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AUG 23 2021

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IN REPLY REFER TO:

HWY-PA 2.6337

**STATE OF HAWAII**
**DEPARTMENT OF TRANSPORTATION**
869 PUNCHBOWL STREET
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August 13, 2021

SUBMIT ONLINE: https://health.hawaii.gov/oeqc/submittal-form/

TO: MARY ALICE EVANS
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ENVIRONMENTAL REVIEW PROGRAM
OFFICE OF PLANNING AND SUSTAINABLE DEVELOPMENT
DEPARTMENT OF BUSINESS, ECONIMIC DEVELOPMENT AND TOURISM

FROM: JADE T. BUTAY
DIRECTOR OF TRANSPORTATION

SUBJECT: DRAFT ENVIRONMENTAL ASSESSMENT AND
ANTICIPATED FINDING OF NO SIGNIFICANT IMPACT FOR
KAMEHAMEHA HIGHWAY PEDESTRIAN SAFETY PROJECT
VICINITY OF LANIAKEA BEACH
HALEIWA, ISLAND OF OAHU, HAWAII

With this letter, the State of Hawaii, Department of Transportation transmits the Draft Environmental Assessment and Anticipated Finding of No Significant Impact for the proposed Kamehameha Highway Pedestrian Safety Project, Vicinity of Laniakea Beach situated in the vicinity of Haleiwa, on the island of Oahu for publication in the next available edition of The Environmental Notice.

If you have any questions, please contact Brian Tyau, Project Manager, Highways Division, Planning Branch at (808) 587-6390 or by email at brian.tyau@hawaii.gov.

22-016

**From:** webmaster@hawaii.gov <webmaster@hawaii.gov>
**Sent:** Friday, August 13, 2021 1:19 PM
**To:** HI Office of Environmental Quality Control <HIOfficeofEnvironmentalQ@doh.hawaii.gov>
**Subject:** New online submission for The Environmental Notice

| **Action Name** |
|---|
| Kamehameha Highway Pedestrian Safety Project, Vicinity of Laniakea |
| **Type of Document/Determination** |
| Draft environmental assessment and anticipated finding of no significant impact (DEA-AFNSI) |
| **HRS §343-5(a) Trigger(s)** |
| • (1) Propose the use of state or county lands or the use of state or county funds<br>• (2) Propose any use within any land classified as a conservation district<br>• (3) Propose any use within a shoreline area |
| **Judicial district** |
| Waialua, Oʻahu |
| **Tax Map Key(s) (TMK(s))** |
| Kamehameha Highway (Route 83) right-of-way (ROW);<br>6-1-005: 023 and 024;<br>6-1-009: 004, 021, and 022; and<br>6-1-010:019 and 020. |
| **Action type** |
| Agency |
| **Other required permits and approvals** |
| HRS Chapter 6E-8 Review, Special Management Area Use Permit and Shoreline Setback Variance, National Pollutant Discharge Elimination System for Stormwater Discharges Associated with Construction Activities, Community Noise Permit, Community Noise Variance, Grading, Grubbing, Stockpiling, and Excavation Permit |
| **Proposing/determining agency** |
| State of Hawaii Department of Transportation, Highways Division |
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**Action summary**

The State of Hawaii Department of Transportation, Highways Division (HDOT) is proposing roadway improvements to address pedestrian safety concerns along Kamehameha Highway in the vicinity of Laniakea Beach. Potential conflicts between pedestrians and roadway traffic occur when vehicles park on the mauka side of Kamehameha Highway and then proceed to cross through traffic to access the beach. Pedestrians crossing the highway are usually doing so for the purpose of seeing resting sea turtles. In addition to pedestrian safety, HDOT seeks to address shoreline erosion, congestion, and roadway reliability caused by wave inundation in the project area.
This Draft EA evaluates and discloses environmental impacts associated with four separate conditions: the No Build Alternative, the No Build Settlement Alternative, a Transportation System Management (TSM) Alternative, and a Pedestrian Shift Alternative.

**Reasons supporting determination**

Chapter 5.0 of the Draft EA provides the agency's reasons for supporting the anticipated FONSI.

**Attached documents (signed agency letter & EA/EIS)**

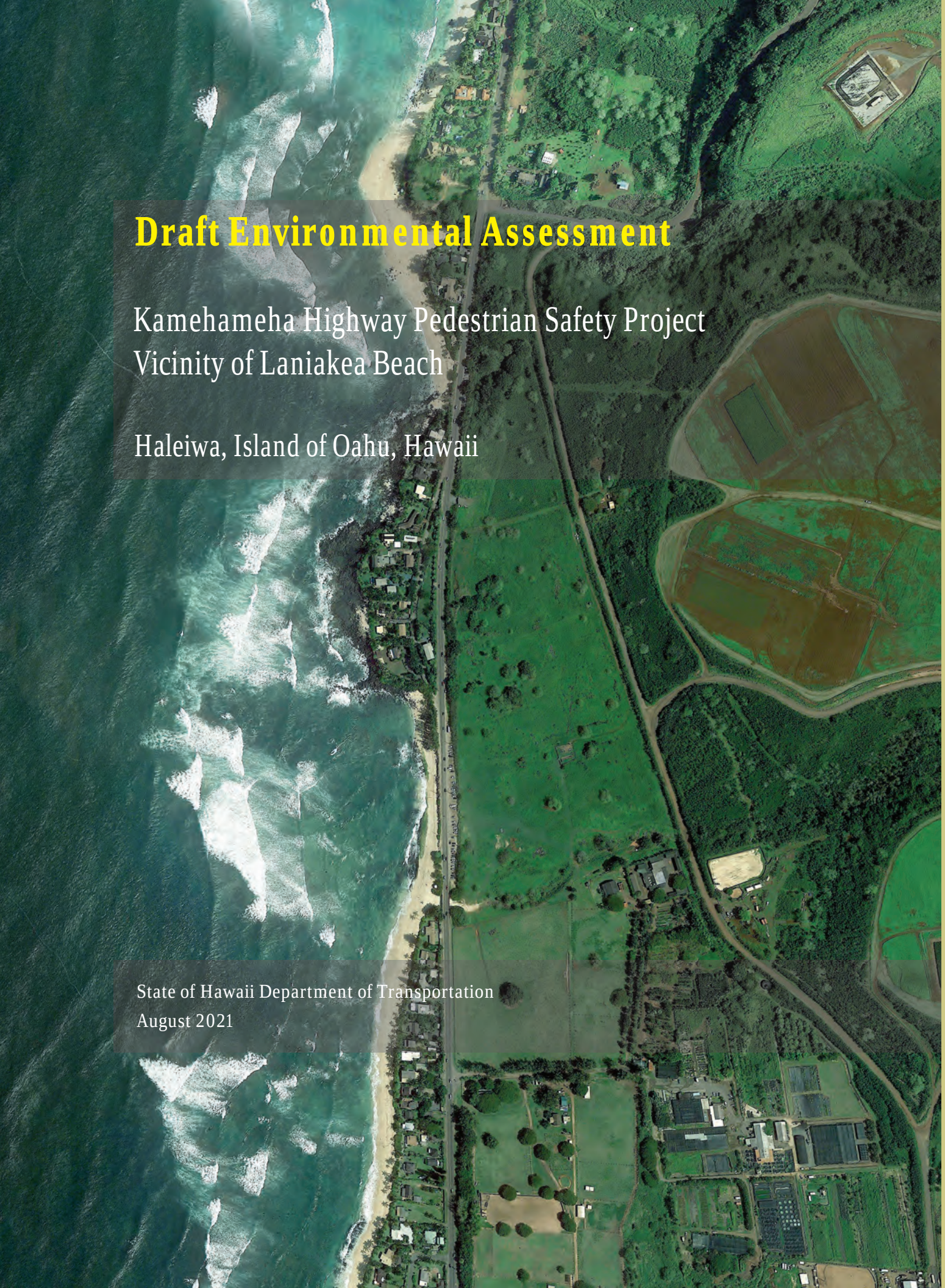
2021-08-13_DraftEA-KamehamehaHwyPedSafety.pdf
- 2021-08-13_DraftEA-KamehamehaHwyPedSafety1.pdf

**Authorized individual**

Rachel Adams

**Authorization**

- The above named authorized individual hereby certifies that he/she has the authority to make this submission.



# Draft Environmental Assessment

## Kamehameha Highway Pedestrian Safety Project
## Vicinity of Laniakea Beach

Haleiwa, Island of Oahu, Hawaii

State of Hawaii Department of Transportation
August 2021

# DRAFT ENVIRONMENTAL ASSESSMENT
# Kamehameha Highway Pedestrian Safety Project, Vicinity of Laniakea Beach Haleiwa, Island of Oahu, Hawaii

Submitted Pursuant to the:

Hawaii Environmental Policy Act,
Chapter 343, Hawaii Revised Statutes, and
Title 11, Chapter 200.1, Hawaii Department of Health Administrative Rules

by the:

Department of Transportation, Highways Division
State of Hawaii

The following person may be contacted for additional information concerning this document:

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This Draft Environmental Assessment documents the anticipated finding that there would be no significant environmental impacts if Kamehameha Highway were realigned in the vicinity of Laniakea Beach. The proposed project addresses pedestrian safety as a priority but also addresses shoreline erosion, congestion, and the reliability of highway operations in the project limits.

August 2021

# EXECUTIVE SUMMARY

The State of Hawaii Department of Transportation, Highways Division (HDOT) is proposing roadway improvements to address pedestrian safety, shoreline erosion, congestion, and roadway reliability along Kamehameha Highway (Route 83) in the vicinity of Laniakea Beach on the island of Oahu. The project reach is approximately 1,000 feet in length and lies at the Northeast end of Laniakea Beach. As pedestrian safety is the primary purpose, the proposed project is referred to as the "Kamehameha Highway Pedestrian Safety Project, Vicinity of Laniakea Beach".

The proposed project requires environmental review in accordance with Hawaii Revised Statutes (HRS) Chapter 343 because it would involve State funds, use of State and County lands, use of land classified as a conservation district, as well as use of shoreline areas. As an agency action, the State of Hawaii Department of Transportation, Highways Division is responsible for preparing this document which must comply with Hawaii Administrative Rules (HAR) Title 11, Chapter 200.1.

Four conditions are analyzed in this Draft EA: The No Build, the No Build Settlement, Transportation System Management (TSM) Alternative, and the Pedestrian Shift Alternatives. The No Build and No Build Settlement serve as two baselines for comparison against the TSM and Pedestrian Shift Alternatives. The Pedestrian Shift Alternative is preferred.

This Draft Environmental Assessment (EA) discloses the foreseeable environmental and social impacts that could result from the project's implementation and commits to the employment of specific measures to prevent, minimize, or mitigate adverse impacts to the environment.

Table ES-1 provides a summary of the potential impacts and the proposed measures to avoid, minimize, or mitigate those potential effects.

Table ES – 1: Summary of Potential Impacts by Alternative

| Section | No Build | No Build Settlement | TSM Alternative | Pedestrian Shift Alternative Impacts | Mitigation / Minimization / Avoidance Measures |
|---|---|---|---|---|---|
| 3.1 Physical Geography and Coastal Processes | Coastal Erosion: Kamehameha Highway could erode away in the near future.<br><br>Sea Level Rise: Flooding and Potential Disruption of Service<br><br>Flood and Tsunami Hazard: Highway would remain in Flood Hazard Area and Tsunami Evacuation Zone. | Coastal Erosion: Same as No Build.<br><br>Sea Level Rise: Same as No Build.<br><br>Flood and Tsunami Hazard: Same as No Build. | Coastal Erosion: Does not meet project purpose.<br><br>Sea Level Rise: Does not meet project purpose.<br><br>Flood and Tsunami Hazard: Does not meet project purpose. | Coastal Erosion: Protects Highway from coastal erosion impacts.<br><br>Sea Level Rise: Minimizes extent of flooding on Highway caused by 3.2-foot sea level rise.<br><br>Flood and Tsunami Hazard: Properties near Lauhulu Stream Bridge, owned by Kamehameha Schools, and the City and County of Honolulu's Department of Parks and Recreation (City DPR) may experience a shallow increase of wave surface inundation.<br><br>No habitable structures would be affected. The detected changes would not be experienced at a scale that would require changes to flood or FIRM maps.. | None proposed. |

Table ES – 1: Summary of Potential Impacts by Alternative

| Section | No Build | No Build Settlement | TSM Alternative | Pedestrian Shift Alternative Impacts | Mitigation / Minimization / Avoidance Measures |
|---|---|---|---|---|---|
| 3.2 Land Use | No impact. | No impact | No impact. | Requires approximately three (3) acres from undeveloped City DPR property and Kamehameha Schools ranch property. Kawailoa Ranch's pasture land and riding trails would be affected. | Planning and design has been and will continue to be coordinated with property owners. Real property would be procured in accordance with federal, State, and local regulations. |
| 3.3 Historic and Archaeological Resources | No impact. | No impact | No impact | Site T-1 would be avoided. Lauhulu Stream Bridge would not be directly affected, but the change in use and alteration of the surrounding environment would be considered an effect in accordance with HAR 13-275. | Effect with mitigation based on impacts to Lauhulu Stream Bridge. Proposed mitigation is preservation in the form of avoidance and protection. Archaeological Monitoring would be conducted as agreed upon between HDOT and the State Historic Preservation Division (SHPD). |
| 3.4 Cultural Resources | No impact. | No impact | No impact | Less than significant. No cultural resources identified, except for Site T-1, which will be avoided. Although no kupuna iwi have been encountered, cultural practitioners expressed concerns for impacts to Kamehameha Schools property, and kupuna iwi. | Archaeological monitoring would be conducted. See Section 3.3.<br><br>HDOT would continue to coordinate with Kamehameha Schools and affected lessees as design progresses. |

Table ES – 1: Summary of Potential Impacts by Alternative

| Section | No Build | No Build Settlement | TSM Alternative | Pedestrian Shift Alternative Impacts | Mitigation / Minimization / Avoidance Measures |
|---|---|---|---|---|---|
| 3.5 Biological Resources | No impact. | No impact. | No impact. | Less than significant. No threatened or endangered species observed within project area. Although, protected seabirds, Hawaiian Hoary Bats, and Hawaiian Green Sea Turtles may be affected by nighttime lighting and construction activities. | Best Management Practices would be employed during construction. See Section 3.16.5. |
| 3.6 Surface Water Resources | No impact. | No impact. | No impact. | Less than significant. No work would be done within the USACE jurisdiction. Proposed impervious surface would be lower than existing, resulting in overall reduction in storm water runoff and improved water quality. | Contractor would be required to illustrate how they would achieve work without placing materials in the stream. See Section 3.16.4 for Water Resources during Construction. |

Table ES – 1: Summary of Potential Impacts by Alternative

| Section | No Build | No Build Settlement | TSM Alternative | Pedestrian Shift Alternative Impacts | Mitigation / Minimization / Avoidance Measures |
|---|---|---|---|---|---|
| 3.7 Parks and Recreational Resources | No impact. | No impact. | TSM Alternative would not affect the City DPR's ability to implement the park in the future. However, based on HDOT's meeting with the City DPR, as long as Laniakea Beach is owned by Kamehameha Schools, there is no City beach recreation area to support. | Recreational access would continue once the Highway is realigned. However, during construction, parking may be inaccessible, as determined by Contractor work areas. Construction is anticipated to last for up to 24 months. | None proposed. |
| 3.8 Visual and Aesthetic Resources | No impact. | No impact. | No impact. | No impact. | None proposed. |
| 3.9 Roadways and Traffic | Traffic would continue to be congested. | Traffic Congestion would be improved over the No Build, assuming that pedestrians use the crosswalks. | Traffic Congestion would be improved similar to the No Build Settlement. | The Pedestrian Shift Alternative would improve traffic congestion. | None proposed. The proposed project in itself is a mitigation measure. |
| 3.10 Pedestrian Safety | No change to safety conditions would occur. | Pedestrians could cross at crosswalks, potentially reducing pedestrian accidents. | Parking would be eliminated on the mauka side of the Highway. This Alternative may move the pedestrians to other parts of the Highway if they can find additional parking. | Pedestrians would no longer need to cross the Highway to access Laniakea Beach eliminating concerns for pedestrian safety. | None proposed. |

Table ES – 1: Summary of Potential Impacts by Alternative

| Section | No Build | No Build Settlement | TSM Alternative | Pedestrian Shift Alternative Impacts | Mitigation / Minimization / Avoidance Measures |
|---|---|---|---|---|---|
| 3.11 Public Facilities and Services | Traffic congestion will hinder effectiveness of emergency response. Additionally, Kamehameha Highway will not be reliable during high surf weather events. | Traffic congestion would be improved over the No Build, thus effectiveness of emergency response would be slightly better than the No Build. Kamehameha Highway would not be reliable during high surf weather events. | Traffic congestion would be similar or slightly better than the No Build Settlement, thus effectiveness of emergency response would be similar or slightly better than the No Build Settlement. Kamehameha Highway would not be reliable during high surf weather events. | Pedestrian Shift Alternative would be most effective at reducing delays or congestion. Improved traffic allows for better efficiency for emergency vehicles. Additionally, the wider right-of-way allows vehicles to pull-over so that emergency vehicles can get through. Kamehameha Highway would remain open during periods of high surf to serve emergency needs. | None proposed. |
| 3.12 Noise Impacts | Thirteen residences, Laniakea Beach, and Chun's Reef experience noise impacts because the ambient environment approaches or exceeds the Noise Abatement Criterian (NAC). | Noise Impacts are the same as the No Build. | Noise Impacts are the same as the No Build and No Build Settlement. | Less than significant. The Pedestrian Shift Alternative reduces the number of affected noise-sensitive receptors to 5 residences and Chun's Reef. | TSM: Although Pedestrian Shift is preferred, should HDOT decide to implement the TSM Alternative, HDOT's Noise Policy and Guidelines require that an evaluation for noise abatement be conducted. Pedestrian Shift: Noise Barriers would not be feasible thus no mitigation is proposed. |
| 3.13 Hazardous Materials | No impact. | No impact. | No impact. | No impact. | None proposed. |
| 3.14 Air Quality | No impact. | No impact. | No impact. | No impact. | None proposed. |

Table ES – 1: Summary of Potential Impacts by Alternative

| Section | No Build | No Build Settlement | TSM Alternative | Pedestrian Shift Alternative Impacts | Mitigation / Minimization / Avoidance Measures |
|---|---|---|---|---|---|
| 3.15 Social and Economic Conditions | No impact. | No impact. | No impact. | No impact. | None proposed |
| 3.16 Construction Impacts | No impact. | No impact. | No impact. | Less than significant. Short-term, temporary disruptions would occur to various resources but would not result in long-term effects. | General good housekeeping practices would be implemented for consideration of all resources. |

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# 1.0 INTRODUCTION

The State of Hawaii Department of Transportation, Highways Division (HDOT) is proposing roadway improvements to address pedestrian safety, shoreline erosion, congestion, and roadway reliability along Kamehameha Highway (Route 83) in the vicinity of Laniakea Beach on the island of Oahu (see Figure 1-1). The project reach is approximately 1,000 feet in length and lies at the Northeast end of Laniakea Beach. As pedestrian safety is the primary purpose, the proposed project is referred to as the "Kamehameha Highway Pedestrian Safety Project, Vicinity of Laniakea Beach".

When this project was initiated in 2011, it was called the "Kamehameha Highway Realignment, Vicinity of Laniakea Beach". At the time, the primary purpose was to address shoreline erosion, and roadway reliability. HDOT approached the project's development by implementing a Context Sensitive Solutions (CSS) process, in which HDOT worked extensively with the affected communities. The goal was to provide an opportunity for the varying stakeholders to be involved at the earliest stages of project planning. To accomplish this goal, HDOT convened a task force comprised of a cross-section of the North Shore community to develop community-driven solutions to transportation issues that they identified, understanding that this location along Kamehameha Highway was an established priority in the 2003 Statewide Highway Shoreline Protection Study for sustained damage from wave-driven erosion (Edward K. Noda Associates, 2003). Section 1.4 summarizes relevant portions of the project's history.

HDOT re-prioritized project objectives when a young boy was hit by a car crossing Kamehameha Highway at Laniakea Beach in August 2019. Frustrated by the conditions, the North Shore community held protests urging lawmakers and the State to make the area safe. In response, HDOT elevated pedestrian safety at this location to become the primary project purpose. Other objectives that were identified in early community engagement processes, including the Highway's protection from erosion, maintaining roadway reliability, and congestion-relief, are relevant criteria to identify appropriate solutions, but pedestrian safety is paramount.

## 1.1 Purpose of this Document

The proposed project requires environmental review in accordance with Hawaii Revised Statutes (HRS) Chapter 343 because it would involve State funds, use of State and County lands, use of land classified as a conservation district, as well as use of shoreline areas. As an agency action, the State of Hawaii Department of Transportation, Highways Division is responsible for preparing this document which must comply with Hawaii Administrative Rules (HAR) Title 11, Chapter 200.1.

This Draft EA discloses the foreseeable environmental impacts that could result from the project's implementation and commits to specific measures to avoid, minimize, or mitigate adverse impacts to the environment. Additionally, this Draft EA contains a record of consultation activities that have been conducted as part of project planning for pedestrian safety. It does not detail all previous project planning that has occurred since HDOT began working on this issue in 2011. However, information gained from meetings with resource agencies, City officials, community groups, adjacent residents, property owners, task force advisory meetings, and affected individuals were

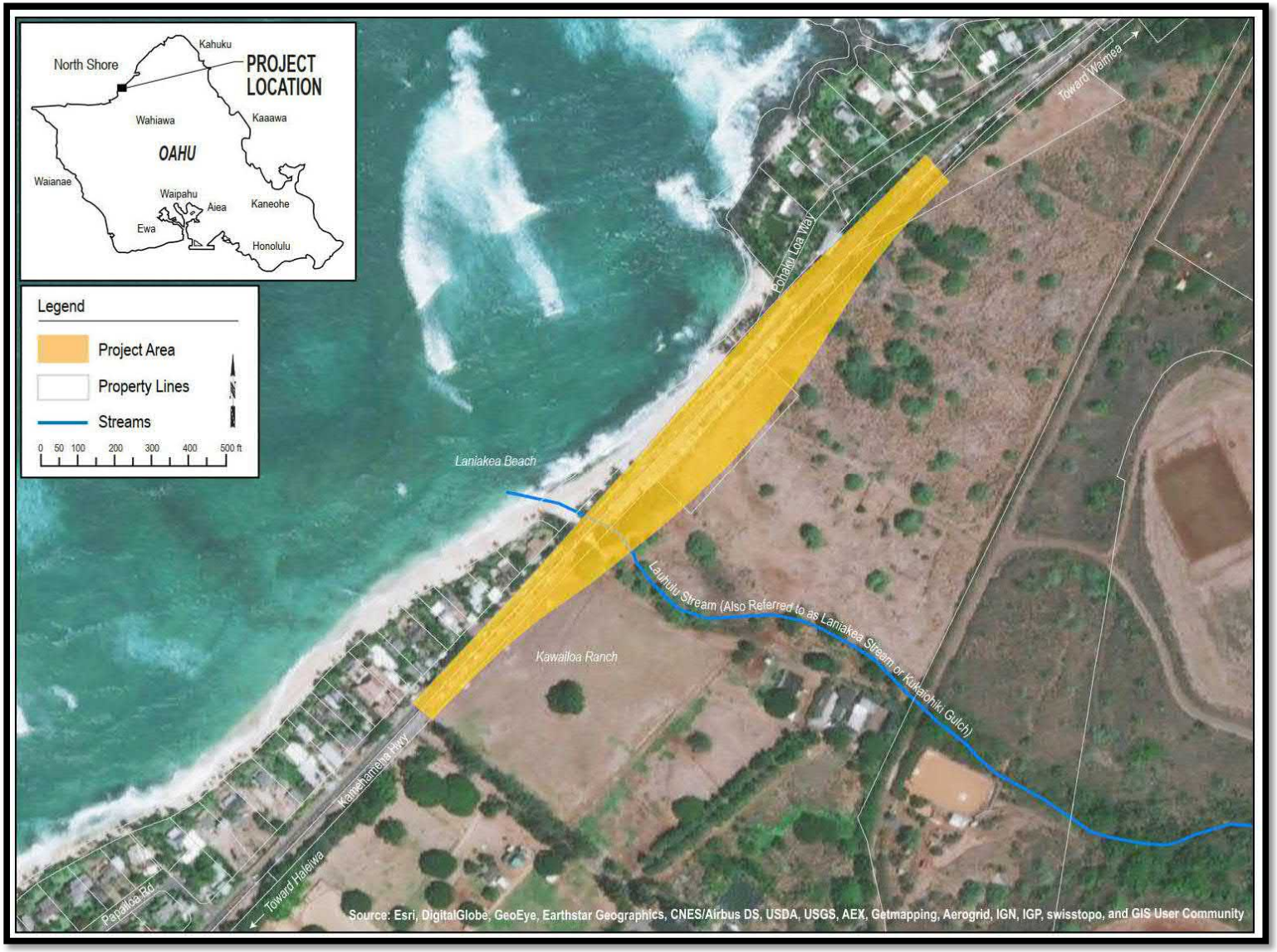



**Figure 1-1. Project Location**

instrumental to guiding project development. Such information has been captured and incorporated into the design alternatives put forward for evaluation. When pertinent, references to these discussions are provided. The very brief history summarized in Section 1.4 provides just enough detail to understand the broader contexts that have guided project decision-making.

Based on the Significance Criteria specified in HAR 11-200.1-13, the proposed project is not likely to have a "significant" impact. Therefore, an EA process was selected for the environmental review. After collecting and considering comments on this Draft EA. If, during the consideration of comments received on this Draft EA, it is determined that a "significant" impact would occur, HDOT will either revise the proposed project to avoid or mitigate the impact's severity or start preparing an Environmental Impact Statement (EIS).

## 1.2 Organization of this Document

This Draft EA is organized as follows:

- Chapter 1.0: Provides an introduction and discusses the purpose and need for the project.
- Chapter 2.0: Presents the project alternatives, including those previously considered but were eliminated, as well as the anticipated schedule and costs. It also lists permits and approvals that may be required.
- Chapter 1.0: Describes existing environmental conditions, potential environmental impacts, and the mitigation measures that are proposed to reduce the level of impact.
- Chapter 4.0: Documents agency and public coordination conducted to date related to the proposed project.
- Chapter 5.0: Provides the anticipated FONSI statement, pursuant to HRS Chapter 343.
- Chapter 6.0: Consists of a list of references used in the preparation of this Draft EA.
- Appendices: Contains records of coordination conducted for the project, and provides various technical reports prepared by specialists.

## 1.3 Naming Conventions in this Document

This document generally uses the directional terms north, south, east, and west. However, the terms "mauka" and "makai" (towards the mountains and towards the ocean, respectively), and "Haleiwa" and "Waimea" are also used, especially where these terms may be the most convenient to describe a direction or location. In this document, mauka generally corresponds to an easterly direction, makai is a northwesterly direction, while towards Haleiwa is a southwesterly direction and towards Waimea corresponds to a northeasterly direction.

## 1.4 Project History

Coastal erosion is a well-documented threat to various sections of Kamehameha Highway. While there are more recent studies that evaluate highway vulnerabilities to shoreline processes, HDOT's 2003 Statewide Highway Shoreline Protection Study was the initial study to identify two sections along Kamehameha Highway as being undermined by ocean currents. Photos from 2000, and

maps dating as far back as 1949 show the Highway's exposure to the ocean at Laniakea Beach with narrow, eroding roadway shoulders as well as near Chun's Reef. At Laniakea, overtopping waves and stormwater run-off had been undercutting the boulder escarpment and beginning to undermine the Highway.

In 2005 the City and County of Honolulu (City) had planned to develop two beach parks, the "Laniakea Beach Support Park" near Laniakea Beach and "Kawailoa Beach Park" near Chun's Reef (see Section 3.2). The EAs for these two beach park projects (City, 2005a and b) suggested coordination with the State Department of Transportation (HDOT) for moving the Highway inland.

In 2007 Department of Land and Natural Resources (DNLR) Office of Conservation of Coastal Lands (OCCL) wrote a memorandum titleds "OMPO Transportation Enhancement Program Kamehameha Highway Relocation Review and Summary Laniakea Beach, Kawailoa, Waialua District Oahu" supporting an effort to relocate the Highway mauka because such a project could address several problems, including chronic erosion, flooding, and storm surge.

In 2012 HDOT held public meetings and developed a Task Force to:

- Identify sources of issues experienced along Kamehameha Highway at both Laniakea Beach and Chun's Reef, and
- Involve the community in creating community-accepted solutions.

The proposed project was to be paid for with federal funds designated to prevent erosion and keep the Highway operational. Many options were discussed and considered, including a seawall type revetment, inland alignments at varying distances from the shoreline, and an option that included beach parking.

During public meeting and task force discussions, the community vocalized their frustration with the traffic congestion created by people parking on the mauka side of the Highway and crossing to see the turtles on the beach. Meeting attendees advised that a low cost, immediate solution of blocking parking along the Highway at Laniakea Beach could be implemented without affecting the traditional cultural resources on the adjacent properties. Equally important was that the community wanted immediate relief. With this input, HDOT developed a pilot program that would test three scenarios for barrier placement: No Parking, Parking on City Property where left turns onto Kamehameha Highway are prohibited, and Parking on City Property where left turns onto Kamehameha Highway are allowed. At the time, the City could not license or allow for the latter scenarios leaving only the No Parking scenario to evaluate.

In December 2013, HDOT installed a 1,000-foot concrete barrier to prevent parking on the mauka side of the Highway. While the barrier is reported to have lessened traffic congestion (see Traffic Evaluation in Appendix B), it was installed as a temporary demonstration project. After a lawsuit filed by a group called Save Laniakea Beach and five individuals, the *Save Laniakea Beach* decision of July 8, 2015 by the State of Hawaii's First Circuit Court mandated HDOT remove the barrier installation.

HDOT removed the barriers on August 24, 2015, storing them on City property just mauka of and parallel to the Highway. Additionally, the *Save Laniakea Beach* decision mandated that re-installation could not occur until all requirements of the law had been complied with. The

underlying assumption being that a Special Management Area (SMA) was required and had not been obtained.

In 2016 HDOT began working on a new EA to support a Special Management Area (SMA) permit allowing the barriers to be reinstalled. Early scoping efforts in the SMA permit process yielded a previously certified shoreline map. HDOT was also informed that the barrier project was likely within the Conservation District instead of the SMA. To determine whether the project is in the Conservation District or the SMA, a Shoreline Certification application was required to be submitted to Hawaii Department of Land and Natural Resources (DLNR).

On May 10, 2017, HDOT submitted a Shoreline Certification application to DLNR. A community member filed a Notice to Appeal on July 30, 2017. The shoreline certification request was ultimately denied on July 5, 2018, based on the appeal's assertion that the earlier barrier installation on City property was considered an unauthorized improvement.

HDOT submitted a second Shoreline Certification application with the Right of Entry agreement with the City attached as proof of the City's authorization for HDOT to have the barriers on City property. DLNR denied this application in the July 23, 2019 issue of The Environmental Notice because the Right of Entry Agreement was deemed insufficient to prove that the City had approved the installation of the traffic barriers.

While addressing the short-term barrier issues, the project continued to work on the primary purpose of the project or long-term solutions that address the Highway's vulnerability to shoreline erosion at both Laniakea Beach and Chun's Reef. The task force was not officially disbanded, but HDOT deemed that the group had achieved its objective and stopped meeting with the advisory group after April 2014. Project development efforts were focused on meeting with adjacent residents and landowners that would be directly impacted by the alternatives, as well as meeting with resource and regulatory agencies with jurisdiction to refine alternatives initially developed in task force meetings.

On August 1, 2019, a child was struck by a car on Kamehameha Highway and badly injured as he ran across the Highway. The accident and community protests prompted HDOT to re-prioritize the project's purpose and need to focus on pedestrian safety, as described in Section 1.5. A change in the project's purpose meant that the range of viable alternatives would shift (See Section 2.5). State funds were then allocated for the project's construction in lieu of the 80% federal funds.

In preparation to submit a third Shoreline Certification to construct the project, HDOT removed the barriers from the location completely in September 2019 so that they do not obstruct the highest naturally occurring inland wash of the waves.

HDOT submitted a new Shoreline Certification Application on January 14, 2020, and DLNR certified the shoreline on July 30, 2020. While the barriers were in the Conservation District, the proposed project is confirmed to be mauka of the shoreline and in the SMA, therefore, an SMA Use Permit and Shoreline Setback Variance will be required for this project.

One conclusion of the *Save Laniakea Beach* decision is that nothing in the order precluded the parties involved from seeking a mutually agreeable barrier installation. On July 9, 2020, Civil Beat reported that an interim solution for how to fix the traffic, access and safety issues along the Laniakea corridor was reached in a court settlement on June 17, 2020. This interim solution is

considered in this EA as a potential baseline condition and referenced as the No Build Settlement Alternative (See Section 2.2).

## 1.5 Project Purpose and Need

The project is located on the North Shore of Oahu. The site is roughly 2.3 miles from Haleiwa at approximately milepost 3.3. Kamehameha Highway (State Route 83) is a two-lane rural highway functionally classified by HDOT as a "Principal Arterial" because it is the principal roadway used for mobility between surrounding urban areas. Although principal arterials typically have limited access, there are a number of local roads, and residential driveways along the Highway within the project area.

The project area is rural in character but is visited more than a typical rural area due to the scenic beauty of the region, natural resource attractions (e.g., turtles and whales), beaches, and surf. While the North Shore, in general, is an attraction, the sea turtles that rest on Laniakea Beach also draw many visitors. The North Shore Sustainable Communities Plan (NSSCP) estimates that in 2005, the North Shore experienced an average of 7,000 visitors per day, for comparison, this was about 40% of the total number of residents on the North Shore at the time (NSSCP, 2011). Such a visitor trend has created significant pressure on the North Shore Community's resources and infrastructure, including Kamehameha Highway at Laniakea Beach.

The primary purpose of this project is to improve safety for pedestrians and all modes of transportation at the section of Kamehameha Highway fronting Laniakea Beach.

Secondary to pedestrian safety, the project is being proposed to:

- Improve Reliability. Reduce the Highway's vulnerability to climate change, wave inundation, and coastal erosion that threatens its ability to operate,
- Relieve Congestion. Relieve congestion by reducing travel times throughout the project area, and
- Pedestrian and Bicycle Facilities. Support alternative transportation modes as identified in regional community and transportation plans.

The remainder of this section describes the need associated with each project purpose.

### 1.5.1 Improve Safety

The primary purpose of this project is to improve safety for both pedestrians and motorists utilizing Kamehameha Highway fronting Laniakea Beach. During the peak hours, approximately 50 to 70 cars park on the mauka side of the Highway. There are no sidewalks and no crosswalks along this section of Kamehameha Highway, yet 200 to 300 hundred pedestrians cross the Highway each hour from about 11:00am to 4:00pm to get to the beach from their vehicles (See Appendix B).

The lack of an established circulation pattern for pedestrians creates conditions where beachgoers cross the Highway at haphazard locations without the benefit of a crosswalk. Crossing the busy road is especially challenging for the disabled, people carrying beach gear, and small children. During free-flowing traffic, pedestrians have darted across the road. Narrow roadway shoulders on the makai side of the Highway also leave pedestrians vulnerable to oncoming traffic as they walk along the road, waiting for the opportunity to cross back to their vehicle.

The safety environment is further complicated by the large volumes of people who are not familiar with the area, attempting vehicle maneuvers in the shoulder to re-orient themselves back to Waimea or towards Haleiwa. Such maneuvers, when attempted in congested areas, interfere with both pedestrian safety and the safety of other vehicles.

Lastly, as a scenic area, drivers are often distracted in this short stretch of Highway because it is the first opportunity to check the surf and ocean conditions as vehicles head toward Waimea. Sometimes this just results in a slowdown of traffic, other times, it creates near misses for vehicle-vehicle and vehicle-pedestrian accidents. Drivers, frustrated by the slowed conditions, have been observed using the roadway shoulder or driving in the on-coming traffic lane to push past the bottleneck.

Improvements are needed to address the conflicts between Kamehameha Highway and beach access.

### 1.5.2 Improve Reliability

A secondary purpose of the project is to reduce the Highway's vulnerability to climate change, including sea level rise, coastal erosion and inundation, thereby improving the roadway's reliability for service.

As the main public thoroughfare and an evacuation route, Kamehameha Highway's service or ability to operate must be reliable. Especially, when considering vehicle response times during emergencies and disasters, as well as supporting evacuation of the area in the event of tsunami, flooding, or hurricane, etc. At Laniakea Beach, both long-term and short-term or seasonal shoreline processes threaten Highway operations. During high surf and flooding this section of the Highway has been closed because it is rendered too hazardous to travel (April 2011, NSSCP). See Figure 1-2.

In 2003, HDOT published the Statewide Highway Shoreline Protection Study, which identified two sections of Kawailoa Beach, a 700-foot section and a 200-foot section of Kamehameha Highway, fronting Laniakea Beach and Chun's Reef, respectively, that are directly exposed to the ocean and have imminent or actual highway damage due to wave attack. At these locations, the Highway is protected by a boulder escarpment; however, overtopping waves and stormwater run-off are undercutting this protection and undermining the Highway.

More recently The National Assessment of Shoreline Change: Historical Shoreline Change in the Hawaiian Islands (2012) and the Integrated Ocean Observing System also document erosion on Hawaii's shoreline. These interactive mapping tools allow sea level and shoreline data to be shown for Laniakea beach and are discussed in more detail in Section 3.11.

Sea level has been projected to rise globally approximately 1-foot by mid-century and 3 feet by the end of the century (Intergovernmental Panel on Climate Change [IPCC], 2014). The Hawaii Sea Level Rise Viewer (HSLRV) similarly identifies 3.2 feet sea level rise by the end of the century (Tetra Tech, Inc. and UH Coastal Geology Group, 2017). More conservatively, the City has assumed a 3.2-foot sea level rise by mid-century and a 6-foot rise by the end of the century as its "planning benchmarks" (City Office of the Mayor, 2018; City Climate Change Commission, 2018).

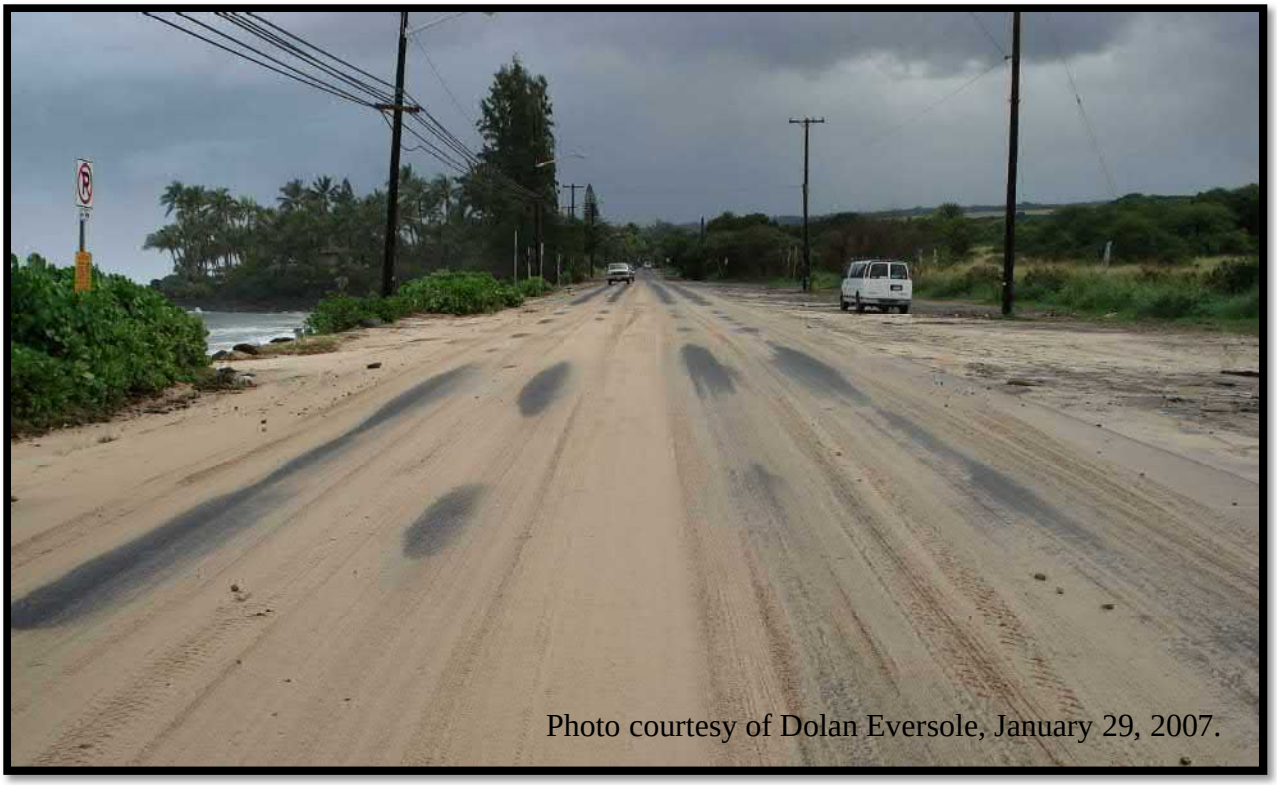



**Figure 1-2. Photograph of Sand Deposition from Waves Overtopping Kamehameha Highway at Laniakea Beach**

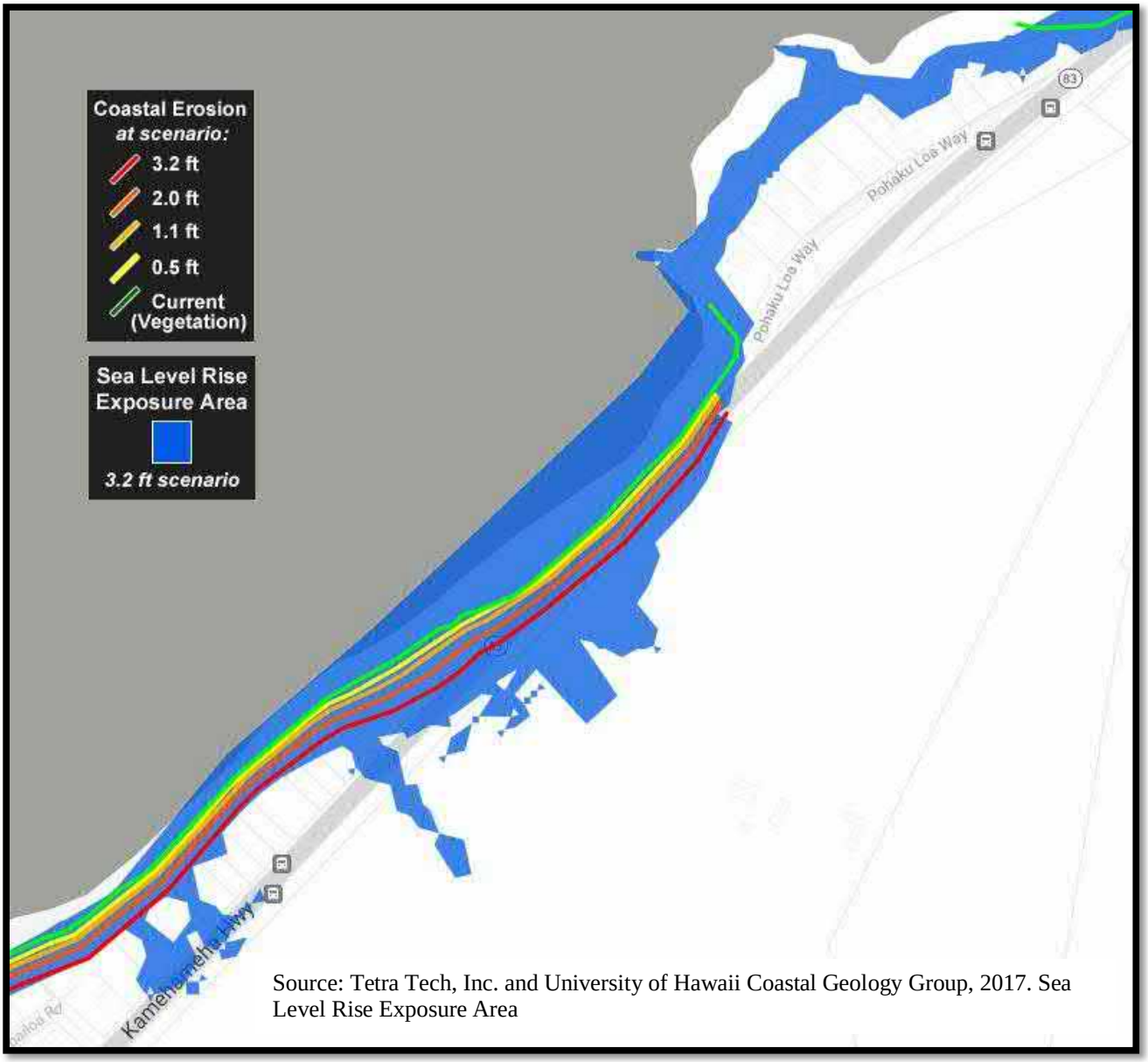
Figure 1-3 provides a map of the project area with the 3.2-foot sea level rise shown, as well as projections for coastal erosion from the HSLRV model. The model predicts that Kamehameha Highway within the project limits would be inundated by the ocean with a 3.2-foot sea level rise. Additionally, although not shown on the figure, the model predicts that just a 0.5-foot sea level rise would be enough to flood the Highway immediately adjacent to Laniakea Beach (Tetra Tech, Inc. and UH Coastal Geology Group, 2017).

In addition to sea level rise, the predicted climate changes may bring more frequent severe weather events, which could result in more frequent hurricanes, high surf, and flooding.

This project is needed to address the Highway's vulnerability to these short and long-term processes that threaten the road's ability to operate presently and in the future.

### 1.5.3 Relieve Congestion

Relieving vehicle congestion in the project area is another secondary project purpose. Traffic delays experienced along Kamehameha Highway are caused by the pedestrian-vehicle conflicts associated with beach access. Traffic demand is not being processed as pedestrians cross or slow traffic by walking alongside the road at Laniakea Beach, as described in Section 1.5.1. Weekend and weekday delays are typically 30 minutes, with vehicles stacked up beyond the Joseph P. Leong Highway intersection (Haleiwa Bypass) and beyond the Kamehameha Highway intersection with Pupukea Road on the Waimea Bay side of the project area. Once beyond the Laniakea Beach area, congestion decreases significantly. See Appendix B for the Traffic Evaluation.




Source: Tetra Tech, Inc. and University of Hawaii Coastal Geology Group, 2017. Sea Level Rise Exposure Area

**Figure 1-3. Sea Level Rise Exposure Area and Shoreline Coastal Erosion Scenarios**

The project is needed to reduce or remove conflicts between beach access and the Highway, which is a source for congestion along this stretch of Kamehameha Highway.

### 1.5.4 Provide Pedestrian and Bicycle Facilities

As indicated by the North Shore Sustainable Communities Plan (NSSCP, 2011), the community does not favor increasing the Highway's capacity to accommodate more cars but supports the promotion of alternative modes of transportation. Currently there are no pedestrian and bicycle facilities within the project limits. Pedestrians and cyclists utilize the roadway shoulders or are forced to the margins of the right-of-way and adjacent properties.

HDOT's master plan for bicycle facilities, Bike Plan Hawaii (HDOT, 2003a), provides a long-term strategy for the State's bicycle improvements. Bike Plan Hawaii identifies two bike facilities in the project area (see Figure 1-4 below):

- Project 55, a priority 1 (highest priority) project to extent the Ke Ala – Pupukea Path from Three Tables to roughly Kawailoa Drive (roughly 3.5 miles). A bike path is generally a 10-foot wide paved path with at least a 5-foot separation from any roadway.
- Project 54, a priority 3 (lowest priority) project to make Kamehameha Highway a signed shared road from roughly Haleiwa Road to Pupukea Road (roughly 3.9 miles). A signed shared road generally consists of sufficiently wide paved shoulders or wider travel lanes with signs.

Multi-modal facilities provided by this project would need to have the potential for future regional connectivity.

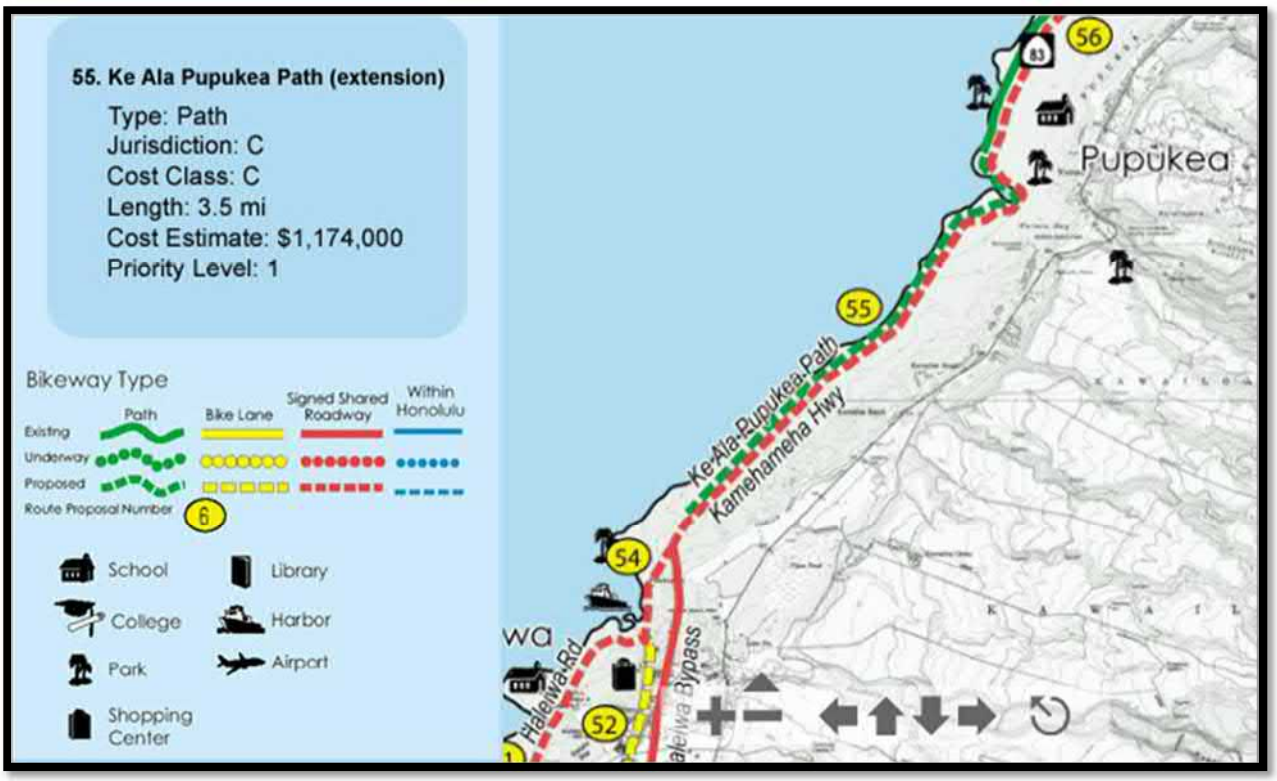



**Figure 1-4. Existing and Proposed Bike Paths in Bike Plan Hawaii (2003)**

# 2.0 PROPOSED PROJECT ALTERNATIVES

Four conditions are analyzed in this EA: The No Build, the No Build Settlement, Transportation System Management (TSM), and the Pedestrian Shift Alternatives.

The No Build and No Build Settlement Alternatives serve as two separate baselines for comparison against the TSM and the Pedestrian Shift Alternatives.

## 2.1 No Build Alternative

The No Build Alternative is the existing condition or "do nothing" approach. It would leave the project area as it is with no changes to the transportation infrastructure.

The No Build Alternative assumes that projects listed on the Statewide Transportation Improvement Program (STIP) and included in the Oahu Regional Transportation Plan 2040 (2016) (ORTP) would be built by 2040, with the exception of the proposed project (Figure 2-1).

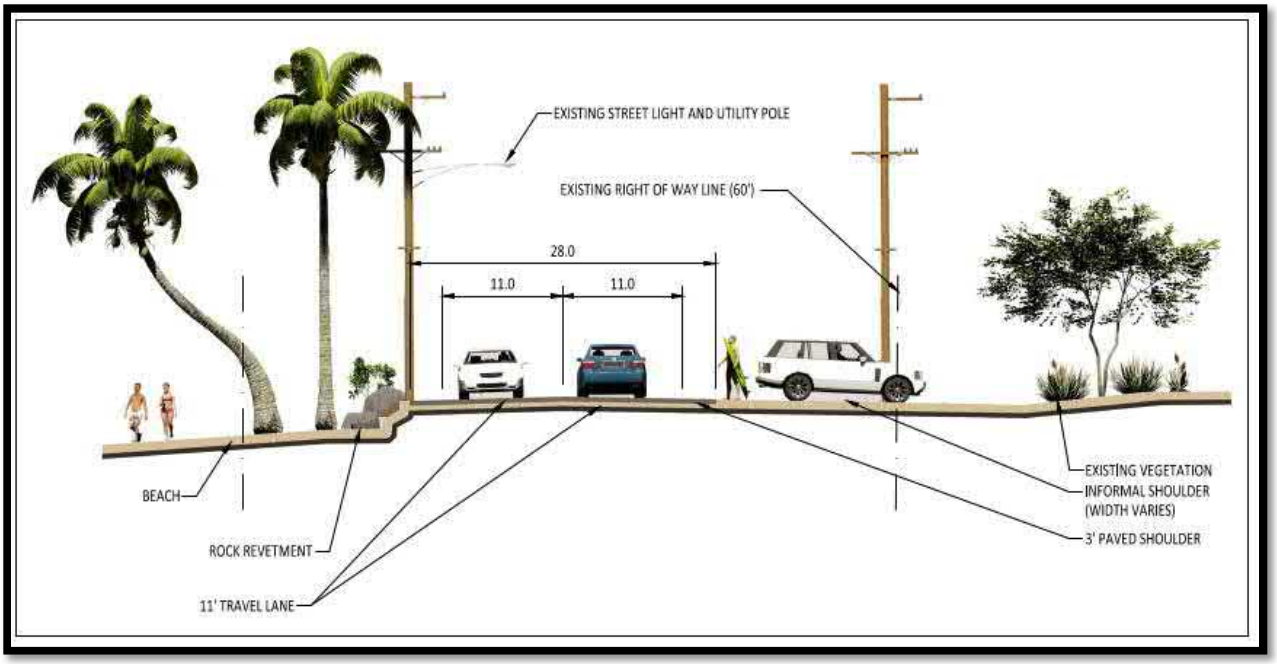



**Figure 2-1. No Build Alternative / Existing Typical Section**

There are no other projects listed on the STIP in the ORTP 2040 that are specific to the Project area. ORTP 2040 project number 10, titled "Kamehameha Highway, Safety Improvements, Haleiwa to Kahaluu" is indicated to include "Construct safety improvements along Kamehameha Highway from Haleiwa to Kahaluu. Improvements include turn lanes, guardrails, signage, crosswalks, etc. to improve safety. Widening of Kamehameha Highway will be only in areas where needed for storage/turn lanes safety improvements." Although turn lanes could be added in the project area under ORTP 2040 project number 10, this is unlikely because there are no major intersections within the project area.

With this Alternative, it is assumed that shoreline erosion mitigation would be undertaken on an as needed basis, as it is today. This typically involves (a) closing the highway during periods of high surf when the highway is overtopped by waves, (b) the removal of sand and debris from the highway surface following high wave events, and (c) periodic maintenance of the rocks protecting the highway embankment along the shoreline. These activities would be performed within the existing highway ROW to the degree practicable.

In the event the Highway was to suffer greater damage, more invasive emergency repair projects may be necessary. Such emergency projects have occurred elsewhere in Hawaii, including, for example, Kamehameha Highway repair at Kaaawa on Oahu and Honoapiilani Highway shoreline repairs on Maui, which both resulted in the installation of shoreline revetments. Some may find these emergency projects preferable to improvement projects due to their speed and perceived short-term improvements. However, such emergency projects have noteworthy shortcomings, including: (a) only the same facilities can be rebuilt, no enhancements can be made; (b) the repairs do not address the underlying cause of the emergency and the facility remains under threat of a repeat event; (c) adverse short-term impacts may occur, both to the travelling public and the natural environment; and (d) unintended adverse long-term impacts may also occur to the natural environment, such as beach loss when shoreline revetments are installed.

Other development in the project area would occur under the No Build Alternative. The scope of all public and private development in the project area between now and 2030 is unknown; however, some projects have been planned or proposed, including the following:

- Papailoa residential infill project, by Kamehameha Schools
- Kapaeloa residential infill project, by Kamehameha Schools
- Kuikuiloloa Ag Area project, by Kamehameha Schools

At this time, the City DPR has no plans to implement the development of Laniakea and Kawailoa Beach Parks as described in Section 3.2.

## 2.2 No Build Settlement Alternative

The No Build Settlement Alternative involves allowing cars to park on the mauka side of the Highway on an unpaved parking area for better public access to Laniakea Beach and installing guardrails and crosswalks so that visitors might cross the Highway in a safer, more orderly fashion. Cars will enter the parking area by making a right-turn from Kamehameha Highway on the Haleiwa side of the parking area. Cars will exit the parking area by making a right-turn onto Kamehameha Highway at the Waimea end. Cars travelling on Kamehameha Highway in the Haleiwa-bound direction will be prohibited from making left-turns into the parking area. Additionally, cars exiting the parking area will be prohibited from making a left turn towards Haleiwa.

As the unpaved parking area is now, it is estimated that 50-60 parking spaces would be available. In addition, the City DPR will move a cattle fence on its property mauka of the Highway so that cars have room to maneuver and park. The agreement further prohibits large tour buses and vans that often shuttle tourists to Laniakea from stopping there. The settlement agreement calls for a one-year trial period, but there is no deadline for the changes to take place.

At the time of writing this document, the City DPR has removed the cattle fence and gate and the new chain link fence construction has been completed. SMA Permit Minor No. 2020/SMA-38 and Minor Shoreline Structure Permit No. 2020/MSS-4 were issued by DPP on December 7, 2020 to allow fencing within the City properties TMK 6-1-005:024, 6-1-009:024, and 6-1-010:019.

Figure 2-2 provides a typical section and Figure 2-3 illustrates a plan view. Because this alternative will be designed and constructed by the City DPR with input from HDOT, these plans are currently in coordination. Illustrations presented in this EA should be considered an artistic rendition to facilitate an understanding of the scenario and not considered final. Despite the lack of final plans or concepts, the simplicity of the Alternative allows for sufficient analysis to satisfy the intent of HRS Chapter 343.

Like the No Build Alternative, the No Build Settlement Alternative includes the assumption that HDOT will conduct shoreline erosion mitigation on an as needed basis, as it is described in the No Build Alternative. Other development in the project area by agencies or entities other than HDOT would continue under the No Build Settlement Alternative similar to the No Build Alternative.

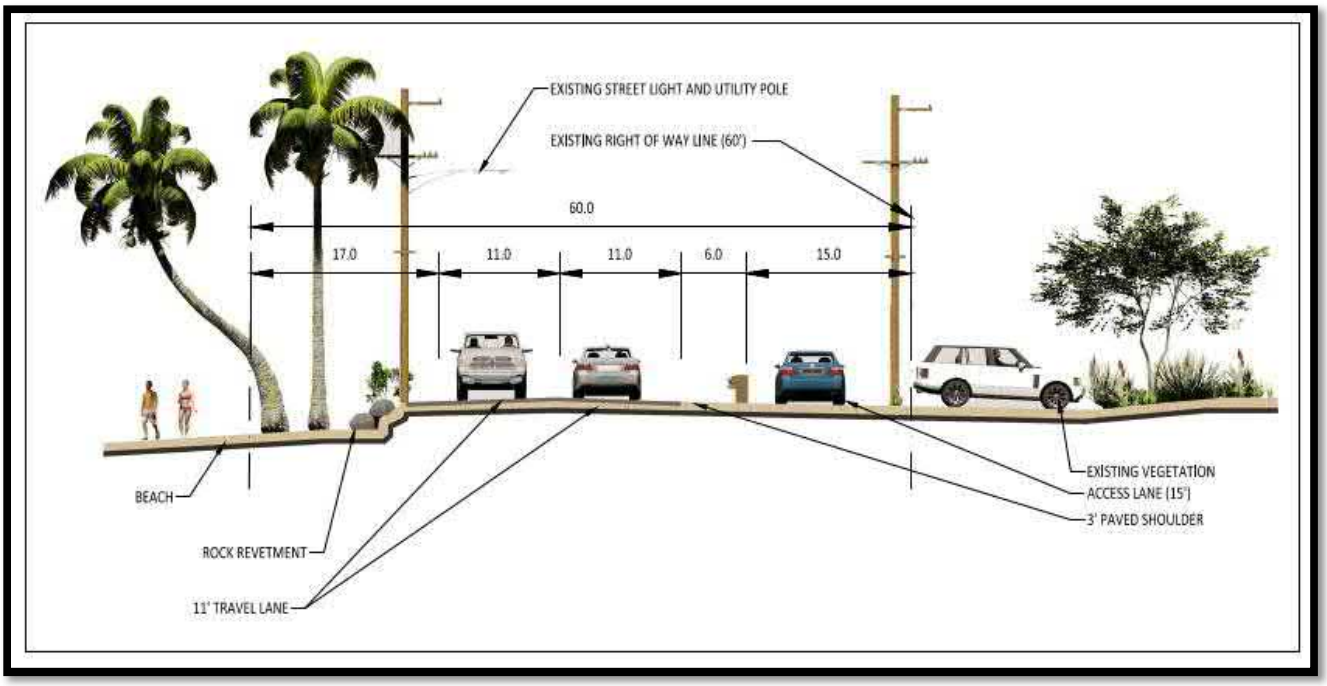



**Figure 2-2. No Build Settlement Typical Section**

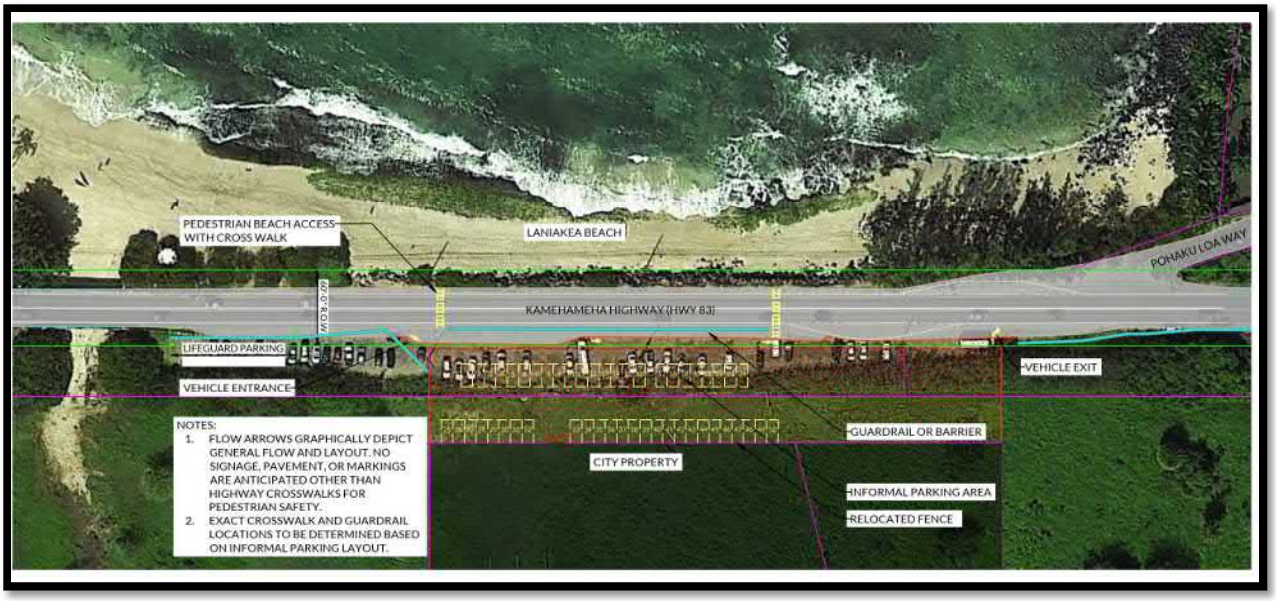



**Figure 2-3. No Build Settlement Alternative Plan View**

## 2.3 Transportation System Management (TSM) Alternative

The Transportation System Management Alternative (TSM) would entail blocking off the mauka side parking with a permanent guardrail. The guardrail would be in a similar location as the concrete barriers that were installed in 2013. See Figure 2-4 below. Parking would be unavailable on the mauka side of the road, and no crosswalks would be established.

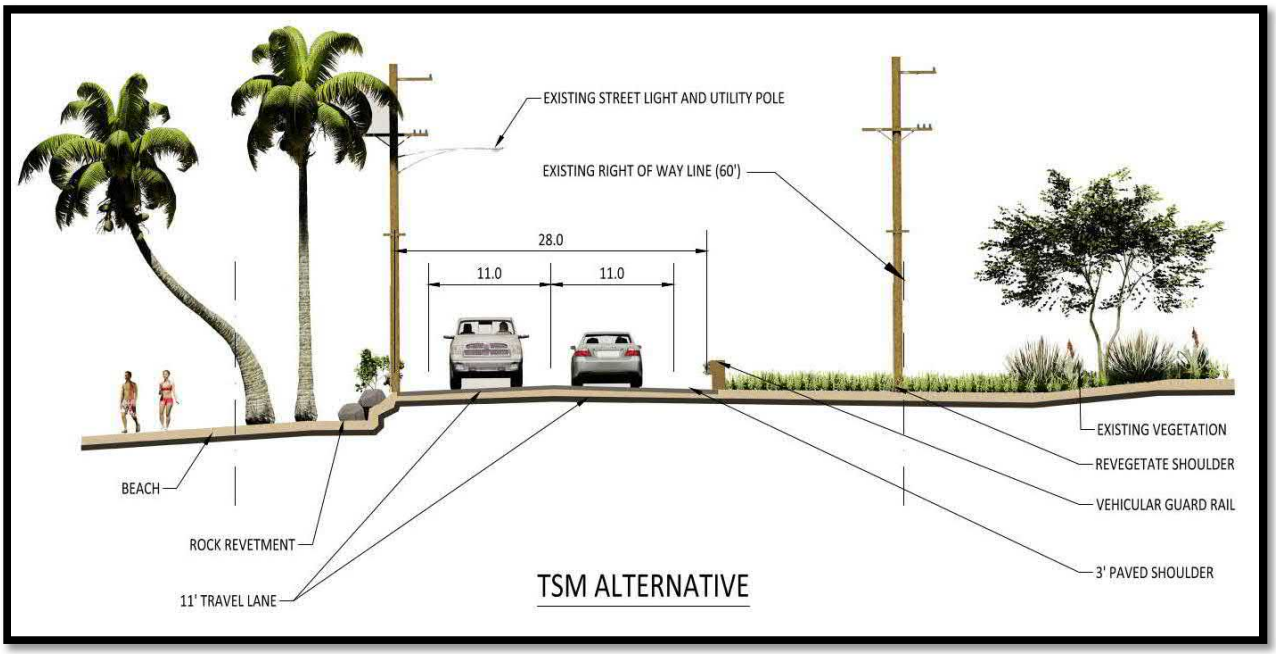



**Figure 2-4. TSM Project Alternative Typical Section**

In addition, the TSM Alternative includes the shoreline erosion mitigation on an as needed basis as it is described in the No Build Alternative. Other development in the project area by agencies or entities other than HDOT would continue under the TSM Alternative.

**Figure 2-5. TSM Project Alternative Plan View**

## 2.4 Pedestrian Shift Alternative

The Pedestrian Shift Alternative is the preferred alternative and is referred to in this document as the proposed project. The Pedestrian Shift Alternative generally consists of realigning Kamehameha Highway mauka up to 80 feet from its current location from the Haleiwa side of Lauhulu Stream bridge to the Haleiwa side of Kawailoa Stream bridge, for roughly 1,100 feet. A typical section of the realigned highway is provided in Figure 2-6 and a plan view is shown in Figure 2-7. Components and details of this Alternative include:

- A highway right-of-way that is generally 120-feet wide with two 12-foot wide through lanes (one in each direction) and a 10-foot wide median refuge lane for part of the realigned distance;
- A normal asphalt road structure with provisions on the makai edge of the highway, a buried concrete cut-off wall, to reduce the potential of soil erosion from under the roadway where needed;
- Vehicular guardrails to prevent parking on the mauka side of the shifted highway, placement of guardrails on the makai side of the shifted highway will be evaluated during final design to allow for streamlining of vehicles;
- Existing cross streets and driveways would be modified to allow access to the realigned Kamehameha Highway with a vehicle control gate at Pohaku Loa Way;
- Streetlights would be installed on the mauka side of the highway;
- Drainage improvements;

- A new bridge at Lauhulu Stream on the mauka side of the existing Lauhulu Stream Bridge; and
- Re-purposing the highway by converting the mauka lane of the existing Kamehameha Highway to a 16-foot wide shared use path for bicycles and pedestrians. The makai lane would be partially removed and revegetated.

This Alternative is based on the previously developed "Minor" Alternative without a large coastal revetment and the "Quinlan" Alternative without parking and tight curves (Section 2.5.3). Because the road is shifted, there would be no open area for parking on the mauka side and the temptation to park and cross the road to access the beach would be removed. However, the makai side of the realigned Highway could accommodate parking with an estimated capacity of 90 cars in the 60-foot-wide by 400-foot-long space. This would exceed the estimated 50-60 cars that could park on the mauka side of the highway under the No Build Settlement.

During construction, the parking area may be restricted or limited by placing guardrail or barriers, as determined by the Contractor's work areas. The guardrail will provide safety by separating the public vehicles and pedestrians from the construction area. Estimated timeframe for construction is 24 months.

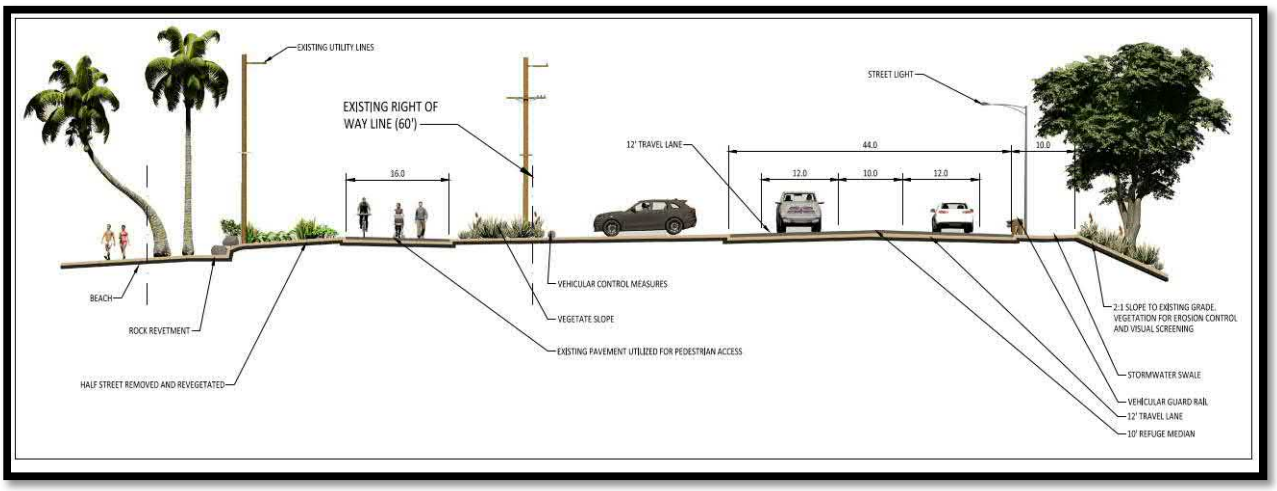



**Figure 2-6. Pedestrian Shift Alternative Alignment Typical Section**

**Figure 2-7. Pedestrian Shift Alternative Plan View**

## 2.5 Other Alternatives Considered but Eliminated

Eleven (11) realignment alternatives were considered in addition to the Pedestrian Shift Alternative. Many of these alternatives are variations of a principal or distinct alignment. Principal alignments that are described in greater detail in subsequent sections are shown in ***bold italics***. Some of these principal alternatives are shown in Figure 2-8.

Realignment alternatives that were considered include:

Alternative 1: Use Cane Haul Road

Alternative 2: Use Cane Haul Road with tighter corners with more super elevation – this option became the ***Most Realignment Alternative***;

Alternative 3: Move existing Kamehameha Highway 250' mauka and connect to Frontage Road (allows for extension further in the Waimea direction);

Alternative 4: Move existing Kamehameha Highway 250' mauka but use the existing Chun's Reef Bridge;

Alternative 5: ***Minor Realignment*** (slighter shift mauka than previous alternatives with revetment fronting Laniakea Beach);

Alternative 6: ***Moderate Realignment*** (similar to Alternatives 3 and 4 but different Waimea terminus);

Alternative 7: New Realignment (alignment running parallel between Moderate and Most);

Alternative 8: ***Waimea Extension*** (allows for Moderate, Most, or New Alignment Alternatives to meet up with the existing Kamehameha Highway at a point closer to Waimea);

Alternative 9: ***Quinlan Realignment*** (Quinlan's proposed relocation of Kamehameha Highway to occur mauka of the future Laniakea Beach Support Park.);

Alternative 10: Modified ***Quinlan Realignment*** (adjusts the Quinlan Realignment to meet design standards for roadway geometry, resulting in an alignment similar to Alternatives 3 and 4 with a different Waimea terminus);

Alternative 11: Modified ***Most Realignment*** (refines Alternative 2 based on input from Kamehameha Schools to shift the realignment curve as far Makai as possible to avoid cultural sites previously unidentified).

In addition to these eleven alternatives for realignment, three (3) connector route alternatives were developed.

Any alternative for consideration had to be designed to comply with the following standards to the extent possible and applicable:

- Americans with Disabilities Act (ADA)
- American Association of State Highway Transportation Officials' (AASHTO's) A Policy on Geometric Design of Highways and Streets
- AASHTO's Guide for the Development of Bicycle Facilities

- AASHTO's LRFD [Load and Resistance Factor Design] Bridge Design Specifications
- AASHTO's Roadside Design Guide
- FHWA's Manual on Uniform Traffic Control Devices (MUTCD)
- HDOT's Design Criteria for Bridges and Structures
- HDOT's Design Criteria for Highway Drainage
- HDOT's Hawaii Statewide Uniform Design Manual for Streets and Highways
- HDOT's Stormwater Permanent Best Management Practices Manual

Each alternative was evaluated on its ability to meet the project purpose and need (See Section 1.5), meet engineering standards, and for their potential to cause significant negative impacts on the natural and human environment. These alternatives were removed from consideration at various times during the review process and are discussed below.

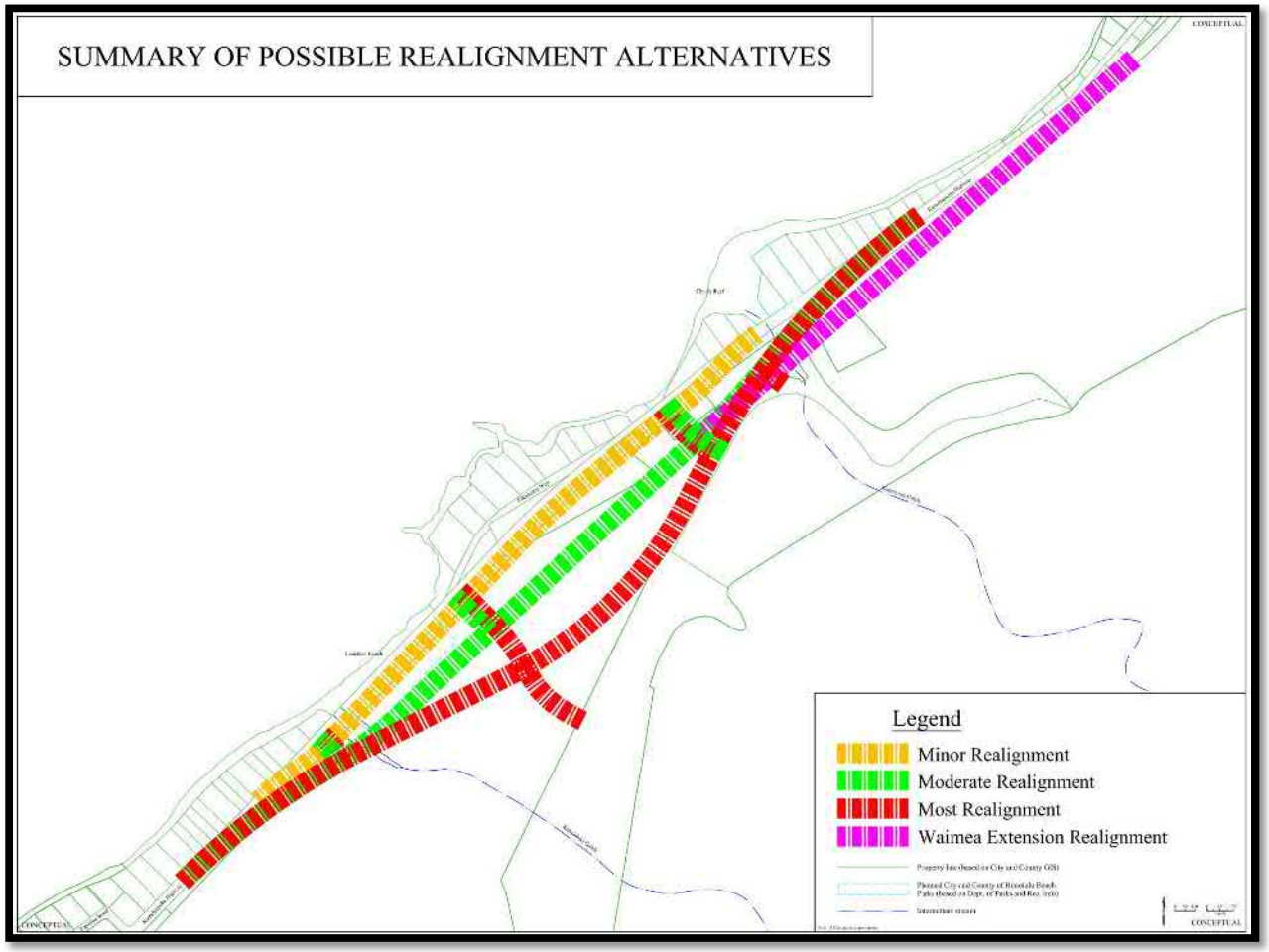



**Figure 2-8. Other Principal Alignments Considered**

Alternatives that did not involve realignment, such as building a pedestrian bridge or signalizing the crosswalks, were also considered. See Section 2.5.7 for a discussion of non-realignment alternatives.

### 2.5.1 Most Realignment Alternative

A well-studied and strongly considered alternative is known as the "Most Realignment" Alternative. It is similar to realignments previously discussed by the DLNR's Office of Conservation of Coastal Lands (Section 1.4).

The "Most Realignment" generally consists of realigning Kamehameha Highway mauka as far as feasible from a location on the Haleiwa side of the Lauhulu Stream bridge to the Waimea side of Ashley Road, a distance of roughly 0.8 mile. A typical section of the realigned highway is provided in Figure 2-9 and a plan view is shown in Figure 2-10. The realigned highway would cross the relatively low-sloped coastal plain and run along the base of the relatively steeper "pali" where a former cane haul road exists. By utilizing the existing cane haul road, the "Most Realignment" would be less likely to encounter undiscovered archaeological sites.

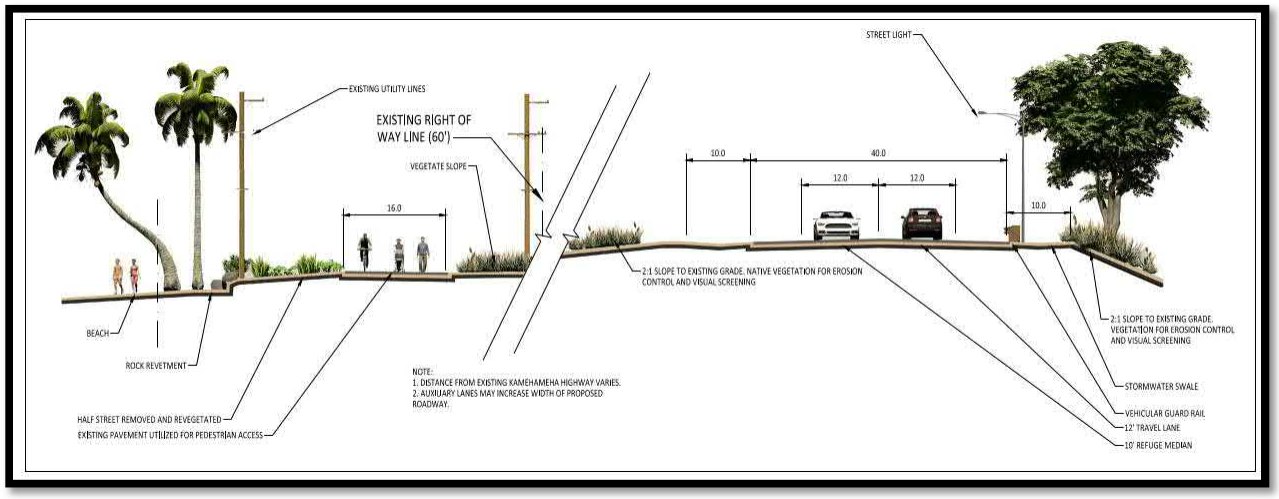



**Figure 2-9. "Most Realignment" Typical Section**

**Figure 2-10. "Most Realignment" Alternative Plan View**

The components of this Alternative included:

- Guardrails and fencing on both sides of Kamehameha Highway.
- Existing cross streets and driveways would be modified to allow access to the shifted Kamehameha Highway.
- Streetlights would be installed on the mauka side of the highway every 120 feet.
- Two new bridges. One at Lauhulu Stream (on the Haleiwa side of Laniakea Beach; also referred to as Lauhulu Stream/Kukaeohiki Gulch) and one at Kawailoa Stream (near Chun's Reef).
- A 16' shared use path on one lane of the existing Kamehameha Highway for bicycles and pedestrians. The other lane would be partially removed and revegetated.
- A new plantation access road to provide access to properties and the City DPR's future beach support.

This alignment was developed after evaluating many other inland alternatives. It was the most studied inland alternative because its impacts on cultural and historic resources were not well known until the project had advanced through many of the steps of environmental review process (see Section 3.3).

This Alternative was removed from consideration because of significant impacts on cultural and historical resources, cost, schedule, and effects on Kamehameha Schools' property.

As described in Section 3.4, Kamehameha Schools, as the property owner, and the Polynesian Voyaging Society representatives utilize a cultural site named Kahokuwelowelo Heiau located mauka of the project area for observations and training youth in traditional navigation and culture. This important site was deemed too close to the Most Realignment to avoid light, noise, and other unacceptable impacts from this highway alternative. Modest changes in the alignment, road geometry, and lighting on the Most Realignment were deemed ineffective in preserving the setting of this historical and cultural resource. In addition, the proposed highway alignment would bifurcate the cultural landscape, diminishing the historic and cultural context of the area.

Kamehameha Schools, besides being guardians of the area's cultural heritage, was also concerned with the highway's incursion into their property. They have had numerous occurrences of trespassing, incidents involving cattle, and breeches of their security. The Most Realignment would have created an orphan property between the old Kamehameha Highway and the new highway. The orphan area would likely be used to walk between the old and new highways and for illegal camping. The area contains numerous important historic and cultural properties that would be threatened or destroyed by these illegal activities.

A conceptual project schedule for this Alternative, showing that it would take about six (6) years to construct the realigned highway, was also unacceptable to HDOT.

After the pedestrian accident in 2019, HDOT's concern for pedestrian safety motivated the State to find a new funding source that could be used for the project. The Pedestrian Shift Alternative could be constructed with State funds from rental car surcharges rather than the federal funds for protecting the highway from erosion. This would enable a shorter environmental review process timeframe, and allow for an expedited design and construction timeframe.

### 2.5.2 Minor Realignment Alternative

The "Minor" Realignment Alternative generally consists of realigning Kamehameha Highway mauka roughly 60 feet from its current location from the Haleiwa side of Lauhulu Stream bridge to the Haleiwa side of Kawailoa and placing a revetment on the makai side of the realigned highway. The alignment is somewhat similar to the Pedestrian Shift, but the elevation of the highway would also be raised roughly 6 to 10 feet vertically. This would be achieved using an earthen embankment and revetment which would be located near the existing highway's location and consist of large boulders or other suitable material.

This Alternative was rejected for its impact on the shoreline and coastal processes. As the sea encroaches on the beach, the revetment would have acted as a seawall, removing the beach and destroying turtle habitat.

### 2.5.3 Quinlan Realignment Alternative

The "Quinlan" Alternative (Figure 2-11) was presented to the Task Force on September 25, 2013 by Bill Quinlan. The same basic design was published in the Star Advertiser on July 14, 2015 by concerned North Shore residents. The alignment would move Kamehameha Highway inland directly in front of Laniakea beach. The geometry of the proposed highway has curves that would

be too tight for the speed limit. In this vicinity, Kamehameha has a 45 mile-per-hour (mph) design speed and is signed for 35 mph. To accommodate such tight turns, a 20 mph design speed would have been required and the turns would have been signed for 10 mph. When the curves are 'smoothed out' the alignment essentially becomes the Pedestrian Shift Alternative, the project proposed in this EA. The Pedestrian Shift can be built following geometric design parameters and standards.

**Figure 2-11. Quinlan Realignment Alternative**

### 2.5.4 Moderate Realignment Alternatives

Many other alignments like the "Moderate" Realignment Alternative (shown in green on Figure 2-8) were also considered between the Minor and Most realignments. These alignments had greater impacts on the archeological sites that were identified during early pedestrian surveys for the project and had a greater possibility of uncovering additional, as of yet, unidentified sites during construction.

### 2.5.5 Waimea Extension of Realignment

Also considered was a plan to continue realigning Kamehameha Highway inland for another approximately half mile toward Waimea as part of the Moderate or Most realignments. The

extension would allow a longer straight road but would have affected Kawailoa Ranch's riding trails and Tin Roof Ranch's frontage, as well as eliminate several driveways on Kamehameha Highway. This extension was eliminated because the primary purpose of the project is to address safety.

### 2.5.6 Pedestrian Shift Alternative Configuration Options

The following configuration options were considered for the Pedestrian Shift Alternative based on suggestions during the pre-EA scoping comments. Some of these options are still under consideration and are marked with an asterisk (*).

- Once realigned, using the existing Kamehameha Highway for access to a parking area. The suggestion was to use Pohaku Loa Way to connect back onto the highway, thus preventing cars from backing out of stalls onto the highway. This could not be considered because Pohaku Loa Way is a private street. In addition, any alternative that leaves Kamehameha Highway as a frontage road was rejected because HDOT cannot retain two parallel/redundant routes.

- Another suggestion was to use the entire City DPR park land as temporary parking or to consider Kamehameha Schools property for parking while the Pedestrian Shift is constructed. This mitigation would not be possible because it would require pedestrians and the general public to pass through active construction work zones.

- A suggestion was made to decrease lane width to slow traffic down if the Pedestrian Shift Alternative is constructed. Reducing the lanes to 11 feet will be considered as the project design progresses. *

- The suggestion to stripe the 10-foot median of the realigned highway for a turn lane will be further evaluated during final design. Current plans include a left-turn lane that would be striped for access to Pohaku Loa Way for residents. This median lane becomes striped as a storage lane area where cars may wait or queue without impeding traffic.

  During final design, HDOT will evaluate whether installing guardrail with openings on the makai side of the realigned highway is needed for circulation, this may have a bearing on how the lanes are striped. *

- Suggestions were made not to place a guardrail on the mauka side of the existing highway during construction of the Pedestrian Shift Alternative because this configuration of the Pedestrian Shift Alternative would limit coastal access until the new parking area was available.

  A guardrail along the existing highway during construction would be needed for the safety of highway operations, pedestrians, and construction workers. Temporary parking and construction in the same area would cause for extremely unsafe conditions between the public and the construction work, therefore temporary parking during construction could not be committed to. Additionally, the reduction of these unsafe conditions would assist in a timely construction completion.

- In conjunction with the Pedestrian Shift Alternative, the suggestion was made to revegetate the entire existing Kamehameha Highway instead of leaving a 14-foot-wide portion of the

old highway in place and revegetating only half. Bikes are rarely seen on Kamehameha Highway as it is a dangerous road for biking so there would be no regional connectivity. In addition, the asphalt half of the old highway could be used for unpermitted commercial purposes such as surf schools or lunch wagons. In addition, vegetation would help with the erosion control and make the area more scenic. Planting trees could block the ocean view and drivers would not be as distracted. Vegetation also prevents cars from parking in places that block visibility.

Re-purposing the existing Kamehameha Highway as a shared use path allows for the historic Lauhulu Bridge to remain in place with some function or context, while initiating a link for regional future multi-modal connectivity consistent with community and regional plans. It is a secondary purpose and need for the projected as described in Section 1.5.4. Measures such as bollards or recycled telephone poles are proposed to protect the path for non-motorized, maintenance, and emergency vehicle use only.

### 2.5.7 Non-Realignment or Crossing Alternatives

Erecting a pedestrian bridge or crosswalks were also options that were discussed at various times during the planning process. However, it is shown that pedestrians prefer to limit walking distance and will often take usual shortcuts to save even a few steps and seconds of time (Texas Transportation Institute, 2000). This study showed that virtually no one will use a pedestrian overpass if it takes 25% longer to cross compared to crossing at grade.

While the No Build Settlement Alternative includes crosswalks, HDOT usually does not provide signalized crosswalks where no sidewalks exist. In addition, there is a question of how much pedestrians would use a crosswalk. Pedestrians are likely to cross the highway when they see an opening, rather than waiting at a crosswalk. In addition, the pedestrians would still be stopping traffic, which has been a cause for congestion.

## 2.6 Project Cost and Schedule

Cost estimates for the Pedestrian Shift Alternative were generated based on conceptual engineering. Construction costs are estimated at $12,000,000 without including the costs to obtain rights-of-way. The project would be constructed with State funds only.

The project schedule is as follows:

- Completion of Environmental Review: December 2021
- Obtain SMA Use permit: July 2022
- Complete Design: January 2023
- Accept Bids to Construct: June 2023
- Award Construction Contract: December 2023
- End Construction: June 2025

## 2.7 Permits and Approvals

Table 2-1 lists approvals and permits that may be required prior to the construction of the proposed project. Applications for most of these permits cannot be made until the HRS Chapter 343 environmental review process is complete.

**Table 2-1. Permits and Approvals**

| Agency | Permit or Approval | Status |
|---|---|---|
| Department of Land and Natural Resources (DLNR), State Historic Preservation Division (SHPD) | HRS Chapter 6E-8 Review | Coordination on-going. See Section 3.4. |
| DLNR, Land Division | Shoreline Certification | Shoreline Certified July 30, 2020. |
| DLNR, Office of Conservation and Coastal Lands | Conservation District Use Permit | Portions of the project are within the Conservation District, based on Shoreline Certification July 30, 2020. Because all project elements makai of the shoreline are within the existing roadway right-of-way, the State Highway exemption codified in HRS 264-6(2) applies. Conservation District design review or approval is not required for the project. |
| City and County of Honolulu, Department of Planning and Permitting | Special Management Area Use Permit and Shoreline Setback Variance | To be obtained once HRS 343 is complete. |
| Department of the Army (DA); (U.S. Army Corps of Engineers, Regulatory Branch) | CWA Section 404, Department of the Army Permit | Not required. New bridge abutments would be outside the stream channel; no wetlands would be impacted. See Section 4.2.3. |
| Department of Health (HDOH), Clean Water Branch (CWB) | CWA Section 401 WQC | Required only if Section 404 permit is required. |
| DLNR, Commission on Water Resource Management (CWRM) | Stream Channel Alteration Permit (SCAP) | Not required. Bridge designed to avoid altering stream channel. |
| HDOH, CWB | National Pollutant Discharge Elimination System (NPDES) Permit for storm water discharges relating to construction activities | To be obtained during final design. |
| HDOH, Indoor Air and Radiological Branch | Noise Permit | To be developed during final design. |
| HDOH, Indoor Air and Radiological Branch | Noise Variance | To be developed during final design if off-hours (i.e., night/weekend) construction is desired. |

# 3.0 AFFECTED ENVIRONMENT, POTENTIAL IMPACTS, AND PROPOSED MITIGATION

This chapter describes the existing environmental conditions of the project site, potential long-term impacts of each project alternative, and the proposed mitigation measures to avoid, minimize, or mitigate those potential effects. The relative impact that will likely remain after mitigation is also described. Each section within this chapter is dedicated to analyzing a specific environmental or social discipline. Short-term potential construction phase impacts are discussed in a single section, Section 3.16.

The information about existing conditions, potential impacts, and potential mitigation measures presented in this chapter has been developed through (a) the review and use of existing information related to the project areas (see references section); (b) studies conducted specifically for this project (see appendices); (c) coordination with regulatory agencies; and (d) consultation with stakeholders.

## 3.1 Physical Geography and Coastal Processes

### 3.1.1 Existing Condition

*Geographic Setting*

The project is located on the edge of the northwest flank of the Koolau Mountains. Prominent physical features in the vicinity of the project site are the shoreline, which transitions from a relatively wide sandy beach in the southwest of the project area, fronting the surf spot known as Laniakea's, then running northeast to a rugged basaltic rocky headland which fronts the surf spots known as Hultin's and Jocko's. The intersection between the sandy beach and the rocky point forms a relatively sheltered cove, where sea turtles are known to congregate in large numbers, drawing large crowds of tourists and visitors who come to see the protected marine animals. A small stream variously referred to as Lanaikea Stream/Lauhulu Stream/Kukaeohiki Gulch, cuts a modest natural drainage channel from mauka to makai, running under the small bridge at the southwest end of Laniakea Beach. The terrain slopes generally upward to the Koolau mountains from the Highway until it reaches a steep-sided escarpment, the base of which is approximately 800 feet from the Highway, beginning at roughly 60 feet above mean sea level (MSL). The makai area is heavily developed with private homes along the shoreline and Highway and scattered with structures and farmland mauka of the Highway. Appendix D, a Coastal Engineering Assessment for the Kamehameha Highway Pedestrian Safety Realignment at Laniakea Beach prepared by Sea Engineering, Inc., provides a detailed description of the geographic setting.

The geology between the volcanic basalt mountains and the coast is Holocene alluvium with sandy beach deposits interbedded with the alluvium. Rock formations on the beach include basalt outcrops, reef rock (coralline limestone), and beach rock (cemented beach sand). The soils mauka of the beach sand at Laniakea Beach have been classified by the Natural Resources Conservation Services (USDA- NRCS, 1972) as Waialua Silty Clay, a phase of the Waialua Series of moderately

well-drained soils on alluvial fans derived from weathered basalt and present on smooth coastal plains.

*Coastal Erosion*

Shoreline erosion for many Hawaii coastlines is caused by hurricanes/storm surge, waves, extreme tides, and occasionally tsunami. With additional erosional pressures likely due to climate change and sea level rise, it is prudent to consider the area at risk. As described in Appendix D, the Coastal Engineering Assessment, Laniakea Beach is dynamic, showing large variations in sand distributions, but the long-term shoreline position appears stable.

The University of Hawaii Coastal Geology Group (UHCGG, 2010) conducted a shoreline erosion study for Oahu by analyzing the position of the beach low water mark on a series of historical aerial photographs. The UHCGG transect study shows areas of long-term beach toe recession on the order of 0.5 to 1.0 foot per year, and similar areas of accretion on the order of up to 0.5 foot per year (Figure 3-1).

**Figure 3-1. Historical aerial photograph analysis by UHCGG**

Although shoreline erosion is difficult to quantify on the North Shore because of the inherently dynamic beaches, recent erosion episodes and indicators, including preventive measures on Laniakea Beach, have shown the vulnerability that exists. With additional erosional pressures likely due to climate change and sea level rise, the project area is at risk. If historic trends continue as illustrated in Figure 3-1, Kamehameha Highway could be eroded away in the near future.

*Sea Level Rise*

Sea level rise has the potential to impact beaches and shorelines in Hawaii. Impacts may include beach narrowing and beach loss, loss of land due to erosion, and infrastructure damage due to inundation and flooding. The impacts from anomalous sea level events (e.g., king tides, mesoscale eddies, storm surge) are also likely to increase. A 2015 study found that, due to increasing sea level rise, average shoreline recession (erosion) in Hawaii is expected to be nearly twice the historical extrapolation by 2050, and nearly 2.5 times the historical extrapolation by 2100 (Anderson et al., 2015).

The State of Hawaii recently published the Hawaii Sea Level Rise Vulnerability and Adaptation Report (Hawaii Climate Change Mitigation and Adaptation Commission (HCCMAC), 2017), which discusses the anticipated impacts of projected future sea level rise on coastal hazards, and the potential physical, economic, social, environmental, and cultural impacts of sea level rise in Hawaii. The State of Hawaii conducted numerical modeling to estimate the potential impacts that a 3.2-foot rise in sea level would have on coastal hazards including passive flooding, annual high wave flooding, and coastal erosion. Figure 3-2 shows the annual high wave flooding exposure area in the vicinity of the project area with 3.2 feet of sea level rise.

The Statewide Coastal Highway Program Report (SCHPR) is a report authored by University of Hawaii (UH) researchers (primarily from the Department of Civil and Environmental Engineering) for the State of Hawaii Department of Transportation. The report was released in August 2019 (Francis et al, 2019). The report includes the definition of an index system, referred to as the Coastal Road Erosion Susceptibility Index (CRESI) to rank coastal roadway systems by their susceptibility to erosion and structural collapse. The CRESI system ranks the project area as having a high susceptibility to coastal erosion. In addition, the CRESI study rates roads that when damaged by coastal hazards, the resulting losses can be substantial and unduly large. The SCHPR report's adaptation recommendations for the project stretch are to monitor the site.

**Figure 3-2. Annual High Wave Flooding at Laniakea Beach under a 3.2-foot Sea Level Rise Scenario**

*Floodplains and Flood Hazards*

The National Flood Insurance Program (NFIP), administered by the Federal Emergency Management Agency (FEMA), maintains floodplain and flood hazard maps for use in determining a reference height that allows property insurance companies to assess flood risk, known as the Base Flood Elevation. On the North Shore of Oahu, Hawaii, the 1% annual flood risk is considered by FEMA to be a result of tsunami wave inundation, and not from storm surge or rainfall accumulation.

The existing Kamehameha Highway in the project area is mostly in the VE zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves (including tsunami runup) and Zone AE (combined zones also in the 100-year flood limits). The current roadway is sometimes (regularly or annually) closed during high surf and flooding because it is rendered too hazardous to travel (NSSCP, 2011). A small portion of the existing highway mauka of Pohaku Loa Way is in Zone D where flood hazards are undetermined, but possible. The FIRM maps indicate that homes on the makai side of Kamehameha Highway in the project area are in flood hazard zones indicating high risks of flooding (Figure 3-3).

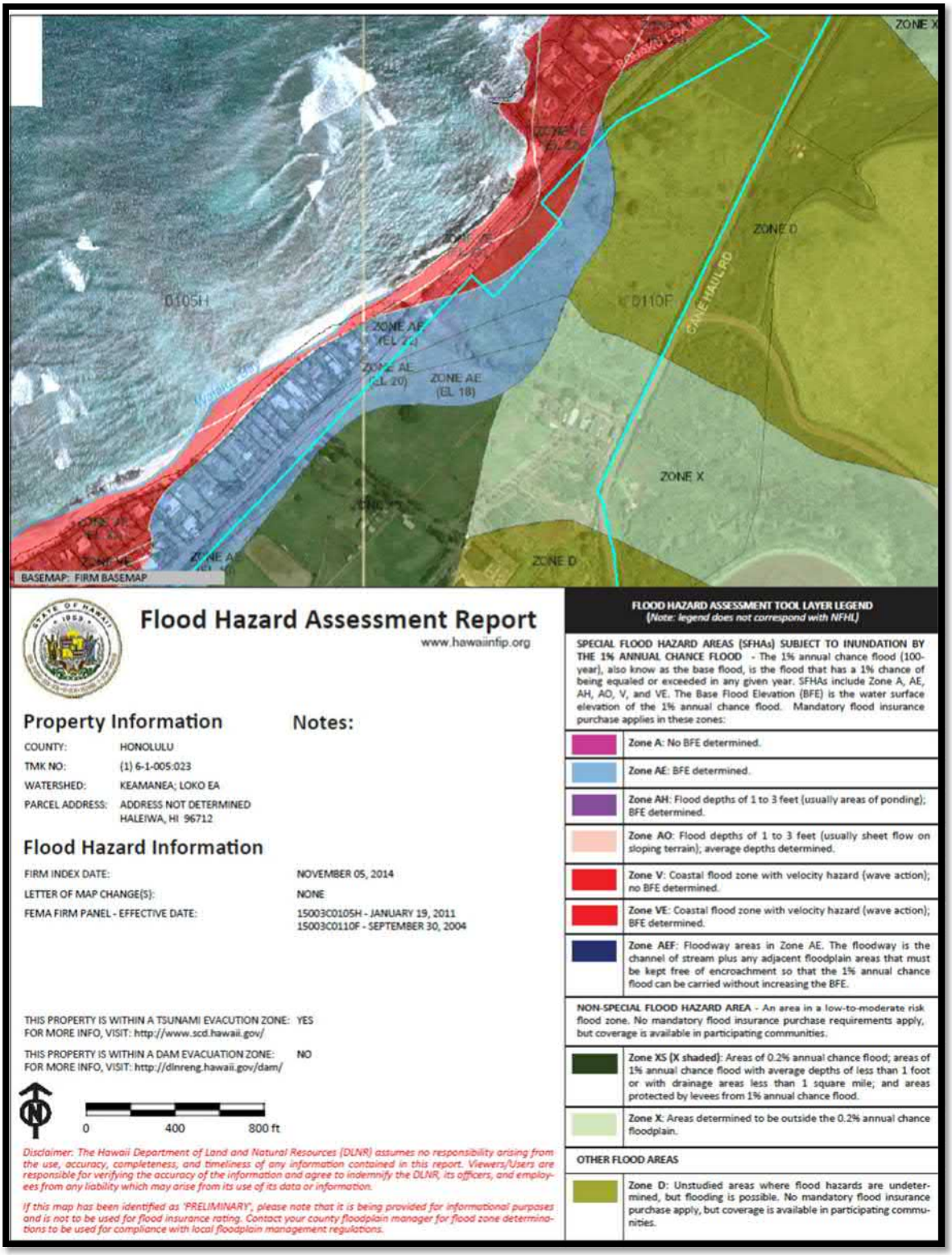



**Figure 3-3. Flood Hazard Assessment Report**

*Tsunami Hazards*

Multiple government agencies attempt to describe and illustrate the hazard created by tsunami to protect the community. A tsunami is a series of waves in a water body caused by the displacement of a large volume of water, generally in an ocean. They are commonly caused by large magnitude earthquakes (typically magnitude 7.0 or greater). Tsunami often travel outwards in a series of waves which occupy the entire water column, even at abyssal depths. Tsunami waves typically have small wave heights in deep water but can have wavelengths of hundreds of miles and travel at speeds up to 500 miles per hour. A tsunami can travel from one side of the Pacific to the other in less than a day. The speed decreases rapidly as the water shoals. The waves increase greatly in height as they shoal, and tsunami runup can push far inland at high speed. Receding waters may also have considerable speed, and the recession often causes as much damage as the original wave front itself.

Most tsunami in Hawaii originate from the tectonically active areas located around the Pacific Rim (e.g., Alaska, Japan, and Chile). Waves created by earthquakes in these areas take hours to reach Hawaii, and the network of sensors that is part of the Pacific Tsunami Warning System can provide Hawaii with several hours of advanced warning prior to the arrival of tsunami waves generated from these locations. Less commonly, tsunami originate from seismic activity in the Hawaiian Islands, and there is less warning for these locally generated events.

Historical tsunami runup in Haleiwa has been recorded as far back as 1878. Table 3-1 is a list of recorded tsunami runup data for the Haleiwa area.

**Table 3-1. Historic Tsunami Runup for Haleiwa**

| Year | Runup (feet) | Source Area |
|---|---|---|
| 1878 | 9 | Aleutian Islands |
| 1923 | 12 | Kamchatka |
| 1946 | 11 | Eastern Aleutian Islands |
| 1652 | 17 | Kamchatka |
| 1957 | 17 | Central Aleutian Islands |
| 1964 | 15 | Gulf of Alaska |
| 1994 | 2 | Kuril Islands |

Sea Engineering Inc. (SEI) applied a FEMA-recognized and accepted methodology to calculate tsunami runup elevations along the Laniakea project site for existing ground conditions, where runup is defined by the United States Geological Survey (USGS) as, "…a measurement of the height of the water onshore observed above a reference sea level"—in this case, MSL. Existing calculations completed by FEMA are based on the same method; however, cross shore transects were spaced far apart (hundreds of meters) along the shoreline. The FIRMs represent the inundation contours interpolated between these far-spaced calculated transects, as determined by floodplain engineers. By comparison, SEI used tightly spaced transects along the shoreline to provide significantly higher resolution for the inundation results. As expected, since the FIRMs used essentially the same method as the SEI study to determine for the hazard zones, the Base Flood Elevation contour values were comparable to the calculated tsunami wave surface elevation values from this analysis. However, because SEI used more closely spaced transects, the calculated tsunami wave surface elevation values from this analysis are much more precise and can provide greater resolution and insight into localized flooding.

*Tsunami Evacuation Zones*

The State has determined evacuation zones to inform the public about evacuating the area when a tsunami is predicted. Based on the Tsunami evacuation zone maps prepared by the City's Department of Emergency Management, the project area is within the tsunami evacuation zone (Figure 3-4).

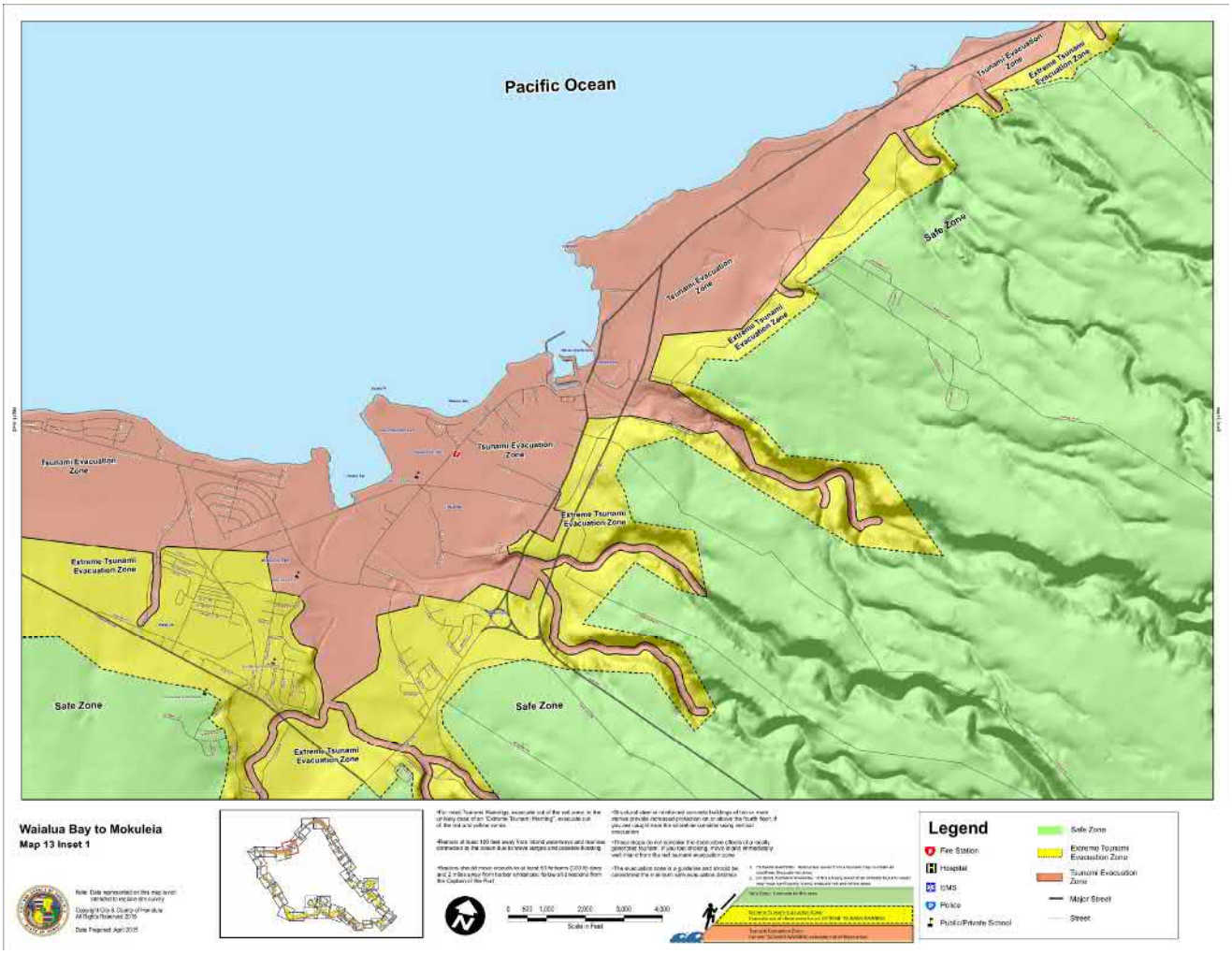



**Figure 3-4. City and County of Honolulu Tsunami Evacuation Zones**

## 3.1.2 Potential Impacts

*No Build Alternative*

Coastal Erosion

Under the No Build Alternative, Kamehameha Highway could be eroded away in the near future, and this section of roadway would remain susceptible to periodic closures during high wave and storm events. It is anticipated that HDOT would continue to address the undermining of the Highway through emergency maintenance repairs, so these closures would be somewhat

temporary. Depending on the severity of the damage or extent of undermining, the road could be out of service anywhere from just a few hours to 9-12 months. Its service would become less and less reliable. Loss of a single road such as Kamehameha Highway in the project area can disrupt traffic flow patterns over a large area, block emergency access, and material delivery.

Sea Level Rise

Figure 3-2 shows the annual high wave flooding inundation that would take place with 3.2 feet of sea level rise in the project area. The results show that the existing Highway could be overtopped and inundated periodically with greater severity and extent than experienced currently for the benchmark year (year 2100).

Not shown in the figure is that much of Kamehameha Highway within the project area would already be inundated by the 0.5-foot sea level rise, a benchmark that is projected for year 2030 (HCCMAC, 2017 and 2021).

Similar to the effects of coastal erosion, is anticipated that HDOT would continue to address the Highway flooding through emergency maintenance repairs, so closures would be somewhat temporary, assuming the passive flooding model. Under more extreme scenarios of flooding, the road could be rendered out of service until remediation is done. Loss of Kamehameha Highway in the project area would cause severe disruptions to the community's access to goods and services along the North Shore, including emergency access, and material delivery.

Flood and Tsunami Hazards

Kamehameha Highway would remain in the tsunami evacuation area prepared by the City's Department of Emergency Management.

*No Build Settlement Alternative*

Coastal Erosion

Under the No Build Settlement Alternative, similar to the No Build, Kamehameha Highway would become less and less reliable. Loss of a single road such as Kamehameha Highway, even temporary, in the project area can disrupt traffic flow patterns over a large area, block emergency access, and material delivery. Because Kamehameha Highway would provide access to a City parking area in this scenario, the area used for parking would be inaccessible, flooded, and rendered out of service until remediation is done.

Sea Level Rise

Under the No Build Settlement Alternative, similar to the No Build, Kamehameha Highway would become less and less reliable. Under more extreme scenarios of flooding, the road and access to the City parking area would be flooded and rendered out of service until remediation is done. Loss of Kamehameha Highway in the project area would cause severe disruptions to the community's access to goods and services along the North Shore, including emergency access, and material delivery.

Flood and Tsunami Hazards

Kamehameha Highway would remain in the tsunami evacuation area prepared by the City's Department of Emergency Management.

*TSM Alternative*

Coastal Erosion

The TSM Alternative would not meet the project's stated purpose and need to improve the Highway's reliability for service, as it would not address Kamehameha Highway's vulnerability to coastal erosion (See Section 1.5.2).

Sea Level Rise

The TSM Alternative would not meet the project's stated purpose and need to improve the Highway's reliability for service (See Section 1.5.2).

Flood and Tsunami Hazards

Under the TSM Alternative, the existing flooding issues and evacuation zones would remain unchanged. The guard rail on the mauka side of the Highway would not effectively block flooding hazards or tsunami runup.

Kamehameha Highway would remain in the tsunami evacuation area prepared by the City's Department of Emergency Management.

*Pedestrian Shift Alternative*

Coastal Erosion

The proposed project would protect Kamehameha Highway from the impacts of erosion by shifting the road approximately 80 feet inland. In addition, as described in Section 2.4, the proposed highway consists of normal asphalt road structure with a buried concrete cut-off wall on the makai edge as a provision to reduce the future potential undermining of the roadway.

Sea Level Rise

The proposed project would protect Kamehameha Highway from the impacts of sea level rise by shifting the road approximately 80 feet inland. Inland relocation minimizes the extent of Kamehameha Highway's projected vulnerability to flooding caused by a 3.2-foot sea level increase (year 2100). Under the current models, the proposed realigned Highway would remain outside the sea level exposure area at the 2.0-foot sea level rise benchmark (year 2075) (HCCMAC, 2017 and 2021).

As sea level rise surpasses the 2.0-foot sea level rise benchmark and approaches the 3.2-foot sea level rise (year 2100), the realigned Highway would begin to experience inundation at the lower-lying areas near Lauhulu Stream Bridge. Based on this understanding, the proposed realignment would serve as a mid-term mitigation, providing an additional 45 years of reliable service.

As described in Section 2.4, the proposed highway consists of normal asphalt road structure with a buried concrete cut-off wall on the makai edge, which would protect the road from being undermined or washed out during severe flood events.

Flood and Tsunami Hazards

Kamehameha Highway would be realigned with a similar elevation as the existing roadway. Grading and filling would be required to accomplish this. According to the locally specific tsunami modeling conducted for this project, under the Pedestrian Shift Alternative, the new road would continue to be in the flood zones VE, AE, and D. Homes on the makai side of Kamehameha Highway in the project area would remain in the flood hazard zones indicating high risks of flooding, as they currently are. Modeling results also showed that the water surface elevation during a flood would potentially change due to the proposed project, mostly in the vicinity of Lauhulu Stream. As a result, the Pedestrian Shift Alternative could 'trap' the tsunami in a limited area predominantly in front of the beach due to the barrier effect of the elevated road decks, potentially causing a localized increase (compared to existing) of tsunami water surface elevation levels adjacent to or over the proposed new roadway. It can be seen in Figure 3-5 that a visible area of wave surface elevation increase—by approximately 1 foot—appears over the new road deck on the northeast side of the bridge over Lauhulu Stream, along with an even shallower area of increase (less than 1 foot) located approximately 500 feet further down the new road alignment in the Waimea direction. The greatest increase of up to 1.4 feet would be adjacent to the bridge. This increase is countered by a slight decrease in wave surface elevation across the extent of the runup mauka of the new road alignment (shown as light blue on Figure 3-5). Inland inundation distance is unchanged at all other locations. In considering these changes, it is important to note that SEI used closely spaced transects to provide a greater resolution or detailed view of localized flooding. Whereas FIRM maps use transects that are hundreds of meters apart to interpolate inundation contours, the contours developed in the SEI model were tightly spaced. Thus the level of change detected, when viewed from a flood zone or FIRM map perspective, are not sufficient to change the flood zone or Base Flood Elevations.

The area most impacted by the tsunami inundation would be Kamehameha Schools' property near the Lauhulu Stream, which is part of the Kawailoa Ranch. The area near the stream is a low-lying area used for grazing cattle, and is subject to periodic flooding, likely from mauka rainfall and ocean runup. Remnants of the City's property that occur mauka of the realigned highway and Kawailoa Ranch's riding trails would experience a shallow increase. No habitable structures would be affected.

**Figure 3-5. Illustration of the Difference Between the Existing Tsunami Wave Surface Elevation and Modeled Change in Wave Surface Elevation Caused by the Proposed Project (Wave Surface Elevation Contours in Feet)**

There would be no impact on the tsunami evacuation zone map prepared by the City's Department of Emergency Management. Both the existing highway and the proposed project are within the tsunami evacuation zone (Figure 3-4).

### 3.1.3 Avoidance, Minimization, and Mitigation Measures

*TSM Alternative*

Under the TSM Alternative, no Avoidance, Minimization, and Mitigation Measures are suggested for this project. Seawalls, scour protection, beach sand maintenance and other temporary measures could be considered to protect Kamehameha Highway but are not part of this proposed project.

*Pedestrian Shift Alternative*

For tsunami hazards and floodplain development, modeling shows that the proposed road would be in the flood zones VE, AE, and D and would continue to be exposed to the threat of flooding caused by tsunami. Homes on the makai side of Kamehameha Highway would be unaffected by the proposed project and would remain in the flood hazard zones indicating high risks of flooding. Although modeling shows an area impacted by increased inundation, the affected area is in the cattle grazing areas on the Waimea side of Lauhulu Stream Bridge, the empty remnant City, and riding trails. Once the tsunami has passed, similar to other flood events currently experienced, the waters would recede, allowing grazing and use of the trails to resume. The increase in inundation would not affect any structures, so no Avoidance, Minimization, and Mitigation Measures are proposed.

Changes to flood zones or to established Base Flood Elevations are not anticipated, therefore a Conditional Letter of Map Revision would not be required.

## 3.2 Land Use

### 3.2.1 Existing Condition

Land use in the project area has been static for the last few decades. Makai of Kamehameha Highway, privately-owned parcels with residential uses are present on either side of Laniakea Beach. Land use mauka of the Highway is primarily owned by the City and County of Honolulu's Department of Parks and Recreation (City DPR) and Kamehameha Schools.

Initially owned by Kamehameha Schools, the property directly mauka of Kamehameha Highway was procured by the City DPR to develop the "Laniakea Beach Support Park" across from Laniakea Beach. The park was planned to generally consist of a parking area, comfort station, and landscaping. Although an EA has been completed for the beach park project (City, 2005a), the City has indicated that they do not intend to move forward with its development.

The remainder of land mauka of Kamehameha Highway is owned by Kamehameha Schools and is used for ranching, agriculture, and other cultural practices. Kawailoa Ranch operates nearest to the Highway with horse boarding, riding trails, and cattle grazing.

In terms of future land use trends, Kamehameha Schools' (KS) "Moku O Waialua North Shore Plan, Paalaa to Kapaeloa" plan (2010) outlines potential projects on their land holdings (roughly 26,200 acres) in the region (See Figure 3-6).

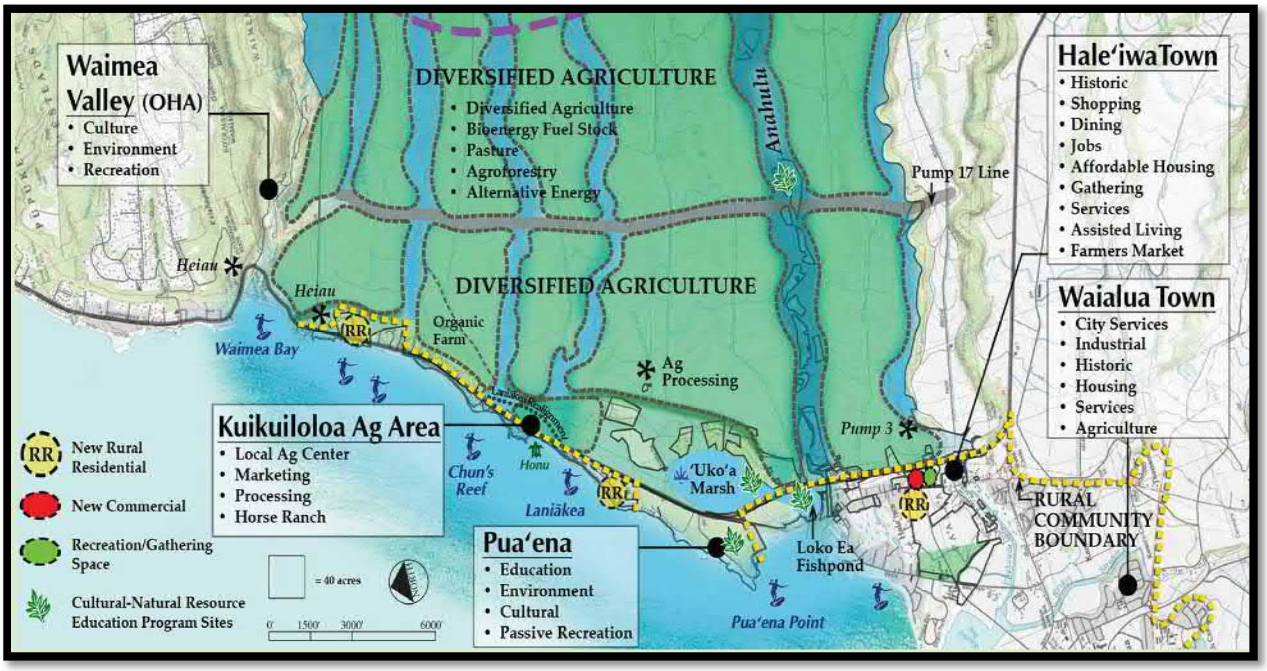



**Figure 3-6. Map from Kamehameha Schools' Moku O Waialua North Shore Plan, Paalaaa to Kapaeloa**

Intended to be consistent with the City's North Shore Sustainable Communities Plan, it includes the following potential future land uses in the project area:

- New infill residential housing areas in Papailoa and Kapaeloa. These projects will "develop approximately 40-50 and 70-80 market-priced house lots for custom home

development, at lot sizes consistent with the surrounding residential subdivisions. Based on the plan map these two residential developments are not within the project area but would occur near the end of the project.

- Kuikuiloloa Agricultural Area is indicated on a plan map in the project area but is not described in detail in the plan. Activities planned for this area include a "local ag center, marketing, processing, and horse ranch." The plan indicates "For the agricultural lands below the bluff, an agricultural water allocation has been obtained from the Honolulu Board of Water Supply and lessees will be transitioning to this new and reliable potable water source. Water and other infrastructure improvement to the Kuikuiloloa Ranch area will secure long term leases with existing and new tenants. The BWS water will be utilized for the Punanue Organic Farm that will increase diversified agriculture acreage and KS' commitment to sustainability."
- Diversified Agriculture would take place further mauka and include "diversified agriculture, bioenergy fuel stock, pasture, agroforestry, and alternative energy." A windfarm alternative energy project has already been developed in the mauka area.

Although the scale of the map does not allow for details concerning the exact alignment for Kamehameha Highway, the road's "Laniakea Realignment" is identified by the land use plan with the Kuikuiloloa Agricultural Area makai of the realignment. The plan suggests that Kamehameha Schools had initially anticipated an alignment further mauka. However, since the plan was published in 2010, the Polynesian Voyaging Society's Malama Honua Worldwide Voyage from 2013 to 2019, has reactivated the site as a kipuka for culturally based learning and place to celebrate Hawaii's native cultural heritage (August 16, 2019 letter from Kamehameha Schools). Accordingly, long term plans for the properties have shifted towards restoring cultural resources that occur within the area such that the mauka alignment is no longer a reflection of Kamehameha Schools' vision.

### 3.2.2 Potential Impacts

*No Build Alternative*

Under the No Build Alternative, no land use impacts would occur.

*No Build Settlement Alternative*

Under the No Build Settlement Alternative, land use would be similar to the No Build as people would continue to informally park vehicles on the City DPR's property.

*TSM Alternative*

Under the TSM Alternative, no land use impacts would occur.

*Pedestrian Shift Alternative*

The Pedestrian Shift Alternative would require ROW acquisition as estimated in Table 3-2. Although coordination is on-going, negotiation on these acquisitions have not yet been finalized with the parcel owners; therefore, the exact acreages are unknown. The current estimate of total acquisition area is approximately three (3) acres.

**Table 3-2. Summary of Potential ROW Acquisition**

| TMK | Area (acres) | Owner | Use | Pedestrian Shift Alternative Acquisition (estimated acres) |
|---|---|---|---|---|
| 6-1-005:023 | 144 | KSBE | Ranch/pasture | 0.4 |
| 6-1-005:023 | 144 | KSBE | Ranch/pasture | 0.2 |
| 6-1-005:024 | 2.084 | City's DPR | Undeveloped, planned Laniakea Beach Support Park | 0.8 |
| 6-1-009:004 | 2.028 | Ung, et.al. | Undeveloped, portion former OR&L ROW | 0.15 |
| 6-1-009:021 | 0.707 | City's DPR | Undeveloped, planned Laniakea Beach Support Park | 0.07 |
| 6-1-009:022 | 0.389 | KSBE | Undeveloped, former OR&L ROW | 0.4 |
| 6-1-010:019 | 0.346 | City's DPR | Undeveloped, planned Laniakea Beach Support Park | 0.3 |
| 6-1-010:020 | 1.44 | KSBE | Ranch/pasture; former OR&L ROW | 0.5 |
| Total | | | | 3 acres |

The Pedestrian Shift Alternative has been designed to avoid and minimize impacts to the City DPR's undeveloped park parcels to the degree possible. However, this Alternative impacts the Laniakea Beach Support Park to the extent that may require redesign of the facilities described in the EA (City, 2005a).

Compliance with eminent domain rules and regulations require fair compensation for the land acquired. The full amount of right-of-way to be acquired will be based on property owner negotiations.

Right-of-way acquisition would result in partial displacement of Kawailoa Ranch's pastureland located Haleiwa of Lauhulu Stream Bridge. Additionally, about 500 feet of a riding trail near Pohaku Loa Way would be affected. The City DPR's acquisition of the Kamehameha Schools property has already disrupted portions of the trail. These land use impacts are not anticipated to be so severe that they would cause the ranch to become inoperable. No land use would be totally displaced.

### 3.2.3 Avoidance, Minimization, and Mitigation Measures

*TSM Alternative*

No Avoidance, Minimization, and Mitigation Measures are needed for the alternative.

*Pedestrian Shift Alternative*

As noted in Section 3.2.2., none of the land use activities occurring on the affected parcels would be fully displaced. However, coordination with the landowners and tenants of affected parcels will be conducted during the project's design to avoid, minimize, and mitigate any unforeseen impacts to land use operations or activities.

Any real property acquisitions or entitlements will be procured in accordance with federal, State and local regulations.

## 3.3 Historic and Archaeological Resources

### 3.3.1 Regulatory Requirements

HRS Chapter 6E-8 (HRS 6E-8), requires State agencies to take into account the effect their projects have on historic properties. Hawaii State statutes define "historic property" as any building, structure, object, district, area, or site, including heiau and underwater sites that is over 50 years old. Only those resources that are considered "significant" are protected by HRS 6E-8.

For a resource to be considered significant it must possess integrity of location, design, setting, materials, workmanship, feeling, and association and meet one or more of the following criteria:

a. Be associated with events that have made an important contribution to the broad patterns of our history;

b. Be associated with the lives of persons important in our past;

c. Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value;

d. Have yielded, or is likely to yield, information important for research on prehistory or history;

e. Have an important traditional cultural value to the native Hawaiian people or to another ethnic group of the state due to associations with traditional cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group's history and cultural identity.

Pursuant to HRS 6E-8, HDOT can render one of the following two possible findings for SHPD review and concurrence:

- No historic properties affected; or
- Effect, with proposed mitigation commitments.

"No historic properties affected" means that either there are no significant historic properties present, or there are significant historic properties present but the undertaking would have no effect upon them of any kind (HAR 13-275-7).

"Effect, with proposed mitigation commitments" means that the project will affect one or more significant historic properties, and the effects will be potentially harmful. However, the agency has proposed mitigation commitments involving one or more forms of mitigation to reasonably and acceptably mitigate the harmful effects.

### 3.3.2 Existing Condition

An archaeological inventory survey (Rechtman and Lauko 2020) conducted for the current proposed project identified two historic properties, one of which is also a cultural resource – a

modified bedrock outcrop that may have been part of the ceremonial cultural landscape that also includes Kahokuwelowelo and Iliilikea heiau along with other related sites (See Section 3.4).

The recorded historic properties in the project area have been assessed for their significance based on criteria in HAR 13-275-6.

SIHP Site L-Bridge

The Lauhulu Stream Bridge (also known as Laniakea Stream or Kukaiohiki Gulch) (Site L-bridge) was previously evaluated as significant under Criterion c (MKE and Fung 2013:4-123) "for its association with early developments in concrete bridge construction in Hawaii." Citing it as "a is a good example of a 1930's reinforced concrete bridge that is typical of its period in its use of materials, method of construction, craftsmanship, and design." The current study found the bridge to be in the same condition as it was when it was earlier evaluated, with no diminished integrity; thus, the Lauhulu Stream Bridge continues to be evaluated as significant under Criterion c as a representative example of 1930s engineering and design in the context of roadway construction in Hawaii.

SIHP Site T-1

Site T-1 is a modified bedrock outcrop interpreted to be a possible ceremonial site. Given this functional interpretation, the site is assessed as significant under Criterion d as a potential source of information relative to pre-contact ceremonial activities within a cultural landscape where several other functionally similar sites have been identified, and under Criterion e for the cultural value that Hawaiian communities assign to such sites. Site T-1 lies within a parcel owned by Kamehameha Schools. While identified to be partially within the current study corridor, this site falls outside of the proposed development footprint.

### 3.3.3 Potential Impacts

*No Build Alternative*

Under the No Build Alternative, no historic properties would be affected.

*No Build Settlement Alternative*

Under the No Build Settlement Alternative, no historic properties would be affected.

*TSM Alternative*

Under the TSM Alternative, no historic properties would be affected.

*Pedestrian Shift Alternative*

Lauhulu Stream Bridge (also referred to as the Laniakea Stream Bridge) would not be physically impacted by the proposed roadway realignment project. A new bridge would be constructed inland along the proposed alignment. The historic bridge would remain in place for pedestrian use; thus, the recommended treatment is preservation in the form of avoidance and protection (conservation).

While Site T-1 is identified to be partially within the current study corridor, this site falls outside of the proposed development footprint, and once roadway construction is complete the realigned Kamehameha Highway will be no closer to Site T-1 than it is currently. Additionally, the area of Site T-1 will not be acquired by the HDOT, but rather will remain under the ownership and control of Kamehameha Schools. Thus, beyond making sure the site is protected during construction activities, any long-term treatment of the site is not within the purview of the HDOT. This finding has been shared with Kamehameha Schools, including the treatment of Site T-1 as ultimately their kuleana (right, responsibility).

### 3.3.4 Avoidance, Minimization, and Mitigation Measures

*TSM Alternative*

No Avoidance, Minimization, and Mitigation Measures are needed for the alternative.

*Pedestrian Shift Alternative*

Given the design of the proposed roadway realignment project, both sites identified within the study corridor would be physically avoided during construction. The Lauhulu Stream Bridge will be converted to pedestrian use, and Site T-1 will remain undisturbed on land owned by Kamehameha Schools. See Section 3.16.7 for protective measures to be employed during construction.

With respect to the Lauhulu Stream Bridge, both the change in use and the alterations of the immediate surrounding environment would be considered an effect as identified in HAR §13-275-7(b), thus the HRS Chapter 6E-8 determination of effect for the proposed project is "effect with proposed mitigation." In accordance with HAR §13-275-8(a)(1)(A), the proposed mitigation is preservation in the form of avoidance and protection (conservation).

Also, given the presence of Jaucus sand deposits within the current study corridor, as an additional precautionary mitigation, archaeological monitoring has been agreed upon between the HDOT and the SHPD. An archaeological monitoring plan will be prepared in accordance with HAR §13-279-4 and submitted to the SHPD for review and acceptance prior to initiating any ground-disturbing activity. If iwi kupuna are discovered during construction, all work shall be halted, the SHPD shall be contacted, and treatment of the site shall be conducted in accordance with HAR §13-300.

## 3.4 Cultural Resources

Gathering input from community members with genealogical ties and long-standing residency or relationships to the study area is vital to the process of assessing potential cultural impacts to resources, practices, and beliefs. It is precisely these individuals that ascribe meaning and value to traditional resources and practices. Community members often possess traditional knowledge and in-depth understanding that are unavailable elsewhere in the historical or cultural records of a place. As stated in the OEQC Guidelines for Assessing Cultural Impacts (OEQC 1997), the goal of the oral interview process is to identify potential cultural resources, practices, and beliefs associated with the affected project area.

In order to prepare a Cultural Impact Assessment (CIA) Report in support of the project, ASM Affiliates identified the following 13 individuals and organizations as possessing knowledge

related to the project area vicinity or other aspects related to the proposed highway realignment project:

| | |
|---|---|
| Jan Becket* | Blake McElheney |
| John DeSoto* | Kathleen Pahinui |
| Malia Evans | Benton Kealii Pang |
| KAHEA – The Hawaiian Alliance | The Office of Hawaiian Affairs (OHA) |
| Shad Kane | Robert "Bobby" Robinson* |
| Bob Leinau* | Wailua Hawaiian Civic Club |
| Mike Lyons | |

Of these 13 individuals/organizations contacted via email, USPS letter, and/or phone, four (4) individuals accepted the interview request. They are noted above with an asterisk (*).

OEQC Guidelines for Assessing Cultural Impacts – Section III regarding ethnographic and oral history interview procedures, suggests that the inclusion of "any constraints or limitations which might have affected the quality of the information as obtained" (OEQC 1997). In December 2019, the World Health Organization (WHO) detected an unknown pneumonia in China and later declared a Public Health Emergency of International Concern the following month. The newly discovered global coronavirus, later called COVID-19, eventually impacted Hawaii. From March 26 through May 6, 2020, the State of Hawaii began a mandatory Stay-At-Home order and encouraged social distancing practices to prevent the spread of COVID-19. Although the Stay-At-Home order was lifted, the residents of Hawaii remain strongly encouraged to maintain social distancing practices and avoid large gatherings. In lieu of some in-person interviews, ASM Affiliates opted to hold telephone and video-conferencing conversations as alternative methods to the consultation process. The first interviews with Bobby Robinson, John DeSoto, and Jan Becket were conducted before the Stay-At-Home mandate, thus, ASM was able to physically meet with these individuals. Subsequent interviews with all four individuals were conducted in July and August and were thus conducted via phone.

It should be noted that some individuals and organizations prefer to meet in-person to share certain items and knowledge, particularly those pieces that are of particular importance to them and their ohana. This could consist of, but not be limited to: personal photos, archaeological sites, trails, gathering areas, etc. Due to COVID-19, that was not possible. The quality of information exchanged during the consultation for this project has been useful in identifying potential cultural impacts; however, not being able to meet in-person, which is the preferred method of consultation for a CIA, may have affected the quality of the information obtained, although this is not readily apparent.

As part of the interview process and with the consent of the interviewees, the interviews were audio recorded for note taking purposes only. Upon completion of the interview, ASM prepared an interview summary, which was emailed to the interviewees for review. Interviewees were asked to review the draft summary and make any necessary edits. With the approval of the interviewees, the finalized version of the summaries was compiled in a CIA report. The CIA report is not

included with this EA in order to protect significant cultural sites by not disclosing their exact locations. The CIA report findings are summarized below.

### 3.4.1 Existing Condition

The Kawailoa plain, the location of the project area, has had a good amount of archaeological and cultural studies with findings spanning from pre-contact to early and late Historic eras. The current project area has been subject to two previous archaeological studies (Hammatt and Shideler 2012; Tulchin et al. 2012) and one recent study (Rechtman and Lauko 2020) (See Section 3.3.). Work has also been conducted mauka within the Kawailoa Ranch property that is owned by Kamehameha Schools, a native Hawaiian trust organization founded by Bernice Pauahi Bishop. Several archaeological/cultural sites have been identified in the vicinity of the current project area through both prior archaeological studies and consultation with Jan Becket, Robert "Bobby" Robinson, and John DeSoto.

The majority of archaeological and cultural studies conducted in Kawailoa focus on two areas: the western-end of the ahupuaa near Loko ea, Ukoa, and the Anahulu River, and to the north of the project area closer to Waimea Bay and valley where heiau such as Kupopolo, Ke Ahu o Hapuu, and Puu o Mahuka stand. Both ends of the ahupuaa have yielded a great deal of pre-contact findings indicating habitation and ceremonial/religious functions, respectively. Historic findings on both ends stem from the plantation era and military activities.

Prior cultural studies conducted within and in the vicinity of the current project area identified cultural concern for encountering burials in the sandy portions of the current project area. While no such sites were encountered during the subsurface testing that was conducted as part of the Rechtman and Lauko (2020) study, the area southward of Lauhulu Stream was identified to contain Jaucas sand. It is within such deposits that Halealoha Ayau, of the now dissolved Hui Malama I Na Kupuna O Hawaii Nei, has indicated iwi kupuna could be found. Mr. Robinson has suggested archaeological and cultural monitoring for all excavation activities.

While the background research and consultation process did not identify any ongoing traditional cultural practices within the current project area, several such practices do occur in the vicinity of the project area, including surfing, limu picking, subsistence fishing (including with a pole and throw net) and diving. Associated traditional aina cultural practices outside of the project area include heiau practices related to solstice/equinox and weather observations, huakai (trips) to archaeological/cultural sites, invasive vegetation removal and site maintenance, observation and education of native birds for navigation purposes, and the restoration and propagation of native plants.

Interviewees Bob Leinau and Kamaki Worthington were particularly concerned about Kahokuwelowelo Heiau and suggested a perimeter be drawn to preserve the area around it. Mr. Worthington expressed concern with the concept of geotagging via social media, which could possibly bring unwanted visitors to the site. Although situated mauka, outside of the project area, Kahokuwelowelo Heiau is considered to be part of a larger cultural landscape that extends through the current project area to the shore. Past interviewees have suggested that the Cane Haul Road cut into Kahokuwelowelo destroying a large portion of the heiau which could extend further makai. It is recommended that the landowners coordinate with interested community members and organizations such as I Nui Ke Aho, a non-profit organization who cares for and conducts ceremonies at Kahokuwelowelo and other sites in Waialua; Malama Loko Ea Foundation; and

other interested parties (such as local schools). Collaborating with these groups to discuss regular vegetation removal from sites, continuing cultural practices and education, and establishing a protective perimeter around Kahokuwelowelo Heiau will serve as a potential mitigation and help to strengthen cultural bonds within the community.

Environmental concerns shared include sea level rise that erodes Laniakea Beach, which has also been associated with public safety, and the possible impact to the water table due to ground disturbance from the proposed project. The latter statement stems from knowledge of subterranean springs that flow from mauka to makai. It is recommended that special attention be paid during construction activities to limit impacts to the water table that could potentially affect the shoreline flow of fresh water and the growth of limu and the spawning of fish.

The proposed project would require HDOT to acquire land held since 1884 by the B. P. Bishop Trust Estate, a Native Hawaiian Organization whose mission it is to "…fulfill Pauahi's desire to create educational opportunities in perpetuity to improve the capability and well-being of people of Hawaiian ancestry" (Kamehameha Schools 2020). As such, any reduction to this estate – now Kamehameha Schools – directly impacts the trust and the organization's capacity to steward their land in accordance with Pauahi's will. Likewise, eliminating any portion of the estate's land impacts its resources and the trust's native Hawaiian beneficiaries.

### 3.4.2 Potential Impacts

*No Build Alternative*

Under the No Build Alternative, no cultural properties would be affected.

*No Build Settlement Alternative*

Under the No Build Settlement Alternative, no cultural properties would be affected.

*TSM Alternative*

Under the TSM Alternative, no cultural properties would be affected.

*Pedestrian Shift Alternative*

As noted in Section 3.4.1, while no cultural resources were identified within the project area (with the exception of the T-1 described in Section 3.3), concerns for kupuna iwi, property acquisition, and the environment were raised.

### 3.4.3 Avoidance, Minimization, and Mitigation Measures

*TSM Alternative*

No Avoidance, Minimization, and Mitigation Measures are needed for the alternative.

*Pedestrian Shift Alternative*

HDOT has agreed to conduct archaeological monitoring. An archaeological monitoring plan would be prepared in accordance with HAR §13-279-4 and submitted to the SHPD for review and acceptance prior to initiating any ground-disturbing activity. If iwi kupuna are discovered during

construction, all work shall be halted, the SHPD shall be contacted, and treatment of the site shall be conducted in accordance with HAR §13-300.

To minimize property acquisition, the current footprint of the proposed development area was significantly reduced as a result of consultation with the current Kamehameha Schools' lessee and community members. HDOT will continue to coordinate with Kamehameha Schools and affected lessees as design progresses.

## 3.5 Biological Resources

### 3.5.1 Existing Condition

A field survey was conducted by LeGrande Biological Surveys, Inc. and Pacific Rim Conservation in October 2019, August 2020, and March 2021. The Terrestrial, Vegetation, and Wildlife Survey is included in Appendix E.

Much of the project area is dominated by an overgrown forest of invasive tree species with a weedy understory. The species are consistent throughout this vegetation type with the dominant tree species including, koa haole (*Leucaena leucocephala*), autograph (*Clusia rosea*), monkeypod (*Samanea saman*), kiawe (*Prosopis pallida*), Chinese banyan (*Ficus macrocarpa*), Java plum (*Syzgium cumini*), and Christmas berry (*Schinus terebinthifolius*). Some mauka areas along the alignment are utilized for ungulate (horse and cow) pastures. These areas are dominated by grassy pastures for foraging or sections of bare dirt and trees scattered in or around the edges of the pastures.

Plant and wildlife habitats along the proposed alignment have been highly modified by human activities, including the intentional and accidental introduction of alien species. Indian mongooses (*Herpestes a. aurpunctatu*s) and feral cats (*Felis catus*) are common throughout the project area. Although not observed during the survey, there are also likely to be numerous rats (*Rattus exulans hawaiiensis*, and *Rattus norvegicus*) and mice (*Mus domesticus*).

Most of the bird species observed within the subject property are introduced. Indigenous bird species include the migratory shorebirds, the Pacific Golden Plover (*Pluvialis fulva*), and the Ruddy Turnstone (*Arenaria interpres*). Other common birds in the area are cattle egrets (*Bubulcus ibis*), doves (*Geopelia striata*), Japanese white eye (*Zosterops japonicas*), mynas (*Acridotheres tritis*), and bulbuls (*Pycnonotus jocosus*).

The endemic Hawaiian short-eared owl or *pueo* (*Asio flammeus sandwichensis*) was not observed nor is it known to occur in the area. It is listed as endangered by the State of Hawaii on the island of Oahu. *Pueo* occupy a variety of habitats and are most common in open habitats including grasslands and shrublands, often in urban areas. It is a ground nesting species, and thus sensitive to land clearing activities.

The Hawaiian hoary bat (*Lasiurus cinereus semotus*), which is listed as endangered by the U.S. Fish and Wildlife Service and the State of Hawaii, is known to occur nearby and could forage or roost in the project area. Hawaiian hoary bats roosts during the day in native and alien trees and other woody vegetation. During the bat breeding season (June through September), young bats may be left unattended in nursery trees while the adults are out foraging.

Although the project area does not provide suitable habitat for seabirds that are listed as threatened or endangered for protection under Section 7 of the Endangered Species Act, they may fly over the project area. Seabirds include the Wedge-tailed shearwater (*Puffinus pacificus*), also known as Uau Kani, the endangered Hawaiian Petrel (*Pterodrama sandwichesis*) and the threatened Newell's Shearwater (*Puffinus auricularis newelli*). The Wedge-tailed Shearwater is known to nest in the makai portion of the proposed Kawailoa Beach Park (City, 2005b).

No endangered water birds were observed during the field survey, and no wetland habitat was found that would be suitable for water birds.

Much of the coastline along the project area is dominated either by Laniakea Beach or by residential houses and yards planted with ornamental landscaping. A basalt rock headland divides the coastline and provides a sheltered cove used by Hawaiian Green Sea Turtles (*Chelonia mydas*) as a grazing area. The cove has become known as "Turtle Beach" and is a popular destination for tourists to observe the endangered species closely. The Hawaiian Green Sea Turtle or Honu is known to frequent the shoreline near Laniakea Beach and neighboring coastal strands, foraging on near shore reefs and resting on the sandy beaches. When Hawaii Tourism Authority funded Malama Na Honu, it became the official turtle viewing spot. The Hawksbill Sea Turtle (*Eretmochelys imbricate*) may also occur in the vicinity of the project site. Artificial lighting is an issue for sea turtles.

Hawaiian Monk Seals (*Monachus schauinslandi*) are also known to frequent the shoreline. The Hawaiian monk seal, is an endangered species of earless seal in the family *Phocidae* that is endemic to the Hawaiian Islands. They are primarily marine animals but haul out on land to rest and give birth.

The National Wetland Inventory (NWI) (2020) has mapped wetlands within the Lauhulu Stream (also referred to as Laniakea Stream/Kukaeohiki Gulch) vicinity of the proposed realignment (see Section 3.6). The stream channel itself is intermittent and appears to have water flow only during heavy rain events. Additionally, an area to the west of the stream is mapped as an estuarine and marine wetland by the NWI, but no evidence of standing water was observed to the west of the intermittent stream during the site survey. No wetland plant species (Obligate Wetland Species or Facultative Wetland Species) were observed during the site survey.

### 3.5.2 Potential Impacts

*No Build Alternative*

The No Build Alternative would not result in any new impacts to biological resources. Landscaping, which includes trimming grass and trimming trees as necessary to maintain safe highway operation, would continue to be maintained as it is now.

Tourists would continue to access the beach to observe and photograph the green sea turtles. The existing parking area on the mauka side of the road would remain barren ground that is susceptible to erosion.

*No Build Settlement Alternative*

The No Build Settlement Alternative would not result in any new impacts to biological resources. Landscaping, which includes trimming grass and trimming trees as necessary to maintain safe highway operation, would continue to be maintained as it is now.

The existing parking area on the mauka side of the road would remain barren ground that is susceptible to erosion. Vehicles parking in the area would contribute to the erosion and lack of vegetation.

*TSM Alternative*

The TSM Alternative would not result in any new impacts to biological resources. Landscaping, which includes trimming grass and trimming trees as necessary to maintain safe highway operation, would continue to be maintained as it is now.

The current barren parking area on the mauka side of the road would regrow and be less susceptible to erosion.

*Pedestrian Shift Alternative*

The proposed roadway realignment is not likely to have any detrimental effects on the plant and wildlife resources of the area. Plant and wildlife habitats along the proposed alignment have already been highly modified by human activities. Much of the plant and bird species observed within the subject property are introduced. The proposed project would allow the plants on the mauka side of the Highway to regrow as cars would no longer be parking in the area. On the makai side of the project area, one lane of the existing Kamehameha Highway would be removed and landscaped, which would promote long-term restoration of the beach ecosystem, resulting in beneficial impacts to wildlife.

The proposed roadway realignment is not likely to have an adverse effect on the avian resources of the area. None of the bird species observed in 2014, 2019, 2020 or 2021 at the proposed project are listed as endangered or threatened. The Pacific Golden Plover and Ruddy Turnstone are protected by the Migratory Bird Treaty Act, but they do not nest in Hawaii and are adaptable in their habitat use during the winter months, foraging and resting in a variety of open habitats, including pastures, grassy fields, lawns, beaches, and shorelines.

### 3.5.3 Avoidance, Minimization, and Mitigation Measures

*TSM Alternative*

No Avoidance, Minimization, and Mitigation Measures are needed for the alternative.

*Pedestrian Shift Alternative*

As shown in Figure 2-7, part of the existing pavement for Kamehameha Highway will be removed and landscaped. Areas that are disturbed during construction would be restored and revegetated.

Street lights would be on poles every 120 feet and would be designed to employ flat lens fixtures are designed to reduce glare and shield light from migrating birds and sea turtles.

As discussed in Section 3.16 on construction impacts, nighttime construction lighting will be limited when possible to protect seabirds, hoary bats, and sea turtles.

## 3.6 Surface Water Resources

### 3.6.1 Existing Condition

Laniakea Beach is well known for turtles and surf spots. Puu Nenue is a broad basalt headland that borders the north end of Laniakea Beach, and Puu Kolea is a broad sand point at the south end. The offshore area is known for high quality surf, with numerous well-known surf breaks including Jocko's, Hultin's, Laniakea's, and Himalaya's (Figure 3-7).

**Figure 3-7. Laniakea Beach Surf Spots**

Lauhulu Stream (also referred to as Laniakea Stream or Kukaiohiki Gulch) is an intermittent stream running through the project area roughly east to west: Lauhulu Stream empties at Laniakea Beach and the streambed is fairly shallow throughout the project area. The bridge overpass near the beach is mainly bare sand (Figure 3-8). The upper reaches of the stream are generally dry unless there are heavy rains and then the stream flows rapidly to the beach. There is periodically standing water on the mauka side of the Highway in the streambed after a storm.

**Figure 3-8. Existing Bridge Over Lauhulu Stream (Also Referred to as Laniakea Stream or Kukaiohiki Gulch)**

The National Wetland Inventory (NWI) (2020) has mapped wetlands within the Lauhulu Stream vicinity of the proposed realignment (Figure 3-9**).** The stream channel itself is intermittent and appears to have water flow only during heavy rain events. Additionally, an area to the west of the stream is mapped as an estuarine and marine wetland by the NWI, but no evidence of standing water was observed to the west of the intermittent stream during site surveys in March 2021 (Appendix E and Section 4.2.2). No wetland plant species (Obligate Wetland Species or Facultative Wetland Species) were observed during site surveys and no wetland soils were present.

While Laniakea Beach is on the DOH's 303d list of impaired waterways, no specific parameters are listed. Laniakea Stream/Kukaiohiki Gulch/ Lauhulu Stream are not on the 303d list.

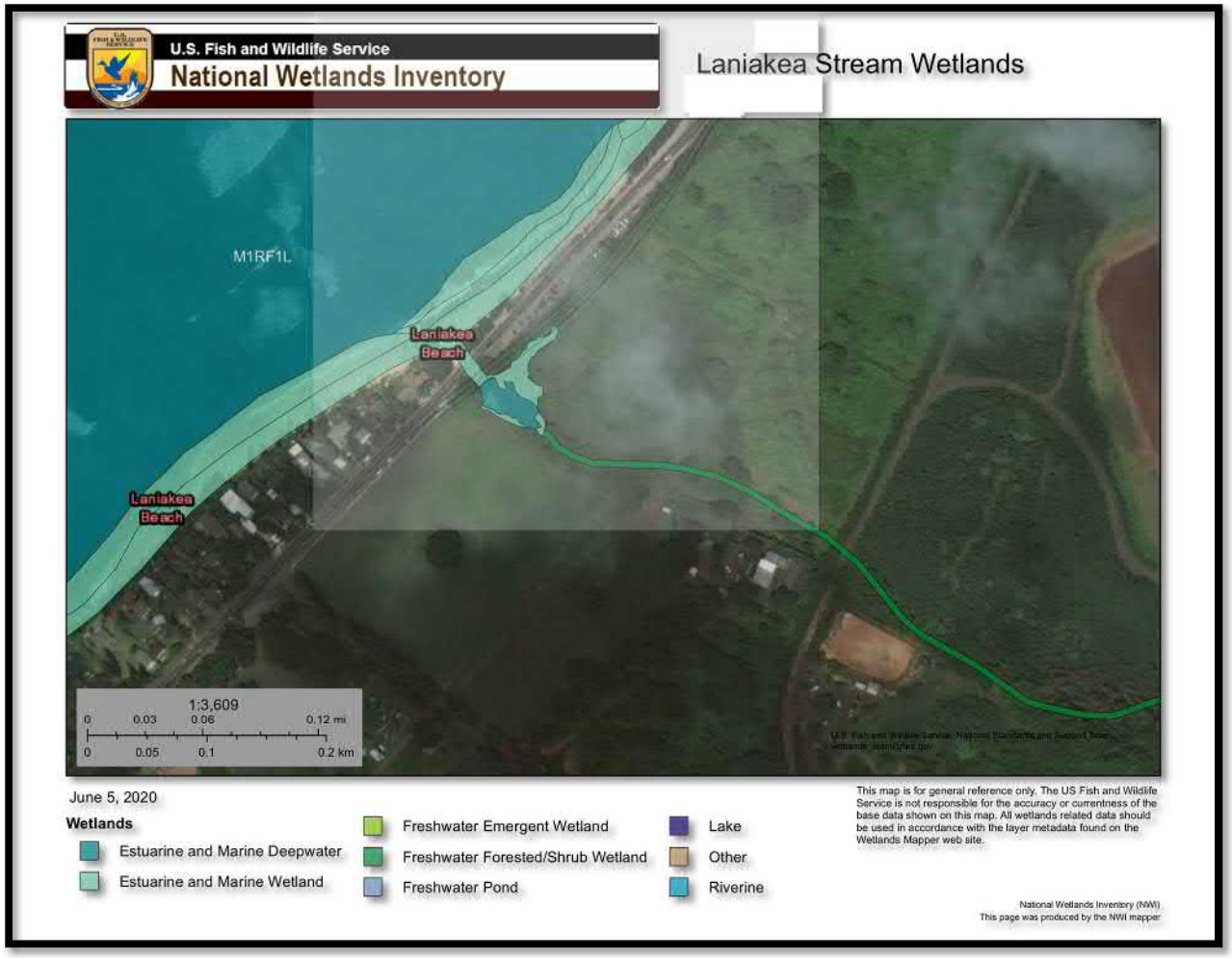



**Figure 3-9. National Wetlands Inventory – Lauhulu Stream Wetlands**

### 3.6.2 Potential Impacts

*No Build Alternative*

Under the No Build Alternative, no new impacts to water resources would occur.

*No Build Settlement Alternative*

Under the No Build Alternative, no new impacts to water resources would occur.

*TSM Alternative*

Under the No Build Alternative, no new impacts to water resources would occur. The current barren parking area on the mauka side of the road would regrow and be less susceptible to erosion.

*Pedestrian Shift Alternative*

For the proposed project, one new bridge over Lauhulu Stream would be required. The new crossing is located close to the existing bridge on Kamehameha Highway. The old bridge is 64

feet long and has a center pier (refer to Figure 3-8). The proposed bridge would be 100 feet long and have no central pier. The new bridge is at an angle to the old bridge because the new highway is curving inland. At their closest point, the two bridges would be approximately 15 feet apart, railing to railing, although this may change slightly during final design.

The new bridge span is short enough as to not require abutments or other structures in the stream beds or any potential adjacent wetlands. Permits related to structures in streams by the Army Corps of Engineers (USACE) and Section 404 of the Clean Water Act would not be required.

The new bridge over Lauhulu Stream will maintain the existing roadway vertical profile. The proposed bridge is sized to have greater flow conveyance capacity than the existing bridge (Appendix F).

With the construction of the new road, more stormwater will be generated from the impervious road surface. However, the amount of exiting impervious surface would be lower when one lane of the current Kamehameha Highway is removed.

### 3.6.3 Avoidance, Minimization, and Mitigation Measures

*TSM Alternative*

No Avoidance, Minimization, and Mitigation Measures are needed for the alternative.

*Pedestrian Shift Alternative*

Coordination with the USACE is being conducted in accordance with Section 404 of the Clean Water Act. The design for the new bridge would not require any permanent structural components be placed in the stream. HDOT would require, in the bid documents, that all contractors clearly illustrate how they would achieve the work without placing materials in the stream in their proposal. Keeping piers and abutements out of the stream and requiring the contractor to keep all their equipment and materials out of the stream will eliminate the need for a Section 404 Department of the Army (DA) permit.

By sizing the proposed bridge to have greater flow conveyance capacity than the existing bridge, no new flooding will be caused by the new bridge. Conveyance capacity for both bridges may require excavating the sand deposits downstream. A maintenance plan will be developed to ensure sand is cleared after storm surges.

The project will also implement the permanent Best Management Practice (BMP) of vegetated swales along the mauka side of the existing road to carry stormwater and to allow infiltration as seen on the cross section shown in Figure 2-6 (See also Appendix G).

## 3.7 Parks and Recreational Resources

### 3.7.1 Existing Condition

The project area is popular and highly visited due to the scenic beauty of the region, natural resources attractions, beaches, and surf. Within the project area is Laniakea Beach, well noted for the sea turtles that feed nearby and come to rest on the sand. As described in Section 3.6.1, Chun's Reef and multiple surf spots also lie within the project area and attracts surfers. Access to Laniakea

Beach is very important for locals and tourists alike and is central to HRS Chapter 205, Coastal Zone Management (See Section 3.17).

Two potential beach parks were studied by the City's DPR: the "Laniakea Beach Support Park" near Laniakea Beach and "Kawailoa Beach Park" near Chun's Reef (Figure 3-10). However, the City's DPR has advised HDOT in a meeting on October 11, 2019 that it does not plan to move forward with either park development at this time.

**Figure 3-10. Proposed City and County of Honolulu Parks**

### 3.7.2 Potential Impacts

*No Build Alternative*

The No Build Alternative would not impact current recreational uses in the area or the City DPR's planned parks. Nothing related to parks and recreational resources would change. Residents and tourists would continue to cross the Highway to access Laniakea Beach.

*No Build Settlement Alternative*

The No Build Settlement Alternative would provide sanctioned parking for Laniakea Beach. Given the existing usage of the same parking area on the mauka side of the Highway, visitation to these recreational sites is anticipated to remain largely the same. There may be a slight increase in visitation, by both tourists and locals alike, if parking access and pedestrian safety is enhanced with guardrails and crosswalks.

*TSM Alternative*

The TSM Alternative would not impact the City DPR's ability to implement the parks in the future.

*Pedestrian Shift Alternative*

For the Pedestrian Shift Alternative, recreational access would continue at Laniakea Beach with the provision of access to parking on the makai side of the Highway. The walk to the beach from the parking area would be safer and easier, especially for families and those with disabilities.

The Pedestrian Shift Alternative was designed recognizing the City DPR's potential future park use. This Alternative would not preclude the City DPR from developing a formal parking area or beach support amenities.

As discussed in Section 3.16.4, parking and access to Laniakea Beach as a recreational area would be more difficult during construction as a guardrail barrier would be installed as determined by the Contractor to establish the work areas. This impact would be temporary, as construction is anticipated to last for up to 24 months.

### 3.7.3 Avoidance, Minimization, and Mitigation Measures

*TSM Alternative*

No Avoidance, Minimization, and Mitigation Measures are needed for the alternative.

*Pedestrian Shift Alternative*

Shifting the Kamehameha Highway mauka would support ready access to Laniakea Beach and its recreational resources by removing the conflicts between the Highway and those wishing to access the beach. As noted in the previous section, parking and access to Laniakea Beach would be temporarily limited for up to 24 months while the improvements are constructed.

## 3.8 Visual and Aesthetic Resources

### 3.8.1 Regulatory Requirements

The project will not use federal funding and will not be required to complete FHWA's *Guidelines for the Visual Impact Assessment of Highway Projects* (FHWA 2015). However, these guidelines, referred to as the "FHWA guidelines," are a broadly accepted approach to analyzing visual impacts, particularly for transportation projects. The FHWA guidelines use changes in visual character and viewer group sensitivity to assess changes in visual quality. The Visual Impact

Assessment prepared for this project is provided in Appendix H. Results of the study are summarized in the remainder of this section.

### 3.8.2 Existing Condition

Areas of ranch land on the coastal plain on the mauka side of the Highway, particularly in the vicinity of the proposed project, offer open views south and east of the Highway toward the bluffs and are characterized by pasture, fencing, and areas of common coastal vegetation (Figure 3-11). Land cover, such as human-made structures, exist but are dispersed and generally not visible from the Highway.

**Figure 3-11. Typical Existing Mauka Side View from Kamehameha Highway in the Project Area**

Periodic scenic beach and open ocean views are available on the makai side of the Highway, including views at Laniakea Beach, which lies within the project limits (Figure 3-12). A portion of Kamehameha Highway in the project area gives drivers their first glimpse of the ocean as they approach the North Shore. The ocean is very close to the Highway and the view is stunningly beautiful. The view of Laniakea Beach, with its turtles, surf, and sand, draws in both residents and visitors alike.

