	0	7.2	0	0	0	0	0	10.6	27.4	0	0	0	27.4	16	0	

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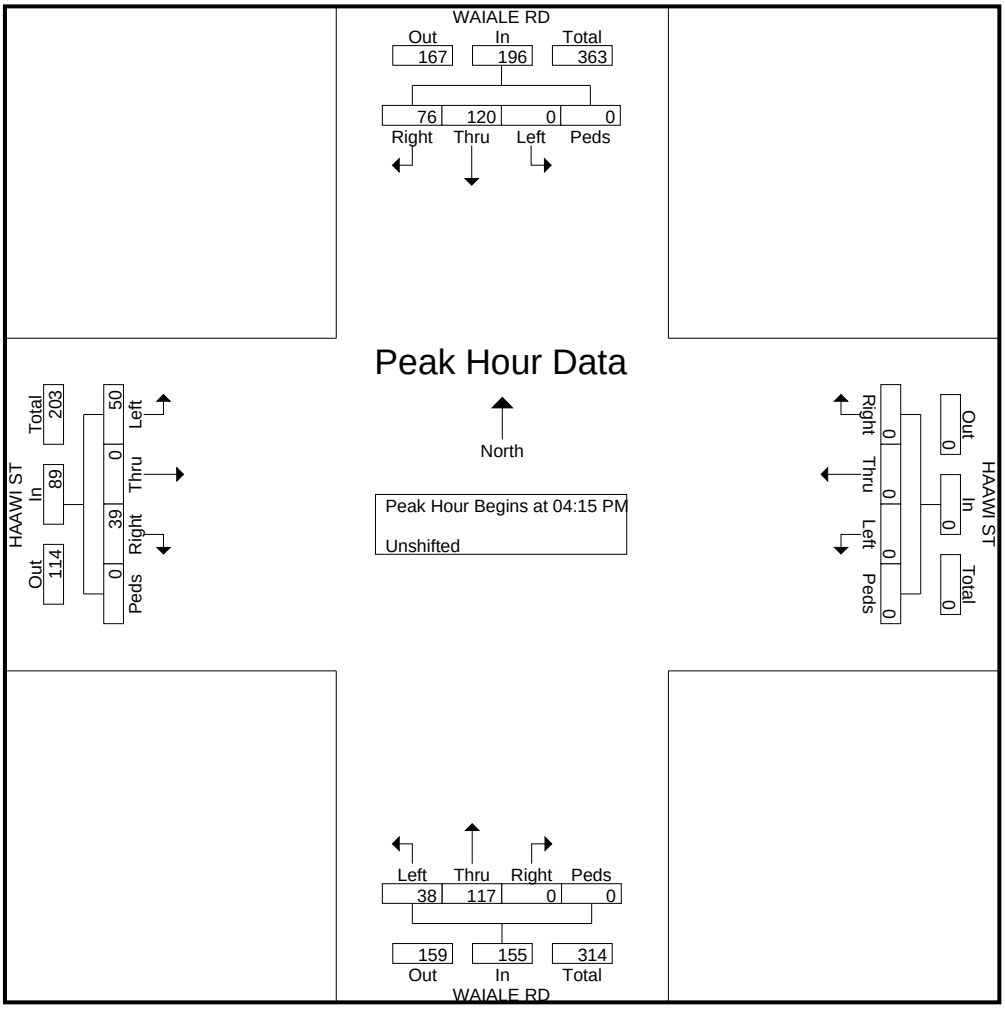
File Name : PM_Waiale Rd - Haawi St
Site Code : 00000000
Start Date : 10/22/2015
Page No : 2

	HAAWI ST Eastbound					HAAWI ST Westbound					WAIALE RD Northbound					WAIALE RD Southbound					
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 04:15 PM to 05:00 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	12	0	5	0	17	0	0	0	0	0	1	27	0	0	28	0	29	16	0	45	90
04:30 PM	14	0	12	0	26	0	0	0	0	0	16	20	0	0	36	0	29	18	0	47	109
04:45 PM	14	0	15	0	29	0	0	0	0	0	11	38	0	0	49	0	31	20	0	51	129
05:00 PM	10	0	7	0	17	0	0	0	0	0	10	32	0	0	42	0	31	22	0	53	112
Total Volume	50	0	39	0	89	0	0	0	0	0	38	117	0	0	155	0	120	76	0	196	440
% App. Total	56.2	0	43.8	0		0	0	0	0		24.5	75.5	0	0		0	61.2	38.8	0		
PHF	.893	.000	.650	.000	.767	.000	.000	.000	.000	.000	.594	.770	.000	.000	.791	.000	.968	.864	.000	.925	.853



Austin Tsutsumi & Associates

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File Name : AM_Waiale Rd - Kokololio St
Site Code : 00000000
Start Date : 10/22/2015
Page No : 1

Groups Printed- Unshifted

	KOKOLOLIO ST Eastbound				KOKOLOLIO ST Westbound				WAIALE RD Northbound				WAIALE RD Southbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:45 AM	23	0	6	0	0	0	0	0	1	29	0	0	0	37	4	0	100
Total	23	0	6	0	0	0	0	0	1	29	0	0	0	37	4	0	100
07:00 AM	20	0	6	0	0	0	0	0	1	59	0	0	0	26	6	0	118
07:15 AM	36	0	7	0	0	0	0	0	1	58	0	0	0	31	9	0	142
07:30 AM	29	0	5	0	0	0	0	0	2	61	0	0	0	36	6	0	139
07:45 AM	12	0	3	0	0	0	0	0	1	26	0	0	0	46	12	0	100
Total	97	0	21	0	0	0	0	0	5	204	0	0	0	139	33	0	499
08:00 AM	10	0	1	0	0	0	0	0	0	26	0	0	0	35	8	0	80
08:15 AM	9	0	1	0	0	0	0	0	2	33	0	0	0	19	7	0	71
Grand Total	139	0	29	0	0	0	0	0	8	292	0	0	0	230	52	0	750
Apprch %	82.7	0	17.3	0	0	0	0	0	2.7	97.3	0	0	0	81.6	18.4	0	
Total %	18.5	0	3.9	0	0	0	0	0	1.1	38.9	0	0	0	30.7	6.9	0	

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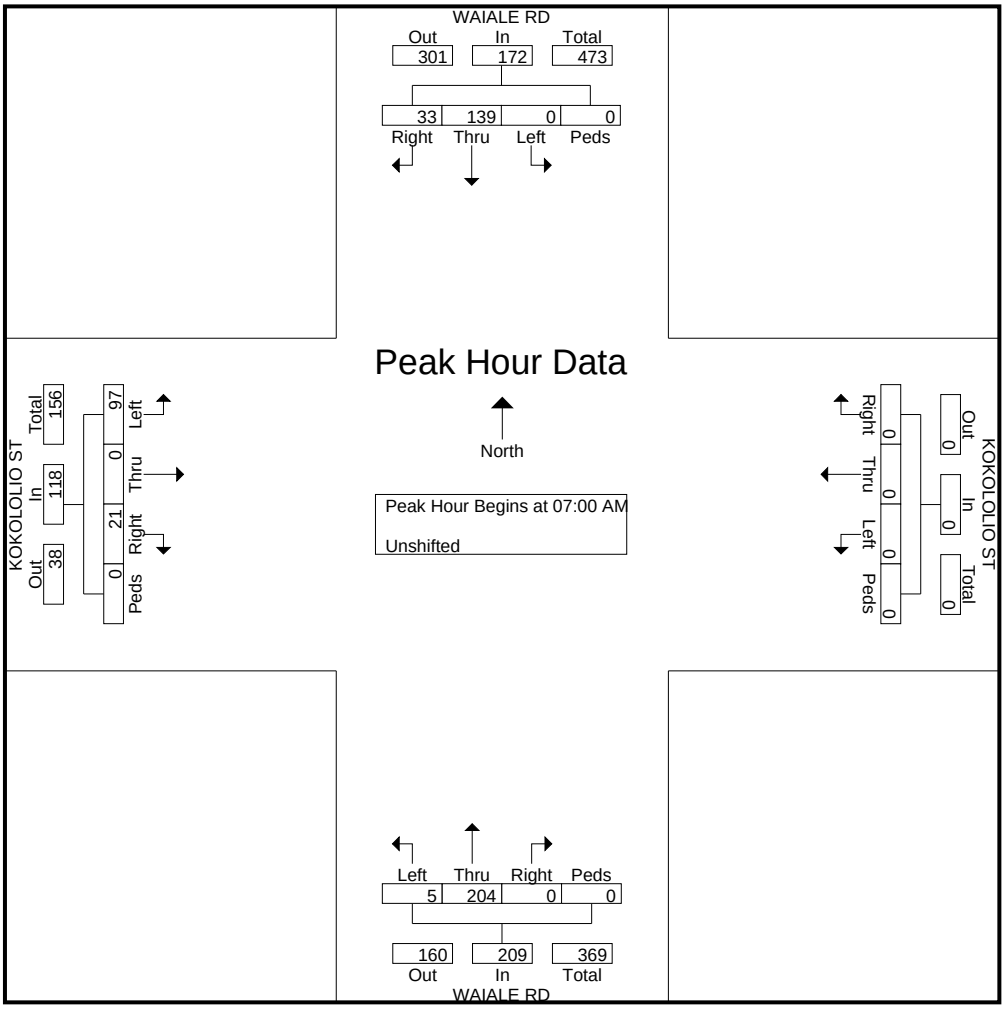
Page No : 2

	KOKOLOLIO ST Eastbound					KOKOLOLIO ST Westbound					WAIALE RD Northbound					WAIALE RD Southbound					
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 07:00 AM to 07:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	20	0	6	0	26	0	0	0	0	0	1	59	0	0	60	0	26	6	0	32	118
07:15 AM	36	0	7	0	43	0	0	0	0	0	1	58	0	0	59	0	31	9	0	40	142
07:30 AM	29	0	5	0	34	0	0	0	0	0	2	61	0	0	63	0	36	6	0	42	139
07:45 AM	12	0	3	0	15	0	0	0	0	0	1	26	0	0	27	0	46	12	0	58	100
Total Volume	97	0	21	0	118	0	0	0	0	0	5	204	0	0	209	0	139	33	0	172	499
% App. Total	82.2	0	17.8	0		0	0	0	0		2.4	97.6	0	0		0	80.8	19.2	0		
PHF	.674	.000	.750	.000	.686	.000	.000	.000	.000	.000	.625	.836	.000	.000	.829	.000	.755	.688	.000	.741	.879



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Page No : 1

Groups Printed- Unshifted

	KOKOLOLIO ST Eastbound				KOKOLOLIO ST Westbound				WAIALE RD Northbound				WAIALE RD Southbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
03:30 PM	7	0	1	0	0	0	0	0	4	31	0	0	0	29	15	0	87
03:45 PM	17	0	4	0	0	0	0	0	4	46	0	0	0	32	15	0	118
Total	24	0	5	0	0	0	0	0	8	77	0	0	0	61	30	0	205
04:00 PM	17	0	6	0	0	0	0	0	4	29	0	0	0	38	13	0	107
04:15 PM	13	0	1	0	0	0	0	0	3	36	0	0	0	44	13	0	110
04:30 PM	17	0	2	0	0	0	0	0	3	31	0	0	0	45	22	0	120
04:45 PM	14	0	2	0	0	0	0	0	5	47	0	0	0	49	21	0	138
Total	61	0	11	0	0	0	0	0	15	143	0	0	0	176	69	0	475
05:00 PM	13	0	1	0	0	0	0	0	4	38	0	0	0	52	17	0	125
05:15 PM	12	0	6	0	0	0	0	0	9	22	0	0	0	41	16	0	106
Grand Total	110	0	23	0	0	0	0	0	36	280	0	0	0	330	132	0	911
Apprch %	82.7	0	17.3	0	0	0	0	0	11.4	88.6	0	0	0	71.4	28.6	0	
Total %	12.1	0	2.5	0	0	0	0	0	4	30.7	0	0	0	36.2	14.5	0	

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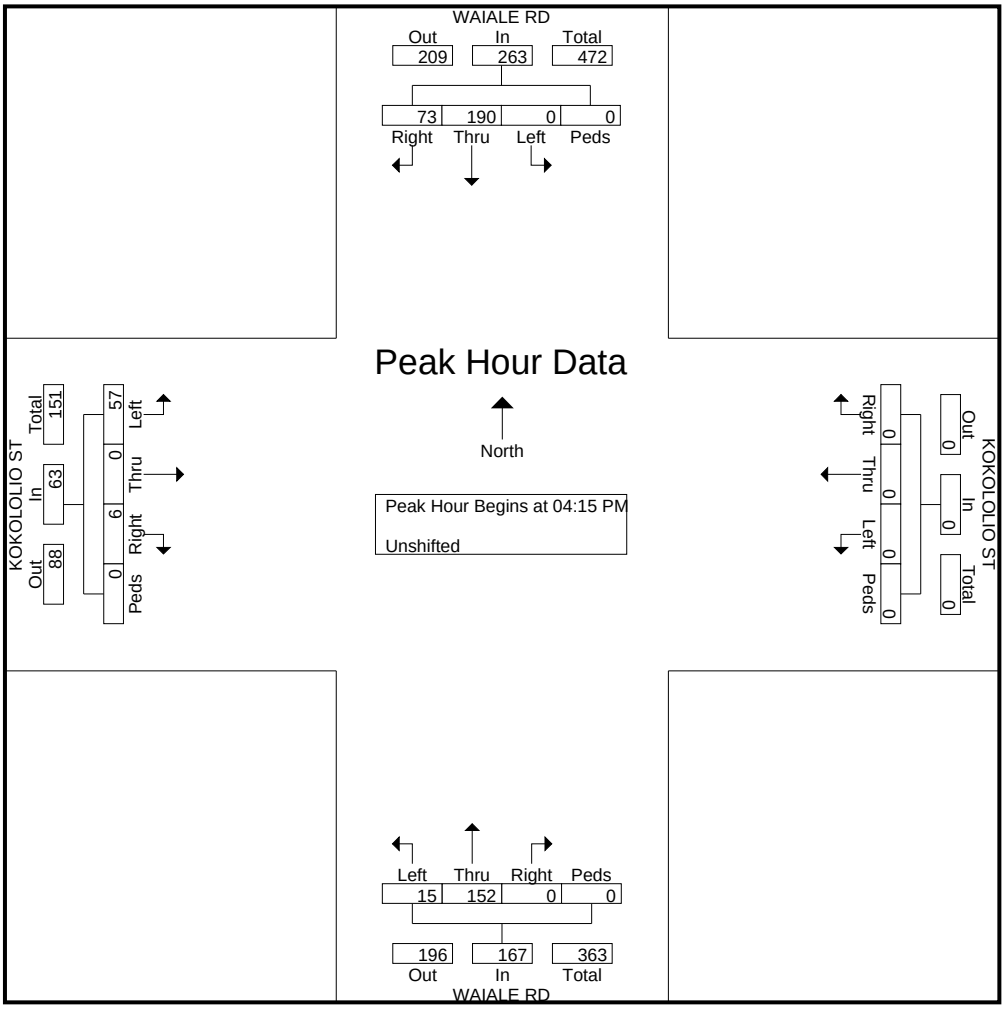
	KOKOLOLIO ST Eastbound					KOKOLOLIO ST Westbound					WAIALE RD Northbound					WAIALE RD Southbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:30 PM to 05:15 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	13	0	1	0	14	0	0	0	0	0	3	36	0	0	39	0	44	13	0	57	110
04:30 PM	17	0	2	0	19	0	0	0	0	0	3	31	0	0	34	0	45	22	0	67	120
04:45 PM	14	0	2	0	16	0	0	0	0	0	5	47	0	0	52	0	49	21	0	70	138
05:00 PM	13	0	1	0	14	0	0	0	0	0	4	38	0	0	42	0	52	17	0	69	125
Total Volume	57	0	6	0	63	0	0	0	0	0	15	152	0	0	167	0	190	73	0	263	493
% App. Total	90.5	0	9.5	0		0	0	0	0		9	91	0	0		0	72.2	27.8	0		
PHF	.838	.000	.750	.000	.829	.000	.000	.000	.000	.000	.750	.809	.000	.000	.803	.000	.913	.830	.000	.939	.893



APPENDIX B

LEVEL OF SERVICE CRITERIA

APPENDIX B – LEVEL OF SERVICE (LOS) CRITERIA

VEHICULAR LEVEL OF SERVICE FOR SIGNALIZED INTERSECTIONS (HCM 2010)

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 2010)

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 C

LEVEL OF SERVICE CALCULATIONS

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Existing Conditions AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	283	196	333	28	172	110	215	460	10	40	334	99
Future Volume (veh/h)	283	196	333	28	172	110	215	460	10	40	334	99
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1545	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	404	213	165	30	187	32	234	500	0	43	363	0
Adj No. of Lanes	1	1	1	1	1	1	1	1	1	1	1	1
Peak Hour Factor	0.70	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, %	10	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	381	525	446	296	254	216	439	735	625	305	603	513
Arrive On Green	0.17	0.28	0.28	0.03	0.14	0.14	0.11	0.39	0.00	0.04	0.32	0.00
Sat Flow, veh/h	1472	1863	1583	1774	1863	1583	1774	1863	1583	1774	1863	1583
Grp Volume(v), veh/h	404	213	165	30	187	32	234	500	0	43	363	0
Grp Sat Flow(s),veh/h/ln	1472	1863	1583	1774	1863	1583	1774	1863	1583	1774	1863	1583
Q Serve(g_s), s	15.0	8.0	7.2	1.2	8.3	1.5	7.1	19.0	0.0	1.4	14.0	0.0
Cycle Q Clear(g_c), s	15.0	8.0	7.2	1.2	8.3	1.5	7.1	19.0	0.0	1.4	14.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	381	525	446	296	254	216	439	735	625	305	603	513
V/C Ratio(X)	1.06	0.41	0.37	0.10	0.74	0.15	0.53	0.68	0.00	0.14	0.60	0.00
Avail Cap(c_a), veh/h	381	525	446	553	521	443	660	1064	904	652	1064	904
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	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	28.4	25.0	24.7	30.3	35.5	32.6	16.6	21.5	0.0	19.0	24.4	0.0
Incr Delay (d2), s/veh	62.9	0.2	0.2	0.1	1.6	0.1	0.4	2.4	0.0	0.1	2.1	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	9.5	4.1	3.2	0.6	4.4	0.7	3.5	10.2	0.0	0.7	7.5	0.0
LnGrp Delay(d),s/veh	91.3	25.2	24.9	30.4	37.1	32.8	17.0	23.8	0.0	19.0	26.4	0.0
LnGrp LOS	F	C	C	C	D	C	B	C		B	C	
Approach Vol, veh/h		782			249			734			406	
Approach Delay, s/veh		59.3			35.7			21.7			25.6	
Approach LOS		E			D			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	8.2	39.9	7.6	30.2	14.3	33.8	20.0	17.7
Change Period (Y+Rc), s	5.0	6.0	5.0	6.0	5.0	6.0	5.0	6.0
Max Green Setting (Gmax), s	20.0	49.0	15.0	24.0	20.0	49.0	15.0	24.0
Max Q Clear Time (g_c+I1), s	3.4	21.0	3.2	10.0	9.1	16.0	17.0	10.3
Green Ext Time (p_c), s	0.0	10.9	0.0	1.7	0.2	11.7	0.0	1.4

Intersection Summary	
HCM 2010 Ctrl Delay	37.6
HCM 2010 LOS	D

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	51	127	63	263	57	221	14	435	331	270	457	7
Future Volume (veh/h)	51	127	63	263	57	221	14	435	331	270	457	7
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1909	1909	1909	1863	1863	1863	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	55	138	22	286	62	82	15	473	0	293	497	4
Adj No. of Lanes	1	1	1	1	1	1	1	1	1	1	1	1
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	187	176	420	423	556	359	664	826	438	875	802
Arrive On Green	0.04	0.10	0.10	0.17	0.23	0.23	0.01	0.36	0.00	0.12	0.47	0.47
Sat Flow, veh/h	1818	1909	1623	1774	1863	1583	1774	1863	1583	1774	1863	1583
Grp Volume(v), veh/h	55	138	22	286	62	82	15	473	0	293	497	4
Grp Sat Flow(s),veh/h/ln	1818	1909	1623	1774	1863	1583	1774	1863	1583	1774	1863	1583
Q Serve(g_s), s	2.1	5.5	1.0	10.7	2.1	2.8	0.4	17.1	0.0	7.6	15.1	0.1
Cycle Q Clear(g_c), s	2.1	5.5	1.0	10.7	2.1	2.8	0.4	17.1	0.0	7.6	15.1	0.1
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	293	187	176	420	423	556	359	664	826	438	875	802
V/C Ratio(X)	0.19	0.74	0.12	0.68	0.15	0.15	0.04	0.71	0.00	0.67	0.57	0.00
Avail Cap(c_a), veh/h	319	220	204	490	501	622	477	811	952	468	930	849
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	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	30.2	34.2	31.5	24.0	24.1	17.3	16.0	21.7	0.0	14.9	15.0	9.5
Incr Delay (d2), s/veh	0.3	8.0	0.1	3.1	0.1	0.0	0.0	3.6	0.0	2.5	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	1.1	3.3	0.4	5.5	1.1	1.2	0.2	9.5	0.0	4.0	8.1	0.0
LnGrp Delay(d),s/veh	30.5	42.2	31.6	27.1	24.2	17.4	16.0	25.3	0.0	17.4	16.3	9.5
LnGrp LOS	C	D	C	C	C	B	B	C		B	B	A
Approach Vol, veh/h		215			430			488			794	
Approach Delay, s/veh		38.1			24.8			25.0			16.7	
Approach LOS		D			C			C			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	13.7	33.8	16.9	13.6	4.8	42.7	6.9	23.7
Change Period (Y+Rc), s	4.0	6.0	4.0	6.0	4.0	6.0	4.0	6.0
Max Green Setting (Gmax), s	11.0	34.0	16.0	9.0	6.0	39.0	4.0	21.0
Max Q Clear Time (g_c+I1), s	9.6	19.1	12.7	7.5	2.4	17.1	4.1	4.8
Green Ext Time (p_c), s	0.1	8.7	0.3	0.2	0.0	11.3	0.0	0.8

Intersection Summary	
HCM 2010 Ctrl Delay	23.0
HCM 2010 LOS	C

Intersection	
Int Delay, s/veh	2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	64	632	463	58	29	89
Future Vol, veh/h	64	632	463	58	29	89
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	145	-	-	-	0	0
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	70	687	503	63	32	97

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	566	0	-	0	1361	535
Stage 1	-	-	-	-	535	-
Stage 2	-	-	-	-	826	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1006	-	-	-	163	545
Stage 1	-	-	-	-	587	-
Stage 2	-	-	-	-	430	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1006	-	-	-	152	545
Mov Cap-2 Maneuver	-	-	-	-	152	-
Stage 1	-	-	-	-	587	-
Stage 2	-	-	-	-	400	-

Approach	EB	WB	SB
HCM Control Delay, s	0.8	0	18.4
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	1006	-	-	-	152	545
HCM Lane V/C Ratio	0.069	-	-	-	0.207	0.178
HCM Control Delay (s)	8.8	-	-	-	34.8	13
HCM Lane LOS	A	-	-	-	D	B
HCM 95th %tile Q(veh)	0.2	-	-	-	0.7	0.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	360	289	47	29	241	219	112	167	61	249	125	179
Future Volume (veh/h)	360	289	47	29	241	219	112	167	61	249	125	179
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1814	1863	1900	1863	1863	1863	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	450	314	46	32	262	37	122	182	52	271	136	142
Adj No. of Lanes	1	1	0	1	1	1	1	1	0	1	1	0
Peak Hour Factor	0.80	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	558	640	94	336	367	312	332	253	72	403	204	213
Arrive On Green	0.23	0.40	0.40	0.03	0.20	0.20	0.08	0.18	0.18	0.14	0.24	0.24
Sat Flow, veh/h	1727	1589	233	1774	1863	1583	1774	1394	398	1774	836	873
Grp Volume(v), veh/h	450	0	360	32	262	37	122	0	234	271	0	278
Grp Sat Flow(s),veh/h/ln	1727	0	1822	1774	1863	1583	1774	0	1792	1774	0	1709
Q Serve(g_s), s	15.3	0.0	11.7	1.1	10.4	1.5	4.4	0.0	9.8	9.4	0.0	11.7
Cycle Q Clear(g_c), s	15.3	0.0	11.7	1.1	10.4	1.5	4.4	0.0	9.8	9.4	0.0	11.7
Prop In Lane	1.00		0.13	1.00		1.00	1.00		0.22	1.00		0.51
Lane Grp Cap(c), veh/h	558	0	733	336	367	312	332	0	325	403	0	417
V/C Ratio(X)	0.81	0.00	0.49	0.10	0.71	0.12	0.37	0.00	0.72	0.67	0.00	0.67
Avail Cap(c_a), veh/h	725	0	895	537	563	479	443	0	542	403	0	516
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	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	17.6	0.0	17.7	24.4	29.8	26.2	23.8	0.0	30.6	21.2	0.0	27.1
Incr Delay (d2), s/veh	5.1	0.0	0.5	0.1	2.6	0.2	0.7	0.0	3.0	4.3	0.0	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	8.0	0.0	5.9	0.6	5.6	0.7	2.2	0.0	5.1	5.0	0.0	5.8
LnGrp Delay(d),s/veh	22.7	0.0	18.2	24.6	32.4	26.4	24.5	0.0	33.6	25.5	0.0	29.4
LnGrp LOS	C		B	C	C	C	C		C	C		C
Approach Vol, veh/h		810			331			356			549	
Approach Delay, s/veh		20.7			30.9			30.5			27.5	
Approach LOS		C			C			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	15.0	20.4	6.0	38.0	10.0	25.4	22.3	21.7
Change Period (Y+Rc), s	4.0	6.0	4.0	6.0	4.0	6.0	4.0	6.0
Max Green Setting (Gmax), s	11.0	24.0	11.0	39.0	11.0	24.0	26.0	24.0
Max Q Clear Time (g_c+I1), s	11.4	11.8	3.1	13.7	6.4	13.7	17.3	12.4
Green Ext Time (p_c), s	0.0	2.7	0.0	4.4	0.1	2.4	1.0	3.2

Intersection Summary	
HCM 2010 Ctrl Delay	25.9
HCM 2010 LOS	C

Intersection	
Intersection Delay, s/veh	62.1
Intersection LOS	F

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR
Lane Configurations																
Traffic Vol, veh/h	0	153	116	101	0	50	147	127	0	176	241	71	0	169	179	203
Future Vol, veh/h	0	153	116	101	0	50	147	127	0	176	241	71	0	169	179	203
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	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	166	126	110	0	54	160	138	0	191	262	77	0	184	195	221
Number of Lanes	0	0	1	0	0	0	1	0	0	1	1	0	0	1	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	2	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	2	2	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	2	1	1
HCM Control Delay	82.3	57.4	43.3	68.1
HCM LOS	F	F	E	F

Lane	NBLn1	NBLn2	EBLn1	WBLn1	SBLn1	SBLn2
Vol Left, %	100%	0%	41%	15%	100%	0%
Vol Thru, %	0%	77%	31%	45%	0%	47%
Vol Right, %	0%	23%	27%	39%	0%	53%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	176	312	370	324	169	382
LT Vol	176	0	153	50	169	0
Through Vol	0	241	116	147	0	179
RT Vol	0	71	101	127	0	203
Lane Flow Rate	191	339	402	352	184	415
Geometry Grp	7	7	2	2	7	7
Degree of Util (X)	0.536	0.885	1.018	0.906	0.507	1.041
Departure Headway (Hd)	10.41	9.715	9.42	9.587	10.253	9.334
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes
Cap	348	376	390	380	355	390
Service Time	8.11	7.415	7.42	7.587	7.953	7.034
HCM Lane V/C Ratio	0.549	0.902	1.031	0.926	0.518	1.064
HCM Control Delay	24.5	53.9	82.3	57.4	23	88
HCM Lane LOS	C	F	F	F	C	F
HCM 95th-tile Q	3	8.7	12.5	9.3	2.7	13.3

Intersection	
Int Delay, s/veh	49

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	192	45	522	635	42	493
Future Vol, veh/h	192	45	522	635	42	493
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	145	-	-	-	-
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	209	49	567	690	46	536

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1539	912	0	0	1258	0
Stage 1	912	-	-	-	-	-
Stage 2	627	-	-	-	-	-
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	~ 127	332	-	-	553	-
Stage 1	392	-	-	-	-	-
Stage 2	532	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 112	332	-	-	553	-
Mov Cap-2 Maneuver	~ 112	-	-	-	-	-
Stage 1	392	-	-	-	-	-
Stage 2	469	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	$ 396.8	0	0.9
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	112	332	553	-
HCM Lane V/C Ratio	-	-	1.863	0.147	0.083	-
HCM Control Delay (s)	-	-	$ 485.7	17.7	12.1	0
HCM Lane LOS	-	-	F	C	B	A
HCM 95th %tile Q(veh)	-	-	16.8	0.5	0.3	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	27	16	7	64	4	44	2	573	67	127	638	9
Future Volume (veh/h)	27	16	7	64	4	44	2	573	67	127	638	9
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1900	1863	1863	1900	1863	1900	1863	1863	1900	1863	1863	1863
Adj Flow Rate, veh/h	29	17	0	70	4	13	2	623	69	138	693	6
Adj No. of Lanes	0	1	1	0	1	0	1	1	0	1	1	1
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	246	130	303	295	21	42	382	873	97	428	1153	980
Arrive On Green	0.19	0.19	0.00	0.19	0.19	0.19	0.00	0.53	0.53	0.09	0.62	0.62
Sat Flow, veh/h	927	678	1583	1141	111	220	1774	1648	183	1774	1863	1583
Grp Volume(v), veh/h	46	0	0	87	0	0	2	0	692	138	693	6
Grp Sat Flow(s),veh/h/ln	1604	0	1583	1472	0	0	1774	0	1831	1774	1863	1583
Q Serve(g_s), s	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	24.3	2.6	19.2	0.1
Cycle Q Clear(g_c), s	1.8	0.0	0.0	4.0	0.0	0.0	0.0	0.0	24.3	2.6	19.2	0.1
Prop In Lane	0.63		1.00	0.80		0.15	1.00		0.10	1.00		1.00
Lane Grp Cap(c), veh/h	376	0	303	358	0	0	382	0	970	428	1153	980
V/C Ratio(X)	0.12	0.00	0.00	0.24	0.00	0.00	0.01	0.00	0.71	0.32	0.60	0.01
Avail Cap(c_a), veh/h	516	0	447	489	0	0	713	0	970	601	1153	980
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	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	28.5	0.0	0.0	29.3	0.0	0.0	10.1	0.0	15.1	10.8	9.8	6.2
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	4.5	0.2	2.3	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	0.9	0.0	0.0	1.8	0.0	0.0	0.0	0.0	13.3	1.2	10.6	0.1
LnGrp Delay(d),s/veh	28.6	0.0	0.0	29.4	0.0	0.0	10.1	0.0	19.6	11.0	12.2	6.2
LnGrp LOS	C			C			B		B	B	B	A
Approach Vol, veh/h		46			87			694			837	
Approach Delay, s/veh		28.6			29.4			19.5			11.9	
Approach LOS		C			C			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	11.7	51.0		22.3	4.1	58.6		22.3
Change Period (Y+Rc), s	4.0	6.0		6.0	4.0	6.0		6.0
Max Green Setting (Gmax), s	16.0	29.0		24.0	16.0	29.0		24.0
Max Q Clear Time (g_c+I1), s	4.6	26.3		3.8	2.0	21.2		6.0
Green Ext Time (p_c), s	0.1	2.4		0.4	0.0	6.7		0.4

Intersection Summary	
HCM 2010 Ctrl Delay	16.5
HCM 2010 LOS	B

Intersection	
Int Delay, s/veh	6.6

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	53	164	54	63	181	61
Future Vol, veh/h	53	164	54	63	181	61
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
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	178	59	68	197	66

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	127	0	-	0	386	93
Stage 1	-	-	-	-	93	-
Stage 2	-	-	-	-	293	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1459	-	-	-	617	964
Stage 1	-	-	-	-	931	-
Stage 2	-	-	-	-	757	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1459	-	-	-	590	964
Mov Cap-2 Maneuver	-	-	-	-	590	-
Stage 1	-	-	-	-	931	-
Stage 2	-	-	-	-	724	-

Approach	EB	WB	SB
HCM Control Delay, s	1.8	0	14.2
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1459	-	-	-	654
HCM Lane V/C Ratio	0.039	-	-	-	0.402
HCM Control Delay (s)	7.6	0	-	-	14.2
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	1.9

Intersection	
Int Delay, s/veh	1.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	18	25	6	111	211	8
Future Vol, veh/h	18	25	6	111	211	8
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	50	0	-	-	-	-
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	20	27	7	121	229	9

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	368	234	238	0	-	0
Stage 1	234	-	-	-	-	-
Stage 2	134	-	-	-	-	-
Critical Hdwy	7.12	6.22	4.12	-	-	-
Critical Hdwy Stg 1	6.12	-	-	-	-	-
Critical Hdwy Stg 2	6.12	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	588	805	1329	-	-	-
Stage 1	769	-	-	-	-	-
Stage 2	869	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	585	805	1329	-	-	-
Mov Cap-2 Maneuver	585	-	-	-	-	-
Stage 1	764	-	-	-	-	-
Stage 2	864	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.4	0.4	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1329	-	585	805	-	-
HCM Lane V/C Ratio	0.005	-	0.033	0.034	-	-
HCM Control Delay (s)	7.7	0	11.4	9.6	-	-
HCM Lane LOS	A	A	B	A	-	-
HCM 95th %tile Q(veh)	0	-	0.1	0.1	-	-

Intersection	
Int Delay, s/veh	1.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	24	19	3	122	194	8
Future Vol, veh/h	24	19	3	122	194	8
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
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	21	3	133	211	9

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	354	215	220	0	-	0
Stage 1	215	-	-	-	-	-
Stage 2	139	-	-	-	-	-
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	644	825	1349	-	-	-
Stage 1	821	-	-	-	-	-
Stage 2	888	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	643	825	1349	-	-	-
Mov Cap-2 Maneuver	643	-	-	-	-	-
Stage 1	821	-	-	-	-	-
Stage 2	886	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.4	0.2	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1349	-	712	-	-
HCM Lane V/C Ratio	0.002	-	0.066	-	-
HCM Control Delay (s)	7.7	0	10.4	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.2	-	-

Intersection	
Int Delay, s/veh	3.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	74	77	11	135	125	35
Future Vol, veh/h	74	77	11	135	125	35
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
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	80	84	12	147	136	38

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	326	155	174	0	-	0
Stage 1	155	-	-	-	-	-
Stage 2	171	-	-	-	-	-
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	668	891	1403	-	-	-
Stage 1	873	-	-	-	-	-
Stage 2	859	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	662	891	1403	-	-	-
Mov Cap-2 Maneuver	662	-	-	-	-	-
Stage 1	873	-	-	-	-	-
Stage 2	851	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	11	0.6	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1403	-	762	-	-
HCM Lane V/C Ratio	0.009	-	0.215	-	-
HCM Control Delay (s)	7.6	0	11	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.8	-	-

Intersection	
Int Delay, s/veh	2.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	97	21	5	204	139	33
Future Vol, veh/h	97	21	5	204	139	33
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	50	-	-	-	-
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	105	23	5	222	151	36

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	402	169	187	0	-	0
Stage 1	169	-	-	-	-	-
Stage 2	233	-	-	-	-	-
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	604	875	1387	-	-	-
Stage 1	861	-	-	-	-	-
Stage 2	806	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	602	875	1387	-	-	-
Mov Cap-2 Maneuver	602	-	-	-	-	-
Stage 1	861	-	-	-	-	-
Stage 2	803	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	11.7	0.2	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1387	-	602	875	-	-
HCM Lane V/C Ratio	0.004	-	0.175	0.026	-	-
HCM Control Delay (s)	7.6	0	12.2	9.2	-	-
HCM Lane LOS	A	A	B	A	-	-
HCM 95th %tile Q(veh)	0	-	0.6	0.1	-	-

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Existing Conditions PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	106	53	118	13	88	71	133	378	25	96	504	194
Future Volume (veh/h)	106	53	118	13	88	71	133	378	25	96	504	194
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	115	58	128	14	96	77	145	411	0	104	548	0
Adj No. of Lanes	1	1	1	1	1	1	1	1	1	1	1	1
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	301	284	242	262	172	146	397	811	690	490	798	678
Arrive On Green	0.08	0.15	0.15	0.02	0.09	0.09	0.07	0.44	0.00	0.06	0.43	0.00
Sat Flow, veh/h	1774	1863	1583	1774	1863	1583	1774	1863	1583	1774	1863	1583
Grp Volume(v), veh/h	115	58	128	14	96	77	145	411	0	104	548	0
Grp Sat Flow(s),veh/h/ln	1774	1863	1583	1774	1863	1583	1774	1863	1583	1774	1863	1583
Q Serve(g_s), s	3.8	1.8	5.0	0.5	3.3	3.1	3.0	10.6	0.0	2.1	15.9	0.0
Cycle Q Clear(g_c), s	3.8	1.8	5.0	0.5	3.3	3.1	3.0	10.6	0.0	2.1	15.9	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	301	284	242	262	172	146	397	811	690	490	798	678
V/C Ratio(X)	0.38	0.20	0.53	0.05	0.56	0.53	0.36	0.51	0.00	0.21	0.69	0.00
Avail Cap(c_a), veh/h	564	672	571	632	672	571	804	1091	928	909	1091	928
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	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	23.8	24.7	26.0	26.6	28.9	28.8	11.3	13.6	0.0	10.0	15.4	0.0
Incr Delay (d2), s/veh	0.3	0.1	0.7	0.0	1.1	1.1	0.2	1.0	0.0	0.1	2.3	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	1.8	0.9	2.2	0.2	1.7	1.4	1.4	5.6	0.0	1.0	8.6	0.0
LnGrp Delay(d),s/veh	24.1	24.8	26.7	26.6	30.0	29.9	11.6	14.7	0.0	10.1	17.7	0.0
LnGrp LOS	C	C	C	C	C	C	B	B		B	B	
Approach Vol, veh/h		301			187			556			652	
Approach Delay, s/veh		25.3			29.7			13.8			16.5	
Approach LOS		C			C			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	9.3	35.0	6.1	16.2	9.8	34.5	10.2	12.2
Change Period (Y+Rc), s	5.0	6.0	5.0	6.0	5.0	6.0	5.0	6.0
Max Green Setting (Gmax), s	20.0	39.0	15.0	24.0	20.0	39.0	15.0	24.0
Max Q Clear Time (g_c+I1), s	4.1	12.6	2.5	7.0	5.0	17.9	5.8	5.3
Green Ext Time (p_c), s	0.1	12.1	0.0	0.9	0.1	10.6	0.1	0.9

Intersection Summary	
HCM 2010 Ctrl Delay	18.6
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	8	66	24	391	97	169	37	371	339	190	442	31
Future Volume (veh/h)	8	66	24	391	97	169	37	371	339	190	442	31
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1909	1909	1909	1863	1863	1863	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	9	72	26	425	105	184	40	403	0	207	480	34
Adj No. of Lanes	1	1	1	1	1	1	1	1	1	1	1	1
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	216	149	164	537	531	607	328	628	876	422	767	666
Arrive On Green	0.01	0.08	0.08	0.22	0.29	0.29	0.02	0.34	0.00	0.10	0.41	0.41
Sat Flow, veh/h	1818	1909	1623	1774	1863	1583	1774	1863	1583	1774	1863	1583
Grp Volume(v), veh/h	9	72	26	425	105	184	40	403	0	207	480	34
Grp Sat Flow(s),veh/h/ln	1818	1909	1623	1774	1863	1583	1774	1863	1583	1774	1863	1583
Q Serve(g_s), s	0.3	2.7	1.1	15.8	3.2	6.0	1.1	13.5	0.0	5.3	15.1	0.9
Cycle Q Clear(g_c), s	0.3	2.7	1.1	15.8	3.2	6.0	1.1	13.5	0.0	5.3	15.1	0.9
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	216	149	164	537	531	607	328	628	876	422	767	666
V/C Ratio(X)	0.04	0.48	0.16	0.79	0.20	0.30	0.12	0.64	0.00	0.49	0.63	0.05
Avail Cap(c_a), veh/h	298	232	236	537	531	607	430	857	1071	512	983	850
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	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	31.0	32.7	30.3	22.6	20.0	15.9	16.1	20.7	0.0	14.2	17.2	12.7
Incr Delay (d2), s/veh	0.1	0.9	0.2	7.9	0.1	0.1	0.1	2.3	0.0	0.3	1.8	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	0.2	1.4	0.5	8.9	1.6	2.6	0.5	7.3	0.0	2.5	8.1	0.4
LnGrp Delay(d),s/veh	31.0	33.6	30.5	30.5	20.1	16.0	16.2	23.1	0.0	14.5	19.0	12.7
LnGrp LOS	C	C	C	C	C	B	B	C		B	B	B
Approach Vol, veh/h		107			714			443			721	
Approach Delay, s/veh		32.6			25.2			22.5			17.4	
Approach LOS		C			C			C			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	11.3	30.9	20.0	11.8	5.7	36.4	4.7	27.1
Change Period (Y+Rc), s	4.0	6.0	4.0	6.0	4.0	6.0	4.0	6.0
Max Green Setting (Gmax), s	11.0	34.0	16.0	9.0	6.0	39.0	4.0	21.0
Max Q Clear Time (g_c+I1), s	7.3	15.5	17.8	4.7	3.1	17.1	2.3	8.0
Green Ext Time (p_c), s	0.1	9.4	0.0	0.2	0.0	10.4	0.0	0.9

Intersection Summary	
HCM 2010 Ctrl Delay	22.2
HCM 2010 LOS	C

Intersection	
Int Delay, s/veh	3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	97	469	482	82	34	130
Future Vol, veh/h	97	469	482	82	34	130
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	145	-	-	-	0	0
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	105	510	524	89	37	141

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	613	0	-	0	1289	568
Stage 1	-	-	-	-	568	-
Stage 2	-	-	-	-	721	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	966	-	-	-	181	522
Stage 1	-	-	-	-	567	-
Stage 2	-	-	-	-	482	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	966	-	-	-	161	522
Mov Cap-2 Maneuver	-	-	-	-	161	-
Stage 1	-	-	-	-	567	-
Stage 2	-	-	-	-	430	-

Approach	EB	WB	SB
HCM Control Delay, s	1.6	0	18.4
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	966	-	-	-	161	522
HCM Lane V/C Ratio	0.109	-	-	-	0.23	0.271
HCM Control Delay (s)	9.2	-	-	-	33.9	14.4
HCM Lane LOS	A	-	-	-	D	B
HCM 95th %tile Q(veh)	0.4	-	-	-	0.8	1.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	249	195	55	65	307	237	46	110	33	283	163	233
Future Volume (veh/h)	249	195	55	65	307	237	46	110	33	283	163	233
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1863	1863	1900	1863	1863	1863	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	271	212	48	71	334	8	50	120	23	308	177	198
Adj No. of Lanes	1	1	0	1	1	1	1	1	0	1	1	0
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	442	501	113	442	446	379	248	229	44	497	225	251
Arrive On Green	0.15	0.34	0.34	0.04	0.24	0.24	0.04	0.15	0.15	0.16	0.28	0.28
Sat Flow, veh/h	1774	1471	333	1774	1863	1583	1774	1520	291	1774	804	900
Grp Volume(v), veh/h	271	0	260	71	334	8	50	0	143	308	0	375
Grp Sat Flow(s),veh/h/ln	1774	0	1804	1774	1863	1583	1774	0	1811	1774	0	1704
Q Serve(g_s), s	7.0	0.0	7.4	2.0	11.1	0.3	1.6	0.0	4.9	9.2	0.0	13.6
Cycle Q Clear(g_c), s	7.0	0.0	7.4	2.0	11.1	0.3	1.6	0.0	4.9	9.2	0.0	13.6
Prop In Lane	1.00		0.18	1.00		1.00	1.00		0.16	1.00		0.53
Lane Grp Cap(c), veh/h	442	0	614	442	446	379	248	0	273	497	0	476
V/C Ratio(X)	0.61	0.00	0.42	0.16	0.75	0.02	0.20	0.00	0.52	0.62	0.00	0.79
Avail Cap(c_a), veh/h	874	0	1054	656	670	569	477	0	651	497	0	612
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	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	15.2	0.0	17.0	17.8	23.5	19.4	22.9	0.0	26.1	17.8	0.0	22.2
Incr Delay (d2), s/veh	1.4	0.0	0.5	0.2	2.6	0.0	0.4	0.0	1.5	2.3	0.0	5.2
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	3.5	0.0	3.8	1.0	6.0	0.1	0.8	0.0	2.5	4.7	0.0	7.0
LnGrp Delay(d),s/veh	16.6	0.0	17.4	18.0	26.1	19.4	23.3	0.0	27.7	20.1	0.0	27.4
LnGrp LOS	B		B	B	C	B	C		C	C		C
Approach Vol, veh/h		531			413			193			683	
Approach Delay, s/veh		17.0			24.6			26.5			24.1	
Approach LOS		B			C			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	15.0	16.1	7.0	28.7	6.4	24.7	13.7	22.0
Change Period (Y+Rc), s	4.0	6.0	4.0	6.0	4.0	6.0	4.0	6.0
Max Green Setting (Gmax), s	11.0	24.0	11.0	39.0	11.0	24.0	26.0	24.0
Max Q Clear Time (g_c+I1), s	11.2	6.9	4.0	9.4	3.6	15.6	9.0	13.1
Green Ext Time (p_c), s	0.0	3.2	0.1	4.2	0.0	2.2	0.7	2.9

Intersection Summary	
HCM 2010 Ctrl Delay	22.4
HCM 2010 LOS	C

Intersection	
Intersection Delay, s/veh	67.7
Intersection LOS	F

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR
Lane Configurations																
Traffic Vol, veh/h	0	206	171	75	0	46	177	208	0	62	99	27	0	153	112	255
Future Vol, veh/h	0	206	171	75	0	46	177	208	0	62	99	27	0	153	112	255
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	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	224	186	82	0	50	192	226	0	67	108	29	0	166	122	277
Number of Lanes	0	0	1	0	0	0	1	0	0	1	1	0	0	1	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	2	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	2	2	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	2	1	1
HCM Control Delay	109.2	76.9	17.4	42.2
HCM LOS	F	F	C	E

Lane	NBLn1	NBLn2	EBLn1	WBLn1	SBLn1	SBLn2
Vol Left, %	100%	0%	46%	11%	100%	0%
Vol Thru, %	0%	79%	38%	41%	0%	31%
Vol Right, %	0%	21%	17%	48%	0%	69%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	62	126	452	431	153	367
LT Vol	62	0	206	46	153	0
Through Vol	0	99	171	177	0	112
RT Vol	0	27	75	208	0	255
Lane Flow Rate	67	137	491	468	166	399
Geometry Grp	7	7	2	2	7	7
Degree of Util (X)	0.189	0.359	1.122	1.018	0.421	0.9
Departure Headway (Hd)	10.689	10.002	8.221	8.25	9.62	8.586
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes
Cap	338	362	442	445	378	427
Service Time	8.389	7.702	6.321	6.25	7.32	6.286
HCM Lane V/C Ratio	0.198	0.378	1.111	1.052	0.439	0.934
HCM Control Delay	15.9	18.2	109.2	76.9	19.1	51.9
HCM Lane LOS	C	C	F	F	C	F
HCM 95th-tile Q	0.7	1.6	17.2	13.4	2	9.6

Intersection	
Int Delay, s/veh	76.5

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	206	45	405	225	68	626
Future Vol, veh/h	206	45	405	225	68	626
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	145	-	-	-	-
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	224	49	440	245	74	680

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1391	563	0	0	685	0
Stage 1	563	-	-	-	-	-
Stage 2	828	-	-	-	-	-
Critical Hdwy	7.12	6.22	-	-	4.12	-
Critical Hdwy Stg 1	6.12	-	-	-	-	-
Critical Hdwy Stg 2	6.12	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	~ 120	526	-	-	908	-
Stage 1	511	-	-	-	-	-
Stage 2	365	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 108	526	-	-	908	-
Mov Cap-2 Maneuver	~ 108	-	-	-	-	-
Stage 1	511	-	-	-	-	-
Stage 2	317	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	$ 477.3	0	0.9
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	108	526	908	-
HCM Lane V/C Ratio	-	-	2.073	0.093	0.081	-
HCM Control Delay (s)	-	-	$ 578.8	12.5	9.3	0
HCM Lane LOS	-	-	F	B	A	A
HCM 95th %tile Q(veh)	-	-	18.9	0.3	0.3	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	12	12	8	60	14	51	5	652	68	47	685	29
Future Volume (veh/h)	12	12	8	60	14	51	5	652	68	47	685	29
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1900	1863	1863	1900	1863	1900	1863	1863	1900	1863	1863	1863
Adj Flow Rate, veh/h	13	13	9	65	15	55	5	709	74	51	745	32
Adj No. of Lanes	0	1	1	0	1	0	1	1	0	1	1	1
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	207	187	318	191	56	125	335	896	94	340	1123	954
Arrive On Green	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.54	0.54	0.07	0.60	0.60
Sat Flow, veh/h	709	932	1583	631	278	625	1774	1659	173	1774	1863	1583
Grp Volume(v), veh/h	26	0	9	135	0	0	5	0	783	51	745	32
Grp Sat Flow(s),veh/h/ln	1641	0	1583	1534	0	0	1774	0	1832	1774	1863	1583
Q Serve(g_s), s	0.0	0.0	0.4	4.0	0.0	0.0	0.1	0.0	28.5	0.9	22.0	0.7
Cycle Q Clear(g_c), s	0.9	0.0	0.4	6.2	0.0	0.0	0.1	0.0	28.5	0.9	22.0	0.7
Prop In Lane	0.50		1.00	0.48		0.41	1.00		0.09	1.00		1.00
Lane Grp Cap(c), veh/h	394	0	318	372	0	0	335	0	989	340	1123	954
V/C Ratio(X)	0.07	0.00	0.03	0.36	0.00	0.00	0.01	0.00	0.79	0.15	0.66	0.03
Avail Cap(c_a), veh/h	531	0	458	505	0	0	669	0	1081	564	1123	954
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	0.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	26.9	0.0	26.7	28.9	0.0	0.0	10.4	0.0	15.3	11.9	10.9	6.7
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	4.6	0.1	2.0	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	0.5	0.0	0.2	2.7	0.0	0.0	0.1	0.0	15.4	0.5	11.8	0.3
LnGrp Delay(d),s/veh	26.9	0.0	26.7	29.1	0.0	0.0	10.4	0.0	20.0	12.0	12.9	6.7
LnGrp LOS	C		C	C			B		B	B	B	A
Approach Vol, veh/h		35			135			788			828	
Approach Delay, s/veh		26.9			29.1			19.9			12.6	
Approach LOS		C			C			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	9.5	50.8		22.7	4.3	56.1		22.7
Change Period (Y+Rc), s	4.0	6.0		6.0	4.0	6.0		6.0
Max Green Setting (Gmax), s	16.0	49.0		24.0	16.0	49.0		24.0
Max Q Clear Time (g_c+I1), s	2.9	30.5		2.9	2.1	24.0		8.2
Green Ext Time (p_c), s	0.0	14.3		0.6	0.0	19.9		0.5

Intersection Summary	
HCM 2010 Ctrl Delay	17.4
HCM 2010 LOS	B

Intersection	
Int Delay, s/veh	4.7

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	59	67	84	124	108	42
Future Vol, veh/h	59	67	84	124	108	42
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
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	64	73	91	135	117	46

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	226	0	-	0	360	159
Stage 1	-	-	-	-	159	-
Stage 2	-	-	-	-	201	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1342	-	-	-	639	886
Stage 1	-	-	-	-	870	-
Stage 2	-	-	-	-	833	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1342	-	-	-	607	886
Mov Cap-2 Maneuver	-	-	-	-	607	-
Stage 1	-	-	-	-	870	-
Stage 2	-	-	-	-	791	-

Approach	EB	WB	SB
HCM Control Delay, s	3.7	0	12.1
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1342	-	-	-	666
HCM Lane V/C Ratio	0.048	-	-	-	0.245
HCM Control Delay (s)	7.8	0	-	-	12.1
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	1

Intersection	
Int Delay, s/veh	1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	14	7	18	167	139	16
Future Vol, veh/h	14	7	18	167	139	16
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	50	0	-	-	-	-
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	15	8	20	182	151	17

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	381	160	168	0	-	0
Stage 1	160	-	-	-	-	-
Stage 2	221	-	-	-	-	-
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	621	885	1410	-	-	-
Stage 1	869	-	-	-	-	-
Stage 2	816	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	611	885	1410	-	-	-
Mov Cap-2 Maneuver	611	-	-	-	-	-
Stage 1	869	-	-	-	-	-
Stage 2	803	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.4	0.7	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1410	-	611	885	-	-
HCM Lane V/C Ratio	0.014	-	0.025	0.009	-	-
HCM Control Delay (s)	7.6	0	11	9.1	-	-
HCM Lane LOS	A	A	B	A	-	-
HCM 95th %tile Q(veh)	0	-	0.1	0	-	-

Intersection	
Int Delay, s/veh	1.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	12	21	145	142	17
Future Vol, veh/h	10	12	21	145	142	17
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
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	11	13	23	158	154	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	367	164	173	0	-	0
Stage 1	164	-	-	-	-	-
Stage 2	203	-	-	-	-	-
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	633	881	1404	-	-	-
Stage 1	865	-	-	-	-	-
Stage 2	831	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	622	881	1404	-	-	-
Mov Cap-2 Maneuver	622	-	-	-	-	-
Stage 1	865	-	-	-	-	-
Stage 2	816	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10	1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1404	-	741	-	-
HCM Lane V/C Ratio	0.016	-	0.032	-	-
HCM Control Delay (s)	7.6	0	10	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.1	-	-

Intersection	
Int Delay, s/veh	2.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	50	39	38	117	120	76
Future Vol, veh/h	50	39	38	117	120	76
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
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	54	42	41	127	130	83

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	382	172	213	0	-	0
Stage 1	172	-	-	-	-	-
Stage 2	210	-	-	-	-	-
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	620	872	1357	-	-	-
Stage 1	858	-	-	-	-	-
Stage 2	825	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	600	872	1357	-	-	-
Mov Cap-2 Maneuver	600	-	-	-	-	-
Stage 1	858	-	-	-	-	-
Stage 2	798	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	11	1.9	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1357	-	695	-	-
HCM Lane V/C Ratio	0.03	-	0.139	-	-
HCM Control Delay (s)	7.7	0	11	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.5	-	-

Intersection	
Int Delay, s/veh	1.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	57	6	15	152	190	73
Future Vol, veh/h	57	6	15	152	190	73
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	50	-	-	-	-
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	62	7	16	165	207	79

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	444	246	286	0	-	0
Stage 1	246	-	-	-	-	-
Stage 2	198	-	-	-	-	-
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	571	793	1276	-	-	-
Stage 1	795	-	-	-	-	-
Stage 2	835	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	563	793	1276	-	-	-
Mov Cap-2 Maneuver	563	-	-	-	-	-
Stage 1	795	-	-	-	-	-
Stage 2	823	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12	0.7	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1276	-	563	793	-	-
HCM Lane V/C Ratio	0.013	-	0.11	0.008	-	-
HCM Control Delay (s)	7.9	0	12.2	9.6	-	-
HCM Lane LOS	A	A	B	A	-	-
HCM 95th %tile Q(veh)	0	-	0.4	0	-	-

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Base Year 2020 AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	320	225	435	30	190	110	245	525	10	40	395	110
Future Volume (veh/h)	320	225	435	30	190	110	245	525	10	40	395	110
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1545	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	457	245	276	33	207	32	266	571	0	43	429	0
Adj No. of Lanes	1	1	1	1	1	1	1	1	1	1	1	1
Peak Hour Factor	0.70	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, %	10	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	339	494	420	285	253	215	434	808	687	294	663	563
Arrive On Green	0.16	0.27	0.27	0.03	0.14	0.14	0.11	0.43	0.00	0.04	0.36	0.00
Sat Flow, veh/h	1472	1863	1583	1774	1863	1583	1774	1863	1583	1774	1863	1583
Grp Volume(v), veh/h	457	245	276	33	207	32	266	571	0	43	429	0
Grp Sat Flow(s),veh/h/ln	1472	1863	1583	1774	1863	1583	1774	1863	1583	1774	1863	1583
Q Serve(g_s), s	15.0	10.4	14.6	1.5	10.1	1.7	8.4	23.5	0.0	1.4	18.1	0.0
Cycle Q Clear(g_c), s	15.0	10.4	14.6	1.5	10.1	1.7	8.4	23.5	0.0	1.4	18.1	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	339	494	420	285	253	215	434	808	687	294	663	563
V/C Ratio(X)	1.35	0.50	0.66	0.12	0.82	0.15	0.61	0.71	0.00	0.15	0.65	0.00
Avail Cap(c_a), veh/h	339	494	420	514	476	405	611	973	827	608	973	827
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	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	31.4	29.2	30.7	33.2	39.4	35.7	17.3	21.7	0.0	19.3	25.3	0.0
Incr Delay (d2), s/veh	174.6	0.3	3.0	0.1	2.5	0.1	0.5	2.9	0.0	0.1	2.3	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	19.1	5.4	6.7	0.7	5.4	0.7	4.1	12.7	0.0	0.7	9.7	0.0
LnGrp Delay(d),s/veh	205.9	29.5	33.7	33.3	41.9	35.9	17.8	24.6	0.0	19.3	27.6	0.0
LnGrp LOS	F	C	C	C	D	D	B	C		B	C	
Approach Vol, veh/h		978			272			837			472	
Approach Delay, s/veh		113.1			40.1			22.5			26.8	
Approach LOS		F			D			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	8.4	46.7	7.9	30.9	15.7	39.4	20.0	18.8
Change Period (Y+Rc), s	5.0	6.0	5.0	6.0	5.0	6.0	5.0	6.0
Max Green Setting (Gmax), s	20.0	49.0	15.0	24.0	20.0	49.0	15.0	24.0
Max Q Clear Time (g_c+I1), s	3.4	25.5	3.5	16.6	10.4	20.1	17.0	12.1
Green Ext Time (p_c), s	0.0	11.9	0.0	1.6	0.3	13.3	0.0	0.6

