# VOLUME II OF II

## Appendices G to U

# Draft Environmental Impact Statement

## PROPOSED CENTRAL MAUI WASTEWATER RECLAMATION FACILITY, MAUI, HAWAIʻI

**Prepared for:**

**County of Maui, Department of Environmental Management**

**Accepting Authority:**

**County of Maui, Department of Environmental Management**

**November 2025**

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**by Munekiyo Hiraga**

MUNEKIYO HIRAGA
Planning. Project Management. Sustainable Solutions.

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# PRELIMINARY DRAINAGE REPORT FOR CENTRAL MAUI WASTEWATER RECLAMATION FACILITY

## APPENDIX

# G

# Preliminary Drainage Report for
# Central Maui Wastewater Reclamation Facility
## Wailuku, Maui, Hawai‘i
## Portion of TMK: (2) 3-8-005:023

Prepared for
County of Maui
Department of Environmental Management
Wastewater Reclamation Division

June 2024

Brown AND Caldwell

2261 Aupuni Street, Suite 201
Wailuku, Maui, Hawai‘i 96793

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# List of Abbreviations

| | |
|---|---|
| BMP(s) | best management practice(s) |
| cf | cubic feet |
| cfs | cubic feet per second |
| FIRM | Flood Insurance Rate Map |
| MSL | mean sea level |
| NRCS | Natural Resource Conservation Service |
| RAS | Return Activated Sludge |
| SAT | Soil Aquifer Treatment |
| TMK | tax map key |
| USGS | United States Geologic Survey |
| WQDV | water quality design volume |
| WWRF | wastewater reclamation facility |

Section 1

# Introduction

This report presents a preliminary drainage plan for the proposed Central Maui Wastewater Reclamation Facility (WWRF) on the island of Maui. The proposed project site is located on the west side of Kuihelani Highway on a portion of Tax Map Key (TMK) Parcel (2) 3-8-005:023. Figure 1-2 displays the location map for the proposed project site.

## 1.1 Purpose and Scope

The objective of this report is to address the primary concern and goal of proper stormwater management, which is to mitigate the adverse impact of new construction on the environment and prevent negative impacts to downstream properties. Stormwater management can generally be separated into two areas:

- Management of the quantity of stormwater runoff: controlling peak flows, thereby preventing increased flows and volumes leaving the site on the downstream watercourses.
- Management of the quality of stormwater runoff: prevention of contaminants such as silt, trash, hydrocarbons, heavy metals, and pesticides from leaving the site through stormwater runoff.

With this goal in mind, this drainage report is intended to evaluate the pre and post development conditions for the proposed WWRF. This evaluation involves determining the existing and proposed stormwater runoff flows (hydrology) and presenting measures that may be taken to mitigate any potential adverse impacts in stormwater quantity or quality to downstream or adjacent properties.

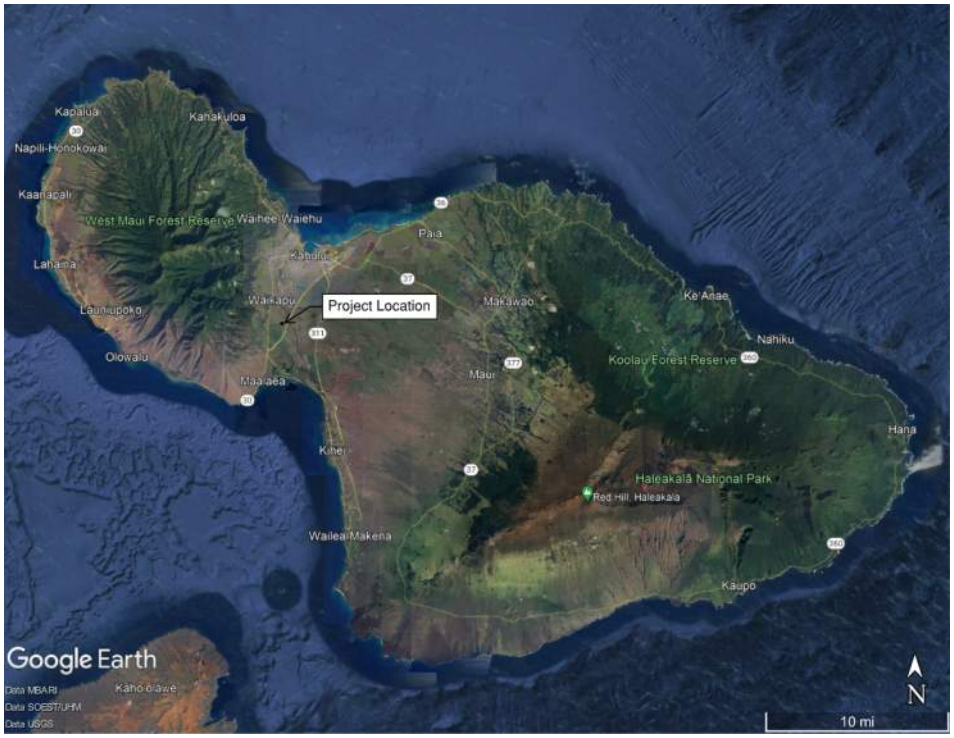



**Figure 1-1. Vicinity Map**




**Figure 1-2. Location Map**

Section 2

# Existing Conditions

## 2.1 Topography and Drainage Patterns

The site is located in an agricultural area on a flat, poorly vegetated parcel. The existing site is zoned as agriculture and is undeveloped. The existing site has an average slope of 1.4 percent with elevations ranging between roughly 200 and 220 feet above mean sea level (MSL), with the highest elevations on the northwest side of the site.

The majority of onsite runoff within the project area is overland sheet flow or shallow concentrated flow that flows down approximately 1 percent slopes in a southeasterly direction towards Kuihelani Highway where it is conveyed into a drainage channel that flows into the Waihee Canal, which flows into the Waikapu Stream. The Waikapu Stream flows south to Kealia pond which ultimately flows into Maalaea Bay and the Pacific Ocean.

The majority of offsite flows come from 117 acres of agricultural land to the west of the site, which travel via shallow concentrated flow to the project site. This offsite flow enters the project site along the western boundary and joins the onsite runoff to discharge into the Waihee Canal.

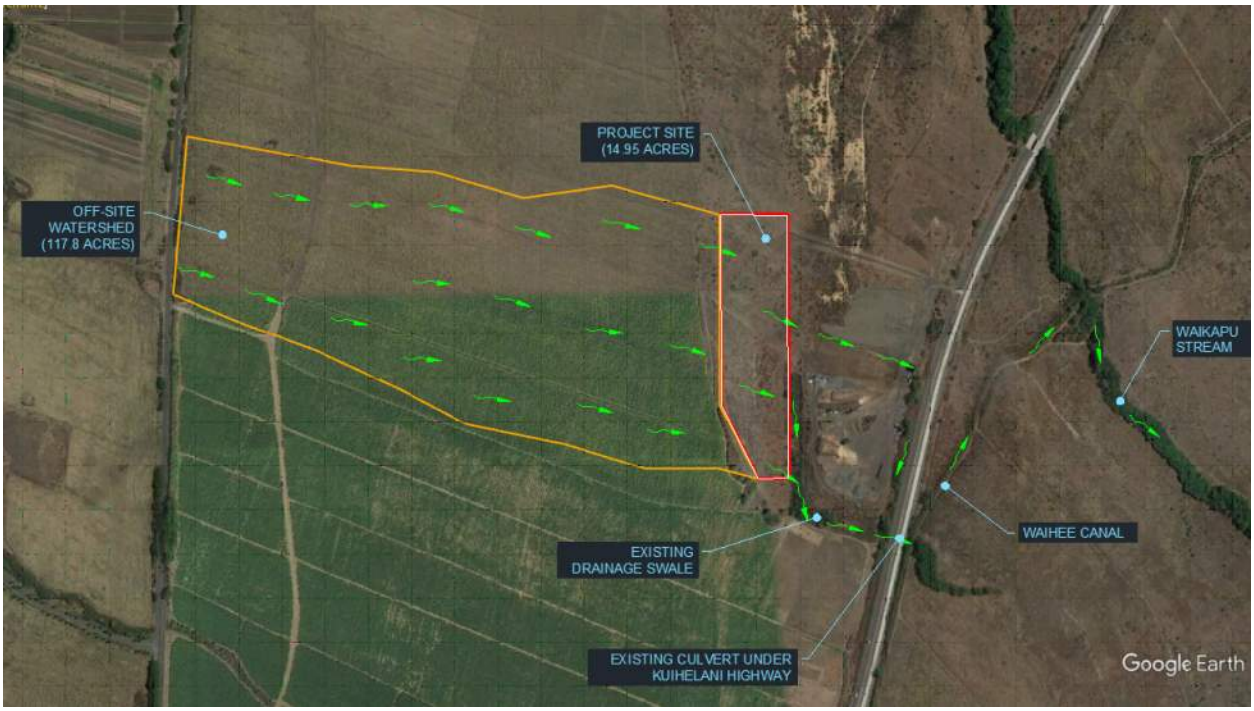



**Figure 2-1. Existing Drainage Flow Paths**

## 2.2 Land Use

The project site is located at TMK (2) 3-8-005:023 which comprises a 209-acre area of land that is zoned as agricultural. Work on this parcel will involve ground disturbance and impact approximately 14.9 acres of land. The project is located within a watershed catchment area that is approximated at 117.8 acres.

Based on the zoning designation and USGS and Google Earth imagery, the project site does not show evidence of previous land uses. The project site is undeveloped and vacant.

## 2.3 Soil Type and Ground Cover

The soil types local to the project area were investigated using the Natural Resources Conservation Service (NRCS) Web Soil Survey (Figure 1-4) which shows that the project area is predominantly Jaucas sand (JaC). Figure 1-4 also shows that the offsite contributing watershed area predominantly contains a mix of Pulehu cobbly clay loam (PtA), Pulehu silt loam (PpB), Pulehu silt loam (PpA), Iao clay (IcB), Pulehu cobbly clay loam (PtB), and Jaucas sand (JaC).

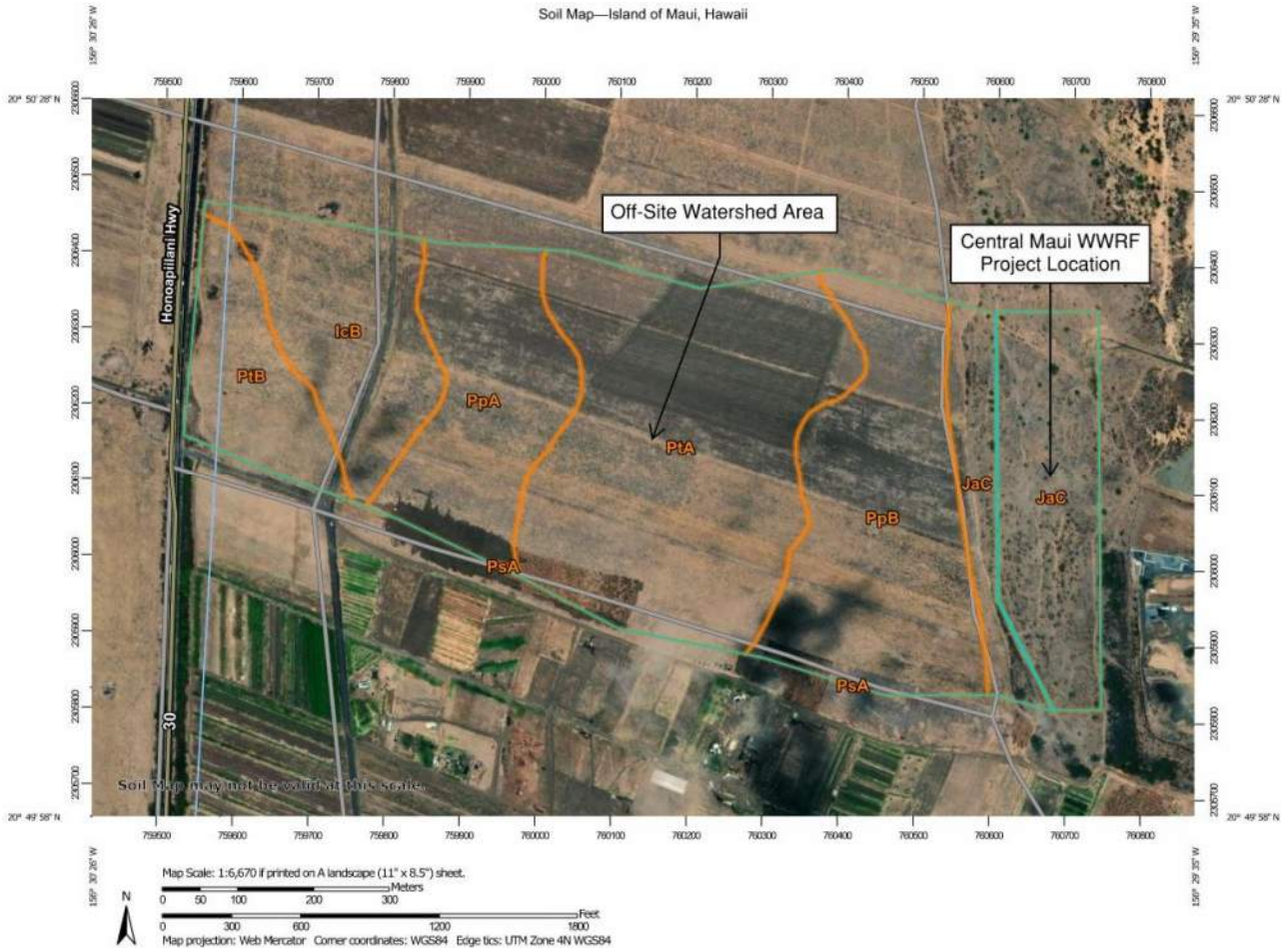



**Figure 2-2. NCRS Soil Survey Map**

## 2.4 Flood and Tsunami Hazard

The subject property is located in Zone X, areas determined to be outside the 0.2 percent annual chance floodplain, as indicated on the current November 4, 2015, Flood Insurance Rate Map (FIRM), Community Panel No. 150003 0393F and therefore is not subject to the requirements of the Flood Hazard Areas, Chapter 19.62, of the Maui County Code. The project site also does not fall within Zones V or VE which designates zones with potential velocity hazard, and therefore is not at risk of tsunami.

Runoff Quantity using Rational Method
**Existing Conditions**

Q = flow rate in cubic feet per second
C = runoff coefficient
I = rainfall intensity in inches per hour for a duration equal to the time of concentration
A = drainage area in acres

**C = 0.20**
**I = 4.1 in/hr**
**A = 14.9 ac**

Q = CIA
Q = 0.20 * 4.1(in/hr) * 14.9(ac)
Q = 12.2 cfs

## 2.5 Existing Peak On-Site Stormwater Runoff

The peak on-site stormwater runoff was estimated using the County of Maui, Department of Public Works and Waste Management, *Chapter 4 – Rules for the Design of Storm Drainage Facilities in the County of Maui*, November 1995. The contribution area for the existing site is approximately 14.9 acres and consist of primarily flat terrain with poor vegetal cover. The 10-year stormwater flow for the existing condition is approximated at 12.2 cubic feet per second (cfs).

### Existing Off-Site Watershed Hydrology

The off-site watershed area contributing to runoff entering the site consists of 117.8 acres of agricultural land to the east of the site. Per the *Chapter 4 – Rules for the Design of Storm Drainage Facilities in the County of Maui*, November 1995, for watersheds over 100 acres the Natural Resources Conservation Service (NRCS) method shall be used. The NRCS small watershed hydrologic model (WinTR-55) was used to analyze the runoff from the off-site watershed area. Under the 100-year 24-hour design storm, the peak flow was calculated to be 257.63 cfs. This flow enters the project site along the western boundary and joins the on-site runoff.

Section 3

# Proposed Conditions

## 3.1 Proposed Improvements

The proposed project involves the construction of the Central Maui WWRF. The changes to site surface areas include the construction of a new headworks facility, activated sludge basins, secondary clarifiers, filters, UV disinfection, anaerobic digesters, a dewatering and blower building, effluent pump station, operations building, RAS pump station, and Soil Aquifer Treatment (SAT) basins. The SAT basins as well as other open top tanks are self-contained, and therefore not included in the calculation for impervious area. The total project site is 14.9 acres, 10.4 of these acres will be self-contained and are removed from the contributing area, the remaining 4.5 acres will be developed and are assumed to be impervious in this analysis.

## 3.2 Proposed Project Site Hydrology

### 3.2.1 Proposed Drainage Improvements

The overall post-development on-site drainage pattern is anticipated to be consistent with the existing condition. Runoff within the project area north of the SAT basins will sheet flow in the predominant southeasterly direction before being channelized and conveyed to the existing drainage swale to the south of the site. There will be no runoff from the areas containing the SAT basins as these basins are self-contained. Differences in runoff volumes will be mitigated by onsite detention. The runoff calculations in this report assume that all areas contributing to runoff are 100 percent impervious. As the design advances, the total planned impervious area may be decreased resulting in a reduction of post construction runoff.

### 3.2.2 Proposed Condition Peak Stormwater Runoff

As required by the County of Maui drainage standards, the post development condition was evaluated for the 10-year 1-hr storm. The estimated 10-year stormwater runoff flow for the proposed site is 16.5 cfs.

Runoff Quantity using Rational Method
**Proposed Condition**

Q = flow rate in cubic feet per second
C = runoff coefficient
I = rainfall intensity in inches per hour for a duration equal to the time of concentration
A = drainage area in acres

**C = 0.90**
**I = 4.1 in/hr**
**A = 4.5 ac**

Q = CIA
Q = 0.90 * 4.1(in/hr) * 4.5(ac)
Q = 16.6 cfs

The proposed construction will result in an increase in runoff of approximately 4.4 cfs (a 35 percent increase). This increase in peak flow and runoff volume is a function of the increase in impervious areas associated with the proposed WWRF infrastructure.

Measures will be taken to reduce runoff and mitigate potential adverse impact on downstream waters or adjacent properties. Potential mitigation measures include reduction of impervious surfaces, onsite retention ponds, infiltration basins, or vegetated swales. Using the TR-55 method to determine retention basin storage volume requirements, a basin of 0.102 acre-feet would be sufficient to reduce post development peak runoff to predevelopment levels and result in no adverse downstream impacts. In addition, a hydrogeological study was also prepared to better understand the project's impact on nearby waters. Mitigation measures will be defined in the final project design documents and will adhere to County standards. A final drainage report will be part of the final design documents and will be submitted for approval by the County's Department of Public Works.

The stormwater runoff flows for both the existing and proposed conditions are summarized in Table 3-1 below.

**Table 3-1. Estimated On-Site Stormwater Runoff Summary (Hydrology)**

| Condition | Drainage Area (Acres) | $C_{avg}$ (Average Runoff Coefficient) | Rainfall Intensity (10-Year Storm; Inches) | Q (Runoff Flow In Cfs) |
|---|---|---|---|---|
| Existing | 14.95 | 0.20 | 4.1 | 12.2 |
| Proposed | 4.49 | 0.90 | 4.1 | 16.6 |
| Net Increase | | | | 4.4 |

### 3.2.3 Offsite Runoff Routing

Offsite runoff flows should be routed around and through the site via conveyance swales sized to pass the 100-year 24-hr storm. In order to reduce the required swale sizes, off-site flow entering the site north of the SAT basins can be passed through the site to join the onsite runoff channelized along the east boundary of the site. Off-site flow entering the site along the SAT basins can be channelized along the west boundary of the site and conveyed towards the existing drainage swale south of the site. These conveyance swales should discharge to the existing drainage channel that contributes to the Waihee Canal. Swale size will be determined during design, one option would be a trapezoidal swale with a 15-foot top width. Energy dissipation structures will be required to maintain discharge velocities at a similar level to existing conditions.

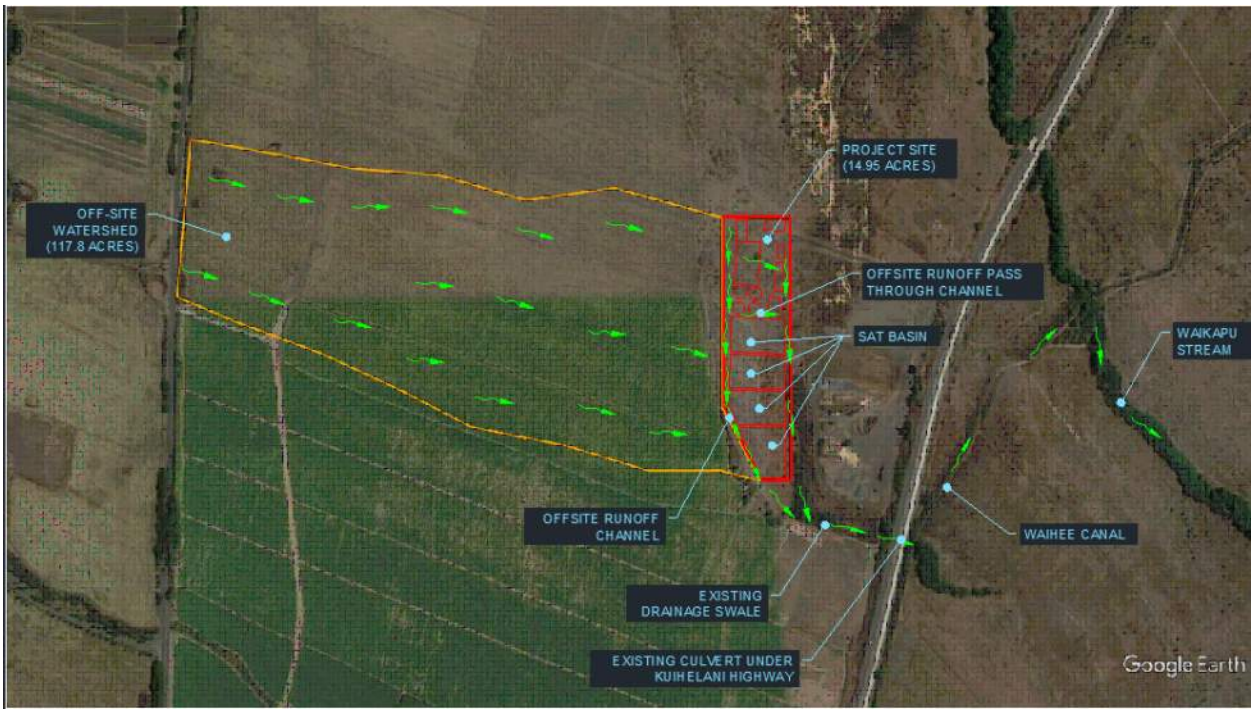



**Figure 3-1. Proposed Drainage Flow Paths**

### 3.2.4 Stormwater Quality

The quality of stormwater leaving the site is also a concern. Stormwater quality degrades with urban development and increased impervious surfaces because various pollutants are introduced into the stormwater runoff.

The first one-inch of runoff during a storm is referred to as the Water Quality Design Volume (WQDV) or the "first-flush" volume. This portion of the runoff from a storm contains measurably more suspended solids plus other contaminants per cubic foot than would be expected in runoff occurring later in the storm. Based on the County of Maui, Department of Public Works, *Chapter 111 - Rules for the Design of Storm Water Treatment Best Management Practices*, November 2012, the WQDV for this project is 15,484 cubic feet (cf), as shown in the calculation below.

**Stormwater Water Quality Design Volume**

**Proposed Condition**

WQDV = water quality design volume in cubic feet
C = runoff coefficient
A = area of the site in acres
3630 = conversion factor

**C = 0.95**
**A = 4.49 ac**

WQDV = C * 1(in) * A * 3630
WQDV = 0.95 * 1(in) * 4.49(ac) * 3630
WQDV = 15,483.77 cf

This volume of water must be treated to reduce pollutants in the runoff in order to avoid adverse impacts to downstream properties and the environment. As design progresses, a sand filter, swale, or other treatment method will be evaluated for feasibility and sized appropriately to treat the WQDV.