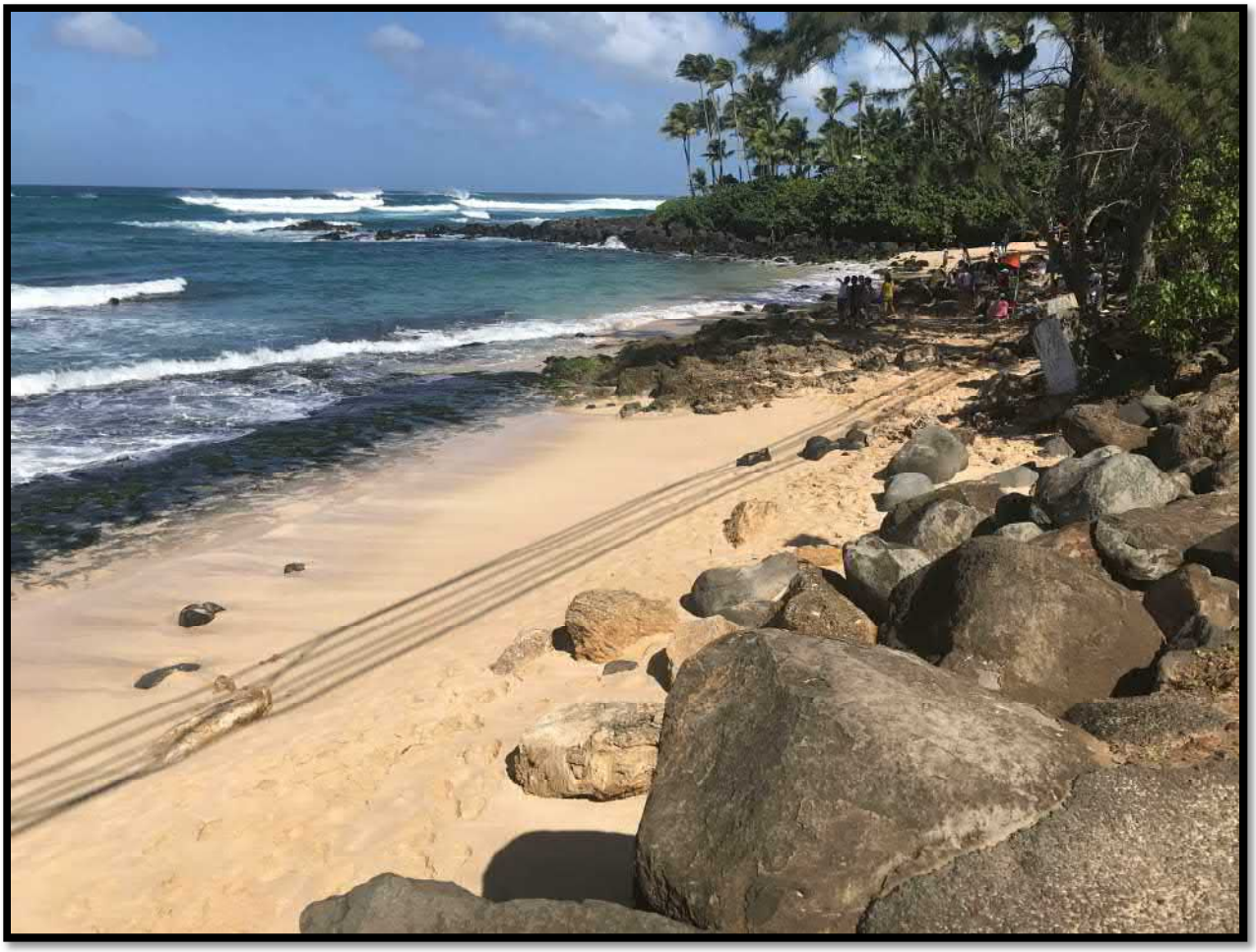


**Figure 3-12. Typical Existing Makai Side View from Kamehameha Highway in the Project Area**

Generally, however, the makai side of the Highway is characterized by human-made features and existing vegetation. Human-made features consist of one or two-story residential building structures with open and opaque fencing and gates of varying materials. These structures are typified by wood/vinyl siding, stucco, natural stone veneers, concrete, metal, glass, and bright colors.

Indoor and outdoor electrical lighting is commonly visible from the highway corridor. Overhead utility lines are common within the highway corridor and can be on both the makai and the mauka sides of the Highway. Figure 3-12 shows the shadow of utility lines on the beach itself.

A culturally sensitive site lies north and east of the project site along Kamehameha Highway. It is located on bluffs above the Highway and overlooks Laniakea Beach. It has views extending both north and south into the middle and background distance zones; however, most views of the Highway and human-made residential and commercial structures from the site are obscured by vegetation and the gently rolling terrain.

### 3.8.3 Potential Impacts

*No Build Alternative*

Under the No Build Alternative, there will be no changed proposed to the roadway and no impact to the scenic resources in the project area.

*No Build Settlement Alternative*

Under the No Build Settlement Alternative, no change would occur in the form or material of the roadway. Guardrail is a common material within the Kamehameha Highway corridor. Additionally, the currently disturbed areas behind the proposed guardrail would remain barren of vegetation in areas where cars drive and park.

Viewer exposure and awareness will not change, and visual conditions for highway travelers, pedestrians, bicyclists, and neighbors are the same as the No Build. The view from the No Build Settlement Alternative will continue to be available for those on the roadway and tempt drivers to slow down to enjoy seeing Laniakea Beach. However, as crosswalks will funnel pedestrians to cross at specific areas, drivers will not be as distracted by pedestrians crossing the Highway haphazardly.

*TSM Alternative*

Under the TSM Alternative, no change is proposed to the form or material of the roadway, and guardrail is a common material within the Kamehameha Highway corridor. Additionally, the currently disturbed areas behind the proposed guardrail would regrow vegetation in areas where cars used to park making the mauka roadside more attractive.

Viewer exposure and awareness will not change, and visual conditions for highway travelers, pedestrians, bicyclists, and neighbors would remain the same. The view from the TSM Alternative would continue to be available for those on the roadway and tempt drivers to slow down to enjoy seeing Laniakea Beach.

*Pedestrian Shift Alternative*

All new roadway and auxiliary features are common visual elements within the existing Kamehameha Highway corridor and would be compatible with the existing visual environment.

Moving the Highway 80 feet to the mauka side of the Highway will displace some of the vegetation at the edge of the existing ranchland; however, this vegetation is not in a natural condition. The makai half of the existing roadway would be demolished and rock and vegetation, and slope stabilization measures would be placed to prevent soil and beach erosion and would add natural visual elements between the beach and proposed roadway. Revegetation and replanting efforts on both sides of the proposed roadway will provide erosion control and visual screening for neighbors, including viewers from the mauka cultural site.

No residential structures, fencing, or other human-made elements would be impacted. Driveways to the existing residences on the Haleiwa side of the stream would be extended to the proposed highway pavement. The makai side of the existing Kamehameha Highway pavement would be demolished and replanted, which would provide visual screening and buffering for the residential

viewers. The resulting changes would provide beneficial effects to the natural environment for most viewers.

The mauka side of the existing road and the existing bridge would remain as separate pedestrian and bicycle facilities. This would allow these travelers to shift focus and attention from roadways and vehicular conflicts to the scenic natural features. Pedestrians and cyclists would have an excellent view from the repurposed highway.

While most visual elements associated with the realigned road are existing in the highway corridor, the size and scale of widened road, refuge median, guardrails, and other ancillary elements may impose slight adverse effects to motorists and residential neighbors; however, the human and project environments would be orderly and coherent for neighbors and travelers.

Views from the Pedestrian Shift Alternative would still tempt drivers to slow down to enjoy the stunning sight of Laniakea Beach. The informal parking on the makai side would block some of the coastal view from the Highway. However, with installation of barriers on the mauka side to prevent parking, pedestrians would not be crossing the Highway and distracting drivers.

Most views of the project from the mauka cultural site would be obscured by existing vegetation. Landforms and existing vegetation would likely obscure all views of the project site for pedestrian travelers to the cultural site. Relocated utility poles and streetlights may be visible above the tops of existing trees and shrubs. Light spill from streetlights may be visible from the cultural site in nighttime conditions; however, these are existing visual elements and new lights could be shielded to reduce glare during nighttime hours.

### 3.8.4 Avoidance, Minimization, and Mitigation Measures

*TSM Alternative*

No mitigation is proposed for the TSM Alternative, because there would be little to no change to the form or material of the roadway, little to no impacts to the scenic resources in the project area, and viewer exposure, awareness, and visual conditions would not change.

*Pedestrian Shift Alternative*

As described above, additional landscaping is proposed along the sides of the realigned highway to mitigate potential changes to visual conditions. Light spill from streetlights may be visible from the cultural site in nighttime conditions; however, these are existing visual elements and new lights could be shielded to reduce glare during nighttime hours.

## 3.9 Roadways and Traffic

Details regarding Kamehameha Highway traffic conditions and the analyses performed to support the analysis of the alternatives are provided in the Traffic and Pedestrian Circulation Study included in Appendix B. This section summarizes that report.

### 3.9.1 Existing Condition

Within the study area, Kamehameha Highway is a two-lane, principal arterial. Despite being classified as such, the roadway's mobility can be compromised by beach-related vehicle and

pedestrian traffic, most notably at Laniakea Beach. In addition, residential direct driveway access is provided on one or both sides of Kamehameha Highway for most of the area between Haleiwa and Waimea. The posted speed limit in the vicinity of Laniakea Beach is 35 miles per hour. There are two bus stops in the project area. Parking spaces are designated for lifeguards.

Traffic congestion is an issue at Laniakea Beach, as the beach is a popular tourist attraction. Long delays are regularly reported by residents. The popularity of the site for both turtle watching and surfing is such that the movement of vehicles in and out of parking, and the number of pedestrians crossing the road in an uncontrolled manner, causes the traffic to slow considerably. There are approximately 50-60 informal parking places on the mauka side of the road. Motorists park on the mauka side of Kamehameha Highway and cross the Highway to observe sea turtles. Vehicular turning movements to and from the Kamehameha Highway combined with the frequent shuttles and the random pedestrian crossing further complicate traffic operation and safety on this segment of Kamehameha Highway. Vehicles are commonly blocked all the way to Haleiwa town.

As described in the Traffic and Pedestrian Circulation Study (Appendix B), pedestrian and vehicle data were collected several times over multiple years to analyze the impacts of both the previous barrier and to evaluate the proposed project.

### 3.9.2 Potential Impacts

*No Build Alternative*

Safety would not be improved as parking on the mauka side of the Highway would continue and people would continue to cross the Highway randomly to go to Laniakea Beach. Kamehameha Highway would continue to be congested and major slowdowns would occur as they do now.

*No Build Settlement Alternative*

From a traffic operations perspective, Kamehameha Highway through traffic would be able to pass through the area with fewer vehicular and pedestrian conflicts, improving mobility along the corridor. When the concrete barriers were previously installed in a similar fashion as the guardrails proposed under the No Build Settlement Alternative, travel times were improved by 10-15 minutes in the Waimea-bound direction on Saturday afternoons. While the installation of barriers at Laniakea Beach appears to be effective as a short-term solution, improving Kamehameha Highway traffic flow through the area is not the only objective of the project. The crosswalks that are part of the No Build Settlement Alternative could help with safety if pedestrians were to use them.

*TSM Alternative*

As demonstrated by the concrete barriers previously placed and then removed from the mauka side of Kamehameha Highway, through traffic would be able to pass through the area with fewer vehicular and pedestrian conflicts, improving mobility along the corridor. When the barriers were previously installed, travel times were improved by 10-15 minutes in the Waimea-bound direction on Saturday afternoons.

*Pedestrian Shift Alternative*

The Pedestrian Shift Alternative would improve traffic congestion. A guardrail installed at the beginning of construction on the mauka side to the Highway for the Pedestrian Shift Alternative would prevent pedestrians from parking along that side of the existing highway.

Once constructed, cars would park on the makai side of the road to access the beach. Under the Pedestrian Shift Alternative there is space to accommodate approximately 90 passenger cars. Adequate parking spaces would be designated for lifeguards. The Pedestrian Shift Alternative would provide a median storage lane to allow vehicles to queue while waiting for gaps in Haleiwa-bound traffic and to act as a refuge lane for exiting traffic. The bus stops would be relocated as needed and brought into compliance with Americans with Disabilities Act Accessibility Guidelines. Retaining the bus stops would help reduce individual vehicles parking when they visit the beach and reduce congestion on the Highway.

### 3.9.3 Avoidance, Minimization, and Mitigation Measures

*TSM Alternative*

No Avoidance, Minimization, and Mitigation Measures are needed for the alternative.

*Pedestrian Shift Alternative*

The proposed project is itself a mitigation measure for the dangerous pedestrian conditions and current traffic congestion in the area. Because the traffic impacts are anticipated to be beneficial in nature, no mitigation is proposed.

## 3.10 Pedestrian Safety

### 3.10.1 Existing Condition

Pedestrians cross Kamehameha Highway after unlawfully parking on the mauka side of the road. The area where people park is a favorite along Kamehameha Highway as the beach and coastal waters are very close to the Highway and are easily accessible to the public within a few short footsteps. The open parking area has been used in excess of fifty years by a variety of beach users, turtle viewers, surfers, kayak paddlers, stand-up paddle (SUP) boarders, and swimmers. It is utilized as a much-needed parking area and recreational equipment unloading area for these users and is integral to their coastal access.

The Traffic and Pedestrian Circulation Study (Appendix B) documents as many as 338 pedestrians crossing the road during a single hour on a Saturday afternoon. The pedestrians are often focused on the scenery and are rushing to see the turtles on the beach. Many of the cars on the road belong to other tourists who are distracted by the view of the beach. Based on the discussion at Task Force meetings, most of the local motorists are polite and let the tourists cross the road. However, as the area gets congested and the tourists dart between the cars, it is likely an accident could occur. In August 2019 a child crossing the Highway was hit by a car, and HDOT changed the focus of the project being proposed at Laniakea.

### 3.10.2 Potential Impacts

*No Build Alternative*

Under the No Build Alternative, no changes to safety conditions would occur. People would continue to park on the mauka side of the road and randomly cross through the traffic

*No Build Settlement Alternative*

Under the No Build Settlement Alternative, changes to safety conditions would occur. People would continue to park on the mauka side of the road, but they could cross traffic at two crosswalks. Cars would have one entrance into the parking area and one exit. Accidents, like the one in August 2019 where a child was hit by a car, may continue, but will likely be reduced due to the installation of crosswalks.

*TSM Alternative*

Parking would be eliminated on the mauka side of the Highway greatly reducing the number of pedestrians crossing the Highway. This Alternative would limit people from reaching the beach easily and may move the pedestrians to other parts of the Highway if they can find additional parking. As with the concrete barriers installed in December 2013 which blocked off parking on the mauka side of the road, the TSM Alternative could create a hazardous situation where pedestrian beachgoers are forced to walk along the narrow highway shoulder for long distances pushing strollers, rolling wheelchairs, and carrying beach chairs, umbrellas coolers, surfboards, kayaks, and SUP and windsurfing boards and equipment. This could increase the danger to pedestrians and stretch that danger out over a longer distance.

*Pedestrian Shift Alternative*

The Pedestrian Shift Alternative would allow cars to park makai site of Kamehameha Highway so that pedestrians would not have to cross it to get to the beach. A refuge lane between the travel lanes would allow vehicles to wait safely before turning. Drivers may still become distracted by the ocean view with the Pedestrian Shift Alternative, but pedestrians would no longer be vulnerable.

Vehicles may still attempt to bypass bottlenecks, but the storage lane would minimize this circumstance, and vehicles would have more space to maneuver.

### 3.10.3 Avoidance, Minimization, and Mitigation Measures

When compared against The No Build and The No Build Settlement, the TSM and Pedestrian Shift Alternatives mitigate the safety concerns for pedestrians to different extents.

Under the TSM Alternative, people would be prevented from parking on the mauka side of the Highway which would eliminate or reduce pedestrian crossings within the TSM limits. While the No Build Alternative would allow for random crossings, the No Build Settlement would funnel pedestrians across at crosswalks. Despite the streamlined access anticipated under the No Build Settlement, accidents may still happen, especially if the crosswalks are ignored by pedestrians. For these reasons, the TSM Alternative provides slightly safer conditions for pedestrians than the

No Build but is not likely considered an improvement for pedestrian safety when viewed against the No Build Settlement Alternative.

The Pedestrian Shift Alternative moves the parking to the other side of the Highway, eliminating the pedestrians running across the road to get to the beach. Because the traffic impacts are anticipated to be beneficial in nature, no mitigation is proposed for the TSM and Pedestrian Shift Alternatives.

## 3.11 Public Facilities and Services

### 3.11.1 Existing Condition

Homes in the project area are served by water, electricity, sewers and telephone/cable lines. Electricity and telephone/cable lines are on poles that also provide highway lighting, and Spectrum has their aerial CATV system attached to both Hawaiian Telcom and Hawaiian Electric Company (HECO) poles.

The City & County of Honolulu's Ocean Safety Division maintains one lifeguard tower at Laniakea Beach and supports the immediate and surrounding area with mobile response teams (using trucks, jet skis, and all-terrain vehicles). Parking places are designated for the lifeguards. There is a consistent threat to public safety because of surfing, swimming, paddling, and fishing accidents, as well as vehicle/pedestrian accidents. The nearest ambulance is at the Waialua Fire Station roughly three (3) miles away, so lifeguards are frequently the first of first responders on scene at any incident near the site of the proposed project. Traffic congestion can hinder the passage of emergency vehicles to the scene. Cars parked on the shoulder prevent cars traveling in the roadway from pulling off to let emergency vehicles pass.

### 3.11.2 Potential Impacts

*No Build Alternative*

No changes to utilities serving the area will be made.

Traffic congestion will continue to hinder the passage of emergency vehicles and cars parked on the shoulder will prevent cars traveling in the roadway from pulling off to let the emergency vehicles pass. Additionally, the Highway will remain vulnerable to periodic high surf events.

*No Build Settlement Alternative*

No changes to utilities serving the area will be made.

The No Build Settlement Alternative is anticipated to experience less congestion than the No Build Alternative. Improved traffic flow during peak hours assumed under this condition will allow vehicles to move over to more effectively accommodate passage of emergency vehicles. However, the issue of cars not having much room to pull over to let emergency vehicles pass will remain due to the mauka guardrail used to control parking. Like the No Build, the Highway will remain vulnerable to periodic high surf events.

*TSM Alternative*

No changes to utilities serving the area will be made.

As demonstrated by the concrete barriers previously installed by HDOT to prevent parking, the TSM Alternative would reduce congestion (See Section 3.9). Improved traffic flow during peak hours as a result of implementing the proposed project would allow vehicles to move over to more effectively accommodate passage of emergency vehicles. Cars are still likely to park along the makai side.

Because the TSM Alternative would improve traffic flow, it is anticipated to improve emergency response times over the No Build Condition and No Build Settlement.

*Pedestrian Shift Alternative*

No changes to utilities serving the area would be made. Water meters, utility poles and sewer manholes would remain accessible for maintenance along the currently existing highway. New poles for lighting would be installed every 120 feet along the new highway alignment.

Overall, the Pedestrian Shift Alternative would reduce congestion and allow easier passage of emergency vehicles. Improved traffic flow during peak hours as a result of implementing the proposed project would allow vehicles to move over to more effectively accommodate passage of emergency vehicles than in the No Build, No Build Settlement, and TSM Alternatives. Furthermore, moving the Highway inland would keep it open during high surf, which is not addressed by the TSM Alternative.

### 3.11.3 Avoidance, Minimization, and Mitigation Measures

*TSM Alternative*

No avoidance, minimization, or mitigation measures to public facilities and services would be needed for this Alternative. However, it should be reiterated that this Alternative does not address the roadway's reliability.

*Pedestrian Alternative*

The Pedestrian Shift Alternative involves creating access controls at Pohaku Loa Way to prevent the private road from being used as overflow parking for beach access, as well as to discourage inadvertent motorized uses of the shared-use path. HDOT will coordinate with the City and County of Honolulu Police, Fire, and Emergency Medical Services to ensure that any access concerns are fully addressed.

## 3.12 Noise

FHWA has established the Noise Abatement Criteria (NAC), for different exterior and interior land use activities which have been adopted by the State of Hawaii as its standard. The NAC do not constitute legally enforceable noise standards but represent a yardstick for evaluating the effect of project noise on the surrounding community.

Under HDOT policy, a noise impact occurs when the predicted traffic noise levels approach or exceed the NAC, or when the predicted traffic noise levels substantially exceed the existing noise

levels. "Approach" means 1 dBA or less than the NAC, and "substantially exceed the existing noise levels" means an increase of at least 15 dBA. If the NAC are approached or exceeded, or if there is a substantial increase above the existing noise level, noise abatement measures must be considered.

Changes in traffic noise are assessed using human perceptions of sound level changes. Generally, changes in noise levels of less than 3 dBA are barely perceptible to most listeners, but a change of 10 dBA is perceived as a doubling (or halving for a decrease) of noise levels.

A traffic noise study was performed for this project and documented in the Noise Impact Assessment in Appendix J. This section summarizes the study methods and findings.

### 3.12.1 Existing Condition

Existing and future noise sensitive land uses and activities adjacent to the Kamehameha Highway Pedestrian Safety Project and nearby major roadways were identified from site inspections and existing land use mapping. Land uses closest to the project area include residences, ranching and agricultural land, and undeveloped land.

The ambient noise environment in the vicinity of the Kamehameha Highway Pedestrian Safety Project is comprised of several noise sources including vehicular traffic traveling on the Highway itself. Other noise sources that are typically audible in the area include landscaping, wildlife, and neighborhood pets. Atmospheric conditions also influence noise levels in the area with variable ocean tides and wind patterns.

At the time of this report, no complaints from the community are on file at HDOT relating to traffic noise along this area of Kamehameha Highway or about experiencing louder nighttime traffic noise levels than during daytime hours. Site observations indicated that short-term measurement periods provided sufficient traffic noise levels with free-flow traffic conditions for noise model validation to support prediction of worst-hour, or loudest hour, traffic noise levels.

To determine the existing worst-hour traffic noise levels, traffic data was used for Existing Year 2015 developed in the traffic analysis for the Kamehameha Highway Realignment (WSP USA, 2020). Input variables to noise modeling and analysis include traffic volumes, speeds, and vehicle fleet mix (auto, medium truck, and heavy truck percentages).

### 3.12.2 Noise Measurement Sites

Short-term (15 to 30 minutes) and long-term (24 hours) measurements were taken at six locations along the project study area to describe the existing noise environment. Field measurements offer a baseline for establishing existing ambient noise levels in the area and are used for estimating future noise levels by adding ambient levels to other noise levels generated by the proposed project.

### 3.12.3 Potential Impacts

*No Build Alternative*

Predicted 2030 worst-hour traffic noise levels without the proposed project would range from 45 dBA to 67 dBA with an increase of 1 to 2 dBA at each modeled site over existing noise levels due to increased traffic volumes along the existing alignment in the year 2030. These levels would

approach or exceed the NAC at 15 modeled sites located adjacent to and makai of Kamehameha Highway representing 13 residences, Laniakea Beach and Chun's Reef. Figure 3-13 shows the modeled noise-sensitive receptor sites. Locations where the levels would exceed or approach the NAC are shown in red.

*No Build Settlement Alternative*

Future noise levels under the No Build Settlement Alternative are the same as the No Build Alternative due to the traffic and roadway lane configurations being consistent between the two alternatives. Predicted 2030 worst-hour traffic noise levels with the guardrail would increase due to increased traffic volumes along the existing alignment in the year 2030, and worst-hour future-year traffic noise levels would approach or exceed the NAC at the same 14 modeled sites shown on Figure 3-13.

*TSM Alternative*

Future noise levels under the TSM Alternative are the same as the No Build Alternative and No Build Settlement Alternative due to the traffic and lane configurations being consistent between the three alternatives. Predicted 2030 worst-hour traffic noise levels with the guardrail would increase due to increased traffic volumes along the existing alignment in the year 2030, and worst-hour future-year traffic noise levels would approach or exceed the NAC at the same 14 modeled sites (See Figure 3-13).

*Pedestrian Shift Alternative*

Predicted 2030 worst-hour traffic noise levels associated with the Pedestrian Shift Alternative would range from 45 dBA to 67 dBA with a decrease of 8 dBA to an increase of 2 dBA compared to existing noise levels. A decrease in noise levels compared to the No Build Alternative is predicted at some modeled sites, where the alignment shifts the furthest away from nearby residences. Increased noise levels of up to 2 dBA would result from increased traffic volumes and the Pedestrian Shift nearer to the modeled sites in the year 2030. Worst-hour future-year traffic noise levels with the Pedestrian Shift Alternative would approach or exceed the NAC at five (5) residences and Chun's Reef located adjacent to and makai of Kamehameha Highway near Ashley Road (See Figure 3-14).

### 3.12.4 Avoidance, Minimization, and Mitigation Measures

Noise abatement measures must be considered as part of the project if traffic noise impacts are identified and must be provided where it is feasible and reasonable to do so. Impacts occur at sites where traffic noise levels approach or exceed the NAC of Leq(h) 67 dBA, or substantially exceed

**Figure 3-13. No Build Alternative Traffic Noise Impacts**

**Figure 3-14. Pedestrian Shift Alternative Traffic Noise Impacts**

(by 15 dBA or more) the ambient noise levels. HDOT's Highway Noise Policy and Abatement Guidelines are used to determine whether noise abatement measures can be implemented, depending on whether these measures are feasible, reasonable, and desired.

The No Build Alternative and No Build Settlement Alternative have 14 sites (12 residences and 2 beach park areas) that would approach or exceed the NAC. These alternatives are used as the baseline to compare future traffic noise levels, therefore noise abatement was not modeled for these alternatives.

*TSM Alternative*

In the event that HDOT decides to proceed with this Alternative instead of the Pedestrian Shift, a noise abatement evaluation would be conducted to determine whether noise mitigation is feasible in accordance with the HDOT Noise Analysis and Abatement Policy.

*Pedestrian Shift Alternative*

When compared to the No Build Alternative and No Build Settlement Alternative, the Pedestrian Shift Alternative noise impact model has five (5) residences and Chun's Reef would approach or exceed the NAC.

Although the Pedestrian Shift reduces the overall impact of the Highway on ambient noise environment by shifting the Highway away from noise sensitive receptors, the HDOT Noise Analysis and Abatement Policy requires that they be evaluated for noise abatement.

All sites predicted to experience impacts under the Pedestrian Shift Alternative were considered for noise abatement. Mitigation considerations include the feasibility of physically constructing noise mitigation (i.e., noise walls or barriers) to shield affected noise receptors from traffic noise in a way that would provide at least a 5-dBA traffic noise reduction. The evaluation concluded that noise barrier placement would not be feasible because access to private driveways and side streets that connect to Kamehameha Highway would have to be maintained and a barrier with such frequent openings could not provide a 5-dBA reduction. Therefore, no noise abatement, including noise barriers, are proposed for the Pedestrian Shift Alternative.

## 3.13 Hazardous Materials

### 3.13.1 Existing Condition

Hazardous materials are transported on Kamehameha Highway, as the only route circumnavigating the North Shore, including transportation by the military. The only businesses in the project area are ranch related; most of the properties are single family residential housing. According to HDOH database (https://eha-cloud.doh.hawaii.gov/connect/map) no hazardous materials were identified at properties in the project area along Kamehameha Highway, and no reported spills were identified in the project area. The Kawailoa Transfer Station is off Kawailoa Drive on the way to the project area from Haleiwa.

### 3.13.2 Potential Impacts

*No Build Alternative*

Under the No Build Alternative, no change in the quantity or type of hazardous materials being transported through the project area are anticipated.

*No Build Settlement Alternative*

Under the No Build Settlement Alternative, no change in the quantity or type of hazardous materials being transported through the project area are anticipated.

*TSM Alternative*

Under the TSM Alternative, no change in the quantity or type of hazardous materials being transported through the project area are anticipated.

*Pedestrian Shift Alternative*

Under the Pedestrian Shift Alternative, no change in the quantity or type of hazardous materials being transported through the project area are anticipated.

### 3.13.3 Avoidance, Minimization, and Mitigation Measures

No avoidance, minimization, and mitigation measures are proposed for any of the alternatives, since no impacts are anticipated.

## 3.14 Air Quality

As required by the 1977 Clean Air Act (CAA), National Ambient Air Quality Standards (AAQS) were established by the U.S. Environmental Protection Agency (USEPA) for seven major air pollutants: carbon monoxide (CO), nitrogen oxides (NOx), ozone ($O_3$), particulate matter smaller than 10 microns ($PM_{10}$), particulate matter smaller than 2.5 microns ($PM_{2.5}$), sulfur oxides (SOx), and lead. Current standards for ozone and $PM_{2.5}$ were established in September 1997. The State of Hawaii has also established its own standards for these pollutants.

CAA Section 107 requires the USEPA to publish a list of geographic areas that are not in compliance with the National AAQS, and these areas are called non-attainment areas. Areas that have insufficient data to make a determination are unclassified, and are treated as attainment areas until proven otherwise. The designation of an area is made on a pollutant-by-pollutant basis.

### 3.14.1 Existing Condition

The State of Hawaii is designated as an attainment area for CO, ozone (O3), $PM_{10}$, and $PM_{2.5}$. The Department of Health does not operate any stationary air monitoring sites on the North Shore of Oahu.

### 3.14.2 Potential Impacts

None of the alternatives is predicted to cause or exacerbate a violation of the State or National AAQS.

The pollutants relevant to evaluating the air quality impacts of a roadway project are those contained in motor vehicle emissions. Vehicles emit carbon monoxide (CO), volatile organic compounds (VOCs), the six-priority mobile source air toxics (MSAT), nitrogen oxide (NOx), and lead (lead levels have decreased substantially and will continue to do so due to the mandated elimination of lead in gasoline). Those pollutants can react in the atmosphere to generate $PM_{10}$ and $PM_{2.5}$ on a regional basis. CO air pollution is generally considered to be a microscale problem that can be addressed locally to some extent. The other pollutants degrade air quality at a regional scale.

Regional air quality impacts related to VOC, the six priority MSAT, NOx, $PM_{10}$, and $PM_{2.5}$ are primarily dependent on changes in vehicle miles traveled (VMT), vehicle hours traveled (VHT), and vehicle mix (gasoline-fueled cars vs. diesel-fueled trucks and buses). None of these factors are predicted to change significantly among the alternatives. Therefore, the four alternatives would have similar impacts.

### 3.14.3 Avoidance, Minimization, and Mitigation Measures

No Avoidance, Minimization, and Mitigation Measures are proposed for any of the alternatives, because no violation of the State or National AAQS is anticipated. Implementing air quality mitigation measures for long-term traffic-related impacts are unnecessary and unwarranted because no significant variation of VMT, VHT, and vehicle mix is expected between the No Build Alternative/No Build Settlement Alternative, and the Build Alternatives (TSM and Pedestrian Shift). In addition, CO concentrations are expected to remain well within the National and State AAQS.

## 3.15 Social and Economic Conditions

### 3.15.1 Non-Discrimination Guidance

HDOT's Title VI Plan (2019) is designed to fulfill its responsibilities under Title VI of the Civil Rights Act of 1964, as amended, Executive Order (EO) 12898 on Environmental Justice, US DOT Order 5610.2 on Environmental Justice, and other related non-discrimination regulations and directives. Because Title VI of the Civil Rights Act of 1964 prohibits discrimination based on race, color, or national origin, HDOT uses detailed race categories to attempt to treat people of different national origins equitably in its highway planning, programs, and activities.

EO 12898, called "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," was signed by the President on February 11, 1994. It directs federal agencies to take appropriate and necessary steps to identify and address disproportionately high and adverse effects of federal projects on the health or environment of minority or low-income populations. If minority or low-income populations are found in the project vicinity, good faith effort must be made to ensure that disproportionate and adverse impacts on low-income and minority populations are prevented, minimized, or mitigated. An example of good faith effort is additional public notification or outreach to these groups. While this is not a federal action, federal guidelines provide an appropriate standard as HDOT's policies are designed to conform to the federal framework.

Pursuant to EO 12898, "low-income" is defined as households with incomes at or below the U.S. Department of Health and Human Services (DHHS) poverty guidelines. The 2019 poverty guidelines for the state of Hawaii is at or below $29,620 for a family/household of four.

The federal definition of "minority" includes the following groups:

- Black: a person having origins in any of the black racial groups of Africa.
- Hispanic: a person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race.
- Asian: a person having origins in any of the original peoples of the Far East, Southeast Asia or the Indian subcontinent or the Pacific Islands.
- American Indian or Alaskan Native (AIAN): a person having origins in any of the original people of North America and who maintains cultural identification through tribal affiliation or community recognition.
- Native Hawaiian or Other Pacific Islander (NHOPI): a person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.

HDOT's definition of a minority group is as follows:

> *Any readily identifiable groups of minority persons who live in geographic proximity, and if circumstances warrant, geographically dispersed/transient persons (such as migrant workers or Native Americans) who will be similarly affected by a proposed HDOT program, policy or activity.*

HDOT's Title VI Plan states that income and demographic data is to be used to identify applicable populations; the methodology for data collection, maintenance, and analysis follows the Title VI Plan. The following discussion relies on 2010 census data, the most recent data available at this time.

### 3.15.2 Existing Condition

*General Socio-Economic Conditions*

The following discussion is based on selected U.S. Census data for the project area, summarized in Table 3-3 through Table 3-5. The statistics are based on the 2010 Census, as the 2020 Census is ongoing. It should be noted that the analysis is for a highway project, which impacts a far greater population than just those who live in the project area.

*Population and Ethnicity*

Table 3-3 exhibits demographic characteristics for the State of Hawaii, Honolulu County (Island of Oahu), and Kawailoa Census Tract (Census Tract 100). Data for each of these three populations are displayed for comparative purposes in order to characterize the demographic and socio-economic data of the area surrounding the project site.

The State of Hawaii is an unusual, but increasingly common case, where traditionally-defined "minority" populations make up most of the population. The largest ethnic group in Hawaii is Asian. This group makes up 38 percent of the overall State population. Those who classify themselves as "Two or More Races" make up 23.8 percent of the population in Hawaii.

The population of the Kawailoa Census Tract, which includes the project area, was 3,616 in 2017. As indicated in Table 3-3, the demographic characteristics of Kawailoa Census Tract residents are for the most part similar to that of the general population of Oahu and the State, except for a few variations. A higher portion of the population in the Kawailoa Census Tract is White and Black or African American than that of the State and island. The other difference is a smaller Asian and Native Hawaiian/Other Pacific islander population in comparison to the island and State.

**Table 3-3. Demographic Characteristics**

| | Hawaii | Honolulu County | Kawailoa Census Tract |
|---|---|---|---|
| Population | 1,406,299 | 980,080 | 3,616 |
| Ethnicity | | | |
| White | 25.1% | 21.1% | 59.8% |
| Black or African America | 1.8% | 2.4% | 12.9% |
| American Indian / Alaska Native | 0.2% | 0.1% | 0% |
| Asian | 38% | 42.9% | 8.9% |
| Native Hawaiian / Other Pacific Islander | 10% | 9.3% | 7.4% |
| Some Other Race | 1% | 1% | 0.1% |
| Two or More Races | 23.8% | 23.2% | 10.9% |
| Age | | | |
| Under 18 Old | 21.6% | 21.4% | 21.5% |
| 18 to 64 Years Old | 61.6% | 62.1% | 71.9% |
| 65 or More Years Old | 16.8% | 16.4% | 6.6% |

Source: U.S. Census Bureau (2017). *American Community Survey 5-year estimates.* Retrieved from *Census Reporter Profile page, Kawailoa Census Tract, Honolulu County, HI*

**Table 3-4. Income and Employment Characteristics**

| | Hawaii | Honolulu County | Kawailoa Census Tract |
|---|---|---|---|
| Number of Households | 455,502 | 311,451 | 1,248 |
| Median Household Income by Household | $74,923 | $80,078 | $53,750 |
| Civilian Labor Force Unemployed | 3.0% | 2.8% | 4.1% |
| Persons Below Poverty Level | 10.3% | 9.1% | 9.7% |

Source: U.S. Census Bureau (2017). *American Community Survey 5-year estimates.* Retrieved from *Census Reporter Profile page for Kawailoa Census Tract, Honolulu County, HI*

*Income and Employment*

Table 3-4 shows the median household incomes and employment characteristics. Median household incomes in the Kawailoa Census Tract were lower than the median incomes for Oahu and the State. The same percentage of households in the Kawailoa Census Tract live on social security, and retirement, in comparison to Oahu overall, but a lower percentage of households receive public assistance. Table 3-4 also shows that unemployment in the project area's subdivision is similar to that of the State and island. The proportion of persons living below the poverty line in the Kawailoa Census Tract is also about the same as the State and island.

*Housing*

As shown in Table 3-5, in the Kawailoa Census Tract, only 21% of the homes are owner occupied, a much lower percentage than the State and the City. The homes are also about a third more expensive than others in the State and City.

**Table 3-5. Housing Characteristics**

| | Hawaii | Honolulu County | Kawailoa Census Tracts |
|---|---|---|---|
| Number of Housing Units | 535,543 | 346,374 | 1,469 |
| Owner-Occupied Units | 58.1% | 55.6% | 21.0% |
| Renter-Occupied Units | 41.9% | 44.4% | 79.0% |
| Median Structure Value | $538,400 | $602,700 | $961,200 |

Source: U.S. Census Bureau (2017). *American Community Survey 5-year estimates.* Retrieved from *Census Reporter Profile page.*

### 3.15.3 Potential Impacts

In accordance with the federal definition of "minority" (See Section 3.15.1) which includes those of Asian and Native Hawaiian/Pacific Island ancestry, the proposed project improvements would not disproportionately affect minority populations. Census data also indicates that low-income populations also would not be disproportionately be affected. Socio-economic trends illustrate a population where the many expensive homes are rented versus owner occupied. Impacts such as noise and air will not worsen as a result of any of the alternatives, and most will be temporary in relation to construction activities. Benefits will include a safer roadway, ease of mobility, and an overall enhancement in the quality of life.

### 3.15.4 Avoidance, Minimization, and Mitigation Measures

No avoidance, minimization, and mitigation measures are proposed for any of the alternatives.

## 3.16 Construction Impacts

In contrast, to the Pedestrian Shift Alternative, the TSM Alternative will have minimal construction impacts. Construction activities for the TSM Alternative would cause motorists on Kamehameha Highway to experience delay and inconvenience for a few days for installation of guardrail, and signage. There would also be some limited fugitive dust and noise impacts from construction activities. This Alternative is not addressed further in this section.

Most construction impacts would be associated with the Pedestrian Shift Alternative; these impacts are the focus of the remainder of this section.

### 3.16.1 Maintenance of Traffic and Parking

The Pedestrian Shift Alternative would cause motorists traveling on Kamehameha Highway to experience delay and inconvenience for approximately twenty four months, the estimated duration of construction. Parking to access Laniakea Beach may be inaccessible, as determined by Contractor work areas. To minimize traffic and access problems on Kamehameha Highway and adjacent side streets, construction phasing and traffic control plans would be developed and implemented. Bus stops would be temporarily relocated as required. No parking signs would be

installed as needed. All necessary signs, lights, barricades, and other safety equipment will be installed and maintained by the contractor during the construction phase of the project.

Most proposed construction activities that directly affect Kamehameha Highway would be restricted to off-peak nighttime hours due to the traffic impacts that would occur if they were performed during daytime hours.

The public would be routinely informed of planned construction activities and lane closures throughout the construction period. Some construction work (i.e., shoulder activities such as placing signage) may take place at any time of the day (daytime and nighttime, 24-hours a day, 7 days a week), provided the activities require the closure of no more than one through lane for a short period of time.

### 3.16.2 Air Quality

Air quality impacts during roadway construction for Pedestrian Shift Alternative generally consist of fugitive dust and mobile source emissions from construction equipment.

Fugitive dust is airborne particulate matter, of usually large particle size, generated by construction vehicles operating around construction sites and from material blown from uncovered haul trucks, stockpiles, and exposed areas. The emission rate for fugitive dust emissions from construction activities is difficult to estimate accurately because its generation varies greatly depending upon the type of soil, the amount and type of dirt-disturbing activity, the moisture content of exposed soil, and wind speed.

Frequent watering would control fugitive dust at construction sites. In addition, wind screens may be used in areas near residences and commercial districts, as well as limiting the areas of disturbance at any given time. Landscaping would be re-established as early as possible. To prevent haul trucks from tracking dirt onto paved streets, tire washing, or road cleaning may be appropriate. State regulations further stipulate that open-bodied trucks be covered at all times when in motion if they are transporting wind-erodible materials.

Construction vehicles and equipment would emit engine exhaust. The largest of this equipment is usually diesel-powered, which emit relatively high levels of NOx in comparison to gasoline-powered equipment. However, standards for such pollutants are set on an annual basis and would therefore not likely be violated by short-term construction equipment emissions.

### 3.16.3 Noise

Construction for the Pedestrian Shift Alternative would involve the use of heavy machinery that may cause temporary noise impacts to adjacent noise sensitive land uses. Table 3-6 presents a range of noise levels for various construction equipment anticipated to be used during construction of the proposed project. Equipment noise levels vary depending on the make and model of the equipment, the operation being performed, the condition of the equipment, and other variables. The noise levels listed are based on published measurements taken at a distance of 50 feet from the equipment.

**Table 3-6. Construction Equipment Noise Levels**

| Equipment | Decibels | Equipment | Decibels |
|---|---|---|---|
| Standard Construction Equipment | | Light Impact Equipment | |
| Truck | 75 - 90 | Jack Hammer | 81 - 98 |
| Saw | 72 - 81 | Jumping Jack | 81 - 97 |
| Light Tower | 62 - 72 | | |
| Cold Planer | 79 - 88 | | |
| Paving Machine | 86 - 88 | Heavy Impact Equipment | |
| Roller | 63 - 70 | | |
| Striping Machine | 75 - 86 | Hoe Rams | 95 - 106 |
| Concrete Truck | 75 - 88 | Vibratory Sheet Pile Driver | 90 - 100 |
| Backhoe / Loader | 72 - 83 | | |
| Compressor | 74 - 87 | | |
| Generator | 71 - 82 | | |
| Crane | 75 - 87 | | |

Since HDOH maintains community noise control standards (HAR Section 11-46) that apply to construction noise, these specifications would be followed. A noise permit would be obtained for construction activities performed during standard work hours (Monday through Friday 7:00 a.m. through 6:00 p.m. and Saturday 9:00 a.m. through 6:00 p.m.).

A noise variance would be obtained to allow construction activities to occur beyond standard work hours. As discussed in Section 3.16.1, construction would occur at night, beyond standard work hours due to the traffic impacts that would ensue, should the work be performed during normal work hours. As part of obtaining the noise variance, HDOT would hold a public meeting, send notices to residents within 500 feet of the project, and place an advertisement in the paper.

The noise variance application outlines mitigation measures that could be employed to lessen noise disturbances during night work, including such tasks as:

- The contractor sending an informational flyer to all addresses within 500 feet of the project area roughly two weeks prior to the start of construction. The flyer will include general project information and the name and phone number of a contractor representative to contact.
- Updating of HDOT's website with information regarding the time and location of night work as well as a name and phone number to contact with questions or complaints.
- Quiet work procedures would be employed to attenuate and control noise emissions emanating from the construction site, such as:
- Either ambient-sensing backup alarms or ground guides will be used for signaling when equipment backs up at night (8:00 p.m. to 6:00 a.m.).
- Construction activity constraints for night work, where applicable.
- The use of temporary noise barriers for both daytime and nighttime sensitive receptors, where feasible.
- The strategic placement of stationary equipment such as compressors and generators.
- All equipment will be maintained in good working order and with appropriate mufflers.

- A job-site inspector will be designated to whom immediate complaints can be forwarded for prompt response and who will have the general responsibility of monitoring quiet work procedures.
- Instructional meetings will be held with construction crews and truck drivers to discuss noise abatement procedures, including the use of engine brakes, loading and unloading cargo, shouting, use of signal callers, and other practices as required.
- The selected contractor would have a corrective action program in place that lays out steps and responsibilities to respond to complaints and correct deficiencies.
- Final noise mitigation measures will be specified in the noise variance granted by DOH.

### 3.16.4 Water Resources

This section discusses three types of water resources: water recreational resources, surface water quality, and drinking water.

The guardrail installed during construction would limit access to the ocean by limiting parking along the mauka side of Kamehameha Highway. Laniakea Beach is well known for turtles and surf spots. Accessing them during construction would require parking in other locations than the informal area on the mauka side of the Highway where people now park.

The other primary potential for construction-phase water resource impacts is associated with erosion and sedimentation associated with the project's earth disturbing activities. Preventing polluted runoff from impacting the nearshore waters is particularly important given the location of the Pedestrian Shift Alternative located adjacent to the nearshore reef. The project would not alter existing drainage patterns.

During construction, BMPs would be implemented to prevent debris and polluted runoff from stream or other natural waters. Storm water runoff and erosion during project construction and landscaping would be mitigated through the use of construction BMPs established and permitted before work begins. The project will obtain a Notice of General Permit Coverage (NGPC) from the HDOH as part of the National Pollutant Discharge Elimination System (NPDES) program. Generally accepted BMPs such as the following would be used:

- Work area isolation devices, such as diversion dams;
- Perimeter controls and sediment barriers, such as silt fences;
- Minimizing disturbance area;
- Excavated/Stockpiled material protection, including the covering of stockpiles;
- Storm drain inlet and catch basin protection devices will be installed; and
- Proper waste management will occur, including separation of recyclable material.

The Board of Water Supply (BWS) will approve the construction plans and any the construction schedule will be coordinated to minimize interruptions to water service to homes in the vicinity of the project.

### 3.16.5 Biological Resources

Construction lighting would be directed to the ground to the extent possible to help avoid confusing seabirds and sea turtles. During the shearwater nesting season, September 15 until December 15, construction activities will be limited to daylight hours whenever possible, and only lighting that is required for safety and security concerns will be allowed. Any necessary lights will be positioned low to the ground, be motion triggered, when possible, and shielded. On-site staff will be educated about seabird fallout that occurs when birds flying at night are attracted to artificially lighted areas resulting in disorientation and exhaustion.

The construction lighting plan would also take sea turtles into consideration. Shielded lighting to reduce direct and ambient lighting of beach habitats within and adjacent to the project site will be used. When possible, night work near the beach will be avoided between May 1and November 1, the sea turtle nesting and hatching season.

To minimize the potential for impacts to the Hawaiian hoary bat, woody vegetation taller than 15 feet (4.6 meters) will not be cleared during the annual the bat pupping season between June 1 and September 15.

### 3.16.6 Solid Waste Management and Hazardous Waste

Good housekeeping BMPs would be required of the contractor, such as ensuring that:

- All waste materials be collected and stored in securely lidded dumpsters that are emptied before becoming overly full and not buried on site;
- Materials stored on-site be stored in a neat, orderly manner in appropriate containers (i.e., per manufacturers recommendations);
- All on-site vehicles be monitored for leaks and receive regular preventive maintenance to reduce the chance of leakage;
- A spill cleanup kit be located on-site where petroleum products, paints, or other hazardous materials are stored; and
- All sanitary waste generated during the construction phase would be collected from portable units as required and directed to a HDOH-permitted treatment facility.

As stated in Section 3.13, hazardous materials contamination is not likely to be uncovered during construction. However, during construction, personnel should be alert for signs of potential petroleum contamination when soil is excavated. If contamination were identified during construction, the contractor would report it immediately to HDOT. Handling of hazardous materials and possible site remediation would be required in accordance with applicable State and federal laws, specifying the handling, treatment, and disposal of contaminated materials.

### 3.16.7 Historic and Archaeological Resources

For Site T-1, during construction, interim protective fencing be established around the potential ceremonial site and stay in place during the entire course of road construction activity. Once construction has been completed and the protective fencing removed, the long-term treatment of the site will remain the responsibility of the landowner (Kamehameha Schools).

Construction activities have the potential to encounter undocumented burial and archaeological sites. A qualified archaeological monitor will be present during ground-disturbing activities associated with development of the proposed roadway. A monitoring plan compliant with HAR §13-279 will be prepared prior to construction. If undocumented burial and archaeological sites are uncovered during construction, work would stop and the appropriate authorities, including SHPD and the police, would immediately be notified. The treatment of burials shall be conducted in accordance with HAR §13-300. Construction in the area of the find would resume upon approval of the appropriate authorities.

### 3.16.8 Relationship of Short-Term Uses and Long-Term Productivity

Construction of the proposed project would have short-term effects on the environment as described in this section. These effects would end with the completion of construction.

The proposed Pedestrian Shift Alternative would provide long-term improvements to the transportation system as described in Section 1.4. The long-term safety and mobility benefit that would be provided by the proposed alternative would be greater than the short-term adverse effects on the human environment. Furthermore, the Pedestrian Shift Alternative does not exclude future options, narrow the range of beneficial uses of the environment, or pose long-term risks to health and safety.

## 3.17 Consistency with Government Plans, Policies, and Controls

This section discusses whether the proposed project is consistent with existing government plans, policies, and controls.

### 3.17.1 State of Hawaii Plans and Land Use Controls

*Hawaii State Plan Transportation Functional Plan*

The Hawaii State Plan (Transportation Functional Plan), 1991, consists of comprehensive goals, objectives, policies and priorities for all areas of government functions, including transportation. Since the Transportation Functional Plan is dated, many of the specific actions have already been completed. This project would address congestion, one of the four issues considered most critical in the plan.

*Hawaii 2050 Sustainability Plan*

The Hawaii 2050 Sustainability Plan, July 2021 (Hawaii State Plan), prepared pursuant to HRS 226-65, serves as strategic action plan for climate and sustainability for the next ten years (2020-2030). Eight focus areas are listed:

1. Promote a Sustainable Economic Recovery through strategies that support local agriculture, green workforce development and education, and sustainable and regenerative tourism.
2. Reduce Greenhouse Emissions by continuing to monitor the State's emissions and reduce greenhouse gas emissions through strategies in the energy, transportation, agriculture and waste sectors.

3. Improve Climate Resilience by continuing to monitor and adapt to climate impacts and take actions to increase the resilience of the natural and built environments and their occupants.
4. Advance Sustainable Communities through strategies that improve land use and access to green space, advance sustainable practices in schools, and encourage sustainable buildings and infrastructure.
5. Advance Equity by ensuring equitable access to resources, addressing affordable housing and homelessness crises, and improving gender equity.
6. Institutional Sustainability Throughout Government by increasing the government's capacity through institutionalized collaboration to address sustainability and greening government operations.
7. Preserve the Natural Environment including a focus on clean water, marine resources and ecosystems, and natural resource protection.
8. Perpetuate Traditional Ecological Knowledge and Values as Hawaii collectively tackles these sustainability challenges.

While the majority can be considered applicable, the project is most consistent with focus area Number 3 (Improve Climate Resilience).

*Hawaii State Land Use Controls*

The State Land Use Commission (SLUC), under the authority granted in HRS Chapter 205, regulates land use through classification of State lands into four classifications: Urban, Agriculture, Conservation, and Rural. The intent of the land classification is to accommodate growth and development while retaining the natural and agricultural resources of the State. Each district has specific land use objectives and development constraints. The proposed project would be in Agricultural zoned land.

*Coastal Zone Management, Chapter 205A-2 of the Hawaii Revised Statutes*

The TSM Alternative would involve placing guardrail within the roadway right-of-way. Because the right-of-way is seaward of the certified shoreline, the Special Management Area (SMA) Use Permit and Shoreline Setback would not be required (See Appendix C for a Map of the Certified Shoreline).

The Pedestrian Shift Alternative is the preferred alternative. This Alternative would involve development, as defined by HRS Chapter 205A-22, within the regulated Special Management Area and Shoreline Setback. Figure 3-15 shows the Pedestrian Shift Alternative relative to the certified shoreline. Therefore, consistency with the Coastal Zone Management (CZM) Program Policies and Objectives is applicable.

**Figure 3-15. Pedestrian Shift Alternative and Certified Shoreline**

The following brief discussion describes the Pedestrian Shift Alternative's consistency with policies and objectives of the CZM Program.

Recreational Resources. The Pedestrian Shift Alternative would remove unsafe conflicts between Highway operations and beach access by moving the existing Highway mauka of Laniakea Beach.

This Alternative would then convert the existing Kamehameha Highway to a shared use path, establishing an initial link to future-planned non-motorized facilities along Kamehameha Highway, which would promote multimodal access to Laniakea Beach, and enhance recreational uses of the area. Remaining sections of the existing pavement would then be reverted to coastal vegetation, which would expand the recreational resource.

No existing recreational resources would be removed by this Alternative. However, access to Laniakea Beach would be indirectly limited during construction. Parking on the City DPR's parcel may be blocked by barriers to secure the construction site during the estimated 24 months that are needed to install the realigned Highway.

Historic Resources. A Draft AIS Report, which included pedestrian survey and subsurface testing was prepared. The Pedestrian Shift Alternative was developed to avoid impacts to significant historic and cultural resources. As described in Section 3.3, both sites identified within the study corridor would be physically avoided during construction. The Lauhulu Stream Bridge would be converted to pedestrian use, and Site T-1 would remain undisturbed on land owned by Kamehameha Schools.

Scenic and Open Space Resources. The Pedestrian Shift Alternative would not obstruct coastal or mountain views.

Coastal Ecosystems. The Pedestrian Shift Alternative would not only protect coastal ecosystems, it would benefit them by reducing and scaling back urban encroachment. Addition of pervious surfaces and permanent BMPs installed by the project would mitigate and minimize surface storm water runoff.

Economic Uses. The Hawaii and North Shore economy is driven by tourism. The traffic delays caused by pedestrians crossing the Highway (who are predominantly visitors) and Oahu residents who feel held captive by traffic delays, is a source of tension between economic use and residential quality of life. While there are larger contexts to this issue, the Pedestrian Shift Alternative would help to restore balance between these interests. Ultimately the Alternative allows coastal economic uses to occur without infringing on the local quality of life.

In addition, moving the Highway inland would improve the resilience and reliability of the transportation network. The movement of goods and services would continue unimpeded by the effects of shoreline erosion and sea level rise.

Coastal Hazards. The Pedestrian Shift Alternative would move Kamehameha Highway inland to mitigate its periodic closures due to wave inundation. Inland relocation would also defend the Highway from the effects of climate change and sea level rise. No changes to flood zone maps would be required as a result of the roadway's relocation.

Managing Development. The Pedestrian Shift Alternative has been developed through public participation. As discussed in Section 2.4 and Section 2.5, it is largely based on the Quinlan Realignment Alternative, which was strongly advocated by the community and presented in a task

force advisory group assembled by HDOT. At the time, it did not meet the purpose and need when the primary project purpose was to address coastal highway erosion at both Laniakea Beach and Chun's Reef. When the project re-prioritized safety at Laniakea Beach, this Alternative became a viable option. HDOT met with residents at Pohaku Loa Way, residents on the Haleiwa side of Laniakea Beach, Kamehameha Schools, the City DPR, and local ranchers to develop the Pedestrian Shift Alternative design.

Public Participation. See Managing Development.

Beach Protection. As certified by the Board of Land and Natural Resources (See Appendix C), the existing Kamehameha Highway is seaward of the shoreline in the project area. The proposed Pedestrian Shift Alternative would relocate the Highway such that it is inland from the certified shoreline. In doing so, the Alternative would accomplish the goals of minimizing the existing Kamehameha Highway's interference with natural shoreline processes.

Marine Resources. The Pedestrian Shift Alternative would not have an adverse impact on marine resources. Revegetation of Kamehameha Highway would benefit the coastal ecosystem.

### 3.17.2 City and County of Honolulu Plans and Controls

*City and County of Honolulu General Plan*

The General Plan Objectives and Policies (General Plan) for the City and County of Honolulu (City) is a requirement of the City Charter. The City first adopted the General Plan in 1977 and since that date, the General Plan has been amended several times, most recently in 2002. This project is consistent with the following objectives and policies in Section V. Transportation and Utilities:

- Objective A, Policy 5 "Improve roads in existing communities to reduce congestion and eliminate unsafe conditions."
- Objective D, Policy 1 "Give primary emphasis in the capital-improvement program to the maintenance and improvement of existing roads and utilities."

The General Plan divides up the island of Oahu into eight sections, each having their own development plans, which are intended to guide City land use approvals, infrastructure improvements and private sector investment decisions. This project is located on the North Shore, within an area designated as rural.

*North Shore Sustainable Communities Plan*

North Shore Sustainable Communities Plan (2011) focuses on the retention of the existing rural character, the provision and maintenance of adequate infrastructure and public facilities, the protection agricultural lands, development pressure, affordable housing and appropriate visitor accommodations. The proposed project is consistent with the policies of the NSSCP because the proposed project preserves adequate infrastructure for transportation and emergency access. It would keep Kamehameha Highway as a two-lane highway consistent with the region's rural character and rural lifestyle.

*Oahu Regional Transportation Plan*

The Oahu Regional Transportation Plan 2040 (ORTP), dated April 2016, identifies the major land transportation improvements needed by the year 2040. The recommendations of the ORTP represent those projects needed to support anticipated growth and development on the Island of Oahu. The proposed project is consistent with the goals and objectives identified in the ORTP.

The ORTP includes System Preservation Projects 502 and 552 for protecting shoreline along Kamehameha Highway, which is a secondary purpose for the project. Twenty million dollars is designated from 2019 to 2029, and 30 million dollars is designated from 2030 to 2040.

*Zoning*

City and County of Honolulu zoning is required to be in conformance with Development Plan designations of the Department of Planning and Permitting (DPP) and Land Use Ordinance (LUO). The LUO provides a list of zoning districts and precincts and the permitted uses and structures for each district and precinct. The purpose of the LUO is to regulate land use to encourage orderly development in accordance with adopted land use policies, including the General Plan and the NSSCP, and to promote and protect the public health, safety and welfare.

The existing Kamehameha Highway right-of-way lies within the AG-1, Restricted Agricultural District. The proposed project would relocate the Highway further inland within this same zone. Current land uses adjacent to the Highway, R-5, Residential (makai) and AG-1, Restricted Agriculture, would remain consistent with their established zoned uses. No changes to land use are anticipated as a result of the proposed project.

*Special Management Area and Shoreline Setback*

HRS Chapter 205A, Chapter 25 of the City and County of Honolulu's Revised Ordinances of Honolulu (ROH), and Chapter 23 of the ROH outline special controls, policies and guidelines for development within areas along the shoreline, which are designated as the SMA, and shoreline setback area. The location of the shoreline was certified by DLNR on July 30, 2020 and is included as Appendix C. Figure 3-15 illustrates which elements of the Pedestrian Shift Alternative are seaward of the certified shoreline, and those elements that are mauka of the certified shoreline**.** Project elements that are mauka of the certified shoreline are presumed to be development, according to the definition provided in Chapter 25 of the ROH. A SMA Major permit and shoreline setback variance would be required.

See Section 3.17.1 for a discussion of the Pedestrian Shift Alternative's consistency with Chapter 205A Program policies and objectives.

## 3.18 Secondary and Cumulative Impacts

Secondary, or indirect, impacts are defined as "effects which are caused by the [proposed] action and are later in time or further removed in distance but are still reasonably foreseeable. Indirect effect may include growth-inducing effects and other effects related to changes in the pattern of land use, population density, or growth rate…"

Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable

future actions regardless of what agency (federal or non-federal) or person undertakes such actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over time." Cumulative impacts include the direct and indirect impacts of a project together with the reasonably foreseeable future actions of others.

### 3.18.1 Potential Secondary Impacts

No significant adverse secondary impacts are anticipated should the proposed project proceed.

Visitors will continue to explore the North Shore, and residents will continue to make their homes there, regardless of the proposed project. While realigning Kamehameha Highway would help improve congestion and prevent erosion, factors affecting development such as demand, property prices, and disposable income levels are likely to have a far greater effect on development or tourism. The proposed project would not constrain development. Proceeding with the project would have only a minor effect on overall development trends on the North Shore. Thus, the proposed project would not induce secondary land uses.

By creating safer access to the beach, more tourists may come, and add to the pressure placed on resting turtles and coastal resources, especially with an increase in vehicular traffic to the North Shore and increased commercial and self-guided tours of the well-publicized Green Sea turtle nesting area on the beach. There is no way to reasonably quantify this potential secondary impact, but federal regulations are in place to protect these species. Additionally, relocating the Highway inland and removing Highway pavement in favor of revegetation provides an opportunity for coastal ecosystems to rebound from human and development pressures.

### 3.18.2 Potential Cumulative Impacts

The Pedestrian Shift Alternative would not result in commitments to implement other projects or result in significant change to how the surrounding community would develop since State Land Use and Zoning controls are in place.

The Pedestrian Shift Alternative also would not directly result in cumulative effects on the environment. Kamehameha Highway is an existing piece of the transportation network, and its continued existence is vital for the community and island visitors.

## 3.19 Unresolved Issues

Unresolved issues include:

- The timing for the construction of the No Build Settlement Alternative is unknown, for this reason, it was included as an alternate baseline condition with the No Build.
- Land acquisitions do not typically occur until after the environmental review has occurred. It is reasonable to assume that right-of-way negotiations with the City and County of Honolulu and Kamehameha Schools may result in larger parcel acquisitions than originally anticipated due to remnants that may remain. To reconcile this issue, land use impacts and impacts to the landowner are the focus of the impact assessment and not necessarily the amount of property acquired.

- Although the Archeological Inventory Survey (AIS) has been completed, coordination with SHPD has not yet been finalized (Section 3.3).

# 4.0 COMMENTS AND COORDINATION

This chapter summarizes the public and agency consultation and coordination activities specific to the pedestrian safety project that have been conducted to date.

## 4.1 Pre-Assessment and Early Consultation

Early consultation for the pedestrian safety project consisted of meetings with adjacent landowners, residents, and regulatory agencies to develop a community-accepted design. Once design concerns were addressed, scoping letters requesting input on the project were sent.

Scoping letters were sent to 284 recipients representing federal, State, and City agencies; organizations; government officials; landowners; and individual residents on January 26, 2021 and between February 2 and February 3, 2021. A list of recipients and copies of correspondences are provided in Appendix A-1.

Responses to scoping requests helped to inform preparation of this Draft EA.

## 4.2 Regulatory Coordination

The project requires compliance with specific environmental laws and regulations. Coordination and consultation was conducted as described below.

### 4.2.1 Hawaii Revised Statutes Chapter 6E-8

As also described in Section 3.3, HRS Section 6E-8 is the State's law protecting historic resources and is applicable to this project because it is an agency-proposed action. HDOT met with the State Historic Preservation Division (SHPD) on June 18, 2020 to coordinate the subsurface testing strategy for the archaeological inventory survey (AIS). Based on this discussion, SHPD and HDOT have agreed to conduct archaeological monitoring for certain areas of the project, as described in Section 3.3 (see Appendix A-2).

A Draft AIS has been prepared and is in the process of being submitted for SHPD's review.

### 4.2.2 Floodplain Coordination

HDOT met with the City and County of Honolulu's Floodplain Manager (City Floodplain Manager) and the Department of Land and Natural Resources' Engineering Division (DLNR-ENG) on November 14, 2019 to discuss regulatory requirements related to the floodplain (Appendix A-7-2). DLNR-ENG recommended that HDOT follow the guidelines that DLNR is developing concerning Flood Insurance Rate Maps (FIRM). Section 3.1 describes the project area's FIRM mapping and floodplain. To address floodplain impacts, Sea Engineering Inc. (SEI) modeled the changes that would occur to flooding for the proposed project (Laniakea Highway Relocation Inundation Analysis and Coastal Assessment, FEMA's FIRM Method Tsunami Runup Modeling, in Appendix A-72). The study showed little change in tsunami inundation caused by the proposed new alignment and no changes to the FIRM maps are proposed.

During the scoping phase for this current project, FEMA (February 17, 2021), wrote to address development in the floodplain. In addition to the study cited above, a hydraulic study and a drainage study (Appendix F and Appendix G) were performed to determine both the impact of the new bridge on flood elevations and required permanent BMPs.

### 4.2.3 Section 404 of the Clean Water Act

Section 404 of the Clean Water Act prohibits the discharge of dredged materials into the waters of the U.S., which include non-navigable streams, wetlands and mudflats, unless the U.S. Army Corps of Engineers (USACE) provides a permit. On March 27, 2021, USACE and HDOT visited the site to determine if any wetlands would be impacted by the proposed project. Although wetlands had been mapped in the area by the Fish and Wildlife Service Mapping Tool, these maps are very generalized, and no wetlands were found. Therefore, no permit from the USACE will be required for the project.

# 5.0 ANTICIPATED FINDING OF NO SIGNIFICANT IMPACT

As the proposing agency, HDOT anticipates rendering a Finding of No Significant Impact (FONSI) for the proposed project in accordance with HRS Chapter 343 and HAR, Sections 11-200.1-19. This assessment is based on an evaluation of project impacts in relation to the "Significance Criteria" specified in HAR 11-200.1-13. The Significance Criteria appear below in italics, followed by a discussion of the project in relation to the specific criterion. The nature of the project's potential impacts is discussed in detail in Chapter 1.0.

1. *Involves an irrevocable commitment to loss or destruction of any natural, cultural or historic resource* – The Pedestrian Shift Alternative was selected because it would avoid impacts to cultural resources. Impacts, as described in Section 3.3, to Lauhulu Stream Bridge (also called Laniakea Stream Bridge) are not considered irrevocable because the impacts are related to its historical function as a road. The project actions do not irretrievably modify the bridge in such a way that it could never be returned to its historical use for transportation.

   As described in Section 3.5, the proposed project is not likely to affect the plant and wildlife resources of the area, especially any threatened or endangered species, or species of concern. Much of the plant and bird species observed within the project area are introduced. The proposed project would allow the plants mauka of the existing Highway to regrow as cars would no longer be parking in the area. Pavement removal and re-vegetation at the makai side of Kamehameha Highway would promote long-term restoration of the beach ecosystem, resulting in beneficial impacts to wildlife.

2. *Curtail the range of beneficial uses of the environment* – The proposed project would not curtail the range of beneficial uses of the environment. Long-term, access to the beach would be improved by removing conflicts between beach access and highway operations. Although the informal parking on City property would be blocked during construction, the impact is temporary, and not a full restriction. Beachgoers can still use alternative modes of transportation (bus, bicycle, walk) or park at a different location.

3. *Conflicts with the State's environmental policies or long-term goals established by law* – The proposed project is consistent with the environmental goals and objectives of the State of Hawaii, as demonstrated in Section 3.17.

4. *Have a substantially adverse effect on the economic welfare, social welfare, or cultural practices of the community and State* – The proposed project would not adversely affect the economic welfare, social welfare, or practices of the community and State. Instead, it would support and enhance the Island's economy and quality of life by contributing to the reliability of the transportation network. The Pedestrian Shift Alternative would help to alleviate frequent roadway flooding and prevent a catastrophic closure of the Highway, as well as mitigate the frequent congestion on Kamehameha Highway.

5. *Have a substantially adverse effect on public health* – The proposed project enhances safety for pedestrians and motorists and would not adversely affect public health.

6. *Involves adverse secondary impacts such as population changes or effects on public facilities*– The proposed project is not expected to cause secondary impacts as it does not increase the roadway capacity. Therefore, the proposed project would not induce secondary land uses, nor would it result in related long-term adverse secondary impacts that would otherwise not occur.
7. *Involves substantial degradation of environmental quality* – The proposed project would not result in a substantial degradation of environmental quality. The project would not result in adverse environmental conditions, as demonstrated in Section 3.0.
8. *Is individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions* – The proposed project would not create a commitment for other actions by HDOT, another government agency, or other party. The proposed project is a complete, independent project, with logical termini, and would not result in commitments for other roadway projects, nor result in cumulative, considerable effect on the environment.
9. *Substantially affects a rare, threatened, or endangered species or its habitat* –As described in Section 3.5 and biological studies conducted for the project (Appendix E), no interactions with protected species is likely to occur. Construction activities are not anticipated to occur where the sea turtles rest. Standard mitigation measures would be employed to protect seabirds, hoary bats, and sea turtles if night time construction is warranted (See Section 3.17).
10. *Have a substantial adverse effect on air or water quality or ambient noise levels* – The proposed project would not have an adverse effect on air or water quality or noise levels. No violations of State or National Ambient Air Quality Standards would be cause by the proposed project. Storm water control BMPs would be implemented during project construction in order to minimize water quality impacts from construction site runoff. Revegetation of portions of the existing highway and permanent BMPs installed by the project would help to reduce storm water runoff and improve overall water quality. No adverse noise impacts are anticipated.
11. *Have a substantial adverse effects or is likely to suffer damage by being located in an environmentally sensitive area such as a floodplain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters* – The Pedestrian Shift Alternative delays the consequences of sea level rise and will help protect Kamehameha Highway at Laniakea from flooding, tsunami, and from being undermined by erosion.
12. *Have a substantial adverse effect on scenic vistas and view planes, during day or night, identified in county or state plans or studies* –The Pedestrian Shift Alternative would continue to provide a view of the beach for drivers while pedestrians and cyclists would enjoy the view from the existing road.
13. *Requires substantial energy consumption or emit substantial greenhouse gases* – The proposed project would not result in substantial energy consumption. While there would be short-term construction-phase energy consumption, it would be offset by the anticipated long-term benefits as vehicular traffic is able to travel more efficiently on Kamehameha Highway.

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Appendix

# A

# Consultation, and Correspondence

Appendix

# A-1

# Pre-Scoping for Kamehameha Highway Pedestrian Safety Project Vicinity of Laniakea Beach

The following agencies, elected officials, organizations, and others were contacted by email on January 26, 2021 and post mail between February 2 and 3, 2021. A copy of the letter is included. The recipients are listed below. An asterisk (*) appears next to those entities that responded to the letter.

Responses to scoping requests helped to inform preparation of this Draft EA.

Federal Agencies

U.S. Army Corps of Engineers, Honolulu District Regulatory Branch

U.S. Department of Agriculture, National Resource Conservation Service

U.S. Department of Commerce, National Oceanic and Atmospheric Administration

U.S. Department of the Interior, U.S. Fish and Wildlife Service

U.S. Department of the Interior, U.S. Geological Survey

U.S. Environmental Protection Agency (EPA), Pacific Islands Contact Office

U.S. EPA, Region IX

U.S. Federal Emergency Management Agency (FEMA), External Affairs Director

U.S. FEMA, Floodplain Management and Insurance Branch**

U.S. FEMA, Mitigation Outreach Specialist

U.S. FEMA, Office of Natural and Technological Hazards Program

State of Hawaii Agencies

Department of Accounting and General Services*

Department of Agriculture*

Department of Budget and Finance

Department of Business, Economic Development & Tourism (DBEDT)

DBEDT, Office of Planning

Department of Defense

Department of Education

Department of Hawaiian Home Lands

Department of Health

Department of Land and Natural Resources (DLNR)

DLNR, Division of State Parks

DLNR, Engineering Division

DLNR, Office of Coastal and Conservation Lands

DLNR, State Historic Preservation Division

Office of Hawaiian Affairs

City and County of Honolulu Agencies

Honolulu Board of Water Supply*

Department of Design and Construction*

Department of Emergency Management*

Department of Environmental Services*

Department of Land Management*

Department of Parks and Recreation*

Department of Planning and Permitting*

Department of Transportation Services *

Emergency Services Department (ESD)*

ESD, Ocean Safety Division*

Honolulu Fire Department*

Honolulu Police Department*

Office of Climate Change, Sustainability and Resiliency

Office of Economic Development

Office of Economic Revitalization

Elected Officials

Honolulu City Councilmember Brandon Elefante, Chair, City Council Transportation Committee

Honolulu City Councilmember Carol Fukunaga, Chair, Committee on Public Infrastructure and Technology

Honolulu City Councilmember Heidi Tsuneyoshi, District 2

Honolulu City Councilmember Kathleen Pahinui, Neighborhood Board No. 2

Honolulu City Councilmember Radiant Cordero, Chair, Committee on Transportation, Sustainability and Health

Mayor Rick Blangiardi, City and County of Honolulu

State Representative Angus L.K. McKelvey, Chair, House Committee on Economic Development and Business

State Representative Cedric Asuega Gates, Chair, House Committee on Culture, Arts, and International Affairs

State Representative David Tarnas, Chair, House Committee of Water and Land

State Representative Henry J.C. Aquino, Chair, House Committee on Transportation

State Representative Mark Nakashima, Chair, House Committee on Judiciary and Hawaiian Affairs

State Representative Richard H.K. Onishi, Chair, House Committee on Tourism and International Affairs

State Representative Ryan Yamane, Chair, House Committee on Water, Land, and Hawaiian Affairs

State Representative Sean Quinlan, District 47, Chair, House Committee on Economic Development

State Representative Scott Saiki, Speaker of the House

State Representative Sylvia Luke, Chair, House Committee on Finance

State Senator Chris Lee, Chair, Senate Committee on Transportation

State Senator Clarence Nishihara, Chair, Senate Committee on Public Safety, Intergovernmental and Military Affairs

State Senator Donovan M. Dela Cruz, Chair, Senate Committee on Ways and Means

State Senator Gil Riviere, District 23*

State Senator Glenn Wakai, Chair, Senate Committee on Energy, Economic Development and Tourism

State Senator Kaialai`i Kahele, Chair, Senate Committee on Water and Land

State Senator Lorraine R. Inouye, Chair, Senate Committee on Water and Land

State Senator Malie S.L. Shimabukuro, Chair, Senate Committee on Hawaiian Affairs

State Senator Ronald D. Kouchi, Senate President

U.S. Representative Ed Case

U.S. Representative Tulsi Gabbard

U.S. Senator Brian Schatz

U.S. Senator Mazie Hirono

Utilities

Charter Communications/ Spectrum*

Hawaiian Electric Company*

Community and Other Organizations

Angelica's Family LTD Partner

Camp North Shore LLC

Chamber of Commerce Hawaii

Council for Native Hawaiian Advancement

Covenant Group Inc.

DCGC LLC

Defend Oahu Coalition

Discover Hawaii Tours

D. Sack Family LTD Partnership

E Noa Corporation

E Pili Kakou LLC.

E Pili Kaua LLC.

Foodland Delivery

Grabber Building LLC.

Hawaii Bicycling League

Hawaii Lodging and Tourism Association

Hawaii Maoli

Hawaii Transportation Association

Hawaii Tourism Authority

Hawaii Visitors and Convention Bureau

Hawaii's Thousand Friends

Historic Hawaii Foundation

Kaalakea Kai Estates

KAHEA

Ka Hoku Hawaii LLC.

Kalekai Properties LLC.

Kamehameha Schools*

Keep the North Shore Country

Kokua Hawaii Foundation

Life of the Land

Malama na Honu

Malama Pupukea-Waimea

Native Hawaiian Economic Alliance

North Shore Chamber of Commerce*

North Shore Community Land Trust

North Shore Lifeguard Association

Oahu Nature Tours

Oni Kai LTD Partnership

Polynesian Adventure Tours

Polynesian Hospitality

Punalau LLC

Ralston Development Corp

Roberts Hawaii

Save Our Surf**

Save the Sea Turtles International

Sierra Club

Surfrider FOundation

The Surf Bus

Travel Plaza Transportation, LLC

Waialua Community Association

Waialua Hawaiian Civic Club

Waialua Oceanview LLC.

Waihuena Farm

Residents, Trusts, and Other Individuals

AMP I

Ann, Leslie, and Lucas Chung

Audry and Steven Yuh Trust

Beverly A. Fettig Trust

Carl Hodel Trust

Charles and Eleni Pfluger

Curtis and Craig Kamisugi

Dan Dillon Trust
Dennis Pettigrow Trust
D.G. Anderson Trust
Diane Peck Trust
Eastern Skateboard Supply Inc.
Edwin and Rebecca Gonzales Trust
Ernesto Simoes & Francine Beckhauser Trust
Fe Asia and Robert Medoff
Fitzgerald Trust
George E. K. Awai Trust
Gillard Family
Guy Tucker Trust
Honu Pacific Surf LLC.
Ishii Trust
James KB & Muriel L Fong Trust
Jason D. Seymour Trust
Jeffery, Michael, and Sandra Jordan
Jeri Lynch Trust
Joao Jabour Trust
John and Etsuko Carper Trust
Joseph and Lyndsey Ekstrom Trust*
Joyce and Michael Farrell Trust
JSP I
Juliana Sanvold Trust
Kelley and Wesley Huggett
LSW Hawaii LLC.
Marcelino Apilado
Marguerite & William Paty Jr. Trust
Marina Whyte Trust
Martha Laxson Trust
Maude M. Silva Trust
Mellissa Dawson Trust
Ms. Anita Apilado
Michael and Christina Fisher
Mr. & Mrs. Alvin and Barbara Santos
Mr. & Mrs. Andrew and Jill Cannon
Ms. Antya Miller
Ms. Barbara Fowls
Ms. Barbara Picayo
Mr. Beau Sheil*
Mr. Bernie Moriaz
Mr. Bill Quinlan*
Mr. Bob Leiman
Mr. Bob Leinau*
Mr. Bob Thorp
Mr. & Mrs. Brett & Dianne Thomas*
Mr. Brian Emmons*
Ms. Carina Cooper
Ms. Carol Philips
Ms. Carolyn Sandian
Ms. Carolyn Sandison
Ms. Cece Bulkley
Mr. Chris Gardner
Ms. Clara Yokotake
Ms. Connie Gazman
Mr. Dale Bordner
Mr. Dale Moore
Mr. David Fisher*
Mr. David T. Tamura
Ms. Deborah Aldrich*
Mr. Dennis Reuter
Ms. Diane Anderson*

Mr. Dolan Eversole
Mr. Douglas Cole
Mr. Douglas Meller**
Ms. Elenore Yuki Goto
Ms. Ellen Fooks
Mr. & Mrs. Fellisimma and Robin Albios
Mr. George Ai
Mr. Gordon Merchant*
Ms. Grace K. Terashima
Mr. & Mrs. Hans and Karin Hedermann*
Mr. Ivan K. Asano
Mr. James Haas
Mr. James T. Eichler
Mr. & Mrs. James and Michelle Hawkins
Mr. & Mrs. James and Molly Lewis
Ms. Jean Martinson
Mr. Jeremy M. Mirels
Ms. Jessica Malcolm
Ms. Jill Cannon
Mr. John DeSato
Mr. John Desoto
Mr. John R. Kleiser
Mr. John Theilst
Mr. Joseph Whitmarsh
Ms. Julia Hirayama
Ms. Karen Gallegher
Ms. Kathleen Gustine
Mr. Kawika Au
Mr. Kenneth Walsh*
Ms. Laura Figueira
Ms. Laura Purdy
Ms. Laura Taylor
Mr. Leland H. Dao
Ms. Lori Watts
Ms. Lorna C. Jensen
Ms. Luann Casey
Ms. Malia Evans
Ms. Marina Hoshi Whyte*
Ms. Mary Lagues
Ms. Mellissa Ginella
Mr. Michael Berman**
Mr. Michael Horack
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Ms. Mikela K Keawe
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Mr. Saipele Manutai
Ms. Sandra Cayocca-Cunha
Mr. Scott Brewer
Ms. Tammy Escorzon
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Pavsek Family Trust
Paul and Sharon Loughran Trust
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Robert and Linda Thorp
Robert Brooks Trust
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Ronald Hill & Borinne K.C. Trust
Ryan and Shauna Ockey
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Scott and Diana Foster Trust
Sheil Family Trust
Silvia Donahue Trust
Susan and Alexander Hendry Jr. Trust
Syren I
Therese A. Boe Trust
Thomas Jacobs Trust
Warren D. Coley Trust
Wilcox Family Trust
William Eilert Trust*

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JADE BUTAY
DIRECTOR

Deputy Directors
LYNN A.S. ARAKI-REGAN
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DEREK J. CHOW

**STATE OF HAWAII**
**DEPARTMENT OF TRANSPORTATION**
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:
HWY-PA 2.5136

January 26, 2021

Subject: Kamehameha Highway Pedestrian Safety Project
Vicinity of Laniakea Beach
Pre-Draft Environmental Assessment (EA) Scoping and Request for Comments
Haleiwa, Island of Oahu, Hawaii

The State of Hawaii Department of Transportation, Highways Division (HDOT) is proposing to realign Kamehameha Highway in the vicinity of Laniakea Beach (Figure 1). The primary purpose of the project is pedestrian safety. Previously, HDOT considered other project alternatives designed to protect the highway from wave-driven erosion and keep it operational as part of the overall transportation system in the area. However, HDOT re-prioritized safety as the project's primary objective in response to community outcry when a pedestrian was struck by a vehicle in August 2019. This re-prioritization led to re-evaluation of project alternatives. These new project alternatives, as presented in this letter, are designed to protect pedestrians and, as a secondary benefit, would help protect the highway from shoreline erosion.

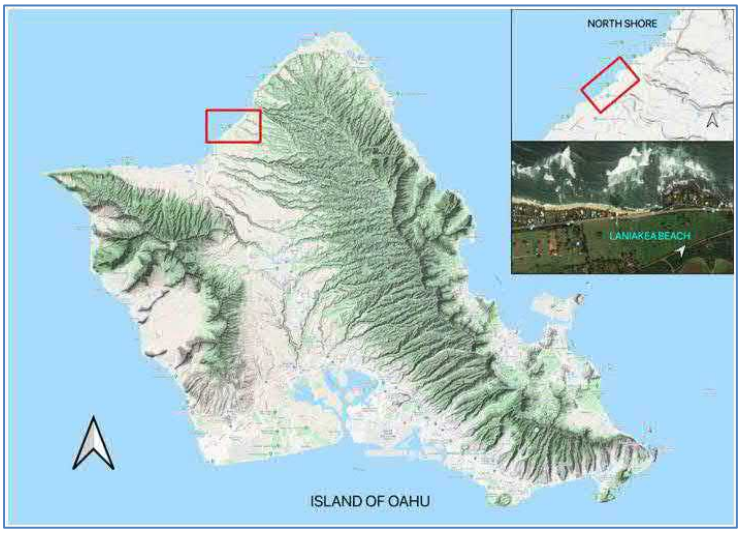

**Figure 1. Project Location**

HDOT has been coordinating with the community since 2011 to address concerns regarding Kamehameha Highway in the vicinity of Laniakea Beach and has developed the current project based on input provided by stakeholders. The community has

endured years of traffic congestion on Kamehameha Highway created by people parking on the mauka side of the highway and crossing to see the turtles. Additional community concerns are specific to people attempting to cross the highway and the safety issues involved due to the lack of an organized crossing system. Input into the project design alternatives was gathered during meetings with affected individual land owners and residents, as well as meetings with City and State agencies.

HDOT is preparing an EA to evaluate the proposed project. There are four potential alternatives being evaluated for which we would like your input: the No Build Alternative, the No Build Settlement Alternative, the Transportation System Management Alternative, and the "Pedestrian Shift" Alternative.

**No Build Alternative**

The No Build Alternative is the existing condition or "do nothing" approach. It would leave the project area as it is with no changes to the transportation infrastructure. See Figure 2 and Figure 3.

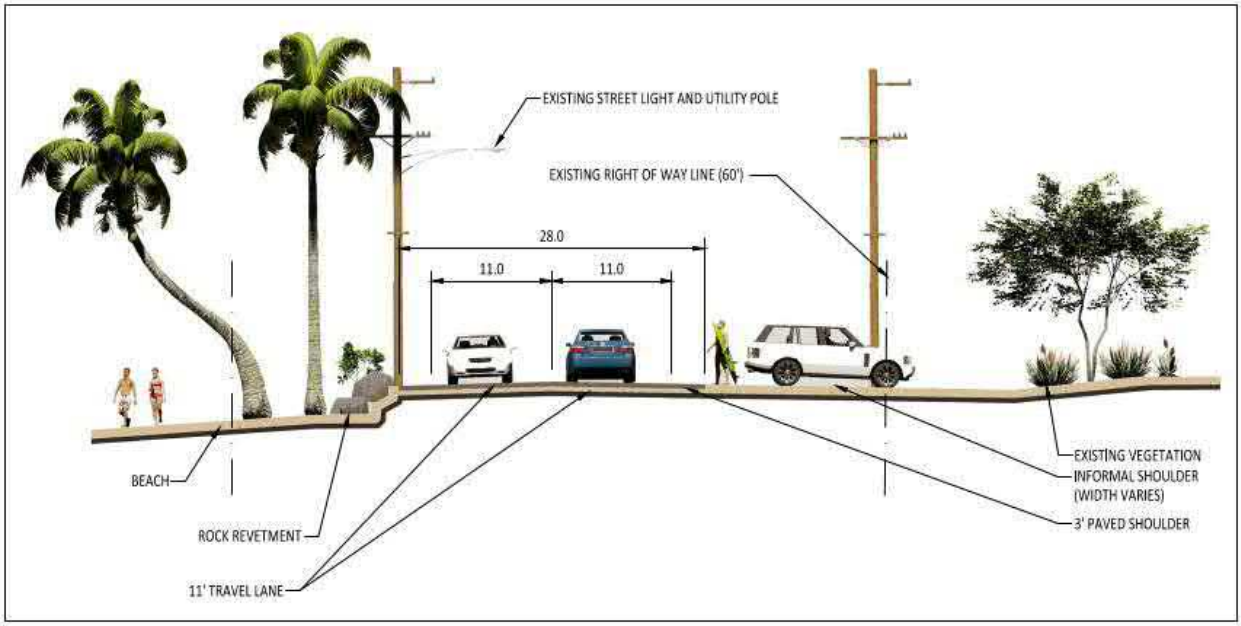


**Figure 2. Existing Typical Section/No Build Alternative**

**Figure 3. Existing Plan View/No Build Alternative**

**No Build Settlement Alternative**

As reported in Civil Beat on July 9, 2020, an interim solution to address access and safety issues along the Laniakea corridor was reached in a court settlement on June 17, 2020. This scenario is considered a "No Build" because this condition would be implemented by an entity other than HDOT. It represents another potential outcome of the "do nothing" alternative.

While there is no schedule for the agreement's implementation, the changes established in the settlement will be addressed in the EA as an alternate scenario for the No Build Alternative. The settlement was reached after a group of North Shore residents, activists, and surfers litigated HDOT over the placement of barriers along the mauka side of Kamehameha Highway in 2014.

The settlement involves allowing cars to park on the mauka side of the highway for better public access to Laniakea Beach, and installing guardrails and crosswalks so that visitors might cross the highway in a safer, more orderly fashion. See Figure 4 and Figure 5. Cars will enter the parking area on the Haleiwa side and exit on the Waimea side. In addition, the City and County of Honolulu will move a cattle fence on its property mauka of the highway so that cars have room to maneuver and park. The agreement further prohibits the large tour buses and vans that often shuttle tourists to Laniakea from stopping there. The settlement agreement calls for a one-year trial period, but there is no deadline for the changes to take place.

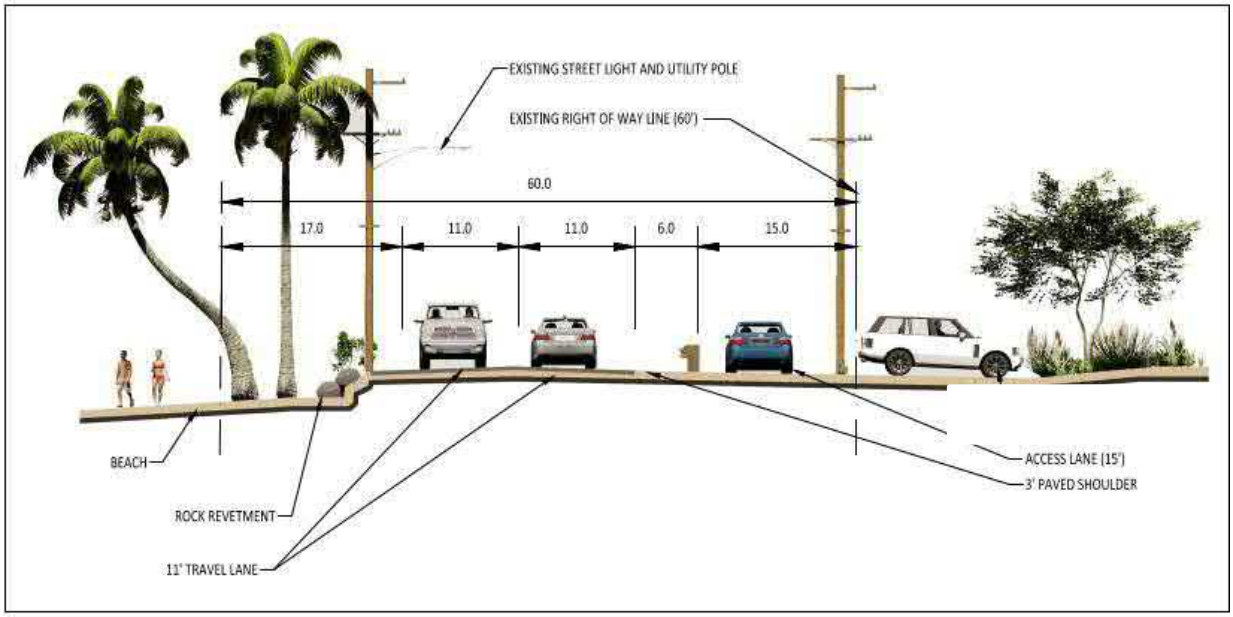


**Figure 4. No Build Settlement Section**

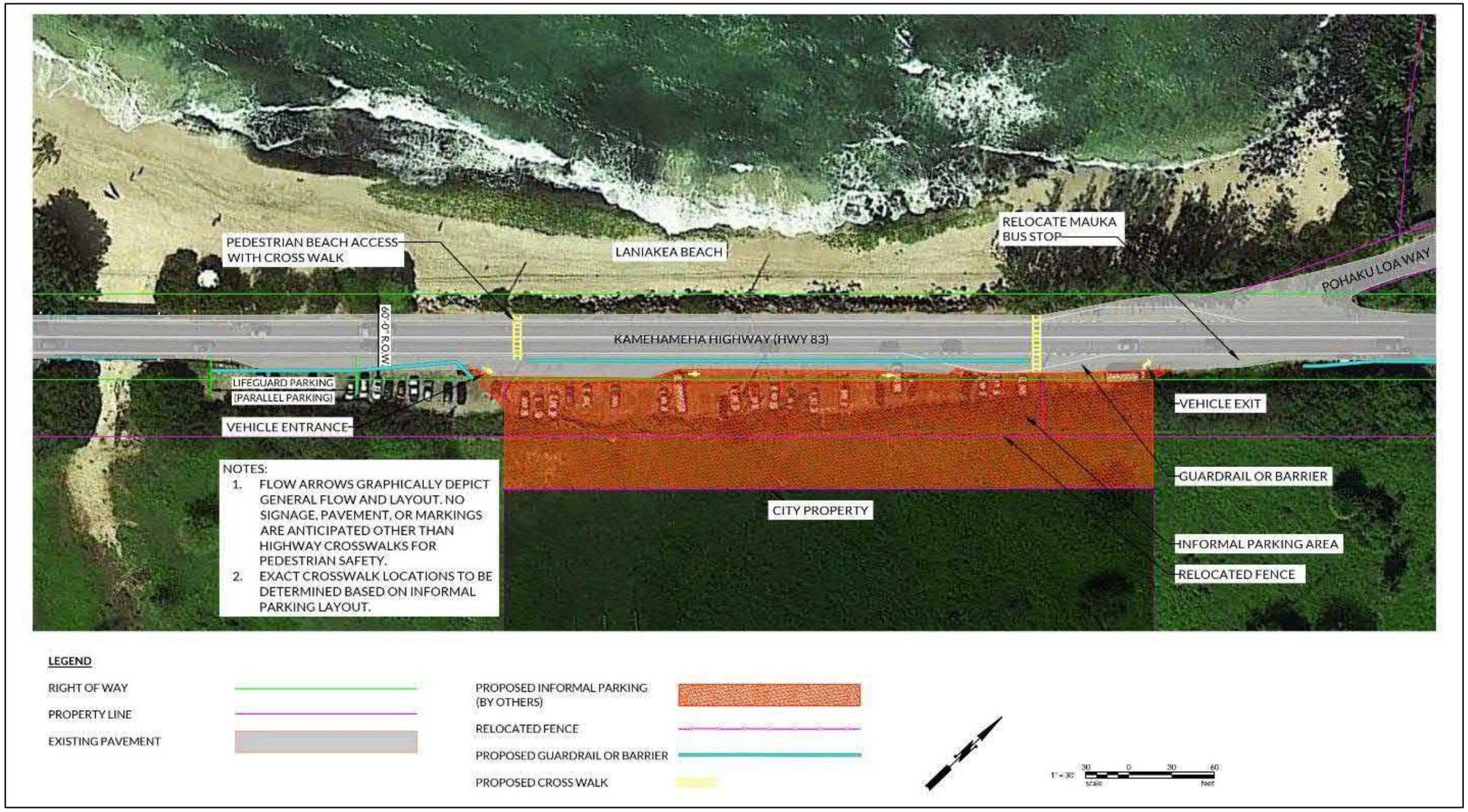


**Figure 5. No Build Settlement Plan View**

**Transportation System Management Alternative**

The Transportation System Management Alternative (TSM) would entail blocking off the mauka side parking with a permanent guardrail. The guardrail would be in a similar location as the concrete barriers that were installed in 2014. See Figure 6 and Figure 7.

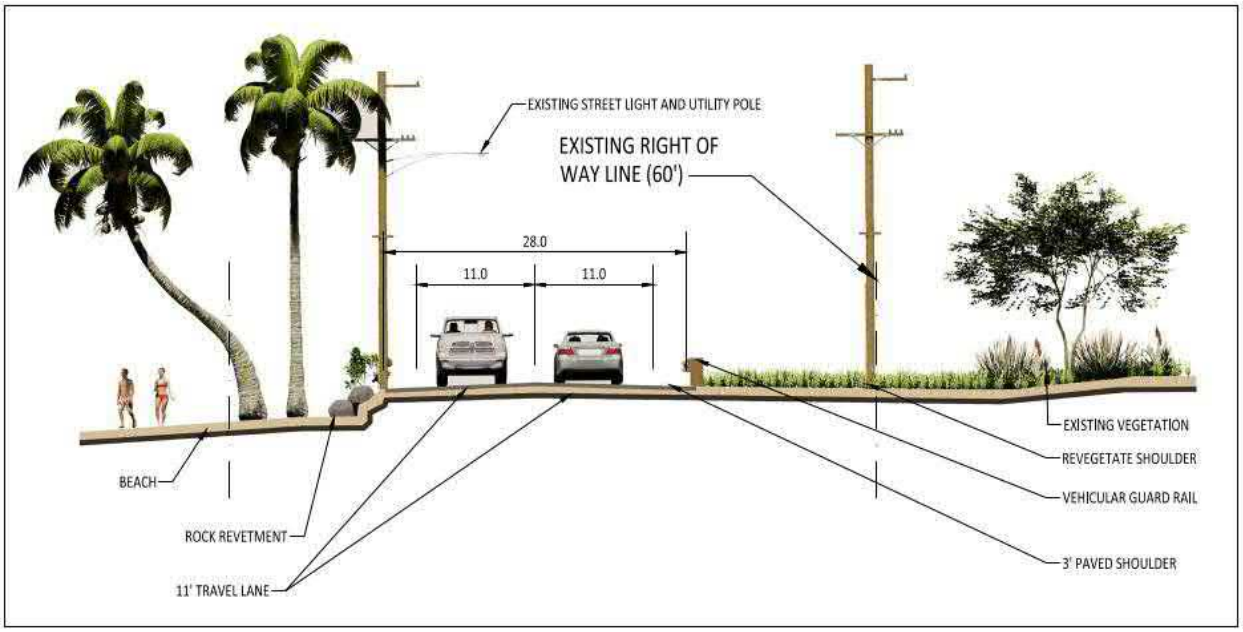


**Figure 6. Typical Section – TSM Project Alternative Section**

**Figure 7. Plan View – TSM Project Alternative Section**

**"Pedestrian Shift" Alternative**

The "Pedestrian Shift" Alternative generally consists of realigning Kamehameha Highway mauka roughly 80 feet from its current location, with the realignment beginning from the Haleiwa side of Laniakea Stream Bridge to the Haleiwa side of Kawailoa Stream Bridge, a distance of roughly 0.5 miles. See Figure 8 and Figure 9 for the proposed realignment.

Because the road would be shifted and guardrails installed, there would be no open area for parking on the mauka side and the ability to park and attempt to cross the road would be removed. Informal parking would be accommodated on the makai side of the highway. Components and details of this alternative would include:

- A highway right-of-way that is generally 120-feet wide with two 12-foot wide through lanes (one in each direction) and a 10-foot wide median refuge lane for part of the realigned distance.
- A normal asphalt road structure with provisions on the makai edge to reduce the potential of soil erosion from under the roadway.
- Vehicular guardrails to prevent parking on the mauka side of the shifted highway.
- Existing cross streets and driveways would be modified to allow access to the realigned Kamehameha Highway and vehicle control gate at Pohaku Loa Way.
- Street lights on the mauka side of the highway.
- One new bridge at Laniakea Stream on the mauka side of the existing Laniakea Stream Bridge.
- Converting one lane of the existing Kamehameha Highway to a 16-foot wide shared use path for bicycles and pedestrians. The other lane would be partially removed and revegetated.

As this alternative would take a few years to design and construct, guardrail would be installed along the mauka edge of the existing highway for the length of the project to protect the construction work area while the highway is realigned.

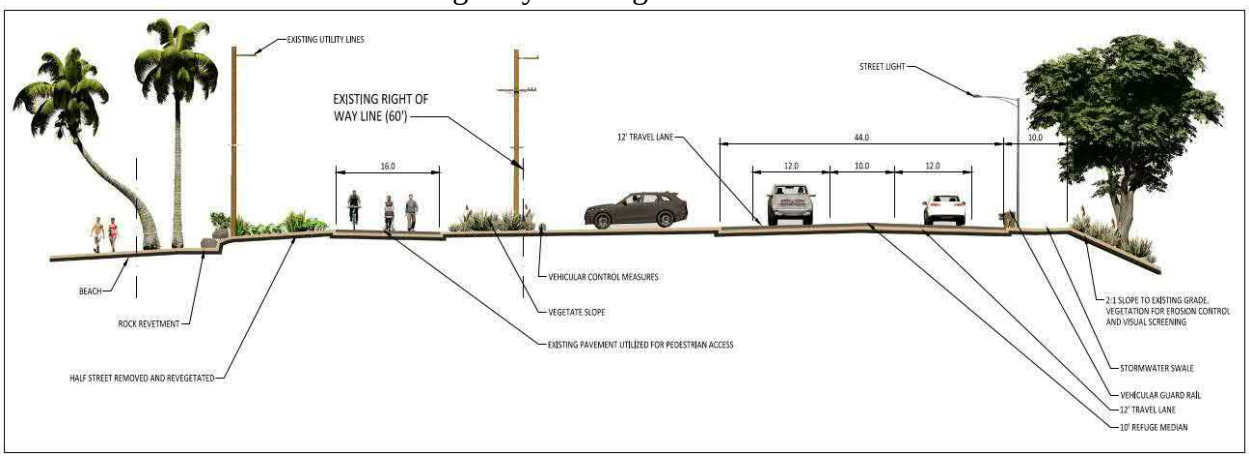


**Figure 8. "Pedestrian Shift" Alternative Alignment Section**

**Figure 9. "Pedestrian Shift" Alternative Plan View**

**Request for Input**

At this time, we do not intend to relocate any utilities, as they would remain within the existing Kamehameha Highway right-of-way. We welcome any comments or input you may have regarding the proposed project. Information gathered during this process will assist us in evaluating the alternatives and preparing the Draft EA. The same project information can be found at the project website, http://www.laniakearealignment.com; updates will be posted accordingly.

To comment on the project, please provide a written response within 30 days of the date of this letter to Brian Tyau via email at Brian.Tyau@hawaii.gov or by U.S. Postal Service to Department of Transportation, 869 Punchbowl Street, Room 301, Honolulu, Hawaii 96813.

Sincerely,

KEN K. TATSUGUCHI
Engineering Program Manager
Highways Division
Planning Branch

**U.S. Department of Homeland Security**
FEMA Region IX
1111 Broadway, Suite 1200
Oakland, CA. 94607-4052

FEMA

February 17, 2021

Brian Tyau
Department of Transportation
869 Punch Bowl Street, Room 307
Honolulu, Hawaii 96813

Dear Mr. Tyau:

This is in response to your request for comments regarding the Kamehameha Highway Pedestrian Safety Project, Vicinity of Laniakea Beach, Pre-Draft Environmental Assessment (EA) Scoping and Request for Comments Haleiwa Island, Oahu Hawaii.

Please review the current effective Flood Insurance Rate Maps (FIRMs) for the City and County of Honolulu (Community Number 150001), Maps revised November 5, 2014. Please note that the City and County of Honolulu, Hawaii are participants in the National Flood Insurance Program (NFIP). The minimum, basic NFIP floodplain management building requirements are described in Vol. 44 Code of Federal Regulations (44 CFR), Sections 59 through 65.

A summary of these NFIP floodplain management building requirements are as follows:

- All buildings constructed within a riverine floodplain, (i.e., Flood Zones A, AO, AH, AE, and A1 through A30 as delineated on the FIRM), must be elevated so that the lowest floor is at or above the Base Flood Elevation level in accordance with the effective Flood Insurance Rate Map.

- If the area of construction is located within a Regulatory Floodway as delineated on the FIRM, any ***development*** must not increase base flood elevation levels. **The term *development* means any man-made change to improved or unimproved real estate, including but not limited to buildings, other structures, mining, dredging, filling, grading, paving, excavation or drilling operations, and storage of equipment or materials.** A hydrologic and hydraulic analysis must be performed *prior* to the start of development, and must demonstrate that the development would not cause any rise in base flood levels. No rise is permitted within regulatory floodways.

- All buildings constructed within a coastal high hazard area, (any of the "V" Flood Zones as delineated on the FIRM), must be elevated on pilings and columns, so that the lowest horizontal structural member, (excluding the pilings and columns), is elevated to or above the base flood elevation level. In addition, the posts and pilings foundation and the structure attached thereto, is anchored to resist flotation, collapse and lateral movement due to the effects of wind and water loads acting simultaneously on all building components.

- Upon completion of any development that changes existing Special Flood Hazard Areas, the NFIP directs all participating communities to submit the appropriate hydrologic and hydraulic data to FEMA for a FIRM revision. In accordance with 44 CFR, Section 65.3, as soon as practicable, but not later than six months after such data becomes available, a community shall notify FEMA of the changes by submitting technical data for a flood map revision. To obtain copies of FEMA's Flood Map Revision Application Packages, please refer to the FEMA website at http://www.fema.gov/business/nfip/forms.shtm.

**Please Note:**

Many NFIP participating communities have adopted floodplain management building requirements which are more restrictive than the minimum federal standards described in 44 CFR. Please contact the local community's floodplain manager for more information on local floodplain management building requirements. The City and County of Honolulu floodplain manager can be reached by calling Mario Siu Li, NFIP Coordinator, at (808) 768-8098.

If you have any questions or concerns, please do not hesitate to call Serena Cheung at (510) 627-7113 or Michael Hornick at (510) 627-7260 of the Mitigation staff.

Sincerely,

Gregor Blackburn, CFM, Branch Chief
Floodplain Management and Insurance Branch

cc:
Mario Siu Li, NFIP Coordinator, City and County of Honolulu
Carol Tyau-Beam, NFIP State Coordinator, State of Hawaii
Serena Cheung, NFIP Floodplanner, DHS/FEMA RIX
Michael Hornick, NFIP Floodplanner, DHS/FEMA RIX
Alessandro Amaglio, Environmental Officer, DHS/FEMA RIX

Mario Siu Li msiuli@honolulu.gov
Carol Tyau-Beam carol_l_tyau@hawaii.gov
Serena Cheung Serena.Cheung@fema.dhs.gov
Michael Hornick Michael.Hornick@fema.dhs.gov
Alessandro Amaglio Alessandro.Amaglio@fema.dhs.gov
Brian Tyau Brian.Tyau@hawaii.gov

**DAVID Y. IGE**
Governor

**JOSH GREEN**
Lt. Governor

**PHYLLIS SHIMABUKURO-GEISER**
Chairperson, Board of Agriculture

**MORRIS M. ATTA**
Deputy to the Chairperson

State of Hawaii
**DEPARTMENT OF AGRICULTURE**
1428 South King Street
Honolulu, Hawaii 96814-2512
Phone: (808) 973-9600 FAX: (808) 973-9613

January 29, 2021

TO: Ken K. Tatsuguchi
Engineering Program Manager
DOT-Highways Division
Planning Branch

ATTN: Brian Tyau

FROM: Phyllis Shimabukuro-Geiser
Chairperson, Board of Agriculture

SUBJECT: Kamehameha Highway Pedestrian Safety Project
Vicinity of Laniakea Beach
Pre-Draft EA Scoping and Request for Comments
Haleiwa, Island of Oahu, Hawaii

The Hawaii Department of Agriculture (HDOA) appreciates the information you provided on the above-mentioned project. However, the HDOA has no comments to provide on the pre-draft environmental assessment.

Thank you.

DAVID Y. IGE
GOVERNOR

CURT T. OTAGURO
COMPTROLLER

AUDREY HIDANO
DEPUTY COMPTROLLER

(P)21.017

**STATE OF HAWAII**
**DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES**
P.O. BOX 119, HONOLULU, HAWAII 96810-0119

FEB 10 2021

**MEMORANDUM**

TO: Brian Tyau, Advance Planning Engineer
Department of Transportation

FROM: Christine L. Kinimaka
Public Works Administrator

SUBJECT: Kamehameha Highway Pedestrian Safety Project
Vicinity of Laniakea Beach
Pre-Draft Environmental Assessment (EA) Scoping and Request for Comments
Haleiwa, Island of Oahu, Hawaii

Thank you for the opportunity to provide comments on the subject project at this pre-draft EA stage. The project does not impact any of the Department of Accounting and General Services' projects or existing facilities, and we have no comments to offer at this time.

If you have any questions, your staff may call Mr. Dennis Chen of the Planning Branch at 586-0491.

DE:mo
c: Ken K. Tatsuguchi, DOT

**BOARD OF WATER SUPPLY**

CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HI 96843
www.boardofwatersupply.com

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ERNEST Y. W. LAU, P.E.
Manager and Chief Engineer

ELLEN E. KITAMURA, P.E.
Deputy Manager and Chief Engineer

February 26, 2021

Mr. Ken K. Tatsuguchi
State of Hawaii
Department of Transportation
869 Punchbowl Street, Room 301
Honolulu, Hawaii 96813

21 MAR -4 P1:39

Attention: Brian Tyau

Dear Mr. Tatsuguchi:

Subject: Letter Dated January 26, 2021 Requesting Comments on the Pre-Draft Environmental Assessment on the Proposed Kamehameha Highway Pedestrian Safety Project in the Vicinity of Laniakea Beach in Haleiwa

The Board of Water Supply has several water transmission mains along Kamehameha Highway in vicinity of Laniakea Beach. We also have water system replacement projects along Kamehameha Highway – Haleiwa Water Systems Improvements, Part I & II in the vicinity of the project site. These projects are currently in the design phase and are tentatively scheduled to be completed in Fiscal Year 2023. Please coordinate with the Design Branch of our Capital Projects Division at 748-5710.

Due to the nature of the proposed realignment alternative, there are many unforeseen circumstances and uncertainties regarding new roadway ownership, public right-of-ways, and water system reliability for existing customers with water service meters along Kamehameha Highway. Existing water mains should be located within paved public right-of-ways and be made accessible for repairs and maintenance. Any structures should be adequately set back from the water main easements for the safety of the public and to prevent damage to any structures in the event of main breaks, repair, and maintenance.

The construction drawings should be submitted for our approval, and the construction schedule should be coordinated to minimize impact to the water system.

The on-site fire protection requirements should be coordinated with the Fire Prevention Bureau of the Honolulu Fire Department.

We reserve further comment until the Draft Environmental Assessment has been submitted for our review and approval.

If you have any questions, please contact Robert Chun, Project Review Branch of our Water Resources Division at 748-5443.

Very truly yours,

ERNEST Y. W. LAU, P.E.
Manager and Chief Engineer

**DEPARTMENT OF DESIGN AND CONSTRUCTION**
**CITY AND COUNTY OF HONOLULU**
650 SOUTH KING STREET, 11TH FLOOR
HONOLULU, HAWAII 96813
Phone: (808) 768-8480 • Fax: (808) 768-4567
Web site: www.honolulu.gov

RICK BLANGIARDI
MAYOR

ALEX KOZLOV, P.E.
DIRECTOR

HAKU MILLES, P.E.
DEPUTY DIRECTOR

February 22, 2021

SENT VIA EMAIL

Mr. Brian Tyau
Brian.Tyau@hawaii.gov

Dear Mr. Tyau,

Subject: Kamehameha Highway Pedestrian Safety Project
Vicinity of Laniakea Beach
Pre-Draft Environmental Assessment (EA) Scoping and Request for Comments
Haleiwa, Island of Oahu, Hawaii

Thank you for the opportunity to review and comment. Our Facilities Division has the following comments.

It should be pointed out that for the no-build settlement alternative, the City has removed the cattle fence and gate. Also, the City has installed a new chain link fence mauka of the cattle fence. This completed the City's portion of the settlement. The remaining work, which includes the guard rail, signage, and crosswalk, are to be installed by the State.

Should you have any further questions, please contact Clifford Lau, Facilities Division Chief at 768-8483.

Sincerely,

for Alex Kozlov, P.E.
Director

AK:cf (839720)

From: Jacinto-Kawabata, Marie <m.jacinto-kawaba@honolulu.gov>
Sent: Monday, February 8, 2021 10:56 AM
To: Tyau, Brian <brian.tyau@hawaii.gov>
Subject: [EXTERNAL] Kamehameha Highway Pedestrian Safety Project Vicinity of Laniakea Beach

Aloha Mr. Tyau,

We received the Kamehameha Highway Pedestrian Safety Project Vicinity of Laniakea Beach Pre-Draft Environmental Assessment (EA).
Director Hiro Toiya has no comments.

Mahalo,

Marie Jacinto-Kawabata
Clerk
City & County of Honolulu
Department of Emergency Management
(808) 723-8960

DEPARTMENT OF ENVIRONMENTAL SERVICES
**CITY AND COUNTY OF HONOLULU**
1000 ULUOHIA STREET, SUITE 308, KAPOLEI, HAWAII 96707
TELEPHONE: (808) 768-3486 • FAX: (808) 768-3487 • WEBSITE: http://envhonolulu.org

RICK BLANGIARDI
MAYOR

WESLEY T. YOKOYAMA, P.E.
DIRECTOR DESIGNATE

MICHAEL O'KEEFE
DEPUTY DIRECTOR

ROSS S. TANIMOTO, P.E.
DEPUTY DIRECTOR

IN REPLY REFER TO:
PRO 21-009

February 9, 2021

**VIA EMAIL: Brian.Tyau@hawaii.gov**

Mr. Ken K. Tatsuguchi, Engineering Program Manager
State of Hawaii, Department of Transportation
Highways Division, Planning Branch
869 Punchbowl Street, Room 301
Honolulu, Hawaii 96813

Attention: Mr. Brian Tyau

Dear Mr. Tatsuguchi:

SUBJECT: Kamehameha Highway Pedestrian Safety Project
Vicinity of Laniakea Beach
Pre-Draft Environmental Assessment (EA) Scoping and Request for Comments
Haleiwa, Island of Oahu, Hawaii

We have reviewed your letter dated January 26, 2021, ref. no. HWY-PA-2.536. The Department of Environmental Services has no comment as the proposed project will have no impact on any of our programs and facilities. You may remove us as a consulted party for the balance of the Environmental Assessment process.

Should you have any questions, please contact Marisol Olaes, Civil Engineer, at 768-3467.

Sincerely,

Wesley T. Yokoyama, P.E.
Director Designate

DEPARTMENT OF LAND MANAGEMENT
CITY AND COUNTY OF HONOLULU
558 SOUTH KING STREET • HONOLULU, HAWAII 96813
PHONE: (808) 768-4277• FAX: (808) 768-4296 • INTERNET: http://www.honolulu.gov/dlm

RICK BLANGIARDI
MAYOR

SCOTT K. HAYASHI
DIRECTOR DESIGNATE

February 1, 2021

Mr. Brian Tyau
State of Hawaii
Department of Transportation
869 Punchbowl Street, Room 301
Honolulu, Hawaii 96813

Dear Mr. Tyau:

SUBJECT: Kamehameha Highway Pedestrian Safety Project
Vicinity of Laniakea Beach
Pre-Draft Environmental Assessment (EA) Scoping and Request for Comments
Haleiwa, Island of Oahu, Hawaii

Thank you for the notice on the Pre-Draft Environmental Assessment that has been done for the Kamehameha Highway Pedestrian Safety Project. At this time, we have no comments as there are no direct impacts to any of our existing or proposed projects.

The City currently owns parcels of land adjacent to the project site. For that, we are interested in any updates and/or developments moving forward.

If you have any questions, please contact Seiji Ogawa, Project Manager, by telephone at 768-4294 or by email at seiji.ogawa@honolulu.gov.

Sincerely,

Scott K. Hayashi
Director Designate

DEPARTMENT OF PARKS & RECREATION

**CITY AND COUNTY OF HONOLULU**

1000 Uluohia Street, Suite 309, Kapolei, Hawaii 96707
Phone: (808) 768-3003 • Fax: (808) 768-3053
Website: www.honolulu.gov

RICK BLANGIARDI
MAYOR

LAURA H. THIELEN
DIRECTOR

MICHELE K. NEKOTA
DEPUTY DIRECTOR

February 19, 2021

Mr. Brian Tyau
Department of Transportation
869 Punchbowl Street, Room 301
Honolulu, Hawaii 96813
Brian.Tyau@hawaii.gov

21

Dear Mr. Tyau:

SUBJECT: Kamehameha Highway Pedestrian Safety Project –
Vicinity of Laniakea Beach
Pre-Draft Environmental Assessment (EA)
Scoping and Request for Comments
Haleiwa, Island of Oahu, Hawaii

This letter responds to letter dated January 26, 2021 from Ken K. Tatsuguchi, Engineering Program Manager, Highways Division, Planning Branch, Department of Transportation (HDOT) requesting comments from the Department of Parks and Recreation (City) to HDOT's four potential alternatives it is evaluating in preparation of the environmental assessment for the above project.

Comments Regarding No Build Alternative (Option 1)

We have no comments.

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there's more!

Comments Regarding No Build Settlement Alternative (Option 2)

After consultation with our legal counsel, we suggest that the HDOT consult with the Department of the Attorney General (AG) concerning the disclosure of the information summarized in your letter concerning Option 2. The summary description of Option 2 appears to mischaracterize the proposal considered by the parties and the negotiations in Reno Abellira, et.al. vs. State of Hawaii Department of Transportation, et. al., Civil Nos. 14-1-005-01 and 15-1-1569-08. We also have been advised that the Court has not approved a final settlement in the foregoing matter and resolution of the lawsuit remains ongoing. HDOT should further consult with the AG on the distribution of the information described in Option 2 which is part of ongoing confidential negotiations and not subject to public dissemination.

In response to your request for comments, the City supports Option 2 as negotiated and agreed to by the parties in the lawsuit which imposes the duty upon the City to make improvements to its property and imposes the duty upon HDOT to make improvements along Kamehameha Highway, including the installation of guard rails, crosswalks, and appropriate signage.

Comments Regarding the Transportation System Management Alternative (Option 3)

This option involves blocking off the mauka side parking with a permanent guardrail or barrier. There will be no public parking in this vicinity. The Department of Parks and Recreation would need access to periodically maintain its property on the mauka side of the highway.

Comments Regarding "Pedestrian Shift" Alternative (Option 4)

This option involves the highway shift approximately 80 feet into City property and the City should be properly compensated. This would be a State initiative and the City's only involvement would be to allow the State to use and/or condemn this parcels for this use.

Other than the foregoing comments, the City remains committed to complying and implementing the proposal negotiated in the Reno Abellira matter.

Thank you for the opportunity to provide comments. Should you have any questions concerning the foregoing, please do not hesitate to contact the undersigned at 768-3001.

Sincerely,

Laura H. Thielen
Director

cc: Mr. Ken K. Tatsuguchi
Engineering Program Manager
Department of Transportation
Highways Division
Planning Branch

DEPARTMENT OF PLANNING AND PERMITTING
**CITY AND COUNTY OF HONOLULU**
650 SOUTH KING STREET, 7TH FLOOR • HONOLULU, HAWAII 96813
PHONE (808) 768-8000 • FAX (808) 768-6041
DEPT WEB SITE www.honoluludpp.org • CITY WEB SITE www.honolulu.gov

RICK BLANGIARDI
MAYOR

DEAN UCHIDA
DIRECTOR

DAWN TAKEUCHI APUNA
DEPUTY DIRECTOR

EUGENE H. TAKAHASHI
DEPUTY DIRECTOR

March 4, 2021

2021/ELOG-238(LP)

Mr. Brian Tyau
Engineering Program Manager
Department of Transportation
869 Punchbowl Street, Room 301
Honolulu, Hawaii 96813

21 MAR -8 A 8:

Dear Mr. Tyau:

SUBJECT: Kamehameha Highway Pedestrian Safety Project
Pre-Draft Environmental Assessment
Vicinity of Laniakea Beach

This is in response to your letter, received February 3, 2021, requesting comments on the Pre-Draft Environmental Assessment (EA) for the subject Project. Specifically you would like input on the four potential alternatives proposed. The following are our comments:

1. The Project site is within the Special Management Area (SMA) and additional information is needed to determine if an SMA Use Permit is required for the different Project alternatives.

2. The Draft EA should disclose how the various project alternatives will be consistent with Hawaii Revised Statutes Section 205A-2 and Chapter 25, Revised Ordinance of Honolulu (ROH). The Draft EA should also identify any significant adverse environmental or ecological effects and specify which elements of the Project would be considered "development" for purposes of Section 25-1.3, ROH.

3. The Draft EA should discuss Chapter 23, ROH and reference the shoreline survey certified for the site on July 30, 2020. The Draft EA should describe and include a figure clearly showing for each alternative which elements of the Project would be makai of the certified shoreline or within the shoreline setback.

4. The Draft EA should include a discussion of any other land use permits anticipated to be required prior to Project implementation.

5. Our records indicate that Laniakea Stream runs through the area, and the stream is considered an "Estuarine Marine Wetland." Therefore, the Draft EA should discuss any activities in this area, any potential impacts to stream waters or wetlands that may occur as a result of the Project, and proposed mitigation measures.

6. Regarding the four project alternatives, we have the following comments:

   a. No Build Alternative: This alternative is not preferred as your analysis indicates it would be unsafe for pedestrians.

   b. No Build Settlement Alternative: Part of this alternative has been completed. Special Management Area Permit Minor No. 2020/SMA-38 and Minor Shoreline Structure Permit No. 2020/MSS-4 were issued by the Department of Planning and Permitting on December 7, 2020 to allow fencing within the City Properties identified as Tax Map Keys 6-1-005: 024, 6-1-009: 024, and 6-1-010: 019. The fence construction has been completed.

   c. Transportation System Management Alternative: The Draft EA should discuss how public access to Laniakea Beach Park would be accommodated under this alternative. Discussion should include any proposed parking location and how the public would access the beach park from the parking location. Based on the previous location of the jersey barriers, it appears this alternative would have a similar impact on traffic and the beach park uses. Therefore, the Draft EA should include a summary and analysis of the information gathered during that time. This section should also discuss how this alternative meets the HRS 205A and Chapter 25, ROH objectives to ensure that adequate public access is provided to recreational resources.

   d. "Pedestrian Shift" Alternative: This alternative appears to retain public access to the beach park and the coastal zone, which meets the criteria of HRS 205A and Chapter 25, ROH. However, being so close to the shoreline may have impacts. The Draft EA should carefully explore the balance among these Coastal Zone Management goals and objectives. This alternative appears to be the safest option for pedestrians who would not have to cross the street to access the beach. However, more

information is needed to determine if a SMA or Shoreline Permit will be required.

Thank you for the opportunity to comment on this proposal. Should you have any questions, please contact Lena Phomsouvanh, of our staff, at (808) 768-8052 or lena.phomsouvanh@honolulu.gov.

Very truly yours,

FOR: Dean Uchida
Director

DEPARTMENT OF TRANSPORTATION SERVICES
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET, 3RD FLOOR
HONOLULU, HAWAII 96813
Phone: (808) 768-8305 • Fax: (808) 768-4730 • web: www.honolulu.gov

RICK BLANGIARDI
MAYOR

J. ROGER MORTON
DIRECTOR DESIGNATE

JON Y. NOUCHI
DEPUTY DIRECTOR

TP2/20-840976

March 5, 2021

Mr. Ken K. Tatsuguchi, Engineering Program Manager
State of Hawaii
Department of Transportation
Highways Division, Planning Branch
869 Punchbowl Street, Room 301
Honolulu, Hawaii 96813

Dear Mr. Tatsuguchi:

SUBJECT: Kamehameha Highway Pedestrian Safety Project
Vicinity of Laniakea Beach
Pre-Draft Environmental Assessment (EA)
Scoping and Request for Comments
Haleiwa, Island of Oahu, Hawaii

Thank you for the opportunity to provide written comments regarding the subject project. The Department of Transportation Services (DTS) strongly supports the intent of this project to improve pedestrian safety. We request to be consulted as this project progresses. Additionally, DTS is willing to provide technical assistance to review and develop conceptual design alternatives that promote Complete Street principles. We also provide the following comments.

1. **Complete Streets.**

   i. We recommend that the project conduct a Safe Speed Study to identify an appropriate speed limit for the project by analyzing conflict density and activity level, among other contextual factors, to determine the speed limit that will best minimize the risk of a person being killed or seriously injured. The National Association of City Transportation Officials (NACTO) Safe Speed Study methodology is recommended.

ii. We recommend that all alternatives provide travel lanes of no more than 11 feet to reduce speeding.

iii. The project area includes two City and County of Honolulu bus stops. We recommend that all alternatives attempt to retain these bus stops to reduce the demand for parking and to reduce traffic congestion. Alternatives should also provide a safe pedestrian crossing for those using these bus stops. The Honolulu Complete Streets Design Manual provides guidance on providing safe pedestrian crossings.

iv. Any bus stop affected by this project must be brought in compliance with Americans with Disabilities Act Accessibility Guidelines (ADAAG). The ADAAG requires a level landing area at bus stops that is clear of obstructions and measures eight feet (perpendicular to the curb) by five feet (parallel to the curb, connected to a pedestrian path or accessible walkway, and a firm stable surface).

v. "Pedestrian Shift" alternative. Of the four alternatives presented, this alternative appears to provide the highest level of safety for people on foot and on bike by providing adequate physical separation from vehicular traffic. However, it appears this alternative is designed to enable high-speed vehicle traffic through the project area. If the existing bus stops were to remain, passengers using the mauka side bus stop would need to cross this high-speed roadway to access Laniakea Beach or the shared-use path. We recommend all the general recommendations mentioned above, as well as, converting the 10' median into a center-turn lane to facilitate parking and reduce vehicle queues from blocking through traffic.

vi. We request that traffic data such as raw multi-modal counts and accompanying analyses be shared with the Regional Planning Branch (RPB) at dtsplanningdiv@honolulu.gov.

2. **Neighborhood Impacts**. The area representatives, neighborhood board, as well as the area residents, businesses, emergency personnel (fire, ambulance, and police), Oahu Transit Services, Inc. (TheBus and TheHandi-Van), etc., should be kept apprised of the details and status throughout the project and the impacts that the project may have on the adjoining local street area network.

3. **Disability and Communication Access Board (DCAB).** Project plans (vehicular and pedestrian circulation, sidewalks, parking and pedestrian pathways, vehicular ingress/egress, etc.) should be reviewed and approved by DCAB to ensure full compliance with Americans with Disabilities Act (ADA) requirements.

Thank you for the opportunity to review this matter. Should you have any questions, please contact Mike Motoki, of my staff, at 768-6684.

Very truly yours,

J. Roger Morton
Director Designate

HONOLULU EMERGENCY SERVICES DEPARTMENT
**CITY AND COUNTY OF HONOLULU**
3375 KOAPAKA STREET, SUITE H-450 • HONOLULU, HAWAII 96819-1814
Phone: (808) 723-7800 • Fax: (808) 723-7836

RICK BLANGIARDI
MAYOR

IAN T.T. SANTEE, MPA
ACTING DIRECTOR

February 19, 2021

**SENT VIA EMAIL**

To: Brian Tyau, Engineer
State of Hawaii, Department of Transportation
Brian.Tyau@hawaii.gov

From: Ian T.T. Santee, Acting Director
Honolulu Emergency Services Department

SUBJECT: Kamehameha Highway Pedestrian Safety Project
Vicinity of Laniakea Beach

Dear Mr. Tyau:

The Honolulu Emergency Services Department (HESD) supports the "Pedestrian Shift" Alternative. We believe this is the best and most practicable plan for an on-going public safety issue.

The HESD's Ocean Safety Division maintains one lifeguard tower at Laniakea Beach, and supports the immediate and surrounding area with mobile response teams (using trucks, jet skis, and all terrain vehicles). Annual statistics show a consistent threat to public safety because of surfing, swimming, paddling, and fishing accidents, *and* an increase in vehicle/pedestrian accidents. The nearest ambulance is at the Waialua Fire Station, so lifeguards are frequently the first of first responders on scene at any incident near the site of the proposed project.

HESD is in strong support of plan to re-route the highway thereby creating a safer corridor for access to the ocean. This proposed "Pedestrian Shift" Alternative will also vastly improve our response times in the area and, quite possibly, save lives.

Thank you for the opportunity to comment. Please contact me at 723-7811 if you have questions.

cc: James Ireland, EMS Chief
John K. Titchen, Ocean Safety Chief

HONOLULU EMERGENCY SERVICES DEPARTMENT
**CITY AND COUNTY OF HONOLULU**
3375 KOAPAKA STREET, SUITE H-450 • HONOLULU, HAWAII 96819-1814
Phone: (808) 723-7800 • Fax: (808) 723-7836

RICK BLANGIARDI
MAYOR

IAN T.T. SANTEE, MPA
ACTING DIRECTOR

February 10, 2021

**MEMORANDUM**

TO: Brian Tyau, Engineer
Department of Transportation

FROM: John K. Titchen, Chief of Ocean Safety Division
Honolulu Emergency Services Department

SUBJECT: Kamehameha Highway Pedestrian Safety Project
Vicinity of Laniakea Beach

The Honolulu Emergency Services Department, Ocean Safety and Lifeguard Services Division, supports the "Pedestrian Shift" Alternative. We believe this is the best and most practicable plan for an on-going public safety issue.

The City & County of Honolulu's Ocean Safety Division maintains one lifeguard tower at Laniakea Beach, and supports the immediate and surrounding area with mobile response teams (using trucks, jet skis, and all terrain vehicles). Annual statistics show a consistent threat to public safety because of surfing, swimming, paddling, and fishing accidents, *and* an increase in vehicle/pedestrian accidents. The nearest ambulance is at the Waialua Fire Station, so Lifeguards are frequently the first of first responders on scene at any incident near the site of the proposed project.

Ocean Safety is in strong support of plan to re-route the highway thereby creating a safer corridor for access to the ocean. This proposed "Pedestrian Shift" Alternative will also logically vastly improve our response times in the area and, quite possibly, save lives.

Mahalo for the opportunity to comment. Please contact me at 723-7863 if you have any questions.

HONOLULU FIRE DEPARTMENT

CITY AND COUNTY OF HONOLULU

636 South Street
Honolulu, Hawaii 96813-5007
Phone: 808-723-7139 Fax: 808-723-7111 Internet: www.honolulu.gov/hfd

RICK BLANGIARDI
MAYOR

MANUEL P. NEVES
FIRE CHIEF

LIONEL CAMARA JR.
DEPUTY FIRE CHIEF

February 17, 2021

21

Mr. Ken Tatsuguchi
Engineering Program Manager
Highways Division, Planning Branch
Department of Transporation
State of Hawaii
869 Punchbowl Street Room 301
Honolulu, Hawaii 96813-5097

Dear Mr. Tatsuguchi:

Subject: Pre-Draft Environmental Assessment Scoping and Request for Comments
Kamehameha Highway Pedestrian Safety Project
Vicinity of Laniakea Beach
Haleiwa, Island of Oahu, Hawaii

In response to your letter dated January 26, 2021, regarding the abovementioned subject, the Honolulu Fire Department (HFD) reviewed the submitted information and requires that the following be complied with:

1. Fire department access roads shall be provided such that any portion of the facility or any portion of an exterior wall of the first story of the building is located not more than 150 feet (46 meters) from fire department access roads as measured by an approved route around the exterior of the building or facility. (National Fire Protection Association [NFPA] 1; 2012 Edition, Sections 18.2.3.2.2 and 18.2.3.2.2.1.)

   A fire department access road shall extend to within 50 feet (15 meters) of at least one exterior door that can be opened from the outside and that provides access to the interior of the building. (NFPA 1; 2012 Edition, Section 18.2.3.2.1.)

2. A water supply approved by the county, capable of supplying the required fire flow for fire protection shall be provided to all premises upon which facilities or buildings, or portions thereof, are hereafter constructed, or moved into or within the county. When any portion of the facility or building is in excess of 150 feet (45,720 millimeters) from a water supply on a fire apparatus access road, as measured by an approved route around the exterior of the facility or building, on-site fire hydrants and mains capable of supplying the required fire flow shall be provided when required by the Authority Having Jurisdiction. (NFPA 1; 2012 Edition, Section 18.3.1, as amended.)

3. The unobstructed width and unobstructed vertical clearance of a fire apparatus access road shall meet county requirements. (NFPA 1; 2012 Edition, Sections 18.2.3.4.1.1 and 18.2.3.4.1.2, as amended.)

4. Submit civil drawings to the HFD for review and approval.

Should you have questions, please contact Battalion Chief Reid Yoshida of our Fire Prevention Bureau at 723-7151 or ryoshida@honolulu.gov.

Sincerely,

JASON SAMALA
Assistant Chief

JS/EO:bh

POLICE DEPARTMENT

**CITY AND COUNTY OF HONOLULU**

801 SOUTH BERETANIA STREET · HONOLULU, HAWAII 96813
TELEPHONE: (808) 529-3111 · INTERNET: www.honolulupd.org

RICK BLANGIARDI
MAYOR

SUSAN BALLARD
CHIEF

JOHN D. McCARTHY
AARON TAKASAKI-YOUNG
DEPUTY CHIEFS

OUR REFERENCE EO-DK

February 19, 2021

SENT VIA EMAIL

Mr. Brian Tyau
Brian.Tyau@hawaii.gov

Dear Mr. Tyau:

This is in response to your agency's letter of January 26, 2021, requesting input on the proposed Kamehameha Highway Pedestrian Safety Project in Haleiwa by the State of Hawaii Department of Transportation, Highways Division.

Whichever one of the four potential alternatives is decided upon, it would greatly impact traffic in and around the Laniakea Beach area. That stretch of road (Pohaku Loa Way) is heavily traversed by both vehicles and pedestrians due to its popularity with visitors and residents alike. The Honolulu Police Department recommends that all necessary signs, lights, barricades, and other safety equipment be installed and maintained by the contractor during the construction phase of the project.

If there are any questions, please call Acting Major Gordon Lum Kee of District 2 (Wahiawa) at 723-8700.

Sincerely,

Darren Chun
Assistant Chief of Police
Support Services Bureau

# The Senate

STATE CAPITOL
HONOLULU, HAWAII 96813

February 25, 2021

Submitted via Email
Brian.Tyau@hawaii.gov

Brian Tyau
Hawaii Department of Transportation
869 Punchbowl St, Room 301
Honolulu, HI 96813

Subject: HWY-PA 2.5136
Kamehameha Highway Pedestrian Safety Project Vicinity of Laniakea Beach
Pre-Draft Environmental Assessment (EA) Scoping and Request for Comments
Haleiwa, Island of Oahu, Hawaii

Aloha, Brian.

Thank you for the opportunity to share these comments.

**No Build Alternative:** The status quo is painful, but it allows parking and beach access to a highly valuable coastline, treasured by surfers offshore, visitors observing sea turtles on the Waimea side, and families enjoying the sandy beach on the Haleiwa side.

**No Build Settlement Alternative:** This option should be carried forward as soon as possible because it can be implemented in conjunction with the Pedestrian Shift Alternative, or stand-alone without impairing future realignment alternatives. This alternative will allow parking, controlled turning movements, and aggregated pedestrian crossing, and it will not require significant investment.

A variation that might be considered is 4-6' high fencing between the highway and parking, and a pedestrian overpass. This could prove effective and more affordable than the Pedestrian Shift Alternative.

**Transportation System Management Alternative:** This is the worst option. Installing barriers to prevent parking when adjacent city owned land is available for this purpose, is unacceptable. The No Build Settlement Alternative would actually serve the public, compared to this plan which would harm public access.

**Pedestrian Shift Alternative:** There should be no reason to build a guardrail along the existing highway during construction with this option. A fence or guard rail could be installed mauka of existing parking to separate construction activity from existing use, or even the No Build Settlement Alternative. Surely the DOT has the capability to design an appropriate plan that allows partial or full parking during construction.

It appears the entire parking area highlighted in red will be open to vehicular turning movement from the highway and a middle refuge lane. Safe access to ample makai parking of the realigned highway is essential. The bike path and removal of the makai lane of the existing roadway are good ideas. The vegetated area in yellow and the designated beach paths are welcome.

This plan resolves several long-term issues and prior funding allotments: shoreline erosion and highway preservation, pedestrian crossing, traffic congestion, and obsolete bridge replacement. With the continuation of parking during construction, this is the best of the four options.

**Other:** The entire city park land is an asset that should be considered now. It could be used as temporary parking, if needed, to facilitate the Pedestrian Shift Alternative. It could be fully incorporated in the No Build Settlement Alternative to provide additional parking. Future ingress and egress to this land must be protected by any action.

As important as it is to resolve the Laniakea problems, careful consideration should also be given to the traffic impacts and pedestrian crossings at Chun's Reef. If realignment behind both these beach areas is unrealistic for the foreseeable future, then please move forward with a viable solution at Laniakea, post haste.

Our community has been crying out for relief for more than 15 years. We deserve better traffic flow, pedestrian safety and continuing access to this important shoreline. Thank you for heeding this call.

Respectfully submitted,

Gil Riviere
Senator, District 23
Oahu's North and Windward Shores

**DATE: 02-04-21**

## Attn: Brian Tyau

### Project: Kamehameha Highway Pedestrian Safety Project
### Subject: HWY-PA 2.5136 (Laniakea Beach)

Dear Brian,

The locations of existing routes and crossings were shown on the provided plans. The exact locations, and routing of all CATV facilities must be verified in the field due to construction variances. The location of the proposed project should not have an effect on Spectrum's existing CATV plant in your work area.

However, if the work or repairs being performed requires special machinery, with a specific height requirements, the contractor performing the work, will be required to notify our office prior to performing any work. Spectrum may need to reattach or move or plant system, in the event that we have to relocate our existing plant system, charges may apply.

At this time, Spectrum utilizes both HECO and HTEL existing poles in your proposed project location. In each of the four proposals Spectrum utilities will not be impacted and currently we no future planned activities or projects to that area. In regards the proposed projects the "Pedestrian Shift" Alternative appears to be the safest for the general public as well as our Spectrum personel. Having a parking area in that section closer to utilities would allow us to maintain our facilities more safely and without impacting traffic, which would help to elevate some of the congestion along that stretch of roadway.

This information has been provided to help minimize delays and prevent damage to existing CATV structures within the project area. Should you have any questions or concerns, please feel free to contact me at 808-348-8359, 808-695-3165, or email me at Chinnough.Colburn@charter.com

Sincerely,

Chinnough Colburn

Construction Coordinator

From: Liu, Rouen <rouen.liu@hawaiianelectric.com>
Sent: Thursday, March 11, 2021 2:38 PM
To: Tyau, Brian <brian.tyau@hawaii.gov>
Cc: Kuwaye, Kristen <kristen.kuwaye@hawaiianelectric.com>
Subject: [EXTERNAL] Pre-Draft EA Scoping and request for comments - Kamehameha Highway Pedestrian Safety Project HWY-PA2.5136

Dear Mr. Tyau

Thank you for the opportunity to comment on the subject project. Hawaiian Electric Company has no objection to the project. Should Hawaiian Electric have existing easements and facilities on the subject project limits, we will need continued access for maintenance of our facilities. We appreciate your efforts to keep us apprised of the subject project in the planning process. As the proposed Kamehameha Highway Pedestrian Safety project comes to fruition, please continue to keep us informed.

Should there be any questions, welcome to contact me at 543-7245

Rouen Liu
Permit Engineer
Hawaiian Electric Company

KAMEHAMEHA SCHOOLS®

February 25, 2021

VIA EMAIL ONLY (brian.tyau@hawaii.gov)

Brian Tyau
Department of Transportation
869 Punchbowl Street, Room 301
Honolulu, Hawai'i 96813

Re: Kamehameha Highway Pedestrian Safety Project
Vicinity of Laniakea Beach
Pre-Draft Environmental Assessment ("EA") Scoping and Request for Comments
Haleiwa, Island of O'ahu, Hawai'i

Dear Mr. Tyau,

Thank you for your letter dated February 3, 2021 and the opportunity to comment on the project proposed by the State of Hawai'i Department of Transportation, Highways Division ("HDOT") to address pedestrian safety in the area of Laniakea Beach ("Project"). Kamehameha Schools ("KS") concurs with HDOT's intent to re-prioritize pedestrian safety, while reaching a resolution that accommodates all of the concerns in the area. With the above in mind, please find below a list of questions and concerns that KS would appreciate if you could address in connection with the HDOT proposed project.

1. **Cultural Sites**. The proposed "Pedestrian Shift" alternative has the potential to impact a cluster of traditional Hawaiian archaeological sites located at the northeastern end of this proposed alternative (see attached map). Of note are the presence of ceremonial and burial sites. KS recommends that these sites be avoided and that appropriate site buffers be created to mitigate any impacts. KS also recommends that Waialua-area cultural descendants and the Waialua Hawaiian Civic Club be consulted to determine the significance of known Hawaiian cultural sites or to learn about any additional sites that could be impacted by the proposed project. For example, there is a high probability that traditional Hawaiian burials may be within the proposed project's footprint due to its proximity to the sandy coastline.

2. **KS Lands**. Based upon the information provided to date, it is unclear whether and to what extent KS lands in the area may be impacted. Please provide detailed information on impacts to KS lands, including, without limitation, whether HDOT will be seeking to acquire any KS lands and/or remove fencing along KS boundaries.

3. **Agricultural Tenant Operations**. KS has several agricultural tenants in the area, including Kawailoa Ranch. Please provide detailed information on how the proposed

Project would impact those tenants, including their use of surrounding trails, ranch operations, and revenue.

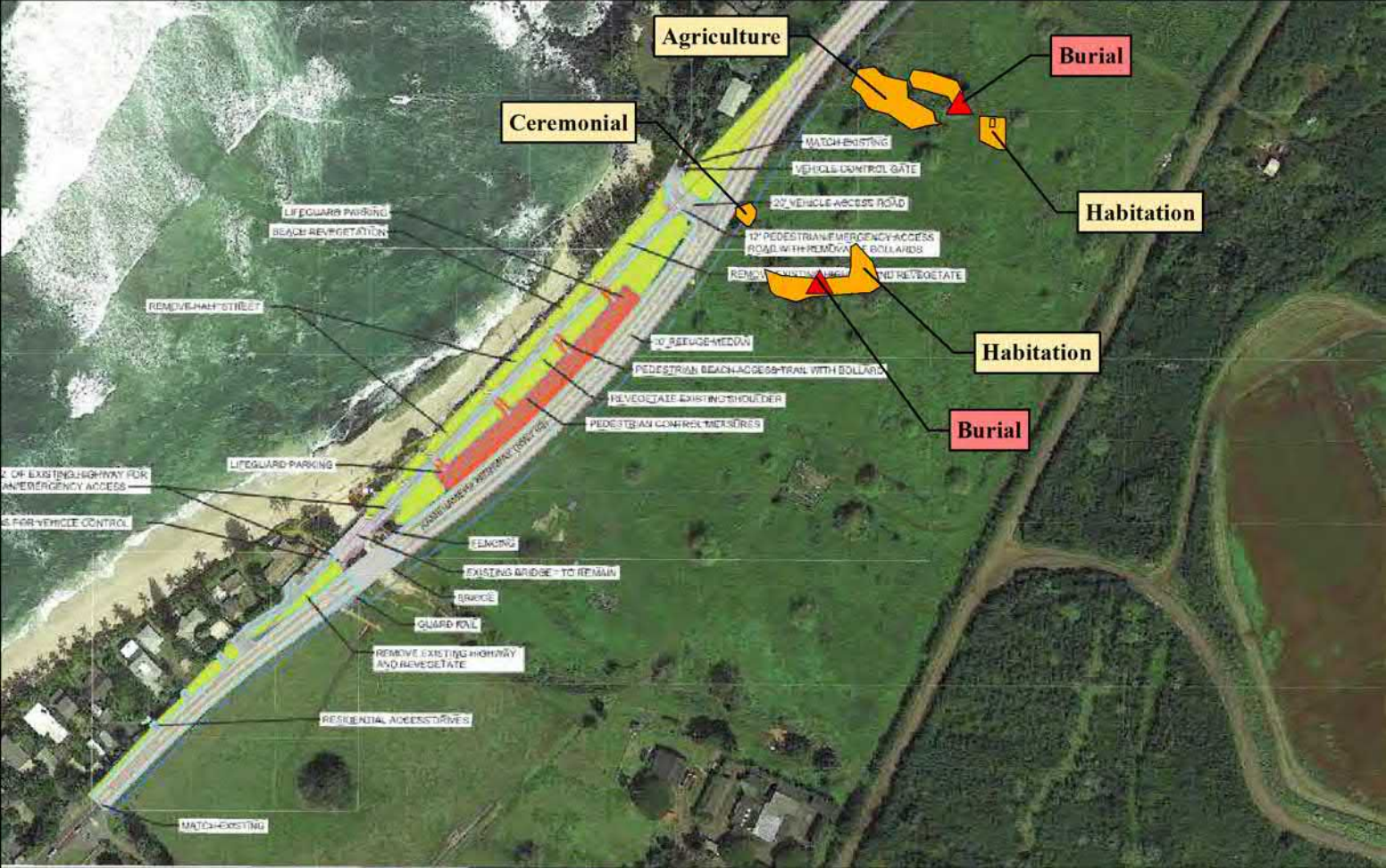
Thank you for consideration. We look forward to your response.

Very truly yours,

KAMEHAMEHA SCHOOLS

Keith K.A. Chang
Land Asset Manager
North Shore - Haleiwa | Maui | Molokai
Community and 'Āina Resiliency

Attachment


Agriculture
Burial
Ceremonial
Habitation
Habitation
Burial
MATCH EXISTING
VEHICLE CONTROL GATE
20' VEHICLE ACCESS ROAD
LIFEGUARD PARKING
BEACH REVEGETATION
12' PEDESTRIAN/EMERGENCY ACCESS ROAD WITH REMOVABLE BOLLARDS
REMOVE HALF STREET
PEDESTRIAN BEACH ACCESS TRAIL WITH BOLLARDS
REVEGETATE EXISTING SHOULDER
PEDESTRIAN CONTROL MEASURES
LIFEGUARD PARKING
FENCING
EXISTING BRIDGE - TO REMAIN
BRIDGE
GUARD RAIL
REMOVE EXISTING HIGHWAY AND REVEGETATE
RESIDENTIAL ACCESS DRIVES
MATCH EXISTING

From: Beau Sheil <beau@tropicblue.net>
Sent: Wednesday, April 7, 2021 3:53 PM
To: Tyau, Brian <brian.tyau@hawaii.gov>
Cc: Joanne Martin <jmartin@stanford.edu>
Subject: [EXTERNAL] Kamehameha Highway Laniakea Beach Project HWY-PA 2.5136

First, thank you for sending us detailed descriptions of four proposed alternatives for fixing the problems with pedestrian access and traffic management at Kamehameha Hwy near Laniakea Beach and soliciting my input.

Of the four alternatives you present, we are strongly in favor of the "Pedestrian Shift" alternative, namely relocating Kamehameha Hwy inland and creating parking between the highway and the shoreline for users of and visitors to the beach. This not only solves the pedestrian and traffic problems, but also defers the day when the highway will have to be moved due to shoreline erosion.

Of the other alternatives, the "No build settlement alternative" is a marginal improvement over the current situation, in that it manages the pedestrian traffic better than the current chaos, but is incomplete in that without traffic lights or other directives to traffic and pedestrians, it would still allow chaotic pedestrian cross traffic.

The other two alternatives are totally unacceptable.

Leaving things as they are, the "No build" alternative, leaves North Shore traffic in a state of intermittent gridlock, to the despair of both residents and visitors.

The "Transportation System management" alternative basically walls off both local beach users and tourist access to a favorite local beach.
What's worse, as the experiment with semi-temporary guardrails showed, it just pushes the parking up and down Kamehameha Hwy for up to half a mile in each direction. It does little to reduce the flow of pedestrians crossing the highway or the traffic chaos that they cause - it just spreads it out.

I'm surprised that the Department of Transportation can even consider either of these alternatives.

Let me also be clear that my preferences are just preferences *among these four alternatives* that you have presented. I'm not convinced that there are not better alternatives, e.g. relocating the highway mauka of both Laniakea *and* Chuns Reef, where mauka parking for the beach creates almost as much traffic chaos as Laniakea.

But among these choices, "Pedestrian Shift" is our clear preference.

Thanks for asking.

- Beau Sheil
  Haleiwa

From: nimboy44@aol.com <nimboy44@aol.com>
Sent: Sunday, March 21, 2021 8:30 PM
To: brian.tyau@hawaii.gov
Cc: roxana@gonorthshore.org; ken.tatsuguchi@hawaii.gov; Adams, Rachel <Rachel.Adams@wsp.com>
Subject: Laniakea North Shore Chamber of Commerce March Board meeting

Aloha, Brian,
the Board very much appreciated DOT's openness to input.
The Board is supportive of the Pedestrian Shift option with one very important adjustment.
The Board voted unanimously to have me advise you that a long period or periods of time with no parking at Laniakea just will not work.
One option raised was could, for example, one bridge be built at a time so that parking could still be made available in the areas of the highway where construction was not taking place.
The community need is to always have some parking available at Laniakea.
Hope your planners can take this into account and be more flexible about parking.
Thanks,
Bill.

Sent via email to: *Brian.Tyau@hawaii.gov*

Brian Tyau
Highways Division
Hawaii Dept. of Transportation
869 Punchbowl St.
Honolulu, HI 96816

Re: Proposed Kamehameha Highway Pedestrian Safety Project
Vicinity of Laniakea Beach, O'ahu

Dear Mr. Tyau,

HDOT Engineering Program Manager Ken K. Tatsuguchi sent a letter dated February 2, 2021, letter to *Save our Surf*, c/o John Kelly, of requesting comment on the D0T's proposed Laniakea project was forwarded to me. Would you kindly update your records to indicate that Mr. Kelly is deceased and that I am serving as Spokesperson for Save our Surf at this time.

The letter asked that comments be sent within 30 days and I am timely responding on behalf of Save Our Surf. I have reviewed the description of the various alternatives to the proposed project in that letter and have the following comments:

**1. Proposal to Eliminate Existing Ocean Access Parking at Laniakea Support Park**

It appears this is a multi-year project with no apparent fixed or predictable timeline. It also appears that one or more of the proposed alternatives call for the complete and closure and elimination of parking across from Laniakea on the City's Laniakea Support Park parcels, TMK #s 6-1-010-024, 6-1-010-019 and 6-1-009-021, for an indefinite period of time - likely years. We feel this is extremely ill advised and would be contrary to both the letter and spirit of Hawaii law, including specifically H.R.S. Chapter 205A.

Chapter 205A, known as the Coastal Zone Management Act ("CZMA"), was passed in the 1970's to recognize, protect and assure public access to Hawaii's unique shoreline and coastal recreational resources and opportunities. That law is binding upon all governmental agencies when proposing projects within the vicinity of those resources and requires that they comply with various objectives, policies, and guidelines set forth in the law. Paramount among those are requirements that agencies preserve, protect and enhance public access to and use of those resources.

The CZMA specifically protects surfing sites and other coastal recreational activities through a series of mandates which require "all agencies" to:

- Consider the importance of public coastal access and the availability of

unique recreational and cultural activities in those area;

- Provide coastal recreational opportunities accessible to the public;

- Protect and preserve those natural and manmade historic and prehistoric resources in the coastal zone management area that are significant in Hawaiian history and culture;

- Protect coastal resources uniquely suited for recreational activities that cannot be provided in other areas;

- Require 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;

- Provide and manage adequate public access, consistent with conservation of natural resources, to and along shorelines with recreational value;

- Providing an adequate supply of shoreline parks and other recreational facilities suitable for public recreation.

In this situation, DOT should be aware that Laniakea is a very unique, world class surf site, as are several other nearby spots including Himalayas and Hultin's. They all depend on the parking across from Laniakea itself.

In addition, there are a number of other unique cultural resources in the Laniakea Beach area. I am sure you are aware of the prolific Green Sea Turtle feeding and viewing area at the East end of the beach. Fishing (including spear, net and hook-and-line) and snorkeling are also very popular here in the summer. Kayakers, swimmers, wind surfers, kite surfers, stand-up paddle-boarders, snorkelers, fishermen, picnickers, tourists, families, wheelchair-bound beachgoers and others have used this area on a regular and frequent basis for many decades.

The City park parking area is a location historically known for the ready ocean access it provides for ocean users - in particular surfers, fishermen and beachgoers. It is unique among oceanfront park properties along O`ahu's North Shore in that its coastal waters are very close to Kamehameha Highway and its parking is such that the waters are easily accessible to the public within a few short footsteps. The clear, level and open parking area that has been used in excess of fifty years by a variety of park and beach users, surfers, kayak paddlers, stand-up paddle (SUP) boarders, swimmers. This is primarily utilized as a much-needed parking area and recreational equipment unloading area for these users and is integral to their coastal access.

Accordingly, the DOT must make every reasonable effort to come up with a solution that does not hinder or diminish the public's ability to enjoy coastal recreational opportunities at Laniakea. There is very limited roadside parking elsewhere along Kamehameha Highway for miles in either direction and there are few side streets where such parking is permitted. Those limited parking areas which do exist lie closer to the highway than the Laniakea parking lot and

are generally less safe and convenient to access, are further away from the shoreline access points and have a much more limited number of legal parking spaces. That parking is totally insufficient to handle the public's heavy use of Laniakea and its surrounding areas. In fact, it appears that the HDOT recently put up no parking signs to eliminate roadside shoulder parking East of Laniakea. Limitations on the availability of parking and areas for the unloading of ocean gear (canoes, surfboards, stand-up surfboards, kayaks, paddleboards, beach wheelchairs, etc.) are significant constraints on public ocean access on O'ahu, particularly on the North Shore.

Accordingly, we feel that HDOT cannot legally proceed with any project alternatives that totally eliminate the existing parking, either during construction or as part of the completed project. In order to comply with the CZMA, the space for approximately 55 to 60 cars must be maintained on the City park parcels or some other alternative arrangement must be made to assure continued uninterrupted access to the coastal resources in the area.

It is important to note that when HDOT installed unpermitted concrete barriers in December 2013 which blocked off parking on the City park parcels, it created a very hazardous situation where pedestrian beachgoers were forced to walk along the narrow highway shoulder for long distances pushing strollers, rolling wheelchairs, and carrying beach chairs, umbrellas coolers, surfboards, kayaks, and SUP and windsurfing boards and equipment. This simply increased the pedestrian danger and stretched that danger out over a longer distance.

In addition, people parked along the mauka shoulder continued to haphazardly cross the highway to reach the beach. With shoulder parking stretching on several hundred yards on either side of the beach, the crossing danger was also more spread out and unpredictable to motorists.

The project must not inadvertently create safety issues on either side of Laniakea by encouraging parking along the highway with its well documented hazards. Clearly, eliminating nearby parking for people trying to access the beach and creating a very dangerous situation in the name of a "pedestrian safety project" is completely counter-productive.

If HDOT cannot phase any of the alternatives in a way that preserves adequate public parking on the City park parcels, it needs to find an alternative temporary location for coastal access parking in the immediate vicinity. KSBE has a considerable amount of land mauka of the highway and one or more temporary parking lots could be set up on that existing, mostly flat and clear acreage. Acquisition of temporary construction easements for that purpose can be included in the ROW condemnation proceedings that HDOT must undertake for any bypass. The current parking takes up less than half-an-acre (0.35 acres on TMK# 6-1-010-019 and 0.07 acres on TMK# 6-1-009-021). A convenient parking lot that size or slightly larger could easily be located somewhere on KSBE's adjacent TMK# 6-1-005-023 on a temporary basis for minimal cost, considering the overall project budget.

And of course, in order to comply with the mandates of the CZMA, the finished project, whatever form it takes, must permanently restore, if not increase and enhance, all of the existing parking. Some of the alternatives vaguely discuss "informal parking" as part of the finished project. However, from the depiction of the "Pedestrian Shift Alternative" on page 9, it does not appear that sufficient consideration or space has been given to keeping parking at current levels.

"Informal parking" seems more like token parking.

In short, adequate parking must be uninterrupted throughout - preserved or enhanced. HDOT cannot ignore its legal responsibility to provide and manage "adequate public access . . . to and along shorelines with recreational value."

**2. <u>Elimination of Laniakea Beach Support Park</u>**

Another disturbing aspect of several of the proposed alternatives is complete closure of, or elimination of access to, Laniakea Beach Support Park. As noted above, the CZMA requires that agencies provide "an adequate supply of shoreline parks and other recreational facilities suitable for public recreation." Although the City has not yet funded significant improvements to that park, it was condemned in 2012 and justified because of the great need for public parks and coastal recreational opportunities on O'ahu's North Shore. It is incumbent upon HDOT to preserve, if not increase and enhance, public park availability at Laniakea. As with parking, this is true for both the construction phase and the final finished project. Again, there is adequate mostly vacant land available nearby that, through the condemnation process, could serve this purpose.

**<u>Conclusion</u>**

We are hopeful that HDOT will take seriously the obligations imposed upon it by the CZMA, H.R.S. Chapter 205A. In order to comply with the law it must make some sort of accommodation for maintaining safe, easy public coastal access. The obligation to mitigate the negative effects impacts of any and all proposed pedestrian safety alternatives is clear. No alternative can be studied or chosen unless it accomplishes that.

Thank you for the opportunity to comment on this matter.

Sincerely,

Keone Downing
Save Our Surf

From: nimboy44@aol.com <nimboy44@aol.com>
Sent: Wednesday, February 17, 2021 12:01 PM
To: Tyau, Brian <brian.tyau@hawaii.gov>
Subject: Re: [EXTERNAL] Laniakea North Shore Chamber of Commerce

Hi, Brian,

thanks for the prompt response.
I will get you feedback from the Chamber Board.

**What follows is from me and not the Chamber:**

I have been "involved" in looking for solution to the Laniakea traffic problem for a number of years.

The attached photo shows how the ocean can break onto the highway. Hope DOT has taken this into account in the planning.

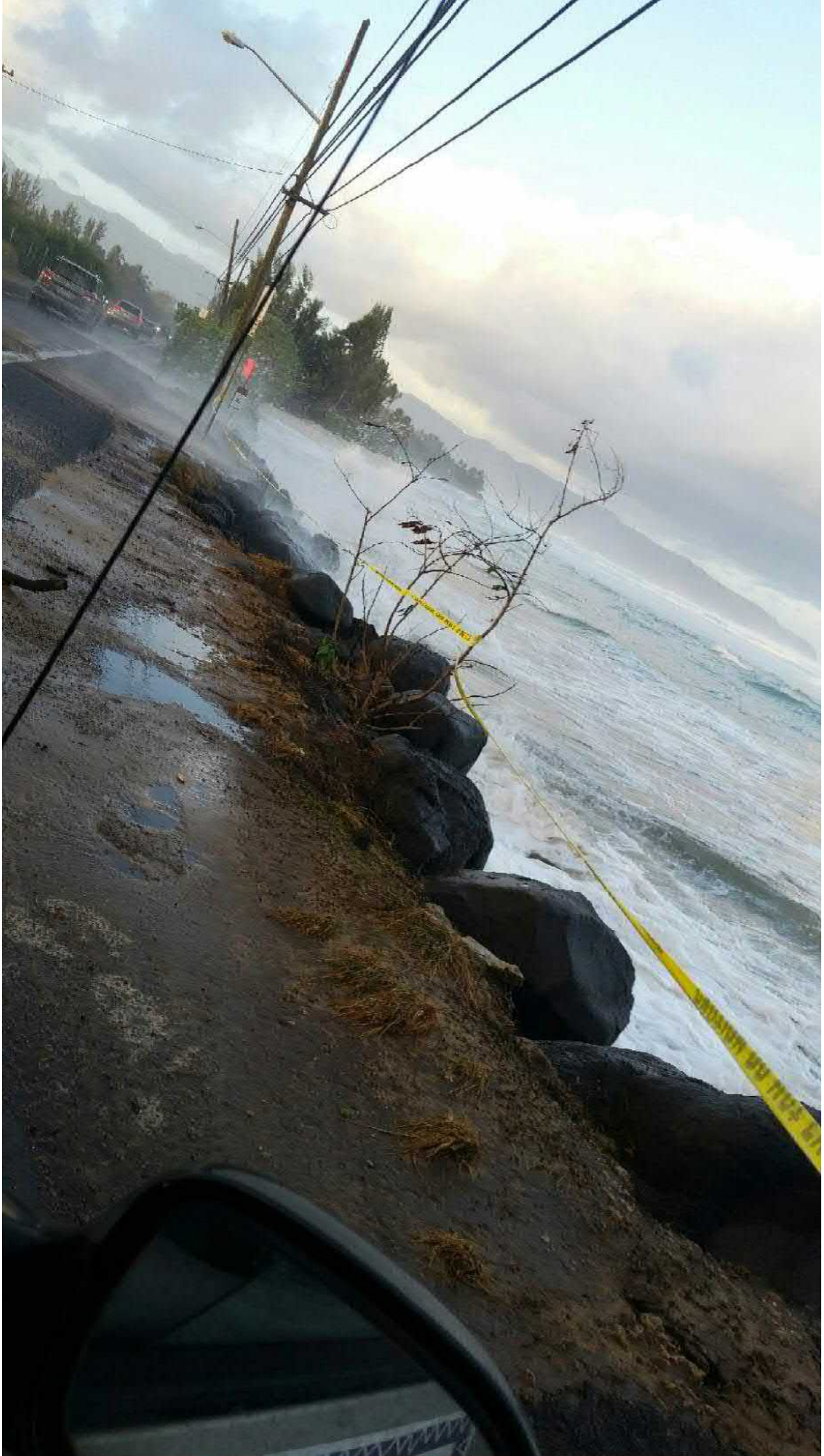
I helped develop the attached plan.

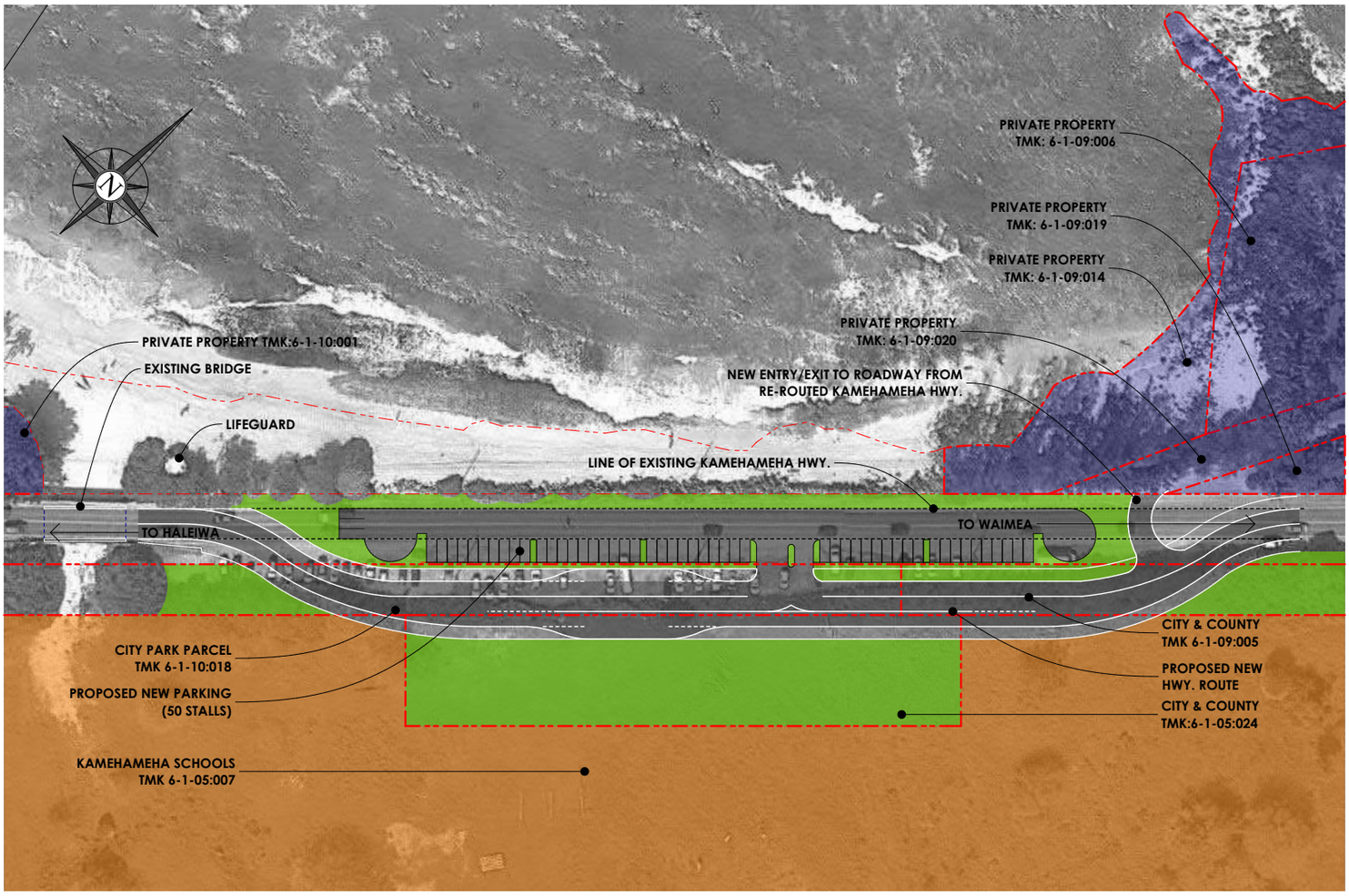
Our thought is that if parking could be on the makai side of the highway it should reduce the traffic problem significantly. Stacking lanes re included in both directions.