Intersection Summary	
HCM 2010 Ctrl Delay	59.8
HCM 2010 LOS	E

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	60	160	75	290	70	270	20	475	390	330	595	10
Future Volume (veh/h)	60	160	75	290	70	270	20	475	390	330	595	10
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1909	1909	1909	1863	1863	1863	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	65	174	36	315	76	135	22	516	0	359	647	7
Adj No. of Lanes	1	1	1	1	1	1	1	1	1	1	1	1
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	220	210	410	442	581	256	659	822	409	874	811
Arrive On Green	0.04	0.12	0.12	0.17	0.24	0.24	0.01	0.35	0.00	0.13	0.47	0.47
Sat Flow, veh/h	1818	1909	1623	1774	1863	1583	1774	1863	1583	1774	1863	1583
Grp Volume(v), veh/h	65	174	36	315	76	135	22	516	0	359	647	7
Grp Sat Flow(s),veh/h/ln	1818	1909	1623	1774	1863	1583	1774	1863	1583	1774	1863	1583
Q Serve(g_s), s	2.6	7.5	1.7	12.7	2.7	5.0	0.7	21.0	0.0	10.6	23.9	0.2
Cycle Q Clear(g_c), s	2.6	7.5	1.7	12.7	2.7	5.0	0.7	21.0	0.0	10.6	23.9	0.2
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	319	220	210	410	442	581	256	659	822	409	874	811
V/C Ratio(X)	0.20	0.79	0.17	0.77	0.17	0.23	0.09	0.78	0.00	0.88	0.74	0.01
Avail Cap(c_a), veh/h	326	248	234	410	462	598	357	747	897	409	874	811
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	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	31.2	36.5	32.8	25.7	25.7	18.6	18.3	24.5	0.0	17.8	18.3	10.1
Incr Delay (d2), s/veh	0.3	12.4	0.1	8.6	0.1	0.1	0.1	6.2	0.0	18.4	4.1	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	1.3	4.7	0.8	7.2	1.4	2.2	0.3	11.9	0.0	7.1	13.2	0.1
LnGrp Delay(d),s/veh	31.5	48.9	33.0	34.3	25.8	18.6	18.4	30.6	0.0	36.1	22.4	10.1
LnGrp LOS	C	D	C	C	C	B	B	C		D	C	B
Approach Vol, veh/h		275			526			538			1013	
Approach Delay, s/veh		42.7			29.0			30.1			27.2	
Approach LOS		D			C			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	15.0	36.0	18.0	15.8	5.2	45.8	7.6	26.1
Change Period (Y+Rc), s	4.0	6.0	4.0	6.0	4.0	6.0	4.0	6.0
Max Green Setting (Gmax), s	11.0	34.0	14.0	11.0	6.0	39.0	4.0	21.0
Max Q Clear Time (g_c+I1), s	12.6	23.0	14.7	9.5	2.7	25.9	4.6	7.0
Green Ext Time (p_c), s	0.0	7.0	0.0	0.2	0.0	9.2	0.0	1.1

Intersection Summary	
HCM 2010 Ctrl Delay	30.1
HCM 2010 LOS	C

Intersection	
Int Delay, s/veh	3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	80	765	535	65	30	105
Future Vol, veh/h	80	765	535	65	30	105
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	145	-	-	-	0	0
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	87	832	582	71	33	114

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	652	0	-	0	1622	617
Stage 1	-	-	-	-	617	-
Stage 2	-	-	-	-	1005	-
Critical Hdwy	4.12	-	-	-	7.12	6.22
Critical Hdwy Stg 1	-	-	-	-	6.12	-
Critical Hdwy Stg 2	-	-	-	-	6.12	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	935	-	-	-	82	490
Stage 1	-	-	-	-	477	-
Stage 2	-	-	-	-	291	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	935	-	-	-	76	490
Mov Cap-2 Maneuver	-	-	-	-	76	-
Stage 1	-	-	-	-	433	-
Stage 2	-	-	-	-	264	-

Approach	EB	WB	SB
HCM Control Delay, s	0.9	0	30
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	935	-	-	-	76	490
HCM Lane V/C Ratio	0.093	-	-	-	0.429	0.233
HCM Control Delay (s)	9.2	-	-	-	84.1	14.6
HCM Lane LOS	A	-	-	-	F	B
HCM 95th %tile Q(veh)	0.3	-	-	-	1.7	0.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	390	375	70	55	285	245	130	210	100	285	185	195
Future Volume (veh/h)	390	375	70	55	285	245	130	210	100	285	185	195
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1863	1863	1900	1863	1863	1863	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	488	408	68	60	310	28	141	228	94	310	201	127
Adj No. of Lanes	1	1	0	1	1	1	1	1	0	1	1	0
Peak Hour Factor	0.80	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	537	631	105	312	387	329	333	278	114	381	325	205
Arrive On Green	0.24	0.41	0.41	0.04	0.21	0.21	0.07	0.22	0.22	0.15	0.30	0.30
Sat Flow, veh/h	1774	1557	260	1774	1863	1583	1774	1254	517	1774	1068	675
Grp Volume(v), veh/h	488	0	476	60	310	28	141	0	322	310	0	328
Grp Sat Flow(s),veh/h/ln	1774	0	1817	1774	1863	1583	1774	0	1771	1774	0	1744
Q Serve(g_s), s	21.8	0.0	22.6	2.8	16.9	1.5	6.6	0.0	18.5	13.8	0.0	17.2
Cycle Q Clear(g_c), s	21.8	0.0	22.6	2.8	16.9	1.5	6.6	0.0	18.5	13.8	0.0	17.2
Prop In Lane	1.00		0.14	1.00		1.00	1.00		0.29	1.00		0.39
Lane Grp Cap(c), veh/h	537	0	736	312	387	329	333	0	392	381	0	530
V/C Ratio(X)	0.91	0.00	0.65	0.19	0.80	0.09	0.42	0.00	0.82	0.81	0.00	0.62
Avail Cap(c_a), veh/h	716	0	867	444	470	400	333	0	514	384	0	652
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	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	23.8	0.0	25.6	31.5	40.3	34.2	29.9	0.0	39.6	26.9	0.0	31.9
Incr Delay (d2), s/veh	12.8	0.0	1.3	0.3	8.0	0.1	0.9	0.0	8.0	12.5	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	12.5	0.0	11.5	1.4	9.6	0.7	3.3	0.0	9.9	8.0	0.0	8.5
LnGrp Delay(d),s/veh	36.6	0.0	26.9	31.8	48.3	34.3	30.8	0.0	47.6	39.3	0.0	33.1
LnGrp LOS	D		C	C	D	C	C		D	D		C
Approach Vol, veh/h		964			398			463			638	
Approach Delay, s/veh		31.8			44.8			42.5			36.1	
Approach LOS		C			D			D			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	19.9	29.7	8.1	49.3	11.0	38.5	29.2	28.2
Change Period (Y+Rc), s	4.0	6.0	4.0	6.0	4.0	6.0	4.0	6.0
Max Green Setting (Gmax), s	16.0	31.0	12.0	51.0	7.0	40.0	36.0	27.0
Max Q Clear Time (g_c+I1), s	15.8	20.5	4.8	24.6	8.6	19.2	23.8	18.9
Green Ext Time (p_c), s	0.0	3.2	0.1	5.9	0.0	4.4	1.4	3.3

Intersection Summary	
HCM 2010 Ctrl Delay	37.0
HCM 2010 LOS	D

Intersection	
Intersection Delay, s/veh	50.6
Intersection LOS	F

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	533	412	598	707
Demand Flow Rate, veh/h	543	420	611	722
Vehicles Circulating, veh/h	494	743	582	509
Vehicles Exiting, veh/h	737	450	455	654
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	26.1	31.0	54.3	77.4
Approach LOS	D	D	F	F

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	543	420	611	722
Cap Entry Lane, veh/h	689	537	631	679
Entry HV Adj Factor	0.981	0.980	0.979	0.979
Flow Entry, veh/h	533	412	598	707
Cap Entry, veh/h	676	527	618	665
V/C Ratio	0.788	0.781	0.968	1.063
Control Delay, s/veh	26.1	31.0	54.3	77.4
LOS	D	D	F	F
95th %tile Queue, veh	8	7	14	19

Intersection	
Int Delay, s/veh	100.8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	225	45	565	690	45	570
Future Vol, veh/h	225	45	565	690	45	570
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	145	-	-	-	-
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	245	49	614	750	49	620

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1706	989	0	0	1364	0
Stage 1	989	-	-	-	-	-
Stage 2	717	-	-	-	-	-
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	~ 100	299	-	-	504	-
Stage 1	360	-	-	-	-	-
Stage 2	484	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 85	299	-	-	504	-
Mov Cap-2 Maneuver	~ 85	-	-	-	-	-
Stage 1	360	-	-	-	-	-
Stage 2	412	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	$ 797.2	0	0.9
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	85	299	504	-
HCM Lane V/C Ratio	-	-	2.877	0.164	0.097	-
HCM Control Delay (s)	-	-	$ 952.7	19.4	12.9	0
HCM Lane LOS	-	-	F	C	B	A
HCM 95th %tile Q(veh)	-	-	23.8	0.6	0.3	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	30	20	10	85	5	55	5	650	100	170	765	10
Future Volume (veh/h)	30	20	10	85	5	55	5	650	100	170	765	10
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1900	1863	1863	1900	1863	1900	1863	1863	1900	1863	1863	1863
Adj Flow Rate, veh/h	33	22	-1	92	5	39	5	707	106	185	832	7
Adj No. of Lanes	0	1	1	0	1	0	1	1	0	1	1	1
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	240	144	313	257	24	85	286	825	124	340	1136	966
Arrive On Green	0.20	0.20	0.00	0.20	0.20	0.20	0.00	0.52	0.52	0.09	0.61	0.61
Sat Flow, veh/h	869	727	1583	943	123	429	1774	1583	237	1774	1863	1583
Grp Volume(v), veh/h	55	0	-1	136	0	0	5	0	813	185	832	7
Grp Sat Flow(s),veh/h/ln	1597	0	1583	1494	0	0	1774	0	1821	1774	1863	1583
Q Serve(g_s), s	0.0	0.0	0.0	4.3	0.0	0.0	0.1	0.0	32.8	3.6	26.8	0.1
Cycle Q Clear(g_c), s	2.2	0.0	0.0	6.5	0.0	0.0	0.1	0.0	32.8	3.6	26.8	0.1
Prop In Lane	0.60		1.00	0.68		0.29	1.00		0.13	1.00		1.00
Lane Grp Cap(c), veh/h	383	0	313	367	0	0	286	0	949	340	1136	966
V/C Ratio(X)	0.14	0.00	0.00	0.37	0.00	0.00	0.02	0.00	0.86	0.54	0.73	0.01
Avail Cap(c_a), veh/h	512	0	447	489	0	0	613	0	949	509	1136	966
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	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	28.2	0.0	0.0	29.8	0.0	0.0	11.8	0.0	17.6	16.0	11.7	6.5
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.0	9.8	0.5	4.2	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	1.1	0.0	0.0	2.8	0.0	0.0	0.1	0.0	18.9	2.4	15.0	0.1
LnGrp Delay(d),s/veh	28.3	0.0	0.0	30.1	0.0	0.0	11.8	0.0	27.5	16.6	15.9	6.5
LnGrp LOS	C			C			B		C	B	B	A
Approach Vol, veh/h		54			136			818			1024	
Approach Delay, s/veh		28.8			30.1			27.4			15.9	
Approach LOS		C			C			C			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	11.9	50.3		22.8	4.3	57.9		22.8
Change Period (Y+Rc), s	4.0	6.0		6.0	4.0	6.0		6.0
Max Green Setting (Gmax), s	16.0	29.0		24.0	16.0	29.0		24.0
Max Q Clear Time (g_c+I1), s	5.6	34.8		4.2	2.1	28.8		8.5
Green Ext Time (p_c), s	0.2	0.0		0.7	0.0	0.2		0.6

Intersection Summary	
HCM 2010 Ctrl Delay	21.8
HCM 2010 LOS	C

Intersection	
Int Delay, s/veh	14.7

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	70	235	75	100	270	75
Future Vol, veh/h	70	235	75	100	270	75
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
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	76	255	82	109	293	82

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	190	0	-	0	544	136
Stage 1	-	-	-	-	136	-
Stage 2	-	-	-	-	408	-
Critical Hdwy	4.12	-	-	-	7.12	6.22
Critical Hdwy Stg 1	-	-	-	-	6.12	-
Critical Hdwy Stg 2	-	-	-	-	6.12	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1384	-	-	-	450	913
Stage 1	-	-	-	-	867	-
Stage 2	-	-	-	-	620	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1384	-	-	-	428	913
Mov Cap-2 Maneuver	-	-	-	-	428	-
Stage 1	-	-	-	-	812	-
Stage 2	-	-	-	-	580	-

Approach	EB	WB	SB
HCM Control Delay, s	1.8	0	33.6
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1384	-	-	-	484
HCM Lane V/C Ratio	0.055	-	-	-	0.775
HCM Control Delay (s)	7.8	0	-	-	33.6
HCM Lane LOS	A	A	-	-	D
HCM 95th %tile Q(veh)	0.2	-	-	-	6.9

Intersection	
Int Delay, s/veh	1.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	20	25	10	160	310	10
Future Vol, veh/h	20	25	10	160	310	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	50	0	-	-	-	-
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	22	27	11	174	337	11

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	538	342	348	0	-	0
Stage 1	342	-	-	-	-	-
Stage 2	196	-	-	-	-	-
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	504	701	1211	-	-	-
Stage 1	719	-	-	-	-	-
Stage 2	837	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	499	701	1211	-	-	-
Mov Cap-2 Maneuver	499	-	-	-	-	-
Stage 1	719	-	-	-	-	-
Stage 2	829	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	11.3	0.5	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1211	-	499	701	-	-
HCM Lane V/C Ratio	0.009	-	0.044	0.039	-	-
HCM Control Delay (s)	8	0	12.5	10.3	-	-
HCM Lane LOS	A	A	B	B	-	-
HCM 95th %tile Q(veh)	0	-	0.1	0.1	-	-

Intersection	
Int Delay, s/veh	1.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	25	20	5	170	295	10
Future Vol, veh/h	25	20	5	170	295	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
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	22	5	185	321	11

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	522	326	332	0	-	0
Stage 1	326	-	-	-	-	-
Stage 2	196	-	-	-	-	-
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	515	715	1227	-	-	-
Stage 1	731	-	-	-	-	-
Stage 2	837	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	512	715	1227	-	-	-
Mov Cap-2 Maneuver	512	-	-	-	-	-
Stage 1	731	-	-	-	-	-
Stage 2	833	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	11.7	0.2	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1227	-	586	-	-
HCM Lane V/C Ratio	0.004	-	0.083	-	-
HCM Control Delay (s)	7.9	0	11.7	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.3	-	-

Intersection	
Int Delay, s/veh	3.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	75	80	15	185	225	35
Future Vol, veh/h	75	80	15	185	225	35
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
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	82	87	16	201	245	38

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	498	264	283	0	-	0
Stage 1	264	-	-	-	-	-
Stage 2	234	-	-	-	-	-
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	532	775	1279	-	-	-
Stage 1	780	-	-	-	-	-
Stage 2	805	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	525	775	1279	-	-	-
Mov Cap-2 Maneuver	525	-	-	-	-	-
Stage 1	780	-	-	-	-	-
Stage 2	794	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12.8	0.6	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1279	-	630	-	-
HCM Lane V/C Ratio	0.013	-	0.267	-	-
HCM Control Delay (s)	7.9	0	12.8	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	1.1	-	-

Intersection	
Int Delay, s/veh	2.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	100	25	5	250	240	35
Future Vol, veh/h	100	25	5	250	240	35
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	50	-	-	-	-
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	109	27	5	272	261	38

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	563	280	299	0	-	0
Stage 1	280	-	-	-	-	-
Stage 2	283	-	-	-	-	-
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	487	759	1262	-	-	-
Stage 1	767	-	-	-	-	-
Stage 2	765	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	485	759	1262	-	-	-
Mov Cap-2 Maneuver	485	-	-	-	-	-
Stage 1	767	-	-	-	-	-
Stage 2	761	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	13.7	0.2	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1262	-	485	759	-	-
HCM Lane V/C Ratio	0.004	-	0.224	0.036	-	-
HCM Control Delay (s)	7.9	0	14.6	9.9	-	-
HCM Lane LOS	A	A	B	A	-	-
HCM 95th %tile Q(veh)	0	-	0.9	0.1	-	-

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Base Year 2020 PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	125	95	155	15	125	75	190	485	25	100	575	270
Future Volume (veh/h)	125	95	155	15	125	75	190	485	25	100	575	270
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	136	103	168	16	136	82	207	527	0	109	625	0
Adj No. of Lanes	1	1	1	1	1	1	1	1	1	1	1	1
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	296	333	283	267	207	176	369	869	739	416	808	687
Arrive On Green	0.09	0.18	0.18	0.02	0.11	0.11	0.09	0.47	0.00	0.06	0.43	0.00
Sat Flow, veh/h	1774	1863	1583	1774	1863	1583	1774	1863	1583	1774	1863	1583
Grp Volume(v), veh/h	136	103	168	16	136	82	207	527	0	109	625	0
Grp Sat Flow(s),veh/h/ln	1774	1863	1583	1774	1863	1583	1774	1863	1583	1774	1863	1583
Q Serve(g_s), s	5.1	3.8	7.7	0.6	5.5	3.8	5.0	16.6	0.0	2.6	22.6	0.0
Cycle Q Clear(g_c), s	5.1	3.8	7.7	0.6	5.5	3.8	5.0	16.6	0.0	2.6	22.6	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	296	333	283	267	207	176	369	869	739	416	808	687
V/C Ratio(X)	0.46	0.31	0.59	0.06	0.66	0.47	0.56	0.61	0.00	0.26	0.77	0.00
Avail Cap(c_a), veh/h	479	565	481	571	565	481	658	919	781	763	919	781
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	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	26.2	28.2	29.8	30.2	33.7	32.9	14.5	15.7	0.0	12.3	19.1	0.0
Incr Delay (d2), s/veh	0.4	0.2	0.7	0.0	1.3	0.7	0.5	1.7	0.0	0.1	4.8	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	2.5	2.0	3.4	0.3	2.9	1.7	2.4	8.9	0.0	1.3	12.5	0.0
LnGrp Delay(d),s/veh	26.7	28.4	30.5	30.2	35.0	33.6	15.0	17.4	0.0	12.4	23.8	0.0
LnGrp LOS	C	C	C	C	D	C	B	B		B	C	
Approach Vol, veh/h		407			234			734			734	
Approach Delay, s/veh		28.7			34.2			16.7			22.1	
Approach LOS		C			C			B			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	9.5	42.9	6.5	20.2	12.1	40.3	11.8	14.8
Change Period (Y+Rc), s	5.0	6.0	5.0	6.0	5.0	6.0	5.0	6.0
Max Green Setting (Gmax), s	20.0	39.0	15.0	24.0	20.0	39.0	15.0	24.0
Max Q Clear Time (g_c+I1), s	4.6	18.6	2.6	9.7	7.0	24.6	7.1	7.5
Green Ext Time (p_c), s	0.1	12.5	0.0	1.2	0.2	9.7	0.1	1.3

Intersection Summary	
HCM 2010 Ctrl Delay	22.9
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	95	35	460	150	275	50	425	410	240	505	40
Future Volume (veh/h)	15	95	35	460	150	275	50	425	410	240	505	40
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1909	1909	1909	1863	1863	1863	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	16	103	38	500	163	299	54	462	0	261	549	43
Adj No. of Lanes	1	1	1	1	1	1	1	1	1	1	1	1
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	209	148	178	580	602	700	261	570	897	368	732	646
Arrive On Green	0.01	0.08	0.08	0.26	0.32	0.32	0.03	0.31	0.00	0.12	0.39	0.39
Sat Flow, veh/h	1818	1909	1623	1774	1863	1583	1774	1863	1583	1774	1863	1583
Grp Volume(v), veh/h	16	103	38	500	163	299	54	462	0	261	549	43
Grp Sat Flow(s),veh/h/ln	1818	1909	1623	1774	1863	1583	1774	1863	1583	1774	1863	1583
Q Serve(g_s), s	0.7	4.4	1.8	21.2	5.5	11.0	1.8	19.3	0.0	8.0	21.4	1.4
Cycle Q Clear(g_c), s	0.7	4.4	1.8	21.2	5.5	11.0	1.8	19.3	0.0	8.0	21.4	1.4
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	209	148	178	580	602	700	261	570	897	368	732	646
V/C Ratio(X)	0.08	0.69	0.21	0.86	0.27	0.43	0.21	0.81	0.00	0.71	0.75	0.07
Avail Cap(c_a), veh/h	397	203	225	580	602	700	330	617	937	388	732	646
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	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	35.1	38.0	34.3	24.3	21.2	16.2	20.3	27.0	0.0	18.7	22.1	15.2
Incr Delay (d2), s/veh	0.2	2.5	0.2	12.7	0.1	0.2	0.1	8.9	0.0	4.6	5.1	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	0.3	2.4	0.8	12.3	2.8	4.8	0.9	11.3	0.0	4.4	12.0	0.6
LnGrp Delay(d),s/veh	35.2	40.5	34.5	37.0	21.3	16.3	20.5	36.0	0.0	23.3	27.2	15.3
LnGrp LOS	D	D	C	D	C	B	C	D		C	C	B
Approach Vol, veh/h		157			962			516			853	
Approach Delay, s/veh		38.5			27.9			34.3			25.4	
Approach LOS		D			C			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	14.1	31.9	26.0	12.6	6.7	39.2	5.3	33.3
Change Period (Y+Rc), s	4.0	6.0	4.0	6.0	4.0	6.0	4.0	6.0
Max Green Setting (Gmax), s	11.0	28.0	22.0	9.0	6.0	33.0	10.0	21.0
Max Q Clear Time (g_c+I1), s	10.0	21.3	23.2	6.4	3.8	23.4	2.7	13.0
Green Ext Time (p_c), s	0.0	4.5	0.0	0.1	0.0	6.5	0.0	1.2

Intersection Summary	
HCM 2010 Ctrl Delay	29.1
HCM 2010 LOS	C

Intersection	
Int Delay, s/veh	5.8

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	135	570	655	90	45	185
Future Vol, veh/h	135	570	655	90	45	185
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	145	-	-	-	0	0
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	147	620	712	98	49	201

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	810	0	-	0	1674	761
Stage 1	-	-	-	-	761	-
Stage 2	-	-	-	-	913	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	816	-	-	-	105	405
Stage 1	-	-	-	-	461	-
Stage 2	-	-	-	-	391	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	816	-	-	-	86	405
Mov Cap-2 Maneuver	-	-	-	-	86	-
Stage 1	-	-	-	-	461	-
Stage 2	-	-	-	-	321	-

Approach	EB	WB	SB
HCM Control Delay, s	2	0	35.9
HCM LOS			E

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	816	-	-	-	86	405
HCM Lane V/C Ratio	0.18	-	-	-	0.569	0.497
HCM Control Delay (s)	10.4	-	-	-	91.7	22.3
HCM Lane LOS	B	-	-	-	F	C
HCM 95th %tile Q(veh)	0.7	-	-	-	2.6	2.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	270	270	80	130	415	285	95	210	95	325	230	260
Future Volume (veh/h)	270	270	80	130	415	285	95	210	95	325	230	260
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1863	1863	1900	1863	1863	1863	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	293	293	75	141	451	60	103	228	90	353	250	228
Adj No. of Lanes	1	1	0	1	1	1	1	1	0	1	1	0
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	355	495	127	376	531	452	243	287	113	427	305	278
Arrive On Green	0.13	0.35	0.35	0.07	0.29	0.29	0.06	0.23	0.23	0.17	0.34	0.34
Sat Flow, veh/h	1774	1432	366	1774	1863	1583	1774	1272	502	1774	899	820
Grp Volume(v), veh/h	293	0	368	141	451	60	103	0	318	353	0	478
Grp Sat Flow(s),veh/h/ln	1774	0	1798	1774	1863	1583	1774	0	1774	1774	0	1718
Q Serve(g_s), s	12.0	0.0	18.1	6.0	24.6	3.0	4.8	0.0	18.2	15.7	0.0	27.4
Cycle Q Clear(g_c), s	12.0	0.0	18.1	6.0	24.6	3.0	4.8	0.0	18.2	15.7	0.0	27.4
Prop In Lane	1.00		0.20	1.00		1.00	1.00		0.28	1.00		0.48
Lane Grp Cap(c), veh/h	355	0	622	376	531	452	243	0	400	427	0	583
V/C Ratio(X)	0.83	0.00	0.59	0.37	0.85	0.13	0.42	0.00	0.79	0.83	0.00	0.82
Avail Cap(c_a), veh/h	431	0	786	395	641	545	243	0	511	506	0	767
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	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	24.8	0.0	28.9	24.8	36.2	28.5	30.7	0.0	39.3	25.8	0.0	32.5
Incr Delay (d2), s/veh	10.6	0.0	0.9	0.6	9.0	0.1	1.2	0.0	6.6	9.4	0.0	5.4
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	6.8	0.0	9.2	3.0	14.0	1.3	2.4	0.0	9.7	8.7	0.0	13.9
LnGrp Delay(d),s/veh	35.4	0.0	29.8	25.4	45.2	28.7	31.9	0.0	45.9	35.2	0.0	37.9
LnGrp LOS	D		C	C	D	C	C		D	D		D
Approach Vol, veh/h		661			652			421			831	
Approach Delay, s/veh		32.3			39.4			42.5			36.8	
Approach LOS		C			D			D			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	22.2	30.3	11.9	43.2	10.0	42.5	18.4	36.7
Change Period (Y+Rc), s	4.0	6.0	4.0	6.0	4.0	6.0	4.0	6.0
Max Green Setting (Gmax), s	23.0	31.0	9.0	47.0	6.0	48.0	19.0	37.0
Max Q Clear Time (g_c+I1), s	17.7	20.2	8.0	20.1	6.8	29.4	14.0	26.6
Green Ext Time (p_c), s	0.6	4.1	0.0	6.3	0.0	5.4	0.4	4.1

Intersection Summary	
HCM 2010 Ctrl Delay	37.2
HCM 2010 LOS	D

Intersection	
Intersection Delay, s/veh	48.8
Intersection LOS	E

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	723	548	327	712
Demand Flow Rate, veh/h	737	559	333	726
Vehicles Circulating, veh/h	415	615	764	448
Vehicles Exiting, veh/h	759	482	388	726
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	54.0	44.8	21.4	59.3
Approach LOS	F	E	C	F

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	737	559	333	726
Cap Entry Lane, veh/h	746	611	526	722
Entry HV Adj Factor	0.980	0.980	0.981	0.981
Flow Entry, veh/h	723	548	327	712
Cap Entry, veh/h	732	599	516	708
V/C Ratio	0.988	0.915	0.633	1.006
Control Delay, s/veh	54.0	44.8	21.4	59.3
LOS	F	E	C	F
95th %tile Queue, veh	16	12	4	17

Intersection	
Int Delay, s/veh	131.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	250	45	510	285	70	715
Future Vol, veh/h	250	45	510	285	70	715
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	145	-	-	-	-
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	272	49	554	310	76	777

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1638	709	0	0	864	0
Stage 1	709	-	-	-	-	-
Stage 2	929	-	-	-	-	-
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	~ 111	434	-	-	779	-
Stage 1	488	-	-	-	-	-
Stage 2	385	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 92	434	-	-	779	-
Mov Cap-2 Maneuver	~ 92	-	-	-	-	-
Stage 1	488	-	-	-	-	-
Stage 2	319	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	$ 831.8	0	0.9
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	92	434	779	-
HCM Lane V/C Ratio	-	-	2.954	0.113	0.098	-
HCM Control Delay (s)	-	-	$ 978.9	14.3	10.1	0
HCM Lane LOS	-	-	F	B	B	A
HCM 95th %tile Q(veh)	-	-	26.3	0.4	0.3	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	15	10	145	20	130	5	715	150	115	755	30
Future Volume (veh/h)	15	15	10	145	20	130	5	715	150	115	755	30
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1900	1863	1863	1900	1863	1900	1863	1863	1900	1863	1863	1863
Adj Flow Rate, veh/h	16	16	11	158	22	141	5	777	163	125	821	33
Adj No. of Lanes	0	1	1	0	1	0	1	1	0	1	1	1
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	185	171	379	210	27	151	285	842	177	228	1164	989
Arrive On Green	0.24	0.24	0.24	0.24	0.24	0.24	0.00	0.56	0.56	0.06	0.62	0.62
Sat Flow, veh/h	586	713	1583	692	112	630	1774	1494	313	1774	1863	1583
Grp Volume(v), veh/h	32	0	11	321	0	0	5	0	940	125	821	33
Grp Sat Flow(s),veh/h/ln	1299	0	1583	1435	0	0	1774	0	1807	1774	1863	1583
Q Serve(g_s), s	0.0	0.0	0.6	25.1	0.0	0.0	0.1	0.0	57.4	3.3	35.9	1.0
Cycle Q Clear(g_c), s	1.6	0.0	0.6	26.7	0.0	0.0	0.1	0.0	57.4	3.3	35.9	1.0
Prop In Lane	0.50		1.00	0.49		0.44	1.00		0.17	1.00		1.00
Lane Grp Cap(c), veh/h	356	0	379	388	0	0	285	0	1019	228	1164	989
V/C Ratio(X)	0.09	0.00	0.03	0.83	0.00	0.00	0.02	0.00	0.92	0.55	0.71	0.03
Avail Cap(c_a), veh/h	379	0	404	411	0	0	322	0	1041	230	1164	989
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	0.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	35.7	0.0	35.4	45.8	0.0	0.0	14.8	0.0	24.1	26.3	15.3	8.7
Incr Delay (d2), s/veh	0.0	0.0	0.0	11.5	0.0	0.0	0.0	0.0	13.6	1.5	2.5	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	0.3	11.8	0.0	0.0	0.1	0.0	32.3	2.5	19.0	0.4
LnGrp Delay(d),s/veh	35.8	0.0	35.4	57.3	0.0	0.0	14.8	0.0	37.6	27.8	17.8	8.8
LnGrp LOS	D		D	E			B		D	C	B	A
Approach Vol, veh/h		43			321			945			979	
Approach Delay, s/veh		35.7			57.3			37.5			18.7	
Approach LOS		D			E			D			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	11.9	74.5		35.1	4.5	81.9		35.1
Change Period (Y+Rc), s	4.0	6.0		6.0	4.0	6.0		6.0
Max Green Setting (Gmax), s	8.0	70.0		31.0	3.0	75.0		31.0
Max Q Clear Time (g_c+I1), s	5.3	59.4		3.6	2.1	37.9		28.7
Green Ext Time (p_c), s	0.0	9.1		1.6	0.0	31.0		0.4

Intersection Summary	
HCM 2010 Ctrl Delay	32.2
HCM 2010 LOS	C

Intersection	
Int Delay, s/veh	9.7

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	75	205	235	290	190	60
Future Vol, veh/h	75	205	235	290	190	60
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
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	82	223	255	315	207	65

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	571	0	-	0	799	413
Stage 1	-	-	-	-	413	-
Stage 2	-	-	-	-	386	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1002	-	-	-	355	639
Stage 1	-	-	-	-	668	-
Stage 2	-	-	-	-	687	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1002	-	-	-	322	639
Mov Cap-2 Maneuver	-	-	-	-	322	-
Stage 1	-	-	-	-	668	-
Stage 2	-	-	-	-	623	-

Approach	EB	WB	SB
HCM Control Delay, s	2.4	0	38.4
HCM LOS			E

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1002	-	-	-	366
HCM Lane V/C Ratio	0.081	-	-	-	0.742
HCM Control Delay (s)	8.9	0	-	-	38.4
HCM Lane LOS	A	A	-	-	E
HCM 95th %tile Q(veh)	0.3	-	-	-	5.8

Intersection	
Int Delay, s/veh	0.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	15	10	20	350	235	20
Future Vol, veh/h	15	10	20	350	235	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	50	0	-	-	-	-
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	16	11	22	380	255	22

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	690	266	277	0	-	0
Stage 1	266	-	-	-	-	-
Stage 2	424	-	-	-	-	-
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	411	773	1286	-	-	-
Stage 1	779	-	-	-	-	-
Stage 2	660	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	402	773	1286	-	-	-
Mov Cap-2 Maneuver	402	-	-	-	-	-
Stage 1	779	-	-	-	-	-
Stage 2	645	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12.5	0.4	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1286	-	402	773	-	-
HCM Lane V/C Ratio	0.017	-	0.041	0.014	-	-
HCM Control Delay (s)	7.8	0	14.3	9.7	-	-
HCM Lane LOS	A	A	B	A	-	-
HCM 95th %tile Q(veh)	0.1	-	0.1	0	-	-

Intersection	
Int Delay, s/veh	0.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	15	25	330	235	20
Future Vol, veh/h	10	15	25	330	235	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
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	11	16	27	359	255	22

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	679	266	277	0	-	0
Stage 1	266	-	-	-	-	-
Stage 2	413	-	-	-	-	-
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	417	773	1286	-	-	-
Stage 1	779	-	-	-	-	-
Stage 2	668	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	406	773	1286	-	-	-
Mov Cap-2 Maneuver	406	-	-	-	-	-
Stage 1	779	-	-	-	-	-
Stage 2	651	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	11.7	0.6	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1286	-	568	-	-
HCM Lane V/C Ratio	0.021	-	0.048	-	-
HCM Control Delay (s)	7.9	0	11.7	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.1	-	-

Intersection	
Int Delay, s/veh	2.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	50	40	40	300	215	80
Future Vol, veh/h	50	40	40	300	215	80
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
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	54	43	43	326	234	87

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	690	277	321	0	-	0
Stage 1	277	-	-	-	-	-
Stage 2	413	-	-	-	-	-
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	411	762	1239	-	-	-
Stage 1	770	-	-	-	-	-
Stage 2	668	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	394	762	1239	-	-	-
Mov Cap-2 Maneuver	394	-	-	-	-	-
Stage 1	770	-	-	-	-	-
Stage 2	640	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	13.9	0.9	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1239	-	502	-	-
HCM Lane V/C Ratio	0.035	-	0.195	-	-
HCM Control Delay (s)	8	0	13.9	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.7	-	-

Intersection	
Int Delay, s/veh	1.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	60	10	15	335	285	75
Future Vol, veh/h	60	10	15	335	285	75
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	50	-	-	-	-
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	65	11	16	364	310	82

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	748	351	391	0	-	0
Stage 1	351	-	-	-	-	-
Stage 2	397	-	-	-	-	-
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	380	692	1168	-	-	-
Stage 1	713	-	-	-	-	-
Stage 2	679	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	374	692	1168	-	-	-
Mov Cap-2 Maneuver	374	-	-	-	-	-
Stage 1	713	-	-	-	-	-
Stage 2	667	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	15.7	0.3	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1168	-	374	692	-	-
HCM Lane V/C Ratio	0.014	-	0.174	0.016	-	-
HCM Control Delay (s)	8.1	0	16.6	10.3	-	-
HCM Lane LOS	A	A	C	B	-	-
HCM 95th %tile Q(veh)	0	-	0.6	0	-	-

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Future Year 2020 AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	325	225	440	30	190	110	255	540	10	40	395	110
Future Volume (veh/h)	325	225	440	30	190	110	255	540	10	40	395	110
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1545	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	464	245	281	33	207	32	277	587	0	43	429	0
Adj No. of Lanes	1	1	1	1	1	1	1	1	1	1	1	1
Peak Hour Factor	0.70	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, %	10	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	336	491	417	284	253	215	441	816	694	288	664	564
Arrive On Green	0.16	0.26	0.26	0.03	0.14	0.14	0.12	0.44	0.00	0.04	0.36	0.00
Sat Flow, veh/h	1472	1863	1583	1774	1863	1583	1774	1863	1583	1774	1863	1583
Grp Volume(v), veh/h	464	245	281	33	207	32	277	587	0	43	429	0
Grp Sat Flow(s),veh/h/ln	1472	1863	1583	1774	1863	1583	1774	1863	1583	1774	1863	1583
Q Serve(g_s), s	15.0	10.6	15.1	1.5	10.2	1.7	8.9	24.5	0.0	1.4	18.2	0.0
Cycle Q Clear(g_c), s	15.0	10.6	15.1	1.5	10.2	1.7	8.9	24.5	0.0	1.4	18.2	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	336	491	417	284	253	215	441	816	694	288	664	564
V/C Ratio(X)	1.38	0.50	0.67	0.12	0.82	0.15	0.63	0.72	0.00	0.15	0.65	0.00
Avail Cap(c_a), veh/h	336	491	417	510	472	401	607	963	819	598	963	819
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	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	31.8	29.6	31.3	33.5	39.8	36.1	17.4	21.8	0.0	19.5	25.5	0.0
Incr Delay (d2), s/veh	189.3	0.3	3.5	0.1	2.5	0.1	0.6	3.2	0.0	0.1	2.3	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	20.3	5.5	6.9	0.7	5.5	0.7	4.4	13.3	0.0	0.7	9.7	0.0
LnGrp Delay(d),s/veh	221.0	29.9	34.7	33.6	42.3	36.2	17.9	25.0	0.0	19.6	27.8	0.0
LnGrp LOS	F	C	C	C	D	D	B	C		B	C	
Approach Vol, veh/h		990			272			864			472	
Approach Delay, s/veh		120.8			40.5			22.8			27.0	
Approach LOS		F			D			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	8.4	47.5	7.9	31.0	16.1	39.8	20.0	18.9
Change Period (Y+Rc), s	5.0	6.0	5.0	6.0	5.0	6.0	5.0	6.0
Max Green Setting (Gmax), s	20.0	49.0	15.0	24.0	20.0	49.0	15.0	24.0
Max Q Clear Time (g_c+I1), s	3.4	26.5	3.5	17.1	10.9	20.2	17.0	12.2
Green Ext Time (p_c), s	0.0	11.8	0.0	1.6	0.3	13.5	0.0	0.6

Intersection Summary	
HCM 2010 Ctrl Delay	62.8
HCM 2010 LOS	E

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	60	160	75	300	70	295	20	475	390	335	595	10
Future Volume (veh/h)	60	160	75	300	70	295	20	475	390	335	595	10
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1909	1909	1909	1863	1863	1863	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	65	174	36	326	76	163	22	516	0	364	647	7
Adj No. of Lanes	1	1	1	1	1	1	1	1	1	1	1	1
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	220	210	410	442	581	256	659	822	409	874	811
Arrive On Green	0.04	0.12	0.12	0.17	0.24	0.24	0.01	0.35	0.00	0.13	0.47	0.47
Sat Flow, veh/h	1818	1909	1623	1774	1863	1583	1774	1863	1583	1774	1863	1583
Grp Volume(v), veh/h	65	174	36	326	76	163	22	516	0	364	647	7
Grp Sat Flow(s),veh/h/ln	1818	1909	1623	1774	1863	1583	1774	1863	1583	1774	1863	1583
Q Serve(g_s), s	2.6	7.5	1.7	13.3	2.7	6.2	0.7	21.0	0.0	10.8	23.9	0.2
Cycle Q Clear(g_c), s	2.6	7.5	1.7	13.3	2.7	6.2	0.7	21.0	0.0	10.8	23.9	0.2
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	319	220	210	410	442	581	256	659	822	409	874	811
V/C Ratio(X)	0.20	0.79	0.17	0.80	0.17	0.28	0.09	0.78	0.00	0.89	0.74	0.01
Avail Cap(c_a), veh/h	326	248	234	410	462	598	356	747	897	409	874	811
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	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	31.1	36.5	32.8	25.9	25.7	18.9	18.3	24.5	0.0	17.8	18.3	10.1
Incr Delay (d2), s/veh	0.3	12.4	0.1	10.4	0.1	0.1	0.1	6.2	0.0	20.2	4.1	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	1.3	4.7	0.8	7.6	1.4	2.7	0.3	11.9	0.0	7.4	13.2	0.1
LnGrp Delay(d),s/veh	31.5	48.9	33.0	36.3	25.8	19.0	18.4	30.7	0.0	38.1	22.4	10.1
LnGrp LOS	C	D	C	D	C	B	B	C		D	C	B
Approach Vol, veh/h		275			565			538			1018	
Approach Delay, s/veh		42.7			29.9			30.2			27.9	
Approach LOS		D			C			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	15.0	36.0	18.0	15.8	5.2	45.8	7.6	26.1
Change Period (Y+Rc), s	4.0	6.0	4.0	6.0	4.0	6.0	4.0	6.0
Max Green Setting (Gmax), s	11.0	34.0	14.0	11.0	6.0	39.0	4.0	21.0
Max Q Clear Time (g_c+I1), s	12.8	23.0	15.3	9.5	2.7	25.9	4.6	8.2
Green Ext Time (p_c), s	0.0	7.0	0.0	0.2	0.0	9.2	0.0	1.1

Intersection Summary	
HCM 2010 Ctrl Delay	30.6
HCM 2010 LOS	C

Intersection	
Int Delay, s/veh	7.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	80	765	10	10	545	65	30	5	30	30	5	105
Future Vol, veh/h	80	765	10	10	545	65	30	5	30	30	5	105
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	145	-	-	50	-	-	-	-	0	-	-	0
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	87	832	11	11	592	71	33	5	33	33	5	114

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	663	0	0	842	0	0	1663	1696	837	1663	1665	628
Stage 1	-	-	-	-	-	-	1011	1011	-	649	649	-
Stage 2	-	-	-	-	-	-	652	685	-	1014	1016	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	926	-	-	794	-	-	77	93	367	77	97	483
Stage 1	-	-	-	-	-	-	289	317	-	458	466	-
Stage 2	-	-	-	-	-	-	457	448	-	288	315	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	926	-	-	794	-	-	51	83	367	61	87	483
Mov Cap-2 Maneuver	-	-	-	-	-	-	51	83	-	61	87	-
Stage 1	-	-	-	-	-	-	262	287	-	415	460	-
Stage 2	-	-	-	-	-	-	340	442	-	233	285	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.9	0.2	96.1	41.7
HCM LOS			F	E

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	54	367	926	-	-	794	-	-	64	483
HCM Lane V/C Ratio	0.705	0.089	0.094	-	-	0.014	-	-	0.594	0.236
HCM Control Delay (s)	165	15.8	9.3	-	-	9.6	-	-	122.9	14.7
HCM Lane LOS	F	C	A	-	-	A	-	-	F	B
HCM 95th %tile Q(veh)	2.9	0.3	0.3	-	-	0	-	-	2.5	0.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	415	380	70	60	290	245	140	225	105	285	190	200
Future Volume (veh/h)	415	380	70	60	290	245	140	225	105	285	190	200
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1863	1863	1900	1863	1863	1863	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	519	413	68	65	315	28	152	245	99	310	207	132
Adj No. of Lanes	1	1	0	1	1	1	1	1	0	1	1	0
Peak Hour Factor	0.80	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	555	649	107	322	381	324	316	287	116	355	326	208
Arrive On Green	0.25	0.42	0.42	0.04	0.20	0.20	0.06	0.23	0.23	0.14	0.31	0.31
Sat Flow, veh/h	1774	1560	257	1774	1863	1583	1774	1263	510	1774	1064	679
Grp Volume(v), veh/h	519	0	481	65	315	28	152	0	344	310	0	339
Grp Sat Flow(s),veh/h/ln	1774	0	1817	1774	1863	1583	1774	0	1773	1774	0	1743
Q Serve(g_s), s	25.5	0.0	24.0	3.3	18.5	1.6	7.0	0.0	21.2	14.8	0.0	19.1
Cycle Q Clear(g_c), s	25.5	0.0	24.0	3.3	18.5	1.6	7.0	0.0	21.2	14.8	0.0	19.1
Prop In Lane	1.00		0.14	1.00		1.00	1.00		0.29	1.00		0.39
Lane Grp Cap(c), veh/h	555	0	756	322	381	324	316	0	404	355	0	534
V/C Ratio(X)	0.94	0.00	0.64	0.20	0.83	0.09	0.48	0.00	0.85	0.87	0.00	0.63
Avail Cap(c_a), veh/h	667	0	813	436	441	375	316	0	482	355	0	611
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	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	26.2	0.0	26.5	33.7	43.4	36.7	32.7	0.0	42.2	29.2	0.0	34.0
Incr Delay (d2), s/veh	18.7	0.0	1.5	0.3	10.9	0.1	1.1	0.0	12.0	20.6	0.0	1.7
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	18.7	0.0	12.3	1.6	10.7	0.7	0.9	0.0	11.8	9.2	0.0	9.4
LnGrp Delay(d),s/veh	44.9	0.0	27.9	34.0	54.4	36.9	33.9	0.0	54.2	49.8	0.0	35.8
LnGrp LOS	D		C	C	D	D	C		D	D		D
Approach Vol, veh/h		1000			408			496			649	
Approach Delay, s/veh		36.8			49.9			48.0			42.5	
Approach LOS		D			D			D			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	20.0	32.0	8.7	53.4	11.0	41.0	32.8	29.3
Change Period (Y+Rc), s	4.0	6.0	4.0	6.0	4.0	6.0	4.0	6.0
Max Green Setting (Gmax), s	16.0	31.0	12.0	51.0	7.0	40.0	36.0	27.0
Max Q Clear Time (g_c+I1), s	16.8	23.2	5.3	26.0	9.0	21.1	27.5	20.5
Green Ext Time (p_c), s	0.0	2.8	0.1	5.9	0.0	4.5	1.2	2.9

Intersection Summary	
HCM 2010 Ctrl Delay	42.5
HCM 2010 LOS	D

Intersection	
Intersection Delay, s/veh	52.6
Intersection LOS	F

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	543	412	604	707
Demand Flow Rate, veh/h	553	420	617	722
Vehicles Circulating, veh/h	494	754	587	515
Vehicles Exiting, veh/h	743	450	460	659
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	27.3	32.1	57.7	79.6
Approach LOS	D	D	F	F

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	553	420	617	722
Cap Entry Lane, veh/h	689	532	628	675
Entry HV Adj Factor	0.981	0.980	0.979	0.979
Flow Entry, veh/h	543	412	604	707
Cap Entry, veh/h	676	521	615	661
V/C Ratio	0.802	0.790	0.982	1.069
Control Delay, s/veh	27.3	32.1	57.7	79.6
LOS	D	D	F	F
95th %tile Queue, veh	8	7	14	19

Intersection	
Int Delay, s/veh	106

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	225	45	580	710	45	575
Future Vol, veh/h	225	45	580	710	45	575
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	145	-	-	-	-
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	245	49	630	772	49	625

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1739	1016	0	0	1402	0
Stage 1	1016	-	-	-	-	-
Stage 2	723	-	-	-	-	-
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	~ 96	289	-	-	487	-
Stage 1	350	-	-	-	-	-
Stage 2	481	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 81	289	-	-	487	-
Mov Cap-2 Maneuver	~ 81	-	-	-	-	-
Stage 1	350	-	-	-	-	-
Stage 2	407	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	$ 853.6	0	1
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	81	289	487	-
HCM Lane V/C Ratio	-	-	3.019	0.169	0.1	-
HCM Control Delay (s)	-	-	$ 1020.3	20	13.2	0
HCM Lane LOS	-	-	F	C	B	A
HCM 95th %tile Q(veh)	-	-	24.2	0.6	0.3	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	30	20	10	90	5	55	5	655	105	170	775	10
Future Volume (veh/h)	30	20	10	90	5	55	5	655	105	170	775	10
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1900	1863	1863	1900	1863	1900	1863	1863	1900	1863	1863	1863
Adj Flow Rate, veh/h	33	22	1	98	5	31	5	712	109	185	842	7
Adj No. of Lanes	0	1	1	0	1	0	1	1	0	1	1	1
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	239	143	313	254	21	61	279	823	126	334	1136	966
Arrive On Green	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.52	0.52	0.09	0.61	0.61
Sat Flow, veh/h	865	724	1583	915	107	307	1774	1578	242	1774	1863	1583
Grp Volume(v), veh/h	55	0	1	134	0	0	5	0	821	185	842	7
Grp Sat Flow(s),veh/h/ln	1589	0	1583	1329	0	0	1774	0	1820	1774	1863	1583
Q Serve(g_s), s	0.0	0.0	0.0	6.2	0.0	0.0	0.1	0.0	33.5	3.6	27.3	0.1
Cycle Q Clear(g_c), s	2.2	0.0	0.0	8.4	0.0	0.0	0.1	0.0	33.5	3.6	27.3	0.1
Prop In Lane	0.60		1.00	0.73		0.23	1.00		0.13	1.00		1.00
Lane Grp Cap(c), veh/h	382	0	313	336	0	0	279	0	948	334	1136	966
V/C Ratio(X)	0.14	0.00	0.00	0.40	0.00	0.00	0.02	0.00	0.87	0.55	0.74	0.01
Avail Cap(c_a), veh/h	511	0	447	458	0	0	606	0	948	503	1136	966
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	0.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	28.2	0.0	27.4	31.1	0.0	0.0	11.9	0.0	17.8	16.4	11.8	6.5
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.3	0.0	0.0	0.0	0.0	10.4	0.5	4.4	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	1.1	0.0	0.0	2.9	0.0	0.0	0.1	0.0	19.4	2.4	15.2	0.1
LnGrp Delay(d),s/veh	28.3	0.0	27.4	31.4	0.0	0.0	11.9	0.0	28.2	16.9	16.2	6.5
LnGrp LOS	C		C	C			B		C	B	B	A
Approach Vol, veh/h		56			134			826			1034	
Approach Delay, s/veh		28.3			31.4			28.1			16.2	
Approach LOS		C			C			C			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	11.9	50.3		22.8	4.3	57.9		22.8
Change Period (Y+Rc), s	4.0	6.0		6.0	4.0	6.0		6.0
Max Green Setting (Gmax), s	16.0	29.0		24.0	16.0	29.0		24.0
Max Q Clear Time (g_c+I1), s	5.6	35.5		4.2	2.1	29.3		10.4
Green Ext Time (p_c), s	0.2	0.0		0.7	0.0	0.0		0.6

Intersection Summary	
HCM 2010 Ctrl Delay	22.3
HCM 2010 LOS	C

Intersection	
Int Delay, s/veh	13.7

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	70	235	75	100	285	80
Future Vol, veh/h	70	235	75	100	285	80
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
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	76	255	82	109	310	87

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	190	0	-	0	544	136
Stage 1	-	-	-	-	136	-
Stage 2	-	-	-	-	408	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1384	-	-	-	500	913
Stage 1	-	-	-	-	890	-
Stage 2	-	-	-	-	671	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1384	-	-	-	468	913
Mov Cap-2 Maneuver	-	-	-	-	468	-
Stage 1	-	-	-	-	890	-
Stage 2	-	-	-	-	628	-

Approach	EB	WB	SB
HCM Control Delay, s	1.8	0	30.2
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1384	-	-	-	524
HCM Lane V/C Ratio	0.055	-	-	-	0.757
HCM Control Delay (s)	7.8	0	-	-	30.2
HCM Lane LOS	A	A	-	-	D
HCM 95th %tile Q(veh)	0.2	-	-	-	6.6

Intersection	
Int Delay, s/veh	1.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	20	25	10	160	310	10
Future Vol, veh/h	20	25	10	160	310	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	50	0	-	-	-	-
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	22	27	11	174	337	11

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	538	342	348	0	-	0
Stage 1	342	-	-	-	-	-
Stage 2	196	-	-	-	-	-
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	504	701	1211	-	-	-
Stage 1	719	-	-	-	-	-
Stage 2	837	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	499	701	1211	-	-	-
Mov Cap-2 Maneuver	499	-	-	-	-	-
Stage 1	719	-	-	-	-	-
Stage 2	829	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	11.3	0.5	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1211	-	499	701	-	-
HCM Lane V/C Ratio	0.009	-	0.044	0.039	-	-
HCM Control Delay (s)	8	0	12.5	10.3	-	-
HCM Lane LOS	A	A	B	B	-	-
HCM 95th %tile Q(veh)	0	-	0.1	0.1	-	-

Intersection	
Int Delay, s/veh	1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	25	20	5	175	320	10
Future Vol, veh/h	25	20	5	175	320	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
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	22	5	190	348	11

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	554	353	359	0	-	0
Stage 1	353	-	-	-	-	-
Stage 2	201	-	-	-	-	-
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	493	691	1200	-	-	-
Stage 1	711	-	-	-	-	-
Stage 2	833	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	491	691	1200	-	-	-
Mov Cap-2 Maneuver	491	-	-	-	-	-
Stage 1	711	-	-	-	-	-
Stage 2	829	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12	0.2	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1200	-	563	-	-
HCM Lane V/C Ratio	0.005	-	0.087	-	-
HCM Control Delay (s)	8	0	12	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.3	-	-

Intersection	
Int Delay, s/veh	3.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	75	80	15	190	250	35
Future Vol, veh/h	75	80	15	190	250	35
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
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	82	87	16	207	272	38

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	530	291	310	0	-	0
Stage 1	291	-	-	-	-	-
Stage 2	239	-	-	-	-	-
Critical Hdwy	7.12	6.22	4.12	-	-	-
Critical Hdwy Stg 1	6.12	-	-	-	-	-
Critical Hdwy Stg 2	6.12	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	460	748	1250	-	-	-
Stage 1	717	-	-	-	-	-
Stage 2	764	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	455	748	1250	-	-	-
Mov Cap-2 Maneuver	455	-	-	-	-	-
Stage 1	707	-	-	-	-	-
Stage 2	753	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	13.9	0.6	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1250	-	570	-	-
HCM Lane V/C Ratio	0.013	-	0.296	-	-
HCM Control Delay (s)	7.9	0	13.9	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	1.2	-	-

Intersection	
Int Delay, s/veh	2.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	100	25	5	255	265	35
Future Vol, veh/h	100	25	5	255	265	35
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	50	-	-	-	-
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	109	27	5	277	288	38

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	595	307	326	0	-	0
Stage 1	307	-	-	-	-	-
Stage 2	288	-	-	-	-	-
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	467	733	1234	-	-	-
Stage 1	746	-	-	-	-	-
Stage 2	761	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	465	733	1234	-	-	-
Mov Cap-2 Maneuver	465	-	-	-	-	-
Stage 1	746	-	-	-	-	-
Stage 2	757	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	14.1	0.2	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1234	-	465	733	-	-
HCM Lane V/C Ratio	0.004	-	0.234	0.037	-	-
HCM Control Delay (s)	7.9	0	15.1	10.1	-	-
HCM Lane LOS	A	A	C	B	-	-
HCM 95th %tile Q(veh)	0	-	0.9	0.1	-	-

Intersection	
Int Delay, s/veh	1.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	30	25	5	375	270	10
Future Vol, veh/h	30	25	5	375	270	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	50	-	-	-
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	33	27	5	408	293	11

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	717	299	304	0	-	0
Stage 1	299	-	-	-	-	-
Stage 2	418	-	-	-	-	-
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	396	741	1257	-	-	-
Stage 1	752	-	-	-	-	-
Stage 2	664	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	394	741	1257	-	-	-
Mov Cap-2 Maneuver	394	-	-	-	-	-
Stage 1	752	-	-	-	-	-
Stage 2	661	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	13.2	0.1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1257	-	501	-	-
HCM Lane V/C Ratio	0.004	-	0.119	-	-
HCM Control Delay (s)	7.9	-	13.2	-	-
HCM Lane LOS	A	-	B	-	-
HCM 95th %tile Q(veh)	0	-	0.4	-	-

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Future Year 2020 PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	125	95	170	15	125	75	195	490	25	100	585	270
Future Volume (veh/h)	125	95	170	15	125	75	195	490	25	100	585	270
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	136	103	185	16	136	82	212	533	0	109	636	0
Adj No. of Lanes	1	1	1	1	1	1	1	1	1	1	1	1
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	295	333	283	266	207	176	365	875	744	415	812	690
Arrive On Green	0.09	0.18	0.18	0.02	0.11	0.11	0.09	0.47	0.00	0.06	0.44	0.00
Sat Flow, veh/h	1774	1863	1583	1774	1863	1583	1774	1863	1583	1774	1863	1583
Grp Volume(v), veh/h	136	103	185	16	136	82	212	533	0	109	636	0
Grp Sat Flow(s),veh/h/ln	1774	1863	1583	1774	1863	1583	1774	1863	1583	1774	1863	1583
Q Serve(g_s), s	5.2	3.8	8.7	0.6	5.6	3.9	5.1	17.0	0.0	2.7	23.4	0.0
Cycle Q Clear(g_c), s	5.2	3.8	8.7	0.6	5.6	3.9	5.1	17.0	0.0	2.7	23.4	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	295	333	283	266	207	176	365	875	744	415	812	690
V/C Ratio(X)	0.46	0.31	0.65	0.06	0.66	0.47	0.58	0.61	0.00	0.26	0.78	0.00
Avail Cap(c_a), veh/h	475	560	476	566	560	476	647	910	773	758	910	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	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	26.5	28.5	30.5	30.5	34.0	33.3	14.8	15.7	0.0	12.4	19.3	0.0
Incr Delay (d2), s/veh	0.4	0.2	1.0	0.0	1.3	0.7	0.5	1.8	0.0	0.1	5.2	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	2.6	2.0	3.9	0.3	2.9	1.7	2.5	9.0	0.0	1.3	13.0	0.0
LnGrp Delay(d),s/veh	27.0	28.7	31.4	30.5	35.3	34.0	15.4	17.5	0.0	12.5	24.5	0.0
LnGrp LOS	C	C	C	C	D	C	B	B		B	C	
Approach Vol, veh/h		424			234			745			745	
Approach Delay, s/veh		29.3			34.5			16.9			22.7	
Approach LOS		C			C			B			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	9.6	43.5	6.5	20.3	12.3	40.8	11.9	14.9
Change Period (Y+Rc), s	5.0	6.0	5.0	6.0	5.0	6.0	5.0	6.0
Max Green Setting (Gmax), s	20.0	39.0	15.0	24.0	20.0	39.0	15.0	24.0
Max Q Clear Time (g_c+I1), s	4.7	19.0	2.6	10.7	7.1	25.4	7.2	7.6
Green Ext Time (p_c), s	0.1	12.6	0.0	1.2	0.2	9.4	0.1	1.3