Stormwater quality treatment methods may be part of a dual-purpose stormwater quantity reduction system such as a dry detention pond, an infiltration basin, or a vegetated swale with storage capacity. Alternatively, stormwater quality systems may be a separate system that are bypassed once the WQDV is met such as a sand filter or biofilter system. The inclusion of a stormwater quality treatment system in the project will result in no impact to the environment.

During construction, temporary best management practices (BMPs), such as temporary sedimentation basins, should be utilized to mitigate erosion and the release of sediment and other pollutants to existing storm drains, waterways, and adjacent properties.




**Figure 3-2. Preliminary Site Plan**

## Section 4

# Conclusion

In terms of site hydrology, the proposed construction will result in an increase in stormwater runoff of 4.4 cfs due to an increase in impervious area. A retention basin of 0.102 acre-feet, or an equivalent system for reducing peak flow volumes will be provided in order to bring peak discharge to predevelopment levels. By maintaining peak flow volumes to predevelopment levels, no adverse impact will be caused to downstream properties.

Off-site runoff flows will be routed through and around the site. Offsite peak runoff flow volumes will not be increased. Offsite flows will be discharged to the same drainage swale, culvert, and drainage canal as in the existing condition. Energy dissipation will be provided to match existing velocities. No adverse impact will be caused by handling of off-site runoff.

Additionally, stormwater quality should be maintained during construction via prudent use of relevant BMPs to control erosion and sequester sediment and silt, in order to minimize pollution to the maximum extent possible and to ensure that downstream properties are not adversely affected. Permanent water quality BMPs will be provided to treat the WQDV to reduce pollutants in the runoff in order to avoid adverse impacts to downstream properties and the environment.

As noted in Section 3, mitigation measures will be defined in the final project design documents and will adhere to County standards. A final drainage report will be part of the final design documents and will be submitted for approval by the County's Department of Public Works.

With all of these considerations taken into account, the proposed construction complies with the County of Maui stormwater requirements and there will be no negative impact on downstream properties.

## Section 5

# References


County of Maui, Department of Public Works, and Waste Management. *Chapter 4 - Rules for the Design of Storm Drainage Facilities in the County of Maui*. 1995.

County of Maui, Department of Public Works. *Chapter 111 - Rules for the Design of Storm Water Treatment Best Management Practices*. 2012.

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# AGRICULTURAL IMPACT ASSESSMENT

# APPENDIX H

# *CENTRAL MAUI WASTEWATER RECLAMATION FACILITY: IMPACTS ON AGRICULTURE*

# *CENTRAL MAUI WASTEWATER RECLAMATION FACILITY: IMPACTS ON AGRICULTURE*

*PREPARED FOR:*
**County of Maui,**
**Department of Environmental Management**

*PREPARED BY:*
**Plasch Econ Pacific LLC**

**April 2024**

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# EXECUTIVE SUMMARY

## 1. PROPOSED DEVELOPMENT

The County of Maui Department of Environmental Management (**County**) proposes to construct the Central Maui Wastewater Reclamation Facility (**WWRF**) and related improvements (the "**Project**"). Two Project components will use land designated for agriculture: (1) the approximately 14.9-acre WWRF site and (2) the approximately 4.1-acre "**Easement**." The Easement will provide access to the WWRF via a 100 foot-wide paved road from the planned Wai'ale Road extension, and will serve as a corridor for pipelines under the road.

## 2. LAND CLASSIFICATIONS

A State District Boundary Amendment will be pursued for the WWRF site to change the designation from Agriculture to Urban. For the County, a *Community Plan* Amendment and a change of Zoning and will be pursued for the WWRF site to allow development of the Project.

## 3. AGRICULTURAL CONDITIONS

The 14.9-acre WWRF site has poor soils for farming. However, about 4 acres of the Easement has favorable conditions for farming, including good soils, moderate slopes, high solar radiation, the availability of irrigation water, and good access to markets. If not used by the County for the Project or some other non-agricultural purpose (such as a larger regional park), then the land could be used for growing crops as part of a larger farm on abutting private property. A standalone farm on just the Easement could be challenging to cultivate due to the long narrow shape of the property (about 1,800 feet by 100 feet).

## 4. IMPACT ON ON-SITE AGRICULTURAL OPERATIONS

The Project will have no impact on existing agricultural operations within the WWRF site or the Easement since these lands are vacant and currently host no farming or ranching activities.

## 5. IMPACT ON NEARBY AGRICULTURAL OPERATIONS

Development and operation of the WWRF and related components will not interfere with nor limit farming on abutting agricultural lands. However, the Project will lower water costs to nearby farmers, will increase the supply of compost, and could increase the risk of equipment and crop theft.

**a. Agricultural Use of Recycled Water**

At full development, the WWRF will supply about 4 million gallons per day (**mgd**) of R-1 recycled water, of which about 2.9 mgd will be available for irrigating about 725 acres of abutting and nearby agricultural fields.

Since the nearby fields are already planned for farming and are supplied with irrigation water from Wailuku Water Co., no significant change in future agricultural activity is expected because of a change to using recycled water. However, farmers will benefit from a cost saving of about 87¢ per 1,000 gallons in lower water costs compared to proposed charges by the Wailuku Water Co. The annual savings will be about $880,000 per year (based on 2.9 mgd at $0.83/1,000 gallons in lower water costs).

**b. Compost**

The digested solids from the WWRF will be combined with green waste at the County's Central Maui Landfill to produce compost, a portion of which may be sold to Maui farmers.

**c. Security**

If open to the public, the Easement road could increase access to abutting farms which, in turn, could increase trespassing onto the farms and possible theft of equipment and crops.

**d. Mitigating Measures**

Recommended mitigating measures to address the risk of trespassing from the Easement road onto abutting farms and possible theft of equipment and crop include: security fencing along the southern border of the Easement, security cameras at the western end of the Easement, and possibly restricted public access to the Easement road.

## 6. IMPACT ON THE GROWTH OF DIVERSIFIED-CROP FARMING

**a. Loss of Farmland**

The Project will result in a loss of about 4 acres of good farmland to be used as the Easement to the WWRF. Without the Project, this land could be used for growing crops as part of a farm on abutting private property.

**b. Impact of Losing Farmland**

The loss of about 4 acres of good farmland is far too small to affect the growth of crop farming on Maui or statewide. The contraction and closure of plantations resulted in a supply of farmland far exceeding demand. Even if farmed, 4 acres would only provide half-time employment for a single worker.

**c. Mitigating Measures**

Since the loss of 4 acres of good farm is far too small to affect the growth farming on Maui or statewide, mitigation measures for the loss of agricultural land are not recommended.

## 7. OFFSETTING BENEFITS

The loss of about 4 acres of good agricultural land will be offset by the following benefits of the Project:

— Construction Activity

- Construction jobs associated with Project development.
- Indirect jobs generated by the purchase of goods and services by construction companies and families of construction workers.
- County tax revenues (excise tax surcharge, etc.) and State tax revenues (excise taxes, personal income taxes, corporate income taxes, etc.) paid by construction companies and workers, and by companies and families that are supported by construction activity.

— Operations, Full Development

- Wastewater treatment services for County-planned urban growth areas in Central Maui consistent with the Maui Island Plan, including services needed for affordable and market-priced housing.
- Diversion of a portion of the wastewater flow that is currently treated at the Wailuku-Kahului WWRF, thereby reducing the volume of treated effluent that is currently disposed via injection wells at the facility.
- About 4 mgd of recycled water provided to irrigate agricultural fields, parks, streetscapes, and landscaped areas located near the Central Maui WWRF.
- An increased supply of compost (digested solids from the WWRF combined with green waste), some of which may sold to Maui farmers.
- Direct jobs provided by WWRF operations.
- Indirect jobs supported by the purchase of goods and services for WWRF operations, and by the families of employees at the WWRF.
- County tax revenues (excise tax surcharge, property taxes, etc.) and State tax revenues (excise taxes, personal income taxes, etc.) paid by (1) on-site employees at the WWRF, and (2) off-site companies and employees supported by WWRF operations.

## 8. CONSISTENCY WITH STATE AND COUNTY POLICIES

### a. Availability of Lands for Agriculture

The *Hawai'i State Constitution*, the *Hawai'i State Plan*, the *State Agriculture Functional Plan*, the *County of Maui 2030 General Plan,* the County's *Maui Island Plan,* and the County's *Wailuku-Kahului Community Plan* call directly or implicitly for preserving the economic viability of plantation agriculture and promoting the growth of diversified agriculture. To accomplish this, an adequate supply of agriculturally suitable lands and water must be assured.

With regard to plantation agriculture, the WWRF site and the Easement are no longer part of a sugarcane plantation.

With regard to diversified agriculture, the Project will not affect any on-site agricultural activities since none exists at the WWRF site and the Easement. However, the Project will reduce the availability of good farmland on Maui by about 4 acres. This loss will not limit the growth of diversified agriculture on Maui or statewide since ample agricultural land is available. This is due to the enormous supply of agricultural land that is now available following the loss of nearly all plantations in Hawai'i.

### b. Conservation of Agricultural Lands

In addition to the above, State and City policies call for conserving and protecting prime agricultural lands, including protecting farmland from urban development.

In compliance with these policies, Maui County has developed a "Directed Growth Plan" as part of the *Maui Island Plan* (2012). This Plan guides future urban, small town and rural development on Maui while protecting prime agricultural land located outside the Growth Boundaries. The WWRF site and Easement are located within the Urban Growth Boundary of the Wailuku–Kahului Planned Growth Plan in an area designated for a Regional Park and County Facilities. Since the WWRF site and Easement are located within the Growth Boundary, these two areas do not include the prime agricultural lands planned for conservation and protection.

It should also be noted that many of the State agricultural policies were written before the major contraction of plantation agriculture (from 1981 to 1996), and assume implicitly that profitable agricultural activities eventually will be available to utilize all available agricultural lands. This has proven to be a questionable assumption in view of the enormity of the contraction of plantation agriculture, the abundant supply of farmland that came available for diversified agriculture, and the slow growth in the amount of land being utilized for diversified agriculture.

Furthermore, discussions in the *Agriculture State Functional Plan* recognize that redesignation of lands from Agricultural to Urban and/or Rural should be allowed "… upon a demonstrated change in economic or social conditions, and where the requested redesigna-

tion will provide greater benefits to the general public than its retention in …agriculture;" that is, when an "overriding public interest exists." The enormous contraction of plantation agriculture, which resulted in the supply of agricultural land far exceeding demand, constitutes a major change in economic conditions. Moreover, the Project will provide community benefits (wastewater treatment, recycled water, jobs, tax revenues, etc.) that far exceed the benefits of leaving the land in agriculture (at most, part-time work for single farmer if the 4.1 acres planned for the Easement were to be farmed). In practice, the Project is expected to have no significant impact on agricultural activity since ample land is available on Maui and statewide to accommodate the anticipated growth of diversified agriculture.

**c. Important Agricultural Lands**

Regarding Important Agricultural Lands (IAL), the WWRF site and Easement are within the County's Directed Growth Boundaries for Urban development. As such, these areas will not be candidates for IAL designation.

**d. County of Maui Land-Use Plans**

As mentioned above, the WWRF site and Easement are located within the Directed Growth Boundaries of the *Maui Island Plan* in an area designated for a Regional Park and County Facilities. Thus, WWRF and Easement are consistent with the *Maui Island Plan.*

The *Wailuku-Kahului Community Plan* (2002) show the WWRF site and Easement in an area designated as Agriculture. As mentioned in Section 2, a *Community Plan* Amendment will be pursued for the WWRF site to allow development of the Project.

# CENTRAL MAUI WASTEWATER RECLAMATION FACILITY: IMPACTS ON AGRICULTURE

## 1. INTRODUCTION

The County of Maui Department of Environmental Management (**County**) proposes to construct the Central Maui Wastewater Reclamation Facility (**WWRF**) and related improvements (the "**Project**"). This new WWRF will provide a number of benefits to the community:

- Wastewater treatment service to urban, rural and small-town growth areas in Central Maui as envisioned in the Maui Island Plan—service which will be required in order to construct affordable and market-priced housing in the area.
- Diversion of a portion of the wastewater flow that is currently treated at the Wailuku-Kahului WWRF, thereby reducing the volume of treated effluent that is currently disposed via injection wells at the facility.
- Recycled water to irrigate agricultural fields, parks, streetscapes, and landscaped areas located near the Central Maui WWRF.

This report addresses the impacts of the Project on agriculture. The material below gives information about the Project, land classifications, the agricultural conditions of the WWRF site and an access and utility easement (the "**Easement**") located on agricultural land, past agricultural uses of the WWRF site and Easement, the impact of the Project on existing agricultural operations in and near the WWRF site and Easement, the impact the Project on the growth of crop farming, benefits of the Project that would offset adverse agricultural impacts, and consistency of the Project with State and County agricultural policies. Figures are at the end of the report. The Appendix provides a summary of State and County goals, objectives, policies and guidelines related to agricultural lands.

## 2. PROJECT INFORMATION

### a. Overview of Facilities

Figure 1 provides an overview of the Central Maui WWRF elements to be built, including:

- The Central Maui WWRF and onsite Soil Aquifer Treatment (**SAT**) system
- A new Kehalani Wastewater Pump Station (**WWPS**).
- A sewage pipeline connecting the two facilities. (Kehalani Sewage Pipeline)
- A sewage pipeline connecting the Central Maui WWRF and the future Waikapū Country Town development.

— A recycled-water pipeline connecting the Central Maui WWRF and the future Waikapū Country Town development.

A non-potable water-storage facility will be built as part of the Waikapū Country Town development.

**b. Service Areas**

Figure 2 presents the wastewater service areas that are expected to contribute wastewater to the Central Maui WWRF.

**c. Flow Projections**

The Central Maui WWRF will have an average dry weather flow capacity of 4 million gallons per day (**mgd**)—see Table 1. Approximately half of the flow is expected to originate from areas that currently contribute flow to the Wailuku-Kahului WWRF. Diversion of the flow from the Wailuku-Kahului WWRF to the Central Maui WWRF will reduce disposal volumes at the current facility.

The remaining half of the flow is projected to originate from New Anticipated Development and Future Potential Development growth areas within the wastewater service areas. The Future Potential Development shown in the table is not defined at this time but could include the existing Māʻalaea community if a decision is made to connect it to the Central Maui WWRF.

**Table 1. Anticipated Buildout Wastewater Flow from Developments in Service Area**

| Wastewater Flow Source | Average Dry Weather Flow (mgd) | Percent of Total Buildout Capacity of 4 mgd |
|---|---|---|
| Existing Development (Diverted Flow from Wailuku-Kahului WWRF) | 1.78 | 45% |
| New Anticipated Development | 1.93 | 48% |
| Future Potential Development | 0.29 | 7% |
| Total | 4.00 | 100% |

Note: mgd = million gallons per day

**d. New Kehalani Wastewater Pump Station**

A new Kehalani Wastewater Pump Station (WWPS) located near Waiʻale Road, will be designed to divert all of the flow from the existing 18-inch sewer in Waiʻale Road away from the Wailuku-Kahului WWRF and instead pump it to the new Central Maui WWRF.

The WWPS will be constructed on parcel tax map key (**TMK**) number (2)3-5-020:036. The parcel is used as a stormwater detention basin which serves the Kehalani development. The new WWPS will occupy at most 10,000 sq. ft (about 0.23 acre), and will be constructed at street level in the southwest corner of the detention basin. Modifications will be made to the detention basin to retain its full function as originally designed.

**e. Central Maui Wastewater Reclamation Facility**

WWRF site

The Central Maui WWRF will be located on a portion of parcel TMK (2)3-8-005:023, owned by the County of Maui. The 209.04-acre parcel will be subdivided to provide a separate 14.9-acre parcel for the WWRF. Figure 3 shows the proposed WWRF location within the larger parcel.

Access and Utility Easement

The Easement will be developed across parcel TMK (2) 3-6-002:004 between the WWRF and the planned Waiʻale Road extension (see Figure 3). It will provide access to the WWRF via a paved road, and will serve as a corridor for pipelines under the road. The Easement will be about 1,800 feet long, 100 feet wide, and about 4.1 acres in area.

WWRF Components

Figure 4 shows a conceptual site plan for the Central Maui WWRF, including the following components:

- Preliminary treatment: screening and grit removal to remove coarse debris prior to further treatment.
- Secondary treatment: biological nutrient removal using activated sludge process with anoxic zones, intermediate mixed liquor recycling, and clarification to remove carbon and nitrogen.
- Tertiary treatment: filtration to remove suspended solids and turbidity.
- Disinfection: UV treatment to inactivate bacteria and viruses.

Ancillary systems for the WWRF will include:

- Electrical Systems: It is anticipated that new electrical service from Hawaiian Electric Company (HECO) will be brought to the WWRF site via underground or aboveground electrical lines from the intersection of Waiale Road and Waiko Road along the proposed Waiale Road extension, or from Honoapiilani Highway. An emergency power system will be provided to ensure uninterrupted wastewater treatment in the event of power failure.

— Potable Water: Potable water needs will be met by connecting to the County water system.

— Non-Potable Water: Non-potable water needs (with connections to hose bibbs, water cannons, and foam sprays) will be met with R-1 effluent. A pump system will provide adequate flow and pressure.

— Fire Protection: Fire protection systems for certain WWRF elements will be provided in accordance with applicable codes.

— Stormwater Management: A stormwater system, possibly including a stormwater pump station, will comply with applicable codes.

— Odor Control: Foul-air collection and treatment will be provided for treatment processes that generate nuisance odors.

**f. Recycled Water**

Water recycling is planned to be a major part of the effluent management system at the Central Maui WWRF. The water recycling program will extend Maui's freshwater resources by putting treated effluent to beneficial non-potable use, freeing up valuable potable and raw water resources for other uses. These uses include facilitating growth within the community and enhancing the environment.

R-1 Water Quality

The Central Maui WWRF will produce effluent that complies with State of Hawaii Department of Health (DOH) R-1 recycled-water requirements, including oxidation, filtration and disinfection. It is the highest grade of recycled water. In addition, the total nitrogen concentration of the effluent will be 10 mg/L or less to (1) ensure that the amount of total nitrogen applied to crops does not exceed nutrient needs, and (2) minimize the potential environmental impacts of the effluent.

Volume and Uses of the Recycled Water

At full development, the WWRF will supply about 4 mgd of recycled water. As indicated in Figure 5, this water will be available for irrigating nearby agricultural fields, County lands, and lands of Waikapu Country Town.

According to the EIS for Waikapu Country Town, this development may use approximately 0.6 mgd of the recycled water for irrigating parks, school yards, and streetscapes. The remaining recycled water—anticipated to be about 3.4 mgd—will be used to irrigate (1) nearby agricultural fields (about 1,077 acres available) and (2) a County regional park (about 100 acres).

For agriculture, the recycled R-1 water can be used for:

- Watering crops via spray, surface drip or subsurface drip irrigation.
- Drinking water for livestock and poultry, but not dairy animals that produce milk for human consumption.
- Cleaning water to wash down livestock, animal pens, etc.

Backup Effluent-Disposal System

A required effluent-disposal backup system will ensure that the effluent can be safely disposed when recycled water supply exceeds demand, or if the recycled water fails to meet the required treatment specifications. The backup disposal system will be designed to process all of the WWRF flow.

Soil aquifer treatment (**SAT**) appears to be a viable effluent disposal approach for the Central Maui WWRF. SAT consists of the intermittent application of effluent at high hydraulic loading rates to basins constructed in highly permeable soils, such as sand or gravel. Treatment is accomplished via biological, chemical, and physical interactions that occur as the water percolates through the soil matrix to groundwater.

**g. Solids Management**

The proposed WWRF will create residual solids that will require management. Grit and screenings will be washed and dewatered prior to disposal at the Central Maui Landfill. Secondary and tertiary solids will be stabilized using aerobic digestion with decant thickening. The digested solids will be dewatered using screw press technology. Currently dewatered solids are composted with green waste at the Central Maui Landfill.

Some of the compost may be sold to farmers.

**h. Sewage Pipelines and Water Storage**

Wastewater will be conveyed to the Central Maui WWRF by gravity sewers, pump stations, and pressurized pipelines. A new sewage pipeline will deliver flow from the Kehalani WWPS to the Central Maui WWRF, and a sewage pipeline will deliver flow from the Waikapū Country Town to the WWRF (see Figure 1).

Figure 5 shows the route of the pipeline that will deliver recycled water to a water storage facility within the Waikapū Country Town. The County will construct the portion of the pipeline located on the Wai‘ale Road Extension. Waikapū Country Town will construct (1) the portion of the pipeline located within the Waikapū Country Town Development, and (2) the recycled water storage facility.

The sewage pipelines will be located under existing and planned roads.

## 3. LAND CLASSIFICATIONS

Current land classifications of the proposed Central Maui WWRF-and Easement are as follows:

— State: Agricultural District

— County

- *Maui Island Plan*: within the Urban Growth Boundary (see Figure 6)
- *Wailuku-Kahului Community Plan*: Agriculture
- Zoning: Agriculture

A State District Boundary Amendment will be pursued for the WWRF site to change the designation to Urban. For the County, a *Community Plan* Amendment and a change of Zoning and will be pursued for the WWRF site to allow development of the Project.

## 4. AGRICULTURAL CONDITIONS

The agricultural conditions of the Central Maui WWRF site and the Easement are given below. However, the conditions for the Kehalani WWPS site are not addressed because the site is unsuitable for agriculture: the site is too small for typical commercial farming (at most 0.23 acre), no agricultural activities occur on the property nor can occur because it is a retention basin, and no agricultural activities currently occur nor are likely to occur on the surrounding properties due to urban zoning and existing homes and industrial development. Other than the Easement, the agricultural conditions for the lands above the pipelines are not addressed since these lands are being used or will be used for paved roads, and will not affect existing, planned or potential agriculture activities. However, the Easement could be used for agriculture if the proposed WWRF were not built.

### a. Soil Types and Characteristics

WWRF Site

According to the Natural Resources Conservation Service (**NRCS**), formerly known as the Soil Conservation Service, the soil type for the 14.9-acre WWRF site is Jaucas sand, 0 to 15 percent slopes (**JaC**)—see Figure 7.

Jaucas Series consists of excessively drained, calcareous soils which occur as narrow strips on coastal plains, adjacent to the ocean. They developed in wind- and water-deposited sand from coral and seashells. For JaC, the slope ranges from 0 to 15 percent, but in most places the slope does not exceed 7 percent. In a representative profile the soil is single grain, pale brown to very pale brown, sandy, and more than 60 inches deep. In many places the surface layer is dark brown as a result of accumulation of organic matter and alluvium. The soil is neutral to moderately alkaline throughout the profile. Permeability is rapid, and runoff

is very slow to slow. The hazard of water erosion is slight, but wind erosion is a severe hazard where vegetation has been removed. The available water capacity is 0.5 to 1.0 inch per foot of soil. In places roots penetrate to a depth of 5 feet or more. Workability is slightly difficult because the soil is loose and lacks stability for use of equipment.

This soil is used for pasture, sugarcane, truck crops, and urban development.

Easement

The approximately 4.1-acre Easement consists of three soil types:

— **PtA**: Pulehu cobbly clay loam, 0 to 3 percent slopes, about 2.6 acres

— **PpB**: Pulehu silt loam, 3 to 7 percent slopes, about 1.2 acres

— **JaC**: Jaucus sand, 0 to 15 percent slopes, about 0.3 acre

The Pulehu Series consists of well-drained soils on alluvial fans and stream terraces and in basins. They developed in alluvium washed from basic igneous rock.