If the Governor could declare an emergency because of the potential damage to the highway from the ocean we thought an emergency rerouting could be built on the mauka side without the cost and complication of Federal Highway standards and processes.

It should be less expensive and fast and would solve the safety problem until the State has the $$$ that will be necessary for a long term solution further mauka.

Thanks again,
Bill Quinlan






Concept Plan Rendering

# LANIAKEA ACCESS PLAN

Laniakea, Haleiwa, Oahu, Hawaii

0 10' 20' 40' 70' 100'

January 28, 2014

SOUTH PACIFIC DESIGN GROUP

March 31, 2021

Aloha Brian Tyau

Brian.Tyau@hawaii.gov

Regarding Laniakea:

What we have in this area is a natural attraction/asset that most any community would be proud to have in its inventory.

What we need [should have] is a holistic collective long-term plan that addresses the potential positive aspects this area has to offer and the potential problems. This plan should be inclusive of all governing agencies [Federal, State, City and County] and no aspect of the plan should preclude another agency's ability to move forward with their part of the plan in the future. [ie the DOT built a road so now there can be no beach park].

This area has a cultural past that predates written history. It has petroglyphs at the shore line, burials [I am told] in the ma uka area, rock alignments that may or may not be of significant historical value, Kahoku welowelo heiau just down the road near Ashly Road Gate, endangered green sea turtles that come to the area due the red limu in the area [and that now bask in the sun since they are protected], fishing and nearshore resources, great world class waves, fresh ground water discharge through the cap rock, to mention a few.

For over the last 50 years surf movies have extoled the amazing right slide waves that can be had on perfect days at Laniakea. Outside the channel [rip] to the west is a large left slid called Himalayas. Due to these unique features, inherent hazards and the thousands of people who stop here the City has stationed lifeguards at this beach.

When Frank Fasi was the Mayor of Honolulu, the Department of Parks and Recreation did planning for the future and Don Griffin was authorized to acquire a considerable amount of land for future parks [approximately 40 or so years ago].

The demand/popularity of the locations that were purchased are under more pressure that ever from those seeking recreational opportunities.

What should be at Laniakea, as envisioned over forty years ago, is a real beach park [like so many others around the island with fewer assets and much less utilization]: adequate parking, showers, a restroom facility, multi-modal access, a lifeguard facility [which could use some storage area], and appropriate staffing.

I fervently hope that the plans currently being considered by the DOT will be compatible with a future Beach Park anticipated for this area and will not create some inherent conflict. Nothing stays the same and the ocean level rising needs to be factored into all ocean front projects looking forward.

Another impact related to this area worthy of mention/consideration are tourists in rental cars who have planned to visit the famous North Shore and now many of them have their first opportunity to pull off the road and have a look at the surf/surfers, look at and/or snorkel with some turtles, take some ocean/beach souvenir selfies, or perhaps to look for a green flash during one of Hawaii's amazing sunsets. Lots of people fit this profile, and Laniakea fits the marketed image of Hawaii. Visits to this area should not be discouraged.

Safe and plentiful parking is critical in the planning phase [and operational phase] for all users and service personnel. If the designed parking is full then a safe, wide enough shoulder on Kamehameha Hwy should be provided. As it is now the overflow [up the road] parking is not safe, as the rear end of cars that cannot pull forward enough often exceeding the white strip defining the right side of the East bound lane.

I feel that of the options that you have provided for consideration that the Pedestrian Safety realignment is the one that most approximates a user-friendly park. Further considerations related to this option is that the bike rider in the illustration be on a delineated bike path [there is plenty of room]. Bike path rules need to be clearly understood. The bike path rules at Sunset Beach are still on a learning curve. Long term it has been the wish of many in the community for over forty years to have a bike path/lane that connects Haleiwa with Sunset Beach and beyond to BYU. In the other direction there is a desire to connect to Kaena Point. Each dedicated piece helps to achieve this goal.

The plan should include significant room for motorized moped/motorcycle parking and a bike rack.

Safety and erosion control both need to be factored into the actual access to the beach area. If improved clearly marked accesses are not delineated, then creative forces will create them in multiple areas. I have seen some serious accidents with mobility challenged individuals taking some nasty falls trying to get down to the water because no improvements have been made … thus far.

It would be of value to make appropriate accommodations for the lifeguards to have an area where they can launch their water safety equipment. In an emergency time may matter a lot.

Landscaping always makes a real difference. Please have that as a line item in the budget.

Signage is a valuable training aid. It would be nice to have some coordinated educational signage that addresses safety issues and honors some cultural and natural history. Lots to tell about this place [look at the EIS-2b : )]

Finally, is the timing/scheduling of the actual work to create the improvements. There needs to be a plan that will not slow traffic down especially during commuter times. Also parking/access to the beach amenities must not be impinged to such a state that the public cannot find places to park. So, sequencing/phasing and timing are critical to the success of this project from the perspective of the users. Key: Minimize inconvenience to recreational users and commuters.

Thank you for the opportunity to share some thoughts about Laniakea improvements along with the many other suggestions that you have received over the years. I know that "the DOT builds roads" …. But /and in this case we would all benefit greatly if you could stretch your mission statement and facilitate some appropriate embellishments.

Sincerely,

Bob Leinau Civic advocate and recreational user for over 50

808-638-7010

From: Dee Thomas <dee@surfingohana.com>
Sent: Thursday, March 4, 2021 1:53 PM
To: Tyau, Brian <brian.tyau@hawaii.gov>
Cc: Brett Thomas <brett@surfingohana.com>
Subject: [EXTERNAL] Kamehameha Hwy: Laniakea Beach

Aloha & mahalo for the detailed proposals sent to us residents. We are quite impressed with the proposal packet and request for our input.
We are in support of the “Pedestrian Shift” alternative as it would allow for better vehicle flow & pedestrian safety. Only concern is that this proposal may be subjected to extreme delay due to local politics. In the mean time, we support “No Build Settlement “ which includes pedestrian cross walks, though the crosswalks will be ineffective unless strictly enforced by police or by implementing pedestrian cross light signals.
Thank you,
Dianne & Brett Thomas

Sent from my iPad

From: Brian Emmons <brimohi@msn.com>
Sent: Sunday, March 21, 2021 7:45:08 PM
To: Tyau, Brian <brian.tyau@hawaii.gov>
Subject: [EXTERNAL] Kam Hwy Pedestrian Safety Project

To whom it may concern-

All that money to consultants, meetings, studies, more money, more meetings, more studies... and nothing done all these years. I was part of the Kam Hwy Realignment Committee years ago... we all saw how that worked out. Of the four alternatives, only the "Pedestrian Shift," makes any sense for us, the community. It's a shame that the DOT had to "re-priortize" and change their objective away from the obviously needed "protection of the highway from wave-driven erosion and keep it operational," when taking care of this priority would have eliminated the pedestrian safety problem as well! If only SOMETHING had been done about it before someone was injured....
Lets hope the DOT, and whoever else has their fingers in the pie, finally gets this done.
Aloha, Brian Emmons

From: David Fisher <wayoverhead@gmail.com>
Sent: Thursday, March 25, 2021 5:39:46 PM
To: Tyau, Brian <brian.tyau@hawaii.gov>
Subject: [EXTERNAL] Laniakea

Aloha, Brian
I firmly believe the only option is The "pedestrian shift" alternative

Mahalos
David Fisher
61–431 Kamehameha highway Haleiwa

-----Original Message-----
From: Deborah Aldrich <surfchick96712@yahoo.com>
Sent: Thursday, March 25, 2021 7:20 AM
To: Tyau, Brian <brian.tyau@hawaii.gov>
Subject: [EXTERNAL] Laniakea

Hi Mr. Tyau,

First of all thanks for doing anything!! It's been so long that we who live out here have been prisoners who didn't go out when we often wanted because we couldn't just turn around and go home.

I support the "Pedestrian Shift" alternative. Just keep them out of the way as they expect everyone to just stop. Too many moving pieces with them crossing willy nilly.
That would also include the barrier going up to delineate the construction zone. The barriers worked. It was unfortunate a vociferous few objected.

For the demographics, if you care, I'm a 71 year old retired RN (woman) who moved here in '77 to surf. I own a home up by Alligator Rock.

Thanks,

Debbie Aldrich
Surfchick96712@yahoo.com

Sent from my iPad

Feb 13, 2021

Kamehameha Hwy Pedestrian Safety Project

Pre-Draft Environmental Assessment ( EA )

Scoping and Request for Comments:

Laniakea Beach Vicinity

DOT – HWY – PA – 2.5136

Reference to Letter dated : January 26, 2021

The State of Hawaii Department of Transportation, Highways Division ( HDOT) is proposing to realign Kamehameha Hwy in the vicinity of Laniakea Beach.

I am very much in favor of realigning Kamehameha Hwy.

**Alternative # 1 and Alternative # 2 as presented are unacceptable.** There is an urgent need to REALIGN the HIGHWAY. To ensure a normal traffic flow, to protect the highway from erosion, and to address pedestrian safety.

#1.**No Build Alternative – This is not acceptable**. It does nothing to resume a free flow of traffic on a major highway, does nothing to stop the gridlock traffic situation or protect pedestrian safety.

#2. **No Build Settlement Alternative – This is not an acceptable alternative**. Because it still allows parking on the mauka side of the highway and allows pedestrians to stop traffic while crossing the highway in both directions. It is extremely doubtful that people would actually use any designated crosswalks especially since there will be no enforcement. It is a waste of our tax dollars.

#3: **Transportation System Management Alternative –** This alternative should be implemented temporarily while Kamehameha Hwy is being realigned. This would at least provide traffic congestion relief and address pedestrian safety by discouraging pedestrians from parking on the mauka side to cross the highway.

#4: **"Pedestrian Shift" Alternative** – This alternative is the only one that addresses pedestrian safety, the flow of traffic ( which is the communities MAIN priority ) and address the safety of the highway itself due to beach erosion.

A year or 2 ago there was a far better alternative proposed by Ed Sniffen which involved moving the highway much much further mauka. What happened to that plan? I would like to see that alternative be considered in an EA.

I am extremely disappointed that the HDOT decided to name and re-prioritized "Pedestrian Safety " as the main reason to spend our tax dollars for this long needed project. I want to know the reason why. I can only imagine that it is due to accessing and obtaining specific funding for a specific reason that addresses "pedestrian safety".

When the **major reason** to spend tax dollars to realign the highway should be to restore a safe and normal life for residents and visitors who are currently trapped in grid lock traffic caused by pedestrians crossing the highway at Laniakea. We desperately need to work towards a normal flow of traffic on our one and only major highway.

The North Shore community residents and the millions of visitors driving through the North Shore have suffered greatly. This gridlock traffic situation could also be construed as a "major safety concern" since thousands of residents and visitors and emergency vehicles are also stuck in the horrendous traffic.

As a long time community member I've been involved in trying to help solve this problem for 10 -20 years now. While it is true that our community has been worried about pedestrians getting hurt by running across the highway and we accept that this is of concern, to say that this is the main need for this project is just false. Renaming the project and scope should be considered.

Addressing the true community needs and respecting the thousands of volunteer hours by community members attending multiple task force meetings over many years, using our tax payer's dollars to keep funding more and more planners, paying for never implemented plans...is shameful. Let's fix the situation properly.

Sincerely,

Diane Anderson Diane Anderson

Douglas Meller
*douglasmeller@gmail.com*

**February 25, 2021 Comments on Proposed Kamehameha Highway Pedestrian Safety Project Submitted to HDOT Project Manager, Mr. Brian Tyau via email at: *Brian.Tyau@hawaii.gov***

HDOT's January 27, 2021 STIP does not propose highway realignment at Laniakea Beach during federal FY 2021-2024. Because HDOT has funding limitations and other priorities, highway realignment could be postponed for many years.

Before the highway is realigned, I support any project solely intended to make it safer for the public to park near and/or walk to Laniakea Beach. However, I strongly oppose any project which would close all public parking at Laniakea Beach for an indefinite multi-year period. Without public parking, most Oahu residents could never visit Laniakea Beach. An HDOT project which prevents most Oahu residents from visiting Laniakea Beach for an indefinite multi-year period would unnecessarily curtail beneficial uses of the environment, conflict with the State's environmental policies, and limit surfing and other community cultural practices.

§11-200.1-10, Hawaii Administrative Rules, requires that HDOT comply with §343-5, Hawaii Revised Statutes, before using state funds to design or construct any HDOT project. (Similarly, NEPA compliance is a prerequisite for FHWA obligation of federal highway funds for design or construction of any federal-aid project.) §343-5(c)(4), Hawaii Revised Statutes, requires preparation of an environmental impact statement (EIS) before the HDOT uses state lands or funds for an action which has a "significant effect". Any HDOT project which prevents most Oahu residents from visiting Laniakea Beach for an indefinite multi-year period would have a "significant effect" as defined under §11-200.1-2, Hawaii Administrative Rules. Under §11-200.1-13(b)(2), Hawaii Administrative Rules, an action which "curtails the beneficial use of the environment" would have a "significant effect". And under §11-200.1-13(b)(3), Hawaii Administrative Rules, an action which conflicts with statutory environmental policies under §205A-2(c)1)(B)(iii & v), Hawaii Revised Statutes, would have a "significant effect".

> ***§343-5 Applicability and requirements.*** *(a) Except as otherwise provided, an environmental assessment shall be required for actions that:*
>
> > *(1) Propose the use of state or county lands or the use of state or county funds, other than funds to be used for feasibility or planning studies for possible future programs or projects that the agency has not approved, adopted, or funded….*
>
> *(b) Whenever an agency proposes an action in subsection (a), … the agency shall prepare an environmental assessment … at the earliest practicable time to determine whether an environmental impact statement shall be required….*
>
> *(c) … (4) A statement shall be required if … the proposed action may have a significant effect….*

***Hawaii Administrative Rules Title 11, Department of Health, Chapter 200.1, Environmental Impact Statement Rules (effective August 9, 2019)***

***§11-200.1-2 Definitions.***

*"Effects" or "impacts" as used in this chapter are synonymous. Effects may include … cultural effects, economic effects, social effects, or health effects whether primary, secondary, or cumulative, whether immediate or delayed. Effects may also include those effects resulting from actions that have both beneficial and detrimental effects….*

*"Significant effect" or "significant impact" means the sum of effects on the quality of the environment, including actions that … curtail the beneficial uses of the environment, are contrary to the State's environmental policies … as established by law, adversely effect the … cultural practices of the community and State, or are otherwise set forth in secion 11-200.1-13*[O1]

***§11-200.1-10 Multiple or phased actions.*** *A group of actions shall be treated as a single action when:*

*(1) The component actions are phases or increments of a larger total program;*
*(2) An individual action is a precedent to a larger action;*
*(3) An individual action represents a commitment to a larger action; or*
*(4) The actions in question are essentially identical and a single EA or EIS will adequately address the impacts of each individual action and those of the group of actions as a whole.*

***§11-200.1-13 Significance Criteria.*** *…*

*(b) … In most instances, an action shall be determined to have a significant effect on the enviroment if it may: …*

*(2) Curtail the beneficial uses of the environment;*
*(3) Conflict with the State's environmental policies … established by law;*
*(4) Have a substantial adverse effect on the … cultural practices of the community or State….*

If HDOT rejects reasonable alternatives, and closes all public parking at Laniakea Beach for an indefinite multi-year period, HDOT will not comply with the following statutory Coastal Zone Management (CZM) policies.

***CHAPTER 205A***
***COASTAL ZONE MANAGEMENT***

***§205A-2 Coastal zone management … policies.*** *…*

*§205A-2(c)(1)(B)(iii) Providing and managing adequate public access … to … shorelines with recreational value …*

*§205A-2(c)1)(B)(v) Ensuring public recreational uses of … shoreline lands and waters having recreational value ...*

*§205A-2(c)(7)(A) Use, implement, and enforce existing law effectively to the maximum extent possible in managing present and future coastal zone development …*

*§205A-2(c)(8)(c) Organize workshops, policy dialogues, and site-specific mediations to respond to coastal issues and conflicts …*

*§205A-2(c)(9)(C) Minimize the construction of public … structures … at sites having sandy beaches and at sites where … structures interfere with existing recreational and waterline activities ….*

No one wants another lawsuit. It would be silly to either threaten or provoke one. But if HDOT rejects reasonable alternatives, and closes all public parking at Laniakea Beach for an indefinite multi-year period, someone will file a lawsuit under §205A-6(a), Hawaii Revised Statutes, which alleges that HDOT is not complying with §205A-4(b) and §205A-5(b), Hawaii Revised Statutes.

***§205A-4****(b) The … policies of this chapter … shall be binding upon actions within the coastal zone management area by all agencies….*

***§205A-5****(b) All agencies shall enforce the … policies of this chapter….*

***§205A-6****(a) Subject to chapters 661 and 662, any person … may commence a civil action alleging that any agency … Is not in compliance with one or more of the … policies … provided … by this chapter….*

*(c) A court … shall have jurisdiction to provide any relief as may be appropriate, including a temporary restraining order or preliminary injunction….*

Dated: Honolulu, Hawaii, February 25, 2021

DOUGLAS MELLER

From: Gordon Merchant <gordon@outtheback.com>
Sent: Tuesday, March 02, 2021 10:51 AM
To: Ho, Tracy <tracy.ho@hawaii.gov>
Subject: [EXTERNAL] Re: Kamehameha Highway Pedestrian Safety Project

Aloha
My preference is for the last option in sketch 8 and 9.

Gordon Merchant.

From: Hans Hedemann <hhsurfschool@gmail.com>
Sent: Thursday, March 11, 2021 10:50 PM
To: Tyau, Brian <brian.tyau@hawaii.gov>
Cc: k hedemann <klhedemann@gmail.com>
Subject: [EXTERNAL] Laniekea Safty Traffic Proposal

Hi Brian,

The best and ultimate solution in my recommendation to organize traffic and safety issues for the long future ahead of Northshore visitor's / residents and ongoing upgrades of Turtle Bay Resort go to destinations would be to implement the Pedestrian Shift.

Best, a long term effective plan to redirect traffic for beach / surfing enjoyment and safety access / parking, so traffic does not back up for hours.

Laniekea is the first major beach entering Northshore and will always be a an major attraction like a reverse Sunset Beach coming from the east side and changes done there.

Laniakea is the first stop to surf, see turtles enjoy the beach, fish and sightsee both visitor and local.

Once upon a time the highway was Pokakuloa road , then was moved out as population grew.

In times now and future we have grown with visitors and local population.

Now is time to plan safety not with a bandaid but for the future of time.
Aloha
Hans Hedemann

**From:** Joey Ekstrom <jcekstrom@gmail.com>
**Sent:** Monday, March 29, 2021 3:14 PM
**To:** Tyau, Brian <brian.tyau@hawaii.gov>
**Subject:** [EXTERNAL] Laniakea Realignment

I've looked through the different proposals I received in the mail. The biggest concerns for me are the safety issues and the traffic congestion. It seems like the "Pedestrian Shift" would be the best solution would be the best to address those. Larger numbers of people are going to continue to go to Laniakea. It's a fact of life. I think it would be best to make the investment now. The number of people is only going to continue to grow. It also seems wise to move the road farther away from ocean encroachment.

From: kennywalshaloha@aol.com <kennywalshaloha@aol.com>
Sent: Thursday, February 25, 2021 7:47:24 AM
To: Tyau, Brian <brian.tyau@hawaii.gov>
Subject: [EXTERNAL] LANIKEA TRAFFIC SOLUTION

ALOHA!

MY NAME IS KENNETH WALSH AND MY WIFE AND I RESIDE AT 61-736 PAPAILOA RD. HALEIWA HI.96712. WE HAVE LIVED HERE SINCE 1975 AND HAVE SUFFERED THROUGH THE LANIKEA TRAFFIC PROBLEM FOR YEARS!!!
IT HAS BEEN STUDIED FOR OVER 10 YEARS AND A SOLUTION IS WAY OVERDUE!!

WE BOTH FEEL THAT THE "PEDESTRIAN SHIFT" ALTERNATIVE IS BY FAR THE BEST WAY TO GO!!

I HOPE YOU MOVE ON THIS PROJECT POST HASTE!!

THANK YOU!

KENNETH WALSH
808-280-1178

From: Marina Hoshi Whyte <marinahoshi@gmail.com>
Sent: Saturday, March 13, 2021 8:32 PM
To: Tyau, Brian <brian.tyau@hawaii.gov>
Subject: [EXTERNAL] Laniakea Realignment Project - Pedestrian Shift

Hi Brian,

I received the project update from Tracy and carefully read those four plans you are presenting.

Pedestrian Shift was my favorite for the following reasons:

I like the fact that you need to block the existing parking area during the construction. This may be the reason that surfers oppose this plan, which I totally understand. But when you think of this as a turtle traffic problem, there is a good chance that while Laniakea beach is sort of off limits for a few years, tourists and tour companies will find another beach to view turtles. Laniakea was the first beach that turtles had started to come back, and with the Hawaii Tourism Authority-funded Malama Na Honu (see the link below), it became the official turtle viewing spot. However, now there are more turtles around Oahu in general, so I'm sure that people can find other places to take photos of turtles, such as Haleiwa Alii beach park,Turtle Bay resort, or the East side. Even if some of the tourists come back after construction is complete, once the idea that there are other turtle viewing spots is widely shared, visitors won't be too obsessed with Laniakea.
https://malamanahonu.org/product/laniakea-ohana/

The ocean side parking eliminates the danger of pedestrians crossing Kam Hwy. I understand that one of the claims by the group that sued HDOT was that disabled people need close parking. This may not be a major point, but still it would be good for everyone to be able to say that there is (sort of) a handicap access.

Just like at Sunset Beach, the erosion is progressing very fast here at Laniakea. Please see the attached photo from the summer of 2020. If you spend any money doing anything to Laniakea it should be to move the road inland. This plan is the only one out of four that moves the road inland.

I know that some people want the road to move even further inland and create a beach park at Laniakea. I oppose this idea. Laniakea beach is too small to begin with and now is quickly disappearing. Any effort to create a beach park will be wasted. In the summer the slippery rocks are exposed and are very dangerous to walk on. Visitors walk west to swim, and the lifeguards can't see them from their tower. The state should not mislead tourists to believe that Laniakea is a safe place to swim. And of course the green sea turtles, a threatened species, shouldn't be bothered by any more beachgoers.

If you plant trees and block the ocean view from the road, tourists will likely just drive through and won't realize that there are people on the beach doing something (taking photos with turtles). I know a community member who has said for years that if we just plant trees and block the view, we can improve the traffic flow dramatically. I didn't know who to ask to plant trees along Kam Hwy, but this plan comes with new vegetation and it's perfect! Just like the drivers' safety improved after the HDOT had blocked the ocean view at the Waimea Bay with the concrete walls, Laniakea needs a hedge.

We will be given extra space in front of our house for vegetation. My biggest concern has been that we need to be able to see oncoming traffic when we leave our driveway. In the past, some visitors had parked on the left side of our driveway completely blocking our visibility. That was really dangerous. If we have this extra space for vegetation, we should be able to trim and keep the trees short in a way that we can always see the oncoming traffic.

The street lights currently shine on the beach, which is not ideal for marine animals. Having street lights on the mountain side is a good idea.

Concerns:

During the construction, people will try to park in front of our house and block our visibility. That will put us in danger. If you could provide us with No Parking signs, that would be great.

If everyone then parks on the mauka side (in front of the horse ranch and Alluvion) and crosses Kam Hwy to get to the makai side, someone could get hurt, which is what you are trying to avoid. So the No Parking signs there may also be needed.

We don't see people walking or riding bikes on this part of Kam Hwy too often. It's too dangerous. There is no bike path to connect to like at Sunset Beach. Therefore, the one lane you are keeping for the bike path may be better used as extra vegetation. I am afraid that this paved space maybe used for things like lunch wagons, surf school tents or large parties. Plants are better for erosion control than the leftover road anyway: Naupaka, Vetiver, Beech Heliotrope, Sea Grapes, Kamani, Coconut, etc.

Thank you very much for working on this project. I hope things can move forward soon.

Aloha,

Marina Whyte

**From:** Michael Berman <mberman@firstrangemanagement.com>
**Sent:** Sunday, March 28, 2021 8:21 AM
**To:** Tyau, Brian <brian.tyau@hawaii.gov>
**Subject:** [EXTERNAL] Kamehameha Highway pedestrian safety project

Brian sorry for the delayed response, we've been traveling. First I'd like to congratulate you on a great presentation and nice executive summary.
In an effort to shorten my response, in summary we would be in favor and support the "pedestrian shift alternative" . Admittedly more expensive and a longer construction project, the end with justify the means. Looking to the future.... this is the right solution for the North Shore. Happy to discuss any of this at your convenience. Thank you for your continuing efforts.
61- 469 Kamehameha Highway
MB

**Michael Berman**
**First Range Management**
6255 Habitat Drive, Suite 3005
Boulder, CO 80301
Office: 303-444-7777
Mobile: 303.638.1999
mberman@FirstRangeManagement.com

**Please send emails to mberman@FirstRangeManagement.com**

From: Michael Lyons <mlyons001@icloud.com>
Sent: Saturday, January 30, 2021 4:55 PM
To: Tyau, Brian <brian.tyau@hawaii.gov>
Subject: [EXTERNAL] Aloha Brian. Regarding laniakea I'm in favor of the pedestrian alternate. I have been involved with cultural services and Nicole Ishihara. The area is heavily involved with cultural sites. I am not in favor of disturbances to these sites.

Sent from my iPhone

From: Richard Whyte <whyte.richard@gmail.com>
Sent: Saturday, March 6, 2021 3:51 PM
To: Tyau, Brian <brian.tyau@hawaii.gov>
Subject: [EXTERNAL] Laniakea

Hi Brian,

The Pedestrian Shift option is of course the best choice to keep people off of highway. However, cars should not be backing on to highway out of stalls. We suggest exit north and south at pohakuloa road connection with with merging lanes. Use old highway for access to new parking lot.

Thank you

Richard Whyte
Area resident

RECEIVED
MAR 29 2021
WSP USA INC.
HONOLULU, HAWAII

March 22, 2021

Mr. Brian Tyau

Subject: Kamehameha Highway
Pedestrian Safety Project
Vacinity Of Laniakea Beach
Proposed Highway Realignment

In regards to this proposed highway realignment in the vacinity of Laniakea beach, we would like to thank you/DOT for all their efforts put fourth on this proposed project. As concerned citizens of the north shore we have been involved in the proposals/fix to the on going health and safety issues for about 20 years. We have, and attempted to inform many on the need to address this huge traffic issue and the health and safety concerns.

During our efforts to bring attention to a proposal/fix and other related concerns, we found that there were plans for the Laniakea beach area that many were unaware of. These plans were tourist and recreational oriented with other possible activities that would put a negative affect on this beach and area. This plan would also affect traffic and become a major safety and health issue.

Once we got much of the proposed plans for the area, we tried to work with the north shore neighborhood board to stop a proposed support park development. (More Info. available.) This proposal had many issues connected to it that needed to be addressed. Attending meetings, meeting with many or contacting by other means, including north shore neighborhood board members, concerned residents, some political leaders, HDOT, cultural survey personnel, other cultural experts, city parks people and more, has given us a very broad understanding and related knowledge of this issue/subject.

The main issue is and has always been the health and safety issues but not limited to it. There is much more to solving this issue that includes this beach, affects on the ocean, the turtles, Hawaiian culture, ag lands, private property and so on.

We appreciate so much those people that gave us an opportunity to share our findings, knowledge and related information prior to moving forward, planing and designing the highway realignment in this area.

All the negative talk about the HDOT by members of the north shore neighborhood board was incorrect to say the least.

As I have mentioned in other letters and or discussion over the many years, the community had agreed with us to the least invasive fix for this area of the highway in the vacinity of Laniakea beach. This was voted on a number of times and had always been to do as we first proposed from the first meeting that we attended on this issue.The fix was for us to drive where people park and park where we presently drive. At all voting on this issue, it was agreed by over 90% voting to do the least invasive. Our proposal has almost aligned with the HDOT plans on page 9. The small group of opposing people that continue to move toward Hawaii becoming a recreational or playground for the rich, and other selfish reasons, will continue to try to get what they want by any means. They put greed and personal benefit ahead of our quality of life, and many other very important things.

Years of information, studies, and related data etc. was discussed as I have mentioned, with so many. Meetings, letters and other related conversations with the HDOT group/team on the proposed fix/realignment plans etc., were very important as they intended to get as much information as possible on this issue. This group/team from the HDOT was and still is very serious and determined to be as informed as possible moving forward with this project.

This HDOT never made us feel that what we had to share or our concerns were not of some importance to them and their work moving forward and we so appreciate that.

Their efforts to address all the concerns is of great importance to this group/team and is greatly appreciated because most of the concerns are important and needs to be addressed correctly and timely.

As stated, we believe that HDOT's plans as is on page 9, from information we recived from the HDOT, is the least invasive. The HDOT has given necessary consideration for Hawaiian culture, agriculture lands, private Hawaiian lands/Kamehameha Schools, cultural connection/flow to Laniakea beach which is part of the cultural connection and flows from mauka to Laniakea beach.

We also feel that the huge health and safety, traffic and other related issues will be greatly improved, if not many eliminated with this HDOT plan.

As many of us on the north shore and throughout the islands ponder thoughts of tourism being placed above all else, many of us try to save what we can of Hawaii as it should be or was.

Hawaii is unique in many ways and should be protected and the people, culture and lands also respected. Hawaiians are an agriculturally sustainable type of people with much culture. Many plans for additional parks and recreational development is to enhance and increase tourism that cause more problems, displace the indiginous life style/way of life, people, quality of life for many and create more homeless/houseless, etc..

The plans for the north shore, beaches etc., seem to be obvious as we continue to move toward a recreational area and development for the rich. Hawaii's leadership, political and other also continue to allow development of ag lands for other then agriculture. This management style continues to draw more outside money to Hawaii as it displaces Hawaiians and other local families. Many here can no longer compete or handle the cost of living and other related issues and must leave to survive or for a better life.

Back to the realignment pedestrian safety project in the vacinity of Laniakea, again, we feel that the plan as seen on page 9, (is the best way to address all issues and or related problems).

We don't know how to thank the people at the HDOT that have allowed us to participate and address our concerns on this very important issue. We hope that the HDOT team/group and others involved in solving this emergency issue in the area of Laniakea on Kamehameha highway will be able to move forward with the plan as shown on page 9.

If we can be of any assistance for anything at any time, please do not hesitate to contact us. We will be more then happy to help.

Sincerely
Robert Robinson

Robert Robinson
North shore resident

From: Email Service <tj4dogs@aol.com>
Sent: Thursday, April 8, 2021 12:38 PM
To: Tyau, Brian <brian.tyau@hawaii.gov>
Subject: [EXTERNAL] laniakea realignment issue

Aloha Brian, I am one of the many North Shore residents that travel Kamehameha Hwy daily between Pupukea and Waialua. The traffic issue at Laniakea is a simple fix.
If I am understanding the proposals properly, the only one that is viable is the Pedestrian Shift alternative. Moving the highway mauka and leaving parking on the makai
side is the ONLY way to alleviate traffic backing up and causing traffic jams. Anywhere on the mainland you will have the ocean, then the parking, then the highway on the
mauka side of the parking lot. ANY alternative that has people walking across traffic is a no go. We have put up with this for TOO LONG and appreciate the opportunity to
input. Hope this comes to fruition without taking any more time. Its the only way to fix this mess. Realign the highway.
Mahalo, Tina Jensen

-----Original Message-----
From: Will Eilert <WEilert@ema.us>
Sent: Friday, March 26, 2021 4:09 PM
To: Tyau, Brian <brian.tyau@hawaii.gov>
Subject: [EXTERNAL] bypass

Super to hear something may be done after 20 years of traffic nightmare! I live on papailoa and unfortunately have had to deal with this problem. The only option is #2 — moving kam Highway is totally unrealistic — it would take another 10 years similar to the rail project — let us put up the barriers and allowing entrance from haleiwa side and exist from north side! I can donate the paint for the walkway crosswalks !! Let's get this going now!! If i did surgery like the state of hawaii has taken care of this problem — i would be in jail!! Wiliam t. Eilert, MD

Appendix

# A-2

# Regulatory Coordination

| | |
|---|---|
| **PROJECT NAME** | Kamehameha Highway Pedestrian Safety Project |
| **DATE** | 18 June 2020 |
| **TIME** | 9:00 a.m. – 10:00 a.m. |
| **VENUE** | Virtual (Microsoft Teams) |
| **SUBJECT** | Discussion With the State Historic Preservation Division (SHPD) Regarding Chapter 6e-8 Approach |
| **CLIENT** | State of Hawaii Department of Transportation, Highways Division (HDOT) |
| **PRESENT** | SHPD: Susan Lebo<br>HDOT: Ken Tatstuguchi, Brian Tyau<br>ASM Affiliates: Robert Rechtman<br>WSP: Dexter Eji, Rachel Adams, Malie McClellan |

- The project will not be using any federal funding.
- ASM: planning to start field work Wednesday, June 24, 2020. It is anticipated that to augment the work that CSH previously performed in the area, ASM will conduct work in an additional 7 trenches.
- The work area is roughly 550-570 meters long, and approximately 100 feet wide, mauka of the existing Kamehameha Highway.
- The proposed project will not be affecting the existing bridge over Laniakea Stream. Lauhulu Bridge is on the inventory list.
- There are two stone enclosure sites in the project area as well that should be considered.
- Monitoring will be proposed for work in the sandy (Jaucus sands) areas for pavement removal; HDOT noted that they would likely agree to this mitigation effort.

## FOLLOW-UP ITEMS

WSP: Draft updated figures with APE, known / noted resources sites

WSP: Initial plans with streetlight and guardrail post locations / spacing

WSP: More in-depth discussion regarding construction methodology

WSP: Reach out to Historic Hawaii Foundation, and verify inclusion on the project mailing list (*added to mailing list June 18*)

WSP: Provide updated figures to SHPD (ASM work area, locations of streetlights and guardrails, etc.) for reference (*provided June 18*)

State Department of Transportation
Highways Division

Kamehameha Highway Pedestrian Safety Project
Vicinity of Laniakea Beach

Meeting Summary

Thursday, November 14, 2019 11:00 a.m. -12:15 p.m.

1. Introductions / Attendance
    - HDOT
        - Ken Tatsuguchi
        - Misako Mimura (via phone)
    - DLNR
        - Carol Tyau-Beam
    - CCH-DPP
        - Mario Siu-Li
    - WSP
        - Dexter Eji
        - Rachel Adams
        - Jan Reichelderfer
        - Malie McClellan

2. Project History / Purpose of Project
    - Pedestrian Safety – pedestrian accident on August 1 2019
        - HDOT funding and therefore focus was on designing the project to address shoreline erosion
        - Barriers had been installed along the mauka edge of the highway to prevent use of the unimproved parcel (owned by CCH) for parking, but due to a lawsuit regarding process / jurisdiction they were removed
            - The barriers effectively closed off the unimproved parcel that had historically been used as an illegal parking area (No Parking signs are posted), and this was argued as an access issue, along with other complaints by area users
        - Shoreline erosion remains an important consideration, but pedestrian safety is a more immediate concern that needs a design consideration that can be constructed quickly
        - Ultimately, HDOT is working to minimize the potential for pedestrian / vehicle conflicts

- Secondary Objectives
    - Vehicular Congestion
    - Beach Access

3. Alternatives
    - No Build
    - Transportation Systems Management (TSM)
    - Build Alternative Design Elements
        - Pedestrian Shift Alignment Alternative
            - HDOT is mindful of their budget and they need to be considerate of the needs of the entire state
            - This would shift the roadway 50 feet mauka (from the existing edge of pavement to the proposed alignment's new makai-side edge of pavement)
            - The proposed design was initially closer to the existing Kamehameha Highway, but was shifted mauka per resident input
            - The proposed alignment wasn't shifted more mauka due to the consideration of existing historic, cultural, and archaeological resources that have been identified in the area
            - The roadway would be raised roughly 3 feet, which isn't necessarily above the storm surge inundation zone (or projected sea level rise depending on year being evaluated) but would provide a time buffer for HDOT while allowing for continued highway system operations
                - The Base Flood Elevation (BFE) is roughly 22-23 feet, and this alignment would be at approximately 20 feet
                - The roadway would be designed to be titled downward from makai to mauka so that runoff would enter a swale and then Laniakea Stream
            - Access to the unimproved parcel would remain (parking would not be sanctioned by HDOT)
            - Kamehameha Highway could remain as a "frontage road" but would require design elements to deter nuisance parking, etc.
            - The existing driveways for residents on the Haleiwa side of the alignment would be extended as needed, and would include the construction of culverts
        - Most Realignment Alternative
            - This alignment would continue to be evaluated
            - The alignment starts at the same location on the Haleiwa side of the project, but would go farther mauka and extend further to match the existing Kamehameha Highway in the vicinity of Chun's Reef
            - This roadway would also be raised, but the design hasn't progressed that far at this time

4. Advice on Studies Needed/Planned and Regulatory Requirements – Letter of Map Amendment (LOMA) or Letter of Map Revision Based on Fill (LOMR-F)?
    - The project team understands that the regulations / requirements regarding work in floodplains are undergoing updates and wants to coordinate early with DLNR and CCH to ensure compliance
        - NFIP requirements are being updated by FEMA now and briefings are anticipated soon
    - The project team will look at FEMA's description regarding what constitutes "development"
        - It was noted that this seems to address almost any change to the surrounding area, so it is likely that the project will be considered a "development", unless the TSM Alternative is selected
    - Grading efforts are likely to be considered as their own category of sorts
    - Previously, HDOT projects haven't needed CCH approval
        - CCH doesn't take jurisdiction of work efforts within HDOT ROW, but the project as proposed would require work outside of HDOT ROW for either of the Build Alternatives
    - CCH has been requesting updated and more involved studies

5. Other Items Discussed
    - Mandatory compliance with FEMA regulations is required for projects that use federal funds
        - DLNR noted that even though this project is not using federal funds, these standards are what should be followed
        - These standards can be considered building blocks regarding the types of requirements that should be considered / implemented
        - New FEMA direction is anticipated to ask for state agencies to comply with their regulations
        - If projects are non-compliant, then FEMA assistance can be suspended (no federal assistance for disaster impacts, etc.)
        - DLNR is working with the Governor's office to begin discussions with state agencies
    - DLNR is still developing / building the Flood Management Program, but will work with the project to assist in providing direction and input
        - Clear guidelines to be established
        - Certain exemptions exist when conditions simply don't allow for the appropriate / mandated design to be applied
    - Structures that were built prior to the implementation of FIRM regulations are considered non-conforming and if work is done that costs more than 50% of the market value of the structure, even if it remains in the same footprint, the structure then needs to be brought into compliance
    - There will be bridge-related construction:
        - The Pedestrian Shift Alignment Alternative will clear-span Laniakea Stream with a new bridge, while the existing bridge will remain in place
        - The Most Realignment Alternative would clear-span Laniakea Stream as well and leave the existing bridge in place, and would also clear-span a second stream, Kawailoa Stream, with a new bridge and leaving the existing bridge in place

        - Changes to bridges, or construction of new bridges, even if considered an improvement for an area, can result in a dramatic difference in the overall environment
            - Changes in the overall BFE, for example, could lead to different requirements for other projects in the area
            - Changes should be documented so that projects are working with the most up-to-date information
            - The documentation of such changes is done through the LOMR process with FEMA
    - Stream(s) need analysis to ensure the project wouldn't affect processes, cause / worsen flooding, etc.
    - Coastal surge processes should be analyzed to ensure that raising the elevation of the roadway by 3 feet won't result in deflection of storm surge waters into adjacent areas
        - Would it raise their BFE?
        - Could have implications for them (insurance, etc.)
    - The existing coastal studies are old, there has been discussion of updating them
        - DOH has done some studies regarding susceptibility of areas
        - North Shore is more susceptible to XX
        - South Shore is more susceptible to hurricane surges
        - The project has a coastal engineer on staff who has been reviewing background information and existing resources
    - Meetings were held with makai landowners
    - Mauka landowners include CCH and KSBE
        - KSBE appreciated efforts to design the alignment so as to avoid / minimize the potential for impacts to historic, cultural, and archaeological resources
        - KSBE also appreciates an alignment that would minimize the potential for disruption to its traditional wayfinding educational area, Kahokuwelowelo

6. Regulations
    - DOT 5650.2
    - 23 CFR 650A
    - 44 CFR 50.1: definitions
    - 44 CFR 60: overall
    - 44 CFR 60.3
    - 44 CFR 65: overall – mapping
    - 44 CFR 65.3: requirement for new technical data
    - 44 CFR 65.10: not coastal, but can still look through for reference

7. Action Items
    - The project will work with Curtis to get input regarding design approach, requirements, etc.
    - The Draft EA (anticipated March 2020) will be sent to CCH and DLNR for review

Appendix

# B

# Traffic Evaluation

TECHNICAL REPORT

# Kamehameha Highway Pedestrian Safety Project
# Vicinity of Laniakea Beach
# Traffic Evaluation

Haleiwa, Island of Oahu, Hawaii

March 2021

Prepared for:
State of Hawaii
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813

## Introduction

This traffic study has been initiated to support the Environmental Assessment (EA) for the Kamehameha Highway Pedestrian Safety Project in accordance with Hawai‘i Revised Statutes (HRS) Chapter 343 due to the use of State funds and land. The purpose of this report is to analyze traffic impacts of the proposed improvements to Kamehameha Highway in the vicinity of Laniakea Beach on the island of Oahu.

This technical evaluation documents the evaluation of future traffic conditions for two alternatives on a realigned Kamehameha Highway for the projected build-out year of 2030 and the 2050 horizon year.

## Project Description

Laniakea Beach is a popular tourist attraction on the North Shore of Oahu, located along Kamehameha Highway northeast of Haleiwa. Sight-seers visit the beach to observe sea turtles basking in the sun on the beach. The beach is also a popular surfing spot. Beach goers generally use the open area mauka of the beach across Kamehameha Highway to park, which creates a safety issue as they cross the highway to reach the beach.

Traffic congestion is also an issue at Laniakea Beach. Vehicular turning movements to and from the Kamehameha Highway from the open area mauka of the highway, combined with the frequent shuttles and the random pedestrian crossing further complicate traffic operation and safety on this segment of Kamehameha Highway. Waimea-bound traffic flow can experience high delays with queuing extending past the Kamehameha Highway/Joseph P. Leong Highway intersection on weekend afternoons.

In December 2013, the Hawaii Department of Transportation (HDOT) installed a barrier to prohibit parking on the mauka side of Kamehameha Highway to help address the traffic congestion issue. This was only intended to be a short-term fix and with the realignment of Kamehameha Highway further inland proposed as a long-term solution. The barrier was effective at reducing congestion on Kamehameha Highway but it was removed in August 2015 due to a legal challenge involving beach access. In August 2019 a pedestrian was hit while crossing the highway and the HDOT began moving forward with the Kamehameha Highway Pedestrian Safety Project.

HDOT is now proposing to realign the Kamehameha Highway near Laniakea Beach (Figure 1) to improve pedestrian safety. The proposed project will also work to improve the public highway

system in terms of congestion, mobility, and reliability, while providing local access to this public beach and private property.

The alternatives are described as:

- No-Build Alternative – No modifications would be made to Kamehameha Highway.
- No Build Settlement Alternative – Regarding the No Build Settlement, the way this alternative would operate is similar to how the existing situation was modeled, but with more defined access points. The No Build Settlement alternative would consist of two intersections while the No Build alternative was modeled as three intersections. Generally speaking, the results from modeling for the No Build alternative can be considered slightly more conservative because it assumed interruptions in traffic in more locations than the No Build Settlement alternative.
- Transportation Systems Management (TSM) Alternative – The TSM alternative would consist of constructing a guard rail on the mauka side of Kamehameha Highway within its right-of-way fronting Laniakea Beach. The guardrail would be an estimated 1,000 linear feet and would enforce the no parking condition. This alternative may also be implemented during the construction of one of the Build Alternatives.
- "Pedestrian Shift" Alternative – The "Pedestrian Shift" Alternative would consist of generally shifting Kamehameha Highway roughly 80' mauka from its current alignment as shown in Figure 2. The modification would be roughly 0.5 miles and include a median refuge lane. The existing Kamehameha Highway would be converted to a 16-foot wide shared use path for pedestrians and bicycles. With the beach and an unsanctioned parking area both on the same side of Kamehameha Highway, no pedestrian crossings are anticipated. Residential driveways would be extended as appropriate and Pohaku Loa Way would be gated on the beach side.
- "Most Realignment" Alternative – The "Most Realignment" Alternative generally consists of realigning Kamehameha Highway mauka as far as feasible on the Haleiwa side of Laniakea Bridge to the Waimea side of Ashley Road, a distance of roughly 0.8 miles, as shown in Figure 3. As part of the alternative, two new roads would be constructed which would connect the realigned Kamehameha Highway to the existing alignment and affected residential properties, which would function as a shared use path for pedestrians and bicycles. Pohaku Loa Way would be gated on the beach side.

Existing Conditions

Within the study area, Kamehameha Highway is a two-lane, principal arterial. Despite being classified as such, the roadway's mobility can be compromised by beach-related vehicle and pedestrian traffic, most notably at Laniakea Beach. In addition, residential direct driveway access is provided on one or both sides of Kamehameha Highway for most of the area between Haleiwa and Waimea. The posted speed limit in the vicinity of Laniakea Beach is 35 miles per hour.

Kamehameha Highway is served by two bus routes at Laniakea Beach: Route 55 – North Shore-Kaneohe (approximately 45-minute headway during commuter peaks) and Route 88A – North Shore Express (2 buses per day). Only standard sized buses traverse Kamehameha Highway. No extended buses are used.

In December 2013, an approximately 1,000-foot long concrete barrier was installed mauka of Kamehameha Highway by HDOT. The purpose of the barrier was to improve traffic safety by reducing pedestrian-vehicle conflicts and to improve Kamehameha Highway traffic delays. The installation of the barrier improved travel times by 10-15 minutes in the Waimea-bound direction on Saturday afternoons. When the barriers were removed, Saturday travel times and delays returned to pre-barrier conditions.

2012 HDOT traffic counts at Chun's Reef (roughly 0.4mile northeast of the Laniakea Beach) were used to establish a baseline for Kamehameha Highway through traffic. An average of two days of 24-hour traffic data in March 2012 was used. The existing Average Daily Traffic (ADT) is between 15,000 and 16,000 vehicles per day. The heavy vehicle percentage is 2.37%. Historical volumes through 2015 were examined and 2020 weekday AM peak hour volumes were estimated. Supplementary January 2020 weekday PM and Saturday counts were conducted to provide the most recent counts for critical peak periods on Kamehameha Highway.

Pedestrian and traffic data was collected on Thursday, January 16, 2020 and Saturday, January 18, 2020. The weekday PM peak hour was 4:00 PM-5:00 PM and the Saturday peak hour was 11:30 AM-12:30 PM. Existing peak hour traffic volumes are shown in Table 1 and Figure 4. Left and right turns into the open area per hour during the weekday PM and Saturday afternoons are shown in Figure 5. Turns during the weekday PM and Saturday peak hours are shown in Table 2. Hourly pedestrian crossings are shown in Figure 6. Pedestrian crossings weekday PM and Saturday peak hours are shown in Table 3.

Table 1 Existing Weekday and Saturday PM Peak Hour Traffic

| | EB | WB | Total |
|---|---|---|---|
| Weekday PM | 742 | 710 | 1452 |
| Saturday | 745 | 666 | 1411 |

Vehicles per hour

Table 2 Existing Weekday and Saturday PM Parking-Related Turns during Peak Hour Traffic

| | In | | | Out | | |
|---|---|---|---|---|---|---|
| | Right | Left | Total | Left | Right | Total |
| Weekday PM | 30 | 16 | 46 | 26 | 21 | 47 |
| Saturday | 53 | 9 | 62 | 19 | 51 | 70 |

Vehicles per hour

Table 3 Existing Weekday and Saturday PM Pedestrian Crossing Volume during Peak Hour Traffic

| | Crossings |
|---|---|
| Weekday PM | 194 |
| Saturday | 304 |

Pedestrians per hour

As shown in Table 1, peak hour traffic volumes at Laniakea Bridge are fairly comparable on weekdays and Saturdays. However, the traffic demand is not being processed due to the delays associated with Laniakea Beach. Tables 2 and 3 show the increase in beach activity on the weekend. While Table 3 shows the observed pedestrian crossings during the traffic peak, the hourly pedestrian crossing peaks were 242 pedestrian crossings per hour during the weekday afternoon (between 2:00 PM and 3:00 PM) and 338 crossings per hour during the Saturday afternoon (between 11:45 AM and 12:45 PM).

Travel time runs were conducted between Haleiwa (Kamehameha Highway/Joseph P. Leong Highway intersection, west of Haleiwa) and Waimea (Waimea Valley Road intersection), a distance of approximately 5.6 miles. The weekday afternoon travel time runs were conducted on Wednesday, January 22, 2020 between 12:00 PM and 5:00 PM and the Saturday afternoon travel

time runs were conducted on Saturday, January 25, 2020 between 11:00 AM and 5:00 PM. Travel time runs would typically take 9-10 minutes during free-flow conditions with minimal beach-related delay. The weekday and Saturday afternoon travel times are shown in Figures 7 and 8.

Waimea-bound weekday afternoon conditions are generally free flow until the Kawailoa Ranch area, where beach-related slowdown is observed. A travel time that would normally be 10 minutes with no Laniakea Beach slowdown would take 11-12 minutes due to about 1-2 minutes of additional delay caused by the beach. Table 4 shows how much additional delay was added in the Waimea-bound direction by comparing each travel time run to the fastest run of the day at a point just east of Laniakea Beach. This helped to show how much delay was directly caused by beach-related traffic. As shown, an additional 3-5 minutes of delay was observed throughout the afternoon on weekdays.

Table 4 Existing Weekday Waimea-bound Laniakea Beach Delay

| Time | Laniakea Delay (min) |
|---|---|
| 12:03 PM | 0:04:25 |
| 12:32 PM | 0:03:33 |
| 1:16 PM | Free-Flow |
| 2:00 PM | 0:02:52 |
| 2:44 PM | 0:02:47 |
| 3:34 PM | 0:05:29 |
| 4:10 PM | 0:03:19 |

As shown in Figure 7, on significant spike in travel time was observed during a travel time starting at 2:44 PM. It is unknown what caused this additional congestion on Kamehameha Highway but it should be noted that it originated downstream of Waimea Bay, caused by an event or incident occurring further east and was therefore not associated with Laniakea Beach. The subsequent 3:34 PM Waimea-bound travel time run was also impacted by the residual queue. Haleiwa-bound runs were generally free flow, although congestion began to build up in the vicinity of Chun's Reef before Laniakea Beach starting around 4:00 PM.

Saturday afternoon traffic conditions are consistent with weekday afternoon conditions in the Haleiwa-bound direction. Travel times were generally close to 11-12 minutes, increasing slightly

in the late afternoon. As shown in Figure 8, Waimea-bound traffic began to queue up starting around 11:30 AM. Almost immediately, the back of queue started to approach the Kamehameha Highway/Joseph P. Leong Highway intersection east of Haleiwa and persisted throughout the afternoon, extending past the Waimea-bound "Welcome to Haleiwa" sign to around the Tsue's Farm driveway. The longest travel time was 34 minutes at 2:01 PM. As shown in Table 5 approximately 25 minutes of the delay was due to Laniakea Beach. This queue began to dissipate around 3:00 PM and was almost completely gone by 5:00 PM.

Table 5 Existing Saturday Waimea-bound Laniakea Beach Delay

| Time | Laniakea Delay (min) |
|---|---|
| 10:10 AM | Free-Flow |
| 11:06 AM | 0:00:49 |
| 11:40 AM | 0:08:05 |
| 12:15 PM | 0:17:08 |
| 1:04 PM | 0:21:48 |
| 2:01 PM | 0:24:58 |
| 3:01 PM | 0:20:15 |
| 4:13 PM | 0:07:40 |

Existing Conditions Analysis Methodology

2020 traffic data and historical Kamehameha Highway data were used to calibrate Synchro/Simtraffic for existing conditions.

The existing conditions were analyzed using Synchro. The Arterial Level of Service (LOS) was obtained to measure regional mobility. Arterial LOS is based on travel speed, which, as defined by the Highway Capacity Manual (HCM), is based on the class of arterial and travel speed along the arterial. Arterial LOS analysis produces an arterial speed and travel time for the entire length of the arterial as well as between signalized intersections. For the purpose of this analysis, the following assumptions were made in order to model conditions at Laniakea Beach:

- The beach was analyzed as two signalized intersections. This was based on the observation that at most, two pedestrian groups or turning vehicles would interrupt traffic at a given time. Modeling the beach with a signalized intersection also helped to ensure that Arterial LOS would provide a node at the beach.
- The cycle length of these signals was based on the total number of peak hour crossing pedestrians divided by the average size of the crossing group (observed to be 3 pedestrians per group on average).

The parameters for the traffic signals at the beach nodes calibrated such that the Arterial LOS travel times that agreed with the existing January 2020 travel time runs. In the case of the Saturday travel time runs, SimTraffic was seeded for 1.5 hours to act as a "warm-up" for simulation to represent Saturday conditions and the queue that builds up during the mid-day hours. The SimTraffic Arterial LOS was compared with the Saturday peak conditions.

Year 2030 Conditions

2030 is the project's proposed build year, when the project is expected to be completed. The No-Build condition would preserve the existing alignment and elevation of Kamehameha Highway. The existing parking conditions would be preserved along with the vehicular and pedestrian conflicts described in the existing conditions. The TSM Alternative would install guardrails on the mauka side of Kamehameha Highway, eliminating the parking area.

The "Pedestrian Shift" and "Most Realignment" Build Alternatives are shown in Figure 2 and 3. The "Pedestrian Shift" Alternative would shift the Kamehameha Highway alignment inland approximately 60 feet such that the existing parking area would on the same side of Kamehameha Highway as Laniakea Beach. The "Most Realignment" Alternative would shift the Kamehameha Highway alignment much further inland and utilize an existing cane haul road. The "Most Realignment" Alternative would prohibit all parking along Kamehameha Highway. In addition, two new intersections are proposed to provide access the beach and residential safely.

Year 2030 Conditions Analysis Methodology

2012 HDOT traffic volumes were used as a base for through traffic on Kamehameha Highway. Historical data on Kamehameha Highway northeast of Laniakea Beach showed a 1.14% annual growth rate between 2007 and 2012. Using the 2035 Oahu Metropolitan Planning Organization (OMPO) model as a reference, a 0.88% annual growth rate was obtained between the base year 2007 and 2035. Averaging the two, a 1.0% annual growth rate was obtained. Projected Year 2030 Kamehameha Highway through traffic volumes were obtained by applying the 1.0% growth rate

to the 2012 traffic volumes. The 2013 Turtle Bay Resort Master Plan traffic impact analysis report by The Traffic Management Consultant was used to incorporate the anticipated impact of the Turtle Bay Resort expansion for future scenarios.

The projected 2030 traffic volumes for the No-Build, TSM, "Pedestrian Shift", and "Most Realignment" Alternatives are shown in Figure 9. The projected turning movements at Laniakea Beach were based off of existing conditions.

The four alternatives were analyzed using Synchro Arterial LOS analysis. Arterial LOS analysis produces an arterial speed and travel times. Tables 6 and 7 show the projected travel times for the No-Build, TSM, "Pedestrian Shift" (with individual driveways and with a second option of combined driveways), and "Most Realignment" alternatives along with the existing condition calculated travel time for the Waimea-bound and Haleiwa-bound directions, respectively. Synchro capacity analysis contained within Appendix B.

Table 6 2030 Waimea-bound Projected Arterial Level of Service

| | | Weekday AM | | Weekday PM | | Saturday | |
|---|---|---|---|---|---|---|---|
| | Distance (mi) | Travel Time (min) | Speed (mph) | Travel Time (min) | Speed (mph) | Travel Time (min) | Speed (mph) |
| Existing | 5.61 | 9.5 | 35.4 | 9.7 | 34.6 | 13.0 | 26.0 |
| No-Build | 5.61 | 10.1 | 33.5 | 16.5 | 20.4 | 18.4 | 18.3 |
| TSM | 5.61 | 9.2 | 36.6 | 9.5 | 35.6 | 9.5 | 35.3 |
| Ped Shift | 5.62 | 9.3 | 36.1 | 9.8 | 34.5 | 10.0 | 33.9 |
| Ped Shift 1 D/W | 5.61 | 9.2 | 36.5 | 9.5 | 35.4 | 9.7 | 34.6 |
| Most | 5.65 | 9.3 | 36.5 | 9.6 | 35.4 | 9.8 | 34.6 |

Table 7 2030 Haleiwa-bound Projected Arterial Level of Service

| | | Weekday AM | | Weekday PM | | Saturday | |
|---|---|---|---|---|---|---|---|
| | Distance (mi) | Travel Time (min) | Speed (mph) | Travel Time (min) | Speed (mph) | Travel Time (min) | Speed (mph) |
| Existing | 5.61 | 9.7 | 34.8 | 9.9 | 34.2 | 10.5 | 32.1 |
| No-Build | 5.61 | 10.3 | 32.6 | 14.2 | 23.8 | 13.1 | 25.7 |
| TSM | 5.61 | 9.5 | 35.4 | 9.8 | 34.4 | 9.9 | 34.0 |
| Ped Shift | 5.62 | 9.7 | 34.8 | 10.1 | 33.3 | 10.2 | 32.9 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Ped Shift 1 D/W | 5.61 | 9.5 | 35.3 | 9.9 | 34.1 | 10.0 | 33.8 |
| Most | 5.65 | 9.6 | 35.3 | 9.9 | 34.1 | 10.0 | 33.8 |

The approximately 10-minute travel time represents near-free flow conditions with few interruptions. As shown in Table 6 and 7, travel time is projected to be roughly the same as existing during the AM peak hour. During the weekday PM and Saturday periods, the No-Build condition is projected to operate worse than all other alternatives, which are projected to operate similarly. Generally speaking, the TSM, "Pedestrian Shift", and "Most Realignment" Alternatives are projected to have almost identical travel times with less than one (1) minute separating the alternatives.

Year 2050 Conditions

2050 is the project's proposed horizon year. Projected Year 2050 Kamehameha Highway through traffic volumes were obtained by applying the 1.0% growth rate to the 2014 traffic volumes combined with projected traffic generated by Turtle Bay. Between 2030 and 2050, no new development is projected that would impact the study area intersections. The projected 2050 traffic volumes for the No-Build, TSM, "Pedestrian Shift", and "Most Realignment" Alternatives are shown in Figure 10. The projected turning movements at Laniakea Beach were based off of existing conditions.

Year 2030 Conditions Analysis Methodology

The four alternatives were analyzed using Synchro Arterial LOS analysis. Arterial LOS analysis produces an arterial speed and travel times. Table 7 shows the projected travel times for the No-Build, TSM, "Pedestrian Shift" (with no driveway and with 1 driveway), and "Most Realignment" Alternatives along with the existing condition calculated travel time.

As shown in Table 8 and 9, travel time is projected to be roughly the same as existing during the AM peak hour. The TSM alternative has the fastest travel time due to completely eliminating beach-related trips as well as any vehicular turning movements or pedestrian crossings at the beach; however, it's still less than a minute faster than the Build Alternatives. The No-Build condition is projected to operate worse than all other alternatives during the Weekday PM and Saturday time periods, especially in comparison to the 2030 analysis year. The TSM, "Pedestrian Shift", and "Most Realignment" Alternatives all are projected to operate within one (1) minute of each other.

Table 8 2050 Waimea-bound Projected Arterial Level of Service

| Waimea-bound | Distance (mi) | Weekday AM | | Weekday PM | | Saturday | |
|---|---|---|---|---|---|---|---|
| | | Travel Time (min) | Speed (mph) | Travel Time (min) | Speed (mph) | Travel Time (min) | Speed (mph) |
| Existing | 5.61 | 9.5 | 35.4 | 9.7 | 34.6 | 13.0 | 26.0 |
| No-Build | 5.61 | 10.2 | 32.8 | 20.7 | 16.2 | 22.7 | 14.8 |
| TSM | 5.61 | 9.2 | 36.5 | 9.7 | 34.6 | 9.9 | 34.1 |
| Ped Shift | 5.62 | 9.4 | 35.9 | 10.2 | 33.1 | 10.8 | 31.1 |
| Ped Shift 1 D/W | 5.61 | 9.3 | 36.4 | 10.0 | 33.7 | 11.9 | 28.2 |
| Most | 5.65 | 9.3 | 36.4 | 10.0 | 33.8 | 12.0 | 28.2 |

Table 9 2050 Haleiwa-bound Projected Arterial Level of Service

| Haleiwa-bound | Distance (mi) | Weekday AM | | Weekday PM | | Saturday | |
|---|---|---|---|---|---|---|---|
| | | Travel Time (min) | Speed (mph) | Travel Time (min) | Speed (mph) | Travel Time (min) | Speed (mph) |
| Existing | 5.61 | 9.7 | 34.8 | 9.9 | 34.2 | 10.5 | 32.1 |
| No-Build | 5.61 | 10.8 | 31.2 | 18.4 | 18.3 | 16.9 | 19.9 |
| TSM | 5.61 | 9.6 | 34.9 | 10.5 | 31.9 | 10.7 | 31.4 |
| Ped Shift | 5.62 | 9.9 | 34.0 | 11.1 | 30.4 | 11.3 | 30.0 |
| Ped Shift 1 D/W | 5.61 | 9.7 | 34.7 | 10.8 | 31.3 | 10.9 | 30.9 |
| Most | 5.65 | 9.8 | 34.7 | 10.8 | 31.3 | 11.0 | 30.9 |

Summary and Recommendations

The No-Build alternative is not recommended because existing traffic congestion issues are expected to persist, exacerbated by regional growth. Delays exceeding 30 minutes are expected. While the TSM Alternative provides the smoothest trip through the corridor with the fewest conflicts, it also entails removing most beach access as a tradeoff. Therefore, the Build Alternatives are preferable because they are projected to maintain/reduce travel times along the corridor while maintaining beach access.

The TSM Alternative has been proven effective as a short-term solution, improving Kamehameha Highway traffic flow through the area and can be implemented during construction. Realigning

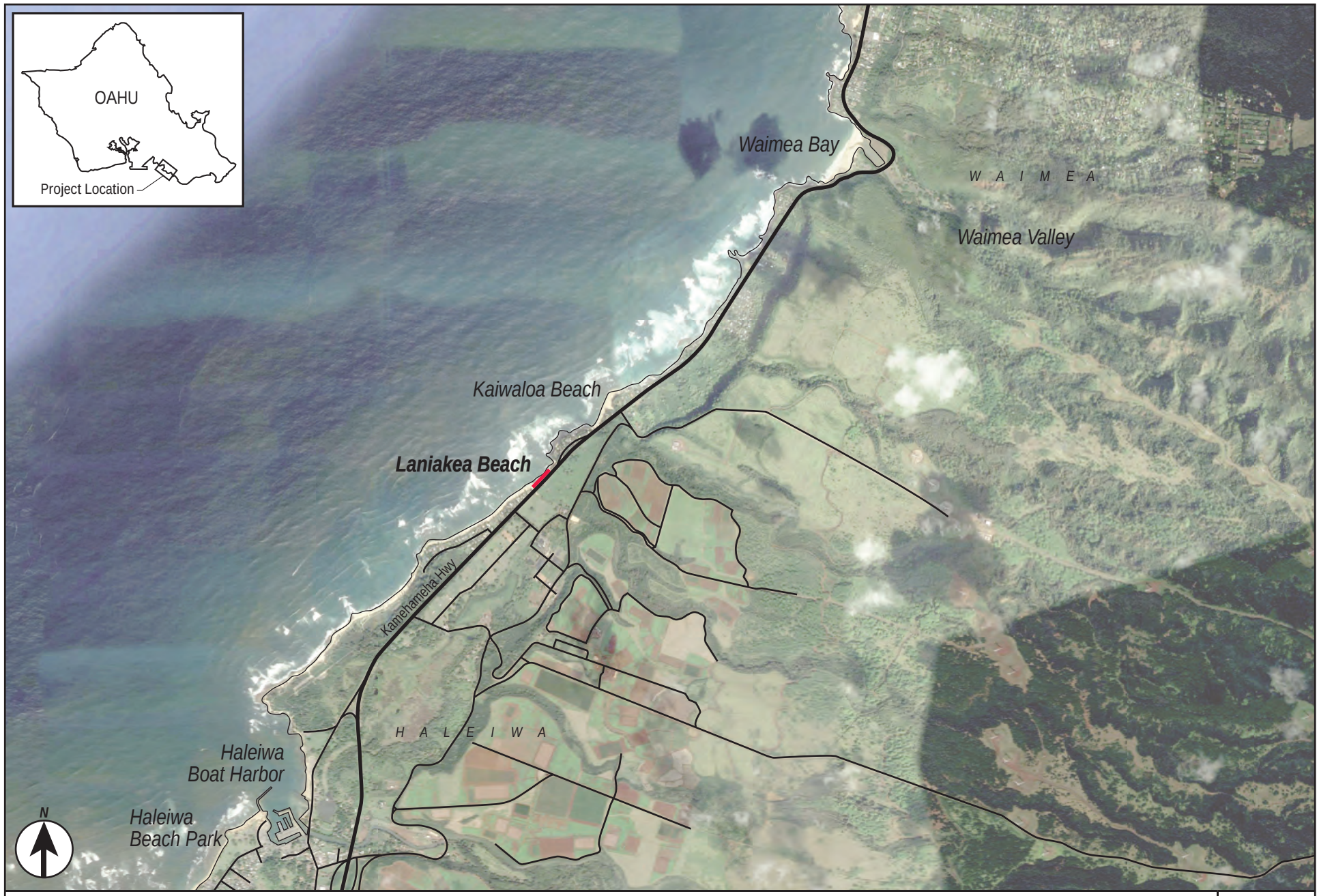
Kamehameha Highway is a logical long term solution which will allow for the restoration of informal parking at Laniakea Beach while also allowing beach patrons to access the beach safely. From a traffic operations perspective, Kamehameha Highway through traffic will be able to pass through the area with fewer vehicular and pedestrian conflicts, improving mobility along the corridor.

The "Pedestrian Shift" Alternative improves safety by vastly reducing the need for pedestrians to cross Kamehameha Highway at Laniakea Beach. This alternative would prohibit all on-street parking and realign Kamehameha Highway mauka of the parking area, essentially eliminating pedestrian conflicts. It is projected to provide greater regional mobility while improving safety. The "Pedestrian Shift" Alternative will provide a median lane to allow vehicles to queue while waiting for gaps in Haleiwa-bound traffic and to act as a refuge lane for exiting traffic.

The "Most Realignment" Alternative also improves safety by shifting the Kamehameha Highway alignment further inland and removing on-street parking. A two-lane access road would provide access to the beach area. This alternative would prohibit all on-street parking, essentially eliminating pedestrian and vehicular conflicts. It is projected to provide greater regional mobility while improving safety.

Since travel times along both proposed Kamehameha Highway alignments are virtually identical, the recommended alignment comes down to safety. The "Most Realignment" Alternative completely removes pedestrians from Kamehameha Highway while also concentrating beach-related traffic at a stop-controlled tee-intersection. The choice between "Pedestrian Shift" Alternative and "Most Realignment" Alternative then becomes a decision to include weighing overall cost and ancillary benefits such as sea level rise and erosion control.

FIGURES




Vicinity Map

Figure
1

Pedestrian Shift Alternative

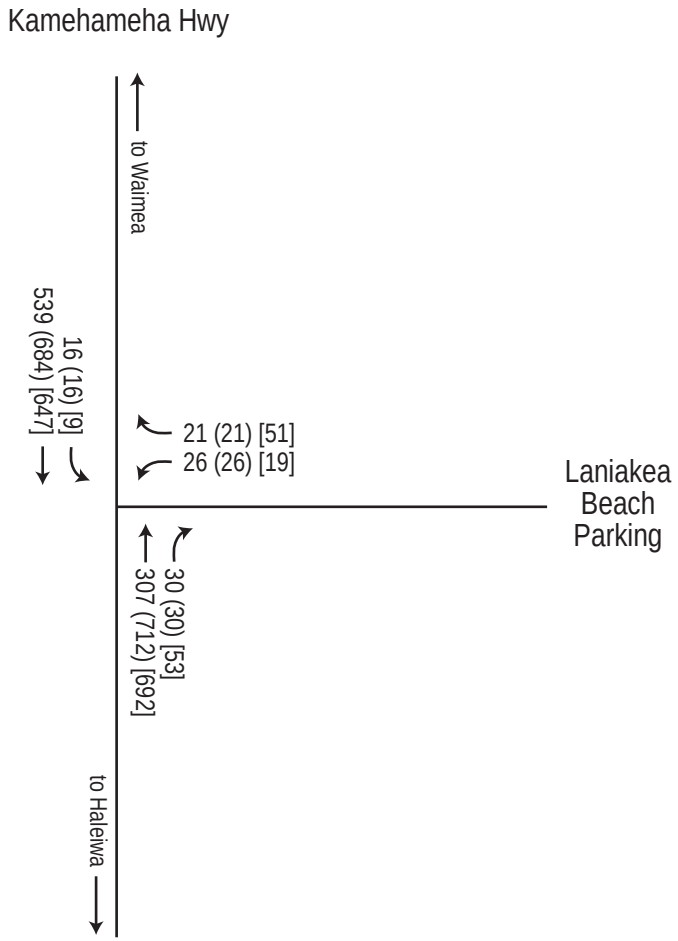
Figure
2

Most Alternative

Figure
3

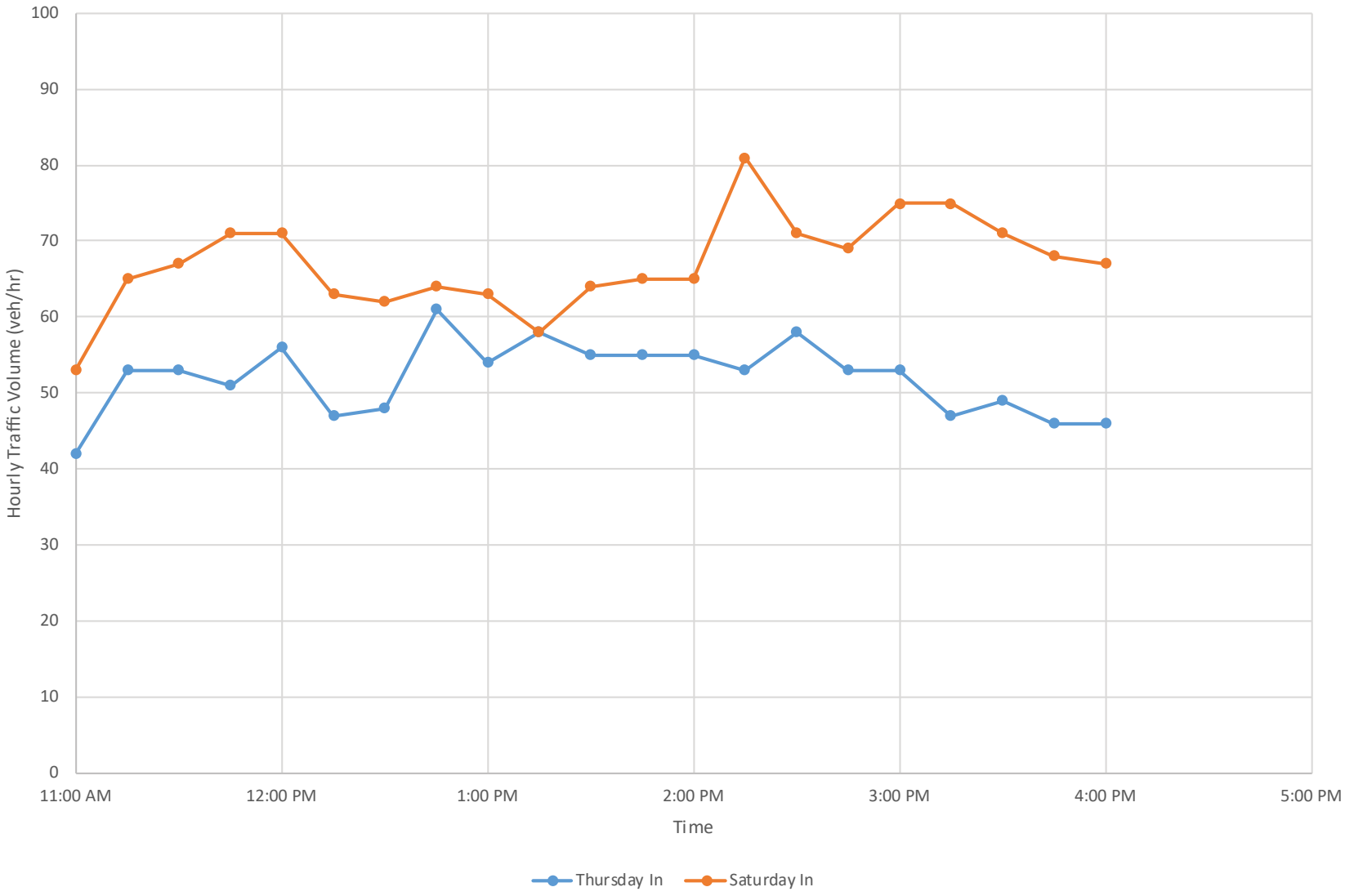
Peak Hour Traffic Turning Movements

Weekday AM (Weekday PM) [Saturday]



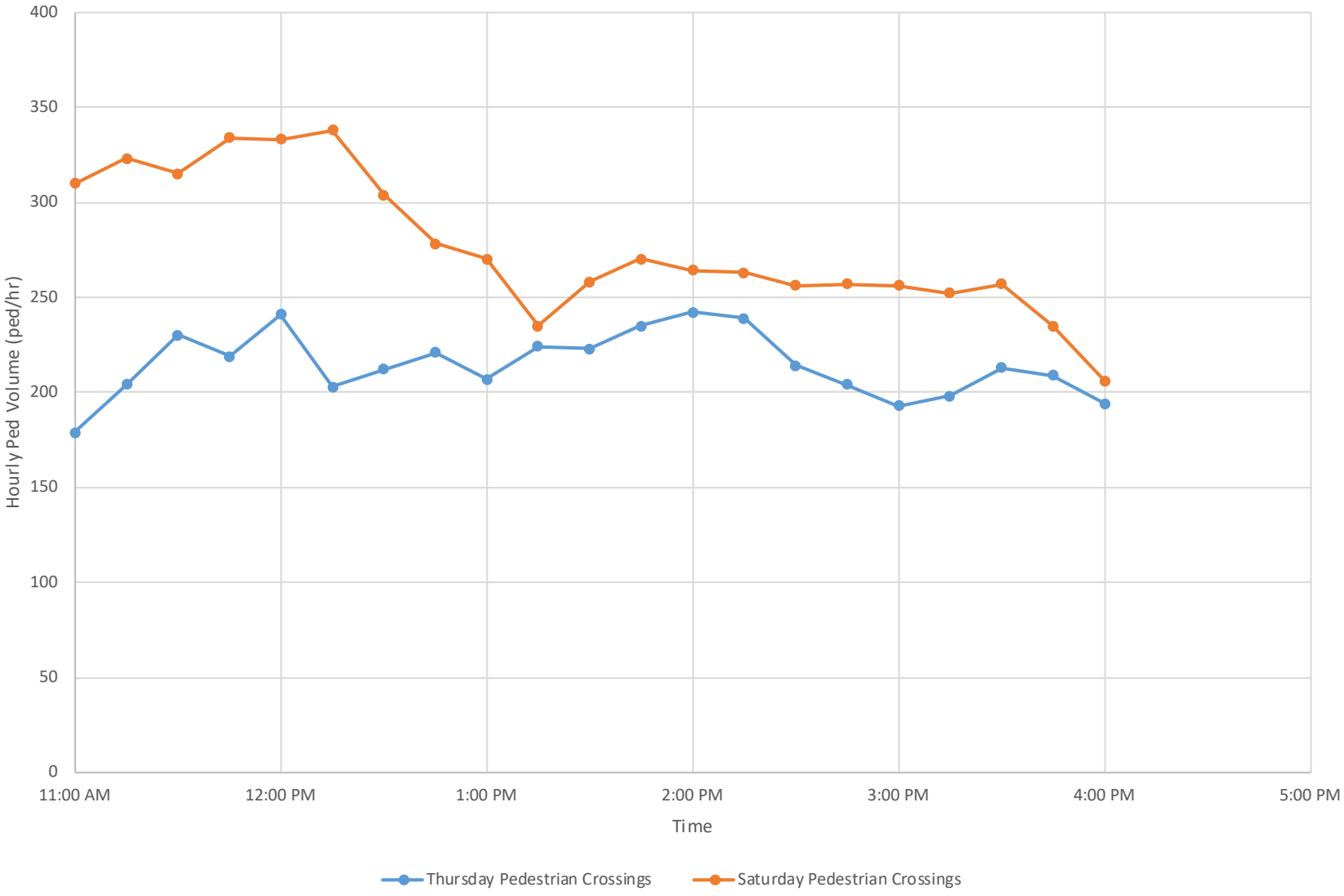

Existing 2020 Traffic Volumes

Figure
4



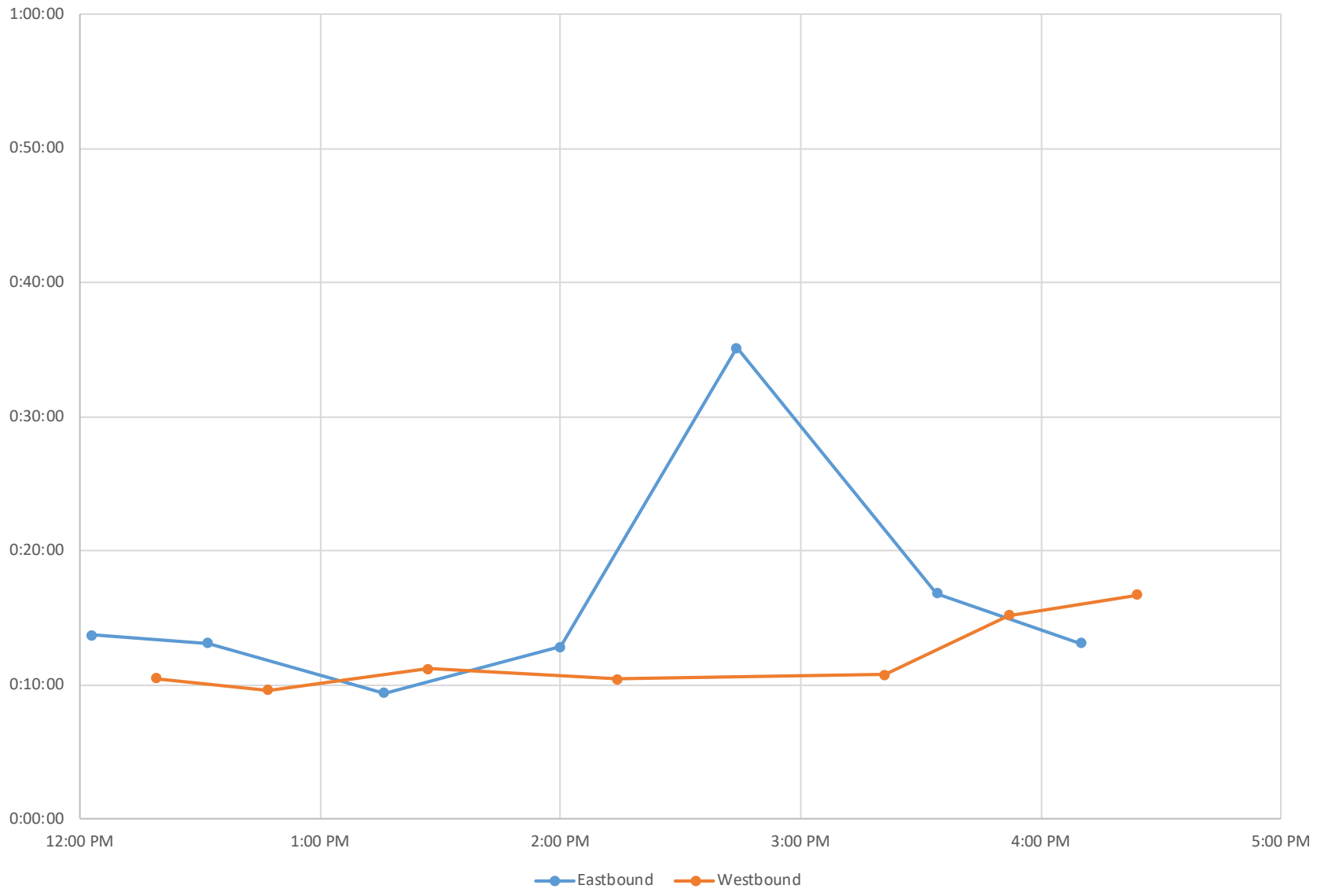

Existing Parking at Laniakea Beach

Figure
5



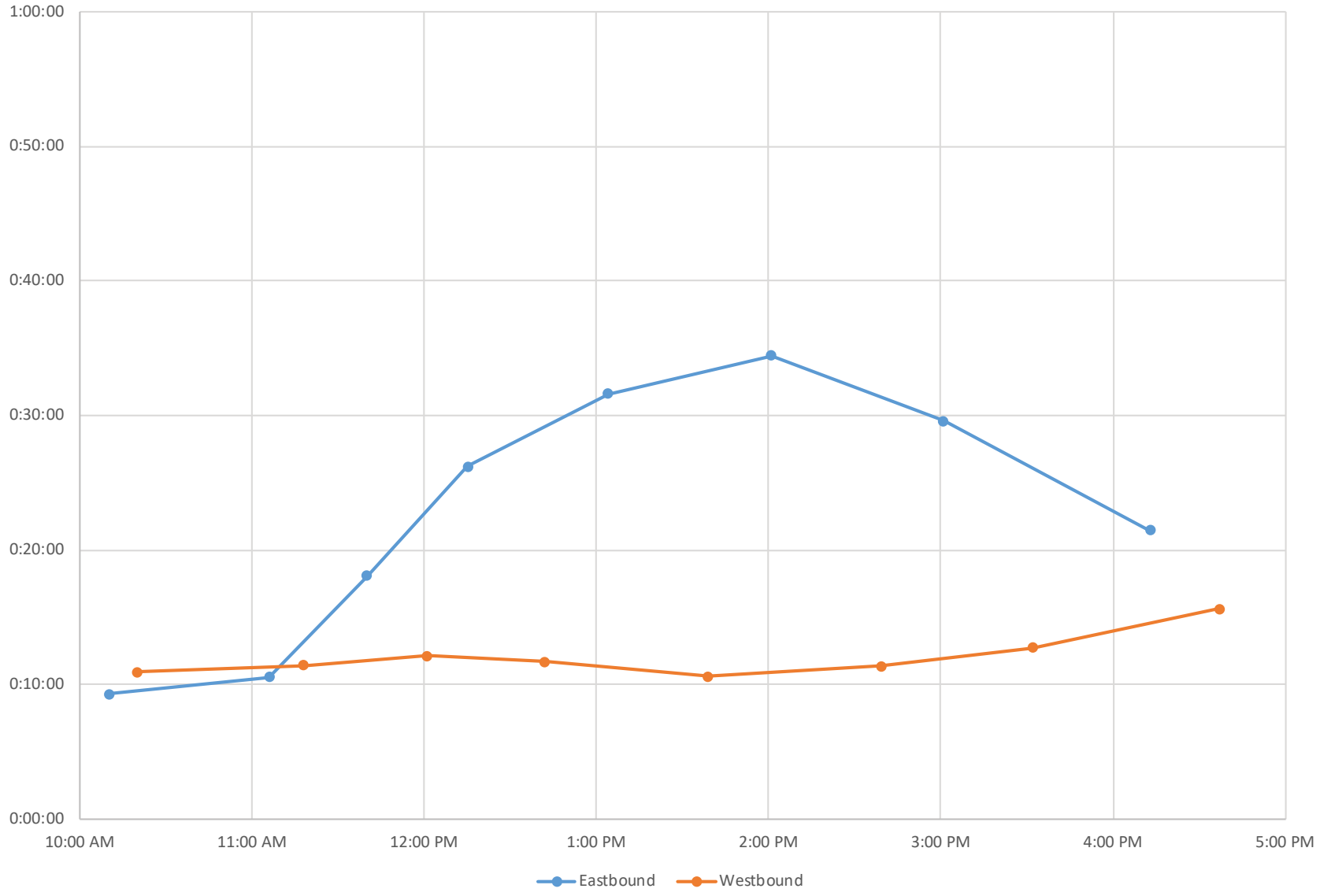

Existing Pedestrian Crossings at Laniakea Beach

Figure
6



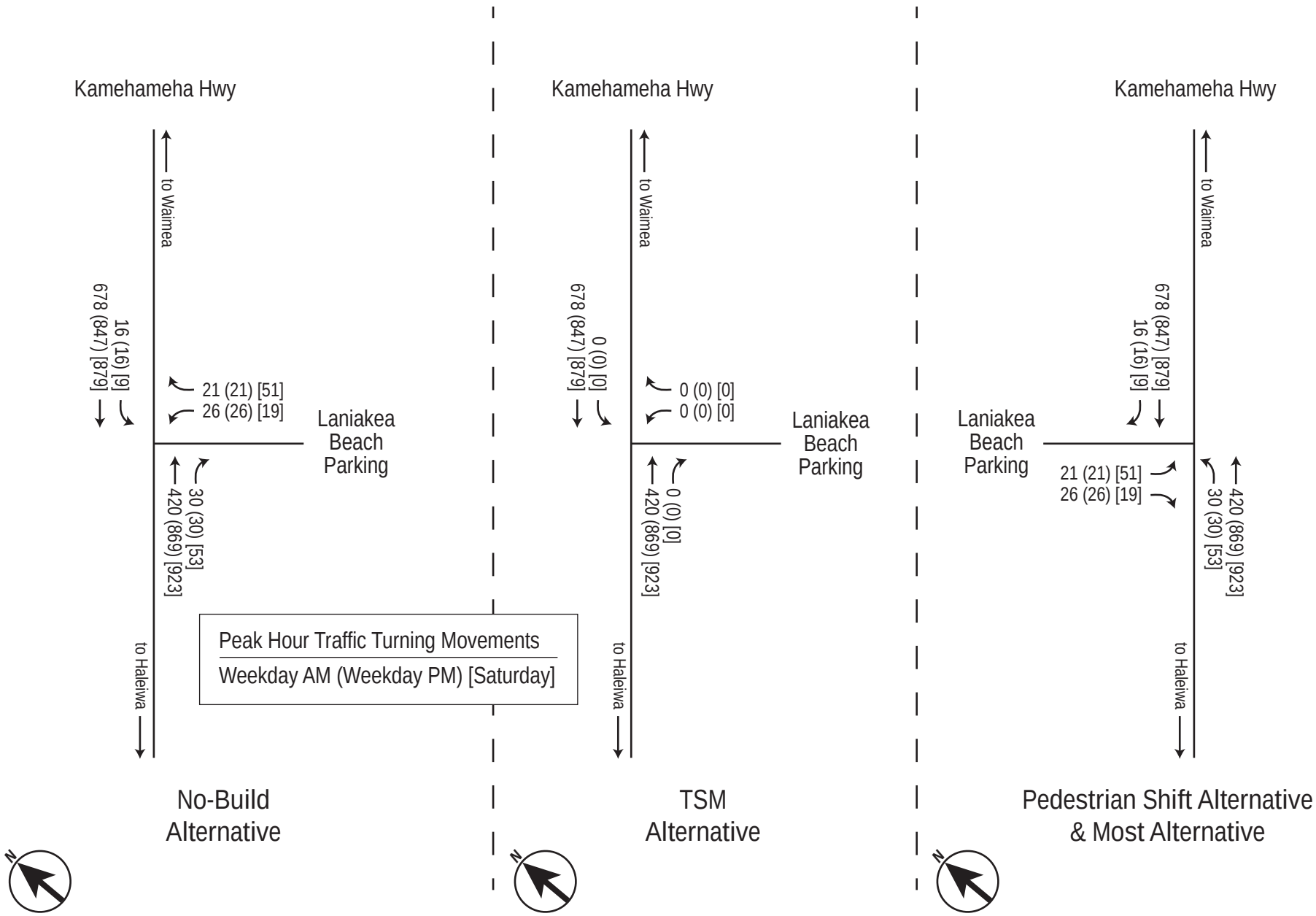

Existing Weekday PM Travel Times

Figure
7



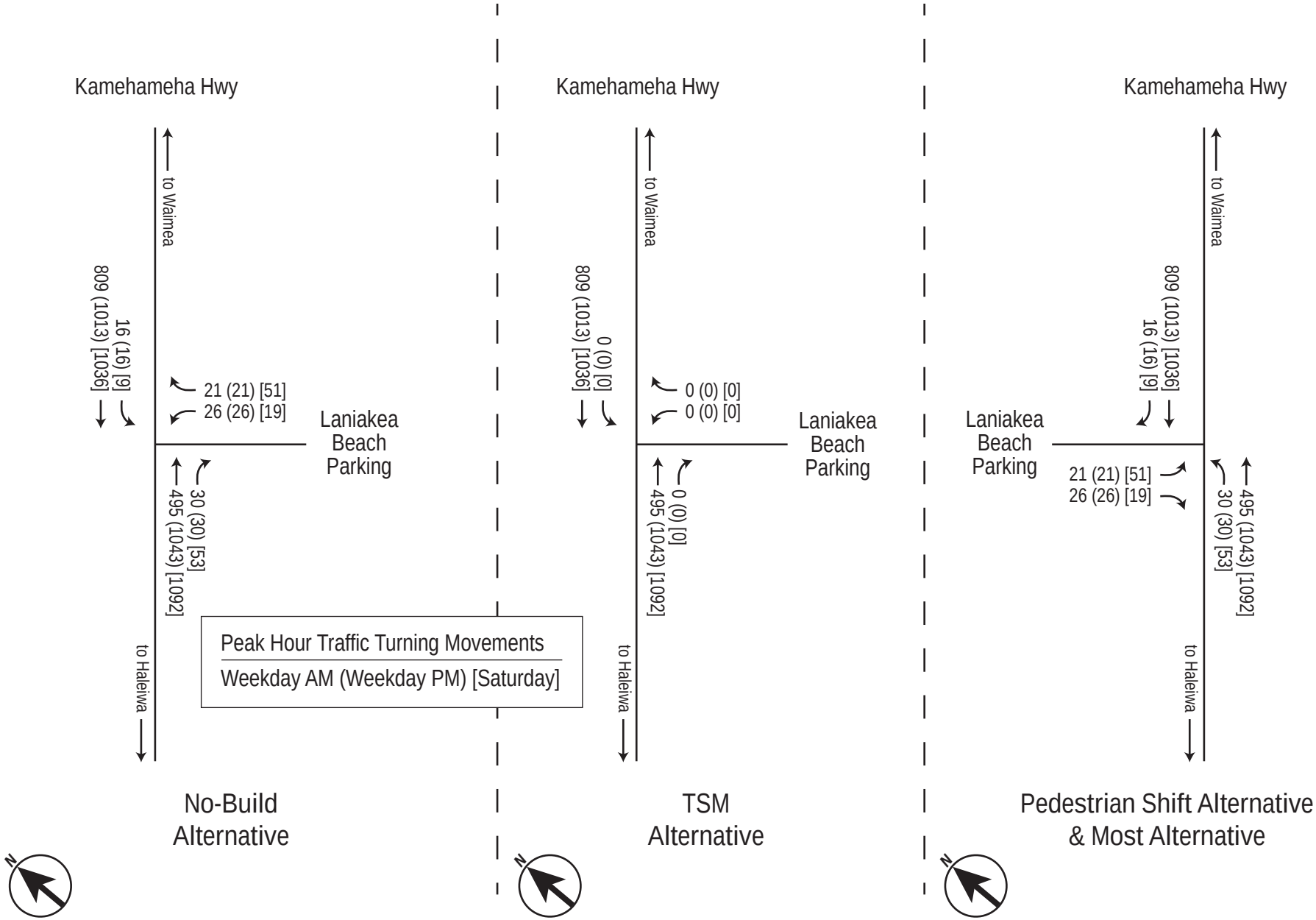

Existing Saturday PM Travel Times

Figure
8




Projected Future 2030 Traffic Volumes

Figure 9



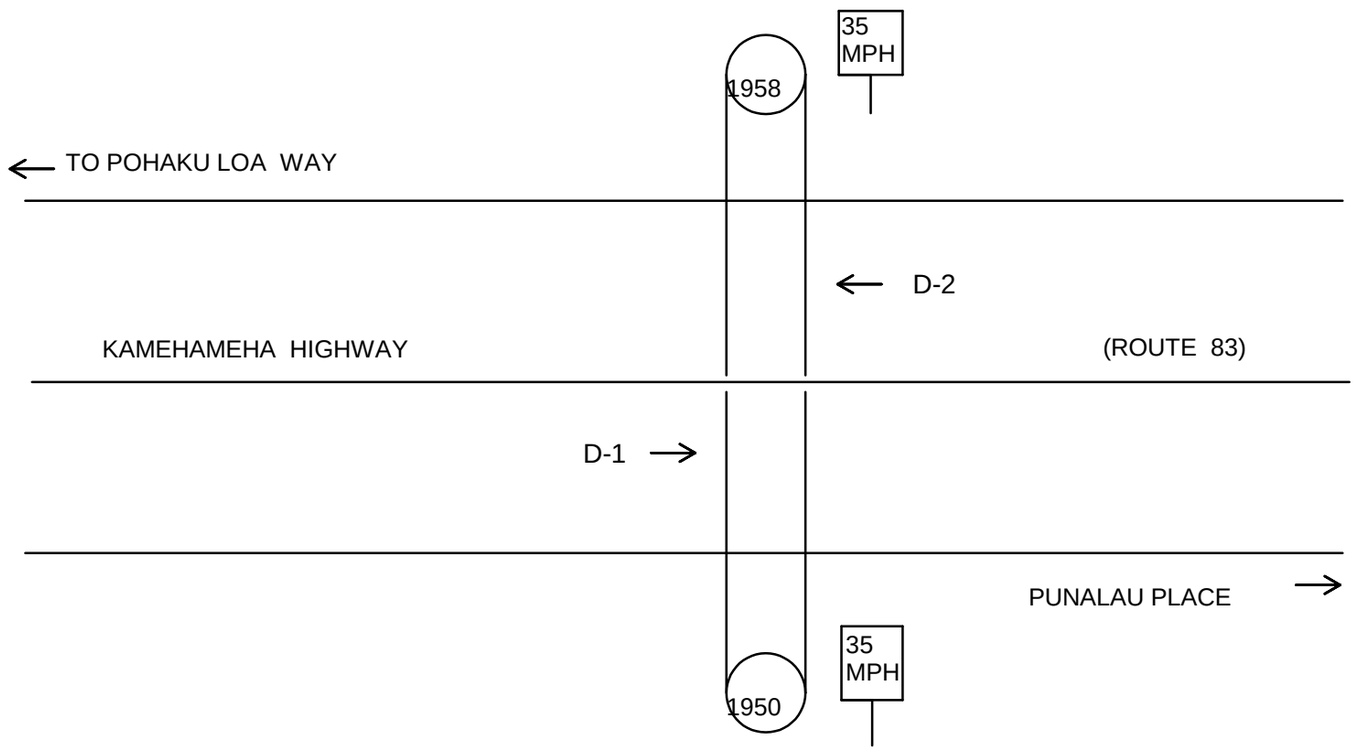

Projected Future 2050 Traffic Volumes

Figure 10

# APPENDIX A TRAFFIC DATA

| |
|---|
| N |
| ISLAND: OAHU |
| AREA: HALEIWA |

CHUN'S REEF




| | |
|---|---|
| Station No: | B72 0083 00358 |

| | | | |
|---|---|---|---|
| Station Location: | | | |
| Kamehameha Highway between Pohaku Loa Way ( N Jct.) & Punalau Pl. | | | |
| Station Mileage: | 3.95 | GPS Coord (Latitude): | 21.623966 N |
| | | GPS Coord (Longitude): | 158.078257 W |
| Begin Survey (Date/Time): | 9-14-15 0000 | End Survey (Date/Time): | 9-17-15 0000 |
| Survey Method: LOOP **HOSE** OTHER | | Survey Type: VOL **CLASS** SPEED OTHER | |
| Survey Crew: | FIELD CREW | Module No.: | |

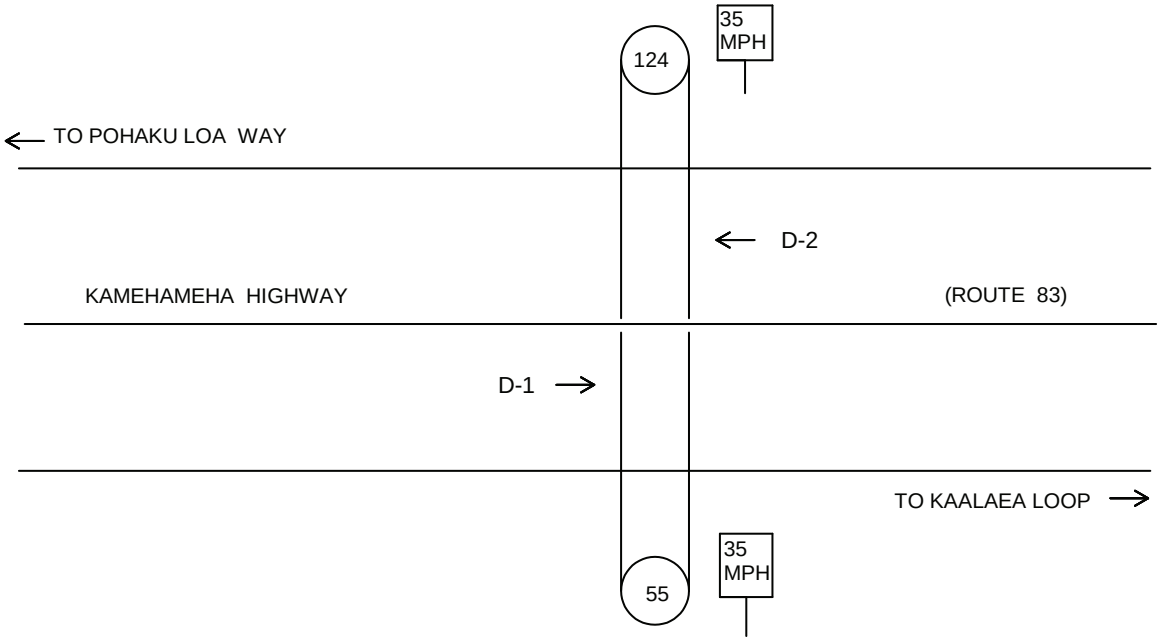
| | | | | | | |
|---|---|---|---|---|---|---|
| HPMS DATA | | | | | | |
| Segment Description: | | | | | | |
| JP LEONG HIGHWAY: KAMEHAMEHA HIGHWAY TO PUPUKEA ROAD. | | | | | | |
| Segment Begin LRS | 1.86 | Segment End LRS | 6.33 | Length | 4.47 | |

| Facility Name | Juris | Func Class | Area Type | Route No. | Route Mile | D-1 = Direction to End of Route<br>D-2 = Direction to Beginning of Route | |
|---|---|---|---|---|---|---|---|
| KAMEHAMEHA HIGHWAY | S | 2 | 1 | 83 | 3.95 | D-1 | TO KALANIANAOLE HWY AND PALI HIGHWAY |
| | | | | | | D-2 | TO KAM HWY/KAUKONAHUA RD & J. P. LEONG HWY JCT. |

| | | | | | |
|---|---|---|---|---|---|
| Sketch By: | RG | Date: | 1/10/2012 | SLD: | 2009 |

| |
|---|
| ISLAND: OAHU |
| AREA: HALEIWA |

CHUN'S REEF




| | |
|---|---|
| Station No: | B72 0083 00186 |

| | | | |
|---|---|---|---|
| Station Location: | | | |
| Kamehameha Highway between Chun's Reef and Kaalaea Loop at the 35 MPH sign on both sides of the roadway | | | |
| Station Mileage: | 3.95 | GPS Coord (Latitude): | 21.62213 N |
| | | GPS Coord (Longitude): | 158.08102 W |
| Begin Survey (Date/Time): | 3-20-12 0000 | End Survey (Date/Time): | 3-22-12 0000 |
| Survey Method: LOOP **HOSE** OTHER | | Survey Type: VOL **CLASS** SPEED OTHER | |
| Survey Crew: | CA, CO, LT, RG | Module No.: | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| HPMS DATA | | | | | | | |
| Segment Description: | | | | | | | |
| JP LEONG HIGHWAY: KAMEHAMEHA HIGHWAY TO PUPUKEA ROAD. | | | | | | | |
| Segment Begin LRS | 1.86 | Segment End LRS | | 6.33 | | Length | 4.47 |
| Facility Name | Juris | Func Class | Area Type | Route No. | Route Mile | D-1 = Direction to End of Route<br>D-2 = Direction to Beginning of Route | |
| KAMEHAMEHA HIGHWAY | S | 2 | 1 | 83 | 3.95 | D-1 | TO KALANIANAOLE HWY AND PALI HIGHWAY |
| | | | | | | D-2 | TO KAM HWY/KAUKONAHUA RD & J. P. LEONG HWY JCT. |

| | | | | | |
|---|---|---|---|---|---|
| Sketch By: | RG | Date: | 1/10/2012 | SLD: | 2009 |

**Run Date:** 2013/03/05

# Hawaii Department of Transportation
## Highways Division — Highways Planning Survey Section
## 2012 Program Count - Summary

**Site ID:** B72008300186 **Town:** Oahu **DIR 1:** +MP **DIR 2:** -MP **Final AADT:** 14800
**Functional Class:** RURAL:PRINCIPAL ARTERIAL - OTHER **Count Type:** CLASS **Counter Type:** Tube **Route No:** 83
**Location:** KAMEHAMEHA Hwy - JOSEPH P. LEONG Hwy

| TIME-AM | DIR 1 | DIR 2 | TOTAL | TIME-AM | DIR 1 | DIR 2 | TOTAL | TIME-PM | DIR 1 | DIR 2 | TOTAL | TIME-PM | DIR 1 | DIR 2 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **DATE : 03/20/2012** | | | | | | | | | | | | | | | |
| 12:00-12:15 | 19 | 8 | 27 | 06:00-06:15 | 40 | 80 | 120 | 12:00-12:15 | 177 | 103 | 280 | 06:00-06:15 | 111 | 108 | 219 |
| 12:15-12:30 | 8 | 6 | 14 | 06:15-06:30 | 36 | 84 | 120 | 12:15-12:30 | 165 | 117 | 282 | 06:15-06:30 | 122 | 108 | 230 |
| 12:30-12:45 | 7 | 5 | 12 | 06:30-06:45 | 60 | 84 | 144 | 12:30-12:45 | 138 | 102 | 240 | 06:30-06:45 | 107 | 84 | 191 |
| 12:45-01:00 | 8 | 6 | 14 | 06:45-07:00 | 59 | 106 | 165 | 12:45-01:00 | 145 | 143 | 288 | 06:45-07:00 | 102 | 169 | 271 |
| 01:00-01:15 | 5 | 0 | 5 | 07:00-07:15 | 78 | 123 | 201 | 01:00-01:15 | 144 | 110 | 254 | 07:00-07:15 | 96 | 116 | 212 |
| 01:15-01:30 | 8 | 2 | 10 | 07:15-07:30 | 74 | 130 | 204 | 01:15-01:30 | 141 | 125 | 266 | 07:15-07:30 | 92 | 88 | 180 |
| 01:30-01:45 | 5 | 6 | 11 | 07:30-07:45 | 84 | 141 | 225 | 01:30-01:45 | 172 | 128 | 300 | 07:30-07:45 | 87 | 55 | 142 |
| 01:45-02:00 | 7 | 2 | 9 | 07:45-08:00 | 61 | 108 | 169 | 01:45-02:00 | 148 | 168 | 316 | 07:45-08:00 | 66 | 58 | 124 |
| 02:00-02:15 | 7 | 3 | 10 | 08:00-08:15 | 53 | 118 | 171 | 02:00-02:15 | 133 | 150 | 283 | 08:00-08:15 | 60 | 34 | 94 |
| 02:15-02:30 | 5 | 2 | 7 | 08:15-08:30 | 72 | 120 | 192 | 02:15-02:30 | 159 | 137 | 296 | 08:15-08:30 | 74 | 28 | 102 |
| 02:30-02:45 | 2 | 1 | 3 | 08:30-08:45 | 85 | 112 | 197 | 02:30-02:45 | 163 | 181 | 344 | 08:30-08:45 | 69 | 34 | 103 |
| 02:45-03:00 | 4 | 5 | 9 | 08:45-09:00 | 64 | 107 | 171 | 02:45-03:00 | 153 | 152 | 305 | 08:45-09:00 | 60 | 33 | 93 |
| 03:00-03:15 | 4 | 3 | 7 | 09:00-09:15 | 95 | 109 | 204 | 03:00-03:15 | 158 | 144 | 302 | 09:00-09:15 | 60 | 27 | 87 |
| 03:15-03:30 | 3 | 4 | 7 | 09:15-09:30 | 93 | 106 | 199 | 03:15-03:30 | 170 | 177 | 347 | 09:15-09:30 | 62 | 25 | 87 |
| 03:30-03:45 | 2 | 6 | 8 | 09:30-09:45 | 97 | 102 | 199 | 03:30-03:45 | 156 | 192 | 348 | 09:30-09:45 | 46 | 34 | 80 |
| 03:45-04:00 | 7 | 6 | 13 | 09:45-10:00 | 108 | 117 | 225 | 03:45-04:00 | 151 | 173 | 324 | 09:45-10:00 | 49 | 37 | 86 |
| 04:00-04:15 | 9 | 8 | 17 | 10:00-10:15 | 100 | 114 | 214 | 04:00-04:15 | 155 | 159 | 314 | 10:00-10:15 | 48 | 30 | 78 |
| 04:15-04:30 | 5 | 11 | 16 | 10:15-10:30 | 120 | 123 | 243 | 04:15-04:30 | 145 | 179 | 324 | 10:15-10:30 | 36 | 15 | 51 |
| 04:30-04:45 | 12 | 17 | 29 | 10:30-10:45 | 144 | 104 | 248 | 04:30-04:45 | 158 | 153 | 311 | 10:30-10:45 | 31 | 12 | 43 |
| 04:45-05:00 | 20 | 35 | 55 | 10:45-11:00 | 135 | 108 | 243 | 04:45-05:00 | 153 | 122 | 275 | 10:45-11:00 | 28 | 8 | 36 |
| 05:00-05:15 | 15 | 46 | 61 | 11:00-11:15 | 134 | 112 | 246 | 05:00-05:15 | 139 | 136 | 275 | 11:00-11:15 | 29 | 9 | 38 |
| 05:15-05:30 | 15 | 59 | 74 | 11:15-11:30 | 148 | 116 | 264 | 05:15-05:30 | 143 | 128 | 271 | 11:15-11:30 | 19 | 12 | 31 |
| 05:30-05:45 | 30 | 67 | 97 | 11:30-11:45 | 137 | 133 | 270 | 05:30-05:45 | 135 | 122 | 257 | 11:30-11:45 | 17 | 6 | 23 |
| 05:45-06:00 | 26 | 65 | 91 | 11:45-12:00 | 161 | 95 | 256 | 05:45-06:00 | 156 | 108 | 264 | 11:45-12:00 | 17 | 4 | 21 |

| AM COMMUTER PERIOD (05:00-09:00) | DIR 1 | DIR 2 | |
|---|---|---|---|
| TWO DIRECTIONAL PEAK | | | |
| AM - PEAK HR TIME | 07:00 AM to 08:00 AM | | |
| AM - PEAK HR VOLUME | 297 | 502 | 799 |
| AM - K FACTOR (%) | | | 5.26 |
| AM - D (%) | 37.17 | 62.83 | 100.00 |
| DIRECTIONAL PEAK | | | |
| AM - PEAK HR TIME | 07:00 AM to 08:00 AM | 07:00 AM to 08:00 AM | |
| AM - PEAK HR VOLUME | 297 | 502 | |

| PM COMMUTER PERIOD (15:00-19:00) | DIR 1 | DIR 2 | |
|---|---|---|---|
| TWO DIRECTIONAL PEAK | | | |
| PM - PEAK HR TIME | 03:15 PM to 04:15 PM | | |
| PM - PEAK HR VOLUME | 632 | 701 | 1333 |
| PM - K FACTOR (%) | | | 8.78 |
| PM - D (%) | 47.41 | 52.59 | 100.00 |
| DIRECTIONAL PEAK | | | |
| PM - PEAK HR TIME | 03:00 PM to 04:00 PM | 03:30 PM to 04:30 PM | |
| PM - PEAK HR VOLUME | 635 | 703 | |

| AM PERIOD (00:00-12:00) | | | |
|---|---|---|---|
| TWO DIRECTIONAL PEAK | | | |
| AM - PEAK HR TIME | 11:00 AM to 12:00 PM | | |
| AM - PEAK HR VOLUME | 580 | 456 | 1036 |
| AM - K FACTOR (%) | | | 6.82 |
| AM - D (%) | 55.98 | 44.02 | 100.00 |

| PM PERIOD (12:00-24:00) | | | |
|---|---|---|---|
| TWO DIRECTIONAL PEAK | | | |
| PM - PEAK HR TIME | 03:15 PM to 04:15 PM | | |
| PM - PEAK HR VOLUME | 632 | 701 | 1333 |
| PM - K FACTOR (%) | | | 8.78 |
| PM - D (%) | 47.41 | 52.59 | 100.00 |

| NON-COMMUTER PERIOD (09:00-15:00) | | | |
|---|---|---|---|
| TWO DIRECTIONAL PEAK | | | |
| PEAK HR TIME | 01:45 PM to 02:45 PM | | |
| PEAK HR VOLUME | 603 | 636 | 1239 |
| DIRECTIONAL PEAK | | | |
| PEAK HR TIME | 11:45 AM to 12:45 PM | 01:45 PM to 02:45 PM | |
| PEAK HR VOLUME | 641 | 636 | |

| 6-HR, 12-HR, 24-HR PERIODS | DIR 1 | DIR 2 | Total |
|---|---|---|---|
| AM 6-HR PERIOD (06:00-12:00) | 2,238 | 2,652 | 4,890 |
| AM 12-HR PERIOD (00:00-12:00) | 2,471 | 3,025 | 5,496 |
| PM 6-HR PERIOD (12:00-18:00) | 3,657 | 3,409 | 7,066 |
| PM 12-HR PERIOD (12:00-24:00) | 5,145 | 4,543 | 9,688 |
| 24 HOUR PERIOD | 7,616 | 7,568 | 15,184 |
| D (%) | 50.16 | 49.84 | 100.00 |

**Run Date:** 2013/03/05

# Hawaii Department of Transportation

## Highways Division — Highways Planning Survey Section

## 2012 Program Count - Summary

**Site ID:** B72008300186 **Town:** Oahu **DIR 1:** +MP **DIR 2:** -MP **Final AADT:** 14800

**Functional Class:** RURAL:PRINCIPAL ARTERIAL - OTHER **Count Type:** CLASS **Counter Type:** Tube **Route No:** 83

**Location:** KAMEHAMEHA Hwy - JOSEPH P. LEONG Hwy

| TIME-AM | DIR 1 | DIR 2 | TOTAL | TIME-AM | DIR 1 | DIR 2 | TOTAL | TIME-PM | DIR 1 | DIR 2 | TOTAL | TIME-PM | DIR 1 | DIR 2 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **DATE : 03/21/2012** | | | | | | | | | | | | | | | |
| 12:00-12:15 | 11 | 9 | 20 | 06:00-06:15 | 48 | 75 | 123 | 12:00-12:15 | 148 | 129 | 277 | 06:00-06:15 | 139 | 94 | 233 |
| 12:15-12:30 | 12 | 12 | 24 | 06:15-06:30 | 43 | 99 | 142 | 12:15-12:30 | 163 | 154 | 317 | 06:15-06:30 | 121 | 105 | 226 |
| 12:30-12:45 | 5 | 2 | 7 | 06:30-06:45 | 65 | 110 | 175 | 12:30-12:45 | 151 | 139 | 290 | 06:30-06:45 | 113 | 81 | 194 |
| 12:45-01:00 | 16 | 3 | 19 | 06:45-07:00 | 69 | 106 | 175 | 12:45-01:00 | 164 | 130 | 294 | 06:45-07:00 | 121 | 100 | 221 |
| 01:00-01:15 | 4 | 2 | 6 | 07:00-07:15 | 73 | 127 | 200 | 01:00-01:15 | 147 | 152 | 299 | 07:00-07:15 | 103 | 140 | 243 |
| 01:15-01:30 | 4 | 6 | 10 | 07:15-07:30 | 88 | 111 | 199 | 01:15-01:30 | 148 | 140 | 288 | 07:15-07:30 | 88 | 85 | 173 |
| 01:30-01:45 | 3 | 4 | 7 | 07:30-07:45 | 110 | 143 | 253 | 01:30-01:45 | 129 | 147 | 276 | 07:30-07:45 | 80 | 76 | 156 |
| 01:45-02:00 | 6 | 5 | 11 | 07:45-08:00 | 74 | 170 | 244 | 01:45-02:00 | 157 | 129 | 286 | 07:45-08:00 | 85 | 47 | 132 |
| 02:00-02:15 | 6 | 2 | 8 | 08:00-08:15 | 70 | 127 | 197 | 02:00-02:15 | 157 | 155 | 312 | 08:00-08:15 | 76 | 45 | 121 |
| 02:15-02:30 | 6 | 5 | 11 | 08:15-08:30 | 83 | 141 | 224 | 02:15-02:30 | 140 | 157 | 297 | 08:15-08:30 | 67 | 33 | 100 |
| 02:30-02:45 | 4 | 3 | 7 | 08:30-08:45 | 105 | 111 | 216 | 02:30-02:45 | 167 | 169 | 336 | 08:30-08:45 | 76 | 29 | 105 |
| 02:45-03:00 | 0 | 8 | 8 | 08:45-09:00 | 106 | 137 | 243 | 02:45-03:00 | 164 | 154 | 318 | 08:45-09:00 | 77 | 22 | 99 |
| 03:00-03:15 | 3 | 1 | 4 | 09:00-09:15 | 88 | 133 | 221 | 03:00-03:15 | 177 | 157 | 334 | 09:00-09:15 | 63 | 40 | 103 |
| 03:15-03:30 | 4 | 2 | 6 | 09:15-09:30 | 90 | 126 | 216 | 03:15-03:30 | 169 | 167 | 336 | 09:15-09:30 | 48 | 23 | 71 |
| 03:30-03:45 | 5 | 6 | 11 | 09:30-09:45 | 109 | 115 | 224 | 03:30-03:45 | 182 | 154 | 336 | 09:30-09:45 | 38 | 55 | 93 |
| 03:45-04:00 | 7 | 6 | 13 | 09:45-10:00 | 102 | 153 | 255 | 03:45-04:00 | 166 | 164 | 330 | 09:45-10:00 | 41 | 42 | 83 |
| 04:00-04:15 | 7 | 14 | 21 | 10:00-10:15 | 123 | 122 | 245 | 04:00-04:15 | 172 | 164 | 336 | 10:00-10:15 | 40 | 22 | 62 |
| 04:15-04:30 | 5 | 13 | 18 | 10:15-10:30 | 108 | 120 | 228 | 04:15-04:30 | 164 | 148 | 312 | 10:15-10:30 | 36 | 18 | 54 |
| 04:30-04:45 | 15 | 21 | 36 | 10:30-10:45 | 104 | 97 | 201 | 04:30-04:45 | 177 | 126 | 303 | 10:30-10:45 | 38 | 11 | 49 |
| 04:45-05:00 | 14 | 31 | 45 | 10:45-11:00 | 126 | 139 | 265 | 04:45-05:00 | 149 | 157 | 306 | 10:45-11:00 | 23 | 18 | 41 |
| 05:00-05:15 | 16 | 32 | 48 | 11:00-11:15 | 118 | 108 | 226 | 05:00-05:15 | 140 | 144 | 284 | 11:00-11:15 | 25 | 19 | 44 |
| 05:15-05:30 | 23 | 55 | 78 | 11:15-11:30 | 136 | 124 | 260 | 05:15-05:30 | 151 | 139 | 290 | 11:15-11:30 | 20 | 13 | 33 |
| 05:30-05:45 | 48 | 59 | 107 | 11:30-11:45 | 133 | 139 | 272 | 05:30-05:45 | 151 | 133 | 284 | 11:30-11:45 | 15 | 9 | 24 |
| 05:45-06:00 | 56 | 65 | 121 | 11:45-12:00 | 145 | 122 | 267 | 05:45-06:00 | 145 | 129 | 274 | 11:45-12:00 | 13 | 0 | 13 |

| AM COMMUTER PERIOD (05:00-09:00) | DIR 1 | DIR 2 | |
|---|---|---|---|
| TWO DIRECTIONAL PEAK | | | |
| AM - PEAK HR TIME | 07:30 AM to 08:30 AM | | |
| AM - PEAK HR VOLUME | 337 | 581 | 918 |
| AM - K FACTOR (%) | | | 5.77 |
| AM - D (%) | 36.71 | 63.29 | 100.00 |
| DIRECTIONAL PEAK | | | |
| AM - PEAK HR TIME | 08:00 AM to 09:00 AM | 07:30 AM to 08:30 AM | |
| AM - PEAK HR VOLUME | 364 | 581 | |

| PM COMMUTER PERIOD (15:00-19:00) | DIR 1 | DIR 2 | |
|---|---|---|---|
| TWO DIRECTIONAL PEAK | | | |
| PM - PEAK HR TIME | 03:15 PM to 04:15 PM | | |
| PM - PEAK HR VOLUME | 689 | 649 | 1338 |
| PM - K FACTOR (%) | | | 8.41 |
| PM - D (%) | 51.49 | 48.51 | 100.00 |
| DIRECTIONAL PEAK | | | |
| PM - PEAK HR TIME | 03:00 PM to 04:00 PM | 03:15 PM to 04:15 PM | |
| PM - PEAK HR VOLUME | 694 | 649 | |

| AM PERIOD (00:00-12:00) | | | |
|---|---|---|---|
| TWO DIRECTIONAL PEAK | | | |
| AM - PEAK HR TIME | 11:00 AM to 12:00 PM | | |
| AM - PEAK HR VOLUME | 532 | 493 | 1025 |
| AM - K FACTOR (%) | | | 6.44 |
| AM - D (%) | 51.90 | 48.10 | 100.00 |

| PM PERIOD (12:00-24:00) | | | |
|---|---|---|---|
| TWO DIRECTIONAL PEAK | | | |
| PM - PEAK HR TIME | 03:15 PM to 04:15 PM | | |
| PM - PEAK HR VOLUME | 689 | 649 | 1338 |
| PM - K FACTOR (%) | | | 8.41 |
| PM - D (%) | 51.49 | 48.51 | 100.00 |

| NON-COMMUTER PERIOD (09:00-15:00) | | | |
|---|---|---|---|
| TWO DIRECTIONAL PEAK | | | |
| PEAK HR TIME | 02:00 PM to 03:00 PM | | |
| PEAK HR VOLUME | 628 | 635 | 1263 |
| DIRECTIONAL PEAK | | | |
| PEAK HR TIME | 02:00 PM to 03:00 PM | 02:00 PM to 03:00 PM | |
| PEAK HR VOLUME | 628 | 635 | |

| 6-HR, 12-HR, 24-HR PERIODS | DIR 1 | DIR 2 | Total |
|---|---|---|---|
| AM 6-HR PERIOD (06:00-12:00) | 2,316 | 2,955 | 5,271 |
| AM 12-HR PERIOD (00:00-12:00) | 2,596 | 3,321 | 5,917 |
| PM 6-HR PERIOD (12:00-18:00) | 3,778 | 3,537 | 7,315 |
| PM 12-HR PERIOD (12:00-24:00) | 5,324 | 4,664 | 9,988 |
| 24 HOUR PERIOD | 7,920 | 7,985 | 15,905 |
| D (%) | 49.80 | 50.20 | 100.00 |

**Run Date:** 2013/03/05

# Hawaii Department of Transportation
## Highways Division
## Highways Planning Survey Section

## Vehicle Classification Data Summary
## 2012

| | | | | | |
|---|---|---|---|---|---|
| **Site ID:** | **B72008300186** | **Route No:** | **83** | **Date From:** | 2012/03/20 0:00 |
| **Town:** | **Oahu** | **Direction:** | +MP | **Date To:** | 2012/03/21 23:45 |
| **Location:** | **KAMEHAMEHA Hwy - JOSEPH P. LEONG Hwy** | | | | |

**Functional Classification: 2 RURAL:PRINCIPAL ARTERIAL - OTHER**

**REPORT TOTALS - 48 HOURS RECORDED**

| | VOLUME | % | NUMBER OF AXLES |
|---|---|---|---|
| **Cycles** | 208 | 0.67% | 417 |
| **PC** | 29163 | 93.80% | 58326 |
| **2A-4T** | 1084 | 3.49% | 2168 |
| **LIGHT VEHICLE TOTALS** | 30455 | 97.96% | 60910 |
| | **HEAVY VEHICLES** | | |
| **Bus** | 43 | 0.14% | 109 |
| **SINGLE UNIT TRUCK** | | | |
| **2A-6T** | 357 | 1.15% | 714 |
| **3A-SU** | 152 | 0.49% | 456 |
| **4A-SU** | 0 | 0.00% | 0 |
| **SINGLE-TRAILER TRUCKS** | | | |
| **4A-ST** | 38 | 0.12% | 152 |
| **5A-ST** | 39 | 0.13% | 195 |
| **6A-ST** | 0 | 0.00% | 0 |
| **MULTI-TRAILER TRUCKS** | | | |
| **5A-MT** | 0 | 0.00% | 0 |
| **6A-MT** | 0 | 0.00% | 0 |
| **7A-MT** | 5 | 0.02% | 35 |
| **HEAVY VEHICLE TOTALS** | 635 | 2.04% | 1661 |
| **CLASSIFIED VEHICLES TOTALS** | 31090 (A) | 100.00% | 62571 (B) |
| **UNCLASSIFIED VEHICLES TOTALS** | -1 | -0.00% | |

**AXLE CORRECTION FACTOR (A/C) =** 0.994

**ROADTUBE EQUIVALENT(B/2) =** 31285 (C)

| **PEAK HOUR VOLUME : 1336**<br>**2012/03/21 15:00** | **PEAK HOUR TRUCK VOLUME** | **% TOTAL PEAK HOUR VOLUME** | **24 HOUR TRUCK VOLUME** | **AADT** | **% OF AADT** | **HPMS K-FACTOR (PEAK/AADT) (ITEM 66)** |
|---|---|---|---|---|---|---|
| **SINGLE UNIT TRUCKS (TYPE 4-7)** | **17** | **(65A-1) 1.29%** | **273** | **14800** | **(65A-2) 1.84%** | **9.03%** |
| **COMBINATION (TYPE 8-13)** | **2** | **(65B-1) 0.15%** | **40** | | **(65B-2) 0.27%** | **9.03%** |

**Run Date:** 2016/06/07

# Hawaii Department of Transportation

## Highways Division — Highways Planning Survey Section

## 2015 Program Count - Summary

**Site ID:** B72008300358 **Town:** Oahu **DIR 1:** +MP **DIR 2:** -MP **Final AADT:** 16900

**Functional Class:** URBAN:PRINCIPAL ARTERIAL - OTHER **Count Type:** CLASS **Counter Type:** Tube **Route No:** 83

**Location:** Kamehameha Hwy btwn Pohaku Loa Way (N. Jct) _Punalau Place

| TIME-AM | DIR 1 | DIR 2 | TOTAL | TIME-AM | DIR 1 | DIR 2 | TOTAL | TIME-PM | DIR 1 | DIR 2 | TOTAL | TIME-PM | DIR 1 | DIR 2 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **DATE : 09/15/2015** | | | | | | | | | | | | | | | |
| 12:00-12:15 | 8 | 6 | 14 | 06:00-06:15 | 46 | 53 | 99 | 12:00-12:15 | 139 | 100 | 239 | 06:00-06:15 | 104 | 111 | 215 |
| 12:15-12:30 | 8 | 9 | 17 | 06:15-06:30 | 60 | 79 | 139 | 12:15-12:30 | 164 | 121 | 285 | 06:15-06:30 | 119 | 90 | 209 |
| 12:30-12:45 | 13 | 5 | 18 | 06:30-06:45 | 65 | 107 | 172 | 12:30-12:45 | 148 | 132 | 280 | 06:30-06:45 | 106 | 67 | 173 |
| 12:45-01:00 | 8 | 4 | 12 | 06:45-07:00 | 53 | 82 | 135 | 12:45-01:00 | 139 | 125 | 264 | 06:45-07:00 | 99 | 80 | 179 |
| 01:00-01:15 | 5 | 3 | 8 | 07:00-07:15 | 77 | 96 | 173 | 01:00-01:15 | 159 | 135 | 294 | 07:00-07:15 | 92 | 65 | 157 |
| 01:15-01:30 | 2 | 1 | 3 | 07:15-07:30 | 81 | 123 | 204 | 01:15-01:30 | 162 | 123 | 285 | 07:15-07:30 | 87 | 95 | 182 |
| 01:30-01:45 | 6 | 6 | 12 | 07:30-07:45 | 73 | 128 | 201 | 01:30-01:45 | 138 | 133 | 271 | 07:30-07:45 | 80 | 68 | 148 |
| 01:45-02:00 | 9 | 4 | 13 | 07:45-08:00 | 86 | 133 | 219 | 01:45-02:00 | 142 | 122 | 264 | 07:45-08:00 | 69 | 38 | 107 |
| 02:00-02:15 | 3 | 4 | 7 | 08:00-08:15 | 95 | 136 | 231 | 02:00-02:15 | 144 | 163 | 307 | 08:00-08:15 | 66 | 37 | 103 |
| 02:15-02:30 | 0 | 1 | 1 | 08:15-08:30 | 77 | 123 | 200 | 02:15-02:30 | 155 | 169 | 324 | 08:15-08:30 | 47 | 38 | 85 |
| 02:30-02:45 | 3 | 2 | 5 | 08:30-08:45 | 92 | 111 | 203 | 02:30-02:45 | 136 | 162 | 298 | 08:30-08:45 | 69 | 36 | 105 |
| 02:45-03:00 | 1 | 5 | 6 | 08:45-09:00 | 94 | 109 | 203 | 02:45-03:00 | 154 | 152 | 306 | 08:45-09:00 | 53 | 39 | 92 |
| 03:00-03:15 | 4 | 2 | 6 | 09:00-09:15 | 91 | 119 | 210 | 03:00-03:15 | 171 | 156 | 327 | 09:00-09:15 | 50 | 28 | 78 |
| 03:15-03:30 | 5 | 6 | 11 | 09:15-09:30 | 100 | 113 | 213 | 03:15-03:30 | 124 | 181 | 305 | 09:15-09:30 | 47 | 24 | 71 |
| 03:30-03:45 | 4 | 7 | 11 | 09:30-09:45 | 103 | 108 | 211 | 03:30-03:45 | 184 | 136 | 320 | 09:30-09:45 | 54 | 35 | 89 |
| 03:45-04:00 | 5 | 5 | 10 | 09:45-10:00 | 111 | 126 | 237 | 03:45-04:00 | 160 | 164 | 324 | 09:45-10:00 | 42 | 27 | 69 |
| 04:00-04:15 | 4 | 14 | 18 | 10:00-10:15 | 129 | 113 | 242 | 04:00-04:15 | 160 | 151 | 311 | 10:00-10:15 | 35 | 13 | 48 |
| 04:15-04:30 | 9 | 20 | 29 | 10:15-10:30 | 116 | 106 | 222 | 04:15-04:30 | 157 | 154 | 311 | 10:15-10:30 | 40 | 15 | 55 |
| 04:30-04:45 | 14 | 22 | 36 | 10:30-10:45 | 109 | 118 | 227 | 04:30-04:45 | 141 | 131 | 272 | 10:30-10:45 | 29 | 16 | 45 |
| 04:45-05:00 | 9 | 29 | 38 | 10:45-11:00 | 145 | 123 | 268 | 04:45-05:00 | 129 | 128 | 257 | 10:45-11:00 | 29 | 13 | 42 |
| 05:00-05:15 | 18 | 55 | 73 | 11:00-11:15 | 150 | 127 | 277 | 05:00-05:15 | 117 | 127 | 244 | 11:00-11:15 | 36 | 12 | 48 |
| 05:15-05:30 | 26 | 54 | 80 | 11:15-11:30 | 156 | 128 | 284 | 05:15-05:30 | 118 | 116 | 234 | 11:15-11:30 | 32 | 10 | 42 |
| 05:30-05:45 | 22 | 69 | 91 | 11:30-11:45 | 138 | 106 | 244 | 05:30-05:45 | 156 | 119 | 275 | 11:30-11:45 | 22 | 9 | 31 |
| 05:45-06:00 | 36 | 71 | 107 | 11:45-12:00 | 176 | 129 | 305 | 05:45-06:00 | 124 | 106 | 230 | 11:45-12:00 | 12 | 5 | 17 |

| AM COMMUTER PERIOD (05:00-09:00) | DIR 1 | DIR 2 | |
|---|---|---|---|
| TWO DIRECTIONAL PEAK | | | |
| AM - PEAK HR TIME | 07:15 AM to 08:15 AM | | |
| AM - PEAK HR VOLUME | 335 | 520 | 855 |
| AM - K FACTOR (%) | | | 5.71 |
| AM - D (%) | 39.18 | 60.82 | 100.00 |
| DIRECTIONAL PEAK | | | |
| AM - PEAK HR TIME | 08:00 AM to 09:00 AM | 07:15 AM to 08:15 AM | |
| AM - PEAK HR VOLUME | 358 | 520 | |

| PM COMMUTER PERIOD (15:00-19:00) | DIR 1 | DIR 2 | |
|---|---|---|---|
| TWO DIRECTIONAL PEAK | | | |
| PM - PEAK HR TIME | 03:00 PM to 04:00 PM | | |
| PM - PEAK HR VOLUME | 639 | 637 | 1276 |
| PM - K FACTOR (%) | | | 8.53 |
| PM - D (%) | 50.08 | 49.92 | 100.00 |
| DIRECTIONAL PEAK | | | |
| PM - PEAK HR TIME | 03:30 PM to 04:30 PM | 03:00 PM to 04:00 PM | |
| PM - PEAK HR VOLUME | 661 | 637 | |

| AM PERIOD (00:00-12:00) | | | |
|---|---|---|---|
| TWO DIRECTIONAL PEAK | | | |
| AM - PEAK HR TIME | 11:00 AM to 12:00 PM | | |
| AM - PEAK HR VOLUME | 620 | 490 | 1110 |
| AM - K FACTOR (%) | | | 7.42 |
| AM - D (%) | 55.86 | 44.14 | 100.00 |

| PM PERIOD (12:00-24:00) | | | |
|---|---|---|---|
| TWO DIRECTIONAL PEAK | | | |
| PM - PEAK HR TIME | 03:00 PM to 04:00 PM | | |
| PM - PEAK HR VOLUME | 639 | 637 | 1276 |
| PM - K FACTOR (%) | | | 8.53 |
| PM - D (%) | 50.08 | 49.92 | 100.00 |

| NON-COMMUTER PERIOD (09:00-15:00) | | | |
|---|---|---|---|
| TWO DIRECTIONAL PEAK | | | |
| PEAK HR TIME | 02:00 PM to 03:00 PM | | |
| PEAK HR VOLUME | 589 | 646 | 1235 |
| DIRECTIONAL PEAK | | | |
| PEAK HR TIME | 11:45 AM to 12:45 PM | 02:00 PM to 03:00 PM | |
| PEAK HR VOLUME | 627 | 646 | |

| 6-HR, 12-HR, 24-HR PERIODS | DIR 1 | DIR 2 | Total |
|---|---|---|---|
| AM 6-HR PERIOD (06:00-12:00) | 2,423 | 2,696 | 5,119 |
| AM 12-HR PERIOD (00:00-12:00) | 2,645 | 3,100 | 5,745 |
| PM 6-HR PERIOD (12:00-18:00) | 3,521 | 3,306 | 6,827 |
| PM 12-HR PERIOD (12:00-24:00) | 4,940 | 4,277 | 9,217 |
| 24 HOUR PERIOD | 7,585 | 7,377 | 14,962 |
| D (%) | 50.70 | 49.30 | 100.00 |

**Run Date:** 2016/06/07

# Hawaii Department of Transportation

## Highways Division — Highways Planning Survey Section

## 2015 Program Count - Summary

**Site ID:** B72008300358 **Town:** Oahu **DIR 1:** +MP **DIR 2:** -MP **Final AADT:** 16900
**Functional Class:** URBAN:PRINCIPAL ARTERIAL - OTHER **Count Type:** CLASS **Counter Type:** Tube **Route No:** 83
**Location:** Kamehameha Hwy btwn Pohaku Loa Way (N. Jct) _Punalau Place

| TIME-AM | DIR 1 | DIR 2 | TOTAL | TIME-AM | DIR 1 | DIR 2 | TOTAL | TIME-PM | DIR 1 | DIR 2 | TOTAL | TIME-PM | DIR 1 | DIR 2 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **DATE : 09/16/2015** | | | | | | | | | | | | | | | |
| 12:00-12:15 | 9 | 10 | 19 | 06:00-06:15 | 41 | 58 | 99 | 12:00-12:15 | 137 | 101 | 238 | 06:00-06:15 | 118 | 97 | 215 |
| 12:15-12:30 | 12 | 7 | 19 | 06:15-06:30 | 67 | 74 | 141 | 12:15-12:30 | 143 | 102 | 245 | 06:15-06:30 | 100 | 111 | 211 |
| 12:30-12:45 | 13 | 3 | 16 | 06:30-06:45 | 56 | 86 | 142 | 12:30-12:45 | 80 | 107 | 187 | 06:30-06:45 | 103 | 97 | 200 |
| 12:45-01:00 | 10 | 6 | 16 | 06:45-07:00 | 55 | 93 | 148 | 12:45-01:00 | 85 | 140 | 225 | 06:45-07:00 | 106 | 90 | 196 |
| 01:00-01:15 | 11 | 0 | 11 | 07:00-07:15 | 73 | 118 | 191 | 01:00-01:15 | 146 | 161 | 307 | 07:00-07:15 | 91 | 94 | 185 |
| 01:15-01:30 | 5 | 4 | 9 | 07:15-07:30 | 90 | 119 | 209 | 01:15-01:30 | 204 | 153 | 357 | 07:15-07:30 | 92 | 74 | 166 |
| 01:30-01:45 | 4 | 2 | 6 | 07:30-07:45 | 75 | 139 | 214 | 01:30-01:45 | 164 | 128 | 292 | 07:30-07:45 | 101 | 74 | 175 |
| 01:45-02:00 | 4 | 2 | 6 | 07:45-08:00 | 86 | 140 | 226 | 01:45-02:00 | 142 | 156 | 298 | 07:45-08:00 | 82 | 52 | 134 |
| 02:00-02:15 | 5 | 4 | 9 | 08:00-08:15 | 67 | 105 | 172 | 02:00-02:15 | 136 | 132 | 268 | 08:00-08:15 | 84 | 41 | 125 |
| 02:15-02:30 | 4 | 2 | 6 | 08:15-08:30 | 94 | 103 | 197 | 02:15-02:30 | 159 | 147 | 306 | 08:15-08:30 | 59 | 33 | 92 |
| 02:30-02:45 | 4 | 3 | 7 | 08:30-08:45 | 80 | 118 | 198 | 02:30-02:45 | 163 | 129 | 292 | 08:30-08:45 | 57 | 29 | 86 |
| 02:45-03:00 | 1 | 4 | 5 | 08:45-09:00 | 74 | 110 | 184 | 02:45-03:00 | 162 | 136 | 298 | 08:45-09:00 | 57 | 28 | 85 |
| 03:00-03:15 | 4 | 3 | 7 | 09:00-09:15 | 79 | 111 | 190 | 03:00-03:15 | 136 | 129 | 265 | 09:00-09:15 | 55 | 38 | 93 |
| 03:15-03:30 | 3 | 3 | 6 | 09:15-09:30 | 79 | 112 | 191 | 03:15-03:30 | 153 | 164 | 317 | 09:15-09:30 | 61 | 19 | 80 |
| 03:30-03:45 | 6 | 7 | 13 | 09:30-09:45 | 83 | 102 | 185 | 03:30-03:45 | 162 | 152 | 314 | 09:30-09:45 | 55 | 60 | 115 |
| 03:45-04:00 | 6 | 9 | 15 | 09:45-10:00 | 85 | 117 | 202 | 03:45-04:00 | 166 | 144 | 310 | 09:45-10:00 | 49 | 33 | 82 |
| 04:00-04:15 | 6 | 9 | 15 | 10:00-10:15 | 113 | 90 | 203 | 04:00-04:15 | 181 | 159 | 340 | 10:00-10:15 | 36 | 31 | 67 |
| 04:15-04:30 | 10 | 16 | 26 | 10:15-10:30 | 103 | 109 | 212 | 04:15-04:30 | 152 | 167 | 319 | 10:15-10:30 | 35 | 13 | 48 |
| 04:30-04:45 | 9 | 28 | 37 | 10:30-10:45 | 105 | 107 | 212 | 04:30-04:45 | 160 | 162 | 322 | 10:30-10:45 | 38 | 12 | 50 |
| 04:45-05:00 | 7 | 28 | 35 | 10:45-11:00 | 120 | 102 | 222 | 04:45-05:00 | 130 | 133 | 263 | 10:45-11:00 | 33 | 13 | 46 |
| 05:00-05:15 | 17 | 37 | 54 | 11:00-11:15 | 114 | 124 | 238 | 05:00-05:15 | 148 | 122 | 270 | 11:00-11:15 | 22 | 8 | 30 |
| 05:15-05:30 | 26 | 43 | 69 | 11:15-11:30 | 116 | 113 | 229 | 05:15-05:30 | 152 | 106 | 258 | 11:15-11:30 | 14 | 12 | 26 |
| 05:30-05:45 | 27 | 53 | 80 | 11:30-11:45 | 126 | 106 | 232 | 05:30-05:45 | 151 | 137 | 288 | 11:30-11:45 | 18 | 11 | 29 |
| 05:45-06:00 | 29 | 70 | 99 | 11:45-12:00 | 131 | 114 | 245 | 05:45-06:00 | 129 | 142 | 271 | 11:45-12:00 | 11 | 21 | 32 |

| AM COMMUTER PERIOD (05:00-09:00) | DIR 1 | DIR 2 | |
|---|---|---|---|
| TWO DIRECTIONAL PEAK | | | |
| AM - PEAK HR TIME | 07:00 AM to 08:00 AM | | |
| AM - PEAK HR VOLUME | 324 | 516 | 840 |
| AM - K FACTOR (%) | | | 5.72 |
| AM - D (%) | 38.57 | 61.43 | 100.00 |
| DIRECTIONAL PEAK | | | |
| AM - PEAK HR TIME | 07:45 AM to 08:45 AM | 07:00 AM to 08:00 AM | |
| AM - PEAK HR VOLUME | 327 | 516 | |

| PM COMMUTER PERIOD (15:00-19:00) | DIR 1 | DIR 2 | |
|---|---|---|---|
| TWO DIRECTIONAL PEAK | | | |
| PM - PEAK HR TIME | 03:45 PM to 04:45 PM | | |
| PM - PEAK HR VOLUME | 659 | 632 | 1291 |
| PM - K FACTOR (%) | | | 8.79 |
| PM - D (%) | 51.05 | 48.95 | 100.00 |
| DIRECTIONAL PEAK | | | |
| PM - PEAK HR TIME | 03:15 PM to 04:15 PM | 03:45 PM to 04:45 PM | |
| PM - PEAK HR VOLUME | 662 | 632 | |

| AM PERIOD (00:00-12:00) | | | |
|---|---|---|---|
| TWO DIRECTIONAL PEAK | | | |
| AM - PEAK HR TIME | 11:00 AM to 12:00 PM | | |
| AM - PEAK HR VOLUME | 487 | 457 | 944 |
| AM - K FACTOR (%) | | | 6.43 |
| AM - D (%) | 51.59 | 48.41 | 100.00 |

| PM PERIOD (12:00-24:00) | | | |
|---|---|---|---|
| TWO DIRECTIONAL PEAK | | | |
| PM - PEAK HR TIME | 03:45 PM to 04:45 PM | | |
| PM - PEAK HR VOLUME | 659 | 632 | 1291 |
| PM - K FACTOR (%) | | | 8.79 |
| PM - D (%) | 51.05 | 48.95 | 100.00 |

| NON-COMMUTER PERIOD (09:00-15:00) | | | |
|---|---|---|---|
| TWO DIRECTIONAL PEAK | | | |
| PEAK HR TIME | 01:00 PM to 02:00 PM | | |
| PEAK HR VOLUME | 656 | 598 | 1254 |
| DIRECTIONAL PEAK | | | |
| PEAK HR TIME | 01:00 PM to 02:00 PM | 01:00 PM to 02:00 PM | |
| PEAK HR VOLUME | 656 | 598 | |

| 6-HR, 12-HR, 24-HR PERIODS | DIR 1 | DIR 2 | Total |
|---|---|---|---|
| AM 6-HR PERIOD (06:00-12:00) | 2,112 | 2,570 | 4,682 |
| AM 12-HR PERIOD (00:00-12:00) | 2,344 | 2,923 | 5,267 |
| PM 6-HR PERIOD (12:00-18:00) | 3,541 | 3,309 | 6,850 |
| PM 12-HR PERIOD (12:00-24:00) | 5,018 | 4,400 | 9,418 |
| 24 HOUR PERIOD | 7,362 | 7,323 | 14,685 |
| D (%) | 50.13 | 49.87 | 100.00 |

**Run Date:** 2016/06/07

# Hawaii Department of Transportation
## Highways Division
## Highways Planning Survey Section

## Vehicle Classification Data Summary
## 2015

| | | | | | |
|---|---|---|---|---|---|
| **Site ID:** | **B72008300358** | **Route No:** | **83** | **Date From:** | 2015/09/15 0:00 |
| **Town:** | **Oahu** | **Direction:** | +MP | **Date To:** | 2015/09/16 23:45 |

**Location:** **Kamehameha Hwy btwn Pohaku Loa Way (N. Jct) _Punalau Place**

**Functional Classification:** **14 URBAN:PRINCIPAL ARTERIAL - OTHER**

**REPORT TOTALS - 48 HOURS RECORDED**

| | VOLUME | % | NUMBER OF AXLES |
|---|---|---|---|
| **Cycles** | 299 | 1.01% | 599 |
| **PC** | 24952 | 84.16% | 49905 |
| **2A-4T** | 3645 | 12.29% | 7290 |
| **LIGHT VEHICLE TOTALS** | 28897 | 97.47% | 57793 |
| | **HEAVY VEHICLES** | | |
| **Bus** | 139 | 0.47% | 348 |
| **SINGLE UNIT TRUCK** | | | |
| **2A-6T** | 300 | 1.01% | 600 |
| **3A-SU** | 137 | 0.46% | 411 |
| **4A-SU** | 4 | 0.01% | 16 |
| **SINGLE-TRAILER TRUCKS** | | | |
| **4A-ST** | 79 | 0.27% | 316 |
| **5A-ST** | 63 | 0.21% | 315 |
| **6A-ST** | 6 | 0.02% | 36 |
| **MULTI-TRAILER TRUCKS** | | | |
| **5A-MT** | 0 | 0.00% | 0 |
| **6A-MT** | 0 | 0.00% | 0 |
| **7A-MT** | 20 | 0.07% | 140 |
| **HEAVY VEHICLE TOTALS** | 750 | 2.53% | 2182 |
| **CLASSIFIED VEHICLES TOTALS** | 29646 (A) | 100.00% | 59976 (B) |
| **UNCLASSIFIED VEHICLES TOTALS** | 1 | 0.00% | |

**AXLE CORRECTION FACTOR (A/C) =** 0.989

**ROADTUBE EQUIVALENT(B/2) =** 29988 (C)

| **PEAK HOUR VOLUME : 1276**<br>**2015/09/15 15:00** | **PEAK HOUR TRUCK VOLUME** | **% TOTAL PEAK HOUR VOLUME** | **24 HOUR TRUCK VOLUME** | **AADT** | **% OF AADT** | **HPMS K-FACTOR (PEAK/AADT) (ITEM 66)** |
|---|---|---|---|---|---|---|
| **SINGLE UNIT TRUCKS (TYPE 4-7)** | **10** | **(65A-1) 0.80%** | **285** | **16900** | **(65A-2) 1.69%** | **7.55%** |
| **COMBINATION (TYPE 8-13)** | **8** | **(65B-1) 0.64%** | **82** | | **(65B-2) 0.49%** | **7.55%** |

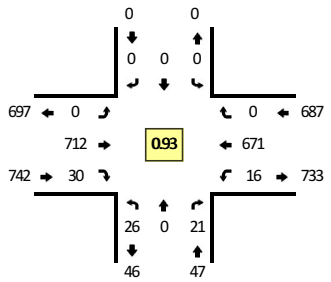
Type of peak hour being reported: Intersection Peak

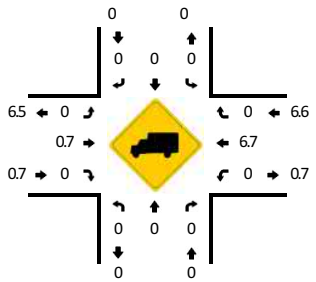
Method for determining peak hour: Total Entering Volume

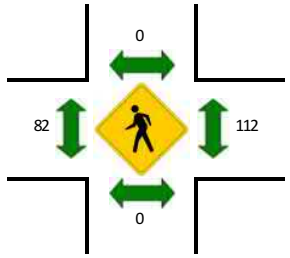
**LOCATION:** Laniakea Beach Parking -- Kamehameha Hwy
**CITY/STATE:** Honolulu County, HI

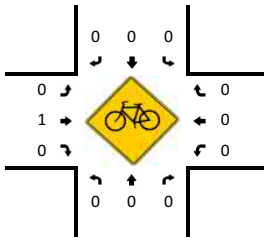
**QC JOB #:** 15153903
**DATE:** Thu, Jan 16 2020

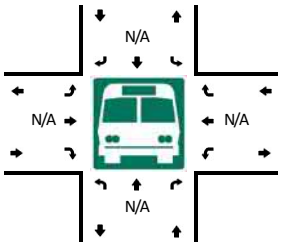
**Peak-Hour: 4:00 PM -- 5:00 PM**
**Peak 15-Min: 4:00 PM -- 4:15 PM**

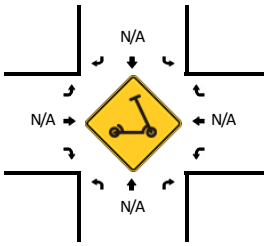







| 15-Min Count Period Beginning At | Laniakea Beach Parking (Northbound) | | | | Laniakea Beach Parking (Southbound) | | | | Kamehameha Hwy (Eastbound) | | | | Kamehameha Hwy (Westbound) | | | | Total | Hourly Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | | |
| 11:00 AM | 9 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 139 | 7 | 0 | 2 | 142 | 0 | 0 | 304 | |
| 11:15 AM | 1 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 124 | 11 | 0 | 1 | 120 | 0 | 0 | 266 | |
| 11:30 AM | 2 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 156 | 6 | 0 | 1 | 114 | 0 | 0 | 284 | |
| 11:45 AM | 5 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 164 | 10 | 0 | 4 | 135 | 0 | 0 | 333 | 1187 |
| 12:00 PM | 2 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 146 | 16 | 0 | 4 | 112 | 0 | 0 | 289 | 1172 |
| 12:15 PM | 2 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 147 | 11 | 0 | 1 | 128 | 0 | 0 | 299 | 1205 |
| 12:30 PM | 1 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 134 | 1 | 0 | 4 | 138 | 0 | 0 | 285 | 1206 |
| 12:45 PM | 8 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 145 | 18 | 0 | 1 | 139 | 0 | 0 | 324 | 1197 |
| 1:00 PM | 7 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 162 | 9 | 0 | 2 | 159 | 0 | 0 | 348 | 1256 |
| 1:15 PM | 7 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 167 | 9 | 0 | 4 | 164 | 0 | 0 | 363 | 1320 |
| 1:30 PM | 3 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 140 | 13 | 0 | 5 | 157 | 0 | 0 | 328 | 1363 |
| 1:45 PM | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 143 | 10 | 0 | 2 | 142 | 0 | 0 | 307 | 1346 |
| 2:00 PM | 2 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 164 | 10 | 0 | 5 | 145 | 0 | 0 | 332 | 1330 |
| 2:15 PM | 2 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 157 | 6 | 0 | 4 | 156 | 0 | 0 | 331 | 1298 |
| 2:30 PM | 5 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 170 | 10 | 0 | 8 | 167 | 0 | 0 | 369 | 1339 |
| 2:45 PM | 6 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 146 | 11 | 0 | 1 | 158 | 0 | 0 | 330 | 1362 |
| 3:00 PM | 7 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 175 | 10 | 0 | 3 | 154 | 0 | 0 | 360 | 1390 |
| 3:15 PM | 3 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 163 | 10 | 0 | 5 | 158 | 0 | 0 | 352 | 1411 |
| 3:30 PM | 5 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 139 | 10 | 0 | 3 | 143 | 0 | 0 | 314 | 1356 |
| 3:45 PM | 8 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 154 | 7 | 0 | 5 | 128 | 0 | 0 | 308 | 1334 |
| 4:00 PM | 8 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 197 | 5 | 0 | 2 | 182 | 0 | 0 | 398 | 1372 |
| 4:15 PM | 4 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 176 | 11 | 0 | 6 | 150 | 0 | 0 | 352 | 1372 |
| 4:30 PM | 8 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 189 | 8 | 0 | 2 | 162 | 0 | 0 | 375 | 1433 |
| 4:45 PM | 6 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 150 | 6 | 0 | 6 | 177 | 0 | 0 | 351 | 1476 |

| Peak 15-Min Flowrates | Northbound | | | | Southbound | | | | Eastbound | | | | Westbound | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | |
| All Vehicles | 32 | 0 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 788 | 20 | 0 | 8 | 728 | 0 | 0 | 1592 |
| Heavy Trucks | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 | 12 | 0 | | 0 | 40 | 0 | | 52 |
| Buses | | | | | | | | | | | | | | | | | |
| Pedestrians | | 0 | | | | 0 | | | | 96 | | | | 132 | | | 228 |
| Bicycles | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 |
| Scooters | | | | | | | | | | | | | | | | | |

*Comments:*

Report generated on 1/28/2020 4:35 PM

SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

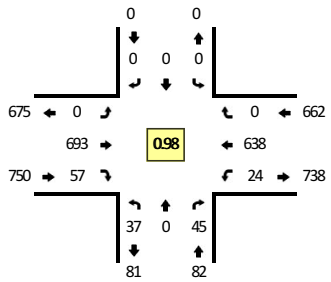
Type of peak hour being reported: Intersection Peak

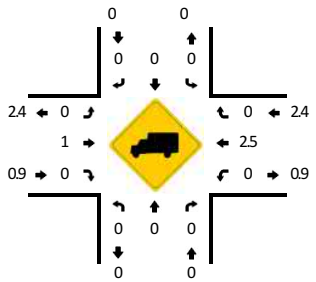
Method for determining peak hour: Total Entering Volume

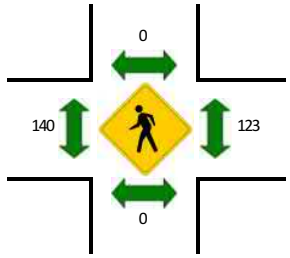
**LOCATION:** Laniakea Beach Parking -- Kamehameha Hwy
**CITY/STATE:** Honolulu County, HI

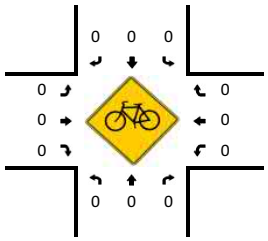
**QC JOB #:** 15153904
**DATE:** Sat, Jan 18 2020

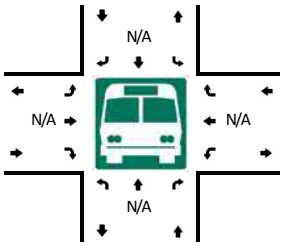
**Peak-Hour: 2:15 PM -- 3:15 PM**
**Peak 15-Min: 3:00 PM -- 3:15 PM**

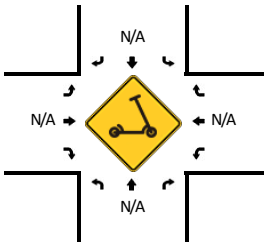







| 15-Min Count Period Beginning At | Laniakea Beach Parking (Northbound) | | | | Laniakea Beach Parking (Southbound) | | | | Kamehameha Hwy (Eastbound) | | | | Kamehameha Hwy (Westbound) | | | | Total | Hourly Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | | |
| 11:00 AM | 1 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 181 | 7 | 0 | 2 | 171 | 0 | 0 | 375 | |
| 11:15 AM | 4 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 170 | 15 | 0 | 1 | 130 | 0 | 0 | 334 | |
| 11:30 AM | 3 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 175 | 10 | 0 | 3 | 150 | 0 | 0 | 352 | |
| 11:45 AM | 1 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 173 | 12 | 0 | 3 | 165 | 0 | 0 | 359 | 1420 |
| 12:00 PM | 6 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 163 | 16 | 0 | 5 | 142 | 0 | 0 | 343 | 1388 |
| 12:15 PM | 4 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 184 | 14 | 0 | 4 | 124 | 0 | 0 | 336 | 1390 |
| 12:30 PM | 3 | 0 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 171 | 15 | 0 | 2 | 152 | 0 | 0 | 359 | 1397 |
| 12:45 PM | 8 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 162 | 13 | 0 | 2 | 166 | 0 | 0 | 365 | 1403 |
| 1:00 PM | 5 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 180 | 12 | 0 | 1 | 159 | 0 | 0 | 369 | 1429 |
| 1:15 PM | 3 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 181 | 13 | 0 | 4 | 170 | 0 | 0 | 380 | 1473 |
| 1:30 PM | 3 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 160 | 12 | 0 | 7 | 146 | 0 | 0 | 342 | 1456 |
| 1:45 PM | 8 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 151 | 12 | 0 | 2 | 161 | 0 | 0 | 340 | 1431 |
| 2:00 PM | 11 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 159 | 5 | 0 | 3 | 155 | 0 | 0 | 345 | 1407 |
| 2:15 PM | 10 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 167 | 16 | 0 | 7 | 155 | 0 | 0 | 366 | 1393 |
| 2:30 PM | 7 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 170 | 10 | 0 | 10 | 156 | 0 | 0 | 363 | 1414 |
| 2:45 PM | 12 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 182 | 12 | 0 | 2 | 161 | 0 | 0 | 382 | 1456 |
| 3:00 PM | 8 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 174 | 19 | 0 | 5 | 166 | 0 | 0 | 383 | 1494 |
| 3:15 PM | 4 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 183 | 13 | 0 | 0 | 141 | 0 | 0 | 348 | 1476 |
| 3:30 PM | 9 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 171 | 9 | 0 | 9 | 145 | 0 | 0 | 355 | 1468 |
| 3:45 PM | 9 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 163 | 17 | 0 | 3 | 163 | 0 | 0 | 361 | 1447 |
| 4:00 PM | 13 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 151 | 15 | 0 | 9 | 146 | 0 | 0 | 344 | 1408 |
| 4:15 PM | 8 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 179 | 5 | 0 | 4 | 179 | 0 | 0 | 380 | 1440 |
| 4:30 PM | 11 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 174 | 11 | 0 | 4 | 158 | 0 | 0 | 363 | 1448 |
| 4:45 PM | 9 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 152 | 15 | 0 | 4 | 176 | 0 | 0 | 362 | 1449 |

| Peak 15-Min Flowrates | Northbound | | | | Southbound | | | | Eastbound | | | | Westbound | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | |
| All Vehicles | 32 | 0 | 44 | 0 | 0 | 0 | 0 | 0 | 0 | 696 | 76 | 0 | 20 | 664 | 0 | 0 | 1532 |
| Heavy Trucks | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 | 20 | 0 | | 20 |
| Buses | | | | | | | | | | | | | | | | | |
| Pedestrians | | 0 | | | | 0 | | | | 128 | | | | 112 | | | 240 |
| Bicycles | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 |
| Scooters | | | | | | | | | | | | | | | | | |

*Comments:*

Report generated on 1/28/2020 4:35 PM

SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

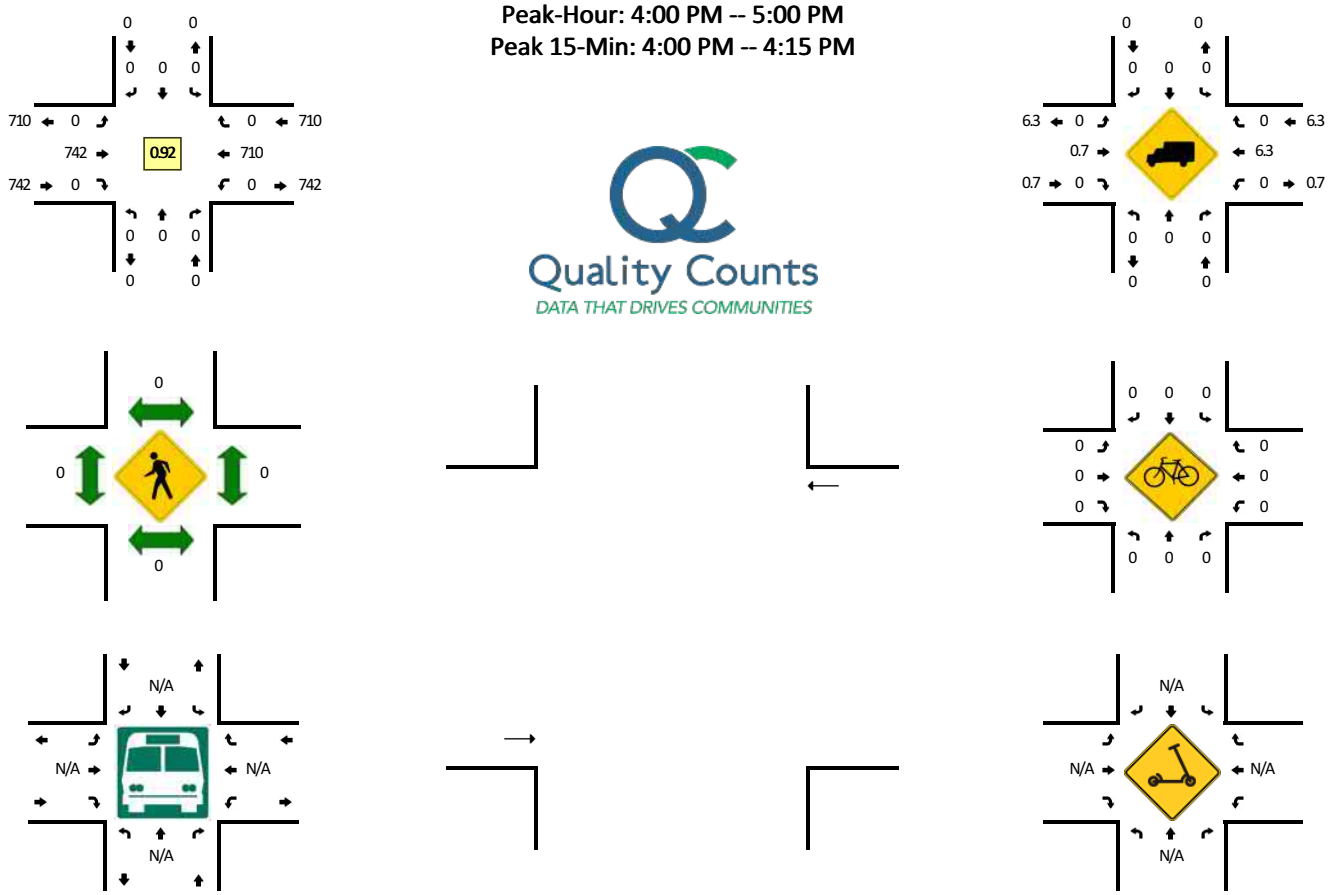
Type of peak hour being reported: Intersection Peak

Method for determining peak hour: Total Entering Volume

**LOCATION:** At Bridge -- Kamehameha Highway
**CITY/STATE:** Haleiwa, HI

**QC JOB #:** 15153905
**DATE:** Thu, Jan 16 2020

**Peak-Hour: 4:00 PM -- 5:00 PM**
**Peak 15-Min: 4:00 PM -- 4:15 PM**




| 15-Min Count Period Beginning At | At Bridge (Northbound) | | | | At Bridge (Southbound) | | | | Kamehameha Highway (Eastbound) | | | | Kamehameha Highway (Westbound) | | | | Total | Hourly Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | | |
| 11:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 146 | 0 | 0 | 0 | 151 | 0 | 0 | 297 | |
| 11:15 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 135 | 0 | 0 | 0 | 122 | 0 | 0 | 257 | |
| 11:30 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 162 | 0 | 0 | 0 | 114 | 0 | 0 | 276 | |
| 11:45 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 174 | 0 | 0 | 0 | 142 | 0 | 0 | 316 | 1146 |
| 12:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 162 | 0 | 0 | 0 | 114 | 0 | 0 | 276 | 1125 |
| 12:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 158 | 0 | 0 | 0 | 131 | 0 | 0 | 289 | 1157 |
| 12:30 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 135 | 0 | 0 | 0 | 140 | 0 | 0 | 275 | 1156 |
| 12:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 163 | 0 | 0 | 0 | 151 | 0 | 0 | 314 | 1154 |
| 1:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 171 | 0 | 0 | 0 | 167 | 0 | 0 | 338 | 1216 |
| 1:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 176 | 0 | 0 | 0 | 171 | 0 | 0 | 347 | 1274 |
| 1:30 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 153 | 0 | 0 | 0 | 161 | 0 | 0 | 314 | 1313 |
| 1:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 153 | 0 | 0 | 0 | 145 | 0 | 0 | 298 | 1297 |
| 2:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 174 | 0 | 0 | 0 | 148 | 0 | 0 | 322 | 1281 |
| 2:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 163 | 0 | 0 | 0 | 159 | 0 | 0 | 322 | 1256 |
| 2:30 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 180 | 0 | 0 | 0 | 175 | 0 | 0 | 355 | 1297 |
| 2:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 157 | 0 | 0 | 0 | 165 | 0 | 0 | 322 | 1321 |
| 3:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 185 | 0 | 0 | 0 | 164 | 0 | 0 | 349 | 1348 |
| 3:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 174 | 0 | 0 | 0 | 161 | 0 | 0 | 335 | 1361 |
| 3:30 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 149 | 0 | 0 | 0 | 152 | 0 | 0 | 301 | 1307 |
| 3:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 161 | 0 | 0 | 0 | 141 | 0 | 0 | 302 | 1287 |
| 4:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 202 | 0 | 0 | 0 | 194 | 0 | 0 | 396 | 1334 |
| 4:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 187 | 0 | 0 | 0 | 156 | 0 | 0 | 343 | 1342 |
| 4:30 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 197 | 0 | 0 | 0 | 176 | 0 | 0 | 373 | 1414 |
| 4:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 156 | 0 | 0 | 0 | 184 | 0 | 0 | 340 | 1452 |

| Peak 15-Min Flowrates | Northbound | | | | Southbound | | | | Eastbound | | | | Westbound | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | |
| All Vehicles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 808 | 0 | 0 | 0 | 776 | 0 | 0 | 1584 |
| Heavy Trucks | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 | 12 | 0 | | 0 | 40 | 0 | | 52 |
| Buses | | | | | | | | | | | | | | | | | |
| Pedestrians | | 0 | | | | 0 | | | | 0 | | | | 0 | | | 0 |
| Bicycles | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 |
| Scooters | | | | | | | | | | | | | | | | | |

*Comments:*

Report generated on 1/28/2020 4:35 PM

SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

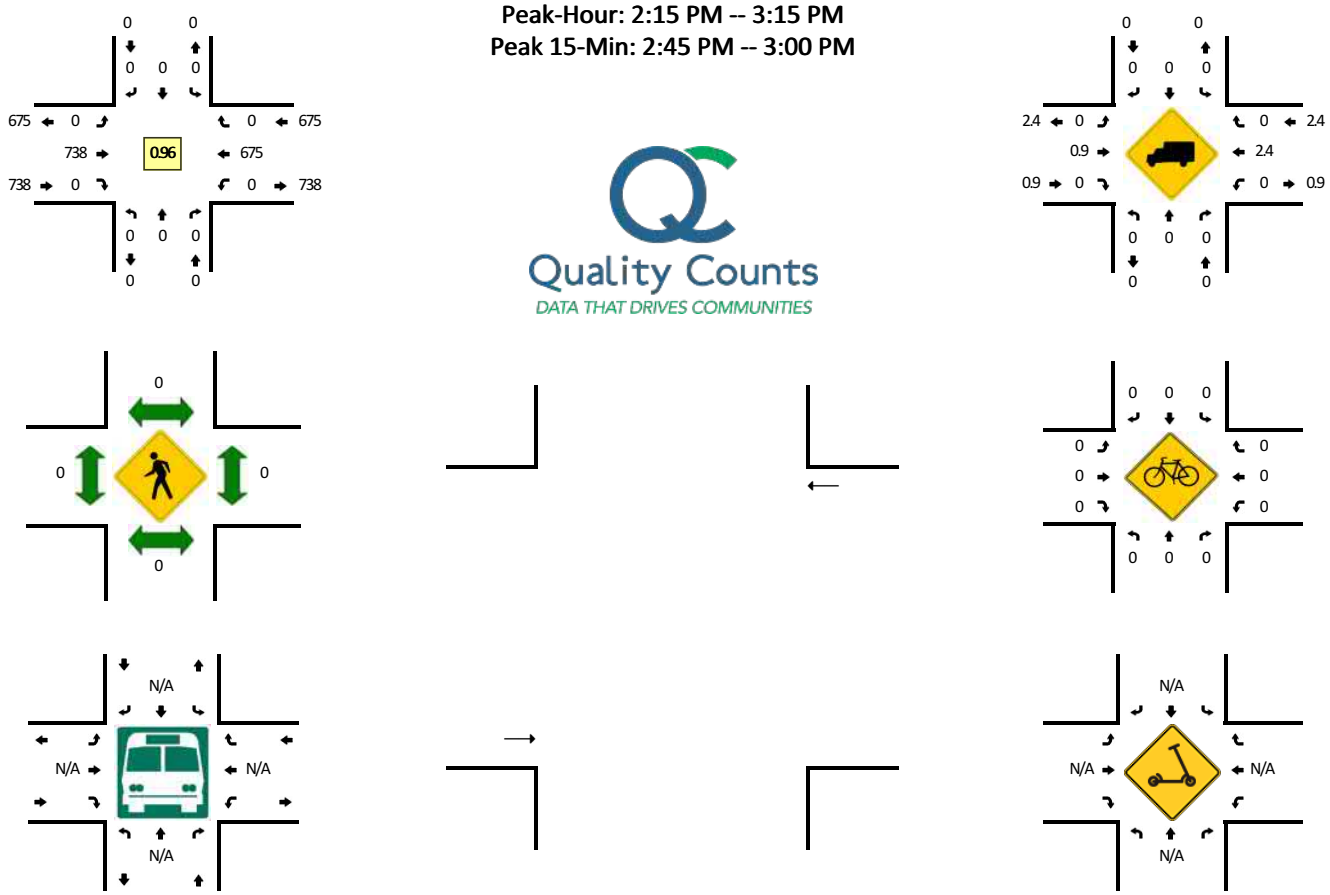
Type of peak hour being reported: Intersection Peak

Method for determining peak hour: Total Entering Volume

**LOCATION:** At Bridge -- Kamehameha Highway
**CITY/STATE:** Haleiwa, HI

**QC JOB #:** 15153906
**DATE:** Sat, Jan 18 2020

**Peak-Hour: 2:15 PM -- 3:15 PM**
**Peak 15-Min: 2:45 PM -- 3:00 PM**




| 15-Min Count Period Beginning At | At Bridge (Northbound) | | | | At Bridge (Southbound) | | | | Kamehameha Highway (Eastbound) | | | | Kamehameha Highway (Westbound) | | | | Total | Hourly Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | | |
| 11:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 194 | 0 | 0 | 0 | 172 | 0 | 0 | 366 | |
| 11:15 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 184 | 0 | 0 | 0 | 134 | 0 | 0 | 318 | |
| 11:30 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 186 | 0 | 0 | 0 | 153 | 0 | 0 | 339 | |
| 11:45 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 178 | 0 | 0 | 0 | 166 | 0 | 0 | 344 | 1367 |
| 12:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 174 | 0 | 0 | 0 | 148 | 0 | 0 | 322 | 1323 |
| 12:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 190 | 0 | 0 | 0 | 128 | 0 | 0 | 318 | 1323 |
| 12:30 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 187 | 0 | 0 | 0 | 155 | 0 | 0 | 342 | 1326 |
| 12:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 176 | 0 | 0 | 0 | 174 | 0 | 0 | 350 | 1332 |
| 1:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 192 | 0 | 0 | 0 | 164 | 0 | 0 | 356 | 1366 |
| 1:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 190 | 0 | 0 | 0 | 173 | 0 | 0 | 363 | 1411 |
| 1:30 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 174 | 0 | 0 | 0 | 149 | 0 | 0 | 323 | 1392 |
| 1:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 157 | 0 | 0 | 0 | 169 | 0 | 0 | 326 | 1368 |
| 2:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 171 | 0 | 0 | 0 | 166 | 0 | 0 | 337 | 1349 |
| 2:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 178 | 0 | 0 | 0 | 165 | 0 | 0 | 343 | 1329 |
| 2:30 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 180 | 0 | 0 | 0 | 163 | 0 | 0 | 343 | 1349 |
| 2:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 195 | 0 | 0 | 0 | 173 | 0 | 0 | 368 | 1391 |
| 3:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 185 | 0 | 0 | 0 | 174 | 0 | 0 | 359 | 1413 |
| 3:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 190 | 0 | 0 | 0 | 145 | 0 | 0 | 335 | 1405 |
| 3:30 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 183 | 0 | 0 | 0 | 154 | 0 | 0 | 337 | 1399 |
| 3:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 169 | 0 | 0 | 0 | 172 | 0 | 0 | 341 | 1372 |
| 4:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 161 | 0 | 0 | 0 | 159 | 0 | 0 | 320 | 1333 |
| 4:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 184 | 0 | 0 | 0 | 187 | 0 | 0 | 371 | 1369 |
| 4:30 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 179 | 0 | 0 | 0 | 169 | 0 | 0 | 348 | 1380 |
| 4:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 158 | 0 | 0 | 0 | 185 | 0 | 0 | 343 | 1382 |

| Peak 15-Min Flowrates | Northbound | | | | Southbound | | | | Eastbound | | | | Westbound | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | |
| All Vehicles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 780 | 0 | 0 | 0 | 692 | 0 | 0 | 1472 |
| Heavy Trucks | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 | 8 | 0 | | 0 | 12 | 0 | | 20 |
| Buses | | | | | | | | | | | | | | | | | |
| Pedestrians | | 0 | | | | 0 | | | | 0 | | | | 0 | | | 0 |
| Bicycles | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 |
| Scooters | | | | | | | | | | | | | | | | | |

*Comments:*

Report generated on 1/28/2020 4:35 PM

SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

1/22/2020

| Eastbound | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12:03 PM | 12:32 PM | 1:16 PM | 2:00 PM | 2:44 PM | 3:34 PM | 4:10 PM | | | | |
| Route 99 & Route 83 | 0:00:00 | 0:00:00 | 0:00:00 | 0:00:00 | 0:00:00 | 0:00:00 | 0:00:00 | | | | |
| Kamehameha Highway | 0:02:47 | 0:02:33 | 0:02:12 | 0:02:18 | 0:02:34 | 0:02:19 | 0:02:45 | | | | |
| Kawailoa Drive | 0:03:37 | 0:03:29 | 0:03:08 | 0:03:12 | 0:03:32 | 0:03:07 | 0:03:40 | | | | |
| First House | 0:04:13 | 0:04:10 | 0:03:51 | 0:03:53 | 0:04:15 | 0:05:15 | 0:04:20 | | | | |
| Papailoa Drive | 0:05:47 | 0:05:47 | 0:04:06 | 0:04:23 | 0:04:31 | 0:07:03 | 0:05:05 | | | | |
| Kawailoa Ranch | 0:06:36 | 0:07:03 | 0:04:21 | 0:05:36 | 0:05:58 | 0:08:40 | 0:06:22 | | | | |
| Laniakea Bridge | 0:08:11 | 0:07:47 | 0:04:40 | 0:06:53 | 0:07:27 | 0:09:51 | 0:07:41 | | | | |
| Pohaku Loa Way W | 0:09:45 | 0:08:53 | 0:05:20 | 0:08:12 | 0:08:07 | 0:10:49 | 0:08:39 | | | | |
| Pohaku Loa Way E | 0:10:09 | 0:09:11 | 0:05:41 | 0:08:34 | 0:08:26 | 0:11:17 | 0:09:01 | | | | |
| Ashley Road | 0:10:36 | 0:09:31 | 0:06:11 | 0:09:06 | 0:08:51 | 0:11:47 | 0:09:34 | | | | |
| Waimea Bridge | 0:13:43 | 0:13:07 | 0:09:25 | 0:12:51 | 0:35:06 | 0:16:50 | 0:13:06 | | | | |
| | 0:04:25 | 0:03:33 | | 0:02:52 | 0:02:47 | 0:05:29 | 0:03:19 | | | | |

| Westbound | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12:19 PM | 12:47 PM | 1:27 PM | 2:14 PM | 3:21 PM | 3:52 PM | 4:24 PM | | | | |
| Waimea Bridge | 0:00:00 | 0:00:00 | 0:00:00 | 0:00:00 | 0:00:00 | 0:00:00 | 0:00:00 | | | | |
| Ashley Road | 0:02:59 | 0:03:16 | 0:03:39 | 0:03:25 | 0:03:37 | 0:06:05 | 0:07:59 | | | | |
| Pohaku Loa Way E | 0:03:24 | 0:04:02 | 0:04:21 | 0:03:57 | 0:04:06 | 0:07:46 | | | | | |
| Pohaku Loa Way W | 0:04:44 | 0:04:24 | 0:05:19 | 0:04:21 | 0:04:42 | 0:09:12 | 0:11:03 | | | | |
| Laniakea Bridge | 0:05:16 | 0:05:04 | 0:06:23 | 0:05:13 | 0:05:25 | 0:10:00 | 0:11:43 | | | | |
| Kawailoa Ranch | 0:05:35 | 0:05:22 | 0:06:46 | 0:05:36 | 0:05:48 | 0:10:22 | 0:11:59 | | | | |
| Papailoa Drive | 0:05:50 | 0:05:37 | 0:07:00 | 0:05:53 | 0:06:06 | 0:10:38 | 0:12:12 | | | | |
| Last House | 0:06:05 | 0:05:51 | | 0:06:10 | 0:06:20 | 0:10:54 | 0:12:25 | | | | |
| Kawailoa Drive | 0:06:39 | 0:06:25 | 0:07:49 | 0:06:46 | 0:06:58 | 0:11:35 | 0:13:01 | | | | |
| Kamehameha Highway | 0:07:57 | 0:07:14 | 0:08:48 | 0:07:56 | 0:08:03 | 0:12:28 | 0:14:00 | | | | |
| Route 99 & Route 83 | 0:10:29 | 0:09:37 | 0:11:11 | 0:10:26 | 0:10:45 | 0:15:10 | 0:16:44 | | | | |

`

Notes:

1 Good weather, good surf. Ranch area almost full, beach full. Lots of peds. BoQ around 1st house
2 EB BoQ around 1st house.
3 No EB Queue
4 EB BoQ around Papailoa, ranch parking cleared out a lot
5 EB BoQ around Papailoa, good surf, lots of EB congestion from beyond Waimea

7 EB BoQ around Papailoa, Beach parking clearing out

1 Parking area not completely full, some double parking. WB BoQ between Pohakuloa streets.

3 Parallel parked shuttle at beach. Last house checkpoint missed, but moving 40 mph

5 EB BoQ at last house
6 Ample parking available at Laniakea, EB BoQ at last bendto the right

1/25/2020

| Eastbound | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10:10 AM | 11:06 AM | 11:40 AM | 12:15 PM | 1:04 PM | 2:01 PM | 3:01 PM | 4:13 PM | | | |
| Route 99 & Route 83 | 0:00:00 | 0:00:00 | 0:00:00 | 0:00:00 | 0:00:00 | 0:00:00 | 0:00:00 | 0:00:00 | | | |
| Kamehameha Highway | 0:02:18 | 0:02:23 | 0:03:01 | 0:09:32 | 0:10:03 | 0:14:48 | 0:12:58 | 0:02:37 | | | |
| Kawailoa Drive | 0:03:10 | 0:03:15 | 0:05:04 | 0:14:37 | 0:17:50 | 0:20:18 | 0:17:58 | 0:05:12 | | | |
| First House | 0:03:42 | 0:03:54 | 0:09:24 | 0:17:56 | 0:22:42 | 0:25:14 | 0:21:18 | | | | |
| Papailoa Drive | 0:03:57 | 0:04:10 | 0:10:11 | 0:19:10 | 0:24:28 | 0:26:34 | 0:22:46 | 0:10:04 | | | |
| Kawailoa Ranch | 0:04:12 | 0:04:28 | 0:11:25 | 0:20:07 | 0:25:09 | 0:27:34 | 0:23:31 | 0:10:54 | | | |
| Laniakea Bridge | 0:04:27 | 0:05:15 | 0:12:14 | 0:21:08 | 0:26:08 | 0:28:59 | 0:24:20 | 0:12:04 | | | |
| Pohaku Loa Way W | 0:05:04 | 0:05:53 | 0:13:09 | 0:22:12 | 0:26:52 | 0:30:02 | 0:25:19 | 0:12:44 | | | |
| Pohaku Loa Way E | 0:05:22 | 0:06:12 | 0:13:31 | 0:22:31 | 0:27:08 | 0:30:19 | 0:25:38 | 0:13:04 | | | |
| Ashley Road | 0:05:41 | 0:06:50 | 0:13:59 | 0:22:52 | 0:27:33 | 0:30:41 | 0:25:59 | | | | |
| Waimea Bridge | 0:09:20 | 0:10:35 | 0:18:07 | 0:26:12 | 0:31:36 | 0:34:26 | 0:29:36 | 0:21:30 | | | |
| | | 0:00:49 | 0:08:05 | 0:17:08 | 0:21:48 | 0:24:58 | 0:20:15 | 0:07:40 | | | |

| Westbound | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10:20 AM | 11:18 AM | 12:01 PM | 12:42 PM | 1:39 PM | 2:39 PM | 3:32 PM | 4:37 PM | | | |
| Waimea Bridge | 0:00:00 | 0:00:00 | 0:00:00 | 0:00:00 | 0:00:00 | 0:00:00 | 0:00:00 | 0:00:00 | | | |
| Ashley Road | 0:04:10 | 0:04:42 | 0:04:23 | 0:04:31 | 0:03:58 | 0:03:35 | 0:03:54 | 0:06:15 | | | |
| Pohaku Loa Way E | 0:04:33 | 0:05:06 | 0:04:51 | 0:04:53 | 0:04:24 | 0:04:02 | 0:04:50 | 0:08:12 | | | |
| Pohaku Loa Way W | 0:04:52 | 0:05:26 | 0:05:13 | 0:05:11 | 0:04:45 | 0:04:38 | 0:06:27 | 0:09:40 | | | |
| Laniakea Bridge | 0:05:18 | 0:06:38 | 0:05:53 | 0:05:42 | 0:05:07 | 0:05:55 | 0:07:16 | 0:10:42 | | | |
| Kawailoa Ranch | 0:05:37 | 0:06:55 | 0:06:13 | 0:06:02 | 0:05:34 | 0:06:23 | | 0:11:00 | | | |
| Papailoa Drive | 0:05:52 | 0:07:11 | 0:06:32 | 0:06:18 | 0:05:50 | 0:06:40 | 0:07:50 | 0:11:16 | | | |
| Last House | 0:06:05 | 0:07:25 | 0:06:52 | 0:06:34 | | | 0:08:06 | 0:11:30 | | | |
| Kawailoa Drive | 0:06:47 | 0:08:01 | 0:07:39 | 0:07:15 | 0:06:44 | | 0:08:41 | 0:12:21 | | | |
| Kamehameha Highway | 0:08:07 | 0:08:53 | 0:09:28 | 0:09:01 | 0:07:46 | 0:08:48 | 0:09:36 | 0:13:14 | | | |
| Route 99 & Route 83 | 0:10:56 | 0:11:28 | 0:12:10 | 0:11:43 | 0:10:37 | 0:11:23 | 0:12:45 | 0:15:40 | | | |

`

Notes:

1. some drizzle, mostly clear, ranch parking empty, high surf

3. some parking at ranch (~5), BoQ at Welcome to Haleiwa sign, ample parking at beach
4. EB BoQ at 2nd bridge beyond Tsue Farm
5. clear weather now, 4 cars at ranch, BoQ at bridge/Tsue's farm
6. EB BoQ at bridge/Tsue's farm

8. Queue is closer to Kawailoa Drive now

2. part of beach caution taped off, peds ignoring it

5. 35 mph at papailoa
6. Laniakea parking filling up
7. 14 ranch parking

# APPENDIX B LEVEL OF SERVICE DEFINITIONS

The 2000 Highway Capacity Manual defines six Intersection Levels of Service (LOS), labeled A through F, from free flow to congested conditions.