Intersection Summary	
HCM 2010 Ctrl Delay	23.3
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	95	35	465	150	290	50	425	420	260	505	40
Future Volume (veh/h)	15	95	35	465	150	290	50	425	420	260	505	40
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1909	1909	1909	1863	1863	1863	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	16	103	38	505	163	315	54	462	0	283	549	43
Adj No. of Lanes	1	1	1	1	1	1	1	1	1	1	1	1
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	209	148	178	577	600	712	264	559	885	375	737	650
Arrive On Green	0.01	0.08	0.08	0.26	0.32	0.32	0.03	0.30	0.00	0.13	0.40	0.40
Sat Flow, veh/h	1818	1909	1623	1774	1863	1583	1774	1863	1583	1774	1863	1583
Grp Volume(v), veh/h	16	103	38	505	163	315	54	462	0	283	549	43
Grp Sat Flow(s),veh/h/ln	1818	1909	1623	1774	1863	1583	1774	1863	1583	1774	1863	1583
Q Serve(g_s), s	0.7	4.5	1.8	21.6	5.5	11.6	1.8	19.6	0.0	8.8	21.4	1.4
Cycle Q Clear(g_c), s	0.7	4.5	1.8	21.6	5.5	11.6	1.8	19.6	0.0	8.8	21.4	1.4
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	209	148	178	577	600	712	264	559	885	375	737	650
V/C Ratio(X)	0.08	0.70	0.21	0.88	0.27	0.44	0.20	0.83	0.00	0.75	0.75	0.07
Avail Cap(c_a), veh/h	396	202	224	577	600	712	332	614	932	379	737	650
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	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	35.3	38.2	34.5	24.7	21.4	16.1	20.6	27.7	0.0	19.0	22.0	15.2
Incr Delay (d2), s/veh	0.2	2.6	0.2	14.1	0.1	0.2	0.1	10.0	0.0	7.4	5.0	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	0.3	2.5	0.8	12.6	2.9	5.1	0.9	11.6	0.0	5.0	12.0	0.6
LnGrp Delay(d),s/veh	35.4	40.8	34.7	38.8	21.5	16.2	20.8	37.6	0.0	26.4	27.0	15.3
LnGrp LOS	D	D	C	D	C	B	C	D		C	C	B
Approach Vol, veh/h		157			983			516			875	
Approach Delay, s/veh		38.8			28.7			35.9			26.2	
Approach LOS		D			C			D			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	14.8	31.5	26.0	12.6	6.7	39.6	5.3	33.3
Change Period (Y+Rc), s	4.0	6.0	4.0	6.0	4.0	6.0	4.0	6.0
Max Green Setting (Gmax), s	11.0	28.0	22.0	9.0	6.0	33.0	10.0	21.0
Max Q Clear Time (g_c+I1), s	10.8	21.6	23.6	6.5	3.8	23.4	2.7	13.6
Green Ext Time (p_c), s	0.0	3.9	0.0	0.1	0.0	6.5	0.0	1.2

Intersection Summary	
HCM 2010 Ctrl Delay	29.9
HCM 2010 LOS	C

Intersection	
Int Delay, s/veh	14.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	135	570	30	30	660	90	15	5	15	45	5	185
Future Vol, veh/h	135	570	30	30	660	90	15	5	15	45	5	185
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	145	-	-	50	-	-	-	-	0	-	-	0
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	147	620	33	33	717	98	16	5	16	49	5	201

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	815	0	0	652	0	0	1763	1809	636	1764	1778	766
Stage 1	-	-	-	-	-	-	929	929	-	832	832	-
Stage 2	-	-	-	-	-	-	834	880	-	932	946	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	812	-	-	935	-	-	66	79	478	66	82	403
Stage 1	-	-	-	-	-	-	321	346	-	363	384	-
Stage 2	-	-	-	-	-	-	362	365	-	320	340	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	812	-	-	935	-	-	26	62	478	50	65	403
Mov Cap-2 Maneuver	-	-	-	-	-	-	26	62	-	50	65	-
Stage 1	-	-	-	-	-	-	263	283	-	297	370	-
Stage 2	-	-	-	-	-	-	172	352	-	248	278	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	1.9	0.3	159.9	76.2
HCM LOS			F	F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	30	478	812	-	-	935	-	-	51	403
HCM Lane V/C Ratio	0.725	0.034	0.181	-	-	0.035	-	-	1.066	0.499
HCM Control Delay (s)	270.3	12.8	10.4	-	-	9	-	-	274.9	22.5
HCM Lane LOS	F	B	B	-	-	A	-	-	F	C
HCM 95th %tile Q(veh)	2.4	0.1	0.7	-	-	0.1	-	-	4.7	2.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	280	270	80	135	420	285	100	215	95	325	255	280
Future Volume (veh/h)	280	270	80	135	420	285	100	215	95	325	255	280
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1863	1863	1900	1863	1863	1863	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	304	293	75	147	457	60	109	234	90	353	277	249
Adj No. of Lanes	1	1	0	1	1	1	1	1	0	1	1	0
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	351	494	127	376	528	449	212	303	116	428	316	284
Arrive On Green	0.14	0.35	0.35	0.08	0.28	0.28	0.05	0.24	0.24	0.17	0.35	0.35
Sat Flow, veh/h	1774	1432	366	1774	1863	1583	1774	1282	493	1774	905	814
Grp Volume(v), veh/h	304	0	368	147	457	60	109	0	324	353	0	526
Grp Sat Flow(s),veh/h/ln	1774	0	1798	1774	1863	1583	1774	0	1776	1774	0	1719
Q Serve(g_s), s	13.1	0.0	19.0	6.5	26.3	3.2	5.3	0.0	19.2	16.3	0.0	32.4
Cycle Q Clear(g_c), s	13.1	0.0	19.0	6.5	26.3	3.2	5.3	0.0	19.2	16.3	0.0	32.4
Prop In Lane	1.00		0.20	1.00		1.00	1.00		0.28	1.00		0.47
Lane Grp Cap(c), veh/h	351	0	621	376	528	449	212	0	419	428	0	600
V/C Ratio(X)	0.87	0.00	0.59	0.39	0.87	0.13	0.51	0.00	0.77	0.83	0.00	0.88
Avail Cap(c_a), veh/h	407	0	749	384	611	519	212	0	488	494	0	731
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	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	26.2	0.0	30.4	26.1	38.4	30.1	32.3	0.0	40.3	26.6	0.0	34.4
Incr Delay (d2), s/veh	15.7	0.0	0.9	0.7	11.2	0.1	2.1	0.0	6.5	9.8	0.0	10.1
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	7.9	0.0	9.6	3.2	15.1	1.4	2.7	0.0	10.2	9.1	0.0	17.0
LnGrp Delay(d),s/veh	41.9	0.0	31.3	26.7	49.6	30.3	34.4	0.0	46.8	36.4	0.0	44.5
LnGrp LOS	D		C	C	D	C	C		D	D		D
Approach Vol, veh/h		672			664			433			879	
Approach Delay, s/veh		36.1			42.8			43.7			41.2	
Approach LOS		D			D			D			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	22.8	32.6	12.5	45.0	10.0	45.4	19.5	38.0
Change Period (Y+Rc), s	4.0	6.0	4.0	6.0	4.0	6.0	4.0	6.0
Max Green Setting (Gmax), s	23.0	31.0	9.0	47.0	6.0	48.0	19.0	37.0
Max Q Clear Time (g_c+I1), s	18.3	21.2	8.5	21.0	7.3	34.4	15.1	28.3
Green Ext Time (p_c), s	0.5	4.1	0.0	6.3	0.0	5.0	0.4	3.7

Intersection Summary	
HCM 2010 Ctrl Delay	40.7
HCM 2010 LOS	D

Intersection	
Intersection Delay, s/veh	49.5
Intersection LOS	E

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	728	548	327	712
Demand Flow Rate, veh/h	743	559	333	726
Vehicles Circulating, veh/h	415	615	770	448
Vehicles Exiting, veh/h	759	488	388	726
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	55.9	44.8	21.7	59.3
Approach LOS	F	E	C	F

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	743	559	333	726
Cap Entry Lane, veh/h	746	611	523	722
Entry HV Adj Factor	0.980	0.980	0.981	0.981
Flow Entry, veh/h	728	548	327	712
Cap Entry, veh/h	732	599	513	708
V/C Ratio	0.996	0.915	0.636	1.006
Control Delay, s/veh	55.9	44.8	21.7	59.3
LOS	F	E	C	F
95th %tile Queue, veh	16	12	4	17

Intersection	
Int Delay, s/veh	166.7

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	265	45	520	295	70	750
Future Vol, veh/h	265	45	520	295	70	750
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	145	-	-	-	-
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	288	49	565	321	76	815

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1693	726	0	0	886	0
Stage 1	726	-	-	-	-	-
Stage 2	967	-	-	-	-	-
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	~ 102	425	-	-	764	-
Stage 1	479	-	-	-	-	-
Stage 2	369	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 83	425	-	-	764	-
Mov Cap-2 Maneuver	~ 83	-	-	-	-	-
Stage 1	479	-	-	-	-	-
Stage 2	302	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	$ 1043.3	0	0.9
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	83	425	764	-
HCM Lane V/C Ratio	-	-	3.47	0.115	0.1	-
HCM Control Delay (s)	-	-	$ 1218	14.6	10.2	0
HCM Lane LOS	-	-	F	B	B	A
HCM 95th %tile Q(veh)	-	-	29.3	0.4	0.3	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	15	10	145	20	130	5	720	155	115	760	30
Future Volume (veh/h)	15	15	10	145	20	130	5	720	155	115	760	30
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
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
Adj Sat Flow, veh/h/ln	1900	1863	1863	1900	1863	1900	1863	1863	1900	1863	1863	1863
Adj Flow Rate, veh/h	16	16	1	158	22	112	5	783	160	125	826	19
Adj No. of Lanes	0	1	1	0	1	0	1	1	0	1	1	1
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	184	170	355	216	27	122	298	864	176	244	1187	1009
Arrive On Green	0.22	0.22	0.22	0.22	0.22	0.22	0.00	0.58	0.58	0.07	0.64	0.64
Sat Flow, veh/h	617	757	1583	757	119	545	1774	1502	307	1774	1863	1583
Grp Volume(v), veh/h	32	0	1	292	0	0	5	0	943	125	826	19
Grp Sat Flow(s),veh/h/ln	1374	0	1583	1421	0	0	1774	0	1809	1774	1863	1583
Q Serve(g_s), s	0.0	0.0	0.1	22.4	0.0	0.0	0.1	0.0	55.0	3.1	34.3	0.5
Cycle Q Clear(g_c), s	1.6	0.0	0.1	24.0	0.0	0.0	0.1	0.0	55.0	3.1	34.3	0.5
Prop In Lane	0.50		1.00	0.54		0.38	1.00		0.17	1.00		1.00
Lane Grp Cap(c), veh/h	353	0	355	365	0	0	298	0	1040	244	1187	1009
V/C Ratio(X)	0.09	0.00	0.00	0.80	0.00	0.00	0.02	0.00	0.91	0.51	0.70	0.02
Avail Cap(c_a), veh/h	408	0	413	420	0	0	336	0	1065	246	1187	1009
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	0.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	36.4	0.0	35.8	45.7	0.0	0.0	13.6	0.0	22.4	24.8	14.0	7.9
Incr Delay (d2), s/veh	0.0	0.0	0.0	8.0	0.0	0.0	0.0	0.0	11.6	0.7	2.3	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	0.8	0.0	0.0	10.2	0.0	0.0	0.1	0.0	30.6	2.5	18.2	0.2
LnGrp Delay(d),s/veh	36.4	0.0	35.8	53.6	0.0	0.0	13.6	0.0	34.0	25.5	16.3	7.9
LnGrp LOS	D		D	D			B		C	C	B	A
Approach Vol, veh/h		33			292			948			970	
Approach Delay, s/veh		36.4			53.6			33.9			17.3	
Approach LOS		D			D			C			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	11.9	74.4		32.6	4.5	81.8		32.6
Change Period (Y+Rc), s	4.0	6.0		6.0	4.0	6.0		6.0
Max Green Setting (Gmax), s	8.0	70.0		31.0	3.0	75.0		31.0
Max Q Clear Time (g_c+I1), s	5.1	57.0		3.6	2.1	36.3		26.0
Green Ext Time (p_c), s	0.0	11.3		1.4	0.0	32.1		0.6

Intersection Summary	
HCM 2010 Ctrl Delay	29.3
HCM 2010 LOS	C

Intersection	
Int Delay, s/veh	11.6

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	85	205	235	305	195	60
Future Vol, veh/h	85	205	235	305	195	60
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
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	92	223	255	332	212	65

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	587	0	-	0	829	421
Stage 1	-	-	-	-	421	-
Stage 2	-	-	-	-	408	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	988	-	-	-	340	632
Stage 1	-	-	-	-	662	-
Stage 2	-	-	-	-	671	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	988	-	-	-	304	632
Mov Cap-2 Maneuver	-	-	-	-	304	-
Stage 1	-	-	-	-	662	-
Stage 2	-	-	-	-	600	-

Approach	EB	WB	SB
HCM Control Delay, s	2.6	0	46.5
HCM LOS			E

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	988	-	-	-	346
HCM Lane V/C Ratio	0.094	-	-	-	0.801
HCM Control Delay (s)	9	0	-	-	46.5
HCM Lane LOS	A	A	-	-	E
HCM 95th %tile Q(veh)	0.3	-	-	-	6.8

Intersection	
Int Delay, s/veh	0.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	15	10	20	350	235	20
Future Vol, veh/h	15	10	20	350	235	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	50	0	-	-	-	-
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	16	11	22	380	255	22

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	690	266	277	0	-	0
Stage 1	266	-	-	-	-	-
Stage 2	424	-	-	-	-	-
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	411	773	1286	-	-	-
Stage 1	779	-	-	-	-	-
Stage 2	660	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	402	773	1286	-	-	-
Mov Cap-2 Maneuver	402	-	-	-	-	-
Stage 1	779	-	-	-	-	-
Stage 2	645	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12.5	0.4	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1286	-	402	773	-	-
HCM Lane V/C Ratio	0.017	-	0.041	0.014	-	-
HCM Control Delay (s)	7.8	0	14.3	9.7	-	-
HCM Lane LOS	A	A	B	A	-	-
HCM 95th %tile Q(veh)	0.1	-	0.1	0	-	-

Intersection	
Int Delay, s/veh	0.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	15	25	350	250	20
Future Vol, veh/h	10	15	25	350	250	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
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	11	16	27	380	272	22

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	718	283	293	0	-	0
Stage 1	283	-	-	-	-	-
Stage 2	435	-	-	-	-	-
Critical Hdwy	7.12	6.22	4.12	-	-	-
Critical Hdwy Stg 1	6.12	-	-	-	-	-
Critical Hdwy Stg 2	6.12	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	344	756	1269	-	-	-
Stage 1	724	-	-	-	-	-
Stage 2	600	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	337	756	1269	-	-	-
Mov Cap-2 Maneuver	337	-	-	-	-	-
Stage 1	704	-	-	-	-	-
Stage 2	584	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12.5	0.5	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1269	-	505	-	-
HCM Lane V/C Ratio	0.021	-	0.054	-	-
HCM Control Delay (s)	7.9	0	12.5	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.2	-	-

Intersection	
Int Delay, s/veh	2.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	50	40	40	320	225	80
Future Vol, veh/h	50	40	40	320	225	80
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
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	54	43	43	348	245	87

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	723	288	332	0	-	0
Stage 1	288	-	-	-	-	-
Stage 2	435	-	-	-	-	-
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	393	751	1227	-	-	-
Stage 1	761	-	-	-	-	-
Stage 2	653	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	376	751	1227	-	-	-
Mov Cap-2 Maneuver	376	-	-	-	-	-
Stage 1	761	-	-	-	-	-
Stage 2	625	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	14.3	0.9	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1227	-	483	-	-
HCM Lane V/C Ratio	0.035	-	0.203	-	-
HCM Control Delay (s)	8	0	14.3	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.8	-	-

Intersection	
Int Delay, s/veh	1.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	60	10	15	355	295	75
Future Vol, veh/h	60	10	15	355	295	75
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	50	-	-	-	-
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	65	11	16	386	321	82

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	779	361	402	0	-	0
Stage 1	361	-	-	-	-	-
Stage 2	418	-	-	-	-	-
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	364	684	1157	-	-	-
Stage 1	705	-	-	-	-	-
Stage 2	664	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	357	684	1157	-	-	-
Mov Cap-2 Maneuver	357	-	-	-	-	-
Stage 1	705	-	-	-	-	-
Stage 2	652	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	16.3	0.3	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1157	-	357	684	-	-
HCM Lane V/C Ratio	0.014	-	0.183	0.016	-	-
HCM Control Delay (s)	8.2	0	17.3	10.3	-	-
HCM Lane LOS	A	A	C	B	-	-
HCM 95th %tile Q(veh)	0	-	0.7	0	-	-

Intersection	
Int Delay, s/veh	0.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	15	15	25	395	385	30
Future Vol, veh/h	15	15	25	395	385	30
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	50	-	-	-
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	16	16	27	429	418	33

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	919	435	451	0	-	0
Stage 1	435	-	-	-	-	-
Stage 2	484	-	-	-	-	-
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	301	621	1109	-	-	-
Stage 1	653	-	-	-	-	-
Stage 2	620	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	294	621	1109	-	-	-
Mov Cap-2 Maneuver	294	-	-	-	-	-
Stage 1	653	-	-	-	-	-
Stage 2	605	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	14.8	0.5	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1109	-	399	-	-
HCM Lane V/C Ratio	0.025	-	0.082	-	-
HCM Control Delay (s)	8.3	-	14.8	-	-
HCM Lane LOS	A	-	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.3	-	-

APPENDIX D

TRAFFIC SIGNAL WARRANT

Appendix D - Warrant 1: Eight-Hour Vehicular Volume

Condition A – Minimum Vehicular Volume									
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100% *	80%	70% **	56%	100% *	80%	70% **	56%
1	1	**500**	400	350	280	**150**	120	105	84
2 or more	1	600	480	420	336	150	120	105	84
2 or more	2 or more	600	480	420	336	200	160	140	112
1	2 or more	500	400	350	280	200	160	140	112

* Basic Minimum Hourly Volume
** May be used when the major street speed exceeds 40 mph, or in an isolated community with a population of less than 10,000.

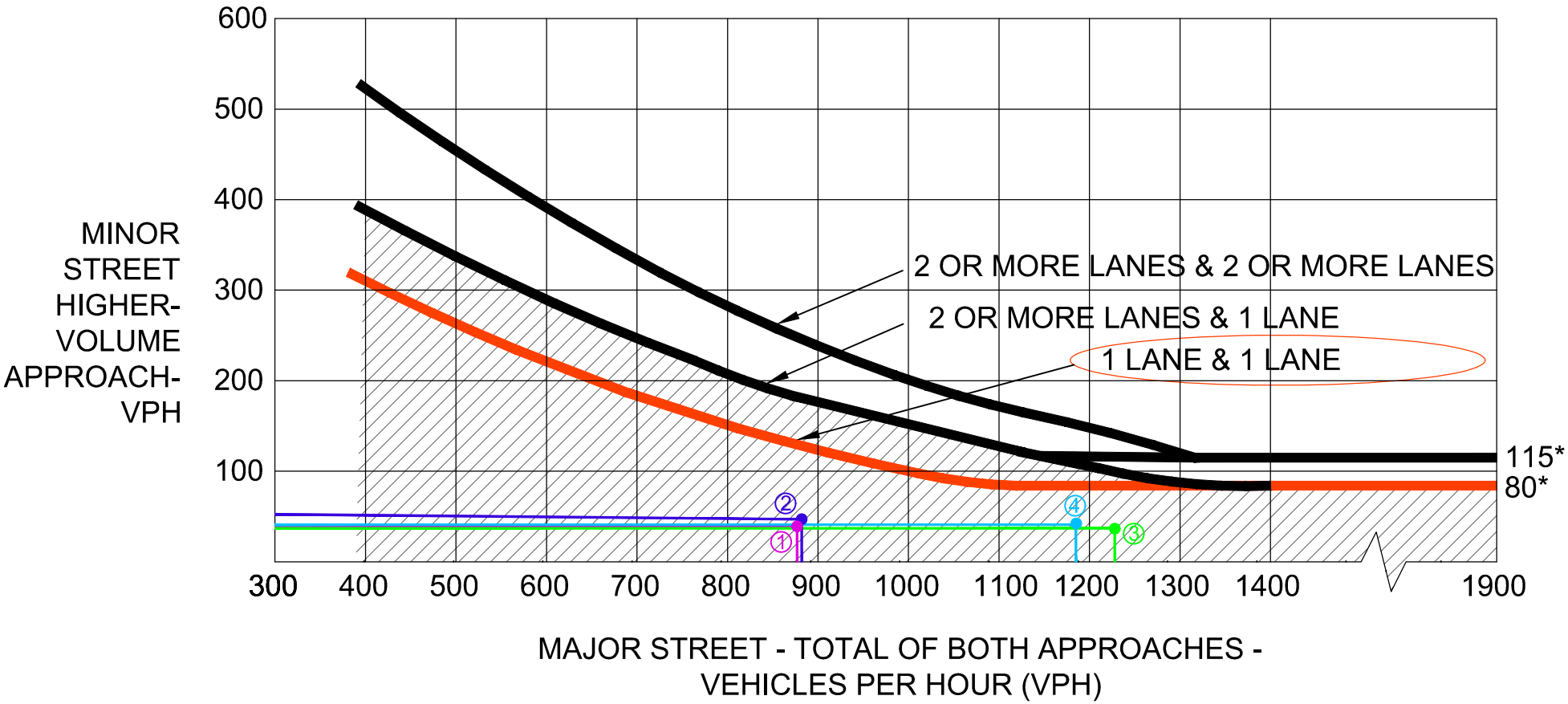
		MAIN STREET		MINOR STREET		MAIN	HIGHEST	Warrant 1B
DATE	TIME	EB	WB	NB	SB	TOTAL	MINOR	100%
03/15/17 Wednesday	6:30	568	450	-	21	1018	21	NO
	7:30	473	438	-	30	911	30	NO
	9:00	291	276	-	22	567	22	NO
	10:00	398	360	-	39	758	39	NO
	11:00	332	354	-	42	686	42	NO
	12:00	314	377		28	691	28	NO
	1:00	386	372	-	19	758	19	NO
	3:30	475	559	-	37	1034	37	NO
	4:30	425	530	-	41	955	41	NO

Condition B - Interruption of Continuous Traffic									
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100% *	80%	70% **	56%	100% *	80%	70% **	56%
1	1	**750**	600	525	420	**75**	60	53	42
2 or more	1	900	720	630	504	75	60	53	42
2 or more	2 or more	900	720	630	504	100	80	70	56
1	2 or more	750	600	525	420	100	80	70	56

* Basic Minimum Hourly Volume
** May be used when the major street speed exceeds 40 mph, or in an isolated community with a population of less than 10,000.

		MAIN STREET		MINOR STREET		MAIN	HIGHEST	Warrant 1B
DATE	TIME	EB	WB	NB	SB	TOTAL	MINOR	100%
03/15/17 Wednesday	6:30	568	450	-	21	1018	21	NO
	7:30	473	438	-	30	911	30	NO
	9:00	291	276	-	22	567	22	NO
	10:00	398	360	-	39	758	39	NO
	11:00	332	354	-	42	686	42	NO
	12:00	314	377		28	691	28	NO
	1:00	386	372	-	19	758	19	NO
	3:30	475	559	-	37	1034	37	NO
	4:30	425	530	-	41	955	41	NO

Warrant 2, Four-Hour Vehicular Volume

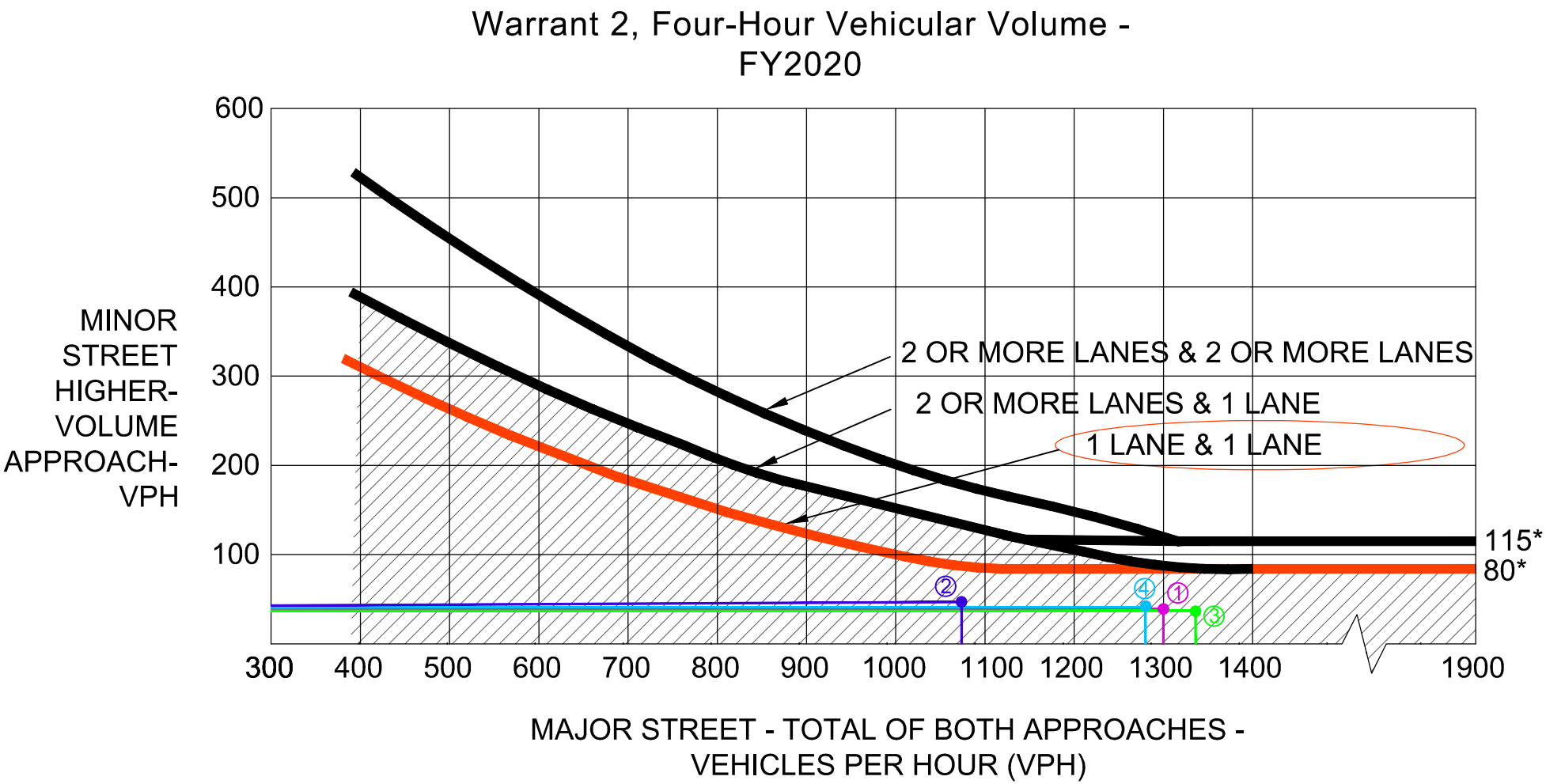


① (10:00 AM to 11:00 AM), (877, 39)
② (11:15 AM to 12:15 AM), (882, 47)
③ (3:30 PM to 4:30 PM), (1228, 37)
④ (4:30 PM to 5:30 PM), (1185, 41)

*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.

* Based upon 2017 traffic counts

WAILUKU APARTMENTS	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	APPENDIX
	TRAFFIC SIGNAL WARRANT FOR KUIKAHI DR/KEHALANI VILLAGE ROAD INTERSECTION	D2



① (7:00 AM to 8:00 AM), (1300, 30)
② (3:00 PM to 4:00 PM), (1077, 32)
③ (4:15 PM to 5:15 PM), (1330, 35)
④ (5:00 PM to 6:00 PM), (1286, 32)

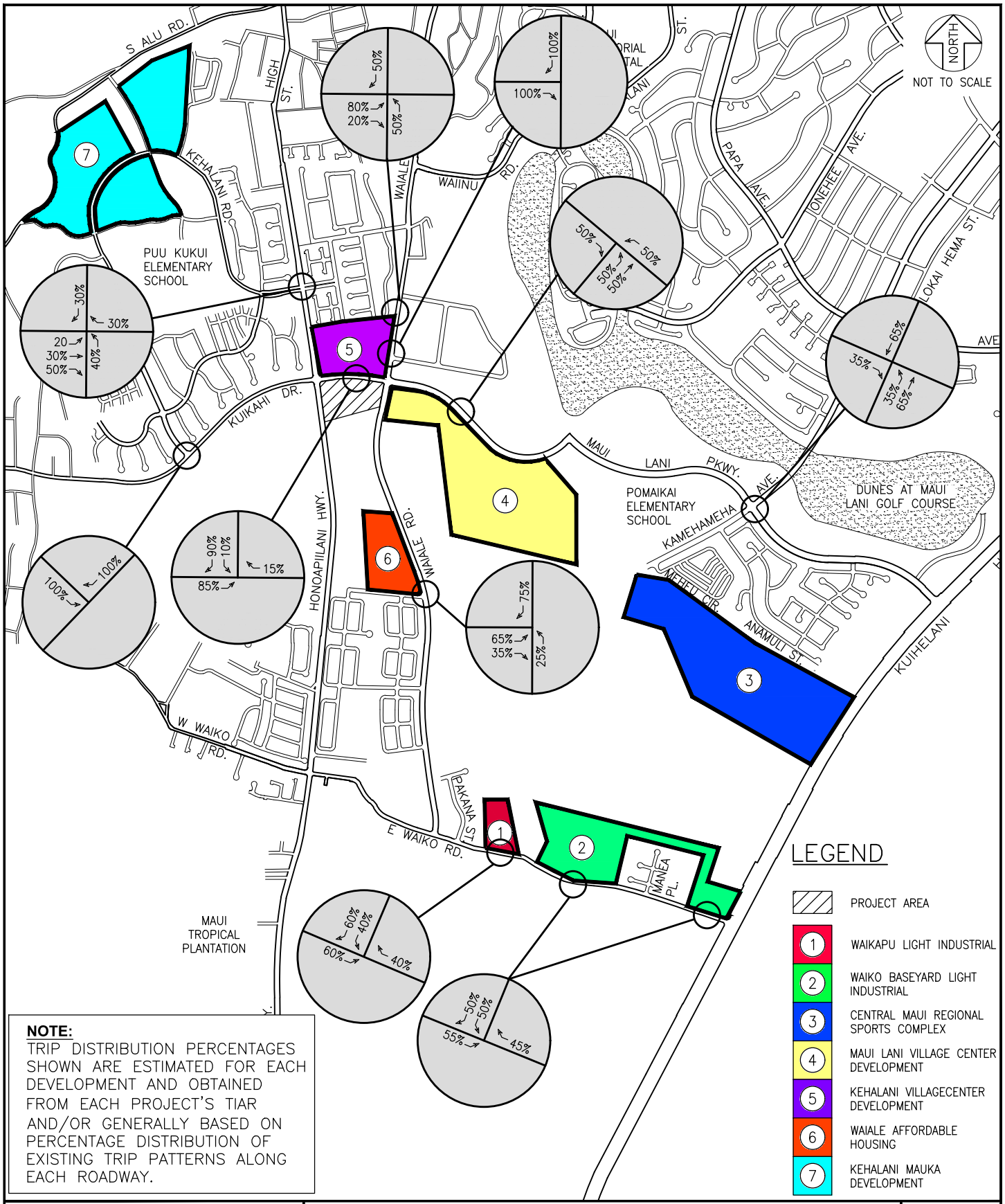
*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.

* Based upon 2017 traffic counts

WAILUKU APARTMENTS	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	APPENDIX
	TRAFFIC SIGNAL WARRANT FOR KUIKAHI DR/KEHALANI VILLAGE ROAD INTERSECTION	D3

APPENDIX E

BACKGROUND PROJECT TRIPS



NOTE:
TRIP DISTRIBUTION PERCENTAGES SHOWN ARE ESTIMATED FOR EACH DEVELOPMENT AND OBTAINED FROM EACH PROJECT'S TIAR AND/OR GENERALLY BASED ON PERCENTAGE DISTRIBUTION OF EXISTING TRIP PATTERNS ALONG EACH ROADWAY.

WAILUKU APARTMENTS

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, HAWAII

FIGURE
E

DISTRIBUTION OF BACKGROUND DEVELOPMENT TRIPS IN PROJECT VICINITY

Appendix F – Flora & Fauna – Biological Resources Survey

BIOLOGICAL RESOURCES SURVEY

for the

KEHALANI 201-H AFFORDABLE HOUSING PROJECT

WAILUKU, MAUI, HAWAII

by

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ENVIRONMENTAL CONSULTANT
Kokomo, Maui
February 2017

Prepared for:
Pier Management Hawaii, LLC

FLORA AND FAUNA SURVEY
KEHALANI 201-H AFFORDABLE HOUSING PROJECT
WAILUKU, MAUI, HAWAII

INTRODUCTION

The Kehalani 201-H Affordable Housing project consists of 14.416 acres located between Wailuku and Waikapu in central Maui. It lies between Honoapiilani Highway and Waiale Road, adjacent to the south edge of East Kuikahi Drive, TMK (2) 3-5-01:064, (see Figures 1 & 2). This biological resources study was initiated by the owners in fulfillment of environmental requirements of the planning process.

SITE DESCRIPTION

The project area lies on gently sloping land on the lower eastern slopes of the West Maui Mountains. The vegetation consists of dense grassland with scattered shrubs and small trees. Elevations range between 320 and 380 feet above sea level. The soils are characterized as Iao silty clay, 0 – 3% slopes (IaA,), and Iao clay, 3 – 7% slopes (IcB), which are deep, dark brown alluvial soils (Foote et al, 1972). Rainfall averages 20 inches per year with winter maximums.

BIOLOGICAL HISTORY

The original vegetation in this area consisted of a dense low statured native forest and shrubland with such components as ʻōhiʻa (*Metrosideros polymorpha*), ʻaʻaliʻi (*Dodonaea viscosa*), olopua (*Nestegis sandwicensis*), lama (*Diospyros sandwicensis*), halapepe (*Chrysodracon auwahiensis*), and a variety of ferns, vines and herbaceous plants.

Hawaiians lived in the area for several centuries, farming in the valley bottoms and lowlands and utilizing forest plants for food, construction materials, tools, fiber and medicines. They altered the landscape somewhat through cultivation and burning. This area is situated on farming lands that were irrigated with waters from the ancient Kama Ditch.

During the mid-1800's this area was cleared for sugar cane agriculture and the area was plowed, planted, burned and harvested in continuous cycles for over 100 years. Native ecosystems were replaced by sugar cane and increasing numbers of agricultural weeds.

When sugar production here ended in the 1990s this area became fallow. All of these practices have resulted in an environment that is now nearly totally lacking in native plants and animal species.

SURVEY OBJECTIVES

This report summarizes the findings of a flora and fauna survey of the proposed Kehalani 201-H Affordable Housing project which was conducted in February 2017. The objectives of the survey were to:

1. Document what plant, and animal species occur on the property or may likely occur in the existing habitat.

2. Document the status and abundance of each species.

3. Determine the presence or likely occurrence of any native flora and fauna, particularly any that are federally listed as Threatened or Endangered. If such occur, identify what features of the habitat may be essential for these species.

4. Determine if the project area contains any special habitats which if lost or altered might result in a significant negative impact on the flora and fauna in this part of the island.

BOTANICAL SURVEY REPORT

SURVEY METHODS

A walk-through botanical survey method was used covering the entire project area. Notes were made on plant species, distribution and abundance as well as on terrain and substrate.

A special focus was made to identify any native plants and ascertain if there were any Endangered or Threatened species (USFWS, 2017) that would require special focus. A complete plant species list is presented herein.

DESCRIPTION OF THE VEGETATION

The vegetation within the project area was dominated by two non-native species, Guinea grass (*Megathyrsus maximus*) and glycine (*Neontonia wightii*). These two species form a tall dense grassland that is smothered by a tangle of vines. Also common were koa haole (*Leucaena leucocephala*) and Castor bean (*Ricinus communis*).

A total of 63 plant species were recorded during two site visits to the project area. Four of these were common native plant species, ʻuhaloa (*Waltheria indica*), kou (*Cordia subcordata*), (*Cyperus polystachyos*) no common name, and koali kua hulu (*Merremia aegyptia*) which are all widespread in Hawaii as well as in many other tropical countries. The remaining 59 species were non-native grasses or agricultural weeds.

DISCUSSION AND RECOMMENDATIONS

The vegetation throughout the project area is dominated by non-native species that are of no particular environmental interest or concern. Just four common indigenous plants, ʻuhaloa, kou, koali kua hulu and (*Cyperus polystachyos*) were found. No federally listed Endangered or Threatened plant species (USFWS, 2017) were found, nor do any plants that are candidates for such status occur on the project area. No special plant habitats occur on or near the project and no potential wetlands occur in this dry upland site.

This project is not expected to have any significant negative impacts on the botanical resources in this part of Central Maui. No recommendations regarding botanical resources are deemed necessary or appropriate.

PLANT SPECIES LIST

Following is a checklist of all those vascular plant species inventoried during the field studies. Plant families are arranged alphabetically within each of two groups: Monocots and Dicots. Taxonomy and nomenclature of the flowering plants (Monocots and Dicots) are in accordance with Wagner et al. (1999).

For each species, the following information is provided:

1. Scientific name with author citation

2. Common English or Hawaiian name.

3. Bio-geographical status. The following symbols are used:

   endemic = native only to the Hawaiian Islands; not naturally occurring anywhere else in the world.

   indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).

   Polynesian = all those plants brought to Hawaii during the course of Polynesian migrations

   non-native = all those plants brought to the islands intentionally or accidentally after western contact.
   .

4. Abundance of each species within the project area:

   abundant = forming a major part of the vegetation within the project area.

   common = widely scattered throughout the area or locally abundant within a portion of it.

   uncommon = scattered sparsely throughout the area or occurring in a few small patches.

   rare = only a few isolated individuals within the project area.

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
MONOCOTS			
CYPERACEAE (Sedge Family)			
Cyperus polystachyos Rottb.	----------	indigenous	rare
Cyperus rotundus L.	nut sedge	non-native	rare
POACEAE (Grass Family)			
Cenchrus ciliaris L.	buffelgrass	non-native	rare
Cenchrus echinatus L.	common sandbur	non-native	rare
Chloris barbata (L.) Sw.	swollen fingergrass	non-native	uncommon
Cynodon dactylon (L.) Pers.	Bermuda grass	non-native	rare
Digitaria ciliaris (Retz.) Koeler	Henry's crabgrass	non-native	rare
Digitaria fuscescens (K. Presl) Henr.	creeping crabgrass	non-native	rare
Digitaria insularis (L.) Mez ex Ekman	sourgrass	non-native	rare
Eleusine indica (L.) Gaertn.	wiregrass	non-native	rare
Eragrostis amabilis (L.) Wight & Arnott	Japanese lovegrass	non-native	rare
Eragrostis pectinacea (Michx.) Nees	Carolina lovegrass	non-native	rare
Megathyrsus maximus (Jacq.) Simon & Jacobs	Guinea grass	non-native	abundant
Melinis repens (Willd.) Zizka	Natal redtop	non-native	rare
Saccharum officinarum L.	sugar cane	non-native	rare
DICOTS			
AMARANTHACEAE (Amaranth Family)			
Alternanthera pungens Kunth	khaki weed	non-native	rare
Amaranthus spinosus L.	spiny amaranth	non-native	uncommon
Amaranthus viridis L.	slender amaranth	non-native	rare
APOCYNACEAE (Dogbane Family)			
Asclepias physocarpa (E. Meyen) Schlect.	baloon plant	non-native	rare
Calotropis procera (Aiton) Aiton	small crown flower	non-native	rare
Plumeria rubra L.	plumeria	non-native	rare
ASTERACEAE (Sunflower Family)			
Bidens pilosa L.	Spanish needle	non-native	uncommon
Conyza bonariensis (L.) Cronq.	hairy horseweed	non-native	rare
Emilia fosbergii Nicolson	red pualele	non-native	rare
Senecio madagascariensis Poir.	fireweed	non-native	rare
Sonchus oleraceus L.	pualele	non-native	uncommon
Tridax procumbens L.	coat buttons	non-native	uncommon
Verbesina encelioides (Cav.) Benth. & Hook.	golden crown-beard	non-native	rare
BORAGINACEAE (Borage Family)			
Cordia subcordata Lam.	kou	indigenous	rare
Heliotropium procumbens Mill.	fourspike heliotrope	non-native	rare
BRASSICACEAE (Mustard Family)			
Lepidium virginicum L.	Virginia pepperwort	non-native	rare
CONVOLVULACEAE (Morning Glory Family)			
Ipomoea triloba L.	little bell	non-native	uncommon
Merremia aegyptia (L.) Urb.	hairy merremia	indigenous	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
CUCURBITACEAE (Gourd Family)			
Cucumis dipsaceus Ehrenb. ex Spach	hedgehog gourd	non-native	rare
Momordica charantia L.	bitter melon	non-native	uncommon
EUPHORBIACEAE (Spurge Family)			
Euphorbia hirta L.	hairy spurge	non-native	rare
Euphorbia hypericifolia L.	graceful spurge	non-native	rare
Ricinus communis L.	Castor bean	non-native	common
FABACEAE (Pea Family)			
Chamaecrista nictitans (L.) Moench	partridge pea	non-native	rare
Crotalaria pallida Aiton	smooth rattlepod	non-native	uncommon
Crotalaria retusa L.	rattlepod	non-native	uncommon
Desmanthus pernambucanus (L.) Thellung	slender mimosa	non-native	rare
Desmodium tortuosum (Sw.) DC.	Florida beggarweed	non-native	uncommon
Indigofera spicata Forssk.	creeping indigo	non-native	rare
Indigofera suffruticosa Mill.	inikō	non-native	rare
Leucaena leucocephala (Lam.) de Wit	koa haole	non-native	common
Macroptilium atropurpureum (DC.) Urb.	siratro	non-native	uncommon
Neonotonia wightii (Wight & Arnott) Lackey	glycine	non-native	abundant
Pithecellobium dulce (Roxb.) Benth.	ōpiuma	non-native	uncommon
Samanea saman (Jacq.) Merr.	monkeypod	non-native	rare
Sesbania grandiflora (L.) Poir.	sesban	non-native	rare
LAMIACEAE (Mint Family)			
Leonotis nepetifolia (L.) R. Br.	lion's ear	non-native	rare
MALVACEAE (Mallow Family)			
Abutilon grandifolium (Willd.) Sweet	hairy abutilon	non-native	rare
Malva parviflora L.	cheese weed	non-native	rare
Malvastrum coromandelianum (L.) Garcke	false mallow	non-native	uncommon
Sida rhombifolia L.	arrowleaf sida	non-native	uncommon
Sida spinosa L.	prickly sida	non-native	rare
Waltheria indica L.	'uhaloa	indigenous	rare
MORINGACEAE (Drumstick Tree Family)			
Moringa oleifera Lamarck	marunggay, horeradish tree	non-native	uncommon
NYCTAGINACEAE (Four-o'clock Family)			
Boerhavia coccinea Mill.	scarlet spiderling	non-native	rare
SOLANACEAE (Nightshade Family)			
Solanum lycopersicum L.	cherry tomato	non-native	uncommon
Solanum torvum Sw.	pea aubergine	non-native	rare
VERBENACEAE (Verbena Family)			
Stachytarpheta jamaicensis (L.) Vahl	Jamaica vervain	non-native	rare

FAUNA SURVEY REPORT

SURVEY METHODS

A walk-through survey method was conducted in conjunction with the botanical survey. All parts of the project area were covered. Field observations were made with the aid of binoculars and by listening to vocalizations. Notes were made on species, abundance, activities and location as well as observations of trails, tracks scat and signs of feeding. In addition an evening visit was made to the area to record crepuscular activities and vocalizations and to see if there was any evidence of occurrence of the Hawaiian hoary bat (*Lasiurus cinereus semotus*) in the area.

RESULTS

MAMMALS

Just two non-native mammals the mongoose (*Herpestes auropunctatus*) and the axis deer (*Axis axis*) were observed during two site visits. Several common non-native mammal species, however, could be occasionally expected to utilize this habitat. These include cats (*Felis catus*), domestic dogs (*Canis familiaris*), rats (*Rattus* spp.) and mice (*Mus domesticus*). These species can be difficult to detect because of the dense vegetation. Taxonomy and nomenclature follow Tomich (1986).

A special effort was made to look for the native Hawaiian hoary bat by making an evening survey of the area. When present in an area these bats can be easily identified as they forage for insects, their distinctive flight patterns clearly visible in the glow of twilight. No evidence of such activity was observed though visibility was excellent. In addition, a bat detecting device (Batbox IIID) was used at two locations, set to the frequency of 27,000 to 28,000 hertz which is the typical range within which these bats are known to echolocate for flying insect prey. No activity was detected using this device.

BIRDS

Birdlife was somewhat sparse within the project area due to the lack of habitat diversity. Just six species of non-native birds were recorded during two site visits. Taxonomy and nomenclature follow American Ornithologists' Union (2017). One species was common, the zebra dove (*Geopelia striata*). Three other species were uncommon, the common myna (*Acridotheres tristis*), the spotted dove (*Streptopelia chinensis*) and the nutmeg mannikin (*Lonchura punctulata*). Two other species were rare, the gray francolin (*Francolinus pondicerianus)* and the red-crested cardinal (*Paroaria coronata*).

A few other non-native bird species may occasionally occur in this habitat such as the northern cardinal (*Cardinalis cardinalis*), the Japanese white-eye (*Zosterops japonicus*), the house finch (*Carpodacus mexicanus*) and the chestnut mannikin (*Lonchura malacca*), but the habitat is unsuitable for Hawaii's native forest birds that are presently restricted to higher elevation native forests beyond the range of mosquitoes and the avian diseases they carry and transmit.

INSECTS

Insect life was moderate in both species diversity and in total numbers. Eighteen species were recorded during two site visits, representing seven insect Orders. Taxonomy and nomenclature follow Nishida et al (1992).

Two species were of common occurrence, the long-tailed blue butterfly (*Lampides boeticus*) and the large Sulphur butterfly (*Phoebis agarithe*). Eleven species were uncommon and four species were rare (see the insect inventory).

Just two native dragonfly species were observed, the green darner (*Anax junius*) and the globe skimmer (*Pantala flavescens*). These two dragonflies are both indigenous in Hawaii and common here, and both also naturally occur in other countries as well. The other 16 species were all non-native insects that are of no special conservation concern.

MOLLUSKS

Just one non-native mollusk species, the giant East African snail (*Achatina fulica*) was found during the survey.

DISCUSSION AND RECOMMENDATIONS

The wildlife within the project area were nearly all non-native species that have come into Hawaii either accidentally or as intentional introductions since first Western contact. The two indigenous dragonflies are both widespread and common in Hawaii and are rated as “of least concern” in conservation status.

No Endangered Hawaiian hoary bats were detected during the evening survey. These bats, however, are wide-ranging and are opportunistic in taking advantage of spikes in nocturnal insect populations wherever they may occur. They may utilize this project area occasionally or seasonally. These bats also breed and raise their young between the months of April and mid-September, and during that time they utilize trees larger than 15 feet in height to place their young when they are too immature to fly. The U.S. Fish and Wildlife service usually recommends not removing these larger trees during the breeding and pupping season to prevent potentially injuring or killing any juvenile bats.

No Endangered Blackburn’s sphinx moths or their eggs or larvae were found during the survey and none of their specific obligate host plants were found growing in the project area either. As a result these moths are not currently likely to occur here and no specific recommendations are offered.

While no protected seabirds were found on the property, the Endangered ua′u (*Pterodrama sanwichensis*) and Threatened ′a′o (*Puffinus newelli*) are known to overfly the area at dawn and dusk to their burrows high in the mountains between the months of March and November. In late fall young birds fledge from their burrows to take their first tentative flights out to sea. These inexperienced birds are easily confused and distracted by bright lights and often crash to the ground where they are particularly vulnerable to being run over by vehicles or killed by predators.

It is recommended that any significant outdoor lighting such as street lights or flood lights that are incorporated into the project design be shielded to direct the light downward so that it is not visible from above.

As a result of these findings, it is determined that there is little of environmental concern with regard to animal life within the project area. With the above recommendations, the development of the project is not expected to have a significant negative effect on the native animal resources int his part of central Maui.

ANIMAL SPECIES LIST

Following is a checklist of the animal species inventoried during the field work. Animal species are arranged in descending abundance within three groups: Mammals, Birds, Insects and Mollusks. For each species the following information is provided:

1. Common name

2. Scientific name

3. Bio-geographical status. The following symbols are used:

   endemic = native only to Hawaii; not naturally occurring anywhere else in the world.

   indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).

   non-native = all those animals brought to Hawaii intentionally or accidentally after western contact.

   migratory = spending a portion of the year in Hawaii and a portion elsewhere. In Hawaii the migratory birds are usually in the overwintering/non-breeding phase of their life cycle.

4. Abundance of each species within the project area:

   abundant = many flocks or individuals seen throughout the area at all times of day.

   common = a few flocks or well scattered individuals throughout the area.

   uncommon = only one flock or several individuals seen within the project area.

   rare = only one or two seen within the project area.

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
MAMMALS			
Axis axis Erxleben	axis deer	non-native	rare
Herpestes auropunctatus Hodgson	mongoose	non-native	rare
BIRDS			
Geopelia striata L.	zebra dove	non-native	common
Acridotheres tristis L.	common myna	non-native	uncommon
Streptopelia chinensis Scopoli	spotted dove	non-native	uncommon
Lonchura punctulata L.	nutmeg mannikin	non-native	uncommon
Francolinus pondicerianus Gmelin	gray francolin	non-native	rare
Paroaria coronata Miller	red-crested cardinal	non-native	rare
MOLLUSKS			
Achatina fulica Bowdich	giant East African snail	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
INSECTS			
Order ARANAE - true spiders			
ARANEIDAE (Orb Weaver Family)			
Araneus diadematus Clerck	European garden spider	non-native	rare
Order COLEOPTERA - beetles			
COCCINELLIDAE (Lady Beetle Family)			
Coccinella septempunctata brucki Multsant	seven-spot lady beetle	non-native	rare
SCARABAEIDAE (Scarab Beetle Family)			
Protaetia orientalis Burmeister	Asian flower beetle	non-native	uncommon
Order DIPTERA - flies			
MUSCIDAE (Housefly Family)			
Musca sorbens Wiedemann	dung fly	non-native	uncommon
SYRPHIDAE (Hoverfly Family)			
Ornidia obesa Fabricius	drone fly	non-native	rare
Order HYMENOPTERA - bees, wasps, ants			
APIDAE (Honey Bee Family)			
Apis mellifera L.	honeybee	non-native	uncommon
Xylocopa sonorina Smith	Sonoran carpenter bee	non-native	uncommon
FORMICIDAE (Ant Family)			
Pheidole megacephala Fabricius	big-headed ant	non-native	uncommon
Order LEPIDOPTERA - butterflies, moths			
CRAMBIDAE (Grass Moth Family)			
Spoladea recurvalis Fabricius	beet webworm moth	non-native	uncommon
LYCAENIDAE (Gossamer-winged Butterfly Family)			
Lampides boeticus L.	long-tailed blue butterfly	non-native	common
NOCTUIDAE (Owlet Moth Family)			
Melipotis indomita Walker	indomitable melipotis	non-native	rare
NYMPHALIDAE (Brush-footed Butterfly Family)			
Danaus plexippus L.	monarch butterfly	non-native	uncommon
PIERIDAE (White and Sulphur Butterfly Family)			
Eurema nicippe Cramer	sleepy orange butterfly	non-native	uncommon
Phoebis agarithe Boisduval	large sulphur butterfly	non-native	common
Pieris rapae L.	cabbage butterfly	non-native	uncommon
Order ODONATA - dragonflies, damselflies			
AESHNIDAE (Hawker Dragonfly Family)			
Anax junius Drury	green darner dragonfly	indigenous	uncommon
LIBELLULIDAE (Skimmer Dragonfly Family)			
Pantala flavescens Fabricius	globe skimmer dragonfly	indigenous	uncommon

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Order ORTHOPTERA - grasshoppers, crickets			
ACRIDIDAE (Grasshopper Family)			
Schistocercis nitens Thunberg	gray bird grasshopper	non-native	uncommon

Kehalani - 15 Acre Ag Parcel
TMK: (2) 3-5-01:064 Wailuku, Maui

Figure 1.

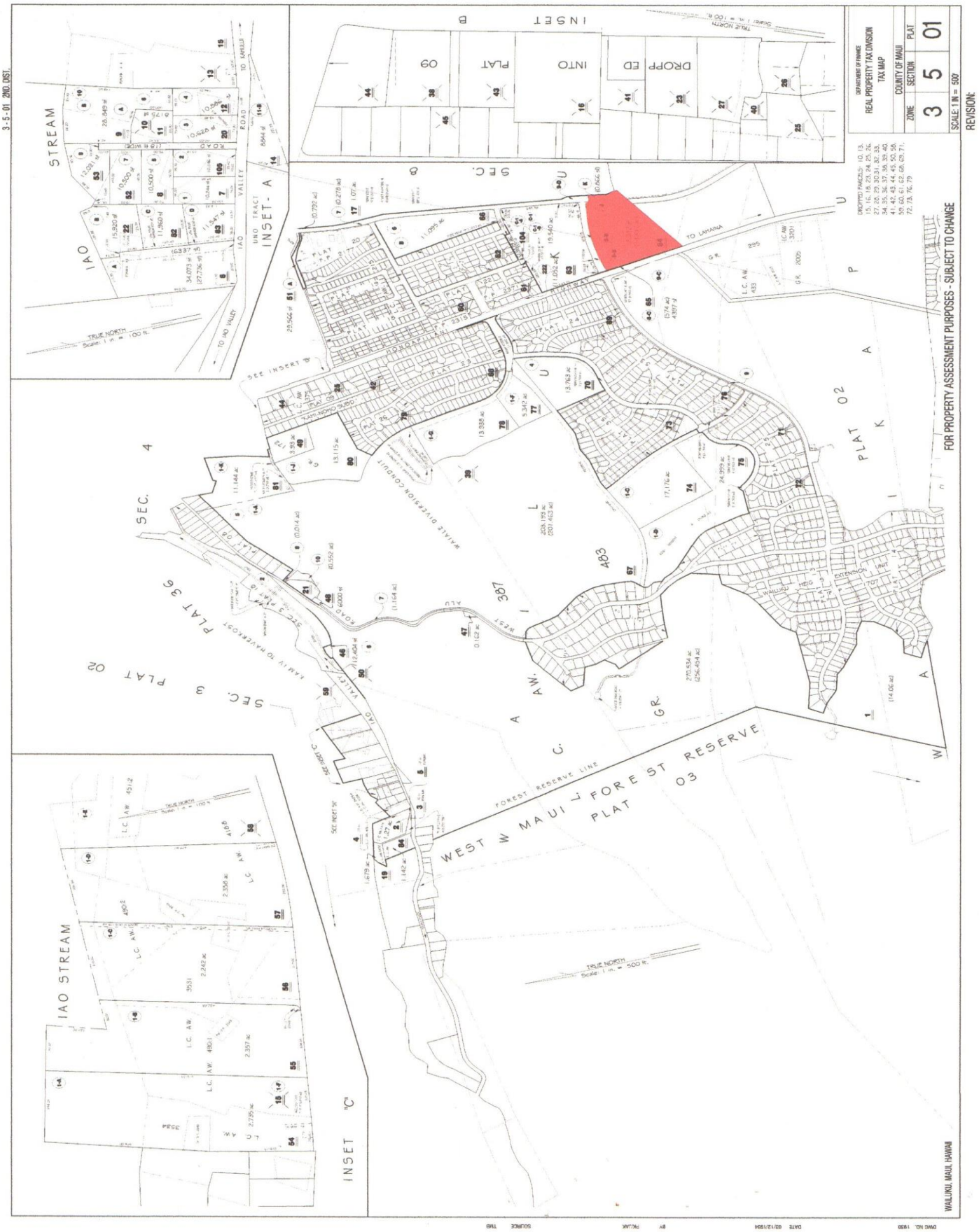

Figure 2. Kehalani 201-H Affordable Housing Project

Figure 3. View west across project area toward Honoapiilani Highway and the West Maui Mountains.

Figure 4. View north across the project area toward Wailuku.

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Appendix G – Aerial Photo & View Photos of Project Site

Aerial Photo of Project Site

Ⓐ View facing West from corner of Kuikahi Drive and Wai‘ale Road

Ⓑ View facing West on Eastern boundary of property on Wai‘ale Road

C View facing North from South adjoining property

D View facing North from South adjoining property

E View facing North from South adjoining property

F View facing East from Western boundary of property on Honoapiʻilani Highway

Ⓖ View facing East from Western boundary of property on Honoapiʻilani Highway

Ⓗ View facing East from Western boundary of property on Honoapiʻilani Highway

I View facing South from Northern boundary of property on Kuikahi Drive

J View facing South from Northern boundary of property on Kuikahi Drive

Ⓚ View facing South from Northern boundary of property on Kuikahi Drive

Appendix H – Market Demand Analysis Report

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July 31, 2017

STATEMENT OF STUDY AND QUALIFICATIONS

To Whom It May Concern:

I performed a market study on the Central Maui Rental Market, that included a description and analysis of the economic conditions in the county, as well of the for-sale and rental residential market. Further, I looked into the supply and demand for a rental project being contemplated in Central Maui, and did so in a way that could help the decision on whether to proceed with such.

Last week, I reviewed the rental market in Maui and discovered a number of indications that in the time since this study was performed there are fewer rental units at the lower price segment that are available, and those that there are are priced higher than previously priced.

Lastly, here is a statement of my qualifications, relative to analyzing residential projects, developments and markets in Hawaii.

I have spent 18 years as an independent, third party, outside consultant doing housing studies on supply and demand, project feasibility, long-range planning and product pricing and absorption, both for for-sale and rental housing. Before that, I had 8 years working as the in-house market analyst for the state's two largest residential developers. This experience and understanding of developer needs is unique amongst market analysts in the state, and it allowed the creation of several extensive data bases on the residential market. My proprietary data includes for-sale transactional (sales) data, for-sale and rental listing (offering) data, housing stock or housing inventory data, future project data, entitled land data and, most uniquely, developer (or new home sales) data on their sales and prices. I was able to collect this privately held data from developers, as it formed the basis of my consulting work for them (and resulted in over 350 studies).