In a representative profile of PtA, the surface layer is dark brown cobbly clay loam about 21 inches thick. This is underlain by dark-brown, dark grayish-brown, and brown, massive and single grain, stratified loam, loamy sand, fine sandy loam, and silt loam about 39 inches thick. Below this is coarse, gravelly or sandy alluvium. The soil is neutral in the surface layer and neutral to mildly alkaline below the surface layer. Permeability is moderate. Runoff is slow, and the erosion hazard is no more than slight. The available water capacity is about 1.4 inches per foot in the surface layer and subsoil. In places roots penetrate to a depth of 5 feet or more. Low areas are subject to flooding. Historically, this soil was used for growing sugarcane and, to a lesser extent, pasture.

PpB is similar to PtA, except that the texture is silt loam. This soil was used for sugarcane.

JAC is described above.

**b. Soil Ratings**

Three classification systems are commonly used to rate Hawai‘i soils: (1) Land Capability Grouping, (2) Agricultural Lands of Importance to the State of Hawai‘i, and (3) Overall Productivity Rating.

Land Capability Grouping (NRCS Rating)]

The 1972 Land Capability Grouping by the U.S. Department of Agriculture, NRCS rates soils according to eight levels, ranging from the highest classification level “I” to the lowest “VIII.”

The soil ratings for the WWRF site and the Easement are as follows:

| | Acres | Irrigated | Not Irrigated |
|---|---|---|---|
| WWRF site | | | |
| JaC | 14.9 | IVs | VIe |
| Easement | | | |
| PtA | 2.6 | IIs | IVs |
| PpB | 1.2 | IIe | IVc |
| JaC | 0.3 | IVs | VIe |

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices. Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both. Class VI soils have severe limitations that make them generally unsuited for cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.

The subclassification "e" indicates that the limitation is due to erosion. Subclassification "s" indicates that the limitation is due to stoniness, shallowness, unfavorable texture, or low water-holding capacity. Subclassification "c" indicates that the limitation is due climate (e.g., very droughty because of limited rainfall).

Agricultural Lands of Importance in the State of Hawai‘i (ALISH)

ALISH ratings were developed in 1977 by the NRCS, UH College of Tropical Agriculture and Human Resources, and the State of Hawai‘i, Department of Agriculture. This system classifies land into three broad categories: (a) "Prime" agricultural land which is land that is best suited for the production of crops because of its ability to sustain high yields with relatively little input and with the least damage to the environment; (b) "Unique" agricultural land which is non-Prime agricultural land used for the production of specific high-value crops (e.g., taro); and (c) "Other" agricultural land which is non-Prime and non-Unique agricultural land that is important to the production of crops.

As indicated in Figure 8, the WWRF site has soils that are rated Other, and the Easement has about 3.8 acres of soils rated Prime and about 0.3 acre rated Other.

Overall Productivity Rating (LSB Rating)

In 1967, the UH Land Study Bureau (**LSB**) developed the Overall Productivity Rating, which classifies soils according to five levels, with "A" representing the class of highest productivity and "E" the lowest.

As indicated in Figure 9, the WWRF site has soils that are rated E, and the Easement has soils rated A.

Summary Evaluation of Soil Quality

The above ratings indicate that the 14.9-acre WWRF site has low-quality soils for farming. The Easement has about 3.8 to 4.1 acres of high-quality soils (rounded to 4 acres), and about 0 to 0.3 acre of low-quality soils.

**c. Elevations**

The elevation of the WWRF site ranges from about 200 feet above sea level to 225 feet, and the Easement ranges from about 225 feet to 280 feet.

**d. Slopes**

Slopes within the WWRF site averages about 2%, and the Easement averages about 7%.

**e. Climatic Conditions**

Like other areas in Hawai‘i, Central Maui has a mild *semi*tropical climate that is due primarily to three factors: (1) Hawai‘i’s mid-Pacific location near the Tropic of Cancer, (2) the surrounding warm ocean waters that vary little in temperature between the winter and summer seasons, and (3) the prevailing northeasterly tradewinds that bring air having temperatures which are close to those of the surrounding waters.

Solar Radiation

The site receives considerable sunshine, with average daily insolation of about 450 calories per square centimeter per day.

Rainfall

Average annual rainfall at is about 17 inches. Most of this rainfall occurs during the winter rainy season (October through April).

Temperatures

At nearby Waikapū, average temperatures range from 64°F to 79°F in the winter, and 72°F to 86°F in the summer.

Winds

The prevailing surface winds are tradewinds that blow from a northeasterly direction across the isthmus and out to sea. Wind speeds range from about 5.5 mph to 13.3 mph.

### f. Irrigation Water

Historically, Wailuku Water Co. delivered West Maui surface water to irrigate agricultural fields in the western portion of Central Maui. Slightly brackish groundwater from nearby wells supplemented the supply of surface water.

At full development, the WWRF will supply about 3.4 mgd of recycled water for irrigating nearby fields and County lands.

Subject to approval by the Hawai‘i Public Utilities Commission (**PUC**), Wailuku Water Co. proposes to charge $1.87 per 1,000 gallons for delivering surface water to nearby fields. For fiscal year 2024, the County charges $1.04 per 1,000 gallons for non-potable water used for agriculture, and is subject to change at the beginning of every fiscal year.

### g. Road Access

The WWRF site and Easement are reached via plantation roads which connect to Kūihelani Highway and Honoapi‘ilani Highway.

### h. Distance to Markets and Shipping Terminals

Farmers in Central Maui are well-located for trucking farm products to (1) Kahului which is the island’s commercial, industrial, distribution and transportation center; (2) Kahului Harbor for shipping products to O‘ahu or the mainland via barges or cargo ships; and (3) Kahului Airport for shipping air cargo to O‘ahu or the mainland. All three locations are less than 6 miles trucking distance from the WWRF site and Easement.

### i. Summary of Agricultural Conditions

The 14.9-acre WWRF site has poor soils for farming. However, about 4 acres of the Easement has favorable conditions for farming, including good soils, moderate slopes, high solar radiation, the availability of irrigation water, and good access to markets. If not used by the County for the Project or some other non-agricultural purpose (such as a larger regional park), then the land could be used for growing crops as part of a larger farm on abutting private property. A standalone farm on just the Easement could be challenging to cultivate due to the long narrow shape of the property (about 1,800 feet by 100 feet).

## 5. PAST AGRICULTURAL USE

For many decades, both the WWRF site and the Easement were used to grow sugarcane as part of the Hawaiian Commercial & Sugar Co. (**HC&S**) sugarcane plantation. The soil ratings indicate that the WWRF site required very careful management because of poor soils.

Sugarcane operations continued until 2016 when HC&S closed its plantation. Since then, the WWRF site and the Easement have been vacant.

## 6. SURROUNDING LANDS

Figure 5 shows lands surrounding the WWRF site and the Easement. As with the WWRF site and Easement, the County owns the lands to the north and east of the WWRF site. Currently, the County Department of Public Works uses about 11 acres west of the WWRF site as a baseyard for storing gravel and other road material. In the future, the Maui Island Plan indicates that County lands shown in Figure 5 will be used for a regional park and County facilities.

Wai‘ale 905 Partners LLC own the abutting lands to the west of the County lands. Currently, these lands are vacant but are planned for urban development as part of the Waikapū Country Town.

Wai‘ale 905 Partners also own the abutting lands to the south of the County lands, about 580 acres. A variety of crops are grown on these lands, and farming will continue according to the Waikapū Country Town Master Plan.

## 7. IMPACT ON ON-SITE AGRICULTURAL OPERATIONS

The Project will have no impact on existing agricultural operations within the WWRF site or the Easement since these lands are vacant and currently host no farming or ranching activities.

## 8. IMPACT ON NEARBY AGRICULTURAL OPERATIONS

Development and operation of the WWRF and related components will not interfere with nor limit farming on abutting agricultural lands. However, the Project will lower water costs to nearby farmers, will increase the supply of compost, and could increase the risk of equipment and crop theft.

### a. Agricultural Use of Recycled Water

A benefit of the Central Maui WWRF facility is that it eventually will supply about 3.4 mgd of water for irrigating nearby agricultural fields and a County park. An estimated 0.5 mgd will be required for the park (100 acres × 5,000 gallons per acre per day (**gpad**) ÷ 1,000,000 = 0.5 mgd).

Remaining water availability for agricultural use is approximately 2.9 mgd (3.4 mgd total – 0.5 mgd for the park = 2.9 mgd for agriculture). This volume of water is sufficient to irrigate about 725 acres of land, assuming an average of approximately 4,000 gpad ( 2.9 mgd × 1,000,000 gallons/mgd ÷ 4,000 gpad = 725 acres)). This average encompasses fields that would be fallow between crop plantings, during which no water will be required. For comparison, Mahi Pono assumes the following average water use for their crops in Central Maui:

- Community farms: 3,392 gpad
- Orchards (citrus, mac nuts, coffee, etc.): 5,089 gpad
- Tropical fruits: 4,999 gpad
- Row and annual crops: 3,392 gpad
- Energy crops: 3,392 gpad

The estimated 725 acres irrigated with recycled water could encompass about 580 acres of farmland abutting and to the south of the WWRF, between Honoapi‘ilani Highway and Kūihelani Highway (see Figure 5). Most of this land is planned by Wai‘ale 905 Partners for farming and, according to Google Earth maps (2-2024), about 420 is already being farmed. The remaining 145 acres could be located west of Honoapi‘ilani Highway (725 acres total – 580 acres to the south = 145 acres west of the highway). Nearly 500 acres west of the highway are planned for agriculture and about 80 acres are being farmed.

Since the nearby fields are already planned for farming and are supplied with irrigation water from Wailuku Water Co., no significant change in future agricultural activity is expected because of a change to using recycled water. However, the farmers would save about 83¢ per 1,000 gallons of water used ($1.87 per 1,000 gallons to be charged by Wailuku Water Co. subject to PUC approval, less $1.04 per 1,000 gallons charged by the County). This translates to annual savings to farmers of about $880,000 per year due to lower water costs (based on 2.9 mgd × 1,000,000 gallons/mgd × $0.83/1,000 gallons in lower water costs × 365 days/yr = $878,555).

**b. Compost**

The digested solids from the WWRF will be combined with green waste at the County’s Central Maui Landfill to produce compost, a portion of which may be sold to Maui farmers (see Section 2.g).

**c. Security**

If open to the public, the Easement road could increase access to abutting farms which, in turn, could increase trespassing onto the farms and possible theft of equipment and crops.

**d. Mitigating Measures**

Recommended mitigating measures to address the risk of trespassing from the Easement road onto abutting farms and possible theft of equipment and crop include: security fencing along the southern border of the Easement, security cameras at the western end of the Easement, and possibly restricted public access to the Easement road.

## 9. IMPACT ON THE GROWTH OF DIVERSIFIED-CROP FARMING

### a. Loss of Farmland

The Project will result in a loss of about 4 acres of good farmland to be used as the Easement to the WWRF. Without the Project, this land could be used for growing crops as part of a farm on abutting private property. As mentioned above, a standalone farm on just the Easement could be challenging to cultivate due to the long narrow shape of the property (about 1,800 feet by 100 feet).

### b. Supply of Available Farmland

Maui Supply

Maui Island has about 72,300 acres of high-quality farmland in the Agricultural District (see Figure 10). This accounting, which excludes land used for country estates and golf courses, is based on agricultural land that has one or more high soil ratings: an NRCS rating of I or II; an ALISH rating of Prime or Unique, and/or an LSB rating of A or B.

Since 1990, the contraction and eventual closure of sugarcane and pineapple plantations released over 55,000 acres of good farmland on Maui. While some of this former plantation land was urbanized, most of it remains available for **diversified crops** (i.e., crops other than sugarcane and pineapple). In 2020, Maui had about 7,700 gross acres in crop, a figure which includes fallow fields, storage areas, farm roads, etc.

The last plantation that closed was the Hawaiian Commercial and Sugar Co. (**HC&S**) plantation in Central Maui. Its closure in 2016 freed about 36,000 acres for other agricultural activities. In December 2018, Mahi Pono purchased from Alexander & Baldwin, Inc. (**A&B**) 41,000 acres of agricultural land in Central Maui, including the former sugarcane lands of HC&S plus ranchlands. Fields will be planted in citrus and other crops, and some of the fields will be leased to small farmers. As of December 2022, about 9,400 acres have been planted in crops, and over 9,000 acres have been planted in pasture grasses to support cattle operations. Thus, over 22,000 acres in Central Maui remain available for growing crops (41,000 acres – 9,400 acres in crop – 9,000 acres in pasture = 22,600 acres).

Statewide Supply

Figure 11 shows the total statewide amount of land in crop from 1960 to 2022, along with the acreage for plantation crops and diversified crops. Net acreages are shown, which is based on the actual amount of land farmed, and excludes fallow fields, storage areas, farm roads, etc.

Starting in the late 1960s, many sugarcane and pineapple plantations contracted and eventually closed, resulting in a decline of over 300,000 acres used for plantation agriculture. In the late 1980s, Hawai‘i had 19 plantations: 14 sugarcane plantations and five pineapple

plantations. Now, just two small pineapple plantations remain: the Maui Gold Pineapple Co. in Upcountry Maui, and Dole Food Company Hawai‘i on O‘ahu.

Of the 300,000 acres released by the plantations, (1) about 32,000 acres (11%) was replanted in diversified crops, (2) much of the former sugarcane land on the Big Island was replanted in commercial forest for a lumber industry which never developed, and (3) some land was urbanized.

Taking advantage of the release of land from plantation agriculture, existing and new farmers planted more land in diversified crops. From the late 1960s to 2000, acreage in diversified crops increased at an average rate of about 800 acres per year, and reached about 50,000 acres in 2000 (see Figure 11). In the late 1990s, much of the production of vegetables and melons shifted from the Neighbor Islands to O‘ahu because good farmland closer the Honolulu markets came available. After 2000, acreage in diversified crops remained at about 50,000 acres for nearly two decades. The lack of growth was due to increased competition from overseas resulting from technology and other advances that improved the delivery of fresh produce (faster, less spoilage, better coordination of supply to demand), along with trade agreements which increased food exports to the U.S. from low-cost producers. The 2017-to-2020 decline in diversified crop acreage was due to the contraction by the seed companies, while the recent increase in acreage after 2020 was due to plantings by Mahi Pono.

Currently, over 200,000 acres of former plantation land remain available for farming, most of which is now used for grazing cattle. The available supply of farmland far exceeds the 58,000 acres in crop.

### c. Impact of Losing Farmland

The loss of about 4 acres of good farmland is far too small to affect the growth of crop farming on Maui or statewide. As indicated above, the contraction and closure of plantations resulted in a supply of farmland far exceeding demand.

Even if farmed, 4 acres would only provide half-time employment for a single worker (based on 1 farm worker per 10 acres farmed).

### d. Mitigating Measures

Since the loss of about 4 acres of good farm is far too small to affect the growth farming on Maui or statewide, mitigation measures for the loss of agricultural land are not recommended.

## 10. OFFSETTING BENEFITS

The loss of about 4 acres of good agricultural land will be offset by the following benefits of the Project:

— Construction Activity
  - Construction jobs associated with Project development.
  - Indirect jobs generated by the purchase of goods and services by construction companies and families of construction workers.
  - County tax revenues (excise tax surcharge, etc.) and State tax revenues (excise taxes, personal income taxes, corporate income taxes, etc.) paid by construction companies and workers, and by companies and families that are supported by construction activity.

— Operations, Full Development
  - Wastewater treatment services for County-planned urban growth areas in Central Maui consistent with the Maui Island Plan, including services needed for affordable and market-priced housing.
  - Diversion of a portion of the wastewater flow that is currently treated at the Wailuku-Kahului WWRF, thereby reducing the volume of treated effluent that is currently disposed via injection wells at the facility.
  - About 4 mgd of recycled water provided to irrigate agricultural fields, parks, streetscapes, and landscaped areas located near the Central Maui WWRF.
  - An increased supply of compost (digested solids from the WWRF combined with green waste), some of which may sold to Maui farmers.
  - Direct jobs provided by WWRF operations.
  - Indirect jobs supported by the purchase of goods and services for WWRF operations, and by the families of employees at the WWRF.
  - County tax revenues (excise tax surcharge, property taxes, etc.) and State tax revenues (excise taxes, personal income taxes, etc.) paid by (1) on-site employees at the WWRF, and (2) off-site companies and employees supported by WWRF operations.

## 11. CONSISTENCY WITH STATE AND COUNTY POLICIES

### a. Availability of Lands for Agriculture

The *Hawai'i State Constitution*, the *Hawai'i State Plan*, the *State Agriculture Functional Plan*, the *County of Maui 2030 General Plan,* the County's *Maui Island Plan,* and the County's *Wailuku-Kahului Community Plan* call directly or implicitly for preserving the economic viability of plantation agriculture and promoting the growth of diversified agriculture. To accomplish this, an adequate supply of agriculturally suitable lands and water must be assured.

With regard to plantation agriculture, the WWRF site and the Easement are no longer part of a sugarcane plantation.

With regard to diversified agriculture, the Project will not affect any on-site agricultural activities since none exists at the WWRF site and the Easement. However, the Project will reduce the availability of good farmland on Maui by about 4 acres. This loss will not limit the growth of diversified agriculture on Maui or statewide since ample agricultural land is available (see Section 9). This is due to the enormous supply of agricultural land that is now available following the loss of nearly all plantations in Hawai‘i (see Figure 11).

**b. Conservation of Agricultural Lands**

In addition to the above, State and City policies call for conserving and protecting prime agricultural lands, including protecting farmland from urban development.

In compliance with these policies, Maui County has developed a "Directed Growth Plan" as part of the *Maui Island Plan* (2012). This Plan guides future urban, small town and rural development on Maui while protecting prime agricultural land located outside the Growth Boundaries. The WWRF site and Easement are located within the Urban Growth Boundary of the Wailuku–Kahului Planned Growth Plan in an area designated for a Regional Park and County Facilities (see Figure 6). Since the WWRF site and Easement are located within the Growth Boundary, these two areas do not include the prime agricultural lands planned for conservation and protection.

It should also be noted that many of the State agricultural policies were written before the major contraction of plantation agriculture (from 1981 to 1996), and assume implicitly that profitable agricultural activities eventually will be available to utilize all available agricultural lands. This has proven to be a questionable assumption in view of the enormity of the contraction of plantation agriculture, the abundant supply of farmland that came available for diversified agriculture, and the slow growth in the amount of land being utilized for diversified agriculture (see Section 9 and Figure 11).

Furthermore, discussions in the *Agriculture State Functional Plan* recognize that redesignation of lands from Agricultural to Urban and/or Rural should be allowed "… upon a demonstrated change in economic or social conditions, and where the requested redesignation will provide greater benefits to the general public than its retention in …agriculture;" that is, when an "overriding public interest exists." The enormous contraction of plantation agriculture, which resulted in the supply of agricultural land far exceeding demand, constitutes a major change in economic conditions (see Section 9 and Figure 11). Moreover, the Project will provide community benefits (wastewater treatment, recycled water, jobs, tax revenues, etc.) that far exceed the benefits of leaving the land in agriculture (at most, part-time work for single farmer if the approximately 4.1 acres planned for the Easement were to be farmed)—see Subsection 9.d and Section 10. In practice, the Project is expected to have no significant impact on agricultural activity since ample land is available on Maui and statewide to accommodate the anticipated growth of diversified agriculture (see Section 9).

**c. Important Agricultural Lands**

In 1978, the State Constitutional Convention proposed the identification and designation of Important Agricultural Lands (**IAL**). After nearly 30 years, the State Legislature adopted legislation to fulfill the intent and purpose of the Constitutional mandate. As stated in HRS Chapter 205: "The objective for the identification of important agricultural lands is to identify and plan for the maintenance of a strategic agricultural land resource base that can support a diversity of agricultural activities and opportunities that expand agricultural income and job opportunities and increase agricultural self-sufficiency for current and future generations." IALs are defined as lands that: "(1) Are capable of producing sustained high agricultural yields when treated and managed according to accepted farming methods and technology; (2) Contribute to the State's economic base and produce agricultural commodities for export or local consumption; or (3) Are needed to promote the expansion of agricultural activities and income for the future, even if currently not in production."

The IAL designation is a supplemental State land use classification administered by the State Land Use Commission (**LUC**). This designation provides access to incentives that promote profitable farming of IALs. Incentives include the approval to construct on-site farm dwellings and employee housing, income tax credits for agricultural costs, financing opportunities, loan guarantees, and expedited State-level permitting for agricultural processing facilities. The designation does not change existing land classifications (i.e., State Land Use Districts, County community plan designations, County zoning, etc.), nor does it restrict allowable uses of IAL-designated agricultural land.

Landowners can petition the LUC to designate as IAL all or portions of their agricultural land. In addition, each county is required to identify, map and recommend lands within its jurisdiction that have potential for IAL designation in keeping with the standards, criteria and procedures established by law. After the LUC reviews a County's recommendations, the LUC is responsible for designating IALs.

The WWRF site and Easement are within the County's Directed Growth Boundaries for Urban development. As such, these areas will not be candidates for IAL designation.

**d. County of Maui Land-Use Plans**

As mentioned above, the WWRF site and Easement are located within the Directed Growth Boundaries of the *Maui Island Plan* in an area designated for a Regional Park and County Facilities (see Figures 5 and 6). Thus, WWRF and Easement are consistent with the *Maui Island Plan.*

The *Wailuku-Kahului Community Plan* (2002) show the WWRF site and Easement in an area designated as Agriculture. As mentioned in Section 3, a *Community Plan* Amendment will be pursued for the WWRF site to allow development of the Project.