For unsignalized intersections, the Highway Capacity Manual evaluates gaps in the major street traffic flow and calculates available gaps for left-turns across oncoming traffic and for the left and right-turns onto the major roadway from the minor street. Average control delay, based on these factors, is still used to define the levels of service.

| | |
|---|---|
| LEVEL OF SERVICE A: | Low control delay, up to 10 s/veh. |
| LEVEL OF SERVICE B: | Control delay greater than 10 and up to 15 s/veh. |
| LEVEL OF SERVICE C: | Control delay greater than 15 and up to 25 s/veh. |
| LEVEL OF SERVICE D: | Control delay greater than 25 and up to 35 s/veh. |
| LEVEL OF SERVICE E: | Control delay greater than 35 and up to 50 s/veh. |
| LEVEL OF SERVICE F: | Control delay in excess of 50 s/veh. |

# APPENDIX C SIMTRAFFIC ANALYSIS WORKSHEETS

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 9.2 | 77.1 | 0.85 | 39.6 | A |
| Haleiwa | II | 45 | 149.6 | 6.1 | 155.7 | 1.87 | 43.2 | A |
| | II | 35 | 142.9 | 12.0 | 154.9 | 1.39 | 32.3 | B |
| | II | 35 | 13.1 | 5.1 | 18.2 | 0.10 | 20.8 | D |
| | II | 35 | 231.0 | 11.0 | 242.0 | 2.25 | 33.4 | B |
| Total | II | | 604.5 | 43.4 | 647.9 | 6.46 | 35.9 | A |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 12.5 | 42.6 | 0.25 | 21.4 | D |
| | II | 35 | 231.0 | 10.6 | 241.6 | 2.25 | 33.5 | B |
| | II | 35 | 13.1 | 4.7 | 17.8 | 0.10 | 21.2 | D |
| Haleiwa | II | 35 | 142.9 | 17.3 | 160.2 | 1.39 | 31.2 | B |
| Haleiwa/Waialua | II | 45 | 149.6 | 11.0 | 160.6 | 1.87 | 41.9 | A |
| Total | II | | 566.7 | 56.1 | 622.8 | 5.86 | 33.9 | B |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 15.0 | 82.9 | 0.85 | 36.9 | A |
| Haleiwa | II | 45 | 149.6 | 8.5 | 158.1 | 1.87 | 42.6 | A |
| | II | 35 | 142.9 | 20.2 | 163.1 | 1.39 | 30.7 | B |
| | II | 35 | 13.1 | 7.0 | 20.1 | 0.10 | 18.8 | D |
| | II | 35 | 231.0 | 11.0 | 242.0 | 2.25 | 33.4 | B |
| Total | II | | 604.5 | 61.7 | 666.2 | 6.46 | 34.9 | B |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 12.5 | 42.6 | 0.25 | 21.4 | D |
| | II | 35 | 231.0 | 11.3 | 242.3 | 2.25 | 33.4 | B |
| | II | 35 | 13.1 | 4.9 | 18.0 | 0.10 | 21.0 | D |
| Haleiwa | II | 35 | 142.9 | 22.9 | 165.8 | 1.39 | 30.2 | B |
| Haleiwa/Waialua | II | 45 | 149.6 | 15.6 | 165.2 | 1.87 | 40.7 | A |
| Total | II | | 566.7 | 67.2 | 633.9 | 5.86 | 33.3 | B |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 15.1 | 83.0 | 0.85 | 36.8 | A |
| Haleiwa | II | 45 | 149.6 | 8.6 | 158.2 | 1.87 | 42.5 | A |
| | II | 35 | 142.9 | 116.8 | 259.7 | 1.39 | 19.3 | D |
| | II | 35 | 13.1 | 104.5 | 117.6 | 0.10 | 3.2 | F |
| | II | 35 | 231.0 | 11.2 | 242.2 | 2.25 | 33.4 | B |
| Total | II | | 604.5 | 256.2 | 860.7 | 6.46 | 27.0 | C |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 11.8 | 41.9 | 0.25 | 21.7 | D |
| | II | 35 | 231.0 | 25.8 | 256.8 | 2.25 | 31.5 | B |
| | II | 35 | 13.1 | 31.0 | 44.1 | 0.10 | 8.6 | F |
| Haleiwa | II | 35 | 142.9 | 21.0 | 163.9 | 1.39 | 30.5 | B |
| Haleiwa/Waialua | II | 45 | 149.6 | 14.3 | 163.9 | 1.87 | 41.1 | A |
| Total | II | | 566.7 | 103.9 | 670.6 | 5.86 | 31.5 | B |

## Arterial Level of Service: NB Kamehameha Highway

| Cross Street | Node | Delay (s/veh) | Travel time (s) | Dist (mi) | Arterial Speed |
|---|---|---|---|---|---|
| | 19 | 5.9 | 67.5 | 0.8 | 42 |
| Haleiwa/Waialua | 1 | 11.7 | 17.4 | 0.1 | 14 |
| | 4 | 3.7 | 11.6 | 0.1 | 31 |
| | 5 | 2.7 | 33.0 | 0.4 | 42 |
| | 6 | 8.5 | 82.7 | 0.9 | 41 |
| Haleiwa | 8 | 11.7 | 47.3 | 0.4 | 34 |
| | 10 | 2.1 | 15.7 | 0.1 | 31 |
| | 20 | 23.7 | 46.3 | 0.2 | 17 |
| | 31 | 111.5 | 130.7 | 0.2 | 5 |
| | 30 | 350.2 | 385.8 | 0.4 | 4 |
| | 29 | 156.3 | 171.2 | 0.2 | 3 |
| | 28 | 150.7 | 165.4 | 0.1 | 3 |
| | 9 | 148.2 | 163.2 | 0.2 | 3 |
| | 26 | 37.8 | 48.4 | 0.1 | 8 |
| | 11 | 3.1 | 8.0 | 0.0 | 21 |
| | 12 | 1.9 | 22.2 | 0.2 | 32 |
| | 13 | 7.4 | 68.3 | 0.6 | 32 |
| | 14 | 12.0 | 103.4 | 0.9 | 32 |
| | 15 | 2.4 | 19.9 | 0.2 | 31 |
| | 16 | 5.1 | 33.0 | 0.3 | 30 |
| | 22 | 8.5 | 12.9 | 0.0 | 13 |
| | 24 | 1.9 | 6.3 | 0.0 | 24 |
| Total | | 1067.2 | 1660.2 | 6.5 | 14 |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Node | Delay (s/veh) | Travel time (s) | Dist (mi) | Arterial Speed |
|---|---|---|---|---|---|
| | 24 | 5.2 | 27.0 | 0.2 | 29 |
| | 22 | 13.6 | 17.6 | 0.0 | 9 |
| | 16 | 2.1 | 6.9 | 0.0 | 23 |
| | 15 | 2.2 | 30.4 | 0.3 | 32 |
| | 14 | 1.7 | 19.2 | 0.2 | 32 |
| | 13 | 10.5 | 103.7 | 0.9 | 32 |
| | 12 | 7.7 | 68.7 | 0.6 | 31 |
| | 11 | 6.8 | 27.4 | 0.2 | 26 |
| | 26 | 17.1 | 22.0 | 0.0 | 8 |
| | 9 | 26.5 | 37.3 | 0.1 | 10 |
| | 28 | 4.3 | 20.2 | 0.2 | 27 |
| | 29 | 1.7 | 17.2 | 0.1 | 31 |
| | 30 | 1.9 | 17.8 | 0.2 | 31 |
| | 31 | 5.2 | 44.7 | 0.4 | 31 |
| | 20 | 2.7 | 22.7 | 0.2 | 30 |
| | 10 | 3.2 | 26.2 | 0.2 | 30 |
| Haleiwa | 8 | 21.2 | 35.2 | 0.1 | 14 |
| | 6 | 7.8 | 44.7 | 0.4 | 36 |
| | 5 | 9.1 | 83.4 | 0.9 | 40 |
| | 4 | 5.0 | 35.8 | 0.4 | 39 |
| Haleiwa/Waialua | 1 | 16.2 | 24.1 | 0.1 | 15 |
| | 19 | 4.1 | 10.0 | 0.1 | 25 |
| Total | | 175.8 | 742.2 | 5.9 | 29 |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 6.6 | 74.5 | 0.85 | 41.0 | A |
| Haleiwa | II | 45 | 149.6 | 6.7 | 156.3 | 1.87 | 43.1 | A |
| | II | 35 | 142.9 | 25.5 | 168.4 | 1.39 | 29.7 | B |
| | II | 35 | 13.1 | 27.4 | 40.5 | 0.10 | 9.3 | F |
| | II | 35 | 231.0 | 7.1 | 238.1 | 2.25 | 34.0 | B |
| Total | II | | 604.5 | 73.3 | 677.8 | 6.46 | 34.3 | B |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 11.4 | 41.5 | 0.25 | 21.9 | D |
| | II | 35 | 231.0 | 21.8 | 252.8 | 2.25 | 32.0 | B |
| | II | 35 | 13.1 | 28.0 | 41.1 | 0.10 | 9.2 | F |
| Haleiwa | II | 35 | 142.9 | 22.2 | 165.1 | 1.39 | 30.3 | B |
| Haleiwa/Waialua | II | 45 | 149.6 | 8.3 | 157.9 | 1.87 | 42.6 | A |
| Total | II | | 566.7 | 91.7 | 658.4 | 5.86 | 32.1 | B |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 12.1 | 80.0 | 0.85 | 38.2 | A |
| Haleiwa | II | 45 | 149.6 | 10.5 | 160.1 | 1.87 | 42.0 | A |
| | II | 35 | 142.9 | 218.2 | 361.1 | 1.39 | 13.9 | E |
| | II | 35 | 13.1 | 209.0 | 222.1 | 0.10 | 1.7 | F |
| | II | 35 | 231.0 | 15.1 | 246.1 | 2.25 | 32.8 | B |
| Total | II | | 604.5 | 464.9 | 1069.4 | 6.46 | 21.7 | D |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 63.6 | 93.7 | 0.25 | 9.7 | F |
| | II | 35 | 231.0 | 136.4 | 367.4 | 2.25 | 22.0 | C |
| | II | 35 | 13.1 | 127.1 | 140.2 | 0.10 | 2.7 | F |
| Haleiwa | II | 35 | 142.9 | 37.7 | 180.6 | 1.39 | 27.7 | C |
| Haleiwa/Waialua | II | 45 | 149.6 | 11.5 | 161.1 | 1.87 | 41.8 | A |
| Total | II | | 566.7 | 376.3 | 943.0 | 5.86 | 22.4 | C |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 14.1 | 82.0 | 0.85 | 37.3 | A |
| Haleiwa | II | 45 | 149.6 | 11.9 | 161.5 | 1.87 | 41.7 | A |
| | II | 35 | 142.9 | 272.1 | 415.0 | 1.39 | 12.1 | F |
| | II | 35 | 13.1 | 265.8 | 278.9 | 0.10 | 1.4 | F |
| | II | 35 | 231.0 | 19.1 | 250.1 | 2.25 | 32.3 | B |
| Total | II | | 604.5 | 583.0 | 1187.5 | 6.46 | 19.6 | D |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 162.2 | 192.3 | 0.25 | 4.7 | F |
| | II | 35 | 231.0 | 97.0 | 328.0 | 2.25 | 24.6 | C |
| | II | 35 | 13.1 | 98.2 | 111.3 | 0.10 | 3.4 | F |
| Haleiwa | II | 35 | 142.9 | 42.7 | 185.6 | 1.39 | 27.0 | C |
| Haleiwa/Waialua | II | 45 | 149.6 | 12.1 | 161.7 | 1.87 | 41.6 | A |
| Total | II | | 566.7 | 412.2 | 978.9 | 5.86 | 21.6 | D |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 6.4 | 74.3 | 0.85 | 41.1 | A |
| Haleiwa | II | 45 | 149.6 | 6.5 | 156.1 | 1.87 | 43.1 | A |
| | II | 35 | 153.7 | 4.7 | 158.4 | 1.49 | 34.0 | B |
| | II | 35 | 231.0 | 6.9 | 237.9 | 2.25 | 34.0 | B |
| Total | II | | 602.2 | 24.5 | 626.7 | 6.46 | 37.1 | A |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 11.1 | 41.2 | 0.25 | 22.1 | C |
| | II | 35 | 231.0 | 6.5 | 237.5 | 2.25 | 34.0 | B |
| Haleiwa | II | 35 | 153.7 | 21.1 | 174.8 | 1.49 | 30.8 | B |
| Haleiwa/Waialua | II | 45 | 149.6 | 8.0 | 157.6 | 1.87 | 42.7 | A |
| Total | II | | 564.4 | 46.7 | 611.1 | 5.86 | 34.5 | B |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 11.5 | 79.4 | 0.85 | 38.5 | A |
| Haleiwa | II | 45 | 149.6 | 10.0 | 159.6 | 1.87 | 42.2 | A |
| | II | 35 | 153.7 | 8.8 | 162.5 | 1.49 | 33.1 | B |
| | II | 35 | 231.0 | 14.4 | 245.4 | 2.25 | 32.9 | B |
| Total | II | | 602.2 | 44.7 | 646.9 | 6.46 | 35.9 | A |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 47.2 | 77.3 | 0.25 | 11.8 | F |
| | II | 35 | 231.0 | 8.5 | 239.5 | 2.25 | 33.8 | B |
| Haleiwa | II | 35 | 153.7 | 33.6 | 187.3 | 1.49 | 28.7 | B |
| Haleiwa/Waialua | II | 45 | 149.6 | 11.0 | 160.6 | 1.87 | 41.9 | A |
| Total | II | | 564.4 | 100.3 | 664.7 | 5.86 | 31.8 | B |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 12.7 | 80.6 | 0.85 | 37.9 | A |
| Haleiwa | II | 45 | 149.6 | 10.9 | 160.5 | 1.87 | 41.9 | A |
| | II | 35 | 153.7 | 9.8 | 163.5 | 1.49 | 32.9 | B |
| | II | 35 | 231.0 | 16.4 | 247.4 | 2.25 | 32.7 | B |
| Total | II | | 602.2 | 49.8 | 652.0 | 6.46 | 35.7 | A |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 95.9 | 126.0 | 0.25 | 7.2 | F |
| | II | 35 | 231.0 | 9.0 | 240.0 | 2.25 | 33.7 | B |
| Haleiwa | II | 35 | 153.7 | 38.9 | 192.6 | 1.49 | 27.9 | C |
| Haleiwa/Waialua | II | 45 | 149.6 | 11.7 | 161.3 | 1.87 | 41.7 | A |
| Total | II | | 564.4 | 155.5 | 719.9 | 5.86 | 29.3 | B |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 6.6 | 74.5 | 0.85 | 41.0 | A |
| Haleiwa | II | 45 | 149.6 | 6.7 | 156.3 | 1.87 | 43.1 | A |
| | II | 35 | 143.6 | 4.9 | 148.5 | 1.40 | 33.9 | B |
| | II | 35 | 15.9 | 4.8 | 20.7 | 0.13 | 22.1 | C |
| | II | 35 | 228.2 | 7.1 | 235.3 | 2.22 | 33.9 | B |
| Total | II | | 605.2 | 30.1 | 635.3 | 6.46 | 36.6 | A |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 11.4 | 41.5 | 0.25 | 21.9 | D |
| | II | 35 | 228.2 | 6.6 | 234.8 | 2.22 | 34.0 | B |
| | II | 35 | 15.9 | 7.5 | 23.4 | 0.13 | 19.6 | D |
| Haleiwa | II | 35 | 143.6 | 22.2 | 165.8 | 1.40 | 30.3 | B |
| Haleiwa/Waialua | II | 45 | 149.6 | 8.3 | 157.9 | 1.87 | 42.6 | A |
| Total | II | | 567.4 | 56.0 | 623.4 | 5.86 | 33.9 | B |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 12.1 | 80.0 | 0.85 | 38.2 | A |
| Haleiwa | II | 45 | 149.6 | 10.5 | 160.1 | 1.87 | 42.0 | A |
| | II | 35 | 143.6 | 9.7 | 153.3 | 1.40 | 32.8 | B |
| | II | 35 | 15.9 | 13.7 | 29.6 | 0.13 | 15.5 | E |
| | II | 35 | 228.2 | 15.1 | 243.3 | 2.22 | 32.8 | B |
| Total | II | | 605.2 | 61.1 | 666.3 | 6.46 | 34.9 | B |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 63.6 | 93.7 | 0.25 | 9.7 | F |
| | II | 35 | 228.2 | 8.7 | 236.9 | 2.22 | 33.7 | B |
| | II | 35 | 15.9 | 12.2 | 28.1 | 0.13 | 16.3 | E |
| Haleiwa | II | 35 | 143.6 | 37.7 | 181.3 | 1.40 | 27.7 | C |
| Haleiwa/Waialua | II | 45 | 149.6 | 11.5 | 161.1 | 1.87 | 41.8 | A |
| Total | II | | 567.4 | 133.7 | 701.1 | 5.86 | 30.1 | B |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 14.1 | 82.0 | 0.85 | 37.3 | A |
| Haleiwa | II | 45 | 149.6 | 11.9 | 161.5 | 1.87 | 41.7 | A |
| | II | 35 | 143.6 | 12.2 | 155.8 | 1.40 | 32.3 | B |
| | II | 35 | 15.9 | 16.9 | 32.8 | 0.13 | 13.9 | E |
| | II | 35 | 228.2 | 19.1 | 247.3 | 2.22 | 32.3 | B |
| Total | II | | 605.2 | 74.2 | 679.4 | 6.46 | 34.2 | B |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 162.2 | 192.3 | 0.25 | 4.7 | F |
| | II | 35 | 228.2 | 9.1 | 237.3 | 2.22 | 33.7 | B |
| | II | 35 | 15.9 | 12.9 | 28.8 | 0.13 | 15.9 | E |
| Haleiwa | II | 35 | 143.6 | 42.7 | 186.3 | 1.40 | 27.0 | C |
| Haleiwa/Waialua | II | 45 | 149.6 | 12.1 | 161.7 | 1.87 | 41.6 | A |
| Total | II | | 567.4 | 239.0 | 806.4 | 5.86 | 26.2 | C |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 6.6 | 74.5 | 0.85 | 41.0 | A |
| Haleiwa | II | 45 | 149.6 | 6.7 | 156.3 | 1.87 | 43.1 | A |
| | II | 35 | 156.7 | 5.1 | 161.8 | 1.52 | 33.9 | B |
| | II | 35 | 228.2 | 7.1 | 235.3 | 2.22 | 33.9 | B |
| Total | II | | 602.4 | 25.5 | 627.9 | 6.46 | 37.0 | A |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 11.4 | 41.5 | 0.25 | 21.9 | D |
| | II | 35 | 228.2 | 6.6 | 234.8 | 2.22 | 34.0 | B |
| Haleiwa | II | 35 | 156.7 | 22.2 | 178.9 | 1.52 | 30.7 | B |
| Haleiwa/Waialua | II | 45 | 149.6 | 8.3 | 157.9 | 1.87 | 42.6 | A |
| Total | II | | 564.6 | 48.5 | 613.1 | 5.86 | 34.4 | B |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 12.1 | 80.0 | 0.85 | 38.2 | A |
| Haleiwa | II | 45 | 149.6 | 10.5 | 160.1 | 1.87 | 42.0 | A |
| | II | 35 | 156.7 | 10.4 | 167.1 | 1.52 | 32.8 | B |
| | II | 35 | 228.2 | 15.1 | 243.3 | 2.22 | 32.8 | B |
| Total | II | | 602.4 | 48.1 | 650.5 | 6.46 | 35.8 | A |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 63.6 | 93.7 | 0.25 | 9.7 | F |
| | II | 35 | 228.2 | 8.7 | 236.9 | 2.22 | 33.7 | B |
| Haleiwa | II | 35 | 156.7 | 37.7 | 194.4 | 1.52 | 28.2 | B |
| Haleiwa/Waialua | II | 45 | 149.6 | 11.5 | 161.1 | 1.87 | 41.8 | A |
| Total | II | | 564.6 | 121.5 | 686.1 | 5.86 | 30.8 | B |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 14.1 | 82.0 | 0.85 | 37.3 | A |
| Haleiwa | II | 45 | 149.6 | 11.9 | 161.5 | 1.87 | 41.7 | A |
| | II | 35 | 156.7 | 19.0 | 175.7 | 1.52 | 31.2 | B |
| | II | 35 | 228.2 | 19.1 | 247.3 | 2.22 | 32.3 | B |
| Total | II | | 602.4 | 64.1 | 666.5 | 6.46 | 34.9 | B |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 162.2 | 192.3 | 0.25 | 4.7 | F |
| | II | 35 | 228.2 | 9.1 | 237.3 | 2.22 | 33.7 | B |
| Haleiwa | II | 35 | 156.7 | 42.7 | 199.4 | 1.52 | 27.5 | C |
| Haleiwa/Waialua | II | 45 | 149.6 | 12.1 | 161.7 | 1.87 | 41.6 | A |
| Total | II | | 564.6 | 226.1 | 790.7 | 5.86 | 26.7 | C |

## Arterial Level of Service: NB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 6.6 | 74.5 | 0.85 | 41.0 | A |
| Haleiwa | II | 45 | 149.6 | 6.7 | 156.3 | 1.87 | 43.1 | A |
| | II | 35 | 143.9 | 5.1 | 149.0 | 1.40 | 33.8 | B |
| | II | 35 | 244.8 | 7.1 | 251.9 | 2.38 | 34.0 | B |
| Total | II | | 606.2 | 25.5 | 631.7 | 6.50 | 37.0 | A |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 11.4 | 41.5 | 0.25 | 21.9 | D |
| | II | 35 | 244.8 | 6.6 | 251.4 | 2.38 | 34.1 | B |
| Haleiwa | II | 35 | 143.9 | 22.2 | 166.1 | 1.40 | 30.3 | B |
| Haleiwa/Waialua | II | 45 | 149.6 | 8.3 | 157.9 | 1.87 | 42.6 | A |
| Total | II | | 568.4 | 48.5 | 616.9 | 5.90 | 34.4 | B |

## Arterial Level of Service: NB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 12.1 | 80.0 | 0.85 | 38.2 | A |
| Haleiwa | II | 45 | 149.6 | 10.5 | 160.1 | 1.87 | 42.0 | A |
| | II | 35 | 143.9 | 10.4 | 154.3 | 1.40 | 32.6 | B |
| | II | 35 | 244.8 | 15.1 | 259.9 | 2.38 | 33.0 | B |
| Total | II | | 606.2 | 48.1 | 654.3 | 6.50 | 35.7 | A |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 63.6 | 93.7 | 0.25 | 9.7 | F |
| | II | 35 | 244.8 | 8.7 | 253.5 | 2.38 | 33.8 | B |
| Haleiwa | II | 35 | 143.9 | 37.7 | 181.6 | 1.40 | 27.7 | C |
| Haleiwa/Waialua | II | 45 | 149.6 | 11.5 | 161.1 | 1.87 | 41.8 | A |
| Total | II | | 568.4 | 121.5 | 689.9 | 5.90 | 30.8 | B |

## Arterial Level of Service: NB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 14.1 | 82.0 | 0.85 | 37.3 | A |
| Haleiwa | II | 45 | 149.6 | 11.9 | 161.5 | 1.87 | 41.7 | A |
| | II | 35 | 143.9 | 19.0 | 162.9 | 1.40 | 30.9 | B |
| | II | 35 | 244.8 | 19.1 | 263.9 | 2.38 | 32.5 | B |
| Total | II | | 606.2 | 64.1 | 670.3 | 6.50 | 34.9 | B |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 162.2 | 192.3 | 0.25 | 4.7 | F |
| | II | 35 | 244.8 | 9.1 | 253.9 | 2.38 | 33.7 | B |
| Haleiwa | II | 35 | 143.9 | 42.7 | 186.6 | 1.40 | 27.0 | C |
| Haleiwa/Waialua | II | 45 | 149.6 | 12.1 | 161.7 | 1.87 | 41.6 | A |
| Total | II | | 568.4 | 226.1 | 794.5 | 5.90 | 26.7 | C |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 6.9 | 74.8 | 0.85 | 40.9 | A |
| Haleiwa | II | 45 | 149.6 | 7.1 | 156.7 | 1.87 | 43.0 | A |
| | II | 35 | 142.9 | 32.4 | 175.3 | 1.39 | 28.5 | B |
| | II | 35 | 13.1 | 30.9 | 44.0 | 0.10 | 8.6 | F |
| | II | 35 | 231.0 | 7.8 | 238.8 | 2.25 | 33.9 | B |
| Total | II | | 604.5 | 85.1 | 689.6 | 6.46 | 33.7 | B |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 15.7 | 45.8 | 0.25 | 19.9 | D |
| | II | 35 | 231.0 | 36.1 | 267.1 | 2.25 | 30.3 | B |
| | II | 35 | 13.1 | 34.7 | 47.8 | 0.10 | 7.9 | F |
| Haleiwa | II | 35 | 142.9 | 29.6 | 172.5 | 1.39 | 29.0 | B |
| Haleiwa/Waialua | II | 45 | 149.6 | 9.4 | 159.0 | 1.87 | 42.3 | A |
| Total | II | | 566.7 | 125.5 | 692.2 | 5.86 | 30.5 | B |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 16.9 | 84.8 | 0.85 | 36.0 | A |
| Haleiwa | II | 45 | 149.6 | 13.1 | 162.7 | 1.87 | 41.4 | A |
| | II | 35 | 142.9 | 337.8 | 480.7 | 1.39 | 10.4 | F |
| | II | 35 | 13.1 | 330.3 | 343.4 | 0.10 | 1.1 | F |
| | II | 35 | 231.0 | 26.6 | 257.6 | 2.25 | 31.4 | B |
| Total | II | | 604.5 | 724.7 | 1329.2 | 6.46 | 17.5 | D |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 587.3 | 617.4 | 0.25 | 1.5 | F |
| | II | 35 | 231.0 | 239.4 | 470.4 | 2.25 | 17.2 | D |
| | II | 35 | 13.1 | 230.1 | 243.2 | 0.10 | 1.6 | F |
| Haleiwa | II | 35 | 142.9 | 83.2 | 226.1 | 1.39 | 22.1 | C |
| Haleiwa/Waialua | II | 45 | 149.6 | 15.5 | 165.1 | 1.87 | 40.8 | A |
| Total | II | | 566.7 | 1155.5 | 1722.2 | 5.86 | 12.3 | F |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 21.1 | 89.0 | 0.85 | 34.3 | B |
| Haleiwa | II | 45 | 149.6 | 15.4 | 165.0 | 1.87 | 40.8 | A |
| | II | 35 | 142.9 | 387.5 | 530.4 | 1.39 | 9.4 | F |
| | II | 35 | 13.1 | 382.2 | 395.3 | 0.10 | 1.0 | F |
| | II | 35 | 231.0 | 38.7 | 269.7 | 2.25 | 30.0 | B |
| Total | II | | 604.5 | 844.9 | 1449.4 | 6.46 | 16.0 | E |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 1345.6 | 1375.7 | 0.25 | 0.7 | F |
| | II | 35 | 231.0 | 182.2 | 413.2 | 2.25 | 19.6 | D |
| | II | 35 | 13.1 | 188.2 | 201.3 | 0.10 | 1.9 | F |
| Haleiwa | II | 35 | 142.9 | 90.3 | 233.2 | 1.39 | 21.5 | D |
| Haleiwa/Waialua | II | 45 | 149.6 | 16.1 | 165.7 | 1.87 | 40.6 | A |
| Total | II | | 566.7 | 1822.4 | 2389.1 | 5.86 | 8.8 | F |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 6.7 | 74.6 | 0.85 | 41.0 | A |
| Haleiwa | II | 45 | 149.6 | 6.8 | 156.4 | 1.87 | 43.0 | A |
| | II | 35 | 153.7 | 5.1 | 158.8 | 1.49 | 33.9 | B |
| | II | 35 | 231.0 | 7.6 | 238.6 | 2.25 | 33.9 | B |
| Total | II | | 602.2 | 26.2 | 628.4 | 6.46 | 37.0 | A |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 15.0 | 45.1 | 0.25 | 20.2 | D |
| | II | 35 | 231.0 | 7.9 | 238.9 | 2.25 | 33.8 | B |
| Haleiwa | II | 35 | 153.7 | 27.3 | 181.0 | 1.49 | 29.7 | B |
| Haleiwa/Waialua | II | 45 | 149.6 | 9.1 | 158.7 | 1.87 | 42.4 | A |
| Total | II | | 564.4 | 59.3 | 623.7 | 5.86 | 33.8 | B |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 15.6 | 83.5 | 0.85 | 36.6 | A |
| Haleiwa | II | 45 | 149.6 | 12.3 | 161.9 | 1.87 | 41.6 | A |
| | II | 35 | 153.7 | 12.8 | 166.5 | 1.49 | 32.3 | B |
| | II | 35 | 231.0 | 24.2 | 255.2 | 2.25 | 31.7 | B |
| Total | II | | 602.2 | 64.9 | 667.1 | 6.46 | 34.9 | B |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 484.1 | 514.2 | 0.25 | 1.8 | F |
| | II | 35 | 231.0 | 11.9 | 242.9 | 2.25 | 33.3 | B |
| Haleiwa | II | 35 | 153.7 | 71.9 | 225.6 | 1.49 | 23.9 | C |
| Haleiwa/Waialua | II | 45 | 149.6 | 14.5 | 164.1 | 1.87 | 41.0 | A |
| Total | II | | 564.4 | 582.4 | 1146.8 | 5.86 | 18.4 | D |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 17.8 | 85.7 | 0.85 | 35.7 | A |
| Haleiwa | II | 45 | 149.6 | 13.6 | 163.2 | 1.87 | 41.2 | A |
| | II | 35 | 153.7 | 14.7 | 168.4 | 1.49 | 32.0 | B |
| | II | 35 | 231.0 | 29.9 | 260.9 | 2.25 | 31.0 | B |
| Total | II | | 602.2 | 76.0 | 678.2 | 6.46 | 34.3 | B |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 754.1 | 784.2 | 0.25 | 1.2 | F |
| | II | 35 | 231.0 | 12.6 | 243.6 | 2.25 | 33.2 | B |
| Haleiwa | II | 35 | 153.7 | 81.6 | 235.3 | 1.49 | 22.9 | C |
| Haleiwa/Waialua | II | 45 | 149.6 | 15.3 | 164.9 | 1.87 | 40.8 | A |
| Total | II | | 564.4 | 863.6 | 1428.0 | 5.86 | 14.8 | E |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 6.9 | 74.8 | 0.85 | 40.9 | A |
| Haleiwa | II | 45 | 149.6 | 7.1 | 156.7 | 1.87 | 43.0 | A |
| | II | 35 | 143.6 | 5.4 | 149.0 | 1.40 | 33.7 | B |
| | II | 35 | 15.9 | 5.3 | 21.2 | 0.13 | 21.6 | D |
| | II | 35 | 228.2 | 7.8 | 236.0 | 2.22 | 33.8 | B |
| Total | II | | 605.2 | 32.5 | 637.7 | 6.46 | 36.5 | A |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 15.7 | 45.8 | 0.25 | 19.9 | D |
| | II | 35 | 228.2 | 8.2 | 236.4 | 2.22 | 33.8 | B |
| | II | 35 | 15.9 | 10.9 | 26.8 | 0.13 | 17.1 | D |
| Haleiwa | II | 35 | 143.6 | 29.6 | 173.2 | 1.40 | 29.0 | B |
| Haleiwa/Waialua | II | 45 | 149.6 | 9.4 | 159.0 | 1.87 | 42.3 | A |
| Total | II | | 567.4 | 73.8 | 641.2 | 5.86 | 32.9 | B |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 16.9 | 84.8 | 0.85 | 36.0 | A |
| Haleiwa | II | 45 | 149.6 | 13.1 | 162.7 | 1.87 | 41.4 | A |
| | II | 35 | 143.6 | 14.9 | 158.5 | 1.40 | 31.7 | B |
| | II | 35 | 15.9 | 19.6 | 35.5 | 0.13 | 12.9 | F |
| | II | 35 | 228.2 | 26.6 | 254.8 | 2.22 | 31.4 | B |
| Total | II | | 605.2 | 91.1 | 696.3 | 6.46 | 33.4 | B |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 587.3 | 617.4 | 0.25 | 1.5 | F |
| | II | 35 | 228.2 | 12.4 | 240.6 | 2.22 | 33.2 | B |
| | II | 35 | 15.9 | 17.7 | 33.6 | 0.13 | 13.6 | E |
| Haleiwa | II | 35 | 143.6 | 83.2 | 226.8 | 1.40 | 22.2 | C |
| Haleiwa/Waialua | II | 45 | 149.6 | 15.5 | 165.1 | 1.87 | 40.8 | A |
| Total | II | | 567.4 | 716.1 | 1283.5 | 5.86 | 16.4 | E |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 21.1 | 89.0 | 0.85 | 34.3 | B |
| Haleiwa | II | 45 | 149.6 | 15.4 | 165.0 | 1.87 | 40.8 | A |
| | II | 35 | 143.6 | 32.3 | 175.9 | 1.40 | 28.6 | B |
| | II | 35 | 15.9 | 27.2 | 43.1 | 0.13 | 10.6 | F |
| | II | 35 | 228.2 | 38.7 | 266.9 | 2.22 | 29.9 | B |
| Total | II | | 605.2 | 134.7 | 739.9 | 6.46 | 31.4 | B |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 1345.6 | 1375.7 | 0.25 | 0.7 | F |
| | II | 35 | 228.2 | 12.9 | 241.1 | 2.22 | 33.1 | B |
| | II | 35 | 15.9 | 18.5 | 34.4 | 0.13 | 13.3 | E |
| Haleiwa | II | 35 | 143.6 | 90.3 | 233.9 | 1.40 | 21.5 | D |
| Haleiwa/Waialua | II | 45 | 149.6 | 16.1 | 165.7 | 1.87 | 40.6 | A |
| Total | II | | 567.4 | 1483.4 | 2050.8 | 5.86 | 10.3 | F |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 6.9 | 74.8 | 0.85 | 40.9 | A |
| Haleiwa | II | 45 | 149.6 | 7.1 | 156.7 | 1.87 | 43.0 | A |
| | II | 35 | 156.7 | 5.7 | 162.4 | 1.52 | 33.8 | B |
| | II | 35 | 228.2 | 7.8 | 236.0 | 2.22 | 33.8 | B |
| Total | II | | 602.4 | 27.5 | 629.9 | 6.46 | 36.9 | A |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 15.7 | 45.8 | 0.25 | 19.9 | D |
| | II | 35 | 228.2 | 8.2 | 236.4 | 2.22 | 33.8 | B |
| Haleiwa | II | 35 | 156.7 | 29.6 | 186.3 | 1.52 | 29.4 | B |
| Haleiwa/Waialua | II | 45 | 149.6 | 9.4 | 159.0 | 1.87 | 42.3 | A |
| Total | II | | 564.6 | 62.9 | 627.5 | 5.86 | 33.6 | B |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 16.9 | 84.8 | 0.85 | 36.0 | A |
| Haleiwa | II | 45 | 149.6 | 13.1 | 162.7 | 1.87 | 41.4 | A |
| | II | 35 | 156.7 | 24.3 | 181.0 | 1.52 | 30.3 | B |
| | II | 35 | 228.2 | 26.6 | 254.8 | 2.22 | 31.4 | B |
| Total | II | | 602.4 | 80.9 | 683.3 | 6.46 | 34.0 | B |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 587.3 | 617.4 | 0.25 | 1.5 | F |
| | II | 35 | 228.2 | 12.4 | 240.6 | 2.22 | 33.2 | B |
| Haleiwa | II | 35 | 156.7 | 83.2 | 239.9 | 1.52 | 22.9 | C |
| Haleiwa/Waialua | II | 45 | 149.6 | 15.5 | 165.1 | 1.87 | 40.8 | A |
| Total | II | | 564.6 | 698.4 | 1263.0 | 5.86 | 16.7 | E |

## Arterial Level of Service: NE Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 21.1 | 89.0 | 0.85 | 34.3 | B |
| Haleiwa | II | 45 | 149.6 | 15.4 | 165.0 | 1.87 | 40.8 | A |
| | II | 35 | 156.7 | 128.3 | 285.0 | 1.52 | 19.2 | D |
| | II | 35 | 228.2 | 38.7 | 266.9 | 2.22 | 29.9 | B |
| Total | II | | 602.4 | 203.5 | 805.9 | 6.46 | 28.9 | B |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 1345.6 | 1375.7 | 0.25 | 0.7 | F |
| | II | 35 | 228.2 | 12.9 | 241.1 | 2.22 | 33.1 | B |
| Haleiwa | II | 35 | 156.7 | 90.3 | 247.0 | 1.52 | 22.2 | C |
| Haleiwa/Waialua | II | 45 | 149.6 | 16.1 | 165.7 | 1.87 | 40.6 | A |
| Total | II | | 564.6 | 1464.9 | 2029.5 | 5.86 | 10.4 | F |

## Arterial Level of Service: NB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 6.9 | 74.8 | 0.85 | 40.9 | A |
| Haleiwa | II | 45 | 149.6 | 7.1 | 156.7 | 1.87 | 43.0 | A |
| | II | 35 | 143.9 | 5.7 | 149.6 | 1.40 | 33.7 | B |
| | II | 35 | 244.8 | 7.8 | 252.6 | 2.38 | 33.9 | B |
| Total | II | | 606.2 | 27.5 | 633.7 | 6.50 | 36.9 | A |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 15.7 | 45.8 | 0.25 | 19.9 | D |
| | II | 35 | 244.8 | 8.2 | 253.0 | 2.38 | 33.9 | B |
| Haleiwa | II | 35 | 143.9 | 29.6 | 173.5 | 1.40 | 29.0 | B |
| Haleiwa/Waialua | II | 45 | 149.6 | 9.4 | 159.0 | 1.87 | 42.3 | A |
| Total | II | | 568.4 | 62.9 | 631.3 | 5.90 | 33.6 | B |

## Arterial Level of Service: NB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 16.9 | 84.8 | 0.85 | 36.0 | A |
| Haleiwa | II | 45 | 149.6 | 13.1 | 162.7 | 1.87 | 41.4 | A |
| | II | 35 | 143.9 | 24.3 | 168.2 | 1.40 | 29.9 | B |
| | II | 35 | 244.8 | 26.6 | 271.4 | 2.38 | 31.6 | B |
| Total | II | | 606.2 | 80.9 | 687.1 | 6.50 | 34.0 | B |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 587.3 | 617.4 | 0.25 | 1.5 | F |
| | II | 35 | 244.8 | 12.4 | 257.2 | 2.38 | 33.3 | B |
| Haleiwa | II | 35 | 143.9 | 83.2 | 227.1 | 1.40 | 22.2 | C |
| Haleiwa/Waialua | II | 45 | 149.6 | 15.5 | 165.1 | 1.87 | 40.8 | A |
| Total | II | | 568.4 | 698.4 | 1266.8 | 5.90 | 16.8 | E |

## Arterial Level of Service: NB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| Haleiwa/Waialua | II | 45 | 67.9 | 21.1 | 89.0 | 0.85 | 34.3 | B |
| Haleiwa | II | 45 | 149.6 | 15.4 | 165.0 | 1.87 | 40.8 | A |
| | II | 35 | 143.9 | 128.3 | 272.2 | 1.40 | 18.5 | D |
| | II | 35 | 244.8 | 38.7 | 283.5 | 2.38 | 30.2 | B |
| Total | II | | 606.2 | 203.5 | 809.7 | 6.50 | 28.9 | B |

## Arterial Level of Service: SB Kamehameha Highway

| Cross Street | Arterial Class | Flow Speed | Running Time | Signal Delay | Travel Time (s) | Dist (mi) | Arterial Speed | Arterial LOS |
|---|---|---|---|---|---|---|---|---|
| | II | 35 | 30.1 | 1345.6 | 1375.7 | 0.25 | 0.7 | F |
| | II | 35 | 244.8 | 12.9 | 257.7 | 2.38 | 33.2 | B |
| Haleiwa | II | 35 | 143.9 | 90.3 | 234.2 | 1.40 | 21.5 | D |
| Haleiwa/Waialua | II | 45 | 149.6 | 16.1 | 165.7 | 1.87 | 40.6 | A |
| Total | II | | 568.4 | 1464.9 | 2033.3 | 5.90 | 10.4 | F |

Appendix

# C

# Shoreline Certification

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

LAND SURVEY DIV
2020 AUG -3 A 11:02

**STATE OF HAWAII**
**DEPARTMENT OF LAND AND NATURAL RESOURCES**

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

August 3, 2020

File No.: OA-1889

WSP USA Inc.
c/o Nami Ohtomo
1001 Bishop Street, Suite 2400
Honolulu, Hawaii 96813

Dear Applicant:

Subject: Transmittal of Signed Shoreline Certification Maps
Owner(s): State of Hawaii, Department of Transportation
Tax Map Key: (1) 6-1-009:021 & 022; (1) 6-1-010:019 & 020; (1) 6-1-005:023

Enclosed please find three (3) copies of the certified shoreline survey maps for the subject property.

If you have any questions, please feel free to call us at (808) 587-0424. Thank you.

Sincerely,

Cal Miyahara
Shoreline Disposition Specialist

Enclosures

cc: DAGS

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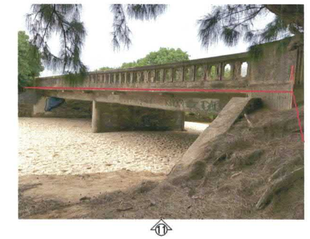

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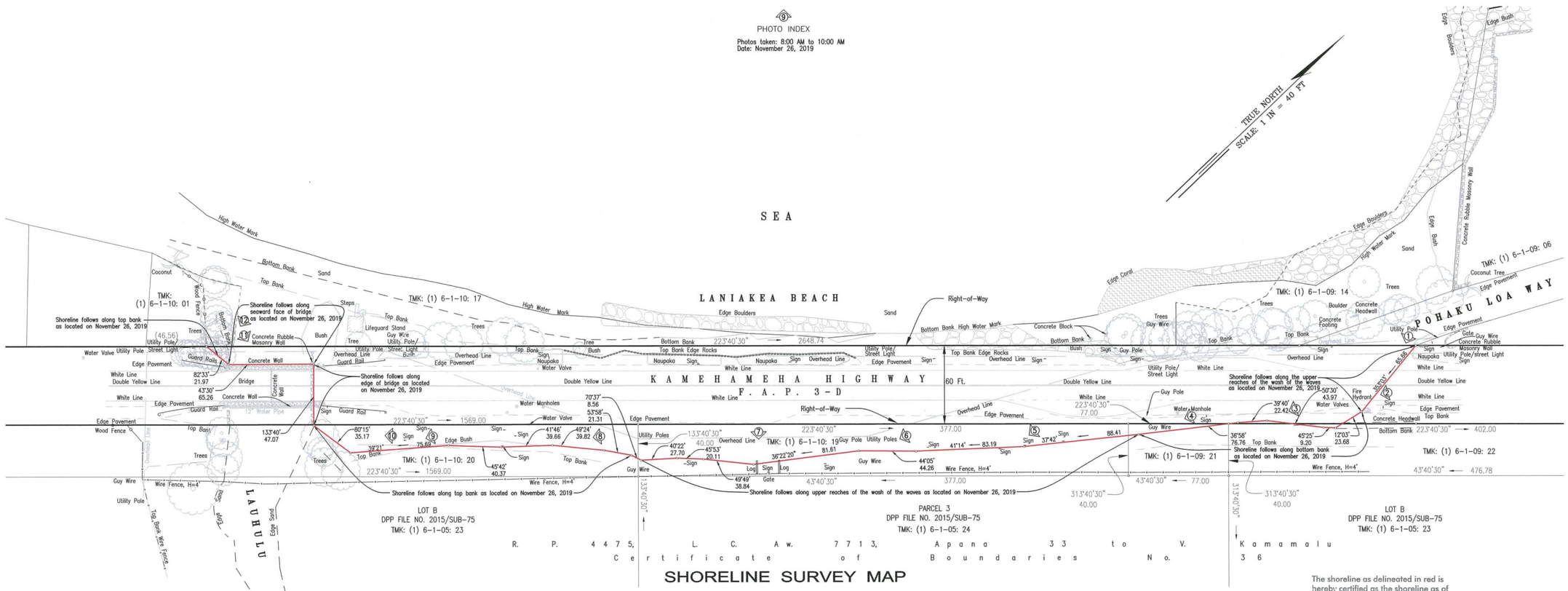
12

9

PHOTO INDEX

Photos taken: 8:00 AM to 10:00 AM
Date: November 26, 2019




NOTE:

9 Photo number and direction

# SHORELINE SURVEY MAP

PORTIONS OF KAMEHAMEHA HIGHWAY, F.A.P. 3-D,
FORMER RAILROAD RIGHT-OF-WAY ( 40-FT. WIDE) AND
PARCEL 3 AND LOT B, OF DPP FILE NO. 2015/SUB-75,
BEING PORTIONS OF R.P. 4475, L.C. AW. 7713, APANA 33 TO V. KAMAMALU
KAWAILOA, WAIALUA, OAHU, HAWAII

GRAPHIC SCALE

40 0 20 40 80 160

( IN FEET )
1 inch = 40 Feet

Owner:

City & County of Honolulu
(1) 6-1-09: 21
(1) 6-1-10: 19
(1) 6-1-05: 23
(1) 6-1-05: 24

Bishop Estate
(1) 6-1-09: 22
(1) 6-1-10: 20

Property Address:

(1) 6-1-09: 21 Pohaku Loa Way
(1) 6-1-09: 22 Pohaku Loa Way
(1) 6-1-10: 19 Kamehameha Hwy
(1) 6-1-10: 20 61-610 Kamehameha Hwy
(1) 6-1-05: 23 61-184 Kawailoa Drive
(1) 6-1-05: 24 Kamehameha Highway

The shoreline as delineated in red is hereby certified as the shoreline as of

JUL 30 2020

Chairperson, Board of Land and Natural Resources

RICO D. EROLIN
LICENSED PROFESSIONAL LAND SURVEYOR
No. 9325
HAWAII, U.S.A.

This work was prepared by me or under my direct supervision.


Rico D. Erolin
Licensed Professional Land Surveyor
Certificate Number 9325-LS
License Expires April 30, 2022

Telephone: (808) 591-2022
Email: rerolin@cpshawaii.net


File: K:\SHORELINE\2016\000\16009-02-2\dwg\16009-02-2_Rev_Shoreline.dwg

TMK: (1) 6-1-10: 19 and 20, (1) 6-1-09: 21 & 22, and (1) 6-1-05: 23 & 24
Job No.: 16009-02-2
F.B. No.: 3491B


CONTROLPOINT SURVEYING, INC.
615 Piikoi Street, Suite 700
HONOLULU, HAWAII 96814


SURVEY OFFICE COPY

36"x24"=6.0 Sq. Ft.
Plot: December 24, 2019
Field Work: November 26, 2019
Updated: June 15, 2020

Appendix

# D

# Coastal Engineering Assessment

# Coastal Engineering Assessment for the Kamehameha Highway Pedestrian Safety Realignment at Laniakea Beach

*Haleiwa, Island of Oahu, Hawaii*

*April 2021*

***Prepared for:***
WSP
1001 Bishop St., American Savings Bank Tower, Suite 2400
Honolulu, Hawaii 96813

***Prepared by:***
Sea Engineering, Inc.
Makai Research Pier
Waimanalo, HI 96795

*Job No. 25743*

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# 1. INTRODUCTION

## 1.1 Background

The State of Hawaii Department of Transportation, Highways Division (HDOT) is proposing a realignment of Kamehameha Highway (Route 83) on the North Shore of Oahu. The realignment occurs at approximately Milepost 3.3 in the vicinity of Laniakea Beach. A basalt rock headland at this location divides the coastline and provides a sheltered cove used by Hawaiian Green Sea Turtles as a grazing area. The cove has become known as "Turtle Beach" and is a popular destination for tourists to closely observe the endangered species.

The popularity of the site for both turtle watching and surfing is such that the movement of vehicles in and out of parking, and the number of pedestrians crossing the road in an uncontrolled manner causes the traffic to slow considerably. Vehicles are commonly blocked all the way to Haleiwa town. The location is also relatively unprotected during high wave events, and overwash of the highway is not uncommon. Realignment of the highway was therefore proposed to both streamline the traffic flow and provide an additional buffer against damage to the highway from future wave events with the anticipation of sea level rise due to climate change. In August 2019 after a child was hit by a vehicle and severely injured, pedestrian safety became the major project focus.

## 1.2 Location

The project location on Oahu is shown in Figure 1-1; the beach and geographic landmarks are shown on the aerial photograph in Figure 1-2. The project reach is approximately 1,000 ft in length and lies at the north end of Laniakea Beach. Pu'u Nenue is a broad basalt headland that borders the north end of Laniakea Beach, and Pu'u Kolea is a broad sand point at the south end. The offshore area is known for high quality surf, with numerous well known surf breaks including *Jocko's*, *Hultin's*, *Laniakea's*, and *Himalaya's* (see Figure 1-2). The south end of the project site includes a bridge crossing Lauhulu Stream. The site is approximately 2.3 miles from Haleiwa.

## 1.3 Project Purpose and Proposed Concepts

### 1.3.1 *Project Purpose*

The purpose of this project is to improve safety for both pedestrians and motorists by providing safe and reliable passage and access for vehicles, bicycles and pedestrians on Kamehameha Highway along with safe access to Laniakea beach for pedestrians. While funding when the project started in 2011 was specifically intended to address shoreline erosion, the project has been redesigned to focus on pedestrian safety. With safety as the emphasis, the improvements will address the following needs:

- Safety. Improve safety for pedestrians and all modes of transportation.
- Reliability. Address or accommodate coastal erosion to improve roadway reliability.
- Congestion. Relieve congestion to reduce travel times throughout the project area.
- Pedestrian and Bicycle Facilities. Help provide safe facilities for alternative transportation.

**Figure 1-1. Project location on Oahu**

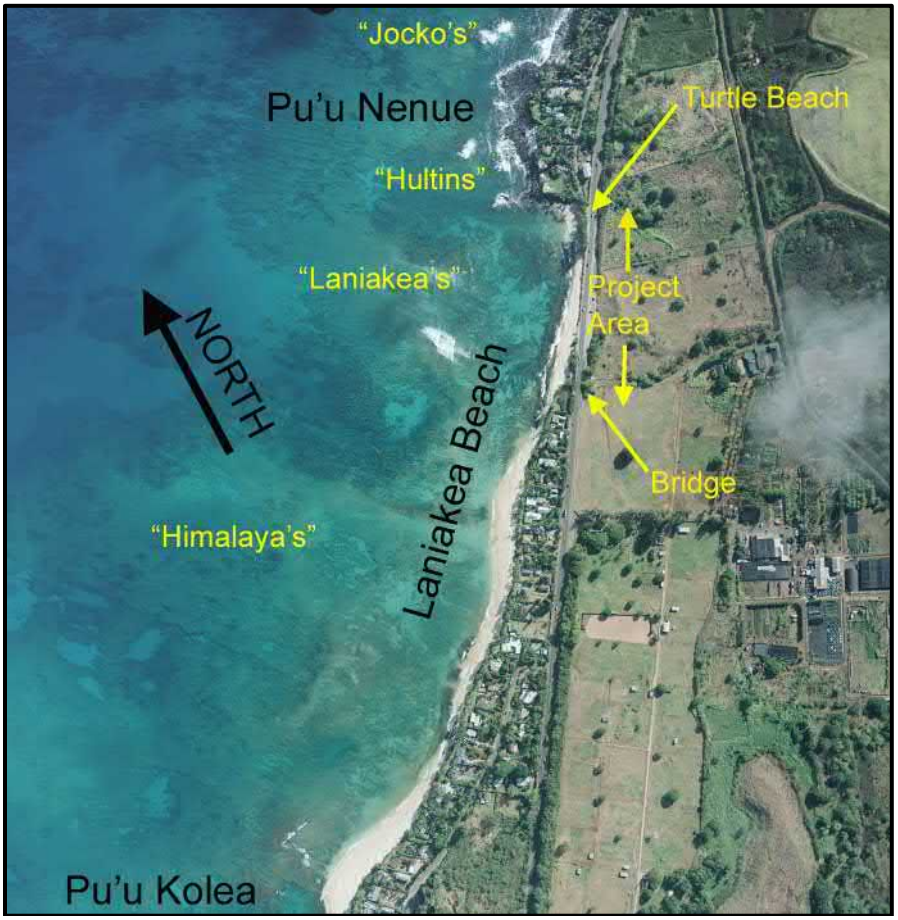



**Figure 1-2. Project area at Laniakea**

### 1.3.2 *Project Concepts*

Various project concepts have been proposed to address safety, congestion, reliability, erosion, and other issues at Laniakea Beach. A schematic section of the existing configuration is shown in Figure 1-3. This report addresses two"Build" concepts -- the "Pedestrian Shift" (Alternative 1) and the "Most" (Alternative 2) realignments. While the "Pedestrian Shift" is currently the locally preferred alternative, the "Most" Alternative has been dropped from consideration due to time and overall cost considerations. However, it is instructive to assess the "Most" Alternative as another example of realigning the highway and it has therefore been retained in this report.

In the Draft Environmental Assessment (EA) the "Pedestrian Shift" Build Alternative is evaluated along with three other concepts that assume no roadway realignment: the "No Build", the "No Build Settlement Alternative", and the "Traffic System Management" (TSM) Alternative. The "No-Build" concept would implement repairs or improvements on an as-needed basis only. The "No Build Settlement Alternative" is in response to a lawsuit filed when barriers were installed to prevent parking and would provide crosswalks from the parking area to the beach. The "TSM Alternative" would allow construction of a 1,000-foot-long guardrail on the mauka side of the highway to prevent parking.

Figure 1-5 is a plan view of the Pedestrian Shift alternative, showing the highway alignment shifted approximately 80 ft inland. The existing highway will be converted to pedestrian/bicycle access. A center utility strip will be vegetated and used for emergency vehicle access and informal parking.

The Pedestrian Shift has no open areas for parking on the mauka side of the road and also has a mauka guardrail, thereby eliminating mauka parking and pedestrian road crossing. Other features include:

• A 10-ft median refuge lane
• Vehicular guardrail to prevent parking on the mauka side of the highway
• Modification of existing cross streets and driveways to allow access to the shifted highway
• One new bridge at Lauhulu Stream
• Pedestrian and bicycle facilities consisting of a 16-ft shared use path using one lane of the existing highway

The Most alternative is a plan to move the highway as far inland as feasible, approximately 0.8 miles. A section view of the proposed alignment is shown in Figure 1-6, and a plan view is shown in Figure 1-7.

In common with the Pedestrian Shift alternative, the Most alternative keeps the pedestrian/bicycle access path and vegetated utility strip for emergency vehicle access and informal parking. Additional features of the Most alternative include:

- Vehicular guardrails will be placed on the mauka side of Kamehameha Highway during the design phase
- Two new roads will connect the new highway to the existing highway alignment
- New turn lanes where the old and new highways intersect
- Modification of existing driveways for access to the new highway
- Vehicle control gate on Pohakuloa Way

- New plantation access road
- Two new bridges at Lauhulu Stream and Kawiloa Stream
- Pedestrian/bicycle facilities on shared 16-ft path re-purposed from one lane of the old highway
- Stormwater BMP's consist of a swale on the mauka side of the highway.

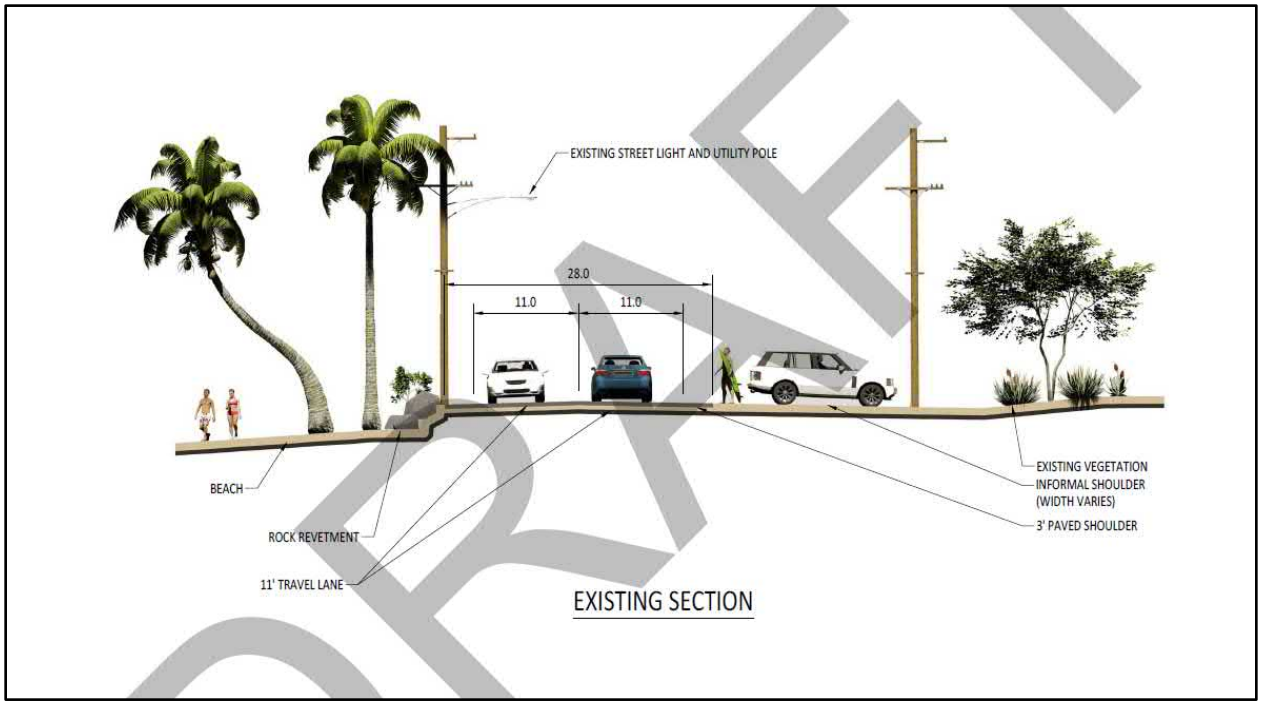



**Figure 1-3. Schematic section of the exiting configuration**

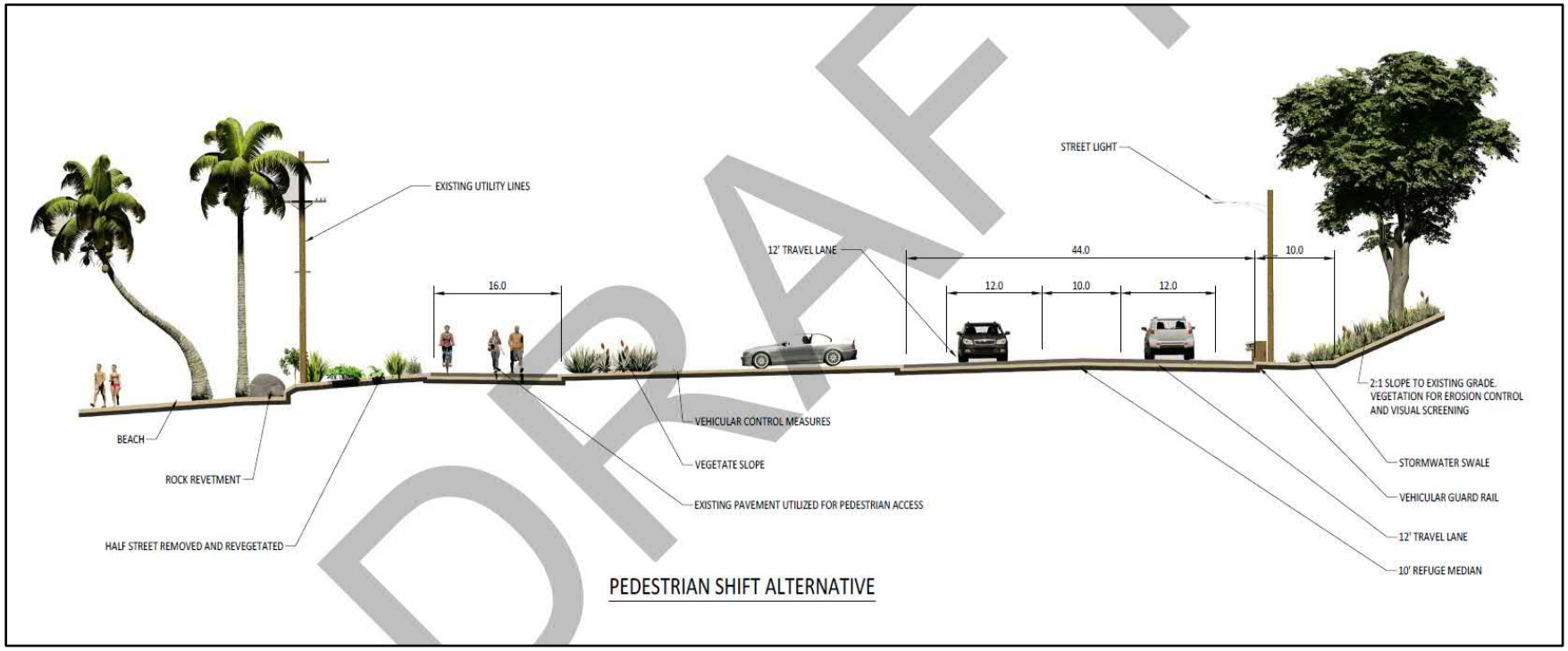



**Figure 1-4. Schematic section of the Pedestrian Shift alternative (Alternative 1)**

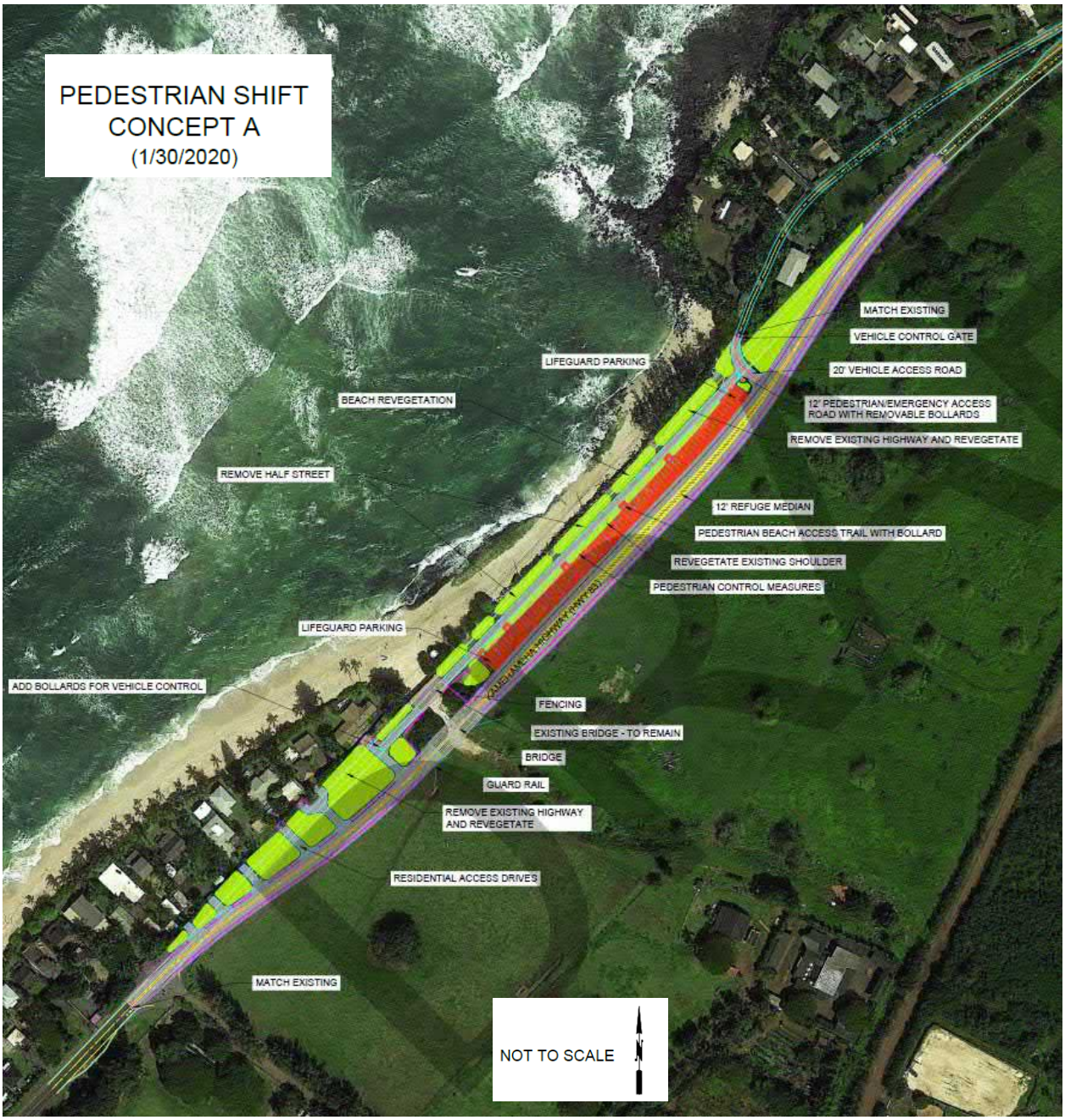



**Figure 1-5. Plan view of the Pedestrian Shift alternative**

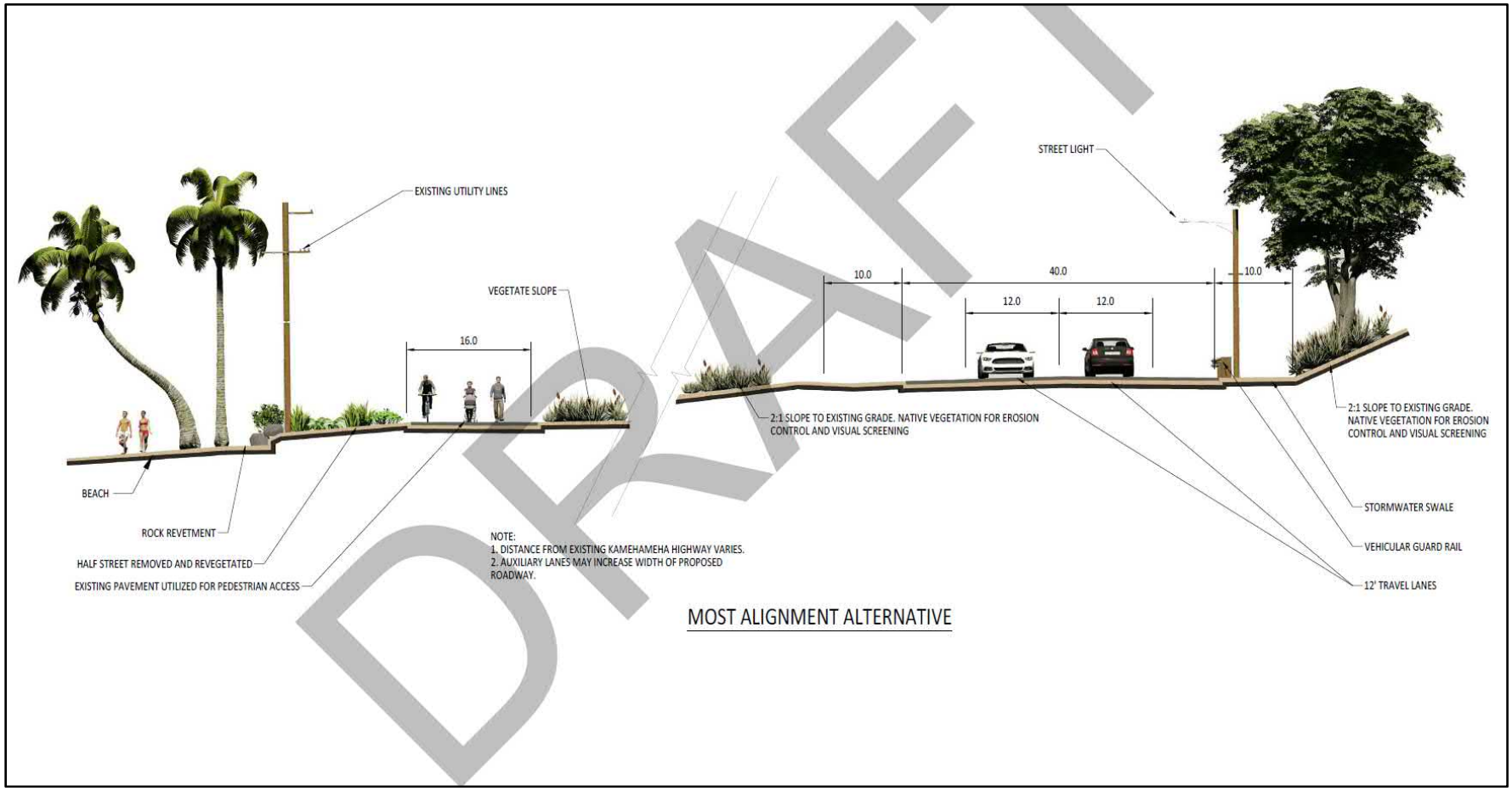



**Figure 1-6. Schematic section of the Most Alignment Alternative (Alternative 2)**

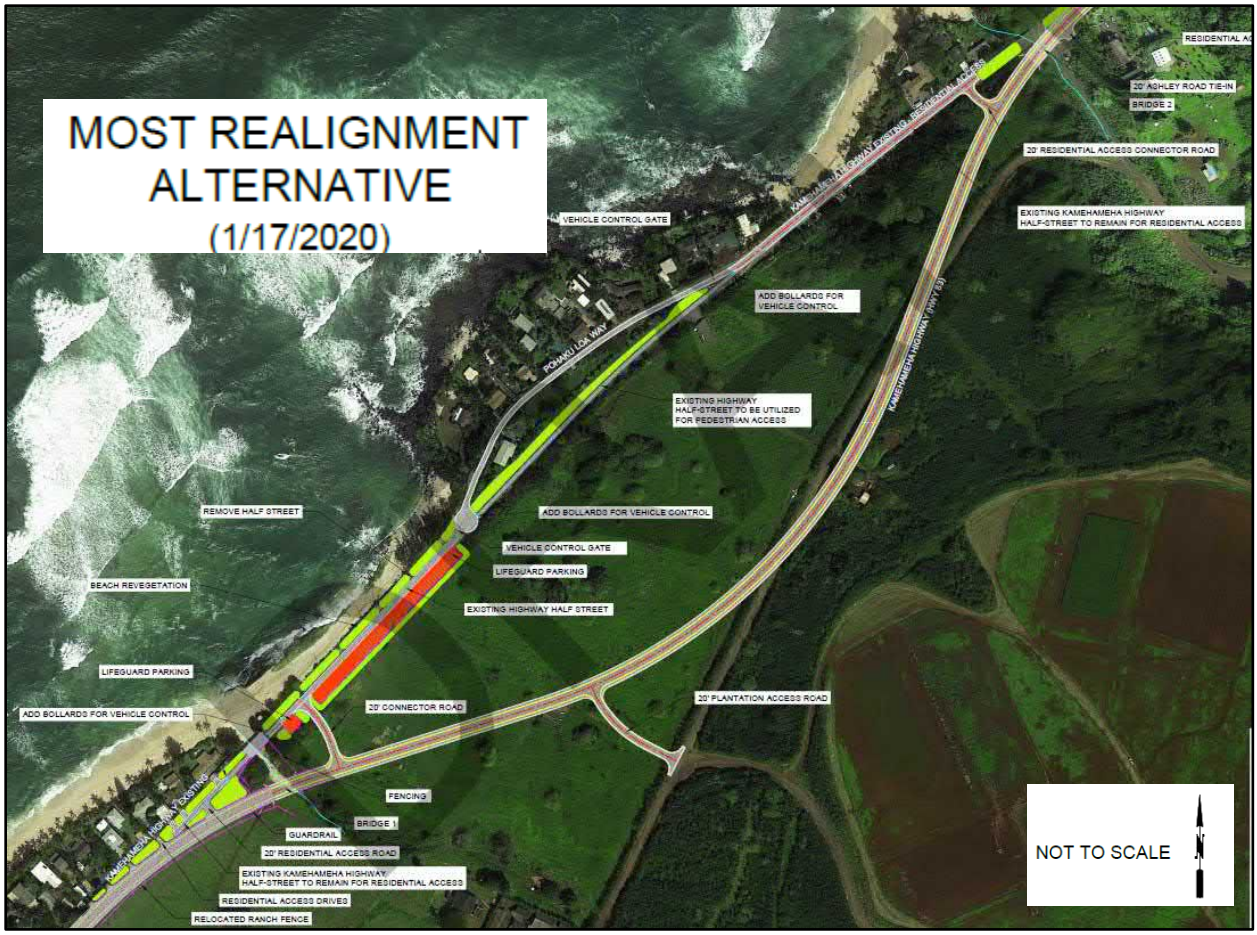



**Figure 1-7. Plan view of the Most alternative (Alternative 2)**

## 1.4 Coastal Assessment

This coastal assessment follows the State of Hawaii Office of Environmental Quality Control (OEQC) guidelines, including:

- Measurement of typical profiles across the shoreline and beach to illustrate typical conditions
- Description of the oceanographic and coastal setting, using existing available information
- Evaluation of documented and potential coastal hazards
- Description of the shoreline condition and the ongoing shoreline processes, including waves, wave run-up, and current and sediment movement
- Historical shoreline analysis of coastal erosion or accretion and shoreline changes at the project site using available aerial photographs
- Discussion of climate change and sea level rise
- Evaluation of impacts to the shoreline of proposed roadway realignments.

In addition, Section 4.4 of this report contains a summary of a companion Sea Engineering, Inc. (SEI) report to analyze tsunami runup and inundation characteristics for a 100-year tsunami event (see SEI, 2020). Section 4.7 summarizes pertinent information contained in the recent State of Hawaii Report, *Statewide Coastal Highway Program Report* (Francis et al, 2019). Section 5 contains mitigation strategies for perceived vulnerabilities and impacts.

# 2. PROJECT SITE DESCRIPTION

## 2.1 Regional Setting

The project location is on the north shore of Oahu (Figure 1-1). The region faces northwest, directly facing the most common large winter waves that the area is famous for. The winter wave climate is the dominant force that has shaped this coastline. The coastal morphology for most of the region is characterized by a high storm berm that typically varies between 15 and 25 feet in elevation depending on location and exposure. The storm berm is notably absent along much of the project area, and this allows the view from the highway to be unblocked and include the ocean.

Sand berms are common beach features that are formed by the deposition of wave-borne sand during the wave run-up process. Sand becomes suspended by the very turbulent conditions created by wave uprush, and then tends to be deposited during the more quiescent conditions at the limits of wave uprush or wave overtopping. Higher berms are created by more energetic waves. Beach berms are mostly ephemeral features that are easily erased by changing wave conditions. However, a storm berm represents the highest run-up levels achieved during extreme wave conditions and are generally fixed features. The storm berms on the north shore of Oahu are notable for their size and continuous length. While durable, certain wave conditions can cause them to erode. The sand berms are sometimes mislabeled as "dunes", but this terminology confuses the very different morphologies of eolian (wind borne) transport processes that form dunes with the hydraulic transport processes that create the storm berms.

The north shore beaches can often be seen as a "low beach" and a "high beach". The high beach consists of the storm berm, and is relatively permanent, while the low beach is the highly dynamic active beach profile that is continuously changing day to day (see Section 2.6.3).

The storm berms on the North Shore are very functional for protection against shoreline erosion. They are the primary defense for preventing wave inundation and damage along this coastline. Where the storm berms exist, overtopping and inland inundation is a rare occurrence even during extreme wave conditions.

While the storm berms are very stable during winter conditions when waves approach from the northwest – the prevailing winter season wave condition, they are vulnerable when waves approach at an oblique angle. Trade wind waves can wrap around the island and approach from the north, certain wave conditions allow approach from more westerly directions, and swell from the north is not infrequent during the winter (see Section 3.3.2). Oblique wave approach causes longshore sand transport and can attack the base of the storm berms, causing eventual slumping and erosion. Erosion hot spots in the storm berm system are not uncommon and can have serious consequences to ocean front homeowners, especially if the erosion persists during the high winter wave season.

The seasonal difference in wave climate (see Section 3.3) causes a general shift in beach width for many North Shore beaches. Trade wind waves occur year-round, and cause sand transport to the southwest during summer months with the absence of balancing waves from the northwest. During the summer, sand will accrete and form wide beaches against headlands such as Rocky Point and Kulalua Point (Ke Iki Beach / Log Cabin's), and the south side of embayments such as Kawiloa Beach. The sand is pushed back to the northeast with the advent of the winter season. The

persistent seasonal migration of sand is an important concept for understanding the coastal processes and erosional dynamics of the region.

In recent years (2016 through 2019) oceanographic phenomena have put erosional pressure on many Hawaiian beaches. Winter waves from a more northerly direction, persistent strong trade winds, and temporary high sea level anomalies are departures from normal conditions and have caused numerous erosional hot spots to develop on the North Shore and in many other locations across the islands. While such erosional conditions have occurred in the past, global climate change may be actively changing what has been perceived as the normal seasonal patterns.

## 2.2 Geology and Soils

Kawailoa Beach is on the edge of the northwest flank of the Koolau Mountains. The geology between the volcanic basalt mountains and the coast is mapped as Holocene alluvium (Figure 2-1; Sherrod et al, 2007), but as with many of the coastal plains between the mountains and the sea there are likely to be sandy beach deposits interbedded with the alluvium. Rock formations on the beach include basalt outcrops, reef rock (coralline limestone) and beach rock (cemented beach sand).

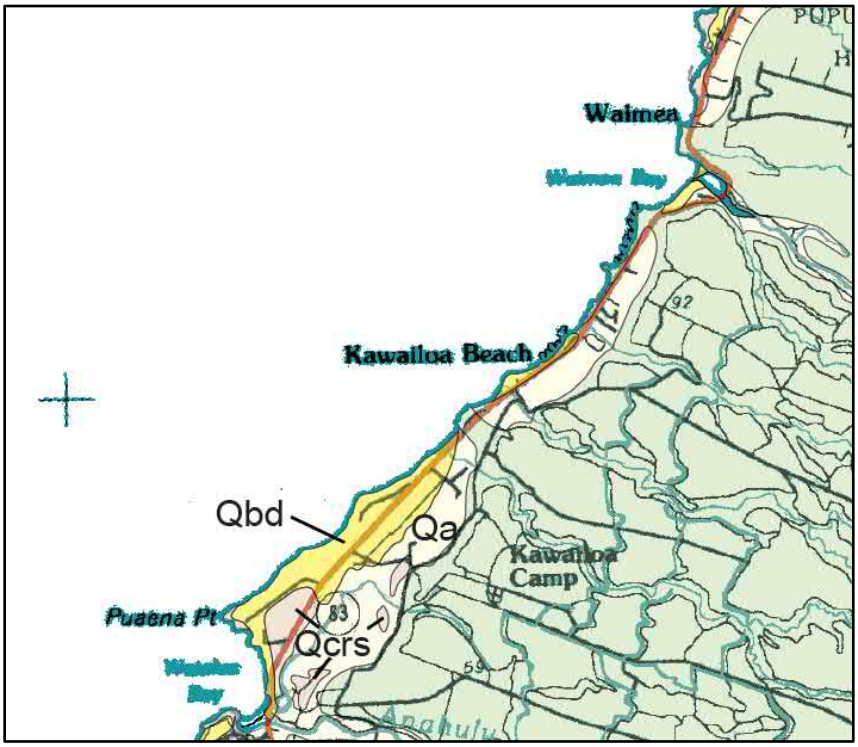



**Figure 2-1. Geologic map from Sherrod et al (2007) showing Holocene alluvium (Qa) in project vicinity**

The area soils analysis is contained in a comprehensive report by the United States Department of Agriculture Natural Resources Conservation Services (USDA- NRCS, 1972). The NRCS was formerly known as the Soil Conservation Service (SCS). Soil classification for agricultural purposes is different from both geological unit classifications and geotechnical soils classifications. Soil profiles are the sequences of natural layers, or horizons. A soil profile extends

from the surface down to the parent material that has not been changed much by leaching or by the action of plant roots. Different soil types are named for the geographic area in which they are first identified, with sub-types being known as phases. Despite using different classification methodology, the alluvial soils catalogued for the project area are compatible with the Holocene alluvium designated on the geologic map in Figure 2-1. The soils map for the area is shown in Figure 2-2.

The soils mauka of the beach sand (BS) at Kawailoa Beach have been classified by the NRCS as *Waialua Silty Clay* (WkA), with 0 to 3 percent slopes. WkB is Waialua Silty Clay with 3 to 8 percent slopes. The Wailua Silty Clay is a phase of the Waialua Series of moderately well drained soils on alluvial fans on Oahu. The soils are derived from weathered basalt. The Wailua Silty Clay is present on smooth coastal plains. The surface layer is about 12 inches in thickness and is a dark reddish-brown silty clay. The sub-soil is about 26 inches in thickness and is also dark reddish-brown and reddish-brown in color, with a sub-angular blocky structure. Permeability of the soil is moderate. W1B is the Waialua stony silty clay, composed of Waialua Silty Clay with enough stones to hinder tillage.

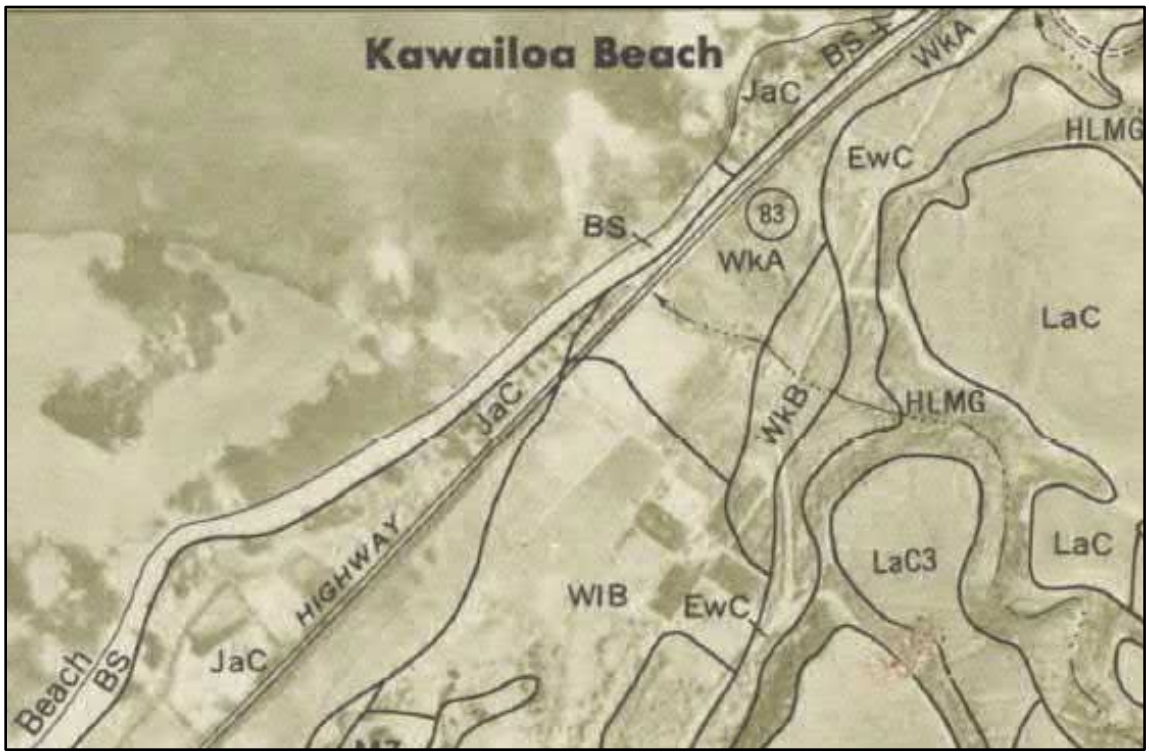



**Figure 2-2. Soil types in the project area**

The southern part of the reach is dominated by Jaucas Sand (JaC). It is composed of excessively drained, calcareous soils. The slope range is 0 to 15 percent and can be more than 60 inches deep. In many places the accumulation of organic matter has turned the surface layer dark brown. The soils are permeable, with low runoff.

Inland areas also contain soil types Ewa Stony Silty Clay (EwC - 6 to 12 percent slopes) and Wahiawa Silty Clay (WaB – 3 to 8 percent slopes). The Ewa Stony Silty Clay has moderate permeability, has a dark reddish-brown color and is about 42 inches in thickness. Surface stones can interfere with tillage. The substratum is coral limestone or gravelly alluvium.

Wahiawa Silty Clay is part of the Wahiawa Series of well-drained soils. They are formed from old alluvium derived from basalt. The surface layer is very dusky red and dusky red silty clay about 12 inches in thickness. The subsoil is about 48 inches in thickness with a dark reddish-brown color and subangular blocky structure. Underlying material is composed of weathered basalt.

## 2.3 Benthic Habitat

Geomorphology and benthic habitat offshore of the project site are shown in Figure 2-3 and Figure 2-4 from the Pacific Islands Ocean Observing System (PACIOOS) Voyager website. The data were originally collected by the National Oceanographic and Atmospheric Administration (NOAA). The images indicate that the site is primarily reef pavement and sand deposits. Biological components consist primarily of turf algae, macroalgae, and coralline algae.

Bottom conditions were also described for the site in the 1983 Oahu Coral Reef Inventory prepared by Aecos, Inc.:

> *The bottom at a depth of around 20 feet off Pu'u Nenue is mostly smooth limestone with little relief. Toward Laniakea Beach, sand channels are located offshore, breaking up the solid limestone bottom into isolated mounds of reef rock. The largest channel occurs offshore of Lauhulu Bridge. Southwest of this channel, overall relief of the limestone bottom increases. A flat bottom at -15 feet drops to depressions at -35 feet, with arches and overhangs around the margins. The depressions contain sand and rubble.*

The flora and fauna were also described in the Aecos report and are compatible with the PACIOOS data:

> *Fleshy algae dominate the bottom off Pu'u Nenue and Laniakea Beach, with 60% cover contributed by Gelidiopssi sp., Turbinaria ornata, Dictyosphaeria cavernosa, and other forms. There is little coral cover. Off Laniakea Beach, coral cover reaches 15%. Pocillopora meandrina and Montipora spp. are most abundant on the deeper, irregular bottom, while Porites lobata and M. flabellate contribute the most cover on the limestone plain at -15 feet. Large Acanthuridae are plentiful around sharp breaks in the bottom topography.*

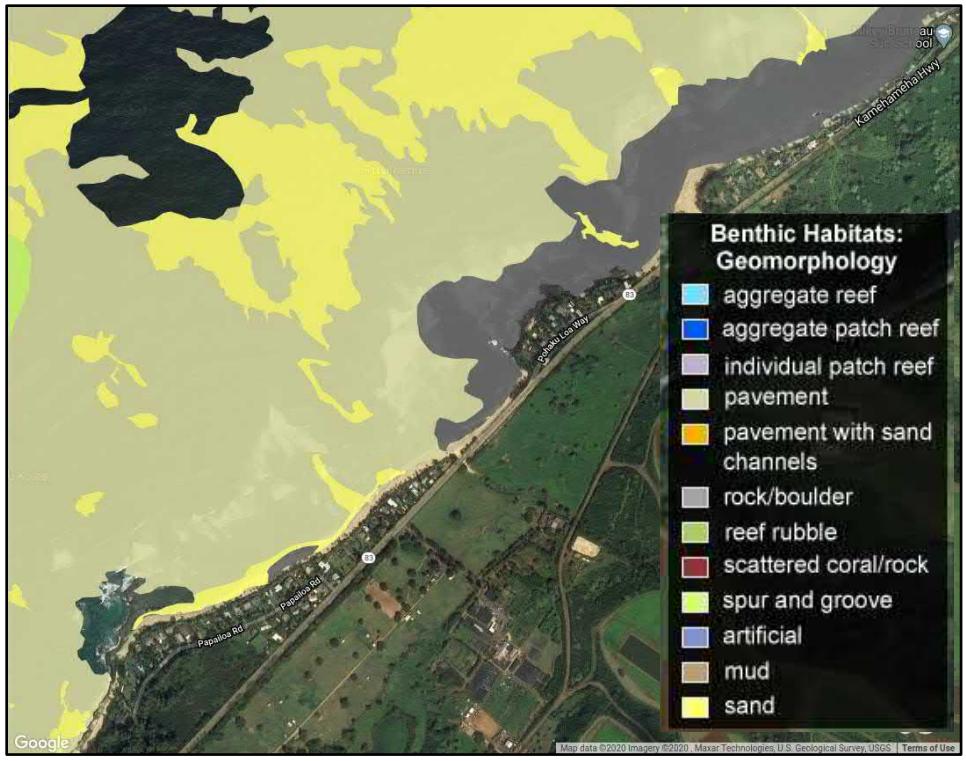



**Figure 2-3. Geomorphology offshore of the project site**

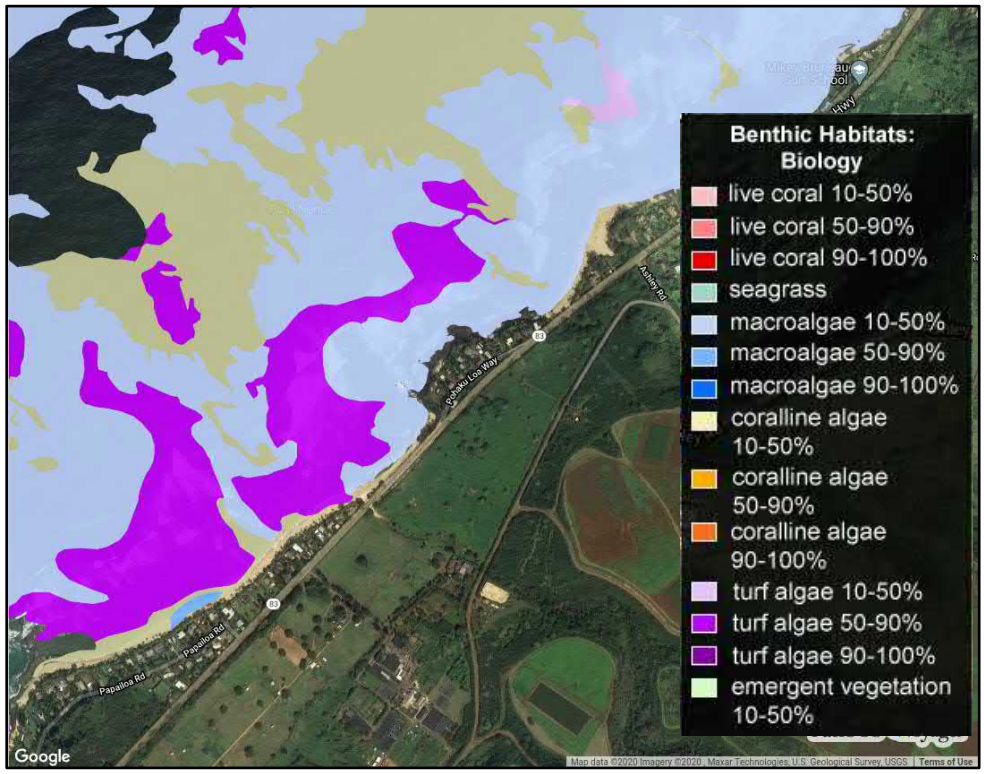



**Figure 2-4. Benthic Habitat offshore of the project site**

## 2.4 Bathymetry

Figure 2-5 is a bathymetry map of the area offshore of the project generated using LiDAR (Light Detection and Ranging) data collected by the U.S. Army Corps of Engineers in 2013. The LiDAR technique uses airborne lasers to penetrate the water and reflect off the seafloor. It is limited to relatively shallow water and calm conditions without breaking waves. The map shows the reefs associated with the four surfing breaks in the area, as well as the two relatively deeper channels on either side of the Laniakea surf site.

The offshore fringing reefs are a first defense against the large winter wave climate. Waves break and dissipate on these reefs so that they become much smaller and less energetic by the time they reach the shoreline.

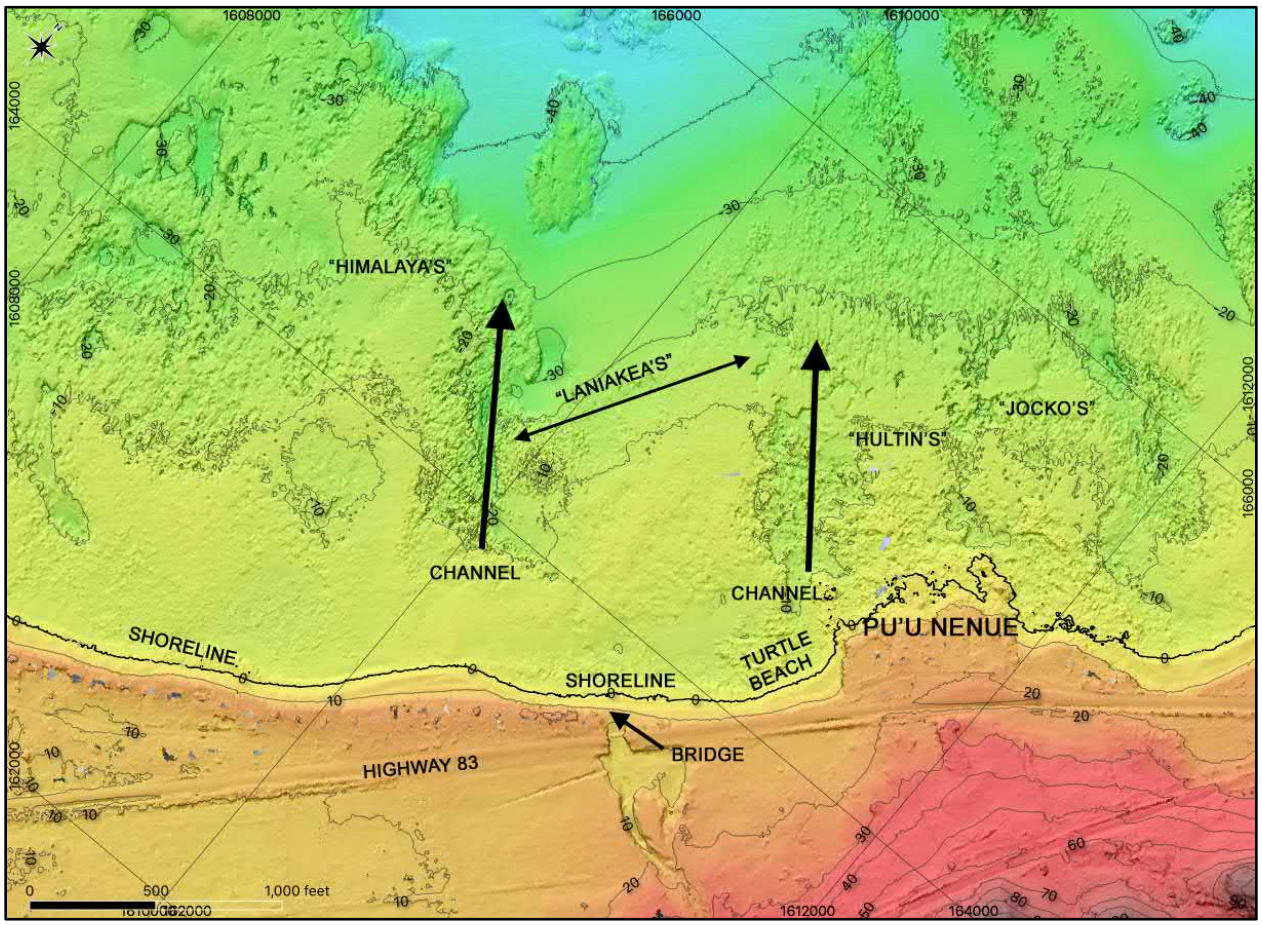



**Figure 2-5. LiDAR bathymetry and topographic map of the project area**

The bottom contours have a great effect on wave formation. The phenomenon of wave refraction causes waves to focus and concentrate over some of the reef promontories. The converse can be true in the channel areas, where waves may tend to radiate and spread out. Figure 2-6 shows the focusing effect of the reef off Pu'u Nenue. The figure is from one of the seminal papers on the wave refraction phenomenon by Walter Munk et al (1947). The figure also shows relatively quiet water in the channel and at Turtle Beach.

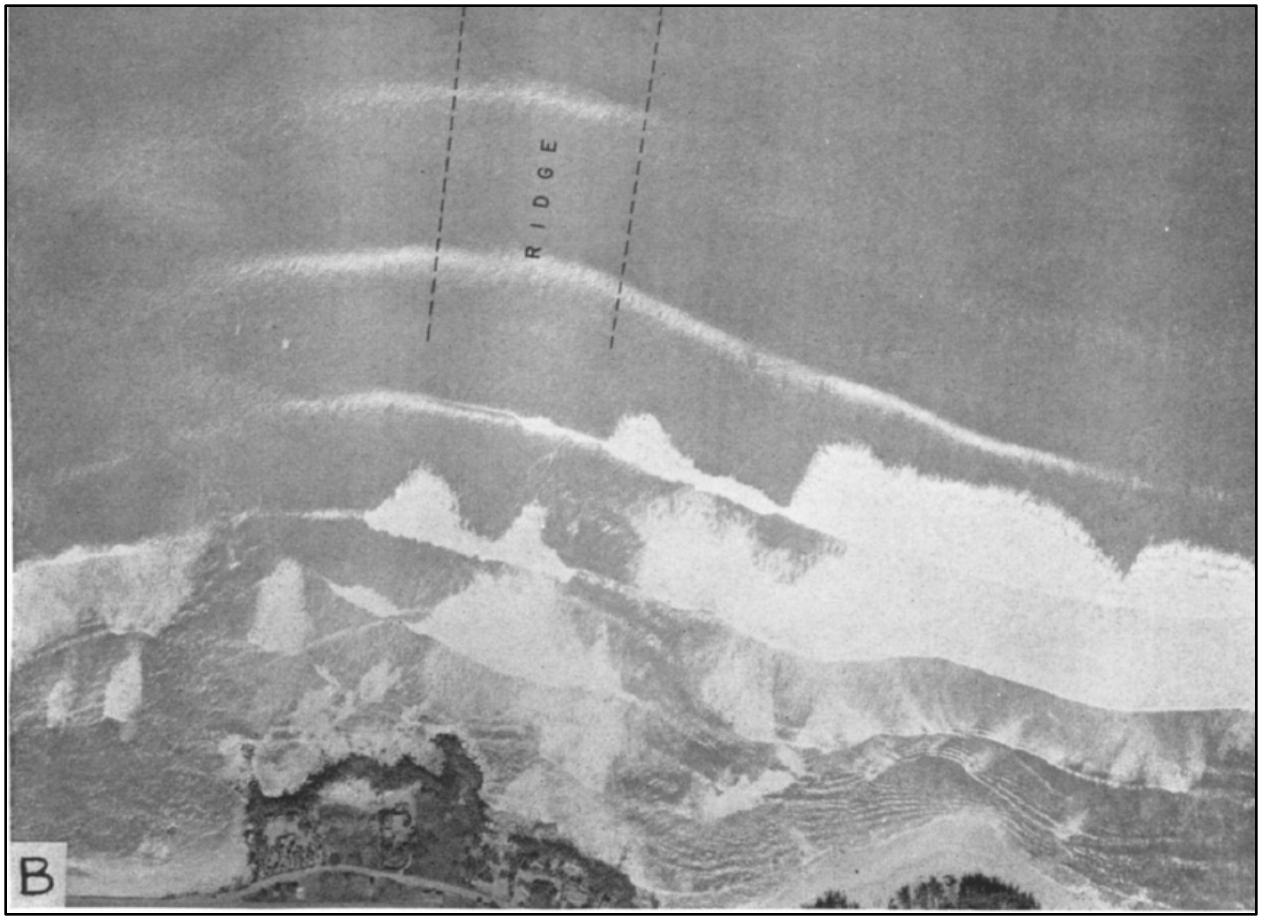



**Figure 2-6. Wave concentration due to refraction at Pu'u Nenue (from Munk et al, 1947)**

## 2.5 Shoreline History

Kawailoa Beach is dynamic, showing large variations in sand distributions, but the long-term shoreline position appears stable. The UHCGG (2010) conducted a shoreline erosion study for Oahu by analyzing the position of the beach low water mark on a series of historical aerial photographs. The Kawailoa Beach analysis used eight photographs from 1928 through 2006 as well as two "T-Sheets" from 1910 and 1924. The T-Sheets are historic coastal surveys that can be useful for showing long term changes if properly rectified to a modern coordinate system. The 1924 T-Sheet is shown in Figure 2-7. Many existing geomorphological features were mapped at that time, including the breakers at the Laniakea surfing site, Pu'u Nenue and Pu'u Kolea, the channel between Laniakea and Hultin's, a possible road near the existing highway, and the ubiquitous beach rock ledge that runs along much of the shoreline. Much of the survey appeared to be concerned with nearshore small boat navigation features such as good landings and channels through the reef.

The UHCGG historical aerial photograph analysis is shown in Figure 2-8. The analysis uses shore-perpendicular transects at 20-meter (66 ft) intervals.

The transects are weighted and smoothed to calculate the shoreline change rate. Each shoreline position is assigned a cumulative uncertainty based on a sum of potential errors in the process. Figure 2-9 is a plotted data set from a typical transect, showing the uncertainties for each point. The shoreline change rate is calculated using a weighted least squares regression (solid line). However, in this data set as well as most in this geographic vicinity, the uncertainty is greater than the change rate. The shoreline change values must therefore be used with care, with the observation that these results are indicative of a dynamic shoreline with broad migrations of sand within the littoral cell.

The UHCGG transect study shows areas of long-term beach toe recession on the order of 0.5 to 1.0 ft per year, and similar areas of accretion on the order of up to 0.5 ft per year. All of these transects are within the same littoral cell, and all accretion and erosion rates have associated high uncertainty values. The study shows the inherent difficulty of applying historical aerial photograph analysis to a highly dynamic beach. In fact, the T-sheets and photos indicate remarkably little change at this beach.

## 2.6 Site Description

A site visit was made by SEI on April 3, 2020 to assess the beach condition, beach morphology, and local geology. The project area comprises a distance of approximately 1,000 ft at the north end of Kawiloa Beach. There are three distinct structural morphologies from north to south along the reach: Turtle Beach, the revetment reach, and the storm berm reach (Figure 2-10).

### 2.6.1 *Turtle Beach*

At Turtle Beach the basalt Pu'u Nenue headland transitions to a very rough reef rock substrate. The transition area is buried by sand. Reef rock is coralline limestone formed from ancient reefs. It was likely formed during a time of higher sea level and may have been repeatedly exposed and inundated by multiple sea level changes. It is fossiliferous, rough, and weathered (Figure 2-11). At Turtle Beach the reef rock is intermittently covered with sand in low areas (Figure 2-12).

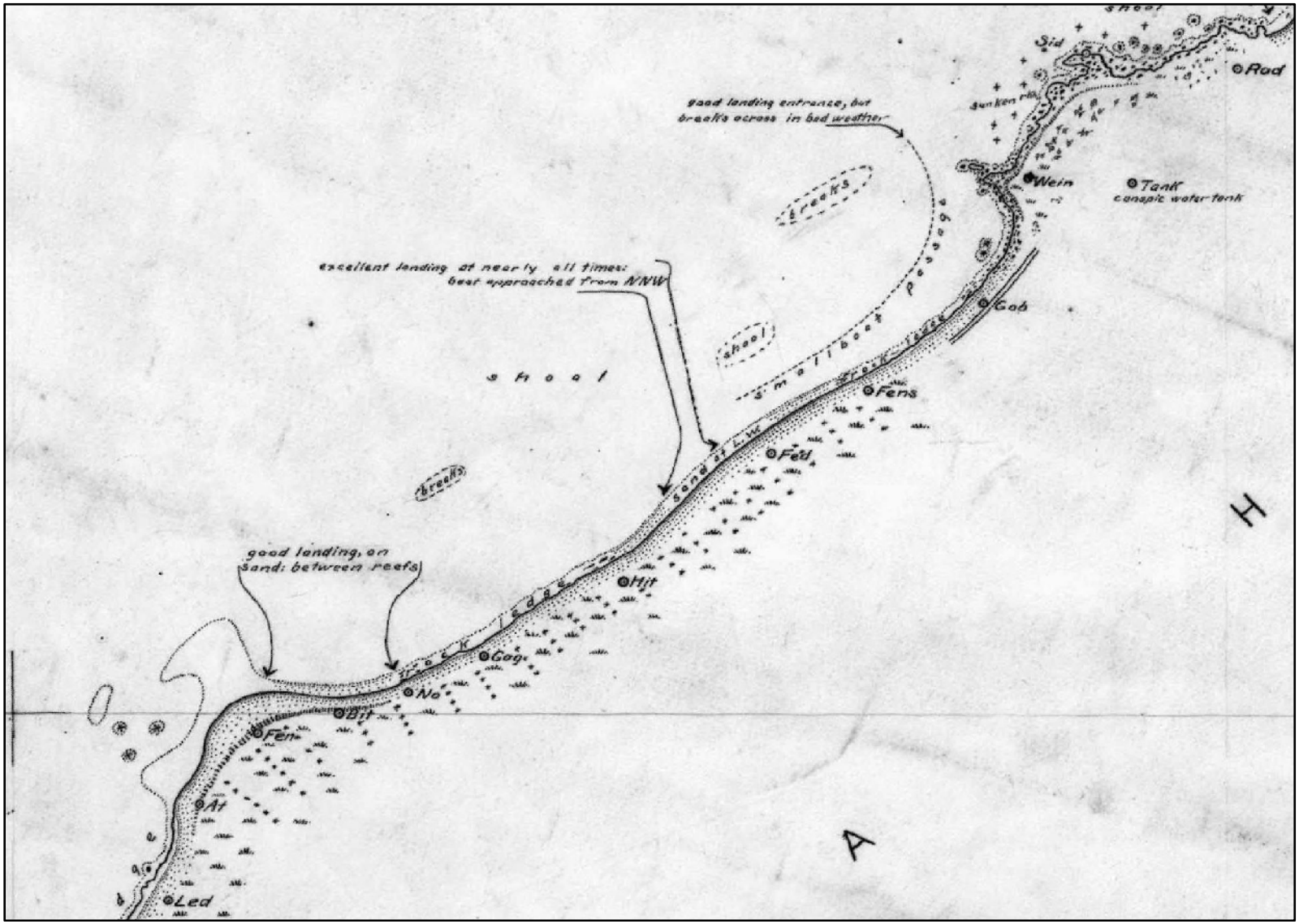



**Figure 2-7. 1924 T-Sheet of Kawailoa Beach**

**Figure 2-8. Historical aerial photograph analysis by UHCGG**

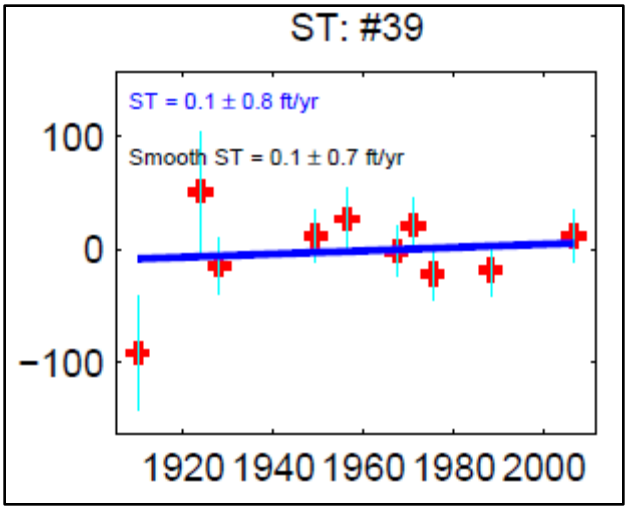



**Figure 2-9. Data analysis of Transect 39 from UHCGG study**

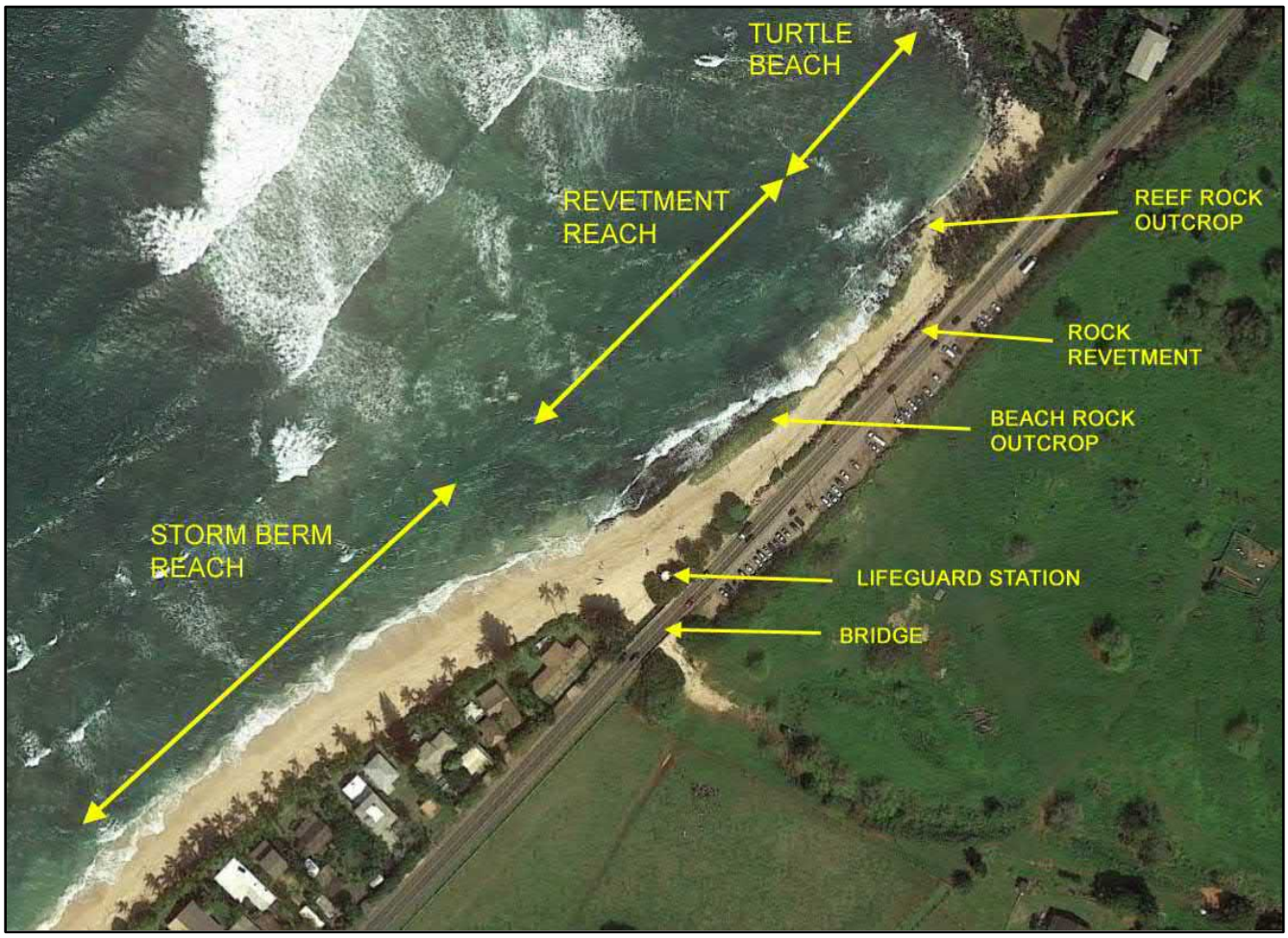



**Figure 2-10. Site reaches and features**

The beach is backed by a steep uncemented rock wall made from stacked basalt boulders (Figure 2-13). The back beach area, including the basalt wall is well-vegetated and does not show evidence of recent wave overtopping.

**Figure 2-11. Reef rock outcrop at Turtle Beach**

**Figure 2-12. Turtle Beach from Pu'u Nenue**

**Figure 2-13. Stacked boulder wall behind Turtle Beach**

### 2.6.2 *Revetment Reach*

The rock rubblemound revetment transitions from the stacked wall at Turtle Beach and extends approximately 450 ft to a location approximately 180 ft north of the bridge. For discussion purposes the revetment reach includes the reach beyond the end of the revetment, including the lifeguard station.

Beside the presence of a rubblemound rock revetment, the revetment reach is characterized by an abrupt transition from reef rock to shoreline outcrops of beach rock (Figure 2-14). Beach rock is a type of sandstone formed by weakly cemented beach sand and is a fundamentally different type of rock from reef rock. The beach rock outcrops underly much of the sand at Kawiloa Beach and are shown on the 1924 T-Sheet (Figure 2-7).

The rock revetment is a continuation of the stacked rock wall from the Turtle Beach reach with larger stone size and vertical height. Figure 2-15 shows a section of the wall in good condition (foreground) adjacent an area showing wall collapse. Figure 2-16 shows some of the typical revetment damage.

As designed, the wall is steep with well-interlocked stones. At damaged areas stones have been pulled away from the structure and are scattered on the beach. Some of the underlying stones are quite small and will likely be stripped away quickly during a major storm wave event. The

highway embankment soils are exposed at many locations along the reach. Although still functioning as shore protection, the structure is vulnerable to extreme storm wave conditions.

**Figure 2-14. Boundary between beach rock (foreground) and reef rock near Turtle Beach**

**Figure 2-15. Revetment reach shown original wall structure (foreground) and damaged area**

**Figure 2-16. Damaged revetment**

The rock revetment ends abruptly with scattered stones approximately 180 feet north of the bridge abutment (Figure 2-17). The lifeguard station is on a sandy knoll next to the bridge abutment and is unprotected by rock boulders. The lifeguard station is shown in Figure 2-18, and the north bridge abutment is shown in Figure 2-19.

**Figure 2-17. Scattered boulders mark the end of the rock revetment**

**Figure 2-18. Lifeguard Station**

**Figure 2-19. North bridge abutment**

Revetment Armor Stone Size Analysis

The stone size of the existing revetment was analyzed in order to understand what level of protection is being provided. Ten of the larger stones were measured along three axes. The average stone dimension is 3.0 ft in diameter. Stone weight for that dimension is just over two tons (4,300 lbs.). For a revetment designed to modern standards, the stone weight correlates with a design nearshore wave height of 6.5 ft.

### 2.6.3 *Storm Berm Reach*

Much of Oahu's North Shore is characterized by a relatively unique storm berm morphology. Storm berms are the high sand berm found at the most landward part of the beach backshore. They are formed by wave uprush, overwash and sand deposition during infrequent large scale wave conditions. In contrast to the storm berm, the "active berm" is a transient beach feature at a lower elevation - part of the active beach profile - generated by smaller prevailing wave conditions. During extreme wave conditions, beach features that may be present during lower wave conditions may disappear, revealing the beach storm profile, including the storm berm. Figure 2-20 is a profile taken at Sunset Beach during moderate wave conditions. The storm profile, including the storm berm, is shown schematically with removal of the active profile.

Although similar in appearance to a storm berm, beach dunes are a wind-generated morphology with very different characteristics. Storm berms are often confused with dunes and, in fact, the two morphologies can be mixed at one location. Berms are limited by the wave runup elevation, while dune height is limited by sand supply, local terrain, and prevailing wind characteristics. Dune sand generally has a much finer grain size distribution than that found in the storm berm.

The Norths Shore storm berms extend with minor interruptions from Sunset Beach to Kulalua Point (Shark's Cove) and from Laniakea to Puaena Point. They are remarkable for their height and length. The berms are formed by the very large winter waves that arrive from the northwest, almost orthogonal to the shoreline. The storm berm at Sunset Beach is approximately 27 ft in elevation (Figure 2-20). Corresponding wave runup values correlate with extreme waves and return periods of 10 years and greater.

The high elevation of the storm berm morphology on the North Shore is due to the very large wave heights that prevail during the winter months (see Section 3.3.2). However, the stability of the storm berms is due to orthogonal ("straight on") approach of these waves. When waves approach at high angles of incidence, the base of the berms is eroded by longshore sand movement, leading to berm slumping and collapse. Anomalies in the wave climate, such as sustained trade wind waves, hurricane waves and other types of north swell, or anomalous west swells can destroy long reaches of the storm berm and threaten private property.

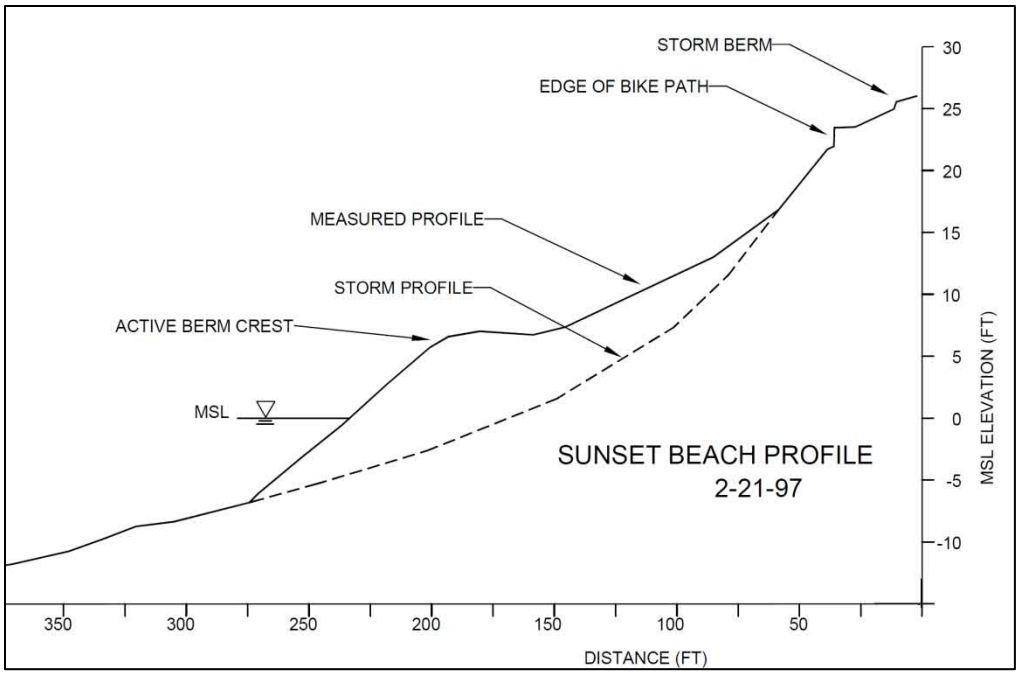



**Figure 2-20. Active (measured) and storm profiles at Sunset Beach**

The storm berm morphology at Kawailoa Beach begins just south of the bridge. The sand berm rises 5 to 10 ft higher than the elevation of the revetment reach. The entire reach is subdivided into lots with single family homes. Individual properties show signs of protective measures to counter erosion, primarily the deployment of geotextile drapes to protect the berm slopes (Figure 2-21 and Figure 2-22). Berm stabilization efforts using vegetation are also in evidence.

The April time frame of the site visit is part of the transitional period between the winter wave climate and the summer wave climate (see Section 3.3.2). Scarping of portions of the beach profile are indications of adjustment and sand migration (Figure 2-23). These observations were corroborated by a long-time local resident.

The storm berm reach appears to be underlain by a wide expanse of reef rock sandstone. The full extent of this formation is not known.

**Figure 2-21. Geotextile drape protection for the storm berm**

**Figure 2-22. Geotextile drape storm berm protection**

**Figure 2-23. Beach scarping indicating initiation of sand migration; note broad beach rock foreshore**

## 2.7 Beach Profiles

Topographic mapping and beach profiles of the project area were done by combining GPS-based survey with 2013 LIDAR (Light Detection And Ranging) surveys conducted by the National Ocean Survey (NOS). Figure 2-24 is a plot of the combined surveys showing the location of profile transects. The profiles are shown on Figure 2-25 and Figure 2-26.

Profiles 1 through 6 are in the Turtle Beach and revetment reaches. These profiles show good agreement between the Lidar and land surveys. Profile 7 is in the middle of the stream, where variation in sand quantities are to be expected. Profile 8, on the edge of the stream bank also shows expected variation. Profiles 9 and 10 are in the storm berm reach and show variations in beach sand quantities on the active beach profiles. The September time frame of the LIDAR survey is at the end of the summer season of trade wind transport and sand migration to the south. A depletion of sand at this north section of Kawiloa Beach is to be expected.

The storm berm profiles are also significantly higher in maximum elevation than the Turtle Beach and revetment reach, with elevations reaching over 20 ft (note: Profile 8 is likely affected by stream clearing operations). As noted in the previous section this height is likely the historical overwash elevation from infrequent extreme wave events.

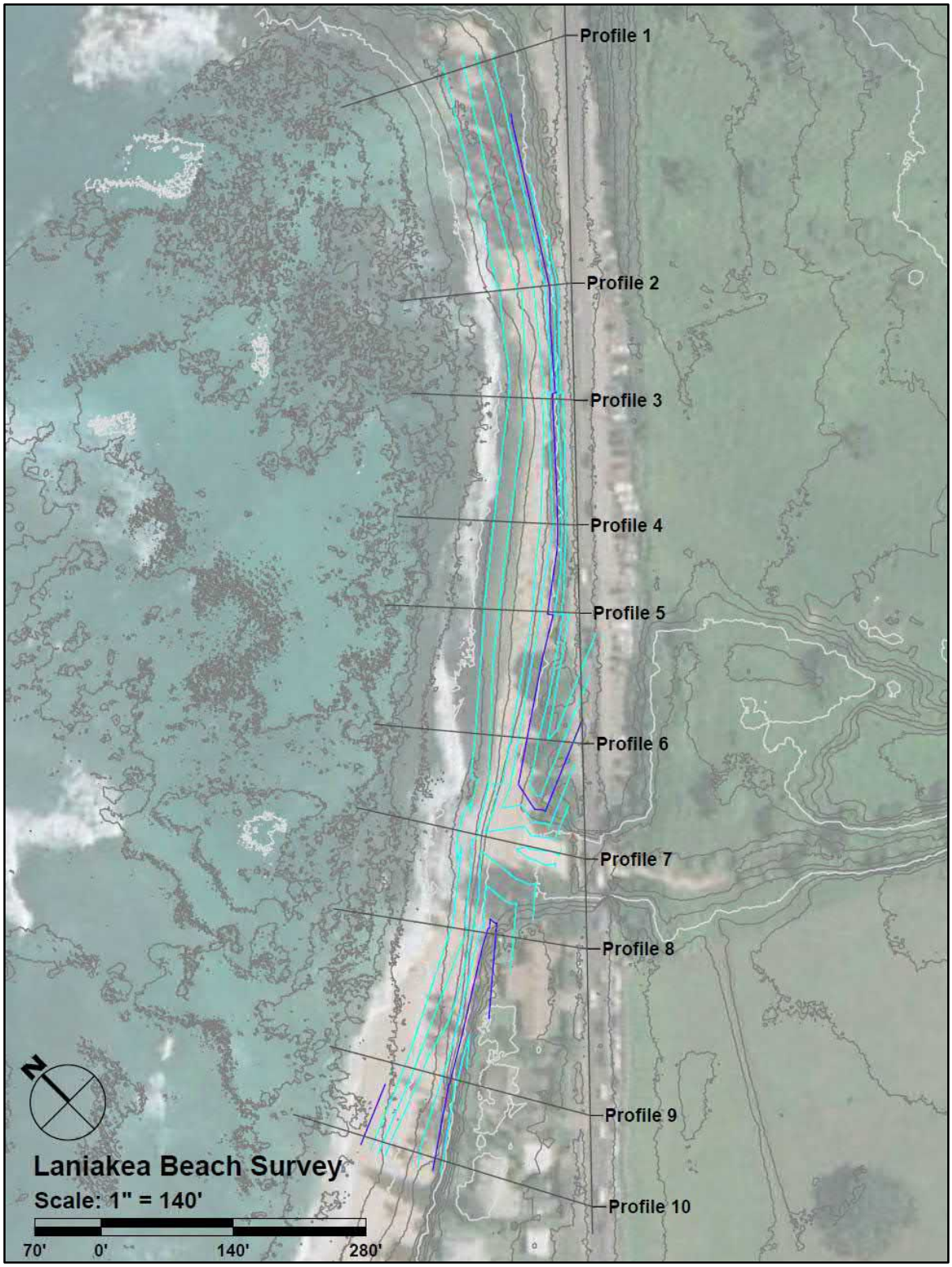



**Figure 2-24. Combined LiDAR and land survey**

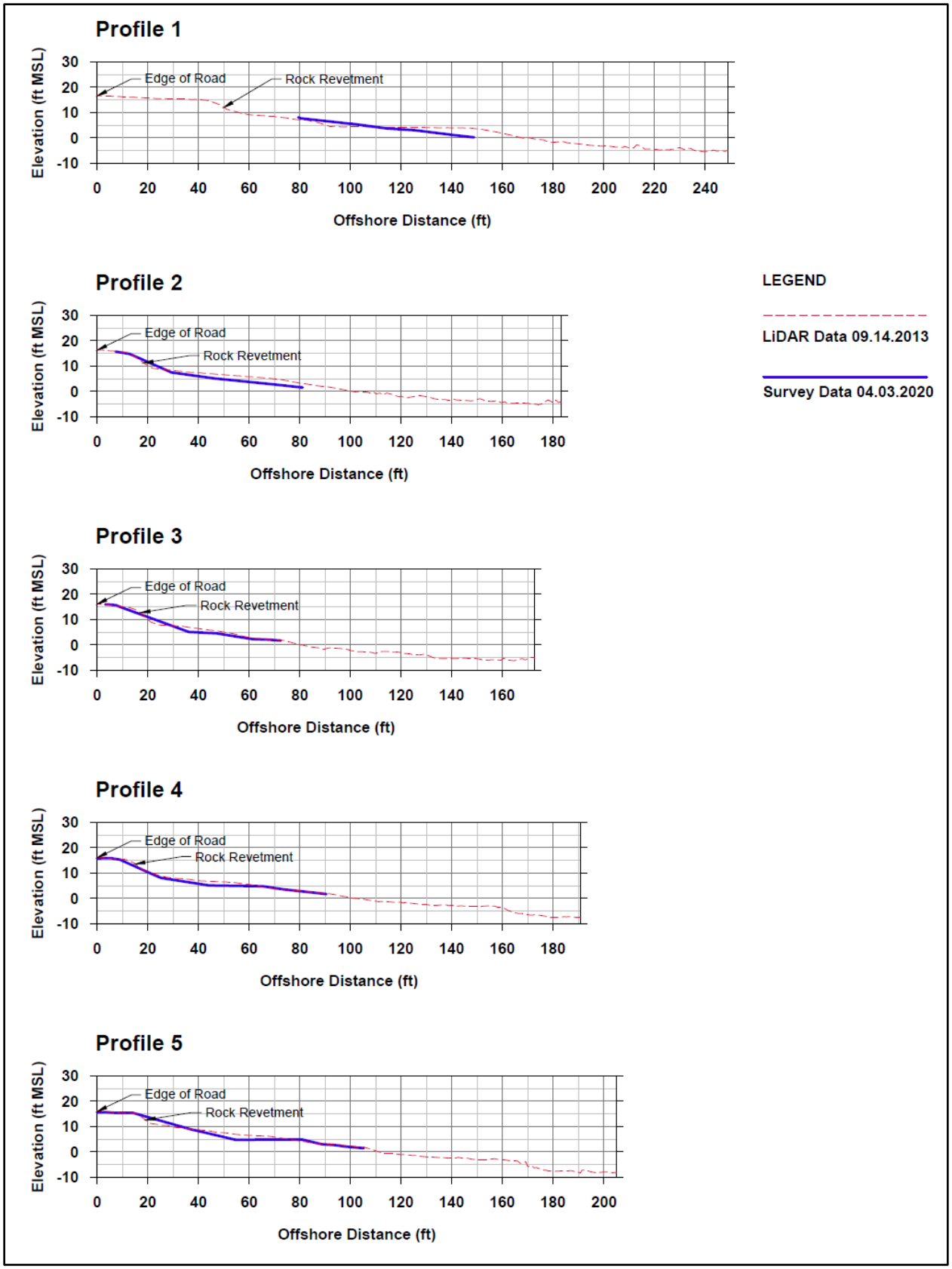



**Figure 2-25. Project area profiles (1 of 2)**

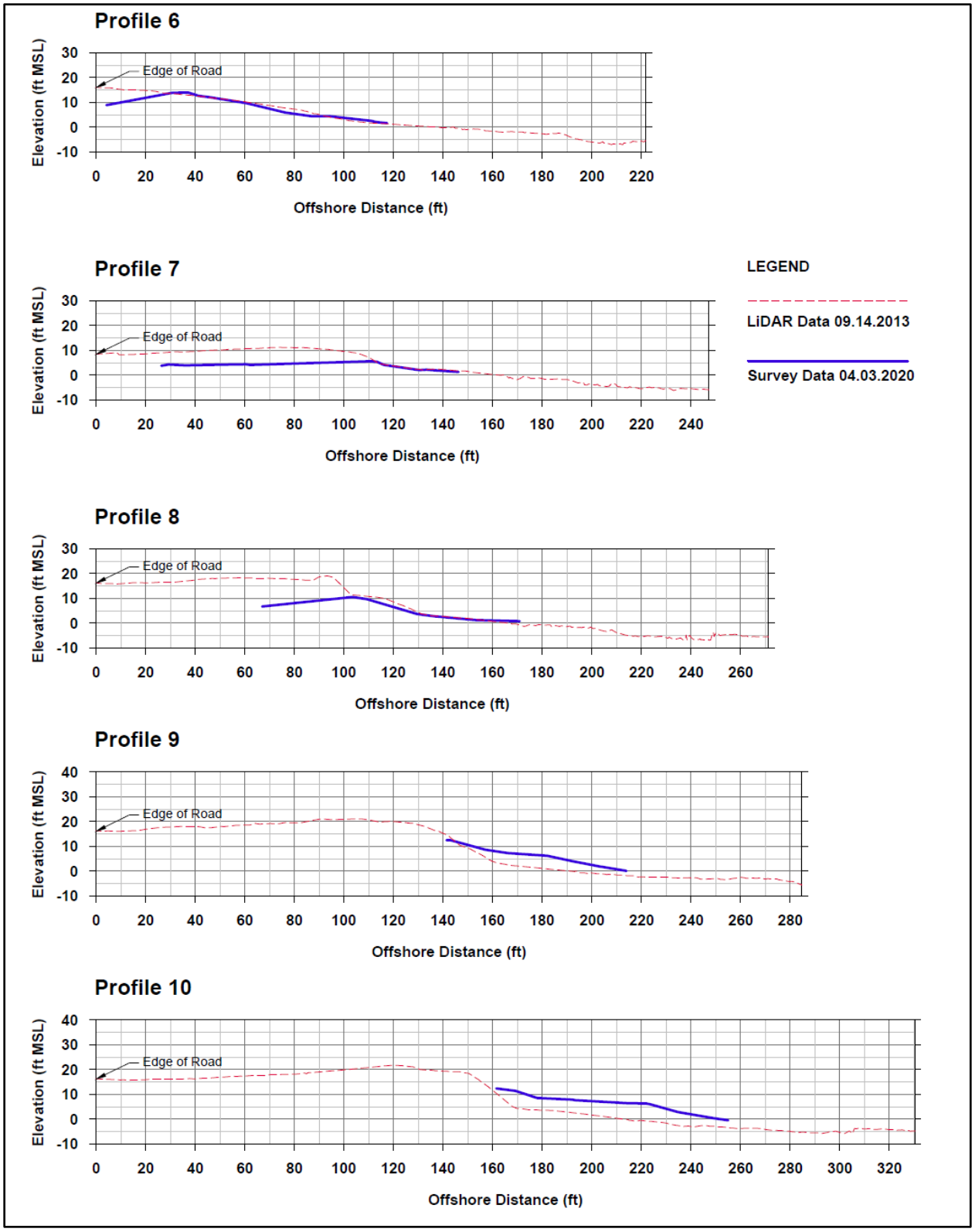



**Figure 2-26. Project area profiles (2 of 2)**

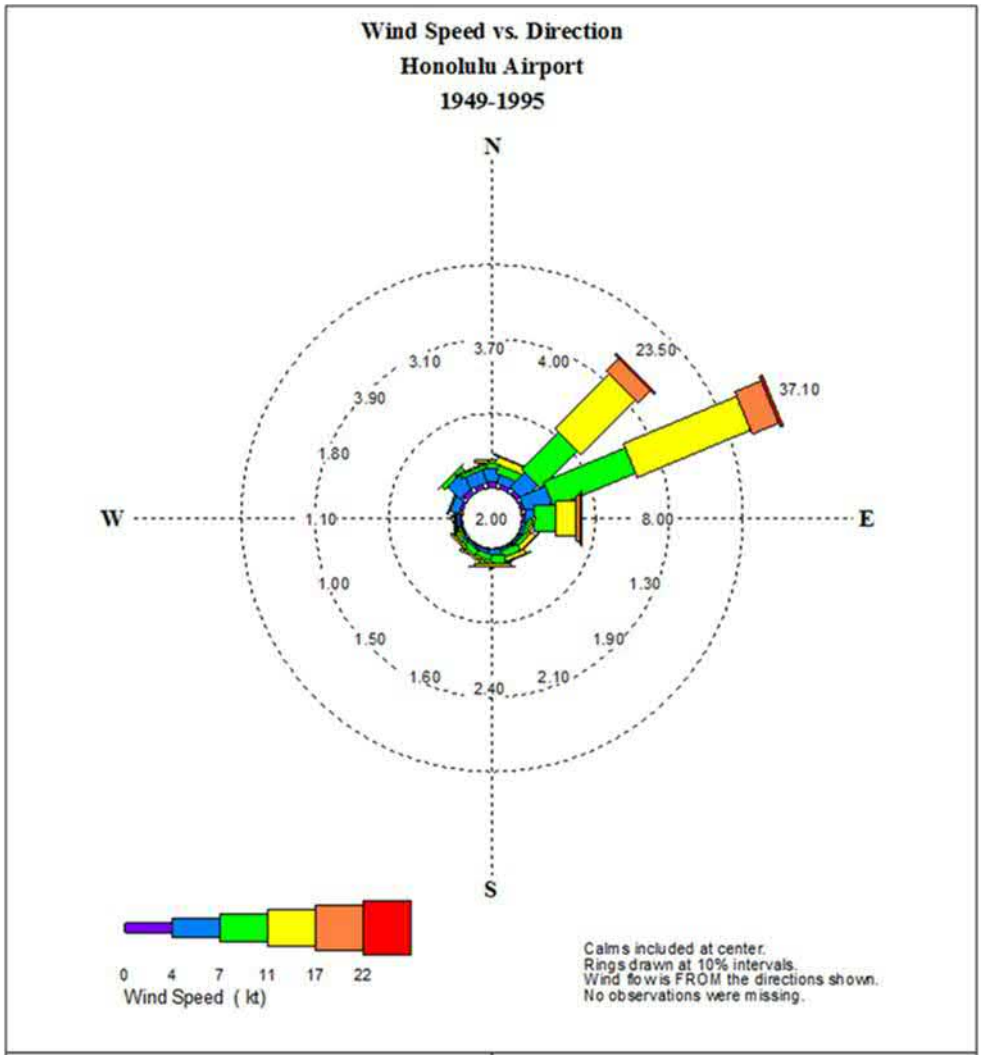
# 3. OCEANOGRAPHIC SETTING

## 3.1 Winds

The prevailing winds throughout the year in Hawaii are the northeasterly trade winds. Trade wind frequency varies from more than 90% during the summer season to only 50% in January, with an overall annual frequency of 70%. Westerly, or Kona, winds occur primarily during the winter months, generated by low pressure systems near the islands. Figure 3-1shows a wind rose diagram applicable to the project site based on wind data recorded at Daniel K. Inouye International Airport between 1949 and 1995.

Trade winds are produced by the outflow of air from the Pacific Anticyclone high pressure system, also known as the Pacific High. The center of this system is located well north and east of the Hawaiian chain and moves to the north and south seasonally. In the summer months, the center moves to the north, causing the trade winds to be at their strongest from May through September. In the winter, the center moves to the south, resulting in decreasing trade wind frequency from October through April. During these months, the average monthly trade wind frequency of occurrence decreases to about 50%.

Wind patterns of a more transient nature increase during the winter months. Winds from extra-tropical storms can be very strong from almost any direction, depending on the strength and position of the storm. The low-pressure systems associated with these storms typically track west to east across the North Pacific, north of the Hawaiian Islands. At Daniel K. Inouye International Airport, gusts resulting from these storms have on several occasions exceeded 60 mph. Kona winds are generally from a southerly to southwesterly direction and are sometimes associated with slow moving low pressure systems known as Kona lows situated to the west of the island chain. These storms are often accompanied by heavy rains.




PERCENT OCCURRENCE: Wind Speed ( kt)
LOWER BOUND OF CATEGORY

| DIR | 0 | 4 | 7 | 11 | 17 | 22 |
|---|---|---|---|---|---|---|
| N | 0.80 | 1.70 | 0.90 | 0.30 | 0.00 | 0.00 |
| NNE | 0.50 | 1.20 | 1.20 | 1.00 | 0.10 | 0.00 |
| NE | 0.60 | 2.80 | 7.10 | 10.30 | 2.40 | 0.30 |
| ENE | 0.40 | 3.80 | 12.00 | 16.60 | 3.90 | 0.40 |
| E | 0.30 | 1.30 | 2.90 | 2.80 | 0.60 | 0.10 |
| ESE | 0.10 | 0.40 | 0.50 | 0.30 | 0.00 | 0.00 |
| SE | 0.10 | 0.30 | 0.70 | 0.70 | 0.10 | 0.00 |
| SSE | 0.10 | 0.30 | 1.00 | 0.60 | 0.10 | 0.00 |

TOTAL OBS = 134736 MISSING OBS = 0

PERCENT OCCURRENCE: Wind Speed ( kt)
LOWER BOUND OF CATEGORY

| DIR | 0 | 4 | 7 | 11 | 17 | 22 |
|---|---|---|---|---|---|---|
| S | 0.10 | 0.60 | 1.20 | 0.40 | 0.10 | 0.00 |
| SSW | 0.10 | 0.40 | 0.80 | 0.30 | 0.00 | 0.00 |
| SW | 0.10 | 0.30 | 0.80 | 0.30 | 0.00 | 0.00 |
| WSW | 0.10 | 0.20 | 0.40 | 0.30 | 0.00 | 0.00 |
| W | 0.20 | 0.50 | 0.20 | 0.20 | 0.00 | 0.00 |
| WNW | 0.40 | 1.20 | 0.20 | 0.00 | 0.00 | 0.00 |
| NW | 0.80 | 2.40 | 0.60 | 0.10 | 0.00 | 0.00 |
| NNW | 0.60 | 1.80 | 0.50 | 0.20 | 0.00 | 0.00 |

CALM OBS = 2695 PERCENT CALM = 2.00

**Figure 3-1. Frequency of occurrence of wind speed and direction, Daniel K. Inouye International Airport**

### 3.1.1 *Extreme Winds*

The annual maximum 2-minute averaged wind speeds are available for the NOAA weather station at Honolulu International Airport for the 44-year period from 1969 to 2012. Results are presented in Table 3-1, ordered by wind speed. Some of the annual maxima shown are associated with specific storm events, most notably, the highest value of 46 miles per hour in November of 1982 which was the result of the passage of Hurricane Iwa. Other events include Hurricane Iniki in

1992 at 38 miles per hour, and several severe Kona storms with wind speeds up to 40 miles per hour.

**Table 3-1. Annual Maximum 2-minute Wind Speeds at Daniel K. Inouye International Airport**

| Year | Wind Speed (MPH) | Year | Wind Speed (MPH) |
|---|---|---|---|
| 1982 | 46 | 1972 | 33 |
| 1969 | 40 | 1973 | 33 |
| 1970 | 40 | 1993 | 33 |
| 2004 | 40 | 1999 | 33 |
| 2007 | 39 | 2010 | 33 |
| 2011 | 39 | 1997 | 32 |
| 1976 | 38 | 2003 | 32 |
| 1992 | 38 | 2005 | 32 |
| 1977 | 37 | 1994 | 31 |
| 2008 | 37 | 2006 | 31 |
| 1975 | 36 | 1981 | 30 |
| 2002 | 36 | 1985 | 30 |
| 1980 | 35 | 1986 | 30 |
| 1990 | 35 | 1989 | 30 |
| 2000 | 35 | 2012 | 30 |
| 2001 | 35 | 1987 | 29 |
| 2009 | 35 | 1988 | 29 |
| 1971 | 34 | 1984 | 28 |
| 1974 | 34 | 1991 | 28 |
| 1978 | 34 | 1995 | 28 |
| 1979 | 34 | 1996 | 28 |
| 1998 | 34 | 1983 | 23 |

An extreme value distribution was applied to the 44-annual maximum 2-minute averaged wind speed records to develop expected extreme wind speeds for various return periods ranging from 1 to 100 years. The extreme value wind speeds are presented in Table 3-2.