I enjoyed the work, and appreciate the consideration you are giving to my study.

Yours truly,

Paul Cassiday Jr.

Executive Summary

Demand for rental housing, both market-rate and affordable, is deep, broad and elastic.

On the affordable side, local families acutely need housing, from mid-range cascading down the housing the ladder in increasing magnitude. The sweet spot is near or at an AMI where the renter makes good income, just not enough for a market rate unit. This is the 80%-100% AMI. The 120% of AMI can go market rental, but the quality there is very poor, as there is strong demand from outsiders who willingly accept inferior because they don't know better.

On the market side, local and offshore (outside) renters need value, which includes the prerequites of reasonable price, comfort, cinvenience and security. WIth few market rental projects, this is very hard to find. security often is the deciding point for mothers who work. This location offers convenience, comfort and security AND a the island's best school district.

Supply of affordable rental housing is narrow, shallow and inelastic (oxymoronic, too). Maui simply did not produce much affordable shelter in the last decade, not even commensurate with the other counties, and not even as much as it could. They informally invalidated the standard development model of developers trading an affordable housing requitment for entitlements (cross-subsidization, one of the other), and did so by upping their affordable requirement in 2007-2008. Almost all development stopped, especially the high-end, thus denying the affordable housing sector their best source of funding.

Looking into the future, there are few rental projects in planning and no rental projects underway. It is likely that there will be one such project, an affordable rental project for the elderly, in the future, if awarded LIHTR money this cycle (decision made this summer), but it is designed to serve a lower AMI target market. There is another project coming through the approval process but that isn't going to be ready to go until 2021, maybe later. And it is in a different location.

Because there are few rental housing projects on Maui, there are few comparables, and even fewer data sets on rentals that are standardized and easy to examine. This is because there is little demand for this (and, for the same reason, there is little competition). Thatt said, the evidence, data and aneqdotal, is supportive of our belief that the currently observable rents are not commensurate with what could be achieved.

UNIT MIX AND RENTAL RATE MODEL

Bed	AMI	Units	Rents, Affordable	Rents, Market
1	80%	60	$1,000	
1	100%	50	$1,305	
1	Market	20		$1,799 to $1,899
2	120%	71	$1,797	
2	Market	80		$2,100 to $2,299
3	Market	20		$2,600 to $2,799

With these rates, we believe this project has a great chance of success – and, we believe, they should be set higher (the market units particularly) at the time the project opens for business in 2019.

I. INTRODUCTION & SCOPE OF WORK

Ricky Cassiday is a market researcher who specializes in analyzing residential real estate markets for developers and lenders. He has been retained to perform a study analyzing the rental market on the island of Maui, relative to a planned mixed income rental housing development in Central Maui.

The study focuses on the accessing, analyzing and projecting the rental market relative to the proposed development of 300 rental units that will exist within a larger master planned development involving Business/Commercial and Residential land uses.

This entailed collecting, comparing and analyzing information that has a bearing on the numerous aspects of market demand for the proposed project, including but not limited to publicly available real property, economic and commercial data. The author makes every effort to verify that all of the information in study and in particular the market description and analysis is accurate, but is aware that 100% accuracy is unlikely.

Scope of Work

The study scope of work is to assess the residential rental market and project the rate of absorption and the level of rents that the proposed project could capture. This was done by updating the Rental Housing Study done for the County in 2014, using 2016 instead of 2013 data, and targets it for this Central Maui site.

On the demand side:

- Look at economic trends now and 5 years out, in terms of population, jobs, incomes and housing. Quantitatively and qualitatively, relative to 300 units.

- Update and look at the demographic data from US Census and Ribbon Demographics for the island and central Maui, and extrapolate for the site.

On the supply side:

- Describe and analyze the housing stock in the area, as it relates to rental housing demand, and on the capacity of the housing in the core area to house and shelter the current and future population in Central Maui.

- Describe and analyze the supply pipeline for all housing on the island as it relates to project and the target market, and determine if there will be competing projects that will interfere competitively with this proposed project.

- Describe and analyze the current rental offerings (listings) from Craigslist and other public ally available rental housing info sources, including Zillow and AirBnB.

Summarize findings and use them to determine target market demand for unit sizes, and counts.

II. PROJECT & AREA DESCRIPTION

Proposed Development

The proposed project site is located in Wailuku, in Central Maui, and is the capital for the County. It is within the major urban growth boundary, with roughly a third of the population in the immediate area. It sits next to the two major master planned communities in Central Maui, Maui Lani and Kehalani, with another one planned at Waikapu.

The total contemplated units are 302, originally broken out as follows:

PROJECT PARTICULARS

Unit	Bed	AMI	Units	Sq Ft	Rent
A	1	80%	60	400	$1,000
B	1	100%	51	450	$1,305
C	2	120%	51	700	$1,797
D	2	140%	140	750	$1,910
			302		$2,276

However, in subsequent discussions with the county, the county allowed that the mix could be changed to allow the 140% of AMI units to become market-rate rentals. This change significantly impacts the project positively: it lifts the ceiling for rental rates in a number of ways, including allowing for a 3-month minimum lease (as opposed to a 6 or 12 month).

Subject Property's Community

Maui County is the third largest county in the state, as ranked by population and economic activity, behind the City & County of Honolulu (Oahu) and the Big Island of Hawaii. Historically, Maui- Lahaina - was the original port of the nation of Hawaii, as well as the first resort area in the state. Maui has since grown into the state's second largest tourist destination, thanks to the major resort areas in West and South Maui.

Agriculture, specifically sugar cane and pineapple crops, had been the historic mainstay of Maui's economy starting in the 19th century. However, high costs and third world competition gutted those businesses, and, in their place arose diversified agriculture (macadamia nuts, vegetables and flowers). The tourism and service industries replaced agriculture as the driver for the county's economy. The visitor industry encompasses three primary destination-resort master planned communities, several similar vacation oriented communities, and the ancillary businesses of real estate, retail, restaurant, service and travel industries. With the growth of tourism, population growth was stimulated, rising almost 75 percent since 1975.

Today, Maui has one of the strongest brands in the global visitor industry, as well as a somewhat diversified economy, at least relative to the other neighbor islands in the state (with agriculture, services and high technology being the other mainstays). That said, the main driver on the island of economic activity is money spent by visitors and homeowners from outside the island on recreation or lifestyle. Indeed, like the rest of the state, the county economy's comparative advantage involves a very high quality of life, relative to the rest of the world.

This quality of life, both for visitors and residents alike, is based on the number of unique advantages that Hawaii has relative to other visitor or second home locations: it's socially safe,

politically stable, US dollar denominated and under American jurisprudence. Additionally, it is naturally beautiful, with a benign environment and near perfect climate. Indeed, the proof of its attractiveness can be found in the quality of the number of 'rich and famous' who have bought in Hawaii, starting with Lawrence Rockefeller in 1960 (followed by John Wayne, Paul Allen, George Harrison, Charles Schwab, Michael Dell, Oprah Winfrey, Akio Morita, Mark Zuckerberg, etc.).

Maui has three major resort destinations:

- **Wailea/Makena**, a 45-minute drive from the Airport, runs along the South Maui coastline, with Haleakala Mountain and, open pastures lands above and Maalaea Bay below.
- **Kaanapali**, along the western shore, 10 miles south of Kapalua Airport, was once the favored area of Hawaiian royalty and today hosts one of the largest percentage of accommodations, shops and historical sites in a single destination.
- **Kapalua**, also along the western shore, 10 miles north of Kapalua Airport, was once a working pineapple plantation and now has two major hotels and a significant residential population.

The majority of the primary housing development is located in Central Maui, within the Kehalani and Maui Lani master planned communities. The majority of the second home housing development is located in and around the resorts in West and South Maui, primarily the areas of Napili and Kihei.

Second home development is a major component of the housing development on the island, accounting for around 25-30% of total sales and 50-60% of the gross revenues (on average, 2003-2013).

By way of context, overall housing construction activity hit a peak on Maui when major resorts were developed in the 1970s; recent high-volume peak years reach to a level that is only half that of the 1970s (see permit section). Furthermore, many of the condominium projects that were developed on Maui since then have been targeted to satisfy the demand from the offshore buyer, not the local market for primary housing (sales records show that upwards of 70% of all condo sales on Maui go to out of state buyers).

Census records have shown that a quarter of Maui County's housing stock and more than 40 percent of housing in West Maui did not house residents in 2000. Thus, while the Census categorizes these units as "vacant," they may be rented to vacationers, reserved by owners as a second home, or both. Demand in the housing market, both for-sale and rental, hence comes from three sources - residents, investors, and non-residents. Thus, this demand pushes up the average prices for Maui housing above and beyond most residents' ability to pay.

Subject Property's Market Area:

The geographic area surrounding the subject property is defined by physical and man-made boundaries, and encompasses an area known as Wailuku-Kahului. This region is located on the north shore of the Island of Maui and encompasses the civic and business centers of Wailuku and Kahului.

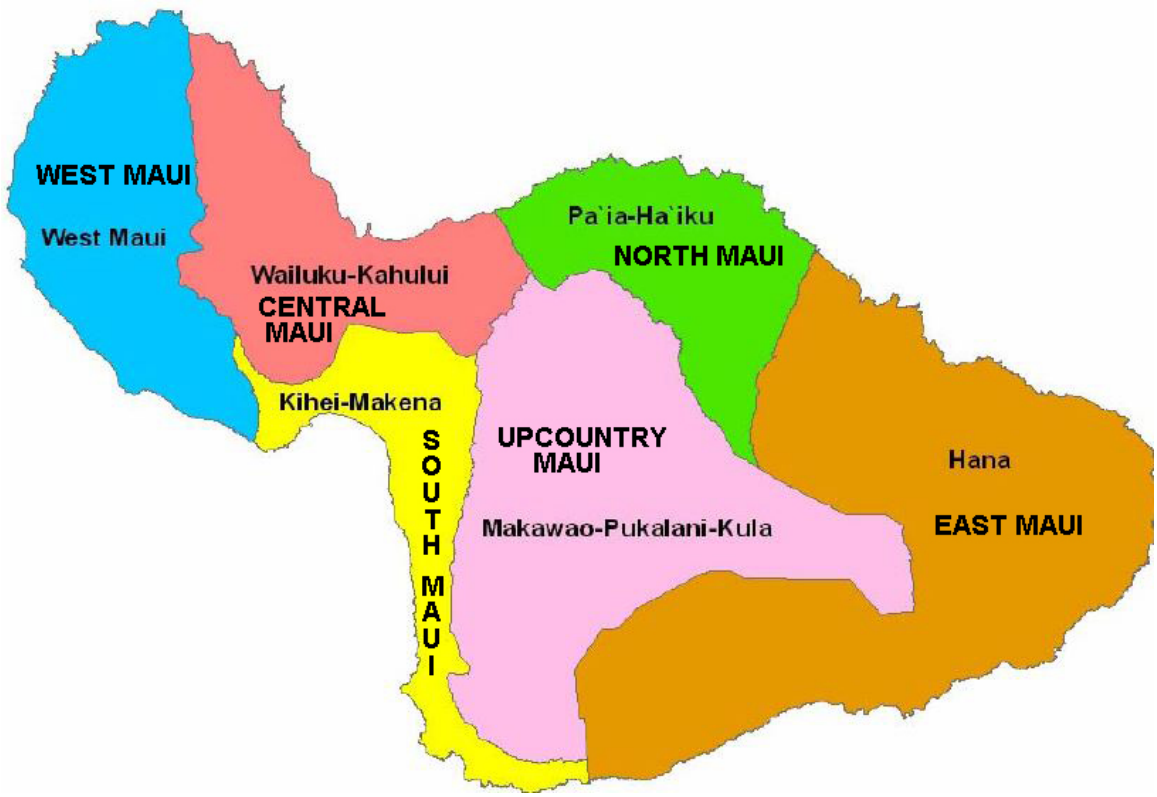
The island's major seaport and primary airport are also contained within the boundaries of this region. The surrounding agricultural land of Central Maui and the eastern half of the West Maui Mountains are also within the Wailuku-Kahului neighborhood.

Population is concentrated in the urban centers of the region. Wailuku is the civic-financial-cultural center while Kahului is the business and industrial center. Kahului Harbor and Airport are major land users in the area. In addition, the region also includes the more rural settlements of Waihee to the north and Waikapu and Puunene to the southeast. Agricultural lands are adjacent

on the lower slopes of the West Maui Mountains and also to the south and east of Kahului. This green border is significant because of its open space and economic value.

In the immediate area, the surrounding properties have mixed uses. North of the subject is the Kehalani Village Center, a commercial retail/office development. Longs Drug Store, the first anchor store in the project, was completed in 2012. Since then, retailers Aloha Gas, Foodland and Coffee Bean & Tea Leaf have opened their doors. As of the effective date, construction of a McDonald's restaurant is ongoing. to the east, is the Maui Lani Village Center, a 79-lot, mixed-use subdivision with commercial, industrial, and residential uses. To the south is vacant agricultural land owned by religious organizations, with the Waikapu Gardens single-family residential subdivision beyond. West of the subject, across Honoapiilani Highway, is another agricultural tract that is seeking rezoning for the proposed Puunani subdivision consisting of multi-family residences and rural lots.

The following table and chart describes the general areas of Maui and defines them in terms of the 4 zones that the county tax assessor uses, called TMK zones, as referred to in this study.



TMK	Orientation	Major Areas
ZONE 1	East Maui	Hana, Keanae
ZONE 2	Upcountry & Resort	Kuau, Makawao, Makena, Wailea
ZONE 3	Central Maui	Kahului, North Kihei, South Kihei, Maalaea, Paia, Wailuku
ZONE 4	West Maui	Honokowai, Kaanapali, Kahana, Kapalua, Lahaina, Napili

The subject property is in ZONE 3, referred to as TMK Zone 2-3, as it includes much of the southern part of Central Maui, which is the adjacent one, TMK Zone 2-2.

Subject Property's Housing Stock:

This section looks first at the inventory of multifamily units in Central Maui that would be comparable to the units for the proposed development. It uses data from the Maui County Tax Assessor to describe them by bedroom count, unit size, assessed value and share of owner occupant vs. investor unit.

Note, the data does not include apartment-zoned units, which are condo units with one owner, as the county tax assessor lumps all of those units into one property (for tax purposes). However, the number of units that go unrepresented in the data by the distinction of being company-owned rental apartments is very few. Most of the wholly owned properties on the island are those oriented towards the visitor industry (such as hotel units).

We start with the total stock of condominiums on the island for the number of bedrooms contemplated by the subject property: One, and Two Bedrooms. The following tables show the market, starting with the entire island of Maui. As seen, most units are investor units, which are non-owner-occupants residing in them. Also, the values assessed on the Owner Occupant units are much lower than the investor, or Non-Owner Occupants.

OWNER OCCUPANT VS. NON-OWNER OCCUPANT (OO), ISLAND OF MAUI

	Non-OO			Owner OCC				
Bedrooms	Units	Assessed Value	Interior Sq Ft	Units	As'sed Value	Interior Sq Ft	**Total Units**	**Non OO Shares**
1	6,780	$487,873	721	642	$348,707	667	7,422	**9%**
2	7,226	$703,332	1,034	1,816	$398,958	910	9,042	**20%**
3	1,672	$1,556,773	1,806	790	$561,298	1,311	2,462	**32%**

Next, we look at a smaller comparable unit set for the subject property, those units located in Central Maui, TMK 2-2 and 2-3.

OWNER OCCUPANT VS. NON-OWNER OCCUPANT (OO), CENTRAL MAUI

	Non-OO			Owner OCC				
Bedrooms	Units	Assessed Value	Interior Sq Ft	Units	As'sed Value	Interior Sq Ft	**Total Units**	**Non OO Shares**
1	3,425	$432,036	688	358	$315,077	637	3,783	**9%**
2	4,730	$613,803	966	1,429	$360,551	866	6,159	**23%**
3	547	$525,149	1,208	487	$413,633	1,178	1,034	**47%**

Finally, we look at the comparable unit set for the subject property, those units located right in the middle of Central Maui, TMK 2-3 excluding South and Central Kihei.

OWNER OCCUPANT VS. NON-OWNER OCCUPANT, WAILUKU-KAHALUUI-NORTH KIHEI

	Non-OO			Owner OCC				
Bedrooms	Units	Assessed Value	Interior Sq Ft	Units	As'sed Value	Interior Sq Ft	**Total Units**	**Non OO Shares**
1	774	$343,518	599	126	$222,260	571	900	14%
2	1,187	$313,130	832	638	$274,447	804	1,825	35%
3	547	$525,149	1,208	487	$413,633	1,178	1,034	**47%**

Next, we compare the number of units in the market area to the number of units this project looks to supply into the market.

PROJECT SHARE OF CENTRAL MAUI CONDO HOUSING STOCK

Bed Rooms	Non- Owner Occupied Unit Counts	Owner Occupied Unit Counts	Total Units In Area	Project Unit Count	Project Share Of Market
1	3,425	358	3,783	130	3.44%
2	4,730	1,429	6,159	151	2.45%
3	547	487	1,178	20	1.70%

As seen, the share of market that the proposed development seeks to capture is a very slight one: about 3% additional supply, in the case of 1-bedroom and 2-bedroom units. For 3-bedroom units, it's less than 2%.

To determine the market's disposition in terms of accepting this project, we turn to describe the drivers of housing demand starting with the economic context that would underwrite this demand.

III. THE ECONOMIC BACKGROUND:

Simply put, real estate sales and values move closely in synch with an area's economic growth, and the mechanism by which this growth occurs is via rising incomes and higher job counts. Both feed directly into demand for housing.

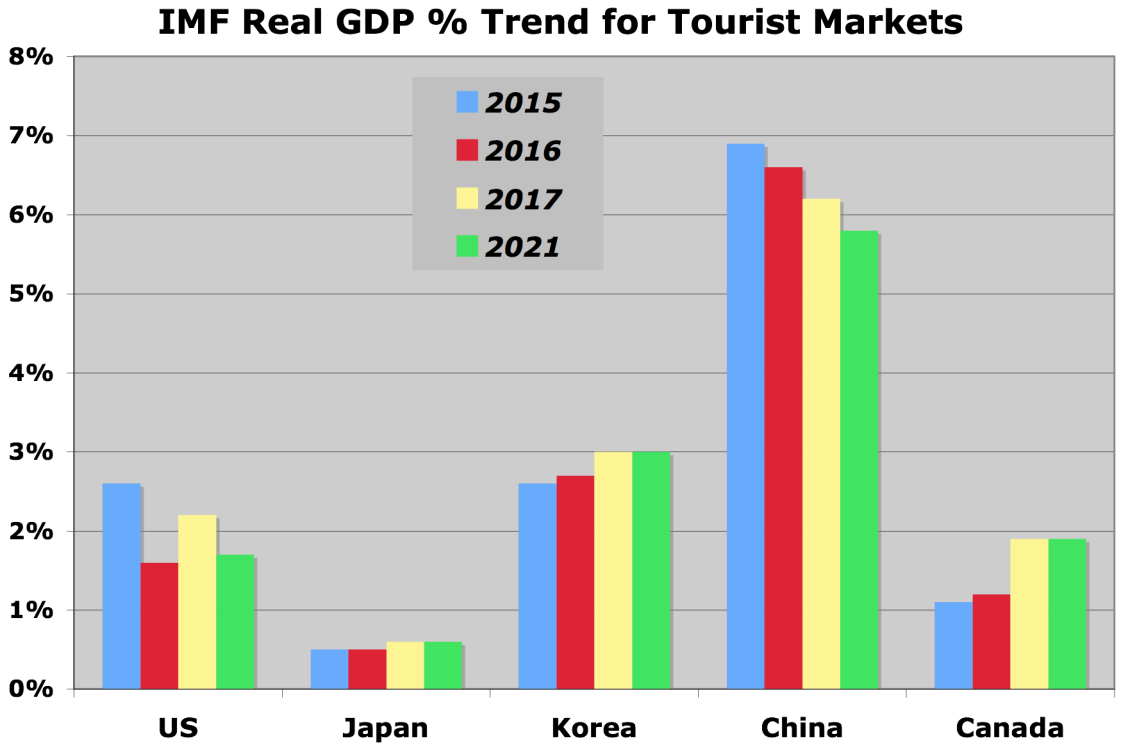
In the short run, economic growth is determined by trading activity, the most important of which is the level and balance of trade between the area and it's major trading partners. In the case of Maui County, the major trade is in recreational goods and services, the largest of which is the visitor industry. The health of this industry is tied to the health of the economies that send visitors to Maui County. The second most important industry is federal spending, mainly national security items, as The state of Hawaii has the second largest concentration of service personal globally. Then, in the longer run, economic growth is also determined by population changes (both migration and demographic) and lifestyle preferences.

As Maui County's major industry is tourism, the major trading partners here would be the US, Canada and Asia (mainly Japan) on the international level: then California, and the west coast states, on the national level: and finally on the state level. As such, we examine the economic health of these trading partners in order to get an understanding of their ability to trade (send visitors, home owners and capital funding) with Maui County, currently and for the future.

Global Economy

The overall global economic forecast by the IMF was lowered in October 2016. They expect that global economic growth will slow to 3.1 percent in 2016 before recovering to 3.4 percent in 2017. The forecast was revised down by 0.1 percentage point for 2016 and 2017 relative to the previous forecast in April 2016, and reflects a more subdued outlook for advanced economies following Brexit and weaker-than-expected growth in the United States. They believed that those developments would put further downward pressure on global interest rates, with monetary policy expected to remain accommodative for longer. However, with the election of Donald Trump, there is a good possibility they will reconsider and possibly reverse this forecast.

The question going forward is whether the benefits of lower energy prices is a net positive or negative, with the negative manifested by lower growth in emerging markets, commodity based economies and industries that benefit from a weak US dollar. The positive manifestations manifest as lower cost of production, higher supply, greater purchasing power and greater private demand, centered in the oil importing nations. The scenarios posited by the IMF showed a net positive effect on global economic growth on average of 0.5% and 0.6%.

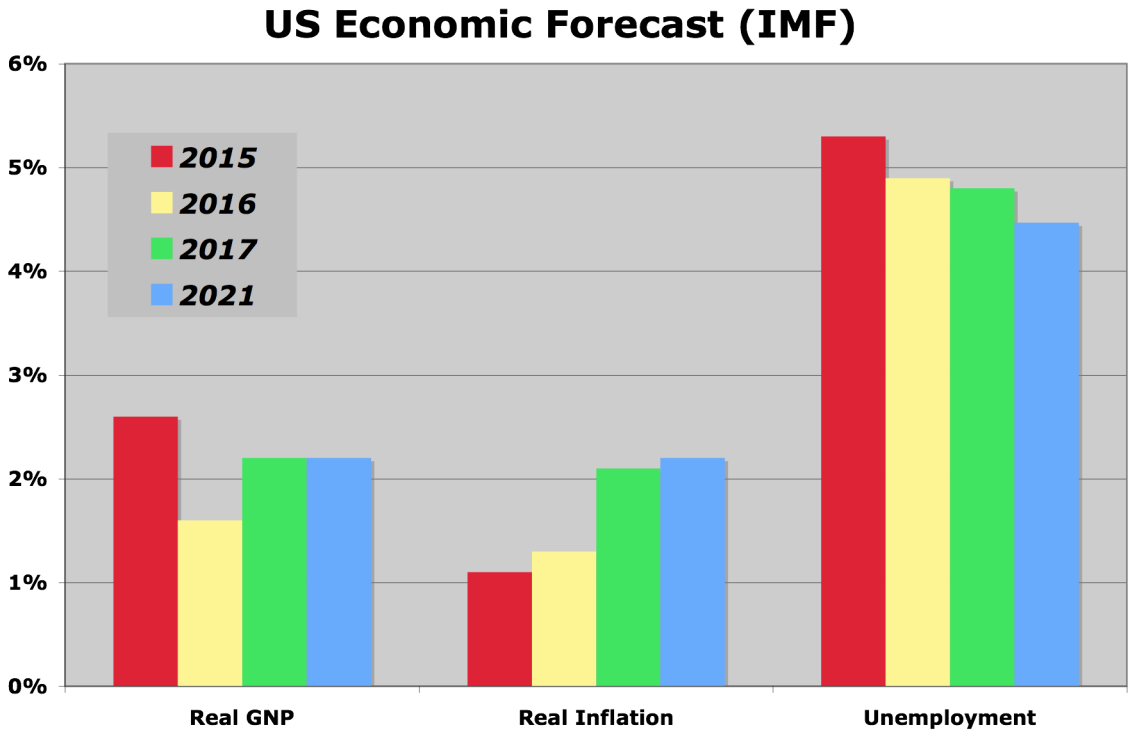


It predicted that if the advanced economies continue to repair their public and financial balance sheets, and stimulate employment, global financial markets and property markets will continue to grow, albeit slowing. The low demand for commodities, the glut of savings and the surplus of labor internationally will result in low demand for final output, a condition that risks deflation (but also on that keeps the cost of money low).

United States

Softer-than-expected activity in the second half of 2015 and the first half of 2016 points to some loss in momentum, despite a mildly supportive fiscal stance and a slower projected pace of monetary policy normalization. Job creation has been healthy, the housing market is improving, and consumer spending remains robust. However, a prolonged inventory correction and weak business investment has caused a downward revision of the 2016 forecast to 1.6 percent. The weakness in capital spending reflects in part still-negative energy investment, dollar appreciation, and financial turbulence earlier in the year, and heightened uncertainty related to the new administration. In 2017, growth is expected to pick up to 2.2 percent, as the drag from lower energy prices and past appreciation of the U.S. dollar fades. Medium term potential growth, projected at 1.8 percent, is held down by an aging population and a continuation of the recent trend of low total factor productivity growth.

That said, the key markets for Hawaii, the higher income households in the western part of North America remain positioned to spend more and more of their discretionary income on vacationing and second homes, particularly to the outer islands.



State of Hawaii

According to economists, Hawaii's economy is expected to continue positive growth for the rest of 2016 and into 2017. This is underwritten by recent developments in the national and global economies, but is really based on the performance of Hawaii's tourism industry, labor market conditions, and the growth of personal income and tax revenues.

The state's economic forecasters at the Department for Business and Economic Development & Tourism (DBEDT) expects that visitor expenditures statewide will grow at a higher rate than projected in their previous forecast for 2016 and 2017. For GDP growth, the current forecast was slightly higher than the previous forecast, and is projected to show a 2.0 percent increase in 2016; 0.1 of a percentage point above the last quarter. The real GDP growth forecast in 2017 is 1.9 percent; same as the previous forecast.

Visitor arrivals are expected to increase 2.3 percent in 2016, 0.4 of a percentage point above the previous forecast. Plus, the forecast for visitor days in 2016 was increased 0.3 of a percentage point to 1.9 percent – and, visitor expenditure growth in 2016 was revised upward to 3.9 percent, from 3.2 percent growth. For 2017, the growth rate of visitor arrivals, visitor days, and visitor expenditures are now expected to be 1.8 percent, 2.0 percent, and 4.0 percent, respectively.

The projection for the non-agricultural wage and salary job growth rate for 2016 is 2.0 percent, 0.2 of a percentage point above the previous forecast. In 2017, jobs are projected to increase 1.2 percent, same as the previous forecast. Unemployment was ranked 5th lowest among all the states in the nation.

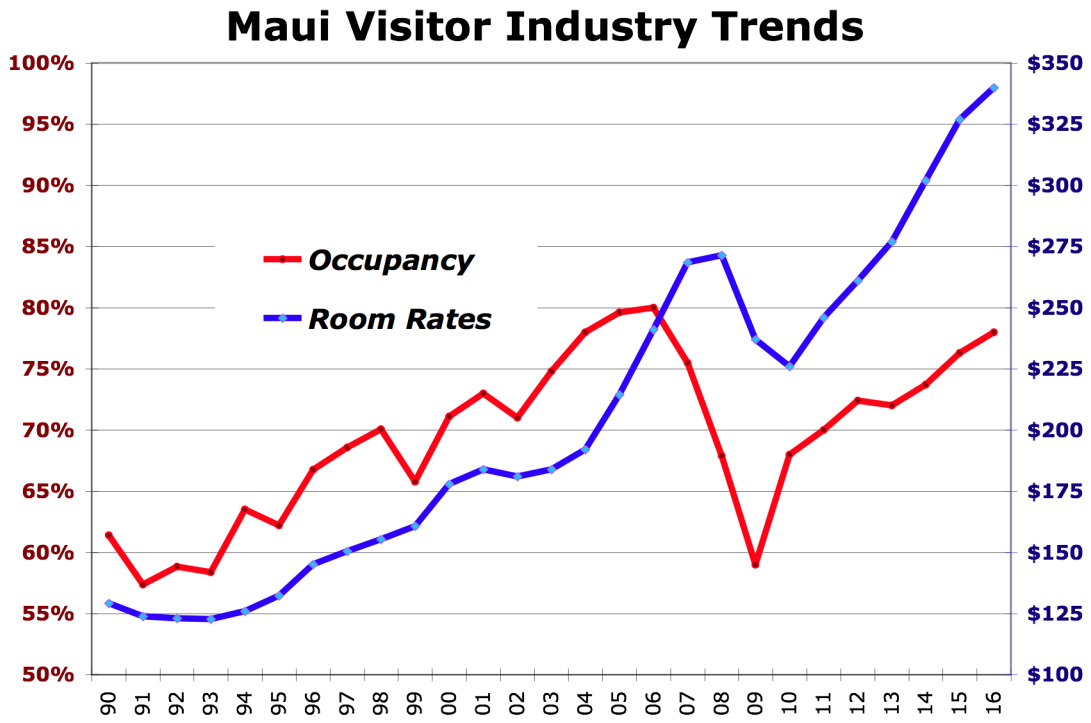
Looking ahead, air service to Hawai'i from the from the U.S. and Canada continues to show double-digit growth in the months ahead (seats from North America are currently expected to increase +10.8 percent in the March through August period) Neighbor Islands will continue to see the bulk of additional scheduled air seats, capturing 64 percent of added capacity in the next six months.

County of Maui

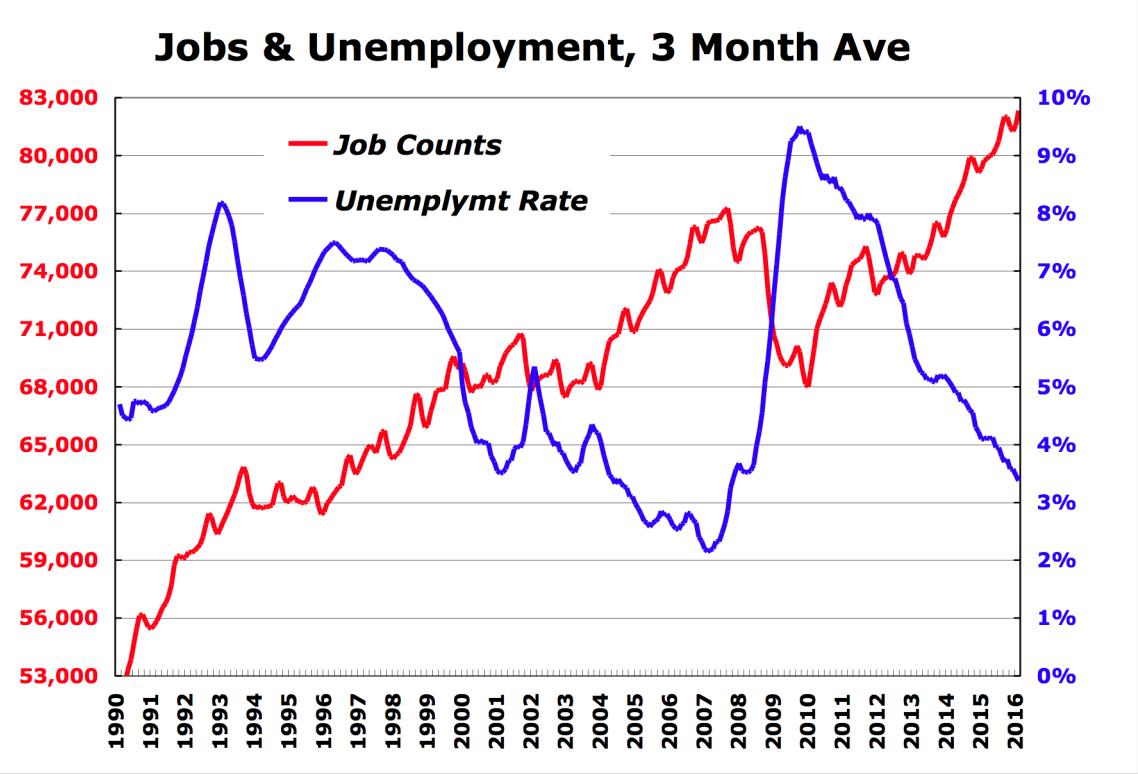
More than most of the rest of the county, the economy of Maui has been growing strongly, thanks to a boom in tourism, which is leading to a recovery/growth in other sectors of the economy, notably construction.

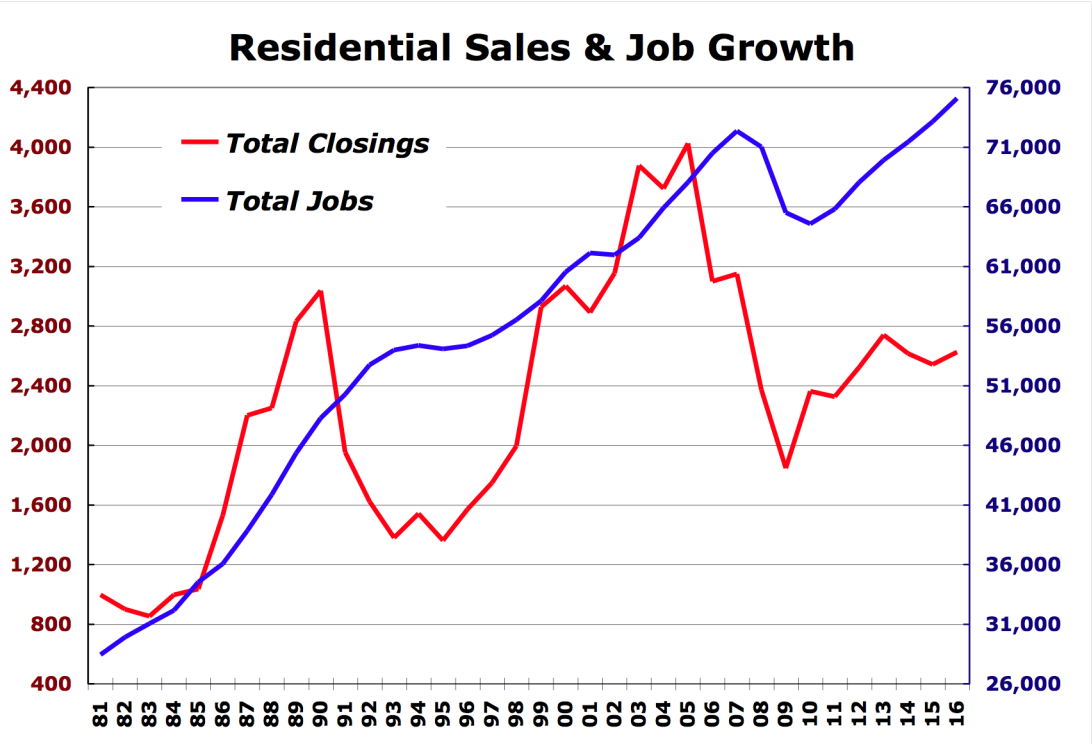
Much of this growth is due to external economic factors, such as the demand for recreational goods and services (hotel rooms and transportation, for example) from the major offshore economies (mainly West Coast of North America and Japan). In the third quarter of 2016, visitor days and visitor arrivals by air increased 6 percent in Maui, and visitor days increased 5.2 percent on Maui.

Additional growth is the result of the rise in construction expenditures, some of which is government spending and some is due to housing, both primary and secondary homes. There is also growth due to federal spending and agricultural activity – although some drag in this sector due to the closing of the sugar plantation at the end of last year.

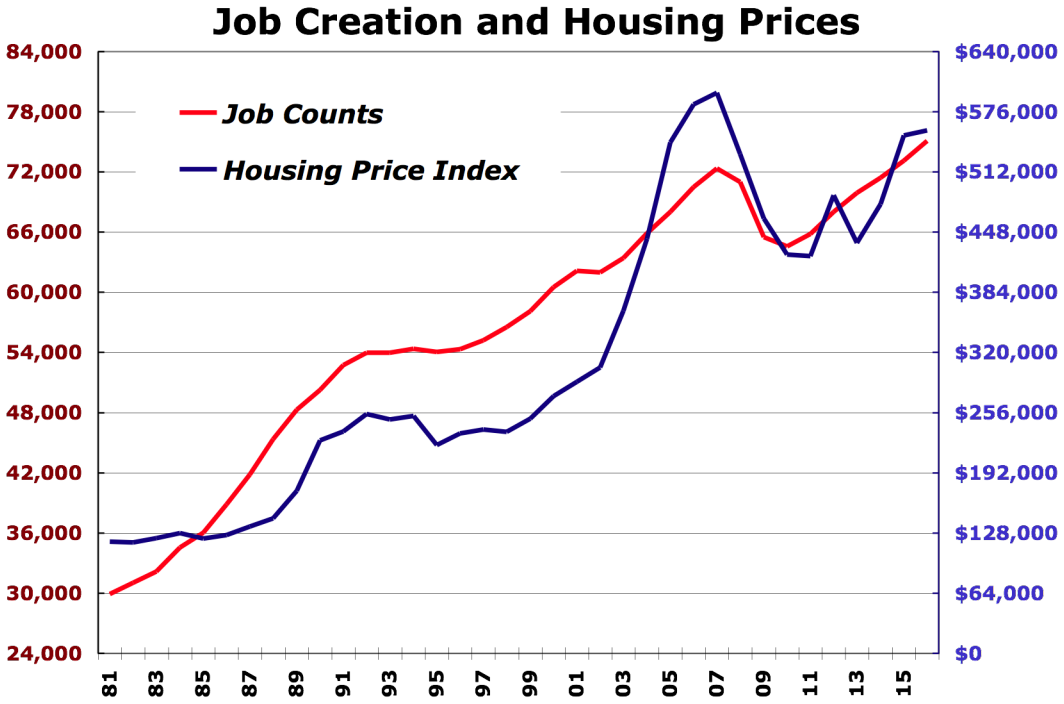


Also, in the third quarter of 2016, the unemployment rate in Maui County decreased 0.2 of a percentage point from 3.6 percent to 3.4 percent. At the same time, it saw a net gain of 2,200 jobs or a 3.0 percent increase.





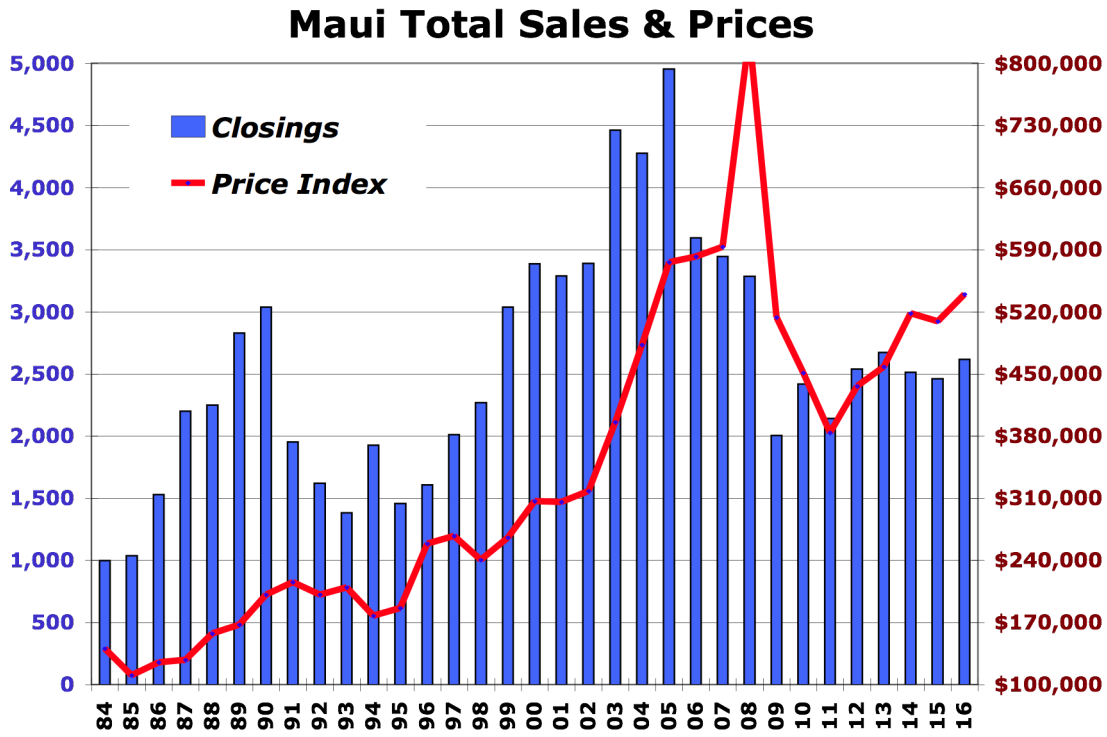
Per usual, the Maui economy and its real estate market act in tandem. As seen in charts, these markets are typified by multi-year periods of mounting activity (leading to housing sales and appreciation) followed by a fall-off in economic activity (and again housing sales and values). Currently, the economic upswing is feeding job growth and housing market expansion.



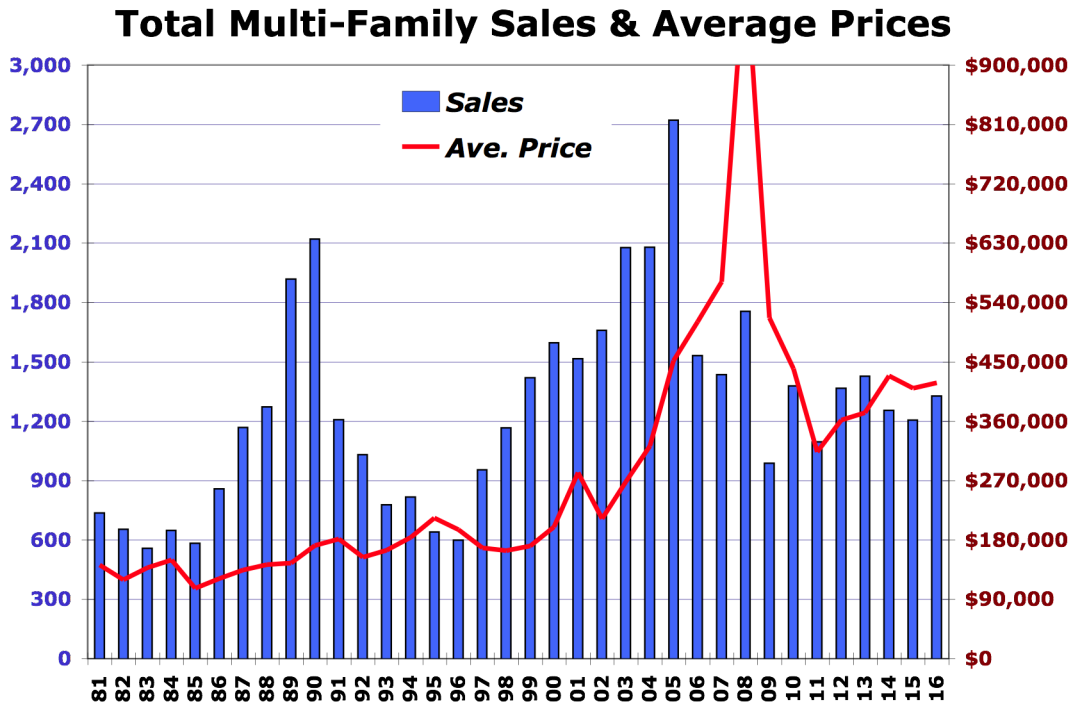
IV. MAUI HOUSING MARKET

Overview: Maui's residential market is arguably one of the most imbalanced in the nation. The chart below shows total sales and average prices of all residential property over the last 30 years. It aggregates both developer and resale broker sales for single family and multifamily units into one time series. While sales rates can double over a cycle, average prices can more than treble. This then makes housing extremely unaffordable… especially since wages statewide have risen only 4.2% p.a. over the past 35 years.

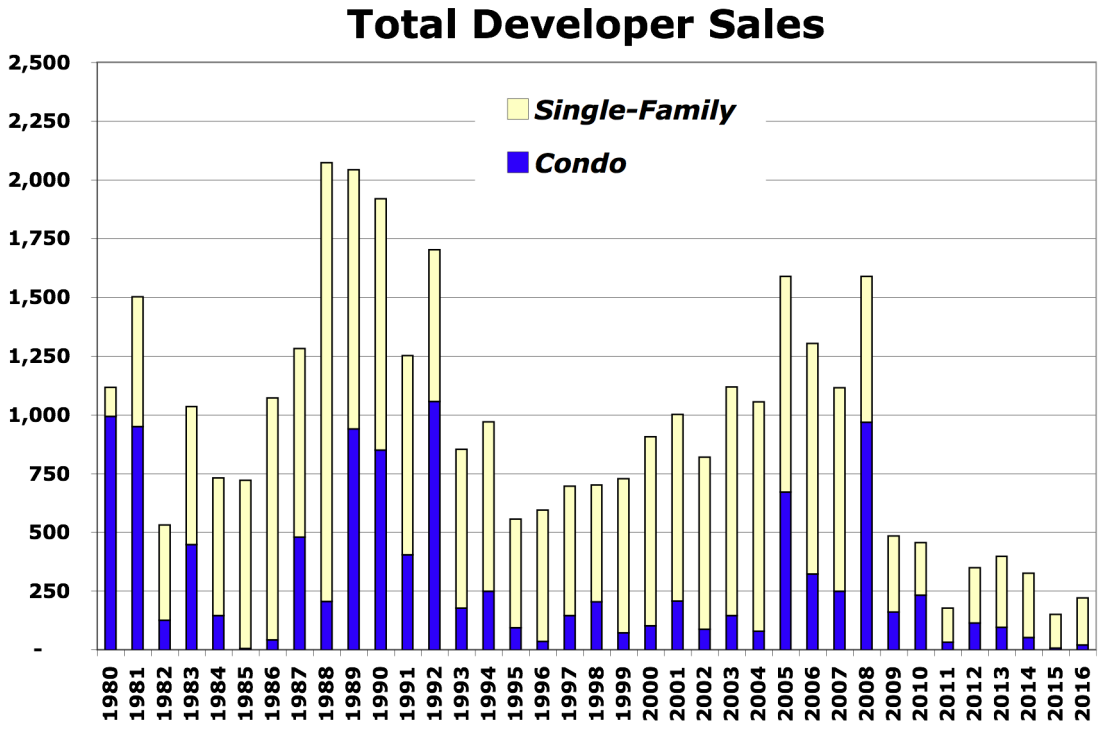
It is for that reason that, in 2016, Hawaii was ranked #1 in the nation for having the widest gap between wages and the price of rental housing by The National Low Income Housing Coalition. This was documented in its annual report, Out of Reach, showing that the gap between wages and the price of housing in Hawaii was greatest in the United States. This also goes for the for-sale housing market.

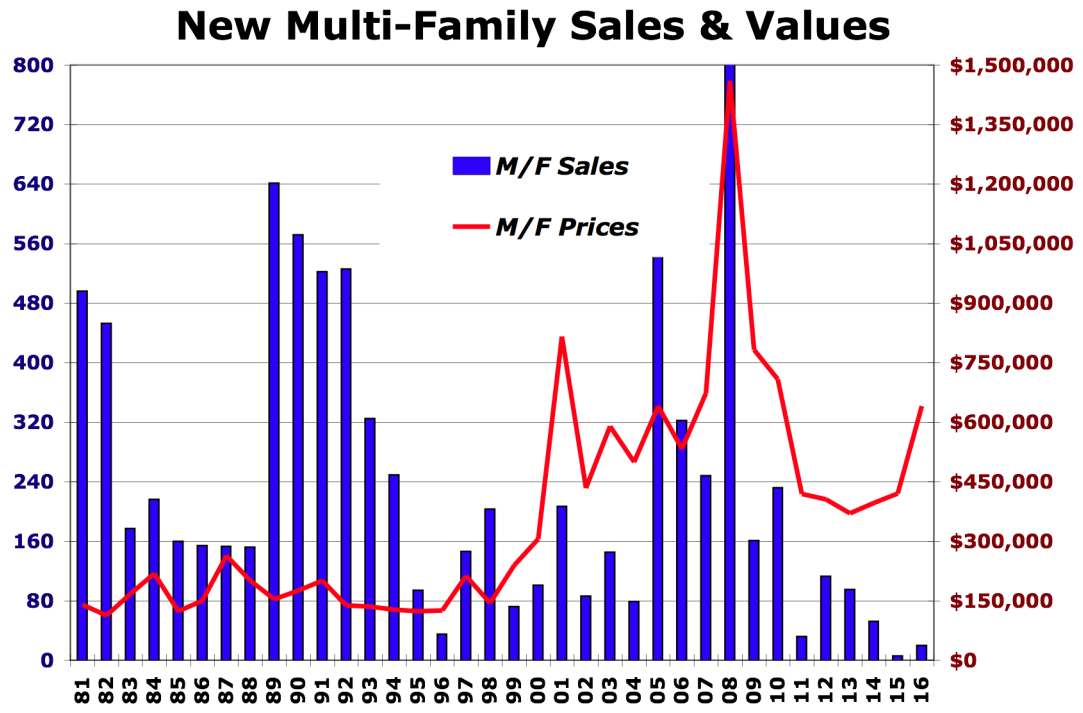


The underlying cause of this is the market is supply constrained and demand abundant… in the extreme. The first condition, limited supply, arises due to Maui being an island, having a very small landmass. This is coupled with inadequate infrastructure and challenging geographic conditions and significant political, social and legal opposition to development. The second, high demand is driven by both local and offshore households attracted by Maui's very high quality of life (as in being a place that is environmentally safe, aesthetically pleasing, socially accommodating, politically stable, etc.). This deep and broad appreciation of that lifestyle itself is the result of by very large influx of tourists every year. They have become accustomed to that lifestyle from repeated visits to the island (mainly West Coast and East Asia). Indeed, Maui has one of the highest rankings in brand awareness and acceptance in the world.

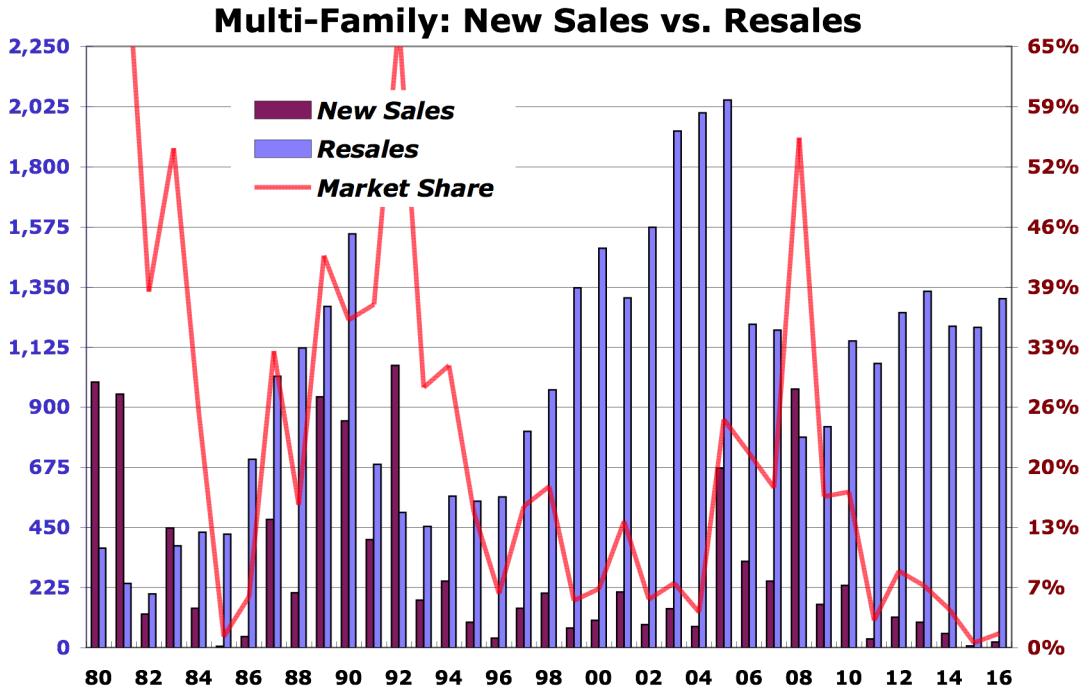


The above chart shows the same time series, but for just attached housing (defined as condos, town homes and apartments, as they serve workforce housing demand, same as market rentals). The chart below also shows how very little housing has been supplied by developers.

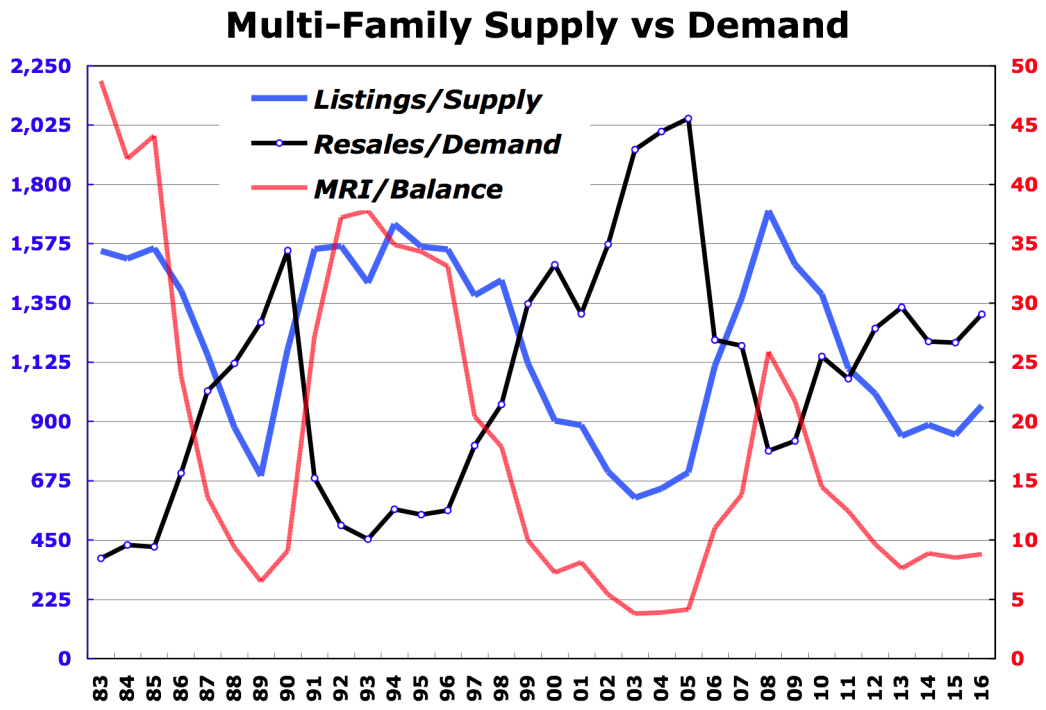




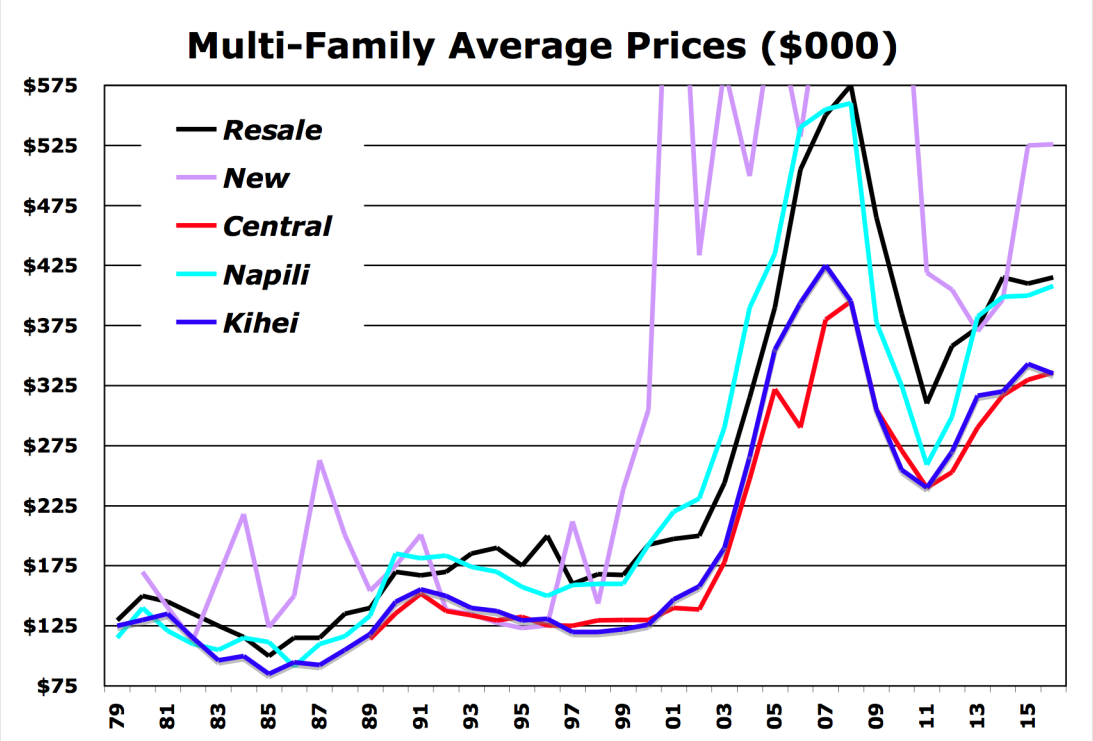
The above chart shows sales and prices for multi-family housing. Note how the prices have not been affordable for working families, the last 15 years. In the chart below, we see just how low the developer's share of total market activity has been.



With little produced, and highly priced, the resale market has to shoulder the burden of providing shelter to the workforce and lower middle class.



The above chart compares listings to sales, and shows the balance between the two - called MRI, or months of remaining inventory. A low MRI (low supply) leads to strong price appreciation.



And ultimately, high prices for for-sale units leads to high rental rates.

Turning now to Housing Supply, and then to housing demand.