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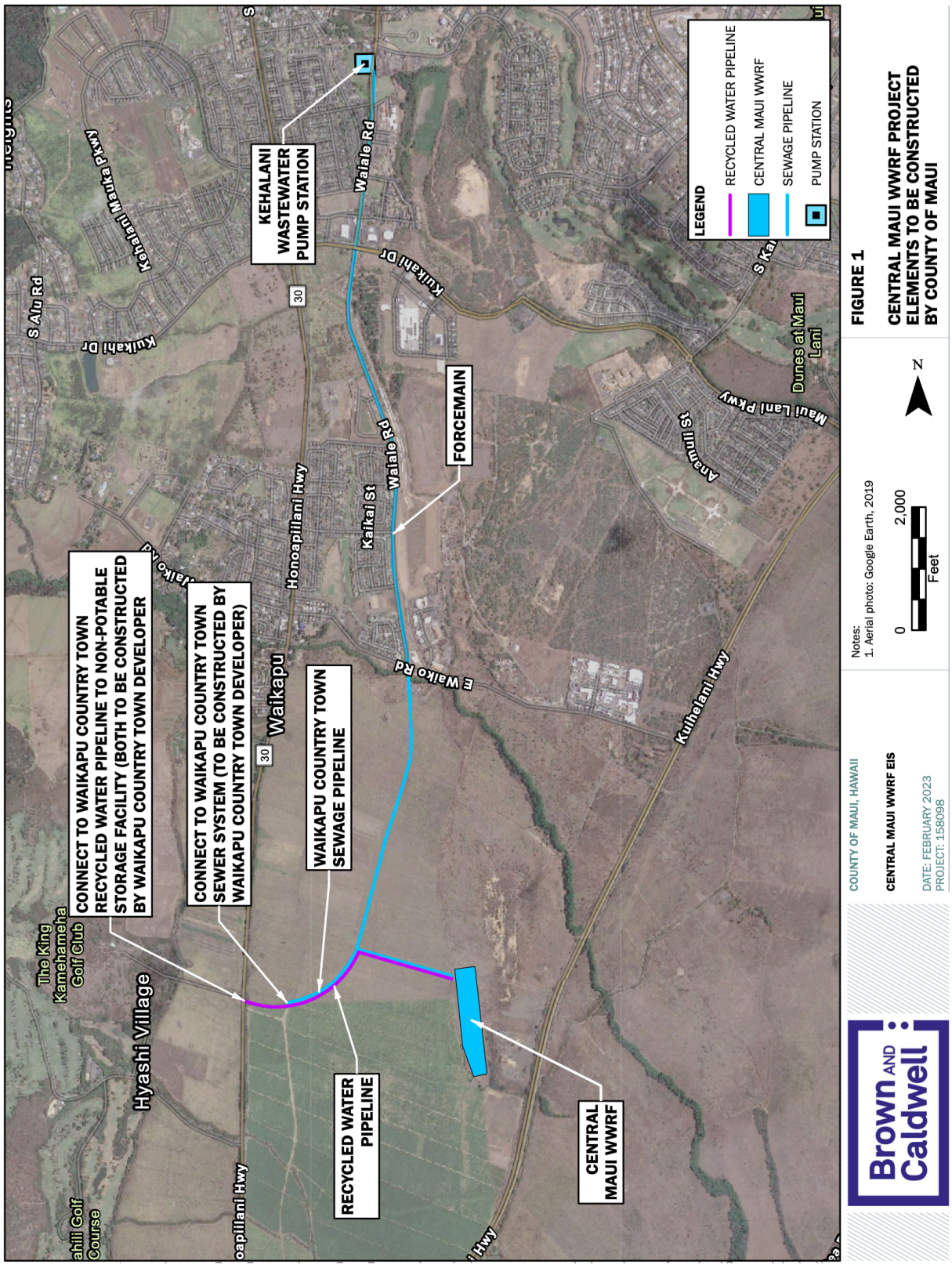