The report Hurricanes in Hawaii (Haraguchi, 1984), prepared for the U. S. Army Corps of Engineers, Honolulu Engineer District, presents a hypothetical hurricane model and a series of worst-case scenarios for the Hawaiian Islands. The model hurricane is defined as the probable hurricane that will strike Hawaii in the future, based on the characteristics of storms that have previously approached or struck the islands. The worst-case hurricane characteristics are derived from a subjective analysis of the data from 20 significant hurricanes in the Central Pacific and an understanding of the basic atmospheric and oceanic conditions surrounding the Hawaiian Islands.

Haraguchi estimated the model hurricane wind speed in the vicinity of the Hawaiian Islands to be 75 miles per hour. This value falls beyond the 100-year return period wind predicted by the extreme value distribution for Honolulu, shown in Table 3-2 By comparison, the maximum 2-

minute averaged wind recorded at Daniel K. Inouye International Airport in the last 44 years (1969 to 2012) was 46 miles per hour, which is equivalent to the 50-year wind speed from Table 3-2.

**Table 3-2. Extreme Value Distribution Return Periods for 2-Minute Averaged Wind Speeds at Daniel K. Inouye International Airport (1969 to 2012)**

| Return Period (years) | Wind Speed (MPH) |
|---|---|
| 1 | 33.3 |
| 2 | 35.6 |
| 5 | 38.7 |
| 7 | 39.8 |
| 10 | 41.0 |
| 15 | 42.3 |
| 20 | 43.3 |
| 25 | 44.0 |
| 30 | 44.6 |
| 40 | 45.6 |
| 50 | 46.3 |
| 75 | 47.7 |
| 100 | 48.6 |

## 3.2 Water Levels

### 3.2.1 *Tides*

Hawaii tides are semi-diurnal with pronounced diurnal inequalities (i.e. two high and two low tides each 24-hour period with different elevations). Variation of the tidal range results from the relative position of the moon and the sun. During full moon and new moon phases, the moon and sun are in line and act together to produce larger "spring" tides, where the difference between high and low tide is the greatest. When the moon is in its first or last quarter, smaller "neap" tides occur, where the difference between high and low tide is the least. The cycle of spring to neap tides and back is half the 27-day period of the moon's revolution around the Earth and is known as the "fortnightly cycle". The combination of diurnal, semi-diurnal and fortnightly cycles dominates variations in sea level throughout the Hawaiian Islands.

*King Tides* is a colloquial term that has become popular in recent years to describe coastal flooding. The term has been used as a label for abnormally high tides that are the result of a combination of water level phenomena. *Perigean spring tides* are the highest tide levels of the year and are caused by the combined alignments of the earth, sun, and moon during the winter and summer months when the moon is closest to the earth (*perigee*). Perigean spring tides are strictly an astronomical phenomenon. Other water level phenomena include localized ocean gyres, or *mesoscale eddies*, that raise local sea level by up to 0.5 ft, and larger scale ocean basin phenomena related to El Nino that can also raise sea level by up to 0.5 ft. The combination of these phenomena became highly noticeable during the summer of 2017 when the King Tide label became widespread.

Tidal predictions and historical extreme water levels are provided by the National Ocean and Atmospheric Administration (NOAA) NOS (National Ocean Service) Center for Operational

Oceanographic Products and Services (CO-OPS). The nearest NOAA tide station is located at Honolulu Harbor (Station ID: 1612340). Water level data from Station 1612340, based on the 1983 to 2001 tidal epoch, is shown in Table 3-3.

**Table 3-3. Water Level Data for Honolulu Harbor, Station 1612340 (NOAA)**

| Datum | Elevation (feet, MLLW) | Elevation (feet, MSL) |
|---|---|---|
| Mean Higher High Water (MHHW) | +1.90 | +1.08 |
| Mean High Water (MHW) | +1.44 | +0.62 |
| Mean Sea Level (MSL) | +0.82 | 0.0 |
| Mean Low Water (MLW) | +0.16 | -0.66 |
| Mean Lower Low Water (MLLW) | 0.00 | -0.82 |

### 3.2.2 *Still Water Level Rise*

Storms and large waves can produce elevated water levels at the shoreline. During annual large wave or heavy storm conditions this water level rise can be on the order of a foot above the tide level. However, during extreme events, the still water level rise can be significantly greater.

During high wave events, the nearshore water level may be elevated above the tide level by the action of breaking waves offshore. This water level rise, termed *wave setup*, may be as much as 10 to 12% of the breaker height. Thus, the water level could be elevated an estimated 1 to 2 feet during severe storm wave conditions.

During strong storm or hurricane conditions, with high winds and very low pressures, an additional water level rise due to wind stress and reduced atmospheric pressure can occur. The combined effect is known as *storm surge*, and this rise can potentially add another 1 to 2 feet to the stillwater level. For example, during the 1992 passage of Hurricane Iniki over Port Allen Harbor on the island of Kauai, a National Weather Service tide gauge recorded a water level rise of 4.9 feet above the predicted tide elevation.

The potential stillwater level rise at the shoreline is an important design parameter because nearshore wave heights are limited by the water depth. Water level rise due to wave setup or storm surge, added to high tide levels, will therefore increase the size of nearshore waves.

The total stillwater level rise is a linear combination of:

1) Astronomical tide (Sa),
2) Sea level rise due to atmospheric pressure reduction (Sp),
3) Wind tide caused by wind stress component perpendicular to the coast line (Sx),
4) Wind tide caused by wind stress component parallel to the coast line (Sy), and
5) Wave set-up on the beach due to breaking waves (Sw).

or,

$$S = Sa + Sp + Sx + Sy + Sw$$

The combination of Sp, Sx and Sy is defined as storm surge. Outside of the breaking surf zone, the stillwater level is composed of storm surge added to the tide level.

### 3.2.3 *Sea Level Anomalies*

The ocean surface has a variable elevation. Sea level anomalies are the difference between the measured and predicted tides apart from the relatively short term storm and wave event related phenomena. The anomalies may be caused by climatic and oceanographic processes, both regional and widespread.

Large oceanic eddies have recently been recognized that propagate through the islands. These eddies, termed *mesoscale eddies* (Merrifield, 2004) produce tide levels that can be on the order of 0.5 ft higher (and sometimes lower) than normal for periods up to several weeks. An additional temporary but long-lived sea level rise on the order of 0.5 feet has also been associated with phenomena related to the El Niño / Southern Oscillation (ENSO). The combined effect can produce sea level anomalies up to one foot above the predicted tides.

In 2017, Hawaii experienced anomalous sea levels which caused significant inundation of low-lying urban areas in Waikiki and Honolulu. The daily maximum recorded tide at Honolulu Harbor from February through October 2017 is shown in Figure 3-2. The plot also shows the corresponding predicted tide and the resulting anomaly. Sea level anomalies during the high-water events ranged from approximately 0.5 ft to 1 ft above the astronomical tide. The anomalies were particularly noticeable during perigean tides, and the highest events became popularly known in media as King Tide events.

The end of 2019 also marked an extended period of large sea level anomalies. Figure 3-3 is a plot of the tides from December 24 to 27, 2019. During this period, sea level anomalies of +0.6 to +1.1 ft added to the winter perigean tides, resulting in the highest recorded water level at Honolulu Harbor of +3.4 ft MLLW.

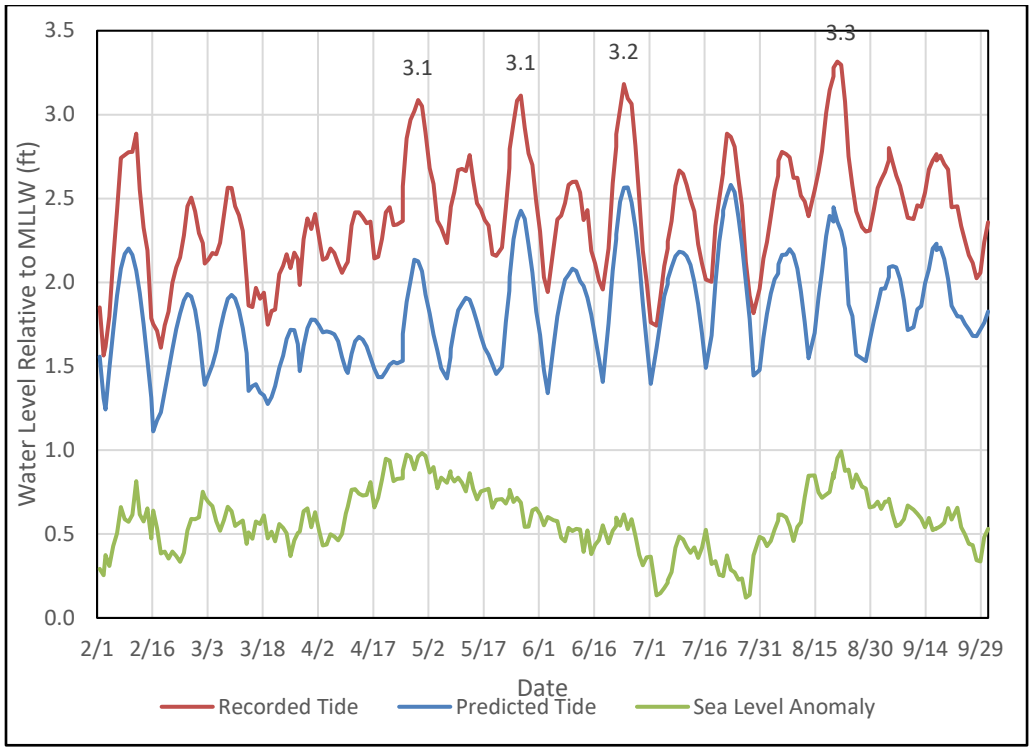



**Figure 3-2. Daily maximum measured tides at Honolulu Harbor and corresponding predicted tides and sea level anomaly (February 1-October 1, 2017)**

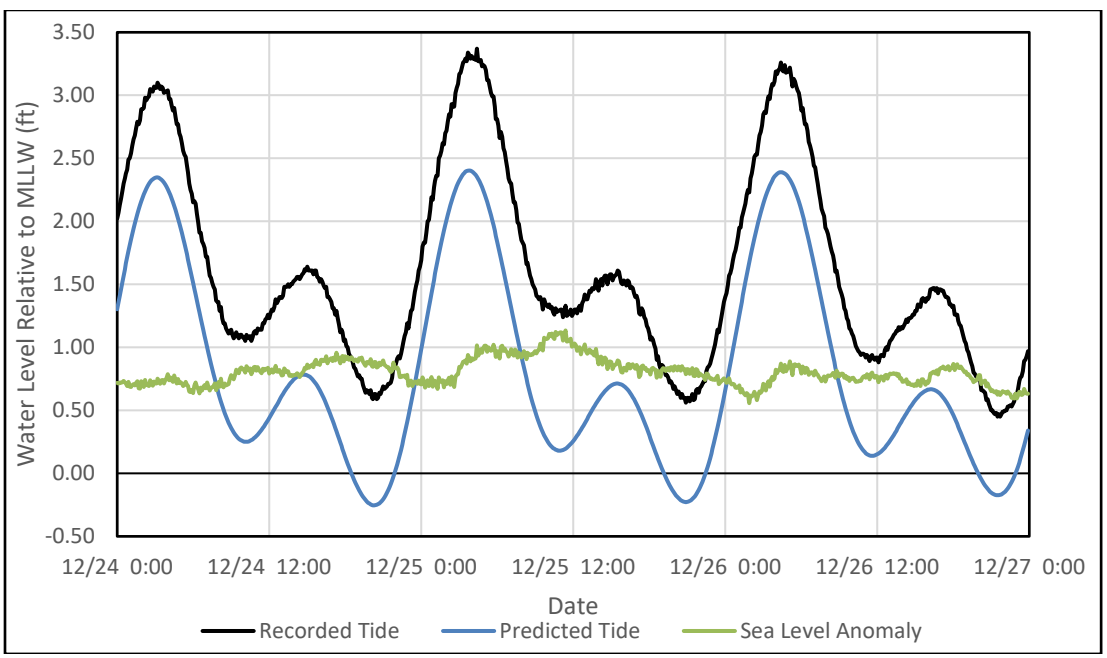



**Figure 3-3. Predicted and measured tides at Honolulu Harbor (December 24-26, 2019)**

## 3.3 Waves

### 3.3.1 *General Wave Climate*

The wave climate in Hawaii is typically characterized by four general wave types. These include northeast trade wind waves, southern swell, North Pacific swell, and Kona wind waves (Figure 3-4). Tropical storms and hurricanes also generate waves that can approach the islands from virtually any direction. Unlike winds, any of these wave conditions may occur at the same time.

Trade wind waves occur throughout the year and are the most persistent in April through September when they usually dominate the local wave climate. They result from the strong and steady trade winds blowing from the northeast quadrant over long fetches of open ocean. Trade wind deep water waves are typically between 3 to 8 feet high with periods of 5 to 10 seconds, depending upon the strength of the trade winds and how far the fetch extends east of the Hawaiian Islands. The direction of approach, like the trade winds themselves, varies between north-northeast and east-southeast and is centered on the east-northeast direction. Although the North Shore is sheltered from the direct approach of trade wind waves by island shadowing, a significant portion of the trade wind wave energy reaches the area by diffracting around the northeast end of the island, and contributes to generally rough offshore sea conditions during trade wind conditions.

Southern swell is generated by storms in the southern hemisphere and is most prevalent during the summer months of April through September. Traveling distances of up to 5,000 miles, these waves arrive with relatively low deep water wave heights of 1 to 4 feet and periods of 14 to 20 seconds. Depending on the positions and tracks of the southern hemisphere storms, southern swells approach between the southeasterly and southwesterly directions. Southern swell is blocked by island shadowing and does not affect the North Shore.

During the winter months in the northern hemisphere, strong storms are frequent in the North Pacific in the mid latitudes and near the Aleutian Islands. These storms generate large North Pacific swells that range in direction from west-northwest to northeast and arrive at the northern Hawaiian shores with little attenuation of wave energy. Deepwater wave heights often reach 15 feet and in extreme cases can reach 30 feet. Periods vary between 12 and 20 seconds, depending on the location of the storm. The North Shore is directly exposed to these waves.

Kona storm waves are infrequent, occurring only about 10 percent of the time during a typical year. Kona waves typically range in period from 6 to 10 seconds with heights of 5 to 10 feet, and approach from the southwest through west. Only the more westerly Kona storm waved reach the North Shore, with other directions blocked by island shadowing. Deepwater wave heights during the severe Kona storm of January 1980 were about 17 feet. The waves during this event had a significant impact on the south and west shores of the islands.

As noted by the historical significance of Hurricanes Iwa (1982) and Iniki (1992), severe tropical storms and hurricanes have the potential to generate extremely large waves that can affect the all shorelines of Oahu.

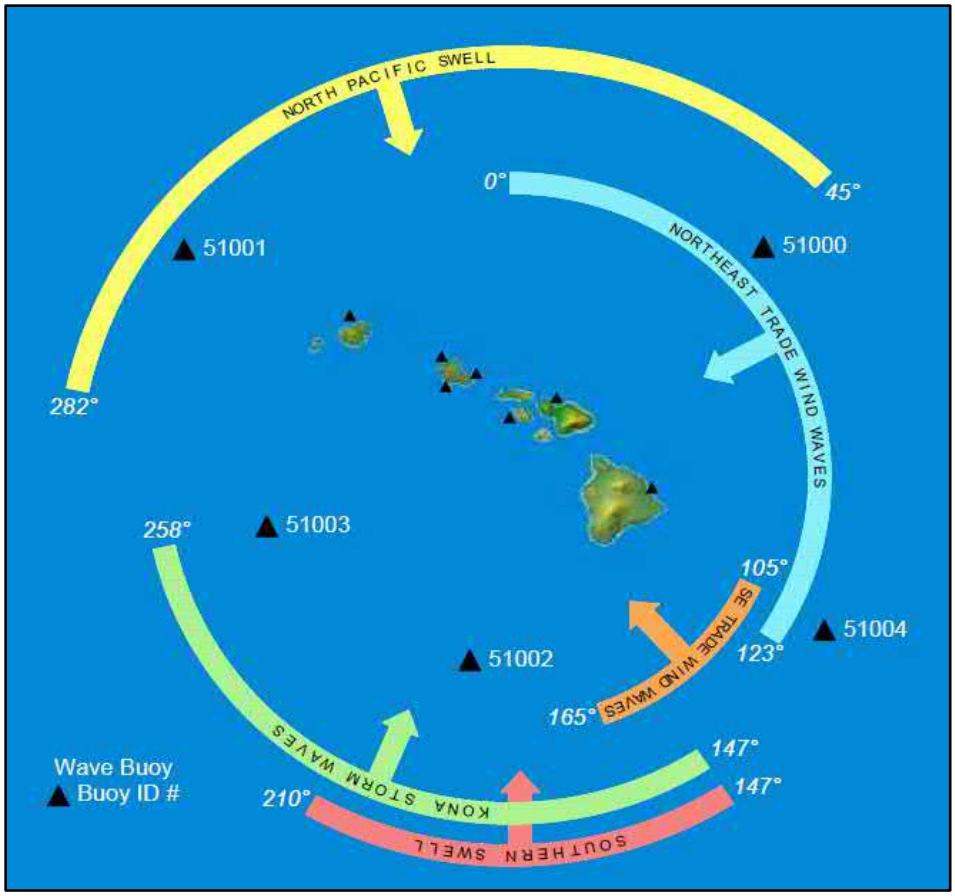



**Figure 3-4. Common wave types and approach directions in Hawaii**

### 3.3.2 *North Shore Wave Climate*

There are two basic wave data analysis presentations. As noted in Section 3.3.1, multiple wave types can be present at any one place and time. *Parametric* data analysis reports only the most energetic or largest existing wave type. *Spectral* data analysis separates wave information into multiple components and then assemble the statistics for each individual wave type. It is a method to show more subtle, smaller waves that might not be apparent in the parametric process. Physical wave measurement can be difficult, and wave buoy data are usually presented as parametric results. In recent years, computer simulations of wave generation and propagation has become a powerful method for wave forecasting and hindcasting. In particular, the WaveWatch III program has become a powerful tool for wave analysis. Global wind data from models and measurements can be used predict complex wave fields anywhere in the world. *Virtual buoys* are convenient locations where the model outputs can be sampled. Spectral data analysis is used at these locations because the wave fields are calculated with the models, and do not have to be measured with a physical device.

CDIP 106 is a wave measurement buoy operated by the National Oceanographic and Atmospheric Administration (NOAA) Coastal Data Information Program (CDIP). The buoy is located approximately four miles offshore of Waimea Bay and has been providing wave data since 2001.

HNL 10 is a virtual buoy located approximately 25 miles NNE of Kahuku Point. Buoy locations are shown in Figure 3-5. Both buoys are sheltered from waves arriving from the south, and CDIP 106 is partially sheltered from trade wind waves from the northeast and east.

**Figure 3-5. Wave buoy locations**

Figure 3-6 is a wave rose diagram for parametric wave height data for CDIP 106 over an eighteen-year period. The direction of arrival is divided into a 16-point compass rose, with size of the sector governed by frequency of occurrence, and significant wave height (Hs) denoted by color. Figure 3-7 shows the wave period rose diagram for the same set of data. The wave period is the interval of time between successive wave crests.

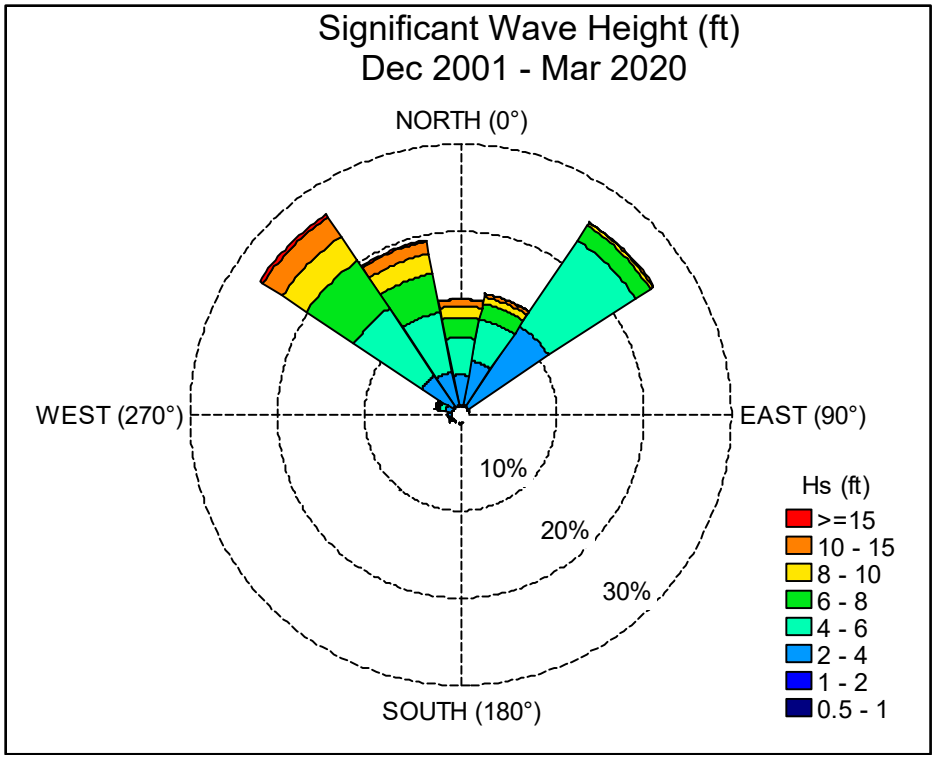



**Figure 3-6. Parametric wave height data for CDIP 106**

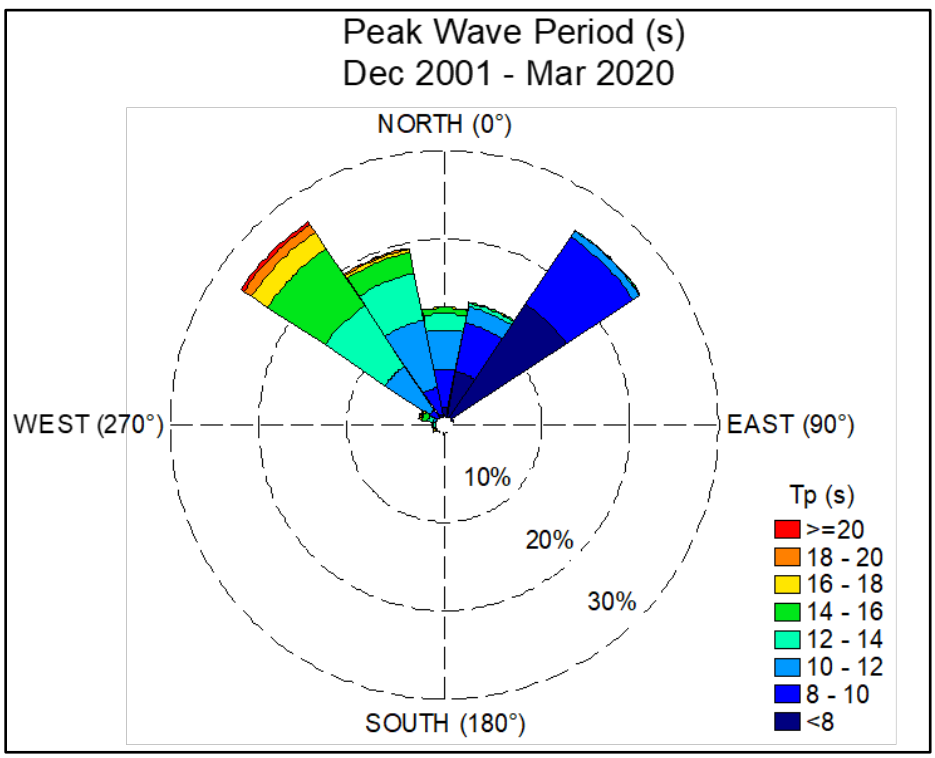



**Figure 3-7. Parametric wave period date for CDIP 106**

From Figure 3-6 and Figure 3-7, the North Shore wave climate has the following characteristics:

- There are no waves from the south because of island shadowing;
- Predominant wave directions are from the northwest (North Pacific swell) and northeast (trade wind waves);
- North Pacific swell has much greater wave heights and longer wave periods than trade wind waves, but the frequency of occurrence is approximately the same.

Figure 3-8 is a wave height rose diagram from CDIP 106 showing the winter wave climate (December-March) only. Figure 3-9 is the corresponding diagram showing the summer wave climate.

The two diagrams show:

- Dominant wave conditions for winter and summer have arrival directions that are approximately 90 degrees apart, or NW for winter and NE for summer. This shift accounts for the seasonal alongshore sand migration.

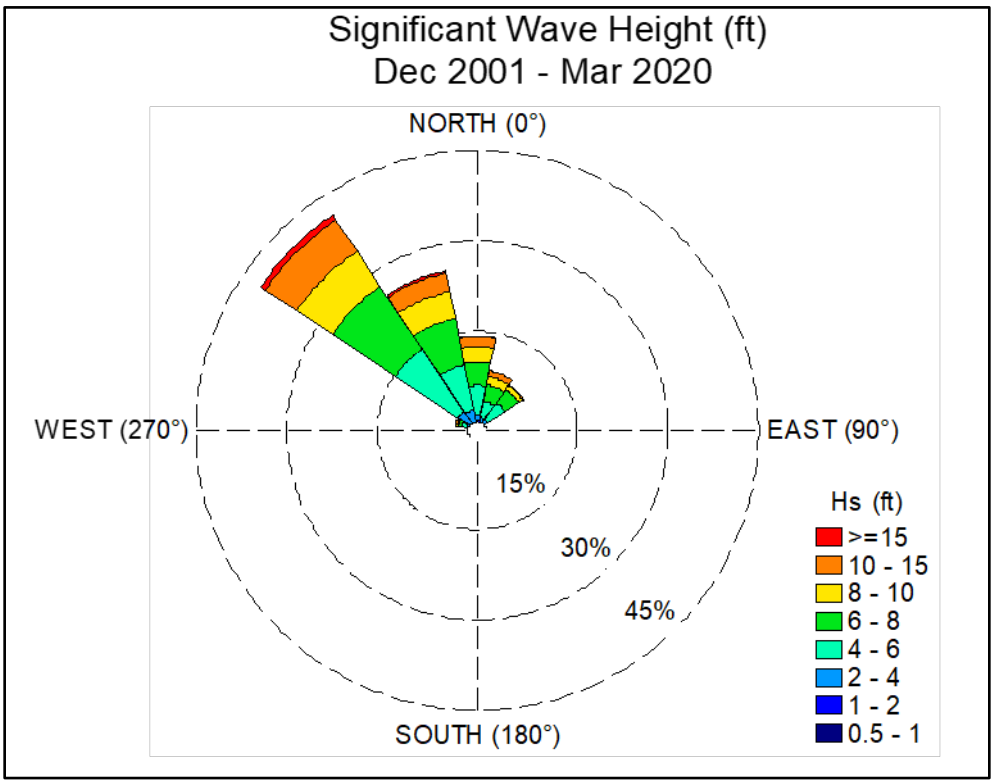



**Figure 3-8. Winter wave climate from CDIP 106**

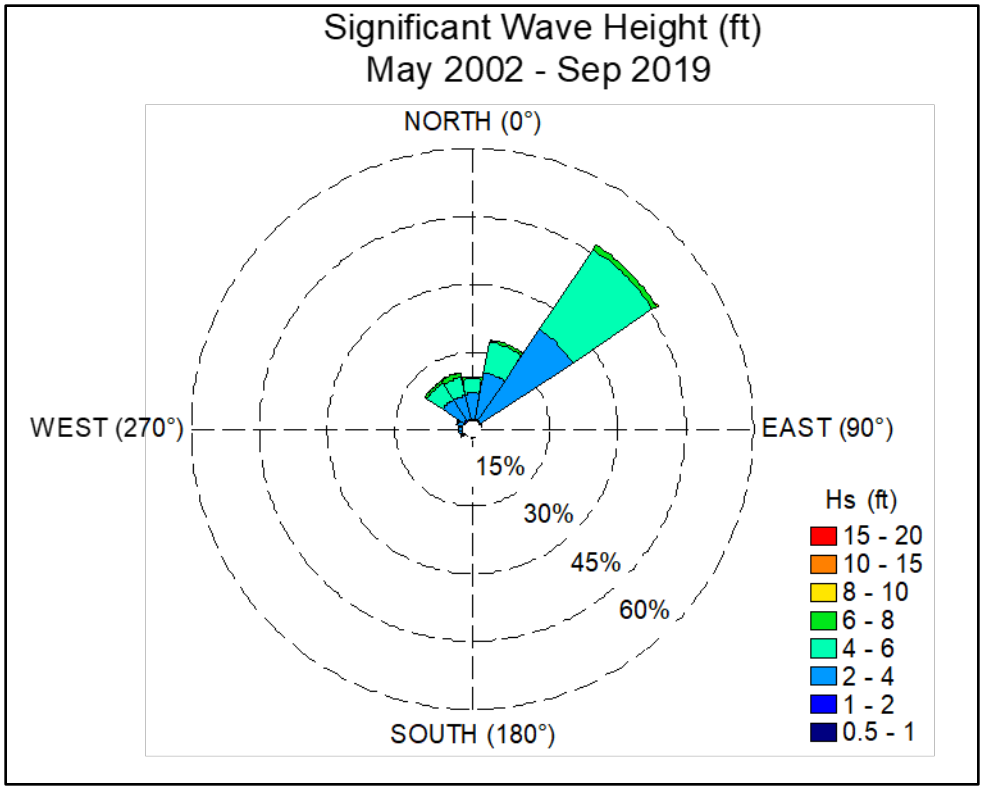



**Figure 3-9. Summer wave climate from CDIP 106**

Figure 3-10 is a winter season diagram for spectral data from virtual buoy HNL 106, again showing the strong prevailing wave climate from the northwest. The more exposed location shows trade wind waves coming from a more easterly direction, indicating that trade wind waves shown at buoy CDIP 106 are diffracted into the lee of Kahuku Point. The diagram also shows waves coming from a westerly direction. This result is due to the spectral analysis method that shows waves that might otherwise be hidden by the dominant northwest wave direction.

The North Shore wave climate can be described as bimodal and seasonal: there are two very different prevailing wave types, one of which occurs predominately in the winter, with the other occurring year-round. North Pacific Swell are long period (long interval) waves derived from distant winter storms, while trade wind waves are short period (short interval) waves derived mostly from local trade wind generated seas. The seasonal differences play a large role in the seasonal sand migrations on the North Shore beaches.

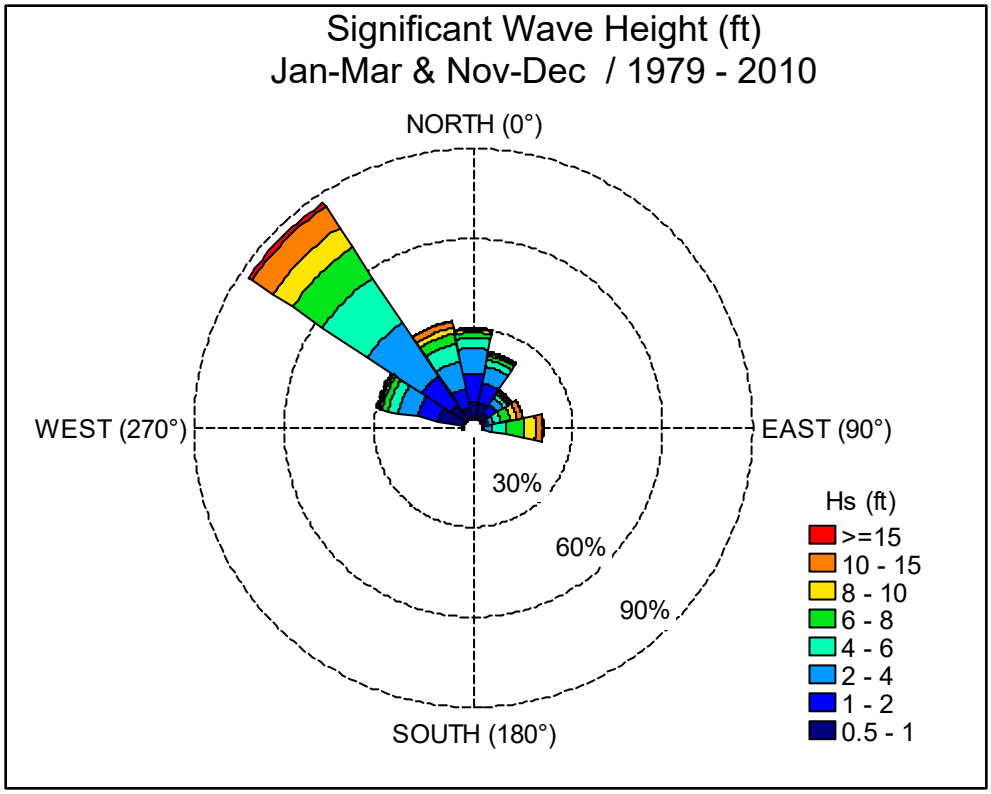



**Figure 3-10. Winter season wave climate from virtual buoy HNL 10**

### 3.3.3 *Extreme Deepwater Waves*

Historical wave buoy data allows the prediction of extreme wave events. These are infrequent, large, powerful, low probability wave events that are typically used for design purposes. For example, a 50-year return period wave event is an extreme event with a 1/50 (i.e., 2%) chance of occurring in any given year. Extreme wave heights were investigated using the measured data from CDIP 106.

The extreme wave height data were used to generate a Weibull extreme value distribution for return period wave heights. The Weibull Distribution is a tool for looking at the relationship between the size of waves and how frequently they occur at a given location. Analysis requires a long-term data set with well-documented wave events. These events are sorted by size, and frequency of occurrence can be assessed by how often these events occur in the record (Table 3-4). The extreme value deep water wave heights are sorted by return period in Table 3-5. Breaking waves can be much larger because of the effects of refraction and shoaling. The significant wave height value (Hs) is defined as the average of the highest third of the wave heights present, and much larger waves can be present sporadically during the wave event.

**Table 3-4. Ten Largest Wave Events**

| Date | Hs (ft) | Tp (s) | Dp (deg) |
|---|---|---|---|
| 2/11/2019 | 29.8 | 15.4 | 334 |
| 2/22/2016 | 27.8 | 16.7 | 325 |
| 1/23/2014 | 24.3 | 18.2 | 307 |
| 1/5/2003 | 23.6 | 18.2 | 319 |
| 12/4/2007 | 22.0 | 15.4 | 339 |
| 1/16/2016 | 21.8 | 16.7 | 324 |
| 1/10/2004 | 21.5 | 18.2 | 318 |
| 1/7/2002 | 21.4 | 18.2 | 315 |
| 3/14/2009 | 21.1 | 15.4 | 10 |
| 12/8/2009 | 21.1 | 18.2 | 325 |

**Table 3-5. Return Period Wave Heights**

| Return Period (years) | Hs (ft) |
|---|---|
| 1 | 19.7 |
| 2 | 22.0 |
| 5 | 25.1 |
| 10 | 27.4 |
| 25 | 30.4 |
| 50 | 32.7 |

# 4. COASTAL HAZARDS

## 4.1 Introduction

Figure 4-1is a comprehensive image showing the hazard potential for the Haleiwa area, including Kawailoa Beach. The overall hazard intensity is rated as 5 with the maximum being 7. The area is particularly susceptible to tsunami, stream flooding and high waves.

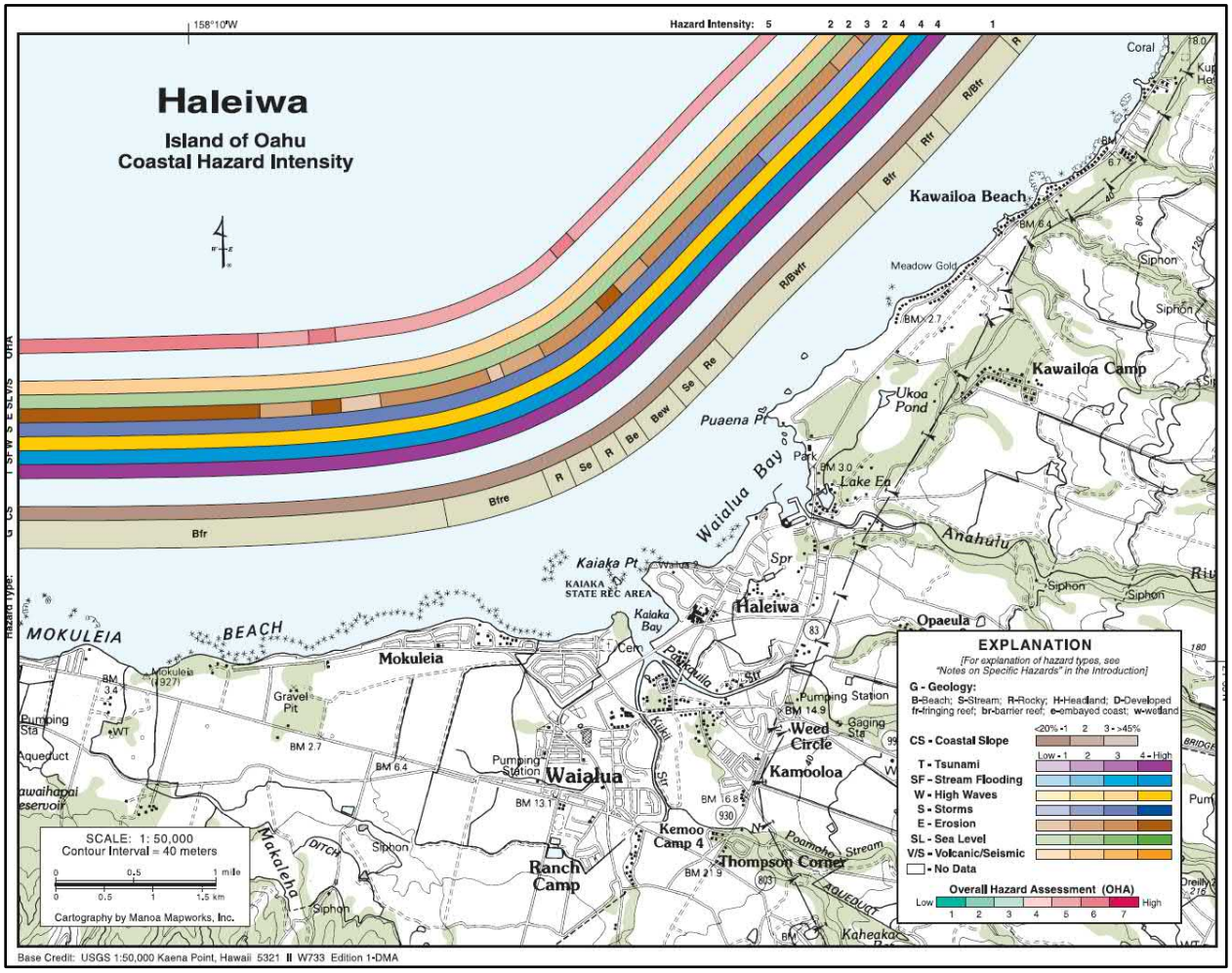



**Figure 4-1. Coastal hazards atlas for Haleiwa area (from Fletcher and others, 2002)**

## 4.2 Hurricanes

Tropical cyclones originate over warm ocean waters, and they are considered hurricane strength when they generate sustained wind speeds over 64 knots (74 mph). Hurricanes that form near the equator, and in the central North Pacific usually move toward the west or northwest. During the primary hurricane season of July through September, hurricanes generally form off the west coast of Mexico and move westward across the Central Pacific. These storms typically pass south of the Hawaiian Islands and sometimes have a northward curvature near the islands. Late season hurricanes follow a somewhat different track, forming south of Hawaii and moving north toward the islands. Three hurricanes have passed through the Hawaiian Islands in the past 25 years: Hurricanes Iwa in 1982 and Iniki in 1992, both passing near or over the island of Kauai as well as

Hurricane Iselle in 2014 passing over the island of Hawaii. These storms caused high surf and wave damage on multiple shores of the islands. However, many others have had a close approach.

The *Windward Oahu Hurricane Vulnerability Study* (Sea Engineering, 1990) indicates that a theoretical model hurricane passing over the island from the south/southwest could result in deep-water waves 44.2 feet in height with periods of 14.6 seconds for Oahu's north and east shores. The Hawaiian Islands are annually exposed to severe storms and waves generated by tropical cyclonic storms (hurricanes).

While it is not uncommon for hurricanes to pass near Hawaii, they often change course or deteriorate by the time they reach Hawaiian waters. Figure 4-2 shows the historical tracks of tropical storms and hurricanes in the central Pacific from 1949 to 2018. While direct hits to the Hawaiian Islands are rare, hurricane tracks to the north or south of the islands are not infrequent and can generate large, damaging waves which can have impacts along the shorelines throughout Hawaii. The historical tracks of hurricanes that have passed near the Hawaiian Islands from 1949 to 2018 are shown in Figure 4-3. The tracks of tropical storms and tropical depressions that have passed near Hawaii are shown in Figure 4-4.

Hurricane Iwa (1982) and Hurricane Iniki (1992) caused significant damage in Hawaii. They have been well-studied and the characteristics of these storms were significantly different from each other. Hurricane Iwa was not as intense as Hurricane Iniki, however Iwa was a much larger storm with an estimated radius of maximum winds of 51 nautical miles (nm) compared to 13 nm for Hurricane Iniki. Hurricane Iwa approached Kauai from the southwest and was a large Category 1 hurricane when it passed northwest of the island with maximum sustained wind speeds of 80 knots (92 mph). While Hurricane Iwa was a Category 1 event throughout its life near the Hawaiian Islands, Hurricane Iniki approached as a Category 4 and reverted to Category 3 just prior to making landfall on Kauai with maximum sustained wind speeds of 116 knots (113 mph). Wave heights, coastal inundation, and damage on the south shore of Oahu were reported to be similar for both Hurricane Iwa and Hurricane Iniki, with waves on the order of 30 ft in height reported for both storms.

Recent years have shown an increase in hurricane activity around Hawaii. The 2014 hurricane season was notable for the passage of three hurricanes near the islands, with one (Hurricane Iselle) making landfall on August 7 on the east shore of Hawaii Island as a tropical storm with maximum sustained wind speeds of 61 knots (70 mph). A few days later, Hurricane Julio passed north of the Hawaiian Islands as a tropical storm, causing little damage. Hurricane Ana passed south of the Hawaiian Islands in October and caused little damage, although large waves were recorded on the south shore of Oahu.

The 2015 hurricane season was the second most active Pacific hurricane season on record behind the 1992 season (Hickey 2016). In August 2015, Hurricanes Kilo, Ignacio, and Jimena had sustained winds between 113 to 122 knots (130 to 140 mph). This was the first time in history that three Category 4 hurricanes existed simultaneously east of the International Date Line (National Hurricane Center, 2015). Radar imagery from this event is shown in Figure 4-5. In 2018, Hurricane Lane resulted in a hurricane warning forecasting potential landfall on the south shore of Oahu. The stormed stalled west of Hawaii Island and rapidly dissipated but still caused damage across the eastern half of the state. Satellite imagery of Hurricane Lane's approach to

Hawaii is shown in Figure 4-6 . Hurricane Norman passed north of Oahu but damaged some of the north shore beaches. Hurricane Olivia downsized to a tropical storm just prior to passing directly over West Maui. Hurricane Walaka generated large surf on the west and south shores of Oahu. Although these hurricanes resulted in little damage on Oahu, minor changes in the 2014, 2015, or 2018 storm tracks could have resulted in very different outcomes, and they serve as reminders of Hawaii's vulnerability.

**Figure 4-2. Central Pacific historical hurricane tracks (1949 to 2018)**

Source: https://coast.noaa.gov/hurricanes/

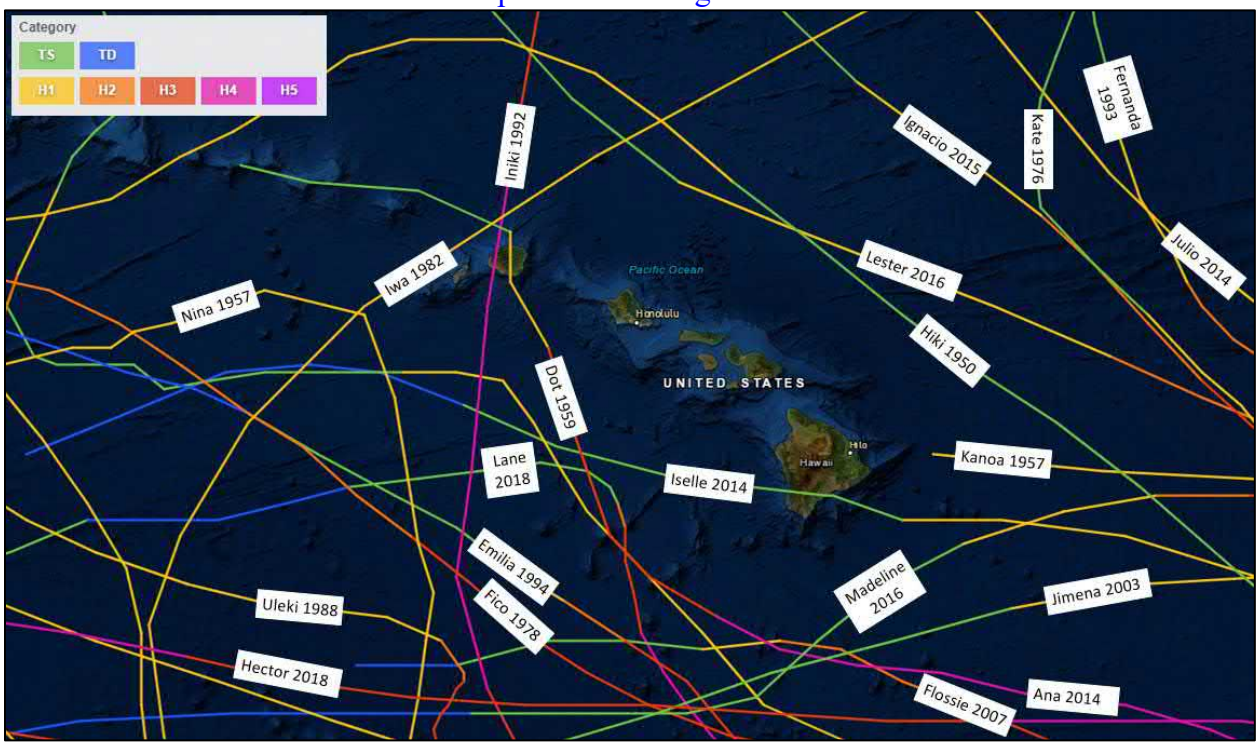



**Figure 4-3. Hawaii historical hurricane tracks (1949 to 2018)**

Source: https://coast.noaa.gov/hurricanes/

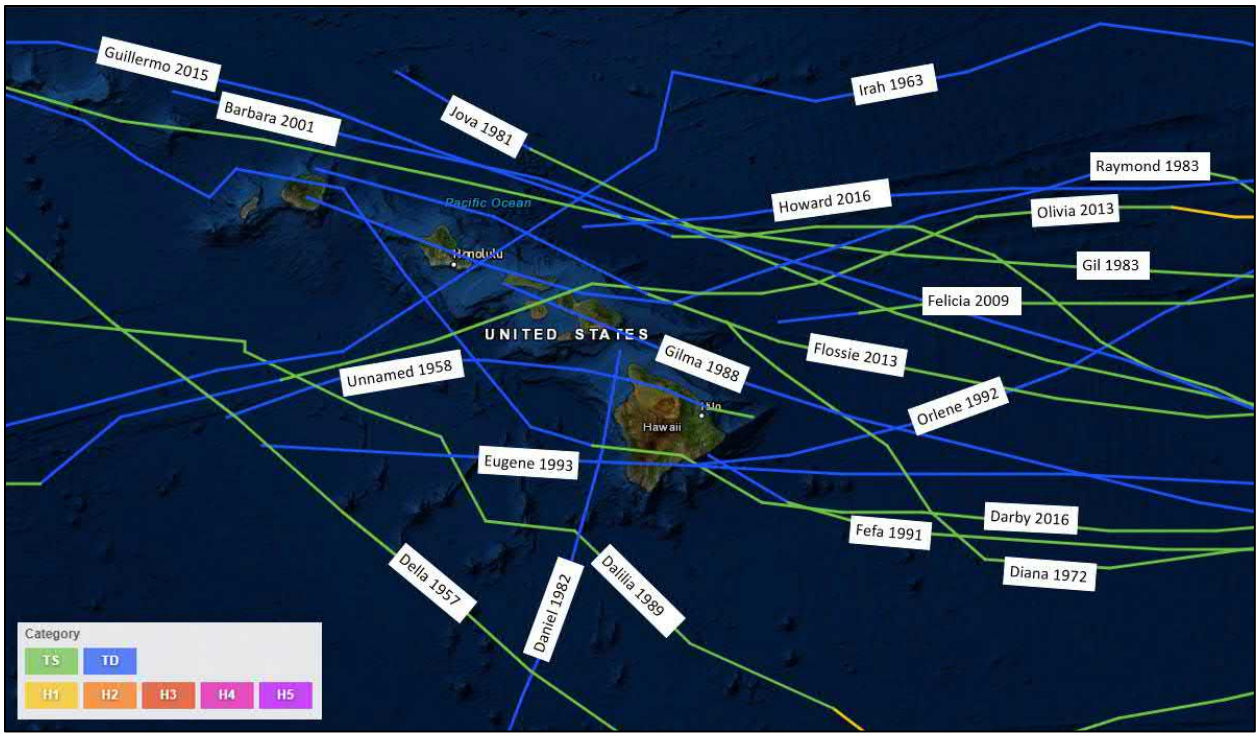



**Figure 4-4. Hawaii historical tropical storms and depressions (1949 to 2018)**

Source: https://coast.noaa.gov/hurricanes/

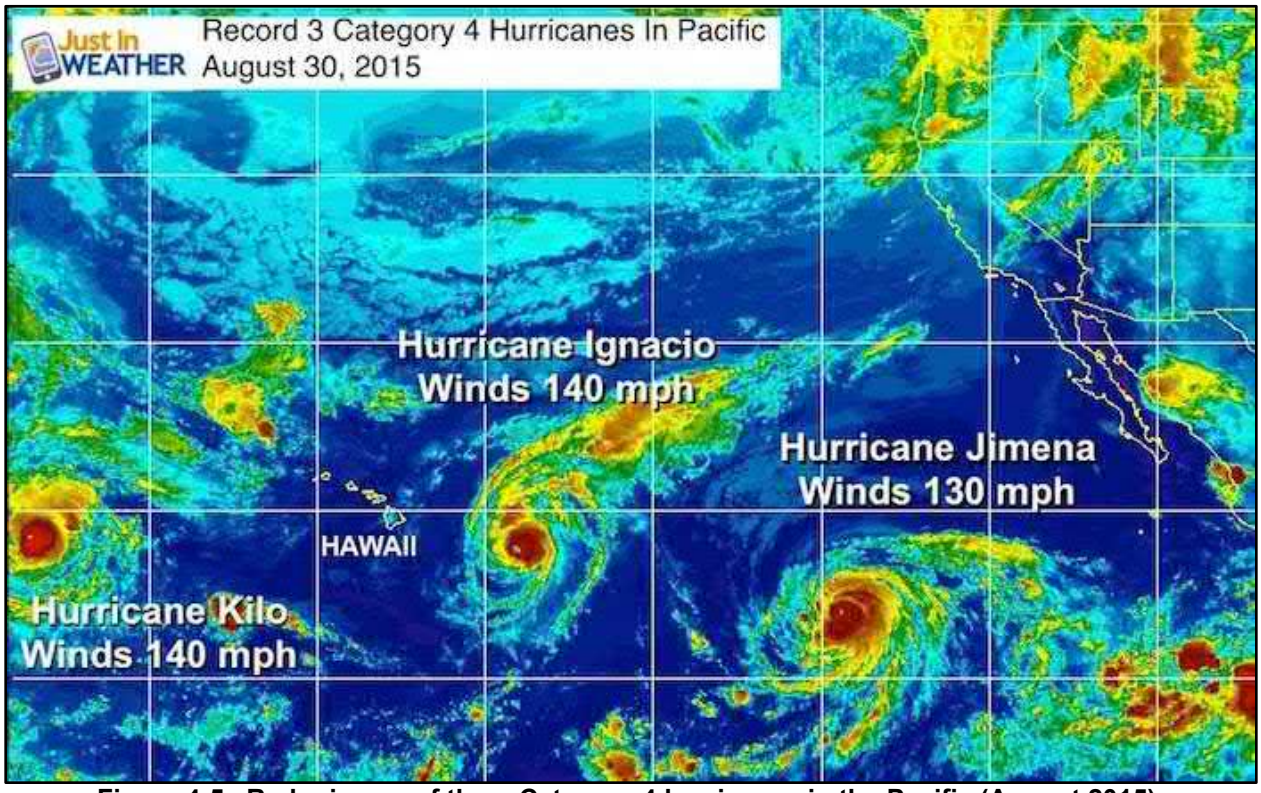



**Figure 4-5. Radar image of three Category 4 hurricanes in the Pacific (August 2015)**

Source: https://www.justinweather.com/

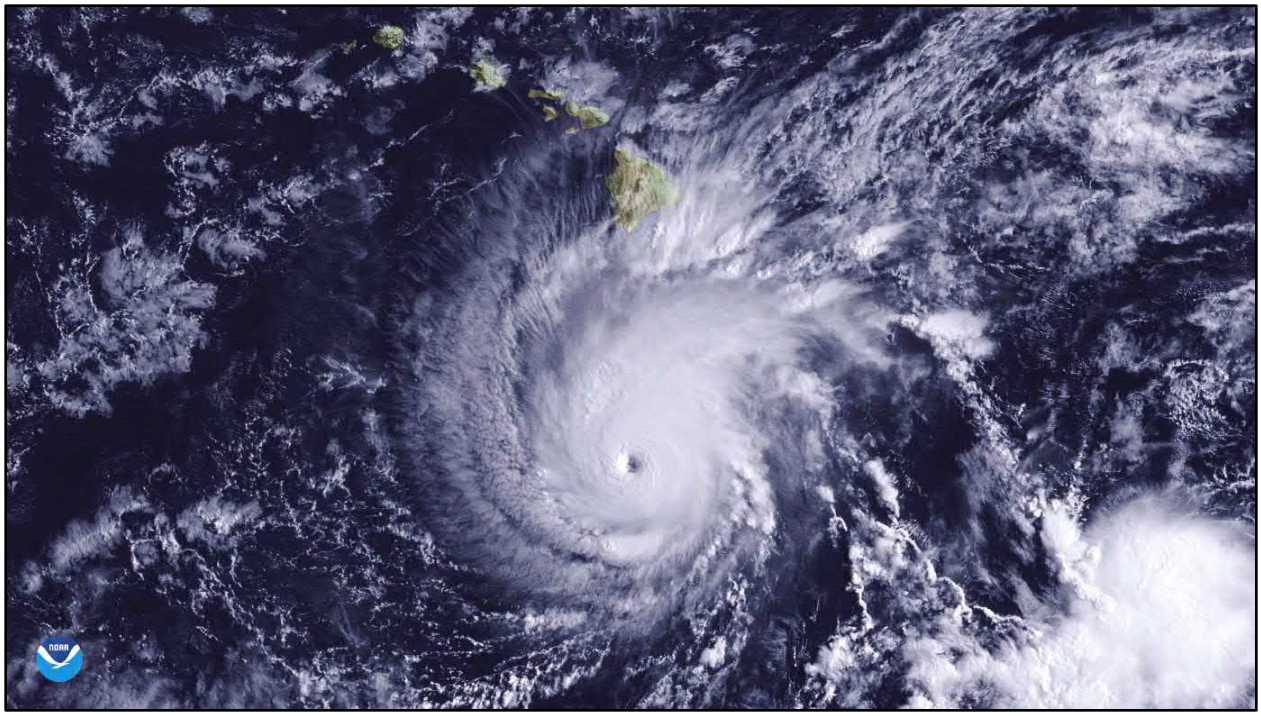


**Figure 4-6. Satellite image of Hurricane Lane approaching Hawaii (August 2018)**
Source: NOAA Environmental Visualization Laboratory

### 4.2.1 *Hurricane Storm Surge*

Hurricane Iwa and Hurricane Iniki generated storm surge above 1 ft in the tidal record at Honolulu Harbor. Based on the recorded data at the tide station, storm surge in Honolulu Harbor from Hurricane Iwa peaked at approximately 1.8 ft, with a maximum recorded water level reaching 2.3 ft. During Hurricane Iniki, the storm surge peaked at approximately 1.5 ft with a maximum recorded water level of 3.2 ft. Measured and predicted tides during Hurricane Iwa are shown in Figure 4-7 and the storm surge is shown in Figure 4-8. Figure 4-9 and Figure 4-10 show the tides and storm surge during Hurricane Iniki. Two interesting observations can be made from the time series. The first is that the peak storm surge lasts a few hours while the bulk of the storm surge persists on the order of 12 hours. While this is representative for similar storm tracks, it may not always be the case. The second observation is the impact of tide levels at the time of the storms. Hurricane Iwa caused peak storm surge during low tide while Hurricane Iniki's peak storm surge occurred during high tide. As a result, the maximum water level during Hurricane Iniki was approximately 1 ft higher than the maximum water level during Hurricane Iwa, even though Hurricane Iniki had a smaller amplitude storm surge.

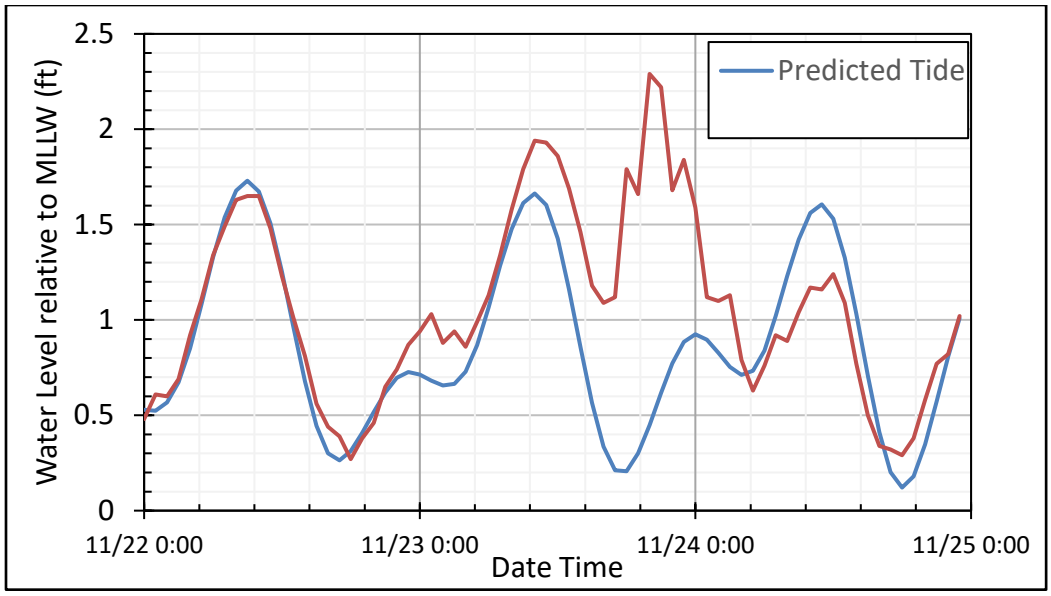



**Figure 4-7. Predicted and measured tide at Honolulu Harbor during Hurricane Iwa**

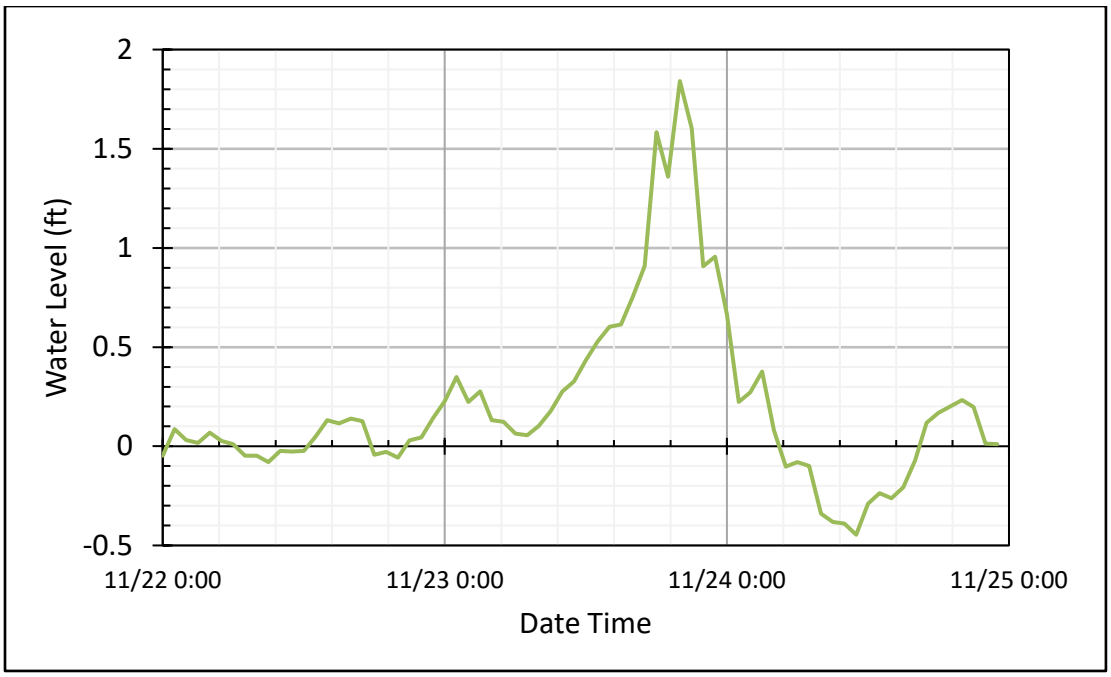



**Figure 4-8. Sea level anomaly at Honolulu Harbor during Hurricane Iwa.**

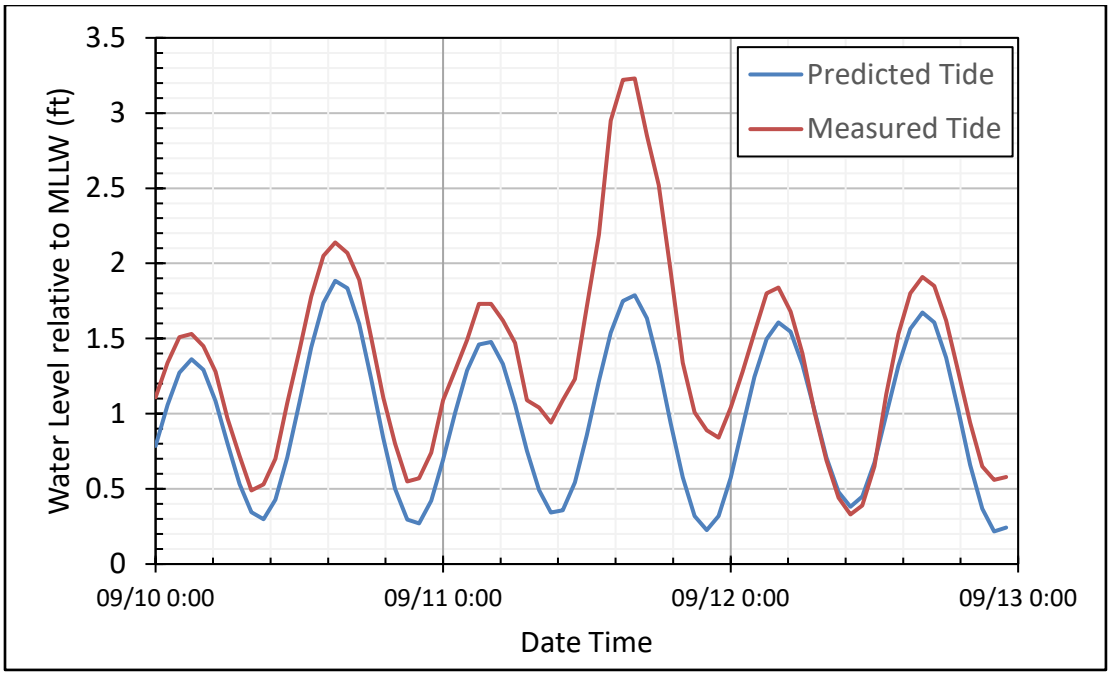



**Figure 4-9. Predicted and measured tide at Honolulu Harbor during Hurricane Iniki**

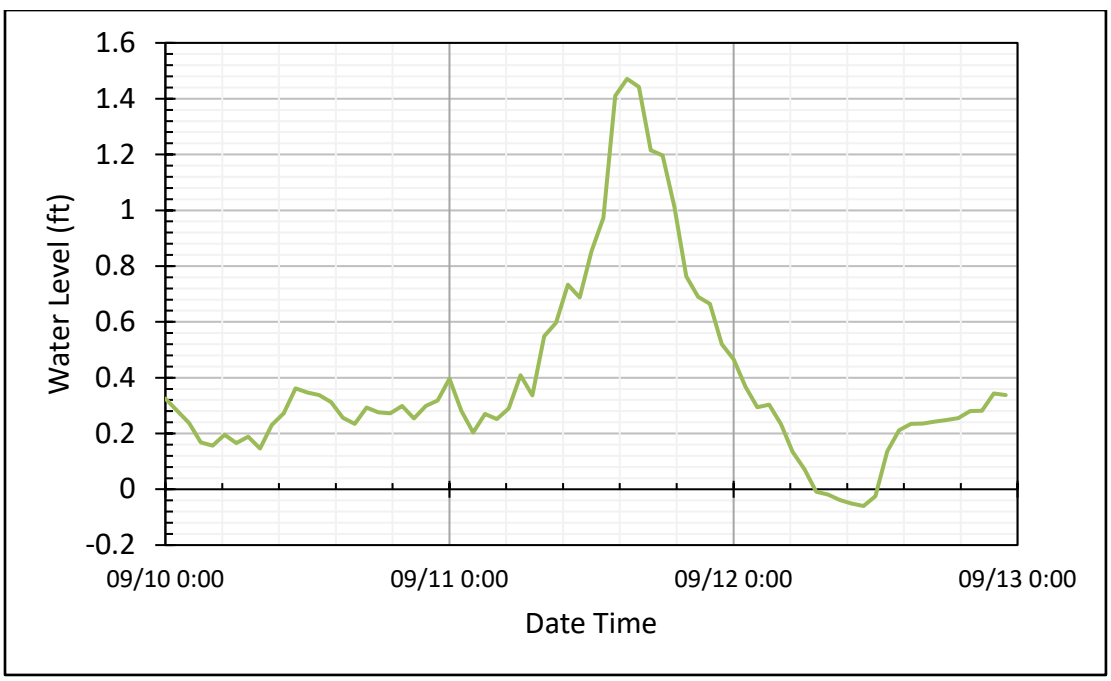



**Figure 4-10. Sea level anomaly at Honolulu Harbor during Hurricane Iniki**

## 4.3 Kona Storms

Kona storms are caused by the close approach of mid-latitude low pressure systems. Occasional strong Kona storms have caused extensive damage to the south- and west-facing shorelines on Oahu. Deepwater wave heights during a severe Kona storm in January 1980 were about 17 feet with a period of 9 seconds.

## 4.4 Tsunami

Tsunami are waves that result from large-scale movement of the seafloor, underwater slides, or other phenomena that cause large displacements of water. They are commonly caused by large magnitude earthquakes (typically magnitude 7.0 or greater). Tsunami often travel outwards in a series of waves which occupy the entire water column, even at abyssal depths. Tsunami waves typically have small wave heights in deep water but can have wavelengths of hundreds of miles and travel at speeds up to 500 miles per hour. A tsunami can travel from one side of the Pacific to the other in less than a day. The speed decreases rapidly as the water shoals. The waves increase greatly in height as they shoal and tsunami runup can push far inland at high speed. Receding waters may also have considerable speed, and the recession often causes as much damage as the original wavefront itself.

Most tsunamis in Hawaii originate from the tectonically active areas located around the Pacific Rim (e.g., Alaska, Japan, and Chile). Waves created by earthquakes in these areas take hours to reach Hawaii, and the network of sensors that is part of the Pacific Tsunami Warning System can provide Hawaii with several hours advance warning prior to the arrival of tsunami waves generated from these locations. Less commonly, tsunami originate from seismic activity in the Hawaiian Islands, and there is less warning for these locally generated events.

In 1946, a tsunami was generated in the Aleutian Islands and was one of the most destructive tsunamis to strike Hawaii. The U.S. Geological Survey (Fletcher et al., 2002) has given the project area a tsunami hazard rating of 4 out of 4 **(**Figure 4-1**).**

Historical tsunami runup in Haleiwa has been recorded as far back as 1878. Table 4-1 is a list of recorded tsunami runup data for the Haleiwa area.

**Table 4-1. Historic Tsunami Runup For Haleiwa**

| Year | Runup (ft) | Source Area |
|---|---|---|
| **1878** | 9 | Aleutian Islands |
| **1923** | 12 | Kamchatka |
| **1946** | 11 | Eastern Aleutian Islands |
| **1952** | 17 | Kamchatka |
| **1957** | 17 | Central Aleutian Islands |
| **1964** | 15 | Gulf of Alaska |
| **1994** | 2 | Kuril Islands |
| **2011** | ? | Japan (Tohoku) |

The National Flood Insurance Program (NFIP), administered by the Federal Emergency Management Agency (FEMA), maintains flood hazard maps for use in determining a reference height used by property insurance companies to assess flood risk, known as the Base Flood Elevation (BFE). On the North Shore of Oahu, Hawaii, the 1% annual flood risk is considered by FEMA to be a result of tsunami wave inundation, and not from rainfall accumulation or hurricane innundation. The North Shore flood zones were determined in a 1979 study utilizing the method

presented in the "*Manual for Determining Tsunami Run-up Profiles on Coastal Areas in Hawaii*", a U.S. Army Corps of Engineers (USACE) manual prepared by M&E Pacific, Inc.

SEI conducted a runup study using the same methodology as the USACE manual, but with a much higher transect density of 130 ft (40 m) between transects instead of the previous study spacing of hundreds of meters (see SEI 2020). The updated SEI study added the altered ground topography for the two bypass alternatives, the Pedestrian Shift, and the Most alignment alternative. Figure 4-11 is the Flood Insurance Rate Map (FIRM) showing the BFE for most of the project area. Maximum BFE is 23 ft in the VE zone (velocity hazard due to wave action). The VE zone is narrow and confined to the beach area in the storm berm reach (see Section 2.6.3) but broadens and moves inland across the lower revetment reach. Inland areas are AE zone with BFE's of 18 and 20 ft.

Figure 4-12 is the FIRM map data simplified and oriented for comparison with the SEI analysis. The SEI analysis for existing conditions is shown in Figure 4-13 overlain on the FIRM BFE map. While the SEI map is more detailed, the general trends and BFE values are similar. A notable WSE decrease at Transect 11 is due to a stream crossing that was not accounted for in the previous study.

Figure 4-14 shows the SEI analysis for the Pedestrian Shift alternative (Alternative 1). The results are similar to the existing case, with marginal differences noted in the stream crossing area and the adjacent realigned roadway near Transect 11 and Transect 12. Figure 4-15 is a plot of the contour differences between Figure 4-14 and Figure 4-15, showing the limited areal extent of the differences. Figure 4-16 is plot of Transect 12 that shows the differences in the inundation elevation. There are slight increases in the WSE (on the order of 1 ft), over some roadway areas, and slight decreases (less than 1 ft) over a broad but limited area landward of the roadway. The maximum inland extent of inundation increased significantly at only one location, Transect 20, which runs through Turtle Beach near Pu'u Nenue. At this location, the new Alternative 1 alignment rejoins the original highway and the horizontal inundation increases by approximately 82 ft. The increase is caused by a high spot in the existing topography that is leveled for the new alignment.

Figure 4-17 is a plan view plot of the tsunami inundation WSE for the Most alternative (Alternative 2), and Figure 4-18 is a difference analysis between the existing conditions (Figure 4-13) and Alternative 2 (Figure 4-17). In contrast to Alternative 1, there are some significant inundation changes due to the proposed new alignment for Alternative 2, with elevation increases of up to 5 ft over the new road deck toward the southern end of the project area between Transect 9 and Transect 13. On Transect 11 (Figure 4-19) the increase is approximately 2.5 ft. Landward of the roadway the elevation increase is less, on the order of 1 ft. There are additional minor changes at the north end of the alignment in the vicinity of transects 28 and 29, and also Transect 32, with both areas having a WSE increase on the order of 1 to 2 ft. The WSE increase on Transect 32 is approximately 100 ft landward of a private residence.

The rise in grade due to the proposed roadway and associated earthworks of Alternative 2 cause some notable decreases in the horizontal inundation extent, in contrast to Alternative 1. At Transects 13 – 15 and 28 – 31 the increase in grade of the proposed road deck blocks further

landward propagation of the tsunami. Figure 4-20 is a plot of horizontal inundation differences for both alternatives.

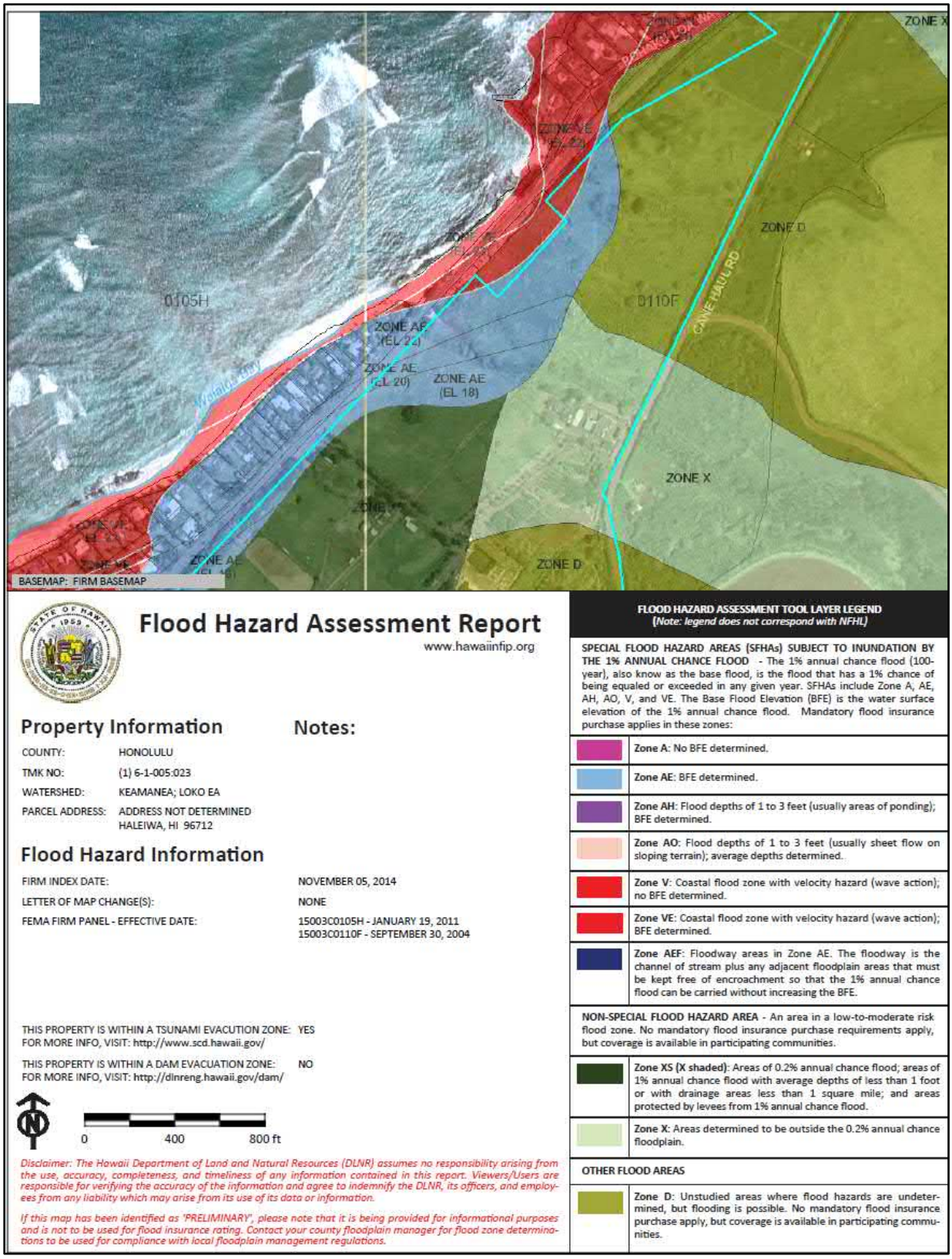



**Figure 4-11. FEMA Flood Hazard Assessment Report (FHAR) for Kawailoa**

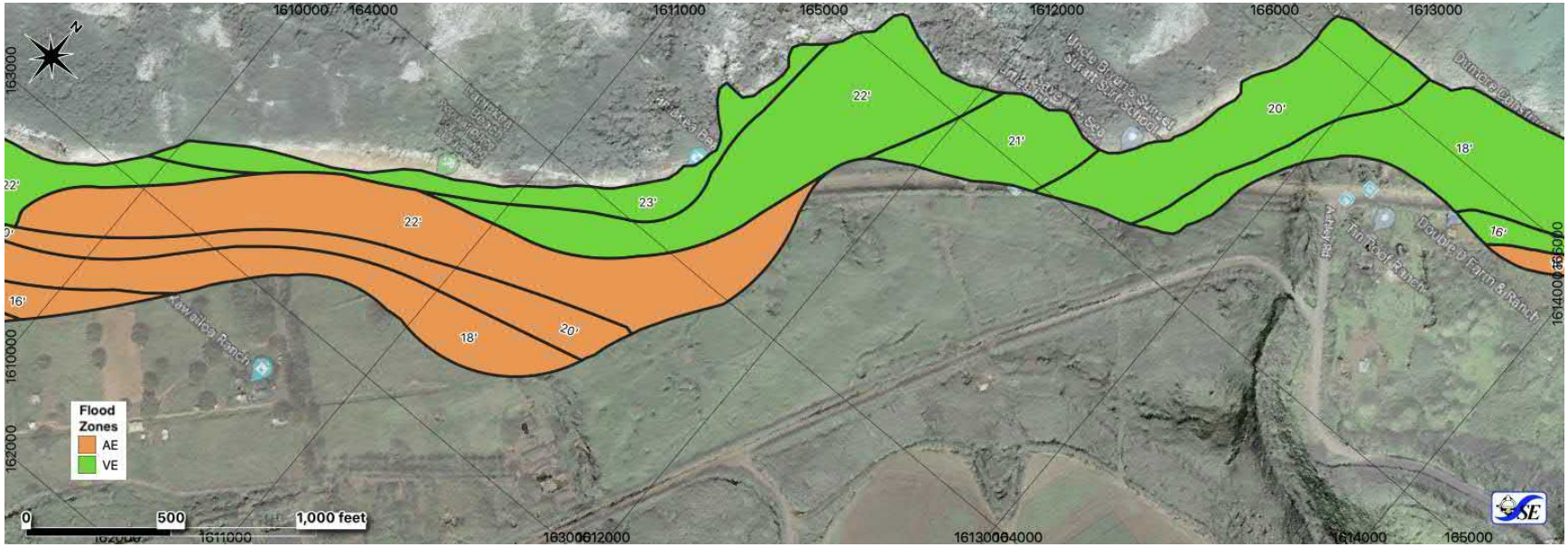



**Figure 4-12. FIRM BFE contours.**

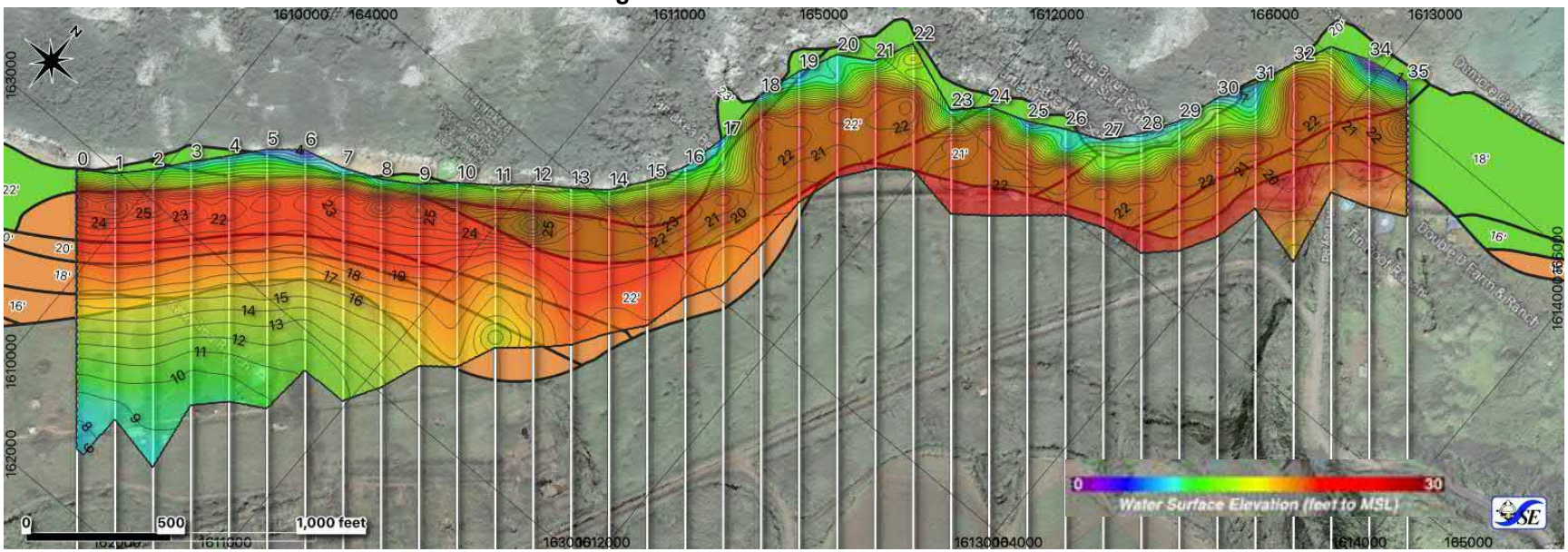



**Figure 4-13. SEI analysis overlaid on the FIRM contours**

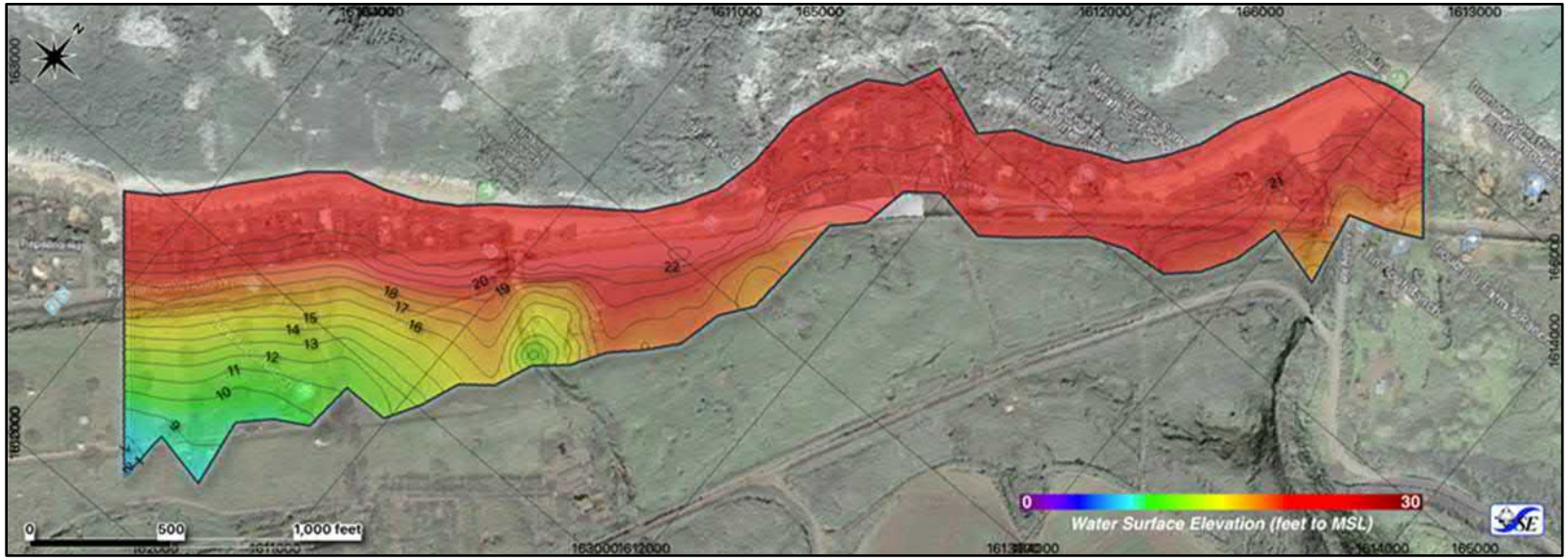



**Figure 4-14. SEI analysis with Pedestrian Shift alternative (Alternative 1)**

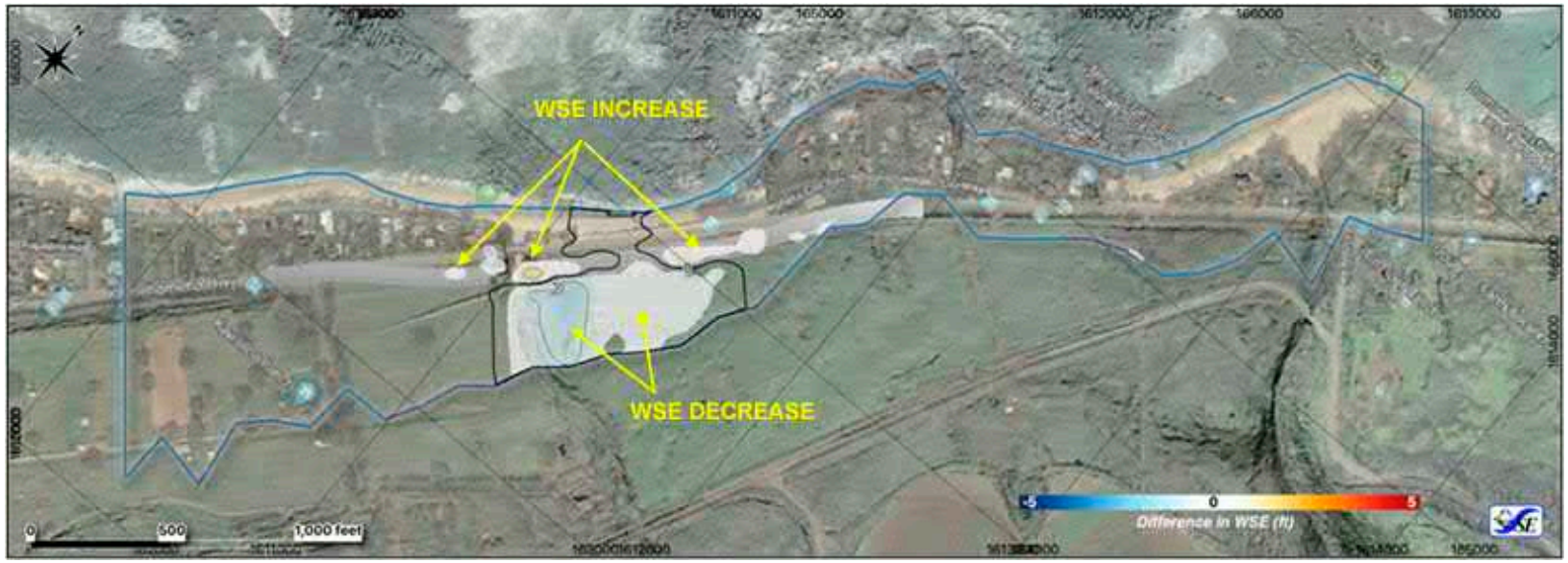



**Figure 4-15. WSE elevation difference analysis between existing condition analysis (Figure 4-13) and Alternative 1 analysis (Figure 4-14)**

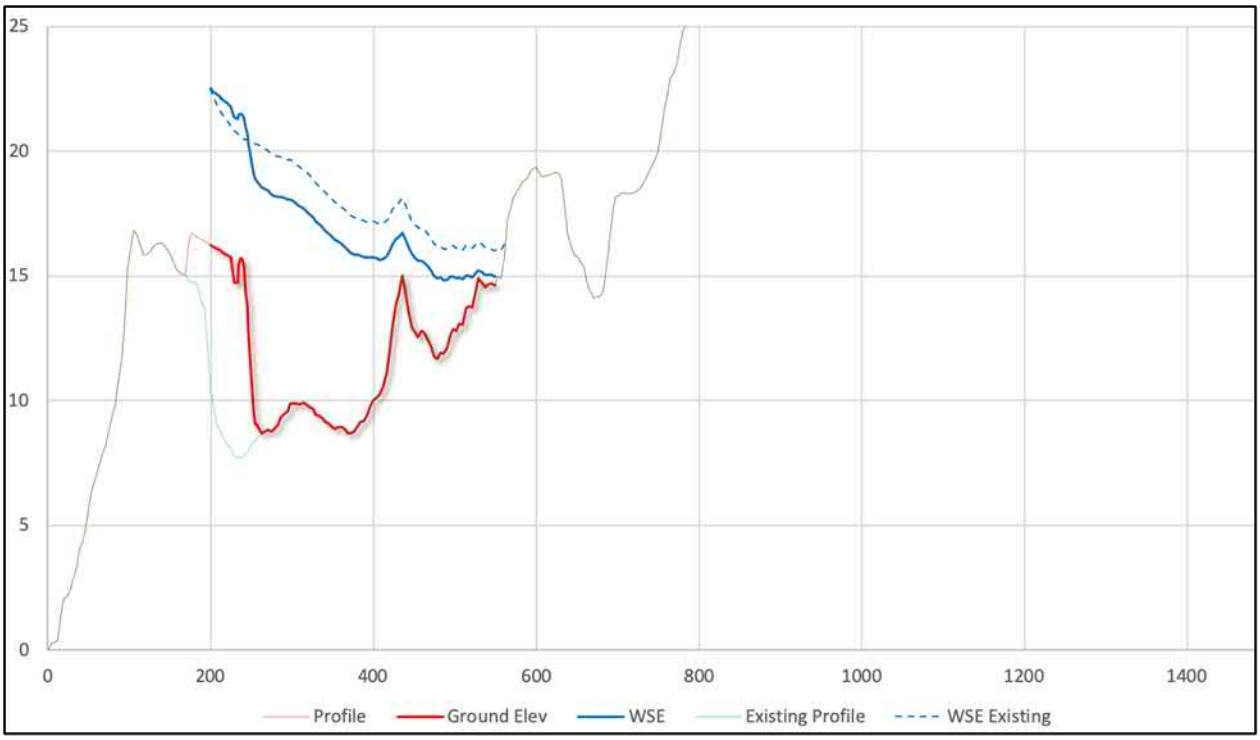



**Figure 4-16. Plot of Transect 12 showing the WSE for Alternative 1 (blue) versus the existing WSE (dashed)**

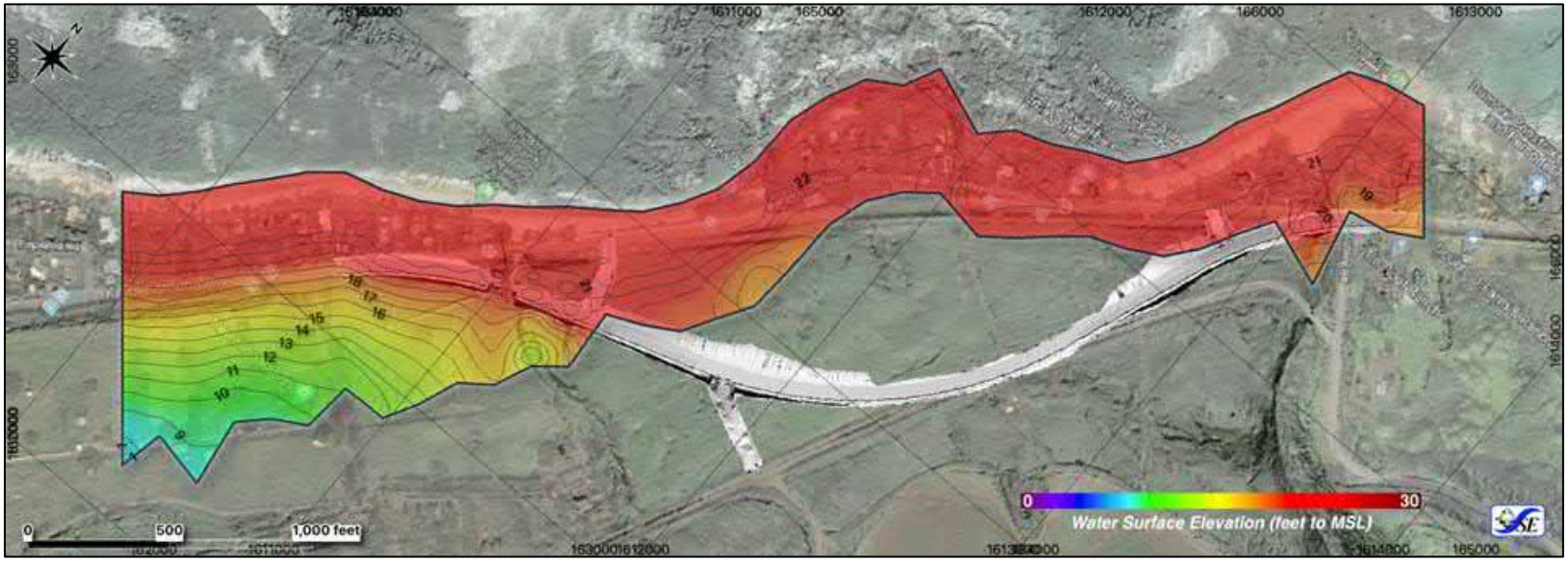



**Figure 4-17. SEI analysis with Most alternative (Alternative 2)**

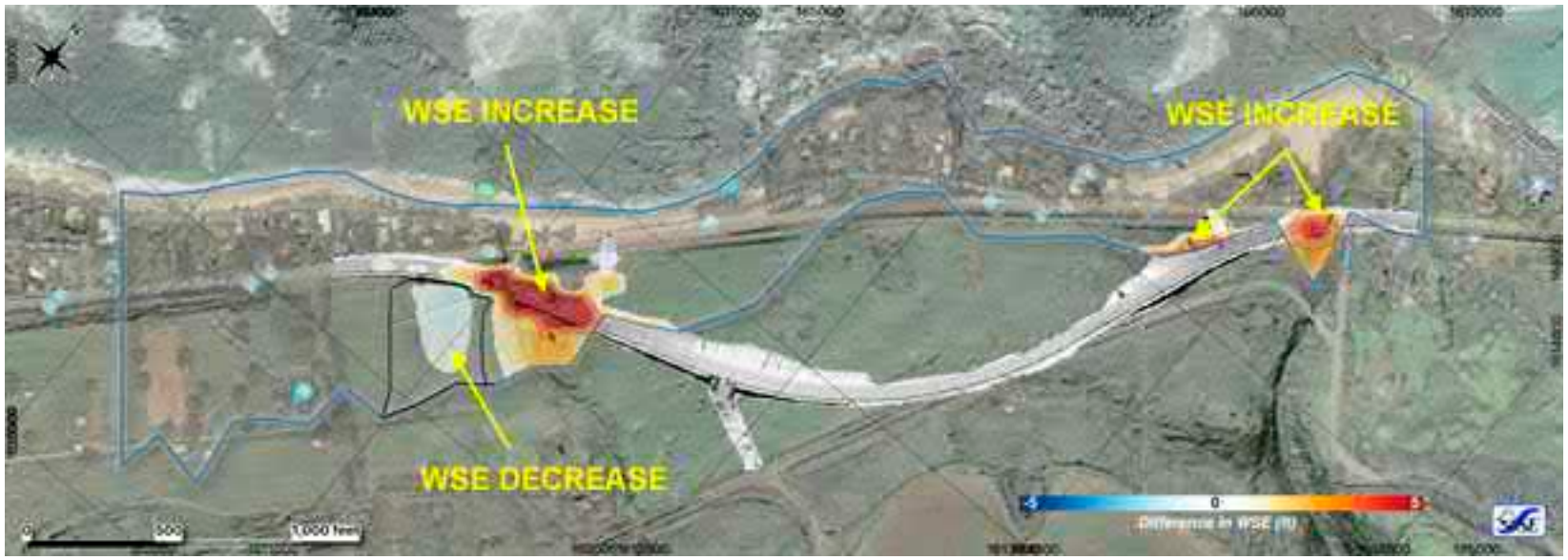



**Figure 4-18. Difference analysis between existing condition (Figure 4-13) and Alternative 2 (Figure 4-17)**

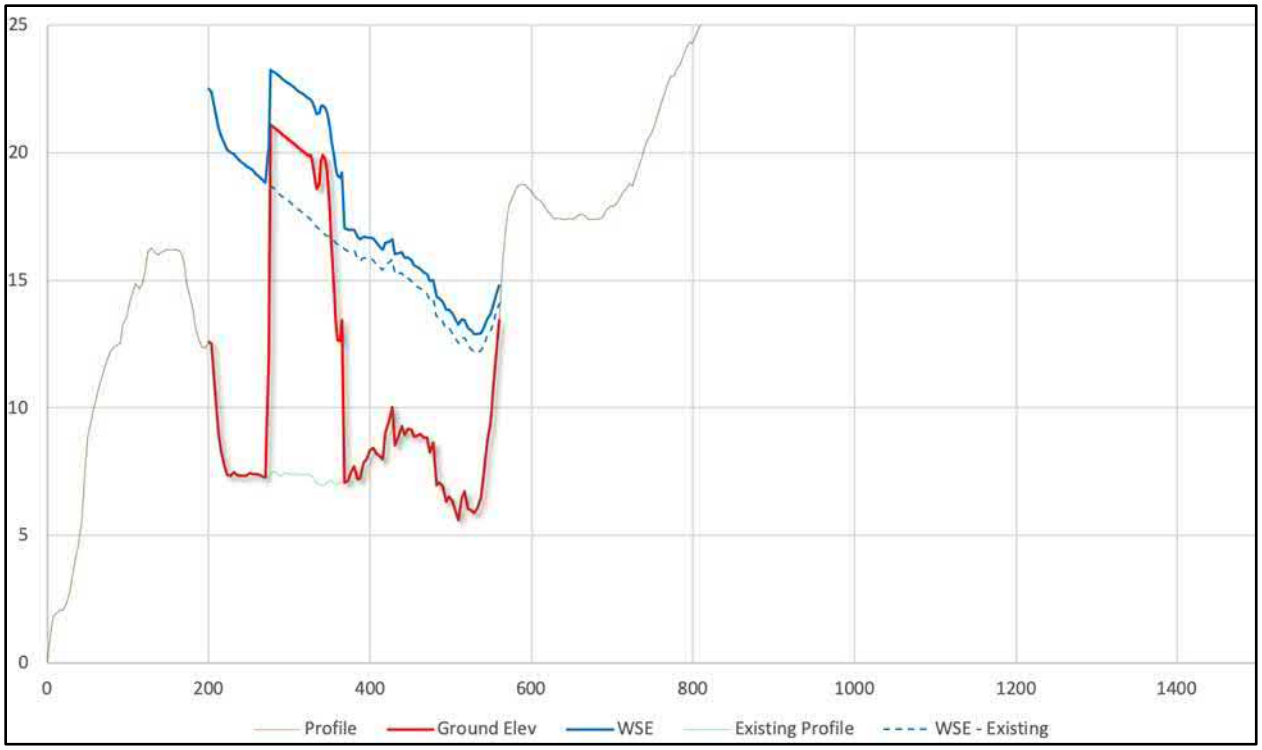



**Figure 4-19. Transect 11 analysis for Alternative 2 showing WSE increase over the road**

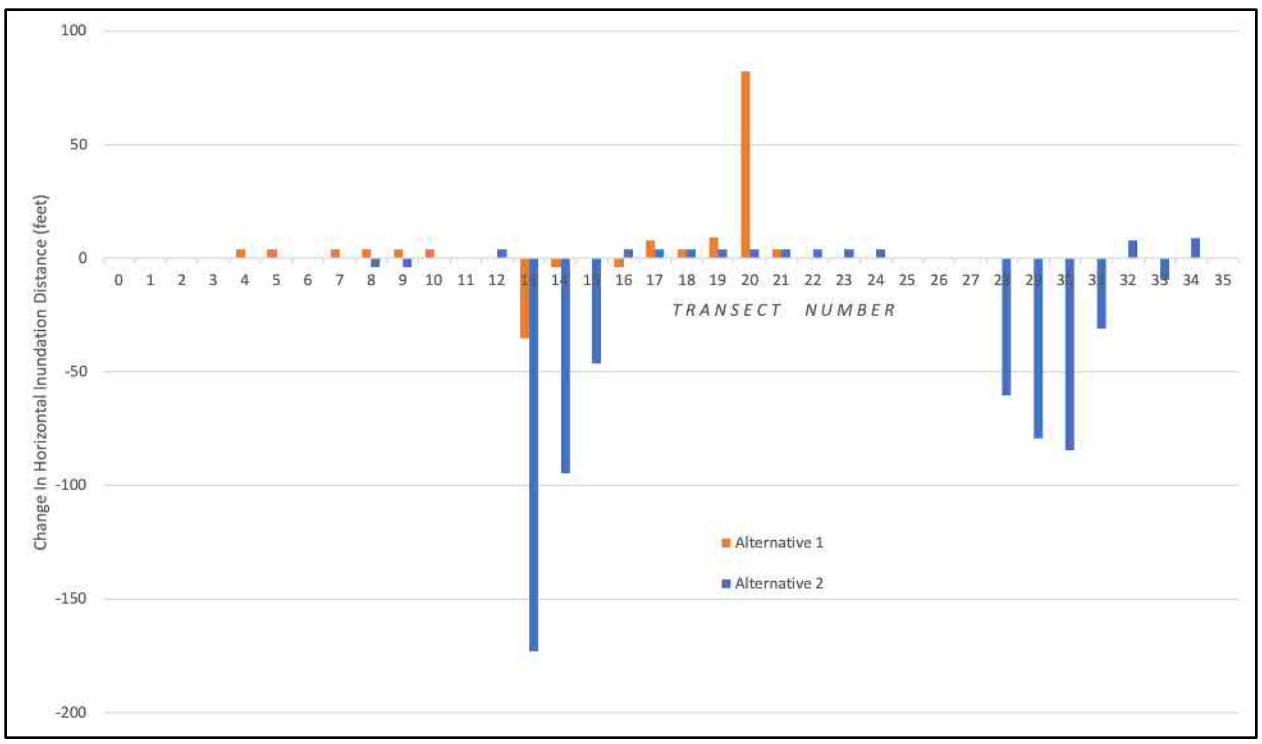



**Figure 4-20. Horizontal inundation distance change between existing topography and Alternative 1 and Alternative 2 conditions**

## 4.5 Sea Level Rise

### 4.5.1 *Global Sea Level Rise Predictions*

Greenhouse gas (GHG) emissions are a driving factor behind the increase in global temperature and sea level rise. In order to quantify the potential risks of global warming, the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5; Church et al. 2013a) establishes four cases representing the climate response to GHG emission levels from different socioeconomic scenarios, referred to as Representative Concentration Pathways (RCPs). The four RCP scenarios are RCP 2.6, RCP 4.5, RCP 6.0, and RCP 8.5. RCP 2.6 requires a strong proactive approach to reduce GHG in the first quarter of the 21$^{st}$ century and includes at least modest active carbon dioxide ($CO_2$) removal from the atmosphere. RCP 4.5 represents moderate mitigation of emissions through the mid-21$^{st}$ century and declining thereafter. RCP 6.0 represents a second moderate mitigation policy scenario with emissions peaking higher than RCP 4.5 and less mitigation through the end of the 21$^{st}$ century. RCP 8.5 can be viewed as corresponding to high-end business-as-usual emissions (Kopp, 2014).

GHG emissions are currently correlated with the RCP 8.5 scenario. The IPCC predictions for future GHG emissions and their effect on global temperatures is shown in Figure 4-21. The corresponding increase in global surface temperatures are shown in Figure 4-22. It is important to note that the IPCC predictions show that, even if global GHG emissions are dramatically reduced, global temperatures will continue to rise.

In 2017, NOAA revised their global projections for relative sea level change through 2100 (Sweet et al. 2017). The study updates the commonly used values presented in the IPCC Fifth Assessment Report (AR5). It is common to see studies site the high-end prediction AR5 global sea level rise values of 0.98 m (3.2 ft) in 2100. The values presented in the AR5 represent the central or 'likely' range of 21$^{st}$ century sea level rise. The IPCC defines the 'likely' range as having at least a 66% probability of occurrence. This leaves a large uncertainty for higher sea level rise scenarios with lower probability of occurrence (Sweet et al. 2017).

To allow planners to make a more complete risk assessment in coastal areas, the NOAA (Sweet et al. 2017) study established six global mean sea level (GMSL) rise scenarios by 2100 (Table 4-2). Global changes in mean sea level are the starting point of the NOAA study. Due to ocean dynamics on a planetary scale, it is projected that Hawaii will experience a higher increase in sea level than the global mean (see Section 4.5.2).

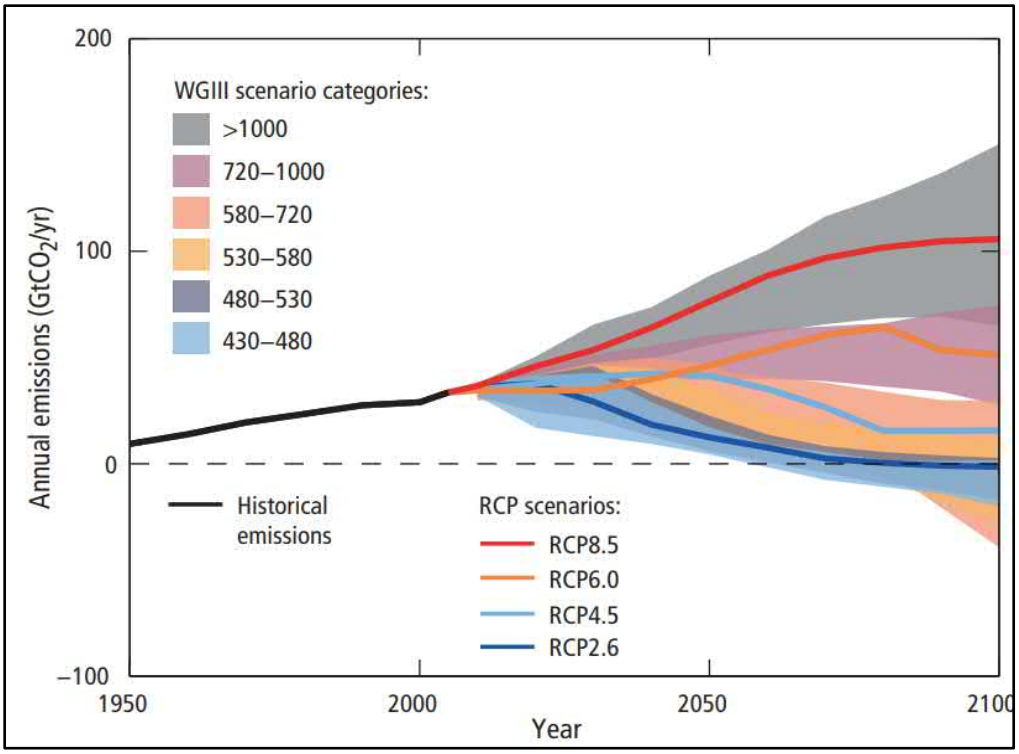



**Figure 4-21. Predicted increase in changes to global temperature from CO2 emissions**

Source: IPCC Fifth Assessment Report

Note: The emissions of all GHG is represented by the equivalent amount of carbon dioxide ($CO_2$) in gigatons (Gt). WGIII scenarios are the range of emission scenarios from scientific literature with values listed equivalent amount of carbon dioxide in parts per million.

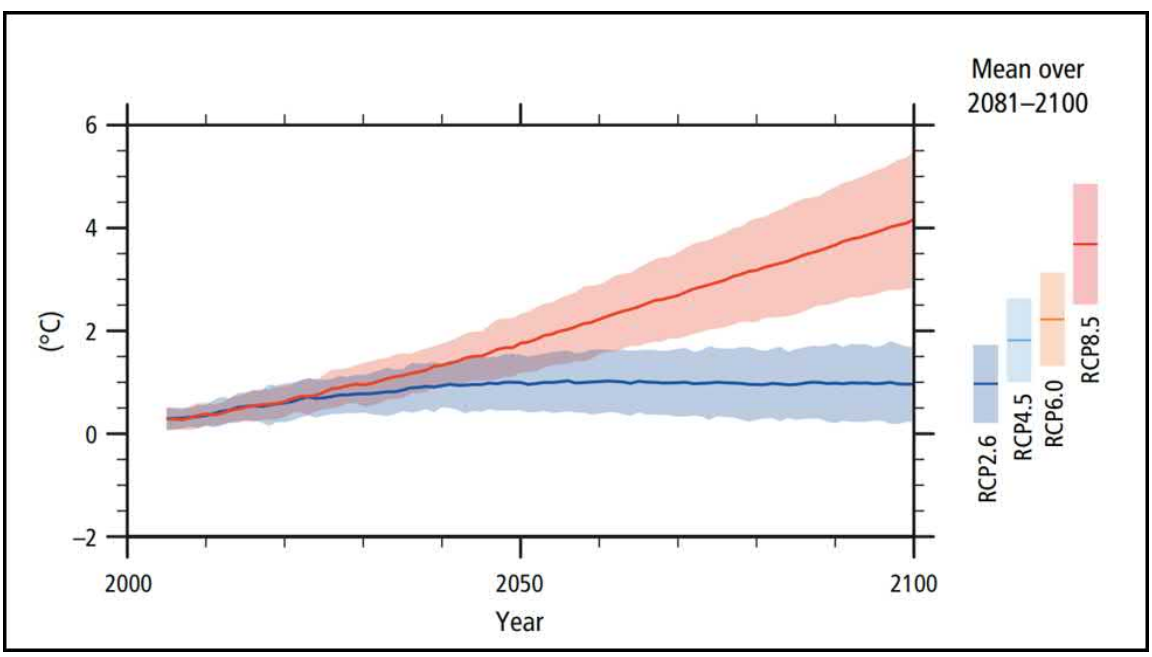



**Figure 4-22. Global average surface temperature change relative to 1986-2005.**

Source: IPCC Fifth Assessment Report

**Table 4-2. Global Mean Sea Level Rise Scenarios (NOAA, 2017).**

| Scenario | GMSL rise |
|---|---|
| Low | 1.0 ft (0.3 m) |
| Low-Intermediate | 1.6 ft (0.5 m) |
| Intermediate | 3.3 ft (1.0 m) |
| Intermediate-High | 4.9 ft (1.5 m) |
| High | 6.6 ft (2.0 m) |
| Extreme | 8.2 ft (2.5 m) |

The *Low* scenario of 1.0 ft (0.3 m) is calculated from measurements of GMSL change of the past 25-years and recent low-end projections of GMSL rise. The *Extreme* scenario for GMSL rise of 8.2 ft (2.5 m) in 2100 represents what is physically plausible, including recent observational and modeling literature related to the potential for rapid ice melt in Greenland and Antarctica (Sweet et al. 2017). The intermediate cases were established by inserting 0.5 m increments between the *Low* and *Extreme* sea level values. The exceedance probability for six GMSL rise scenarios in 2100 using the RCP-based probabilistic projections from Kopp et al. (2014) are shown in Table 4-3.

**Table 4-3. Probability of Exceeding GMSL (median value) Scenarios In 2100 Based Upon Kopp et al. (2014).**

| GMSL rise Scenario | RCP2.6 | RCP4.5 | RCP8.5 |
|---|---|---|---|
| **Low (1.0 ft, 0.3 m)** | 94% | 98% | 100% |
| **Intermediate-Low (1.6 ft, 0.5 m)** | 49% | 73% | 96% |
| **Intermediate (3.3 ft, 1.0 m)** | 2% | 3% | 17% |
| **Intermediate-High (4.9 ft, 1.5 m)** | 0.40% | 0.50% | 1.30% |
| **High (6.6 ft, 2.0 m)** | 0.10% | 0.10% | 0.30% |
| **Extreme (8.2ft, 2.5 m)** | 0.05% | 0.05% | 0.10% |

The NOAA (Sweet et al. 2017) report cites new evidence that the Antarctic ice sheet may be melting more rapidly than previously expected, which significantly increases the probability of the *Intermediate-High*, *High*, and *Extreme* scenarios, particularly for RCP 8.5 projections based on Kopp et al. (2014). Studies by DeConto and Pollard (2016) found that a change in the rate of glacial ice melt is possible meaning that sea level rise trends may follow the *Intermediate* scenario early in the 21st century but jump up to the *High* or *Extreme* scenario late in the 21st century (Sweet et al. 2017).

### 4.5.2 *Hawaii Sea Level Rise Predictions*

Hawaii thus far has experienced a rate of sea level rise less than the global average; however, this is expected to change. Hawaii is in the "far field" of the effects of melting land ice so those effects have been significantly less in Hawaii compared to areas nearer to the ice melt. Over the next few decades, those effects will spread to Hawaii, which is then projected to experience sea level rise greater than the global average.

The present rate of global mean sea level change is +3.4 ± 0.4 mm/yr (NOAA, 2017), where a positive number represents a rising sea level. Globally, sea level rise appears to be accelerating compared to the mean of the 20th Century. The sea level trend for Honolulu Harbor for the period of 1905 to present is shown in Figure 4-23 (NOAA, 2020). The rate of sea level change is shown in the figure as being +1.49 ± 0.21 mm/yr based on monthly data for the period of 1905 to 2019. The figure also shows monthly averages of sea level anomalies greater than 0.5 ft (15 cm), which occur on an interannual basis.

The NOAA (2017) sea level rise predictions for the Honolulu Harbor tide station presented in Table 4-4 and Figure 4-24 are based on the revised NOAA projections and include the far field effects. While the projections are based on the most current scientific models and measurements, discretion is necessary in selecting the appropriate scenario. Selecting the appropriate sea level rise projections is a function of many parameters, including but not limited to existing uses and site conditions, presence and type(s) of infrastructure, design life, potential for adaptation, and socioeconomic value.
Since we are currently twenty years into the sea level rise prediction, we are able to compare the modeled sea level rise scenario projections to empirical measurements of sea level (Figure 4-25). The mean trend line from measured sea level is below the current sea level rise predictions; however, the range of the average of monthly measured mean sea level exceeds the range of the sea level rise predictions.

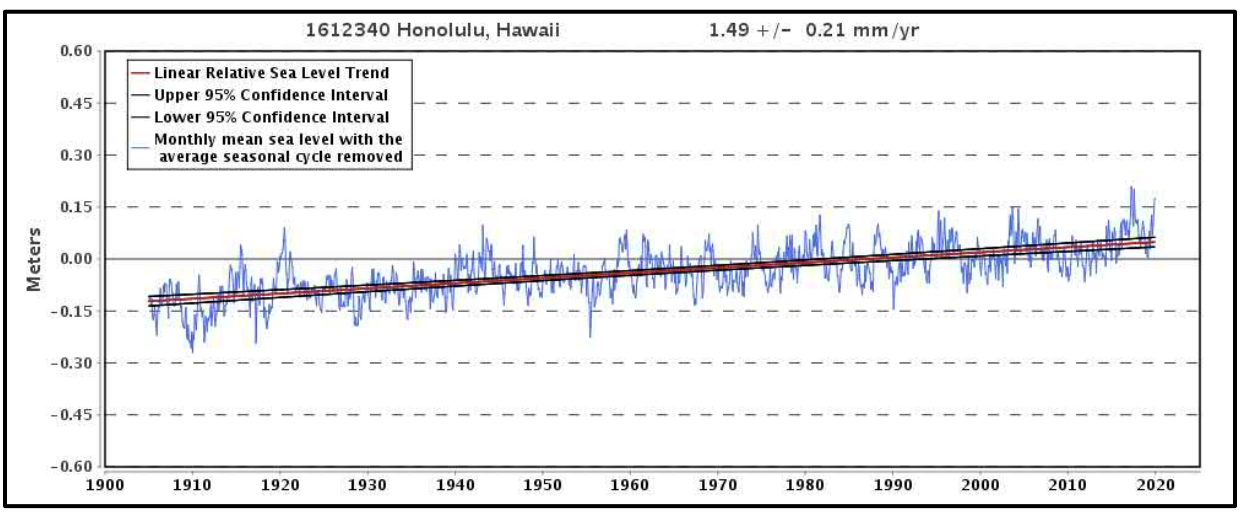



**Figure 4-23. Mean sea level trend, Honolulu Harbor, 1905 to present (NOAA, 2020)**

Source: https://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?id=1612340

**Table 4-4. Hawaii Sea Level Rrise Scenarios (adapted from NOAA, 2017)**

| Scenario (feet) | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | 2080 | 2090 | 2100 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Low** | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.7 | 0.9 | 1.0 | 1.1 | 1.2 | 1.3 |
| **Int-Low** | 0.1 | 0.2 | 0.4 | 0.5 | 0.7 | 0.9 | 1.1 | 1.3 | 1.4 | 1.6 | 1.8 |
| **Intermediate** | 0.1 | 0.3 | 0.5 | 0.7 | 1.0 | 1.4 | 1.8 | 2.3 | 2.8 | 3.3 | 4.0 |
| **Int-High** | 0.1 | 0.4 | 0.6 | 0.9 | 1.4 | 2.0 | 2.6 | 3.4 | 4.3 | 5.2 | 6.4 |
| **High** | 0.1 | 0.4 | 0.7 | 1.1 | 1.8 | 2.5 | 3.5 | 4.6 | 5.9 | 7.2 | 8.9 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Extreme** | 0.1 | 0.4 | 0.7 | 1.3 | 2.0 | 3.0 | 4.1 | 5.5 | 7.0 | 8.7 | 10.9 |

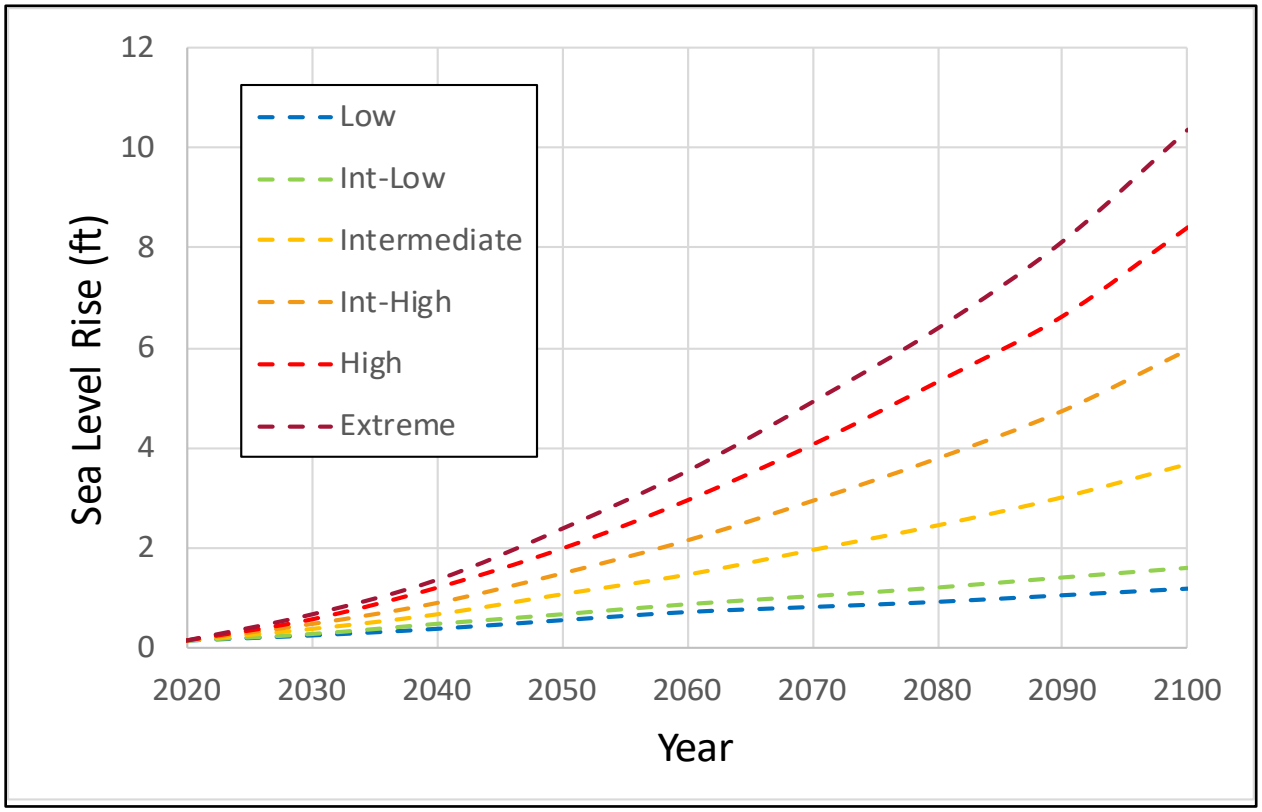



**Figure 4-24. Projected sea level rise at Honolulu Harbor tide station (adapted from NOAA, 2017)**

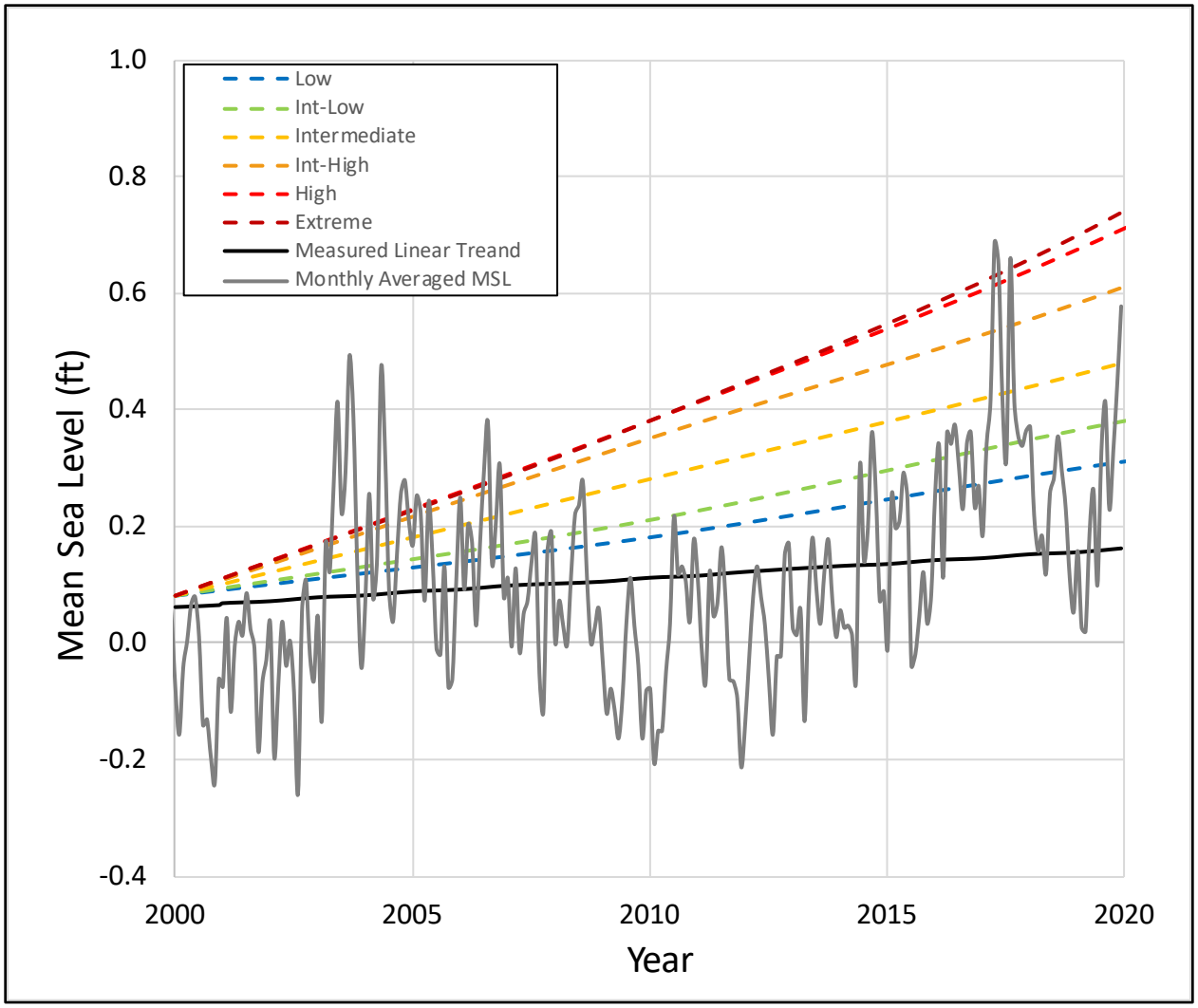



**Figure 4-25. Comparison of sea level rise projections to measured mean sea level trends**

## 4.6 Projected Impacts of Sea Level Rise

Sea level rise has the potential to impact beaches and shorelines in Hawaii. Impacts may include beach narrowing and beach loss, loss of land due to erosion, and infrastructure damage due to inundation and flooding. The impacts from anomalous sea level events (e.g., king tides, mesoscale eddies, storm surge) are also likely to increase. A 2015 study found that, due to increasing sea level rise, average shoreline recession (erosion) in Hawaii is expected to be nearly twice the historical extrapolation by 2050, and nearly 2.5 times the historical extrapolation by 2100 (Anderson et al., 2015).

The State of Hawaii recently published the *Sea Level Rise Vulnerability and Adaptation Report for Hawaii*, which discusses the anticipated impacts of projected future sea level rise on coastal hazards, and the potential physical, economic, social, environmental, and cultural impacts of sea level rise in Hawaii. The University of Hawaii conducted numerical modeling to estimate the potential impacts that a 3.2-foot rise in sea level would have on coastal hazards including passive flooding, annual high wave flooding, and coastal erosion. Figure 4-26 shows the inundation that

would take place under a one-year return period wave height with 3.2 ft of sea level rise. The results show that the highway would be overtopped and inundated.

**Figure 4-26. Annual high wave flooding at Kawailoa Beach under a 3.2 ft sea level rise scenario**

## 4.7 The Statewide Coastal Highway program report

### 4.7.1 *The CRESI Methodology*

The Statewide Coastal Highway Program Report (SCHPR) is a report authored by University of Hawaii (UH) researchers (primarily from the Department of Civil and Environmental Engineering) for the State of Hawaii Department of Transportation. The report was released in August 2019 (Francis et al, 2019). The report defines an index system, referred to as the Coastal Road Erosion Susceptibility Index (CRESI) to rank coastal roadway systems by their susceptibility to erosion and structural collapse.

The CRESI method evaluates eleven variables to evaluate the roadway erosion hazard potential:

1. Beach geomorphology
2. Coast geomorphology
3. Erodible volume
4. Slope
5. Coastal ground cover and existing structures above ground
6. Road base and subgrade condition
7. Armoring
8. Rate of sea level change
9. Shoreline accretion or erosion rate
10. Mean tide change
11. Significant wave height

Each variable is assigned a susceptibility value from Very Low (1) to Very High (5).

The CRESI variables are statistically weighted and combined to range in value from 0 to 100, although typical values in Hawaii do not exceed 40.

Part of the study results are shown as colorized roadway segments. Yellow segments have low susceptibility to erosion (CRESI values between 0 and 9), blue segments have medium susceptibility values (CRESI values between 10 and 19), and red segments have high susceptibility values (CRESI values equal to or greater than 20).

Specific road sections were also prioritized in order to rank the most critical areas. The twenty most critical segments were ranked and numbered, with others designated as Level 1, Level 2, and Level 3, and Level 4, in decreasing importance. Recommendations for remediation measures were assigned to each ranked segment, including hardening, relocation, elevation, slope protection, beach nourishment and more.

Figure 4-27 shows CRESI values for the North Shore of Oahu. The inset shows the project area at milepost (MP) 3+0.30, with a high susceptibility value of 23. Figure 4-28 is the color-coded susceptibility map. The project reach is colored red, indicating high susceptibility. The project area and the Sunset Beach area were the only sections on the North Shore to be assigned the *High* susceptibility rating.

### 4.7.2 *Traffic-Prioritized Road Segment Significance*

When roads are damaged by coastal hazards, the resulting losses can be substantial and unduly large. Loss of a single road can disrupt traffic flow patterns over a large area, and block emergency access and material delivery. A roadway priority ranking is therefore an important additive to the CRESI study.

A second part of the UH study constructed a traffic-related priority index involving a range of traffic demand patterns, roadway topological characteristics, and socioeconomic factors. The new parameter was created in a way that it could be added to the CRESI index. The following characteristics were considered:

1. Annual Average Daily Traffic (AADT)
2. Directional peak traffic volume
3. Directional non-peak traffic volume
4. Traffic composition
5. Network redundancy
6. Connectivity
7. Accessibility
8. Capacity
9. Reliability
10. Impacted population groups
11. Trip generation
12. Function and social impact.

The first four variables are elements for traffic demand dynamics. Roadway network topology is represented by variables 5 through 9, and the last three are related to land use.

Data used were a combination of field collected data, existing available data from the Hawaii Department of Transportation, and the use of Google Earth software. Figure 4-29 shows the CRESI susceptibility values for the North Shore updated with the traffic priority index. Changes are minor, but the project area at Laniakea is still rated "high".

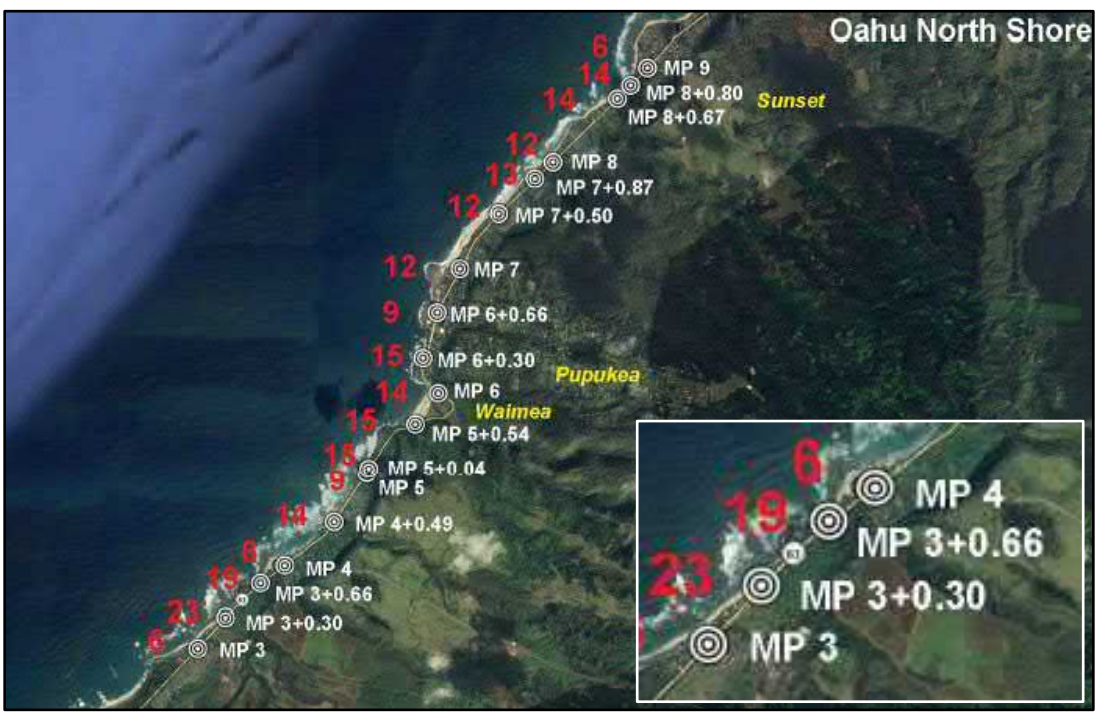



**Figure 4-27. CRESI susceptibility values for the North Shore; inset is the project area**

**Figure 4-28. Road erosion susceptibility; inset is the project area**

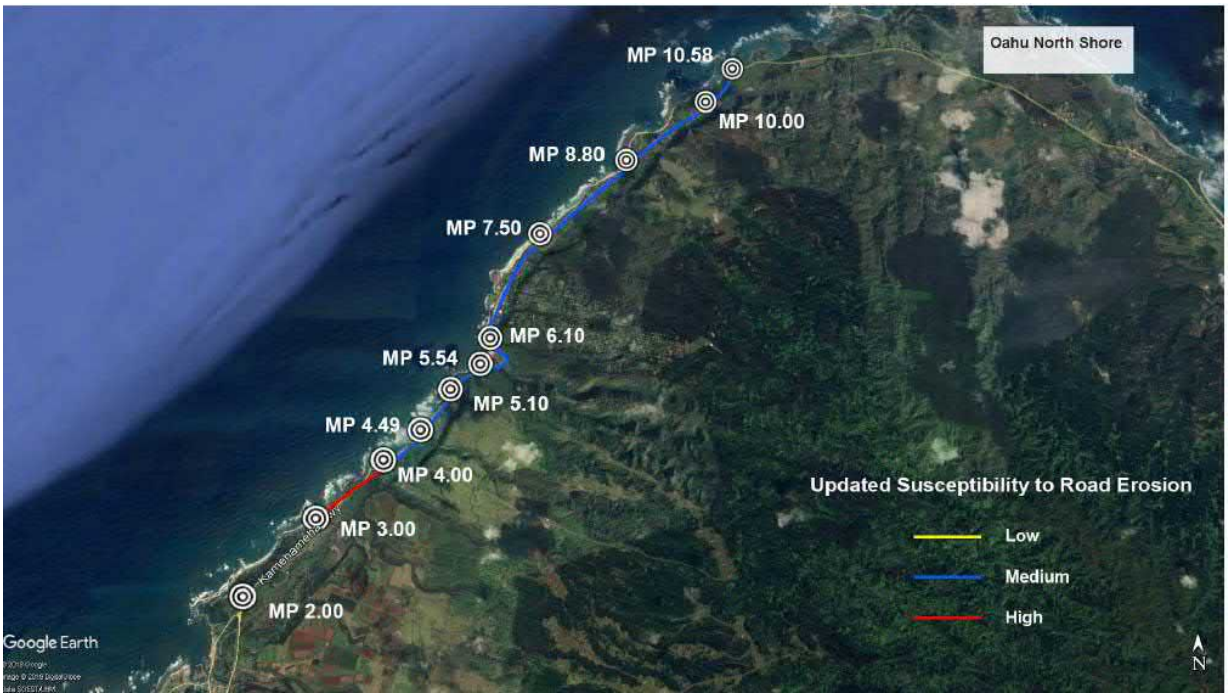



**Figure 4-29. North Shore erosion susceptibility updated to include traffic priority index**

### 4.7.3 *Ocean Hazards*

The UH report also includes an Ocean Hazards Database (OHD) and a scheme for classifying ocean hazards termed the Ocean Hazards Classification Scheme (OHCS). Seven OHD variables include:

1. Sea Level Rise (2050, 2100),
2. Tides,
3. Wave period and height,
4. Shoreline change rate and armoring,
5. Tsunami historical and hypothetical depth flows
6. Storm surge,
7. Nearshore benthic habitat zone – major structure, detailed structure, and coverage.

The data are presented for 302 mileposts around the coastlines of all the major Hawaiian Islands and listed in nine summary tables in the report. The variables and sub-variables are shown in Figure 4-30, the Ocean Hazards Data variables and sub-variables (Table 3.1 from Francis et al, 2019).

The classification scheme, including vulnerability rankings is shown in Figure 4-31 (Table 3.2 from Francis et al, 2019) However, only four variables are presently incorporated in the CRESI analysis:

1. Sea level rise (historical rate),
2. Tides,
3. Wave height,
4. Shoreline change.

### 4.7.4 *Adaptation Recommendations*

The final section in the UH report presents adaptation recommendations for specific highway sections and mileposts. The adaptation options were ranked in terms of a cost benefit analysis that included social, technical, administrative, political, economic, and environmental consideration. Adaptation options include:

**Relocate (R):** this option is to move away from the water. There are two sub-categories: relocation to an old road (R-O), or relocation to a new road (R_N).

**Protect (P):** this option is to keep the water out. Options include hard structures (P-H) including seawalls and revetments, or soft approaches including beach nourishment (P-SB) and living dunes (P-SD).

**Accommodate (A):** this option is the ability to live with the water. Four sub-categories include: vegetative cover / existing green space (GO), wetland construction (WN), and elevated development (E).

**Combination (C):** this option combines a number of the previous alternatives. These include hard protection with and elevated road (H-E), hard and soft protection (H-SD), and relocate with added green space (R-G). Combination sub-categories include C-H-E, C-H-SD, and C-R-G.

**Monitor or no action (M):** this option is to leave the road alone and monitor the site periodically.

The results for the project site (milepost 3+0.3) is to monitor the site (Figure 4-32).

| Variable | Sub-Variable | Classification | Sub-classification |
|---|---|---|---|
| 1 | 1a | Sea Level Rise | 2050 Sea Level Rise Rate[1,2] (1905-2050, extreme scenario) [in/yr] |
| | 1b | Sea Level Rise | 2100 Sea Level Rise Rate[1,2] (1905-2100, extreme scenario) [in/yr] |
| | 1c | Sea Level Rise | Historical Sea Level Rise Rate[3,2] (1905-2016) [in/yr] |
| 2 | --- | Tides | Mean Tidal Range[4] (1983-2001) [ft] |
| 3 | 3a | Maximum Annually Recurring Waves | Peak Wave Period[5] (2010-2018) [sec] |
| | 3b | Maximum Annually Recurring Waves | Significant Wave Height[5] (2010-2018) [ft] |
| 4 | 4a | Shoreline Change | Mean Shoreline Change Rate[6] (2008 - 2100) [ft/yr] |
| | 4b | Shoreline Change | CRESI - Armoring Ranking[7] [1 - 5] |
| 5 | 5a | Tsunami | Historical Flow Depth[8] [ft] |
| | 5b | Tsunami | Hypothetical Flow Depth[8] [ft] |
| 6 | 6a | Storm Surge | Category 1 Storm Inundation Height[9] (Hypothetical) [ft] |
| | 6b | Storm Surge | Category 2 Storm Inundation Height[9] (Hypothetical) [ft] |
| | 6c | Storm Surge | Category 3 Storm Inundation Height[9] (Hypothetical) [ft] |
| | 6d | Storm Surge | Category 4 Storm Inundation Height[9] (Hypothetical) [ft] |
| 7 | 7a | Nearshore Benthic Habitat | Zone[10] |
| | 7b | Nearshore Benthic Habitat | Major Structure[10] |
| | 7c | Nearshore Benthic Habitat | Detailed Structure[10] |
| | 7d | Nearshore Benthic Habitat | Coverage[10] |

**Figure 4-30. Table 3.1 from Francis et al, 2019 showing ocean hazards variables selected from the Ocean Hazards Database**

| Vunerability Rank | Percent | Variable 1 | | | Variable 2 | Variable 3 | | Variable 4 | Variable 5 | Variable 6 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Sea Level Rise | | | Tides | Maximum Annually Recurring Waves | | Shoreline Change | Tsunami | Storm Surge |
| | | 2050 Sea Level Rise Rate[1,2]* (1905-2050, extreme scenario) [1a] | 2100 Sea Level Rise Rate[1,2] (1905-2100, extreme scenario) [1b] | Historical Sea Level Rise Rate[3,2] (1905-2016) [1c] | Mean Tidal Range[4] (1983-2001) [2] | Peak Wave Period[5] (2010-2018) [3a] | Significant Wave Height[5]* (2010-2018) [3b] | Mean Shoreline Change Rate[6]* (2008-2100) [4a] | Tsunami Flow Depth[7]* (Historical and Hypothetical) [5] | Weighted Mean Storm Surge Inundation Height[8]* (Hypothetical) [6] |
| 1 | 0-20% | < 0.1 in/yr | < 0.2 in/yr | < 0.02 in/yr | < 2.0 ft | < 4 sec | < 7 ft | < 0 ft/yr | No inundation or Hypothetical inundation < 16 ft with no Historical Inundation | No Inundation or Category 4 Inundation < 4 ft |
| 2 | 21-40% | 0.1 to 0.2 in/yr | 0.2 to 0.4 in/yr | 0.02 to 0.04 in/yr | 2.0 to 2.1 ft | 4 to 7 sec | 7 to 14 ft | 0 to 2 ft/yr & "N/A" with > 3 Armoring Ranking | Hypothetical inundation ≥ 16 ft with no Historical Inundation | Category 3 Inundation < 4 ft or Category 4 Inundation of 4 to 8 ft |
| 3 | 41-60% | 0.2 to 0.3 in/yr | 0.4 to 0.7 in/yr | 0.04 to 0.06 in/yr | 2.1 to 2.2ft | 7 to 11 sec | 14 to 21 ft | 2 to 5 ft/yr & "N/A" with ≤ 3 Armoring Ranking | Historical inundation < 6 ft | Category 3 Inundation of 4 to 7 ft or Category 2 Inundation < 1 ft |
| 4 | 61-80% | 0.3 to 0.4 in/yr | 0.7 to 0.9 in/yr | 0.06 to 0.08 in/yr | 2.2 to 2.3 ft | 11 to 14 sec | 21 to 29 ft | 5 to 7 ft/yr | Historical inundation of 6 to 12 ft | Category 2 Inundation of 1 to 6 ft or Category 1 Inundation < 1 ft |
| 5 | 81% or greater | ≥ 0.4 in/yr | ≥ 0.9 in/yr | ≥ 0.08 in/yr | ≥ 2.3 ft | ≥ 14 sec | ≥ 29 ft | > 7 ft/yr | Historical inundation ≥ 12 ft | Category 1 Inundation of 1 to 4 ft |

**Figure 4-31. Table 3.2 from Francis et al (2019) showing Ocean Hazards Classification Scheme rankings for selected variables**

**Figure 4-32. Adaptation recommendation for the project site is to Monitor (M)**

# 5. COASTAL HAZARD REVIEW AND MITIGATION

## 5.1 Coastal Process Review

As noted in Section 3.3.2, the North Shore has a bimodal wave climate consisting primarily of long period North Pacific swell from the northwest in the winter, and short period trade wind waves from the north and northeast that occur year-round.

The North Shore beaches are unusually dynamic because of the wave climate and the large volume of sand available. Erosion estimates are difficult and prone to error (see Section 2.5). However, recent transient sea level rise events and anomalous wave climate seasons have shown that the existing conditions are fragile and subject to change.

The giant waves from one prevailing direction (northwest) that occur during the winter months have constructed a large sand storm berm, 20 to 25 ft in elevation, that forms the landward edge of the beach backshore for much of the entire North Shore. It is an unusual and defining morphological feature. During winter conditions there may be many cycles of beach transformation whereby a low elevation active berm and beach profile are formed during smaller wave conditions and then transition to a beach storm profile as wave conditions increase in magnitude (see Figure 2-20).

With the end of the energetic winter wave season, the trade wind waves from the north tend to push the lower active beach to the south. This sand migration transforms many of the North Shore beaches over the course of the summer. Sand will tend to collect at natural headland formations such as Rocky Point, Kulalua Point and the southern end of embayments such as Kawailoa Beach. Prolonged longshore transport to the south can result in degradation and collapse of the storm berm morphology during the transition period of late summer and early fall (Figure 5-1).

**Figure 5-1. Storm berm collapse at Ke Nui Road, October 2013**

## 5.2 Coastal Hazard Review

The major coastal hazards likely to affect the Laniakea Highway realignment project area can be divided into two main areas, shoreline erosion and coastal flooding. Shoreline erosion is an increasingly chronic condition for many Hawaii coastlines. Signs of erosion at the project site are detailed in Section 2.6. Figure 4-21 in Section 4.5.2 shows that the entire project reach is vulnerable to wave overtopping and coastal flooding with a projected 3.2 ft sea level rise scenario. Section 4.4 details the likely inundation effects of a 100-year tsunami.

### 5.2.1 *Shoreline Erosion Mitigation Options*

Although shoreline erosion is difficult to quantify on the North Shore because of the inherently dynamic beaches, recent erosion episodes and indicators, including preventive measures on Kawiloa Beach, have shown the vulnerability that exists. With additional erosional pressures likely due to climate change and sea level rise, it is prudent to consider the area at risk. If project stakeholder goals are to protect the area from erosion, mitigation and protection options are outlined below. There are three reaches defined for the project area (see Section 2.6), Turtle Beach, the revetment reach, and the storm berm reach.

<u>Turtle Beach</u>

Situated in the lee of Pu'u Nenue, Turtle Beach is relatively well protected. The back shore is well vegetated and the stacked rock wall does not show strong evidence of wave attack. The foreshore consists of a broad expanse of reef rock (see Figure 2-11) which is highly resistant to erosion and offers good natural protection by helping to dissipate wave energy.

Although Turtle Beach has good natural protection, wave energy and erosional pressure are expected to increase with rising sea level, and damage to the stacked wall and backshore are possible. Replacement of the stacked rock wall with a modern rock revetment engineered to account for sea level rise would prevent future erosion and damage to the backshore. A seawall could also be used for protection on this reach if a reduced footprint is required.

<u>Revetment Reach</u>

The revetment reach is probably the most exposed and vulnerable area within the project shoreline area. The revetment is necessary to prevent shoreline erosion at present, and the need will only grow with time and impending climate change. The existing structure is damaged and will become increasingly vulnerable to wave attack, exposing the backshore to erosion and damage.

Replacement of the existing, damaged rock rubble mound structure with modern rock revetment engineered to account for sea level rise would prevent continued erosion and damage to the backshore. The design should be updated to modern standards and design wave heights that accommodate predicted sea level changes. The revetment should ideally extend past the existing reach and terminate at the north bridge abutment. It is also recommended that it be extended across the Turtle Beach reach (see Figure 5-2).

Storm Berm Reach

The storm berm reach extends from the south bridge abutment to the end of Kawailoa Beach (out of the project area). While the morphology provides robust natural erosion protection, there are seasonal risks as discussed in Section 2.1 and Section 2.6.3 and Section 5.1. Most of the storm berm reach is buffered by private homes and properties that are 100 to 200 ft in lot depth. The most at-risk area is the approximately 50-ft reach adjacent to and just south of the south bridge abutment (Figure 5-2). This area has a lower berm elevation than further reaches, and the distance to the road is less, providing a shorter erosion buffer. The properties close to this area have temporary shore protection in the form of geotextile fabric draped over the storm berm and filled with sand at the base. Some of the protection consists of stacked sand-filled geotubes formed in place by the fabric.

Sand pushing is recommended as the primary mitigation effort for erosion protection of the storm berms. Stream clearing of built up sand can also serve as a sand source to build up the abutment area. Geotextile drapes can be used for emergency protection. The soils immediately behind the abutment can also be protected using scour protection methods such as HDPE (Tensar) rock mattresses. Hardening of storm berm shorelines with a seawall or revetment is not recommended because it can interfere with the adaptability of the berm and will change the inherent shoreline morphology.

**Figure 5-2. Recommended 875-ft reach for new revetment; location of south abutment area**

### 5.2.2 *Coastal Flooding Recommendations*

Flooding of the project upland area can occur from wave overtopping, hydrologic events (rainfall), or from tsunami. Flood protection involves thoughtful design, drainage, and scour protection. Drainage design is an essential part of flood control of all types to ensure that 1) flooding does not pond in place or, 2) drainage velocities are restricted or the drainage conduits are well protected from scour. Both wave overtopping and tsunami inundation can produce high water velocities. Irregular topography can produce pockets of scour. Protruding structures such as walls or posts are at risk of both causing scour and being damage or undermined from flowing water.

Scour protection can help prevent erosion of the substrate, especially in vulnerable areas such as embankments, or high flow areas such as drainage channels. In critical areas stone rip rap or rock-filled HDPE mattresses can be designed to prevent scour. In less critical areas scrub vegetation can be effective.

### 5.2.3 *Mitigation Options*

<u>Hard Shore Protection: Revetments and Seawalls</u>

Seawalls and revetments have been used with mixed success in the storm berm morphology on the North Shore. Due to the berm elevation and wave climate, hard structures will tend to be massive unless the bottom substrate is relatively shallow. The hard structures interfere with the berm building process and change the character of the beach. They are generally not recommended, with some exceptions such as the exposed revetment reach of this project.

*Seawall*

A seawall is a vertical or sloping concrete, cement-rubble-masonry (CRM), or cement-masonry-unit (CMU) wall used to protect the land from wave damage and erosion (Figure 5-3). A seawall, if properly designed and constructed, is a proven, long lasting, and relatively low maintenance shore protection method. Seawalls also have the advantage of having a relatively small "footprint" on the shore.

The impervious and vertical face of a seawall results in very little wave energy dissipation. Hence, wave energy is deflected both upward and downward, and a large amount of wave energy is reflected seaward. Reflected wave energy can inhibit accretion of sand in front of the wall, and thus seawalls should be used with some caution and a full understanding of local conditions.

The downward energy component can cause scour at the base of the wall, and thus the foundation of a seawall is critical for its stability. Ideally, a seawall should be constructed on solid, non-erodible substrate. Seawalls are not flexible structures, and their structural stability is dependent on the stability of their foundations.

If the foundation of the seawall is breached, hydraulic action can erode fill material behind the wall. With the loss of enough fill, the ground surface behind the seawall will collapse into a *sink hole*. When a sink hole is observed, repairs should be made as soon as possible or the wall will eventually fail. Repairs are usually done by excavating behind the wall, reinforcing the foundation with concrete, and replacing the fill with appropriately graded material.

A seawall is not recommended for protection against shoreline protection in the project area, except for the Turtle Beach reach, where either a seawall or revetment could replace the existing stacked rock wall.

**Figure 5-3. CRM seawall in Kahala**

*Rock Rubblemound Revetment*

A revetment is a sloping uncemented structure built of wave resistant material. The most common method of revetment construction is to place an armor layer of stone, sized according to the design wave height, over an underlayer and filter designed to distribute the weight of the armor layer and to prevent loss of fine shoreline material through voids in the revetment.

Toe scour protection can be provided by excavating to place the toe on solid substrate where possible, constructing the foundation as much as practical below the maximum depth of anticipated scour, or extending the toe to provide a scour apron of excess stone.

Properly designed and constructed rock revetments are durable, flexible, and highly resistant to wave damage. Should toe scour occur, the structure can settle and readjust without major failure. Damage from large waves is typically not catastrophic, and the revetment can still function effectively even if damage occurs. A revetment currently protects the existing roadway in the project area. Damage to the revetment, already evident in places, can be expected to increase with rising sea level. Replacement of the existing revetment with a new revetment structure designed to account for sea level rise will provide assured protection and resiliency for the backshore infrastructure.

Figure 5-4 shows a typical design section for a rock rubblemound revetment. The toe configuration assume that the nearshore and foreshore beach rock outcrops extend to the back shore area (see Figure 2-23). A detailed design analysis will be necessary for armor stone size calculation, but it

will likely be on the order of 2 to 4 tons. The existing stone is approximately 4,300 lbs (see Section 2.6.2).

Figure 5-2 shows the suggested extent of the new revetment. The reach extends from Turtle Beach to the north bridge abutment and is approximately 875 ft in length. One of the difficulties in revetment design is proper start and end configurations. Extending into existing structures such as the bridge abutment is a design convenience that reduces potentially more problematical end arrangements.

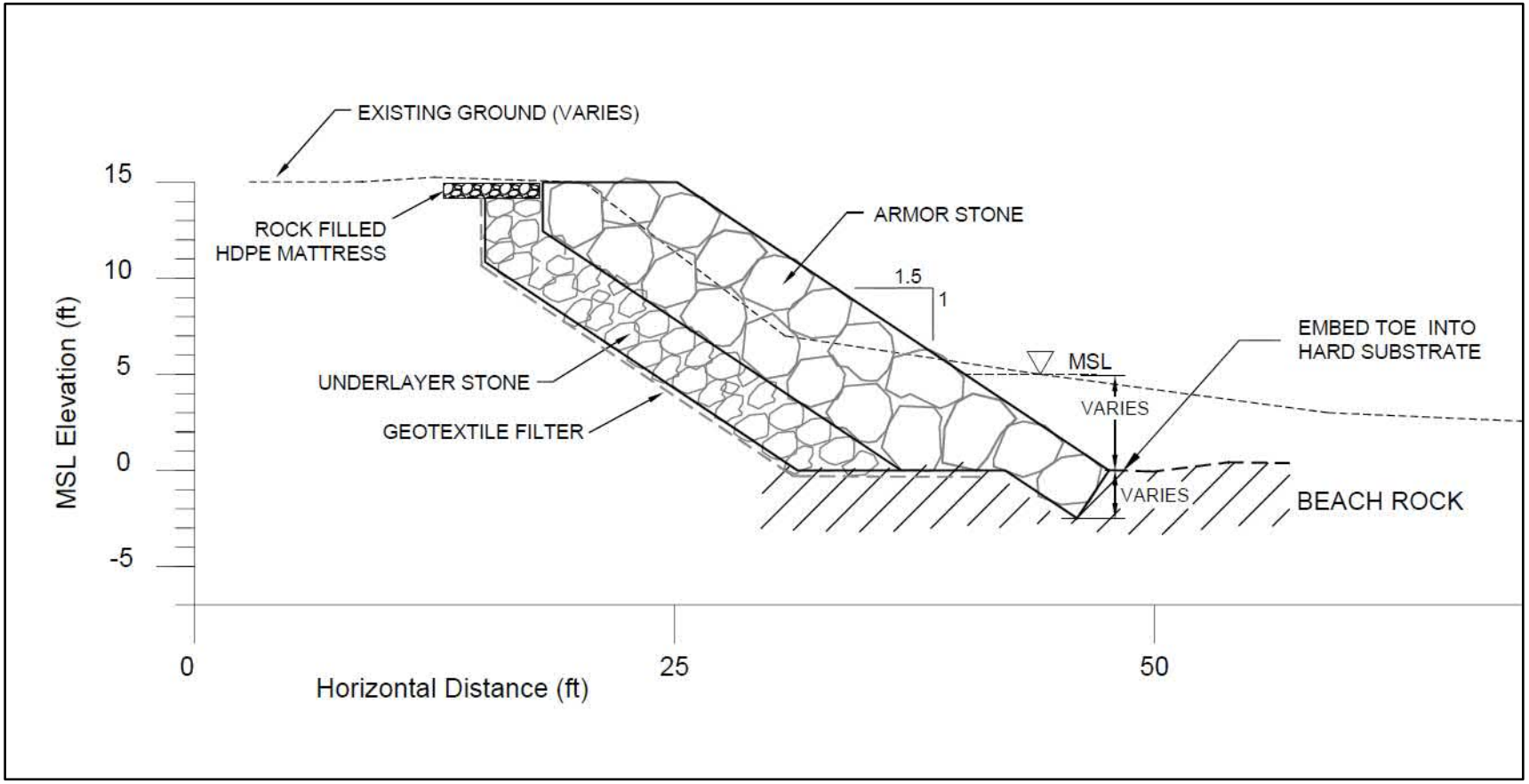



**Figure 5-4. Typical revetment section**

Soft Shore Protection: Beach Maintenance and Temporary Protection

Soft Shore Protection includes the options of beach nourishment, berm stabilization (sand pushing), and shoreline retreat. Beach nourishment is not a viable option for most North Shore Beaches because the extreme wave climate and substantial seasonal sand movement render it infeasible to bring in enough additional material to make a difference. Although it can be viewed as a form of beach nourishment, berm stabilization is really a beach maintenance option using existing sand, including sand cleared from stream mouths. It has proven effective on the North Shore. The project itself is a form of managed retreat from the shoreline, i.e. it moves threatened infrastructure away from the vulnerable shoreline.

*Beach Maintenance - Sand Pushing*

Sand pushing is a maintenance effort that has been used successfully to restore the storm berm at many North Shore erosion hot spots such as Sunset Beach, Rocky Point, and Ehukai Beach (Figure 5-5). It is preventive maintenance best accomplished when there is maximum accretion on the low active beach. The spring transitions months of April through June are probably the opportune time for sand pushing on the North Shore. The transition months of September through November are typically the time where the storm berm can be most eroded, and the low beach absent for those areas most affected by trade wind sand migration. The maintenance effort should therefore occur approximately 6 months before the season of active erosion.

Sand should ideally be pushed as high as possible on the berm to mimic the natural process of berm building during high wave conditions. A robust berm system has a better chance of surviving adverse seasonal or anomalous conditions to provide shore protection during the winter high wave season.

*Temporary Berm Protection*

The use of geotextile draped over the storm berm has proven successful as a temporary emergency measure to help prevent destruction of the storm berm during erosional conditions (see Figure 2-21 and Figure 2-22). The geotextile is difficult to anchor in place and is not sustainable for longer than one or two years.

*Stream Clearing*

Sand will naturally build up in front of stream mouths, forming a temporary dam and creating an estuary or muliwai. Natural clearing occurs when the water level behind the dam overtops and erodes the sand. Clearing as a maintenance effort occurs to prevent flooding of upland areas. Cleared sand from Lauhulu Stream is a natural source for berm restoration and a valuable source for out of season sand.

**Figure 5-5. Sand pushing on the North Shore (DLNR photo)**

Scour Protection

Scour protection involves the use of natural or engineered materials to resist the scour induced by wave action or flooding. Light scour can be mitigated with the use of ground cover. Heavy scour from wave inundation or heavy flooding from hydrologic events or tsunami can be prevented using rip rap sized to the design conditions, or encased rock mattresses. High Density Polyurethane (HDPE), or polymeric rock mattresses are relatively recent innovation that uses HDPE webbing to encase cobble-sized rock material.

*Rip Rap*

Rock Rip rap structures are similar to rock rubblemound structures but are generally used for smaller wave environments or riverbank protection. Rip rap uses a wide gradation of stone size, versus the limited range used for a rubblemound structure. While not recommended for shore protection in the project setting, rip rap stone could be used in some applications for scour protection.

*Rock Filled HDPE Mattress*

Triton Marine Mattresses are fabricated by the Tensar Corp. and consist of rock-filled HDPE (high density polyethylene) geogrid. The typical width is 5 ft and the recommended maximum length is 35 ft. However, the length can vary and design length is dependent on the desired handling characteristics of the mattress. A 12-inch by 35-ft mattress weighs about 9 tons. Figure 5-6 is a photograph of the Triton mattresses used as an articulating revetment. Rock-filled mattresses can be effective scour protection. They have the advantage that they can be covered with sand or fill and vegetated, enabling them to be hidden from view or used as part of landscaping (Figure 5-7).

**Figure 5-6. Rock-filled HDPE mattresses used for articulating protection**

**Figure 5-7. Rock-filled HDPE mattresses with fill and vegetation**

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Appendix

# E

# Terrestrial Vegetation and Wildlife Survey

## Report of Findings

# Terrestrial Vegetation and Wildlife Survey
# Kamehameha Highway Pedestrian Safety Project, Hale`iwa, O`ahu, Hawaii

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April 2021

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## INTRODUCTION

This report includes the findings of a plant and animal inventory conducted at the proposed alternative alignment for the Kamehameha Highway Pedestrian Safety Project on the Island of O`ahu, Hawaii. The HDOT is proposing to improve Kamehameha Highway in the vicinity of Laniākea Beach. While funding when the project started in 2011 was specifically intended to address shoreline erosion, the focus has now shifted to improve pedestrian safety. The proposed project will also address coastal erosion to improve roadway reliability; relieve congestion to reduce travel times through the area; and provide safe facilities and access for vehicles, pedestrians, and cyclists. This report addresses regulatory issues under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act, species for Hawaii Revised Statutes (HRS) Chapter 195D, and documentation for HRS Chapter 343.

The primary objectives of the field studies were to inventory the plants and animals located within the project area and vicinity of the proposed alignment (Study Area), provide a general description of the vegetation within the Study Area, and search for threatened and endangered species as well as species of concern. The federal and State of Hawaii listed species status follows species identified in the following referenced documents, (Department of Land and Natural Resources (DLNR) 1998, 2014; U. S. Fish & Wildlife Service (USFWS) 2021).

## SITE DESCRIPTION

The Study Area includes the proposed highway realignment transect (Figure 1) of Kamehameha Highway in the vicinity of Laniākea Beach on the North Shore of O`ahu as well as adjacent lands, including the coastal strand. The project area is dominated by disturbed pastureland, the existing highway, and parking areas.

The climate in the Study Area is characterized as moderately dry and sunny. According to the Online Rainfall Atlas of Hawai‘i (Giambelluca et al. 2013), the area receives a mean annual rainfall of approximately 36 inches (932 millimeters [mm]). Rainfall is typically highest in January and lowest in June-July (Giambelluca et al. 2013). The topography of the Study Area is relatively flat with Lauhulu Stream bisecting near the western section with elevations ranging between about 28 feet (8.5 m) above mean sea level (amsl) at the mauka extent to about 6 feet (2 m) above amsl at the makai extent of the Study Area. Principal soil types include Waialua Silty Clay [WkA], Waialua Stony Silty Clay [WIB], Jaucus sand [JaC], and Beaches [BS]. (NRCS, 2019). Photographs of the project area are found in Appendix A.