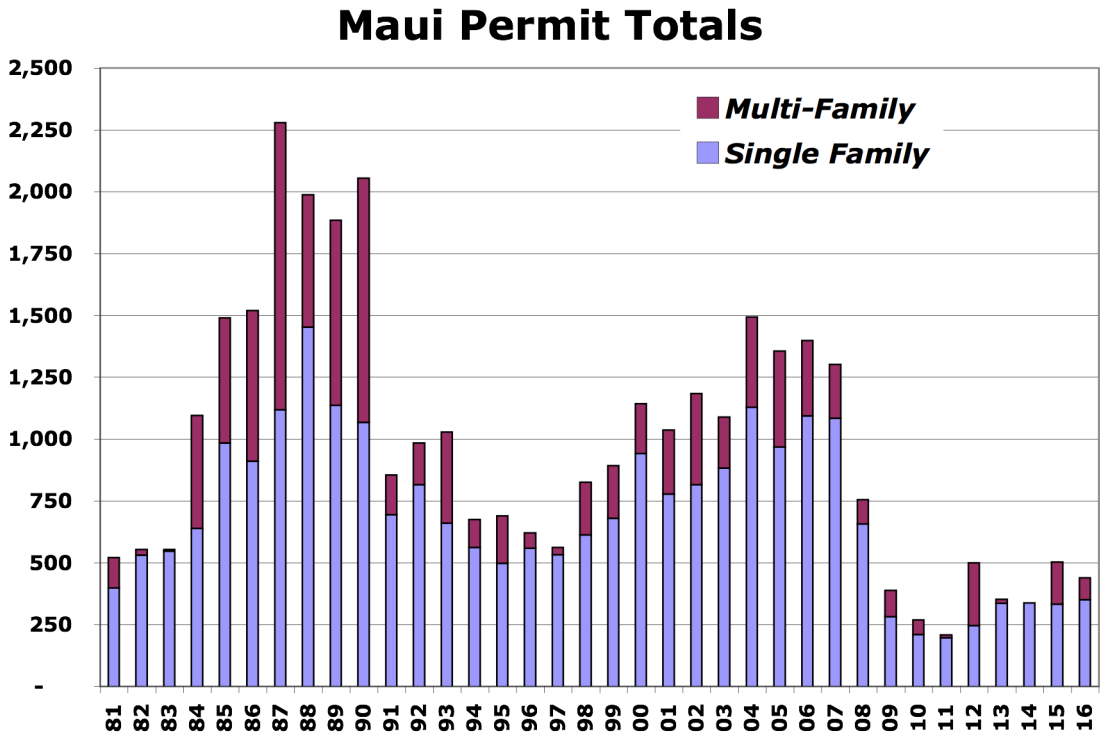
V. CURRENT AND FUTURE HOUSING SUPPLY

Permits

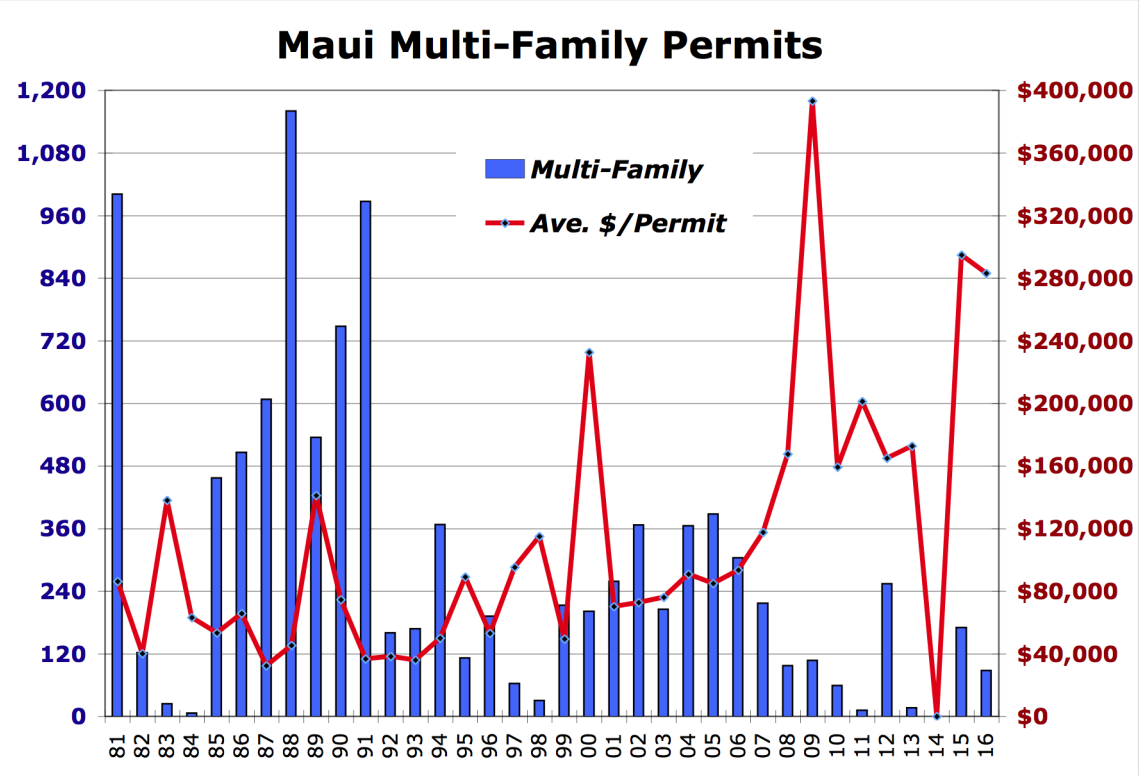
The easiest way to look ahead to where the housing market is going in the short-term is by examining the activity in permits (where developers apply for permission, and pay their fees, for building residential units). The number of building permits approved in a given year is an indicator of the demand for new housing units. To be sure, the count may be affected by a other considerations, such as home mortgage financing, current zoning situations, land use issues, infrastructure condition and financing, affordable housing requirements and other regulatory issues, project readiness, and other considerations that affect the scheduling of permit applications.

That said, a high level of activity indicates more supply, which means that more demand will be met, and the potential for prices adjusting downwards. Obviously, a low level of permits indicates less supply of housing (and potentially higher prices). In addition, low levels of per unit value indicate that the units being built are for the lower end of the market (and vice versa). And over time, this has not been the case overtime on Maui, indicating that most of the new housing has been targeted to the upper income end of the housing market.

A quick overview of the MAUI PERMITS Chart shows that permitted units has sunk so low that it set an all-time historical low three years ago for condo (multifamily) units.



Next, we look at just the multifamily segment. Per the Chart, the level of permits pulled this decade is woefully less than prior ones, indicating a potential shortfall in housing for the lower and med-level income households. This is substantiated by the average dollar value per condo – it spikes upwards on a regular basis, usually at the peak of economic growth, when there is optimism in the industry about the continuation of housing demand.



Planned Developments

The Master Planned Communities on Maui that are active include the following:

- Maui Lani consists of approximately 1,000 acres of land in the Central Maui plains that has approximately 950 units completed. Completed phases are the Greens, Grand Fairways North, Grand Fairways, The Island and The Bluffs. There's an upcoming Village project containing mixed-use product that will allow both residential (of approximately 650 units) and small-scale commercial uses. Some 2,000 units remain to be developed.

- Kehalani has approximately 550 acres of developable land area with numerous ongoing residential developments and approximately 1,000 dwelling units remaining within this project district.

The Master Planned Communities that are in their preliminary stages of development include:

- Pulelehua in West Maul (former Maui Land and Pineapple land) sits between the main highway and the Kapalua Airport on 310 acres of land. This plan has single family and multi-family residential units, totaling 882 residential units with approximately 50% being affordable targeting between 80-140 percent of the county's median income level. It was sold for $15 million in June 2015 to a Dallas company, USA Infrastructure Investments LP. They met with the community in November of 2015 and announced plans to do 130 workforce and 120 market-rate rental units.

- Wailea 670, or Honua'ula, received Maul Planning Commission approval to rezone the land from on agriculture to residential and commercial districts. The owners hope to be allowed to build some 1,400 single-family homes and multi-family units, 2.1 units per

acre. A golf course and approximately 80,000 square feet of retail space was contemplated, but plans have changed. The Council and Mayor approved their zoning through adoption of an Ordinance and not by the Maui Planning Commission. They agreed that their 250 affordable units would be located offsite, at Kaonoulu. Due to environmental concerns, however, it looks unlikely that there will be a golf course as a feature of this master plan. This throws into uncertainty the viability of the entire development.

- Kaanapali 2020 sits on some 4,300 acres in Kaanapali, and is planning for a mix of cluster housing, single-family residential, multifamily, commercial uses, schools, churches, medical, and a cultural center, golf course and transportation center. Developers have hoped to build some 2,800 housing units in the next 20 to 30 years.

- Waine'e abuts the eastern boundary of the Lahaina Aquatic Center & Recreation Center, with approximately 240 acres of land owned by the Kaanapali Development Corporation. They hope to build approximately 1,100 housing units with approximately half being affordable.

- Maalaea Mauka may build some 1,100 housing units mauka of the boat harbor. Potentially, it will have different products including affordable, market priced and luxury units.

- Waiehu Mauka Affordable Housing: 100 multi-family units housed in 20 buildings and six (6) single-family residential lots on an 8-acre parcel. The multi-family units will target households earning up to 120 percent of the area median income category.

- Kihei Mauka is a residential project in Kihei, Maui providing 600 new affordable and market-priced homes, a mixture of single-family and multi-family, with prices expected to range between $300,000 and $600,000. The first units will be multi-family, and affordable, and closed in 2018-2019. They sit next to Monsanto and downwind from Sugar Mill.

- Pu'unani will be a largely rural 550-unit subdivision with 310 house lots and 240 town homes. It abuts Kehalani, Wailuku Heights II and Waiolani Mauka. It is a development by Towne Island Homes, Steve Goodfellow of Maui and a partnership led by Lloyd Sodetani of Maui Realty Co. Inc. It is on 210 acres of prime but fallow Maui farmland.

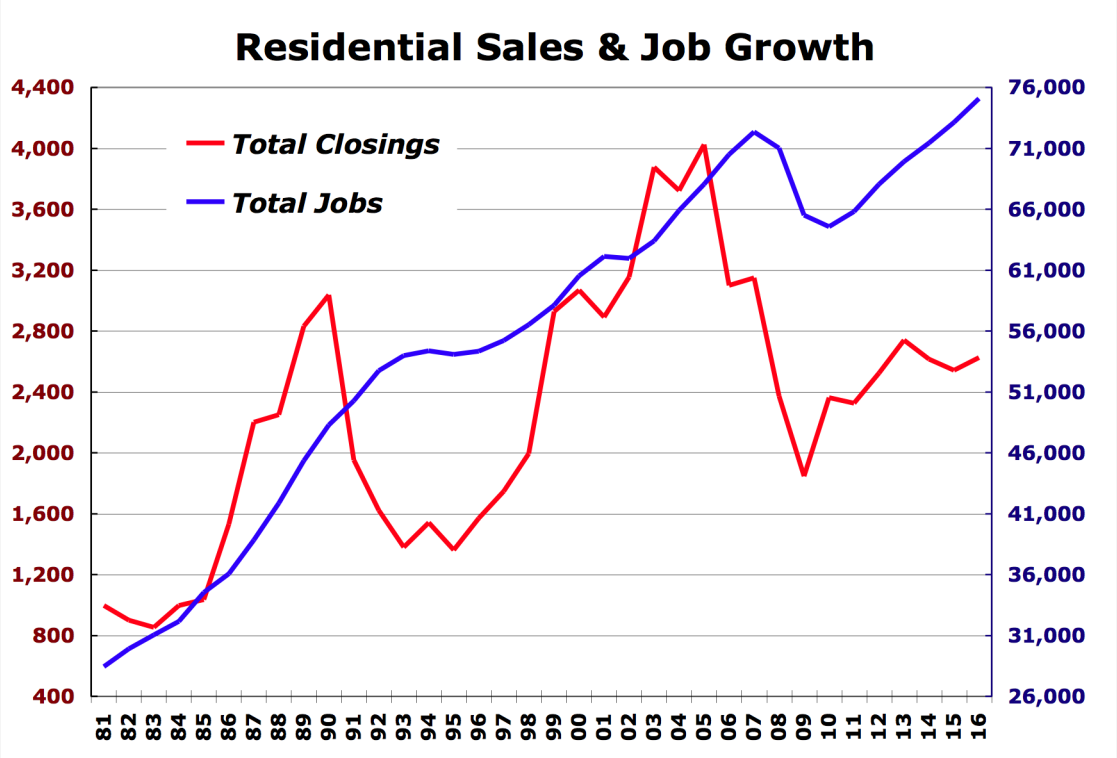
Turning from housing supply, we look at housing demand: past, current and future.

VI. OVERALL HOUSING DEMAND

The prime determinant of housing demand is household formation, itself is a function of the economy and demographic and social trends. As noted above, in the short term, residential housing demand is driven by economics – specifically of job creation/income growth, as well as interest rate trends. In the long term, housing demand is driven by population growth, demographic changes and lifestyle attitudes (indeed, faster population (growth means higher land and housing values).

Housing Demand, Driven by Job Growth

Second to none, housing demand is driven by the creation of jobs – jobs provide the incomes to buy homes, and they drive immigration, which is a prime source of housing demand (sometimes linked to population growth). This linkage is best illustrated in the SALES & JOB GROWTH Chart.



What is notable is how job creation was quite steady up until 2009, when the financial conflagration globally caught up with Maui. Since then, the market has stabilized somewhat, with few job losses in the ensuing two years.

What's also notable is that, in the short run, housing sales are a leading indicator for job creation: as can be seen in the early 1980s and the late 1990s. This year, it appears that while the trend is upwards, housing sales have softened, while jobs continue to grow. In the longer run, housing sales should turn back upwards, as new jobs create housing demand (new job holders are now able to afford to own a home).

In the tables below, we describe DBEDT's predictions for wage and salary job creation on Maui for the next 10-15 years, and derive from that a general expectation for housing demand over the next five to ten years (in other words, we will translate it into housing demand).

DBEDT'S 2035 JOB FORECAST FOR MAUI COUNTY, WAGE & SALARY JOBS

	2007	2015	2020	2025
Total civilian wage and salary jobs	76,730	81,810	86,670	91,390
5 Year Growth		5,080	4,860	4,720
Annual Job Growth		635	972	944
Annual Housing Demand (2 Jobs: 1 Home)		318	486	472

As seen, we use the annual changes in job counts to derive housing demand on the conservative premise that it will take 2 new jobs to generate demand for one new house (with the lower the salaries, the smaller or cheaper the house needs to be).

However, the job counts used in the charts and tables above are just the number of wage and salary jobholders, and do not encompass the self-employed or home worker. According to DBEDT's projections, self-employed workers consist of about 20% of the total work force, but are growing to 25% in the next ten to twenty years. The following transforms those projections into annual job growth projections, and then summarizes it in a complete DBEDT projection table.

DBEDT'S 2035 JOB FORECAST FOR MAUI COUNTY, SELF-EMPLOYED

	2007	2015	2020	2025
Total civilian wage and salary jobs	26,254	27,800	29,450	31,030
5 Year Growth		1,546	1,650	1,580
Annual Job Growth		193	330	316
Annual Housing Demand (2 Jobs: 1 Home)		97	165	158

Finally, the table below summarizes it in a complete DBEDT projection table.

DBEDT'S 2035 JOB FORECAST FOR MAUI COUNTY, TOTALED

	2007 to 2015	2015 to 2020	2020 to 2025
Annual Housing Demand (2 Jobs: 1 Home)	414	651	630

To be sure, most long-term projections are subject to error, but this one does not come close to what the average number of permits pulled has been on Maui (in the last 5 years, 337 permits, p.a., unadjusted for offshore demand) (when adjusted to off-shore demand, or 60% of condos taken out of the equation, then annual permitting has been 270 units, p.a.).

Housing Demand, Driven by Population Growth

This section looks at the level and the sources of long-term housing demand, given expected population changes, and analyzes how this would fit with the proposed projects' development plan.

HOUSING DEMAND SINCE 2000: The following tables show population growth per annum, starting in 2000 and ending in 2015, the last year we have population data for. This time frame roughly encompasses an entire real estate cycle, as 2000 was a few years into the upswing of the 1998-2006 market, just as 2015 is a few years past the bottom of this market, 2010-2011.

Note that in the table, the population change per annum is changed into a household one – a change per annum. This is done by factoring it by the average number of people in a household, as determined by the US Census. This becomes the number of new households in the market, which then equates to an annual creation of housing need.

Next, the annual housing need is compared to the annual number of homes available to them – meaning the number of new homes that were produced that year. In that year, if there were more homes produced than households were formed (an assumption), then there would be a surplus of supply (homes) over demand (population growth) for the year, and vice versa.

A note here: the annual number of homes produced are the actual new homes created, as drawn from and defined in the tax assessor's data base as 'Year Built.'

However, not all those new homes created in any one year are available to the general public. This is reference to the housing production that is absorbed by offshore buyers as second homes. While this is an insignificant amount in almost all national markets, it is a significant one in Hawaii. And it is particularly significant on Maui, which has a large and very highly rated visitor industry. In fact, about 80% of the attached housing and about 20% of the detached dwellings on Maui are non owner-occupied.

Thus, the total housing produced in any one year will not be available to them, particularly those at the lower income levels. As seen in this report, a preponderance of new homes are produced for households making a higher income, as they are a more profitable and less risky market segment for developers.

To account for this, our total annual housing production number is reduced by a factor that reflects that a portion of these new homes are not available to local families. This factor relates to data above owner-occupied (i.e., whether they were sold to households that occupy the dwelling unit, or to those who do not, meaning second home owners and investors). When the entire stock of housing of condominiums and single-family homes in the county was considered, 20% of condominiums and 68% of single-family homes were owner-occupants.

Given that, we assumed that this factor should be set at a level that was half the stated percentage for non-owners, second home owners. This was because some of these non-owner occupied units would turn out to be rented out by their owner-investors, and thus they would be available as rental units. We deemed this to be conservative, as it is our experience that most newly created housing is not absorbed by investors, save at the higher price ranges.

In sum, the annual housing production was factored down, then compared to households created. the difference was calculated, showing housing need surplus or deficit, and then calculated cumulatively.

MAUI HOUSING GROWTH TO HOUSING DEMAND, 2000 to 2015

	Population	Annual Change	Persons Per Household	Households Created	Housing Production	Need vs. Production	Cumulative Need
2000	129,078		2.91		591		
2001	132,428	3,350	2.90	1,155	772	(383)	(383)
2002	134,583	2,155	2.89	744	540	(204)	(587)
2003	137,596	3,013	2.89	1,043	735	(308)	(895)
2004	140,625	3,029	2.88	1,051	719	(332)	(1,227)
2005	143,448	2,823	2.87	984	1,001	17	(1,210)
2006	145,776	2,328	2.86	815	551	(264)	(1,474)
2007	148,117	2,341	2.85	823	600	(222)	(1,696)
2008	151,424	3,307	2.83	1,167	442	(725)	(2,421)
2009	153,393	1,969	2.82	698	214	(484)	(2,905)
2010	155,052	1,659	2.82	588	228	(360)	(3,265)
2011	156,651	1,599	2.82	567	113	(454)	(3,718)
2012	158,510	1,709	2.82	606	221	(385)	(4,104)
2013	160,947	2,437	2.82	863	280	(583)	(4,687)
2014	163,398	2,451	2.82	868	231	(637)	(5,324)
2015	164,637	1,239	2.82	439	137	(302)	(5,626)

Under these assumptions, the model indicates that every year in this time period, save for one, there was greater household growth than housing production, or an imbalance. An annual imbalance of this sort affects the housing market by favoring or stimulating higher prices (and thus higher rental rates). Further, this imbalance, or unmet housing need, when carried forward to the next year, increases pressure on prices and rents upwards. As seen, the potential for unmeet housing need, just over the last 15 years, is 5,626 units.

HOUSING DEMAND, 2015 TO 2020

Next, we look into the future. The tables below describe DBEDT's predictions for population for the county, and derive from that a general expectation for housing demand over the next five years (in other words, we will translate it into housing demand). Note that the model* used here is the seventh in a series of long-range projections dating back to the first report published in 1978.

Like the data used to determine the number of households by income and age in the rental housing demand study, this one uses the detailed population characteristics from the 2010 Decennial Census. This DBEDT study also uses the 2010 estimates of economic variables, and input-output (I-O) tables based on the 2007 Economic Census as baseline data for the projection.

The writers of this study note that: "these projections are neither targets nor goals. They are DBEDT's best estimates of likely trends in important population and economic variables based on currently available information. The accuracy of these projections depends on the degree to which historical trends provide guides to the future, changing external conditions, infrastructure capacity, and other supply constraints which have not been incorporated into the model.

Thus, the further this projection of the census and economic data goes out into the future, it is more susceptible to inaccuracies, relative to what finally transpires. That said, it is useful for setting expectations and planning for those contingencies.

Our analysis of this market begins with the population growth 2010-2020, using data from the US Census. Again, we took the change in the population, and then used that to derive housing demand. In this, we averaged the size of household over this ten-year time period, which came out to 2.82 people per household on average.

HOUSING NEED, PER DBEDT 2040 POPULATION PROJECTIONS

	2000	2010	2020
Resident population	129,078	155,214	181,000
Pop Growth		26,136	25,786
Household size (US Census)	2.87	2.91	2.82
Housing Need		8,981	9,131
Housing Need, p.a.		898	913

We again compared future household growth to past housing production, the growth of housing supply, over the 2000-2010 period. This measure of total homes supplied (from the table above) was 5,698 units, or 570 units per annum. Thus, comparing the future household growth of 9,131 dwellings to past housing production available to owner occupants, this exercise shows a deficit of 243 dwelling units, on an annual basis: 570-913=(243), shortage of homes relative to housing need.

Accounting for past and future, this model thus shows that more than 9,100 dwelling units will be needed in the county to accommodate future projected household housing need. Additional to this future need, there remains the past need of the 5,626 dwellings that accumulated as unmet potential housing need from 2000.

VII. HOUSEHOLD HOUSING DEMAND BY INCOME, AGE & UNIT SIZE

OVERVIEW: This section looks at the actual demand for housing, based on incomes, family size and head of household age. It does this for the entire island including Lahaina, which has a large population.

HOUSEHOLD INCOME, SIZE AND AGE

The following demographic data on household incomes, household sizes and household head ages comes from Ribbon Demographics, a firm that specializes in taking the 2010 US Census data and representing it in ways that are meaningful to those seeking to understand the demographic demand for housing.

The table below takes the total population of households in the county that are renting, and it into income brackets and household size (by the number of people in the household)

ALL HOUSEHOLDS, COUNTS BY INCOME AND HOUSEHOLD SIZE, 2016

Incomes	1-Person	2-Person	3-Person	4-Person	5+-Person	Total
$0-10,000	1,199	613	241	196	157	2,406
$10,000-20,000	1,935	1,020	442	146	148	3,691
$20,000-30,000	1,852	1,441	462	327	454	4,536
$30,000-40,000	2,061	1,435	662	605	399	5,162
$40,000-50,000	1,177	1,210	740	536	380	4,043
$50,000-60,000	1,041	945	612	541	346	3,485
$60,000-75,000	1,172	2,098	783	685	510	5,248
$75,000-100,000	1,171	2,868	1,488	1,085	1,192	7,804
$100,000-125,000	662	1,816	1,124	1,082	1,129	5,813
$125,000-150,000	378	1,417	597	544	819	3,755
$150,000-200,000	323	905	931	498	1,210	3,867
$200,000+	587	1,301	792	471	1,169	4,320
TOTALS	**13,558**	**17,069**	**8,874**	**6,716**	**7,913**	**54,130**

Then, the income limits per household, according to the HUD 2016 AMI definition, is shown below.

MULTIFAMILY TAX SUBSIDY PROJECT INCOME LIMITS, 2016

AMI	1 Person	2 Person	3 Person	4 Person	5 Person	6 Person	7 Person
20%	$11,280	$12,880	$14,500	$16,100	$17,400	$18,680	$19,980
30%	$16,920	$19,320	$21,750	$24,150	$26,100	$28,020	$29,970
50%	$28,200	$32,200	$36,250	$40,250	$43,500	$46,700	$49,950
60%	$33,840	$38,640	$43,500	$48,300	$52,200	$56,040	$59,940
80%	$45,120	$51,520	$58,000	$64,400	$69,600	$74,720	$79,920
100%	$56,400	$64,400	$72,500	$80,500	$87,000	$93,400	$99,900
120%	$67,680	$77,280	$87,000	$96,600	$104,400	$112,080	$119,880
140%	$78,960	$90,160	$101,500	$112,700	$121,800	$130,760	$139,860

The following table then takes the data and reformats it, using the income limit guidelines of HUD for 2016, starting at 30% and running up to 140% AMI. Note that this data is for renters only.

RENTER ONLY HOUSEHOLDS BY AMI AND SIZE, 2016

AMI	1-Person	2-Person	3-Person	4-Person	5-Person	6-Person	7+-Prsn	Total
30%	1,846	856	488	341	198	121	155	4,004
40%	1,537	1,201	534	378	215	118	157	4,140
50%	490	397	342	197	111	57	67	1,662
60%	1,119	847	537	586	122	115	77	3,403
80%	695	795	380	383	195	103	122	2,675
100%	348	915	426	319	165	86	83	2,342
140%	348	706	358	149	141	42	21	1,764

Next, we looked at this data by owner households only.

OWNER ONLY HOUSEHOLDS BY AMI AND SIZE, 2016

AMI	1-Person	2-Person	3-Person	4-Person	5-Person	6-Person	7+ Persn	Totals
30%	1,041	913	298	218	130	73	94	2,767
40%	728	870	402	471	139	79	110	2,799
50%	360	518	256	279	63	36	47	1,558
60%	917	813	524	298	72	48	59	2,731
80%	666	1,042	439	398	204	142	176	3,066
100%	320	934	523	488	268	160	173	2,866
140%	317	1,118	463	700	295	116	153	3,161

The comparison between the owner and the renter households shows that the renter demographic is skewed toward the lower AMI segments. Thereafter, the skew is in favor of the owner households

The following table combines both renter and owner data.

RENTER & OWNER HOUSEHOLDS BY AMI AND SIZE, 2016

AMI	1-Person	2-Person	3-Person	4-Person	5-Person	6-Person	7+ Persn	Totals
30%	2,887	1,768	786	558	328	194	249	6,771
40%	2,265	2,071	936	849	354	197	267	6,939
50%	849	914	598	476	175	93	115	3,220
60%	2,036	1,660	1,061	884	194	163	135	6,134
80%	1,361	1,837	820	781	399	245	298	5,740
100%	668	1,849	950	807	433	246	256	5,208
140%	664	1,824	820	849	436	158	174	4,926

The table shows that there are significant ‘bulges’ in the income demography at the 30%, 40% and 60% of AMI, relative to the other segments. And, within those segments, the 1-person households are the largest component, followed by the 2-person segment.

Next, we looked at the data not by individual renter segments, but in a cumulative, summary, vantage point (by accumulating the total number of households at or below a particular AMI level).

CUMULATIVE DATA FOR RENTER ONLY HOUSEHOLDS BY AMI AND SIZE, 2016

AMI	1-Persn	2-Persn	3-Persn	4-Persn	5-Persn	6-Persn	7+ Persn	Totals
30% & below	1,846	856	488	341	198	121	155	4,004
50% & below	3,383	2,056	1,022	719	413	239	312	8,144
60% & below	3,873	2,453	1,364	915	524	295	380	9,805
80% & below	4,992	3,300	1,901	1,502	646	410	456	13,208
100% & below	5,687	4,095	2,282	1,885	841	514	578	15,883
120% & below	6,035	5,011	2,708	2,204	1,006	600	661	18,225
140% & below	6,383	5,717	3,066	2,352	1,148	642	682	19,989

Next, we looked at the data not by individual segments, but in a cumulative, summary, vantage point (by accumulating the total number of households at or below a particular AMI level).

CUMULATIVE COUNTS & SHARE OF HOUSEHOLDS, RENTERS & OWNERS, 2016

AMI.	Renter Total	Owner Total	Renter & Owner	% Renter Total Population	% Owner Total Population	%, Renter & Owner
30%	4,004	2,894	6,898	7%	5%	12%
50%	8,144	5,935	14,079	14%	10%	24%
60%	9,805	7,743	17,549	17%	13%	30%
80%	13,208	10,826	24,034	23%	18%	41%
100%	15,883	14,161	30,044	27%	24%	51%
120%	18,225	16,989	35,213	31%	29%	60%
140%	19,989	20,011	40,000	34%	34%	68%

This shows there are some 9,805 renter only households living at or below the 60% of median income, or 17% of the total population on the island. If the threshold is raised to 80% AMI, then this ratio becomes 22.6%. Note that these numbers, through the 140% of AMI, encompass the most of the households on Maui (40,000 out of 58,643 households).

Next, we broke just the renter data by AMI down into three age groupings: one for families, defined as households whose head of house was between the ages of 25 and 54 years, and two for senior households, the first defined as households whose head was aged 55 years and older, and the second defined by a head of household aged 65 years and older.

RENTER HOUSEHOLDS AGED 25-54 YEARS BY AMI AND SIZE, 2016

AMI	1-Persn	2-Persn	3-Persn	4-Persn	5-Persn	6-Persn	7+ Prsn	Totals
30%	710	491	428	269	171	105	135	2,310
50%	694	923	438	312	191	104	139	2,801
60%	276	212	290	163	100	51	61	1,153
80%	660	534	439	511	109	101	69	2,422
100%	381	486	307	276	177	96	114	1,837
120%	194	586	288	165	147	72	65	1,517
140%	194	449	237	98	111	33	16	1,140

Note that the data in these next two charts overlap: the table for the 55+ Years Old data includes those that are 65+ years old (but not vice versa).

SENIOR RENTER HOUSEHOLDS AGED 55+ YEARS, BY AMI AND SIZE, 2016

AMI	1-Persn	2-Persn	3-Persn	4-Persn	5-Persn	6-Persn	7+ Prsn	Totals
30%	1,136	365	60	71	27	16	20	1,694
50%	843	278	96	66	25	13	18	1,339
60%	214	185	53	34	11	6	7	509
80%	459	313	98	76	13	14	8	981
100%	314	309	74	107	17	7	8	838
120%	154	329	138	154	18	14	18	825
140%	153	257	120	50	30	9	5	625

As seen, the elderly need is greater than the family one in the one-person household making under than 30% and 50%. As the households get larger, the elderly need gets smaller in absolute numbers.

ANALYSIS BY HOUSING UNIT COUNTS: The following tables take the potential demand for housing units in relation to the number of people in the households that are currently renting, as was described in the section above, the data was used to translate it into a particular housing unit type that suits those sizes, (sizes that relate to bedroom counts).

The translation here assumes that the Imputed Persons Per Bedroom* is in accordance with the project using financing under IRS Section 142 Tax-Exempt Bond in the Honolulu MSA for a project. The alternative is to use financing via the IRS Section 42 Low-Income Housing Tax Credit (LIHTC). The interesting point is that the LIHTC assumption has more people living in the larger bedroom count units and less in the smaller bedroom count units. For our purposes, we rely on the other assumption, the one for the Tax-Exempt Bond.

** While affordable rental housing markets do vary across the nation, and HUD assumptions sometimes wander far a field from reality, the Hawaii affordable rental housing market area is one of the most housing constrained in the nation, if not the absolute worst. A reasonable assumption would that the imputed number is probably slightly lower than the actual usage. Our assumption here is that the imputed number is probably much lower than the actual usage, meaning the actual usage far exceeds the imputed number (meaning a significant degree of overcrowding).*

The table below describes the differences:

IMPUTTED FAMILY SIZE PER UNIT BEDROOM TYPE

	Tax-Exempt Bond	LIHTC Credit
Efficiency/Studio	1 Person	1 Person
1 Bedroom	2 People	1.5 People
2 Bedroom	3 People	3 People
3 Bedroom	4 People	4.5 People
4 Bedroom	5 People	6 People
5 Bedroom	6 people	5 People

For simplicity's sake, we use the Imputed Persons Per Bedroom factor to derive the specific housing type that is needed. So a one-person household will demand a studio. And a two person household will demand a one bedroom unit, we have highlighted the highest need in yellow and the second highest need in green per the bedroom type.

POTENTIAL HOUSING DEMAND, HOUSEHOLDS AGED 25-54 YEARS BY AMI

AMI	Studio (1.0)	1 Bed (2.0)	2 Beds (3.0)	3 Beds (4.0)	4 Beds (5.0)
30%	710	491	428	269	171
50%	694	923	438	312	191
60%	276	212	290	163	100
80%	660	534	439	511	109
100%	381	486	307	276	177
120%	194	586	288	165	147
140%	194	449	237	98	111

POTENTIAL-HOUSING DEMAND, HOUSEHOLDS AGED 55+ YEARS, BY AMI

AMI	Studio (1.0)	1 Bed (2.0)	2 Beds (3.0)	3 Beds (4.0)	4 Beds (5.0)
30%	1,136	365	60	71	27
50%	843	278	96	66	25
60%	214	185	53	34	11
80%	459	313	98	76	13
100%	314	309	74	107	17
120%	154	329	138	154	18
140%	153	257	120	50	30

However, since the project will not address any of the demand below 80% AMI, this table only shows the potential need for households at 80% AMI to 140% of AMI and higher.

POTENTIAL HOUSING DEMAND, HOUSEHOLDS AGED 25-54 YEARS BY AMI

AMI	Studio (1 ppl)	1 Bed (2 ppl)	2 Beds (3 ppl)	3 Beds (4 ppl)
80%	660	534	439	511
100%	381	486	307	276
120%	194	586	288	165
140%	194	449	237	98

The following table compares the potential demand with the proposed unit count and mix, for the previous unit mix.

UNIT MIX VS POTENTIAL HOUSING DEMAND, HOUSEHOLDS AGED 25-54 YEARS BY AMI

Bed	AMI	Units	Potential Demand	Market Share
1	80%	60	534	11%
1	100%	50	486	10%
2	120%	71	288	18%
1	Market	20	916+	NA
3	Market	80	1,146+	NA
3	Market	20	720+	NA

Note that the potential demand for the affordable units was derived under the methodology described above, specifically local Maui demand by level of income and the number of people in the household (family size).

On the other hand, the market rate units describe the potential demand at a much higher level. This is because that demand can come from a renter household making $80,000 and up for a one bedroom, which encompasses many more households (on up to $200,000 and higher). We have noted this with a “+” added after the demand number, which reflects the addition of these higher income households.

Note, if consideration was given to producing 3 bedroom units for the affordable renter segment, the demand would be 98 households at the 140% level. However, our experience is that there are very few projects with 3 bedroom units targeting the affordable renter because building costs are prohibitive, and market rents are so much more remunerative.

Note that although the unit mix has changed to accommodate the allowance for market-rate units in the project, we repeat the table and considerations, as it validates the project WITHOUT this new (and beneficial) change.

The new table is below, makes the assumption that 40% of the units will be at market rates and eliminates the requirement to restrict these remaining units at 140% of AMI.

UNIT MIX VS POTENTIAL DEMAND, AFFORDABLE HOUSEHOLDS AGED 25-54 YEARS

Bed	AMI	Units	Potential Demand	Market Share
1	80%	60	534	11%
1	100%	50	486	10%
2	120%	71	288	18%

The market rate units are not dependent on local households as potential renters. Indeed, it opens up these market units to offshore demand in a significant way – significant in terms of higher potential demand and higher rental revenue. As mentioned earlier, the ability to have a 3-month lease period is important, as that can take advantage of seasonal demand – meaning the winter and the summer 'high' periods.

As the market rate units have a wider audience, further thought should be given to market-rate conditions. Thus, we turn to look at rental market conditions.

VIII. THE COUNTY'S RENTAL MARKET

OVERVIEW: Multi-family living has been an important part of the county's housing market since the late 1960's. With developable land limited and construction costs expensive, multi-family units have been the most efficient way to provide affordable housing, both in terms of owning and renting, for a significant percentage of the island's residents.

That said, multi-family housing was also attractive to visitors from outside the island, primarily as a way to lower the cost of their vacation. Further, it also became an opportunity to own a second home and/or to invest in a rental property.

Over the latter part of the 1990's, the county enjoyed strong growth in the demand for these vacation rentals, thanks to the high quality of life in the state and the attractiveness of lifestyle on the island. Indeed, there are a large numbers of rental units targeting visitors only.

This investor market grew to be the predominant one on Maui today. It is characterized by high rental rates. This is why many of the island's multifamily unit owners cater to this demand both individual owners of rental units, as well as corporate or institutional owners of rental projects.

Because of this, there are two rental markets on Maui, the high-end and the low-end, with little or nothing in between. Indeed, much of the mid-range rental housing demand has found a source in single-family rentals, either whole unit, half-unit, ohana (meaning family but connoting a 'granny' unit, or a backyard cottage. The problem is, and has been, a mismatch between housing costs and household incomes. This has been going on for generations, and has just gotten worse.

High-priced housing markets like Maui's often have high ratios of shelter cost to household income – and those whose shelter-to-income (STI) ratios greater than 30 percent are income challenged, or cost burdened. In 2011, about 51 percent of local residents were paying less than 30 percent of their monthly income for shelter. At that level, households can use 70 percent of their income for necessities and are more likely to qualify for mortgage loans. In 2016, the proportion paying less than 30 percent of household income for shelter (rent or mortgage plus utilities) was up to 58 percent.

As mentioned earlier, in 2016, Hawaii ranked #1 in the nation for having the widest gap between wages and the price of rental housing by The National Low Income Housing Coalition's annual report, Out of Reach. It showed that in 2016, the national Housing Wage is $20.30 for a two-bedroom rental unit, assuming a 40-hour workweek, 52 weeks per year. In comparison, Hawaii's Housing Wage is $32.44 for a two-bedroom rental unit.

In 2016, the fair market rent for a two-bedroom apartment in Hawaii was $1,780. In order to afford this level of rent and utilities—without paying more than 30% of income on housing—a household must earn $5,932 monthly or $71,184 annually. A worker earning the federal minimum wage of $7.25 per hour would not be able to afford a two-bedroom apartment at HUD's fair market rent even if he worked 24 hours a day, 7 days a week.

HOUSEHOLD CONDITIONS, SIZE AND OWNERSHIP: A major effect of high housing costs on families is that they re-rent part of their shelter to friends or families. Evidence of this is measured by the US Census, and they define crowding as 2 or more persons per bedroom.

They also measure doubling up via surveys and define that as 'more than one family group' in a household. . In the last Housing Planning Study, such a survey was performed and the results from Maui show that for owners, 4.5% of the respondents characterized their living situation as

'crowded' and another 14.7% indicated 'doubling up' in the household. For renter respondents, 18.4% of them indicated 'crowding' and another 13.5% said yes to 'doubling up."

CROWDING & DOUBLING UP, ALL MAUI HOUSEHOLDS SURVEYED

	Owners	Renter
Crowded	4.50%	18.40%
Doubled up	14.70%	13.50%
Crowded & Doubled Up	18.00%	26.60%

The following tables show the data by area, with West Maui showing the worst conditions.

MAUI HOUSEHOLDS DOUBLING UP, BY AREA

	Upcountry	Central Maui	North Shore	South Maui	West Maui
Yes	12.20%	13.70%	13.50%	16.30%	16.50%
No	87.80%	86.30%	86.50%	83.70%	83.50%

MAUI HOUSEHOLDS CROWDING, BY AREA

Ppl/Bedroom	Upcountry	Central Maui	North Shore	South Maui	West Maui
Less than 2	92.30%	88.80%	94.90%	91.10%	85.70%
More than 2	7.70%	11.20%	5.10%	8.90%	14.30%

MAUI HOUSEHOLDS DOUBLING UP & CROWDING, BY AREA

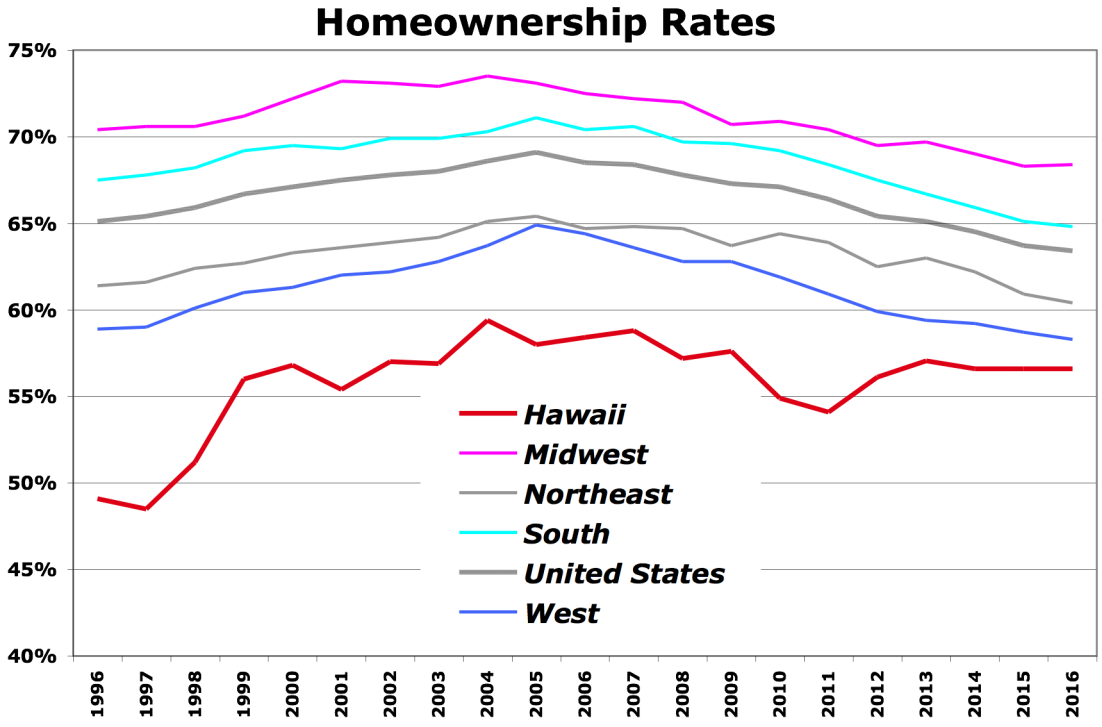
	Upcountry	Central Maui	North Shore	South Maui	West Maui
Either or Both	18.70%	22.70%	17.40%	22.00%	25.50%
Neither	81.30%	77.30%	82.60%	78.00%	74.50%

Another way that this condition is made apparent is the measurement of household size. Indeed, as households cannot afford housing, then overtime pent-up demand increases, household formation is delayed and the average household size grows. The statewide average for household size increased by 2.8% from 2.88 persons per household to 3.11. This is consistent with a housing market where demand was greater than supply. The following table shows that Maui County had second highest increase in average household size over the 10-year period.

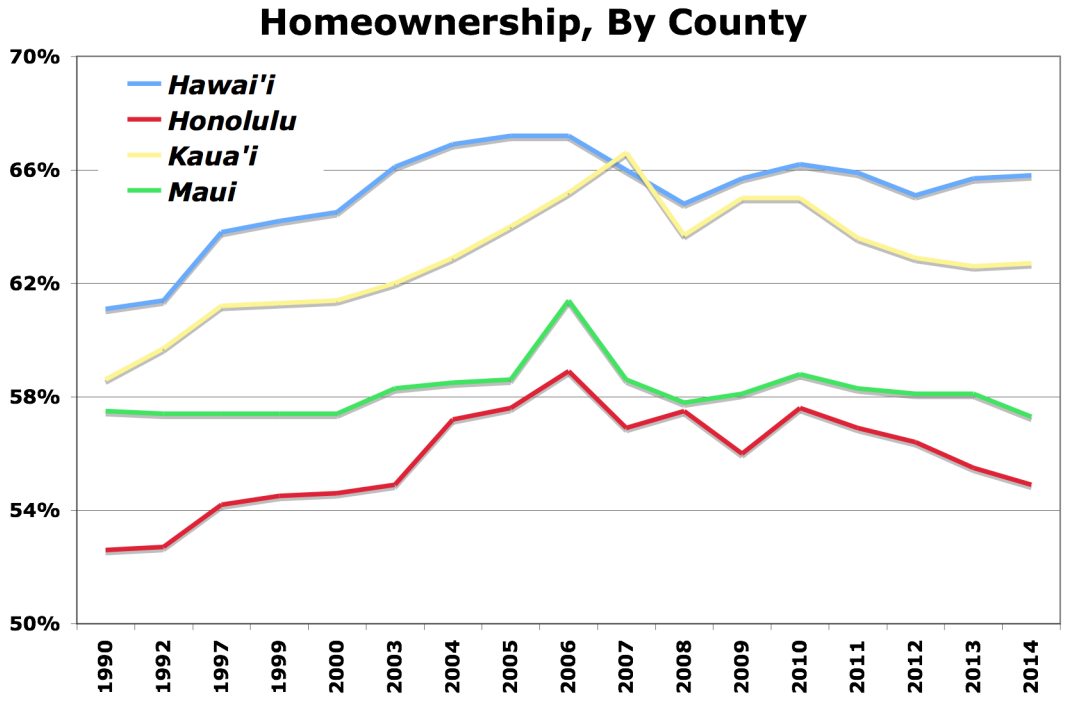
MAUI HOUSEHOLDS DOUBLING UP & CROWDING, BY AREA

	Population Growth	Household Growth	Housing Size Growth
Hawaii	19.1%	17.0%	0.3%
Honolulu	10.9%	3.5%	8.8%
Kauai	14.3%	11.7%	2.3%
Maui	19.3%	12.5%	5.8%

Another manifestation of high-priced housing is low ownership. The following charts illustrate.

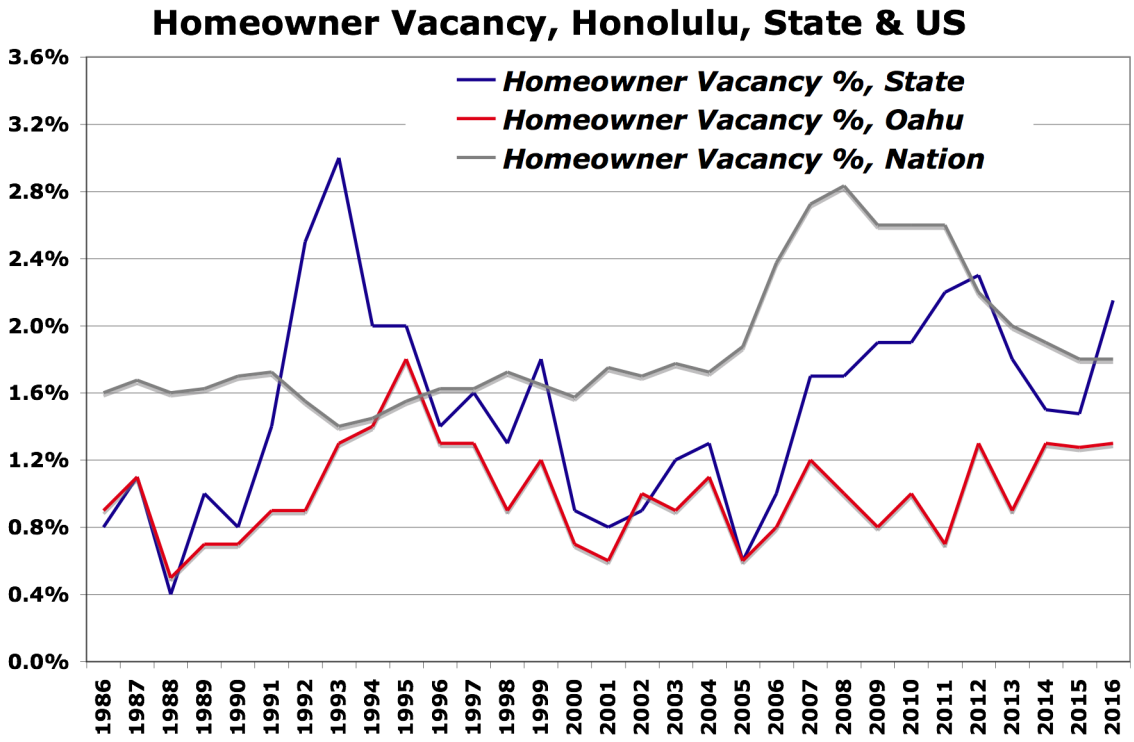


Maui County shows a low rate of homeownership, relative to the rest of the nation, and relative to the state.



Hawaii also had the one of the lowest homeowner vacancy rates, and renter vacancy rates.

Besides, low homeownership, the US Census calculates the rental vacancy rates. That data is illustrated in the chart below.



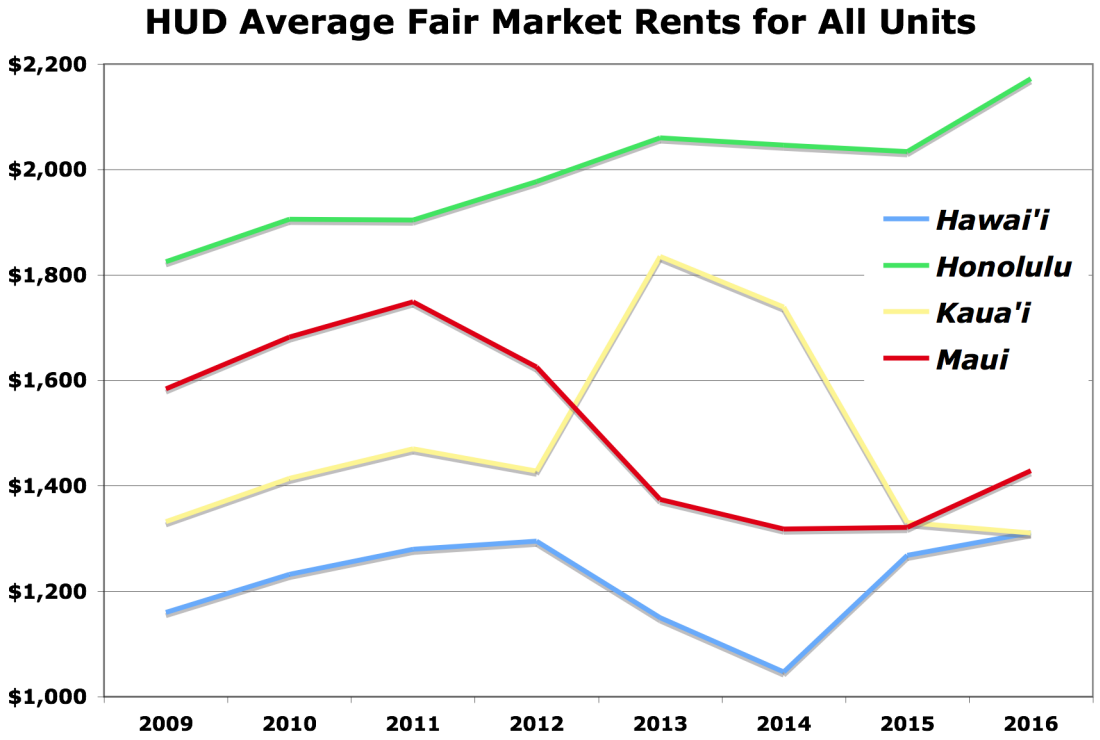
Note that the Hawaii Census data does not break down by Counties so data for Maui County is not available. What's shown in the graph below shows a statewide vacancy rate that at first glance seems rather high but it includes units that have seasonal availability. The skewed data is also driven by temporary vacation rentals throughout the islands and condominium conversions whereby investors put out short-term rentals. This outside tourism demand increases documented vacancy rates. It is difficult to extrapolate specifically for Maui County.

All of this speaks to the desirability of living in a dwelling in Hawaii, and – by extension – the difficulty of finding affordable housing, rental or otherwise for local households, particularly those making 100% and below the median income for the area.

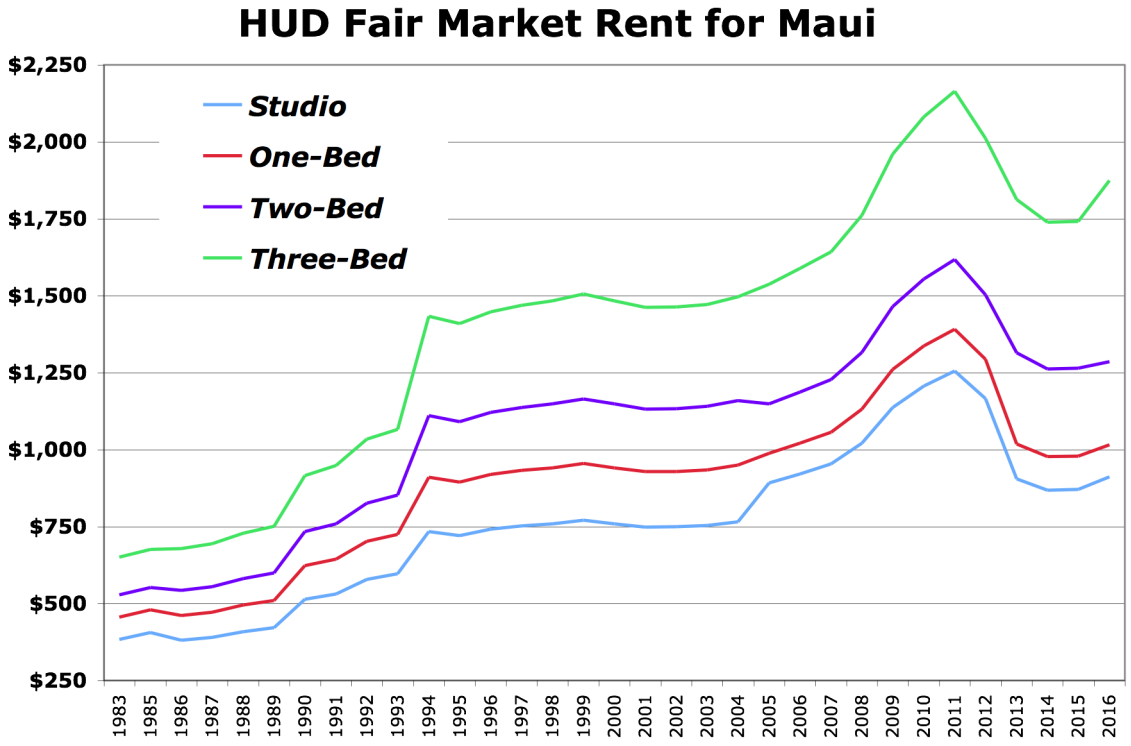
Turning to an examination of the actual rental rates being charged in the market (other than the rental market survey, in the next section), there are a few government resources to draw upon.

The best known one is called "Fair Market Rents" (FMR) and comes from the US Housing and Urban Development department, HUD. Every year, HUD analyzes the rental markets across the country annually, and then publishes a set of gross rent estimates for an area. They include the shelter rent plus the cost of all tenant-paid utilities, minus conveniences, like telephone and Internet.

HUD does so by using (to quote them) "the most accurate and current data available" – per (http://www.huduser.org/datasets/fmr.html) - and this data includes the 2010 US Census data, the last American Community Survey (ACS) data, and telephone surveys of eligible recent rental unit movers.



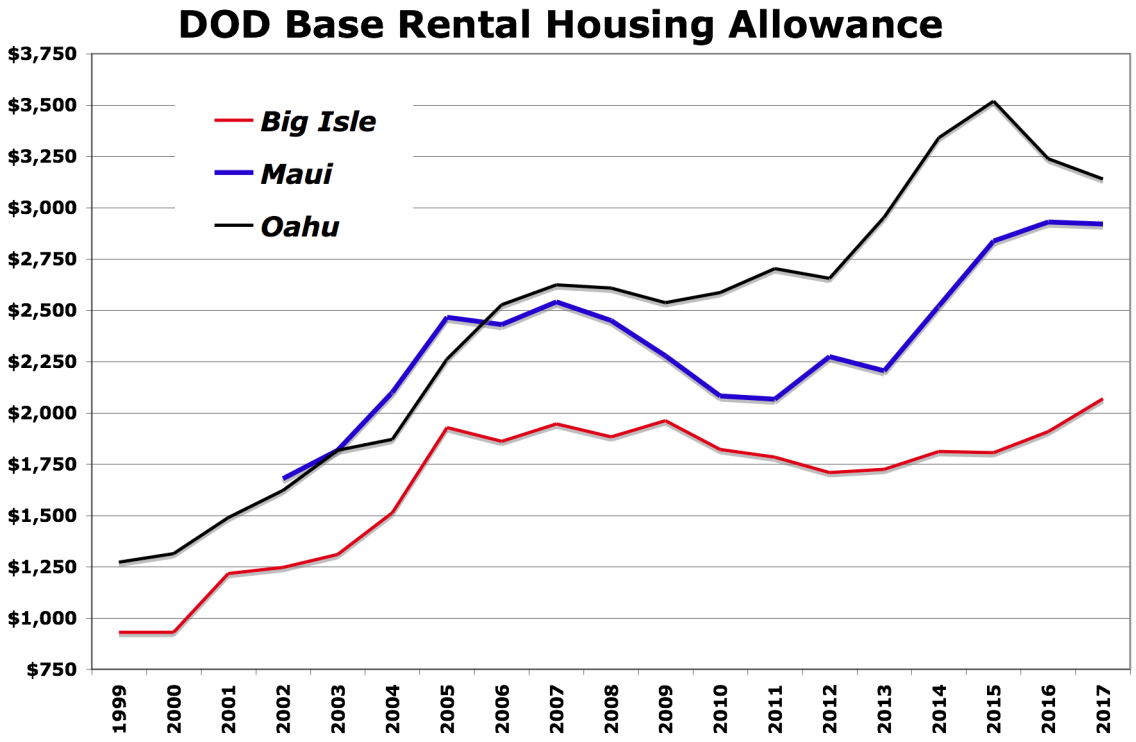
As seen, the HUD defined rents for the county declined in 2011, accelerated the following year, before declining dramatically again. This appears to be an anomaly, as these years saw the economy and the residential real estate cycle reviving, both for prices and closings in the for-sale market. Generally, the for-sale and the rental markets trend closely, one tracking the other.



One possible explanation for this here, and repeating later, that two of these data sources – ACS and Census - are static, done every few years. The other one is that their methodology is not very accurate: telephone surveys of people moving in and out of units done randomly, are not very reliable, especially in non-urban areas, non-English speaking areas, and areas where there is a high turnover in rental units, such as vacation destinations. As such, the trends of the FMR do not match up with those rental trends from other sources, as seen.

Another source of rental trend information comes from the Department of Defense. It is called the BAH, or Base Allowance for Housing, and it is their description of the rental market rates, done in conjunction with providing their personal based in the county with a rental allowance, This is done for all counties where military personnel are based, and adjusted for a cost of living.