**Figure 1. Location of the Project**

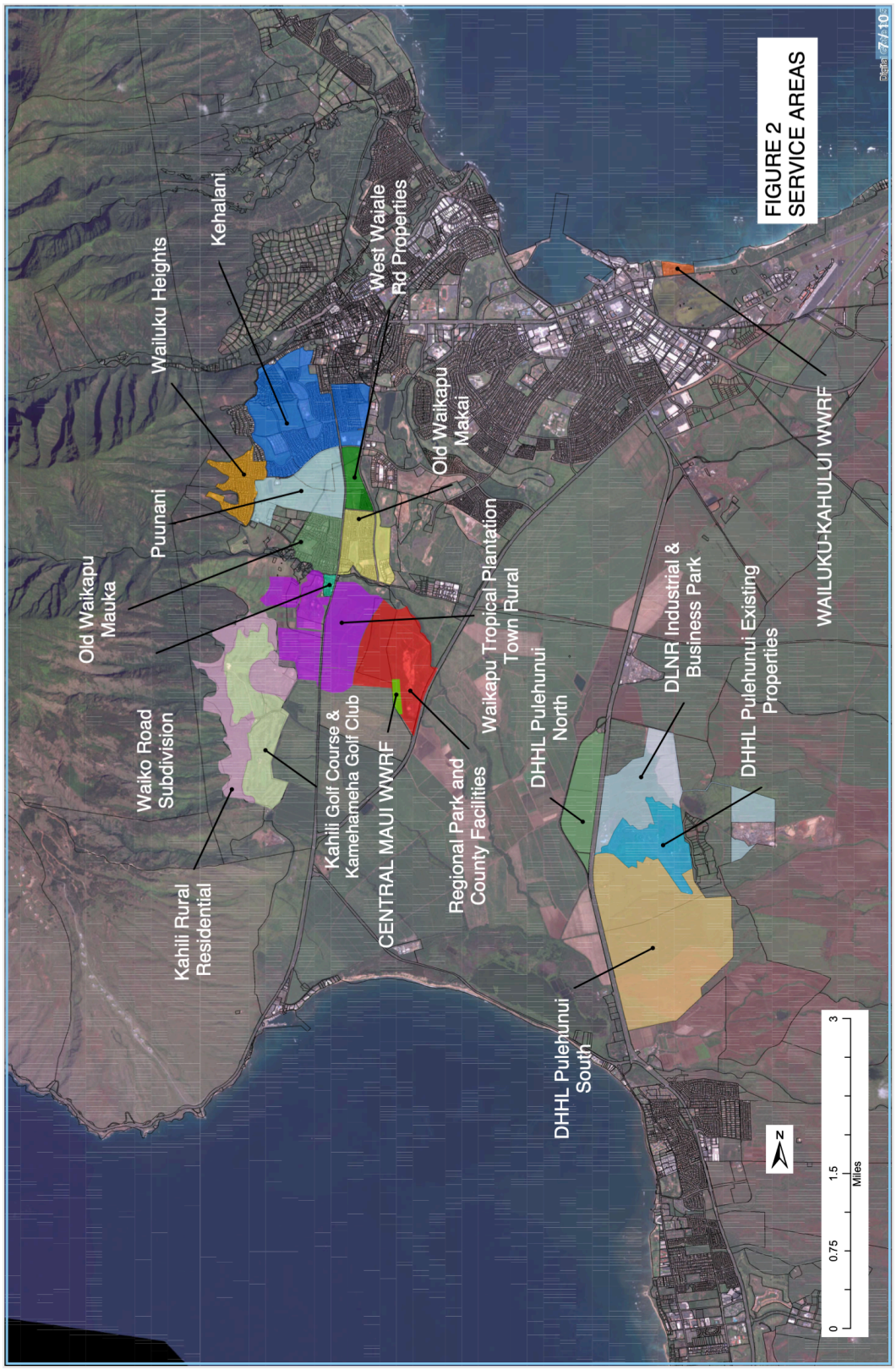



**Figure 2. Service Areas**

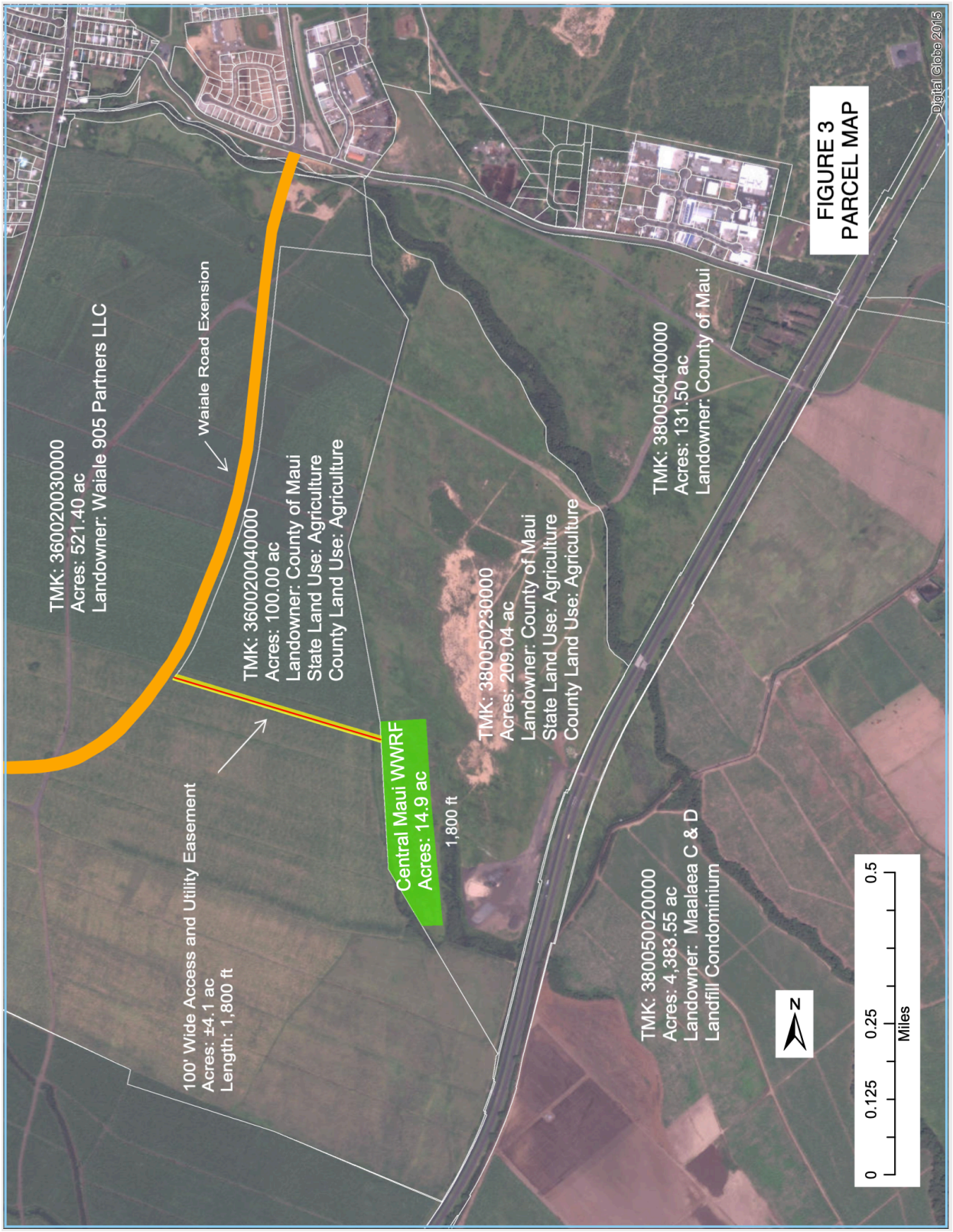



**Figure 3. Parcels**

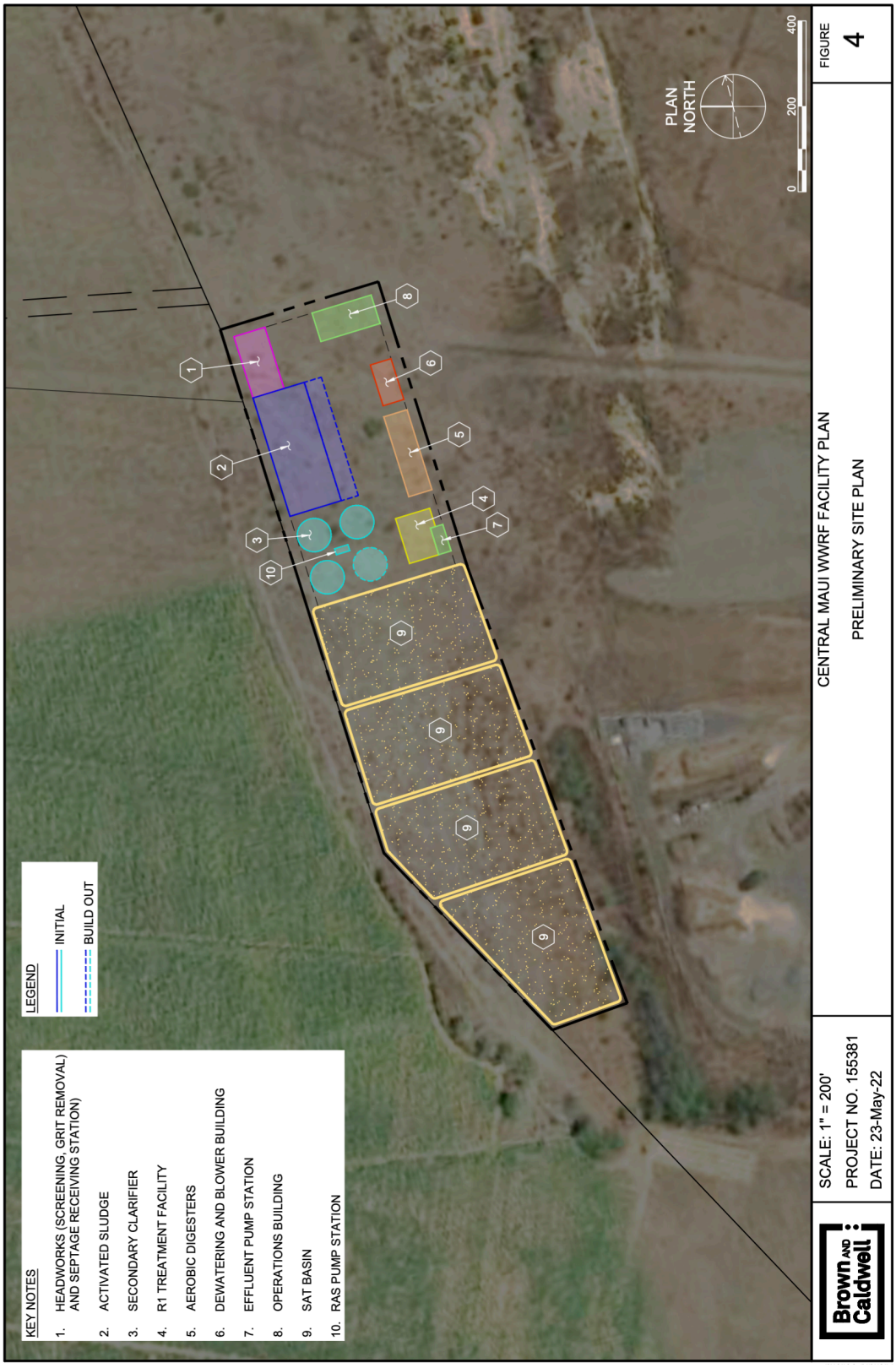



**Figure 4. Preliminary Site Plan, WWRF**

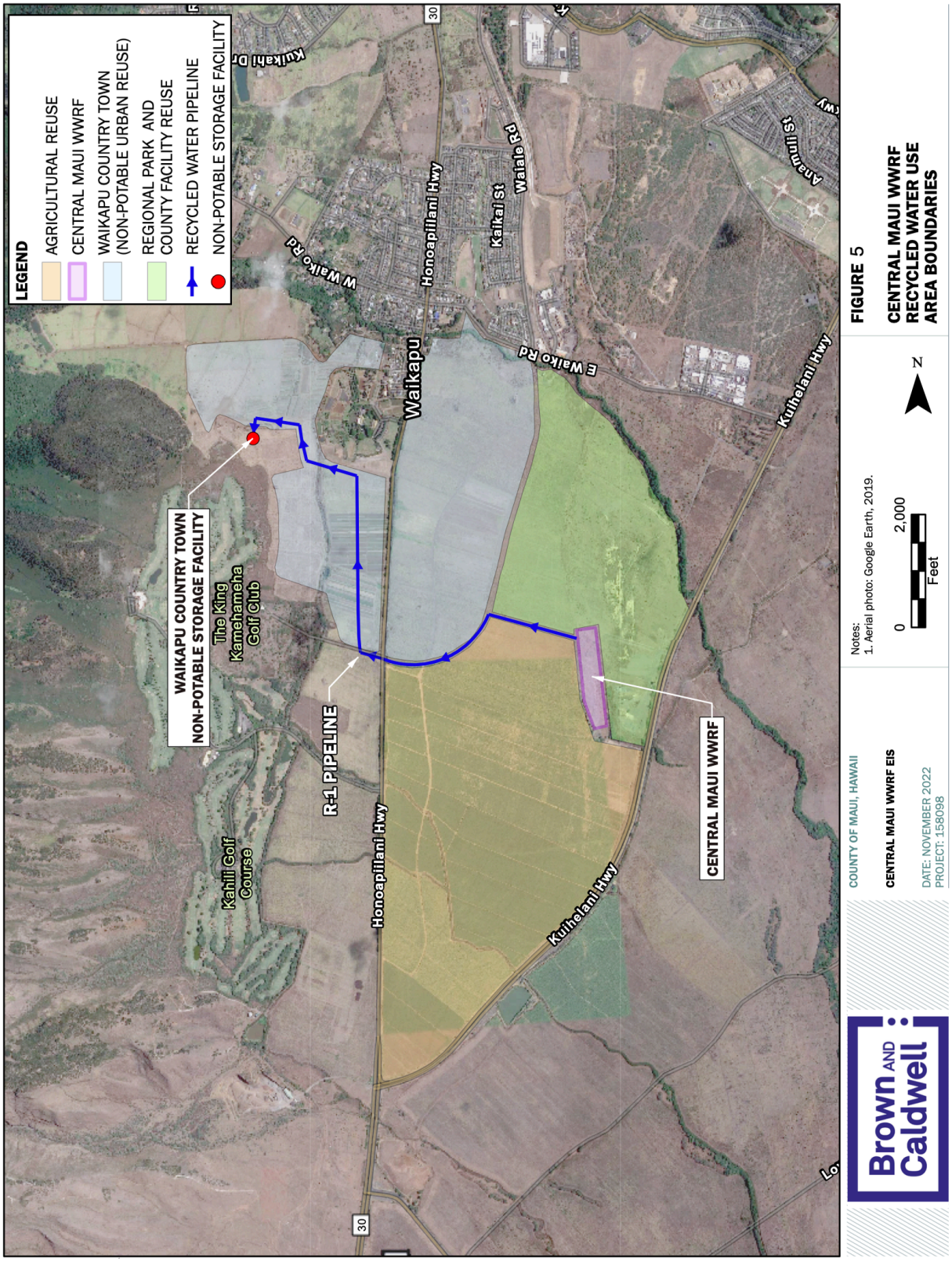



**Figure 5. Recycled Water-Use Areas**

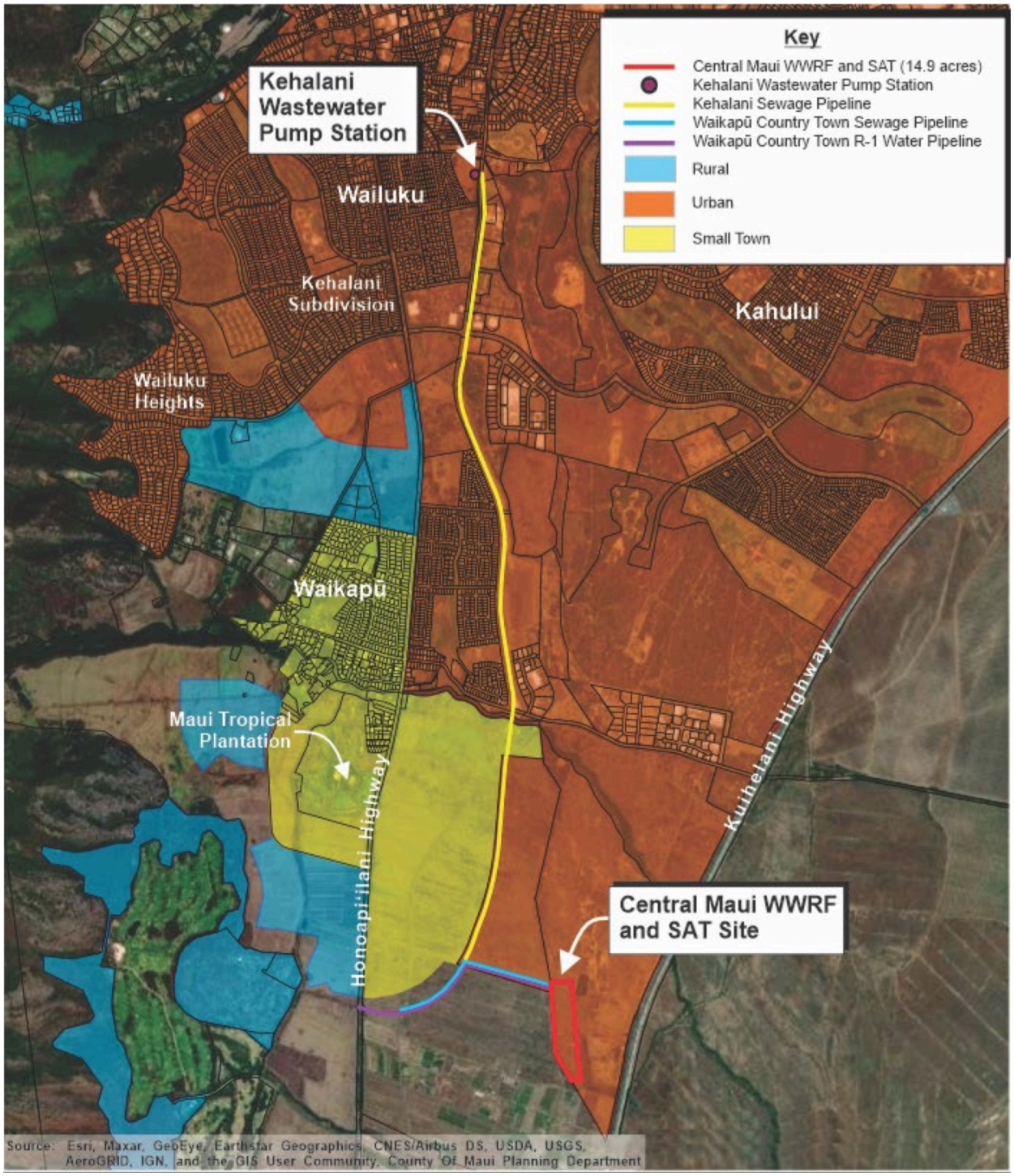



**Figure 6. Maui Island Plan**

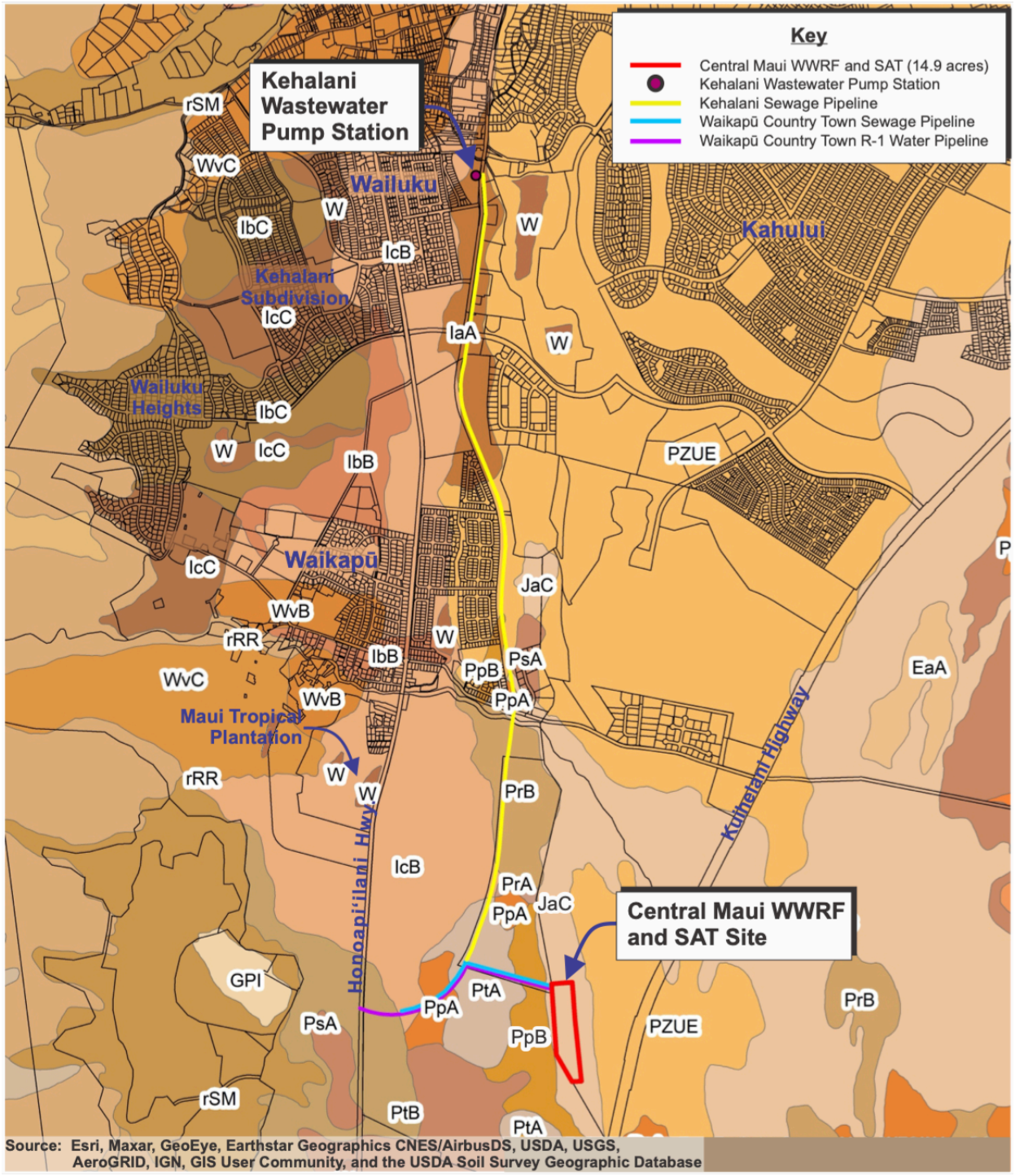



**Figure 7. Soils Map**

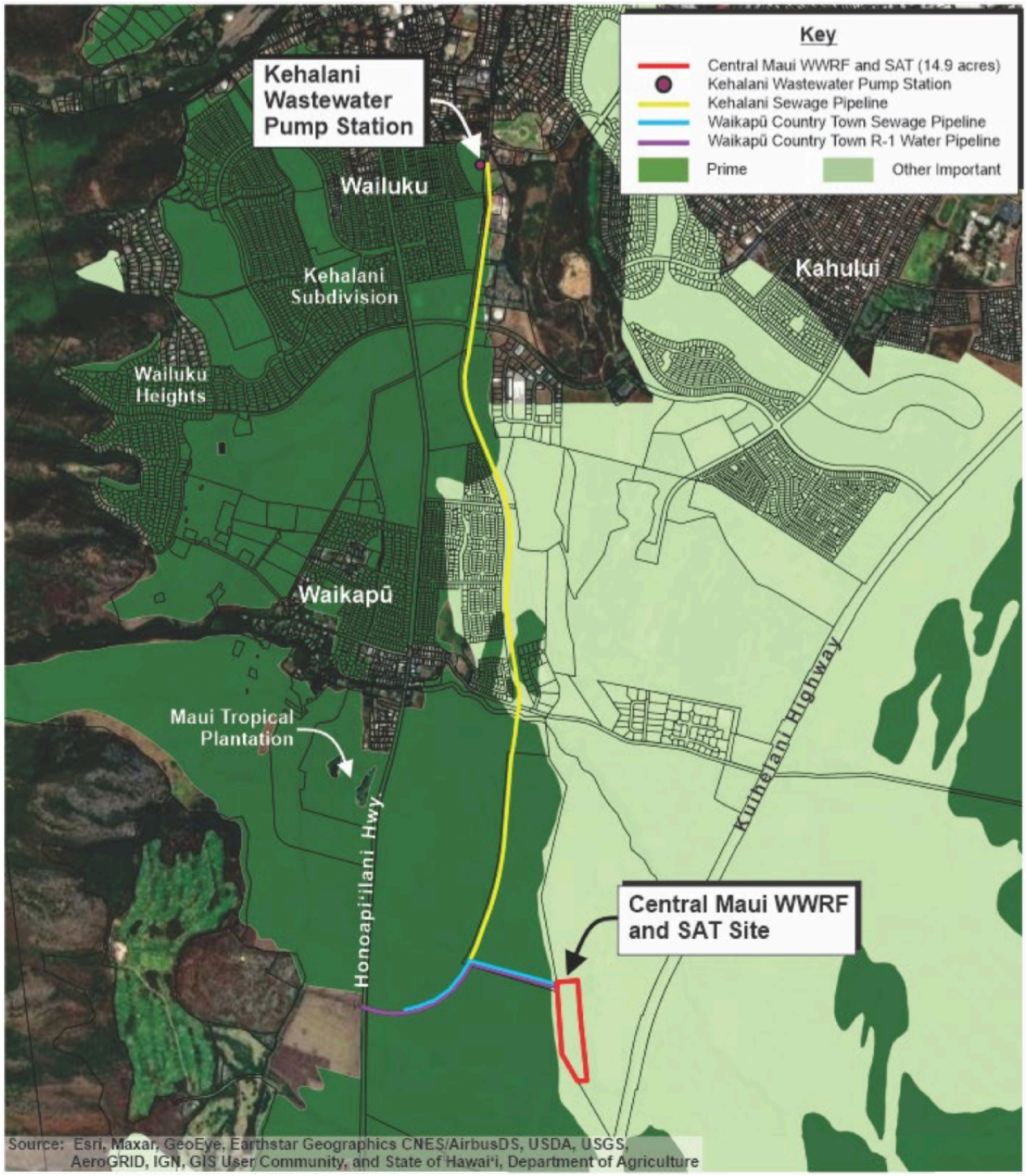



**Figure 8. ALISH Map**

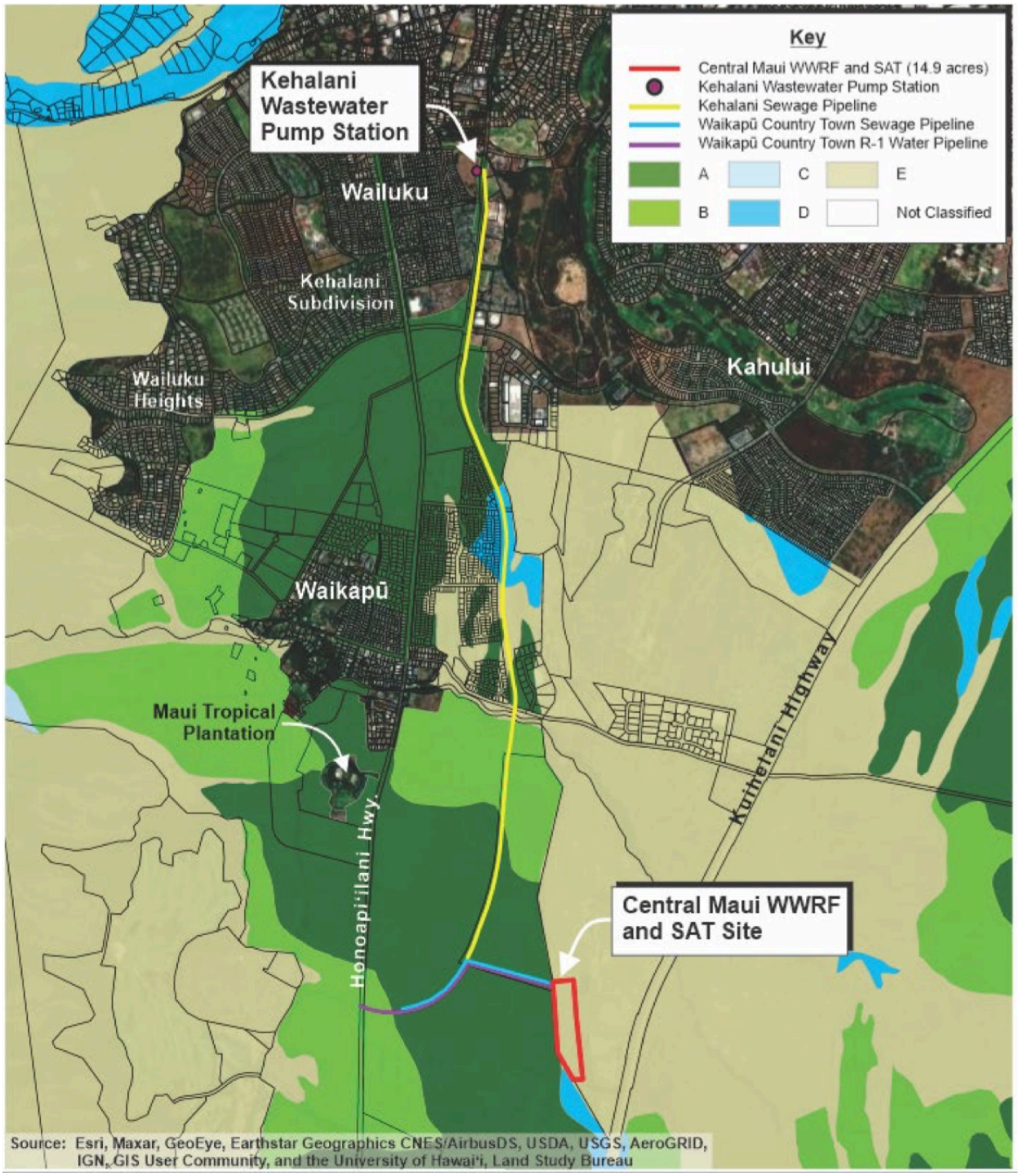



**Figure 9. LSB Map**

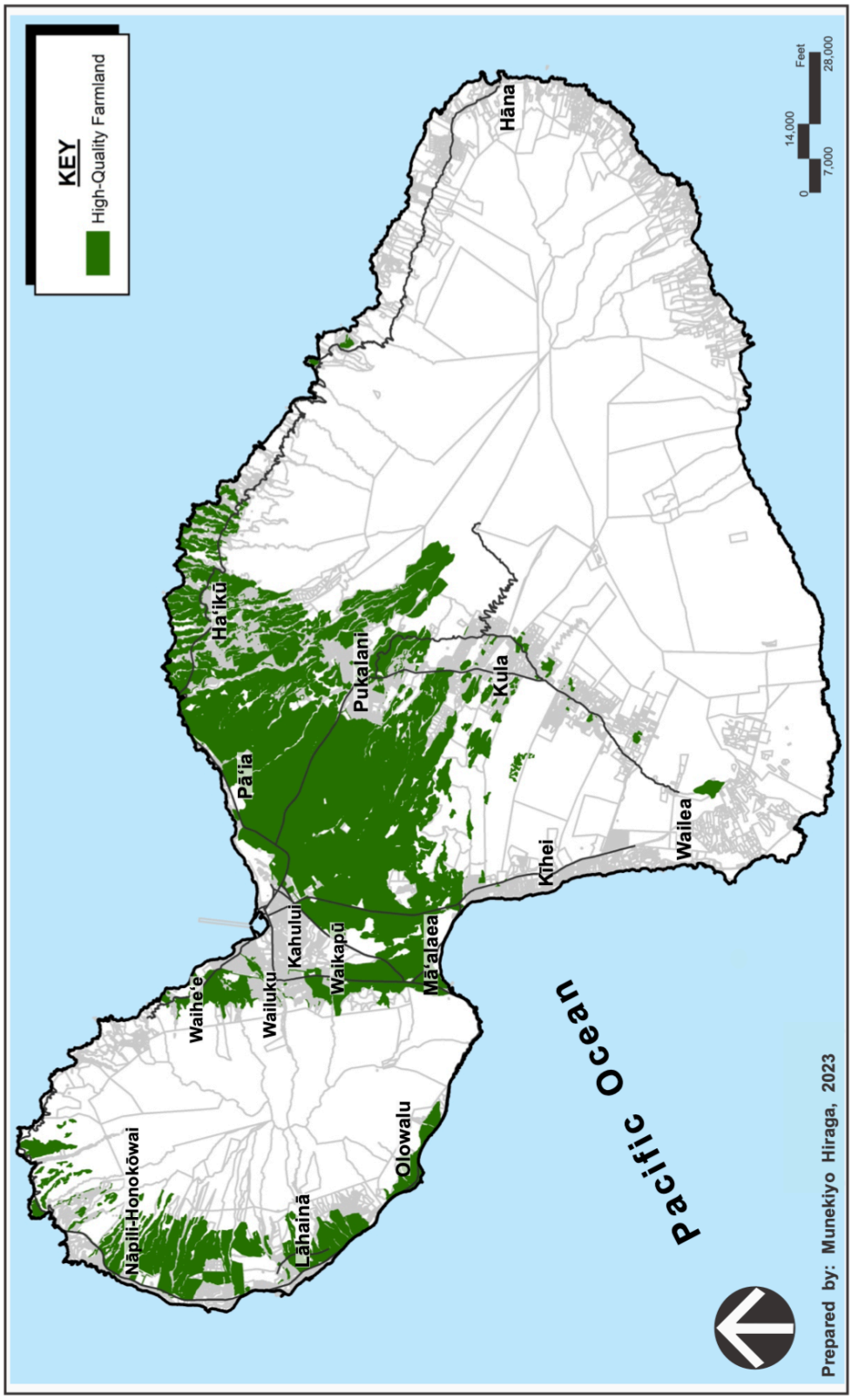



**Figure 10. High-Quality Farmland**

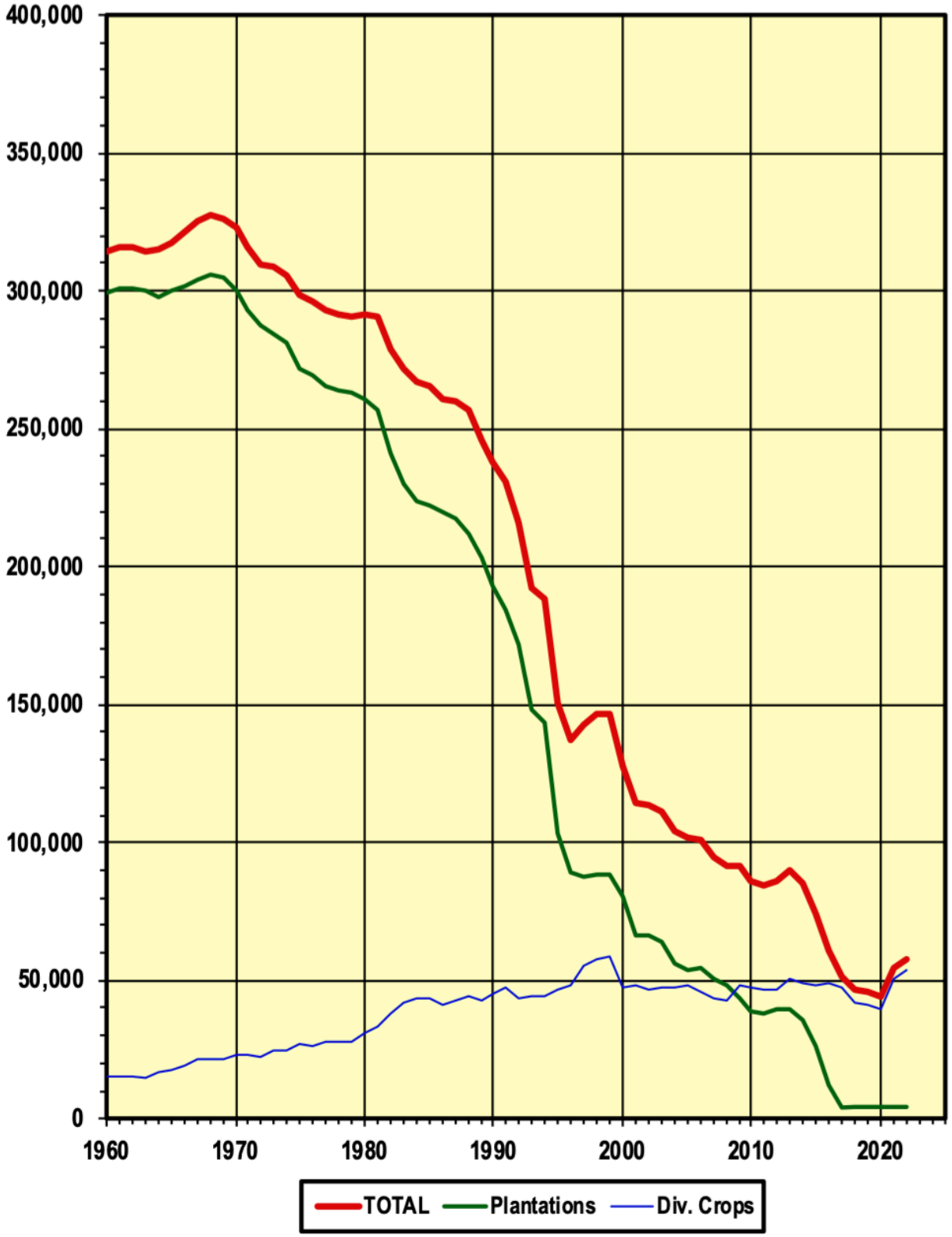



**Figure 11. Acreage in Crop, Statewide: 1960 to 2022**

# APPENDIX

## STATE AND COUNTY GOALS, OBJECTIVES, POLICIES AND GUIDELINES RELATED TO AGRICULTURAL LANDS

**1. HAWAI'I STATE CONSTITUTION** (Article XI, Section 3):

> …to conserve and protect agricultural lands, promote diversified agriculture, increase agricultural self-sufficiency and assure the availability of agriculturally suitable lands…

**2. HAWAI'I STATE PLAN** (Chapter 226, Hawaii Revised Statutes, as amended):

**Section 226-7 Objectives and policies for the economy--agriculture.**

(a) Planning for the State's economy with regard to agriculture shall be directed towards achievement of the following objectives:

(1) Viability in Hawaii's sugar and pineapple industries.

(2) Growth and development of diversified agriculture throughout the State.

(3) An agriculture industry that continues to constitute a dynamic and essential component of Hawaii's strategic, economic, and social well-being.

(b) To achieve the agricultural objectives, it shall be the policy of the State to:

(2) Encourage agriculture by making best use of natural resources.

(10) Assure the availability of agriculturally suitable lands with adequate water to accommodate present and future needs.

(16) Facilitate the transition of agricultural lands in economically nonfeasible agricultural production to economically viable agricultural uses.

**Section 226-103 Economic priority guidelines.**

(c) Priority guidelines to promote the continued viability of the sugar and pineapple industries:

(1) Provide adequate agricultural lands to support the economic viability of the sugar and pineapple industries.

(d) Priority guidelines to promote the growth and development of diversified agriculture and aquaculture:

(1) Identify, conserve, and protect agricultural and aquacultural lands of importance and initiate affirmative and comprehensive programs to promote

economically productive agricultural and aquacultural uses of such lands.

(10) Support the continuation of land currently in use for diversified agriculture.

**Section 226-104 Population growth and land resources priority guidelines.**

(b) Priority guidelines for regional growth distribution and land resource utilization:

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

### 3. AGRICULTURAL STATE FUNCTIONAL PLAN (1991)

(Functional plans are guidelines for implementing the State Plan. They are approved by the Governor, but not adopted by the State Legislature.)

Objective H: Achievement of Productive Agricultural Use of Lands Most Suitable and Needed for Agriculture.

Policy H(2): Conserve and protect important agricultural lands in accordance with the Hawaii State Constitution.

Action H(2)(a): Propose enactment of standards and criteria to identify, conserve, and protect important agricultural lands and lands in agricultural use.

Action H(2)(c): Administer land use district boundary amendments, permitted land uses, infrastructure standards, and other planning and regulatory functions on important agricultural lands and lands in agricultural use, so as to ensure the availability of agriculturally suitable lands and promote diversified agriculture.

### 4. COUNTY OF MAUI 2030 GENERAL PLAN, COUNTYWIDE POLICY PLAN (2010)

**Countywide goals, objectives, policies and actions**

**F. Strengthen the Local Economy**

**Objective**

2. Diversify and expand sustainable forms of agriculture and aquaculture.

**Policies**

b. Prioritize the use of agricultural land to feed the local population, and promote the use of agriculture lands for sustainable and diversified agricultural activities.

e. Support ordinances, programs, and policies that keep agricultural land and water available and affordable to farmers.

**Implementing Actions**

c. Create agricultural parks in areas distant from genetically modified crops.

**J. Promote Sustainable Land Use and Growth Management**

**Objective**

2. Improve planning for and management of agricultural lands and rural areas.

**Policies**

a. Protect prime, productive, and potentially productive agricultural lands to maintain the islands' agricultural and rural identities and economies.

c. Discourage developing or subdividing agriculturally designated lands when non-agricultural activities would be primary uses.

**Implementing Actions**

a. Inventory and protect prime, productive, and potentially productive agricultural lands from competing non-agricultural land uses.

## 5. MAUI ISLAND PLAN, GENERAL PLAN 2030 (2012)

**Core Values**

E. Preserve rural and agricultural lands and encourage sustainable agriculture.

**Agricultural Lands**

**Goal**

7.1 Maui will have a prosperous agricultural industry and will protect agricultural lands.

**Objective**

7.1.1 Significantly reduce the loss of productive agricultural lands.

**Policies**

7.1.1.a Allow, where appropriate, the clustering of development on agricultural lands when approved as a CSD [Conservation Site Design] plan or similar approval mechanism.

7.1.1.b Require, where appropriate, the review and approval of CSD plans prior to the subdivision of agricultural land.

7.1.1.c Discourage developing or subdividing productive agricultural lands for residential uses in which the residence would be the primary use and any agricultural activities would be secondary uses.

7.1.1.e Focus urban growth, to the extent practicable, away from productive and important agricultural lands.

7.1.1.f Strongly discourage the conversion of productive and important agricultural lands (such as sugar, pineapple, and other produce lands) to rural or urban use, unless justified during the General Plan update, or when other overriding factors are present.

7.1.1.h Provide incentives for landowners to preserve and protect agricultural lands from development through the use of TDR/PDR, tax credits, easement programs, or similar means.

7.1.1.j Require all major developments adjacent to agricultural lands to provide an appropriate and site-specific agricultural protection buffer as part of a required site plan.

**Directed Growth Plan**

**Rural Growth Area, Policies**

8.2.d All development within rural growth areas should avoid encroachment upon prime agricultural land.

**Wailuku-Kahului**

As shown in Figure 6, Pu‘unani is within the Growth Area for Wailuku, with a portion within the Urban Boundary and a portion within the Rural Boundary.

## 6. COUNTY OF MAUI, WAILUKU–KAHALUI COMMUNITY PLAN (2002)

### B. Intended Effects of the Wailuku-Kahului Community Plan

… The plan seeks to balance future growth and development in a manner reflective of the urban/agricultural character of the region. … the protection of agricultural lands is an inherent part of the plan.

### C. Goals, Objectives, Policies and Implementing Actions

**ECONOMIC ACTIVITY**

**Goal**

A stable and viable economy that provides opportunities for growth and diversification to meet long-term community and regional needs and in a manner that promotes agricultural activity and preserves agricultural lands and open space resources.

**Objectives and policies**

1. Support agricultural production so agriculture can continue to provide employment and contribute to the region’s economic well-being.

9. Support the establishment of agricultural parks for truck farming, piggery operations, bee keeping and other diversified agricultural operations within larger unsubdivided agricultural parcels and in locations that are compatible with residential uses.

**ENVIRONMENT**

**Objectives and policies**

1. Preserve agricultural lands as a major element of the open space setting that which borders the various communities within the planning region …

**HOUSING**

**Objectives and policies**

3. Seek alternative residential growth areas within the planning region, with high priority given to the Wailuku and Kahului areas. This action should recognize that crucial issues of maintaining important agricultural lands …

**LAND USE**

**Objectives and policies**

1. Ensure that adequate lands are available to support the region's present and future agricultural activities.
2. Identify prime or productive agricultural lands, and develop appropriate regulations for their protection.
3. The direct and cumulative impacts of agricultural subdivisions and the impacts on the community shall be assessed and considered.
4. Establish administrative procedures and standards … to ensure that agricultural subdivisions shall not be approved unless their uses are expressly permitted by Chapter 205, Hawaii Revised Statutes.
5. Encourage traditional Hawaiian agriculture, such as taro cultivation, within the agricultural district, in areas.

## 7. REFERENCES

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# BIOLOGICAL RESOURCES SURVEY

# APPENDIX I-1

# BIOLOGICAL RESOURCES SURVEY

for the CENTRAL MAUI

WASTEWATER RECLAMATION FACILITY

WAIKAPŪ, WAILUKU DISTRICT, MAUI

by

Robert W. Hobdy
Environmental Consultant
Kokomo, Maui
March 2023

Prepared for: The County of Maui
Department of Environmental Management

BIOLOGICAL RESOURCES SURVEY
CENTRAL MAUI WASTEWATER RECLAMATION FACILITY
WAIKAPŪ, MAUI, HAWAII

## INTRODUCTION

The Central Maui Wastewater Reclamation Facility consists of the construction of a new wastewater reclamation facility and appurtenant transmission pipelines and utilities that would service the Wailuku and Waikapū communities. In support of this project a biological resources survey has been requested to assess the flora and fauna within the project area to identify any protected or sensitive species of concern.