## METHODS OF STUDY

This study was conducted by LeGrande Biological Surveys Inc. flora and fauna specialists. Prior to conducting fieldwork, the biologists reviewed existing scientific literature, a previous biological survey report of the area (LBS, 2014), topographic maps and images, and engineering drawings relevant to the proposed project. Field data was collected on October 7, 2019, August 25, 2020, and March 26, 2021.

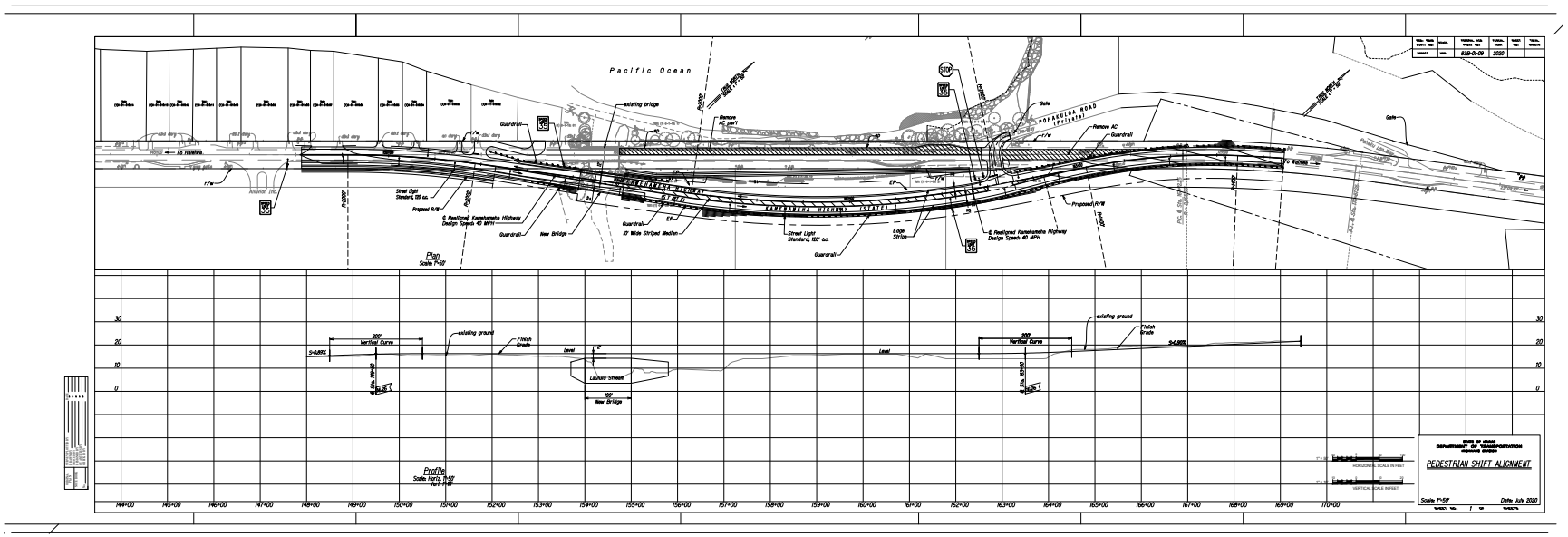


Figure 1. Plan and Profile for the Proposed Pedestrian Shift showing study area.

Plants and animals were inventoried during a pedestrian survey along the proposed alternative alignment as well as the proposed area of impact. The area of impact included the coastline at the high tide line and inland, extending up to 50 feet past the proposed new road alignment (Figure 1). Both the Hale`iwa or west end and the Waimea or east end of the new alignment were surveyed at least 250 feet in all directions from where the alignments depart the present roadway. Notes were collected on plant associations and plant distribution, disturbances, topography, substrate types, exposure, drainage, and related factors. Ornamental plants that are planted or used for landscaping were not included in the species list but included in the discussion.

Faunal surveys involved walking the Study Area and noting all bird species observed. Birds were identified by sight using the naked eye and 7x42 binoculars, and by songs and calls. For native bird species, the actual number of individuals observed is reported, for alien species only a list of species is provided. Special attention was given to the intermittent stream that crosses the project area in order to search for possible wetland habitats that could harbor endangered native waterbirds, including the Hawaiian Duck (*Anas wyvilliana*), Hawaiian Coot (*Fulica alai*), Hawaiian Gallinule (*Gallinula galeata sandvicensis*), and the Hawaiian Stilt (*Himantopus mexicanus knudseni*). Observations of mammals, amphibians, reptiles, and insects were made incidental to the collection of avian point-counts and related surveys of vegetation. Visual observations of animals, animal vocalizations, tracks, and scat were tallied. No effort was made to develop quantitative estimates of mammal populations within the Study Area.

## SURVEY RESULTS

### *Vegetation*

A total of 77 plant species were observed within the Study Area. These species are listed in Appendix B. 73 of the 77 species observed, or over 95%, are alien to Hawaii and 5 are native (all indigenous). We found none of the plant species listed as a threatened species, endangered species, or a species of concern (U.S. Fish and Wildlife Service, 2015) within the Study Area.

The coastline within the Study Area is either dominated by residential houses and yards, planted with ornamental landscaping, or comprised of sandy substrate that is dominated by coastal strand species such as naupaka (*Scaevola taccada*), milo (*Thespesia populnea*), ironwood (*Casuarina oppositifolia*), coconut (*Cocos nucifera*), pohuehue (*Ipomoea pes-caprae*), and kipukai (*Heliotropium curassavicum*).

The land at the western end of the alignment is utilized for ungulate (horse) pasture, dominated by grassy areas for foraging with sections of bare dirt. Tree species scattered in or around the edges of the pasture include Christmas berry (*Schinus terebinthifolius*), Chinese banyan (*Ficus macrocarpa*), ironwood, kiawe (*Prosopis pallida*), koa haole (*Leucaena leucocephala*), and autograph trees (*Clusia rosea*). Grass species include Bermuda grass (*Cynodon dactylon*), Guinea grass (*Panicum maximum*), kikuyu (*Pennisetum clandestinum*), buffelgrass (*Cenchrus ciliaris*) and swollen fingergrass (*Chloris barbata*).

The intermittent stream, Lauhulu (also known as Laniākea and Kukaiohiki), transects the Survey Area at the western end of Laniākea Beach. The existing bridge that spans the stream is located near the coastline, thus the substrate under the bridge, and for approximately 40 feet mauka (inland), is sand. Very little vegetation was observed in this area. Some vines of pohuehue were observed growing in the dry steam bed and milo trees are growing on both sides of the bridge near the roadway. Koa haole, Guinea grass, lion's ear (*Leonotis nepetifolia*), beggar tick (*Bidens alba*), and Chinese violet (*Asystasia gangetica*) were observed in the upper (inland) areas. The slope area close to the current highway is dominated by weedy pasture species such as kiawe, cocklebur (*Xanthium strumarium* var. *canadense*), sourbush (*Pluchea carolinensis*), and false ragweed (*Parthenium hysterophorus*). The bridge overpass near the beach is mainly bare sand with scattered species such as pohuehue, naupaka, and milo. Milo trees are prevalent at the coastal section. No wetland plant species (Obligate Wetland Species) were observed in the general area of the stream channel or surrounding areas.

The majority of the Study Area on the mauka (inland) side of the road is dominated by an overgrown forest of invasive tree species with weedy understory or open pastureland. The species are consistent throughout this vegetation type with the dominant tree species including, koa haole, autograph tree, kiawe, Chinese banyan, and Christmas berry. Understory plants include, Guinea grass, mock orange (*Murraya paniculata*), bougainvillea (*Boerhavia coccinea*), and khaki weed (*Alternanthera pungens*).

***Wildlife***

A total of 9 bird species were observed on the proposed project site during the site visits, of which 8 were alien (non-native) and one is indigenous (Table 1). The indigenous bird species observed is a migratory shorebird, the Pacific Golden Plover or kolea, which nests in Alaska and spend the winter months in the Hawaiian Islands and elsewhere. One Pacific Golden Plover was observed in the pasture at the western end of the project area.

No endangered waterbirds were observed, and no wetland habitat was found that would be suitable for waterbirds. The Lauhulu drainage channel was dry and showed no evidence of recent flow during the 2019 and 2020 site visits. During the March 2021 survey, Lauhulu Stream had standing water due to several major precipitation events that preceded in February and March. No waterbirds were observed utilizing the Lauhulu Stream area.

The endemic Hawaiian short-eared owl or pueo (*Asio flammeus sandwichensis*) is listed as endangered by the State of Hawaii on the Island of Oʻahu. Pueo occupy a variety of habitats and are most common in open habitats including grasslands and shrublands, often in urban areas. It is a ground nesting species, and thus sensitive to land clearing activities. Its key habitat requirements are difficult to determine due to a lack of historical population data. Pueo were not observed and is not known to occur in the area, but it is possible that it could occasionally use the grassy habitat in the area for foraging or nesting.

### Table 1. Birds observed within the Survey Area during site visits on October 7, 2019 & August 25, 2020

The following list is an inventory of the bird species observed at the Survey Area. It is possible that additional introduced bird species are present in the area and might be seen with greater survey effort. The names are arranged in generally accepted phylogenetic order and named in accordance with the American Ornithologists Union Checklist (2005).
Status codes:
X=Alien species introduced to the Hawaiian Islands by humans, intentionally or accidentally.
I=Indigenous species native to the Hawaiian Islands and also found elsewhere in the world.

| SCIENTIFIC NAME | COMMON NAME | STATUS |
|---|---|---|
| ARDEIDAE-HERONS | | |
| *Bubulcus ibis* | Cattle Egret | X |
| PLUVIALIDAE-PLOVERS | | |
| *Pluvialis fulva* | Pacific Golden Plover | I |
| COLUMBIDAE – PIGEONS AND DOVES | | |
| *Geopelia striata* | Zebra dove | X |
| ZOSTEROPIDAE – WHITE-EYES | | |
| *Zosterops japonicas* | Japanese white eye | X |
| STURNIDAE – MYNAS AND STARLINGS | | |
| *Acridotheres tristis* | Common Myna | X |
| RINGILLIDAE – FINCHES | | |
| *Carpodacus mexicanus* | House Finch | X |
| *Paroaria coronate* | Red-crested Cardinal | X |
| ESTRILDIDAE – WAXBILLS AND MANNIKINS | | |
| *Padda oryzivora* | Java Sparrow | X |
| *Lonchura atricapilla* | Chestnut Mannikin | X |

Indian mongooses (*Herpestes a. auropunctatus*) were observed within the Study Area. Feral cats (*Felis catus*) were seen and cat tracks were observed in several areas near the bypass alignment. Although not observed, Norway rats (*Rattus norvegicus*), Polynesian rats (*Rattus exulans hawaiiensis*), Roof rats (*Rattus r. rattus*), and European house mice (*Mus domesticus*) most likely also inhabit the project area. These introduced predators are known to have detrimental impacts upon populations of native wildlife, and also serve as a means of passive transport for propagules of invasive and noxious plants.

***Wetlands***

The National Wetland Inventory (NWI) (2020) has mapped wetlands within the Lauhulu Stream vicinity of the proposed realignment (Figure 2). The stream channel itself is intermittent and appears to have water flow or fill only during heavy rain events. Additionally, an area to the west of the stream is mapped as an estuarine and marine wetland by the NWI, but no evidence of standing water or wetland plant species were observed to the west of the intermittent stream during the site surveys on October 7, 2019 or August 25, 2020. A wetland reconnaissance site visit was conducted with a group from WSP USA, Army Corps of Engineers, and the author on March 26, 2021 to investigate the

mapped estuarine wetland. Site data (Appendix C) from the investigation summarized the area as a non wetland.

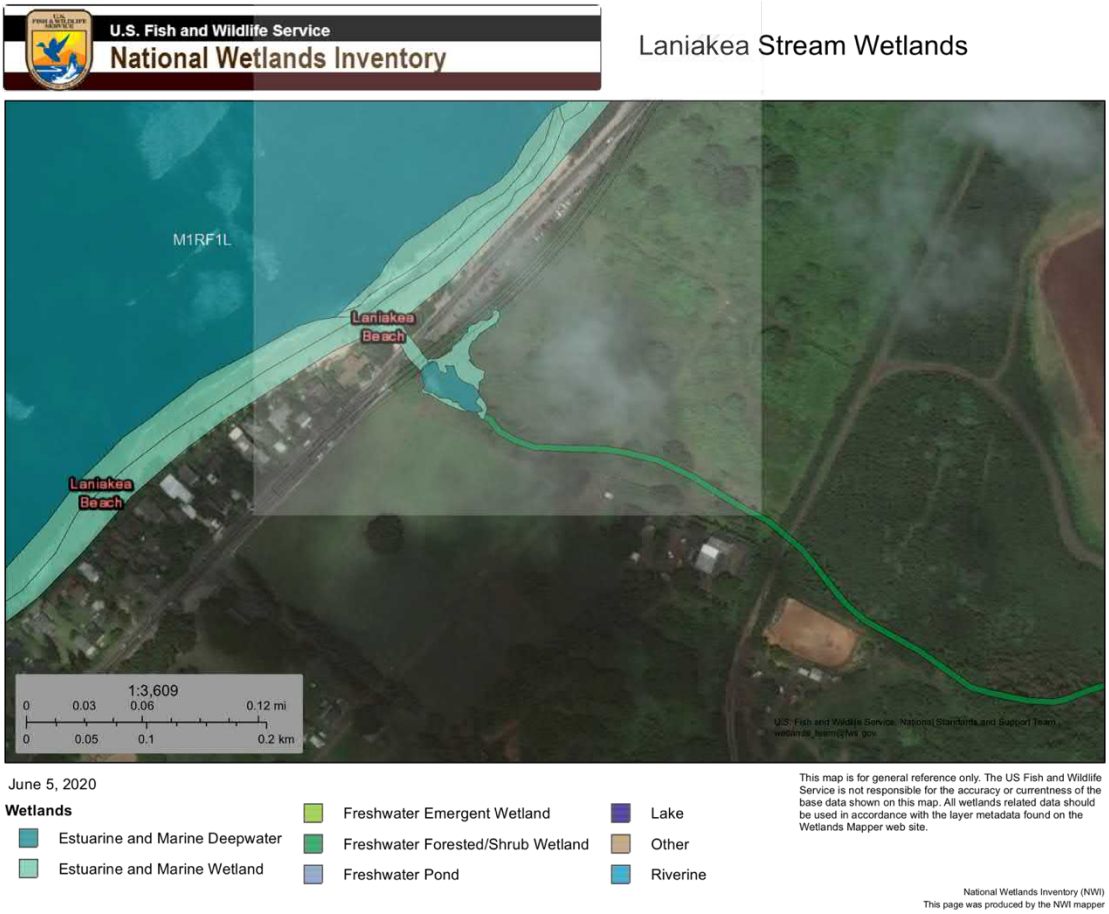


Figure 2. National Wetland Inventory Map showing mapped Estuarine and Marine Wetland and Estuarine Marine Deepwater in and around Lauhulu Stream.

## DISCUSSION & RECOMMENDATIONS

The results of the fieldwork represent a snapshot of the wildlife and plants inhabiting the Survey Area. As such, these data cannot be considered a definitive list of all species that utilize habitats. Many species are diminutive and cryptic in nature making observation difficult. Other species are nocturnal and/or may use the area infrequently depending upon season, weather, interaction with other species, and dynamic changes in their populations. However, when considered together with the results of historical surveys, we can compile a reasonably accurate description of the environment and biota of the project area.

Plant and wildlife habitats within the Survey Area have been highly modified by human activities, including the intentional and accidental introduction of alien species. The vast majority of the plant and bird species observed within the Survey Area are introduced.

*Critical Habitat*

There is no federally delineated Critical Habitat for any plant, avian, or mammalian species on, or close to the proposed Survey Area. Thus, modifications of habitat on the site will not result in impacts to federally designated Critical Habitat. There is no equivalent statute under state law.

*Potential Impacts to Protected Species*

None of the plant or bird species observed at the Survey Area are listed as endangered or threatened. The Pacific Golden Plover are protected by the Migratory Bird Treaty Act, but they do not nest in Hawaii and are adaptable in their habitat use during the winter months, foraging and resting in a variety of open habitats, including pastures, grassy fields, lawns, beaches, and shorelines.

Even though pueo were not observed during the site surveys, it is recommended that a pre-construction nest survey be conducted to confirm there are no pueo nesting in the area prior to any vegetation clearance. All construction and on-site staff should be trained to identify pueo and possible nests present in the project area (any area that construction activities modify the vegetation and/or landscape). If a pueo nest is observed, a 50-foot buffer should be established and marked clearly so that it is not disturbed by construction. The appropriate DOFAW representative should be notified of location and minimization measures taken.

It is possible that the endangered Hawaiian Petrel (*Pterodroma sandwichesis*) and the threatened Newell's Shearwater (*Puffinus auricularis newelli*) over-fly the project area between April and the middle of December each year in very small numbers. Newell's Shearwaters are not known to breed on the Island of O`ahu, though recent acoustical surveys conducted on the island have recorded low numbers of this species calling over the higher reaches of the island (Young, et al., 2019). There is no suitable nesting or roosting habitat for any of these seabird species within the Study Area. Although the Study Area does not provide suitable habitat for listed Hawaiian seabirds, they may fly over the general area at night and may be attracted to construction lighting. In order to minimize potential impacts to seabirds it is recommended that construction activities be limited to daylight hours during peak fallout period (September 15-December 15) or shielded lighting be in place for night time work.

The Hawaiian hoary bat (*Lasiurus cinereus semotus*), which is listed as endangered by the U.S. Fish and Wildlife Service and the State of Hawaii, is known to occur nearby and could forage or roost in the project area. As bats use multiple roosts within their home territories, the potential disturbance resulting from the removal of the vegetation is likely to be minimal. During the pupping season, females carrying their pups may be less able to rapidly vacate a roost site while vegetation is cleared. Additionally, adult female bats sometimes leave their pups in the roost tree while they themselves forage, and very small pups may be unable to flee a tree that is being felled. Potential adverse effects from such disturbance can be avoided or minimized by not clearing woody vegetation taller than 4.6 meters (15-feet), between June 1 and September 15, the pupping season. It is recommended that these guidelines are followed post-construction as well. If additional fencing is included in the construction phase it is recommended that any type of barbed wire or razor wire not be used.

Green Sea Turtles or honu (*Chelonia mydas*) were observed in the waters off Laniākea Beach during the survey adjacent to the Survey Area. Green Sea Turtle nesting mostly occurs in the Northwestern Hawaiian Islands. It is also possible that the Hawaiian Monk Seal (*Monachus schauinslandi*) may occur in the area. Any construction activities that may be in close proximity to the coastal strand should be monitored to ensure that neither of these two marine species are disturbed.

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# APPENDIX A – SITE PHOTOGRAPHS

Figure 1. Near entrance to Alluvion Farms at western end of project area looking east. Open pastureland characterizes the proposed alignment to the bridge crossing at Lauhulu Stream.

Figure 2. Existing bridge at Lauhulu Stream. Milo trees and Guinea grass dominate the vegetation at the sloping banks of the stream.

Figure 3. Vegetation within the sandy dry streambed of Lauhulu includes pohuehue, Guinea grass, and castor bean.

Figure 4. Lauhulu intermittent Stream bisects the bridge and leads directly to the shore at Laniakea Beach.

Figure 5. Looking mauka near the middle point of the survey transect. Pastureland mauka of the new alignment and the survey area is dominated by weedy vegetation; koa haole and Guinea grass thickets.

Figure 6. At the junction of Kamehameha Highway and Pohaku Loa Way, a proposed turnaround may alter the existing vegetation of naupaka, milo, sea grape, and ironwood.

Figure 7. Existing highway is in close proximity to the coastline that is sparsely vegetated with pohuehue vines, invasive grasses, and trees such as milo, kiawe, and tree heliotrope.

# APPENDIX B: PLANT SPECIES LIST

The following checklist is an inventory of all the plant species observed within the Survey Area for the proposed new Kamehameha Highway alignment at Laniākea Beach. The plant names are arranged alphabetically by family and then by species into each of two groups: Monocots and Dicots. The taxonomy and nomenclature of the flowering plants (Monocots and Dicots) are in accordance with Wagner *et al*. (1990), Wagner and Herbst (1999) and Staples and Herbst (2005). Recent name changes are those recorded in the Hawaii Biological Survey series (Evenhuis and Eldredge, eds., 1999-2002). For each species, the following name is provided:

1. Scientific name with author citation.
2. Common English and/or Hawaiian name(s), when known.
3. Biogeographic status. The following symbols are used:

   I= indigenous= native to the Hawaiian Islands and elsewhere.
   X=introduced or alien = all those plants brought to the Hawaiian Islands by humans, intentionally or accidentally, after Western contact, that is Cook's arrival in the islands in 1778

| SCIENTIFIC NAME | COMMON NAME | STATUS |
|---|---|---|
| **MONOCOTS** | | |
| **ALOEACEAE** | | |
| *Aloe vera* (L.) N.L.Burm. | aloe | X |
| **ARECACEAE** | | |
| *Areca catechu* L. | betel nut palm | X |
| *Cocos nucifera* L. | coconut | X |
| *Phoenix dactylifera* | date palm | X |
| **CYPERACEAE** | | |
| *Cyperus rotundus* L. | kili oʻopu | X |
| **PLANTAGINACEAE** | | |
| *Plantago major* L. | common plantain | X |
| **POACEAE** | | |
| *Brachiaria mutica* (Forssk.) Stapf | California grass | X |
| *Cenchrus ciliaris* L. | buffelgrass | X |
| *Cenchrus echinatus* L. | common sandbur | X |
| *Chloris barbata* (L.) Sw. | swollen fingergrass | X |
| *Cynodon dactylon* (L.) Pers | manienie, Bermuda | X |
| *Digitaria insularis* (L.) Mez ex Ekman | sourgrass | X |
| *Eleusine indica* (L.) Gaertn. | wiregrass | X |
| *Eragrostis tenella* (L.) P.Beauv. Ex Roem.&Schult. | | X |
| *Melinus repens* (Willd.) Zizka | natal redtop | X |
| *Panicum maximum* L. | Guinea grass | X |
| *Pennisetum clandestinum* | kikuyu | *X* |

## DICOTS

| | | |
|---|---|---|
| **ACANTHACEAE** | | |
| *Asystasia gangetica* (L.) T. Anderson | Chinese violet | X |
| **AIZOACEAE** | | |
| *Tetragonia tetragonioides* (Pall.) Kuntze | New Zealand spinach | X |
| **AMARANTHACEAE** | | |
| *Alternanthera pungens* Kunth | khaki weed | X |
| *Amaranthus spinosus* L. | spiny amaranth | X |
| *Amaranthus viridis* L. | slender amaranth | X |
| **ANACARDIACEAE** | | |
| *Schinus terebinthifolius* Raddi | Christmas berry | X |
| **ASTERACEAE** | | |
| *Bidens alba* (L.) DC. var. *radiata* Ballard ex Melchert | beggar tick | X |
| *Calyptocarpus vialis* Less. | straggler daisy | X |
| *Eclipta alba* L. | false daisy | X |
| *Parthenium hysterophorus* L. | false ragweed | X |
| *Pluchea carolinensis* (Jacq.) G. Don | sourbush | X |
| *Tridax procumbens* (L.) | coat buttons | X |
| *Verbesina encelioides* (Cav.) Benth. & Hook | golden crown-beard | X |
| *Xanthium strumarium* var. *canadense* Mill. | cocklebur | X |
| **BORAGINACEAE** | | |
| *Heliotropium curassavicum* L. | kipukai | I |
| *Heliotropium foertherianum* L. | tree heliotrope | X |
| *Heliotropium procumbens* Mill. var. *depressum* | | X |
| **BRASSICACEAE** | | |
| *Lepidium virginicum* L. | pepperwort | X |
| **CASUARINACEAE** | | |
| *Casuarina equisetifolia* L. | ironwood | X |
| **CHENOPODIACEAE** | | |
| *Atriplex semibaccata* R.Br. | Australian saltbush | X |
| **CLUSIACEAE** | | |
| *Clusia rosea* Jacq. | autograph tree | X |
| **COMMELINACEAE** | | |
| *Commelina benghalensis* L. | hairy honohono | X |
| **CONVOLVULACEAE** | | |
| *Ipomoea obscura* (L.) Ker Gawl. | | X |
| *Ipomoea pes-caprae* subsp. *brasiliensis* (L.) | pohuehue | I |
| *Ipomoea triloba* L. | little bell | X |
| **CUCURBITACEAE** | | |
| *Coccinea grandis* (L.) Voigt | ivy gourd | X |

| | | |
|---|---|---|
| **EUPHORBIACEAE** | | |
| *Chamaesyce hirta* (L.) Millsp. | hairy spurge | X |
| *Chamaesyce hypercifolia* (L.) Millsp. | graceful spurge | X |
| *Ricinus communis* L. | castor bean | X |
| **FABACEAE** | | |
| *Acacia farnesiana* (L.) Willd. | klu, aroma, kolu | X |
| *Chamaecrista nictitans* (L.) Moench | partridge pea | X |
| *Crotalaria incana* L. | fuzzy rattlepod | X |
| *Crotalaria pallida* Aiton | smooth rattlepod | X |
| *Desmanthus pernambucanus* (L.) Thell. | slender or virgate mimosa | X |
| *Desmodium tortuosum* (Sw.) DC | Florida beggarweed | X |
| *Indigofera hendecaphylla* Jacq. | creeping indigo | X |
| *Indigofera suffritocosa* Mill. | iniko | X |
| *Leucaena leucocephala* (Lam.) de Wit | koa haole | X |
| *Macroptilium lathyroides* (L.) Urb. | wild bean | X |
| *Pithecellobium dulce* (Roxb.) Benth. | opiuma | X |
| *Prosopis pallida* (Humb. & Bonpl. Ex Willd.) Kunth | kiawe, algaroba | X |
| **GOODENACEAE** | | |
| *Scaevola taccada* (Gaertn.) Roxb. | naupaka | I |
| **LAMIACEAE** | | |
| *Leonotis nepetifolia* (L.) R.Br. | lion’s ear | X |
| **MALVACEAE** | | |
| *Abutilon grandifolium* (Willd.) Sweet | hairy abutilon | X |
| *Malva parviflora* L. | cheese weed | X |
| *Thespesia populnea* (L.) Sol. Ex Correa | milo | X |
| **MORACEAE** | | |
| *Ficus microcarpa* L.f. | Chinese banyan | X |
| **NYCTAGINACEAE** | | |
| *Boerhavia coccinea* Mill. | | X |
| *Bougainvillea sp.* A.L. Jussieu | bougainvillea | X |
| **OXALIDACEAE** | | |
| *Oxalis corniculata* L. | yellow wood sorrel | X |
| **POLYGONACEAE** | | |
| *Coccoloba uvifera* (L.) L. | sea grape | X |
| **PORTULACACEAE** | | |
| *Portulaca oleracea* L. | pigweed | X |
| **RUTACEAE** | | |
| *Murraya paniculata* (L.) Jack | mock orange | X |
| **SOLANACEAE** | | |
| *Nicotiana glauca* Graham | tree tobacco | X |
| *Physalis angulata* L. | husk tomato | X |
| *Solanum americanum* Mill. | glossy nightshade, popolo | I |

| | | |
|---|---|---|
| *Solanum lycopersicum* L. var. *cerasiforme* (Dunal) Spooner, G.J. Anderson & R.K. Jansen | cherry tomato | X |
| *Solanum seaforthianum* Andrews | | X |
| **STERCULIACEAE** | | |
| *Waltheria indica* L. | uhaloa | I |
| **VERBENACEAE** | | |
| *Duranta erecta* L. | golden dewdrop | X |
| *Stachytarpheta jamaicensis* (L.) Vahl | Jamaican vervain | X |

# APPENDIX C: WETLAND DATA

Field Investigation March 26, 2021

A mapped National Wetland Inventory (NWI) Estuarine and Marine Wetland previously noted as a non-wetland by M. LeGrande was visited for further investigation.

Two test pits were dug within a representative area within the proposed NWI mapped wetland. Vegetation notes and a sketch of vegetation zones for the area are described below. Common name and scientific name are provided for dominant plants as well as percent cover and wetland rating (US Army Corps of Engineers, 2018. National Wetland Plant List)

There were 4 zones divided from NW to SE (or Makai to Mauka)

**Zone 1** (closest to the shoreline and Highway is dominated by bare muddy substrate with large tress up to 45 feet in height.

Kiawe (*Prosopis pallida*) 40% FACU

Milo (*Thespesia populnea*) 30% FAC

Christmas Berry (*Schinus terebinthifolius*) 20% FACU

**Zone 2** (transition zone between shaded forest to pasture. Large percentage of bare muddy substrate with scattered grass and shrub species. Test Pit 2 (TP2) is located in this zone)

Bermuda grass (*Cynodon dactylon*) 90% FACU

Golden crown-beard (*Verbesina encelioides*) 7% FACU

Apple of Peru (*Nicandra physalodes*) 2% N/A

Spiny Amaranth (*Amaranthus spinosus*) less than 2% FACU

Swollen fingergrass (*Chloris barbata*) less than 3% FACU

Straggler daisy (*Calyptocarpus vialis*) less than 3% FAC

**Zone 3** (Mini Micro High-narrow zone with monotypic dominant vegetation)

Spiny Amaranth (*Amaranthus spinosus*) 95% FACU

**Zone 4** (Open pasture area with mixed vegetation and minimal bare ground. Test Pit 1 (TP1) is located in this zone.)

Bermuda grass (*Cynodon dactylon*) 75% FACU

Straggler daisy (*Calyptocarpus vialis*) 50% FAC

False ragweed (*Parthenium hysterophorus*) 5% UPL

Figure 1. Vegetation at Zones 1 and 2. Location of Test Pit 2

Figure 2. Vegetation at Zones 3 and 4. Location of Test Pit 1

Figure 3. Test pit 1

Figure 4.  Test Pit 2

Prosopis pallida - Kiawe 40% FACU
Thespesia populnea - milo 30% FAC
Schinus terebinthifolius -
Christmas Berry - 20% FACU

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Bermuda grass 90% FACU
Golden crownbeard 7% FACU
Apple of Peru 2% —

TP2

Amaranth >2 % FACU
Swollen Finger grass >3 FACU
Straggler Daisy >3 FAC

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"Mini Micro High"

Amaranth 95% FACU

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Bermuda grass 75% FACU
Straggler Daisy 50% FAC
Parthenium 5 UPL

TP1

## WETLAND DETERMINATION DATA FORM – Hawai'i and Pacific Islands

Project/Site: Kamehameha Highway Pedestrian Shift City: Haleiwa Sampling Date: 3/26/2021 Time: 10:00

Applicant/Owner: HDOT State/Terr.: HI Island: Oahu Sampling Point: Test Pit #2 in Zone 1

Investigator(s): Malie McCullen, Jan Reichelderfer, Dexter Eji, Maya LeGrande TMK/Parcel: 61005023

Landform (hillslope, coastal plain, etc.): coastal plain Local relief (concave, convex, none): none

Lat: 21.617256 Long: -158.086259 Datum: _____ Slope (%): 1-3%

Soil Map Unit Name: Wailua Series NWI classification: estuarine and marine wetland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No x (If no, explain in Remarks.)

Are Vegetation yes, Soil yes, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes _____ No x

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes _____ | No x | **Is the Sampled Area within a Wetland?** Yes _____ No x |
| Hydric Soil Present? | Yes _____ | No x | |
| Wetland Hydrology Present? | Yes _____ | No x | |

Remarks:

Animals browsing and resting under the trees.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: _____ ) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | _____ = Total Cover | | |
| **Sapling/Shrub Stratum (Plot size: _____ )** | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | _____ = Total Cover | | |
| **Herb Stratum (Plot size: _____ )** | | | |
| 1. Bermuda Grass (Cynodon dactylon) | 90% | | |
| 2. Golden Crown-beard (Verbesina encelioides) | 7% | | |
| 3. Apple of Peru (Nicandra physalodes) | 2% | | |
| 4. Spiny Amaranth (Amaranthus spinosus) | 2% | | |
| 5. Swollen fingergrass (Chloris barbata) | 3% | | |
| 6. Straggler daisy (Calyptocarpus vialis) | 3% | | |
| 7. | | | |
| 8. | | | |
| | _____ = Total Cover | | |
| **Woody Vine Stratum (Plot size: _____ )** | | | |
| 1. | | | |
| 2. | | | |
| | _____ = Total Cover | | |

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: _____ (A)

Total Number of Dominant Species Across All Strata: _____ (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: _____ (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | | Multiply by: |
|---|---|---|
| OBL species | _____ | x 1 = _____ |
| FACW species | _____ | x 2 = _____ |
| FAC species | _____ | x 3 = _____ |
| FACU species | _____ | x 4 = _____ |
| UPL species | _____ | x 5 = _____ |
| Column Totals: | _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

__ 1 - Rapid Test for Hydrophytic Vegetation

__ 2 - Dominance Test is >50%

__ 3 - Prevalence Index is ≤3.0[1]

__ Problematic Hydrophytic Vegetation[1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes _____ No x

Remarks:

Weather conditions have been rainier than usual over the preceding weeks.

## SOIL

Sampling Point: Test Pit 2

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-2.5 | 7.5YR3/3 | | | | | | | |
| 2.5-12 | 7.5YR3/4 | | | | | | | |
| 12-21 | 7.5YR3/4 | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators:**

- __ Histosol (A1)
- __ Histic Epipedon (A2)
- __ Black Histic (A3)
- __ Hydrogen Sulfide (A4)
- __ Muck Presence (A8)
- __ Depleted Below Dark Surface (A11)
- __ Thick Dark Surface (A12)
- __ Sandy Gleyed Matrix (S4)
- __ Sandy Redox (S5)
- __ Dark Surface (S7)
- __ Loamy Gleyed Matrix (F2)
- __ Depleted Matrix (F3)
- __ Redox Dark Surface (F6)
- __ Depleted Dark Surface (F7)
- __ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- __ Stratified Layers (A5)
- __ Sandy Mucky Mineral (S1)
- __ Red Parent Material (TF2)
- __ Very Shallow Dark Surface (TF12)
- __ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if observed):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** Yes _____ No X

Remarks:

Zone 1 is closest to the highway and consists of large trees. Zone 2 is further mauka in the area partially shaded by tall trees. Soil is covered with animal waste as this is where the cattle and horses go to be in the shade. Test pit #2 was dug in this transition between shaded forest to pasture. Large percentage of bare muddy substrate with scattered grass and shrub species.

## HYDROLOGY

**Wetland Hydrology Indicators:** (Explain observations in Remarks, if needed.)

Primary Indicators (minimum of one required; check all that apply)

- __ Surface Water (A1)
- __ High Water Table (A2)
- __ Saturation (A3)
- __ Water Marks (B1)
- __ Sediment Deposits (B2)
- __ Drift Deposits (B3)
- __ Algal Mat or Crust (B4)
- __ Iron Deposits (B5)
- __ Inundation Visible on Aerial Imagery (B7)
- __ Water-Stained Leaves (B9)
- __ Aquatic Fauna (B13)
- __ Tilapia Nests (B17)
- __ Hydrogen Sulfide Odor (C1)
- __ Oxidized Rhizospheres on Living Roots (C3)
- __ Presence of Reduced Iron (C4)
- __ Recent Iron Reduction in Tilled Soils (C6)
- __ Thin Muck Surface (C7)
- __ Fiddler Crab Burrow X (C10) (Guam, CNMI, and American Samoa)
- __ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- X Surface Soil Cracks (B6)
- __ Sparsely Vegetated Concave Surface (B8)
- __ Drainage Patterns (B10)
- __ Dry-Season Water Table (C2)
- __ Salt Deposits (C5)
- __ Stunted or Stressed Plants (D1)
- __ Geomorphic Position (D2)
- __ Shallow Aquitard (D3)
- __ FAC-Neutral Test (D5)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

## WETLAND DETERMINATION DATA FORM – Hawai'i and Pacific Islands

Project/Site: Kamehameha Highway Pedestrian Shift City: Haleiwa Sampling Date: 3/26/2021 Time: 10:00

Applicant/Owner: HDOT State/Terr.: HI Island: Oahu Sampling Point: Test Pit #1 in Zone 2

Investigator(s): Malie McCullen, Jan Reichelderfer, Dexter Eji, Maya LeGrande TMK/Parcel: 61005023

Landform (hillslope, coastal plain, etc.): coastal plain Local relief (concave, convex, none): none

Lat: 21.617158 Long: -158.086272 Datum: _____ Slope (%): 1-3%

Soil Map Unit Name: Wailua Series NWI classification: estuarine and marine wetland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation yes, Soil yes, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes _____ No X

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes _____ | No X |
| Hydric Soil Present? | Yes _____ | No X |
| Wetland Hydrology Present? | Yes _____ | No X |

**Is the Sampled Area within a Wetland?** Yes _____ No X

Remarks:

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: _____ ) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | _____ = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: _____ ) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | _____ = Total Cover | | |
| **Herb Stratum** (Plot size: _____ ) | | | |
| 1. Bermuda grass (Cynodon dactylon) | 75% | | |
| 2. Straggler daisy (Calyptocarpus vialis) | 50% | | |
| 3. False Ragweed (Parthenium hysterophorus) | 5% | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| | _____ = Total Cover | | |
| **Woody Vine Stratum** (Plot size: _____ ) | | | |
| 1. | | | |
| 2. | | | |
| | _____ = Total Cover | | |

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: _____ (A)

Total Number of Dominant Species Across All Strata: _____ (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: _____ (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

__ 1 - Rapid Test for Hydrophytic Vegetation

__ 2 - Dominance Test is >50%

__ 3 - Prevalence Index is ≤3.0[1]

__ Problematic Hydrophytic Vegetation[1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes _____ No X

Remarks:

Weather conditions have been rainier than usual over the preceding weeks.

## SOIL

Sampling Point: Test Pit 1

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-3 | reddish | | | | | | | could not dig further, hit rock |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators:**

- __ Histosol (A1)
- __ Histic Epipedon (A2)
- __ Black Histic (A3)
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- __ Muck Presence (A8)
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**Indicators for Problematic Hydric Soils[3]:**

- __ Stratified Layers (A5)
- __ Sandy Mucky Mineral (S1)
- __ Red Parent Material (TF2)
- __ Very Shallow Dark Surface (TF12)
- __ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if observed):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** Yes _____ No X

Remarks:

This zone was referred to as Zone 4. Test pit #1 was dug here.

## HYDROLOGY

**Wetland Hydrology Indicators:** (Explain observations in Remarks, if needed.)

Primary Indicators (minimum of one required; check all that apply)

- __ Surface Water (A1)
- __ High Water Table (A2)
- __ Saturation (A3)
- __ Water Marks (B1)
- __ Sediment Deposits (B2)
- __ Drift Deposits (B3)
- __ Algal Mat or Crust (B4)
- __ Iron Deposits (B5)
- __ Inundation Visible on Aerial Imagery (B7)
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- __ Tilapia Nests (B17)
- __ Hydrogen Sulfide Odor (C1)
- __ Oxidized Rhizospheres on Living Roots (C3)
- __ Presence of Reduced Iron (C4)
- __ Recent Iron Reduction in Tilled Soils (C6)
- __ Thin Muck Surface (C7)
- __ Fiddler Crab Burrow (C10) (Guam, CNMI, and American Samoa) X
- __ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- X Surface Soil Cracks (B6)
- __ Sparsely Vegetated Concave Surface (B8)
- __ Drainage Patterns (B10)
- __ Dry-Season Water Table (C2)
- __ Salt Deposits (C5)
- __ Stunted or Stressed Plants (D1)
- __ Geomorphic Position (D2)
- __ Shallow Aquitard (D3)
- __ FAC-Neutral Test (D5)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Appendix

# F

# Lauhulu Stream Hydraulic Analysis

Kamehameha Highway Pedestrian Safety Project

Vicinity of Laniakea Beach, Honolulu County, Hawaii

Lauhulu Stream Hydraulic Analysis

## Purpose

A hydraulic analysis was conducted to support a "No-Rise" self-certification in the Lauhulu stream for the realignment of the Kamehameha Highway. The Pedestrian Shift alignment alternative includes a new bridge over the Lauhulu stream while maintaining the existing roadway vertical profile. The project location is shown in Figure 1.

Figure 1 - Project Location

## Background

Lauhulu stream (also known as Laniakea stream or Kukaiohiki Gulch) is an intermittent stream that flows northwest through the project area to its confluence at Laniakea Beach. At the bridge overpass location, the stream channel is sandy. The upper reaches of the stream are steep which contributes to rapid flow during heavy rain.

The Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) and Flood Insurance Rate Map (FIRM) include coastal AE and VE flood zone designations for the entire north coast of Oahu Island. However, the FEMA FIS and FIRM do not include individual riverine studies or water surface flood elevation profiles for the Lauhulu stream which is designated Zone X. The nearest streams that are studied in detail by FEMA are the nearby Waimea River and Anahulu River for which base flood elevations, and Zone AE and regulatory floodway boundaries, are published. The FEMA flood zone designations near the project site are shown on Figure 2.

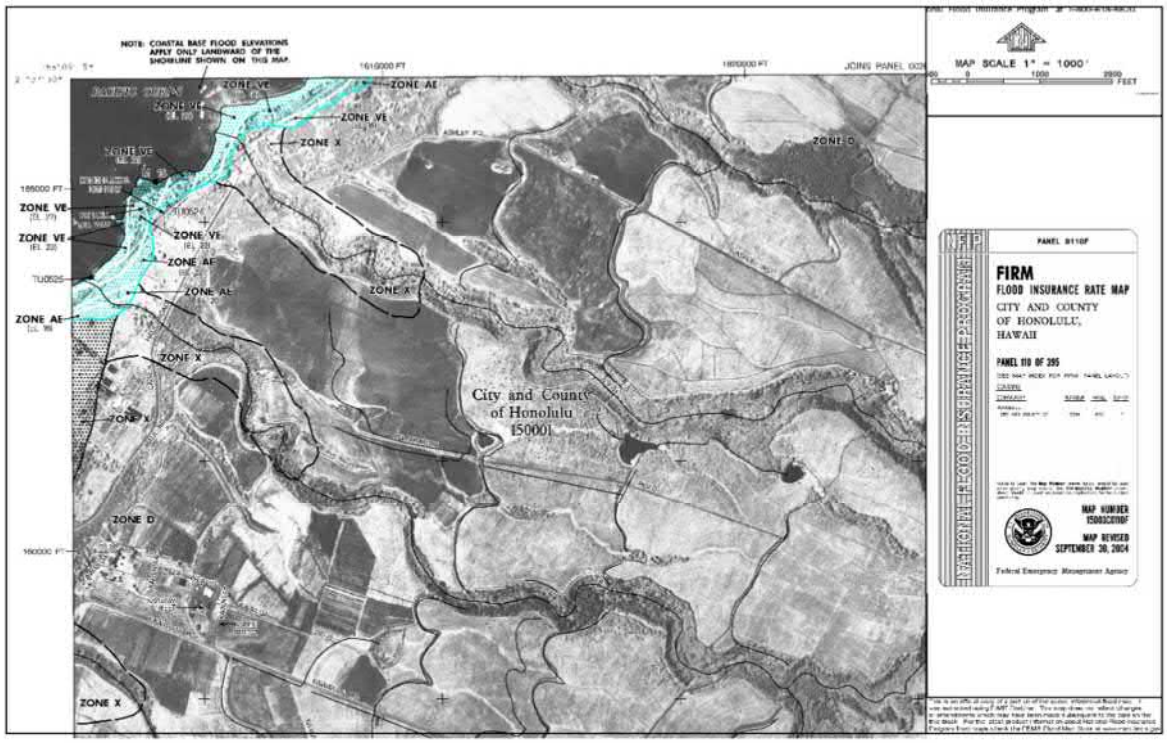


Figure 2 – FEMA Flood Zones

Zone X floodplains are not Special Flood Hazard Area (SFHA) and are not regulated by FEMA under the National Flood Insurance Program (NFIP). However, state and local regulatory agencies may require a "No-rise" certification for the proposed alternatives. The "No-rise" certification requires a riverine hydraulic analysis to compare water surface elevation profiles of existing and proposed conditions. The "No-rise" certification is focused on the impact of the proposed alternatives on the flood elevations caused by riverine flooding and is a separate consideration from the coastal flood hazards.

Study Approach

Open channel hydraulic models of existing and proposed conditions must be developed to calculate and compare the respective water surface elevation profiles of the design riverine flood in the absence of coastal flooding. The hydraulic models are typically developed for the 1% annual chance flood (also referred to as the 100-year flood) using the US Army Corps of Engineers HEC-RAS computer program in steady-state 1D mode. For each stream, the study reach extends from the mouth of the stream several hundred feet upstream of the proposed bridge.

Lauhulu stream is not in a designated riverine SFHA, therefore, a hydraulic model meeting FEMA's standard for approximate studies is sufficient for "no-rise" certification unless disallowed by the regulatory review agency. As in a detailed model, an approximate model provides a comparison between existing and proposed conditions to support a "no-rise" certification. However, approximate models use generalized watershed information and ground elevation data without the benefit of site-specific hydrology or ground surveys. The results of the approximate model is appropriate for planning purposes and it should not be used for site design or for establishing base flood elevations for construction of new structures.

Data Sources

Elevation Data

The geometry of existing stream cross-sections in the study reach was derived from 2013 1-meter Digital Terrain Model (DTM) of Oahu, downloaded from the State of Hawaii GIS Program website. For use in this project, the DTM was re-projected to State Plane Coordinates and elevations converted to feet.

Hydrology

The design discharge is the 1% annual chance flood flow. The United States Geologic Survey (USGS) StreamStats online tool was used to delineate the drainage area, estimate hydrologic parameters of the watershed, and calculate the design discharge from regression equations. The StreamStats report is included in Exhibit 1.

Existing Bridge Data

The geometry of the existing bridge over the Lauhulu stream was obtained from plans shown in Exhibit 2. The existing bridge is 64 feet long and has a center pier. For this project, this bridge will remain in place for pedestrian and cyclist use.

Land Cover

Land cover information was obtained from recent aerial orthophotography to estimate Manning's roughness coefficients in the hydraulic model.

Proposed Design

The proposed bridge is a 100-ft clear span concrete slab with vertical abutments and wingwalls located just upstream of the existing 65-foot bridge. The bridge is at an approximately ten-degree skew with the existing bridge. The average distance between the two bridges is 20 feet although this may change slightly during final design.

The proposed bridge is designed to meet no-rise conditions. It is sized to have greater flow conveyance capacity than both the existing bridge downstream and the existing stream channel at the new alignment. The proposed bridge location and proposed design sketches are shown in Exhibit 3.

Hydraulic Model

A HEC-RAS hydraulic model of the Lauhulu stream was developed for this project based on the 1% annual chance discharge. The model is designed to compare the 1% annual chance water surface elevations under existing and proposed conditions. Manning's n values were based on aerial photography and V.T. Chow's Open Channel Hydraulics Manning's n for Channels - Mountain Streams.

The stream channel includes steep banks, trees and brush along the banks submerged at higher flood stages. Manning's n value of 0.045 was used for the main channel whereas n value of 0.07 is applied to the overbanks accounting for medium brush in the floodplain.

Downstream boundary conditions were calculated using normal depth. The downstream channel slope obtained from the 2013 1-meter DTM of Oahu is used as the energy slope. Existing and proposed bridges were modeled using the bridge routine in HEC-RAS. For the 1% annual chance design discharge, the road is overtopped by the 100-year flood for both existing and proposed conditions, and bridge flow is represented in the model using the Pressure and Weir bridge modeling approach.

Study Results

HEC-RAS output tables and plots are included in Exhibit 4. A comparison of 1% water surface elevations (WSEs) for existing and proposed conditions upstream of the proposed bridge is shown in Table 1. It indicates that the proposed Pedestrian Shift realignment of Kamehameha Highway at Lauhulu stream would not result in a surcharge to the bridge headwater.

| HEC-RAS Cross-section upstream of proposed bridge | Pedestrian Shift Realignment Alternative | Existing 1% Annual Chance WSE (ft NAVD88) | Proposed 1% Annual Chance WSE (ft NAVD88) |
|---|---|---|---|
| RS 435 | Bridge Headwater | 17.61 | 17.58 |

Table 1 - Comparison of 1% water surface elevations

During final design, the calculations should be refined to reflect the site topographic survey and construction plans. Any potential minor surcharges may be mitigated using one or more of the following:

- Modifying the wingwall design to streamline flow between the existing and proposed bridges and reduce flow contraction and expansion losses.
- Excavating the sand deposits downstream of the existing bridge to maintain conveyance. A maintenance plan may be required to ensure sand is cleared after storm surges.
- Excavating the channel at the bridge and downstream of it to increase the flow area and conveyance.
- Paving the channel under the bridge to reduce Manning's n value and increase conveyance.

Conclusion

The proposed bridge is sized to have greater flow conveyance capacity than the existing bridge. The hydraulic analysis indicates that the proposed bridge is not expected to result in an increase in the 1% annual chance flood elevations of Lauhulu stream.

Exhibit 1 – StreamStats reports
Exhibit 2 – Plans of existing bridge
Exhibit 3 – Proposed bridge
Exhibit 4 – Pedestrian Shift - Lauhulu Stream - HEC-RAS Output table and plots

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115 West Washington Street
Indianapolis, IN 46204

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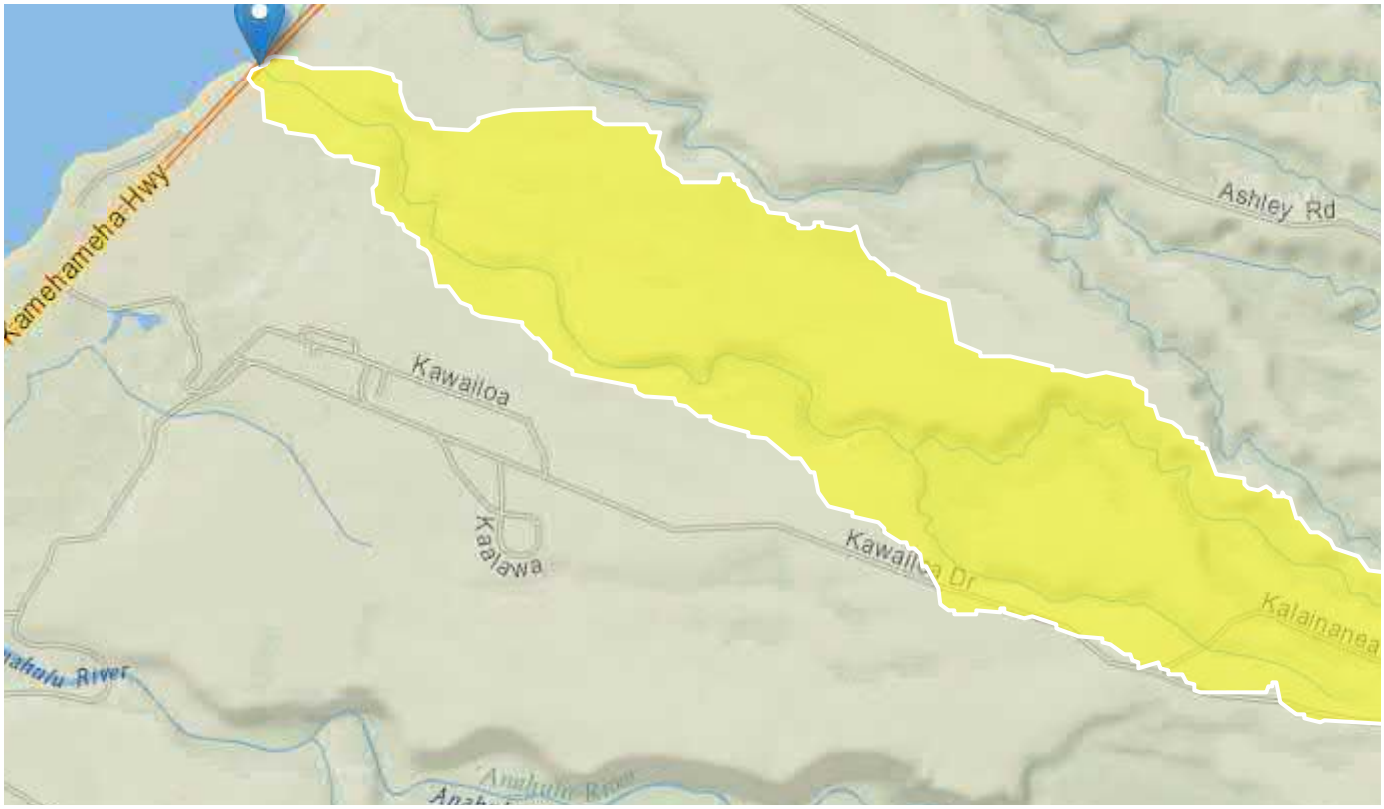
wsp.com

# Exhibit 1: StreamStats Reports

# StreamStats Report

**Region ID:** HI
**Workspace ID:** HI20200202235430080000
**Clicked Point (Latitude, Longitude):** 21.61711, -158.08671
**Time:** 2020-02-02 16:54:47 -0700




Basin Characteristics

| Parameter Code | Parameter Description | Value | Unit |
|---|---|---|---|
| BASINPERIM | Perimeter of the drainage basin as defined in SIR 2004-5262 | 13.5 | miles |
| BSLDEM10M | Mean basin slope computed from 10 m DEM | 14.4 | percent |
| CENTROIDY | Basin centroid vertical (y) location in state plane units | 2389128.6 | meters |
| COMPRAT | A measure of basin shape related to basin perimeter and drainage area | 2.59 | dimensionless |

| Parameter Code | Parameter Description | Value | Unit |
|---|---|---|---|
| CSL10_85 | Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known | 169 | feet per mi |
| DRNAREA | Area that drains to a point on a stream | 2.18 | square miles |
| ELEV | Mean Basin Elevation | 593 | feet |
| ELEV10FT | Elevation at 10 percent from outlet along longest flow path slope using DEM | 112 | feet |
| ELEV10FT3D | Elevation at 10 percent from outlet along longest flow path slope using 3D line | 112 | feet |
| ELEV85FT | Elevation at 85 percent from outlet along longest flow path slope using DEM | 878 | feet |
| ELEV85FT3D | Elevation at 85 percent from outlet along longest flow path slope using 3D line | 874 | feet |
| ELEVMAX | Maximum basin elevation | 1180 | feet |
| I24H100Y | Maximum 24-hour precipitation that occurs on average once in 100 years | 14.4 | inches |
| I24H10Y | Maximum 24-hour precipitation that occurs on average once in 10 years | 8.85 | inches |
| I24H25Y | Maximum 24-hour precipitation that occurs on average once in 25 years | 11 | inches |
| I24H2Y | Maximum 24-hour precipitation that occurs on average once in 2 years - Equivalent to precipitation intensity index | 5.25 | inches |
| I24H500Y | Maximum 24-hour precipitation that occurs on average once in 500 years | 18.8 | inches |
| I24H50Y | Maximum 24-hour precipitation that occurs on average once in 50 years | 12.7 | inches |
| I24H5Y | Maximum 24-hour precipitation that occurs on average once in 5 years | 7.27 | inches |
| I48H100Y | Maximum 48-hour precipitation that occurs on average once in 100 years | 15.9 | inches |
| I48H10Y | Maximum 48-hour precipitation that occurs on average once in 10 years | 9.98 | inches |
| I48H25Y | Maximum 48-hour precipitation that occurs on average once in 25 years | 12.3 | inches |

| Parameter Code | Parameter Description | Value | Unit |
|---|---|---|---|
| I48H2Y | Maximum 48-hour precipitation that occurs on average once in 2 years | 6.08 | inches |
| I48H500Y | Maximum 48-hour precipitation that occurs on average once in 500 years | 20.2 | inches |
| I48H50Y | Maximum 48-hour precipitation that occurs on average once in 50 years | 14.1 | inches |
| I48H5Y | Maximum 48-hour precipitation that occurs on average once in 5 years | 8.27 | inches |
| I60M100Y | Maximum 60-min precipitation that occurs on average once in 100 years | 4.11 | inches |
| I60M10Y | Maximum 60-min precipitation that occurs on average once in 10 years | 2.69 | inches |
| I60M25Y | Maximum 60-min precipitation that occurs on average once in 25 years | 3.25 | inches |
| I60M2Y | Maximum 60-min precipitation that occurs on average once in 2 years | 1.75 | inches |
| I60M500Y | Maximum 60-min precipitation that occurs on average once in 500 years | 5.15 | inches |
| I60M50Y | Maximum 60-min precipitation that occurs on average once in 50 years | 3.68 | inches |
| I60M5Y | Maximum 60-min precipitation that occurs on average once in 5 years | 2.28 | inches |
| I6H100Y | 6-hour precipitation that is expected to occur on average once in 100 years | 8.68 | inches |
| I6H10Y | Maximum 6-hour precipitation that occurs on average once in 10 years | 5.65 | inches |
| I6H25Y | Maximum 6-hour precipitation that occurs on average once in 25 years | 6.85 | inches |
| I6H2Y | Maximum 6-hour precipitation that occurs on average once in 2 years | 3.57 | inches |
| I6H500Y | Maximum 6-hour precipitation that occurs on average once in 500 years | 10.8 | inches |
| I6H50Y | Maximum 6-hour precipitation that occurs on average once in 50 years | 7.77 | inches |
| I6H5Y | Maximum 6-hour precipitation that occurs on average once in 5 years | 4.75 | inches |

| Parameter Code | Parameter Description | Value | Unit |
|---|---|---|---|
| IMPNLCD01 | Percentage of impervious area determined from NLCD 2001 impervious dataset | 3.12 | percent |
| LC01BARE | Percentage of area barren land, NLCD 2001 category 31 | 0 | percent |
| LC01CROP | Percentage of area crop, NLCD 2001 category | 9 | percent |
| LC01DEV | Percentage of land-use from NLCD 2001 classes 21-24 | 15.2 | percent |
| LC01DEVHI | Percentage of area developed, high intensity, NLCD 2001 category 24 | 0 | percent |
| LC01DEVMD | Percentage of area developed, medium intensity, NLCD 2001 category 23 | 0 | percent |
| LC01EVERG | Percentage of area evergreen forest, NLCD 2001 category 42 | 36 | percent |
| LC01OPNLO | Percentage of area developed, open space and low intensity combined, NLCD2001 cat. 21 and 22 | 15 | percent |
| LFPLENGTH | Length of longest flow path | 6 | miles |
| MINBELEV | Minimum basin elevation | 4 | feet |
| PERM12IN | Area-weighted average soil permeability for top 12 inches of soil | 3.77 | inches per hour |
| PERM24IN | Area-weighted average soil permeability for top 24 inches of soil | 3.49 | inches per hour |
| PRECIP | Mean Annual Precipitation | 51.5 | inches |
| RELIEF | Maximum - minimum elevation | 1180 | feet |
| RELRELF | Basin relief divided by basin perimeter | 86.9 | feet per mi |
| SLOP30_10M | Percent area with slopes greater than 30 percent from 10-meter NED | 13 | percent |
| SLPFM3D | Change in elevation divided by length between points 10 and 85 percent of distance along the longest flow path to the basin divide, LFP from 3D grid | 195 | feet per mi |

Peak-Flow Statistics Parameters[Peak Region 3 2010 5035 Oahu leeward]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 2.18 | square miles | 0.56 | 45.1 |
| PRECIP | Mean Annual Precipitation | 51.5 | inches | 31.9 | 252 |

Peak-Flow Statistics Flow Report[Peak Region 3 2010 5035 Oahu leeward]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

| Statistic | Value | Unit | SE | SEp |
|---|---|---|---|---|
| 2 Year Peak Flood | 319 | ft^3/s | 51 | 51 |
| 5 Year Peak Flood | 750 | ft^3/s | 42 | 42 |
| 10 Year Peak Flood | 1170 | ft^3/s | 40 | 40 |
| 25 Year Peak Flood | 1880 | ft^3/s | 40 | 40 |
| 50 Year Peak Flood | 2550 | ft^3/s | 40 | 40 |
| 100 Year Peak Flood | 3340 | ft^3/s | 41 | 41 |
| 500 Year Peak Flood | 5710 | ft^3/s | 44 | 44 |

*Peak-Flow Statistics Citations*

**Oki, D.S., Rosa, S.N., and Yeung, C.W.,2010, Flood-frequency estimates for streams on Kauaʻi, Oʻahu, Molokaʻi, Maui, and Hawaiʻi, State of Hawaiʻi: U.S. Geological Survey Scientific Investigations Report 2010-5035, 121 p. (http://pubs.usgs.gov/sir/2010/5035/)**

USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

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Application Version: 4.3.11

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wsp.com

# Exhibit 2: Existing Structure Plans

| FED. ROAD DIST. NO. | STATE | FED. AID PROJ. NO. | FIRCAL YEAR | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| HAWAII | MAW | 3D | 1936 | 1 | 48 |

## - INDEX TO DRAWINGS -

| SHEET NO. | DESCRIPTION |
|---|---|
| 1 | Title Sheet |
| 2 | Typical Sections |
| 3 - 13 | Plan & Profile |
| 14 | R.R. Crossing Detail |
| 15 - 16 | Standard Details 1, 2 |
| 17 | Culvert Details |
| 18 - 20 | Bridge Details |
| 21 - 48 | Cross Sections |

TERRITORY OF HAWAII
TERRITORIAL HIGHWAY DEPARTMENT
HONOLULU T.H.

# PLANS OF
# KAMEHAMEHA HIGHWAY
## FEDERAL AID PROJECT NO 3-D

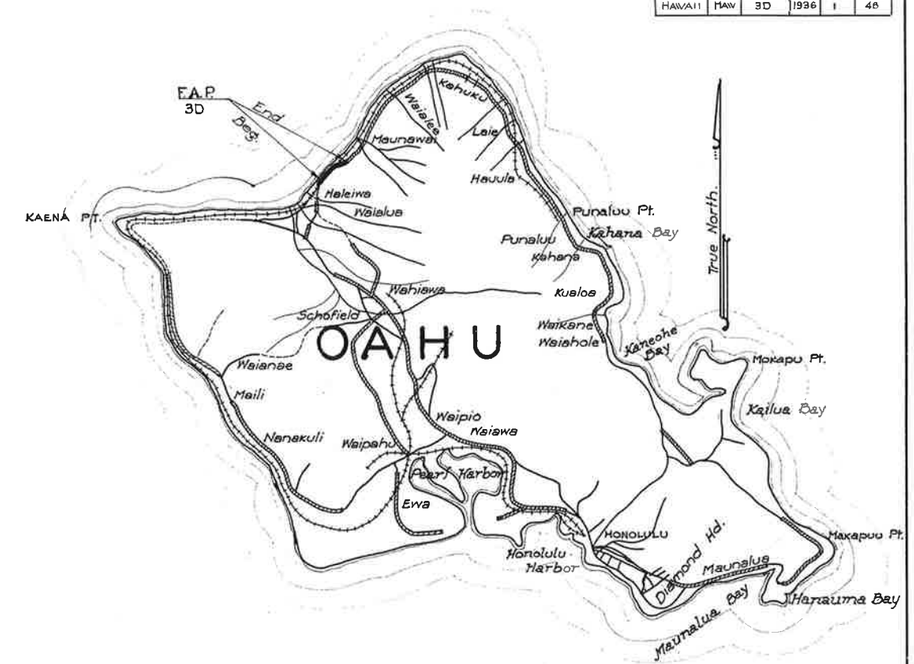
## DISTRICT OF WAIALUA
## ISLAND OF OAHU.

### CONVENTIONAL SIGNS

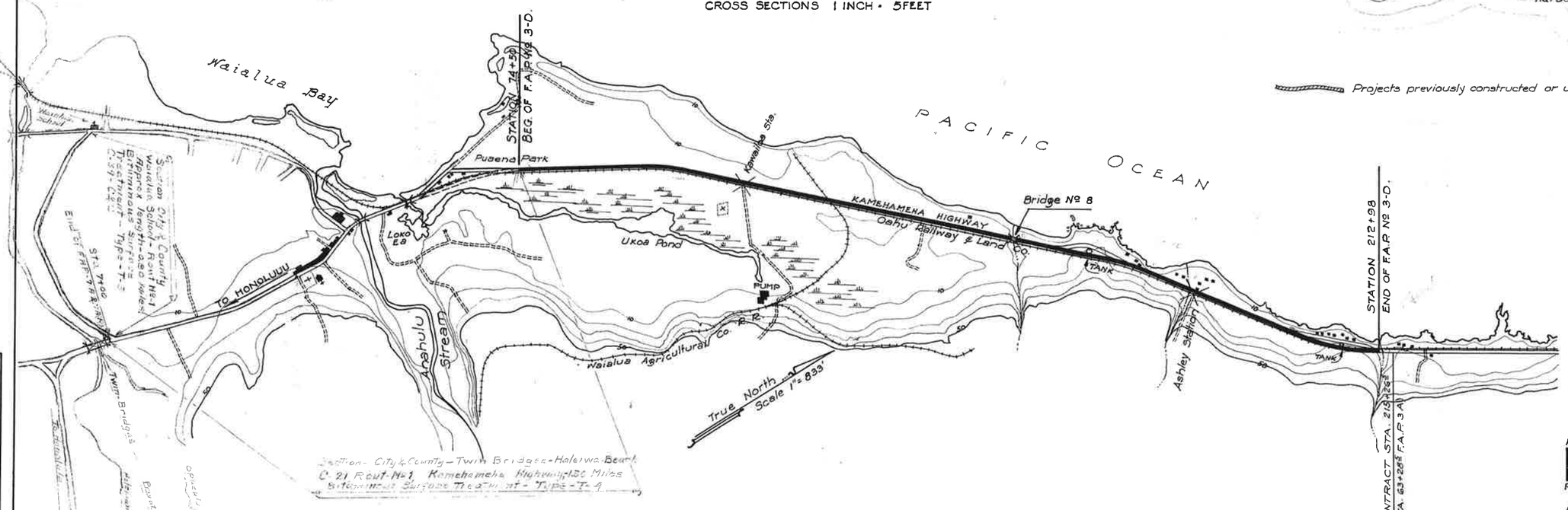
EXISTING ROAD
EXISTING FENCE
BOUNDARY LINE (NOT FENCED)
EXISTING STONE FENCE
RAILROAD
CENTER LINE
LARGE TREE
CEMENT RUBBLE RETAINING WALL
BRIDGES
CULVERTS

### SCALES

| | | |
|---|---|---|
| PLAN | | 1 INCH = 50 FEET |
| PROFILE | HORIZ | 1 INCH = 50 FEET |
| | VERT | 1 INCH = 10 FEET |
| CROSS SECTIONS | | 1 INCH = 5 FEET |




Projects previously constructed or under construction.




Section - City & County - Twin Bridges - Haleiwa Beach
C. 21 Route No 1, Kamehameha Highway 1.30 Miles
Bituminous Surface Treatment - Type - T-4

## LAYOUT OF PROJECT

| | |
|---|---|
| GROSS LENGTH | 2.622 MILES. |
| BRIDGES OVER 20 FT. | .013 " |
| NET LENGTH | 2.609 " |

| ORIGINAL PLAN | | DATE |
|---|---|---|
| | SURVEY PLOTTED BY | |
| | DESIGNED BY | " |
| | DRAWN BY C.F. Wagner | 7/36 |
| NOTE BOOK | TRACED BY Chagnon | " |
| | QUANTITIES BY R.E. Smith | " |
| No. | CHECKED BY | |

APPROVED
Louis R. Paine
DATE. 11-5-36
Territorial Highway Engineer.

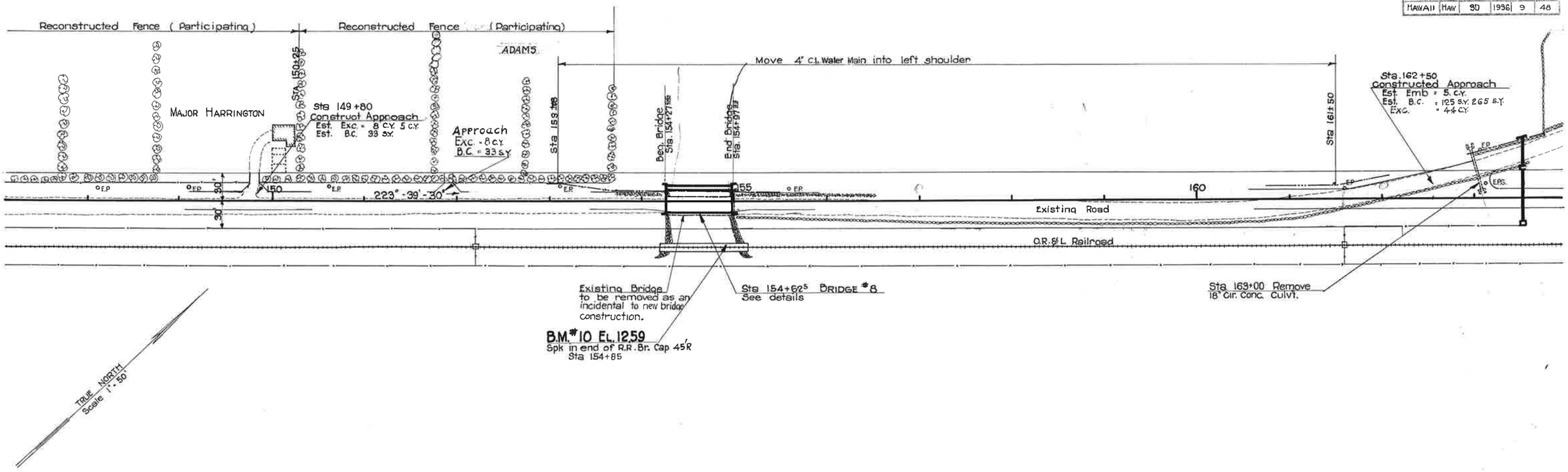
RECOMMENDED FOR APPROVAL
[redacted]
Principal Highway Engr. Bureau of Pub. Rds.

RECOMMENDED FOR APPROVAL
[redacted]
Chief Engineer, Bureau of Pub. Roads.

APPROVED
[redacted]
Chief, Bureau of Public Roads.

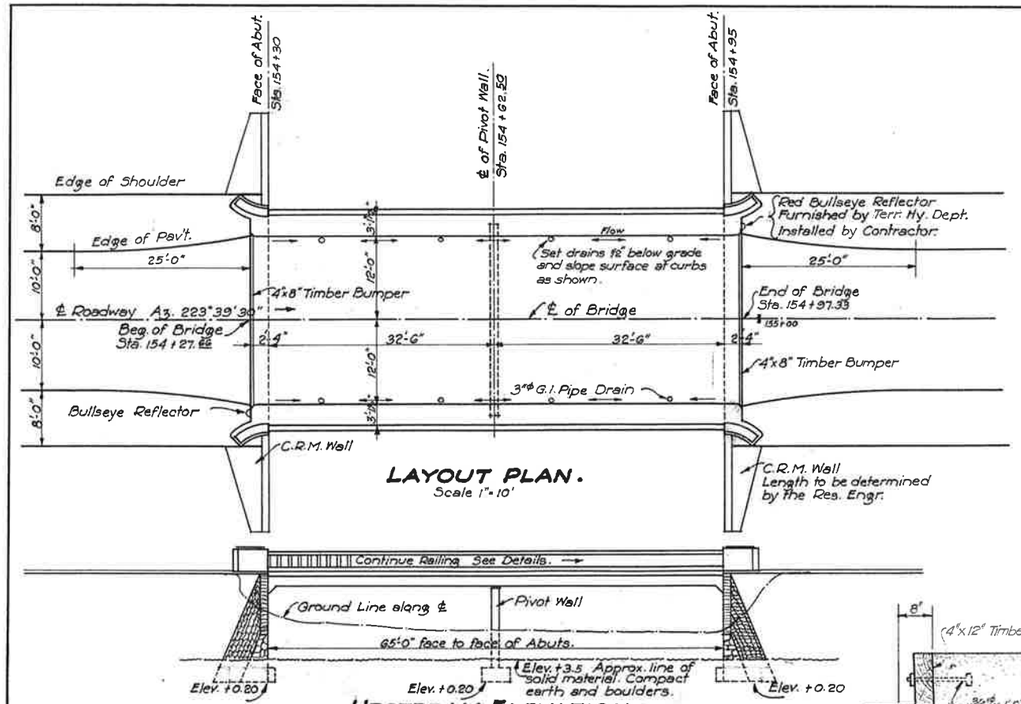
4385.1

| FED. ROAD DIST. NO. | STATE | FED. AID PROJ. NO. | FISCAL YEAR | SHEET NO. | TOT. SHEETS |
|---|---|---|---|---|---|
| HAWAII | HAW | BD | 1996 | 9 | 48 |

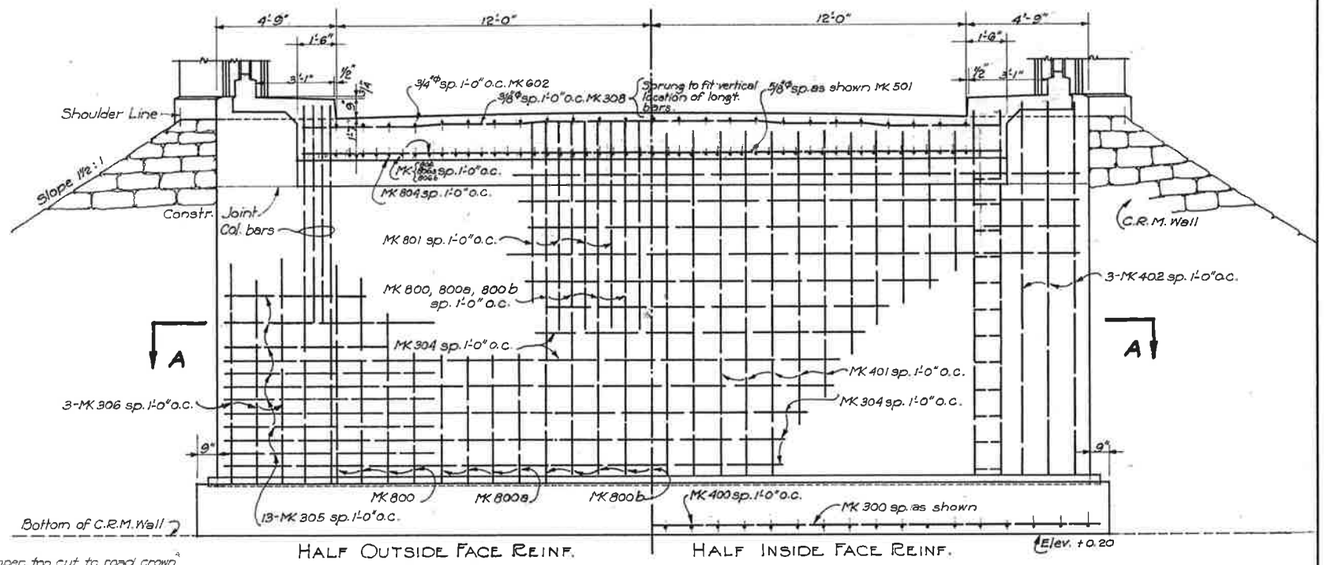



4385.9

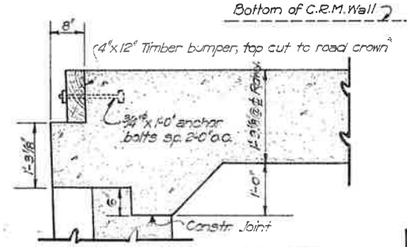
| FED. ROAD DIST. NO. | STATE | FED. AID PROJ. NO. | FISCAL YEAR | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| Hawaii | Haw | 3D | 1936 | 18 | 48 |



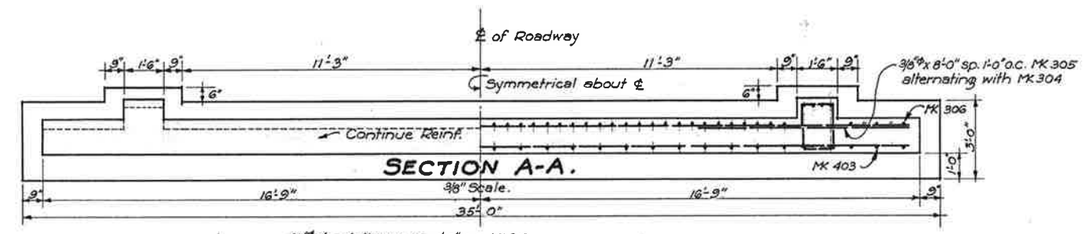

## LAYOUT PLAN.
Scale 1"=10'




## ABUTMENT AT END OF BRIDGE.
3/8" Scale.




## REVISED DETAIL OF TIMBER BUMPER
Scale 3/4"=1'-0"

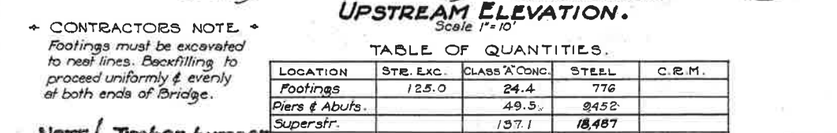



## SECTION A-A.

+ CONTRACTORS NOTE +

*Footings must be excavated to neat lines. Backfilling to proceed uniformly & evenly at both ends of Bridge.*

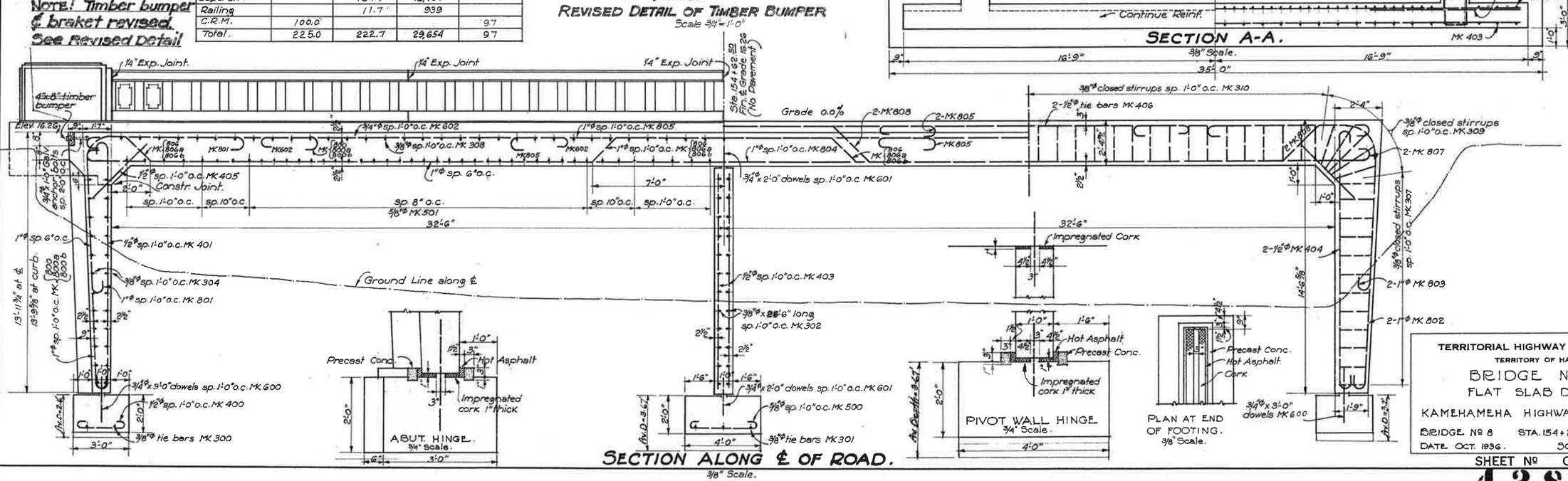
**NOTE! Timber bumper & braket revised. See Revised Detail**




## UPSTREAM ELEVATION.
Scale 1"=10'

TABLE OF QUANTITIES.

| LOCATION | STR. EXC. | CLASS "A" CONC. | STEEL | C.R.M. |
|---|---|---|---|---|
| Footings | 125.0 | 24.4 | 776 | |
| Piers & Abuts. | | 49.5 | 9452 | |
| Superstr. | | 137.1 | 18,487 | |
| Railing | | 11.7 | 939 | |
| C.R.M. | 100.0 | | | 97 |
| Total. | 225.0 | 222.7 | 29,654 | 97 |




## SECTION ALONG ℄ OF ROAD.
3/8" Scale.

**TERRITORIAL HIGHWAY DEPARTMENT**
TERRITORY OF HAWAII

BRIDGE No 8
FLAT SLAB DESIGN

KAMEHAMEHA HIGHWAY F.A.P. 3-D.

BRIDGE No 8 STA. 154+27.22 TO 154+97.33
DATE OCT. 1936. SCALES AS NOTED.

SHEET No OF SHEETS
**4385.18**

| ORIGINAL PLAN | SURVEY PLOTTED BY | DATE |
|---|---|---|
| | DESIGNED BY W.E. Bartels | |
| | DRAWN BY C.F. Wagner | " Oct. 1936 |
| NOTE BOOK | TRACED BY " | " " |
| | QUANTITIES BY " | " " |
| No. | CHECKED BY W.E. Bartels | " " |

Timber bumper & bracket Revised Mar. 24, 1937
Revised Jan. 15 1937

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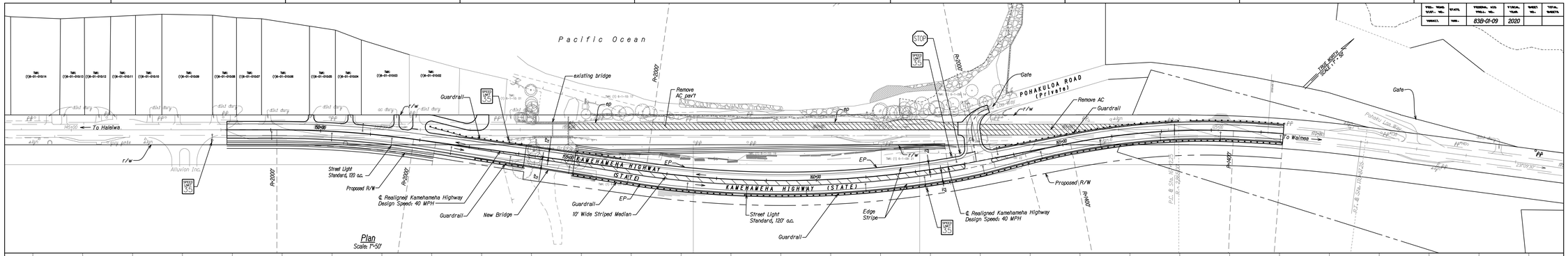
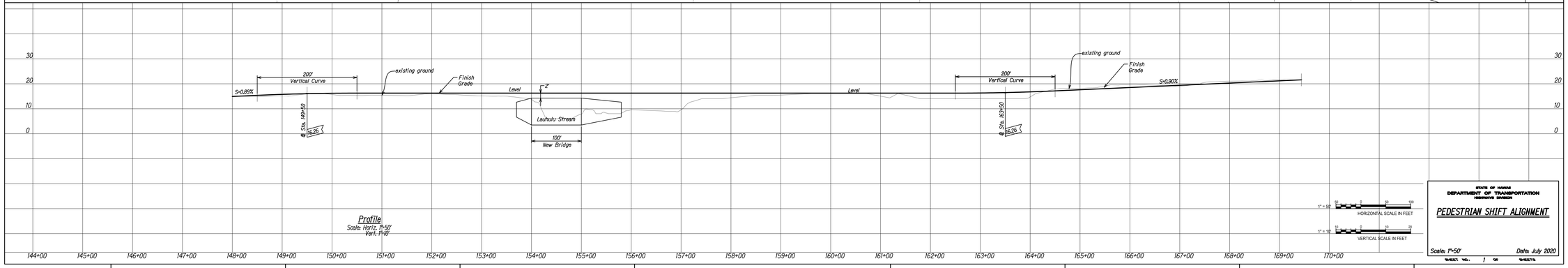
# Exhibit 3: Proposed Structure Plans

| FED. ROAD DIST. NO. | STATE | FEDERAL AID PROJ. NO. | FISCAL YEAR | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| HWA-A | HAW. | B3B-01-09 | 2020 | | |




STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

# PEDESTRIAN SHIFT ALIGNMENT

Scales: 1"=50' Date: July 2020

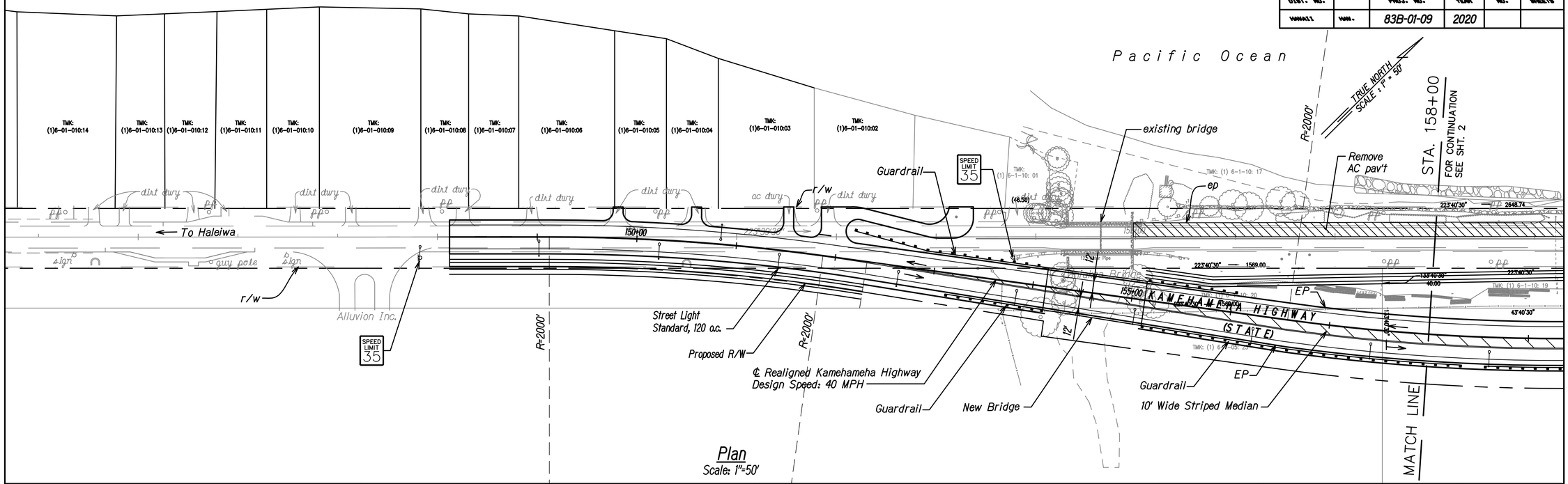
SHEET NO. 1 OF SHEETS

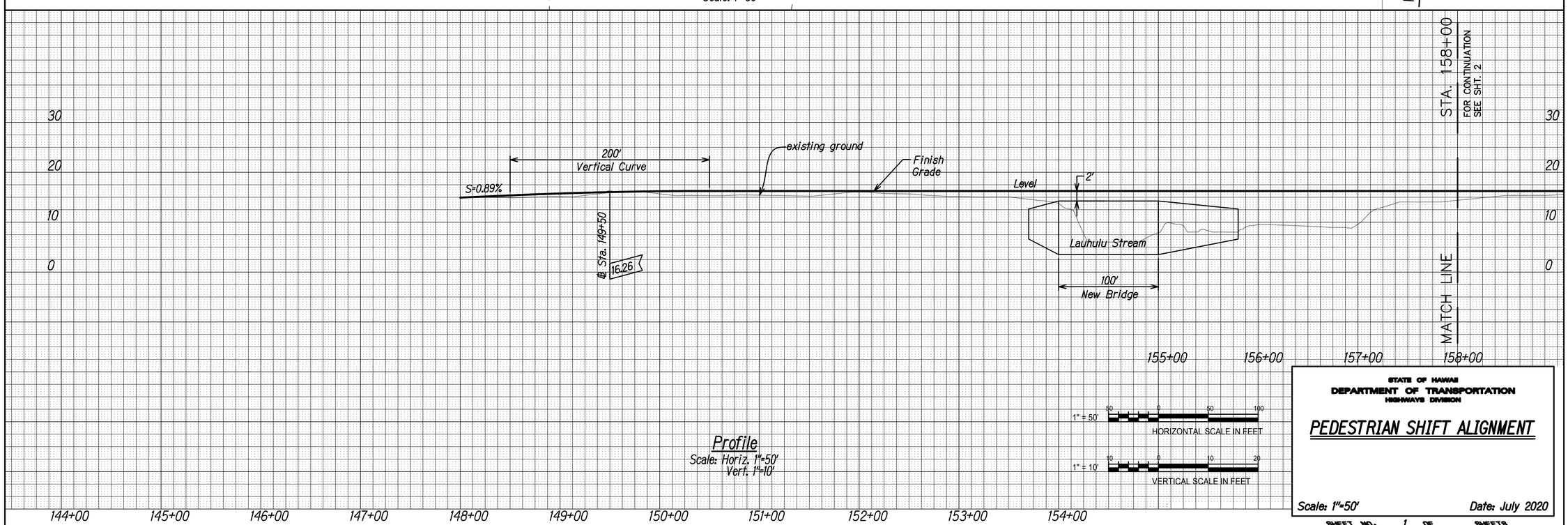
1" = 50' HORIZONTAL SCALE IN FEET

1" = 10' VERTICAL SCALE IN FEET

| | | |
|---|---|---|
| SPECIAL WORK | SYSTEM ENGINEER | DATE |
| | DESIGNER | |
| | CHECKED | |
| | SUPERVISOR | |
| | CONTRACTOR | |
| | INSPECTOR | |
| SHEET BOOK | No. | |

| FED. ROAD DIST. NO. | STATE | FEDERAL AID PROJ. NO. | FISCAL YEAR | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| HONOLULU | HAW. | 83B-01-09 | 2020 | | |




STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

## PEDESTRIAN SHIFT ALIGNMENT

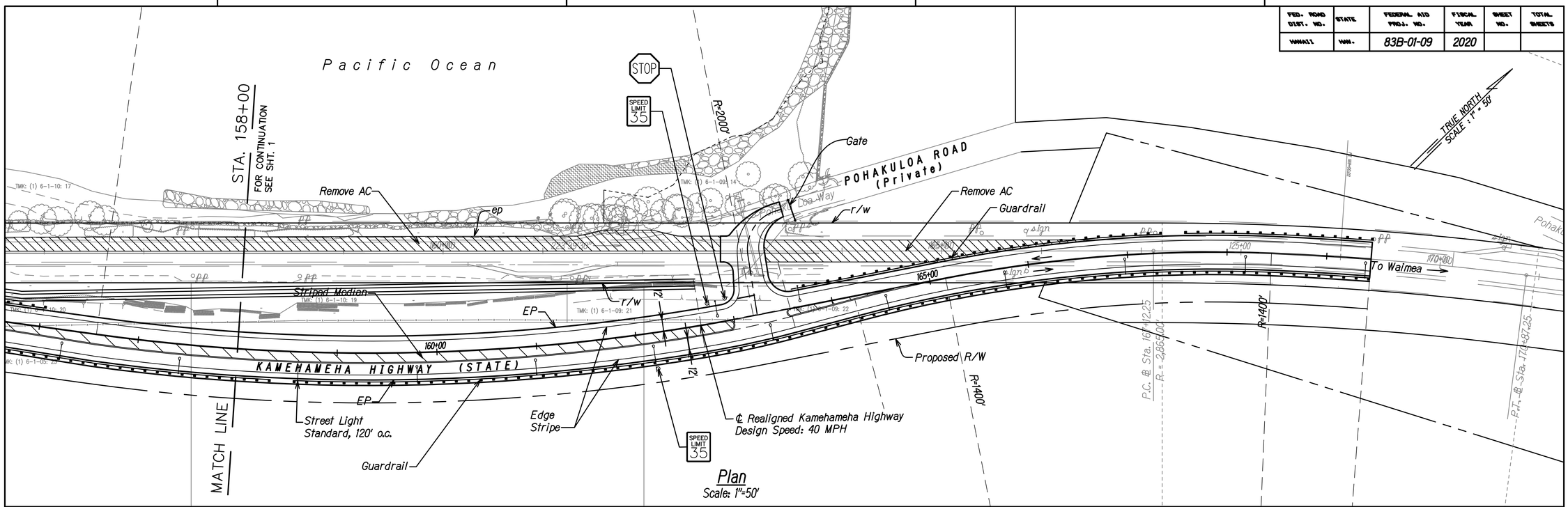
Scale: 1"=50'

Date: July 2020

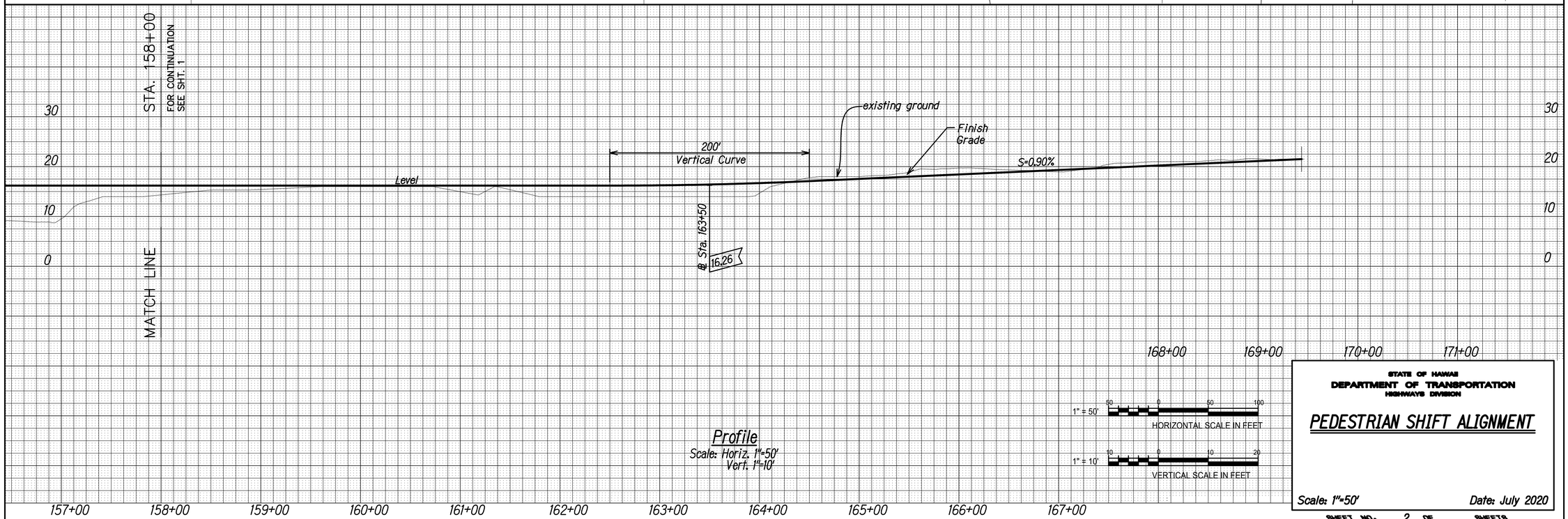
SHEET NO. 1 OF SHEETS

| ORIGINAL PLAN | SURVEY PLOTTED BY | DATE |
|---|---|---|
| | DRAWN BY | |
| NOTE BOOK | TRACED BY | |
| | DESIGNED BY | |
| | QUANTITIES BY | |
| No. | CHECKED BY | |

| FED. ROAD DIST. NO. | STATE | FEDERAL AID PROJ. NO. | FISCAL YEAR | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| HAWAII | HAW. | 83B-01-09 | 2020 | | |




Plan
Scale: 1"=50'




Profile
Scale: Horiz. 1"=50'
Vert. 1"=10'

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

**PEDESTRIAN SHIFT ALIGNMENT**

Scale: 1"=50'
Date: July 2020

SHEET NO. 2 OF SHEETS

| | | |
|---|---|---|
| ORIGINAL PLAN | SURVEY PLOTTED BY | DATE |
| | DRAWN BY | " " |
| NOTE BOOK | TRACED BY | " " |
| | DESIGNED BY | " " |
| | QUANTITIES BY | " " |
| No. | CHECKED BY | |

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Fax: +1 317 972-1708
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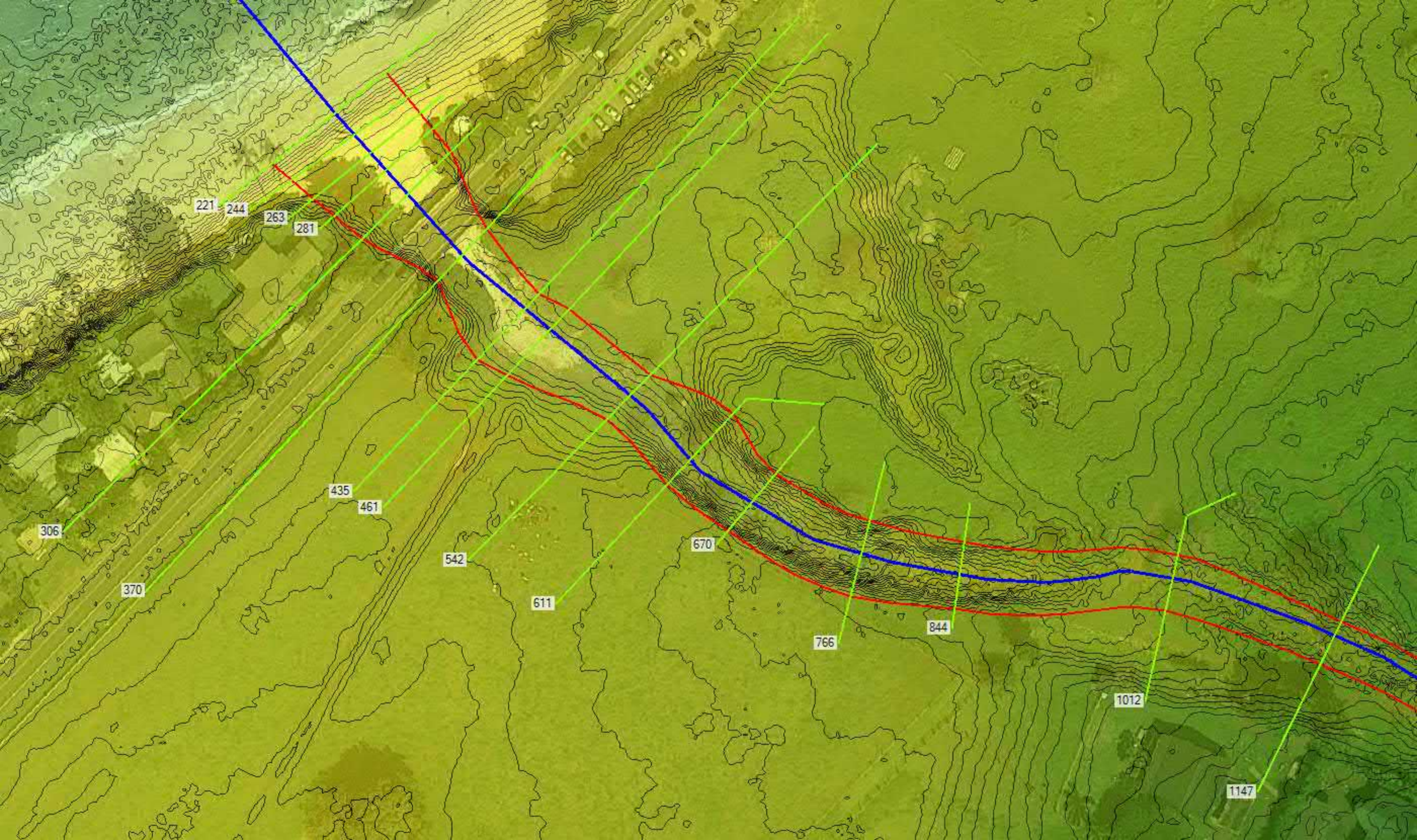
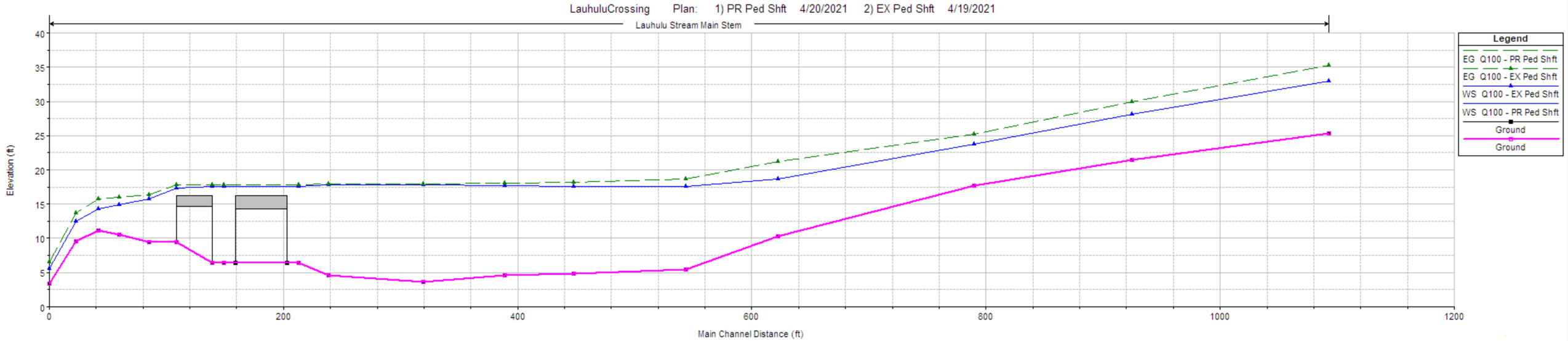
# Exhibit 4
# HEC-RAS Output and Plots
# Laniakea Stream - Pedestrian Shift


221
244
263
281
306
370
435
461
542
611
670
766
844
1012
1147

Profile Plot - Warning Geometry is newer than output.

File Options Help

Reaches ... Profiles ... Plot Initial Conditions Reload Data

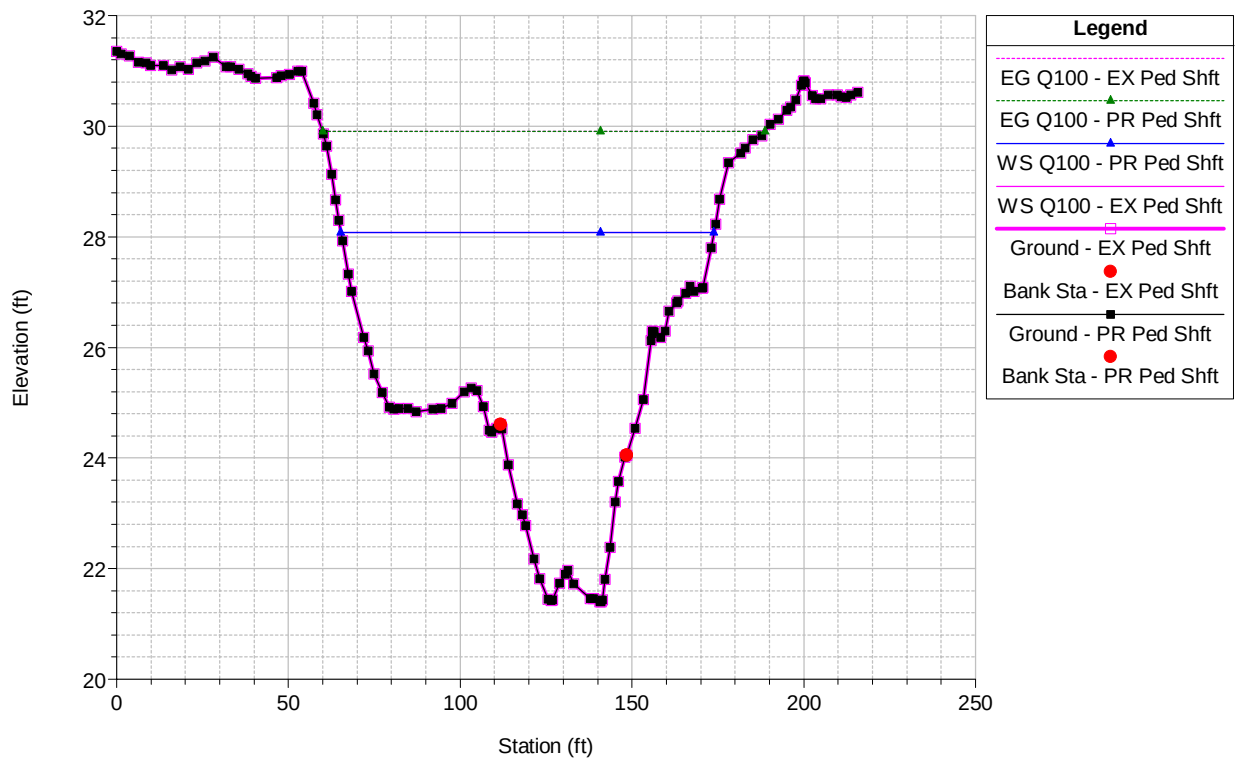


HEC-RAS River: Lauhulu Stream Reach: Main Stem Profile: Q100

| Reach | River Sta | Profile | Plan | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Main Stem | 1316 | Q100 | PR Ped Shft | 3340.00 | 25.31 | 32.94 | 32.94 | 35.26 | 0.013167 | 13.03 | 326.75 | 78.28 | 0.90 |
| Main Stem | 1316 | Q100 | EX Ped Shft | 3340.00 | 25.31 | 32.94 | 32.94 | 35.26 | 0.013167 | 13.03 | 326.75 | 78.28 | 0.90 |
| | | | | | | | | | | | | | |
| Main Stem | 1147 | Q100 | PR Ped Shft | 3340.00 | 21.40 | 28.08 | 28.08 | 29.90 | 0.013566 | 12.11 | 384.65 | 108.56 | 0.89 |
| Main Stem | 1147 | Q100 | EX Ped Shft | 3340.00 | 21.40 | 28.08 | 28.08 | 29.90 | 0.013566 | 12.11 | 384.65 | 108.56 | 0.89 |
| | | | | | | | | | | | | | |
| Main Stem | 1012 | Q100 | PR Ped Shft | 3340.00 | 17.71 | 23.71 | 23.71 | 25.19 | 0.018219 | 11.45 | 414.32 | 148.77 | 0.99 |
| Main Stem | 1012 | Q100 | EX Ped Shft | 3340.00 | 17.71 | 23.71 | 23.71 | 25.19 | 0.018219 | 11.45 | 414.32 | 148.77 | 0.99 |
| | | | | | | | | | | | | | |
| Main Stem | 844 | Q100 | PR Ped Shft | 3340.00 | 10.28 | 18.67 | 18.67 | 21.17 | 0.018469 | 12.70 | 263.41 | 57.71 | 0.99 |
| Main Stem | 844 | Q100 | EX Ped Shft | 3340.00 | 10.28 | 18.67 | 18.67 | 21.17 | 0.018469 | 12.70 | 263.41 | 57.71 | 0.99 |
| | | | | | | | | | | | | | |
| Main Stem | 766 | Q100 | PR Ped Shft | 3340.00 | 5.41 | 17.61 | | 18.67 | 0.005160 | 8.25 | 405.74 | 66.67 | 0.54 |
| Main Stem | 766 | Q100 | EX Ped Shft | 3340.00 | 5.41 | 17.61 | | 18.67 | 0.005174 | 8.26 | 405.22 | 66.40 | 0.54 |
| | | | | | | | | | | | | | |
| Main Stem | 670 | Q100 | PR Ped Shft | 3340.00 | 4.83 | 17.55 | | 18.22 | 0.002500 | 6.60 | 522.09 | 100.28 | 0.39 |
| Main Stem | 670 | Q100 | EX Ped Shft | 3340.00 | 4.83 | 17.54 | | 18.22 | 0.002508 | 6.60 | 521.31 | 99.95 | 0.40 |
| | | | | | | | | | | | | | |
| Main Stem | 611 | Q100 | PR Ped Shft | 3340.00 | 4.56 | 17.71 | | 18.03 | 0.001066 | 4.58 | 797.87 | 272.92 | 0.27 |
| Main Stem | 611 | Q100 | EX Ped Shft | 3340.00 | 4.56 | 17.70 | | 18.02 | 0.001069 | 4.59 | 796.93 | 272.68 | 0.27 |
| | | | | | | | | | | | | | |
| Main Stem | 542 | Q100 | PR Ped Shft | 3340.00 | 3.62 | 17.84 | | 17.92 | 0.000245 | 2.78 | 1800.44 | 457.50 | 0.14 |
| Main Stem | 542 | Q100 | EX Ped Shft | 3340.00 | 3.62 | 17.84 | | 17.91 | 0.000245 | 2.78 | 1798.96 | 457.50 | 0.14 |
| | | | | | | | | | | | | | |
| Main Stem | 461 | Q100 | PR Ped Shft | 3340.00 | 4.59 | 17.84 | 9.44 | 17.90 | 0.000187 | 2.38 | 1841.14 | 509.60 | 0.12 |
| Main Stem | 461 | Q100 | EX Ped Shft | 3340.00 | 4.59 | 17.85 | 9.34 | 17.89 | 0.000118 | 1.89 | 2588.60 | 509.60 | 0.10 |
| | | | | | | | | | | | | | |
| Main Stem | 435 | Q100 | PR Ped Shft | 3340.00 | 6.42 | 17.58 | 11.55 | 17.84 | 0.000792 | 4.48 | 1248.55 | 575.90 | 0.24 |
| Main Stem | 435 | Q100 | EX Ped Shft | 3340.00 | 6.42 | 17.61 | 11.55 | 17.86 | 0.000780 | 4.45 | 1258.21 | 575.90 | 0.24 |
| | | | | | | | | | | | | | |
| Main Stem | 400 | | | Bridge | | | | | | | | | |
| | | | | | | | | | | | | | |
| Main Stem | 370 | Q100 | PR Ped Shft | 3340.00 | 6.42 | 17.55 | 11.55 | 17.82 | 0.000805 | 4.51 | 1237.81 | 575.90 | 0.24 |
| Main Stem | 370 | Q100 | EX Ped Shft | 3340.00 | 6.42 | 17.55 | 11.55 | 17.82 | 0.000805 | 4.51 | 1237.81 | 575.90 | 0.24 |
| | | | | | | | | | | | | | |
| Main Stem | 350 | | | Bridge | | | | | | | | | |
| | | | | | | | | | | | | | |
| Main Stem | 306 | Q100 | PR Ped Shft | 3340.00 | 9.49 | 15.71 | 13.56 | 16.32 | 0.004046 | 6.34 | 555.54 | 130.71 | 0.48 |
| Main Stem | 306 | Q100 | EX Ped Shft | 3340.00 | 9.49 | 15.71 | 13.56 | 16.32 | 0.004046 | 6.34 | 555.54 | 130.71 | 0.48 |
| | | | | | | | | | | | | | |
| Main Stem | 281 | Q100 | PR Ped Shft | 3340.00 | 10.54 | 14.93 | | 16.02 | 0.011549 | 8.49 | 408.52 | 133.47 | 0.78 |
| Main Stem | 281 | Q100 | EX Ped Shft | 3340.00 | 10.54 | 14.93 | | 16.02 | 0.011549 | 8.49 | 408.52 | 133.47 | 0.78 |
| | | | | | | | | | | | | | |
| Main Stem | 263 | Q100 | PR Ped Shft | 3340.00 | 11.15 | 14.31 | 14.31 | 15.71 | 0.021399 | 9.78 | 366.90 | 140.53 | 1.02 |
| Main Stem | 263 | Q100 | EX Ped Shft | 3340.00 | 11.15 | 14.31 | 14.31 | 15.71 | 0.021399 | 9.78 | 366.90 | 140.53 | 1.02 |
| | | | | | | | | | | | | | |
| Main Stem | 244 | Q100 | PR Ped Shft | 3340.00 | 9.63 | 12.52 | 12.52 | 13.74 | 0.026116 | 9.58 | 402.89 | 169.90 | 1.09 |
| Main Stem | 244 | Q100 | EX Ped Shft | 3340.00 | 9.63 | 12.52 | 12.52 | 13.74 | 0.026116 | 9.58 | 402.89 | 169.90 | 1.09 |
| | | | | | | | | | | | | | |
| Main Stem | 221 | Q100 | PR Ped Shft | 3340.00 | 3.35 | 5.55 | 5.55 | 6.56 | 0.034199 | 9.00 | 431.44 | 217.90 | 1.19 |
| Main Stem | 221 | Q100 | EX Ped Shft | 3340.00 | 3.35 | 5.55 | 5.55 | 6.56 | 0.034199 | 9.00 | 431.44 | 217.90 | 1.19 |

LauhuluCrossing Plan: 1) PR Ped Shft 2) EX Ped Shft

RS = 1147

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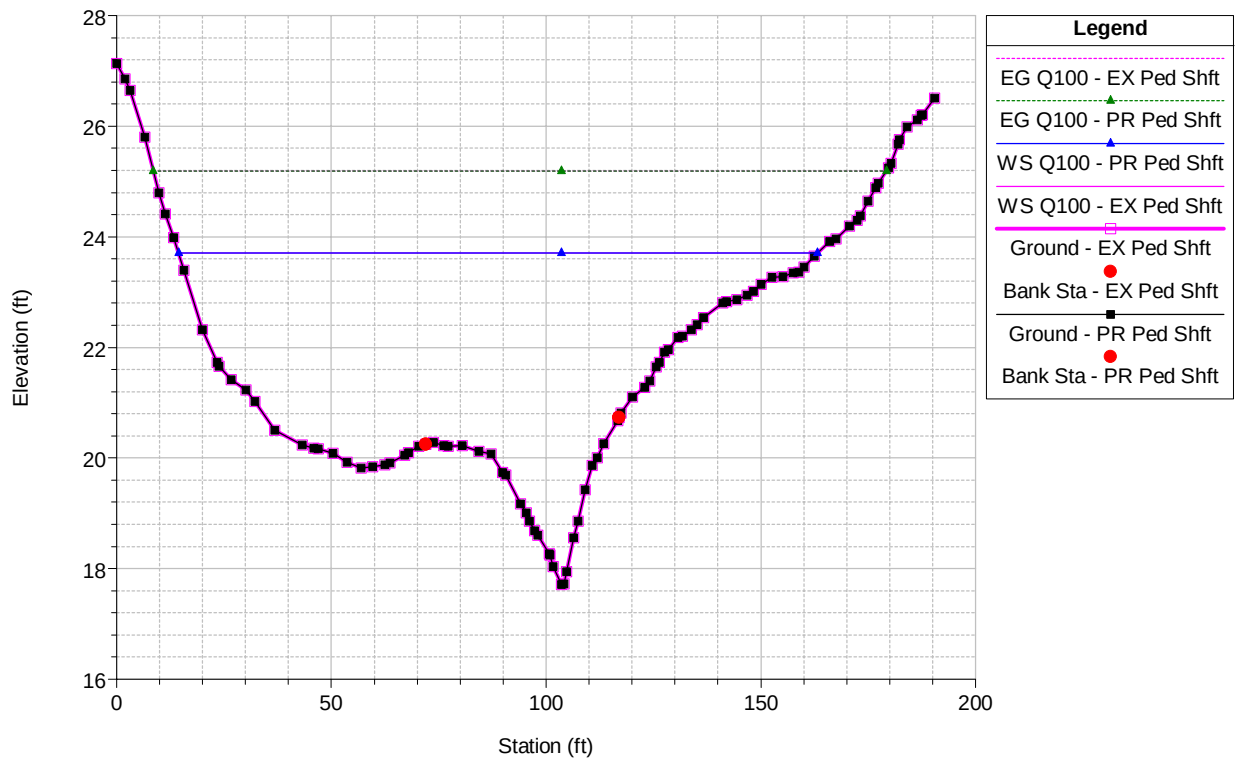

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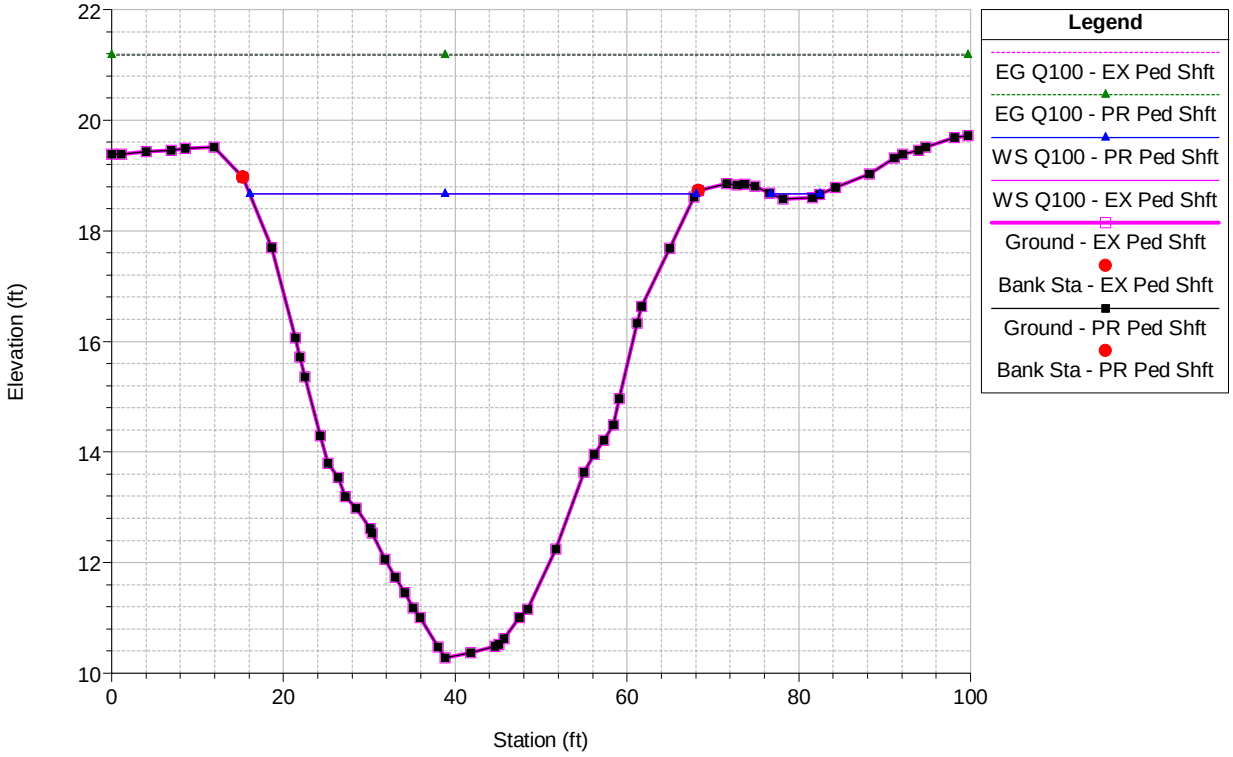


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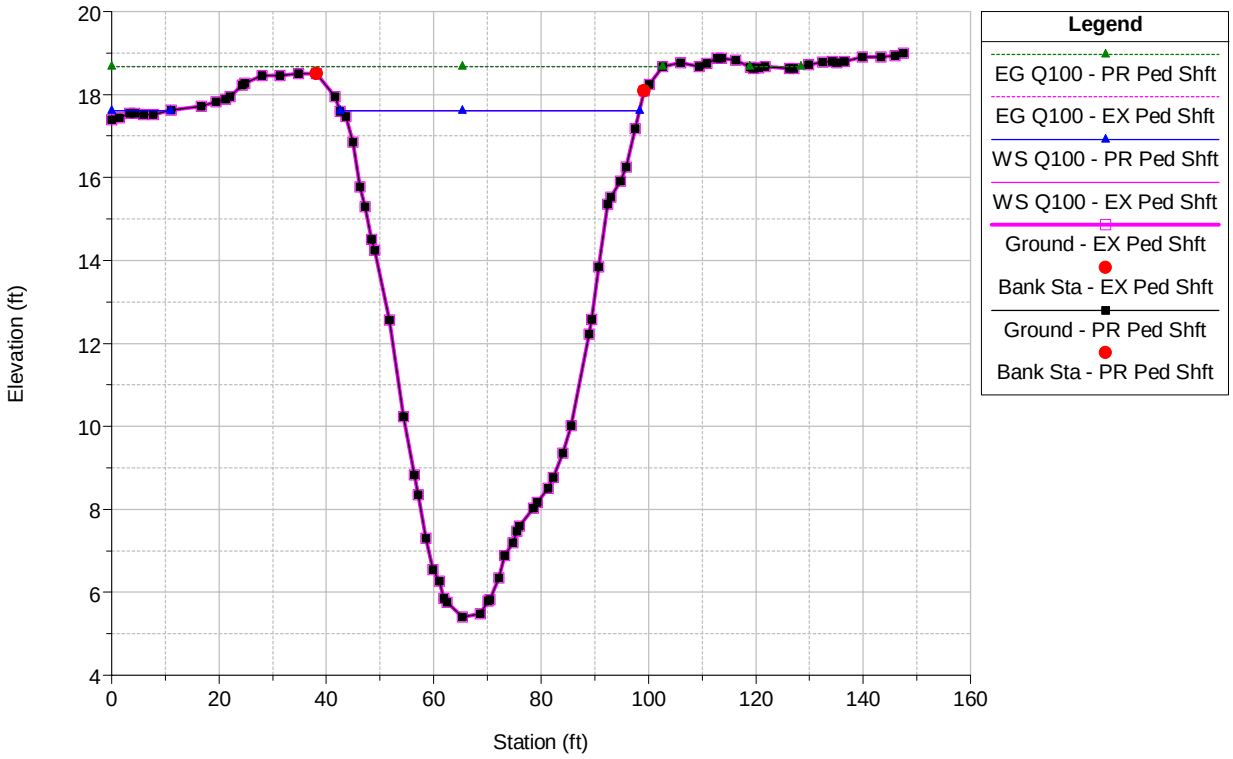

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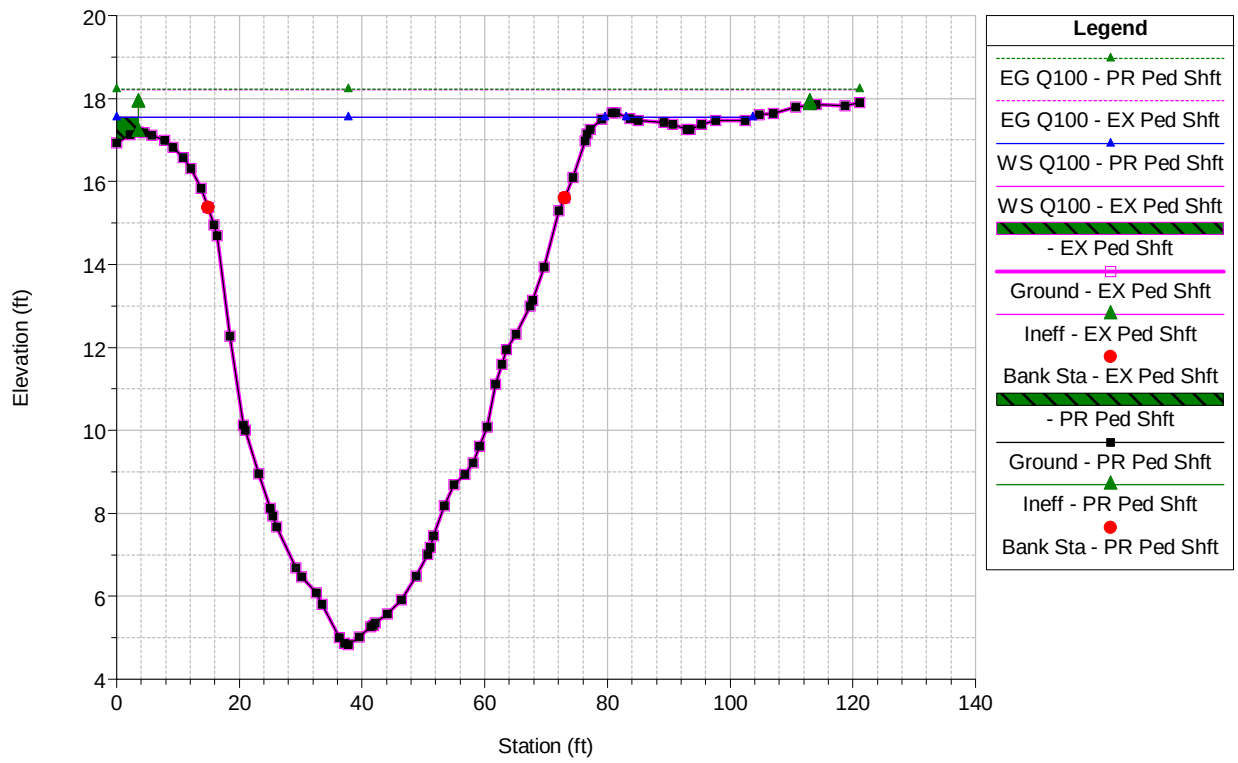


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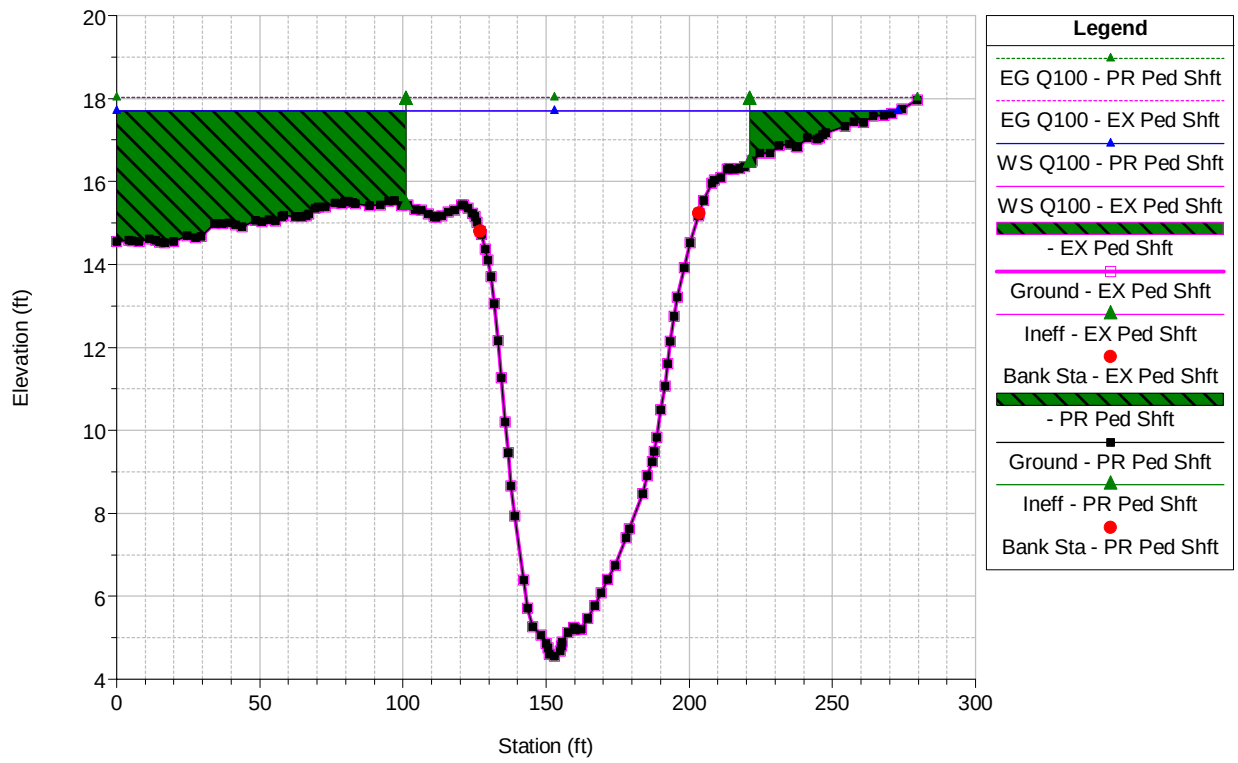

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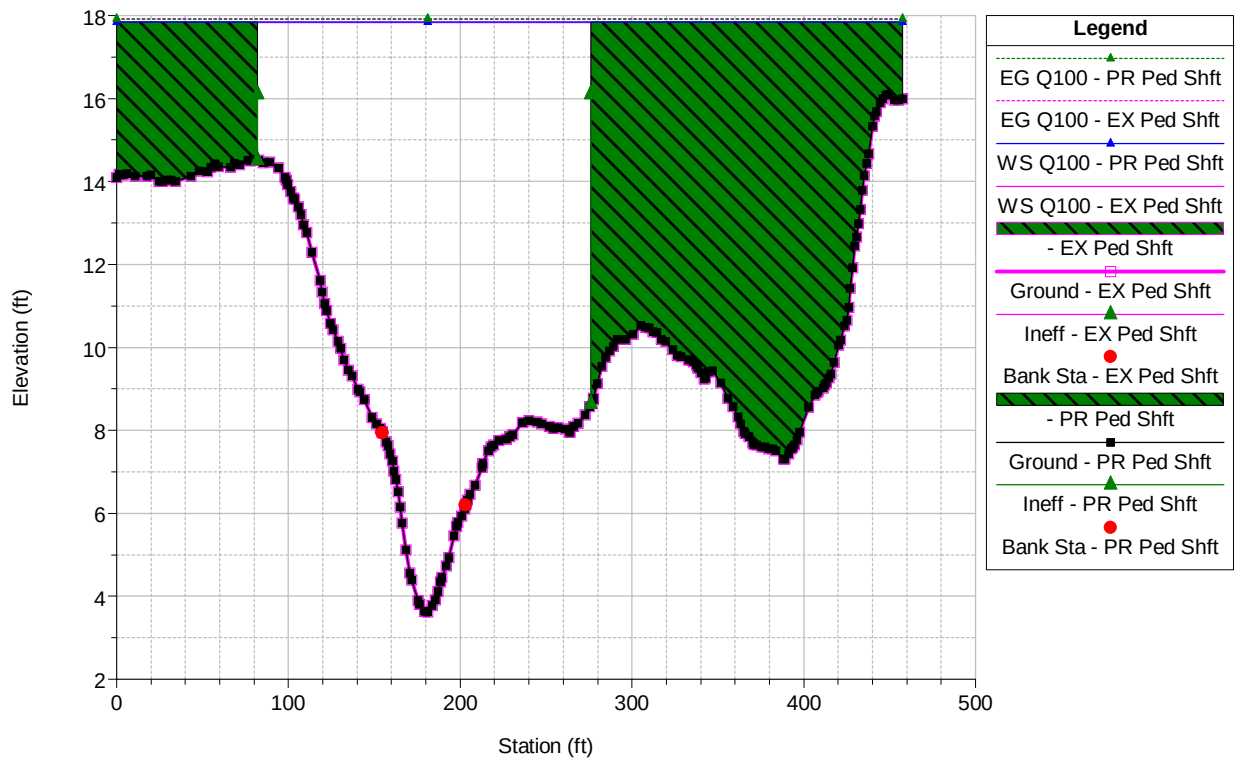


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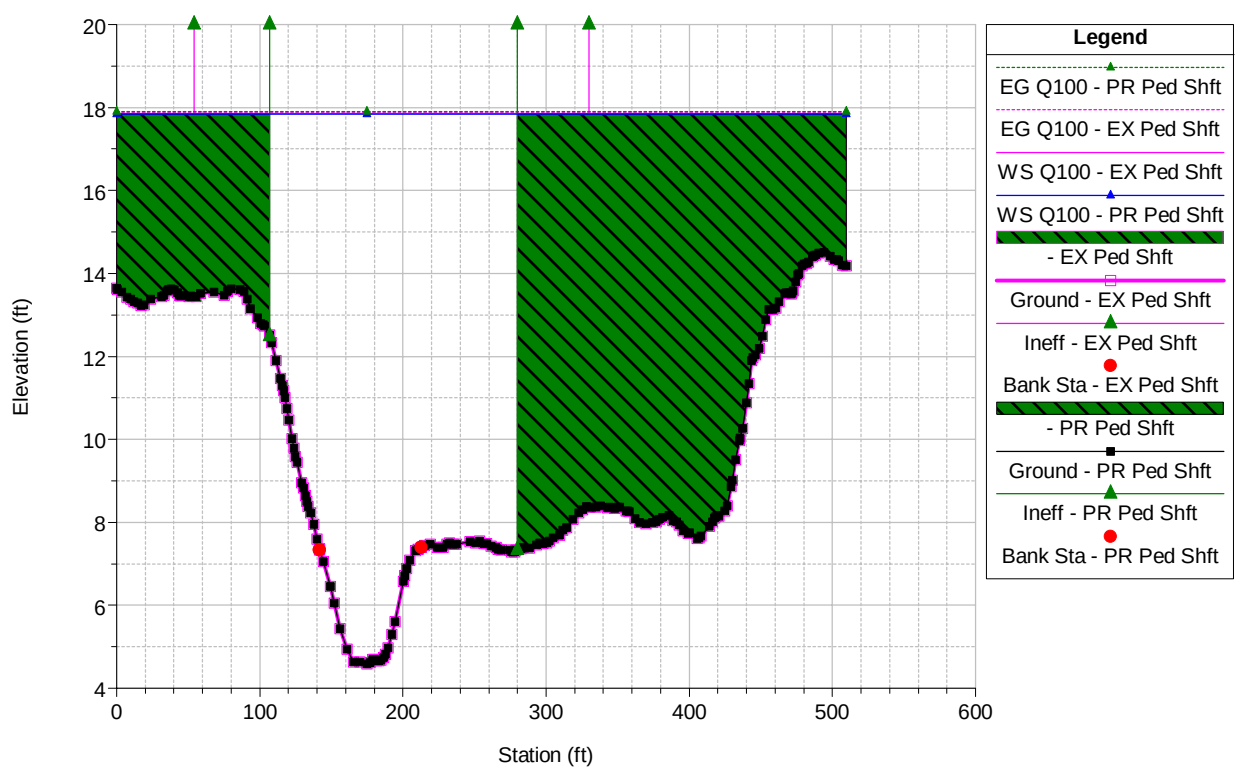
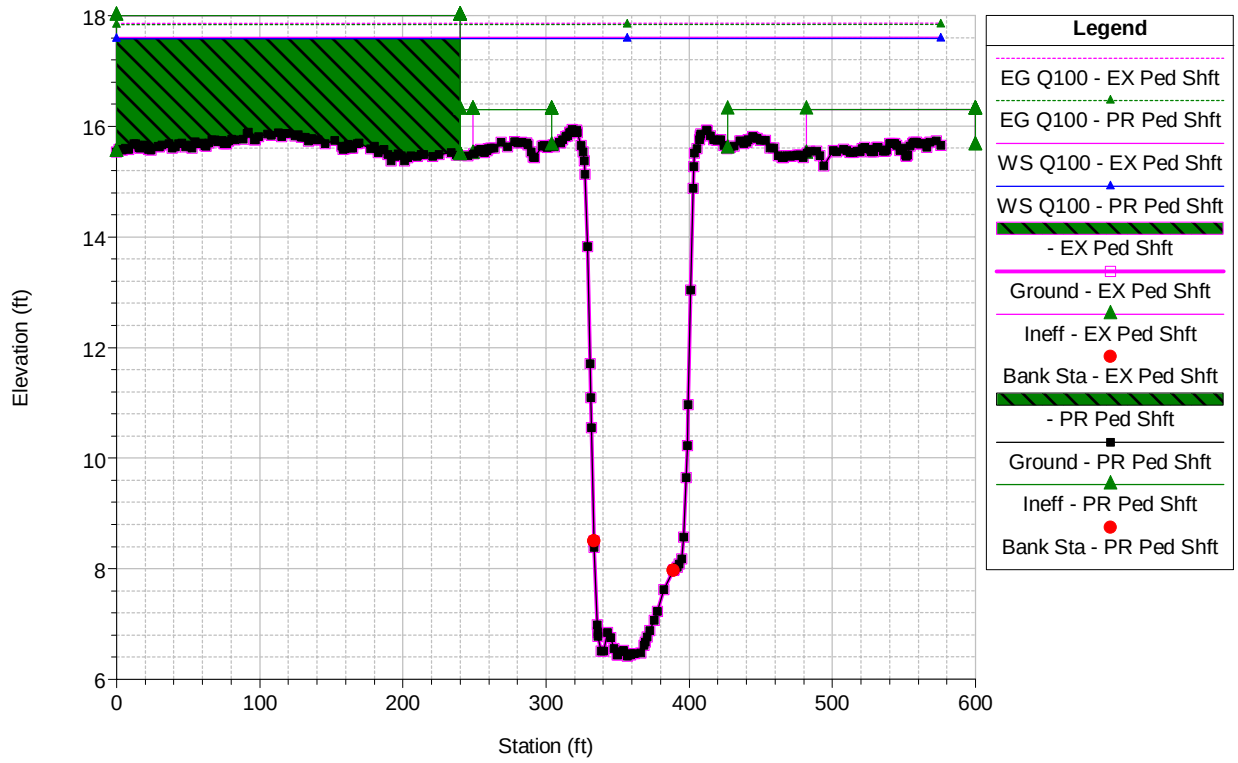
RS = 461



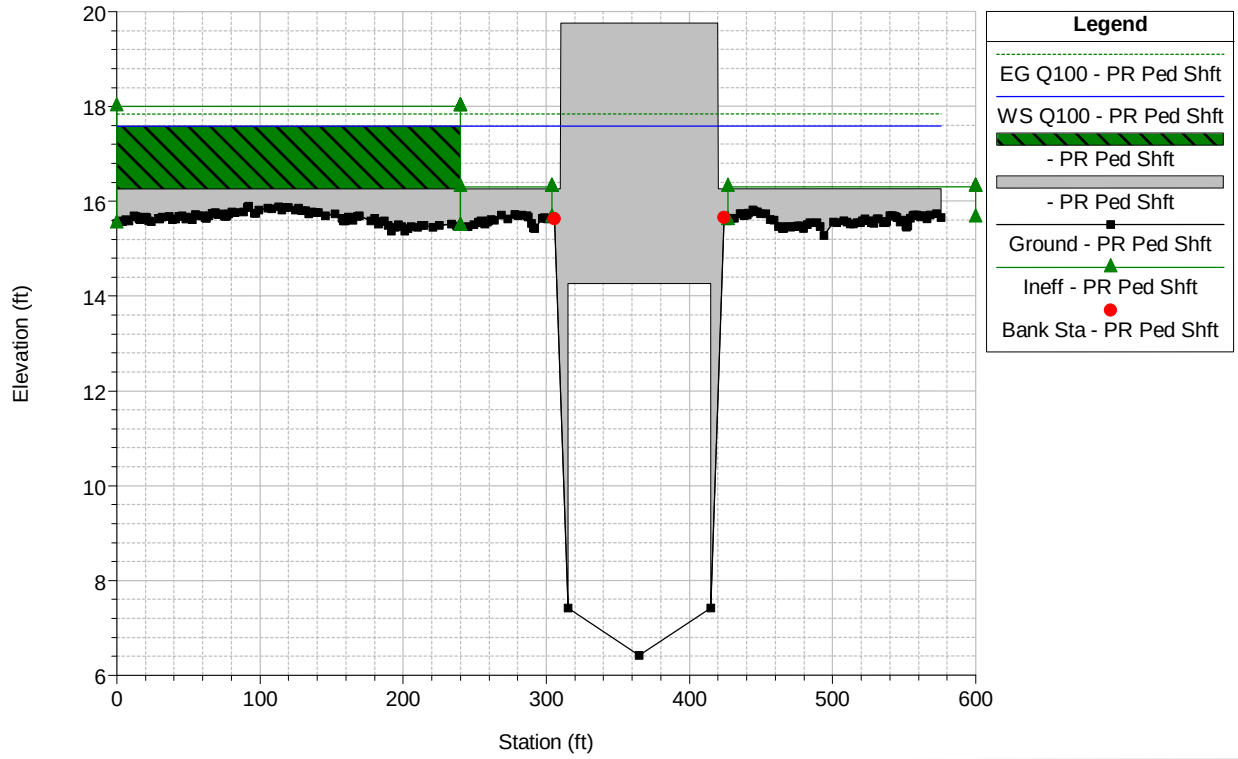
LauhuluCrossing Plan: 1) PR Ped Shft 2) EX Ped Shft

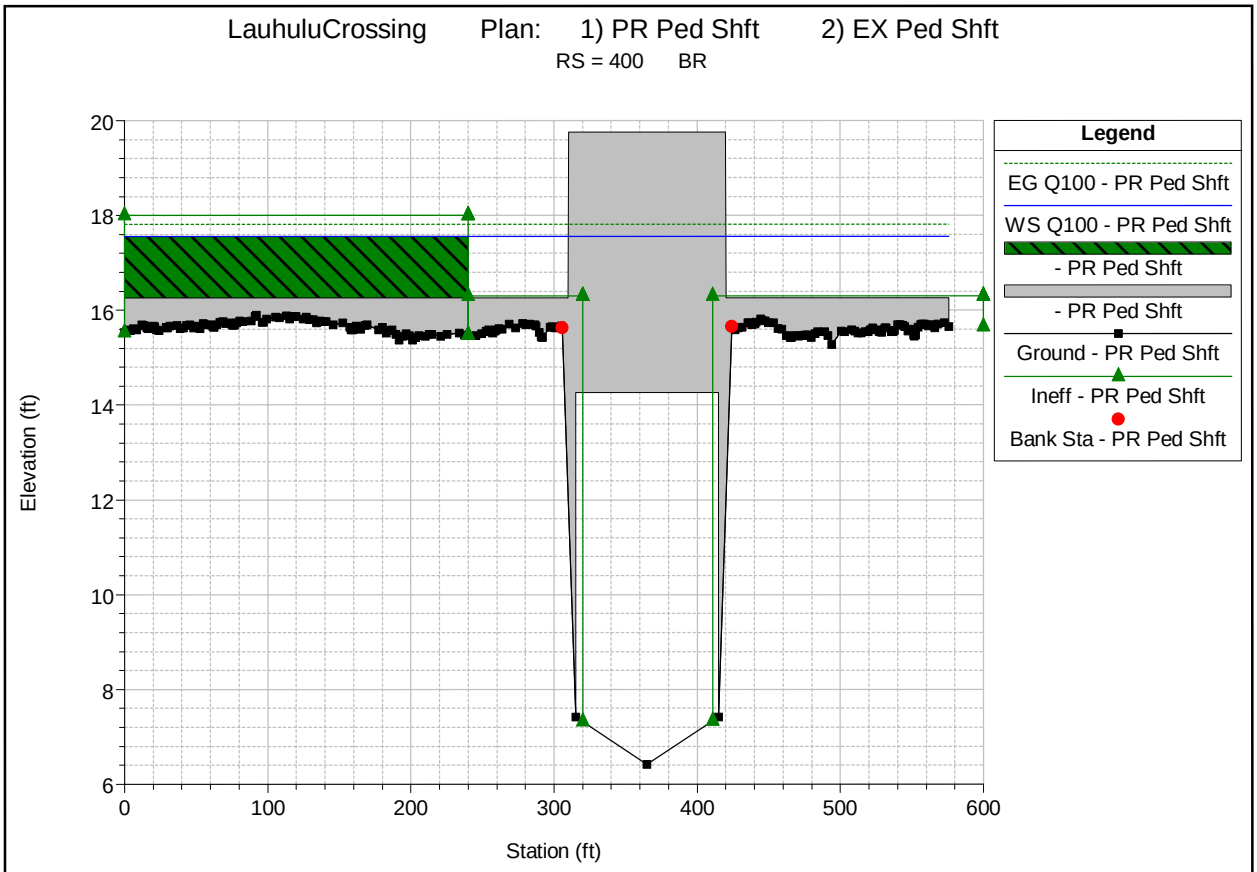
RS = 435

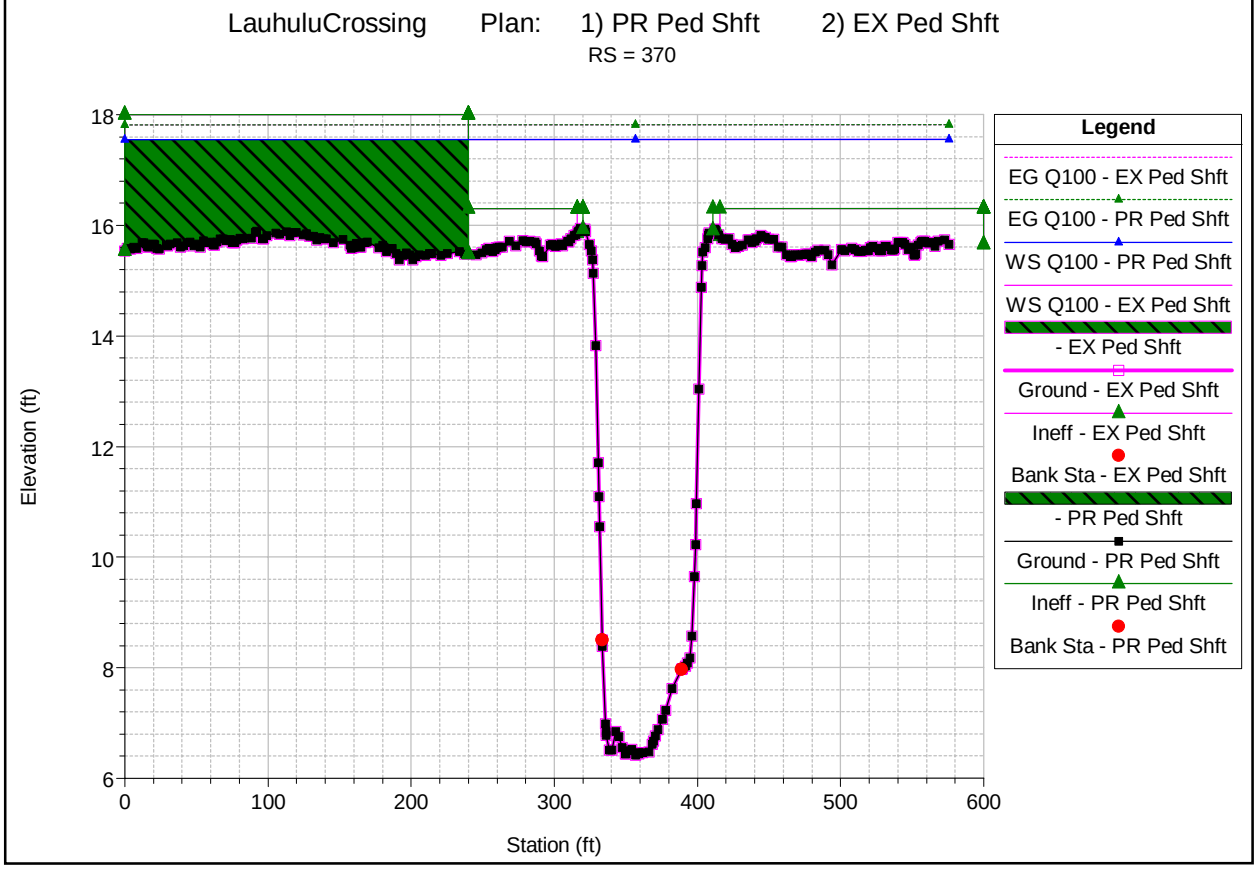


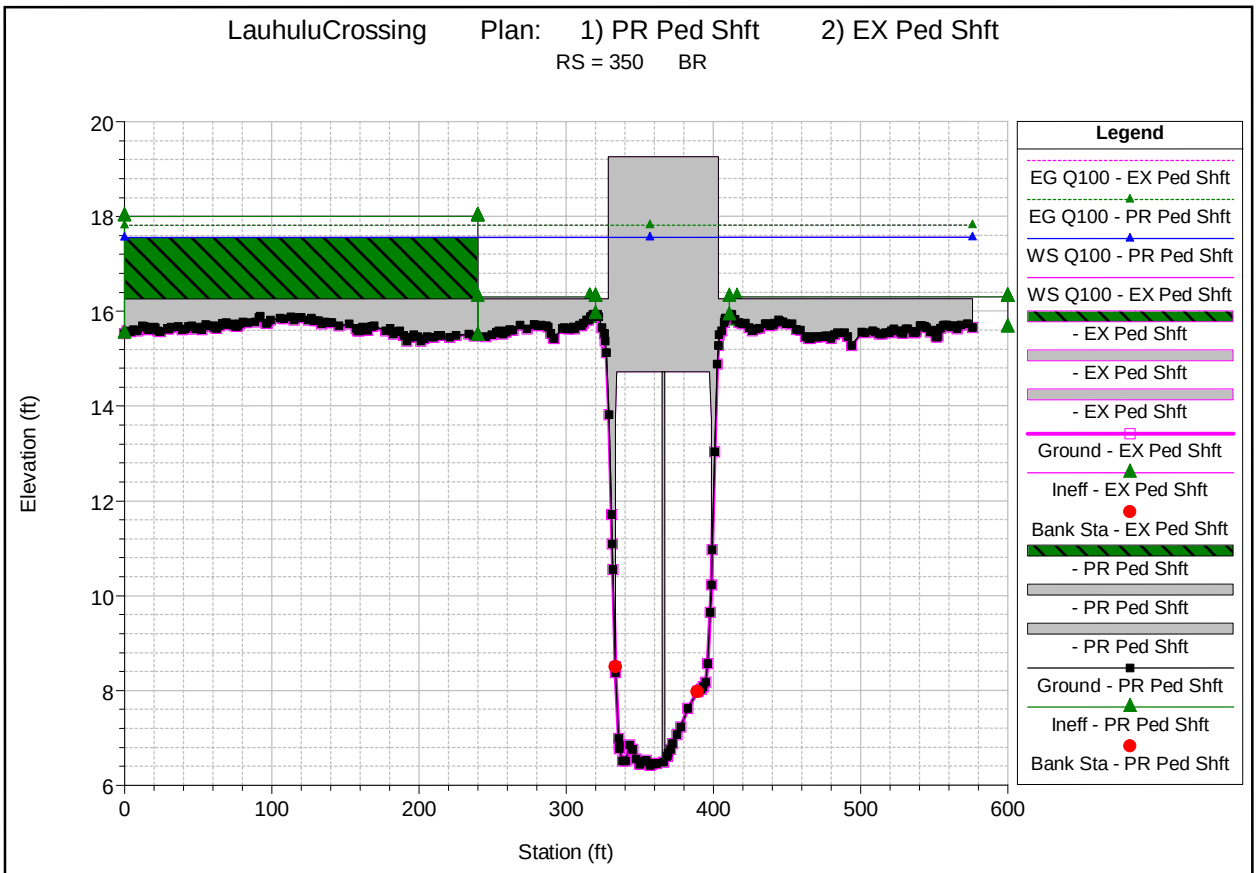

LauhuluCrossing Plan: 1) PR Ped Shft 2) EX Ped Shft

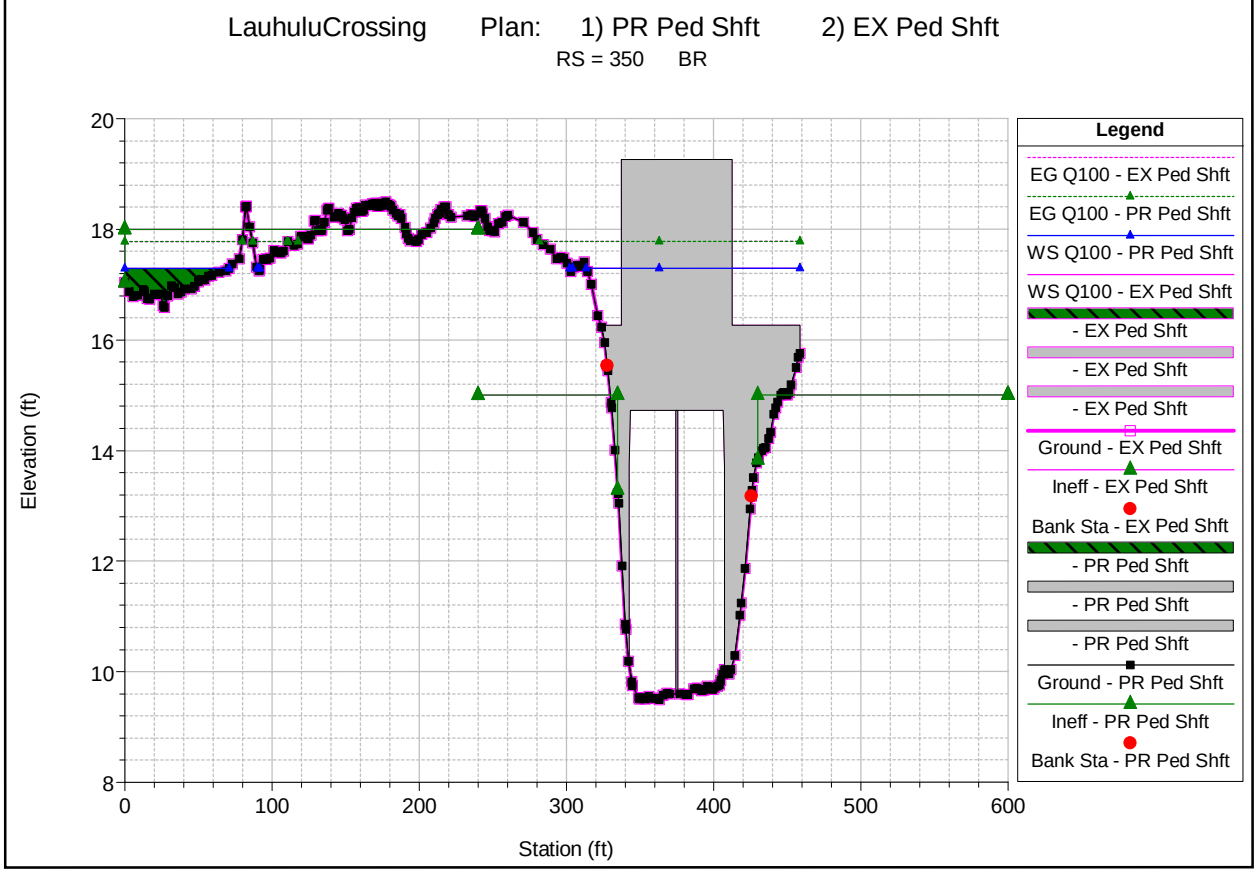
RS = 400 BR




LauhuluCrossing Plan: 1) PR Ped Shft 2) EX Ped Shft
RS = 400 BR
Elevation (ft)
Station (ft)
Legend
EG Q100 - PR Ped Shft
WS Q100 - PR Ped Shft
- PR Ped Shft
- PR Ped Shft
Ground - PR Ped Shft
Ineff - PR Ped Shft
Bank Sta - PR Ped Shft

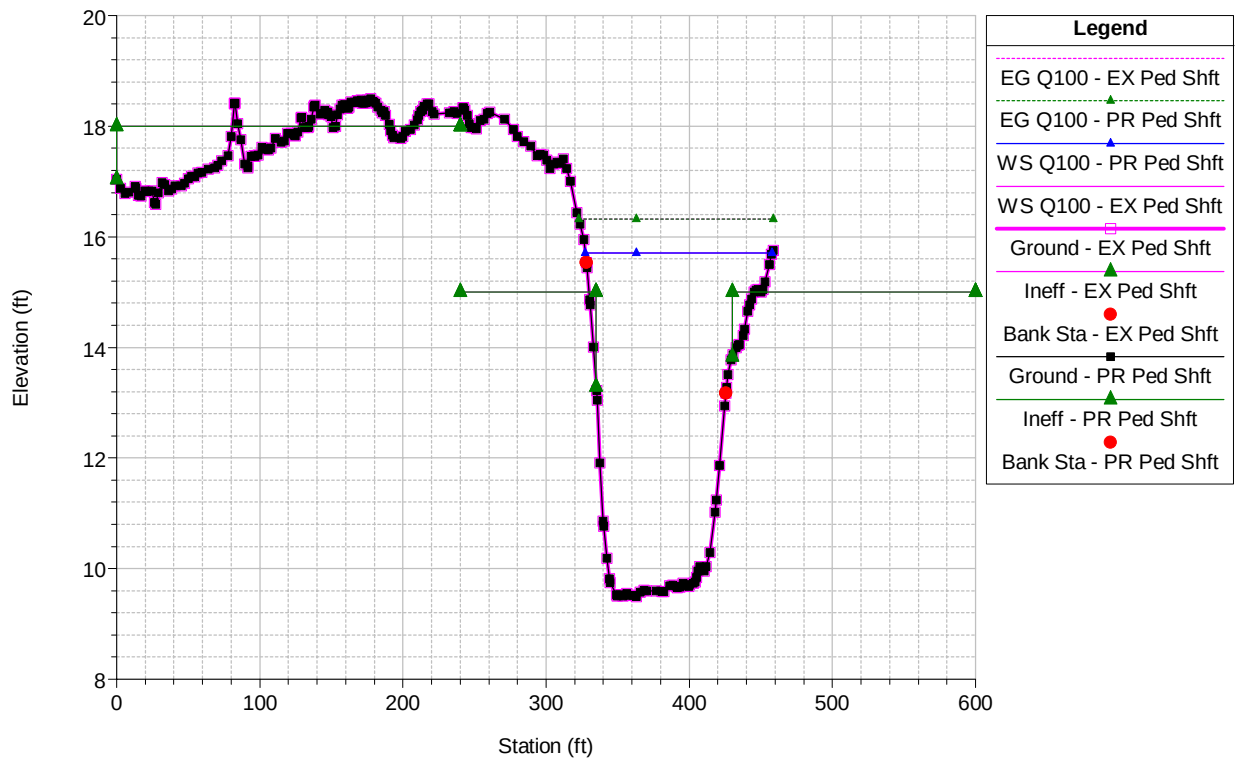

LauhuluCrossing Plan: 1) PR Ped Shft 2) EX Ped Shft
RS = 370
Elevation (ft)
Station (ft)
Legend
EG Q100 - EX Ped Shft
EG Q100 - PR Ped Shft
WS Q100 - PR Ped Shft
WS Q100 - EX Ped Shft
- EX Ped Shft
Ground - EX Ped Shft
Ineff - EX Ped Shft
Bank Sta - EX Ped Shft
- PR Ped Shft
Ground - PR Ped Shft
Ineff - PR Ped Shft
Bank Sta - PR Ped Shft


LauhuluCrossing Plan: 1) PR Ped Shft 2) EX Ped Shft
RS = 350 BR
Elevation (ft)
Station (ft)
Legend
EG Q100 - EX Ped Shft
EG Q100 - PR Ped Shft
WS Q100 - PR Ped Shft
WS Q100 - EX Ped Shft
- EX Ped Shft
- EX Ped Shft
- EX Ped Shft
Ground - EX Ped Shft
Ineff - EX Ped Shft
Bank Sta - EX Ped Shft
- PR Ped Shft
- PR Ped Shft
- PR Ped Shft
Ground - PR Ped Shft
Ineff - PR Ped Shft
Bank Sta - PR Ped Shft


LauhuluCrossing Plan: 1) PR Ped Shft 2) EX Ped Shft
RS = 350 BR
Elevation (ft)
Station (ft)
Legend
EG Q100 - EX Ped Shft
EG Q100 - PR Ped Shft
WS Q100 - PR Ped Shft
WS Q100 - EX Ped Shft
- EX Ped Shft
- EX Ped Shft
- EX Ped Shft
Ground - EX Ped Shft
Ineff - EX Ped Shft
Bank Sta - EX Ped Shft
- PR Ped Shft
- PR Ped Shft
- PR Ped Shft
Ground - PR Ped Shft
Ineff - PR Ped Shft
Bank Sta - PR Ped Shft

LauhuluCrossing Plan: 1) PR Ped Shft 2) EX Ped Shft

RS = 306

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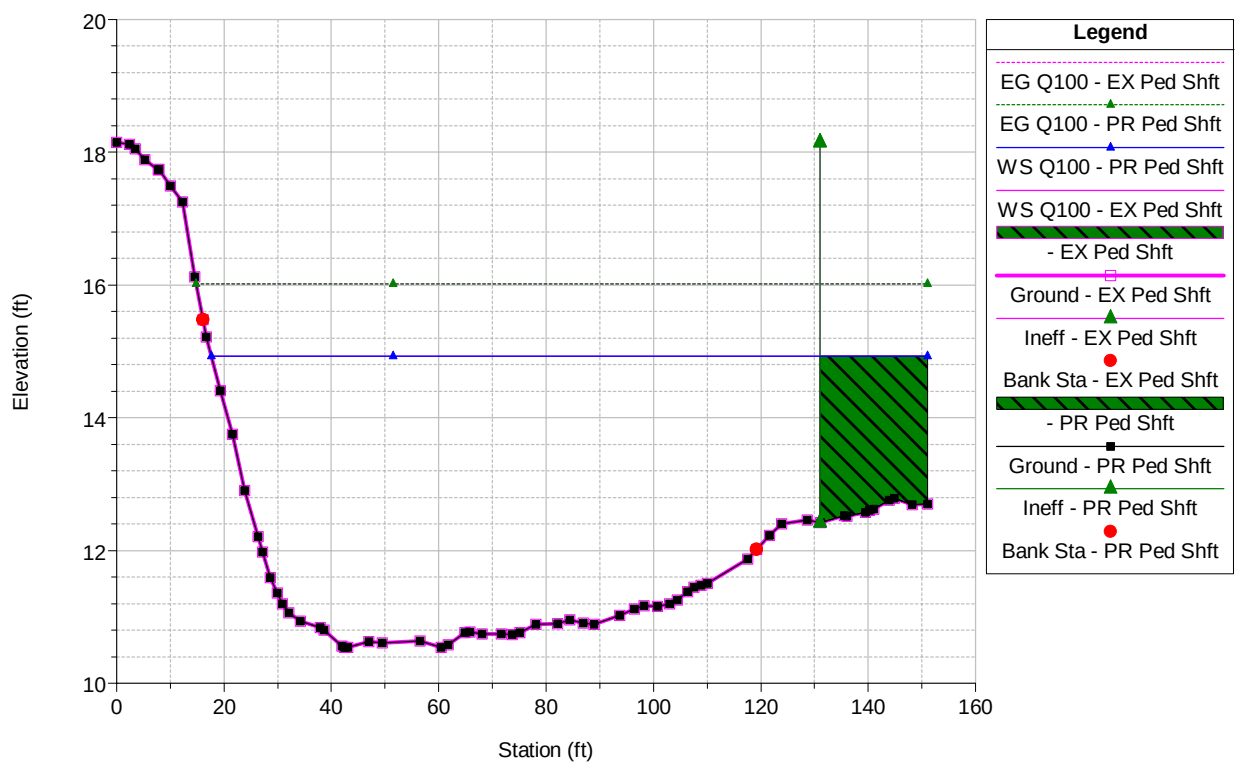
RS = 281



Appendix

# G

# Preliminary Drainage Report

*TECHNICAL REPORT*

# *Kamehameha Highway Pedestrian Safety Project*
# *Vicinity of Laniakea Beach*
# *Preliminary Drainage Report*

*Haleiwa, Island of Oahu, Hawaii*

*April 2021*

Prepared for:
State of Hawaii
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813

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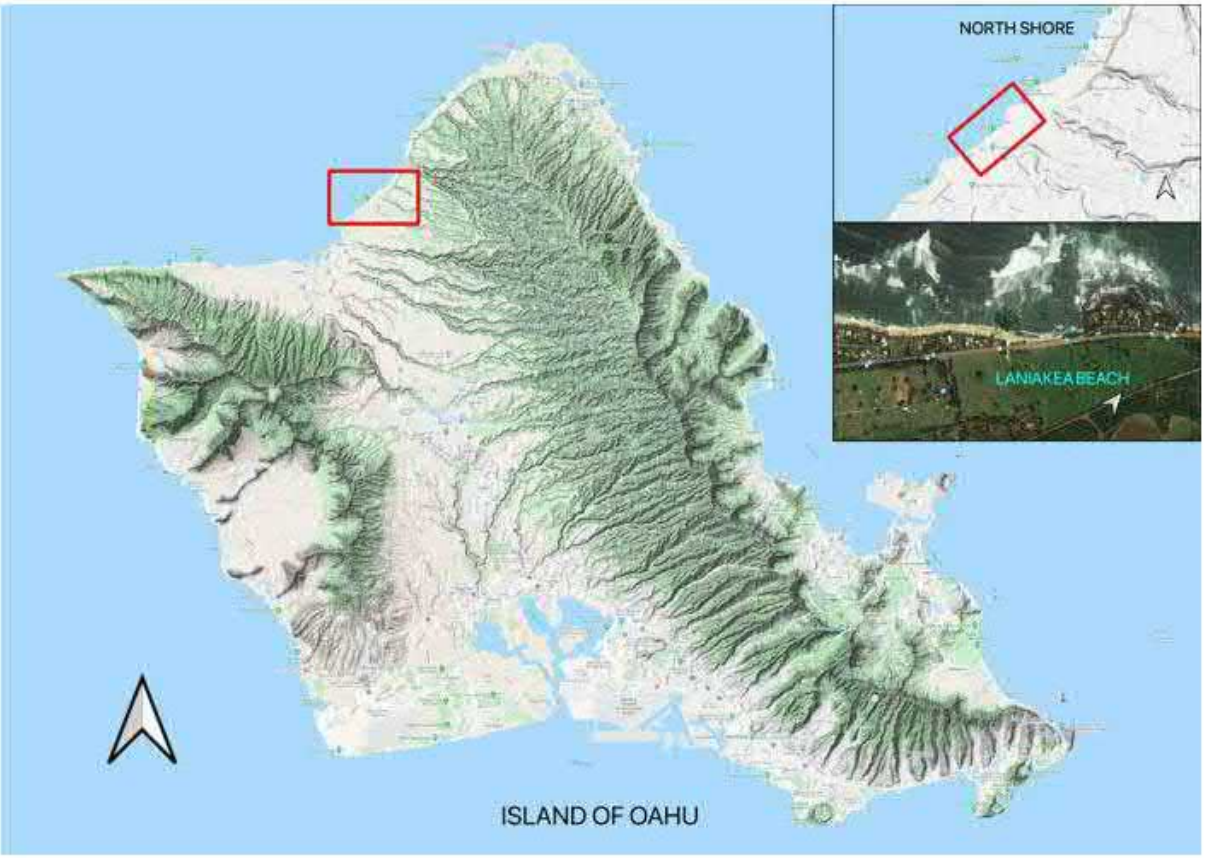
# 1 INTRODUCTION

## 1.1 PROJECT LOCATION AND DESCRIPTION

The proposed project, identified as the Kamehameha Highway Pedestrian Safety Project, will be discharging stormwater to two outfalls locations. One located on the Hale'iwa side of the Lauhulu Stream Watershed (also referred to as Laniakea Stream) to the west and another one to the Kawailoa Stream watershed to the east. The proposed stormwater drainage system will collect and convey the onsite runoff along the highway towards a system of ditches and swales to collect and convey offsite runoff and discharge it to Lauhulu Stream. Figure 1 provides the Project Location Map.