The following chart shows the average allowance that the military provides to its households when stationed in an area, in this case, Maui and the other counties. As seen, the allowance for Maui has risen from about $1,750 to $2,500, a hefty rise of over 40% – contrary to the Fair Market Rent trend for the same period (which is curious, looking at the spike up and down the last 3 years).



As seen, these two government agencies have differing views on the trend and the level of rental rates in Maui County.

Given that, rental housing research and researchers have used publicly available data on rental rates to describe the market place. Historically, the best source, in terms of depth, breadth and consistency, was classified advertising in the local newspapers. The listings here provided a wealth of important data, such as asking rents, unit size, unit location, unit features, unit restrictions, etc., This data, when collected overtime, then allowed a research to show rental rate and unit availability trends, and do so by location, bedroom count, rents and other features.

However, the advent of the internet disrupted the classified advertising marketplace by allowing that activity – and information - to migrate from a hard copy print in a newspaper into an electronic data held within a website. Thus, the research done using newspaper classified waned while that done using Internet websites that specialize in rental units in the area.

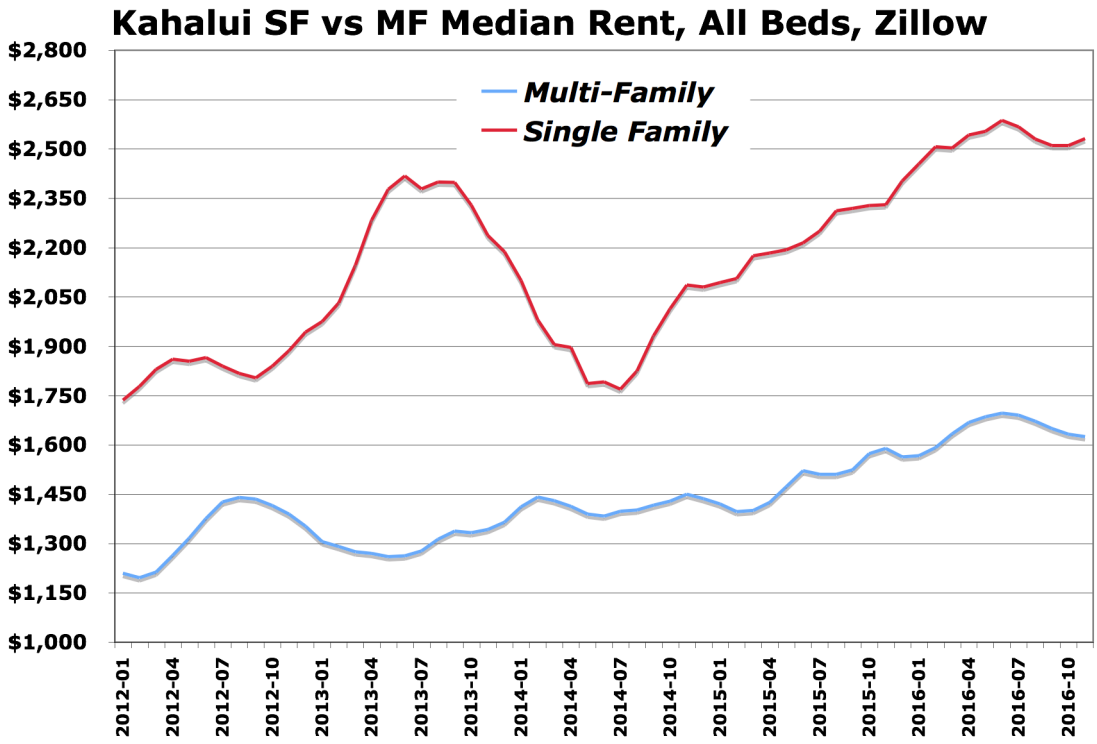
One that provides rental information most comprehensively is Craigslist. In essence, this website replaced the classified ads in the newspapers in terms of being the clearinghouse for rentors and renters. Another source is Zillow.

Rental Market, Per Zillow Data

Zillow Group is an online real estate database company that was founded in 2005 by former Microsoft executives. In addition to giving value estimates of homes, it offers several features including value changes of each home in a given time. Where it can access appropriate public data, it also provides basic information on a given home, such as square footage and the number of bedrooms and bathrooms. In December 2009, Zillow expanded its services to include the rental market. The addition of rental listings enabled users to list a home for rent and search for both rental homes and homes for sale.

Zillow rental data consists of listings, listing prices, estimated listing prices per square foot, and can be segmented by county, zip code, city and neighborhood. While it breaks the data out by property type – homes vs. condos vs. apartments – it does not do it by bedroom counts. As such, it is a good tool for looking at the market overview, but not a good one for making fine distinctions and comparisons between the properties in that data.

Here follows a chart comparing the median rent for single family homes and for multifamily homes. As it does not break out the data by bedroom type, it's value is limited to giving a sent of the market trend.



As seen, the trend is rising, albeit in a volatile fashion.

Rental Market, Per Craigslist Data

Another, and better, set of rental data can be found on Craigslist, a classified advertisements website with sections devoted to jobs, housing, personals, for sale, items wanted, services, etc. It began in 1995 as an email distribution list to friends, then became a web-based service in 1996 and expanded into other classified categories. It started expanding to other U.S. cities in 2000, and now covers 50 countries. The site serves over 20 billion page views per month, putting it in 37th place overall among websites worldwide and 10th place overall among websites in the United States.

As it pertains to rental data, Craigslist is as good, or as bad, as those listing units for rent. This is to admit potential inaccuracies that can degrade the value of the data. There are two general areas of inaccurate data, the worst being 'scam' artists soliciting readers to remit rental deposits for phony units. The second is simple errors or omissions on the part of the imputer of the unit. We make every effort to 'clean' this data, editing the entries for accuracy, integrity and consistency, and are reasonably satisfied that it represents the market fairly. This is especially so, given that this market is significant in terms of both the monetary and emotional investment in finding and securing a dwelling.

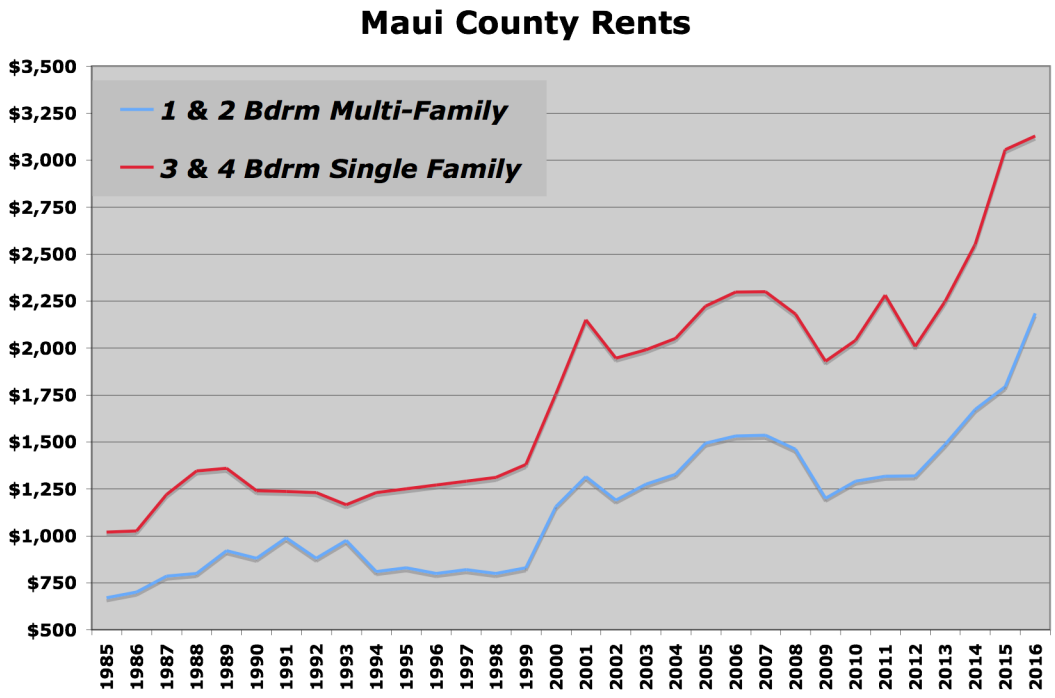
While we have been working with the data for over 10 years, our current database extends backward only to 1st quarter of 2012. This was because before then the utility of this data to the researcher was only in doing spot studies, mainly for affordable housing projects. However, two years ago, the state public housing financing department commissioned a comprehensive rental housing study covering all islands and property types, and asked the start date be set 1Q 2012.

Their methodology intended to update a similar study done in 2011, which used a combination of Craigslist data and data drawn from the classified ads of the local newspaper (a practice that had started in 1985). Per the scope of work, this last study updated those charts, and they are reproduced below. Note that the data here is for 'asking rents' by landlords, but it is segmented by product type (condo, apartment, etc.), bedroom count, and location, minimum – but also, when the data is inputted, by project name, square footage, term (short or long-term) and other terms or characteristics.

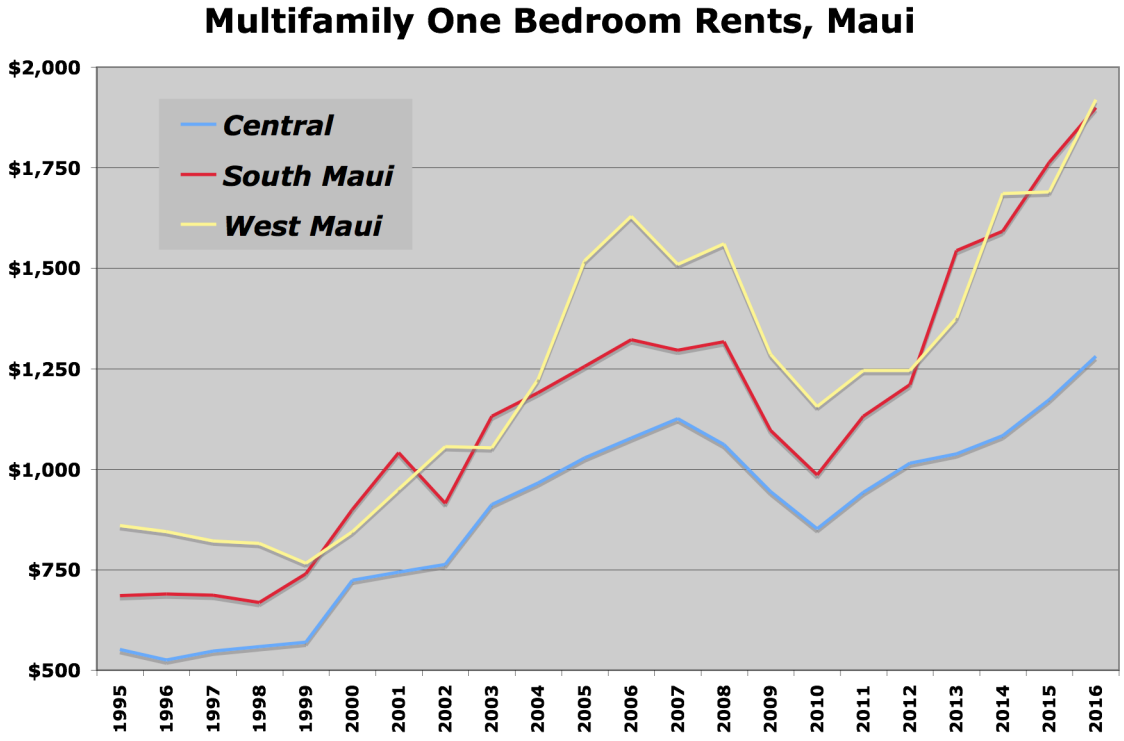
Note: we aggregate the data for town homes, condos and apartments into attached housing, or MF, multi-family housing. While we can break them into these different segments, we find that by combining them, the data provides a better look at the trends affecting the overall rental market.

The following charts show first the overview of the Maui market, and then focus on the multi-family market, as well as the Central Maui market.

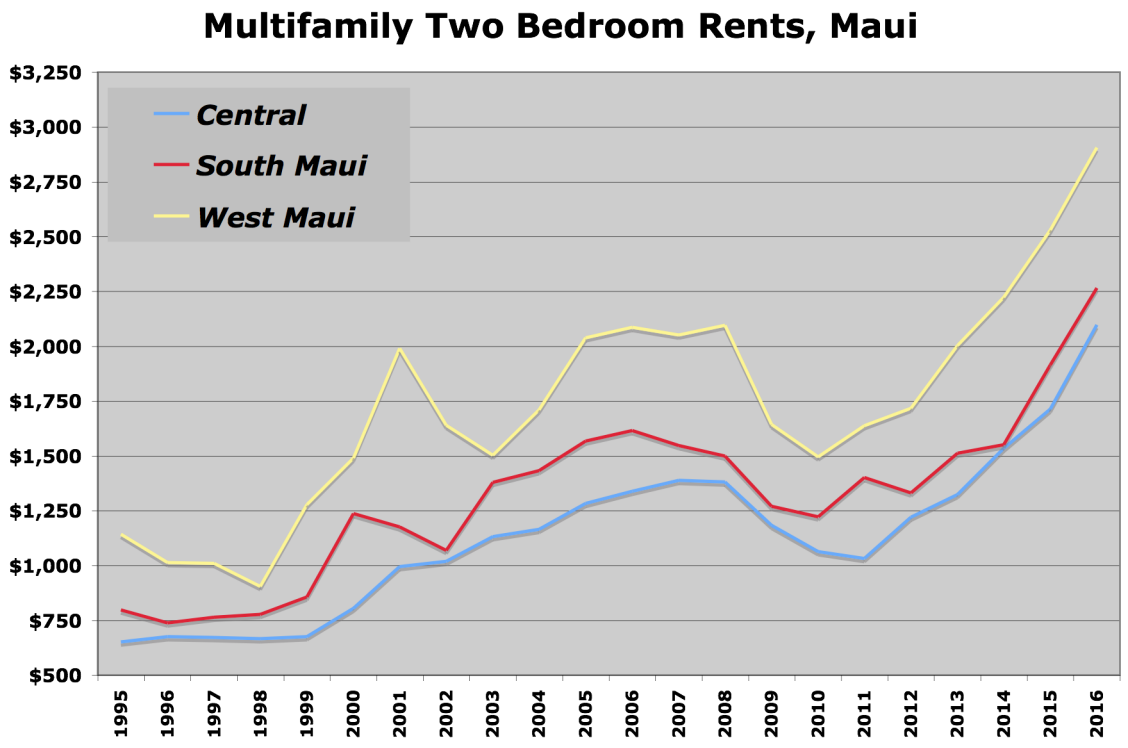
(Note that there is no data for the studio or the three-bedroom apartment).



The following charts show the multifamily data since 1995.



As seen, the areas with high rental rates are the same areas that have the major resorts on Maui, South and West Maui.



Relative to the one-bedroom market, the rates for two bedroom units are lower in South Maui than in West Maui. This is because South Maui has relatively more stock of multifamily housing than West Maui, housing stock is more appropriate for local families in the workforce.

In every area described, the rental rates in all locations have risen above the levels that were attained in the last real estate market cycle. This trend is consistent with what has been occurring in the for-sale market, by dint of rental rates exceeding the peak in the last cycle.

Indeed, the rental market trend actually is more dramatic than that of the for-sale market in moving higher this cycle – again, in most areas.

In sum, the rental rate trends are going higher, and this then is indicative of market conditions in which either supply is inadequate, or demand is excessive, or both.

IX. CENTRAL MAUI RENTAL TRENDS

The following tables describe the average rents per by bedroom type within the market area, as defined as West Maui, Upcountry Maui, South Maui, Central Maui and the North Shore. It shows it for Three Bedrooms, as well as One and Two Bedrooms.

The first three columns show the counts of listings in Craigslist, and the second three show the average rental rates. In an effort to prevent these averages from being unduly influenced by the offshore visitor rental demand, rental units priced over $4,000 a month were excluded from the data. This has the effect of putting a ceiling on the rental rates for the two and especially the three bedroom units, but it also gives a better reading of rental rate trends that pertain to the target market for market rate units.

RENTAL TREND, 2012-2016, MARKET AREA, LISTINGS & ASKING RENTS

	Studio Listings	One Beds	Two Beds	Three Beds	Studio Rents	One Beds	Two Beds	Three Beds
2012	64	100	114	22	$915	$1,191	$1,627	$1,880
2013	46	68	79	16	$1,071	$1,305	$1,640	$2,181
2014	27	74	69	20	$1,158	$1,424	$1,926	$2,394
2015	27	46	44	17	$1,155	$1,659	$2,151	$2,788
2016	35	52	74	20	$1,200	$1,658	$2,133	$2,591

As seen, the trend shows that listing counts have declined over the last 5 years, and average rental rates have grown in general. That said, this last year, with data current up through the first 3 quarters, shows listings rising, and rental rates rising less than the previous year (falling for the two and 3 bedroom units).

To get a closer look at the market just in the area, the following data excludes all listings in West Maui, Upcountry Maui, South Maui and the North Shore, leaving just the area of Kahului and Wailuku.

RENTAL TREND, 2012-2016, CORE MARKET AREA

	Studio Listings	One Beds	Two Beds	Three Beds	Studio Rents	One Beds	Two Beds	Three Beds
2012	15	18	31	7	$863	$985	$1,184	$1,635
2013	12	17	29	6	$1,035	$1,009	$1,353	$1,798
2014	5	8	15	6	$917	$1,106	$1,429	$2,048
2015	5	7	7	3	$1,231	$1,322	$1,793	$2,183
2016	5	14	21	4	$1,174	$1,279	$1,650	$2,098

Next, we look at the frequency of rental listings by price segment in the following tables. It shows how many listings there were per bedroom type on a quarterly basis, over the last 5 years.

The first table shows the quarterly one bedroom listing counts for the total market area, West Maui to Upcountry (which includes Central, South and North Shore Maui). The second table just concentrates on the core market of just Central Maui.

STUDIO LISTING COUNTS BY PRICE SEGMENT, 2012-2016, MARKET AREA

	2012	2013	2014	2015	2016	Cost Per Day
$700-$799	3	5	1	-	1	*$25*
$800-$899	7	3	3	2	3	*$28*
$900-$999	3	3	2	2	7	*$32*
$1000-$1099	1	2	2	2	5	*$35*
$1100-$1199	3	3	2	1	-	*$38*
$1200-$1299		4	2	3	4	*$42*
$1300-$1399	1	4	1	-	2	*$45*
$1400-$1499	0	1	-	1	2	*$48*
$1500-$1599	2	1	1	2	5	*$52*
$1600-$1699	-	-	1	1	2	*$55*
$1700-$1799	2	1	2	3	3	*$58*
$1800-$1899	1	2	2	3	7	*$62*

STUDIO LISTING COUNTS BY SEGMENT, 2012-2016, CORE MARKET AREA

	2012	2013	2014	2015	2016
$700-$799	2	3	1	-	-
$800-$899	6	1	2	-	1
$900-$999	2	1	1	1	2
$1000-$1099	1	1	1	1	1
$1100-$1199	1	1	-	-	-
$1200-$1299	-	1	1	1	1
$1300-$1399	-	3	-	-	1
$1400-$1499	0	-	-	1	-
$1500-$1599	-	1	-	1	2
$1600-$1699	-	-	-	1	-
$1800-$1899	-	1	-	1	-

As seen, the frequency of listings in the lower price segments has been trending lower. In addition, we see the highest population of listings around the $900-$1,100 range. Given that the units of this project will be very well located, well-designed, very well managed and brand-new, we conservatively believe the main opportunity in this market is right above those price ranges, or around $1,100 to $1,200/month, for market rate units.

A good part of the demand for these units – especially studios, we believe - would be from off-shore renters coming into the market to enjoy a 3-4 month stay – using these units as a substitute for hotel rooms. On that basis, they would be paying under $40/day for units that would run over $120/day. This is why the last column, 'cost per day' is added.

Next, we look at the one bedroom market.

ONE BEDROOM LISTING COUNTS BY PRICE SEGMENT, 2012-2016, MARKET AREA

	2012	2013	2014	2015	2016	Cost/Day
$800-$899	5	5	2	-	1	*$28*
$900-$999	5	2	2	1	1	*$32*
$1000-$1099	4	6	3	1	3	*$35*
$1100-$1199	8	6	4	2	4	*$38*
$1200-$1299	8	4	5	3	6	*$42*
$1300-$1399	1	2	4	2	6	*$45*
$1400-$1499	0	5	3	3	5	*$48*
$1500-$1599	3	2	3	3	5	*$52*
$1600-$1699	4	3	2	4	6	*$55*
$1700-$1799	0	-	1	1	4	*$58*
$1800-$1899	0	2	1	3	2	*$62*
$1900-$1999	-	-	1	2	2	*$65*
$2000-$2099	-	-	1	1	1	*$68*
$2100-$2199	-	-	1	-	1	*$72*
$2200-$2299	1	1	1	2	2	*$75*
$2300-$2399	-	1	1	1	-	*$78*

ONE BEDROOM LISTING COUNTS BY SEGMENT, 2012-2016, CORE MARKET AREA

	2012	2013	2014	2015	2016
$800-$899	4	4	1	-	1
$900-$999	3	1	1	1	1
$1000-$1099	2	4	1	1	3
$1100-$1199	2	3	2	1	3
$1200-$1299	2	2	1	1	2
$1300-$1399	0	1	-	-	1
$1400-$1499	-	1	1	1	2
$1500-$1599	1	-	0	1	2
$1600-$1699	0	-	-	2	1
$1700-$1799	-	-	0	1	1
$1800-$1899	-	-	-	-	1
$2200-$2299	-	-	-	-	1

As seen, the frequency of listings in the lower price segments has been trending lower.

Again, on the supposition that a new one-bedroom unit will out-compete an existing one-bedroom unit, on the open market, it looks like the conservative price point opportunity here is around the $1,799 to $1,899 rental price segment.

And, again, these units are a good deal in comparison with taking a hotel room or a short-term rental at VRBO (which has now migrated their pricing upwards, in relation to hotel room rates).

Next, we look at the two-bedroom market.

TWO BEDROOM LISTING COUNTS BY PRICE SEGMENT, 2012-2016, MARKET AREA

	2012	2013	2014	2015	2016	*Cost/Day*	*Cost/Day/ Bedroom*
$1000-$1099	6	2	0	-	-	*$35*	*$17*
$1100-$1199	12	2	1	-	1	*$38*	*$19*
$1200-$1299	18	9	4	1	-	*$42*	*$21*
$1300-$1399	9	7	9	1	2	*$45*	*$22*
$1400-$1499	7	18	5	3	5	*$48*	*$24*
$1500-$1599	4	5	3	1	4	*$52*	*$26*
$1600-$1699	5	4	3	4	2	*$55*	*$27*
$1700-$1799	1	2	2	4	5	*$58*	*$29*
$1800-$1899	4	2	2	2	3	*$62*	*$31*
$1900-$1999	1	1	1	2	2	*$65*	*$32*
$2000-$2099	2	1	2	3	1	*$65*	*$34*
$2100-$2199	1	1	3	1	5	*$68*	*$36*
$2200-$2299	1	1	3	3	5	*$72*	*$37*
$2300-$2399	0	1	2	-	1	*$75*	*$39*
$2400-$2499	0	2	1	1	4	*$78*	*$41*
$2500-$2599	1	1	3	2	4	*$82*	*$42*
$2600-$2699	0	1	1	3	3	*$85*	*$44*
$2700-$2799	-	1	2	1	2	*$88*	*$46*

TWO BEDROOM LISTING COUNTS BY SEGMENT, 2012-2016, CORE MARKET AREA

	2012	2013	2014	2015	2016
$1000-$1099	3	2	0	-	-
$1100-$1199	6	1	1	-	1
$1200-$1299	11	5	3	1	-
$1300-$1399	2	4	4	-	1
$1400-$1499	1	13	4	1	4
$1500-$1599	1	1	1	-	4
$1600-$1699	2	1	1	1	2
$1700-$1799	-	1	0	1	2
$1800-$1899	0	-	1	2	1
$1900-$1999	-	-	-	1	-
$2000-$2099	-	-	0	-	-
$2200-$2299	-	-	-	1	-
$2400-$2499	-	1	-	1	-
$2500-$2599	-	-	-	-	1
$2900-$2999	-	-	-	-	1

The same trends as above, but the opportunity segments are less defined, more diffuse. One area that stands out would be the $2,100 to $2,299 segment, maybe higher. Again, these units are a deal in comparison with taking a hotel room, especially on a per room basis.

Finally, we look at the three-bedroom market.

THREE BEDROOM LISTING COUNTS BY PRICE SEGMENT, 2012-2016, MARKET AREA

	2012	2013	2014	2015	2016	*Cost/Day*	*Cost/Day/ Bedroom*
$2000-$2099	2	1	1	1	-	*$68*	*$23*
$2100-$2199	-	-	1	1	1	*$72*	*$24*
$2200-$2299	-	1	1	-	1	*$75*	*$25*
$2300-$2399	0	1	2	1	1	*$78*	*$26*
$2400-$2499	1	1	2	1	4	$82	$27
$2500-$2599	0	1	1	1	3	$85	$28
$2600-$2699	-	2	1	1	2	$88	$29
$2700-$2799	1	1	0	1	1	$92	$31
$2800-$2899	0	1	2	2	-	$95	$32
$2900-$2999	-	-	0	1	-	$98	$33
$3000-$3099	0	-	2	1	-	$102	$34
$3200-$3299	0	1	1	1	-	$108	$36
$2400-$2499	1	1	2	1	4	$82	$27

THREE BEDROOM LISTING COUNTS BY SEGMENT, 2012-2016, CORE MARKET AREA

	2012	2013	2014	2015	2016
$2000-$2099	0	-	1	1	-
$2100-$2199	-	-	1	1	1
$2200-$2299	-	1	-	-	-
$2300-$2399	0	1	1	1	-
$2400-$2499	-	-	1	-	1
$2500-$2599	-	-	-	1	1
$2600-$2699	-	-	0	-	-
$2800-$2899	-	1	0	-	-
$2900-$2999	0	-	1	-	2
$3000-$3099	-	-	1	1	-

The data here is not very deep, making it harder to determine the obvious market opportunity. The reason why is that there is no inventory, nothing was built in terms of attached housing for-sale.

To better see the demand, we include the data for 3 bedroom houses into the data.

THREE BEDROOM LISTING COUNTS BY SEGMENT, 2012-2016, MARKET AREA

	2012	2013	2014	2015	2016	*Cost/Day*	*Cost/Day/ Bedroom*
$2200-$2299	3	3	2	1	3	*$75*	*$25*
$2300-$2399	5	3	5	4	3	*$78*	*$26*
$2400-$2499	4	4	3	2	6	*$82*	*$27*
$2500-$2599	6	2	4	6	5	*$85*	*$28*
$2600-$2699	3	3	2	2	5	*$88*	*$29*
$2700-$2799	2	2	1	1	3	*$92*	*$31*
$2800-$2899	2	3	4	3	5	*$95*	*$32*
$2900-$2999	0	-	3	3	6	*$98*	*$33*
$3000-$3099	-	1	3	5	3	*$102*	*$34*
$3100-$3199	-	-	0	1	1	*$105*	*$35*
$3200-$3299	2	2	2	3	3	*$108*	*$36*
$3300-$3399	1	2	0	1	5	*$112*	*$37*

THREE BEDROOM LISTING COUNTS BY SEGMENT, 2012-2016, CORE MARKET AREA

	2012	2013	2014	2015	2016
$2200-$2299	1	2	1	1	-
$2300-$2399	1	1	2	2	1
$2400-$2499	1	1	1	-	2
$2500-$2599	0	1	1	1	1
$2600-$2699	2	1	1	-	1
$2700-$2799	-	1	-	-	2
$2800-$2899	1	1	1	1	1
$2900-$2999	0	-	1	-	2
$3000-$3099	-	-	1	1	-
$3100-$3199	-	-	0	-	-
$3300-$3399	-	-	-	-	1

As seen, there are a higher number of listings in the general area, but not in the core area of just Central Maui. Thus, we see demand, and suggest it conservatively would be in the $2,600 to $2,799 range.

It could be higher, but what is hard to know without data. However, there is data in another area that might speak to the potential demand for bedrooms, the area of short-term visitor oriented rentals, known also as the home-stay or the home-share business.

The following is a rough estimate of this model on Maui.

HOMESTAY BUSINESS MODEL, MAUI

	Listings	Trip Nights/year	Host Revenue	Ave Revenue Per Host	Average Daily Rate
2015	1,700	100,000	$16,000,000	$9,000	$200
2016	2,700	160,000	$29,000,000	$10,000	$233

Of note in this data is the business of renting out a private room in the owner's unit. This practice is widespread on Maui, and we estimate that there are over 300 hosts in the general market area who charge over $110 a night, and gain over $7,500/host per year. This is akin to discounting the monthly rent by $600/month.

If the room is shared, not private, the nightly rate drops to about $40/night and the monthly supplemental (or discount) comes to $350/month.

These numbers double if there are two rooms 'in service' so to speak. We ran some more estimates and found that these numbers are higher for the core area, save for the number of hosts, which are probably a third of the general area (or $100 for renting out a private room).

X. CURRENT AND FUTURE DRIVERS OF RENTAL DEMAND

Current:

Currently, there are two significant sources of demand:

1. Local or long-time residents.
2. Off-shore 'visitors' or recent immigrants, and

In the first case of the existing long-term rental demand, there is a significant portion of the local population that is 'under housed' in the sense that they are unable to find themselves housing shelter at a price affordable to their incomes. Indeed, some 25% of all households in the state and on Maui are at very low-income levels, 80% of median income and below.

This condition has existed for decades, since the boom of the visitor in the 1970s, followed by the second home industry, in the 1980s. It will not be satisfied in any significant degree anytime soon, meaning the next ten years. Thus, this sets a floor beneath which current rents – and even next year's rents - will not easily sink below. Like the prices in the for-sale market, the rents in the rental market are 'sticky' downward – they rarely decline, and do so only in sync with a major economic event (like the Gulf War, or the Sub-Prime Recession).

In the second case, there is strong demand for market-rate rental housing, and that comes from both out of state and outside the US, driven by Maui's high quality of living. This has been shown in the high percent of outside investors, and the non-owner occupant units.

Future:

Looking ahead, these drivers of demand will grow. The first will be fed by the overall growth of the local economy on Maui and the concurrent rise in the personal wealth. Note that this growth is strongly correlated to the growth of the US economy, the Californian economy and the general rise in the financial markets. Simply put, the rental housing market on Maui responds better than most housing markets in the US to growth at the high-end, by the linkage between high-end wealth generation and the island's visitor traffic and second home industry.

The second - offshore demand - will grow also with the general US economic growth, but also the growth in their 'home' market or the industry or community where they make their money. For Maui, this is both Northern and Southern California, as well as Canada. We expect that Maui's visitor industry will continue to enjoy success and thereby cultivate amongst a portion of the short-term visitors a desire to lengthen their stay the following trip by renting a unit for 3 months, the minimum period for this project. We expect the demand here coming out of Canada and the northern states of the US.

The third, demand will be driven by the continuation of the popularity of Maui life-style in the younger demographics in North America and Asia. This includes, at the lower end, the younger demographic (i.e., aficionados of extreme sports, such as wind-surfing, paddle boarding, big wave surfing, etc.). At the upper end, this would be those in a dynamic and growing business or industry, such as electronic hardware and software, and entertainment. These slightly older demographics constitute a group looking to rent on island at the most reasonable rates (as well as at the highest value). Finally, there would be a senior demographic component, those wanting to just get away from the weather in their residence or taking the grandchildren for a summer holiday. Thus, a newly built rental property that is off-water and convenient would be attractive.

We see all sources of demand being present and accounted for (the first being particularly significant) over the life of the project (say, 35-50 years). Over the long run, the offshore demand being more remunerative or profitable, but more volatile. The local demand will be less remunerative, but valuable in terms of stability, both in terms of turnover and community responsibility. We suggest there be a healthy mix, as the local presence will make project more attractive to the offshore rental demand.

XI. CURRENT AND FUTURE PROSPECTS FOR RENTAL SUPPLY

In contrast to demand, we now examine the supply side of the market. The overview is that there are very few large size rental unit projects in the state – they have not been very feasible historically: limited land, little capital, high costs, small market, and isolated from continental US.

In terms of Maui, no large-scale dedicated rental projects have been built in Maui since 1990 that where not subsidized. Furthermore, apartment counts and size data is not readily available, unlike condominiums and town homes. However, earlier studies on the overall market determined that there were 3,702 apartment units in the county. Of those, some 2,340 are subsidized units. This would mean that there are only about 1,350 market apartments on all of Maui, at maximum. That said, the actual number is probably lower, given that apartment units are normally government-owned or corporation-owned (the former as military housing, the later as corporate timeshares).

Current:

AFFORDABLE PROJECTS:

Given rising for-sale prices and high rents, the affordable inventory on the island is fully occupied with long wait lists. Here follows a partial list of such projects.

SELECTED AFFORDABLE RENTAL HOUSING PROJECTS, MAUI

Name	Units	AMI	Where	Studio	Rent Studio	One Bed	Rent One Bed	Vacancy	Waitlist
Hale Mahaolu Akahi	5	50%	Central	5	$514			0	60
Hale Mahaolu Akahi	68	50%	Central	68	$593			1	70
Hale Mahaolu Akahi	37	50%	Central			37	$673	0	90
Hale Mahaolu Eha	40	50%	Central	39	$825			0	279
Hale Mahaolu Ehiku, Ph. IA	34	30%	Central			34	$940	0	61
Hale Mahaolu Ehiku, Ph. IB	20	50%	Central			19	$800	0	79
Hale Mahaolu Ehiku, Ph. II	30	30%	Central			30	$653	0	166
Hale Mahaolu Ehiku, Ph. II	29	60%	Central			29	$1,055	0	20
Hale Mahaolu Ekolu	42	50%	Central	10	$1,336	31	$1,487	0	250
Hale Mahaolu Elima	60	50%	Central			59	$667	1	302
Hale Mahaolu Elua	180	60%	Central			179	$1,089	1	370
Lokenani Hale	62	50%	Central			61	$625	0	100
Hale Mahaolu Eono	10	50%	West			10	$1,020	1	33
Hale Mahaolu Eono	19	50%	West			19	$1,020	0	33
Hale Mahaolu Eono	5	50%	West			4	$825	0	88

Furthermore, there is not much in the pipeline. The table below shows the recent awards from Hawaii Housing Finance and Development Corporation on Maui. As seen, there has been very little activity, of late.

AFFORDABLE RENTAL HOUSING PROJECT AWARDS, MAUI

PROJECT	Hale Mahaolu Ehiku	Kahului Town Terrace	Puukolii Mauka I	Hale Mahaolu Ehiku P 2	Honokowai Villa Apartments	Imi Ikena Apartments
Award Year	2004	2007	2007	2008	2009	2011
Units	34	72	100	60	56	28
Location	Kihei	Central	West	Kihei	West	Central
Rent/4Sale	Rent	Rent	Rent	Rent	Rent	Rent
LIHTC	YES	YES		YES/1602	YES/1602	YES
RHTF		YES			YES	
HMMF		YES				
201H			YES			
GET	YES	YES		YES	YES	YES

MARKET RENTAL PROJECTS:

There are only two dedicated large-scale rental properties in the market area that we could find.

Piilani Gardens was built in the early 1990s on 13.4 acres of land and has a density of 15 units per acres. There are 18 garden style apartment buildings. They have 200 units of 2bd/2ba (3 floor plans of 800-925sf), with appliances included (oven/range, refrigerator, dishwasher, garbage disposal) but not laundry. There are 2 assigned parking stalls, one covered, with extra stalls running $80/month. They have 6 months to 1-year leases, running at 1,625-$1,725 per month ($1.92 - $2.04/sf) ($50 extra for a premium downstairs unit).

The amenities on site include a childcare center, self-storage units ($80 per unit), Satellite TV and Internet services, and fenced yards. A property manager operates the property professionally, as opposed to living in a project with owners and renters.

Currently there are no vacancies with a long waitlist, as most tenants work nearby in the resort area. Per the rental agents there is a demand for 3 bedrooms, typically from extended families over 5 members in a household.

That said, the complex gets consistently bad reviews on YELP, with the main culprits being aged appliances, poorly kept carpets and inconsiderate management.

The Waterfront Apartments in Kahului is the other property whereby the owners have converted dormitory rooms as apartments. Students weren't leasing them so they opened the project to the public. The conversion brought the fixtures and furnishings up to date, but they couldn’t do much with the floorplan layout, as most units are narrow rectangles that originally accommodated roommates. The property is gated with security patrol. The buildings is 4 stories, with one elevator, a common laundry room, a simple community room and interior courtyard. It comes with cable, water, trash, and wifi. Kitchens are smaller with very little counter and pantry space because it was purpose built for students and not households of various sizes.

They have 113 units, studios (300-400 sf, renting for $900) and one bedrooms (475-525 sf, renting for $1,500 to $1,650), but mainly 2 bedroom/1.5 baths (750-775 sf, renting for $1,750 to $1,850, with view units higher, $1,895-$1,995).

In contrast with the Piilani Gardens, the YELP reviews of this property are less negative, with the main drawback being the smell of sewage from the harbor.

Pipeline Projects:

AFFORDABLE PROJECT:

To our knowledge, there is only one affordable project that is eminent. The developer is the Catholic Charities and they successfully applied for LHITR funding in 2015 (and are likely to reapply this year). It is in Kahalui, the market area, and is called Kane Street Elderly.

It will be producing only one-bedroom unit rentals for those making approximately 30%, 50% and 60% of the Area Median Income (AMI). The table below describes the project's number of units by AMI count.

UNIT BREAKDOWN

	Counts
AMI @ 30%	16
AMI @ 50%	16
AMI @ 60%	132

MARKET RATE:

There is a proposed 74.871-acre project sit located in Kihei, mauka of the intersection of Kaonoulu Road and Piilani Highway, called Piilani Promenade North. The project boundary is adjacent to the Kihei Commercial Center to the North, Kulanihakoi Gulch to the South, Piilani Highway to the West, and ranch land to the East extending up to Kula

It is anticipated that the Piilani Promenade project will be constructed in two (2) phases as market conditions warrant:

- Phase one is the Piilani Promenade North development will include development of the northern developable lot (Parcel 16) that will include 100,000 square feet of business commercial uses, 226 rental apartment uses and 57,558 square feet of light industrial use. Phase one includes construction of the future Kihei Upcountry Highway and improving the intersection of Kaonoulu and Piilani Highway that provides access to the project. Phase one also includes construction of the 1.0 MG water tank, the irrigation well with pump and related utility and offsite easements.

- Phase two is the development of the 2 southern parcels (Parcels 170 and 171) that will consist of 430,000 square feet of business commercial.

The proposed multi-family component will consist of 226 units with a 2-acre park space and necessary support infrastructure including, but not limited to, off-street parking, sewer, water, roadways, and sidewalks. The units will be a mix of one, two and three bedroom units, of which 25% (current requirement) will be rented at an affordable rate in compliance with the Maui County Residential Workforce Housing Ordinance.

Future:

If we ask what will drive supply into the market, first and foremost, we believe rental-housing supply will be constrained by high costs, politics, and NIMBYism.

The net of this has been a high barrier to entry for all multi-family projects on Maui historically - and this barrier has been overcome almost only by high-end multifamily properties, meaning waterfront (and resort) properties.

That said, this barrier to new multifamily construction has been overcome when there have been public subsidies available, no matter what the economic cycle is. It has also been overcome when market demand and economic prosperity are strong and costs are low. This only happens in the first couple years of the market's upswing, while construction costs are low and the market is bouncing back up (construction costs will rise as more development crowds into the market, thus raising labor costs).

Relative to the proposed project here, the current barriers to entry for this project are relatively low, given the point in time for the housing cycle (moving from recovery to expansion) and the cumulative effect of a low production of rental housing historically.

Thus, we address the possibility of competitive interference – in terms of a similar rental project coming to market either before or after that can cannibalize demand (and thus limit the project's occupancy and hold down the project's market rental rates).

Because this is the first project in a very long time, it will benefit by being the first to market (it will present a barrier to market by taking away current and future demand). Projects coming after this project in this area will be harder pressed to project out (expect) adequate demand. In this cycle, the next projects will not have the benefit of having today's lower construction costs.

As a footnote, there simply are not a lot of resources available (i.e., quality construction crews, adept construction management and astute political ability and guidance) in the state and the county for such a project. And once those resources are absorbed or put into play by this project, then the aforementioned barriers to entry that are in place for the rest of the cycle come into play.

XII. MARKET REVIEW & PROJECT RENT RATE SUGGESTION

OVERALL: In sum, the economic context is that the global recovery has taken hold and has been feeding housing demand on Maui via tourism. The current demand is additional to the pent-up demand that has been growing for a generation.

Looking ahead, there are several significant renovations in the works for two of the four major Maui resorts – Makena and Kaanapali. The Makena renovation is quite large and includes both renovating an existing hotel and new construction. It is being marketed by Discovery Land, an ultra-high end marketer. It will stimulate quality jobs, thus housing demand for both work-force families and higher-end professional households, starting next year and extending well into the next decade. The Kaanapali resort renovation will not have an effect for 4-6 years, and maybe not until the next economic cycle. However, it will be significant, and act beneficially in the same way as the Makena redevelopment, both in this area of South Maui, as well as in West Maui.

Given that the residential market has lifted off the bottom of the cycle, we expect that the market in the near and mid-term will see a significant appreciation of prices. Further, the production of

new for-sale housing on Maui, has been at a low point historically thus will be inadequate for meeting the housing needs of the growing workforce and population.

Much of this is attributed to over regulation by the public and their political representatives, who instituted an unrealistic affordable housing requirement to housing production in 2006, which required a 50% affordable requirement (half of the total units could not be 'market' units, and had to be sold or rented out at affordable prices and rents).

As can be seen in the earlier sections, tables and charts, the effect on Maui's housing supply during this period was detrimental to the production of market (or any) housing. These regulations have since been lightened in 2014 and housing production has come back to Maui.

And that is why we expect this development of rental housing in Central Maui will be successful – not only will it benefit from strong demand, but limited supply.

Looking ahead at where demand for rental housing in Maui will come from, it will come first and foremost from families already living on island that are 'workforce' and immediately above that segment (moving up the housing ladder). These workforce households will be involved in service industries, perform construction jobs - both of which are good wage occupations. The fit for these households in terms of this project here is value and convenience: a new rental dwelling that is reasonably priced, well managed, in a new community that has amenities, in a central location.

Then, there will be additional demand from offshore individuals and families who value the high quality of life on the island. They can either work on Maui full-time or work elsewhere for some the year, then come and vacation on Maui for 3 months of the year. We think this demand will grow, overtime, as jobs become unteethered from location, and knowledge workers or financially independent individuals live where they want.

RENTAL RATES: Our suggested affordable unit counts are driven by need, as described by potential demand using Ribbon Demographics data. Our rental rates were given by the county housing office, in conjunction with HUD requirements.

UNIT MIX VS POTENTIAL HOUSING DEMAND, HOUSEHOLDS AGED 25-54 YEARS BY AMI

Bed	AMI	Units	Potential Demand	Market Share
1	80%	60	534	11%
1	100%	50	486	10%
2	120%	71	288	18%
1	Market	20	916+	NA
2	Market	80	1,146+	NA
3	Market	20	720+	NA

Our market rental rates take into account the aforementioned lack of supply and surplus of demand from the local residents. In conversations with rental managers and housing officials, there is evidence of renters joining together, room-mate style, in order to be able to rent bigger units.

There will be additional demand from offshore renters. It may be likely that offshore demand might even be as high as a quarter or a third of the units. A reading of the comments on YELP in reviewing the current rental projects in Central Maui demonstrates that there is an apparent offshore demand for these types of units.

The other source of market preferences that we think is worth considering comes from a housing survey done every 5 years. It asks the respondents "What is their preferred number of bedrooms?"

The following table describes the Maui respondent's preferences:

UNIT MIX AS INDICATED BY SURVEY PREFERENCES

Year	Studio or One	Two Bed	Three Bed	4 Bed or More
1992	6.40%	41.00%	49.00%	1.00%
1997	17.90%	34.30%	34.80%	12.70%
2003	9.10%	37.40%	34.00%	18.10%
2006	7.50%	43.70%	35.90%	11.90%
2011	11.60%	47.30%	34.80%	6.30%
2016	11.20%	41.90%	36.90%	8.90%

This indicates a strong preference for a three-bedroom unit. Note, though, it does not make a distinction between attached or detached housing. Nor does 'preference' indicate 'acceptance' or 'ability to make rental payments.' Nevertheless, we believe a three-bedroom model in this mix is prudent in terms of diversifying product and risk, and proactive in meeting the market, especially the offshore one.

PROJECT MIX AND RENTAL RATES: That said, we have weighted the mix most onto the 2 bedroom unit, as that is the most adaptable in the market, and has the highest preference. We have given second strongest weighting to the one bedroom unit, as that has the deepest demographic, as an affordable unit. Plus, we expect very good offshore demand for a small unit, such as this.

Our rental mix shows a small number of three bedrooms, based on our belief that the housing stock of the island shows a scarcity of larger bedroom counts (3 bedrooms and above) units. The demand for the three bedroom units will come from multi-tenant renter occupants (room-mates teaming up), as well as multigenerational families. We also see a good potential demand for renting them out on the minimum lease of 3 months to offshore visitors, grandparents who will cycle their grandchildren through the unit over the summer or winter months.

There are no studios, as they attract a more transient demand, especially at the market level – but if there's a cost/benefit argument for migrating out of the one-bedroom units and into the studios, that's acceptable (risk diversification, as well a desirable unit in 30 years when put out to market).

UNIT MIX AND RENTAL RATE MODEL

Bed	AMI	Units	Rents, Affordable	Rents, Market
1	80%	60	$1,000	
1	100%	50	$1,305	
1	Market	20		$1,799 to $1,899
2	120%	71	$1,797	
2	Market	80		$2,100 to $2,299
3	Market	20		$2,600 to $2,799

Note that the mix has 180 affordable units, or 59.9%.

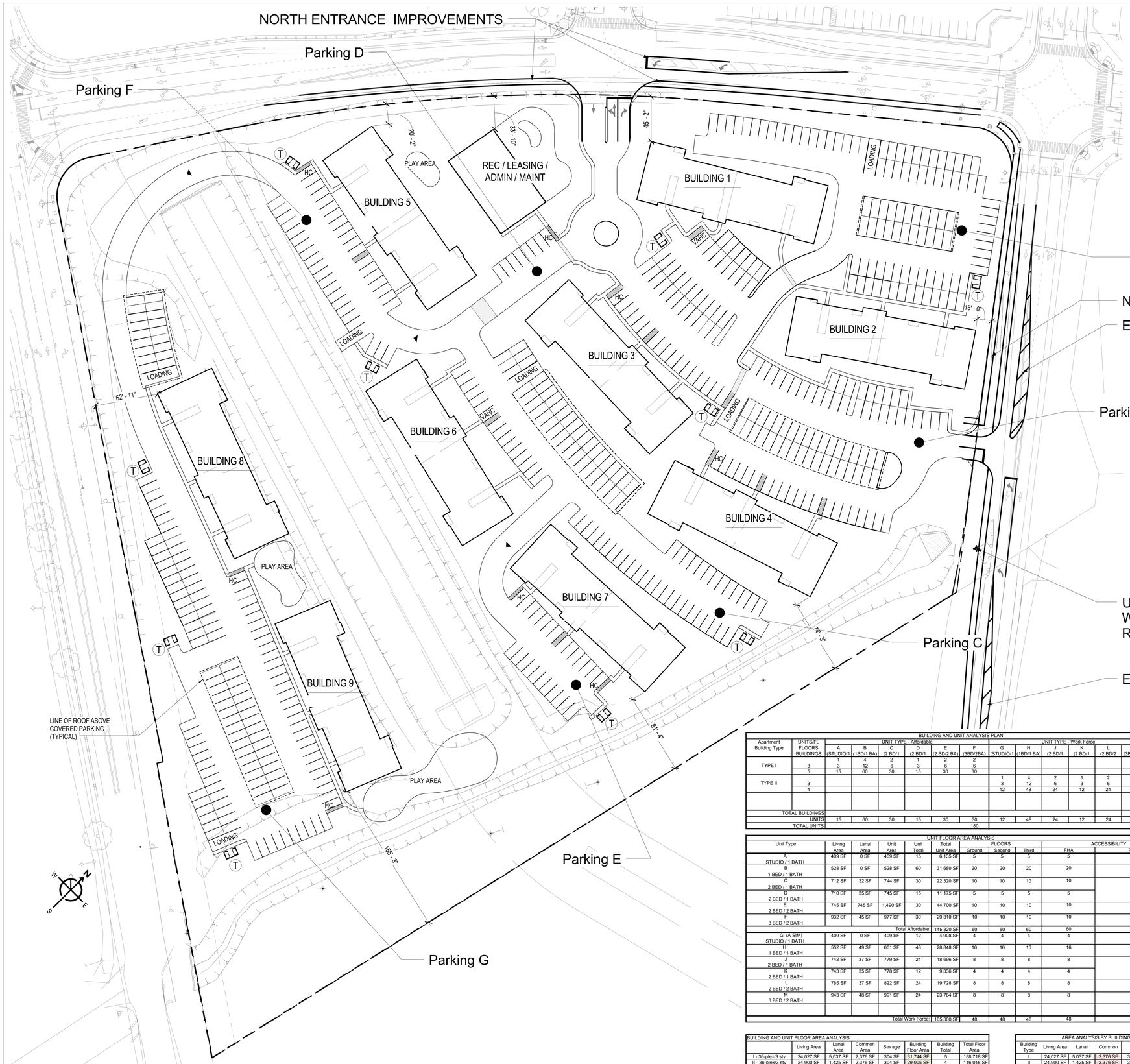
RENTAL RATES: in terms of the affordable rates, the original projected program is acceptable. Indeed, they are advantageous, relative to some of the existing affordable rental projects in

Central Maui.

In terms of the market rents, these rates are at or slightly higher than the published rates of existing rental projects. They are so because these will be newly constructed, professionally marketed and competently managed. The two projects that exist currently, and therefore are the major comparables in this study, are – at best – neither. This goes for both the one bedroom and the two-bedroom unit.

The three-bedroom unit rental rate was set in comparison to the three bedroom single family offerings on the market, and the rents on these multifamily units currently are set a little bit higher than for the single family or detached units. This is achievable for several reasons: the aforementioned local and offshore demand. In terms of local demand, the strongest selling point of the big unit would be the security of the property, given that those households would contain school age children and/or elderly grandparents. Thus, a working mother could count on her children being watched over by the project security, and be happy that there are public schools in the immediate area. The other local demand could come from roommates teaming up.

Appendix I – Unit Plans & Elevation



SITE PLAN LEGEND

T	TRASH
HC	ACCESSIBLE STALLS
V	VAN ACCESS

1 PRELIMINARY CONCEPT SITE PLAN

1" = 40'-0"

0' 10' 20' 40' 80'

BUILDING AND UNIT ANALYSIS PLAN														
Apartment Building Type	UNITS/FL FLOORS BUILDINGS	UNIT TYPE - Affordable						UNIT TYPE - Work Force						
		A (STUDIO/1 BA)	B (1BD/1 BA)	C (2 BD/1	D (2 BD/1	E (2 BD/2 BA)	F (3BD/2BA)	G (STUDIO/1 BA)	H (1BD/1 BA)	J (2 BD/1	K (2 BD/1	L (2 BD/2	M (3BD/2BA)	Total
TYPE I	3	1	4	2	1	2	2							12
	5	3	12	6	3	6	6							36
		15	60	30	15	30	30							180
TYPE II	3							1	4	2	1	2	2	12
	4							3	12	6	3	6	6	36
								12	48	24	12	24	24	144
TOTAL BUILDINGS														9
UNITS		15	60	30	15	30	30	12	48	24	12	24	24	
TOTAL UNITS							180						144	324

UNIT FLOOR AREA ANALYSIS										
Unit Type	Living Area	Lanai Area	Unit Area	Unit Total	Total Unit Area	FLOORS Ground	Second	Third	ACCESSIBILITY FHA	RHAG
A STUDIO / 1 BATH	409 SF	0 SF	409 SF	15	6,135 SF	5	5	5	5	1
B 1 BED / 1 BATH	528 SF	0 SF	528 SF	60	31,680 SF	20	20	20	20	3
C 2 BED / 1 BATH	712 SF	32 SF	744 SF	30	22,320 SF	10	10	10	10	2
D 2 BED / 1 BATH	710 SF	35 SF	745 SF	15	11,175 SF	5	5	5	5	
E 2 BED / 2 BATH	745 SF	745 SF	1,490 SF	30	44,700 SF	10	10	10	10	2
F 3 BED / 2 BATH	932 SF	45 SF	977 SF	30	29,310 SF	10	10	10	10	2
				Total Affordable:	145,320 SF	60	60	60	60	10
G (A SIM) STUDIO / 1 BATH	409 SF	0 SF	409 SF	12	4,908 SF	4	4	4	4	1
H 1 BED / 1 BATH	552 SF	49 SF	601 SF	48	28,848 SF	16	16	16	16	2
J 2 BED / 1 BATH	742 SF	37 SF	779 SF	24	18,696 SF	8	8	8	8	2
K 2 BED / 1 BATH	743 SF	35 SF	778 SF	12	9,336 SF	4	4	4	4	
L 2 BED / 2 BATH	785 SF	37 SF	822 SF	24	19,728 SF	8	8	8	8	1
M 3 BED / 2 BATH	943 SF	48 SF	991 SF	24	23,784 SF	8	8	8	8	1
				Total Work Force:	105,300 SF	48	48	48	48	7

BUILDING AND UNIT FLOOR AREA ANALYSIS							
	Living Area	Lanai Area	Common Area	Storage	Building Floor Area	Building Total	Total Floor Area
I - 36-plex/3 sty	24,027 SF	5,037 SF	2,376 SF	304 SF	31,744 SF	5	158,718 SF
II - 36-plex/3 sty	24,900 SF	1,425 SF	2,376 SF	304 SF	29,005 SF	4	116,018 SF
					TOTAL:	9	274,736 SF

AREA ANALYSIS BY BUILDING				
Building Type	Living Area	Lanai	Common	Storage
I	24,027 SF	5,037 SF	2,376 SF	304 SF / 24 / bldg
II	24,900 SF	1,425 SF	2,376 SF	304 SF / 24 / bldg

***Note: The above area calculations are preliminary and require verification through the architectural design/review process.**

Accessibility:

- All ground floor 1- story units shall comply with the Federal Fair Housing Act Accessibility Guidelines (FHA)

- All public and accessible routes shall comply with the Americans with Disabilities Act Accessibility Guidelines (ADAAG)

- 5% of total units shall comply with the Hawaii State Residential Housing Accessibility Guidelines (RHAG)

- 2% of total units shall comply with Visual and Audio requirements.

DENSITY	
Land Area (Acres)	Units/Acre
14.416	22.475

PARKING ANALYSIS	
Programmed: 324 x 1.5 = 486 Stalls	
Full Size:	375
Tandem:	101
Guest:	76
Accessible:	8
(1:6 Van Accessible):	2
TOTAL:	562
Loading:	6
Mail area:	2

FACILITIES		
Rec Center		2,500 SF
Lease / Admin / Maint		2,500 SF
Exterior Storage (8'x9')	30 units	2,160 SF
Trash Enclosures		12
TOTAL		4,672 SF

ZONING INFORMATION	
APPLICABLE ORDINANCE:	CODE OF THE COUNTY OF MAUI EFFECTIVE 08/08/16
LOCATION:	WAIALE ROAD, WAILUKU, MAUI, HAWAII
TAX MAP KEY:	(2)3-5-001:064
LOT AREA:	14.416 ACRES (627,961 SF)
LUC CLASSIFICATION:	URBAN (REDESIGNATED FROM AGRICULTURAL)
SPECIAL MANAGEMENT AREA (SMA):	NOT WITHIN SMA
GENERAL PLAN:	COUNTY OF MAUI 2030 GENERAL PLAN
MAUI ISLAND PLAN:	WITHIN URBAN GROWTH BOUNDARY
PLANNING DISRICT:	KAHULUI-WAILUKU COMMUNITY PLAN DISTRICT
	WITHIN GROWTH RESERVE
ZONING DISTRICT:	A-2 APARTMENT (REDESIGNATED FROM AGRICULTURAL)
FLOOD ZONE:	ZONE X
HEIGHT LIMIT (A-2):	60 FT
SETBACKS: FRONT YARD	20 FT
REAR YARD	20 FT
SIDE YARD	15 FT
MAX FAR:	90 PERCENT (565,165 SF)
PROJECT FAR:	274,736 SF
MAX LOT COVERAGE :	35 PERCENT (219,786 SF)
PROJECT LOT COVERAGE	88,678 SF

BUILDING CODE INFORMATION	
APPLICABLE CODE:	INTERNATIONAL BUILDING CODE 2006 EDITION
	AS AMMENDED
TYPE OF CONSTRUCTION:	II-B SPRINKLED
OCCUPANCY CLASSIFICATION:	R-2
ALLOWABLE BUILDING AREA PER STORY	Aa = {At + [At x If] + [At x Is]}
	At = 7,000
	If = 0
	Is = 2
	21,000 = {7,000 + [7,000 x 0] + [7,000 x 2]}
BUILDING TYPE I AREA PER STORY:	9,710 SF
BUILDING TYPE II AREA PER STORY:	10,032 SF

CliffordPlanning LLC Architecture

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55 MERCHANT STREET, SUITE 3020
HONOLULU, HAWAII 96813

PHONE: 808.537.1200 FAX: 808.537.2271

CONSULTANT:

NO.	DATE	DESCRIPTION	BY

Authorization to use these plans for the issuance of a Building Permit shall be evidenced only by the appearance of the Architect's stamp below, together with the original signature of the Architect.

This work was prepared by me or under my supervision and construction of this project will be under my observation. (Observation of construction as defined in Section 16-115-9 of the State of Hawaii, Department of Commerce and Consumer Affairs, Hawaii Administrative Rules, for Professional Engineers, Architects, Surveyors, and Landscape Architects 10/26/01).