## SITE DESCRIPTION

The Central Maui Wastewater Reclamation Facility (WWRF) lies on 14.9 acres TMK (2) 3-8-005:023 (portion) of fallow land at an elevation of 210 feet (see Figure 1). The force main pipeline will follow the existing Waiale Road from the Kehalani Wastewater Pump Station in Wailuku 2.25 miles south to East Waikō Road, and then an additional 1.4 miles along the proposed Waiale Road extension from East Waikō Road to Honoapi`ilani Highway (No TMK). The last component is an access and utility easement connecting the Waiale Road Extension with the WWRF (4.1 acres) TMK (2) 3-6-002:004 (portion).

The vegetation in the existing Waiale Road is entirely a maintained landscape with mowed grass and a few ornamental street trees. The vegetation along the Waiale Road extension and the access and utilities easement is entirely a dense grassland with an occasional shrub. A dense but narrow forest grows along the banks of the Waikapū stream where the Waiale Road extension will cross over it. The vegetation in the WWRF site is also a dense grassland but with more medium sized trees and shrubs. Annual rainfall averages 20 to 25 inches with most occurring during the winter months.

## SURVEY OBJECTIVES

This report summarizes the findings of a flora and fauna survey of the proposed Central Maui Wastewater Reclamation Facility Project which was conducted during March 2023. The objectives of the survey were to:

1. Document what plant and animal species occur on the property or may likely occur in the existing habitat.

2. Document the status and abundance of each species.

3. Determine the presence or likely occurrence of any native flora and fauna, particularly any that are Federally listed as Threatened or Endangered (USFWS, 2023). If such occur, identify what features of the habitat may be essential for these species.

4. Determine if the project area contains any special habitats which if lost or altered might result in a significant negative impact on the flora and fauna in this part of the island.

## BOTANICAL SURVEY REPORT

### SURVEY METHODS

A walk-through botanical survey method was used to cover the entire project area. Notes were made on plant species, distribution, and frequency. Special focus was made to identify native species and any significant native plant communities present that might warrant attention.

### DESCRIPTION OF THE VEGETATION

Almost the entire undeveloped project area is covered by a dense grassland dominated by two species. Guinea grass (*Megathyrsus maximus*) was abundant everywhere. Buffelgrass (*Cenchrus ciliaris*) is the next most common species. A total of 79 plant species were recorded during the survey. Besides the above two grass species, 27 species were uncommon and an additional 50 species were of rare occurrence.

Just three of these species were native plants: `uhaloa (*Waltheria indica*), `ilima (*Sida fallax*) and koali kuahulu (*Merremia aegyptia*). All three of these are indigenous species, meaning that they occur naturally throughout the Hawaiian islands but also occur naturally in other parts of the world as well. All three are quite common in Hawaii and are considered to be of no environmental concern.

The remaining 76 plants recorded during the survey are considered to be non-native, many of which are known to be agricultural or roadside weeds in Hawaii (see the inventory list).

### DISCUSSION AND RECOMMENDATION

The vegetation in the project area is dominated by non-native species that are of no particular conservation concern. The three indigenous native plants, the ʻuhaloa, koali kuahulu and ʻilima, are common throughout Hawaii, and also occur naturally in other countries in the Pacific. None have any special conservation status. No federally listed Endangered or Threatened species (USFWS, 2019) were found to occur on the project area.

Because of the above findings it is determined that there is little of botanical concern and that the proposed project is not expected to have a significant negative impact on the botanical resources in this part of Maui.

## PLANT SPECIES LIST

Following is a checklist of all those vascular plant species inventoried during the field studies. Plant families are arranged alphabetically within each of two groups: Monocots and Dicots. Taxonomy and nomenclature are in accordance with Wagner et al. (1999).

For each species, the following information is provided:

1. Scientific name with author citation.

2. Common English or Hawaiian name.

3. Bio-geographical status. The following symbols are used:

   endemic = native only to the Hawaiian Islands; not naturally occurring anywhere else in the world.

   indigenous = native to the Hawaiian Islands and also to one or more other geographical area(s).

   Polynesian = all those plants brought to Hawaii during the course of Polynesian migrations.

   non-native = all those plants brought to the islands intentionally or accidentally after western contact.

4. Abundance of each species within the project area:

   abundant = forming a major part of the vegetation within the project area.

   common = widely scattered throughout the area or locally abundant within a portion of it.

   uncommon = scattered sparsely throughout the area or occurring in a few small patches.

   rare = only a few isolated individuals within the project area.

| SCIENTIFIC NAME | COMMON NAME | STATUS | ABUNDANCE |
|---|---|---|---|
| **MONOCOTS** | | | |
| CYPERACEAE (Sedge Family) | | | |
| *Cyperus rotundus* L. | nutsedge | non-native | uncommon |
| *Kyllinga brevifolia* Rottb. | kili'o'opu | non-native | rare |
| POACEAE (Grass Family) | | | |
| *Bothriochloa pertusa* (L.) A. Camus | pitted beardgrass | non-native | uncommon |
| *Cenchrus ciliaris* L. | buffelgrass | non-native | common |
| *Cenchrus echinatus* L. | common sandbur | non-native | uncommon |
| *Cenchrus purpureus* (Schumach.) Morrone | Napier grass | non-native | rare |
| *Chloris barbata* (L.) Sw. | swollen fingergrass | non-native | uncommon |
| *Cynodon dactylon* (L.) Pers. | mānienie grass | non-native | uncommon |
| *Digitaria ciliaris* (Retz.) Koeler | tropical crabgrass | non-native | uncommon |
| *Digitaria violascens* Link | smooth crabgrass | non-native | rare |
| *Eleusine indica* (L.) Gaertn. | wire grass | non-native | rare |
| *Eragrostis amabilis* (L.) Wight & Arnott | Japanese lovegrass | non-native | rare |
| *Eragrostis pectinaceus* (Michx.) Nees | Carolina lovegrass | non-native | uncommon |
| *Megathyrsus maximus* (Jacq.) Simon & Jacobs | Guinea grass | non-native | abundant |
| *Melinis repens* (Willd.) Zizka | Natal redtop | non-native | uncommon |
| *Saccharum officinarum* L. | sugar cane | non-native | rare |
| *Setaria verticillata* (L.) P. Beauv. | bristly foxtail | non-native | rare |
| *Urochloa subquadripara* (Trin.) R.D. Webster | tropical signalgrass | non-native | rare |
| **DICOTS** | | | |
| AMARANTHACEAE (Amaranth Family) | | | |
| *Alternanthera pungens* Kunth | khaki weed | non-native | rare |
| *Amaranthus lividus* L. | livid amaranth | non-native | rare |
| *Amaranthus spinosus* L. | spiny amaranth | non-native | rare |
| *Amaranthus viridis* L. | slender amaranth | non-native | rare |
| *Chenopodium murale* L. | 'aheahea | non-native | rare |
| APOYCYNACEAE (Dogbane Family) | | | |
| *Calotropis procera* (Aiton) Aiton | small crown flower | non-native | rare |
| ASTERACEAE (Sunflower Family) | | | |
| *Bidens pilosa* L. | Spanish needle | non-native | uncommon |
| *Emilia fosbergii* Nicolson | red pualele | non-native | rare |
| *Pluchea carolinensis* (Jacq.) G. Don | sourbush | non-native | rare |
| *Senecio madagascariensis* Poir. | Madagascar fireweed | non-native | rare |
| *Sonchus oleraceus* L. | pualele | non-native | uncommon |
| *Thymophylla tenuiloba* (DC.) Small | Dahlberg daisy | non-native | rare |
| *Tridax procumbens* L. | coat buttons | non-native | rare |
| *Verbesina encelioides* (Cav.) Benth. & Hook. | golden crown-beard | non-native | uncommon |
| *Xanthium strumarium* L. | kīkānia | non-native | rare |
| BORAGINACEAE (Borage Family) | | | |
| *Heliotropium procumbens* Mill. | four-spike heliotrope | non-native | rare |

| SCIENTIFIC NAME | COMMON NAME | STATUS | ABUNDANCE |
|---|---|---|---|
| BRASSICACEAE (Mustard Family) | | | |
| *Lepidium virginicum* L. | pepperwort | non-native | rare |
| CONVOLVULACEAE (Morning Glory Family) | | | |
| *Ipomoea obscura* (L.) Ker-Gawl. | obscure morning glory | non-native | rare |
| *Ipomoea triloba* L. | little bell | non-native | uncommon |
| *Merremia aegyptia* (L.) Urb. | koali kuahulu | indigenous | rare |
| CUCURBITACEAE (Gourd Family) | | | |
| *Cucumis dipsaceus* Ehrenb. ex Spach | hedgehog gourd | non-native | rare |
| *Momordica charantia* L. | bitter melon | non-native | rare |
| EUPHORBIACEAE (Spurge Family) | | | |
| *Euphorbia heterophylla* L. | kaliko | non-native | rare |
| *Euphorbia hirta* L. | hairy spurge | non-native | rare |
| *Euphorbia hypericifolia* L. | graceful spurge | non-native | uncommon |
| *Euphorbia prostrata* Aiton | prostrate spurge | non-native | rare |
| *Macaranga tanarius* (L.) Mull.Arg. | parasol leaf tree | non-native | rare |
| *Ricinus communis* L. | Castor bean | non-native | uncommon |
| FABACEAE (Pea Family) | | | |
| *Chamaecrista nictitans* (L.) Moench | partridge pea | non-native | rare |
| *Crotalaria incana* L. | fuzzy rattlepod | non-native | uncommon |
| *Crotalaria pallida* Aiton | smooth rattlepod | non-native | uncommon |
| *Crotalaria retusa* L. | rattlepod | non-native | rare |
| *Desmanthus pernambucanus* (L.) Thellung | slender mimosa | non-native | rare |
| *Desmodium tortuosum* (Sw.) DC. | Florida beggarweed | non-native | uncommon |
| *Indigofera spicata* Forssk. | creeping indigo | non-native | rare |
| *Indigofera suffruticosa* Mill. | inikō | non-native | rare |
| *Leucaena leucocephala* (Lam.) de Wit | koa haole | non-native | uncommon |
| *Macroptilium atropurpureum* (DC.) Urb. | siratro | non-native | uncommon |
| *Medicago lupulina* L. | black medic | non-native | rare |
| *Neonotonia wightii* (Wight & Anott) Lackey | glycine | non-native | rare |
| *Pithecellobium dulce* (Roxb.) Benth. | 'opiuma | non-native | rare |
| *Prosopis pallida* (Humb. & Bonpl. ex Willd.) Kunth | kiawe | non-native | uncommon |
| *Senna surratensis* (N.L. Burm.) H. Irwin & Barneby | kolomona | non-native | rare |
| LAMIACEAE (Mint Family) | | | |
| *Leonotis nepetifolia* (L.) R. Br. | lion's ear | non-native | uncommon |
| MALVACEAE (Mallow Family) | | | |
| *Abutilon grandifolium* (Willd.) Sweet | hairy abutilon | non-native | rare |
| *Malva parviflora* L. | cheese weed | non-native | uncommon |
| *Malvastrum coromandelianum* (L.) Garcke | false mallow | non-native | uncommon |
| *Melochia umbellata* (Houtt.) Staph | melochia | non-native | rare |
| *Sida ciliaris* L. | bracted fanpetals | non-native | rare |
| *Sida fallax* Walp. | 'ilima | indigenous | rare |
| *Sida rhombifolia* L. | arrowleaf sida | non-native | uncommon |

| SCIENTIFIC NAME | COMMON NAME | STATUS | ABUNDANCE |
|---|---|---|---|
| *Sida spinosa* L. | prickly sida | non-native | rare |
| *Waltheria indica* L. | 'uhaloa | indigenous | uncommon |
| MYRTACEAE (Myrtle Family) | | non-native | |
| *Syzygium cumini* (L.) Skeels | Java plum | non-native | rare |
| NYCTAGINACEAE (Four-o'clock Family) | | | |
| *Boerhavia coccinea* Mill. | scarlet spiderling | non-native | uncommon |
| PAPAVERACEAE (Poppy Family) | | | |
| *Argemone mexicana* L. | Mexican poppy | non-native | rare |
| PASSIFLORACEAE (Passion Flower Family) | | | |
| *Passiflora edulis* Sims | passion fruit | non-native | rare |
| SOLANACEAE (Nightshade Family) | | | |
| *Nicandra physalodes* (L.) Gaertn. | apple of Peru | non-native | uncommon |
| *Nicotiana glauca* R.C. Graham | tree tobacco | non-native | rare |
| *Solanum lycopersicum* L. | cherry tomato | non-native | rare |
| VERBENACEAE (Verbena Family) | | | |
| *Stachytarpheta jamaicensis* (L.) Vahl | Jamaica vervain | non-native | rare |

# FAUNA SURVEY REPORT

## SURVEY METHODS

A walk-through fauna survey method was conducted in conjunction with the botanical survey. All parts of the project area were covered. Field observations were made with the aid of binoculars and by listening to vocalizations. Notes were made on species abundance, activities, and location as well as observations of trails, tracks, scat and signs of feeding. In addition, an evening visit was made to the area to record crepuscular activities and vocalizations and to see if there was any evidence of occurrence of the Hawaiian hoary bat (*Lasiurus cinereus semotus*) in the area.

## RESULTS

### MAMMALS

Three non-native mammal species were recorded in the project area during three site visits. Taxonomy and nomenclature follow Tomich (1986). Axis deer (*Axis axis*) tracks and droppings were observed in many areas within the undeveloped portions of the project area. Likewise, a few tracks of feral pigs (*Sus scropha*) were seen. Some mongooses (*Herpestes auropunctatus*) were also observed.

A special effort was made to detect the presence of the endemic `ōpe`ape`a or Hawaiian hoary bat (*Lasiurus cinereus semotus*) by making an evening survey at two locations using a bat detector (Batbox III D) set to the frequency of 27 megahertz which these bats are known to emit when echolocating for nocturnal flying insects on which they prey. None of these bats were detected with the use of this device.

Other non-native mammals one might expect to occur in this habitat, but not seen include rats (*Rattus* spp.), mice (*Mus domesticus*), domestic dogs (*Canis familiaris*) and feral cats (*Felis catus*).

### BIRDS

Nine non-native bird species were recorded in the project area during three site visits. Taxonomy and nomenclature follow American Ornithological Society (2023). One species was common, the zebra dove (*Geopelia striata*). Five other species were uncommon: spotted dove (*Streptopelia chinensis*), black francolin (*Francolinus francolinus*), common myna (*Acridotheres tristis),* house sparrow (*Passer domesticus*) and the nutmeg mannikin (*Lonchura punctulata*). Three other species were of rare occurrence.

The project area is not suitable for native seabirds, waterbirds, forest birds or nēnē geese and none were seen.

### INSECTS

Insects were represented by nine non-native species, representing four insect Orders. Taxonomy and nomenclature follow Nishida et al (1992). Two species were common: the long-tailed blue butterfly (*Lampides boeticus*) and the short-horned grasshopper (*Oedaleus abruptus*). Four species were uncommon: dung fly (*Musca sorbens*), monarch butterfly (*Danaus plexippus*), large suphur butterfly (*Phoebis agarithe*) and the cabbage butterfly (*Pieris rapae*). Three other species were of rare occurrence. No native insects were recorded during the survey.

## DISCUSSION AND RECOMMENDATIONS

The fauna survey in this project habitat did not record any native mammal, bird or insect species during three site visits.

Three young tree tobacco plants were found during the survey. Tree tobacco is an important non-native host plant for the endemic and Endangered Blackburn's sphinx moth (*Manduca blackburni*) which lays its eggs on them and whose larvae feed upon the leaves and mature on them before pupating and completing their life cycle. These tree tobaccos were examined but no eggs or larvae were found on them. Without this connection with the endangered moth, the tree tobacco is of no other conservation concern and no recommendations are made here.

While no bats were detected during the survey, they could occasionally pass through the area during the wetter months when the nocturnal flying insects they feed on are more plentiful. These bats have a breeding season during the spring and summer months and raise their pups in the medium to large sized trees. During these months before the pups can fly, they are vulnerable if trees are destroyed. The project area has almost no large trees in the undeveloped roadways and access easements. Such trees occur in the narrow Waikapū stream crossing and scattered within the WWRF site. Standard federal guidance recommends that trees over 15 feet tall not be removed between March and mid-September to provide protection in case any young bat pups are present.

While no federally protected seabirds utilize the project area, the Endangered `ua`u or Hawaiian dark-rumped petrel (*Pterodroma sandwichensis*) and `akē`akē or band-rumped storm petrel (*Oceanodroma castro*) as well as the Threatened `a`o or Newell's shearwater (*Puffinus newelli*) are known to fly over lowlands to and from their nesting burrows high in the mountains between the months of March and November. These birds are often distracted and confused by bright outdoor lighting which can cause them to crash to the ground where they are vulnerable to be run over by vehicles or killed by predators. Young birds taking their first fledging flights out to sea are particularly vulnerable. The County of Maui has recently required that all outdoor lighting must now be shielded so all light is directed toward the ground to address this danger.

With the above recommendations and guidance in place there are no further concerns regarding fauna resources, and the project is not expected to have a significant negative impact on the native fauna resources in this part of Maui.

# ANIMAL SPECIES LIST

Following is a checklist of the fauna species inventoried during the field work. Species are arranged in descending abundance within three groups: Mammals, Birds & Insects. For each species the following information is provided:

1. Common name

2. Scientific name

3. Bio-geographical status. The following symbols are used:

   endemic = native only to Hawaii; not naturally occurring anywhere else in the world.

   indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).

   non-native = all those animals brought to Hawaii intentionally or accidentally after western contact.

   migratory = spending a portion of the year in Hawaii and a portion elsewhere. In Hawaii the migratory birds are usually in the over wintering/non-breeding phase of their life cycle.

4. Abundance of each species within the project area:

   abundant = many flocks or individuals seen throughout the area at all times of day.

   common = a few flocks or well scattered individuals throughout the area.

   uncommon = only one flock or several individuals seen within the project area.

   rare = only one or two seen within the project area.

| SCIENTIFIC NAME | COMMON NAME | STATUS | ABUNDANCE |
|---|---|---|---|
| **MAMMALS** | | | |
| CERVIDAE (Deer Family) | | | |
| *Axis axis* Erxleben | axis deer | non-native | uncommon |
| SUIDAE (Swine Family) | | | |
| *Sus scropha* L. | domestic pig | non-native | rare |
| VIVERRIDAE (Mongoose Family) | | | |
| *Herpestes auropunctatus* Hodgson | small Indian mongoose | non-native | rare |
| **BIRDS** | | | |
| ARDEIDAE (Heron Family) | | | |
| *Bubulcus ibis* L. | cattle egret | non-native | rare |
| COLUMBIDAE (Dove Family) | | | |
| *Geopelia striata* L. | zebra dove | non-native | common |
| *Streptopelia chinensis* Scopoli | spotted dove | non-native | uncommon |
| ESTRILDIDAE (Estrildid Finch Family) | | | |
| *Lonchura punctulata* L. | nutmeg mannikin | non-native | uncommon |
| PASSERIDAE (Sparrow Family) | | | |
| *Passer domesticus* L. | house sparrow | non-native | uncommon |
| PHASIANIDAE (Pheasant Family) | | | |
| *Francolinus francolinus* L. | black francolin | non-native | uncommon |
| *Gallus gallus* L. | common chicken | non-native | rare |
| STURNIDAE (Starling Family) | | | |
| *Acridotheres tristis* L. | common myna | non-native | uncommon |
| ZOSTEROPIDAE (White-eye Family) | | | |
| *Zosterops japonicus* Temmink & Schlegel | Japanese white-eye | non-native | rare |

| SCIENTIFIC NAME | COMMON NAME | STATUS | ABUNDANCE |
|---|---|---|---|
| **INSECTS** | | | |
| Order DIPTERA - flies | | | |
| CULICIDAE (Mosquito Family) | | | |
| *Culex quinquefasciatus* Say | Southern house mosquito | non-native | rare |
| MUSCIDAE (House Fly Family) | | | |
| *Musca sorbens* Wiedemann | dung fly | non-native | uncommon |
| Order HYMENOPTERA - bees, wasps & ants | | | |
| APIDAE (Honey Bee Family) | | | |
| *Apis mellifera* L. | honeybee | non-native | rare |
| Order LEPIDOPTERA - butterflies & moths | | | |
| LYCAENIDAE (Gossamer-winged Butterfly Family) | | | |
| *Lampides boeticus* L. | long-tailed blue butterfly | non-native | common |
| NYMPHALIDAE (Brush-footed Butterfly Family) | | | |
| *Danaus plexippus* L. | monarch butterfly | non-native | uncommon |
| PIERIDAE (White and Sulphur Butterfly Family) | | | |
| *Euremia niccipe* Cramer | sleepy orange butterfly | non-native | rare |
| *Phoebis argarithe* Boisduval | large sulphur butterfly | non-native | uncommon |
| *Pieris rapae* L. | cabbage butterfly | non-native | uncommon |
| Order ORTHOPTERA - grasshoppers, crickets | | | |
| ACRIDIDAE (Grasshopper Family) | | | |
| *Oedaleus abruptus* Thunberg | short-horned grasshopper | non-native | common |

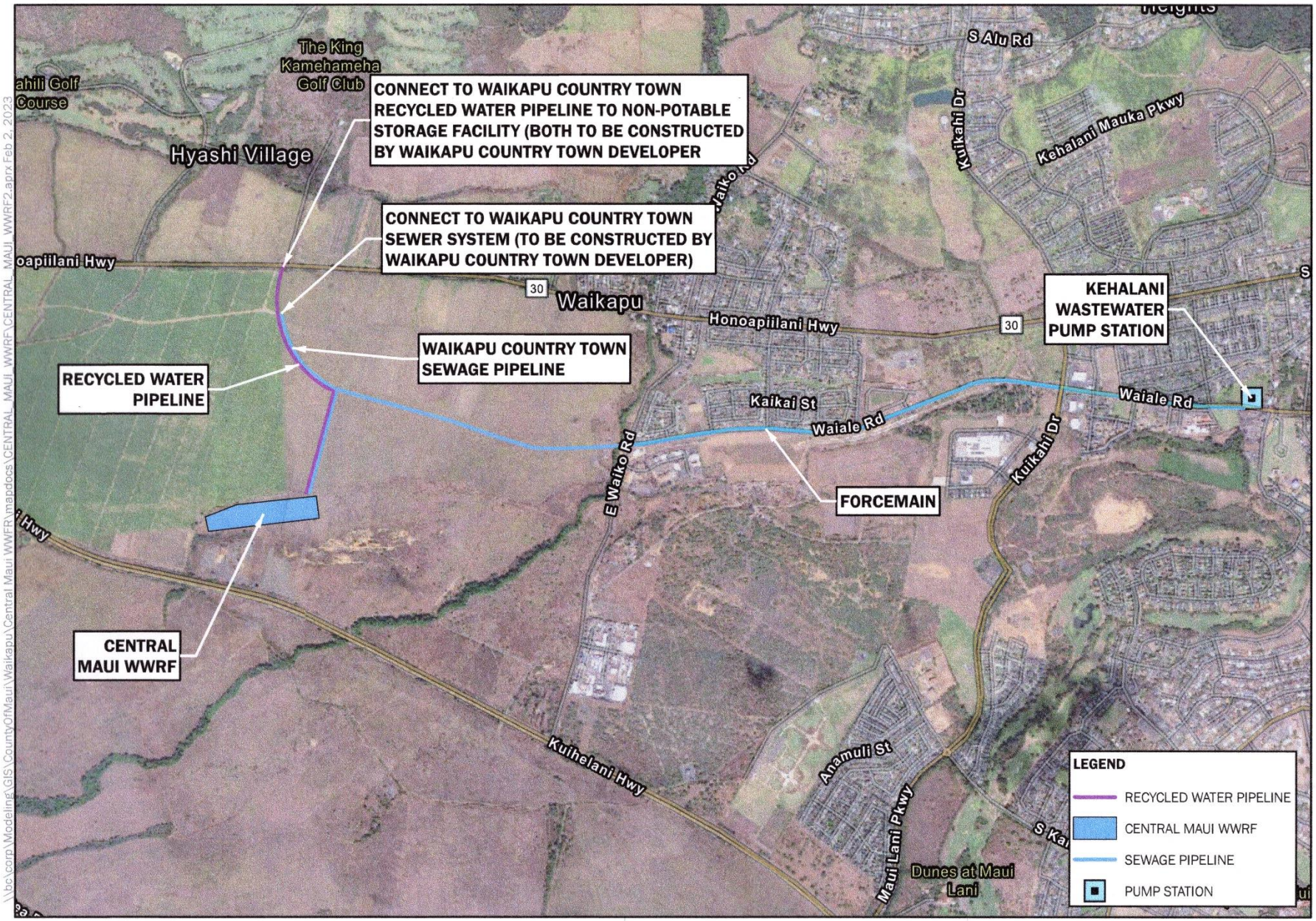



Figure 1. Central Maui Wastewater Reclamation Facility

# INFORMATION FOR PLANNING AND CONSULTATION (IPAC) SPECIES LIST

## APPENDIX I-2

# United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish And Wildlife Office
300 Ala Moana Boulevard, Box 50088
Honolulu, HI 96850-5000
Phone: (808) 792-9400 Fax: (808) 792-9580

In Reply Refer To: 07/30/2025 21:34:06 UTC
Project Code: 2025-0129322
Project Name: Central Maui WWRF and SAT

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened and endangered species, as well as designated critical habitat that may occur within the boundary of your proposed project and that may be affected by project related actions. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*). Please contact the Service's Pacific Islands Fish and Wildlife Office (PIFWO) at 808-792-9400 if you have any questions regarding your IPaC species list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may adversely affect threatened and endangered species and/or designated critical habitat.

Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the IPaC system by completing the same process used to receive the enclosed list.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a Biological

Evaluation, similar to a Biological Assessment, be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment or Biological Evaluation are described at 50 CFR 402.12.

Due to the significant number of listed species found on each island within PIFWO's regulatory jurisdiction, and the difficulty in accurately mapping ranges for species that we have limited information about, your species list may include more species than if you obtained the list directly from a Service biologist. We recommend you use the species links in IPaC to view the life history, habitat descriptions, and recommended avoidance and minimization measures to assist with your initial determination of whether the species or its habitat may occur within your project area. If appropriate habitat is present for a listed species, we recommend surveys be conducted to determine whether the species is also present. If no surveys are conducted, we err on the side of the species, by regulation, and assume the habitat is occupied. Updated avoidance and minimization measures for plants and animals, best management practices for work in or near aquatic environments, and invasive species biosecurity protocols can be found on the PIFWO website at: https://www.fws.gov/office/pacific-islands-fish-and-wildlife/library.

If a Federal agency determines, based on the Biological Assessment or Biological Evaluation, that a listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at: http://www.fws.gov/endangered/esa-library/index.

Non-federal entities can also use the IPaC generated species list to develop Habitat Conservation Plans (HCP) in accordance with section 10(a)(1)(B) of the Act. We recommend HCP applicants coordinate with the Service early during the HCP development process. For additional information on HCPs, the Habitat Conservation Planning handbook can be found at https://www.fws.gov/sites/default/files/documents/habitat-conservation-planning-handbook-entire.pdf.

Please be aware that wind energy projects should follow the Service’s wind energy guidelines (http://www.fws.gov/windenergy) for minimizing impacts to migratory birds. Listed birds and the Hawaiian hoary bat may also be affected by wind energy development and we recommend development of a Habitat Conservation Plan for those species, as described above. Guidance for minimizing impacts to migratory birds for projects including communications towers can be found at:

- http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers
- http://www.towerkill.com
- http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow

Fish and Wildlife Coordination Act: Any modification to freshwater or marine waters of the U.S. including impounding, diverting, deepening, controlling, or modification for any other purpose requires a Fish and Wildlife Coordination Act (FWCA) consultation with the U.S Fish and Wildlife Service, State/ Territorial wildlife agency (State of Hawaii Division of Aquatic

Resources, American Samoa’s Department of Marine and Wildlife Resources, Guam’s Division of Aquatic and Wildlife Resources, or the Northern Mariana Island’s Division of Fish and Wildlife) and the National Marine Fisheries Service. The Pacific Islands Fish and Wildlife Office in Honolulu should be notified of a FWCA consultation request with a project description and any relevant biological information in order to expedite the appropriate level of coordination and consultation needs.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation actions that benefit threatened and endangered species into their project planning to further the purposes of the Act in accordance with section 7(a)(1). Please include the Consultation Tracking Number associated with your IPaC species list in any request for consultation or correspondence about your project that you submit to our office. Please feel free to contact us at PIFWO_admin@fws.gov or 808-792-9400 if you need more current information or assistance regarding the potential impacts to federally listed species and federally designated critical habitat.

Attachment(s):

- Official Species List

# OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

**Pacific Islands Fish And Wildlife Office**
300 Ala Moana Boulevard, Box 50088
Honolulu, HI 96850-5000
(808) 792-9400

# PROJECT SUMMARY

Project Code: 2025-0129322
Project Name: Central Maui WWRF and SAT
Project Type: Wastewater Facility - New Construction
Project Description: The County of Maui, Department of Environmental Management (DEM) is proposing to develop a new Central Maui Wastewater Reclamation Facility (WWRF) and onsite Soil Aquifer Treatment (SAT) system on approximately 14.9 acres of former agricultural lands between Honoapiʻilani Highway and Kūihelani Highway in Waikapū, as well as related offsite infrastructure improvements. Offsite improvements consist of a wastewater pump station (WWPS) near the existing master-planned Kehalani community (“Kehalani WWPS”), a sewage pipeline from the Kehalani WWPS to the WWRF (“Kehalani Sewage Pipeline”) in Wailuku, portions of sewage pipeline and R-1 recycled water pipeline that connect the WWRF and the future Waikapū Country Town development (“Waikapū Country Town Sewage Pipeline” and “Waikapū Country Town R-1 Recycled Water Pipeline”), and a WWRF access road. The total project area (onsite and offsite improvements) is approximately 21.5 acres. The proposed WWRF will service existing and planned developments throughout the Waikapū/Wailuku area, as well as State of Hawaiʻi projects in Pūlehunui. Implementation of this new WWRF will reduce wastewater flows currently being handled and treated by the WailukuKahului WWRF, the main wastewater treatment facility servicing the Central Maui region.

Most of the project components are located within undeveloped lands and rights-of-way (ROW) owned by the County of Maui, except for the Kehalani WWPS proposed to be located on the periphery of an existing stormwater basin parcel owned by the County of Maui and portions of pipeline alignments which are located on lands currently owned by private landowners.

Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@20.8360511,-156.49533959089806,14z




Counties: Maui County, Hawaii

# ENDANGERED SPECIES ACT SPECIES

There is a total of 24 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

## MAMMALS

| NAME | STATUS |
|---|---|
| Hawaiian Hoary Bat *Lasiurus cinereus semotus* | Endangered |

No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/770
General project design guidelines:
https://ipac.ecosphere.fws.gov/project/BYD2INUSYZGWRD6N6EBTJAEJKY/documents/generated/6477.pdf

## BIRDS

| NAME | STATUS |
|---|---|
| Band-rumped Storm-petrel *Hydrobates castro* | Endangered |

Population: USA (HI)
No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/1226
General project design guidelines:
https://ipac.ecosphere.fws.gov/project/BYD2INUSYZGWRD6N6EBTJAEJKY/documents/generated/6939.pdf

Hawaiian Coot (alae Ke`oke`o) *Fulica alai* — Endangered

No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/7233
General project design guidelines:
https://ipac.ecosphere.fws.gov/project/BYD2INUSYZGWRD6N6EBTJAEJKY/documents/generated/6934.pdf

Hawaiian Duck *Anas wyvilliana* — Endangered

No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/7712
General project design guidelines:
https://ipac.ecosphere.fws.gov/project/BYD2INUSYZGWRD6N6EBTJAEJKY/documents/generated/6934.pdf

Hawaiian Goose *Branta (=Nesochen) sandvicensis* — Threatened

No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/1627
General project design guidelines:
https://ipac.ecosphere.fws.gov/project/BYD2INUSYZGWRD6N6EBTJAEJKY/documents/generated/6925.pdf

Hawaiian Petrel *Pterodroma sandwichensis* — Endangered

No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/6746
General project design guidelines:
https://ipac.ecosphere.fws.gov/project/BYD2INUSYZGWRD6N6EBTJAEJKY/documents/generated/6939.pdf

Hawaiian Stilt *Himantopus mexicanus knudseni* — Endangered

No critical habitat has been designated for this species.

NAME STATUS

Species profile: https://ecos.fws.gov/ecp/species/2082
General project design guidelines:
https://ipac.ecosphere.fws.gov/project/BYD2INUSYZGWRD6N6EBTJAEJKY/documents/generated/6934.pdf

Newell"s Shearwater *Puffinus newelli* — Threatened
No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/2048
General project design guidelines:
https://ipac.ecosphere.fws.gov/project/BYD2INUSYZGWRD6N6EBTJAEJKY/documents/generated/6939.pdf

## REPTILES

NAME STATUS

Hawksbill Sea Turtle *Eretmochelys imbricata* — Endangered
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
Species profile: https://ecos.fws.gov/ecp/species/3656

## INSECTS

NAME STATUS

Blackburn's Sphinx Moth *Manduca blackburni* — Endangered
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
Species profile: https://ecos.fws.gov/ecp/species/4528
General project design guidelines:
https://ipac.ecosphere.fws.gov/project/BYD2INUSYZGWRD6N6EBTJAEJKY/documents/generated/6926.pdf

## FLOWERING PLANTS

NAME STATUS

`aiea *Nothocestrum latifolium* — Endangered
No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/1061

`ena`ena *Pseudognaphalium sandwicensium var. molokaiense* — Endangered
No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/5993

Awiwi *Schenkia sebaeoides* — Endangered
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
Species profile: https://ecos.fws.gov/ecp/species/7103

Carter's Panicgrass *Panicum fauriei var. carteri* — Endangered
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
Species profile: https://ecos.fws.gov/ecp/species/5578

Ihi *Portulaca villosa* — Endangered
No critical habitat has been designated for this species.

NAME STATUS

Species profile: https://ecos.fws.gov/ecp/species/4886

Ko`oko`olau *Bidens micrantha ssp. kalealaha* Endangered
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
Species profile: https://ecos.fws.gov/ecp/species/7697

Ko`oloa`ula *Abutilon menziesii* Endangered
No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/3268

Lanai Sandalwood (=`iliahi) *Santalum haleakalae var. lanaiense* Endangered
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
Species profile: https://ecos.fws.gov/ecp/species/3282

Ohai *Sesbania tomentosa* Endangered
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
Species profile: https://ecos.fws.gov/ecp/species/8453
General project design guidelines:
https://ipac.ecosphere.fws.gov/project/BYD2INUSYZGWRD6N6EBTJAEJKY/documents/generated/7050.pdf

Round-leaved Chaff-flower *Achyranthes splendens var. rotundata* Endangered
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
Species profile: https://ecos.fws.gov/ecp/species/4709

Spermolepis hawaiiensis Endangered
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
Species profile: https://ecos.fws.gov/ecp/species/1670

Uhiuhi *Mezoneuron kavaiense* Endangered
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
Species profile: https://ecos.fws.gov/ecp/species/7129

Vigna o-wahuensis Endangered
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
Species profile: https://ecos.fws.gov/ecp/species/8445

Wahine Noho Kula *Isodendrion pyrifolium* Endangered
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
Species profile: https://ecos.fws.gov/ecp/species/2235

# CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

## IPAC USER CONTACT INFORMATION

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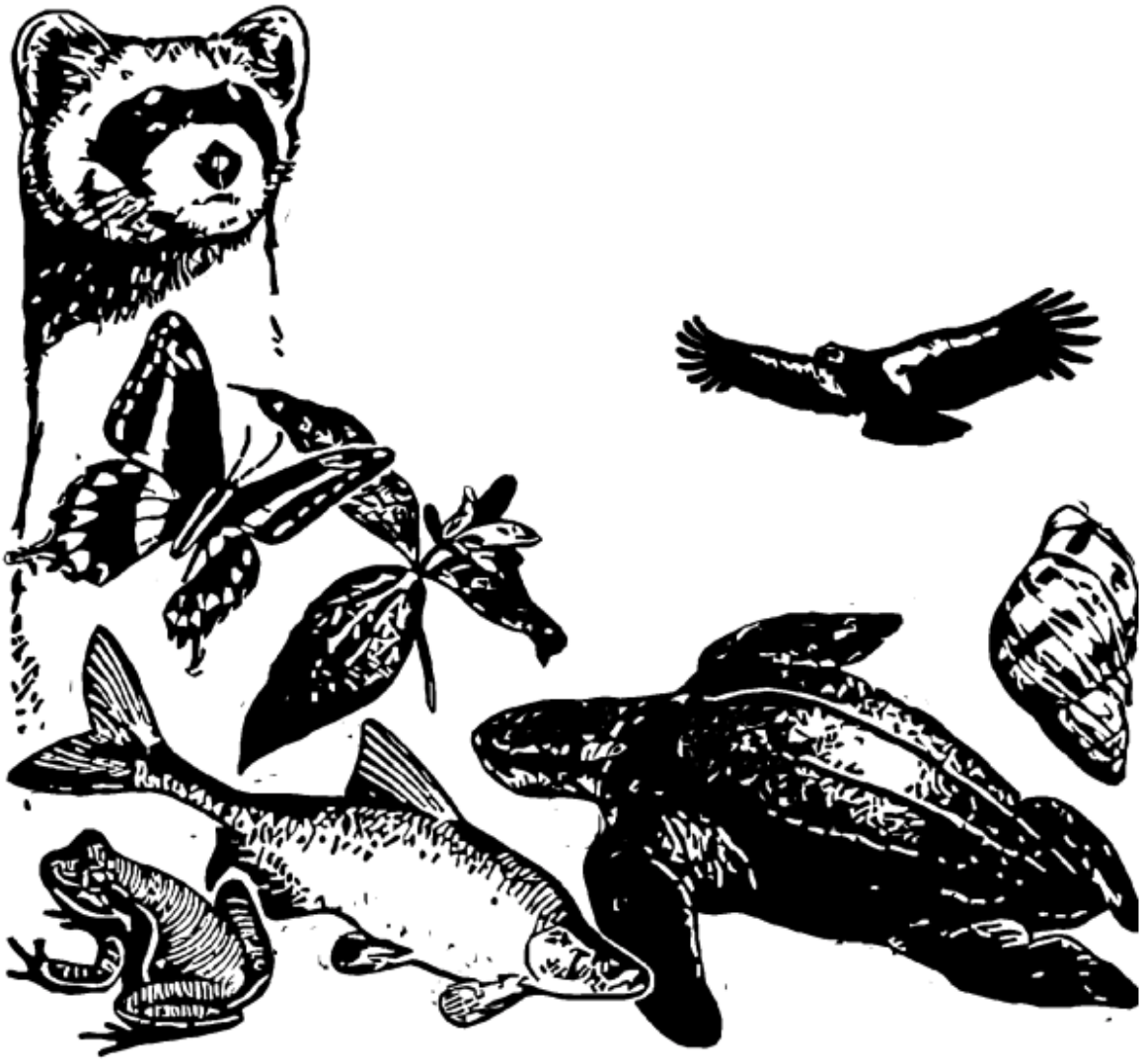
## LEAD AGENCY CONTACT INFORMATION

Lead Agency: County of Maui

**U.S. Fish & Wildlife Service**

# *General Project Design Guidelines (10 Species)*

Generated July 30, 2025 09:42 PM UTC,  IPaC v6.128.5-rc1



IPaC - Information for Planning and Consultation (https://ipac.ecosphere.fws.gov/): A project planning tool to help streamline the U.S. Fish and Wildlife Service environmental review process.

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Band-rumped Storm-petrel Hydrobates castro

Blackburn's Sphinx Moth Manduca blackburni

Hawaiian Coot (alae Ke`oke`o) Fulica alai

Hawaiian Duck Anas wyvilliana

Hawaiian Goose Branta (=Nesochen) sandvicensis

Hawaiian Hoary Bat Lasiurus cinereus semotus

Hawaiian Petrel Pterodroma sandwichensis

Hawaiian Stilt Himantopus mexicanus knudseni

Newell"s Shearwater Puffinus newelli

Ohai Sesbania tomentosa

## Species without general design guidelines available

`aiea Nothocestrum latifolium

`ena`ena Pseudognaphalium sandwicensium var. molokaiense

Awiwi Schenkia sebaeoides

Carter's Panicgrass Panicum fauriei var. carteri

Hawksbill Sea Turtle Eretmochelys imbricata

Ihi Portulaca villosa

Ko`oko`olau Bidens micrantha ssp. kalealaha

Ko`oloa`ula Abutilon menziesii

Lanai Sandalwood (=`iliahi) Santalum haleakalae var. lanaiense

Round-leaved Chaff-flower Achyranthes splendens var. rotundata

Spermolepis hawaiiensis

Uhiuhi Mezoneuron kavaiense

Vigna o-wahuensis

Wahine Noho Kula Isodendrion pyrifolium

**Hawaiian waterbirds (Hawaiian stilt, *Himantopus mexicanus knudseni*; Hawaiian coot, *Fulica alai*; Hawaiian common gallinule, *Gallinula galeata sandvicensis*; Hawaiian duck, *Anas wyvilliana*):**
Listed Hawaiian waterbirds are found in fresh and brackish-water marshes and natural or man-made ponds. Hawaiian stilts may also be found wherever ephemeral or persistent standing water may occur. Threats to these species include non-native predators, habitat loss, and habitat degradation. Hawaiian ducks are also subject to threats from hybridization with introduced mallards.

The creation of standing or open water may result in the attraction of Hawaiian waterbirds to a site (creative nuisance or habitat sink). In particular, the Hawaiian stilt is known to nest in sub-optimal locations (e.g. any ponding water), if water is present. Hawaiian waterbirds attracted to sub-optimal habitat may suffer adverse impacts, such as predation and reduced reproductive success, and thus the project may create an attractive nuisance. Therefore, we recommend you work with our office during project planning so that we may assist you in developing measures to avoid impacts to listed species (e.g., fencing, vegetation control, predator management).

To avoid and minimize potential project impacts to Hawaiian waterbirds we recommend you incorporate the following applicable measures into your project description:

- In areas where waterbirds are known to be present, post and enforce reduced speed limits, and inform project personnel and contractors about the presence of endangered species on-site.
- Incorporate the Service's Best Management Practices for Work in Aquatic Environments into the project design.
- Have a biological monitor that is familiar with the species' biology conduct Hawaiian waterbird nest surveys, where appropriate habitat occurs within the vicinity of the proposed project site, prior to project initiation. Repeat surveys again within 3 days of project initiation and after any subsequent delay of work of 3 or more days (during which the birds may attempt to nest). If a nest or active brood is found:
    - Contact the Service within 48 hours for further guidance.
    - Establish and maintain a 100-foot buffer around all active nests and/or broods until the chicks/ducklings have fledged. Do not conduct potentially disruptive activities or habitat alteration within this buffer.
    - Have a biological monitor that is familiar with the species' biology present on the project site during all construction or earth moving activities until the chicks/ducklings fledge to ensure that Hawaiian waterbirds and nests are not adversely impacted.

**Avoidance, Minimization, and Conservation Measures for listed plants in the Pacific Islands**

Project activities may affect listed plant species by causing physical damage to plant parts (roots, stems, flowers, fruits, seeds, etc.) as well as impacts to other life requisite features of their habitat which may result in reduction of germination, growth and/or reproduction. Cutting and removal of vegetation surrounding listed plants has the potential to alter microsite conditions (e.g., light, moisture, temperature), damaging or destroying the listed plants and also increasing the risk of invasion by nonnative plants which can result in higher incidence or intensity of fire. Activities such as grazing, use of construction equipment and vehicles, and increased human traffic (i.e. trails, visitation, monitoring), can cause ground disturbance, erosion, and/or soil compaction which decrease absorption of water and nutrients and damage plant root systems and may result in reduced growth and/or mortality of listed plants. Soil disturbance or removal has the potential to negatively impact the soil seed bank of listed plant species if such species are present or historically occurred in the project area.

In order to avoid or minimize potential adverse effects to listed plants that may occur on the proposed project site, we recommend minimizing disturbance outside of existing developed or otherwise modified areas. When disturbance outside existing developed or modified sites is proposed, conduct a botanical survey for listed plant species within the project action area, defined as the area where direct and indirect effects are likely to occur. Surveys should be conducted by a knowledgeable botanist with documented experience in identifying native Hawaiian and Pacific Islands plants, including listed plant species. Botanical surveys should optimally be conducted during the wettest part of the year (typically October to April) when plants and identifying features are more likely to be visible, especially in drier areas. If surveys are conducted outside of the wet season, the Service may assume plant presence.

The boundary of the area occupied by listed plants should be marked with flagging by the surveyor. To avoid or minimize potential adverse effects to listed plants, we recommend adherence to buffer distances for the activities in the **Table below**. Where disturbed areas do not need to be maintained as an open area, restore disturbed areas using native plants as appropriate for the location. Whenever possible we recommend using native plants for landscaping purposes. The following websites are good resources to use when choosing landscaping plants: Landscape Industry Council of Hawai‘i Native Plant Poster (http://hawaiiscape.wpengine.com/publications/), Native Hawaiian Plants for Landscaping, Conservation, and Reforestation (https://www.ctahr.hawaii.edu/oc/freepubs/pdf/of-30.pdf), and Best Native Plants for Landscapes (https://www.ctahr.hawaii.edu/oc/freepubs/pdf/OF-40.pdf).

If listed plants occur in a project area, the avoidance buffers are recommended to reduce direct and indirect impacts to listed plants from project activities. However, where project activities will occur within the recommended buffer distances, additional consultation is required. The impacts to the plants of concern within the buffer area may be reduced by placing temporary fencing or other barriers at the boundary of the disturbance, as far from the affected plants as practicable.

The above guidelines apply to areas outside of designated critical habitat. If project activities occur within designated critical habitat unit boundaries, additional consultation is required.