**Figure 1-1. Project Location Map**




The Kamehameha Highway Pedestrian Safety Project will realign Kamehameha Highway inland approximately 80 feet mauka from its furthest point to the existing highway. Guardrails on the mauka side of highway will discourage vehicles parking on the mauka side of the highway, thereby reducing pedestrian and vehicular conflicts.

The project includes the following facilities:

- Realigned Kamehameha Highway,
- One new bridge at Lauhulu Stream.
- Existing bridge at Lauhulu Stream will remain for pedestrian and bicycling use.
- Portions of the existing highway will remain for pedestrian and bicycling use.
- Permanent BMP consisting of grass swale and landscaping between the pedestrian and bicycling path and realigned highway.

## 1.2 REPORT PURPOSE

The drainage report provides calculations for the amount of stormwater runoff generated by the subdivided drainage areas along the proposed development areas. It provides the peak flows based on the 10-year, 25-year, 50-year, and 100-year storm events.

In summary, this report includes the hydrologic analysis of the following:

- The pre and post-development hydrologic conditions and 10-year, 25-year, 50-year, and 100-year peak stormwater runoff rates using the Rational Method, and
- The design of drainage features using the 50-year storm event.

# 2 EXISTING DRAINAGE SETTING AND FACILITIES

## 2.1 DRAINAGE SETTING

The current Kamehameha Highway, in the vicinity of Laniakea Beach, is located in the Keamanea Watershed which was subdivided into three sub-basins. The first sub-basin encompasses the Kawailoa Stream with an area of 2.1 acres and drains along Ashley Road through an existing arch culvert. The second sub-basin drains an area of 51 acres towards the start of Pohaku Loa Way. The third sub-basin is part of the Lauhulu Stream and drains 352 acres towards an existing Lauhulu Bridge on the Hale'iwa side of Laniakea Beach.

### 2.1.1 CLIMATE

The United States Department of Agriculture (USDA) Web Soil Survey tool was used to understand the climate conditions for the project area. The mean annual precipitation around the project is 59.9 inches/hour. The susceptibility of the soil to sheet and rill erosion by water was rated between 0.17 to 0.28. The estimates are based primarily on the percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of Ksat range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water. Surface runoff is rated from low to medium.

### 2.1.2 LAND USE AND SOILS

The USDA Web Soil Survey tool was used to run various soil data reports showing soil characterization on Oahu. The hydrologic soil group for the site is classified as rating C, Waialua silty clay, with 0 to 3 percent slopes, and slow infiltration rate. Offsite drainage areas were classified with HSG B, and moderate infiltration rate.

### 2.1.3 GROUNDWATER

The island of Oahu has been divided into seven major ground-water areas that are delineated by deep-seated structural geohydrologic barriers. The project is located in the groundwater North Central Oahu area, which contains a basal lens of freshwater with some confinement along the coast, is bound on the east by the Ko`olau rift zone, on the south by the north Schofield ground-water barrier, on the west by the Waianae rift zone, and on the north by the sea.

### 2.1.4 FLOODPLAIN

The area is located within Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Community Panel Number 15003C0362G, and is categorized as *Area with high flood risk due to levee; Zone D.* The area within the limits of the project

are Zones AE, VE on the Hale‘iwa side of the Lauhulu Stream bridge and Zone X to the Waimea side of Ashley Road

The applicable flood zones are defined as follows:

- Zone AE and VE: Area subject to inundation by the 1 percent annual chance (100-year) flood event. Base-flood elevations have been determined by FEMA
- Zone D: Area with flood risk due to levee.
- Zone X (unshaded): Area determined to be outside the 0.2 percent annual chance (500-year) floodplain.

## 2.2 EXISTING DRAINAGE FACILITIES

### 2.2.1 SURFACE DRAINAGE

The Kamehameha Highway existing hydrology was analyzed by subdividing the 0.4 miles of the considered segment of the roadway into smaller drainage areas using the crown of the roadway as a breaking point. An area east of the existing arch culvert by Ashley Road is impacted by 8.1 acres of offsite runoff. The roadway is flat with no drainage features on either side of the roadway. Another area being impacted by 22.3 acres of offsite runoff is located west of the existing arch culvert by Ashley Road, there are no drainage features along the road. The westbound side of the road starts sloping to a small degree mauka around Pohaku Loa Way. The roadway is impacted by 17.2 acres of offsite runoff. An area west of the Lauhulu Stream receives 2.25 acres of offsite runoff. Most of the runoff impacting the 0.4 miles of highway sheet flows towards Laniakea Beach or dissipates through some available slope shoulders around the existing bridge.

# 3 METHODOLOGY

The Project hydrologic, hydraulic, and storm drain design criteria follows the Hawaii Department of Transportation (HDOT) Highway Division Design Criteria for Highway Drainage summarized below. The primary goal of the analysis is to provide pre and post-development peaks flow for the 10-year, 25-year, 50-year, and 100-year event flow. The design recurrence interval selected in the analysis of existing and proposed drainage features follows the Hawaii Design Criteria for Highway Drainage. The drainage features shall be designed to convey the 50-year event flow.

The Federal Highway Administration (FHWA), Hydraulic Engineering Circular No. 22 (HEC-22), Urban Drainage Design Manual was used for runoff calculations. The Rational Method was selected as used, given as:

$$Q = (CIA)/Ku$$

where:

Q = Flow, cubic feet per second (cfs)

C = Dimensionless runoff coefficient, was determined as a function of the ground cover and a host of other hydrologic abstractions using equation $C = \Sigma (C_x A_x)/A_{total}$. It relates the estimated peak discharge to a theoretical maximum of 100% runoff. Values for C were based on Table 3.1 of the FHWA HEC-22 manual. In general:

Road C value = 0.95; Silty-clay soils with 0 to 3% slopes C value = 0.20.

I = Intensity o rainfall in inches per hour as determined by time of concentration ($T_c$). Rainfall intensity, duration, and frequency curves were available from the National Oceanic Atmospheric Administration (NOAA).

A = Drainage area, hectares, ha (acres)

Ku = Units conversion factor equal to 1.0 in English Units

Tc= Time required for water to flow from the most remote part of the drainage area to the outlet point under consideration. The minimum Tc shall be 10 minutes. The time of concentration was calculated as the sum of the travel times within the various consecutive flow segments.

Sheet flow is the shallow mass of runoff on a planar surface with a uniform depth across the sloping surface. This usually occurs at the headwater of streams over relatively short distances, rarely more than about 400 ft, and possibly less than 80 ft. Sheet flow is commonly estimated with a version of the kinematic wave equation, a derivative of Manning's equation, as follows:

$$T_{ti} = (K_u/I^{0.4})(nL/\sqrt{S})^{0.6}$$

where:

$T_{ti}$ = Sheet flow travel time, min

n = Roughness coefficient, concrete 0.013; grasses 0.20.

L = Flow length, ft

I = Rainfall intensity, in/hr

S = Surface slope, ft/ft

$K_u$ = Empirical coefficient equal to 0.933

Shallow Concentrated Flow Velocity. After short distances of at most 400 ft, sheet flow tends to concentrate in rills and then gullies of increasing proportions. Such flow is usually referred to as shallow concentrated flow. The velocity of such flow can be estimated using a relationship between velocity and slope as follows:

$$V = K_u \, k \, Sp^{0.5}$$

where:

$K_u$ = 3.28 in

V = Velocity, feet per second (fps)

k = Intercept coefficient. Paved area 0.619; Unpaved 0.491; Grassed waterway 0.457;
Short grass pasture 0.213

$S_p$ = Slope, percent

Open Channel and Pipe Velocity. Flow in gullies empties into channels or pipes. Open channels are assumed to begin where either the blue streamline shows on United States Geological Survey (USGS) quadrangle sheets or the channel is visible on aerial photographs. Cross-section geometry and roughness should be obtained for all channel reaches in the watershed. Manning's equation can be used to estimate average flow velocities in pipes and open channels as follows:

$$V = (K_u/n) \, R^{2/3} \, S^{1/2}$$

where:

n = Roughness coefficient

V = Velocity, fps

R = Hydraulic radius (defined as the flow area divided by the wetted perimeter), ft

S = Slope, ft/ft

Ku = Units conversion factor equal to 1.49

The Bentley Flow-Master application was used to calculate the channel flow velocity within the undeveloped vegetated areas on the project. The travel time is then calculated as follows:

$$T_{ti} = L / (60\ V)$$

where:

$T_{ti}$ = Travel time for Segment I, min

L = Flow length for Segment I, ft

V = Velocity for Segment I, fps

Assumptions inherent in the Rational formula are as follows:

• Peak flow occurs when the entire watershed is contributing to the flow.

• Rainfall intensity is the same over the entire drainage area.

• Rainfall intensity is uniform over a time duration equal to the time of concentration, $t_c$. The time of concentration is the time required for water to travel from the hydraulically most remote point of the basin to the point of interest.

• Frequency of the computed peak flow is the same as that of the rainfall intensity, i.e., the 10-year rainfall intensity is assumed to produce the 10-year peak flow.

• The coefficient of runoff is the same for all storms of all recurrence probabilities.

## 3.1 ANALYSIS RESULTS

The following tables show the peak flow results for the 0.4 miles of Kamehameha Highway in the vicinity of Laniakea Beach.

**Table 1 Existing Peak Flows**

| Existing Peak Flows (cfs) | | | |
|---|---|---|---|
| 10- year | 25-year | 50-year | 100-year |
| 53.2 | 66.0 | 75.6 | 82.4 |

The proposed peak flows are as follows:

**Table 2 Proposed Peak Flows**

| Proposed Peak Flows (cfs) | | | |
|---|---|---|---|
| 10- year | 25-year | 50-year | 100-year |
| 20.6 | 24.9 | 28.2 | 31.6 |

In addition, the 50-year Peak flow was selected to analyze and design the drainage features for the project. The offsite drainage will convey flows towards a system of ditches/berms. The analyzed proposed peak flows are as follows:

**Table 3 Offsite Proposed Peak Flow**

| Offsite<br>Proposed Peak Flows (cfs) |
|---|
| 50-year |
| 41.7 |

# 4 PROPOSED DRAINAGE SYSTEM RECOMMENDATIONS

## 4.1 PEDESTRIAN SAFETY ALIGNMENT

The Kamehama Highway Pedestrian Safety alignment will be designed with the highway tilted (reverse crown) towards vegetated swales located between the realigned highway and the pedestrian and bicycle path to provide water quality treatment. Some cross culverts will be required to convey roadway and offsite runoff. The hydrology and hydraulic calculation summary tables are provided in Appendix A. The proposed hydrology exhibit is provided in Appendix B.

# APPENDIX

# A CALCULATION SUMMARY TABLES

| Existing 10 yr | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DMA | AREA, Impervious (ac) | Area, Pervious (ac) | C | C, Pervious | Min Tc (min) | Sheet Flow Length(ft) | Shallow Flow Length(ft) | Channelized Flow Length (ft) | 10 min. Rainfall Intensity, in/hr. | Shallow Surface Slope (%) | Sheet Flow $K_u$ | Shallow Flow $K_u$ | Roughness Coefficient, n | Sheet Flow Travel Time,$T_{ti}$ (min) | Shallow Velocity (ft/s) | Shallow Flow Travel Time (min) | Channelized Velocity, ft/s | Channelized Tc (min) | Total Tc (min) | Rainfall Intensity (in/hr) | 10-yr Q (cfs) |
| A-1 | | 8.06 | | 0.20 | | 400 | 400 | 36 | 6.24 | 3.75 | 0.933 | 3.28 | 0.24 | 16.13 | 1.35 | 4.93 | 6.97 | 0.09 | 21.15 | 4.59 | 7.40 |
| A-2 | 0.15 | | 0.95 | | | | | | 6.24 | | | | | | | | | | | 6.24 | 0.87 |
| B | 0.15 | | 0.95 | | | | | | 6.24 | | | | | | | | | | | 6.24 | 0.87 |
| C-1 | | | | | | | | | 6.24 | | | | | | | | | | | | |
| C-2 | 0.05 | | 0.95 | | | | | | 6.24 | | | | | | | | | | | 6.24 | 0.29 |
| D | 0.05 | | 0.95 | | | | | | 6.24 | | | | | | | | | | | 6.24 | 0.29 |
| E | 0.32 | | 0.95 | | | | | | 6.24 | | | | | | | | | | | 6.24 | 1.88 |
| F-1 | | 11.28 | | 0.20 | | 400 | 400 | 49 | 6.24 | 9.3 | 0.933 | 3.28 | 0.24 | 14.29 | 2.13 | 3.13 | 6.97 | 0.12 | 17.53 | 4.96 | 11.19 |
| F-2 | 0.32 | | 0.95 | | | | | | 6.24 | | | | | | | | | | | 6.24 | 1.88 |
| G-1 | | 51.84 | | | | | | | 6.24 | | | | | | | | | | | | |
| G-2 | 0.02 | | 0.95 | | | | | | 6.24 | | | | | | | | | | | 6.24 | 0.12 |
| H | 0.02 | | 0.95 | | | | | | 6.24 | | | | | | | | | | | 6.24 | 0.12 |
| I-1 | | 17.15 | 0.95 | 0.20 | | 400 | 400 | 250 | 6.24 | 9.3 | 0.933 | 3.28 | 0.24 | 14.29 | 2.13 | 3.13 | 6.97 | 0.60 | 18.01 | 4.91 | 16.84 |
| I-2 | 0.42 | | 0.95 | | | | | | 6.24 | | | | | | | | | | | 6.24 | 2.46 |
| J | 0.69 | | 0.95 | | | | | | 6.24 | | | | | | | | | | | 6.24 | 4.10 |
| K-1 | | | | | | | | | 6.24 | | | | | | | | | | | | |
| K-2 | 0.05 | | 0.95 | | | | | | 6.24 | | | | | | | | | | | 6.24 | 0.30 |
| L | 0.05 | | 0.95 | | | | | | 6.24 | | | | | | | | | | | 6.24 | 0.30 |
| M-1 | | 2.25 | | 0.20 | | 400 | 400 | 250 | 6.24 | 10 | 0.933 | 3.28 | 0.24 | 13.84 | 2.21 | 3.02 | 6.97 | 0.60 | 17.46 | 4.97 | 2.24 |
| M-2 | 0.17 | | 0.95 | | | | | | 6.24 | | | | | | | | | | | 6.24 | 1.03 |
| N | 0.17 | | 0.95 | | | | | | 6.24 | | | | | | | | | | | 6.24 | 1.03 |
| | | | | | | | | | | | | | | | | | | | | | 53.19 |

| Existing 25 yr | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DMA | AREA, Impervious (ac) | Area, Pervious (ac) | C | C, Pervious | Min Tc (min) | Sheet Flow Length(ft) | Shallow Flow Length(ft) | Channelized Flow Length (ft) | 10 min. Rainfall Intensity, in/hr. | Shallow Surface Slope (%) | Sheet Flow $K_u$ | Shallow Flow $K_u$ | Roughness Coefficient, n | Sheet Flow Travel Time,$T_{ti}$ (min) | Shallow Velocity (ft/s) | Shallow Flow Travel Time (min) | Channelized Velocity, ft/s | Channelized Tc (min) | Total Tc (min) | Rainfall Intensity (in/hr) | 25-yr Q (cfs) |
| A-1 | 0 | 8.06 | | 0.20 | | 400 | 400 | 36 | 7.54 | 10 | 0.933 | 3.28 | 0.24 | 12.83 | 2.21 | 3.02 | 6.97 | 0.09 | 15.94 | 6.19 | 9.98 |
| A-2 | 0.15 | | 0.95 | | | | | | 7.54 | | | | | | | | | | | 7.54 | 1.05 |
| B | 0.15 | | 0.95 | | | | | | 7.54 | | | | | | | | | | | 7.54 | 1.05 |
| C-1 | 0 | | | | | | | | 7.54 | | | | | | | | | | | | |
| C-2 | 0.05 | | 0.95 | | | | | | 7.54 | | | | | | | | | | | 7.54 | 0.35 |
| D | 0.05 | | 0.95 | | | | | | 7.54 | | | | | | | | | | | 7.54 | 0.35 |
| E | 0.32 | | 0.95 | | | | | | 7.54 | | | | | | | | | | | 7.54 | 2.27 |
| F-1 | 0 | 11.28 | | 0.20 | | 400 | 400 | 49 | 7.54 | 9.3 | 0.933 | 3.28 | 0.24 | 13.24 | 2.13 | 3.13 | 6.97 | 0.12 | 16.49 | 6.12 | 13.80 |
| F-2 | 0.32 | | 0.95 | | | | | | 7.54 | | | | | | | | | | | 7.54 | 2.27 |
| G-1 | 0 | 51.84 | | | | | | | 7.54 | | | | | | | | | | | | |
| G-2 | 0.02 | | 0.95 | | | | | | 7.54 | | | | | | | | | | | 7.54 | 0.14 |
| H | 0.02 | | 0.95 | | | | | | 7.54 | | | | | | | | | | | 7.54 | 0.14 |
| I-1 | 0 | 17.15 | 0.95 | 0.20 | | 400 | 400 | 250 | 7.54 | 9.3 | 0.933 | 3.28 | 0.24 | 13.24 | 2.13 | 3.13 | 6.97 | 0.60 | 16.97 | 6.06 | 20.79 |
| I-2 | 0.42 | | 0.95 | | | | | | 7.54 | | | | | | | | | | | 7.54 | 2.97 |
| J | 0.69 | | 0.95 | | | | | | 7.54 | | | | | | | | | | | 7.54 | 4.96 |
| K-1 | 0 | | | | | | | | 7.54 | | | | | | | | | | | | |
| K-2 | 0.05 | | 0.95 | | | | | | 7.54 | | | | | | | | | | | 7.54 | 0.36 |
| L | 0.05 | | 0.95 | 0.20 | | | | | 7.54 | | | | | | | | | | | 7.54 | 0.36 |
| M-1 | 0 | 2.25 | | 0.20 | | 400 | 400 | 250 | 7.54 | 10 | 0.933 | 3.28 | 0.24 | 12.83 | 2.21 | 3.02 | 6.97 | 0.60 | 16.45 | 6.00 | 2.70 |
| M-2 | 0.17 | | 0.95 | | | | | | 7.54 | | | | | | | | | | | 7.54 | 1.24 |
| N | 0.17 | | 0.95 | | | | | | 7.54 | | | | | | | | | | | 7.54 | 1.24 |
| | | | | | | | | | | | | | | | | | | | | | 66.03 |

| Existing 50 yr | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DMA | AREA, Impervious (ac) | Area, Pervious (ac) | C | C, Pervious | Min Tc (min) | Sheet Flow Length(ft) | Shallow Flow Length(ft) | Channelized Flow Length (ft) | Rainfall Intensity, in/hr. | Shallow Surface Slope (%) | Sheet Flow $K_u$ | Shallow Flow $K_u$ | Roughness Coefficient, n | Sheet Flow Travel Time,$T_{ti}$ (min) | Shallow Velocity (ft/s) | Shallow Flow Travel Time (min) | Channelized Velocity, ft/s | Channelized Tc (min) | Total Tc (min) | Rainfall Intensity (in/hr) | 50-yr Q (cfs) |
| A-1 | 0 | 8.06 | | 0.20 | | 400 | 400 | 36 | 8.54 | 10 | 0.933 | 3.28 | 0.24 | 12.21 | 2.21 | 3.02 | 6.97 | 0.09 | 15.31 | 7.11 | 11.46 |
| A-2 | 0.15 | | 0.95 | | | | | | 8.54 | | | | | | | | | | | 8.54 | 1.19 |
| B | 0.15 | | 0.95 | | | | | | 8.54 | | | | | | | | | | | 8.54 | 1.19 |
| C-1 | 0 | | | | | | | | 8.54 | | | | | | | | | | | | |
| C-2 | 0.05 | | 0.95 | | | | | | 8.54 | | | | | | | | | | | 8.54 | 0.39 |
| D | 0.05 | | 0.95 | | | | | | 8.54 | | | | | | | | | | | 8.54 | 0.39 |
| E | 0.32 | | 0.95 | | | | | | 8.54 | | | | | | | | | | | 8.54 | 2.57 |
| F-1 | 0 | 11.28 | | 0.20 | | 400 | 400 | 49 | 8.54 | 9.3 | 0.933 | 3.28 | 0.24 | 12.60 | 2.13 | 3.13 | 6.97 | 0.12 | 15.85 | 7.03 | 15.86 |
| F-2 | 0.32 | | 0.95 | | | | | | 8.54 | | | | | | | | | | | 8.54 | 2.57 |
| G-1 | 0 | 51.84 | | | | | | | 8.54 | | | | | | | | | | | | |
| G-2 | 0.02 | | 0.95 | | | | | | 8.54 | | | | | | | | | | | 8.54 | 0.16 |
| H | 0.02 | | 0.95 | | | | | | 8.54 | | | | | | | | | | | 8.54 | 0.16 |
| I-1 | 0 | 17.15 | 0.95 | 0.20 | | 400 | 400 | 250 | 8.54 | 9.3 | 0.933 | 3.28 | 0.24 | 12.60 | 2.13 | 3.13 | 6.97 | 0.60 | 16.33 | 6.96 | 23.88 |
| I-2 | 0.42 | | 0.95 | | | | | | 8.54 | | | | | | | | | | | 8.54 | 3.37 |
| J | 0.69 | | 0.95 | | | | | | 8.54 | | | | | | | | | | | 8.54 | 5.61 |
| K-1 | 0 | | | | | | | | 8.54 | | | | | | | | | | | | |
| K-2 | 0.05 | | 0.95 | | | | | | 8.54 | | | | | | | | | | | 8.54 | 0.41 |
| L | 0.05 | | 0.95 | 0.20 | | | | | 8.54 | | | | | | | | | | | 8.54 | 0.41 |
| M-1 | 0 | 2.25 | | 0.20 | | 400 | 400 | 250 | 8.54 | 10 | 0.933 | 3.28 | 0.24 | 12.60 | 2.21 | 3.02 | 6.97 | 0.60 | 16.22 | 6.98 | 3.14 |
| M-2 | 0.17 | | 0.95 | | | | | | 8.54 | | | | | | | | | | | 8.54 | 1.41 |
| N | 0.17 | | 0.95 | | | | | | 8.54 | | | | | | | | | | | 8.54 | 1.41 |
| | | | | | | | | | | | | | | | | | | | | | 75.58 |

| Existing 100 yr | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DMA | AREA, Impervious (ac) | Area, Pervious (ac) | C | C, Pervious | Min Tc (min) | Sheet Flow Length(ft) | Shallow Flow Length(ft) | Channelized Flow Length (ft) | Rainfall Intensity, in/hr. | Shallow Surface Slope (%) | Sheet Flow $K_u$ | Shallow Flow $K_u$ | Roughness Coefficient, n | Sheet Flow Travel Time,$T_{ti}$ (min) | Shallow Velocity (ft/s) | Shallow Flow Travel Time (min) | Channelized Velocity, ft/s | Channelized Tc (min) | Total Tc (min) | Rainfall Intensity (in/hr) | 50-yr Q (cfs) |
| A-1 | 0 | 8.06 | | 0.20 | | 400 | 400 | 36 | 9.56 | 10 | 0.933 | 3.28 | 0.24 | 11.67 | 2.21 | 3.02 | 6.97 | 0.09 | 14.77 | 8.10 | 13.06 |
| A-2 | 0.15 | | 0.95 | | | | | | 9.56 | | | | | | | | | | | 9.56 | 1.33 |
| B | 0.15 | | 0.95 | | | | | | 9.56 | | | | | | | | | | | 9.56 | 1.33 |
| C-1 | 0 | | | | | | | | 9.56 | | | | | | | | | | | | |
| C-2 | 0.05 | | 0.95 | | | | | | 9.56 | | | | | | | | | | | 9.56 | 0.44 |
| D | 0.05 | | 0.95 | | | | | | 9.56 | | | | | | | | | | | 9.56 | 0.44 |
| E | 0.32 | | 0.95 | | | | | | 9.56 | | | | | | | | | | | 9.56 | 2.88 |
| F-1 | 0 | 11.28 | | 0.20 | | 400 | 400 | 49 | 9.56 | 9.3 | 0.933 | 3.28 | 0.24 | 12.04 | 2.13 | 3.13 | 6.97 | 0.12 | 15.29 | 7.95 | 17.93 |
| F-2 | 0.32 | | 0.95 | | | | | | 9.56 | | | | | | | | | | | 9.56 | 2.88 |
| G-1 | 0 | 51.84 | | | | | | | 9.56 | | | | | | | | | | | | |
| G-2 | 0.02 | | 0.95 | | | | | | 9.56 | | | | | | | | | | | 9.56 | 0.18 |
| H | 0.02 | | 0.95 | | | | | | 9.56 | | | | | | | | | | | 9.56 | 0.18 |
| I-1 | 0 | 17.15 | 0.95 | 0.20 | | 400 | 400 | 250 | 9.56 | 9.3 | 0.933 | 3.28 | 0.24 | 12.04 | 2.13 | 3.13 | 6.97 | 0.60 | 15.77 | 7.03 | 24.12 |
| I-2 | 0.42 | | 0.95 | | | | | | 9.56 | | | | | | | | | | | 9.56 | 3.77 |
| J | 0.69 | | 0.95 | | | | | | 9.56 | | | | | | | | | | | 9.56 | 6.28 |
| K-1 | 0 | | | | | | | | 9.56 | | | | | | | | | | | | |
| K-2 | 0.05 | | 0.95 | | | | | | 9.56 | | | | | | | | | | | 9.56 | 0.45 |
| L | 0.05 | | 0.95 | 0.20 | | | | | 9.56 | | | | | | | | | | | 9.56 | 0.45 |
| M-1 | 0 | 2.25 | | 0.20 | | 400 | 400 | 250 | 9.56 | 10 | 0.933 | 3.28 | 0.24 | 12.04 | 2.21 | 3.02 | 6.97 | 0.60 | 15.66 | 7.90 | 3.56 |
| M-2 | 0.17 | | 0.95 | | | | | | 9.56 | | | | | | | | | | | 9.56 | 1.57 |
| N | 0.17 | | 0.95 | | | | | | 9.56 | | | | | | | | | | | 9.56 | 1.57 |
| | | | | | | | | | | | | | | | | | | | | | 82.44 |

**Proposed -10yr**

| DMA | Total Area | Area, Impervious (ac) | Area, Pervious (ac) | C, Impervious | C, Pervious | Weighted C | Min Tc (min) | Sheet Flow Length(ft) | Channelized Flow Length (ft) | 10 minute Tc Rainfall Intensity, in/hr. | Sheet Surface Slope (ft/ft) | Sheet Flow $K_u$ | Roughness Coefficient, n | **Sheet Flow Travel Time,$T_{ti}$ (min)** | Channelized Velocity, ft/s | **Channelized Tc (min)** | **Total Tc (min)** | **Design Tc (min)** | **Design Intensity (in/hr)** | **10-yr Q (cfs)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.82 | 0.66 | 0.16 | 0.95 | 0.20 | 0.80 | 10 | 44 | 700 | 6.24 | 0.02 | 0.933 | 0.013 | 1.04 | 2.20 | 5.30 | 6.34 | 10 | 6.24 | 4.14 |
| 2 | 2.37 | 1.91 | 0.46 | 0.95 | 0.20 | 0.80 | 10 | 44 | 700 | 6.24 | 0.02 | 0.933 | 0.013 | 1.04 | 3.20 | 3.65 | 4.68 | 10 | 6.24 | 11.89 |
| 3 | 1.01 | 0.72 | 0.29 | 0.95 | 0.20 | 0.73 | 10 | 44 | 700 | 6.24 | 0.02 | 0.933 | 0.013 | 1.04 | 2.18 | 5.35 | 6.39 | 10 | 6.24 | 4.61 |
| | | | | | | | | | | | | | | | | | | | | **20.64** |

**Proposed -25yr**

| DMA | Total Area | AREA, Impervious (ac) | Area, Pervious (ac) | C | C, Impervious | Weighted C | Min Tc (min) | Sheet Flow Length(ft) | Channelized Flow Length (ft) | Rainfall Intensity, in/hr. | Sheet Surface Slope (ft/ft) | Sheet Flow $K_u$ | Roughness Coefficient, n | **Sheet Flow Travel Time,$T_{ti}$ (min)** | Channelized Velocity, ft/s | **Channelized Tc (min)** | **Total Tc (min)** | **Design Tc (min)** | **Design Intensity (in/hr)** | **25-yr Q (cfs)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.82 | 0.66 | 0.16 | 0.95 | 0.20 | 0.80 | 10 | 44 | 700 | 7.54 | 0.02 | 0.933 | 0.013 | 0.96 | 2.20 | 5.30 | 6.26 | 10 | 7.54 | 5.00 |
| 2 | 2.37 | 1.91 | 0.46 | 0.95 | 0.20 | 0.80 | 10 | 44 | 700 | 7.54 | 0.02 | 0.933 | 0.013 | 0.96 | 3.20 | 3.65 | 4.61 | 10 | 7.54 | 14.36 |
| 3 | 1.01 | 0.72 | 0.29 | 0.95 | 0.20 | 0.73 | 10 | 44 | 700 | 7.54 | 0.02 | 0.933 | 0.013 | 0.96 | 2.18 | 5.35 | 6.31 | 10 | 7.54 | 5.58 |
| | | | | | | | | | | | | | | | | | | | | **24.94** |

**Proposed -50yr**

| DMA | Total Area | AREA, Impervious (ac) | Area, Pervious (ac) | C | C, Impervious | Weighted C | Min Tc (min) | Sheet Flow Length(ft) | Channelized Flow Length (ft) | Rainfall Intensity, in/hr. | Sheet Surface Slope (ft/ft) | Sheet Flow $K_u$ | Roughness Coefficient, n | **Sheet Flow Travel Time,$T_{ti}$ (min)** | Channelized Velocity, ft/s | **Channelized Tc (min)** | **Total Tc (min)** | **Design Tc (min)** | **Design Intensity (in/hr)** | **50-yr Q (cfs)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.82 | 0.66 | 0.16 | 0.95 | 0.20 | 0.80 | 10 | 44 | 700 | 8.54 | 0.02 | 0.933 | 0.013 | 0.92 | 2.20 | 5.30 | 6.22 | 10 | 8.54 | 5.66 |
| 2 | 2.37 | 1.91 | 0.46 | 0.95 | 0.20 | 0.80 | 10 | 44 | 700 | 8.54 | 0.02 | 0.933 | 0.013 | 0.92 | 3.20 | 3.65 | 4.56 | 10 | 8.54 | 16.27 |
| 3 | 1.01 | 0.72 | 0.29 | 0.95 | 0.20 | 0.73 | 10 | 44 | 700 | 8.54 | 0.02 | 0.933 | 0.013 | 0.92 | 2.18 | 5.35 | 6.27 | 10 | 8.54 | 6.32 |
| | | | | | | | | | | | | | | | | | | | | **28.25** |

**Proposed -100yr**

| DMA | Total Area | AREA, Impervious (ac) | Area, Pervious (ac) | C | C, Impervious | Weighted C | Min Tc (min) | Sheet Flow Length(ft) | Channelized Flow Length (ft) | Rainfall Intensity, in/hr. | Sheet Surface Slope (ft/ft) | Sheet Flow $K_u$ | Roughness Coefficient, n | **Sheet Flow Travel Time,$T_{ti}$ (min)** | Channelized Velocity, ft/s | **Channelized Tc (min)** | **Total Tc (min)** | **Design Tc (min)** | **Design Intensity (in/hr)** | **100-yr Q (cfs)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.82 | 0.66 | 0.16 | 0.95 | 0.20 | 0.80 | 10 | 44 | 700 | 9.56 | 0.02 | 0.933 | 0.013 | 0.87 | 2.20 | 5.30 | 6.18 | 10 | 9.56 | 6.34 |
| 2 | 2.37 | 1.91 | 0.46 | 0.95 | 0.20 | 0.80 | 10 | 44 | 700 | 9.56 | 0.02 | 0.933 | 0.013 | 0.87 | 3.20 | 3.65 | 4.52 | 10 | 9.56 | 18.21 |
| 3 | 1.01 | 0.72 | 0.29 | 0.95 | 0.20 | 0.73 | 10 | 44 | 700 | 9.56 | 0.02 | 0.933 | 0.013 | 0.87 | 2.18 | 5.35 | 6.23 | 10 | 9.56 | 7.07 |
| | | | | | | | | | | | | | | | | | | | | **31.62** |

**Offsite Drainage - 50 year**

**Offsite Drainage**

| DMA | Total Area (ac) | Pervious Area (ac) | C | Min Tc (min) | Sheet Flow Length(ft) | Shallow Flow Length(ft) | Channelized Flow Length (ft) | 10 minute Rainfall Intensity, in/hr. | Shallow Surface Slope (%) | Sheet Flow $K_u$ | Shallow Flow $K_u$ | Sheet Flow Roughness Coefficient, n | **Sheet Flow Travel Time,$T_{ti}$ (min)** | Shallow Velocity (ft/s) | **Shallow Flow Travel Time (min)** | Channelized Velocity, ft/s | **Channelized Tc (min)** | **Total Tc (min)** | **Design Tc (min)** | **Design Intensity (in/hr)** | **50-yr Q (cfs)** | **Normal Depth Ditch Berm** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DA-1-A | 26 | 26.00 | 0.20 | 10 | 400 | 400 | 364 | 8.54 | 3.75 | 0.933 | 3.28 | 0.24 | 14.23 | 2.20 | 3.03 | 6.97 | 0.87 | 18.13 | 18.13 | 6.73 | 35.00 | 1.1 |
| DA-2-B | 3.9 | 3.90 | 0.20 | 10 | 400 | 200 | 18 | 8.54 | 9 | 0.933 | 3.28 | 0.24 | 6.67 | 2.20 | 1.52 | 7.97 | 0.04 | 8.22 | 10 | 8.54 | 6.66 | 0.6 |
| | | | | | | | | | | | | | | | | | | | | | **41.66** | |

**NOAA Atlas 14, Volume 4, Version 3**
**Location name: Haleiwa, Hawaii, USA***
**Latitude: 21.6217°, Longitude: -158.0815°**
**Elevation: 17.42 ft****
* source: ESRI Maps
** source: USGS

**POINT PRECIPITATION FREQUENCY ESTIMATES**

S. Perica, D. Martin, B. Lin, T. Parzybok, D. Riley, M. Yekta, L. Hiner, L.-C. Chen, D. Brewer, F. Yan, K. Maitaria, C. Trypaluk, G. M. Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

## PF tabular

**PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]**

| Duration | Average recurrence interval (years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | 4.10 (3.62-4.67) | 5.47 (4.85-6.31) | 7.13 (6.34-8.20) | 8.41 (7.43-9.71) | 10.2 (8.83-11.8) | 11.5 (9.84-13.4) | 12.9 (10.8-15.1) | 14.3 (11.6-16.8) | 16.2 (12.6-19.3) | 17.6 (13.3-21.3) |
| 10-min | 3.05 (2.69-3.46) | 4.06 (3.59-4.68) | 5.29 (4.70-6.07) | 6.24 (5.50-7.19) | 7.54 (6.55-8.72) | 8.54 (7.29-9.94) | 9.56 (7.99-11.2) | 10.6 (8.62-12.5) | 12.0 (9.35-14.3) | 13.1 (9.84-15.8) |
| 15-min | 2.55 (2.25-2.90) | 3.40 (3.01-3.92) | 4.42 (3.93-5.08) | 5.22 (4.61-6.02) | 6.31 (5.48-7.30) | 7.15 (6.10-8.32) | 8.00 (6.68-9.36) | 8.87 (7.22-10.5) | 10.0 (7.83-12.0) | 11.0 (8.24-13.2) |
| 30-min | 1.80 (1.58-2.04) | 2.39 (2.12-2.76) | 3.11 (2.77-3.58) | 3.68 (3.24-4.24) | 4.44 (3.86-5.14) | 5.03 (4.30-5.85) | 5.63 (4.70-6.59) | 6.24 (5.08-7.36) | 7.06 (5.51-8.42) | 7.71 (5.80-9.28) |
| 60-min | 1.18 (1.04-1.34) | 1.57 (1.39-1.81) | 2.05 (1.82-2.35) | 2.42 (2.13-2.79) | 2.92 (2.54-3.38) | 3.31 (2.83-3.85) | 3.71 (3.10-4.34) | 4.11 (3.34-4.84) | 4.65 (3.62-5.54) | 5.07 (3.81-6.11) |
| 2-hr | 0.815 (0.714-0.932) | 1.10 (0.972-1.27) | 1.44 (1.27-1.65) | 1.70 (1.50-1.96) | 2.06 (1.78-2.38) | 2.34 (1.99-2.72) | 2.61 (2.18-3.07) | 2.90 (2.36-3.43) | 3.29 (2.57-3.94) | 3.59 (2.70-4.35) |
| 3-hr | 0.614 (0.536-0.706) | 0.847 (0.753-0.976) | 1.11 (0.987-1.27) | 1.31 (1.16-1.51) | 1.59 (1.38-1.84) | 1.80 (1.54-2.10) | 2.02 (1.69-2.36) | 2.24 (1.82-2.64) | 2.53 (1.98-3.02) | 2.76 (2.08-3.33) |
| 6-hr | 0.399 (0.347-0.459) | 0.538 (0.477-0.621) | 0.712 (0.631-0.818) | 0.846 (0.743-0.970) | 1.02 (0.887-1.18) | 1.16 (0.989-1.34) | 1.30 (1.08-1.51) | 1.43 (1.17-1.69) | 1.62 (1.26-1.93) | 1.76 (1.32-2.12) |
| 12-hr | 0.240 (0.206-0.277) | 0.328 (0.290-0.377) | 0.443 (0.393-0.509) | 0.534 (0.469-0.614) | 0.656 (0.568-0.758) | 0.750 (0.639-0.871) | 0.845 (0.704-0.988) | 0.942 (0.765-1.11) | 1.07 (0.835-1.28) | 1.17 (0.881-1.41) |
| 24-hr | 0.140 (0.121-0.161) | 0.195 (0.169-0.224) | 0.270 (0.234-0.312) | 0.330 (0.284-0.382) | 0.411 (0.352-0.479) | 0.475 (0.404-0.556) | 0.541 (0.457-0.637) | 0.610 (0.511-0.722) | 0.704 (0.582-0.841) | 0.778 (0.636-0.937) |
| 2-day | 0.081 (0.070-0.093) | 0.112 (0.097-0.128) | 0.153 (0.132-0.176) | 0.185 (0.160-0.213) | 0.228 (0.196-0.264) | 0.261 (0.223-0.304) | 0.294 (0.250-0.344) | 0.329 (0.277-0.387) | 0.374 (0.312-0.444) | 0.410 (0.337-0.490) |
| 3-day | 0.059 (0.052-0.068) | 0.081 (0.071-0.093) | 0.110 (0.096-0.127) | 0.133 (0.115-0.153) | 0.162 (0.140-0.187) | 0.184 (0.158-0.214) | 0.207 (0.176-0.241) | 0.229 (0.194-0.269) | 0.259 (0.216-0.306) | 0.282 (0.233-0.336) |
| 4-day | 0.049 (0.042-0.055) | 0.066 (0.058-0.075) | 0.089 (0.078-0.102) | 0.106 (0.093-0.122) | 0.129 (0.112-0.149) | 0.146 (0.126-0.169) | 0.163 (0.139-0.189) | 0.180 (0.152-0.210) | 0.202 (0.169-0.237) | 0.218 (0.181-0.259) |
| 7-day | 0.032 (0.028-0.036) | 0.043 (0.038-0.049) | 0.057 (0.050-0.065) | 0.068 (0.059-0.078) | 0.082 (0.071-0.094) | 0.092 (0.079-0.106) | 0.102 (0.087-0.118) | 0.112 (0.095-0.130) | 0.124 (0.104-0.146) | 0.134 (0.111-0.158) |
| 10-day | 0.025 (0.022-0.028) | 0.033 (0.029-0.038) | 0.044 (0.039-0.051) | 0.052 (0.045-0.060) | 0.062 (0.054-0.072) | 0.070 (0.060-0.081) | 0.077 (0.066-0.090) | 0.084 (0.072-0.098) | 0.093 (0.078-0.110) | 0.100 (0.083-0.118) |
| 20-day | 0.016 (0.014-0.018) | 0.021 (0.019-0.024) | 0.028 (0.024-0.032) | 0.033 (0.028-0.037) | 0.039 (0.033-0.044) | 0.043 (0.037-0.050) | 0.047 (0.040-0.055) | 0.051 (0.043-0.060) | 0.056 (0.047-0.066) | 0.059 (0.049-0.070) |
| 30-day | 0.012 (0.011-0.014) | 0.016 (0.014-0.019) | 0.021 (0.019-0.024) | 0.025 (0.022-0.029) | 0.029 (0.026-0.034) | 0.033 (0.028-0.038) | 0.036 (0.031-0.042) | 0.039 (0.033-0.046) | 0.043 (0.036-0.051) | 0.046 (0.038-0.054) |
| 45-day | 0.010 (0.009-0.011) | 0.013 (0.011-0.015) | 0.017 (0.015-0.019) | 0.020 (0.017-0.023) | 0.023 (0.020-0.027) | 0.026 (0.022-0.030) | 0.028 (0.024-0.033) | 0.031 (0.026-0.036) | 0.034 (0.028-0.040) | 0.036 (0.030-0.042) |
| 60-day | 0.009 (0.008-0.010) | 0.011 (0.010-0.013) | 0.015 (0.013-0.017) | 0.017 (0.015-0.019) | 0.020 (0.017-0.023) | 0.022 (0.019-0.025) | 0.024 (0.021-0.028) | 0.026 (0.022-0.030) | 0.028 (0.024-0.033) | 0.030 (0.025-0.036) |

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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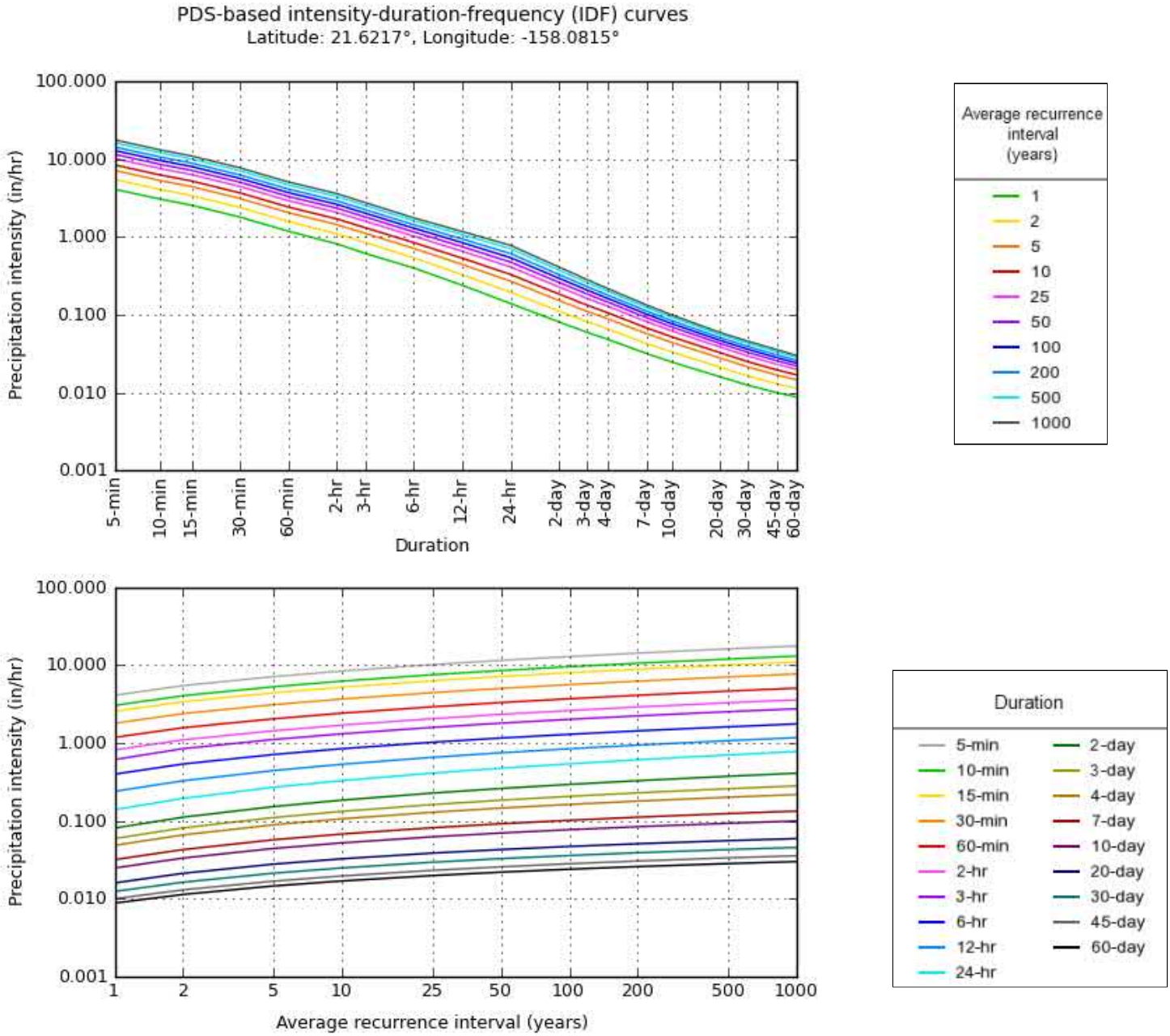
## PF graphical

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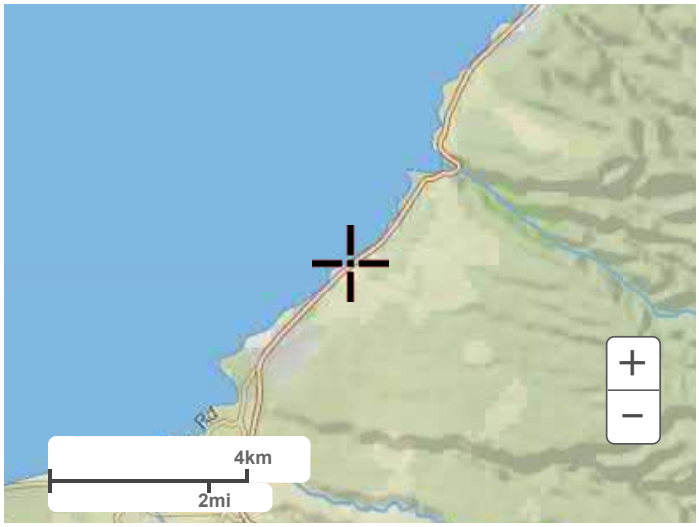
## Maps & aerials

**Small scale terrain**

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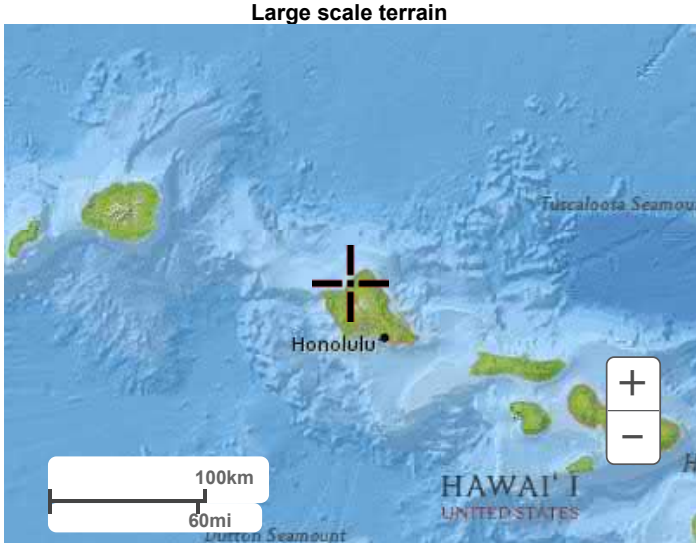


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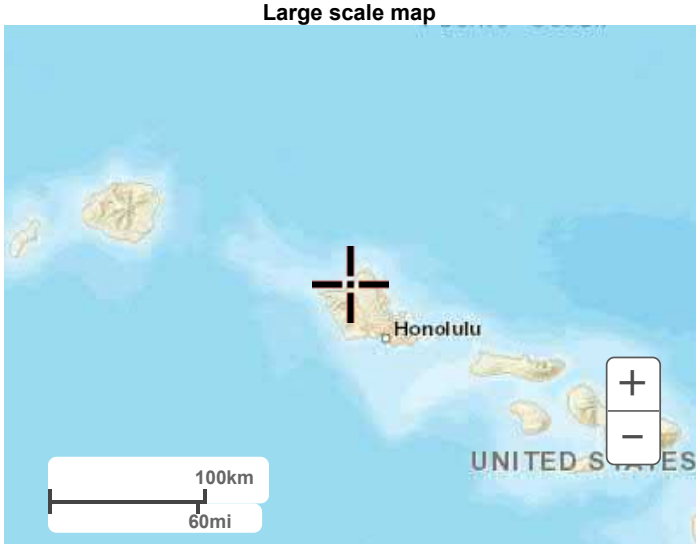


**Large scale aerial**

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Silver Spring, MD 20910
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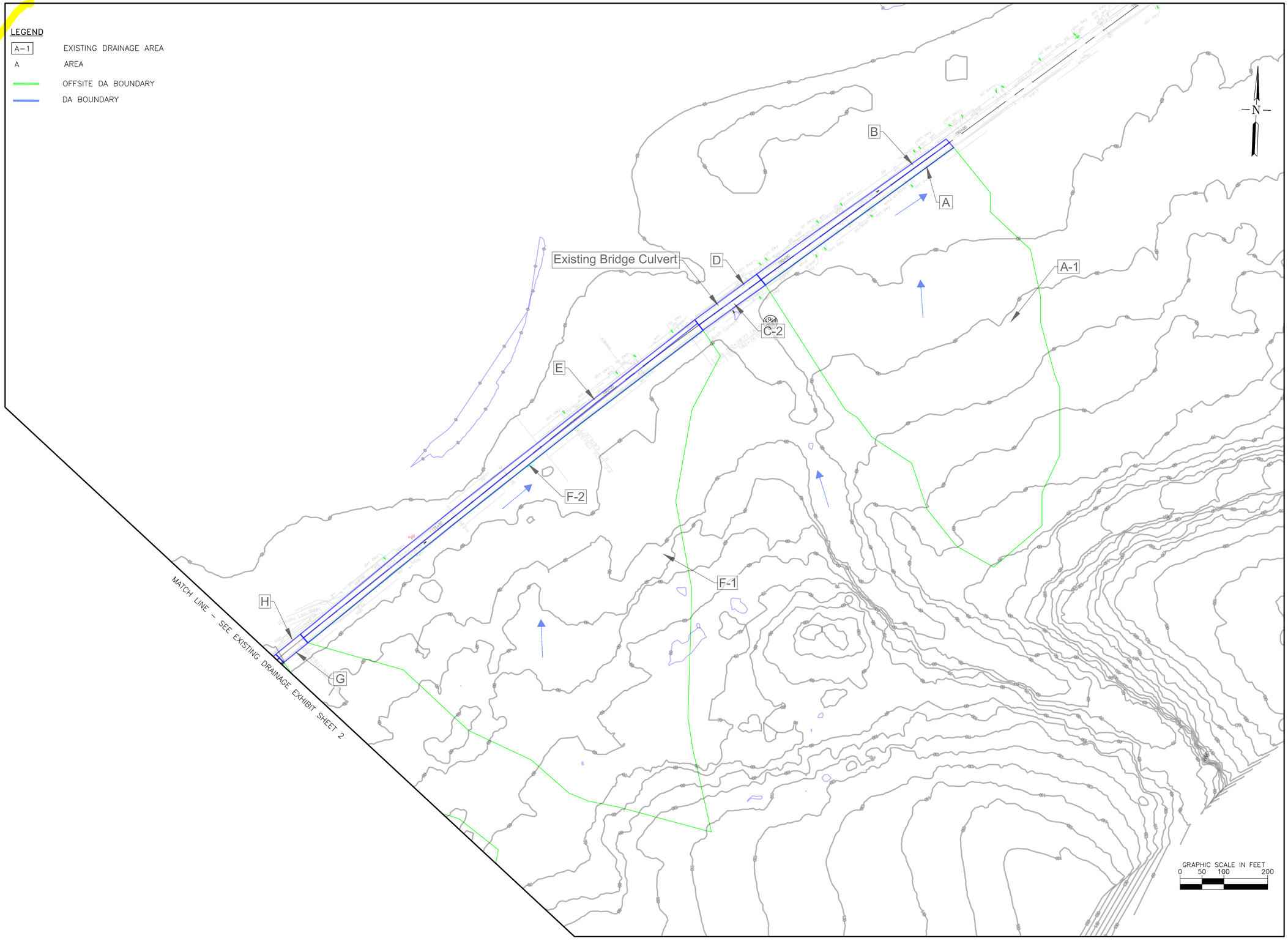
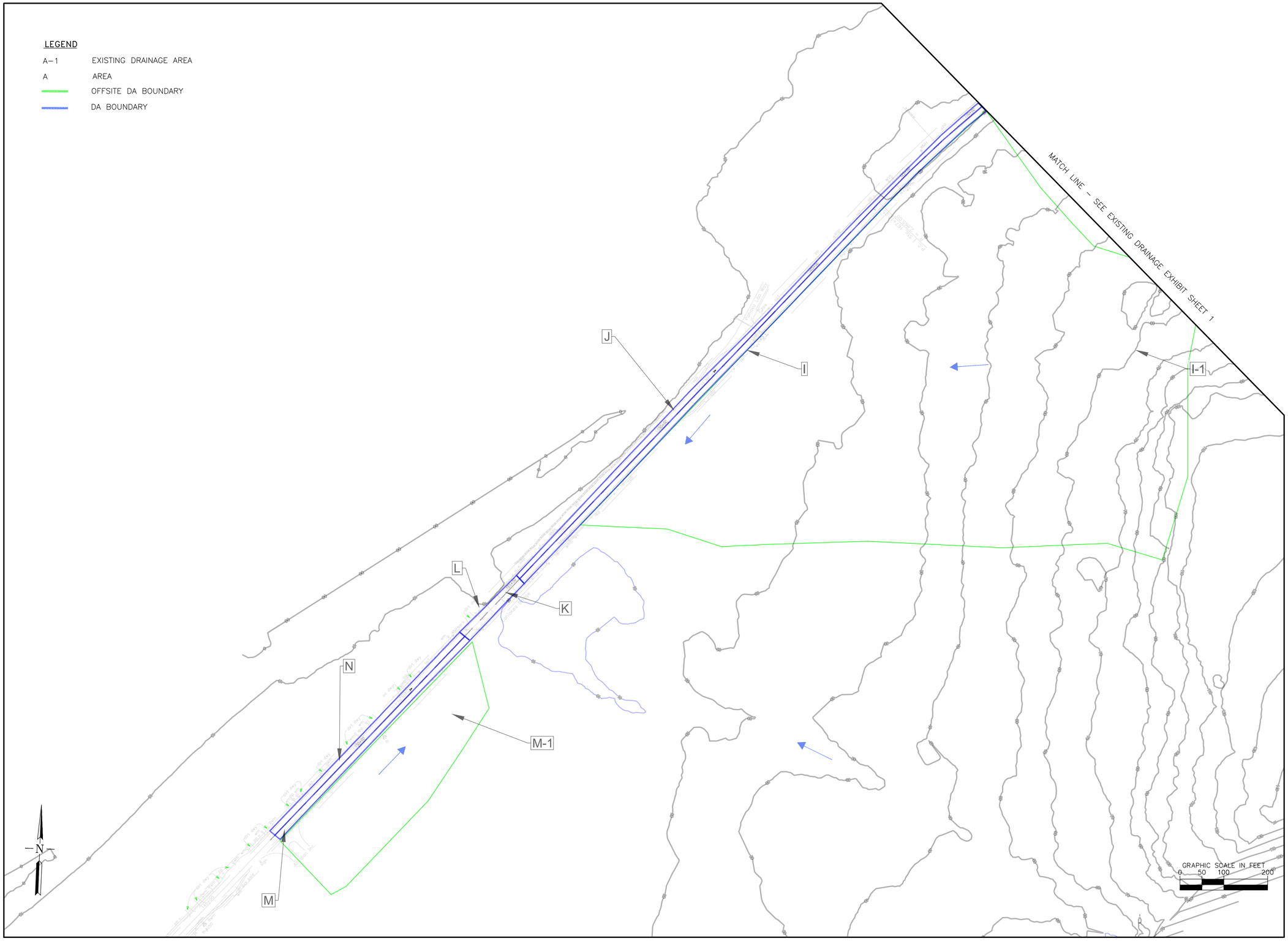
# B EXISTING HYDROLOGY EXHIBIT

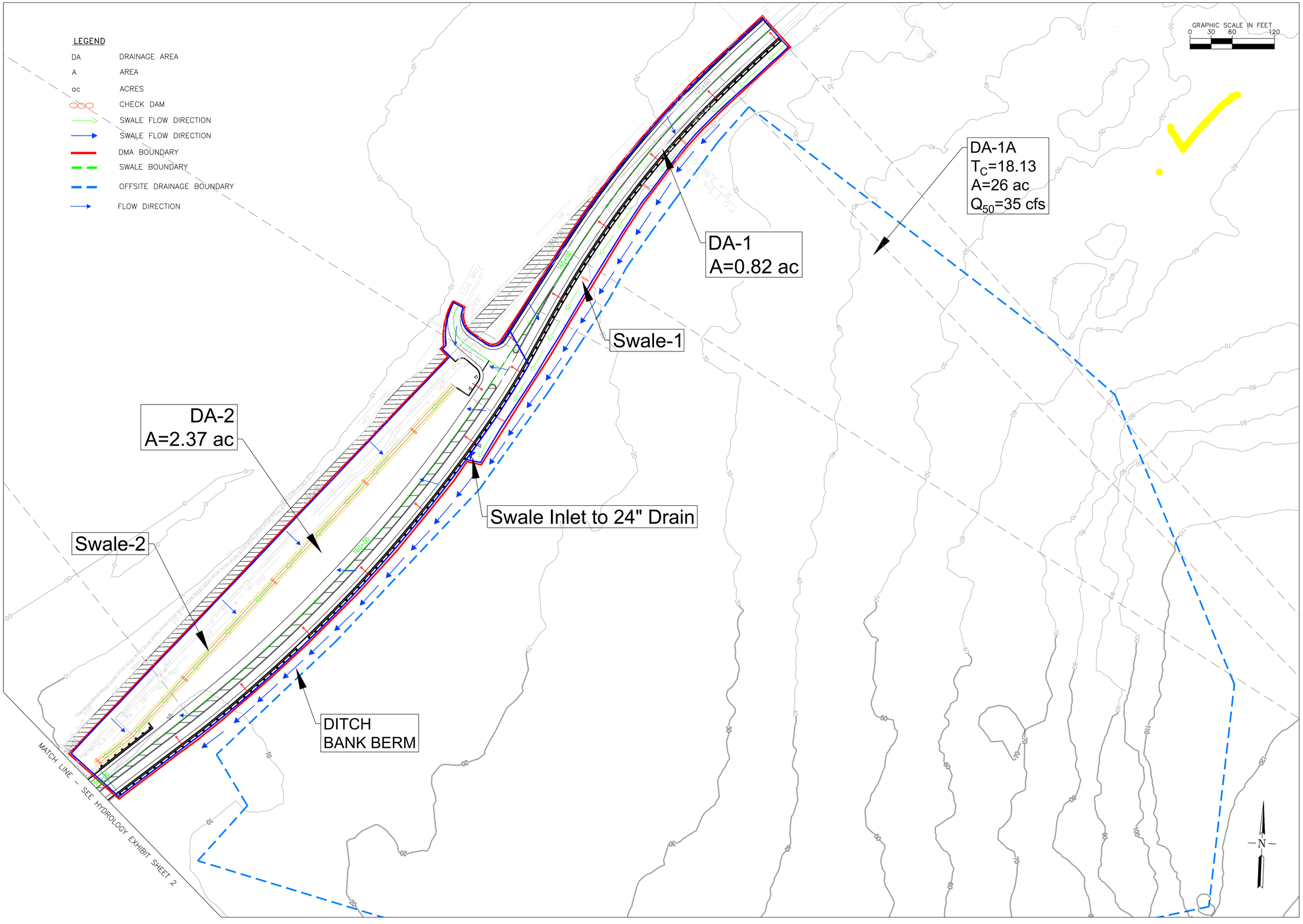



EXISTING DRAINAGE
EXHIBIT SHEET 1

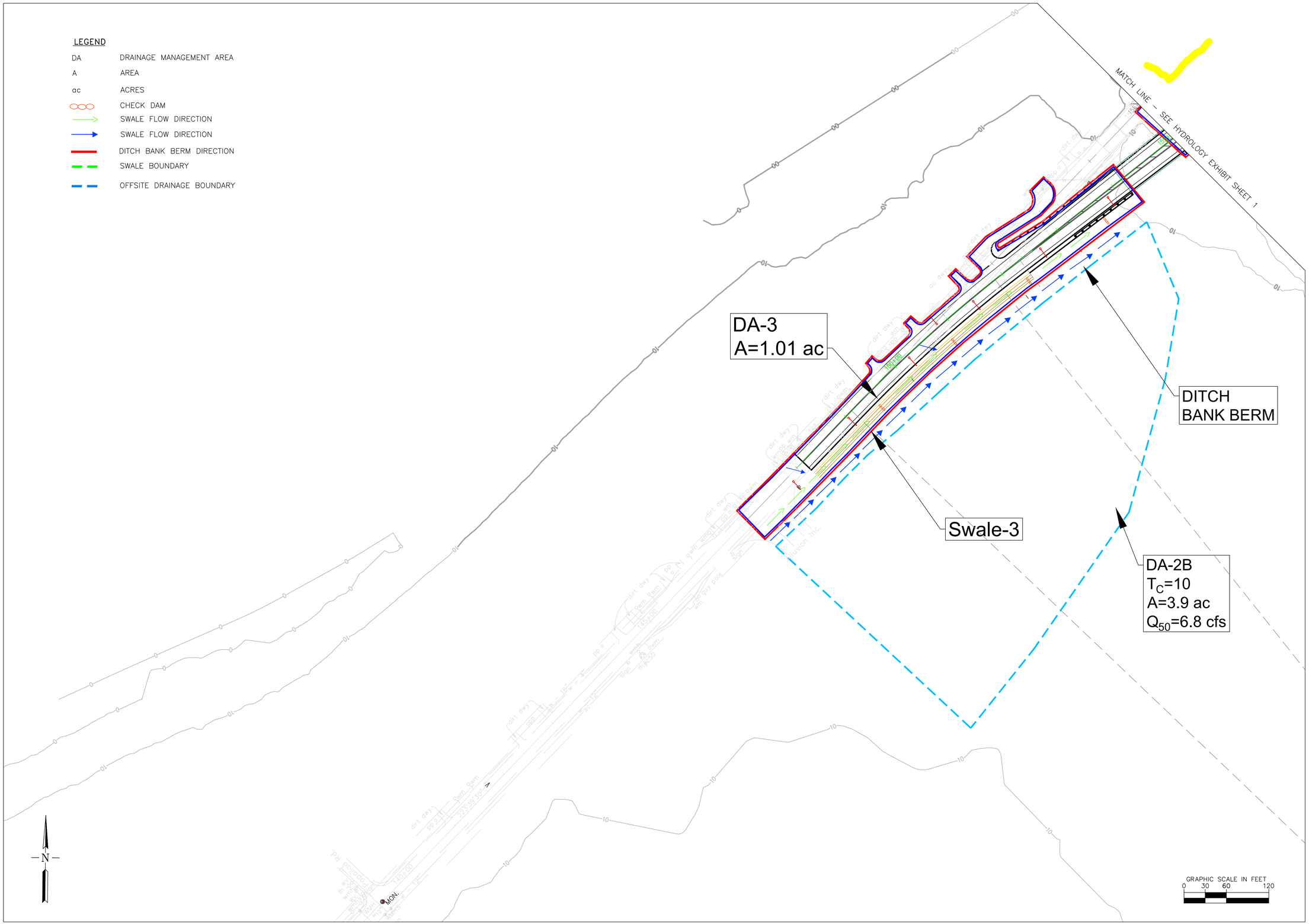



EXISTING DRAINAGE EXHIBIT SHEET 2

# C PROPOSED HYDROLOGY EXHIBITS




PEDESTRIAN SHIFT
HYDROLOGY
EXHIBIT 1




PEDESTRIAN SHIFT
HYDROLOGY
EXHIBIT 2

Appendix

# H

# Visual and Aesthetic Resources Technical Report

- TECHNICAL REPORT

# *Kamehameha Highway Pedestrian Safety Project*
# *Vicinity of Laniakea Beach*
# *Visual and Aesthetic Resources*

*Haleiwa, Island of Oahu, Hawaii*

*April 2021*

Prepared for:
State of Hawaii
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813

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## Acronyms, Abbreviations, and Translations

| | |
|---|---|
| AVE | Area of Visual Effect |
| CZM | Coastal Zone Management |
| DLNR | Hawaii Department of Land and Natural Resources |
| EA | Environmental Assessment |
| FHWA | Federal Highway Administration |
| HDOT | Hawaii State Department of Transportation |
| Mauka | Mountain Side |
| Makai | Ocean Side |
| ROH | Revised Ordinances of Honolulu |
| Project | Kamehameha Highway Pedestrian Safety Project, Vicinity of Laniakea Beach |
| SMA | Shoreline Management Area |
| TSM | Transportation System Management |

# EXECUTIVE SUMMARY

This Visual and Aesthetic Resources Technical Report provides an assessment of changes in visual resources, visual character, and visual quality as a result of the proposed Kamehameha Highway Pedestrian Safety Project, Vicinity of Laniakea Beach. This assessment uses the U.S. Department of Transportation Federal Highway Administration's *Guidelines for the Visual Impact Assessment of Highway Projects* to evaluate changes to the natural, human, and project environments and how those changes would be perceived by viewers. (FHWA 2015)

The project and the viewers that may be impacted are discussed below; however, in general, proposed visual elements would be consistent and compatible with existing conditions. The project would have similar visual characteristics such as vegetation, materials, colors, form, height, and shape as the existing Kamehameha Highway. Thus, viewers would generally not experience adverse negative impacts and the project would blend visually with the existing natural, human, and project environments.

This technical report identifies the existing visual conditions of the natural, human, and project environments within the project study area. Information provided will inform the evaluation of options and will be used during the project's environmental review phase.

# CHAPTER 1
# INTRODUCTION

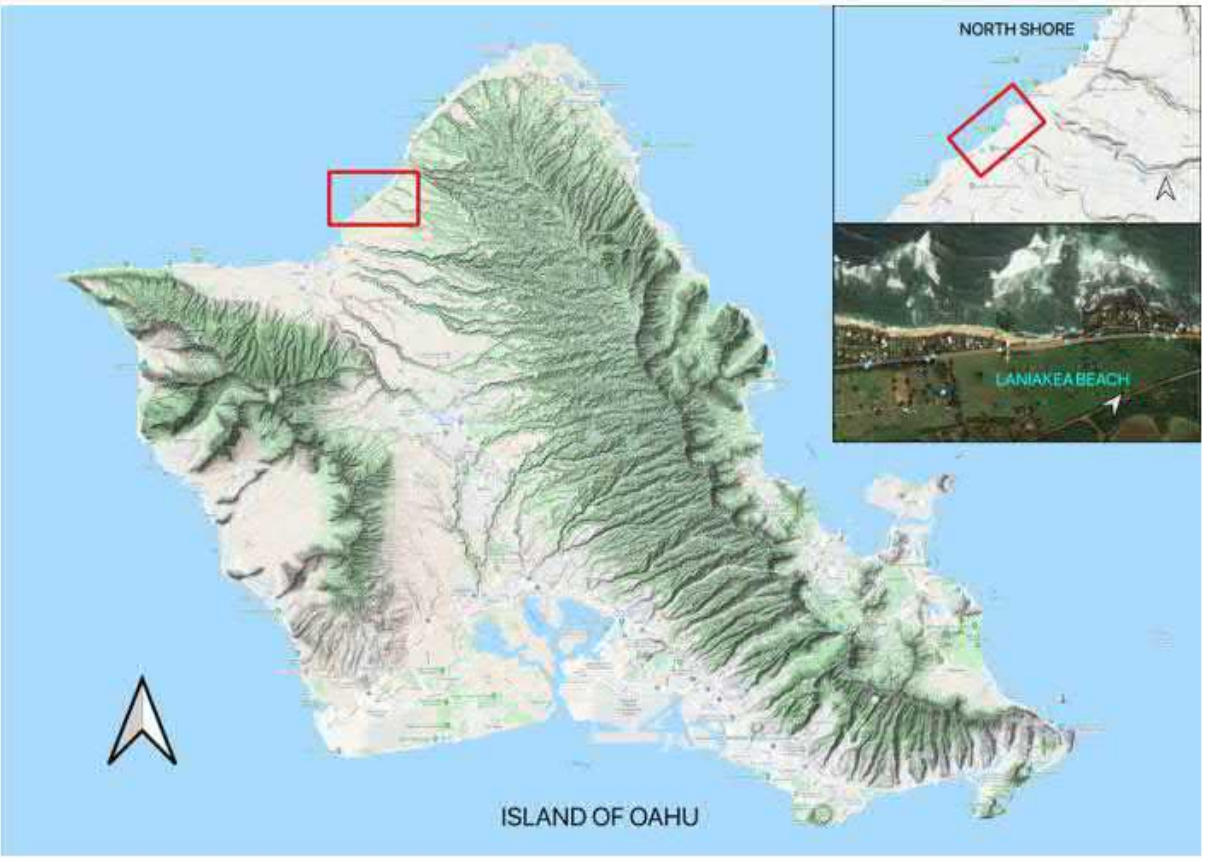
## 1.1 OVERVIEW

Coastal erosion is a perennial threat to various sections of Kamehameha Highway. The Hawaii Department of Transportation 2003 Statewide Highway Shoreline Protection Study identified the project area because of overtopping waves and stormwater run-off undercutting the boulder escarpment and beginning to undermine the highway within the right-of-way fronting Laniakea Beach (Figure 1-1).

In 2012, HDOT began various efforts to start evaluating alternatives and gathering input to an EA by multiple parties and stakeholders. The proposed project was to be paid for with federal and state funds designated to prevent erosion and keep the highway operational. However, during the discussions, the community emphasized their frustration with the congestion created by people parking on the mauka side of the highway and crossing to see the turtles that rest on the beach. Various meetings and conversations were had, but it was difficult to gain momentum considering any one alternative, and variations of the alternatives were provided by community members and groups. HDOT put public outreach efforts on hold while internally considering all the information that had been received throughout such efforts.

On August 1, 2019, a child was struck by a car on Kamehameha Highway and badly injured as he ran across the highway. HDOT prioritized the project, decided to use only State funds and changed the project's purpose and need to focus on pedestrian safety.

**Figure 1-1. Project Location Map**




## 1.2 PURPOSE OF TECHNICAL REPORT

This Visual and Aesthetic Resources Technical Report was developed to assess potential visual impacts resulting from the construction and operation of four roadway alternatives. It follows the abbreviated visual impact assessment approach within the U.S. Department of Transportation Federal Highway Administration's (FHWA) *Guidelines for the Visual Impact Assessment of Highway Projects* (FHWA 2015).

This report identifies the viewer groups that would see the changes to the visual environment, documents how they would perceive those changes to the visual environment, and assesses whether it would result in changes to the existing visual quality of the area. This technical report also suggests how changes to the visual environment may be mitigated to reduce negative changes in visual quality and enhance the visual experience of travelers and neighbors. The project components would be seen by: motorists traveling along the Kamehameha Highway (Route 83) and local roads; pedestrians and bicyclists; and neighbors and community members.

# CHAPTER 2
# PROJECT DESCRIPTION

This section summarizes the regulatory context of the project, identifies the project's Area of Visual Effect (AVE), summarizes coordination and data sources, and describes the methodology used to assess impacts to visual quality and aesthetic resources.

## 2.1 REGULATIONS, CRITERIA, AND GUIDELINES

The following summarizes the federal, state, regional, and local regulatory context for this visual impact assessment.

### 2.1.1 Federal

The project will not use federal funding and will not be required to complete FHWA's *Guidelines for the Visual Impact Assessment of Highway Projects* (FHWA 2015). However, these guidelines, referred to as the "FHWA guidelines," are a broadly-accepted approach to analyzing visual impacts, particularly for transportation projects, and will be utilized to assess visual impacts for the project. The FHWA guidelines use changes in visual character and viewer group sensitivity to assess changes in visual quality. For this project, an abbreviated visual impact assessment generally following FHWA guidelines was conducted because:

- The project is not expected to result in a notable change in the physical characteristics of the existing environment.
- The project would be expected to be compatible with the existing visual character.
- Based on public engagement activities to date, there has been a low level of local concern regarding the project's visual components.
- Conventional mitigation such as landscaping and aesthetic treatments are expected to address visual changes.
- No adverse cumulative impacts are anticipated.

### 2.1.2 State

The following is the state regulatory context for this abbreviated visual impact assessment:

- **Hawaii Environmental Policy Act Chapter 343-5, Revised Statues**. A policy to that requires review of projects due to use of state or county lands and the use of state funds.

- **Hawaii Department of Health Administrative Rules Title 11, Chapter 200.1**. A the "Environmental Impact Statement Rules" for the State of Hawaii.
- **Hawaii Revised Statutes Chapter 205A, Coastal Zone Management (CZM)**. A policy to protect, preserve, and where desirable, restore, the quality of coastal scenic and open space resources. http://dlnr.hawaii.gov/occl/files/2013/07/205a.pdf
- **Special Management Area Regulations.** The authority established by the State's CZM program, but the City & County of Honolulu separately administer the Shoreline Management Area (SMA), which the project will trigger. HRS 205A-26 (1)(D) requires that the local authority review:

  "Alterations to existing land forms and vegetation, except cross, and construction of structures shall cause minimum adverse effect to water resources and scenic and recreational amenities……"

### 2.1.3 Regional

The following is the regional regulatory context for this abbreviated visual impact assessment:

- **Revised Ordinances of Honolulu Chapter 25** sets the City's objectives and review procedures for the SMA permit (see link below). The permit review guidelines point back to the objectives and policies set in HRS 205A-26 (see quoted policy above). https://www.honolulu.gov/rep/site/ocs/roh/ROH_Chapter_25_article_1_12.pdf
- **North Shore Sustainable Community Plan**, dated May 2011. Section 3.1.2.7 contains guidelines and policies for "Scenic Resources and Scenic Views" on the North Shore. http://www.honoluludpp.org/Portals/0/pdfs/planning/NorthShore/NSSCP_May_2011.pdf

## 2.2 ESTABLISHMENT PHASE

Using FHWA guidelines, the visual impact assessment process is carried out in four phases: Establishment, Inventory, Analysis, and Mitigation. The primary purpose of the establishment phase is to define the AVE or the study area. The AVE is the area that can be seen from the project (limits of human sight), which is influenced by the physical constraints of landform, land cover, and atmospheric conditions (FHWA 2015). The establishment phase also sets an understanding of the character of the proposed project.

### 2.2.1 Area of Visual Effects

As described below, the AVE for the project considered visual distance zones and existing physical limitations. Additionally, a desktop analysis and field visit was conducted to understand the limits of visibility from the project limits.

Some views of the project are static and are what a neighbor would see from a single stationary location. Other views are dynamic and refer to a series of views available as a viewer travels through a landscape. Dynamic views are directional and can be quite different for viewers traveling in different directions. Dynamic views are also affected by whether a viewer is a driver whose primary focus is on driving or a passenger who has more discretion to look in other directions.

#### *2.2.1.1 Visual Distance Zones*

In general, there are three distance zones:

- Foreground: Comprises views from 0.0 mile to 0.25 mile. Changes to the visual environment are mostly discernible in this zone. Foreground views tend to be the most affected by changes in visual quality and views are generally not limited by atmospheric conditions. For the purposes of this technical report, impacts will primarily focus on viewers within the foreground distance zone.
- Middle ground: Comprises views from 0.25 mile to 5.0 miles. In this zone, most views are greatly reduced by landform (hills and mountains) and land cover (such as buildings, structures, signage, and other physical objects), as well as existing vegetation that limits the line-of-sight for viewers. In the middle ground, changes in visual details are generally not discernible. A small number of viewers on ridges above the elevation of the highway may have views of the project from the middle ground distance zone; however, viewer numbers will be small and visual details are generally not discernible in this zone. Atmospheric conditions typical of the island, including low clouds, fog, and precipitation, can further obscure visual elements.
- Background: Comprises views beyond 5.0 miles. Few, if any, viewers in the background distance zone would have unobstructed views of the project and project details and changes to visual quality would generally not be discernible from this distance. Land form, land cover, and existing vegetation are expected to completely obscure the site. Furthermore, atmospheric conditions would easily affect or obscure any available views from the background distance zone.

#### *2.2.1.2 Physical Constraints*

The highway corridor in the foreground is characterized by two lanes of asphalt pavement and shoulders of varying width, existing bridges over intermittent streams, signage, and at times, heavy vehicular traffic and congested parking on roadway shoulders. The coastal plain where the highway is located is generally 0.25 to 0.5 miles wide. Bluffs rising from the plain can be very steep and generally range from 100 to 250 feet in elevation. They are periodically cut by streams with steep side slopes. The bluffs block most views to the south and east of the highway corridor, including views of the scenic Koolau Mountains and the Ewa Forest Reserve.

The existing highway road grade along the coastal plain in the project area varies between approximately five and fifteen feet in elevation. The highway is lined with broadleaf trees, palm trees, and undergrowth typical of tropical Pacific Islands. The highway rises slightly north of Waimea Bay and offers more extended views; however, due to the rolling hills, bluffs, and existing vegetation, the project site is not visible from this location. Similarly, residential areas in the Pupukea community are located on the bluffs above the coastal plain and potentially have more extended views but views of the project are obscured by landform and vegetation.

Views of the project site are primarily limited to the foreground viewing zone.

### 2.2.2 Landscape Units and Visual Character

The AVE of a project is divided into distinct geographic units called Landscape units, or "outdoor rooms." (FHWA 2015) . Each landscape unit has a unique visual character, viewers, and visual quality that can be conceived of as a spatially defined landscape with a distinctive visual identity. Because the Kamehameha Highway project has a fairly consistent visual quality common throughout the project area, it would generally be considered as one Landscape Unit; however, a culturally sensitive area east of the project site may attract users who may be more sensitive to changes in visual quality; therefore, two landscape units will be considered:

- Kamehameha Highway
- Cultural Site

#### *2.2.2.1 Kamehameha Highway*

Areas of ranch land on the coastal plain on the mauka side of the highway, particularly in the vicinity of the proposed project, offer open views south and east of the highway toward the bluffs, and are characterized by pasture, fencing, and areas of common coastal vegetation (See Figure 2-1). Land cover, such as human-made structures, exist but is dispersed and generally not visible from the highway.

**Figure 2-1. Typical Existing Mauka Side View from Kamehameha Highway in the Project Area**

Periodic scenic beach and open ocean views are available on the makai side of the highway, including views at Laniakea Beach, which lies within the project limits. Generally, however, the makai side of the highway is characterized by human-made features and existing vegetation. Human-made features consist of one or two-story residential building structures with open and opaque fencing and gates of varying materials. These structures are typified by wood/vinyl siding, stucco, natural stone veneers, concrete, metal, glass, bright colors. (See Figure 2-2)

Indoor and outdoor electrical lighting is commonly visible from the highway corridor. Overhead utility lines are common within the highway corridor and can be on both the makai and the mauka sides of the highway.

**Figure 2-2. Typical Existing Makai Side View from Kamehameha Highway in the Project Area**

### *2.2.2.2 Cultural Site*

A culturally sensitive site lies north and east of the project site along Kamehameha Highway. It is located on bluffs above the highway and overlooks Laniakea Beach. It has views extending both north and south into the middle and background distance zones; however, most views of the highway and human-made residential and commercial structures from the site are obscured by vegetation and the gently rolling terrain. (See Figure 2-3).

**Figure 2-3. Typical Existing Cultural Site View**

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# CHAPTER 3
# INVENTORY PHASE

The inventory phase examined the existing visual quality, or what people like or dislike seeing. It described the existing affected environment and visual character and the affected population or existing viewers, as presented in the following sections.

## 3.1 AFFECTED ENVIRONMENT

The affected environment is the existing visual character of the AVE. It can be assessed based on an inventory of visual resources divided into the natural, human, and project environments. (FHWA 2015)

- Natural: Land, water, vegetation, animals, and atmospheric conditions (devoid of build environment) determines the natural environments. Viewers evaluate if the environment is harmonious or inharmonious.
- Human: Buildings, infrastructure, structures, artifacts, and art determines human environments. Viewers evaluate if the environment is orderly or disorderly.
- Project: Constructed elements, grading, vegetation, and ancillary visual elements associated with the project development. Viewers evaluate if the environment is coherent or incoherent.

The natural, human, and project environments were assessed for each landscape unit and are presented below in Table 3-1.

**Table 3-1. Affected Environment of the AVE**

| Landscape Unit | Description of Activity |
|---|---|
| Kamehameha Highway | |
| Natural | Land within the AVE of the highway ranges from 5 to 15 feet in elevation. Available views are primarily limited to the coastal plain with bluffs limiting views south and east; however, views in most locations are contained by trees, palms, coconut trees, and tropical vegetation lining the roadway. Natural elements such as native and ornamental landscaping are associated with human development on the makai side of the highway except where the road is located close to the beach and views of the ocean and beach are available. Laniakea and Kawailoa beaches offer scenic and natural visual elements. The mauka side is also characterized by natural and ornamental vegetation but vegetation visible from the highway is not typically in a natural condition. Open pastures exist in some locations that offer and longer views but are also limited by the bluffs. |
| Human | The Human AVE should be considered rural residential and ranchland. Residential structures on the makai side are typically one to two stories with both open and opaque fencing along the highway. Views from the highway are typically of garages and the back of buildings. Ranch buildings (residences, barns, sheds, etc.) on the mauka side of the highway are not typically visible from the road. |

| | |
|---|---|
| Project | The project component is the existing two-lane highway and paved and unpaved shoulders. Grades on both the mauka and makai side are generally with 12”-24” of the road grade and include shallow drainage swales in some locations. At Laniakea beach riprap retains the area under Kamehameha Highway for approximately 24”-36” below the road grade and then drops directly onto the beach. Overhead utility lines are on poles located on the mauka or makai sides or in some cases both sides. Road signs are generally limited to speed limit, no parking, or other small-scale signs. |
| Cultural Site | |
| Natural | The natural environment of this AVE includes gently rolling hills, bluffs, and views of the ocean. Natural visual elements include trees, palms, understory vegetation, and stone outcroppings. Views are also available of the mountains south of Haleiwa in the background distance zone. |
| Human | No modern human-made elements exist on the cultural site; however, portions of structures can be seen through vegetation in the foreground and middle distance zones and lights from residential structures can be seen during nighttime hours. |
| Project | Only very small patches of the existing roadway are visible from the Cultural Site through the existing vegetation. Overhead utility lines are visible in some locations. Street lights can also be seen in some locations during nighttime hours. |

## 3.2 AFFECTED POPULATION

Viewers can generally be categorized into two distinct groups: neighbors and travelers. Both travelers and neighbors may be further subdivided to establish viewer preference and their sensitivity to changes in visual resources (FHWA 2015). Although each viewer will have individual preferences and sensitivities, FHWA guidelines recognize three basic responses to visual environments:

- When viewing the natural environment, viewers evaluate the natural harmony of the existing scene, determining if the composition is harmonious or inharmonious.
- When viewing the human environment, viewers evaluate the human order, determining if the composition is orderly or disorderly.
- When viewing the project environment, viewers evaluate the coherence of the project components, determining if the project’s composition is coherent or incoherent.

### 3.2.1 Types of Neighbors

Neighbors are viewers who typically view the project from a stationary location (see Table 3-2 below for details). Viewsheds are static and affected by landform and land cover. The AVEs for this project include the following types of neighbors (FHWA 2015):

- **Residential**: Residential neighbors include single-family residences located along the highway. Their visual preference tends toward maintaining existing landscape character and they are not generally interested in change. Depending on location, residential viewers prefer natural harmony and human order. The majority of viewers and human-made structures with views of project alternatives are residential.

- **Recreational**: Recreational neighbors participate in recreation and/or cultural activities and tend to be transitory. Their visual preference tends to be the status quo and they are leery of changes that may cause adverse impacts to their activity, although they may be willing to entertain improvements if they improve or enhance the recreational experience. Recreational viewers prefer natural harmony with some project coherence.
- **Commercial/Retail**: Commercial and Retail neighbors are merchants or shoppers that sell goods or services to the public. A small number of structures adjacent to the highway would be considered Commercial/Retail. Ranching, farming, or other non-residential neighbors south and east of the highway would also be considered commercial neighbors and would prefer some project coherence and order.

**Table 3-2. Affected Neighbors**

| | Affected Population within the AVE | Visual Preference |
|---|---|---|
| Landscape Unit | | |
| Kamehameha Highway | Commercial / Retail | Project Coherence, Human Order |
| | Residential | Human Order, Natural Harmony |
| Cultural Site | Purposeful Users | Natural Harmony, Project Coherence |

### 3.2.2 Types of Travelers

Travelers are viewers who typically view as they move along a corridor, such as a road or a highway (see Table 3-3 below for details). Viewsheds are dynamic and change as a series of views reveals different views. Foreground, middle ground, and background views continuously change at different rates depending on the speed of the traveler. The AVEs for the landscape units include the following types of travelers (FHWA 2015):

- **Pedestrian**: Pedestrians use self-propelled means (walking, wheelchair, or other mobility aid) to move through a site on roadways, sidewalks, or trails. Pedestrians have a slight preference for human order over natural harmony and project coherence. A limited number of pedestrians use the highway shoulders and transit stops located within the project.
- **Bicycling**: Bicycles or other similar self-propelled devices travel through a site at a higher speed than pedestrians but much slower than vehicular travel. Bicyclists also have a slight preference for project coherence.
- **Motoring**: Motorists travel in vehicles propelled by engines such as cars, trucks, buses, or motorcycles. A variety of engine types, sizes, and fuel sources help propel travelers at higher speeds in comparison to other modes. Drivers primarily focus on activities associated with

driving and prefer project coherence. Passengers are typically less engaged with driving tasks and prefer natural harmony and human harmony.

**Table 3-3. Affected Travelers**

| | Affected Population within the AVE | Visual Preference |
|---|---|---|
| Landscape Unit | | |
| Kamehameha Highway | Motorist – Local | Project Coherence, Human Order |
| | Bicycling/Pedestrian | Project Coherence, Human Order |
| Cultural Site | Pedestrian | Project Coherence, Human Order |

## 3.3 EXISTING VISUAL QUALITY

This section describes how professional judgment was applied to describe what viewers within each AVE for the project components would be expected to like and dislike about the existing environment and their perceptions of visual quality.

### 3.3.1 Kamehameha Highway

Figure 3-1 is a photograph of Kamehameha Highway looking northeast at Laniakea Beach. The terrain is relatively flat along the highway corridor. As shown, the natural environment is natural vegetation and landscaping associated with the roadway. Trees and vegetation on the makai side of the road line the beach or are located on residential properties (residential structures are not visible in the photograph). Vegetation lines most of the roadway on the mauka side; however, some ranch land pastures open up to the roadway where views extend south and east to the bluffs. The limited natural environment is harmonious, especially at Laniakea Beach where views of the beach and ocean are available from the highway.

The human environment is primarily residential properties along the makai side of the road and ranch lands on the mauka side. Viewer expectations are consistent along the highway. The project environment includes the two-lane highway and associated shoulders. Both the human and project environments become cluttered and non-coherent near Laniakea Beach as cars park along the shoulders. Traffic slows and congestion can be high at times.

Table 4-1, shown later in this document, describes the affected populations within Kamehameha Highway.

**Figure 3-1. Kamehameha Highway – Existing Street View**

### 3.3.2 Cultural Site

Figure 2-3 is a photograph from the Cultural Site looking south toward Haleiwa showing the existing conditions. The Cultural Site is located on a bluff overlooking the coastal plain and ocean. The natural environment is characterized by rolling hills, bluffs, trees, palms, tropical vegetation, and rock outcroppings. While ranchlands are common, taller vegetation obscures most open pastures. The vegetation and bluffs also entirely obscure most visual elements of the mostly flat highway corridor.

The Cultural Site is located on private property and gated. Limited access can be provided from Ashley Road approximately 200' northeast of the site. Access is regulated and allowed at the landowner's discretion, so the number of neighbors and travelers would be very small. Vegetation obscures most views of the human environment but some distant (middle ground) views of structures, overhead utility lines, and other human-made elements of the human environment are visible. Similarly, existing vegetation obscures most views of the project environment except screened views of the distant highway.

# CHAPTER 4
# VISUAL ANALYSIS

This section describes the visual changes anticipated to occur as a result of the project and specifically any changes to the overall visual quality of the AVE. Impacts to visual quality are discussed in terms of visual compatibility of proposed improvements, viewer sensitivity, direct impacts, activities during construction, and the resulting visual quality. The visual analysis will also include indirect and cumulative impacts in the next section.

## 4.1 PROJECT ALTERNATIVES

The project has identified four Alternatives for evaluation: 1) No Build Alternative, 2) Transportation System Management (TSM) which includes installing a guardrail or other type of barrier in accordance with all laws and regulations, 3) No Build Settlement Alternative which involves involves crosswalks and allowing cars to park on the mauka side of the highway, and 4) the Pedestrian Shift Alternative which moves to the road approximately 80 feet mauka. Each project alternative will have impacts on the natural, human and project visual environment.

## 4.2 NO BUILD ALTERNATIVE

The No Build Alternative would retain the existing road alignment in its existing condition and configuration. No improvements beyond routine operations and maintenance would be constructed / performed as part of the Kamehameha Highway corridor at this location.

**Figure 4-1. Typical Section – Existing Conditions / No Build Alternative**

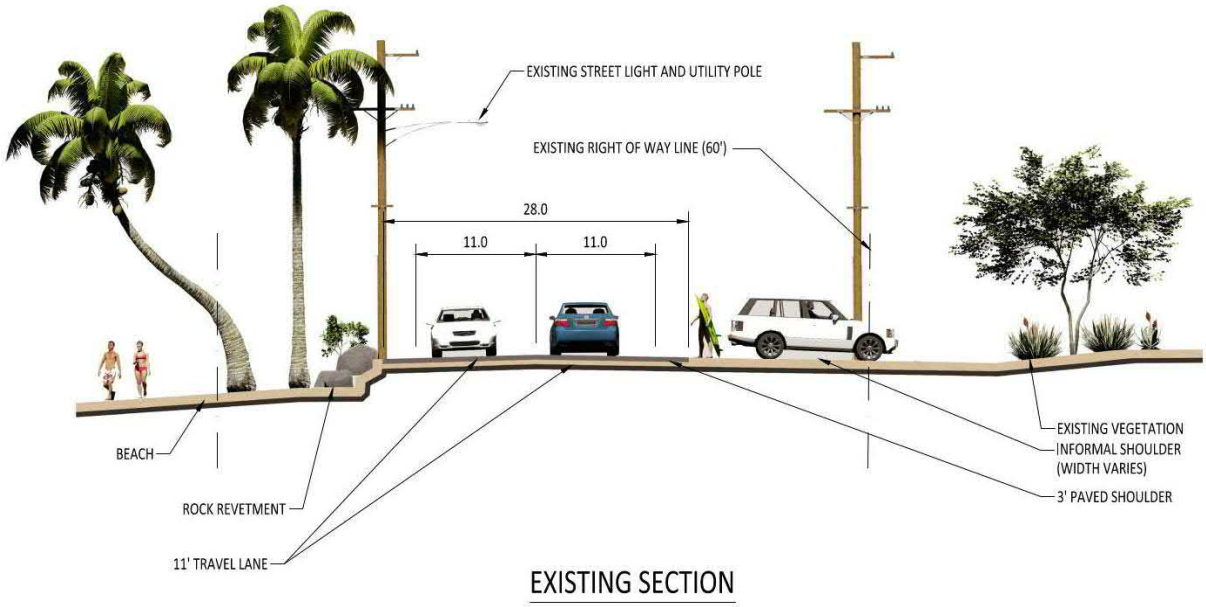



**Figure 4-2. Plan View – Existing Conditions / No Build Alternative**

### 4.2.1 Visual Compatability

There would be no change to the existing project scale, form, material, or visual character associated with the No Build Alternative.

**Table 4-1. Viewer Sensitivity – No Build Alternative**

| Viewer Type | Exposure | Awareness | Distance | Overall Sensitivity |
|---|---|---|---|---|
| Kamehameha Highway | | | | |
| Residential / Commercial | Low numbers of residential structures are located behind opaque fences, gates, and vegetation. | Attention and focus would not change in visual conditions. Views are of long duration and have become routine. | Due to the proximity of some residential viewers, as close as 20 feet from existing highway pavement, sensitivity would generally be high but most views are obscured by fences and vegetation. | Moderate |
| Motorist | High numbers of viewers utilize the highway corridor. The overall visual experience of motorists would not change. | Drivers and passengers would not experience a change in visual conditions. Views would be of short duration as motorists travel through the site. | Travelers would use roadways within the project limits. The posted speed is 35 miles per hour. | Low |
| Bicycle / Pedestrian | No formal bicycle or pedestrian facilities are provided along the existing highway corridor. The number of pedestrians traveling to Laniakea Beach can be high at times. They will not experience a change to the visual environment within the project AVE. | Bicyclists and pedestrians will not experience a change in visual conditions. Views would be of short duration. | Bicyclists and pedestrians would use the existing roadways within the project limits. | Low |
| Cultural Site | | | | |
| Recreational | The Cultural Site is located on private property and gated with restricted access from Ashley Road. Existing trees, brush, and vegetation currently obscure all but distant views of the highway outside project limits. The number of recreational viewers at the Cultural Site would be very small. | Views are scenic but not protected. Views would be of short duration but would not change with this alternative. Attention and focus on scenic conditions would not change. | Recreational viewers would be within the foreground to middle ground proximity zones of project limits. | Low |

### 4.2.2 Direct Impacts

There would be no change to the visual quality as the existing roadway would remain in place. Viewer exposure and awareness will not change and visual conditions for highway travelers, pedestrians, bicyclists, and neighbors would remain the same. The existing natural, human, and project environments will be compatible with the existing conditions; however, vehicle congestion, traffic conflicts, and unsafe pedestrian conditions would persist.

### 4.2.3 Construction Impacts

No construction would be associated with the No Build alternative.

### 4.2.4 Visual Quality

There would be no change to visual quality with the No Build alternative. The overall impact on visual quality would be neutral for both Highway and Cultural site neighbors and travelers.

## 4.3 NO BUILD SETTLEMENT ALTERNATIVE

The No Build Settlement Alternative was designed in response to a lawsuit that was brought against HDOT by a group of North Shore residents, activists, and surfers over the placement of barriers along the mauka side of Kamehameha Highway in 2014. A settlement was reached between the City and County of Honolulu (City), HDOT, and the litigants.

The settlement involves allowing cars to park on the mauka side of the highway to access Laniakea Beach, and will install guardrails and crosswalks along Kamehameha Highway. Cars will enter the parking area on the Haleiwa side and will exit on the Waimea side. In addition, the City will move a cattle fence on its property mauka of the highway so that cars have room to maneuver and park. The agreement prohibits the large tour buses and vans that often shuttle tourists to Laniakea Beach from stopping there. The settlement agreement calls for a one-year trial period, but there is no deadline for the changes to take place. During the trial period, the performance of the No Build Settlement will be evaluated for its impacts on, safety, traffic, and accessibility. HDOT is not responsible for implementing this alternative and no schedule has been provided to the community.

This alternative would result in an uninproved area that would provide space for roughly 50-60 passenger cars on the mauka side of Kamehameha Highway.

**Figure 4-3. Typical Section – No Build Settlement Alternative**

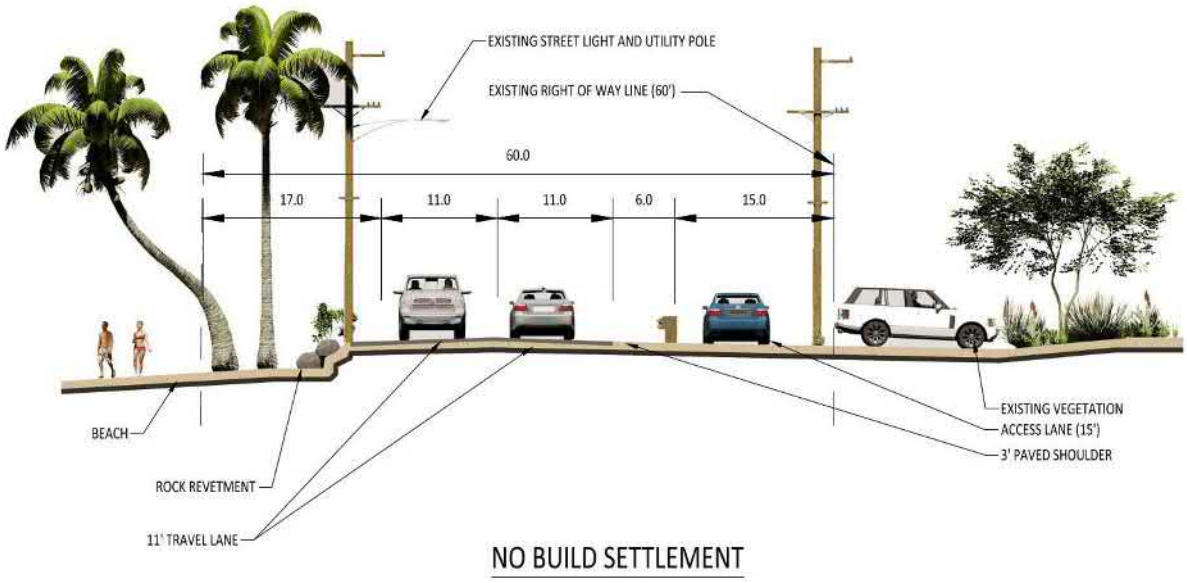
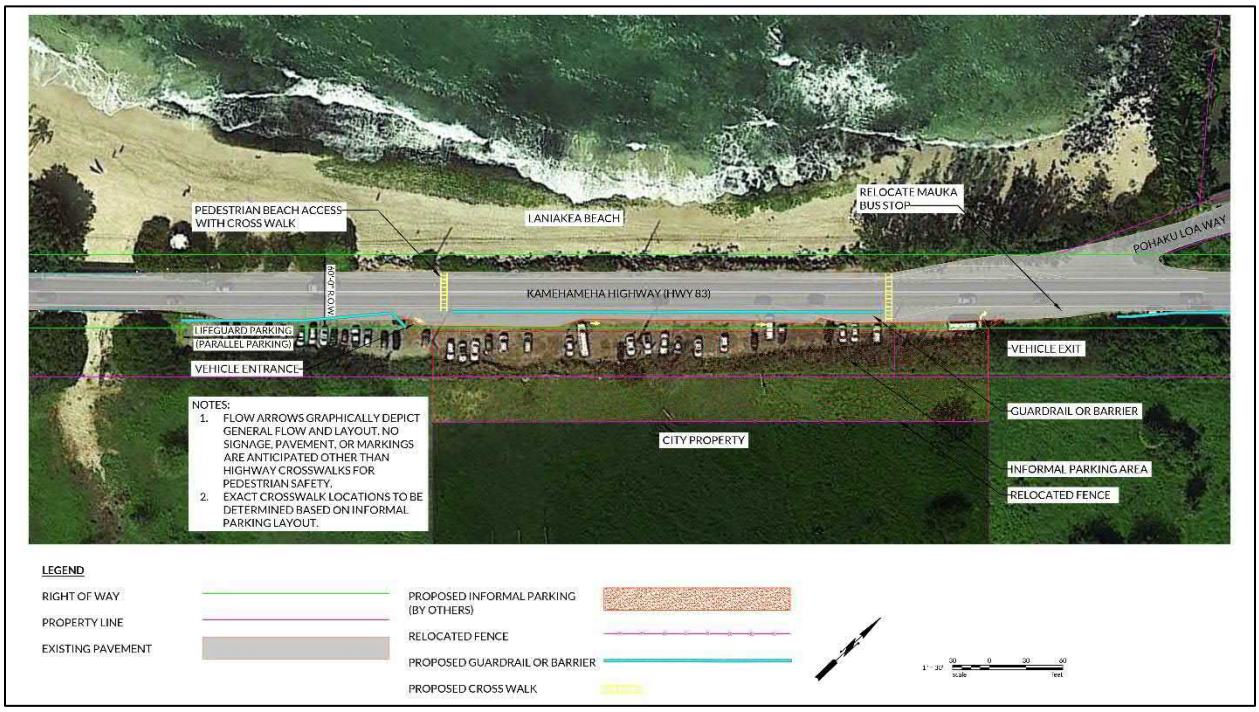



**Figure 4-4. Plan View – No Build Settlement Alternative**




## 4.3.1 Visual Compatability

No change is proposed to the form or material of the roadway but this alternative would construct approximately 700 feet of guardrails, expand the informal parking area on the mauka side of the highway

on City-owned property, and add crosswalks within the immediate vicinity of Laniakea Beach. Additionally, existing transit stops will be moved to accommodate the guardrail and informal parking. All new roadway and auxiliary features are common visual elements within the existing Kamehameha Highway corridor and would be compatible with the scale, form, materials, and character of the existing visual environment. Existing elements of parked cars and pedestrians would remain but the guardrails and crosswalks would reduce vehicular conflicts and improve pedestrian safety.

While adding guardrails, crosswalks, and expanding the informal parking near Laniakea Beach would change the size and scale of the existing visual elements, they are all common materials within the Kamehameha Highway corridor. The proposed No Build Settlement Alternative and associated guardrail would be compatible with existing visual conditions.

**Table 4-2. Viewer Sensitivity – No Build Settlement Alternative**

| | Exposure | Awareness | Distance | Overall Sensitivity |
|---|---|---|---|---|
| Kamehameha Highway | | | | |
| Neighbor: Residential / Commercial | A low number of residences would have direct views; however, fencing and vegetation would obscure most views of the guardrail. Views of congested parking would be partially obscured by the guardrail. | Attention and focus would not change in visual conditions. Static views would be of long duration and would become routine. | Due to the proximity of some residential viewers, as close as 50 feet from the proposed guardrail, sensitivity would generally be high but most views are obscured by fences and vegetation. | Moderate |
| Traveler: Motorist | High numbers of viewers utilize the highway corridor. The overall visual experience of motorists would be similar to existing conditions. The project's visual environment would be consistent with their expectations. | Motorists would primarily be focused on driving and would have short-duration dynamic views. Passengers may be more aware but would also have short-duration views. | Travelers would use roadways within the project limits. The posted speed is 35 miles per hour. | Low |
| Traveler: Bicycle / Pedestrian | No formal bicycle or pedestrian facilities are provided along the existing highway corridor. The visual environment would benefit from crosswalks, off-road access, and reduced vehicular conflicts. | Bicyclists and pedestrians would be less sensitive to visual changes to the highway corridor due to short-duration dynamic views and focus would primarily be on traveling to and from the beach. | Bicyclists and pedestrians would use the roadways within the project limits. | Low |

| Cultural Site | | | | |
|---|---|---|---|---|
| Neighbor: Recreational | Existing trees, brush, and vegetation currently obscure all but distant views of the highway outside project limits. The number of recreational viewers at the Cultural site would be very small. | Views are scenic but not protected. Views would be of short duration but would not change with this alternative. Attention and focus would not change. | Recreational viewers are within foreground and middle ground proximity zones. | Low |

### 4.3.2 Direct Impacts

The existing natural, human, and project environments will be compatible with the existing conditions as the form, material and visual character of the existing roadway would remain. Although guardrail is common along the existing Kamehameha Highway corridor, the scale and extent of the proposed guardrail would slightly increase exposure for highway travelers, pedestrians, and bicyclists. Adding guardrail along the mauka side of Kamehameha Highway would separate highway motorists from the informal paring area and would reduce vehicular conflicts. The addition of crosswalks would also increase pedestrian safety by congregating pedestrians at the designated and marked crosswalks. The overall impacts on the existing visual environment will be beneficial to highway users.

Residential and commercial viewers in close proximity to roadway improvements would typically have a high degree of sensitivity to change in the visual environment; however, existing fences, gates, vegetation, and structures will obscure views of the guardrail for most viewers and may benefit from a more orderly parking condition. Any potential views of the No Build Settlement Alternative would become routine as these views would be of long duration. Neighbors will likely have a moderate sensitivity to visual changes associated with the No Build Settlement Alternative.

Existing vegetation is expected to obscure all views of the proposed No Build Settlement Alternative from the Cultural Site for recreational and pedestrian viewers. Neighbors and travelers would have a low sensitivity to change.

### 4.3.3 Construction Impacts

Construction equipment and activities may be noticeable throughout the active construction period. Although HDOT is not involved in the implementation of this project, construction is estimated to last approximately 1 month.

Construction equipment is likely to include heavy trucks, augers, and/or a small truck mounted crane. This equipment is often brightly colored to promote visibility and safety. Other sources of visual changes during construction would include staging areas, material storage, trailers, fencing, vehicular and pedestrian detours, construction signing, flashing safety lights, and work lighting. Visual detractions from construction activities would be removed upon completion of the project. Construction activities and equipment are not expected to be visible from the Cultural Site.

### 4.3.4 Visual Quality

The No Build Settlement Alternative would utilize the existing roadway, pavements, shoulders, and alignment. The guardrail would be constructed within the existing disturbed right-of-way and on City-owned property. The overall landform of the area would not change as the existing roadway would not change and views of the beach and open ranchlands would not be adversely affected. The installation of guardrail along the project area would add visual elements but would not degrade any sensitive natural visual resources in the AVE, including beach vegetation and may help to protect some disturbed roadside vegetation. The informal parking area would expand to allow room for parking and maneuvering. Some vegetation would likely be affected but most existing vegetation is small shrubs and grasses that are not in a native condition and would quickly naturalize. The project would be neutral to natural harmony.

The human environment would remain orderly as the project proposes no change to existing structures, fencing, or other human-made elements. The project environment would be consistent with the type, shape, and form of the existing roadway. Conflicts associated with parked cars, which can be heavy at times and visual clutter would be reduced as the guard rails separate parked cars from the travel lanes. Proposed crosswalks would lessened vehicle conflicts and create a safer environment for pedestrians. Visual coherence in the project environment would be improved and the overall impact on visual quality would be neutral to beneficial for both the Kamehameha Highway and Cultural Site neighbors and travelers.

## 4.4 TSM ALTERNATIVE

The Transportation System Management (TSM) alternative would utilize the existing highway alignment but would construct a guardrail on the mauka side within the Kamehameha Highway right-of-way fronting Laniakea Beach (Figure 4-5). The guardrail would be an estimated 1,000 linear feet long and would improve pedestrian safety, protect coastal resources, and enhance beach safety by enforcing the the no parking condition along the State Highway facility. All applicable rules and regulations would be adhered

to as appropriate. As this alternative would be fully state-funded, all state rules and regulations would apply.

**Figure 4-5. Typical Section – TSM Project Alternative**

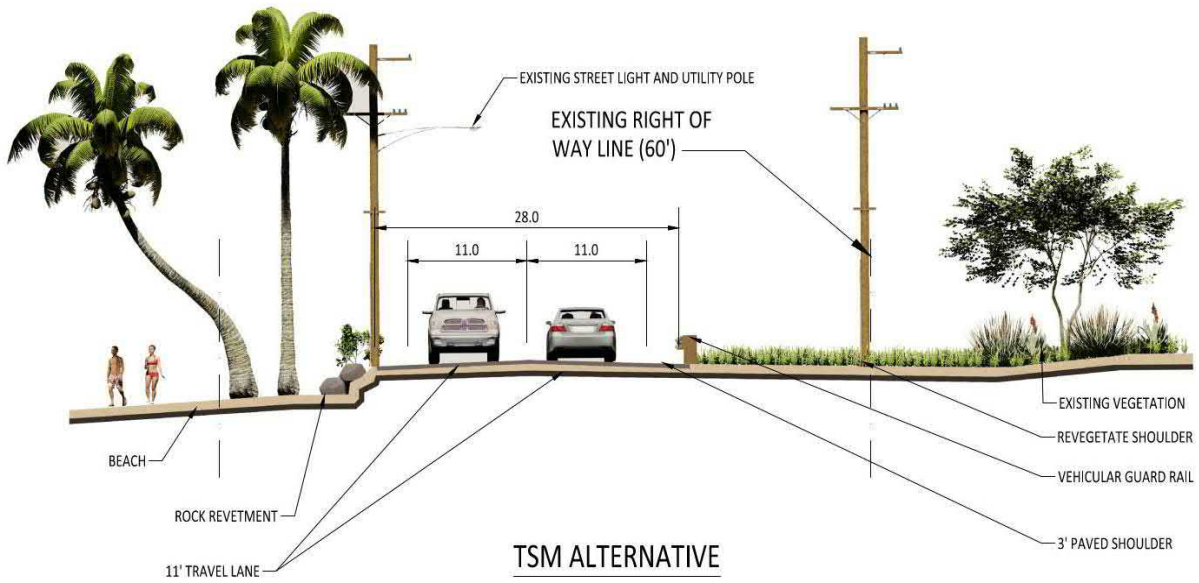



**Figure 4-6. Plan View – TSM Project Alternative**

### 4.4.1 Visual Compatability

No change is proposed to the form or material of the roadway but this alternative would construct approximately 1,000 linear feet of guardrail on the mauka side of the highway within the immediate vicinity of Laniakea Beach.

While adding guardrail in the immediate vicinity of Laniakea Beach would change the size and scale of this visual element, guardrail is a common material within the Kamehameha Highway corridor. Additionally, currently disturbed areas behind the proposed guardrail would be revegetated, which could add new natural visual elements to the area. The proposed TSM Alternative and associated guardrail would be compatible with existing visual conditions.

**Table 4-2. Viewer Sensitivity – TSM Alternative**

| | Exposure | Awareness | Distance | Overall Sensitivity |
|---|---|---|---|---|
| Kamehameha Highway | | | | |
| Neighbor: Residential / Commercial | A low number of residences would have direct views; however, fencing and vegetation would obscure most views of the guardrail. Views of congested parking would be eliminated. | Attention and focus would not change in visual conditions. Static views would be of long duration and would become routine. | Due to the proximity of some residential viewers, as close as 50 feet from the proposed guardrail, sensitivity would generally be high but most views are obscured by fences and vegetation. | Moderate |
| Traveler: Motorist | High numbers of viewers utilize the highway corridor. The overall visual experience of motorists would be similar to existing conditions. The project's visual environment would be consistent with their expectations. | Motorists would primarily be focused on driving and would have short duration dynamic views. Passengers may be more aware but would also have short duration views. | Travelers would use roadways within the project limits. The posted speed is 35 miles per hour. | Low |
| Traveler: Bicycle / Pedestrian | No formal bicycle or pedestrian facilities are provided along the existing highway corridor. The visual environment would benefit with reduced vehicular conflicts. | Bicyclists and pedestrians would be less sensitive to visual changes to the highway corridor due to short duration dynamic views and focus would primarily be on traveling to and from the beach. | Most bicyclists and pedestrians would use the roadways within the project limits. | Low |
| Cultural Site | | | | |

| | | | | |
|---|---|---|---|---|
| Neighbor: Recreational | Existing trees, brush, and vegetation currently obscure all but distant views of the highway outside project limits. The number of recreational viewers at the Cultural site would be very small. | Views are scenic but not protected. Views would be of short duration but would not change with this alternative. Attention and focus would not change. | Recreational viewers are within foreground and middle ground proximity zones. | Low |

### 4.4.2 Direct Impacts

The existing natural, human, and project environments will be compatible with the existing conditions as the form, material and visual character of the existing roadway would remain. Although guardrail is common along the existing Kamehameha Highway corridor, the scale and extent of proposed guardrail would slightly increase exposure for highway travelers, pedestrians, and bicyclists. It should be noted, however, that adding guardrail along the highway in this location would reduce vehicular congestion in the area. The addition of guardrail along the mauka side of Kamehameha Highway would reduce the likelihood of pedestrian / vehicular conflicts.

Residential and commercial viewers in close proximity to roadway improvements would typically have a high degree of sensitivity to change in the visual environment; however, fences, gates, vegetation, and structures will obscure views of the guardrail for most viewers. Any potential views of the TSM Alternative would become routine as these views would be of long duration. Neighbors will likely have a moderate sensitivity to visual changes associated with the TSM alternative.

Vegetation is expected to obscure all views of the proposed TSM Alternative from the Cultural Site for recreational and pedestrian viewers. Neighbors and travelers would have a low sensitivity to change.

### 4.4.3 Construction Impacts

Construction equipment and activities may be noticeable throughout the active construction period. Construction of this project alternative would be expected to last approximately 1 month.

Construction equipment is likely to include heavy trucks, augers, and/or a small truck-mounted crane. This equipment is often brightly colored to promote visibility and safety. Other sources of visual changes during construction would include staging areas, material storage, trailers, fencing, vehicular and pedestrian detours, construction signing, flashing safety lights, and work lighting. Visual detractions from

construction activities would be removed upon completion of the project. Construction activities and equipment are not expected to be visible from the Cultural Site.

### 4.4.4 Visual Quality

The TSM Alternative would utilize the existing roadway, pavements, shoulders, and alignment. The guardrail would be constructed within the existing disturbed right-of-way of the existing highway. The installation of this length of guardrail along the project area would not degrade any sensitive natural visual resources in the AVE, including beach vegetation and mature trees. The overall landform of the area would not change as the existing roadway would not change and views of the beach and open ranchlands would not change. The remaining disturbed area behind the guardrail would be seeded and would naturalize over time. The project would be neutral to beneficial to natural harmony.

The human environment would remain orderly as the project proposes no change to structures, fencing, or other human-made elements. The project environment would be consistent with the type, shape, and form of the existing roadway. The proposed guardrail would reduce vehicle congestion and pedestrian conflicts, creating a safer environment due to lessened vehicle / pedestrian conflicts in the area. Visual clutter associated with the parked cars, which can be heavy at times, would be eliminated. Visual coherence in the project environment would be improved and the overall impact to visual quality would be neutral to beneficial for both the Kamehameha Highway and Cultural Site neighbors and travelers.

## 4.5 PEDESTRIAN SHIFT ALTERNATIVE

The Pedestrian Shift Alternative would realign approximately 1,100 linear feet of the Kamehameha Highway mauka (inland) and away from the most intense coastal hazard zone, and would include a new bridge over Lauhulu Stream (also referred to as Laniakea Stream or Kūkaeʻōhiki Gulch). The proposed Pedestrian Shift Alternative would diverge from the existing Kamehameha Highway beginning approximately 310 feet southwest of Lauhulu Stream and a new bridge would span the stream for approximately 100 feet. The new alignment would then merge back to the existing Kamehameha Highway approximately 450 feet northeast of Pohaku Loa Way. A connector road north of Laniakea Beach and a vehicle control gate would provide residential access to Pohaku Loa Way.

Because this alternative would result in a shift to the existing Kamehameha Highway, there would conservatively be spaces for roughly 90 passenger cars on the mauka side of the roadway.

Sections of the existing Kamehameha Highway adjacent to Laniakea Beach and the existing bridge over Lauhulu Stream would remain as pedestrian access and provide emergency access to Laniakea Beach.

Vehicular control measures (e.g., concrete piles, guardrails) would be placed between the existing roadway and the new roadway for vehicle control and fencing and guardrails would provide additional pedestrian safety adjacent to the proposed bridge and stream bed. Residential and commercial driveways would be extended where necessary to maintain access to the shifted Kamehameha Highway.

Facilities included with this alternative would consist of:

- A two-lane highway, with one lane of traffic in each direction and a 10' refuge median for left-turning movements.
- One new bridge at Lauhulu Stream (on the Haleiwa side of Laniakea Beach).
- The existing bridge and a portion of the existing road would be utilized for cycling and walking (makai side would be demolished and replanted/renaturalized).

**Figure 4-7. Typical Section – Pedestrian Shift Alternative**

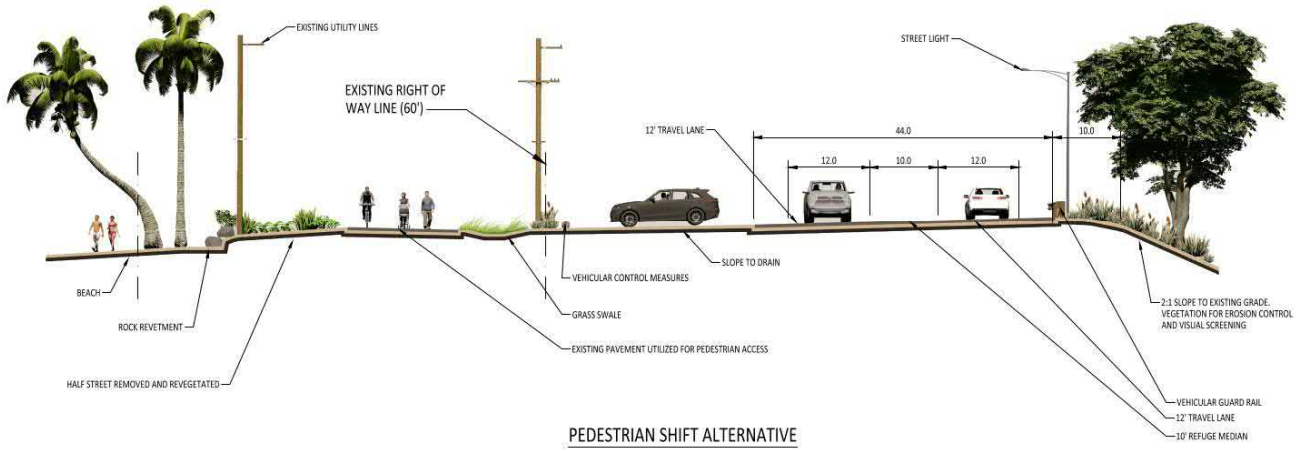
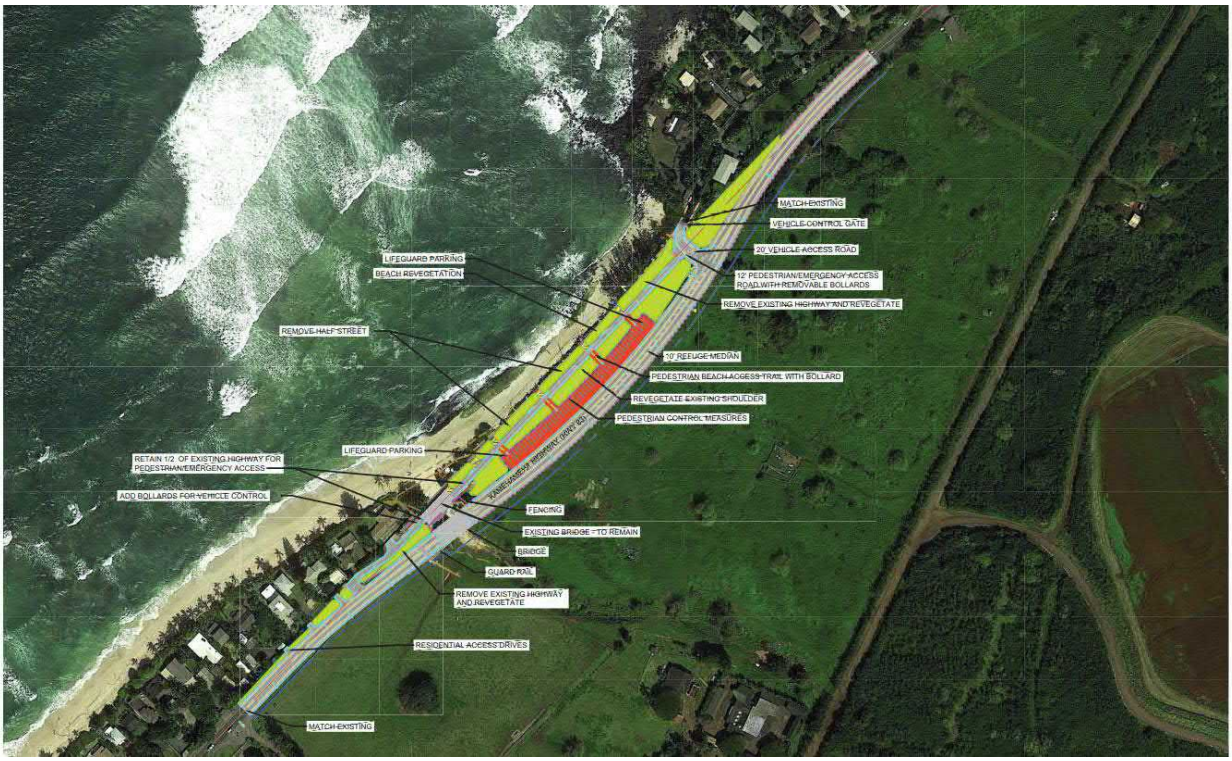


**Figure 4-8. Plan View – Pedestrian Shift Alternative**




## 4.5.1 Visual Compatability

All new roadway and auxiliary features are common visual elements within the existing Kamehameha Highway corridor and would be compatible with the scale, form, materials, and character of the existing visual environment.

**Table 4-3. Viewer Sensitivity – Pedestrian Shift Alternative**

| | Exposure | Awareness | Distance | Overall Sensitivity |
|---|---|---|---|---|
| Kamehameha Highway | | | | |
| Neighbor: Residential / Commercial | This alternative would be visible from the closest residential viewers; however, the highway would move away from adjacent residential lots. A small number of commercial views on the mauka side would be visually impacted. | Static views would be of long duration and residential viewers are sensitive to change; however, attention and focus would continue to be directed toward scenic visual resources. The change due to the proposed shift would become routine. | Due to the proximity of some residential viewers, sensitivity would be high but the roadway would move away from these viewers and most views would be obscured by fences and vegetation | Low |

| | | | | |
|---|---|---|---|---|
| Traveler: Motorist | High numbers of viewers utilize the existing Kamehameha Highway corridor. The project's visual environment would be consistent with their expectations but would have the beneficial effects of reduced pedestrian conflicts and the construction of a refuge median. | Motorists would primarily be focused on driving. Passengers may be more aware but would have short duration dynamic views. | Travelers would use roadways within the project limits. The posted speed would likely be 35 miles per hour. | Low |
| Traveler: Bicycle / Pedestrian | Bicycle and pedestrian facilities would be provided along the existing highway corridor. The visual environment would benefit from reduced pedestrian / vehicular conflicts. | Focus and awareness will shift away from pedestrian / vehicular conflicts for bicyclists and pedestrians with dynamic views. | Most bicyclists and pedestrians would use the roadways within the project limits. | Low |
| Cultural Site | | | | |
| Neighbor: Recreational | Existing trees, brush, and vegetation currently obscure all but distant views of the highway outside project limits. The number of recreational viewers at the Cultural site would be small. | Views are scenic but not protected. Viewers may experience minor changes in visual conditions but would be of short duration and attention and focus would remain on scenic resources. | Recreational viewers are within foreground and middle ground proximity zones. | Low |

### 4.5.2 Direct Impacts

Moving the highway 80 feet to the mauka side of the highway will displace some of the vegetation at the edge of the existing ranchland; however, this vegetation is not in a natural condition. The makai half of the existing roadway would be demolished and rock, vegetation, and slope stabilization measures would be placed to prevent soil and beach erosion and would add natural visual elements between the beach and proposed roadway. Revegetation and replanting efforts on both sides of the proposed roadway will provide erosion control and visual screening for neighbors, including viewers from the Cultural site.

No residential or commercial structures, fencing, or other human-made elements will be impacted. Vehicular access to the existing residences on the Haleiwa side of the stream would be extended to the proposed highway pavement and the existing Kamehameha Highway pavement would be demolished and replanted which will provide visual screening and buffering for the residential viewers. The resulting changes will provide beneficial effects to the natural environment for most neighbors and travelers.

The mauka side of the existing road and the existing bridge will remain as separate pedestrian and bicycle facilities. This will allow these travelers to shift focus and attention from roadways and vehicular conflicts to the scenic natural features. While most visual elements associated with the realigned road are existing in the highway corridor, the size and scale of widened road, refuge median, guardrails, and other ancillary elements may impose slight adverse effects to motorists and a small number of commercial neighbors; however, the human and project environments will be orderly and coherent for neighbors and travelers.

Most views of the project from the Cultural Site will be obscured by existing vegetation. Landforms and existing vegetation would likely obscure all views of the project site for pedestrian travelers to the Cultural Site. Relocated utility poles and streetlights may be visible above the tops of existing trees and shrubs. Light spill from street lights may be visible from the Cultural Site in nighttime conditions; however, these are existing visual elements and new lights could be shielded to reduce glare during nighttime hours. Figure 4-9 shows the existing view from the Cultural Site during daytime and Figure 4-10 shows the exsting view from the Cultural Site during nighttime.

**Figure 4-9. Photographic Simulation – Pedestrian Shift, Cultural Site at Daytime**

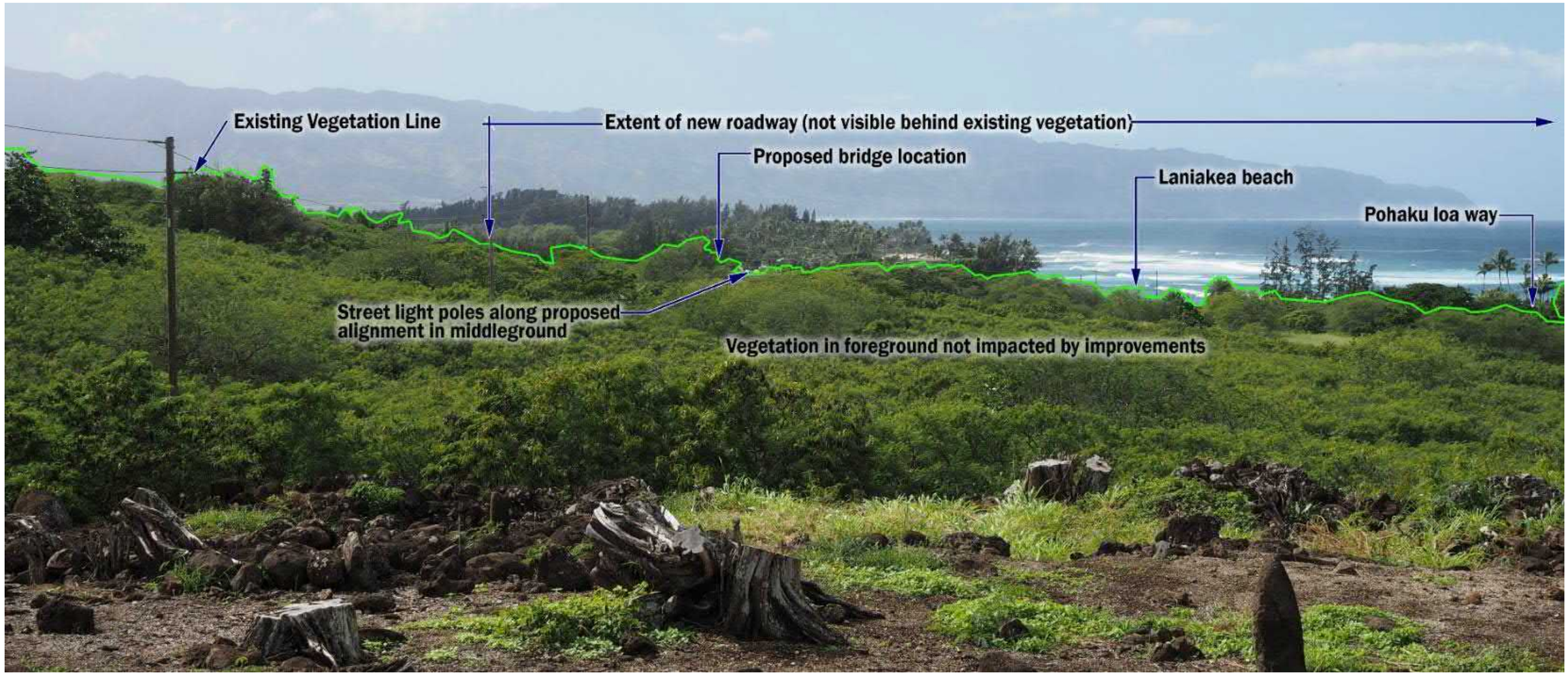


**Figure 4-10. Photographic Simulation – Pedestrian Shift, Cultural Site at Nighttime**

### 4.5.3 Construction Impacts

Construction equipment and activities may be noticeable throughout the active construction period. The design and construction of this project alternative would be expected to last approximately 18 months.

Construction would occur primarily within the immediate vicinity of Laniakea Beach. Construction equipment and activities may be noticeable throughout the active construction period. For this project, construction equipment is likely to include excavators, loaders, backhoes, bulldozers, compactors, trucks, mixers, and cranes. This equipment is often brightly colored to promote visibility and safety. Other sources of visual changes during construction would include staging areas, material storage, trailers, fencing, vehicular and pedestrian detours, and construction signing. Flagging crews, construction access, barricades, erosion control measures, and flashing safety lights would be common. Lights may be used to safely illuminate the workspaces during low light hours, which could cause spillover light onto adjacent properties; lights will be shielded appropriately and will be used only as necessary. Therefore, during the construction of this alternative, both neighbors and travelers could perceive that the visual quality of this AVE would be temporarily degraded. Visual detractions from construction activities would be removed upon completion of construction of the project.

Existing trees, brush, and vegetation currently obscure all but distant views of the highway that are outside of the construction limits. This vegetation will remain and visual conditions for both neighbors and travelers at the Cultural Site are not likely to change. Viewer preference for project coherence will be met; therefore, construction would be expected to have a neutral effect on visual quality during construction from the Cultural Site.

### 4.5.4 Visual Quality

Realigning the highway will move visual elements associated with the roadway and displace natural elements; however, the scale, size, type, and character of the roadway will be similar to that of the existing highway and most of the land and vegetation along the highway shoulders and existing ranchland is not in a natural condition. Landforms would not change as the proposed roadway would be placed at approximately the same elevation. The Pedestrian Shift Alternative would increase the size and scale of the roadway causing adverse visual impacts; however, revegetation and new planting areas would have a beneficial visual impact for neighbors and travelers. The overall visual impact will be neutral to the experience of natural harmony in the AVE.

The human environment would remain orderly as the project would not propose changes to structures, fencing, or other human-made elements; however, the highway would move away from the closest

residential structures, and revegetation measures will likely improve visual conditions for those viewers. Improvements to the roadway would also reduce vehicle congestion and pedestrian conflicts. Visual coherence in the project environment would be improved and the overall impact on visual quality would be neutral to beneficial for both Highway and Cultural site neighbors and travelers durig daytime conditions.

Additional streetlights proposed with the Pedestrian Shift Alternative would improve safety and visibility for highway motorists and pedestrians during nighttime conditions but would increase the number of light sources and overall ambient light levels. Changes to nighttime conditions would be neutral to beneficial for most viewers; however, the Cultural Site is used at night for wayfinding and star navigation. These viewers would be sensitive to adverse impacts to the existing nighttime light conditions and would likely experience negative impacts to visual coherence; however, existing landforms, trees, and vegetation would primarily block or obscure most proposed light sources for viewers form the Cutural Site (see Figure 4-10. Photographic Simulation – Pedestrian Shift, Cultural Site at Nighttime). Additionally, light sources are prevalent in the existing nighttime environment, the number of viewers at the Cultural Site would be small, and the frequency of nighttime viewers would be limited. Mitigation measures to help reduce the effects of light and glare sources will help to reduce negative impacts for these viewers during nighttime conditions.

## 4.6 INDIRECT AND CUMULATIVE IMPACTS

Potential indirect impacts would occur when the project would result in additional changes later in time or farther in distance. Cumulative impacts on visual quality would occur when the project component's impact on visual quality is combined with other past, present, and foreseeable future actions. Indirect or cumulative impacts could be to the natural, human, or project environments.

### 4.6.1 No Build Alternative Indirect Impacts

Rising sea levels and coastal hazards, such as chronic erosion, seasonal wave overtopping, flooding, and storm surges will likely eventually degrade the existing roadway base and beach slopes. Additional efforts to stabilize the beach and roadway could cause visual and environmental degradation and could include visual impacts. Viewer exposure and awareness would likely change with any proposed relocation of the existing roadway.

### 4.6.2 No Build Settlement Alternative

Indirect impacts would be the same as the No Build Alternative.

### 4.6.3 TSM Alternative Indirect Impacts

Indirect impacts would be the same as the No Build Alternative.

### 4.6.4 Pedestrian Shift Alternative Indirect Impacts

The Pedestrian Shift Alternative is expected to stabilize the highway for a minimum of 15 to 20 years

# CHAPTER 5
# MITIGATION

This report includes the consideration of mitigation to help lessen the visual impacts of the project. Mitigation may be proposed to address direct impacts to maintain or enhance the existing visual quality. Mitigation measures are categorized into the following five areas, listed in order of preference:

1. Avoidance: Altogether avoiding adverse impacts by not taking a certain action or parts of an action. Avoidance may mean selecting alternatives that do not incur the impact or degree of adverse impact.
2. Minimization: Minimizing impacts by limiting the degree or magnitude of the action and its implementation.
3. Rectification: Repairing, rehabilitating, or restoring the affected environment.
4. Reduction: Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
5. Compensation: Compensating for the impact by replacing or providing substitute resource or environments (FHWA 2015).

## 5.1 MITIGATION MEASURES FOR VISUAL IMPACTS

### 5.1.1 No Build Alternative

No mitigation measures would be proposed for the No Build Alternative.

### 5.1.2 No Build Settlement Alternative

Rectification measures:

- Disturbed land behind the proposed barrier would be seeded with native grasses. Mitigation measures could be revegetated native trees and shrubs to provide a more natural visual setting.

### 5.1.3 TSM Alternative

Rectification measures:

- Disturbed land behind the proposed guardrail would be seeded with native grasses. Mitigation measures could be revegetated native trees and shrubs to provide a more natural visual setting.

### 5.1.4 Pedestrian Shift Alternative

Avoidance measures:

- Proposed Roadway alignment may be adjusted to avoid large trees, native plantings, or visually pleasing features; particularly adjacent to the Lauhulu Stream riparian corridor.

Minimization measures:

- Shielding street lights to direct light to roadway surfaces, minimize light spill to surrounding areas, and minimize light and glare impacts, particularly where visible from the cultural site.

Rectification measures:

- Planting and revegetation are proposed for disturbed areas; however, additional plantings, particularly between residential viewers and the proposed roadway would provide additional screening.
- Opaque fencing and visual screening could be provided or expanded for adjacent residential and commercial viewers.
- Revegetation and plantings associated with the Laniakea Beach and Stream could be increased in size and density to provide a more natural setting.

### 5.1.5 Project Construction Considerations Regarding Visual Quality and Aesthetics

During the construction phase, the following actions would minimize temporary impacts on visual quality and aesthetics:

- Preserve existing vegetation and minimize clearing for storage and laydown areas. Utilizing existing hard /paved areas for project staging where practical.
- Limit construction to daylight hours whenever possible. Include directional work and safety lighting and direct lights away from residential areas where nighttime construction is necessary.
- Reduce temporary construction light and glare impacts by shielding and aiming light sources downward and toward work areas to avoid light spillover
- Screen views of construction equipment and materials from pedestrians and residential areas, as practical
- Restore landscaping disturbed by construction-related activities after completion of work.

# CHAPTER 6
# REFERENCES

FHWA. 2015. “Guidelines for the Visual Impact Assessment of Highway Projects.” U.S. Department of Transportation Federal Highways Administration.

Appendix

# I

# FEMA's Firm Method Tsunami Runup Modeling

# Laniakea Highway Relocation Inundation Analysis and Coastal Assessment – Task 1

## FEMA's FIRM Method Tsunami Runup Modeling

*North Shore, Oahu, Hawaii*

*March 2021*

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# 1. INTRODUCTION

The Hawaii Department of Transportation (HDOT) is pursuing a proposal to realign a segment of Kamehameha Highway (Route 83) in the vicinity of Laniakea Beach on the North Shore of Oahu, potentially relocating the roadway to a position further inland, in an effort to alleviate frequently congested traffic and mitigate hazardous pedestrian crossings along this stretch of road. As a part of that effort, Sea Engineering, Inc. (SEI) has been contracted to provide assistance for a number of coastal engineering related tasks, including tsunami (seismic or tidal wave) runup inundation analyses, storm wave runup and inundation analyses, as well as a general coastal assessment of the project site. Results from this work are prepared for inclusion in the eventual draft environmental assessment (EA) for the project.

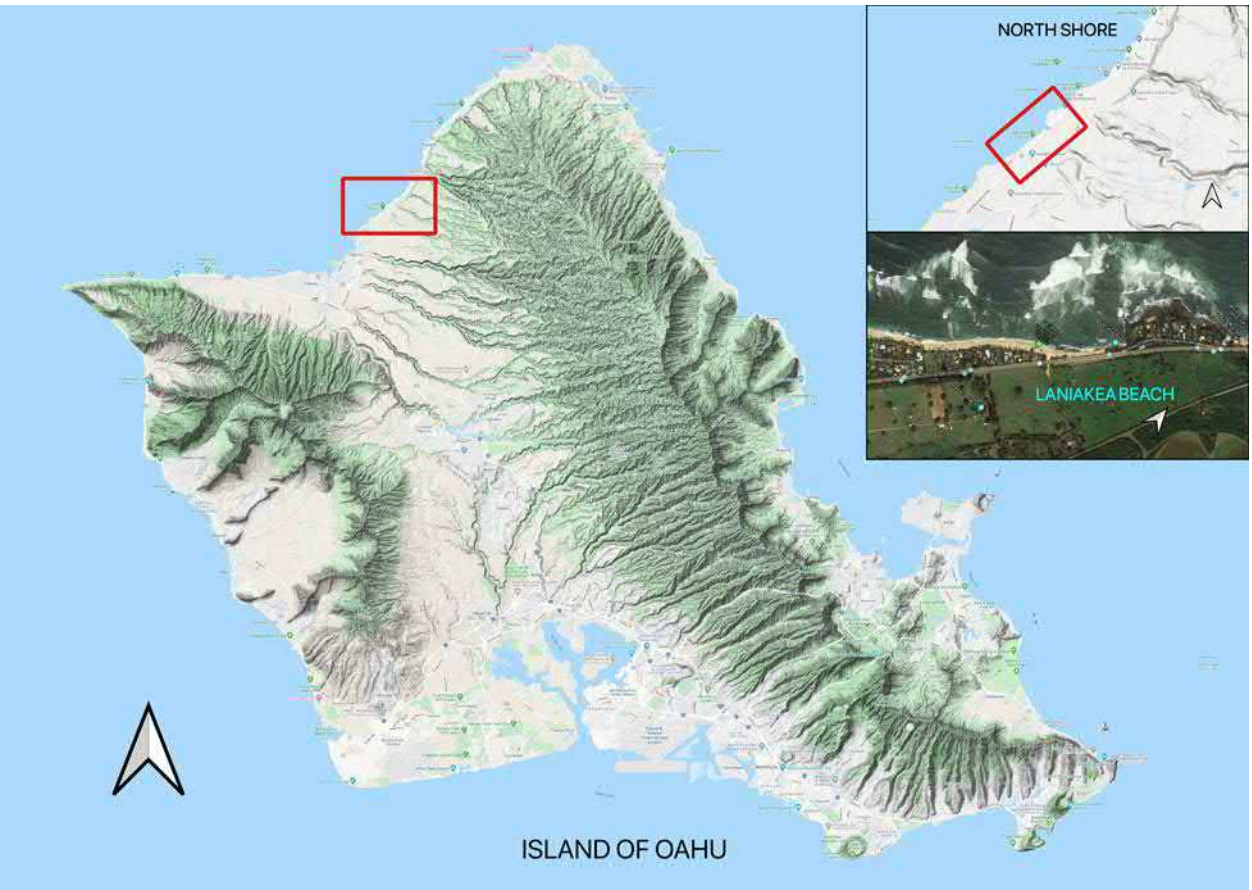


**Figure 1-1. Project location map**

This document summarizes the methodology, results and conclusions from a 1-dimensional model of tsunami runup along a series of shoreline transects in the project area, and what implications, if any, may result to the current runup profiles as a result of the proposed roadway realignments that have been provided. The project site is the section of road along Laniakea Beach, and surrounding vicinity, as shown in the project location map presented in Figure 1-1.

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## 2. METHODOLOGY & PROCEDURES

The National Flood Insurance Program (NFIP), administered by the Federal Emergency Management Agency (FEMA), maintains flood hazard maps for use in determining a reference height used by property insurance companies to assess flood risk, known as the Base Flood Elevation (BFE). On the North Shore of Oahu, Hawaii, the 1% annual flood risk is considered by FEMA to be a result of tsunami wave inundation, and not from rainfall accumulation. The North Shore flood zones were determined in a 1979 study utilizing the method presented in the "Manual for Determining Tsunami Run-up Profiles on Coastal Areas in Hawaii", a U.S. Army Corps of Engineers (USACE) manual prepared by M&E Pacific, Inc.

SEI has applied this FEMA-recognized and accepted methodology here to calculate tsunami runup elevations along the Laniakea project site for existing ground conditions, along with two proposed highway relocation alternatives provided by WSP, where runup is defined by the United States Geological Survey (USGS) as, "…a measurement of the height of the water onshore observed above a reference sea level "—in this case, mean sea level (MSL). Existing calculations completed by FEMA are based on the same one-dimensional method, however, cross shore transects were spaced far apart (hundreds of meters) along the shoreline. The Flood Insurance Rate Maps (FIRMs) represent the inundation contours interpolated between these far-spaced calculated transects, as determined by floodplain engineers. By comparison, for this project, SEI has used tightly-spaced transects (40 m) along the shoreline to provide significantly higher resolution for the inundation results.

Aerial laser-based LiDAR (Light Detection And Ranging) elevation data were supplemented as necessary by beach and backshore profiles measured by SEI engineers. Run-up elevations for the proposed alternatives are compared to existing conditions to evaluate any changes. The process work flow is illustrated in Figure 2 1, and includes: acquisition of existing topographic and bathymetric LiDAR data sets; development of digital terrain models (DTMs) from the LiDAR data for existing ground conditions and for the proposed roadway modifications; slicing of the DTMs along cross shore transects, spaced at a 130 ft (40 m) interval to generate ground elevation profiles for the calculations; completion of the tsunami runup calculations along each of the profiles, for all of the ground conditions (existing, 2 alternatives); mapping of the runup results; and, comparison of the results.

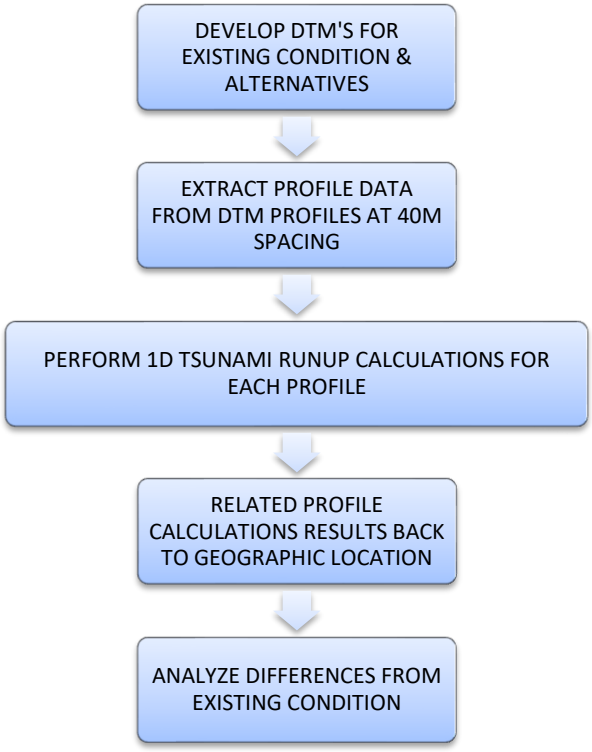


**Figure 2-1. Modeling and analysis work-flow**

A key input for the modeling analysis were the provided design data for the

proposed ground elevation changes for each realignment alternative. The designs, provided to SEI as CAD-based surface data, clearly govern the runup ground elevation profiles upon which the calculations are based. It should also be noted that because the calculations are one-dimensional in nature, two-dimensional flow (e.g., flow components parallel to the shoreline) and impacts to the surrounding area were not directly evaluated. Additionally, tsunami runup incorporating sea level rise considerations were not addressed at this time.

The project site (Figure 1-1) is the section of Kamehameha Highway along the North Shore in the vicinity of Laniakea Beach; a map of the topographic and bathymetric contours for the project area overlaid on a hybrid satellite image, and additionally overlaid with a semi-transparent sun-shaded DTM relief image, is presented in Figure 2-2[1] . Prominent physical features in the vicinity of the project site are the shoreline, which transitions from a relatively wide sandy beach in the southwest of the project area, fronting the surf spot known as Laniakea's, then running northeast to a rugged basaltic rocky headland which fronts the surf spots known as Hultin's and Jocko's. The intersection between the sandy beach and the rocky point forms a relatively sheltered cove, where sea turtles are known to congregate in large numbers, drawing large crowds of tourists and visitors who come to see the protected marine animals. A small intermittent stream cuts a modest natural drainage channel from mauka to makai, running under the small bridge or culvert at the southwest end of Laniakea. The terrain slopes generally upward to the Koolau mountains from the highway until it reaches a steep-sided escarpment, the base of which is approximately 800 ft from the highway, beginning at roughly 60 ft above MSL. The makai area is heavily developed with private homes along the shoreline and highway and scattered with structures and farmland mauka of the highway. A sun-shaded relief map of the combined bathymetry (underwater terrain) and topography (bathy-topo) DTM is presented in Figure 2-3, more clearly illustrating the terrain of the project site. In this figure, ground elevation above MSL is indicated in feet by color using the provided color scale, where sea level is approximately yellow in color. The inundation calculations are based on a method that begins with an initial tsunami wave height for a location 200 ft inland from the shoreline; Figure 2-4 illustrates the location of a 200 ft shoreline buffer—calculations start at that location.

**Figure 2-2. Project site with topographic contours labeled at 10 ft interval, with MSL in bold**

[1] Full-sized prints of all significant figures are provided in Appendix A at the end of this document

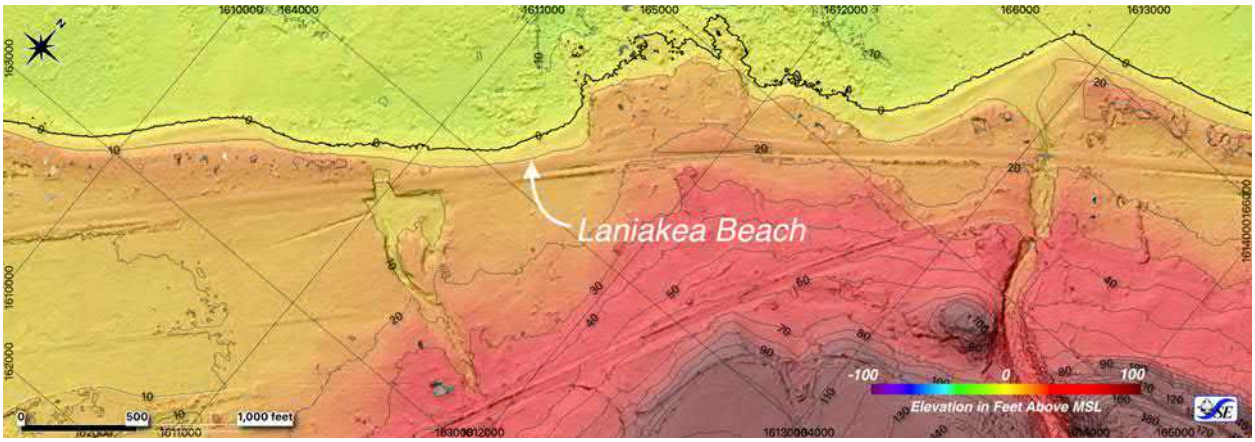


**Figure 2-3. Color shaded DTM of project site, with topographic contours at 10ft interval**

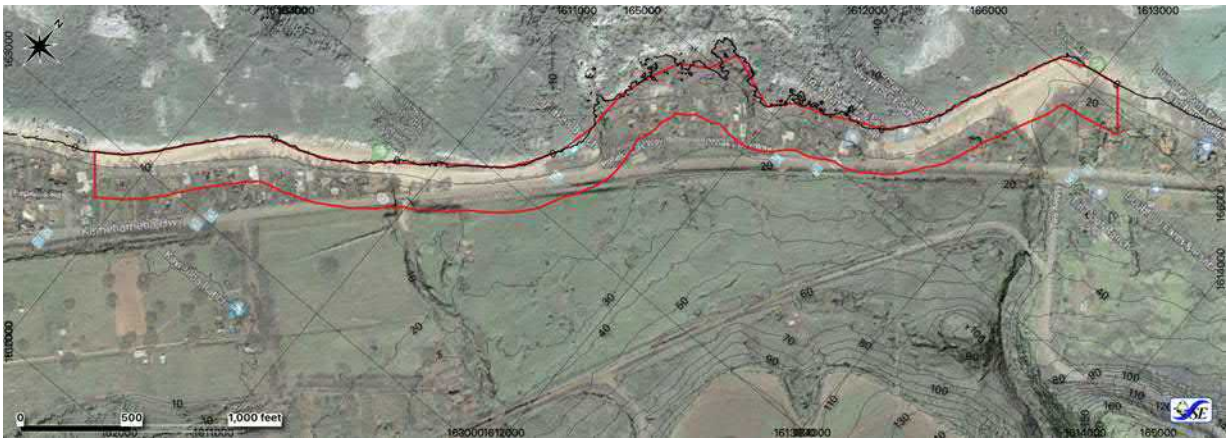


**Figure 2-4. Laniakea shoreline buffer distance of 200 ft (red line)**

Profile transects were developed at a 130 ft (40 m) spacing, to provide a reasonably high-resolution result, as illustrated in Figure 2-5, with a total of 35 individual profiles for the entire project area.

**Figure 2-5. Runup transect locations at Laniakea**

## 2.1 Tsunami Crest Height

The one-dimensional method for tsunami inundation utilized in this study is taken from the *Manual for Determining Tsunami Runup Profiles on Coastal Areas of Hawaii* (M & E Pacific, Inc., 1978). The empirical method begins with calculation of maximum tsunami crest height, in feet above MSL, at a location 200 ft inland from the shoreline, which was developed based on the ten largest recorded tsunamis occurring in Hawaii from 1837 through 1976. Predicted tsunami crest elevation is calculated using Equation 1 below:

$$H = -B - A \cdot log_{10}F \quad \textbf{Equation 1}. \ (\textit{M\&E Pacific, 1978})$$

where, **H** = maximum elevation of tsunami crest above MSL, 200 ft inland of shoreline

**F** = frequency of occurrence; the FEMA FIRM analysis uses 100-year event, or 0.01

**A, B** = coefficients determined in the manual for locations along the shoreline of Oahu.

Referring to Plate 3 of the manual, which indicates numbered reporting stations for the site coefficients, it is seen that Laniakea is approximately 1/3rd of the way between points 10 and 11, as shown in Figure 2-6, which has rubber-sheeted Plate 3 over a conventional map of Oahu to accurately find the correct position of the project area.

**Figure 2-6. Laniakea Beach (red pin) in relation to Plate 3 reporting stations *(M&E Pacific, 1978)***

Coefficients A and B for Laniakea are determined from Plates 21 and 24 in the manual (Figure 2-7 and Figure 2-8, respectively) by reading the charts and interpolating between the corresponding station numbers of 10 and 11. For coefficient A, approximately one-third of the way from 10 to 11, we find a value of 18 from Plate 21. Similarly, for coefficient B, we find a value of 13.5 from Plate 24.

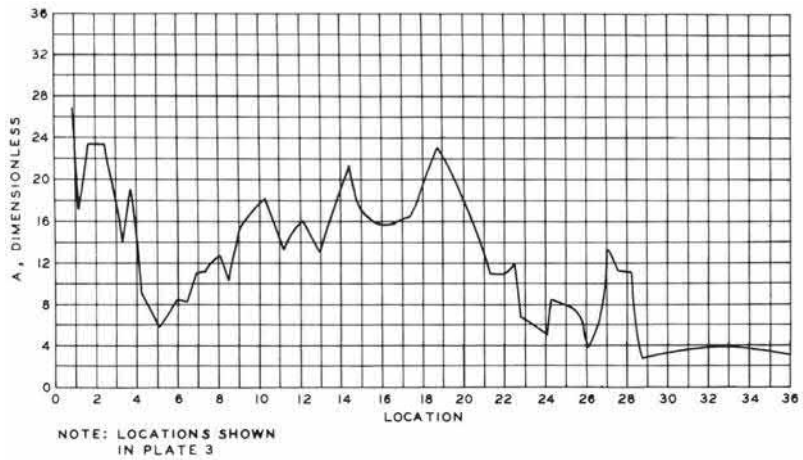


**Figure 2-7. Plate 21, "Coefficient A vs Location"** ***(M&E Pacific, 1978)***

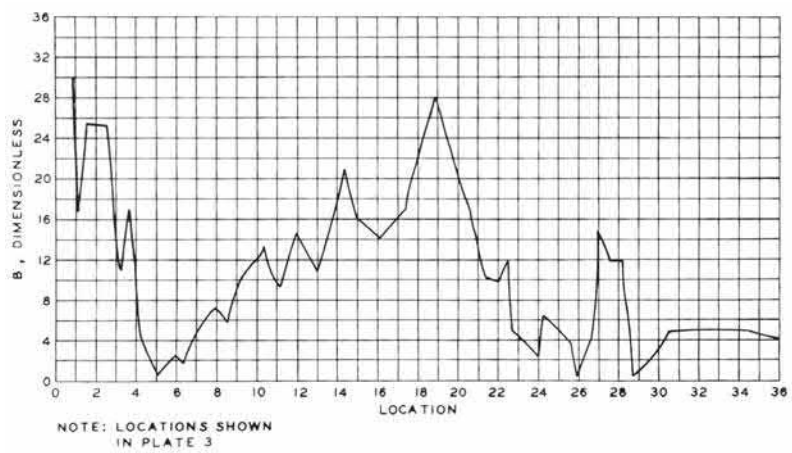


**Figure 2-8. Plate 24, "Coefficient B vs Location"** ***(M&E Pacific, 1978)***

Taking the values found for the coefficients A and B, and substituting them into Equation 1 using a 100-year event (F = 0.01), we find a maximum tsunami crest elevation above MSL at a location 200 ft inland of the shoreline at Laniakea:

$$H_{100} = -B - A \cdot log_{10}F = -13.5 - 18 \cdot log_{10}(0.01) = \underline{\text{22.5 ft above MSL.}}$$

This $H_{100}$ value of 22.5 ft MSL is then used to initialize the tsunami calculation for every transect (e.g., the elevation of the inundation water surface above MSL for every transect shown in Figure 2-5 starts with a value of 22.5 ft at a location 200 ft inland along the transect). For the region

between the shoreline and 200 ft inland (red polygon shown in Figure 2-4), the FIRM maps suggest that the H100 value is held constant through this area, and will be assumed as part of this method.