LEGACY PARTNERS
WAIALE ROAD, WAILUKU, MAUI, HAWAII
(2)3-5-001:064

PROJECT NAME: WAILUKU WORKFORCE APARMENTS

PROJECT NUMBER: 416.007

TITLE:
PRELIMINARY CONCEPT SITE PLAN

DATE: JULY 18, 2017

SCALE: As indicated | DRAWN BY: RY | CHECKED BY: JC

DRAWING NO: A100

SHEET ___ OF ___

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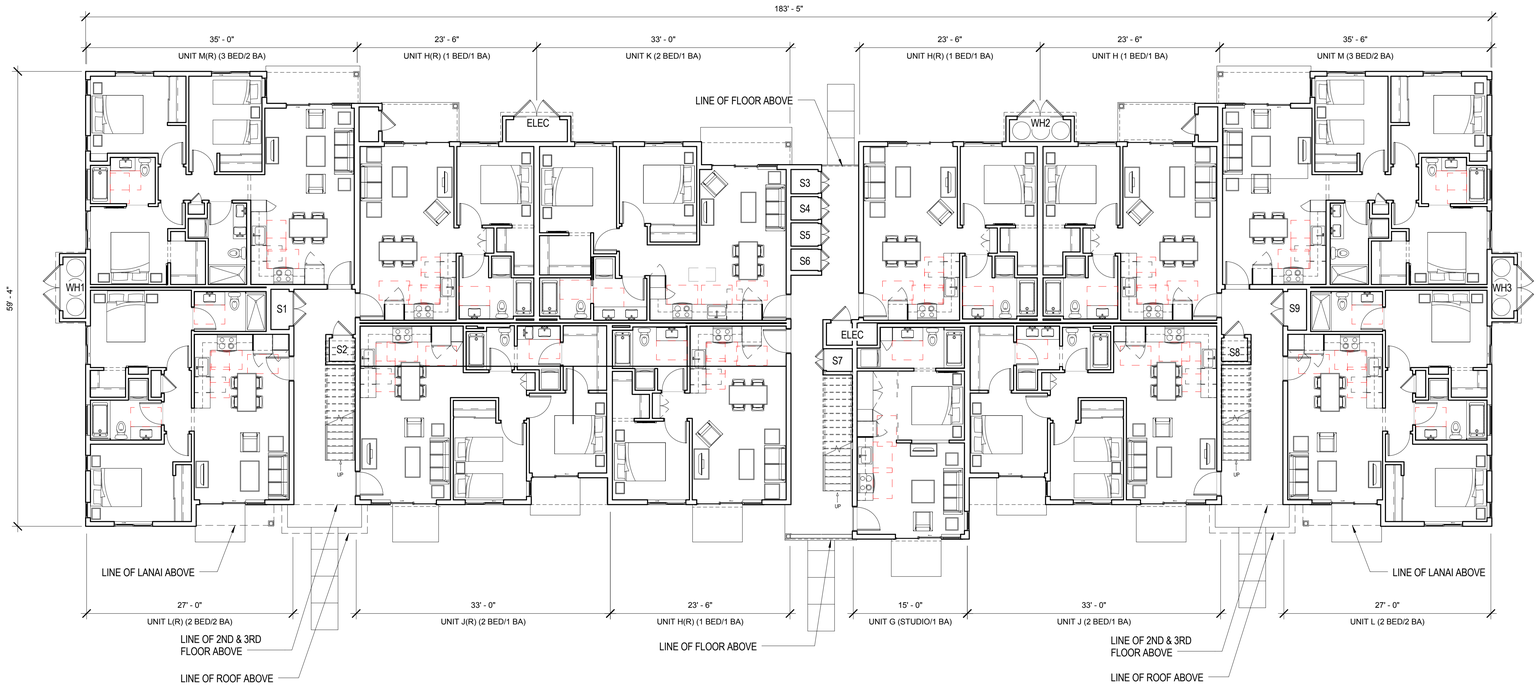
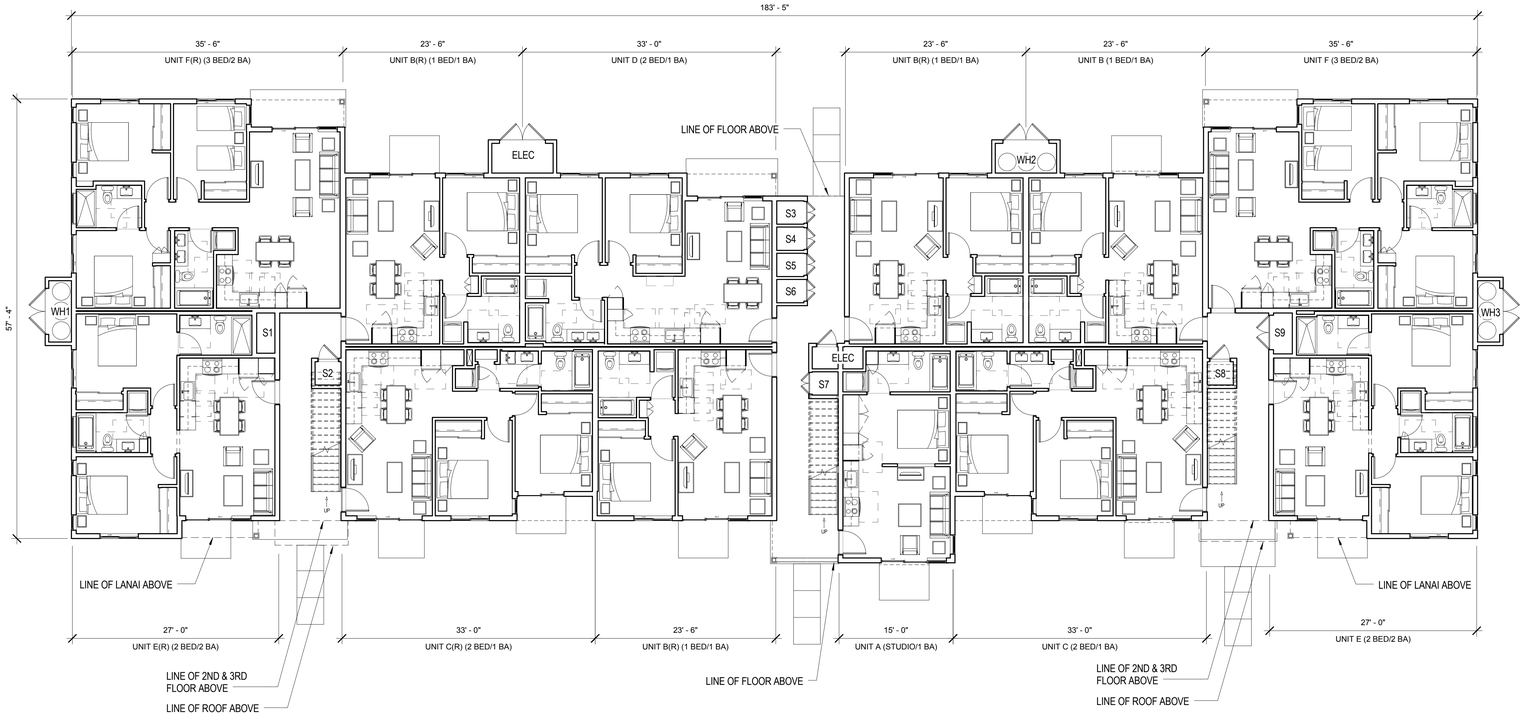


2 BUILDING TYPE II OVERALL FLOOR PLAN

1/8" = 1'-0"



1 BUILDING TYPE I OVERALL FLOOR PLAN

1/8" = 1'-0"

0' 2' 4' 8' 16'

CliffordPlanning LLC Architecture

HARBOR COURT
55 MERCHANT STREET, SUITE 3020
HONOLULU, HAWAII 96813

PHONE: 808.537.1200 FAX: 808.537.2271

CONSULTANT:

NO.	DATE	DESCRIPTION	BY

Authorization to use these plans for the issuance of a Building Permit shall be evidenced only by the appearance of the Architect's stamp below, together with the original signature of the Architect.

This work was prepared by me or under my supervision and construction of this project will be under my observation. (Observation of construction as defined in Section 16-115-9 of the State of Hawaii, Department of Commerce and Consumer Affairs, Hawaii Administrative Rules, for Professional Engineers, Architects, Surveyors, and Landscape Architects 10/26/01).

LEGACY PARTNERS
WAIALE ROAD, WAILUKU, MAUI, HAWAII

PROJECT NAME: WAILUKU WORKFORCE APARTMENTS

PROJECT NUMBER: 416.007

TITLE:
OVERALL BUILDING PLANS

DATE: JUNE 28, 2017

SCALE:	DRAWN BY:	CHECKED BY:
1/8" = 1'-0"	KK/SE	JC

DRAWING NO: A101

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4 NORTH ELEVATION

1/8" = 1'-0"

3 EAST ELEVATION

1/8" = 1'-0"

2 WEST ELEVATION

1/8" = 1'-0"

1 SOUTH ELEVATION

1/8" = 1'-0"

0' 2' 4' 8' 16'

CliffordPlanning LLC Architecture

HARBOR COURT
55 MERCHANT STREET, SUITE 3020
HONOLULU, HAWAII 96813

PHONE: 808.537.1200 FAX: 808.537.2271

CONSULTANT:

NO.	DATE	DESCRIPTION	BY

Authorization to use these plans for the issuance of a Building Permit shall be evidenced only by the appearance of the Architect's stamp below, together with the original signature of the Architect.

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LEGACY PARTNERS
WAIALE ROAD, WAILUKU, MAUI, HAWAII

PROJECT NAME: WAILUKU WORKFORCE APARTMENTS

PROJECT NUMBER: 416.007

TITLE:
BUILDING TYPE I ELEVATIONS

DATE: JUNE 28, 2017

SCALE:	DRAWN BY:	CHECKED BY:
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DRAWING NO: A102

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4 NORTH ELEVATION

1/8" = 1'-0"

3 EAST ELEVATION

1/8" = 1'-0"

2 WEST ELEVATION

1/8" = 1'-0"

1 SOUTH ELEVATION

1/8" = 1'-0"

0' 2' 4' 8' 16'

CliffordPlanning LLC Architecture

HARBOR COURT
55 MERCHANT STREET, SUITE 3020
HONOLULU, HAWAII 96813

PHONE: 808.537.1200 FAX: 808.537.2271

CONSULTANT:

NO.	DATE	DESCRIPTION	BY

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LEGACY PARTNERS
WAIALE ROAD, WAILUKU, MAUI, HAWAII

PROJECT NAME: WAILUKU WORKFORCE APARTMENTS

PROJECT NUMBER: 416.007

TITLE:
BUILDING TYPE II ELEVATIONS

DATE: JUNE 28, 2017

SCALE:	DRAWN BY:	CHECKED BY:
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DRAWING NO: A103

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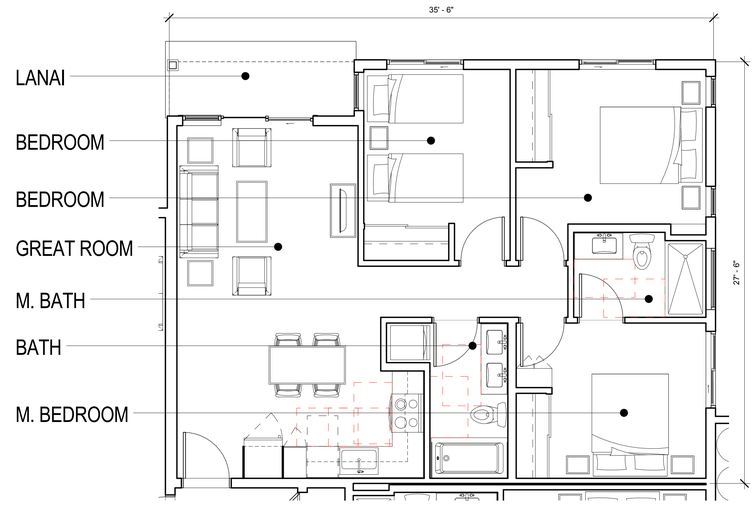
DERIVED FROM FFHAA DESIGN GUIDELINES



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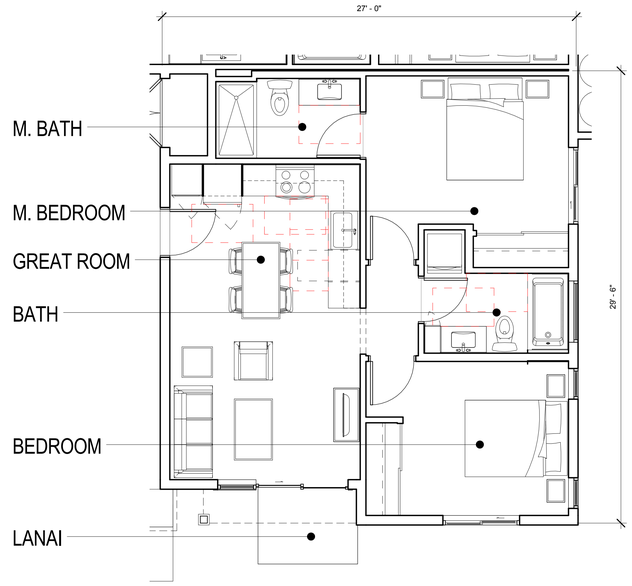

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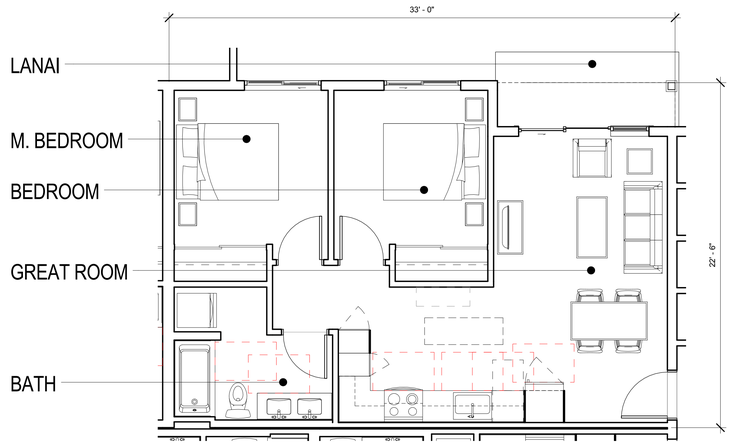

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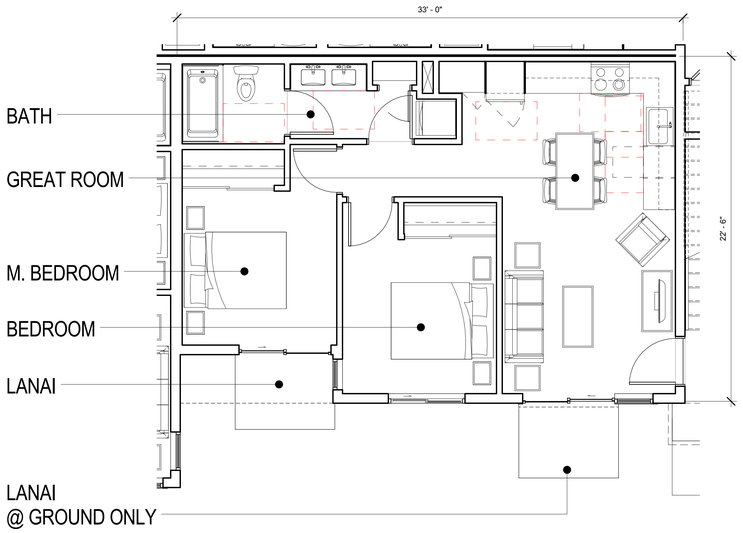

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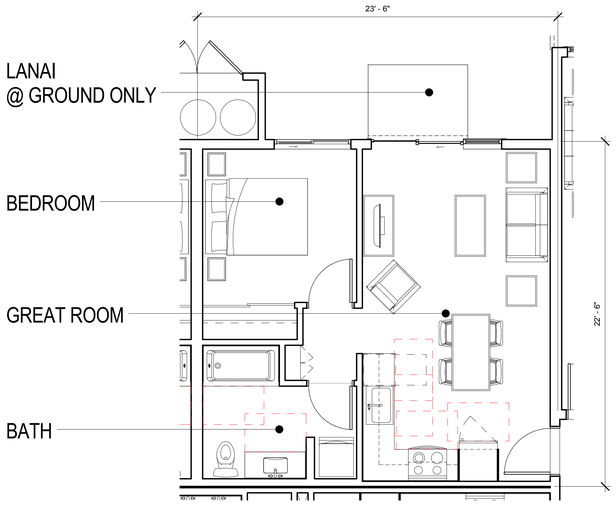

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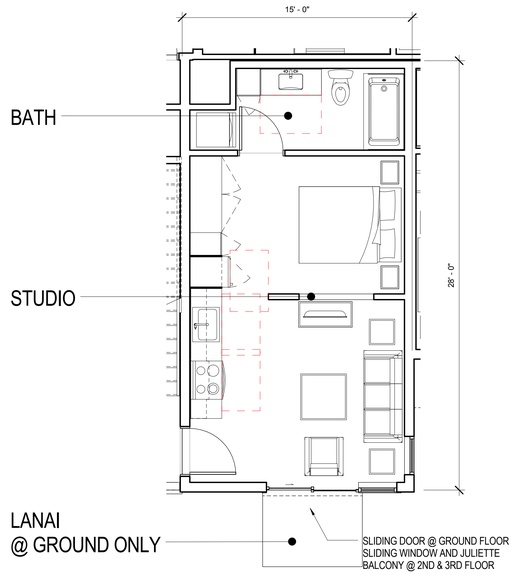

1 UNIT A (STUDIO)
1/4" = 1'-0"

0' 1' 2' 4' 8'

CliffordPlanning LLC Architecture
HARBOR COURT
55 MERCHANT STREET, SUITE 3020
HONOLULU, HAWAII 96813
PHONE: 808.537.1200 FAX: 808.537.2271

CONSULTANT:

NO.	DATE	DESCRIPTION	BY

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LEGACY PARTNERS
WAIALE ROAD, WAILUKU, MAUI,
HAWAII

PROJECT NAME: WAILUKU WORKFORCE APARTMENTS

PROJECT NUMBER: 416.007

TITLE:
BUILDING TYPE I ENLARGED UNIT PLANS

DATE: JUNE 28, 2017

SCALE:	DRAWN BY:	CHECKED BY:
1/4" = 1'-0"	KK/RY	JC

DRAWING NO: A104

SHEET ___ OF ___

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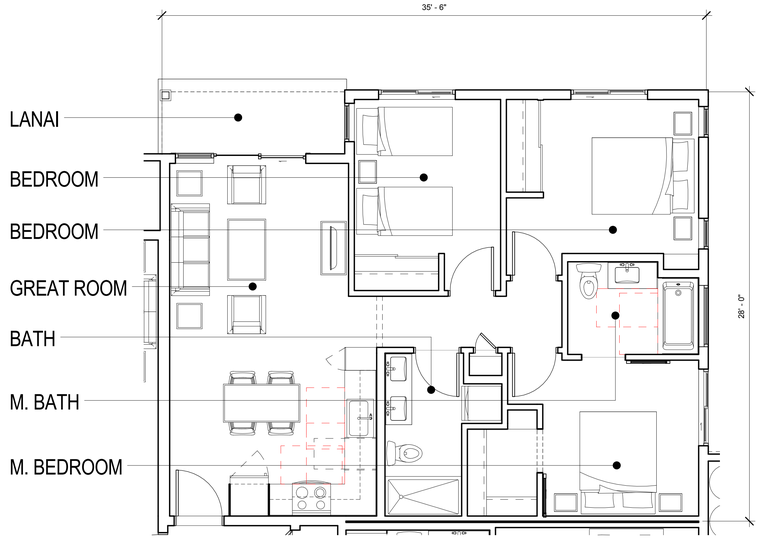

6 UNIT M (3BD/2BA)
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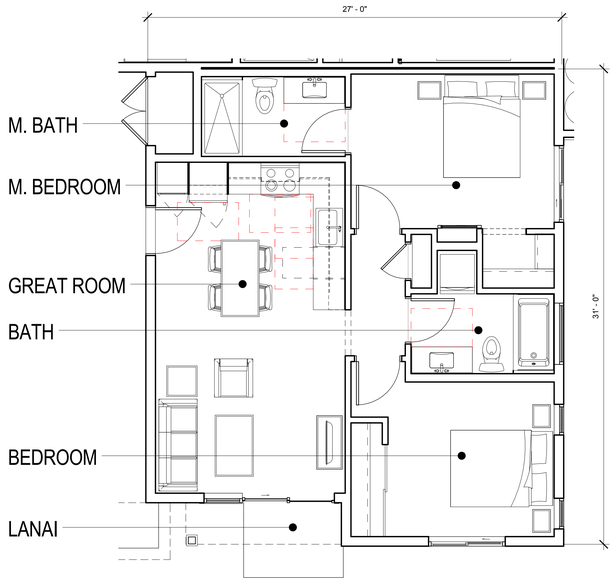

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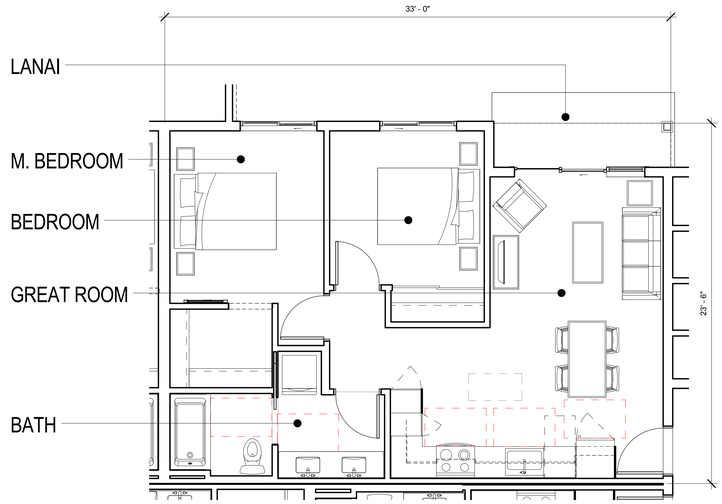
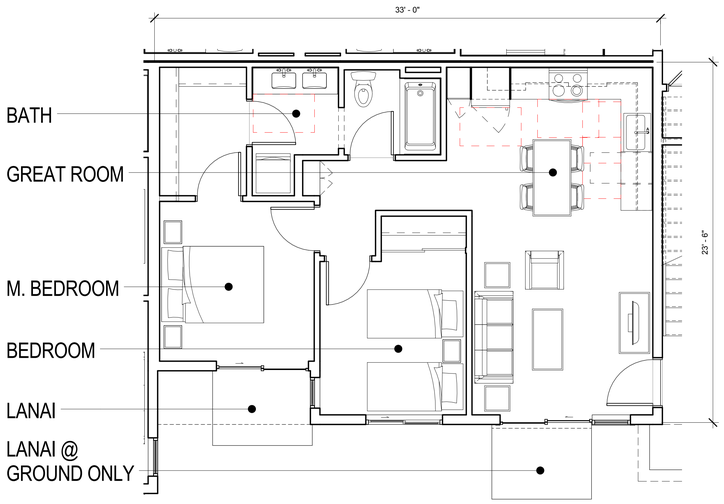


4 UNIT K (2BD/1BA)
1/4" = 1'-0"



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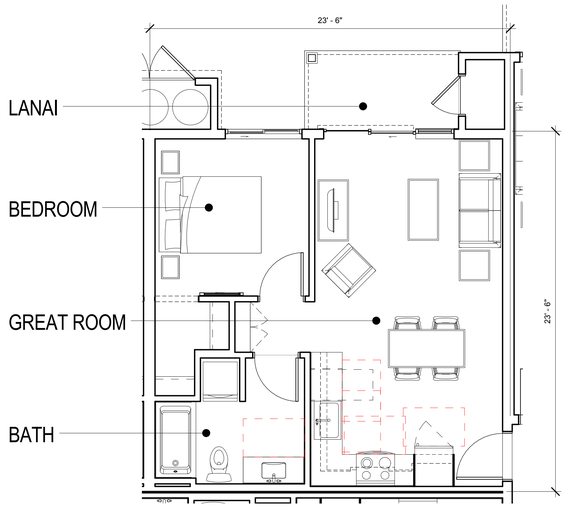
1/4" = 1'-0"



2 UNIT H (1BD/1BA)
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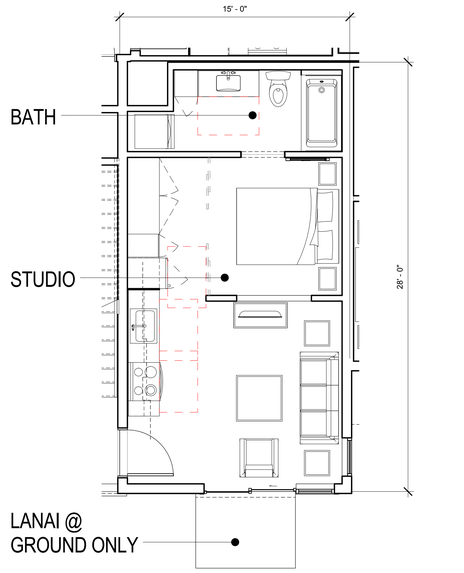

1 UNIT G (STUDIO)
1/4" = 1'-0"

0' 1' 2' 4' 8'

CliffordPlanning LLC Architecture
HARBOR COURT
55 MERCHANT STREET, SUITE 3020
HONOLULU, HAWAII 96813
PHONE: 808.537.1200 FAX: 808.537.2271

CONSULTANT:

NO.	DATE	DESCRIPTION	BY

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LEGACY PARTNERS
WAIALE ROAD, WAILUKU, MAUI, HAWAII
(2)3-5-001:064

PROJECT NAME: WAILUKU WORKFORCE APARTMENTS

PROJECT NUMBER: 416.007

TITLE:
BUILDING TYPE II ENLARGED UNIT PLANS

DATE: JUNE 28, 2017

SCALE:	DRAWN BY:	CHECKED BY:
1/4" = 1'-0"	KK/SE	JC

DRAWING NO: A105

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Appendix J – Preliminary Landscape Plan

NOTE: ALL LANDSCAPE PLANTING AREAS SHALL BE IRRIGATED WITH AN AUTOMATIC IRRIGATION SYSTEM UTILIZING WATER AND ENERGY CONSERVING EQUIPMENT AND PRACTICES.

PRELIMINARY PLANT LIST:

1. LARGE SHADE TREES:
   (35' Canopy or Larger)
   e.g.: Kukui
   Kamani
   Koa
2. MEDIUM-SIZED SHADE TREES:
   (35' Canopy Max.)
   e.g.: Kou
   Manele
   Ho'awa
3. SMALL TREES:
   (16' Canopy Max.)
   e.g.: 'Ohi'a
   Hala
   Koai'a
   Alahe'e
4. LARGE SPECIMEN SHADE TREE:
   e.g.: Monkeypod (Existing Onsite tree to be relocated)
5. SINGLE-TRUNKED PALMS:
   e.g.: Coconut
   Loulu
6. MULTI-TRUNKED PALMS:
   e.g.: Areca
   MacArthur
7. SHRUBS:
   e.g.: A'ali'i
   Anapanapa
   Blue Vitex
   Nanu
   Koki'o Ke'oke'o
   'Ulei
   Beach Naupaka
   Pikake
   Ma'o Ma'o Hau Hele
   Kulu'i
8. GROUND COVERS:
   e.g.: 'Ilima papa
   Nehe
   Kupukupu Fern
   Pili Grass
   Pohinahina
   Naio Papa
   'Uki'uki
9. GRASSES:
   e.g.: Hybrid Bermuda
   El Toro Zoysia

RUSSEL Y. GUSHI
ASLA
LANDSCAPE
ARCHITECT

P.O. BOX 2291
WAILUKU, MAUI, HAWAII 96793
TEL: (808) 242-6503
e-mail: yoshigushi@hawaii.rr.com

LICENSED PROFESSIONAL LANDSCAPE ARCHITECT No. 6012

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION AND CONSTRUCTION OF THIS PROJECT WILL BE UNDER MY OBSERVATION AS DEFINED IN SECTION 16-115-2, HAWAII ADMINISTRATIVE RULES, DEPARTMENT OF COMMERCE AND CONSUMER AFFAIRS, STATE OF HAWAII, PROFESSIONAL ENGINEERS, ARCHITECTS, SURVEYORS AND LANDSCAPE ARCHITECTS.

LICENSE EXPIRES: APRIL 30, 2018

WAILUKU WORKFORCE APARTMENTS
TMK: (2) 3-5-001-064
EAST KUIKAHE DRIVE & WAIALE ROAD
WAILUKU, MAUI, HAWAII

PRELIMINARY LANDSCAPE PLAN

NO.	DATE	REVISION	BY

TITLE: PRELIMINARY LANDSCAPE PLAN

PROJECT NO: 17-06

DATE: JULY, 2017

DRAWING NO: LP-1

SHEET OF

Appendix K – Zoning and Flood Confirmation Form

17/2091

COUNTY OF MAUI
DEPARTMENT OF PLANNING
One Main Plaza Building
2200 Main Street, Suite 315
Wailuku, Hawaii 96793

Zoning Administration and
Enforcement Division (ZAED)
Telephone: (808) 270-7253
Facsimile: (808) 270-7634
E-mail: planning@mauicounty.gov

RECEIVED
APR 18 2017
DEPT. OF PLANNING
COUNTY OF MAUI

ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME RCFC Kehalani, LLC **TELEPHONE** 808-244-1500

PROJECT NAME Kehalani Ag Lot **E-MAIL** marilyn@dowlingco.com

PROPERTY ADDRESS East Kuikahi Drive & Waiale Road, Wailuku **TAX MAP KEY** (2) 3-5-001:064

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?**
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:

A) ☐ Yes ■ No **Will it be processed under a consistency exemption from** Section 18.04.030(B), MCC**?**
IF YES, which exemption? (No. 1, 2, 3, 4 or 5) n/a

B) State the purpose of subdivision and the proposed land uses (*ie 1-lot into 2-lots for all land uses allowed by law*):
Confirm zoning

INSTRUCTIONS:
1) **Please use a separate Zoning & Flood Confirmation Form for each Tax Map Key (TMK) number.**
2) **If this will be used with a subdivision application AND the subject property contains multiple districts/designations of (1) State Land Use Districts, (2) Maui Island Plan Growth Boundaries, (3) Community Plan Designations, or (4) County Zoning Districts; submit a signed and dated Land Use Designations Map, prepared by a licensed surveyor, showing the metes & bounds of the subject parcel and of each district/designation including any subdistricts.**
3) **If this will be used with a subdivision application AND the subject property contains multiple State Land Use Districts; submit an approved District Boundary Interpretation from the State Land Use Commission.**

(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION: [1]

☐ (SMA) Special Management Area

STATE DISTRICT: ☐ Urban ☐ Rural ☒ Agriculture ☐ Conservation

MAUI ISLAND PLAN Growth Boundary:[2] ☒ Urban ☐ Small Town ☐ Rural ☐ Planned Growth Area ☐ Outside Growth Boundaries

Protected Area:[2] ☐ Preservation ☐ Park ☐ Greenbelt ☐ Greenway ☐ Sensitive Land ☒ Outside Protected Areas

COMMUNITY PLAN:[2] Future Growth Reserve

COUNTY ZONING: Agriculture District

OTHER/COMMENTS:

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION: A Flood Development Permit is required if any portion of a parcel is designated V, VE, A, AO, AE, AH, D, or Floodway, and the project is on that portion.

FLOOD HAZARD AREA ZONES [3] & BASE FLOOD ELEVATIONS: Zone X

☐ FEMA DESIGNATED FLOODWAY For Flood Zone AO, FLOOD DEPTH:

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).

_____ (Signature)
☐ Not Applicable, (Due to processing under consistency exemption No. ☐1, ☐2, ☐3, ☐4, ☐5).
☐ Interim Zoning, (The parcel or portion of the parcel that is zoned interim shall not be subdivided).

☐ [4] Consistent, (LUDs appear to have ALL permitted uses in common).

☐ [4] Consistent, upon obtaining an SMA, PD, or PH subdivision approval from Planning.

☐ [4] Consistent, upon recording a permissible uses unilateral agreement processed by Public Works (See Pg.2).

NOTES:

1 The conditions and/or representations made in the approval of a State District Boundary Amendment, Community Plan Amendment, County Change In Zoning, SMA Permit, Planned Development, Project District and/or a previous subdivision, may affect building permits, subdivisions, and uses on the land.

2 Please review the Maui Island Plan and the Community Plan document for any goals, objectives, policies or actions that may affect this parcel.

3 Flood development permits might be required in zones X and XS for any work done in streams, gulches, low-lying areas, or any type of drainageway; Flood development permits are required for work in all other zones. Subdivisions that include/adjoin streams, gulches, low-lying areas, or any type of drainageway might require the following designations to be shown on the subdivision map: 100-year flood inundation limits; base flood elevations; drainage reserves.

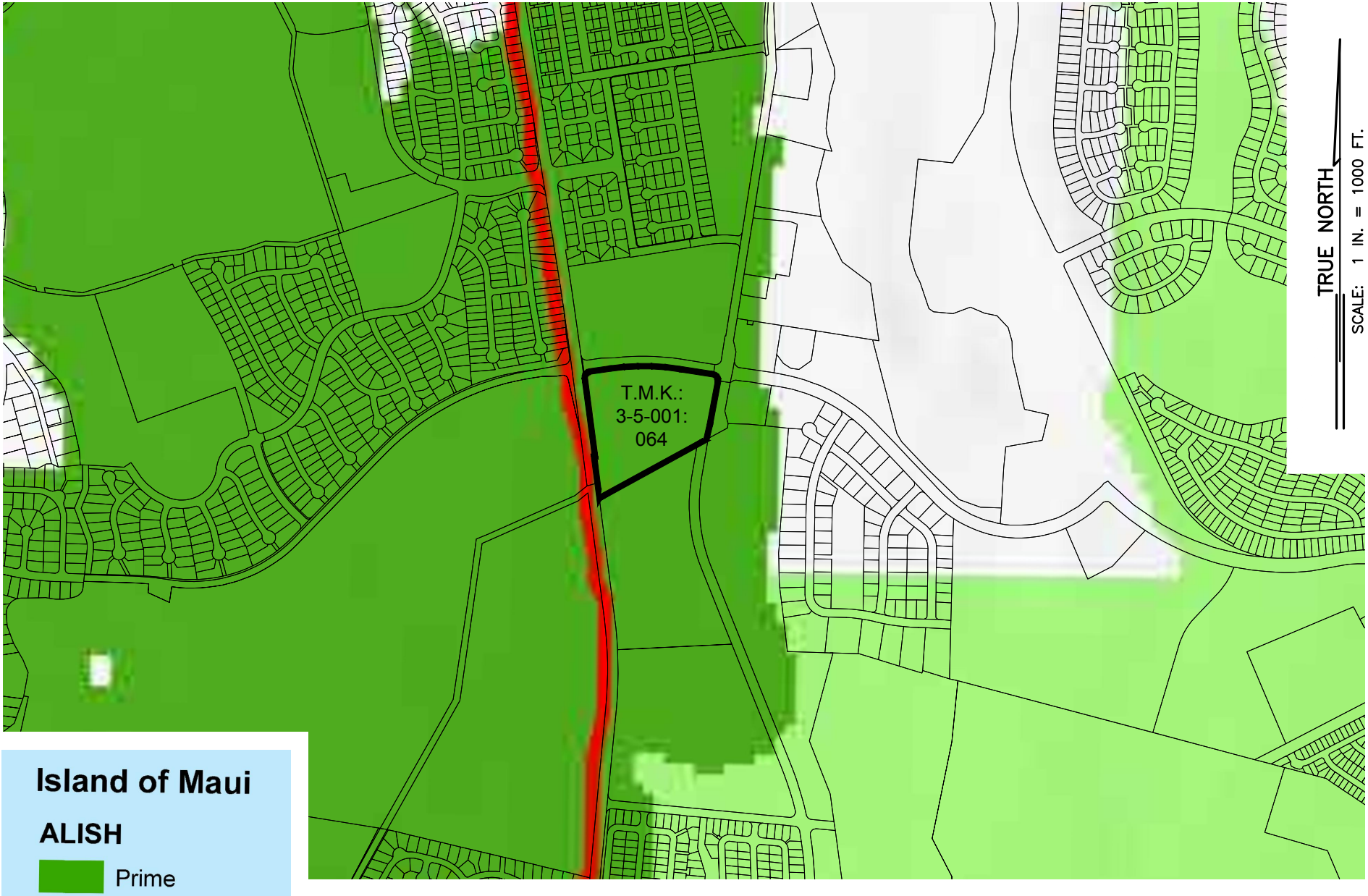
4 Subdivisions will be further reviewed during the subdivision application process to verify consistency, unilateral agreement requirements, and the conditions associated with a unilateral agreement [Section 18.04.030.D, Maui County Code].

REVIEWED & CONFIRMED BY:

Sheila Nakagawa (Signature) 4/19/17 (Date)

For: John S Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

Appendix L - ALISH Map



Island of Maui

ALISH

- Prime
- Unique
- Other
- Major Roads

0 1000 2000 3000 4000

SCALE: 1 IN. = 1000 FT.

WARREN S. UNEMORI ENGINEERING, INC.
CIVIL & STRUCTURAL ENGINEERS / LAND SURVEYORS

April 28, 2017

V:\Projdata\16proj\16052\dwg\exhibits\Map Maui-00.dwg

Appendix M – Cultural Impact Assessment

SCS Project Number 2114-CIA-1

A CULTURAL IMPACT ASSESSMENT REPORT IN ADVANCE OF THE PROPOSED WAILUKU AFFORDALE HOUSING PROJECT WAILUKU AND WAIKAPŪ AHUPUA‘A, WAILUKU DISTRICT ISLAND OF MAUI, HAWAI‘I

[TMK: (2) 3-5-001:006]

Prepared by:
Cathleen A. Dagher, B.A.

August 2017
DRAFT

Prepared for:
Legacy Wailuku, LLC
lindaschatz@schatzcollaborative.com

SCIENTIFIC CONSULTANT SERVICES, Inc.

HAWAII

1347 Kapiolani Blvd., Suite 408 Honolulu Hawai`i 96814

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INTRODUCTION

At the request of Legacy Wailuku LLC, Scientific Consultant Services (SCS), Inc., has prepared a Cultural Impact Assessment (CIA) in advance of the proposed Waikapu Affordable Housing Project. The proposed project will be located in Wailuku, Wailuku and Waikapū Ahupuaʻa, Wailuku District, Maui Island, Hawaiʻi [TMK: (2) 3-5-001:06] (Figures 1 through 3). The proposed project area consists of a total of approximately 14.416-acre property, which is owned by Kehalani Agricultural Investors LLC.

The Hawaii State Office of Environmental Quality Control (OEQC 1997:11) states that "an environmental assessment of cultural impacts" gathers information about cultural practices and cultural features that may be affected by significant environmental effects:

> 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.

The purpose of a Cultural Impact Assessment is to identify the possibility of previous and current cultural practices and resources within a project area and ahupuaʻa, and then to assess the potential for impacts to these cultural resources.

PROJECT DESCRIPTION

The proposed consists of a 324-unit apartment project will include a recreation center, swimming pool, and three children's play areas. Of the 324 units, 194 will be workforce rentals for families and the remaining 130 units will be unrestricted rentals.

CULTURAL IMPACT ASSESSMENT METHODOLOGY

The Constitution of the State of Hawaiʻi clearly states the duty of the State and its agencies is to preserve, protect, and prevent interference with the traditional and customary rights of native Hawaiians. Article XII, Section 7 (2000) requires the State to "protect all rights, customarily and traditionally exercised for subsistence, cultural and religious purposes and possessed by *ahupuaʻa* tenants who are descendants of native Hawaiians who inhabited the Hawaiian Islands prior to 1778." Additionally, Article IX and XII, of the state constitution, other

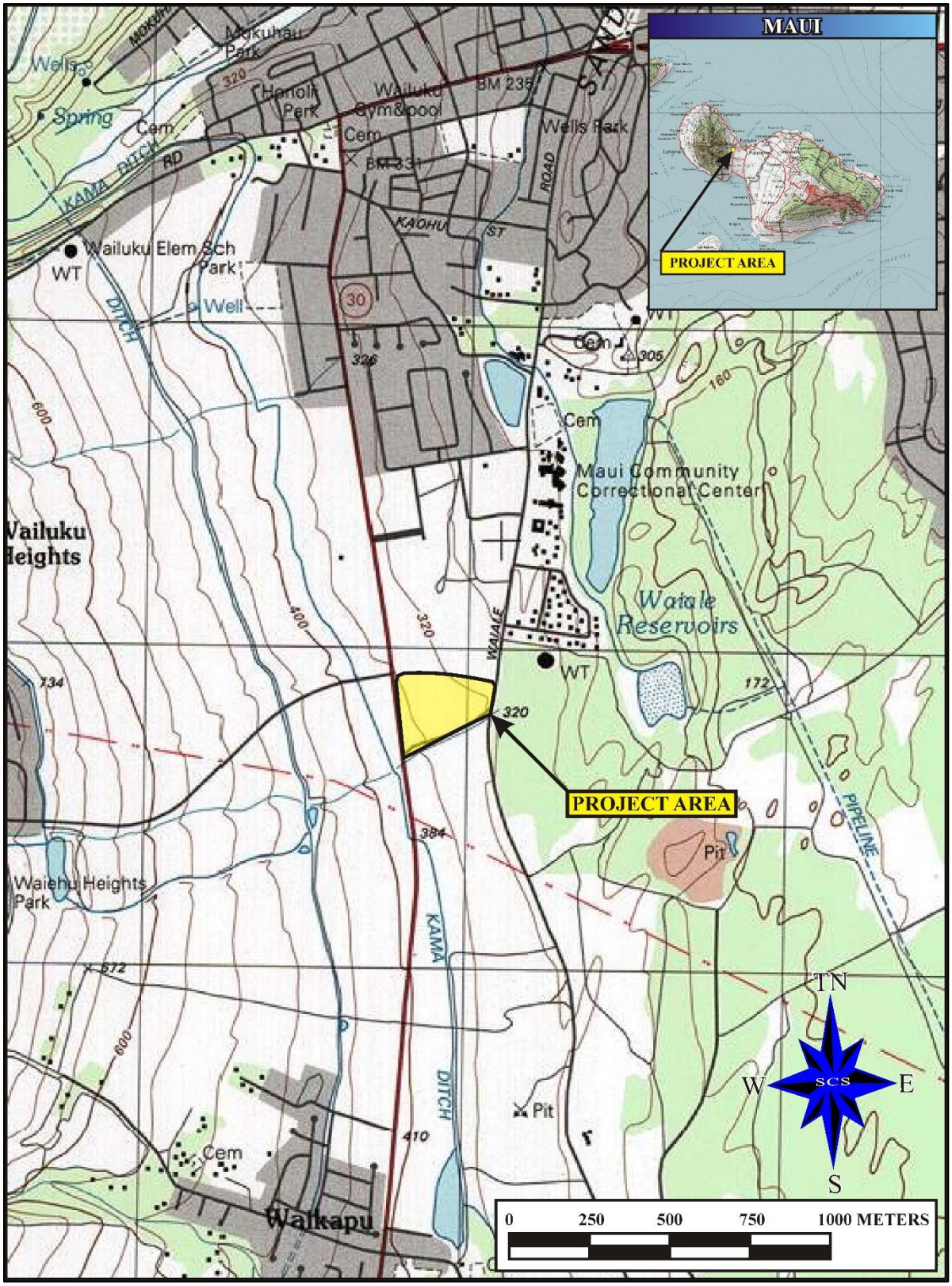

Figure 1: USGS (Wailuku, HI 1997; 1:24,000) Quadrangle Map Showing Proposed Project Area Location.

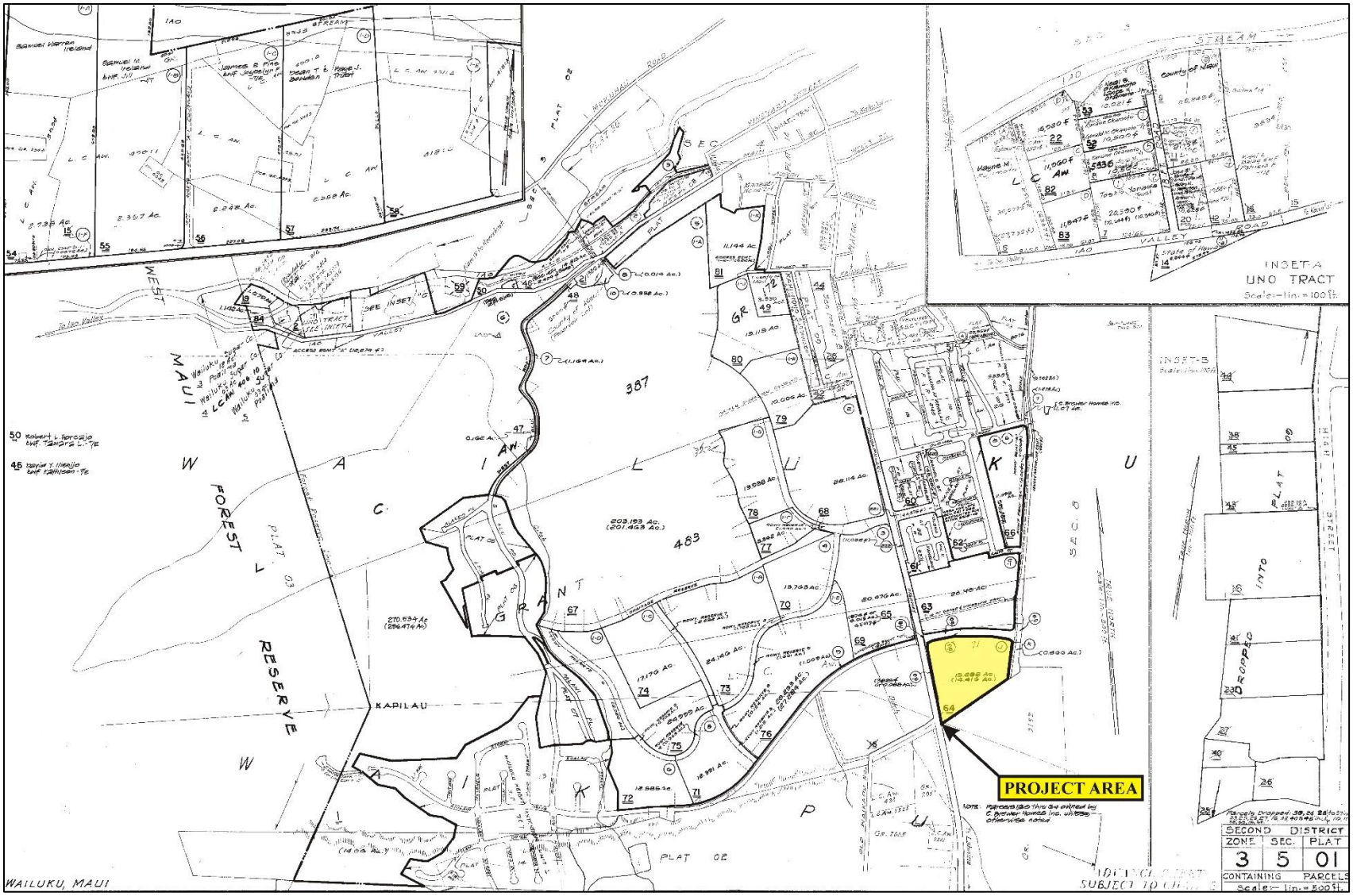

Figure 2: Tax map Key [TMK: (2) 3-5-001] Showing Proposed Project Area Location.

PROJECT AREA
Waiale Reservoirs
Kenalani
Kaupo St
Waimaluhia Pl
Maui Lani Pkwy
Waiale Rd
Kuikahi Dr
Mahalani St
Kea St
Kaiai St
Olomea St
Kolo Pl
Koa Pl
Akolea St
Kaiaulu St
Kaiaulu Pl
Kaiaulu Cir
Kamaile Cir
Onehee Ave
Kuulama St
Kuulama Pl
Hulihuli Pl
Kamaiki Cir
Puumaile St
Puumaeole St
Paama Cir
Hulihuli St
Kaiaulu Cir
Kaiaulu Ave
Kaiaulu St
Kaiaulu Pl

state laws, and the courts of the State, impose on government agencies a duty to promote and protect cultural beliefs and practices, and resources of Native Hawaiians as well as other ethnic groups.

Kamehameha III (Kauikeaouli) preserved the peoples traditional right to subsistence. As a result, in 1850, the Hawaiian Government confirmed the traditional access rights to native Hawaiian *ahupua'*a tenants to gather specific natural resources for customary uses from undeveloped private property and waterways under the Hawaiian Revised Statutes (HRS) 7-1. In 1992, the State of Hawai'i Supreme Court, reaffirmed HRS 7-1 and expanded it to include, "native Hawaiian rights…may extend beyond the *ahupua'a* in which a native Hawaiian resides where such rights have been customarily and traditionally exercised in this manner" [Pele Defense Fund v. Paty, 73 Haw.578, 620, 837 P.2d 1247, 1272 (1992)].

Act 50, enacted by the Legislature of the State of Hawai'i (2000) with House Bill (HB) 2895, relating to Environmental Impact Statements, proposes that:

> …there is a need to clarify that the preparation of environmental assessments or environmental impact statements should identify and address effects on Hawaii's culture, and traditional and customary rights… [H.B. NO. 2895].
>
> Act 50 also requires state agencies and other developers to assess the effects of proposed land use or shoreline developments on the "cultural practices of the community and State" as part of the HRS Chapter 343 (2001) environmental review process.

It also re-defined the definition of "significant effect" to include "the sum of effects on the quality of the environment including actions that impact a natural resource, limit the range of beneficial uses of the environment, that are contrary to the State's environmental policies, or adversely affect the economic welfare, social welfare or cultural practices of the community and State." Cultural resources can include a broad range of often overlapping categories, including places, behaviors, values, beliefs, objects, records, stories, etc. (H.B. 2895, Act 50, 2000).

The purpose of a CIA is to identify the possibility of on-going cultural activities and resources within a project area, or its vicinity, and then assessing the potential for impacts on these cultural resources. The CIA is not intended to be a document of in depth archival-historical land research, or a record of oral family histories, unless these records contain information about specific cultural resources that might be impacted by a proposed project.

GEOGRAPHICAL EXTENT

As defined by the Hawaii State Office of Environmental Quality Control (OEQC 1997:11), the geographical extent should be greater than the area over which the proposed project will take place in order to ensure that cultural practices that occur outside of the project area, but which may still be affected, are included in the assessment. For example, a project that may not, itself, physically impact traditional gathering practices, but may block access to those locations would be included within the assessment. The concept of geographical expansion is recognized by using, as an example, "the broad geographical area, e.g. district or *ahupua'a.*" In some cases, the geographical extent could extend beyond the *ahupua'a* if cultural practices do so as well.

OEQC GUIDELINES FOR ASSESSING CULTURAL IMPACTS

According to the Guidelines for Assessing Cultural Impacts established by the Hawaii State Office of Environmental Quality Control (OEQC 1997:12):

> The types of cultural practices and beliefs subject to assessment may include subsistence, commercial, residential, agricultural, access-related, recreational, and religions and spiritual customs. The types of cultural resources subject to assessment may include traditional cultural properties or other types of historic sites, both man made and natural, which support such cultural beliefs.

The meaning of "traditional" was explained by in *National Register Bulletin*:

> Traditional" in this context refers to those beliefs, customs, and practices of a living community of people that have been passed down through the generations', usually orally or through practice. The traditional cultural significance of a
>
> historic property then is significance derived from the role the property plays in a community's historically rooted beliefs, customs, and practices. . . . [Parker and King 1998:1]

This CIA was prepared as much as possible in accordance with the suggested methodology and content protocol in the Guidelines for Assessing Cultural Impacts (OEQC 1997:11-13). In outlining the "Cultural Impact Assessment Methodology", the OEQC (1997:11) states that:

> "…information may be obtained through scoping community meetings, ethnographic interviews and oral histories…"

This Cultural Impact Assessment was prepared in accordance with the Guidelines for Assessing Cultural Impacts (OEQC 1997:11-13). The Guidelines recommend that preparers of assessments analyzing cultural impacts adopt the following protocol:

1. Identify and consult with individuals and organizations with expertise concerning the types of cultural resources, practices and beliefs found within the broad geographical area, e.g., district or ahupua'a;

2. Identify and consult with individuals and organizations with knowledge of the area potentially affected by the proposed action;

3. Receive information from or conduct ethnographic interviews and oral histories with persons having knowledge of the potentially affected area;

4. Conduct ethnographic, historical, anthropological, sociological, and other culturally related documentary research;

5. Identify and describe the cultural resources, practices and beliefs located within the potentially affected area; and

6. Assess the impact of the proposed action. alternatives to the proposed action, and mitigation measures, on the cultural resources, practices and beliefs identified.

CULTURAL IMPACT ASSESSMENT CONTENTS

The Guidelines state that an assessment of cultural impacts should address, but not be limited to:

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.

B. Description of methods adopted by the preparer to identify, locate, and select the persons interviewed, including a discussion of the level of effort undertaken.

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.

D. Biographical information concerning the individuals and organizations consulted their particular 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.

E. 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 particular perspective of the authors, any opposing views, and any other relevant constraints, limitations or biases.

F. 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.

G. 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.

H. Explanation of confidential information that has been withheld from public disclosure in the assessment.

I. Discussion concerning any conflicting information in regard to identified cultural resources, practices and beliefs.

J. 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.

K. A bibliography of references, and attached records of interviews which were allowed to be disclosed.

If on-going cultural activities and/or resources are identified within the project area, assessments of the potential effects on the cultural resources in the project area and recommendations for mitigation of these effects can be proposed.

PROJECT METHODOLOGY

This report contains archival and documentary research, as well as communication with organizations and individuals having knowledge of the project area, its cultural resources, and its practices and beliefs. An example of the initial letter of inquiry is presented in Appendix A; an example of the follow up letter is presented in Appendix B; and the signed information release forms are presented in Appendix C. This Cultural Impact Assessment was prepared in accordance with the suggested methodology and content protocol provided in the Guidelines for

Assessing Cultural Impacts (OEQC 1997:13), whenever possible. The assessment concerning cultural impacts may include, but not be limited to:

ARCHIVAL RESEARCH

Archival research focused on a historical documentary study involving both published and unpublished sources. These included legendary accounts of native and early foreign writers; early historical journals and narratives; historic maps, land records, such as Land Commission Awards, Royal Patent Grants, and Boundary Commission records; historic accounts, and previous archaeological reports.

Historical and cultural source materials were extensively used and can be found listed in the References Cited portion of this report. Such scholars as Samuel Kamakau, Martha Beckwith, Jon J. Chinen, Lilikalā Kameʻeleihiwa, R. S. Kuykendall, Marion Kelly, E. S. C. Handy and E.G. Handy, John Papa ʻĪʻī, Gavin Daws, A. Grove Day, and Elspeth P. Sterling and Catherine C. Summers, and Mary Kawena Pukuʻi and Samuel H. Elbert continue to contribute to our knowledge and understanding of Hawaiʻi, past and present. The works of these and other authors were consulted and incorporated in this report where appropriate. Land use document research was supplied by the Waihona ʻAina (2017) Database and the Honolulu's Real Property Assessment and Tax Billing Information website.

INTERVIEWS

Interviews are conducted in accordance with Federal and State laws and guidelines when knowledgeable individuals are able to identify cultural practices in, or in close proximity to, the project area. If they have knowledge of traditional stories, practices and beliefs associated with a project area or if they know of historical properties within the project area, they are sought out for additional consultation and interviews. Individuals who have particular knowledge of traditions passed down from preceding generations and a personal familiarity with the project area are invited to share their relevant information concerning particular cultural resources. Often people are recommended for their expertise, and indeed, organizations, such as Hawaiian Civic Clubs, the Island Branch of Office of Hawaiian Affairs (OHA), historical societies, Island Trail clubs, and Planning Commissions are depended upon for their recommendations of suitable informants. These groups are invited to contribute their input and suggest further avenues of inquiry, as well as specific individuals to interview. It should be stressed again

that this process does not include formal or in-depth ethnographic interviews or oral histories as described in the OEQC's *Guidelines for Assessing Cultural Impacts* (1997). The assessments are intended to identify potential impacts to ongoing cultural practices, or resources, within a project area or in its close vicinity.

If knowledgeable individuals are identified, personal interviews are sometimes taped and then summarized. These draft summaries are returned to each of the participants for their review and comments. After corrections are made, each individual is to sign an information release form, making the interview available for this study. When telephone interviews occur, a summary of the information is also sent for correction and approval, or dictated by the informant and then incorporated into the document. If no cultural resource information is forthcoming and no knowledgeable informants are suggested for further inquiry, interviews are not conducted.

ENVIRONMENTAL SETTING

The island of Maui ranks second in size of the eight main islands in the Hawaiian Archipelago. The Island was formed by two volcanoes, Mount Kukui in the west and Haleakalā in the east. Pu'u Kukui, forming the west end of the island (1,215 m above mean sea level), is composed of large, heavily eroded amphitheater valleys that contain well-developed permanent stream systems that watered fertile agricultural lands extending to the coast. The deep valleys of West Maui and their associated coastal regions have been witness to many battles in ancient times and were coveted productive landscapes. These are joined together by an isthmus containing dry, open country (*kula*), which includes a portion of the lands within Wailuku District.

PROJECT AREA

The proposed project area is located in the city of Wailuku, Wailuku and Waikapū Ahupua'a, Wailuku District, Maui Island, Hawai'i. Kuikahi Drive forms the northern project area boundary, Honoapiilani Highway and Waiale Road form the west and east boundaries, respectively. The southern boundary is formed by an irrigation ditch, which appears to be a portion of the Kama Ditch, State Site 50-50-04-5474. The proposed project area is situated on the western edge of the isthmus, approximately 2.5 miles inland from Kahului Harbor at an elevation of 320 to 360 feet above mean sea level (amsl).

SOILS

According to Foote *et al*. (1972: Sheet Number 100; Figure 4) two soil types representing the Iao Soil Series are present within the proposed project area (Figure 4). Iao clay, 3 to 7 percent slopes (IcB) comprise the western portion, while Iao silty clay, 0 to 3 (IaA) percent slopes comprise the eastern portion of the proposed project area.