## 2.2 Tsunami Inundation Profile

The equation for tsunami elevation profile along the ground elevation profile is calculated by the differential equation for runup provided in Equation 2 of the manual:

$$\frac{dh}{dx} = -\left[\tan\theta + \frac{n^2 g F^2 h^{-\frac{1}{3}}}{1.486^2}\right]\left[\frac{F^2}{2} + 1\right]^{-1}$$

**Equation 2**. (*M&E Pacific, 1978*)

where,

**h** = tsunami wave depth in feet

**x** = horizontal distance along profile in feet

**tan θ** = ratio of vertical rise in ground elevation over horizontal distance

**n** = Manning's friction factor, 0.035

**g** = gravitational acceleration (32.17 ft/s$^2$)

**F** = Froude Number (specified value of 1 for non-bore tsunami propagation mode)

The calculation commences by solving for the initial value of h, performed at the 200-foot x-coordinate of the transect by subtracting ground elevation from the H100 value. Note that, by definition, H100 is equivalent to the water surface elevation (WSE) at this specific coordinate of every transect. Using the existing condition tsunami WSE results for transect 3 (shown in Figure 2-9) as an example, we calculate:

$$h_{initial} = H_{100} - \text{elevation}_{(200\text{ft})} = 22.5 - 18.2 = 4.3 \text{ ft}$$

Equation 2 is then directly solved for the quantity dh based on the initial tsunami wave depth, and then solved incrementally as a function of distance along each ground elevation profile as dx, in our case, completed in spreadsheet columns. This is done by re-writing Equation 2 in the form:

$$h_2 = -[x_2 - x_1]\left[\tan\theta + \frac{n^2 g F^2 h^{-\frac{1}{3}}}{1.486^2}\right]\left[\frac{F^2}{2} + 1\right]^{-1} + h_1 \quad \text{where, } \frac{\Delta h}{\Delta x} = \frac{h_2 - h_1}{x_2 - x_1}$$

The quantity dx can essentially be thought of as the resolution of the DTM (grid size), which in this case was approximately 3.9 ft. The maximum horizontal inundation distance is found when the wave height quantity reduces to zero ($h \rightarrow 0$), with some exceptions made for small localized obstructions. For example, the plot in Figure 2-9 illustrates the ground elevation profile in red and computed tsunami crest water surface elevation in blue, starting from 200 ft inland, where ground elevation directly beneath the tsunami WSE is highlighted by thick red, while the entire profile from the shoreline to 1,500 feet inland is light red for reference. The maximum inundation distance for this example is approximately 840 ft, however, it can also be seen that the WSE appears to first zero at a small obstruction near 780 ft, then continues to terminate at 840 ft. This is because,

although the computations are one-dimensional in nature, reality is a three-dimensional environment, and if the ground elevation on either side of this profile is lower at this location, flowing water will be capable of filling the low area behind the small obstruction. For this reason, it is assumed in this study that if the slope of the WSE curve, such as illustrated by the dashed blue line in Figure 2 10, has not yet converged with the general slope of the ground profile such as that illustrated by the red dashed line, then water will be capable of filling the breach.

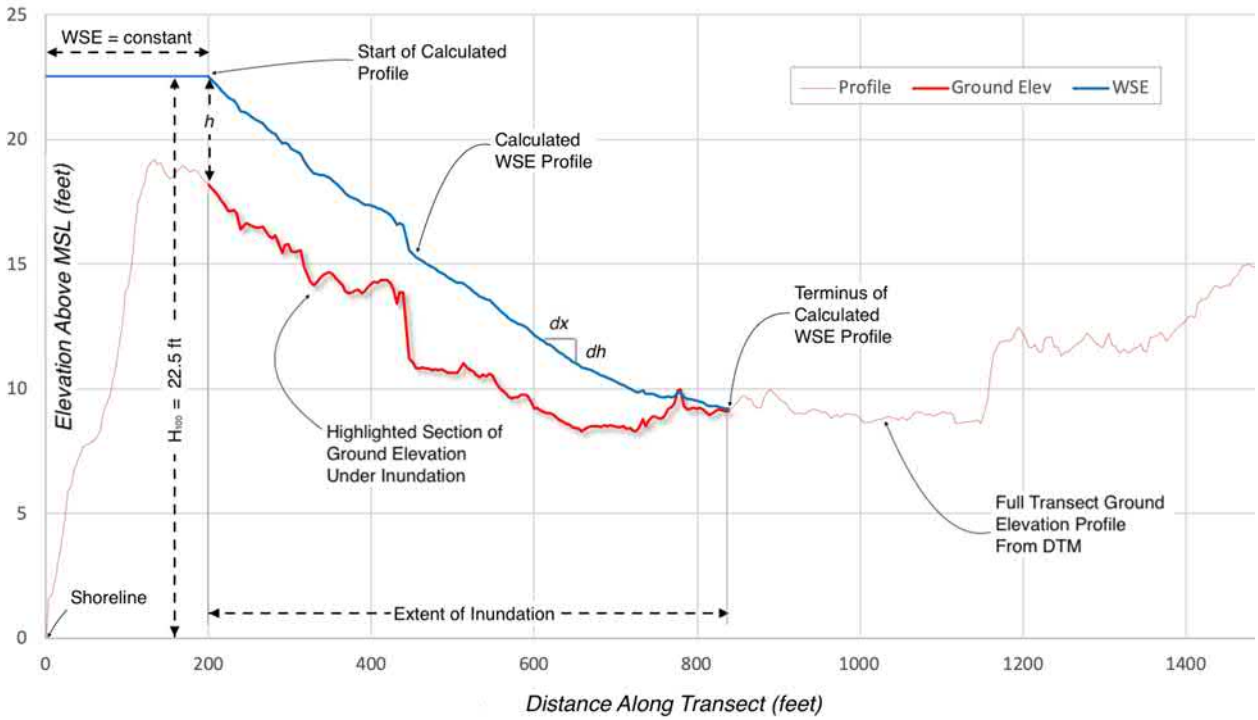


**Figure 2-9. Annotated plot of tsunami inundation as a function of distance for transect 3**

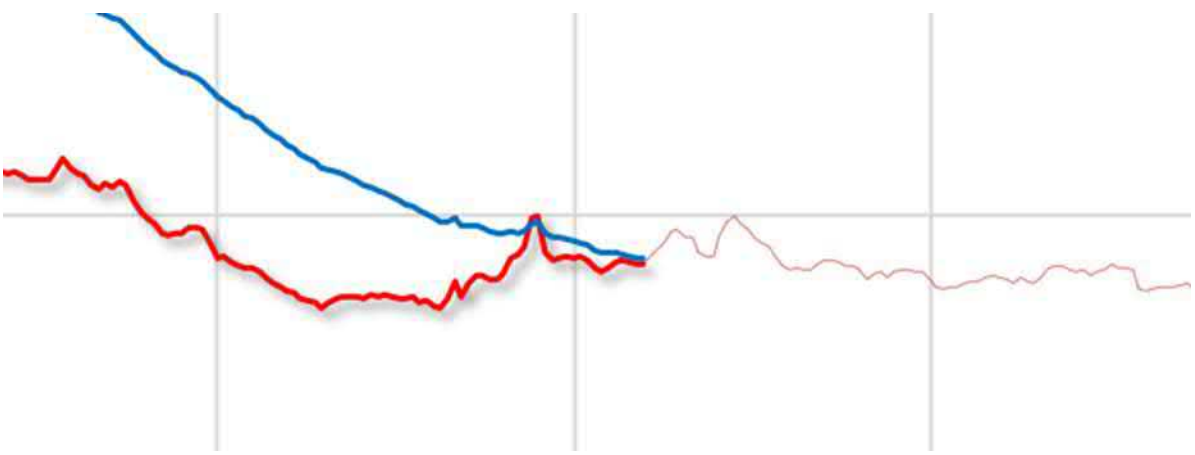

**Figure 2-10. Convergence of tsunami WSE with ground profile along transect 3**

## 2.3 Realignment Alternatives Configurations

The calculation method described above was followed for each transect shown in Figure 2 5, for the existing ground condition (Figure 2-2), and for the two provided realignment alternatives.

Alternative 1, referred to as the 'Pedestrian Shift Alternative,' is the least modified realignment alternative; it involves a limited shift of the road centerline mauka (landward) by approximately 80 ft for a length of nearly 1,700 ft centered on Laniakea Beach, as shown in Figure 2-11. The existing length of Kamehameha Highway remains in place, along with driveways for beach access and local resident traffic. Position of the proposed new roadway for Alternative 1, in relation to the established calculation transects, is shown in Figure 2-12.

Alternative 2, referred to as the 'Most Alignment Alternative,' is the more complex of the two modification options, with a proposed sweeping centerline shift of up to nearly 700 ft mauka, over a length of approximately 3,600 ft, starting southwest of the existing bridge at Laniakea and terminating just northeast of Chun's Reef (see Figure 2-13). The existing length of Kamehameha Highway also remains in place, along with new lanes for beach access and local resident traffic. Position of the proposed new roadway for Alternative 2, in relation to the established calculation transects, is presented in Figure 2-14.

**Figure 2-11. Conceptual illustration of Kamehameha Hwy realignment Alternative 1 *(WSP, 2020)***

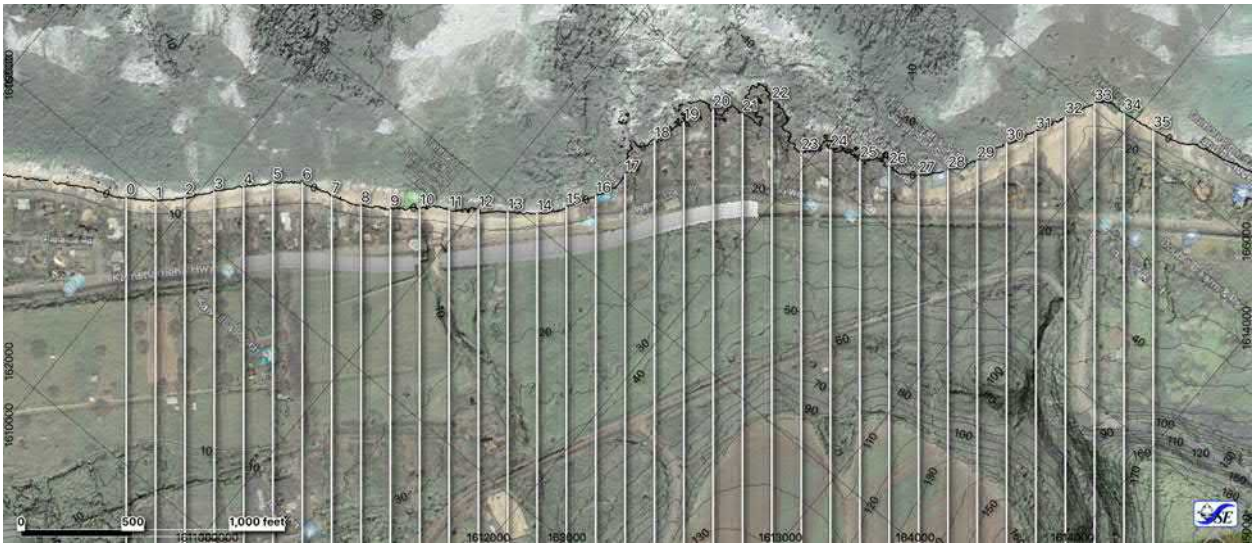


**Figure 2-12. Realignment Alternative 1 incorporation into base DTM, shown with tsunami transects**

**Figure 2-13. Conceptual Illustration of Kamehameha Hwy realignment Alternative 2 *(WSP, 2020)***

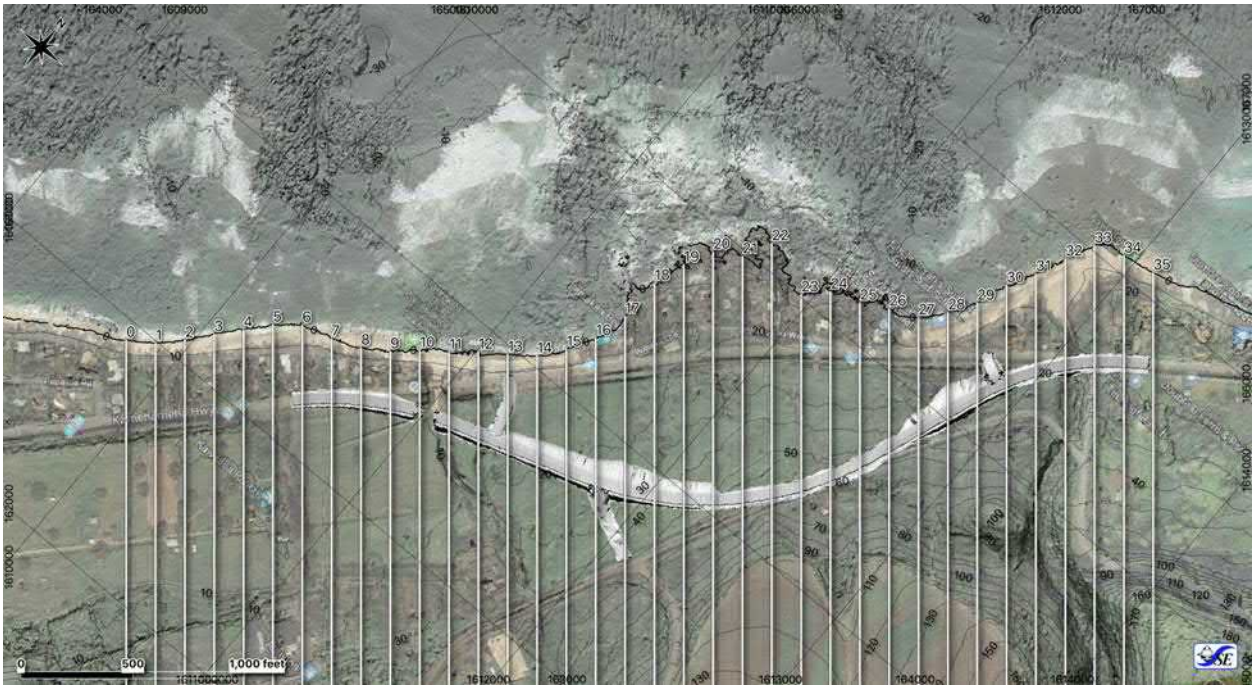


**Figure 2-14. Realignment Alternative 2 incorporation into base DTM, shown with tsunami transects**

# 3. RESULTS & DISCUSSION

Results of the calculations are presented in a series of plots showing ground elevation profile along with calculated tsunami crest water surface elevation, as illustrated by the example in Figure 2-9. There are 36 of these plots—one for each transect—for the existing condition. The entire collection of existing condition plots is provided in Appendix B. For the alternatives, only affected cross sections as shown in Figure 2-12 and Figure 2-14 are provided; there are 18 affected calculated transects for Alternative 1, and 29 affected transects for Alternative 2. All plots for both alternatives are also provided in the appendix.

## 3.1 Existing Condition

For the existing condition, data from the one-dimensional section plots were used to construct a geographic representation of the results by plotting the tsunami WSE curves as data points along their appropriate transects at their actual coordinate locations, and then gridding the entire data set of x-y-z values using a regularized spline tension (RST) algorithm to generate a surface that represents WSE for the entire area covered by the transects. The result is a surface that passes through (honoring) each data point while interpolating with a tension parameter in between transects. Contours of WSE at a one-foot interval are provided for visual reference, along with a continuous color ramp scale of elevation.

The maximum tsunami crest water surface elevation—the maximum height of the wave above mean sea level (a fixed vertical tidal datum)—is shown in Figure 3-1, where the region between the 200 ft inshore boundary and the shoreline is populated with values equivalent to the tsunami wave height at the inshore boundary. In other words, from the shoreline (0 MSL elevation contour) to 200 ft inland, the tsunami WSE is equivalent to H100 (22.5 ft). Contours of WSE at a one-foot interval are provided for reference, along with a continuous color ramp scale of WSE at lower right of the image.

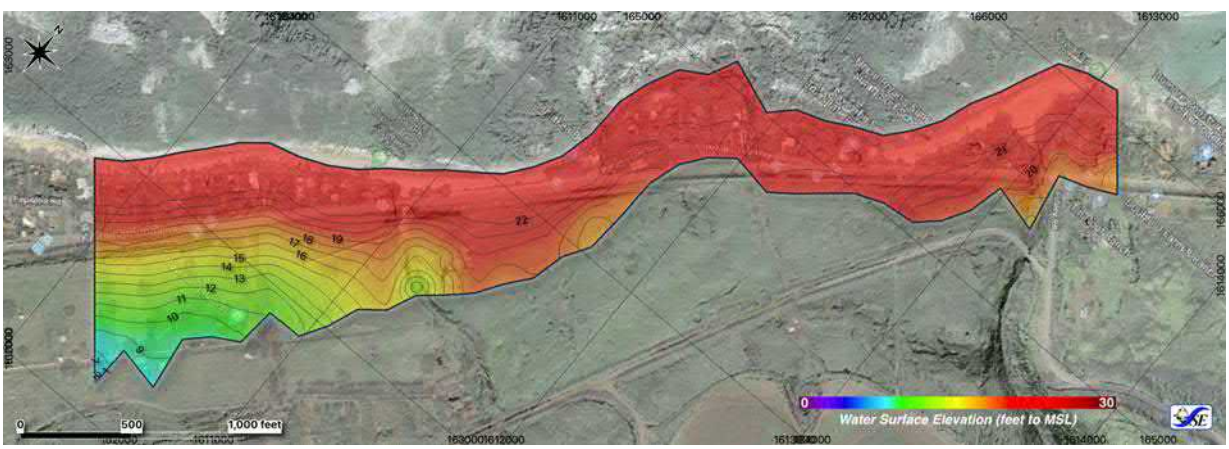


**Figure 3-1. Gridded surface of tsunami crest WSE data for existing condition (WSE contours in feet)**

Digitized layers representing FEMA's base flood elevation contours were obtained from the Hawaii Statewide GIS Program website (Flood Hazard Areas, 2020) as shapefile polygon data, and overlaid on the project base map, as presented in Figure 3 2. It is presumed that since the FIRMs used essentially the same method for the hazard zones VE (coastal high hazard areas subject to high waves and defined by the 100-year flood) and AE (combined zones also in the 100-

year flood limits), that the BFE contour values should be comparable to the calculated tsunami WSE values from this analysis.

The existing tsunami WSE data from Figure 3-1 were then overlaid on the FIRM data shown in Figure 3-2 to produce the comparison map displayed in Figure 3-3, where the thin black contours with dark black labels are for the existing WSE gridded surface, while the thick lines and black-with-white-outline labels represent FEMA's FIRM BFE data. The comparison suggests good general agreement over much of the area where there is overlap, with differences in elevation typically on the order of (± 2) feet. The only discrepancy of significance in the entire area of comparison appears to be a limited region of elevation deviation at the mauka end of transect 11, where the calculated tsunami elevation profile drops relatively quickly compared to the base flood elevation data or adjacent calculated profiles on either side. Examining the WSE contours at this location, as well as the transect plot in Figure 3-4, it appears that tsunami elevation drops down to approximately 12 ft. Neighboring transects (10 and 12) indicate a calculated WSE of approximately 16 ft, while the BFE is labeled as 18 ft for the same location, resulting in a maximum local deviation of 4 to 6 ft of water surface elevation here. However, a closer inspection of the terrain at this site (refer to Figure 2-5) reveals that the transect 11 alignment passes over an intermittent stream gulch at precisely this location, resulting in the relatively lower calculated WSE. The difference here is due to the higher resolution of the present study, which is able to resolve the gulch elevation, while the BFE interpolates across it. Aside from the above noted discrepancy, the calculated data and BFE values compare well.

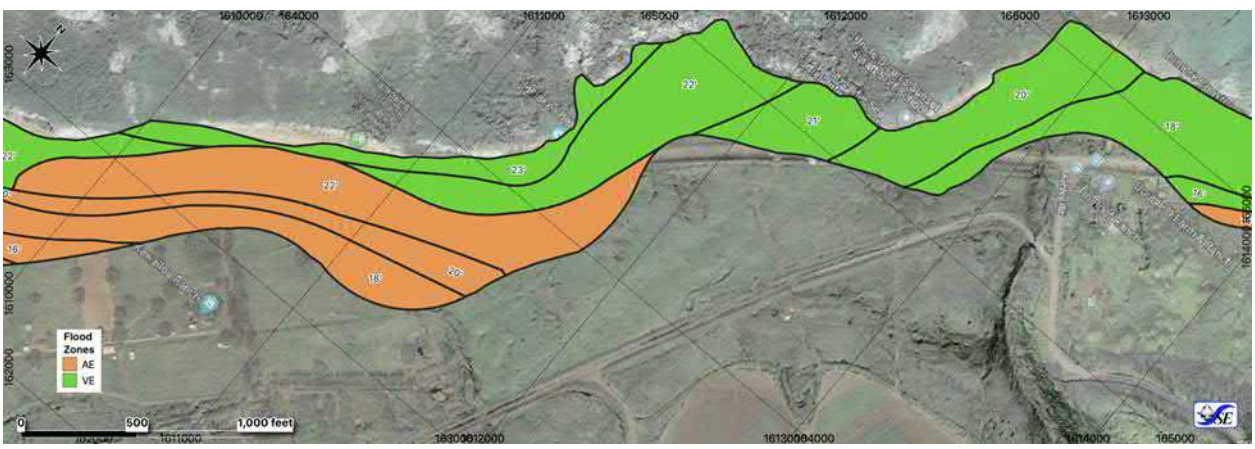


**Figure 3-2. FEMA BFE contours extracted from statewide DFIRM website**

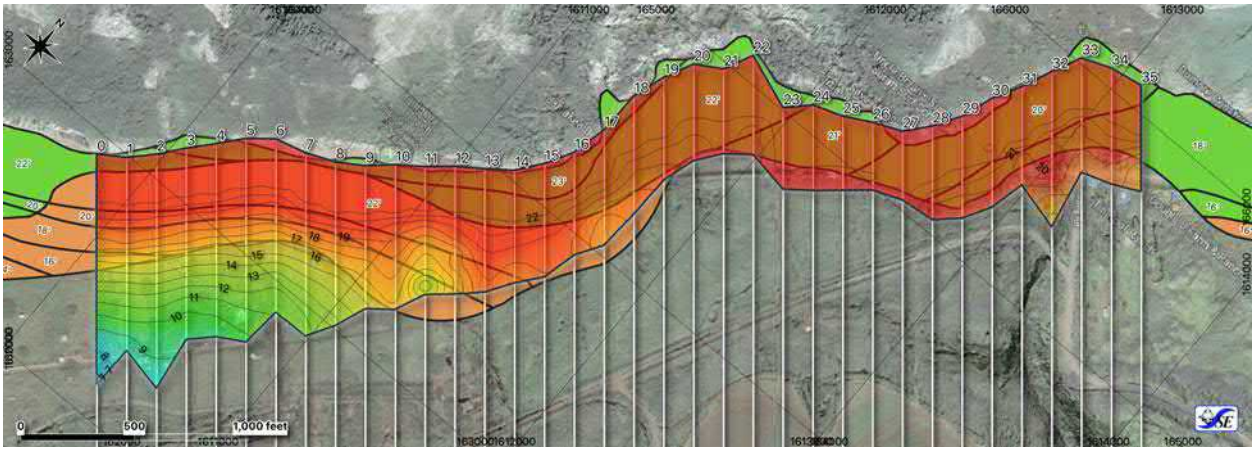


**Figure 3-3. Comparison of calculated tsunami WSE with FIRM BFE contours**

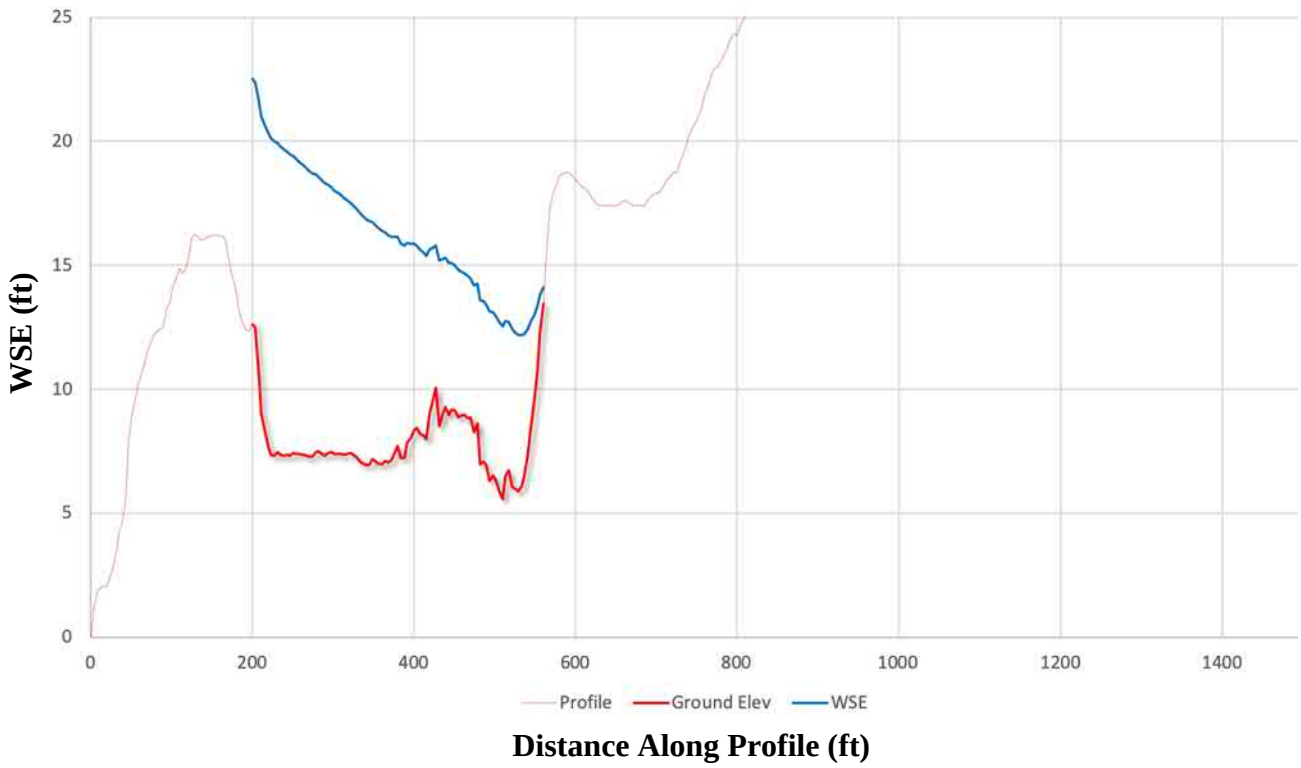


**Figure 3-4. Plot of calculated tsunami WSE with associated DTM ground elevation profile**

## 3.2 Alternative 1

In the same manner as that performed for the existing condition in the preceding section, a gridded surface of WSE was produced for Alternative 1, as shown in Figure 3-5. The results for Alternative 1 appear quite similar to those for the existing case, except for a limited region of marginal difference, primarily in the vicinity of the aforementioned stream gulch crossing, as well as the adjacent realigned roadway. The WSE plot of Alternative 1 for transect 11 (shown in Figure 3-6) is illustrative of the magnitude of difference generally experienced by this area, where the solid blue curve represents the tsunami runup elevation for Alternative 1, while the dashed blue curve

is that for the existing condition, provided for reference. The plot indicates a slight increase of runup elevation on the order of a foot directly over the road deck (200’ < x < 250’), and a larger area of lower runup elevation—on the order of less than a foot—mauka of the road deck (250’ < x < 550’).

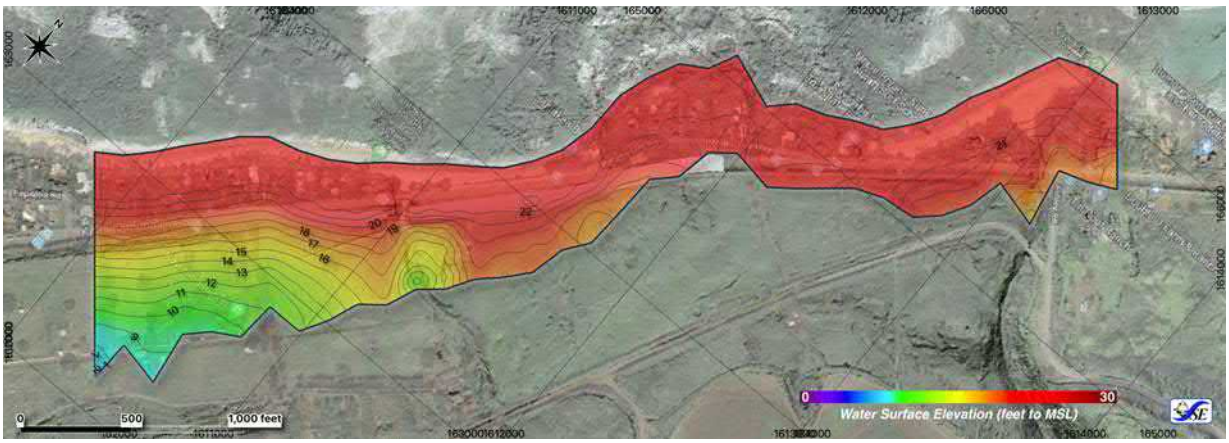


**Figure 3-5. Gridded surface of tsunami crest WSE data for Alternative 1 (WSE contours in feet)**

To reveal changes in tsunami runup due to modifications of the ground profile associated with Alternative 1 versus the existing case, a surface subtraction operation was utilized to subtract the existing condition results from Alternative 1, resulting in the difference map illustrated in Figure 3-7. In the this figure, for this particular order of subtraction [Alternative 1 – existing], negative values (darker blue color) indicate a relative drop in tsunami WSE or lowering of water depth compared to the existing condition, as shown in Figure 3-6; while increasing shades of red color, representing positive values, indicate a net increase in WSE compared to the existing condition. It can be seen in the figure that a visible area of WSE increase—by approximately 1 ft—appears over the new road deck on the northeast side of the bridge, along with an even shallower area of increase (less than 1 ft) located approximately 500 ft further down the new road alignment in the northbound direction. The maximum value for increase in WSE is approximately 1.4 feet, which is located at the center of the area that was identified adjacent to the bridge. Both of the identified areas of WSE increase (reddish hue) appear in general to be limited in depth and breadth, and to not appear to be located adjacent to any inhabitable structures. A comparatively wider area of relative decrease in WSE (bluish hue) is found along the mauka side of the new alignment, stretching from the stream gulch in the south and spanning northeastward for a length of approximately 600 to 700 ft, with an inland reach of approximately 400 ft. The bulk of this change is found along transect 12, as illustrated by the associated profile plot in
Figure 3-8.

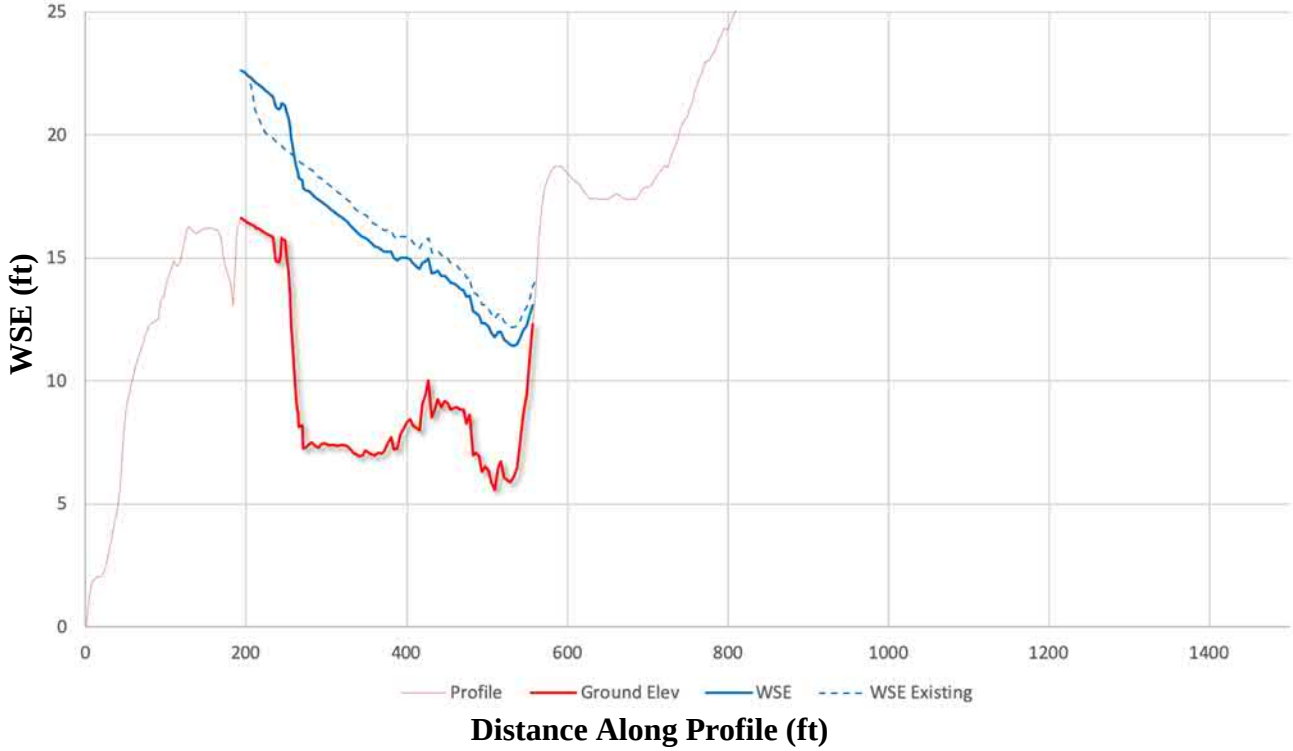


**Figure 3-6. Transect 11, showing WSE profile for Alternative 1 (solid blue) with existing WSE (dashed)**

The maximum inland extent of inundation was found to increase significantly at only one location, transect 20, which runs through the rocky headland bounding Laniakea Beach to the northeast. At this location, the northern end of Alternative 1's roadway alignment rejoins the original highway, and the calculated horizontal inundation distance increases by approximately 82 feet inland. The associated WSE plot for transect 20, shown in Figure 3-9, reveals the source of this increase—a high spot in the existing ground elevation profile (400' < x < 500') has been graded over, reducing its elevation by approximately one foot to accommodate the roadway, and subsequently allowing an increase in tsunami inundation distance based on the new lower profile. It is noted that for Figure 3-9, the WSE curves for the existing condition and Alternative 1 are coincident for the range (200' < x < 420').

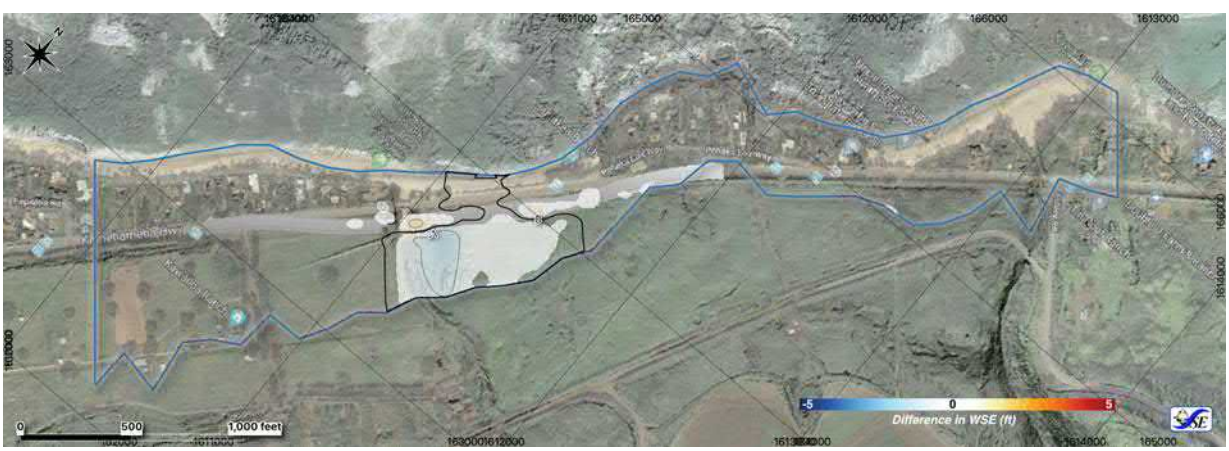


**Figure 3-7. Difference map of tsunami WSE [Alternative 1 - Existing] (WSE contours in feet)**

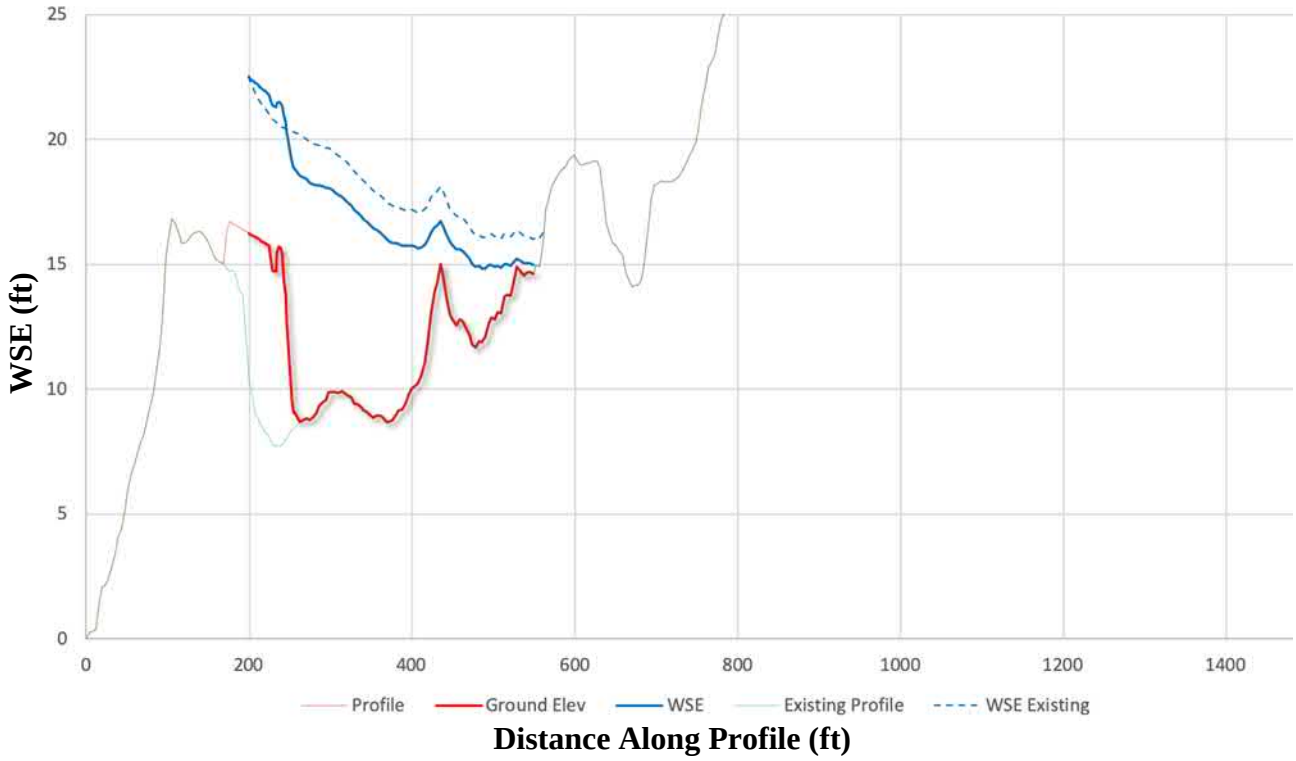


**Figure 3-8. Transect 12, showing WSE profile for Alternative 1 (solid blue) with existing WSE (dashed)**

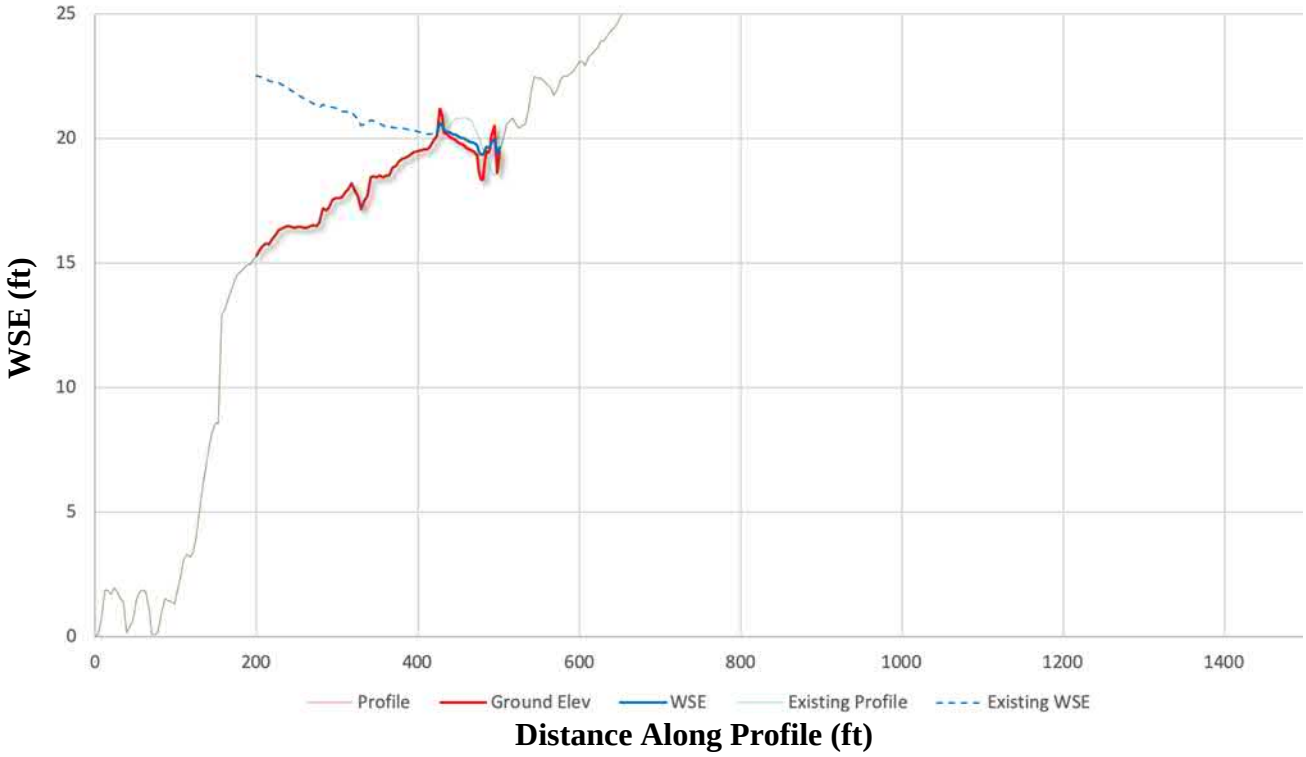


**Figure 3-9. Transect 20, showing WSE profile for Alternative 1 (solid blue) with existing WSE (dashed)**

## 3.3 Alternative 2

Replicating the method of the previous two sections, for the existing case and Alternative 2, a gridded surface of WSE was likewise produced for Alternative 2 and presented in Figure 3-10. Similar to Alternative 1, results for Alternative 2 are also generally quite comparable to the existing condition, with some limited areas of discrepancy.

Using the surface subtraction method presented in the previous section, a difference map [Alternative 2 – existing] for Alternative 2 reveals four notable areas of change, as shown in Figure 3-11. The most significant area of change is located near the southwest end of Laniakea Beach, where the proposed road realignment begins to split off from the existing alignment. The profile plot of transect 11, presented in Figure 3-12 reveals an increase in magnitude of calculated WSE of nearly 5 feet over the new road deck (200' < x < 400'). From Figure 3-11, it can be seen that this zone of significantly increased WSE appears to span approximately from transect 9 to 13, centered on the proposed new road alignment, and reaching approximately 200 ft to 300 ft inland; although mauka of the roadway, the level of increase is much smaller and is on the order of one foot. A small area of WSE relative reduction appears mauka of the roadway, at the southern end of the new alignment, lowering WSE values by approximately half a foot. Two additional, however less notable, areas of WSE increase are found elsewhere; one on the makai side of the northern alignment merge in the vicinity of transects 28 and 29, and another spanning the roadway makai-to-mauka as it crosses the stream gulch near Chun's Reef, at the northern end of the proposed realignment in the vicinity of transect 32—both regions exhibiting a relative maximum increase of approximately one-to-two feet (Figure 3-12). None of the significant areas of change identified above appear to be directly over or adjacent to inhabitable structures, except for the northernmost area, identified near transect 32, which appears to be approximately 100 ft mauka of a private residence near Chun's Reef.

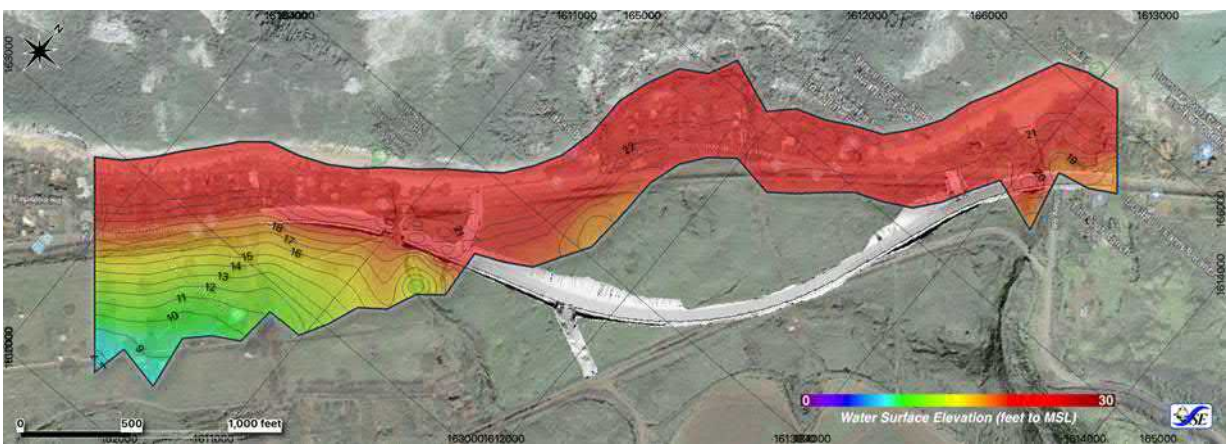


**Figure 3-10. Gridded surface of tsunami crest WSE data for Alternative 2 (WSE contours in feet)**

**Figure 3-11. Difference map of tsunami WSE [Alternative 2 - Existing] (WSE contours in feet)**

The calculated results for Alternative 2 revealed some noteworthy decreases in horizontal inundation distance, particularly at transects 13 through 15, and also at transects 28 through 31, located at the south and north ends of the proposed realignment, respectively. For example, the WSE plot for transect 13 shown in Figure 3-14 illustrates the substantial increase in grade—greater than 5 ft in height from the existing condition—for the new roadway and supportive embankment ($350 < x < 450$ ft inland), which together appear to block further landward propagation of the tsunami wave. According to the calculations, maximum horizontal inundation extent is reduced by approximately 173 ft at this location. Neighboring adjacent transects show reductions ranging from 46 to 95 ft.

Likewise, the WSE plot for transect 30 at the northern end of the proposed realignment, presented in Figure 3-15, also indicates a sizeable rise in grade due to the proposed roadway and associated earthworks ($400 < x < 500$ ft inland), suggesting that the structures act to block further propagation of the tsunami beyond its seaward-facing flank, located at approximately 400 ft inland. Compared to the existing condition, horizontal inundation extent is reduced by approximately 85 ft at this location. Nearby adjacent transects similarly show declines in inundation extent, ranging from 31 to 79 ft of reduction.

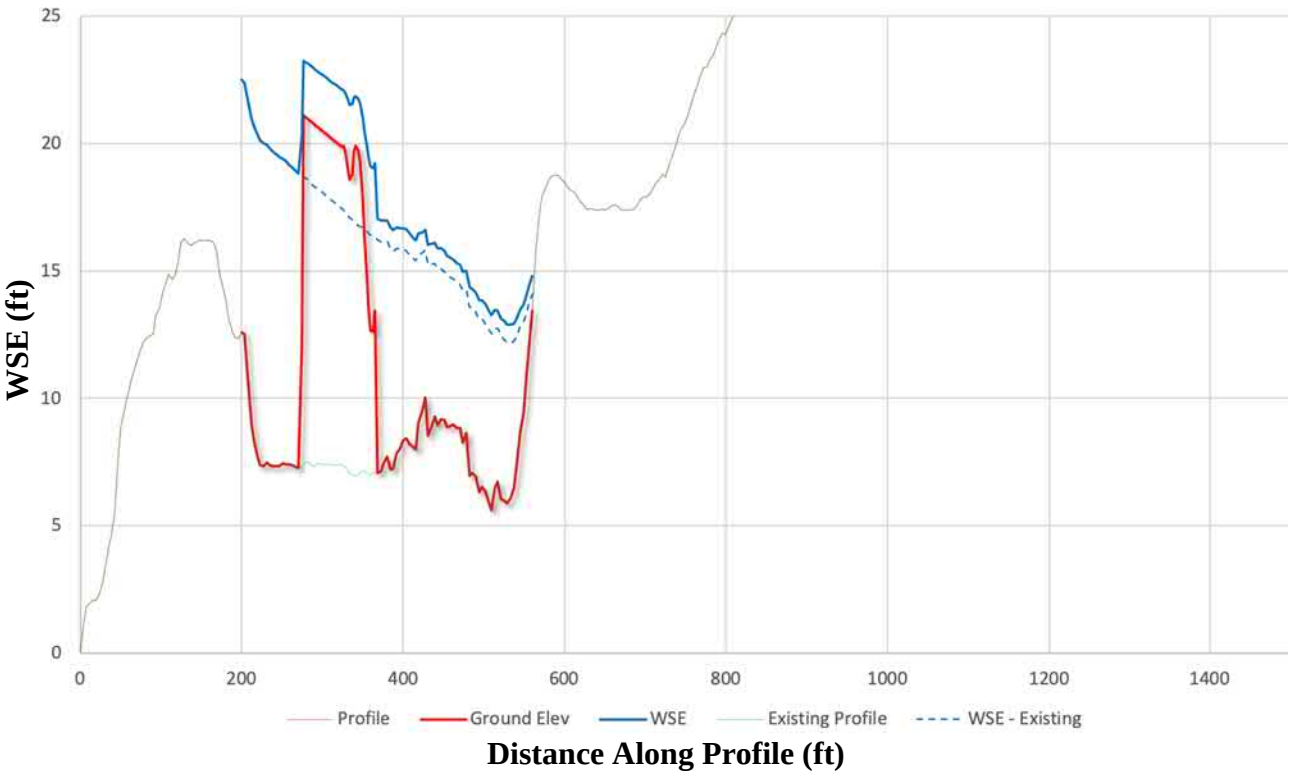


**Figure 3-12. Transect 11, showing WSE profile for Alternative 2 (solid blue) with existing WSE (dashed)**

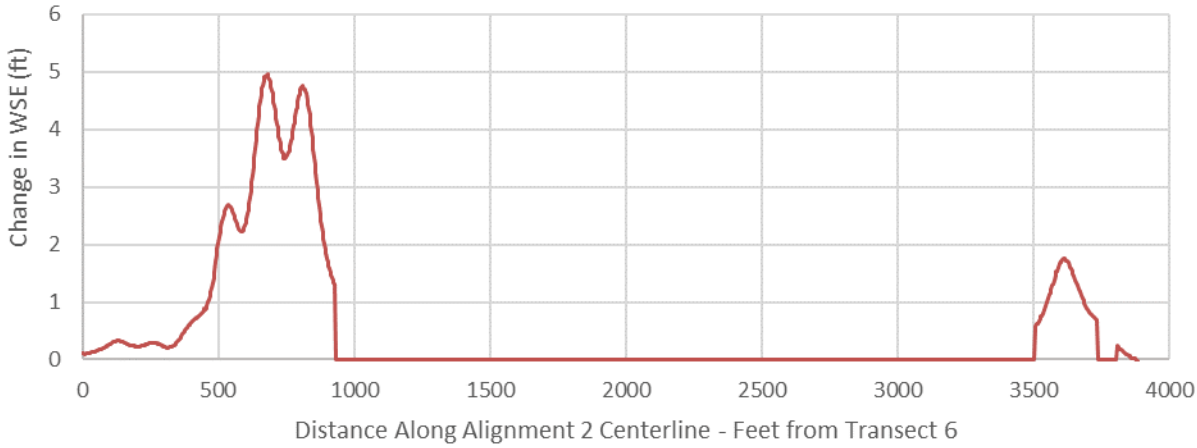


**Figure 3-13. Profile of WSE change over Alt. 2 centerline, from transect 6 to 34**

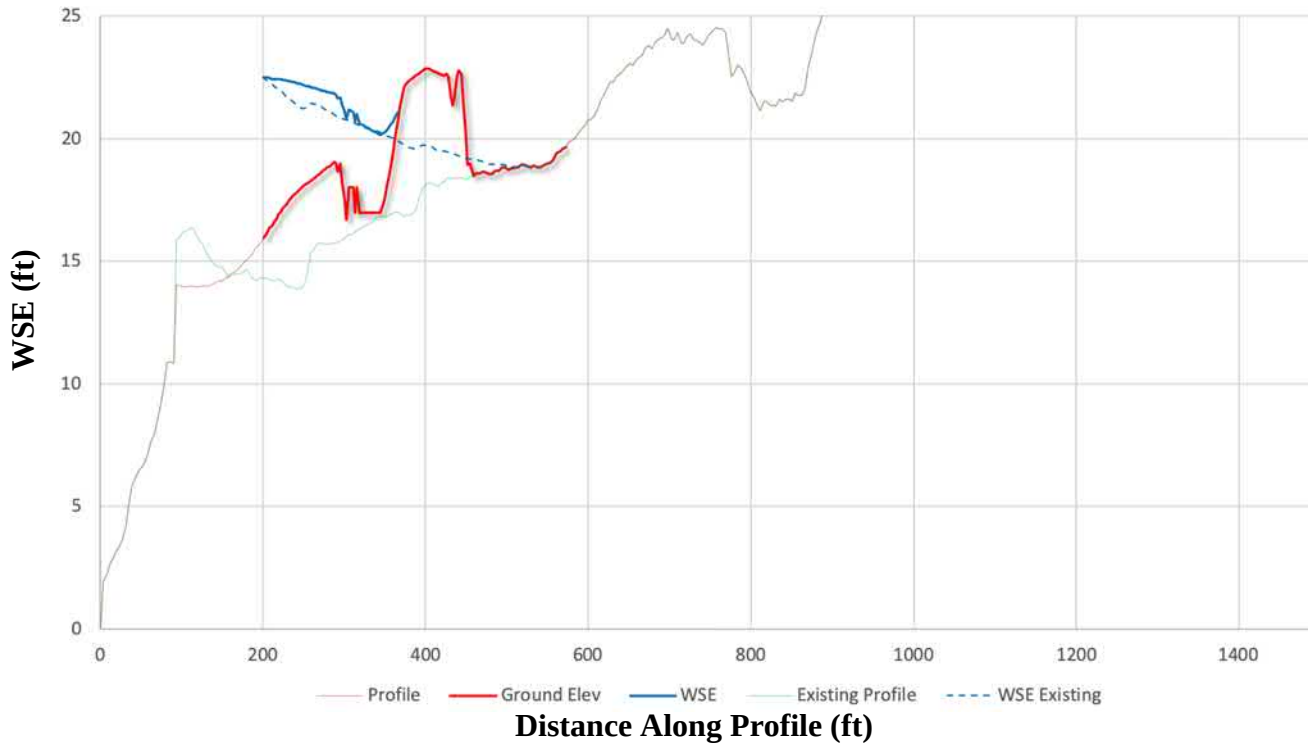


**Figure 3-14. Transect 13, showing WSE profile for Alternative 2 (solid blue) with existing WSE (dashed)**

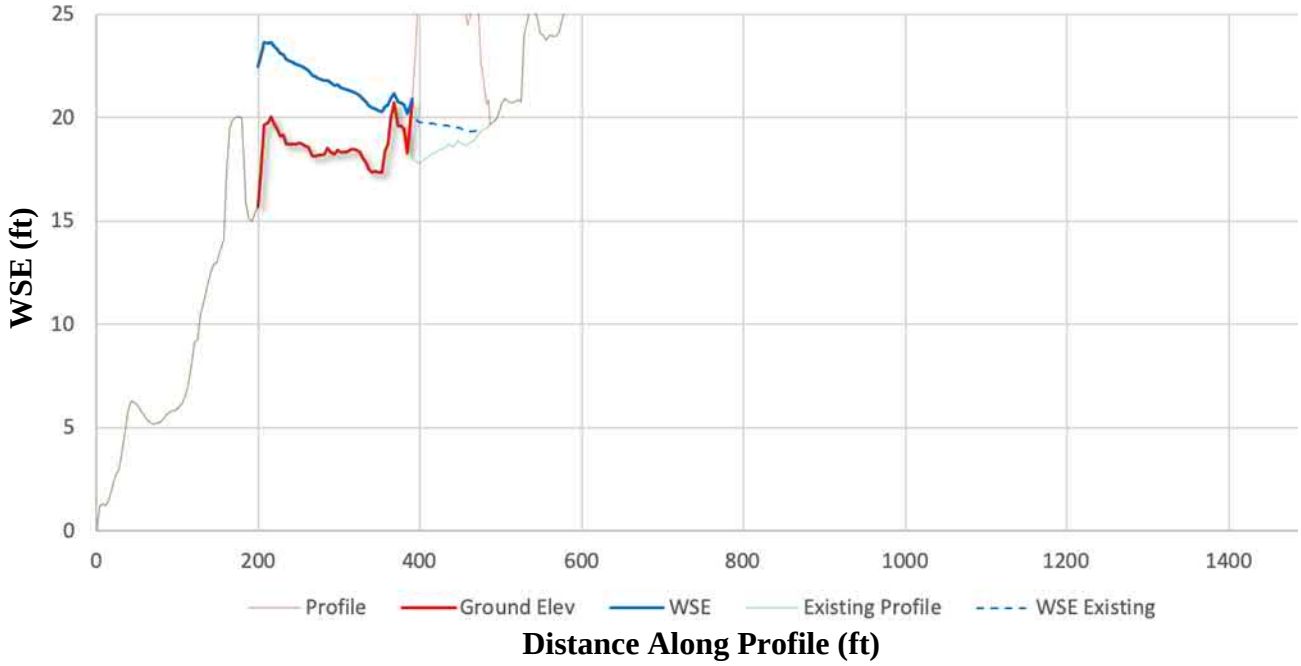


**Figure 3-15. Transect 30, showing WSE profile for Alternative 2 (solid blue) with existing WSE (dashed)**

## 3.4 Summary

The maximum horizontal inundation distances for each transect, including for the existing condition and each alternative, is provided in Table 3-1. Calculated Tsunami Horizontal Inundation Distances (all units in feet). Based on the results in the table, change in maximum inland inundation from the existing condition is illustrated graphically by the bar plot in Figure 3-16, where a positive quantity indicates an increase in inland inundation distance along the transect while a negative quantity signals a reduction in inundation distance from existing conditions. The results in Figure 3-16 indicate that tsunami inundation distances are increased significantly at only one location (transect 20), by approximately 80 ft, and for only one of the alternatives (Alternative 1).

The increase in inundation distance at this location can be linked directly to the removal or grading over of an existing high spot the ground elevation profile necessary to construct the proposed road realignment. Calculations show that removal of this high spot allows the tsunami to propagate approximately an additional 80 feet. Otherwise, it appears that Alternative 2 may actually mitigate—to a limited degree—existing horizontal inundation limits at a handful of locations, including the aforementioned transects 13 through 15 and transects 28 through 31. The trade-off however, for Alternative 2's reduction of horizontal inundation distances, is the higher tsunami crest water level elevation (or WSE) levels revealed at the north and south ends of the proposed roadway, as discussed in Section 3.3.

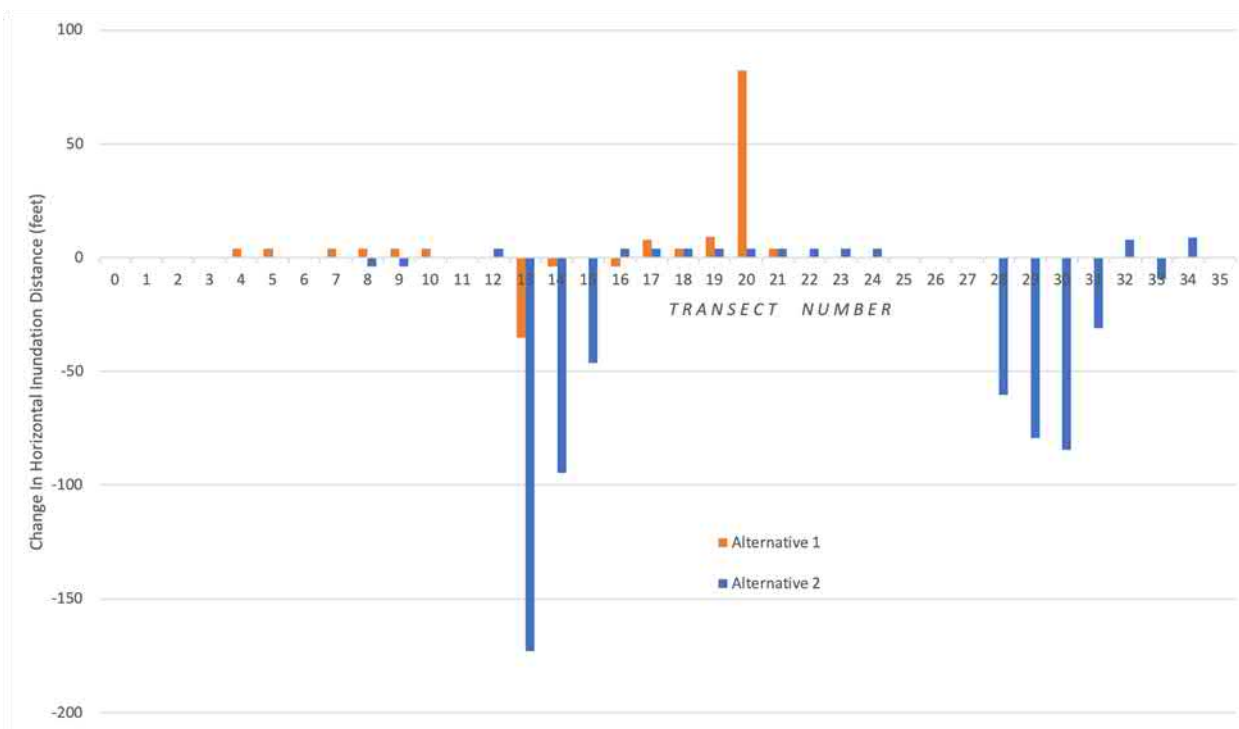


**Figure 3-16. Horizontal inundation distance change from existing (e.g., existing - alternative)**

**Table 3-1. Calculated Tsunami Horizontal Inundation Distances (all units in feet)**

| Transect Number | Existing Condition | Realignment Alternative 1 | Realignment Alternative 2 | Δ Existing - Alternative 1 | Δ Existing - Alternative 2 |
|---|---|---|---|---|---|
| 0 | 964.26 | 964.26 | 964.26 | 0.00 | 0.00 |
| 1 | 846.67 | 846.67 | 846.67 | 0.00 | 0.00 |
| 2 | 1,026.97 | 1,026.97 | 1,026.97 | 0.00 | 0.00 |
| 3 | 838.83 | 838.83 | 838.83 | 0.00 | 0.00 |
| 4 | 846.67 | 850.59 | 846.67 | 3.92 | 0.00 |
| 5 | 893.70 | 897.62 | 893.70 | 3.92 | 0.00 |
| 6 | 760.43 | 760.43 | 760.43 | 0.00 | 0.00 |
| 7 | 803.55 | 807.47 | 803.55 | 3.92 | 0.00 |
| 8 | 717.31 | 721.23 | 713.39 | 3.92 | -3.92 |
| 9 | 627.16 | 631.08 | 623.24 | 3.92 | -3.92 |
| 10 | 635.00 | 638.92 | 635.00 | 3.92 | 0.00 |
| 11 | 560.52 | 560.52 | 560.52 | 0.00 | 0.00 |
| 12 | 560.52 | 560.52 | 564.44 | 0.00 | 3.92 |
| 13 | 540.93 | 505.65 | 368.02 | -35.28 | -172.91 |
| 14 | 493.89 | 489.97 | 399.34 | -3.92 | -94.55 |
| 15 | 497.81 | 497.81 | 451.54 | 0.00 | -46.27 |
| 16 | 450.77 | 446.85 | 454.69 | -3.92 | 3.92 |
| 17 | 505.65 | 513.49 | 509.57 | 7.84 | 3.92 |
| 18 | 517.41 | 521.33 | 521.33 | 3.92 | 3.92 |
| 19 | 450.77 | 459.75 | 454.69 | 8.98 | 3.92 |
| 20 | 423.33 | 505.65 | 427.25 | 82.31 | 3.92 |
| 21 | 372.38 | 376.30 | 376.30 | 3.92 | 3.92 |
| 22 | 435.09 | 435.09 | 439.01 | 0.00 | 3.92 |
| 23 | 356.70 | 356.70 | 360.62 | 0.00 | 3.92 |
| 24 | 376.30 | 376.30 | 380.22 | 0.00 | 3.92 |
| 25 | 325.34 | 325.34 | 325.34 | 0.00 | 0.00 |
| 26 | 297.90 | 297.90 | 297.90 | 0.00 | 0.00 |
| 27 | 301.82 | 301.82 | 301.82 | 0.00 | 0.00 |
| 28 | 411.57 | 411.57 | 351.05 | 0.00 | -60.52 |
| 29 | 446.85 | 446.85 | 367.45 | 0.00 | -79.40 |
| 30 | 478.21 | 478.21 | 393.70 | 0.00 | -84.51 |
| 31 | 431.17 | 431.17 | 400.26 | 0.00 | -30.91 |
| 32 | 682.04 | 682.04 | 689.88 | 0.00 | 7.84 |
| 33 | 501.73 | 501.73 | 492.12 | 0.00 | -9.60 |
| 34 | 509.57 | 509.57 | 518.37 | 0.00 | 8.80 |
| 35 | 466.45 | 466.45 | 466.45 | 0.00 | 0.00 |

In summary, results from the one-dimensional modeling for the existing condition compare well with FEMA's FIRM maps and BFE contours. Results also suggest that both realignment alternatives may have the capacity for trapping the tsunami in limited areas due to the barrier effect of the elevated road decks, potentially causing a localized increase (compared to existing) of tsunami water surface elevation levels on the order of 2 to 5 ft adjacent to or over the proposed new roadways. However, it also appears that the proposed realignment options—alternative 2 in particular—may have the ability to reduce the extent of maximum inland inundation, in some locations reduced on the order of 100 to 200 feet.

In conclusion, results of the 1-D tsunami modeling show that predicted inland inundation distances are affected significantly only by Alternative 1, and only at one of the 35 total calculation transects (Transect 18). Inundation distance at this location is increased by approximately 80 ft compared to the existing condition. There are no apparent habitable structures mauka of Kamehameha Highway along this transect, nor along the transects on either side of it, that could be affected by this predicted increase in inundation (based on current aerial images used in this study). Alternative 2 shows no significant increases in inundation distances, and actually appears to shorten existing inundation distances along several transects, likely due to the built-up ground elevation from berms and a raised highway corridor of this alternative. The FEMA method (See Section 2.1) of tsunami crest elevation calculation utilized by this study starts, by definition, at a location 200 ft inland from the shoreline, as illustrated in Figure 2-4 and Figure 2-9. For the region between the shoreline and 200 ft inland, the FIRM maps suggest the tsunami elevation is held constant. As shown in Figure 2-4, the vast majority of homes included in the study area lie within (i.e., seaward of) this offset, and are therefore within the area assumed not to change in this method and not included in inundation equation. In order to investigate the effects on tsunami crest elevation throughout the regional area incorporating the details of the topography, a more sophisticated modeling approach would be required. Advanced modeling methods, such as the use of computational fluid dynamics (CFD), which are capable of capturing the complex flow field and hydrodynamic processes, would be needed to quantify changing water surface elevations due to complicated environments.

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APPENDIX A

FULL-SIZED FIGURES

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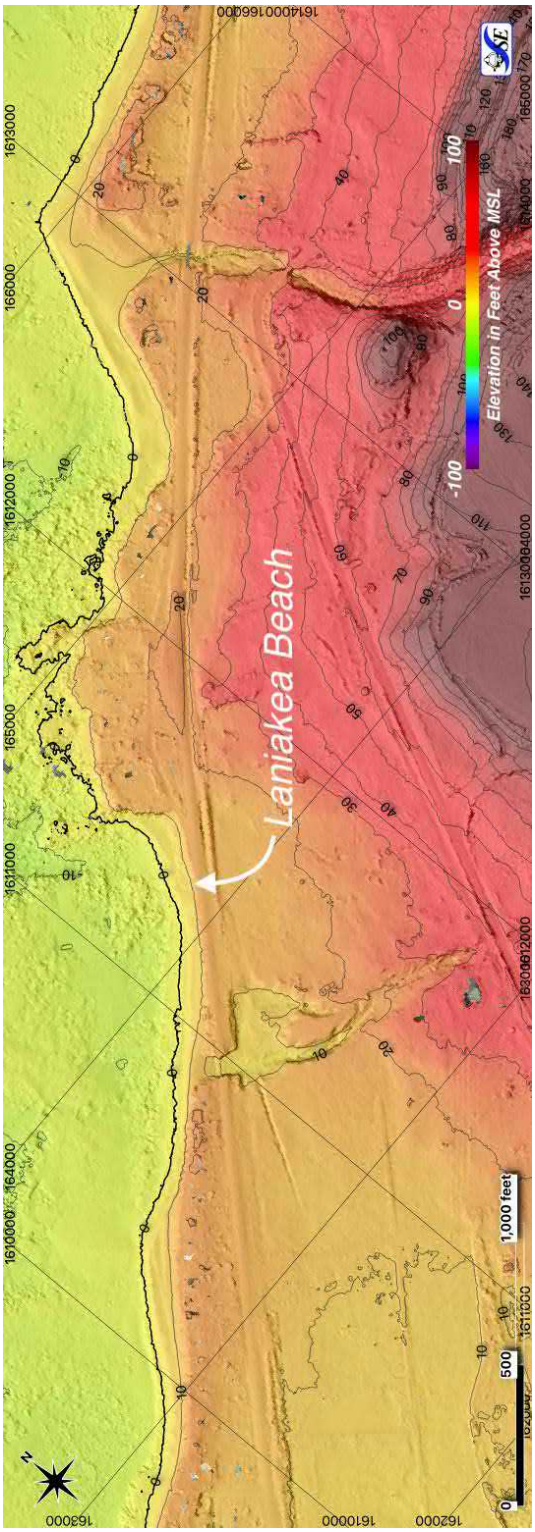
Figure 2-2

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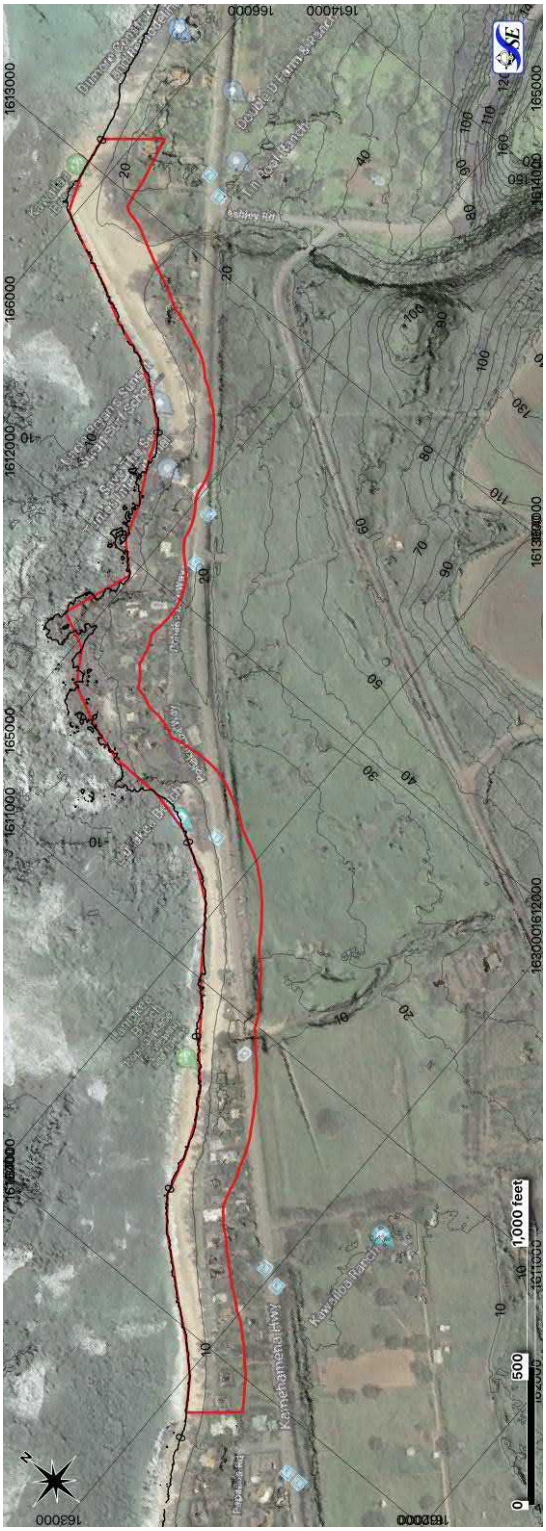


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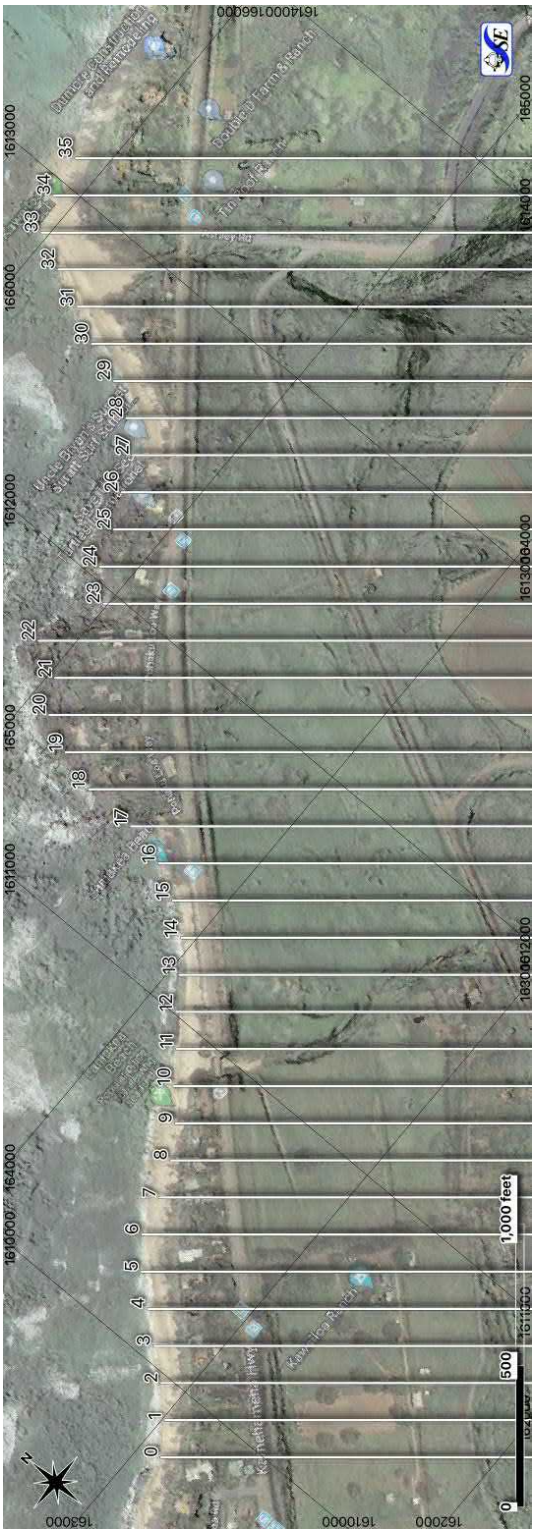


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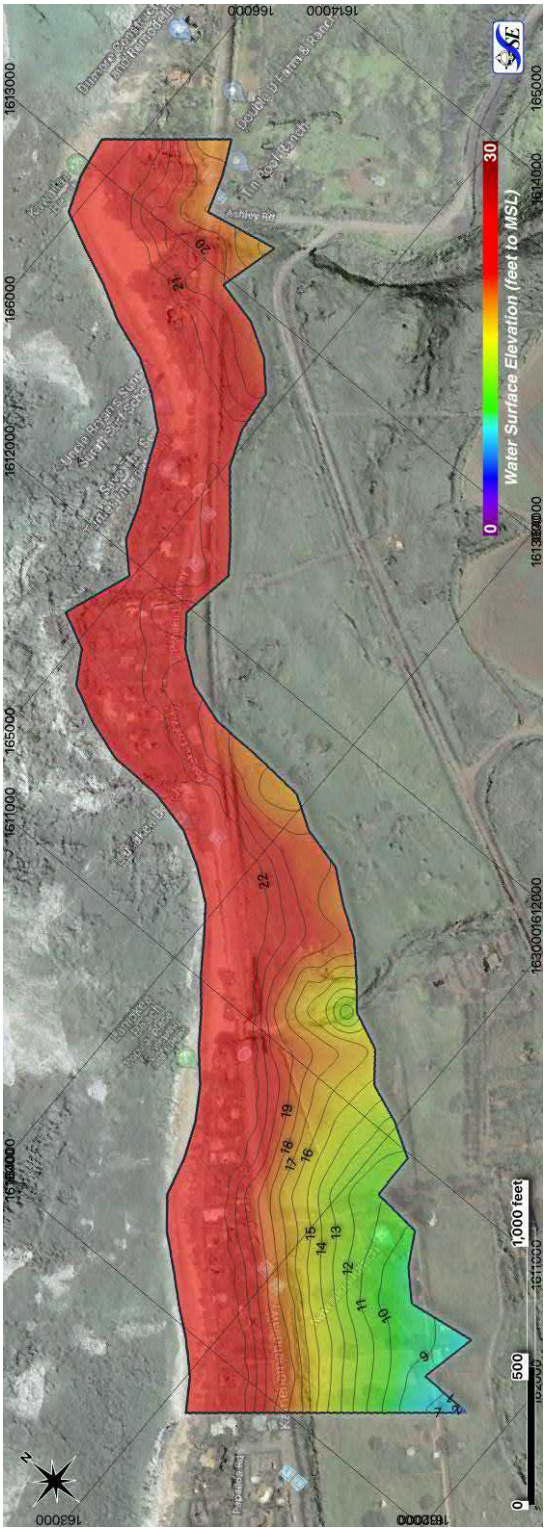


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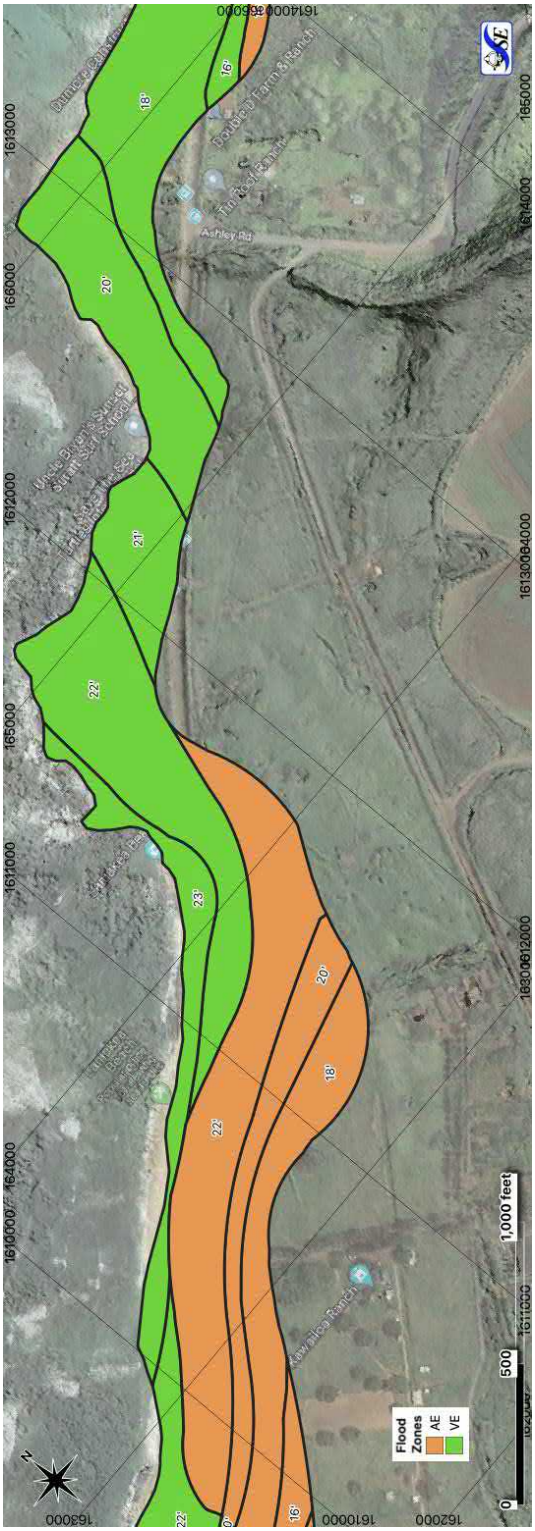
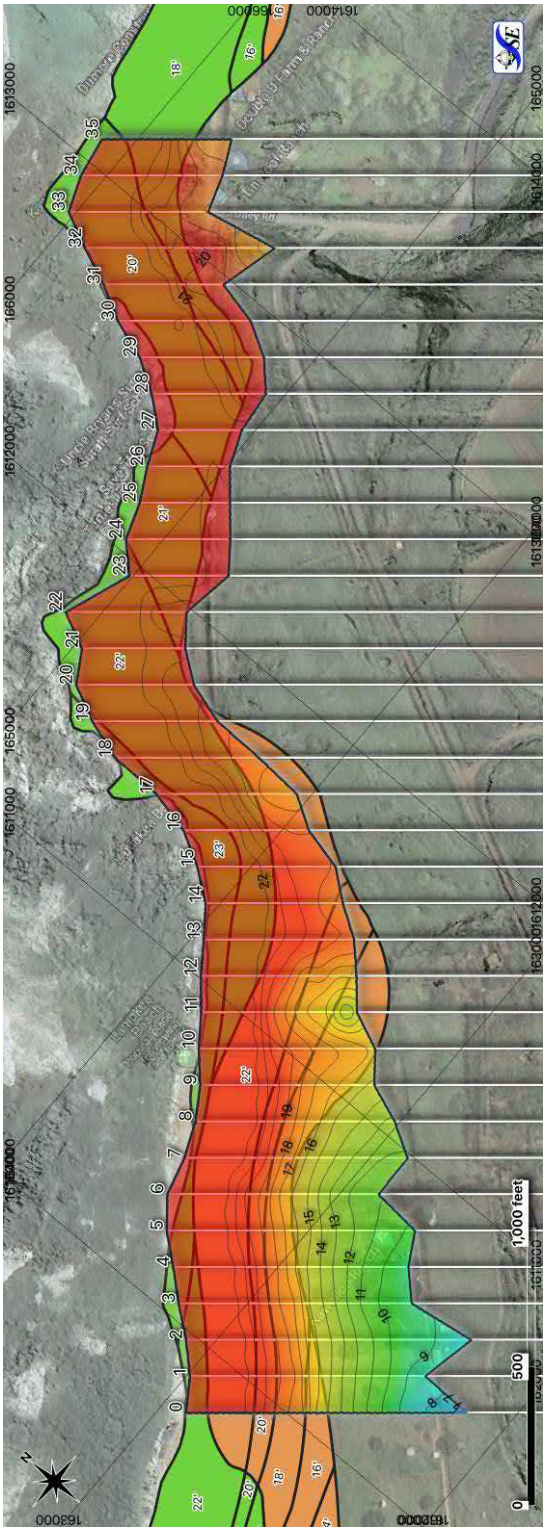



Figure 3-2

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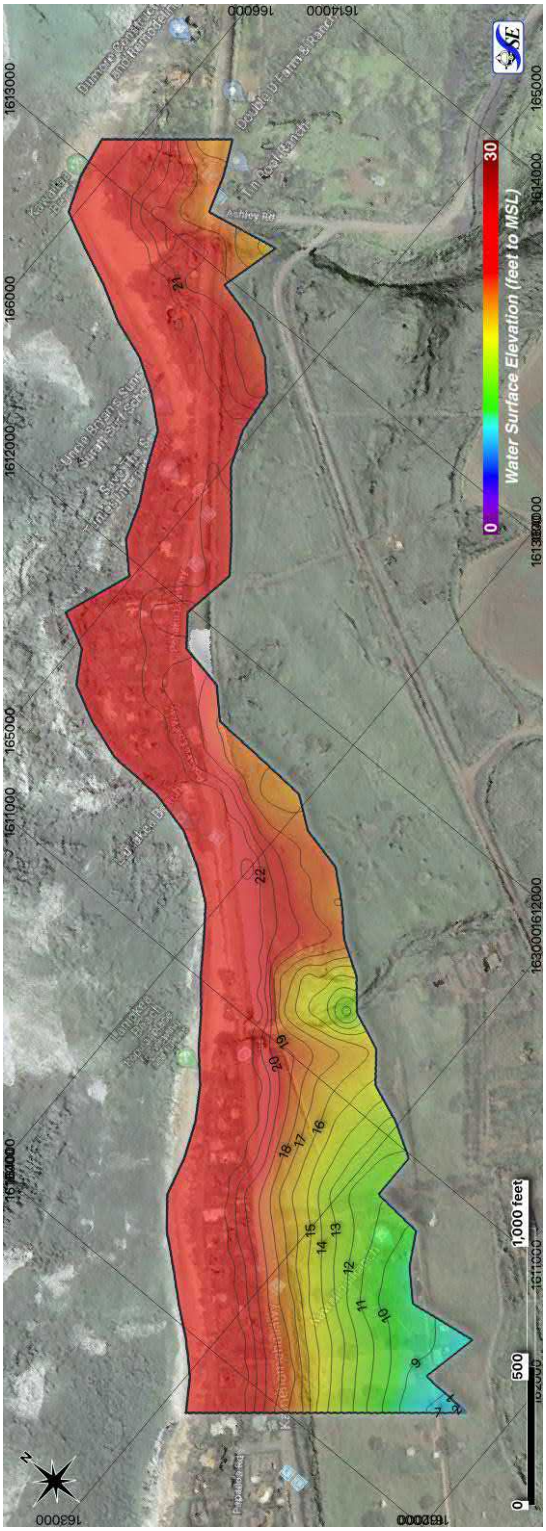


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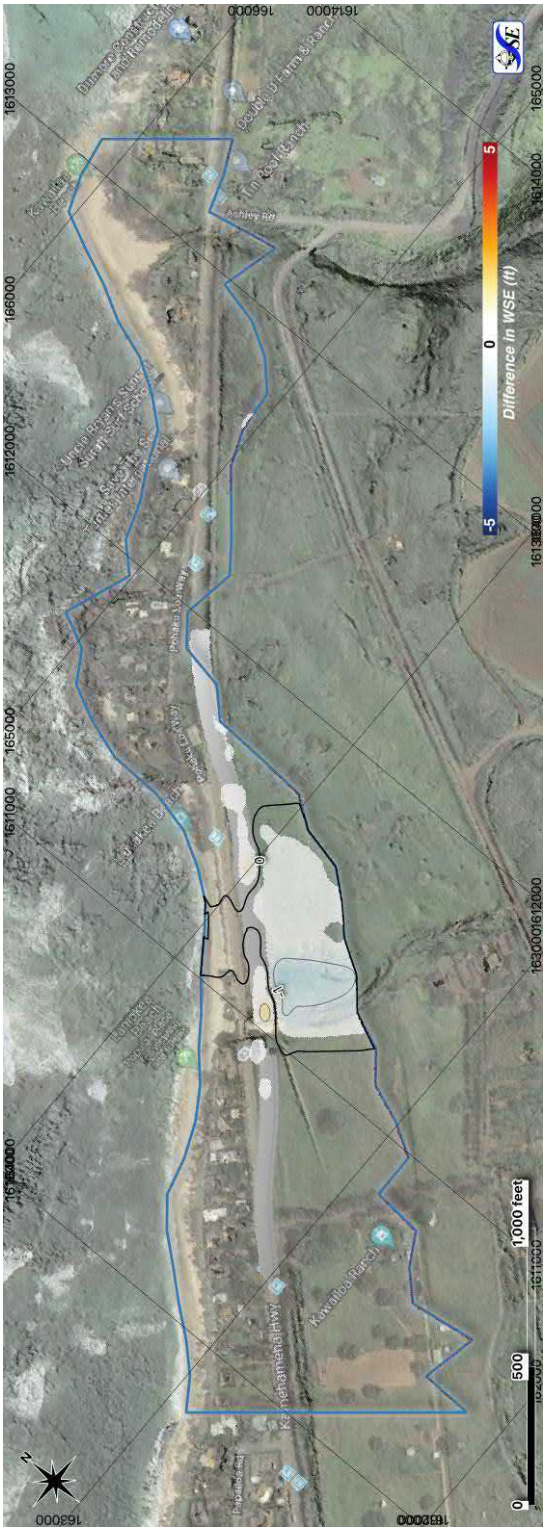


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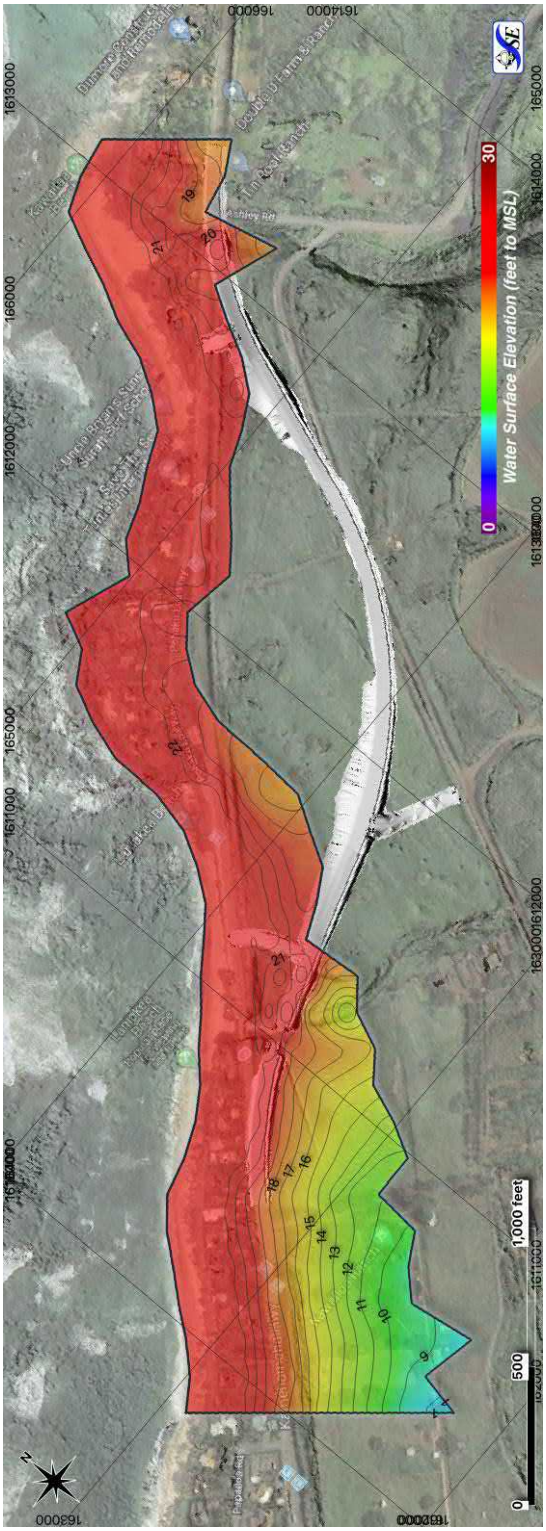


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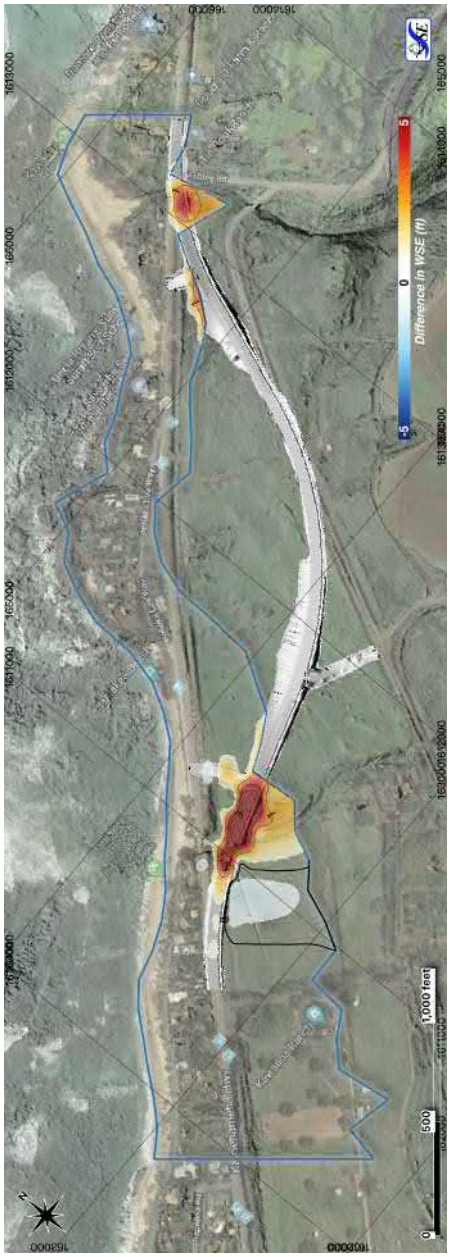


Figure 3-11

# APPENDIX B

# WATER SURFACE ELEVATION PLOTS

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Appendix

# J

# Traffic Noise Technical Report

TECHNICAL REPORT

# Kamehameha Highway Pedestrian Safety Project
# Vicinity of Laniakea Beach
# Traffic Noise

Haleiwa, Island of Oahu, Hawaii

March 2021

Prepared for:
State of Hawaii
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813

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# EXECUTIVE SUMMARY

The purpose of this report is to analyze the traffic noise impacts of the proposed realignment of Kamehameha Highway (Route 83) in the vicinity of Laniakea Beach (Figure 2-1), on the island of Oahu. The Hawaii State Department of Transportation (HDOT) is proposing to realign the highway to improve pedestrian safety, system reliability, and local access to beach and private property, while working to improve overall system mobility with the new alignment.

Two realignment Build alternatives are being considered: (1) the "Pedestrian Shift" Alternative, which would shift the highway roughly 80 feet mauka from the centerline of the existing highway alignment to the centerline of the proposed realigned highway; and a "Most Realignment" Alternative, which would shift the highway further mauka to near the base of the steeper slope where a former cane haul road exists. No-Build and Transportation System Management (TSM) alternatives are also being considered. Typical lane configurations on Kamehameha Highway with the proposed Project area are shown in Figure 2-2.

Land uses closest to the Project area include residences, ranching and agricultural land, windmills, and undeveloped land.

Short-term and long-term measurements were conducted by Parsons Brinckerhoff on October 1st and 2nd, 2014. Noise levels measured were used to validate the FHWA Traffic Noise Model (TNM) at six sites. TNM was then used to model existing and future worst-hour traffic noise levels (Table 3-4 and Table 4-2). WSP conducted site visits in November and December of 2019 to confirm consistency between the sound levels and noise sources documented in 2014.

Worst-hour traffic noise levels were modeled with updated traffic data for existing conditions (year 2015) and future year 2030. Existing traffic noise levels approached or exceeded the Noise Abatement Criteria (NAC) at five residences and at two areas of Laniakea Beach closest to Kamehameha Highway. Existing modeled worst-hour traffic noise levels range from 44 dBA to 66 dBA (Table 3-4). The six sites modeled to experience existing noise levels that approach or exceed the NAC are located adjacent to and makai of Kamehameha Highway.

Worst-hour future-year traffic noise levels without the proposed Project (2030) would approach or exceed the NAC at 14 residences and at two areas of Laniakea Beach closest to Kamehameha Highway. Future year modeled worst-hour traffic noise levels without the Project range from 45 dBA to 67 dBA

(Table 4-2). The 15 modeled sites predicted to experience future noise levels that approach or exceed the NAC without the Project are located adjacent to and makai of Kamehameha Highway.

Worst-hour future-year traffic noise levels with the proposed Project (2030) would approach or exceed the NAC with the "Pedestrian Shift" Alternative at 6 residences and 1 formerly planned park and with the "Most Realignment" Alternative at 1 residence. Future-year modeled worst-hour traffic noise levels with the Project range from 45 dBA to 67 dBA with the "Pedestrian Shift" Alternative and range from 45 dBA to 66 dBA with the "Most Realignment" Alternative (Table 4-2). The 6 sites modeled to experience future noise levels that approach or exceed the NAC with the "Pedestrian Shift" Alternative are located adjacent to and makai of Kamehameha Highway near the southern end of the Project area. Only one site modeled experienced future noise levels that approach or exceed the NAC with the "Most Realignment" Alternative and is located adjacent to and makai of Kamehameha Highway near the southern end of the Project area.

Noise abatement was considered at all 6 sites predicted to experience noise levels that would approach or exceed the NAC with both Project Alternatives; however, noise abatement would be not feasible at all 6 locations.

During Project construction, adjacent areas would be exposed to construction noise in addition to traffic-related noise. Impacts during construction are of short duration and standard specifications for noise control would minimize or eliminate impacts during construction.

Based on the modeling results and future traffic volumes and speeds included in this report, areas within 200 feet of Project improvements along Kamehameha Highway (for both alternative alignments) may experience noise levels that exceed the HDOT residential and recreational land use noise abatement criteria of 66 dBA. Commercial areas located within 50 feet of Kamehameha Highway (for both alternative alignments) may exceed the commercial abatement criteria of 71 dBA. It is recommended that the local officials use this information as a guide when developing future land use plans, zoning, or building code requirements. The use of this information may assist local government with future development plans and thereby result in development that is consistent with the noise environment.

# CHAPTER 1
# INTRODUCTION

This traffic noise study has been initiated to support the National Environmental Policy Act (NEPA) and Hawaii Environmental Policy Act (HEPA) Environmental Assessment (EA) for the Kamehameha Highway Pedestrian Safety Project. The purpose of this report is to analyze noise impacts of the proposed improvements to Kamehameha Highway in the vicinity of Laniakea Beach, on the island of Oahu.

This study evaluates the existing conditions and Future conditions with two build alternatives. Worst-hour traffic noise levels were modeled with traffic data for existing condition year 2015 and Future year 2030.

This study was prepared in accordance with FHWA rules and procedures (FHWA 2010) and HDOT Noise Analysis and Abatement Policy (HDOT, 2016). Its elements include:

1. Measurements of existing noise levels at representative noise sensitive receivers;
2. Prediction of future traffic noise levels;
3. Comparison of existing and predicted future traffic noise levels with the FHWA Noise Abatement Criteria (NAC);
4. Noise impact assessment;
5. The effects of construction noise and consideration of mitigation measures; and
6. Information to local planning officials.

# CHAPTER 2
# PROJECT DESCRIPTION

HDOT is proposing to realign the Kamehameha Highway near Laniakea Beach (Figure 2-1) to improve the public highway system in terms of pedestrian safety, mobility, and reliability while supporting local access to this public beach and private property. Two Build Alternatives are being considered: (1) the "Pedestrian Shift" Alternative, which would shift the highway roughly 80 feet mauka from the centerline of the existing highway alignment to the centerline of the proposed realigned highway; and a "Most Realignment" Alternative, which would shift the highway further mauka to near the base of the steeper slope where a former cane haul road exists. No-Build and Transportation System Management (TSM) alternatives are also being considered. The Build Alternatives share the following characteristics:

- Highway right-of-way would typically be 60 feet wide, but adjusted narrower or wider depending on needs related to the proposed improvements and existing constraints.
- A highway with two 12-foot wide through lanes (one in each direction).
- Vehicular guardrails on the mauka side of Kamehameha Highway prior to construction of the new alignments.
- Bus stops.
- Bicycle and pedestrian facilities consisting of a 16-foot wide shared use path on a portion of the existing Kamehameha Highway. The remaining portion of the highway would be removed and revegetated.
- Permanent stormwater best management practices (BMPs) to address highway stormwater runoff.

The alternatives would retain the current roadway capacity by providing one through lane in each direction. Pedestrian and bicycle facilities would be included along the old Kamehameha Highway for both Build alternatives. The Project is included in the current Statewide Transportation Improvement Program (STIP) and the Hawaii Long Range Land Transportation Plan. Project construction is expected to be completed in roughly 18 months, including design and construction, from HDOT receiving Notice to Proceed with the Project if the "Pedestrian Shift" Alternative is selected. If the "Most Realignment" Alternative is chosen, the duration of the necessary design, permiting, and construction processes may take approximately 6 years. The typical lane configurations that the proposed Project would use are shown in Figure 2-2.

## 2.1 "PEDESTRIAN SHIFT" ALTERNATIVE

The "Pedestrian Shift" Alternative generally consists of realigning Kamehameha Highway mauka roughly 80 feet from its current location from the Haleiwa side of Lauhulu Stream bridge to the Haleiwa side of Kawailoa Stream bridge, a distance of roughly 0.44 mile.

This alternative would include the items discussed above and be designed in compliance with the guidelines indicated to the degree possible. Additional components and details of this alternative would include:

- Vehicular guardrails could be placed on the mauka side of the existing Kamehameha Highway during the Project design and construction phases.
- A normal asphalt road structure with underlying concrete reinforcement on the makai side to protect the road from eroding.
- A 10-foot wide median refuge lane for part of the distance.
- Vehicular guardrail to prevent parking on the mauka side of the shifted highway.
- Existing cross streets and driveways would be modified to allow access to the shifted Kamehameha Highway.
- Turn lanes as deemed necessary at the intersections of the realigned Kamehameha Highway and existing cross streets.
- One new bridge at Lauhulu Stream (on the Haleiwa side of Laniakea Beach). The existing bridge at Laniakea Stream would remain.
- A vehicle control gate on Pohaka Loa Way.
- Under this alternative it is proposed that the permanent stormwater BMPs will consist of the construction / installation of a grassed swale on the mauka side of the highway for stormwater treatment.

## 2.2 "MOST REALIGNMENT" ALTERNATIVE

The "Most Realignment" Alternative generally consists of realigning Kamehameha Highway mauka as far as feasible from a location on the Haleiwa side of the Laniakea Stream bridge to the Waimea side of Ashley Road; a distance of roughly 0.8 mile. The realigned highway would cross the relatively low-sloped coastal plain and run along the base of the relatively steeper "pali" where a former cane haul road exists.

This alternative would include the characteristics discussed above along with these additional components:

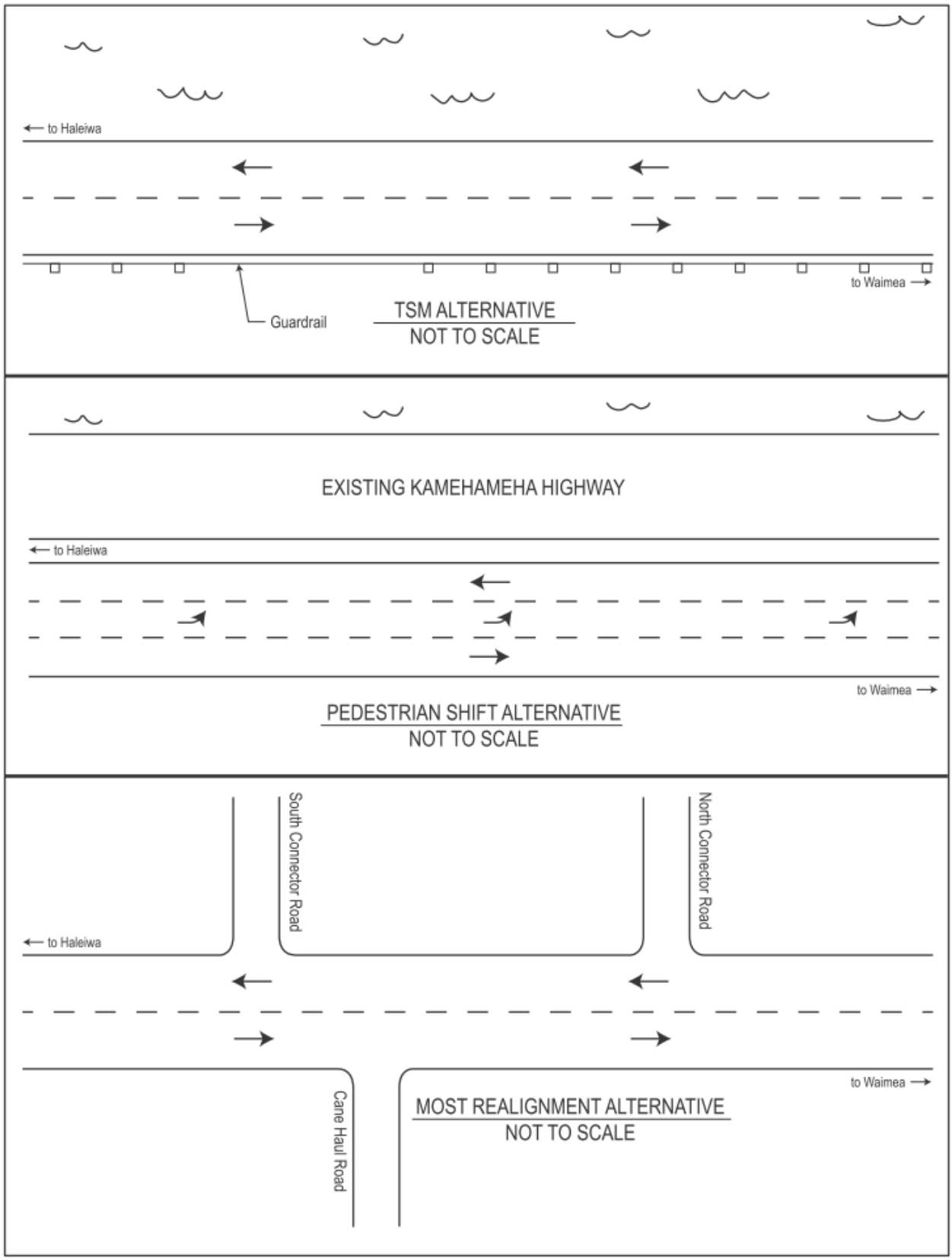
- Vehicular guardrails could be placed on the mauka side of the existing Kamehameha Highway during the Project design and construction phases.
- Two new roads connecting the realigned Kamehameha Highway to the existing highway alignment. These connector roads would have the following general design:
  - Typically a 60-foot wide ROW.
  - Typically two 10-foot wide travel lanes wtih four-foot wide shoulders.
- Connector road intersections with Kamehameha Highway would be stop controlled (stop sign for the connector road only).

- Existing driveways would be modified to allow access to the realigned Kamehameha Highway.
- A vehicle control gate on Pohaka Loa Way.
- New Cane Haul connector road.
- Two new bridges. One at Laniakea Stream (on the Haleiwa side of Laniakea Beach) and one at Kawailoa Stream (near Chun's Reef Beach).
- Under this alternative it is proposed that permanent stormwater BMPs consist of a stormwater swale on the mauka side of the highway.

Figure 2-1. Project Location and Project Alternatives

WSP, 2020

Figure 2-2. Existing and Proposed Project Lane Configurations




WSP, 2020

# CHAPTER 3
# EXISTING NOISE ENVIRONMENT

## 3.1 BACKGROUND

Noise is defined as any sound that is undesirable or interferes with normal human activities. The decibel (dB) scale is used to quantify sound intensity and represents the ratio between a given sound and the faintest sound detectable by human hearing. Because sound pressure levels vary widely within the range of human hearing, the dB scale is logarithmic. The human ear is not equally sensitive to all frequencies within the entire sound spectrum. Accordingly, noise measurements are made using an A-weighting (dBA) scale to correspond to human perceptions of noise. A-scale sound levels are currently in use in many community and city noise ordinances and in state and city highway traffic noise codes.

Time variation in noise exposure is typically accounted for as a constant energy level equivalent (Leq) for a given time period. The Leq is the constant noise level over a specified period of time that is equivalent in energy to a fluctuating (or brief) noise "averaged" over that period of time. Leq is also a function of time and is expressed as Leq (time period). For example, Leq(h), expressed in A-weighted decibels (dBA), is the calculated constant noise over one hour which is equivalent in total energy to the varying noise levels actually measured during that one hour.

## 3.2 NOISE STANDARDS

The HDOT Noise Analysis and Abatement Policy implements FHWA regulations on noise abatement (23 CFR 772) for the State of Hawaii. The regulations and policy require that a noise analysis be performed whenever potentially affected receivers exist, either as developed lands or lands that are planned, designed, or programmed for future use.

Projects requiring traffic noise studies include one of the following characteristics:

1. Construction of a highway in a new location; or
2. Substantial horizontal or vertical alteration of an existing highway; or
3. Addition of through traffic lane(s) or most auxiliary lanes including restriping existing pavement to add through traffic lane(s) or auxiliary lane(s); or
4. Addition or relocation of interchange lanes or ramps; or

5. Addition of a new or substantial alteration of a weigh station rest stop, ride-share lot or toll plaza; or

6. If a project meets one of the Type I project criteria presented above, the entire project area is defined as a Type I project for inclusion in the traffic noise study.

The Type I project definition that this project meets is the inclusion of a substantial horizontal and vertical shift in highway alignment.

FHWA has established the Noise Abatement Criteria (NAC), shown in Table 3-1, for different exterior and interior land use activities. The NAC do not constitute legally-enforceable noise standards, but represent a yardstick for evaluating the effect of Project noise on the surrounding community. The NAC established by FHWA have been adopted by the State of Hawaii as its standard.

Under HDOT policy, a noise impact occurs when the predicted traffic noise levels approach or exceed the NAC, or when the predicted traffic noise levels substantially exceed the existing noise levels. "Approach" means at least 1 dBA less than the NAC, and "substantially exceed the existing noise levels" means an increase of at least 15 dBA. If the NAC are approached or exceeded, or if there is a substantial increase above the existing noise level, noise abatement measures must be considered.

Changes in traffic noise are assessed using human perceptions of sound level changes. Generally, changes in noise levels of less than 3 dBA are barely perceptible to most listeners, but a change of 10 dBA is perceived as a doubling (or halving for a decrease) of noise levels. These guidelines permit estimation of an individuals probable perception of changes in noise levels.

Table 3-1. FHWA NAC

| Activity Category | Activity Leq(h) dBA[1] | Criteria [2] L10(h) | Evaluation Location | Description of Activity |
|---|---|---|---|---|
| A | 57 | 60 | Exterior | Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose. |
| B[3] | 67 | 70 | Exterior | Residential. |
| C[3] | 67 | 70 | Exterior | Active sports areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas Section 4(f) sites, schools, televisions studios, trails, and trail crossings. |

| | | | | |
|---|---|---|---|---|
| D | 52 | 55 | Interior | Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios. |
| E[3] | 72 | 75 | Exterior | Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F. |
| F | ---- | ---- | ---- | Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities, (water resources, water treatment, electrical), and warehousing. |
| G | ---- | ---- | ---- | Undeveloped lands that are not permitted. |

Notes: [1] Either Leq(h) or L10(h) (but not both) may be used on a Project.
[2] The Leq(h) and the L10(h) Activity Criteria values are for impact determination only, and are not design standards for noise abatement measures.
[3] Includes undeveloped lands permitted for this activity category.
L10(h) is the noise level exceeded for 10% of the time of the measurement duration (one hour).
Source: Federal Highway Administration

## 3.3 EXISTING AND FUTURE NOISE-SENSITIVE LAND USES

Existing and future noise sensitive land uses and activities adjacent to the Kamehameha Highway Pedestrian Safety Project and nearby major roadways were identified from site inspections and existing land use mapping. Where private parcels are present on the makai side of the highway, residential uses (Category B land use activity) dominate with two former residential parcels now being owned by the City and County of Honolulu for use as a park (land use Category C). Category B and Category C activities have an exterior NAC of Leq(h) 67 dBA. Land use on the mauka side of the highway is dominated by ranching and agricultural uses (Category F land use category). Category F land use activities do not have corresponding noise impact thresholds. There is one residence on the mauka side of the highway; the Tin Roof Ranch is both an agricultural operation and residence.

Mauka of the Project area, above the pali on Ashley Road, is a windfarm with windmills among the agriculture fields. Previously these fields were used for sugar cultivation but are now used for seed corn and other crops. On the Haleiwa side of the Project area is the town of Haleiwa, a commercial (land use Category E) and residential town popular with visitors. Category E activities have an exterior NAC of Leq(h) 72 dBA. Kamehameha Highway, State Route 83, previously went through the town of Haleiwa. State Route 83 now bypasses Haleiwa town and is known as the Joseph P. Leong Highway. On the Waimea side of the Project area the general development trends continue – residential uses on the makai side of the highway and agricultural uses on the mauka side; however, more residential uses are being developed on the mauka side both before and after Waimea Bay, a nonprofit botanical garden and cultural park.

There are no pending or proposed modifications to the State land use districts in the Project area. The current land uses are also consistent with the City and County of Honolulu land use zoning. The residential areas on the makai side of the highway are zoned R-5 and the agricultural areas on the mauka side of the highway are zoned AG-1. Because the current land uses are consistent with zoning, no significant changes in land use are anticipated.

The City and County of Honolulu had plans to develop two beach parks: the "Laniakea Beach Support Park" near Laniakea Beach and "Kawailoa Beach Park" near Chun's Reef Beach. EAs have been completed for these two beach park projects but the City and County of Honolulu no longer intends to develop these facilites. The Laniakea Beach Support Park was planned for the mauka side of Kamehameha Highway and the Kawailoa Beach Park consisted of areas on both the mauka and makai side of Kamehameha Highway. The parks were planned to generally consist of parking areas, comfort stations (bathrooms and showers), and landscaped areas.

Kamehameha Schools' "Moku O Waialua North Shore Plan, Paalaa to Kapaeloa" plan outlines potential projects on their land holdings (roughly 26,200 acres) in the region, which includes the majority of the land on the mauka side of Kamehameha Highway in the Project area.

## 3.4 NOISE MEASUREMENT SITES

In 2014 short-term (15 to 30 minutes) and long-term (24 hours) measurements were taken at six locations along the Project study area to describe the existing noise environment. Field measurements offer a baseline for establishing existing ambient noise levels in the area and are used for estimating future noise levels by adding ambient levels to other noise levels generated by the proposed Project. The field measurements were conducted in accordance with FHWA guidelines (Parsons Brinckerhoff, 2014).

The ambient noise environment in the vicinity of the Project is comprised of several noise sources including vehicular traffic traveling on the highway itself. Other noise sources that are typically audible in the area include landscaping, wildlife, and neighborhood pets. Atmospheric conditions also influence noise levels in the area with variable ocean tides and wind patterns. A 24-hour noise measurement was conducted between October 1 and 2, 2014 that shows that hourly sound levels range from 55 to 64 dBA Leq from midnight to 8:00 a.m. with sound levels ranging from 66 to 69 dBA Leq during daytime hours (Parsons Brinckerhoff, 2014).

For this study, the six short-term measurements located near Kamehameha Highway were used to validate the traffic noise model. The location of the short-term measurements is illustrated on Figure 3-1 land uses and measured noise levels at each site described in Table 3-2.

Short-term measurements were conducted for 15 minutes to obtain an equivalent sound level during free-flowing traffic conditions. Vehicular traffic counts and traffic mix were documented during the measurement periods. The noise measurements were taken using a Larson-Davis Laboratories, Model 820, Type-1 integrating sound level meter together with a Larson-Davis microphone. This equipment satisfies the ANSI S1.4-1983 specification and has been certified by the manufacturer within the recommended 2-year calibration period. The microphone and sound level meter were mounted on a tri-pod and a windscreen covered the microphone throughout the duration of each measurement.

HDOT was contacted to identify any noise complaints received within the Project corridor. At the time of this report, no complaints are on file at HDOT relating to traffic noise along this area of Kamehameha Highway and no complaints from the community about experiencing louder nighttime traffic noise levels than during daytime hours (HDOT, 2019). Site observations indicated that short-term measurement periods provided sufficient traffic noise levels with free-flow traffic conditions for noise model validation to support prediction of worst-hour, or loudest hour, traffic noise levels.

WSP conducted site visits in November and December of 2019 to confirm consistency between the sound levels and noise sources documented in 2014.

Figure 3-1. Short-Term Noise Measurement Locations

Source :WSP (Parsons Brinckerhoff), 2015

## 3.5 MODELING SITES

Forty-four residential sites and one recreation area were modeled to evaluate existing noise levels and future noise levels with and without the Project Alternatives. Modeling locations will also provide information to local authorities to predict noise levels at undeveloped properties along the Project area. Modeling locations were placed at outdoor areas of frequent human use facing Kamehameha Highway. The approximate location of each modeled site is illustrated in Figures 3-2, 4-1, 4-2, and 4-3.

### 3.5.1 Sites MD1 to MD6 and MD8 to MD20

Modeling Sites MD1 through MD6 and MD8 through MD19 were chosen to represent noise levels at first row residences located on the makai side of Kamehameha Highway between Papailoa Road and Laniakea Beach. Modeling locations are within 100 feet of the existing Kamehameha Highway alignment.

### 3.5.2 Site MD7

Modeling Site MD7 was added to the noise model to represent the residence closest to Project improvements on the mauka side of Kamehameha Highway between Papailoa Road and Laniakea Beach. Site MD7 is within 200 feet of the existing Kamehameha Highway alignment.

### 3.5.3 Site MD20

Modeling Site MD7 was added to the noise model to represent outdoor use at Laniakea Beach. Site MD20 is within 100 feet of the existing Kamehameha Highway alignment.

### 3.5.4 Sites MD21 to MD30

Modeling Sites MD21 through MD30 were chosen to represent noise levels at residences located on the makai side of Kamehameha Highway along Pohaku Loa Way. Modeling locations are within 200 feet of the existing Kamehameha Highway alignment.

### 3.5.5 Sites MD31 to MD42

Modeling Sites MD31 through MD42 were chosen to represent noise levels at first row residences located on the makai side of Kamehameha Highway east of Ashley Road. Modeling locations are within 100 feet of the existing Kamehameha Highway alignment.

### 3.5.6 Site MD43

Modeling Site MD43 was added to the noise model to represent properties on the mauka side of Kamehameha Highway between Papailoa Road and Laniakea Beach. Site MD43 is located approximately 500 feet east of the existing Kamehameha Highway alignment.

### 3.5.7 Site MD44

Modeling Site MD44 was added to the noise model to represent properties on the mauka side of Kamehameha Highway east of Ashley Road. Site MD44 is located approximately 100 feet east of the existing Kamehameha Highway alignment.

### 3.5.8 Site MD45

Modeling Site MD45 was added to the noise model to represent properties on the mauka side of Kamehameha Highway west of Ashley Road. Site MD45 is located approximately 625 feet east of the existing Kamehameha Highway alignment.

## 3.6 MODEL CALIBRATION

The traffic noise prediction model was calibrated to adjust the model to actual site conditions. Model calibration is performed by adjusting calculated future noise levels by adding a constant derived from the difference between measured and calculated noise levels at representative sites. The distinction between calculated and predicted noise levels is as follows:

- Calculated noise levels (existing or future) are the results of the model.
- Predicted noise levels are adjusted or “calibrated” modeled values.

If there is reasonable agreement between measured and model noise levels (within 3.0 dBA), a calibration factor is not used to adjust the existing and future noise levels.

FHWA Traffic Noise Model (TNM) version 2.5 was used to model existing traffic noise levels at the measurement sites along the existing Kamehameha Highway and the sites along the proposed Project Alternatives (Figure 2-1). Geometries of the existing roadway and noise modeling sites were entered into the model. Traffic volumes counted during the short-term measurement periods were scaled up to one-hour volumes and entered into the model along with the measured vehicle speeds.

There is reasonable agreement between measured and modeled noise levels (within 2.0 dBA) for all the measured sites along Kamehameha Highway. All modeling sites were modeled to show existing and future noise levels at outdoor areas of frequent human use.

Table 3-2. Noise Measurement Data and TNM Model Validation

| Site ID | Site Location | Land Use | Date of Measurement and Start Time | Measured Leq(h), dBA | Modeled Noise Level for Calibration Leq(h), dBA | Difference between Modeled and Measured Noise Level Leq(h), dBA |
|---|---|---|---|---|---|---|
| 1 | Laniakea Beach/ Kamehameha Hwy | Residential | 10/1/14; 1:39 p.m. | 74 | 72 | -2 |
| 2 | Across Street from 61427 Kamehameha Hwy | Residential | 10/1/14; 10:44 a.m. | 65 | 65 | 0 |
| 3 | Adj to 61-499 Kamehameha Hwy | Residential | 10/1/14; 2:05 p.m. | 72 | 71 | -1 |
| 4 | 61-540 Pohaku Loa Way | Residential | 10/1/14; 11:21 a.m. | 72 | 72 | 0 |
| 5 | Chuns Reef/ Kamehameha Hwy | Recreation | 10/1/14; 12:15 p.m. | 63 | 64 | 1 |
| 6 | 61635 Kamehameha Hwy | Residential | 10/1/14; 11:52 a.m. | 73 | 71 | -2 |

Note : All measurements were taken at outdoor use areas for 15 minutes
Modeled Noise Levels Leq(h) are within 3 dBA of measured values indicating the model is correctly calibrated.

## 3.7 EXISTING NOISIEST TRAFFIC HOUR

To determine the existing worst-hour traffic noise levels, traffic data was used for Existing Year 2015 developed in the traffic analysis for the Kamehameha Highway Realignment (WSP USA, 2020). Input variables to noise modeling and analysis include traffic volumes, speeds, and vehicle fleet mix (auto, medium truck, and heavy truck percentages). The existing vehicle mix to be 97.5 percent autos, 1.5 percent medium trucks, 0.5 percent heavy trucks, and 0.5 percent buses for all roadways. Table 3-3 shows the existing worst-hour traffic volumes.

Table 3-3. Existing 2015 (Worst-Hour) Traffic Volumes

| Roadway | From Cross Street | To Cross Street | Northbound Vehicles per Hour | Southbound Vehicles per Hour | Posted Speed Limit (MPH) |
|---|---|---|---|---|---|
| Kamehameha Highway | From North | Pohaku Loa Way | 742 | 710 | 35 |
| Kamehameha Highway | At Cross Street | Pohaku Loa Way | 742 | 710 | 35 |
| Kamehameha Highway | From South | Pohaku Loa Way | 742 | 710 | 35 |

Note : Traffic volumes from Kamehameha Highway Pedestrian Safety Traffic Analysis, WSP USA, 2020.

Figure 3-2. Predicted Existing Worst-Hour Traffic Noise Levels

Source :WSP, 2020

## 3.8 RESULTS OF EXISTING YEAR NOISE MODELING

Table 3-4 presents the modeled existing worst-hour (PM peak hour) traffic noise levels, the number of receptors represented by each measurement site, and the NAC for each of the short-term and modeled measurement locations. Existing modeled worst-hour traffic noise levels for residential areas range from 44 dBA to 66 dBA (Table 3-4). Modeling sites primarily represent noise levels at outdoor areas at first row homes located adjacent to Kamehameha Highway with two modeled sites (MD20 and MD30) representing two areas of Laniakea Beach. Worst-hour noise levels depend on the proximity of the receiver to the roadway traffic and the presence of buildings and topography providing noise attenuation between the receiver and the roadway. The worst-hour traffic noise levels approached or exceeded the NAC at six sites that represent: five residences located adjacent to and makai of Kamehameha Highway, Laniakea Beach and a formerly planned park.

Table 3-4. Predicted Existing Worst-Hour Traffic Noise Levels

| Site ID | Land Use Activity/HDOT Noise Abatement Category (Criterion)* Leq(h), dBA | Number of Receivers Represented | Modeled Existing Worst-Hour Leq(h), dBA | A/E Impact or None) |
|---|---|---|---|---|
| MD1 | B/66 | 1 | 65 | None |
| MD2 | B/66 | 1 | 63 | None |
| MD3 | B/66 | 1 | 64 | None |
| MD4 | B/66 | 1 | 64 | None |
| MD5 | B/66 | 1 | 64 | None |
| MD6 | B/66 | 1 | 65 | None |
| MD7 | B/66 | 1 | 60 | None |
| MD8 | B/66 | 1 | 65 | None |
| MD9 | B/66 | 1 | 64 | None |
| MD10 | B/66 | 1 | 64 | None |
| MD11 | B/66 | 1 | 64 | None |
| MD12 | B/66 | 1 | 63 | None |
| MD13 | B/66 | 1 | 65 | None |
| MD14 | B/66 | 1 | 64 | None |
| MD15 | B/66 | 1 | 65 | None |
| MD16 | B/66 | 1 | 66 | A/E |
| MD17 | B/66 | 1 | 65 | None |
| MD18 | B/66 | 1 | 66 | A/E |
| MD19 | B/66 | 1 | 65 | None |
| MD20 | C/66 | Park | 66 | A/E |
| MD21 | B/66 | 1 | 64 | None |
| MD22 | B/66 | 1 | 56 | None |
| MD23 | B/66 | 1 | 57 | None |
| MD24 | B/66 | 1 | 58 | None |
| MD25 | B/66 | 1 | 59 | None |
| MD26 | B/66 | 1 | 61 | None |
| MD27 | B/66 | 1 | 62 | None |
| MD28 | B/66 | 1 | 62 | None |
| MD29 | B/66 | 1 | 64 | None |

| | | | | |
|---|---|---|---|---|
| MD30 | B/C/66 | 1 + Park | 66 | A/E |
| MD31 | B/66 | 1 | 66 | A/E |
| MD32 | B/66 | 1 | 66 | A/E |
| Site ID | Land Use Activity/HDOT Noise Abatement Category (Criterion)* Leq(h), dBA | Number of Receivers Represented | Modeled Existing Worst-Hour Leq(h), dBA | A/E Impact or None) |
| MD33 | B/66 | 1 | 65 | None |
| MD34 | B/66 | 1 | 65 | None |
| MD35 | B/66 | 1 | 61 | None |
| MD36 | B/66 | 1 | 61 | None |
| MD37 | B/66 | 1 | 62 | None |
| MD38 | B/66 | 1 | 62 | None |
| MD39 | B/66 | 1 | 63 | None |
| MD40 | B/66 | 1 | 63 | None |
| MD41 | B/66 | 1 | 64 | None |
| MD42 | B/66 | 1 | 64 | None |
| MD43 | B/66 | 1 | 44 | None |
| MD44 | B/66 | 1 | 63 | None |
| MD45 | B/66 | 1 | 44 | None |

Note : See Table 3-1 for descriptions of Noise Abatement Categories.
Bold = level approaches or exceeds the NAC.
A "Receiver" is an area of frequent human outdoor activity, homes, apartments, motel, hotels, etc.
Modeled worst hour Leq(h) values are within 3 dBA of measured values indicating the model is correctly calibrated.
A/E Impact = Approach or Exceed NAC Impact

# CHAPTER 4
# FUTURE TRAFFIC NOISE IMPACTS

## 4.1 PREDICTION METHODOLOGY

FHWA TNM version 2.5 was used to model the worst-hour (PM peak hour) noise levels in 2030 at 45 sites for the proposed Project Alternatives ("Pedestrian Shift" and "Most Realignment") along Kamehameha Highway. Future noise levels were calculated for the Year 2030 traffic.

Input variables to noise modeling and analysis include traffic volumes, speeds, and vehicle fleet mix (auto, medium truck, and heavy truck percentages). The noise analysis considers the peak traffic hour as the noisiest hour of the day. The number of vehicles expected to travel on Kamehameha Highway in 2030 is based on traffic data from traffic modeling analysis, February 2020 (WSP USA, 2020). Future vehicle mix is projected to be 97.5 percent autos, 1.5 percent medium trucks, 0.5 percent heavy trucks, and 0.5 percent buses for all roadways.

Table 4-1. Proposed Project 2030 (Worst-Hour) Traffic Volumes

| Roadway | From Cross Street | To Cross Street | Northbound Vehicles per Hour | Southbound Vehicles per Hour | Posted Speed Limit (MPH) |
|---|---|---|---|---|---|
| Kamehameha Highway | From North | Pohaku Loa Way | 899 | 873 | 35 |
| Kamehameha Highway | At Cross Street | Pohaku Loa Way | 899 | 873 | 35 |
| Kamehameha Highway | From South | Pohaku Loa Way | 899 | 873 | 35 |

Note : Traffic volumes from Kamehameha Highway Pedestrian Safety Traffic Analysis, WSP USA, 2020.

## 4.2 NOISE IMPACT ANALYSIS

In terms of the one-hour Leq (h) noise descriptor, a noise impact could potentially require mitigation if either of the following conditions is predicted to occur:

- Future year traffic noise approaches or exceeds the FHWA NAC, or
- Future year traffic noise substantially exceeds (15 dBA or more) the existing ambient noise level.

Predicted 2030 worst-hour traffic noise levels without the proposed Project would range from 45 dBA to 67 dBA (Table 4-2) with an increase of 1 to 2 dBA at each modeled site over existing noise levels due to increased traffic volumes along the existing alignment in the year 2030. Worst-hour future-year traffic noise levels without the proposed Project (2030) would approach or exceed the NAC at 15 modeled sites

located adjacent to and makai of Kamehameha Highway representing 14 residences, Laniakea Beach, and a formerly planned park.

Predicted 2030 worst-hour traffic noise levels with the proposed Project under the "Pedestrian Shift" Alternative would range from 45 dBA to 67 dBA (Table 4-2) with a decrease of 8 dBA to an increase of 2 dBA compared to existing noise levels. A decrease in noise levels compared to existing conditions is predicted at modeled sites MD12 to MD21, where the alignment shifts the furthest away from nearby residences under the "Pedestrian Shift" Alternative. Increased noise levels of up to 2 dBA would result from increased traffic volumes and the minor alignment shift nearer to the modeled sites in the year 2030. Worst-hour future-year traffic noise levels with the "Pedestrian Shift" Alternative (2030) would approach or exceed the NAC at 6 residences and 1 formerly planned park located adjacent to and makai of Kamehameha Highway near the southern end of the Project area.

Predicted 2030 worst-hour traffic noise levels with the proposed Project under the "Most Realignment" Alternative would range from 45 dBA to 66 dBA (Table 4-2) with a decrease of 18 dBA to an increase of 7 dBA compared to existing noise levels. A decrease in noise levels compared to existing conditions is predicted in the central area of the Project where the Kamehameha Highway alignment shifts the furthest away from residences currently located near the existing alignment. Increased noise levels of up to 7 dBA are predicted where the "Most Realignment" Alternative shifts nearer to the modeled sites, which combined with the increased traffic volume in 2030 would increase noise levels at homes/sensitive located nearby. Worst-hour future-year traffic noise levels with the "Most Realignment" Alternative (2030) would approach or exceed the NAC at 1 residence located adjacent to and makai of Kamehameha Highway near the southern end of the Project.

There would be no substantial noise increase impacts as a result of the proposed Project with either Project Alternative.

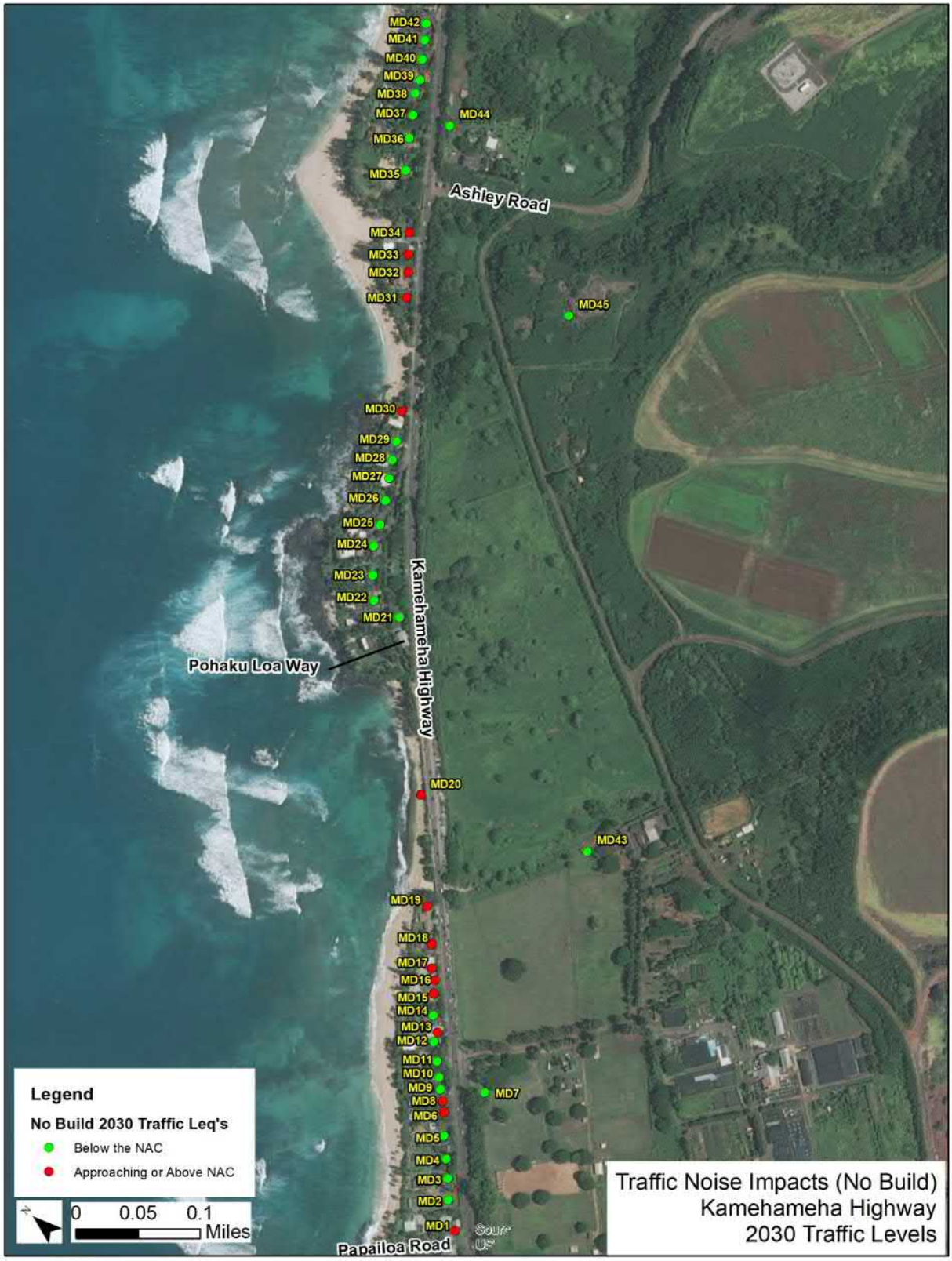
Table 4-2. Existing and Proposed Project Worst-Hour Traffic Noise Levels

| Site ID | Land Use Activity/HDOT Noise Abatement Category (Criterion)* Leq(h), dBA | Number of Receivers Represented | Modeled Existing Worst-Hour Leq(h), dBA | Modeled No Build Worst-Hour Leq(h), dBA | No Build Impact Type* (S, A/E, or None) | Modeled Build (Ped Shift) Worst-Hour Leq(h), dBA | Leq(h), dBA Increase (+) or Decrease (-) | Build (Ped Shift) Impact Type* (S, A/E, or None) | Modeled Build (Most) Worst-Hour Leq(h), dBA | Leq(h), dBA Increase (+) or Decrease (-) | Build (Most) Impact Type* (S, A/E, or None) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MD1 | B/66 | 1 | 65 | 66 | A/E | 66 | +1 | A/E | 66 | +1 | A/E |
| MD2 | B/66 | 1 | 63 | 64 | None | 64 | +1 | None | 64 | +1 | None |
| MD3 | B/66 | 1 | 64 | 65 | None | 65 | +1 | None | 65 | +1 | None |
| MD4 | B/66 | 1 | 64 | 65 | None | 65 | +1 | None | 65 | +1 | None |
| MD5 | B/66 | 1 | 64 | 65 | None | 64 | 0 | None | 65 | +1 | None |
| MD6 | B/66 | 1 | 65 | 66 | A/E | 64 | -1 | None | 65 | 0 | None |
| MD7 | B/66 | 1 | 60 | 61 | None | 61 | +1 | None | 61 | +1 | None |
| MD8 | B/66 | 1 | 65 | 66 | A/E | 64 | -1 | None | 65 | 0 | None |
| MD9 | B/66 | 1 | 64 | 65 | None | 64 | 0 | None | 64 | 0 | None |
| MD10 | B/66 | 1 | 64 | 65 | None | 64 | 0 | None | 64 | 0 | None |
| MD11 | B/66 | 1 | 64 | 65 | None | 63 | -1 | None | 64 | 0 | None |
| MD12 | B/66 | 1 | 63 | 64 | None | 62 | -1 | None | 63 | 0 | None |
| MD13 | B/66 | 1 | 65 | 66 | A/E | 64 | -1 | None | 65 | 0 | None |
| MD14 | B/66 | 1 | 64 | 65 | None | 62 | -2 | None | 64 | 0 | None |
| MD15 | B/66 | 1 | 65 | 66 | A/E | 62 | -3 | None | 64 | -1 | None |
| MD16 | B/66 | 1 | 66 | 67 | A/E | 62 | -4 | None | 65 | -1 | None |
| MD17 | B/66 | 1 | 65 | 66 | A/E | 61 | -4 | None | 63 | -2 | None |
| MD18 | B/66 | 1 | 66 | 67 | A/E | 60 | -6 | None | 63 | -3 | None |
| MD19 | B/66 | 1 | 65 | 66 | A/E | 59 | -6 | None | 60 | -5 | None |
| MD20 | C/66 | Beach Park | 66 | 67 | A/E | 58 | -8 | None | 52 | -14 | None |
| MD21 | B/66 | 1 | 64 | 65 | None | 62 | -2 | None | 46 | -18 | None |
| MD22 | B/66 | 1 | 56 | 57 | None | 57 | +1 | None | 45 | -11 | None |
| MD23 | B/66 | 1 | 57 | 58 | None | 58 | +1 | None | 45 | -12 | None |
| MD24 | B/66 | 1 | 58 | 59 | None | 58 | 0 | None | 45 | -13 | None |
| MD25 | B/66 | 1 | 59 | 60 | None | 60 | +1 | None | 45 | -14 | None |
| MD26 | B/66 | 1 | 61 | 62 | None | 61 | 0 | None | 46 | -15 | None |
| MD27 | B/66 | 1 | 62 | 62 | None | 62 | 0 | None | 47 | -15 | None |
| MD28 | B/66 | 1 | 62 | 63 | None | 63 | +1 | None | 47 | -15 | None |
| MD29 | B/66 | 1 | 64 | 65 | None | 64 | 0 | None | 48 | -16 | None |
| MD30 | B/C/66 | 1 + Beach Park | 66 | 67 | A/E | 67 | +1 | A/E | 49 | -17 | None |

| Site ID | Land Use Activity/HDOT Noise Abatement Category (Criterion)* Leq(h), dBA | Number of Receivers Represented | Modeled Existing Worst-Hour Leq(h), dBA | Modeled No Build Worst-Hour Leq(h), dBA | No Build Impact Type* (S, A/E, or None) | Modeled Build (Ped Shift) Worst-Hour Leq(h), dBA | Leq(h), dBA Increase (+) or Decrease (-) | Build (Ped Shift) Impact Type* (S, A/E, or None) | Modeled Build (Most) Worst-Hour Leq(h), dBA | Leq(h), dBA Increase (+) or Decrease (-) | Build (Most) Impact Type* (S, A/E, or None) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MD31 | B/66 | 1 | 66 | 66 | A/E | 66 | 0 | A/E | 53 | -13 | None |
| MD32 | B/66 | 1 | 66 | 66 | A/E | 66 | 0 | A/E | 55 | -11 | None |
| MD33 | B/66 | 1 | 65 | 66 | A/E | 66 | +1 | A/E | 56 | -9 | None |
| MD34 | B/66 | 1 | 65 | 66 | A/E | 66 | +1 | A/E | 57 | -8 | None |
| MD35 | B/66 | 1 | 61 | 62 | None | 62 | +1 | None | 59 | -2 | None |
| MD36 | B/66 | 1 | 61 | 62 | None | 62 | +1 | None | 60 | -1 | None |
| MD37 | B/66 | 1 | 62 | 63 | None | 63 | +1 | None | 61 | -1 | None |
| MD38 | B/66 | 1 | 62 | 63 | None | 63 | +1 | None | 61 | -1 | None |
| MD39 | B/66 | 1 | 63 | 64 | None | 64 | +1 | None | 63 | 0 | None |
| MD40 | B/66 | 1 | 63 | 64 | None | 64 | +1 | None | 63 | 0 | None |
| MD41 | B/66 | 1 | 64 | 65 | None | 65 | +1 | None | 63 | -1 | None |
| MD42 | B/66 | 1 | 64 | 64 | None | 64 | 0 | None | 63 | -1 | None |
| MD43 | B/66 | 1 | 44 | 45 | None | 46 | +2 | None | 49 | +5 | None |
| MD44 | B/66 | 1 | 63 | 64 | None | 64 | +1 | None | 64 | +1 | None |
| MD45 | B/66 | 1 | 44 | 45 | None | 45 | +1 | None | 51 | +7 | None |

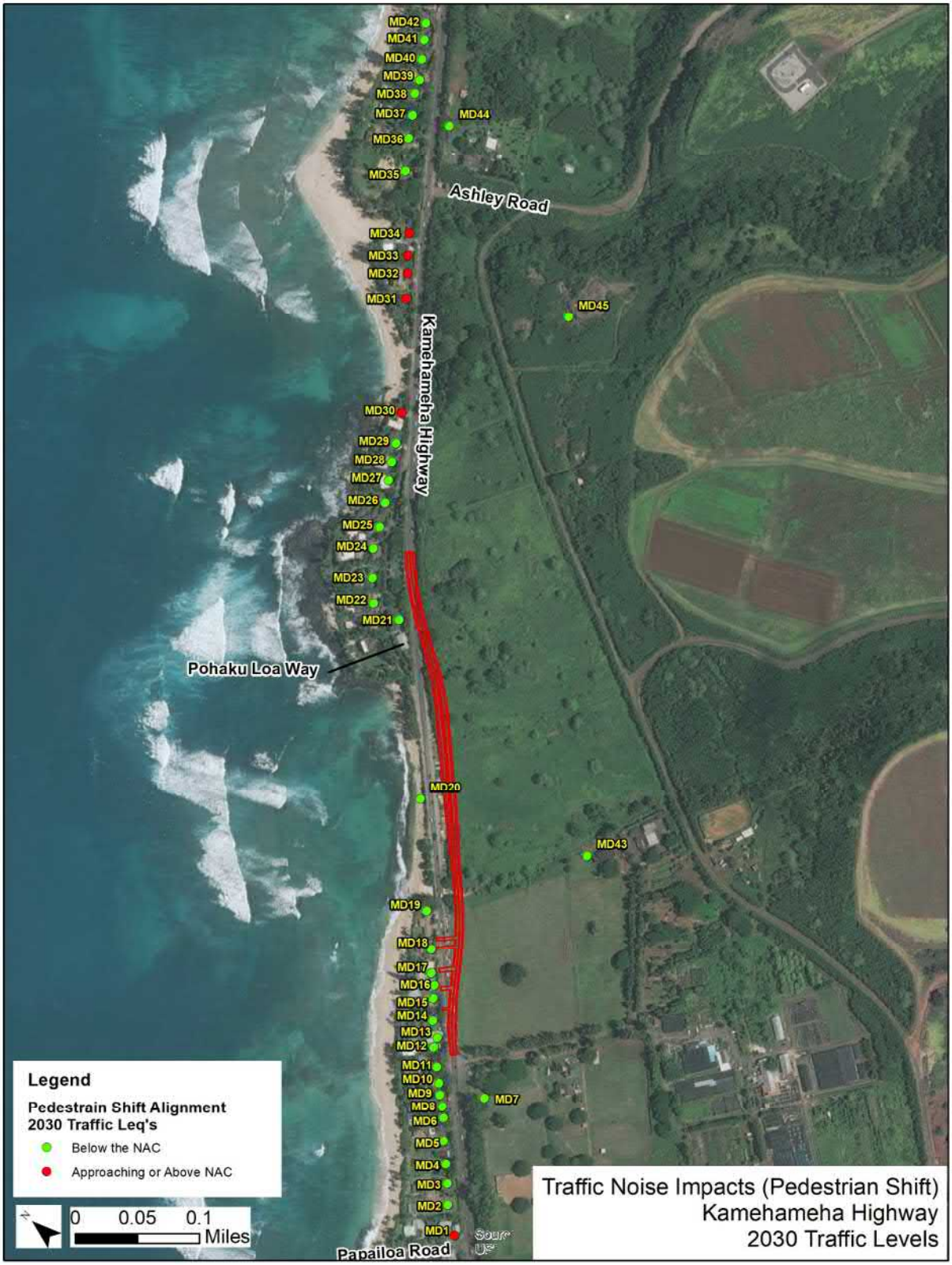
Note: See Table 3-1 for descriptions of Land Use Activities and Noise Abatement Categories.
Bold = level approaches or exceeds the NAC.
A "Receiver" is an area of frequent human outdoor activity, homes, apartments, motel, hotels, etc.
*Impact Type: S = Substantial Increase (15 dBA or more), A/E = Approach or Exceed NAC
Sites that begin with letters are modeled only sites.

Figure 4-1. Predicted Future No Build Worst-Hour Traffic Noise Levels



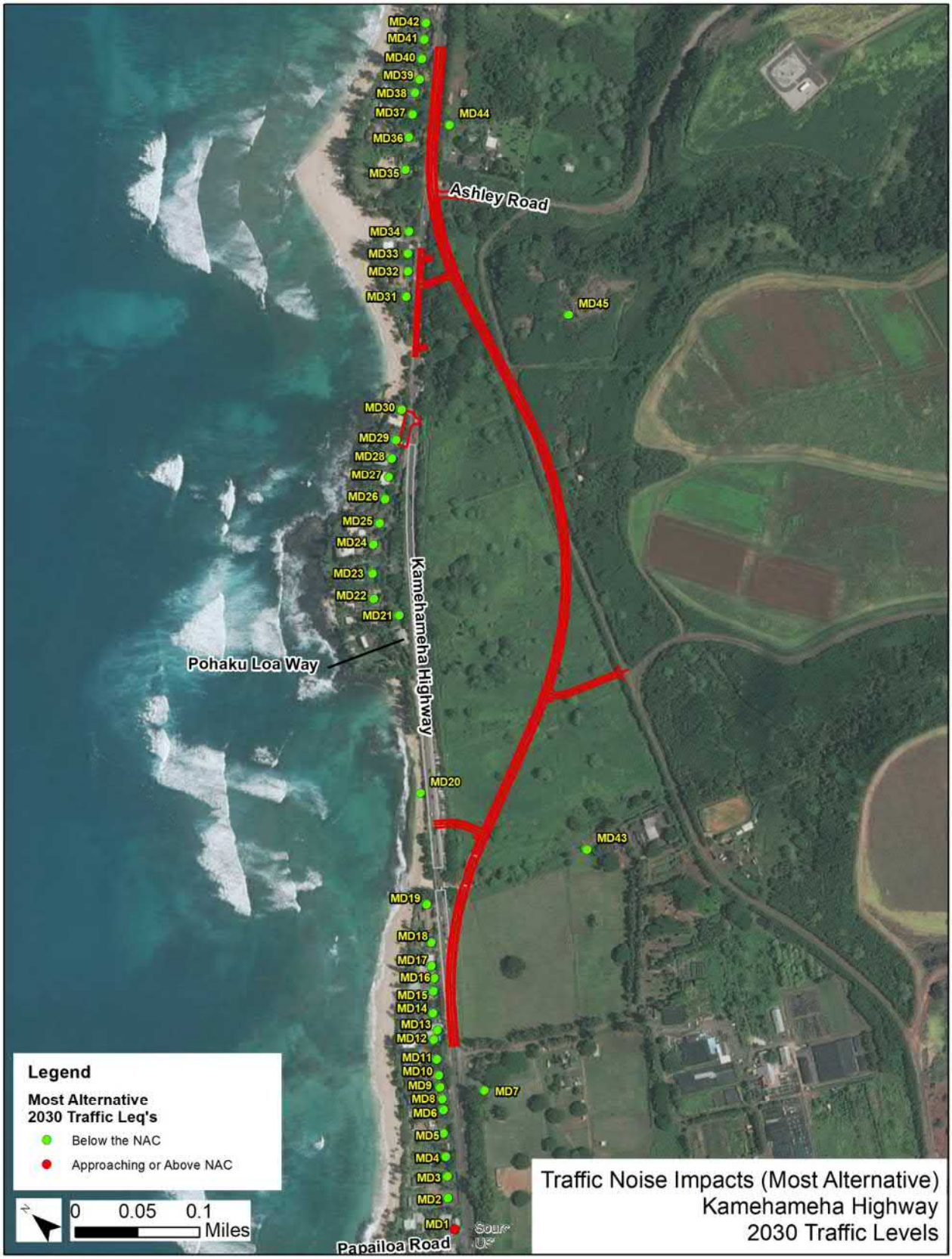

Source :WSP, 2020

Figure 4-2. Predicted Future Build ("Pedestrian Shift" Alternative) Worst-Hour Traffic Noise Levels




Source :WSP, 2020

Figure 4-3. Predicted Future Build ("Most Realignment" Alternative) Worst-Hour Traffic Noise Levels




Source :WSP, 2020

# CHAPTER 5
# CONSTRUCTION NOISE IMPACTS

The duration and level of construction noise depend on the phase and type of activity, such as:

- Ground clearing and excavation;
- Removal of existing trees, rocks and soil;
- Placement of foundations and roadbeds;
- Erection of structures including bridges and retaining walls; and
- Finishing, including filling, grading, paving, landscaping and cleanup operations.

Early construction work including ground clearing and excavation, typically generate the highest noise levels. Noise generated by construction equipment, including trucks, graders, excavators, bulldozers, concrete mixers, and portable generators can reach levels from 78 dBA to 91 dBA at 50 feet. Construction equipment noise emissions are regulated by the Environmental Protection Agency's Noise Control Program (Part 204 of Title 40, Code of Federal Regulations). Presently, air compressors are the only equipment under regulation and no new regulations are currently under consideration.

Noise levels for equipment which might be used during the excavation and construction of the proposed Project are presented in Table 5-1. The noise levels presented are at a reference distance of 50 feet. Since construction equipment noise levels decrease at a rate of approximately 6 dBA per doubling of distance, at 100 feet the noise levels would be about 6 dBA less than the levels shown at 50 feet. Similarly, at 200 feet the noise levels would be 12 dBA less than shown. Intervening structures or topography can act as a noise barrier to further reduce noise levels.

Table 5-1. Construction Equipment Noise Levels

| Equipment | Decibels | Equipment | Decibels |
|---|---|---|---|
| Standard Construction Equipment | | Compressor | 81 |
| Dump Truck | 78 | Generator | 78 |
| Saw | 78 | Grader | 91 |
| Light Tower | 62 | Water Truck | 75 |
| Cold Planer | 80 | Crane | 71-93 |
| Paving Machine | 82 | Light Impact Equipment | |
| Roller | 63 | Jack Hammer | 100 |
| Striping machine | 85 | Jumping Jack | 100 |
| Concrete Truck | 70 – 95 | Heavy Impact Equipment | |
| Backhoe/Loader | 73 – 83 | Hoe rams | 95 – 106 |
| Compressor | 81 | Vibratory Sheet pile driver | 90 – 100 |
| Pavement Saw | 90 | D9 Bulldozer | 85 |
| | | Drill Rig | 85 |

Source: Federal Highway Administration, Highway Construction Noise: Measurement, Prediction, and Mitigation, 1976

The State of Hawaii Department of Health (DOH) maintains community noise control standards that apply to construction noise. Construction activities for the Project could not exceed the stipulated noise limits unless a variance is granted by the DOH.

The following are anticipated conditions of the Noise Variance, which will be finalized upon its issuance.

The Noise Variance application will grant permission for the Contractor to work from:

- Sunday: 7:00 a.m. to Monday 6:00 a.m.
- Monday: 8:00 p.m. to Tuesday 6:00 a.m.
- Tuesday: 8:00 p.m. to Wednesday 6:00 a.m.
- Wednesday: 8:00 p.m. to Thursday 6:00 a.m.
- Thursday: 8:00 p.m. to Friday 6:00 a.m.

Subject to the following conditions during the variance hours:

- The Contractor shall make every effort to minimize noise emanating from the Project.
- The use of reverse signal alarms shall be prohibited during the variance hours. Alternative methods such as utilizing a ground guide for signaling shall be employed.
- Traffic noise from heavy vehicles traveling to and from the construction site shall be minimized near residences.
- The Contractor shall have a job-site inspector to whom immediate complaints can be forwarded for prompt response and who shall have the general responsibility of monitoring quiet work procedures.
- The Contractor shall give sufficient notice regarding the Project to any residents that may be impacted by the nighttime activity. The notification for the planned nighttime activity shall also contain the name and telephone number of the job-site inspector. In addition, a copy of any notifications, as well as progress reports, shall be sent to the Indoor and Radiological Health Branch.
- If noise level is such that the numerous complaints are received by the Department, the Contractor shall cease operations upon receipt of an order and complete the Project during hours on weekdays and weekends as directed.
- The Contractor shall notify the Indoor and Radiological Health Branch, State Department of Health, as to the date and time of any variance hour activity as soon as the dates are confirmed and also when the Project is completed.

Noise control measures during construction would be required to minimize impacts on existing noise sensitive land uses. Because impacts to residences cannot be accurately determined without detailed construction plans and schedules, the measures recommended in this section should be re-evaluated in greater detail as Project design is refined. General abatement measures presented below are recommended as guidelines in developing construction plans that consider the adverse impacts of construction noise.

- Design Considerations - During the early stages of construction plan development, strategic placement of stationary equipment, such as compressors and generators, can be considered for use as shielding against construction noise.
- Source Control - The Contractor shall comply with HDOT Standard Specifications and all local sound control and noise level rules, regulations and ordinances which apply to any work performed pursuant to the contract. Each internal combustion engine used for any purpose on the job, or related to the job, shall be equipped with a muffler of a type recommended by the manufacturer. No internal combustion engine shall be operated on the Project without a muffler.
- Community Relations - Community meetings can be held to explain the construction work, time involved, and the control measures to be taken to reduce the impact of the construction noise.

The aforementioned measures can be incorporated into site-specific construction plans in order to minimize noise impacts to sensitive receivers along the Project corridor, and additional noise emission limits could be developed as well. Construction hours could be set, different from those anticipated above, and noise level criteria could be decided upon and adhered to during construction.

# CHAPTER 6
# NOISE ABATEMENT MEASURES

Noise abatement measures must be considered as part of the Project if traffic noise impacts are identified and must be provided where it is feasible and reasonable to do so. Impacts occur at sites where traffic noise levels approach or exceed the NAC of Leq(h) 67 dBA, or substantially exceed (by 15 dBA or more) the ambient noise levels. HDOT's Highway Noise Policy and Abatement Guidelines (HDOT, 2016) are used to determine whether noise abatement measures can be implemented, depending on whether these measures are reasonable and feasible based on the following criteria:

- Provide at least 5 dBA highway traffic noise reduction for two thirds of front row receptors located along the subject Type I Project.
- Determination that it is possible to design and construct the barrier after considering issues related to safety, barrier height, topography, drainage, utilities, maintenance, maintenance access to adjacent properties, and access to adjacent properties.
- Consideration of viewpoints of the property owners and residents benefited by the barrier.
- Cost of noise abatement does not exceed $60,000 per benefited receptor.
- Achieve noise reduction design goal of 7 dBA for 75% of the benefited front-row receptors located along the subject Project.

## 6.1 NOISE ABATEMENT EVALUATION: NO BUILD ALTERNATIVE

The No-Build Alternative has 15 sites (14 residences and 2 formerly planned beach park areas) that would approach or exceed the NAC (Table 4-2). The No-Build Alternative is used as the baseline to compare future traffic noise levels. Noise abatement was not modeled for the No-Build alternative.

## 6.2 NOISE ABATEMENT EVALUATION: BUILD ALTERNATIVES

The "Pedestrian Shift" Build Alternative has 6 residences and one formerly planned park that would approach or exceed the NAC (Table 4-2). The 6 residences are represented by modeled sites MD1 and MD30 to 34 (Figure 4-2). The "Most Realignment" Alternative has 1 residence that would approach or exceed the NAC. The 1 residence is represented by modeled sites MD1. Each of the 6 sites predicted to experience impacts under either Project Alternatives were considered for noise abatement. Mitigation considerations include the feasibility of physically constructing noise mitigation (i.e., noise walls or barriers) to shield affected noise receptors from traffic noise in a way that would provide at least a 5-dBA traffic noise reduction. Noise barrier placement would not be feasible at all 6 sites that were predicted to experience noise impacts under either Project Alternative because access to private driveways and side streets that connect to Kamehameha Highway would have to be maintained and a

barrier with such frequent openings could not provide a 5-dBA reduction. Therefore, no noise abatement, including noise barriers are proposed for either Project Alternative.

# CHAPTER 7
# CONCLUSIONS

## 7.1 FINDINGS

Existing traffic noise levels approach or exceed the NAC at five residences and at Laniakea Beach (at two areas closest to Kamehameha Highway). Future year 2030 modeled worst-hour traffic noise levels without the Project approach or exceed the NAC at 15 modeled sites that represent 14 residences and 2 formerly planned beach parks). 2030 modeled worst-hour traffic noise levels with the Project approach or exceed the NAC at 6 residences and 1 formerly planned park under the "Pedestrian Shift" Alternative and 1 residence under the "Most Realignment" Alternative.

Noise abatement was considered at all 6 sites predicted to experience noise levels that approach or exceed the NAC with both Project Alternatives; however, noise abatement would not be feasible at all 6 locations.

## 7.2 INFORMATION TO LOCAL OFFICIALS

A copy of this report will be made available to the City and County of Honolulu DPP by HDOT. This report will serve to inform the Planning Department of the effects of the highway and highway-construction-related noise in the area studied. The information contained within this report can assist local officials in their planning process and help guide noise compatible planning concepts.

At the time of this report, several undeveloped or vacant lots are located with the Project noise study area. A review of zoning near the Project area and a review of current permits on file at the City and County of Honolulu Department of Public Works, Building Division identified no planned developments that would add noise-sensitive land uses in the noise study that arent included in this technical analysis.

Based on the modeling results and future traffic volumes and speeds included in this report, areas within 200 feet of Project improvements along Kamehameha Highway (for both alternative alignments) may experience noise levels that exceed the HDOT residential and recreational land use noise abatement criteria of 66 dBA. Commercial areas located within 50 feet of Kamehameha Highway (for both alternative alignments) may exceed the commercial abatement criteria of 71 dBA. It is recommended that the local officials use this information as a guide when developing future land use plans, zoning, or building code requirements. The use of this information may assist local government with future development plans and thereby result in development that is consistent with the noise environment.

# CHAPTER 8
# REFERENCES


Department of Planning; Online review of zoning maps near Kamehameha Highway Pedestrian Safety noise study area accessed December 19, 2019 at website: http://www.cohplanningdept.com/zone-maps/.

Building Division; Online review of building permits at parcels located with Kamehameha Highway Pedestrian Safety noise study area accessed, December 19, 2019 at website: http://qpublic9.qpublic.net/hi_Hawaii_search.php.

WSP USA; Kamehameha Highway Pedestrian Safety Traffic Evaluation, April 2020.

State of Hawaii, Department of Transportation (HDOT), Highways Division and U.S. Department of Transportation, Federal Highway Administration; Highway Noise Policy and Abatement Guidelines, April 18, 2016.

U.S. Department of Transportation, Federal Highway Administration (FHWA), 1973. Fundamentals and Abatement of Highway Traffic Noise. Washington D.C.

U.S. Department of Transportation, Federal Highway Administration (FHWA), 2010. Highway Traffic Noise: Analysis and Abatement Guidance. Washington D.C.

U.S. Department of Transportation, Federal Highway Administration (FHWA), 1982. Procedures for Abatement of Highway Traffic Noise and Construction Noise. Federal-Aid Highway Program Manual. Volume 7, Chapter 7, Section 3. Washington, D.C.

U.S. Department of Transportation, Federal Highway Administration (FHWA), 1998, 2004. FHWA Traffic Noise Model Users Guide. Washington D.C.

U.S. Department of Transportation, Federal Highway Administration (FHWA), 1996. Measurement of Highway-Related Noise. Washington D.C.

U.S. Environmental Protection Agency (EPA), 1974. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety. Report Number 550/9-74-004.

U.S. Department of Transportation, Federal Highway Administration (FHWA), Regulations. CFR Title 23, Part 772 (http://www.fhwa.dot.gov/legsregs/directives/fapg/cfr0772.htm).

United States Geological Survey (USGS), July 28, 2004. Last access online in March 2020 at: http://seamless.usgs.gov/website/seamless/index.asp.

# CHAPTER 9
# SUPPORTING DATA

Noise Measurement and Observed Traffic Data can be found here:

Parsons Brinckerhoff; Kamehameha Highway Realignment Traffic Noise Monitoring; October 1 and 2, 2014

Traffic Noise Modeling (TNM) 2.5 Output Files can be found here:

WSP USA; Kamehameha Highway Pedestrian Safety Traffic Noise Modeling files (Provided electronically)