In general, the well-drained volcanic soils of the Iao Series occur on valley fill and alluvial fans between 100 to 500 feet amsl in areas receiving 25 to 4 inches of rainfall annually (Foote *et al*. 1972: 46). The IcB soils, in a representative profile, exhibit a 15 inch surface layer composed of dark-brown clay; a 45 inch subsurface layer composed of very dark brown, dark-brown, and very dark greyish-brown clay and silty clay. The substratum is composed of clayey alluvium (Foote *et al*. 1972: 46). The IcB soils exhibit moderately slow permeability, medium runoff, and a slight to moderate erosion hazard. These soils are used for the cultivation of sugarcane and as residential sites (Foote *et al*. 1972: 46).The IaA soils exhibit slow runoff and a slight erosion hazard and are utilized for the cultivation of sugarcane (Foote *et al*. 1972: 46-47)

CLIMATE

According to (Armstrong 1980:64), the project area exhibits a temperate climate with summer temperatures ranging from the high 60s to the low 90s (degrees Fahrenheit) in the summer months. During winter months, the temperature in the project area ranges around 50s to 90 degrees (Fahrenheit). Giambelluca *et al*. (2013) indicate the project area receives approximately 24 inches of rainfall annually.

CULTURAL HISTORICAL CONTEXT

Wailuku District inhabits the eastern side of the West Maui Mountains (Mauna Kahalawai) and occupies the isthmus through the center of the island to coastal reaches in Kahuku and Mā‘alaea. Wailuku, together with Waikapū, Waihe‘e, and Waiehu, is one of the Nā Wai ‘Ehā, or “the four waters,” known for the occupancy of chiefly individuals (Kame‘eleihiwa 1992; Pukui and Elbert 1992; and Creed 1993). Wailuku District and Wailuku Ahupua‘a are frequently mentioned in historical texts and oral traditional accounts as being politically, ceremonially, and geographically important areas during traditional times (Cordy 1981, 1996; Kirch 1985). Wailuku was considered a "chiefly center" (Sterling 1998:90) with many of the chiefs and much of the area’s population residing near or within portions of ‘Īao Valley and lower Wailuku. The many *heiau* constructed in the Wailuku area point to its ceremonial and

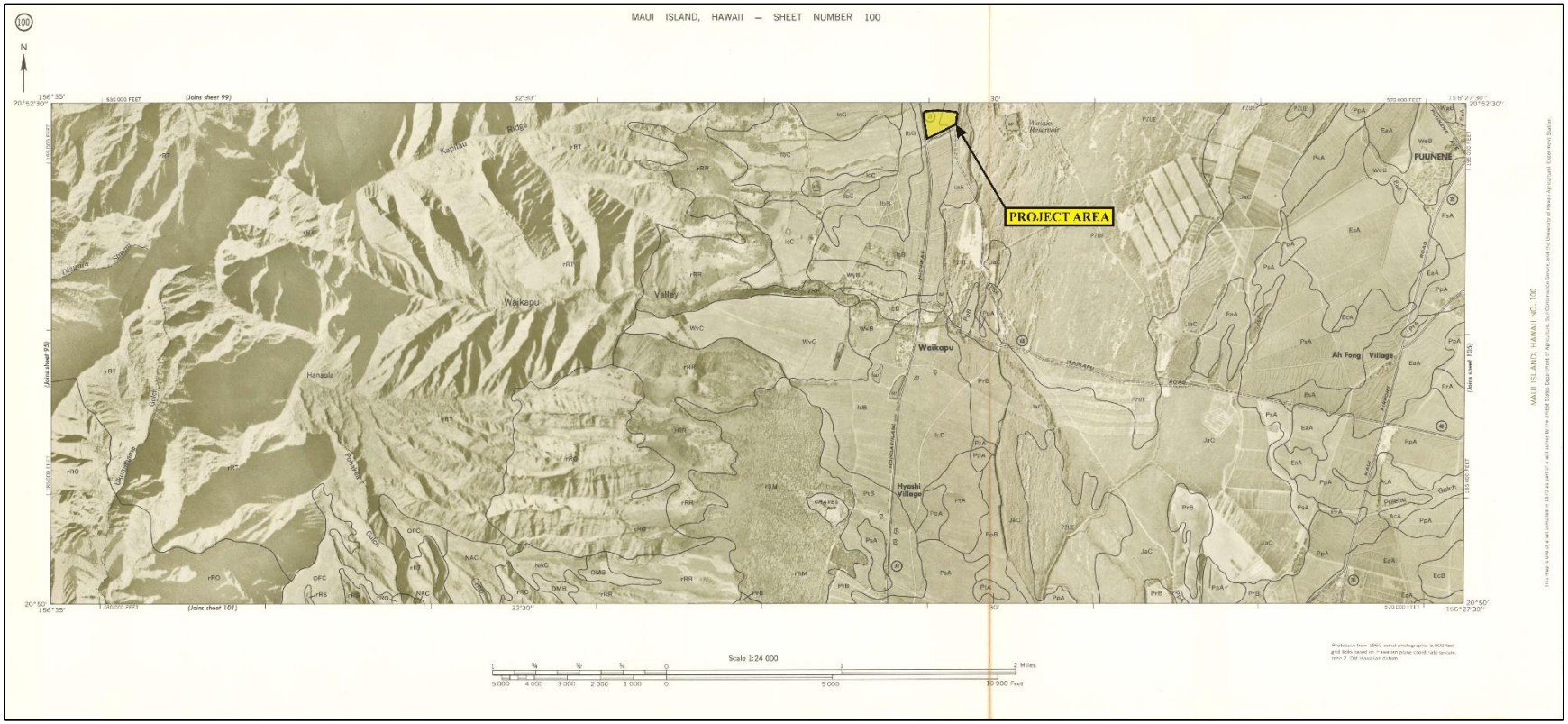

Figure 4: : USDA (Foote *et al*. 1972; Sheet Number 100) Showing Soil Types Within the Proposed Project Area.

religious importance during the pre-Contact Period (pre-1778). During the Historic Period (post-1778), after numerous battles in the area, the large concentration of Land Commission Awards granted in Wailuku, particularly in lower ʻĪao Valley, also attest to a sizeable population base and the importance of the lands for cultivation through time. More recent land use in the area included sugar cane cultivation and use of the land for pasture.

Creed (1993) has written extensively on the traditional background of the Waikapū area, much of which directly applies to the open landscape north of Waikapū. Creed (1993:19–21) provides an extensive list, including traditional sites that include agricultural sites (*kula* lands, *wauke* patches, *hala* trees, pigs, and potato patches), boundary walls, burials (sometimes located in habitation terraces), feather gathering areas (particularly in the mountains to the west), habitation loci, and *pohaku* (an adze stone marks the border between Wailuku and Waikapū). While populations were predominantly centered in ʻĪao Valley and Waikapū Valley, there was agricultural and habitation activity in the open grasslands above the coastal flats.

PAST POLITICAL BOUNDARIES

Approximately 600 years ago, the Hawaiian population had expanded throughout the Hawaiian Islands to a point where large, political districts could be formed (Lyons 1903; Kamakau 1991; Moffat and Fitzpatrick 1995). During the pre-Contact Period, Maui was divided into twelve districts or *moku* (Sterling 1998:3). Following the Civil Code of 1859, the twelve districts were consolidated into four districts: Lāhainā, Wailuku, Makawao, and Hāna (Sterling 1998:3). Traditionally, the division of Maui A Example Letter of Inquiry Island into districts (*moku*) and sub-districts was performed by a *kahuna* (priest, expert) named Kalaihaʻōhia, during the time of the *aliʻi* Kakaʻalaneo (Beckwith 1940:383; Fornander 1919-1920, Vol. 6:248) places Kakaʻalaneo at the end of the 15th century or the beginning of the 16th century. Land was considered the property of the king or *aliʻi ʻai moku* (the *aliʻi* who eats the island/district), which he held in trust for the gods. The title of *aliʻi ʻai moku* ensured rights and responsibilities pertaining to the land, but did not confer absolute ownership. The king kept the parcels he wanted, his higher chiefs received large parcels from him and, in turn, distributed smaller parcels to lesser chiefs. The *makaʻāinana* (commoners) worked the individual plots of land.

In general, several terms, such as *moku*, *ahupuaʻa*, *ʻili* or *ʻili ʻāina* were used to delineate various land sections. A district (*moku*) contained smaller land divisions (*ahupuaʻa*) which customarily continued inland from the ocean and upland into the mountains. Extended household groups living within the *ahupuaʻa* were therefore, able to harvest from both the land

and the sea. Ideally, this situation allowed each *ahupua'a* to be self-sufficient by supplying needed resources from different environmental zones (Lyons 1875:111). The *'ili 'āina* or *'ili* were smaller land divisions next to importance to the *ahupua'a* and were administered by the chief who controlled the *ahupua'a* in which it was located (Lyons 1875:33; Lucas 1995:40). The *mo'o'āina* were narrow strips of land within an *'ili*. The land holding of a tenant or *hoa 'āina* residing in an *ahupua'a* was called a *kuleana* (Lucas 1995:61).

TRADITIONAL AND HISTORIC SETTING

Archaeological settlement pattern data indicates that initial colonization and occupation of the Hawaiian Islands occurred on the windward shoreline areas around c. A.D. 900, with populations eventually settling into drier leeward areas at later periods (Kirch 1985:87). Coastal settlement was still dominant, but populations began exploiting and living in the upland *kula* (plains) zones. Greater population expansion to inland areas did not occur until sometime during the 12th century and continued through the 16th century. Large scale or intensive agricultural endeavors were implemented in association with habitation. Coastal lands were used for settlement and taro was cultivated in near-coastal reaches and in the uplands. Recent research within Wailuku Ahupua'a indicates that the area was likely settled between c. A.D. 1100 (Kirch 1985:142) and A.D. 1200 (Fredericksen and Fredericksen 1992).

TRADITIONAL SETTLEMENT PATTERNS

The Hawaiian economy was based on agricultural production and marine exploitation, as well as raising livestock and collecting wild plants and birds. Extended household groups settled in various *ahupua'a*. During the pre-Contact Period, there were primarily two types of agriculture, wetland and dry land, both of which were dependent upon geography and physiography. River valleys provided ideal conditions for wetland *kalo* (*Colocasia esculenta*) agriculture that incorporated pond fields and irrigation canals. Other cultigens, such as *kō* (sugar cane, *Saccharum officinaruma*) and *mai'a* (banana, *Musa* sp.), were also grown and, where appropriate, such crops as *'uala* (sweet potato, *Ipomoea batatas*) were produced. This was the traditional agricultural pattern seen on all the Hawaiian Islands (Kirch and Sahlins 1992, Vol. 1:5, 119; Kirch 1985). It must be noted that Handy (1940:105 stated that, ". . . the bounds of cultivation . . . were strictly drawn by limitation of water for irrigation." The word "*kula*" meant "open country, or plain", according to Handy and Handy, and was often used to differentiate between dry, or *kula* land, and wet-taro land. The height and size of Haleakalā to the east,

prevents moisture from reaching its southern and western flanks, causing and desert-like conditions throughout the region (Handy and Handy 1972:510). Handy and Handy (1972:510) further state:

> This is an essential characteristic of Kula, the central plain of Maui which is practically devoid of streams. Kula was always an arid region, throughout its long, low seashore, vast stony *kula* lands, and broad uplands.

As to the occupation of this vast plain, Handy and Handy (1972:511) stated:

> Both on the coast, where fishing was good, and on the lower westward slopes of Haleakala a considerable population existed. So far as we could learn Kula supported no Hawaiian taro, and the fishermen in this section must have depended for vegetable food mainly on *poi* brought from the wet lands of Waikapu and Wailuku to westward across the plain to supplement their usual sweet-potato diet.

An early witness to its lack of productivity was George Vancouver. During his second visit to Hawaiʻi in 1793 as a Captain, Vancouver anchored in Māʻalaea Bay, which he describes as follows (Vancouver 1984:852):

> The appearance of this side of Mowee was scarcely less forbidding than that of its southern parts, which we had passed the preceding day. The shores, however, were not so steep and rocky, and were mostly composed of a sandy beach; the land did not rise so very abruptly from the sea towards the mountains, not was its surface so much broken with hills and deep chasms; yet the soil had little appearance of fertility, and no cultivation was to be seen. A few habitations were promiscuously scattered near the water side, and the inhabitants who came off to us, like those seen the day before, had little to dispose of.

Not much had changed 24 years later (1817) when Peter Corney sailed this way, bound for Oʻahu. He made special reference to Keālia Pond (now the Keālia Pond and Wildlife Refuge), a short distance southwest of the project area:

> . . . Next morning we passed Morokenee (Molokini), and made sail up Mackerey (Maalaea) bay. . . This bay is very deep and wide, and nearly divides the island, there being but a narrow neck of land and very low, keeping the two parts of the island together. . . On this neck of land are their principal salt-pans, where they make most excellent salt [Corney 1965:70-71].

To the northwest of the current project area lies ‘Īao Valley, one of the most important locations in the area for prehistoric activity. Connolly (1974:5) states that the pre-Contact valley [‘Īao] had a large population base with “most people residing in a settlement near ‘Īao Needle,” just north of the project area. Supposedly, the subsistence base of this population consisted of fish and taro, with Kahului Harbor and the coast close by and *lo‘i* systems lining ‘Īao Valley’s stream banks. Prehistoric ditches or ‘*auwai* were utilized in taro cultivation (Connolly 1974:5). Sterling (1998:86) adds that two ‘*auwai* within the valley:

> …have existed immemorially and were evidently constructed for the purpose of irrigating kalo on the plains which stretch away to the northward and southward of the [‘Īao] river. Several minor ‘auwai have, since ancient times, tapped the river at different points lower down and spread the water through the lands in the gulch on either side of the river bed.

Handy in Sterling (1998:63) further notes that “…[f]rom Waihee and Wailuku Valley, in ancient times, was the largest continuous area of wet taro cultivation in the islands." Cheever (1851:124) writes: "the whole valley of Wailuku, cultivated terrace after terrace, gleaming with running waters and standing pools, is a spectacle of uncommon beauty to one that has a position a little above it."

Recent archaeological research (Fredericksen and Fredericksen 1996:52) has revealed that habitation sites along what is now Lower Main Street in Wailuku “are associated with the rich taro producing lands in the Lower ‘Īao River flood plain, and the extensive cultivation systems present in ‘Īao Valley." These habitation sites have been dated to the A.D. 15th through 17th centuries. The ‘Īao Valley area was not only renowned for its agricultural base during prehistoric times but its ceremonial and political base as well (see also Cordy 1996; Donham 1996).

No discussion of Wailuku District is complete without mentioning the important *heiau* complex above ‘Īao Valley near its seaward terminus. During the mid to late 18th century, the Halekii-Pihana *heiau* complex was supposedly designed by a Hawaiian named Kiha (Sterling 1998:89). These monuments, designated as State Site 50-50-04-522 and occurring along the northwest flank of the current project area, are described as very important *heiau* within Hawaiian history. Yent (1983:7) notes the life cycle of the *ali‘i* was represented here. It was the place where Kamehameha I’s wife (Keōpuolani) was born, Kahekili lived, and Kekaulike died. Thrum (1909:46) reported that Kamehameha I evoked his war god at Pihana Heiau after his

warriors defeated Kalanikupuli's forces during the Battle of ʻĪao in 1790. The two *heiau* are primarily associated with Kahekili, who is connected with the Halekii-Pihana complex between c. A.D. 1765 and 1790, and Kamehameha, during his conquering of Maui in 1792 (Yent 1983:18). As stated, the area within and adjacent to the current project is known not only for its religious and/or ceremonial significance, but for its political prominence as well.

PRE-CONTACT PERIOD (PRE-1778)

According to Kamakau (cited in 1870 in Sterling 1998: 2), "...the ancient name of the island of Maui was Ihikapalaumaewa..." The island was renamed "...after a famous child of Wakea and Papa who became ancestor of the people of Maui" (cited in 1870 in Sterling 1998: 2). By the end of the 18th century, Fredericksen and Fredericksen (1992:52) state that politically, Wailuku [village] was known as a central settlement for high-ranking chiefs and their retinue. Kahekili, chief of Maui, resided with his entourage in Wailuku.

In 1837, the village of Kahului consisted of twenty-six *pili*-grass houses living close to the sea and depending on fishing in the coastal waters for the majority of their food (Bartholomew and Bailey 1994). Kahului is also famous for the twin fishponds Kanahā and Mauoni where mullet was still harvested in the early 1900s (Bartholomew and Bailey 1994). According to Mrs. Rosalie Blaisdell (in Stokes cited in Sterling 1998:87-88):

> The construction of the ponds was initiated by Kapiiohookalani, the ruling *aliʻi* of the islands of Oʻahu and half of Molokaʻi, using men from Oʻahu, Maui, and Molokaʻi to construct the ponds. According to legend, the line of workers extended from Makawela to Kanahā with the men standing so close together they were able to pass the boulders used in the construction of the fishpond walls from hand to hand. Before the construction of the ponds had been completed, Kapiiohookalani was killed at the battle of Kawela, Molokaʻi by Alapainui, of Hawaiʻi Island. Kamehamehanui, the ruling *aliʻi* of Maui oversaw the completion of construction of the fishponds. Once the ponds were built, Kamehamehanui placed a *kapu* (taboo) on the *kuapa* (wall) separating the two ponds.
>
> Kapiiohookalani was survived by two children; a young son named Kanahā okalani and a daughter named Kahamaluihiikeaoihilani. According to legend, Kahamaluihiikeaoihilani was of such high status, she was able to break Kamehamehanui's *kapu* and name the seaward pond Kanahā, in honor of her brother, and the other pond Mauoni, the name she used when traveling incognito.

Of interesting note is that according to Pukui *et al*. (1974:83), the *ali‘i nui* Kiha-a- Pi‘ilani is said to be credited with the construction of Kanahā Fishpond during the 1500s.

WAILUKU AND WAIKAPŪ AHUPUA‘A

Wailuku and Waikapū Ahupua‘a are located in the land division (‘*okana)* which was once known as "Nā Wai Ehā" (The Four Streams). This area is …comprised the four great valleys [Waihe‘e, Waiehu, Wailuku, and Waikapū] which cut far back into the slopes of West Maui and drain the eastward watershed of Pu‘u Kukui and the ridges radiating northeastward, eastward, and southeastward from it" (Handy and Handy 1972:497). This area once was renowned for "…its majesty and splendid living, whose native songs gather flowers in the dew and weave wreaths of ohelo berries" (S.W. Nailiili in Sterling 1998:93).

W. D. Alexander (in Sterling 1998: 63) also states that "…the lands of Waikapu and Wailuku appropriated almost the whole of the isthmus so as to cut off half of the lands in the district of Kula from access to the sea. These two *ahupua‘a*, together with Waiehu and Waihe‘e, which were independent, belonging to no Moku, were called Na Poko, and have been formed into a district in modern times."

"Much of the upper section of what is now the city of Wailuku is built on old terrace sites" (Handy and Handy 1972:407) and Waikapū once was the setting of vast wet-land taro fields. Evidence of the widespread *lo‘i* planting is provided by the Land Commission Awards, which indicate there once were more than 1,300 wet-land taro patches extending along the boundaries of Waikapū Stream (Creed 1993). Handy and Handy (1972: 497) describe the general Waikapū area as follows:

> Spreading north and south from the base of Waikapu to a considerable distance below the below the valley are the vestiges of extensive wet-taro plantings, now almost obliterated by sugar-cane cultivation; a few here and there are preserved in plantation camps and under house and garden sites along the roads. Among these gardens there were, in 1934, a few patches of Japanese taro. Far on the north side, just above the main road and at least half a mile below the entrance to the canyon, an extensive truck garden on old terrace ground showed the large area and the distance below and away from the valley that was anciently developed in terraced taro culture. On the south side there are likewise several sizable kuleana where in 1934 old terraces were used for truck gardening. In the largest of these a few old patches were flooded and planted with Hawaiian wet taro. Several terraces were used as ponds planted with lotus for their edible seed. There were probably once a few small terraces on the narrow of valley bottom in the lower canyon.

WAHI PANA (LEGENDARY PLACES)

"Wahi Pana" can be defined as celebrated or noted places or locations (Pukui and Elbert 1986:313, 376), and refers to legendary places or landmarks of historical significance. These places of note have distinctive features (*i.e*., mountain peaks, streams, wind, rain, etc.) that are given specific names through which the history of an area is passed down from generation to generation through chants, legends, and songs.

WAILUKU AHUPUA'A

A famous chant from the Rebecca Nuuhiwa Audio collection (in Sterling 1998:62), called The Four Winds, is associated with Wailuku:

> Wailuku's wind is the Makani-lawe-mailie, the wind that takes it easy.
> Waiehu's wind is the Makani-hoo'eha-ili, the wind that hurts the skin.
> Waikapu's wind is the Makani-ko-kololio, the gusty wind.
> Waihee's wind is the Makani-kili-'o'pu.

According to Fornander (in Sterling 1998"63), "Wailuku is the source of the flying clouds. It is the broad plain where councils are held".

"Wailuku" translated literally means "water of destruction" (Pukui *et al*. 1974:225) and the Wailuku area was witness to many battles, from the Battles of 'Īao and Sand Hills to the Battles of Kepaniwai and Kakanilua. The most famous battle was that of Kepaniwai where Kamehameha I, in July 1790, finally wrested control of Maui Island. Kamehameha I and his warriors landed at the Kawela portion of Kahului Bay and proceeded up 'Īao and other valleys to score a decisive victory. Of additional note is that in the Kauahea area of 'Īao Valley (southeast of 'Īao Stream below Pihana Heiau), warriors apparently dwelt and were "trained in war skills and there was a boxing site in the time of Kahekili" (Sterling 1998:89).

In his bid to conquer Kahekili and obtain Maui (A.D.1776), Kalani'opu'u brought his famous, and fearless, 'Ālapa warriors who were slaughtered by Kahekili's men. "The dead lay in heaps strewn like *kukui* branches; corpses lay heaped in death; they were slain like fish enclosed in a net…" (Kamakau 1991:85-89).

An interesting anecdote is recounted by George W. Bates (1854:309), during his journey from Wailuku to Kahului in 1854:

> Leaving Wai-lu-ku [town], and passing along toward the village Kahului, a distance of three miles, the traveler passes over the old battle-ground named after the village. It is distinctly marked by moving sand-hills, which owe their formation to the action of the northeast trades. Here these winds blow almost with the violence of a sirocco, and clouds of sand are carried across the northern side of the isthmus to a height of several hundred feet. These sand-hills constitute a huge "Golgotha" for thousands of warriors who fell in ancient battles. In places laid bare by the action of the winds, there were human skeletons projecting, as if in the act of struggling for resurrection from their lurid sepulchers. In many portions of the plain who cart-loads were exposed in this way. Judging of the numbers of the dead, the contest of the old Hawaiians must have been exceedingly bloody. . . .

G.W. Bates' (1854) interpretation of a major battleground site in Kahului may not have been accurate, although there are many oral traditions about battles in this general area.

The 1776 encounter between Kahekili and Kalani'ōpu'ū resulted in a temporary truce which was broken in 1790 by the battle of Kepaniwai, when Kamehameha I consolidated his control over Maui Island. There were so many warriors and canoes invading from Hawai'i Island that it was called the Great Fleet. During Kamehameha's campaign, it was recorded ((Kamakau 1991: 148) that the bay from Kahului to Hopukoa was filled with war canoes and they extended to Kalae'ili'ili at Waihe'e and below Pu'uhele and Kamakailima:

> . . . Kamehameha and his chiefs went on to the principal encounter at Wailuku. The bay from Kahului to Hopukoa was filled with war canoes. For two days there was constant fighting in which many of the most skillful warriors of Maui took part, but Kamehameha brought up the cannon, Lopaka, with men to haul it and the white men, John Young and Isaac Davis, to handle it; and there was great slaughter..

From Kahului, Kamehameha marched on to Wailuku Village where Kalanikupule, Kahekili's son, waited with his warriors.

WAIKAPŪ AHUPUA'A

According to several accounts (Handy and Handy 1972:497, Sterling 1998:93-94, and Pukui *et al*. 1976:223, the name "Waikapū" (Water of the Conch) refers to an ancient cave in the area where a famous conch shell (*pū*) was hidden until it was stolen by Puapua-lenalena (a supernatural dog). Sterling (1998:93) offers two alternative origins of the name "Waikapū." In one account, the area known as "Nā Wai Ehā" was renowned for the battles fought there; the name Waikapū (the water where the conch was blown) referred to a conch shell that was blown

to announce the commencement of a battle (C. W. Stoddard 1894 in Sterling 1998). In another account (H. T Cheever 1851 in Sterling 1998:63), "Waikapū" (Forbidden Water) refers to the time Kamehameha I, the Conqueror, beached his canoes at Kalepolepo and placed a *kapu* (taboo, restriction) on the nearest stream (Stoddard in Sterling 1998:63). Although Waikapū Stream is not the closest stream to Kalepolepo, it does drain into Keālia Pond, and it may have been the closest stream with flowing water at the time of Kamehameha's landing (Sterling 1998:63).

On a cliff above the stream and opposite the cave was a dog named Puapualenalena who had also heard the conch and was searching for it. However, those that guarded the conch were very attentive and so far, the dog had not located it.

> The owners of the conch did not believe, perhaps, that any supernatural being would succeed in taking it away, so they tried to be a little careless. It was not taken, but on the day that Pualenalena did get it away, they had been utterly careless. After he took it, it sounded no more to this day. It used to be heard everywhere in these islands and was annoying to some people. From this conch, the whole of the place was named Waikapū (Water of the conch). This is the legend of how it received its name and is a place much visited by strangers who wish to see it [W. K. Kaualililehua, *Ka Nupepa Kuokoa,* Sept 21, 1872].

Oral traditions preserved by Fornander (1969) and Kamakau (1963) contribute to our knowledge of Waikapū. The battle of Ahulau ka piipii i Kakanilua featuring the elite ʻĀlapa warriors of Kalaniopuʻu was fought in 1776 on the sand hills southeast of Wailuku:

> …Taking part of his forces around by water, *Kalaniopuu* landed again at Kiheipukoa, near the Kealia or salt marsh between Kalepolepo and Māʻalaea…The detachment or regiment known as the *Alapa*, mustering eight hundred men, was selected for this hazardous expedition, and with high courage they started across the isthmus of Kamaomao, now known as the Waikapu common, determined, as the legend says, "to drink the waters of the Wailuku that day." This regiment was considered the bravest and best of *Kalaniopuu's* army, every man in its ranks being a member of "*la haute noblesse*" of Hawaii. They are said to have all been of equal stature and their spears of equal length; and the legend represents their appearance-with their feather cloaks-reflecting the sunshine and the plumes of their helmets tossing in the wind-as a gorgeous and magnificent spectacle…Offering no resistance to the enemy while crossing the common, *Kahekili* distributed his forces in various directions on the Wailuku side of the common, and fell upon the Hawaii *corps dʻarnée* as it was entering among the sandhills south-east of Kalua, near Wailuku. After one of the most sanguinary battles recorded in Hawaiian legends and deeds of valor …the gallant and devoted Alapa were literally annihilated; only two out of the eight hundred escaped alive to tell Kalaniopuu of this Hawaiian Balaclava…[Fornander 1969:153].

In a similar version, Kamakau (1963:65–86) recounts:

> …The Alapa were led by Inaina, Kuaʻana, Kane-haʻi-lua, and Keawe-hano. There were 800 of them, all expert spear-point breakers, every one of whose spears went straight to the mark, like arrows shot from a bow, to drink the blood of a victim. Across the plains of Puʻuʻainako and Kamaʻomaʻo shone the feather cloaks of the soldiers, woven in the ancient pattern and colored like the hues of the rainbow in red, yellow, and green, with helmets on their heads whose arcs shone like a night in summer when the crescent lies within the moon…Said Ka-leo-puʻupuʻu to Kahekili, "the fish have entered the sluice; draw in the net." Like a dark cloud hovering over the Alapa, rose the destroying host of Ka-hekili seaward of the sandhills of Kahaluʻu, the "smoke head" (*poʻouahi*) and the "red coconut" (*niuʻula*) divisions. They slew the Alapa on the sandhills at the southeast of Kalua. There the dead lay in heaps strewn like *kukui* branches; the corpses lay heaped in death; they were slain like fish enclosed in a net. This great slaughter was called *Ahulau ka Piʻipiʻi Kakanilua.*

Although it has been said that Waikapū Valley contained "many temples and sites", most of their locations were not recorded (Ashdown 1970:58). Thrum (1917) refers to a *heiau* that was reportedly located on Puʻu Hele, but he did not confirm this. Thrum (1917) also mentions two *heiau* located below the road but again, they were not investigated and their name and function had been lost (1916). One *moʻolelo* recounting the origin of its name was published in *Ka Nupepa Kuokoa* in 1872:

> The Wai-Ka-pū now being discussed was named by some of the ancients and it remains by this name to this day. This place, Waikapu, has a cave away up the stream, about a mile or more from the village. On the left side of the stream is a cave and in the cave was the conch. It sounded all the time, unseen by the public, but a prophet of Kauai listened for it and came to seek with the idea of finding it…

According to Manu Moses (in Sterling 1998:94), there is a legend associated with the *aliʻi* Kihapiʻilani that refers to an "adze rock" which marked the boundary between Wailuku and Waikapū Ahupuaʻa:

> As Kihapiilani and his wife traveled on, they saw many people filling the road. At the stream of Wailuku (Waikapu?) the people were innumerable. Said the wife to the chief, "What are the people doing who are congesting the road? Kihapiilani said, "It would seem it has something to do with adzes.
>
> When they arrived at this place, they decided to go from the place where it was so crowded with people. There was a huge rock directly above the stream of

> Waikapu, mauka of the road which still passes at this time. This adze rock is the boundary between Wailuku and Waikapū Ahupuaa and it remains there to this day.

THE MĀHELE

Once Article IV of the Board of Commissioners to Quiet Land Titles was passed in December 1845, the legal process of private land ownership was begun. The land division, called the Māhele, began in 1848. As stated above, the lands of the kingdom of Hawai‘i were divided among the king (crown lands), the *ali‘i* and *konohiki*, and the government.

In the 1840s, traditional land tenure shifted drastically with the introduction of private land ownership based on western law. While it is a complex issue, many scholars believe that in order to protect Hawaiian sovereignty from foreign powers, Kauikeaouli (Kamehameha III) was forced to establish laws changing the traditional Hawaiian economy to that of a market economy (Kame‘eleihiwa 1992:169-70, 176; Kelly 1983:45, 1998:4; Daws 1962:111; Kuykendall 1938 Vol. I:145). The Māhele of 1848 divided Hawaiian lands between the king, the chiefs, the government, and began the process of private ownership of lands. The subsequently awarded parcels were called Land Commission Awards (LCAs). Once lands were made available and private ownership was instituted, the *maka‘āinana* (commoners) were able to claim the plots on which they had been cultivating and living. These claims did not include any previously cultivated but presently fallow land, *‘okipū* (on O‘ahu), stream fisheries, or many other resources necessary for traditional survival (Kelly 1983; Kame‘eleihiwa 1992:295; Kirch and Sahlins 1992). If occupation could be established through the testimony of two witnesses, the petitioners were awarded the claimed LCA and issued a Royal Patent after which they could take possession of the property (Chinen 1961:16). If occupation could be established through the testimony of witnesses, the petitioners were issued a Royal Patent number and could then take possession of the property.

During the Māhele, Wailuku District was declared Crown Land and numerous Land Commission Awards, approximately 180, were awarded within Wailuku Ahupua‘a while approximately 100 were awarded for Waikapū Ahupua‘a (Creed 1993). A handful of foreigners (*i.e.*, Anthony Catalena, James Louzada, E. Bailey) gained control of large parcels of lands that would later be used for mass cultivation of sugar. Significantly, the majority of LCAs were awarded to Hawaiians, a gauge that can be used to measure pre-Contact settlement (Creed 1993:38). In Waikapū, the LCAs reflect *lo‘i* cultivation, *kula* lands, and house sites. These keep with the overall LCA pattern of the Waikapū-Wailuku area intimating taro cultivation in

association with permanent residences. Such a pattern is historically documented from 1848, but likely extended deeper into the past.

According to R.D. King (in J.W. Coulter cited in Sterling 1998:3) "[t]he large ahupuaas of Wailuku and Waikapu…belonged to no district, and at the time of the Mahele were said to be Na Poko, Na Poko in this case meaning a smaller division of the island." As Waikapū Ahupuaʻa belonged to the government, it was overseen by the Department of Education (Sterling 19978:95). According to Sterling (1998:95):

> In 1875 the Board of Education sold at auction the "Land known as the Ahupuaa of Waikapu, saving grants hitherto made within said ahupuaa, or sales by the Board of Education," to Henry Cornwell, the Government issuing a royal patent to the above terms without survey or statement of area. Mr. Cornwall afterward sold to Claus Spreckels and others the part known as Waikapu Commons.

LAND COMMISSION AWARDS (LCAS)

A search of the Waihona ʻAina Database (2017) indicated 278 LCAs were claimed in Wailuku Ahupuaʻa. However, none of these are located within the proposed project area.

The Waihona ʻAina Database (2017) listed 138 claimed LCAs in Waikapū Ahupuaʻa. The Office of Hawaiian Affairs Kipuka Database (2017) described LCA 71 (Royal Patent 4549) as consisting of 303.5 acres, which included the land now comprising the proposed project area. According to both the Waihona ʻAina Database (2017) and the Office of Hawaiian Affairs Kipuka Database, LCA 71 (Royal Patent 4549) was awarded to M.I. Nowlein (Nowlien) who was also known as Michael J .Nowlein, in 1863.

LAND GRANTS

A search of the Waihona ʻAina Database (2017) indicated a total of two land grants were purchased in Wailuku Ahupuaʻa. The Office of Hawaiian Affairs Kipuka Database (2017) indicates one of these, Land Grant 3343, was located within the current area of interest. In 1882, Claus Spreckels purchased 24,000 acres of land for the commercial cultivation of sugar cane (Waihona ʻAina Database 2017). Land Grant records, including Land Grant 3343) are presented in Appendix D. By contrast, a total of eighty-one land grants were purchased in Waikapū Ahupuaʻa. Please note that the referenced databases refer to the lands of LCA 71 (Royal Patent 4549) and Land Grant 3343 as being located in both Wailuku and Waikapū Ahupuaʻa.

HISTORIC PERIOD (POST-1778)

As the sugar industry developed in the mid-1800s, more and more land was leased or purchased for what had become an intensely profitable endeavor. Water was an issue, but in 1876, the Hamakua Ditch Company (Alexander and Baldwin) was formed and within two years was bringing water from the streams of Haleakalā to four plantations in East Maui (Dorrance and Morgan 2000).

Also in 1876, the Reciprocity Treaty's ratification notice arrived by steamer, along with Claus Spreckles, California's sugar magnate, who viewed the sugar situation and decided two years later to turn the dry plains of Maui into a garden of cultivated cane (Van Dyke 2008). By various questionable means, he was able to acquire half interest in 16,000 acres of land in Waikapū commons and was able to lease 24,000 acres of Crown Lands on the Wailuku plains in central Maui for $1,000 (Van Dyke 2008).

Having seen the success of the recently completed Hamakua Ditch now bringing mountain water to the otherwise dry, and unproductive East Maui fields, and having lost his battle to control this ditch water, Spreckles formed the Hawaiian Commercial Company and decided to construct a ditch system of his own on East Maui above the Hamakua Ditch, for his newly acquired land (Wilcox 1996). Spreckles' Haiku Ditch extended 30 miles, from Honomanū Stream to the Kīhei boundary and the water was used to irrigate his cane lands in the central Maui plains (*ibid.*).

In 1882, Spreckles reorganized his company into a California corporation, called Hawaiian Commercial and Sugar Company, or HC&S (Wilcox 1996). Later he constructed another water system known as the Waihee Ditch in West Maui. It brought water from 15 miles away, starting at an elevation of 435 feet, to Kalua where it emptied into HC&S Waiale Reservoir (*ibid.*).

The ensuing years brought trials and tribulations between Spreckles, his associates, and the Maui sugar planters, resulting finally in the 1898 sale of his HC&S stock, at an all-time low, to James Castle in partnership with Alexander and Baldwin, and the departure of Claus Spreckles from Hawai'i (Dorrance and Morgan 2000; Wilcox 1996).

Thomas Hogan built the first western building, a warehouse, near the shoreline of Kahului in 1863 (Clark 1980). The dredging of Kahului harbor through the years filled in large sections of the ponds, eventually blocking the outlet to the sea.

As the sugar industry developed, Kahului became a cluster of warehouses, stores, wheelwright, and blacksmith shops close to the harbor. A small landing was constructed in 1879 to serve the sugar company (Clark 1980). In the late 1800s, Kahului possessed a new custom house, a saloon, Chinese restaurants, a railroad and a small population of residents. Kahului's main focus was shipping. The 1900 bubonic plague outbreak destroyed much of the town as officials decided to burn down the Chinatown area in an effort to contain the epidemic. The Chinese, Japanese and Hawaiian residents were displaced by this action. To further ensure isolation, authorities encircled the entire town with corrugated iron rat-proof fences which ended the spread of the plague (Bartholomew and Bailey 1994). The Kahului Railroad Company built a 1,800 foot long rubble-mound breakwater in 1910 and dredging of the harbor now allowed ships with a 25-foot draft to dock at the new 200-foot wharf (Clark 1980).

Henry Baldwin and Lorrin Thurston formed the Kihei Sugar Company in 1899, to grow cane on their ranch lands in south central Maui, which included the project area (Dorrance and Morgan 2000). It was sent to the mill at Puʻunēnē to be ground, but, although production was high, it was not enough to cover the costs (Dorrance and Morgan 2000) .

After the annexation in 1898, some of the planters on Maui, including Alexander and Baldwin, had decided to combine plantations to reap maximum profit. They formed the Maui Agricultural Company, a co-partnership that initially encompassed seven plantations and two mills. In 1904, five new plantations became part of the Maui Agricultural Company, as Kula Plantation Company, Makawao Plantation Company, Pulehu Plantation Company, Kailua Plantation and Kalianui Plantation Company were newly formed by carving up the unprofitable Kihei Plantation land (Dorrance and Morgan 2000). Maui Agricultural Company merged with HC&S in 1948 (Dorrance and Morgan 2000).

Land use in Wailuku and Waikapū Ahupuaʻa in the mid-19th and early 20th century was largely devoted to the sugar industry. During the 1860s, the sugar business was growing, with plantations and mills at Wailuku, Waiheʻe, Waikapū, and Haʻikū. Many of the plantation camps associated with these mills were centered in the Puʻunēnē, Kahului, and Wailuku area (see Denham *et al.* 1992:16). Hopoi Camp is said to have been located near Hopoi Reservoir. Hopoi Reservoir was constructed by at least by 1922, when references to Hopoi Camp occurred on an area map. Historic utilization of the Waikapū-Wailuku landscape near the project area focused on industrial-levels of cultivating sugar cane and pineapple. Water was channeled from traditional sources (*e.g.*, Waikapū Stream, western aquifers or springs) through plantation lands. Both local and imported workers operated on these plantation lands and the area maintained fair

population density. These former sugar cane and pineapple lands are now being reclaimed through residential developments and industrial baseyards.

PREVIOUS ARCHAEOLOGY

Archaeological studies in the greater area began in the early 20th Century by T. Thrum (1909), J. Stokes (1909–1916), and W. M. Walker (1931), under the auspice of the Bernice Pauahi Bishop Museum. These studies are briefly discussed below and the project locations are presented in Figure 5.

Thrum (1909-1918:59) mentions that two *heiau* may have possibly existed within the *ahupua'a* of Waikapū, but evidence of the two sites no longer remains. A group of approximately 45 house and shelter sites (State Sites 50-50-09-1441, the McGregor Point C-shaped structures, and State Site 50-50-09-1287, the Mā'alaea Complex) was identified by Walker (1931) to the west of Mā'alaea. Chronology for these sites has yet to be determined (Creed 1993). Walker (1931:58) also described a *koa*, or fishing shrine, and two petroglyph fields with an associated *heiau* (State Sites 50-50-09-1169 and -1199) at Mā'alaea. The *koa* was not assigned a State Site number, nor has it been relocated.

The Bishop Museum (Rotunno-Hazuka *et al*. 1995) conducted excavations at the Maui Lani Development Property identified State Site 50-50-04-2797, multiple traditional pre-Contact native Hawaiian burials.

Pantaleo and Sinoto (1996) conducted archaeological subsurface sampling at the Maui Lani Development. Findings included one concentration of multiple burials and isolated individual burials located at the tip of the dune (in the highest elevational locations). A more contemporary report documenting additional burial finds at Maui Lani should aid in clarifying the overall results of that project and bolster the number of burials and significant finds during the project.

Archaeological Surveys Hawaii LLC (Guerriero 2004) conducted an Archaeological Inventory Surveyof a 50-acre parcel of land in Wailuku and Waikapū ahupua'a, Wailuku District, Maui Island, Hawai'i [TMK: (2) 3-5-002:por. 001], located adjacent and south of the proposed project area. During the survey, State Site 50-50-04-5474, Kama Ditch, was

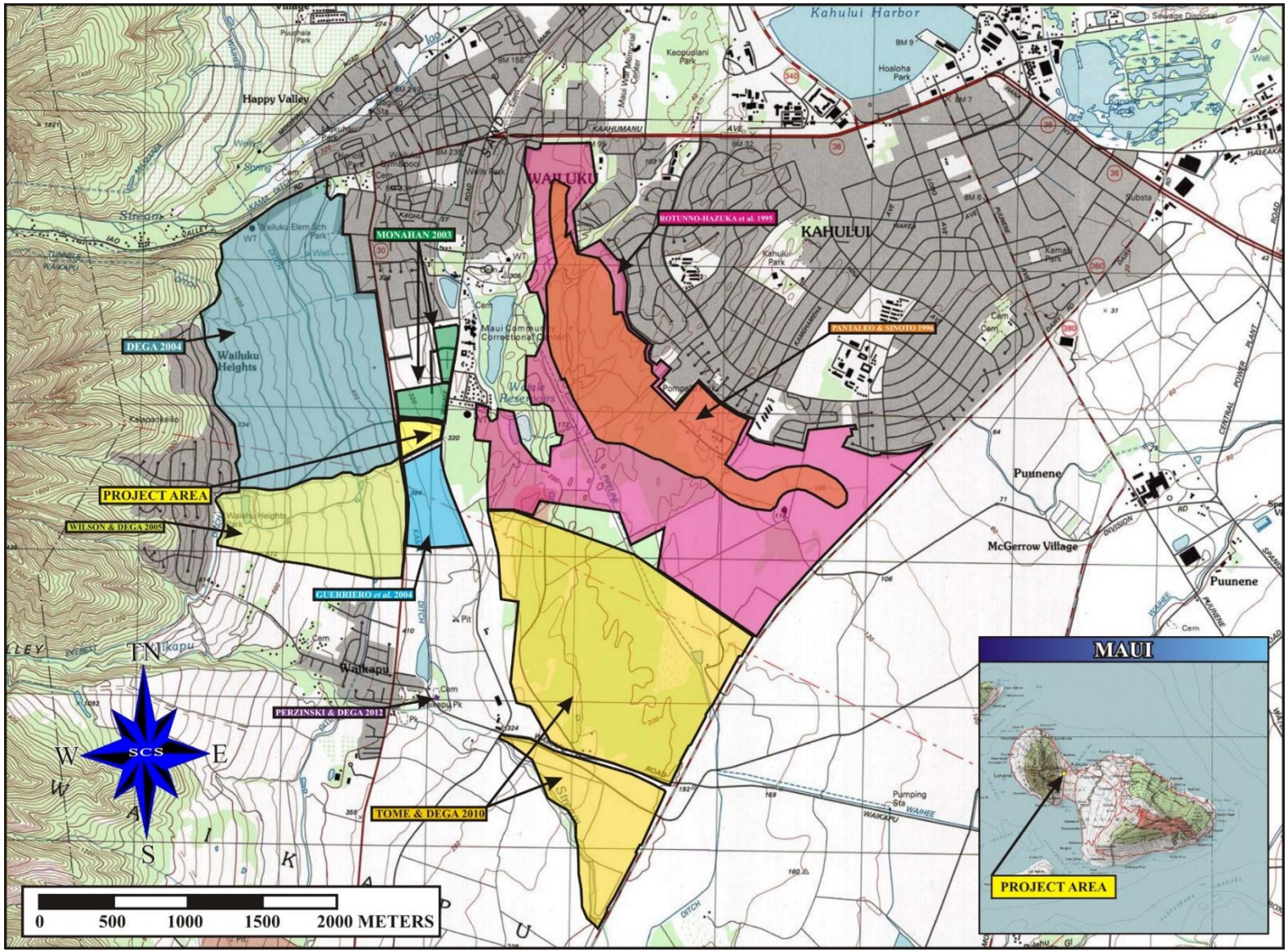

Figure 5: USGS (Wailuku, HI 1997; 1:24,000) Quadrangle Map Showing Previous Archaeological Studies in the Vicinity of the Proposed Project Area.

documented. Kama Ditch, constructed around 1905 to 190, provided water to the sugarcane and subsequent pineapple fields. Use of the irrigation ditch was terminated approximately 30 years ago.

Scientific Consultant Services, Inc. (Dega 2003) conducted an Archaeological Inventory Survey of 100 acres located Wailuku Ahupuaʻa, Wailuku District, Maui Island, Hawaiʻi [TMK: (2) 3-5-001:portion of 001], located adjacent and northwest of the proposed project area. Three historic sites were documented during this Inventory Survey: State Site. 50-50-04-5473 Hopoi Reservoir; State Site 50-50-04-5474, Kama Ditch; and State Site 50-50-04-5478, an isolated basalt adze. Subsurface testing yielded negative findings.

Scientific Consultant Services, Inc. (Monahan 2003) conducted an Archaeological Inventory Survey on two undeveloped lots totaling approximately 30 acres in Wailuku Ahupuaʻa, Wailuku District, Maui Island, Hawaiʻi [TMK: (2) 3-5-o01: o61, 063,and 066; formerly 017]. No historic properties were identified.

Scientific Consultant Services, Inc. (Wilson and Dega 2005) conducted an Archaeological Inventory Survey of t 215.800 acres, Waikapū (and partially Wailuku) Ahupuaʻa, Wailuku District, Maui Island, Hawaiʻi [TMK: (2) 3-5-02: 02 and 03], located adjacent and southwest of the proposed project area. Seven historic sites were documented during this Inventory Survey: State Site 50-50-04-5197, Waihee Ditch; State Site 50-50-04-5493, Waikapu Ditch; State Site 50-50-04-5729,a lesser, un-named, rock and mortar ditch;. State Site 50-50-04-5726, a lesser, un-named, earthen ditch/drainage; State Site 50-50-04-5727, a large, un-named reservoir—the terminus of Waikapu Ditch; State Site 50-50-04-5728, a sugar field erosion-control site comprised of 14 cross-slope, earthen berms of varying length that are positioned regularly throughout the project area; and State Site 50-50-04-5730, "Old Waikapu Road", a cane-haul transport, dirt road.

Scientific Consultant Services, Inc. (Tome and Dega 2010) conducted Archaeological Inventory Survey of approximately 607-acres of land in Waiʻale, Wailuku, and Waikapū Ahupuaʻa, Wailuku District Maui [TMK: (2) 3-8-005:23 (por.), 37 and (2) 3-8-007: 71, 101, 102, 104], located southeast of the proposed project area. During the survey previously identified sites were relocated: State Site 50-50-04-3525, burials; State Site 50-50-04-4200, State Site 50-50-04-4201, a terrace; and State Site 50-50-04-4202, several Historic Period sites. State Site 50-50-04-6578, a subsurface firepit/imu was newly identified. Mechanical test excavations yielded negative findings.

Scientific Consultant Services, Inc. (Perzinski and Dega 2012) conducted Archaeological Inventory Survey of 2.0 acres of arid land in Waikapū, Waikapū Ahupuaʻa, Wailuku District, Maui Island, Hawaiʻi [TMK:(2): 3-5-002:015]. Four Historic Period archaeological sites were documented during the Inventory Survey. State Site 50-50-04-6808 represents Waikapu Cemetery. The community cemetery (not a municipal cemetery) contains approximately 75 marked burials and 20 unmarked burials, and was used for interment from 1900 through 1961. State Site r 50-50-04-6809 is a Historic Period cistern associated with a piggery. State Site 50-50-04-6810 represents an Historic Period overflow ditch, long since abandoned. State Site 50-50-04-6811 represents at least two traditional Native Hawaiian burials that have been identified through consultation as occurring *makai* or east of the historic cemetery. One Hawaiian burial is demarcated by a headstone and represents the resting place of Ernest Malai. A second burial, that of Papia Nawa`a, is unmarked and was designated by lineal descendents. Representative subsurface testing yielded negative results.

CONSULTATION

The consultation process is ongoing. Once the consultation process has been completed, SCS will be able to provide a cultural impact summary and assess the potential of impacts to traditional cultural practices or native rights within the proposed project area. In addition, SCS will also be better able assess the potential of specific valued cultural, historical, or natural resources are within the project area; and whether traditional customary native Hawaiian rights are being exercised within the project area.

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APPENDIX A: EXAMPLE LETTER OF INQUIRY

APPENDIX B: EXAMPLE FOLLOW UP LETTER

APPENDIX C: SIGNED INFORMATION RELEASE FORMS

APPENDIX D: LAND COMMISSION AWARD 71 AND LAND GRANT 3343

Document Delivery

Mahele Database Documents

Number: 00071

Claim Number:	**00071**
Claimant:	**Nowlein, M.I. (Nowlien)**
Other claimant:	
Other name:	Nowlein, Michael J.
Island:	**Maui**
District:	**Wailuku**
Ahupuaa:	**Waikapu**
Ili:	**Papakapu, Kapoi**

Apana:	**2**	Awarded:	**1**
Loi:		FR:	75v1, 77v1
Plus:		NR:	
Mala Taro:		FT:	**139v1**
Kula:		NT:	**56v1**
House lot:		RP:	**4549**
Kihapai/Pakanu:		Number of Royal Patents:	**1**
Salt lands:		Koele/Poalima:	**No**
Wauke:		Loko:	**No**
Olona:		Lokoia:	**No**
Noni:		Fishing Rights:	**No**
Hala:		Sea/Shore/Dunes:	**No**
Sweet Potatoes:		Auwai/Ditch:	**No**
Irish Potatoes:		Other Edifice:	**No**
Bananas:		Spring/Well:	**No**
Breadfruit:		Pigpen:	**No**
Coconut:		Road/Path:	**No**
Coffee:		Burial/Graveyard:	**No**
Oranges:		Wall/Fence:	**No**
Bitter Melon/Gourd:		Stream/Muliwai/River:	**No**
Sugar Cane:		Pali:	**No**
Tobacco:		Disease:	**No**

Koa/Kou Trees:		Claimant Died:	**No**
Other Plants:		Other Trees:	
Other Mammals:	**No**	Miscellaneous:	

No. 71, M.I. Nowlein, Claimant, Maui
F.R. 75, 77v1

To the Honorable Land Commissioners, June 8th 1846

I wish to put my claim before the commissioners for a tract of land held by me in the state of Waikapu.

In the month of April 1827 I gave to Kahumanu $18 eighteen dollars in cash, and She gave to me a tract of land called Koii, bounded on one side by Awikiwiki & the Lapahalii; on the other extending the parra on the mountain westward; and to the sand hills on the eastward.
Michael I. Nowlien

[See No. 325, F.R. 182v1, No. 325]

F.R. 139v1
Claim No. 71, Nowlien

See evidence of Kaweka

F.T. 139v1
Claim No. 71, I. Nowlien

See evidence of Kaweka [note: Register Page 75]

N.T. 56v1
No. 71, Kimo M. I. Nowlien [Nowlein], Lahaina, December 21, 1846

Kaweka's sworn testimony:

Kimo asked Kaahumanu for a piece of property at Waikapu. She consented to his request but because she did not want people to know that she had land, she directed me to give approval and to grant a piece of property, so I asked Napuupahoehoe, "You, give a piece of property for the haole, Kimo. Our chief has asked us to do this and I have consented." Kimo gave me the money which I took and found the chief at Kamakapelapela's place. I gave him, to Keahonui, a part of the money. Then he asked how much it had cost. Eight dollars was received from Kimo and he wanted to know who owned the document.

This document is not mine, I have not made any contacts or agreements because I have had problems in the past months.

Question: Was there any other people who had heard this?
Answer: Other foreign women only.

That was the end.

[Award 71; R.P. 4529B & R.P. 4549; Papakapu Waikapu; 1 ap.; 303.5 Acs; Kapoi Waikapu; 2 Acs]

Land Grants Documents

Grant Number(LG)	**03343**	Source Book:	**15**
Grantee:	**Spreckles, Claus**	Acreage::	**24000** Acs
Ahupua`a	**Wailuku**	Year	**1882**
District:	**Wailuku**	Cancelled	**False**
Island	**Maui**	TMK	

Miscellaneous

No. 3343, Spreckles, Claus, Wailuku Ahupuaa, District of Wailuku, Island of Maui, Vol. 15, pps. 417-419
[LG Reel 5, 01055-01057]

No. 3343
ROYAL PATENT

(GRANT)

Kalakaua, By the Grace of God, King of the Hawaiian Islands, by this His Royal Patent, makes known unto all men, that he hath, for himself, his heirs and successors, this day granted and given unto Claus Spreckles, under and w[?] of the provisions of an Act of the Legislative Assembly of the of the Hawaiian Islands, approved on the 21st day of July 1882 entitled An Act to authorize the Commission of Crown Lands to [give up?] certain portions of such lands to Claus Spreckles in dis…[disputes?] of ~~for the consideration of~~ all claims he may have on such lands, ~~paid into the Royal Exchequer~~, all that piece of Land situate ~~at~~ in Wailuku, and known as the Ahupuaa of Wailuku with the Ilis therein or thereunto belonging and described as follows:

Beginning at a red wood post and pile of stones on the sea shore and adjoining the land of Hamakuapoko at the place called Kapukaahea from which post the Government survey station of Puunene bears South 8° 15’ West true and running
South 9° 59’ East true 1062 feet along Hamakuapoko to Keonekupoo
South 41° 7’ East true 3013 feet along Hamakuapoko to pile of stones, at Nukukahawai
South 22° 3’ East true 934 feet to a large rock called Olopua, which forms the corner of Wailuku, Haliimaile and Hamakuapoko. Thence
South 26° 40’ East true (South 35 1/2° East magnetic)1304 feet along Haliimaile to Puupili, Thence
South 21° 17’ East true (South 30 East magnetic) 1610 feet along the ravine to marked rock called Kaiokukukini[?] about 170 feet South of the road to Kahului, thence
South 17° 4’ East true (South 25 3/4 East magnetic) 1592 feet to a pile of stones at Kauhiana on West side of ravine, thence
South[?] 32° 18’ East true (South 40 3/4 East magnetic) 1390 feet to a marked rock by the by the path at Pulunali
South 35° 7’ East true (South 42 1/4 East magnetic) 3508 feet to wiliwili tree on West bank of gulch which is the corner of Haliimaile and the district of Kula. Thence
South 36° 27’ West true 5346 feet along Kula,
South 29° 21’ West true 6159[?] feet along Kula,

South 28° 36’ West true 982 feet along Kula to a concrete post marked with a cross at the Northwest corner of Kalialinui and Wailuku, from which the Government survey station on Puu o Koha bears South 38° 25’ East true, thence
South 28° 36’ West true 1376 feet along Kalihiwai to top of a large rock called Puukoae, Thence
South 36° 41’ West true 3050.5 feet along Kalialinui to a granite post at the corner of Kalialinui, Wailuku and Pulehunui. From which the Government survey station on Puu Hele bears South 82° 6’ West true, Thence
North 64° 5’ West true 36030 feet along Pulehunui and Waikapu to Pohakoi a marked rock a short distance West of road to Waikapu, Thence
North 73° 45’ West true (North 85° West magnetic) 53262 feet along Waikapu up ridge
North 82° 30’ West true (South 86° 15’ West magnetic) 11088 feet along Waikapu to stone post on the crest of the ridge known as Kalapaokailio, Thence along up centre of this ridge along Waikapu always following the water shed to the ridge forming the head of Olowalu Valley, Thence following said ridge dividing [Page 418] this from Olowalu Valley, Thence around by the ridge forming the head of Wailuku Valley, to the head of the land of Waihee, thence along the dividing ridge between the Wailuku and the Waihee Valleys to the head of Waiehu, Thence
South 70° 59’ East true 3366 feet along Waiehu down ridge
North 80° 36’ East true 2161.5 feet along same to junction of ridges called Kahoolima [liwa?]
North 63° 36’ East true 6315.5 feet along same
North 85° 6’ East true 3445.3 feet along same to end of ridge, Thence
North 19° 51’ East true 1039.5 feet along same to black rock marked thus ? at edge of gulch, Thence
North 71° 21’ East true 427.7 feet along Waiehu along edge of qulch,
North 16° 51’ East true 569.6 feet along same to point near a large black stone marked ?
North 66° 36’ East true 803.9 feet along same,
North 46° 6’ East true 937.2 feet along Waiehu to stone marked thus ?
North 46° 21’ East true 1029.6 feet along Waiehu
North 49° 36’ East true 1025 feet along Waiehu to stone marked thus ?
North 20° 30’ West true 128 feet along Waiehu
North 22° 15’ East true 244 feet along Waiehu
North 11° 44’ West true 310 feet along Waiehu
North 51° 50’ East true 264 feet along Waiehu
South 44° 30’ East true 753 feet along Waiehu along stone wall
North 73° 00’ East true 674 feet along Waiehu along stone wall to tall stone marked ? From which the above mentioned marked stone ? bears South 70° 21’ West true 1451.6 feet. Thence
South 66° 6’ East true 1617.8 feet crossing the Government road to stone marked ? at sand hills, Thence
North 77° 52’ East true 1589.3 feet along Waiehu across sandy hollow to stone marked ?, Thence
North 65° 45’ East true 1003 feet along Waiehu to a stone marked ? at sea shore. Thence along sea shore to initial point. Subject to all existing leases and tenancies and to the rights of Native tenants.

[Page 419]

Containing 24,000 Acres, more or less; excepting and reserving to the Hawaiian Government, all mineral or metallic mines of every description.

To have and to hold the above granted Land in Fee Simple, unto the said Claus Spreckles, his Heirs and Assigns forever

Witness Ourself at Honolulu this 30th day of September 1882, in the Ninth year of Our Reign.

BY THE KING, Signed, Kalakaua Rex
The Minister of the Interior,
Signed, Jno E. Bush

[Land Patent Grant No. 3343, Spreckles, Claus, Wailuku Ahupuaa, District of Wailuku, Island of Maui, 24,000 Acres, 1882]