All activities, including site surveys, risk introducing nonnative species into project areas. Specific attention needs to be made to ensure that all equipment, personnel and supplies are properly checked and are free of contamination (weed seeds, organic matter, or other contaminants) before entering project areas. Quarantines and or management activities occurring on specific priority invasive species proximal to project areas need to be considered or adequately addressed. This information can be acquired by contacting local experts such as those on local invasive species committees (Kauai: https://www.kauaiisc.org/; Oahu: https://www.oahuisc.org/; Maui Nui: https://mauiinvasive.org/; and Hawaii: https://www.biisc.org/

Table 1. Recommended buffer distances to minimize and avoid potential adverse impacts to listed plants from activities listed below.

| **Action** | **Buffer Distance (feet (meters)) - Keep Project Activity This Far Away from Listed Plant** | |
|---|---|---|
| | **Grasses/Herbs/Shrubs and Terrestrial Orchids** | **Trees and Arboreal Orchids** |
| **Walking, hiking, surveys** | 3 ft (1 m) | 3 ft (1 m) |
| **Cutting and Removing Vegetation By Hand or Hand Tools (e.g., weeding)** | 3 ft (1 m) | 3 ft (1 m) |
| **Mechanical Removal of Individual Plants or Woody Vegetation (e.g., chainsaw, weed eater)** | 3 ft up to height of removed vegetation (whichever greater) | 3 ft up to height of removed vegetation (whichever greater) |
| **Removal of Vegetation with Heavy Equipment (e.g., bulldozer, tractor, "bush hog")** | 2x width equipment + height of vegetation | 820 ft (250 m) |

| | | | |
|---|---|---|---|
| **Use of Approved Herbicides (following label)** | **Ground-based Spray Application; hand application (no wand applicator; spot treatment)** | 10 ft (3 m) | Crown diameter |
| | **Ground-based Spray Application; manual pump with wand, backpack** | 50 ft (15 m) | Crown diameter |
| | **Ground-based Spray Application; vehicle-mounted tank sprayer** | 50 ft (15 m) | Crown diameter |
| | **Aerial Spray (ball applicator)** | 250 ft (76 m) | 250 ft (76 m) |
| | **Aerial Application – herbicide ballistic technology (individual plant treatment)** | 100 ft (30 m) | Crown diameter |
| | **Aerial Spray (boom)** | Further consultation required | Further consultation required |
| **Use of Insecticides (pollinators, seed dispersers)** | | Further consultation required | Further consultation required |
| **Ground/Soil Disturbance/Outplanting/Fencing (Hand tools, e.g. shovel, `ō`ō; Small mechanized tools, e.g., auger)** | | 20 ft (6 m) | 2x crown diameter |
| **Ground/Soil Disturbance (Heavy Equipment)** | | 328 ft (100 m) | 820 ft (250 m) |
| **Surface Hardening/Soil compaction** | **Trails (e.g., human, ungulates)** | 20 ft (6 m) | 2x crown diameter |
| | **Roads/Utility Corridors, Buildings/Structures** | 328 ft (100 m) | 820 ft (250 m) |
| **Prescribed Burns** | | Further consultation required | Further consultation required |
| **Farming/Ranching/Silviculture** | | 820 ft (250 m) | 820 ft (250 m) |

**Definitions** (Wagner *et al*. 1999)

**Crown**: The leafy top of a tree.
**Herb**: A plant, either annual, biennial, or perennial, with the non-woody stems dying back to the ground at the end of the growing season.
**Shrub**: A perennial woody plant with usually several to numerous primary stems arising from or relatively near the ground.
**Tree**: A woody perennial that usually has a single trunk

**References Cited**

USFWS. 2010. Endangered and threatened wildlife and plants; determination of endangered status for 48 species on Kauai and designation of critical habitat. Federal Register 75: 18960–19165.

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. 2016. Endangered and threatened wildlife and plants; determination of endangered status for 49 species from the Hawaiian Islands. Federal Register 81: 67786–67860.

. 2016. USFWS Rare plant database. Unpublished.

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**Hawaiian goose (nene), (*Branta (Nesochen) sandvicensis*):** Nene are found on the islands of Hawaii, Maui, Molokai, and Kauai. They are observed in a variety of habitats, but prefer open areas, such as pastures, golf courses, wetlands, natural grasslands and shrublands, and lava flows. Threats to the species include introduced mammalian and avian predators, wind facilities, and vehicle strikes.

To avoid and minimize potential project impacts to nene we recommend you incorporate the following measures into your project description:

- Do not approach, feed, or disturb nene.
- If nene are observed loafing or foraging within the project area during the breeding season (September through April), have a biologist familiar with nene nesting behavior survey for nests in and around the project area prior to the resumption of any work. Repeat surveys after any subsequent delay of work of 3 or more days (during which the birds may attempt to nest).
- Cease all work immediately and contact the Service for further guidance if a nest is discovered within a radius of 150 feet of proposed project, or a previously undiscovered nest is found within the 150-foot radius after work begins.
- In areas where nene are known to be present, post and implement reduced speed limits, and inform project personnel and contractors about the presence of endangered species on-site.

**nene 4(d) rule:** A 4(d) rule was established at the time the nene was downlisted to threatened status. Under the 4(d) rule, the following actions are not prohibited under the Act, provided the additional measures described in the downlisting rule are adhered to:

- Take by landowners, or their agents, conducting intentional harassment in the form of hazing or other deterrent measures not likely to cause direct injury or mortality, or nene surveys.
- Take that is incidental to conducting lawful control of introduced predators or habitat management activities for nene.
- Take by authorized law enforcement officers for the purpose of aiding or euthanizing sick, injured, or orphaned nene; disposing of dead specimens; and salvaging a dead specimen that may be used for scientific study.

**Endangered Hawaiian petrel (*Pterodroma sandwichensis*), Threatened Newell's shearwater (*Puffinus auricularis newelli*), and Endangered Hawaii Distinct Population Segment of the band-rumped storm-petrel (*Oceanodroma castro*):**
Hawaiian seabirds may traverse the project area at night during the breeding, nesting and fledging seasons (March 1 to December 15). Outdoor lighting could result in seabird disorientation, fallout, and injury or mortality. Seabirds are attracted to lights and after circling the lights they may become exhausted and collide with nearby wires, buildings, or other structures or they may land on the ground. Downed seabirds are subject to increased mortality due to collision with automobiles, starvation, and predation by dogs, cats, and other predators. Young birds (fledglings) traversing the project area between September 15 and December 15, in their first flights from their mountain nests to the sea, are particularly vulnerable to light attraction.

To avoid and minimize potential project impacts to seabirds we recommend you incorporate the following measures into your project description:

- Fully shield all outdoor lights so the bulb can only be seen from below.
- Install automatic motion sensor switches and controls on all outdoor lights or turn off lights when human activity is not occurring in the lighted area.
- Avoid nighttime construction during the seabird fledging period, September 15 through December 15.

Listed seabirds have been documented colliding with communication towers, particularly in areas of high seabird passage rate. In general, self-supporting monopoles are the least likely to result in collisions, whereas lattice towers, particularly those that rely on guy-wires, have a greater risk.

To avoid and minimize the likelihood that towers will result in collisions by listed seabirds we recommend you incorporate the following measures into your project description:

- The profile of the tower should be as small as possible, minimize the extent of the tower that protrudes above the surrounding vegetation layer, and avoid the use of guywires.
- If the top of the tower must be lit to comply with Federal Aviation Administration regulations, use a flashing red light verses a steady-beam red or white light.
- If possible, co-locate with existing towers or facilities.

Seabirds have been known to collide with fences, powerlines, and other structures near nesting colonies. To avoid and minimize the likelihood of collision we recommend you incorporate the following measures into your project description:

- Where fences extend above vegetation, integrate three strands of polytape into the fence to increase visibility.
- For powerlines, guywires and other cables, minimize exposure above vegetation height and vertical profile.

**Hawaiian hoary bat (*Lasiurus cinereus semotus*):** The Hawaiian hoary bat roosts in both exotic and native woody vegetation across all islands and will leave young unattended in trees and shrubs when they forage. If trees or shrubs 15 feet or taller are cleared during the pupping season, there is a risk that young bats could inadvertently be harmed or killed since they are too young to fly or may not move away. Additionally, Hawaiian hoary bats forage for insects from as low as 3 feet to higher than 500 feet above the ground and can become entangled in barbed wire used for fencing.

To avoid and minimize impacts to the endangered Hawaiian hoary bat we recommend you incorporate the following applicable measures into your project description:

- Do not disturb, remove, or trim woody plants greater than 15 feet tall during the bat birthing and pup rearing season (June 1 through September 15).
- Do not use barbed wire for fencing.

**Blackburn's sphinx moth (*Manduca blackburni*):**
Adult Blackburn's sphinx moths feed on nectar from native plants, including beach morning glory (*Ipomoea pes-caprae*), iliee (*Plumbago zeylanica*), and maiapilo (*Capparis sandwichiana*); larvae feed upon non-native tree tobacco (*Nicotiana glauca*) and native aiea (*Nothocestrum* sp.). To pupate, the larvae burrow into the soil and can remain in a state of torpor for a year or more before emerging from the soil. Soil disturbance can result in death of the pupae.

We offer the following survey recommendations to assess whether the Blackburn's sphinx moth is within the project area:

- A biologist familiar with the species should survey areas of proposed activities for Blackburn's sphinx moth and its larval host plants prior to work initiation.
    - Surveys should be conducted during the wettest portion of the year (usually November-April or several weeks after a significant rain) and within 4-6 weeks prior to construction.
    - Surveys should include searches for eggs, larvae, and signs of larval feeding (chewed stems, frass, or leaf damage).
    - If native aiea or tree tobacco over 3 feet tall, or adult Blackburn's sphinx moths are found during surveys, do not disturb them and contact the Service for additional guidance to avoid take.

If no Blackburn's sphinx moth, aiea, or tree tobacco are found during surveys, it is imperative that measures be taken to avoid attraction of Blackburn's sphinx moth to the project location and prohibit tree tobacco from entering the site. Tree tobacco can grow greater than 3 feet tall in approximately 6 weeks. If it grows over 3 feet after surveys have been completed, the plants may become a host plant for Blackburn's sphinx moth larvae. We therefore recommend that you:

- Remove any tree tobacco less than 3 feet tall.
- Monitor the site every 4-6 weeks for new tree tobacco growth before, during, and after the proposed ground-disturbing activity. This monitoring for can be completed by any staff, such as groundskeeper or regular maintenance crew, if they are provided with picture placards of tree tobacco at different life stages.

# APPENDIX J

# AIR QUALITY STUDY

# CENTRAL MAUI WASTEWATER RECLAMATION FACILITY PROJECT

## Air Quality Study

Prepared for:
*Munekiyo Hiraga*

Prepared by:
*Terry A. Hayes Associates Inc.*

November 2024

taha
environmental planners

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# 1.0 SUMMARY OF FINDINGS

Terry A. Hayes Associates Inc. (TAHA) has completed an Air Quality Study for the Central Maui Wastewater Reclamation Facility Project (proposed project). Key findings are listed below.

- The proposed project would not result in an adverse effect related to regional construction emissions. The primary sources of pollutant emissions during construction activities would be exhaust from diesel-powered equipment and trucks. Emissions would not exceed the United Stated Environmental Protection Agency (USEPA) Prevention of Significant Deterioration (PSD) limits. Construction activities would also generate fugitive dust emissions during earthwork activities. In addition, the Hawaii Department of Health (DOH) Clean Air Branch published a Fugitive Dust Fact Sheet that includes examples of reasonable precautions to reduce fugitive dust. Control measures include, but are not limited to, fugitive dust control plans, watering as necessary to maintain soils in a damp condition, limiting the amount of exposed areas through planning and timing of project phases, and covering temporarily exposed areas with mulch. Which control measures to implement is/are the responsibility of the owner, project manager, or operator of the site. The site topography and surroundings, soil conditions, meteorological conditions, site activities, site equipment, and types of material processed must be considered. Generally, dry and windy conditions would require more control measures than rainy and calm periods.

- The proposed project would not result in adverse effects related to regional operational emissions. Electricity generation and vehicle exhaust associated with worker trips would be the primary sources of emissions, although the following analysis demonstrates that these emissions would not exceed the USEPA PSD limits. In addition, the project site is located in an Attainment/Unclassified area for all National Ambient Air Quality Standards (NAAQS) and regional air quality is good.

- Screening results for a carbon monoxide (CO) dispersion modeling exercise determined that traffic volumes would be low compared to volumes needed to generate a localized hot-spot. The operational traffic volumes would include ten septic haulers per day during normal working hours. In addition, CO is not a pollutant of concern as evident by the lack of monitoring in the project area. There is no potential for the proposed project to result in a CO hotspot.

# 2.0 INTRODUCTION

## 2.1 PURPOSE

The proposed project requires preparation of an Environmental Impact Statement (EIS) pursuant to Chapter 343, Hawaii Revised Statutes. The Study is intended to support the EIS being prepared in accordance with the Hawaii Environmental Policy Act (HEPA). The Study purpose is to evaluate the potential for adverse air quality effects associated with implementation of the proposed project.

## 2.2 PROJECT DESCRIPTION

The proposed project is located in Waikapu on the island of Maui on agricultural lands between Honoapiilani Highway and Kuihelani Highway.

The proposed project would consist of the following:

- A new Kehalani Wastewater Pump Station (WWPS) at an existing stormwater detention basin near the Waiale Road/Olomea Street intersection.

- A new Central Maui Wastewater Reclamation Facility (WWRF) and Soil Aquifer Treatment (SAT) basins located on a vacant County owned parcel Tax Map Key (TMK) (2) 3-8-005:023.

- A new wastewater pipeline that would deliver flows from the WWPS to the WWRF. This new pipeline would run along Waiale Road and the future Waiale Road Extension.

- A new 100-feet wide access and utility easement approximately 1,800 feet long, to provide access from the future Waiale Road Extension to the WWRF. This access runs through a vacant County-owned parcel TMK (2) 3-6-002:004.

- A new wastewater pipeline and a new recycled water pipeline that connect the WWRF and the Waikapu Country Town (WCT) Mauka development. Only a segment of these pipelines would be constructed by the County as part of this Project, up to the future Honoapiilani Highway/Waiale Road Extension intersection. The remaining segment of these pipelines would be constructed by WCT.

During construction, it is anticipated that daily traffic to the site would consist of an average of 161 workers and four delivery trucks. For full operation (post-construction), it is anticipated that trip generation to the site would be lower than it was during construction and would consist of worker's vehicles and ten septage haulers per day during working hours. **Figure 2-1** shows the project location and **Figure 2-2** shows the preliminary site plan.




Source: Brown and Caldwell, 2022.

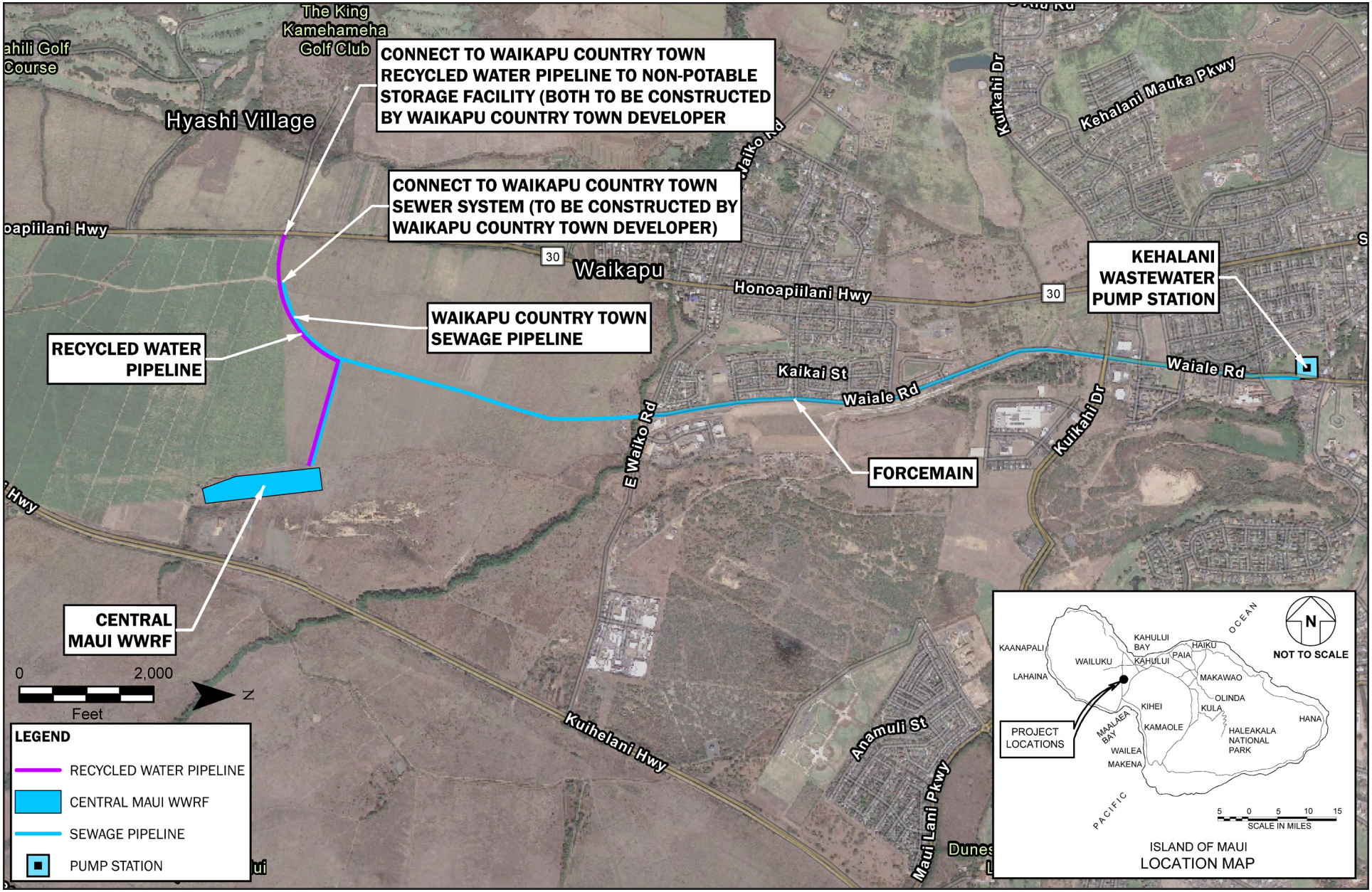
Central Maui Wastewater Reclamation Facility Project
Air Quality Study

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MUNEKIYO HIRAGA

*FIGURE 2-2*

PRELIMINARY SITE PLAN




Source: Brown and Caldwell, 2023. TAHA, 2023.

taha environmental planners

TAHA 2021-098

Central Maui Wastewater Reclamation Facility Project
Air Quality Study

MUNEKIYO HIRAGA

*FIGURE 2-1*

PROJECT LOCATION

# 3.0 TOPICAL BACKGROUND & REGULATORY FRAMEWORK

This section provides an overview of how ambient air quality is characterized and the applicable regulations that have been established to protect public health and the environment. According to the DOH, air pollution is a general term that refers to the presence in the outdoor air of substances in quantities and for durations which may endanger human health or welfare, plant or animal life, property, or may reasonably interfere with the comfortable enjoyment of life and property.

Through extensive scientific research, specific chemical substances have been identified as air pollutants that are known to cause adverse health effects and degradation of environmental quality. Concentrations of the following pollutants in ambient air are regulated at the federal and state level to protect public health and the environment.

## 3.1 AIR POLLUTANTS

The Study discusses pollutants from two perspectives: daily emissions and pollutant concentrations. “Emissions” refer to the quantity of pollutant released into the air, measured in pounds per day (ppd) or tons per year (tpy). “Concentrations” refer to the amount of pollutant material per volumetric unit of air, measured in ppm for gaseous pollutants and micrograms per cubic meter ($\mu g/m^3$) for pollutants in the particulate phase.

**Ozone ($O_3$)**. $O_3$, or smog, is not emitted directly into the environment, but is formed in the atmosphere by complex chemical reactions between reactive organic gases (ROG) and nitrogen oxides ($NO_X$) in the presence of sunlight. $O_3$ formation is greatest on warm, windless, sunny days. The main sources of $NO_X$ and ROG, often referred to as $O_3$ precursors, include combustion processes (including motor vehicle engines), the evaporation of solvents, paints, and fuels, and biogenic sources.

Automobiles are the single largest source of $O_3$ precursors. Tailpipe emissions of ROG are highest during cold starts, hard acceleration, stop-and-go conditions, and slow speeds. They decline as speeds increase up to about 50 miles per hour (mph), then increase again at high speeds and high engine loads. ROG emissions associated with evaporation of unburned fuel depend on vehicle and ambient temperature cycles. Nitrogen oxide emissions exhibit a different curve; emissions decrease as the vehicle approaches 30 mph and then begin to increase with increasing speeds.

$O_3$ levels usually build up during the day and peak in the afternoon hours. Short-term exposure can irritate the eyes and cause constriction of the airways. Besides causing shortness of breath, it can aggravate existing respiratory diseases such as asthma, bronchitis and emphysema. Chronic exposure to high $O_3$ levels can permanently damage lung tissue. $O_3$ can also damage plants, trees, and materials such as rubber and fabrics.

**Nitrogen Dioxide ($NO_2$)**. $NO_2$ is a reddish-brown gas that is a by-product of combustion processes. Automobiles and industrial operations are the main sources of $NO_2$. Aside from its contribution to ozone formation, nitrogen dioxide can increase the risk of acute and chronic respiratory disease and reduce visibility. $NO_2$ may be visible as a coloring component of a brown cloud on high pollution days, especially in conjunction with high ozone levels.

**Carbon Monoxide (CO)**. CO is an odorless, colorless gas formed by the incomplete combustion of fuels. The single largest source of CO is motor vehicles. Emissions are highest during cold

starts, hard acceleration, stop-and-go driving, and when a vehicle is moving at low speeds. New findings indicate that CO emissions per mile are lowest at about 45 mph for the average light-duty motor vehicle and begin to increase again at higher speeds. When inhaled at high concentrations, CO combines with hemoglobin in the blood and reduces the oxygen carrying capacity of the blood. This results in reduced oxygen reaching the brain, heart and other body tissues. This condition is especially critical for people with cardiovascular diseases, chronic lung disease or anemia, as well as fetuses. Even healthy people exposed to high CO concentrations can experience headaches, dizziness, fatigue, unconsciousness, and death.

**Sulfur Dioxide ($SO_2$)**. $SO_2$ is a colorless acid gas with a pungent odor. It has potential to damage material, and it can have health effects at high concentrations. It is produced by the combustion of sulfur-containing fuels, such as oil, coal and diesel. $SO_2$ can irritate lung tissue and increase the risk of acute and chronic respiratory disease.

**Particulate Matter**. Particulate matter refers to a wide range of solid or liquid particles in the atmosphere including smoke, dust, aerosols, and metallic oxides. Respirable particulate matter with an aerodynamic diameter of 10 micrometers or less is referred to as $PM_{10}$. $PM_{2.5}$ includes a subgroup of finer particles that have an aerodynamic diameter of 2.5 micrometers or less. Some particulate matter, such as pollen, is naturally occurring. Most particulate matter is caused by combustion, factories, construction, grading, demolition, agricultural activities, and motor vehicles. Extended exposure to particulate matter can increase the risk of chronic respiratory disease. $PM_{10}$ is of concern because it bypasses the body's natural filtration system more easily than larger particles and can lodge deep in the lungs. The USEPA revised their PM standards to apply only to these fine particles. $PM_{2.5}$ poses an increased health risk because the particles can deposit deep in the lungs and contain substances that are particularly harmful to human health.

**Lead (Pb)**. Pb is a metal found naturally in the environment as well as in manufactured products. The major sources of lead emissions have historically been mobile and industrial sources. As a result of the phase-out of leaded gasoline, metal processing is currently the primary source of Pb emissions. The highest levels of Pb in air are generally found near lead smelters. Other stationary sources are waste incinerators, utilities, and lead-acid battery manufacturers.

Twenty years ago, mobile sources were the main contributor to ambient Pb concentrations in the air. In the early 1970s, the USEPA set national regulations to gradually reduce the Pb content in gasoline. In 1975, unleaded gasoline was introduced for motor vehicles equipped with catalytic converters. The USEPA banned the use of leaded gasoline in highway vehicles in December 1995. As a result of the USEPA's regulatory efforts to remove lead from gasoline, emissions of lead from the transportation sector and levels of lead in the air decreased dramatically.

**Hydrogen Sulfide ($H_2S$)**. $H_2S$ is a colorless gas with a strong odor of rotten eggs. Exposure may cause irritation to the eyes and respiratory system. It can also cause apnea, coma, convulsions, dizziness, headache, weakness, irritability, insomnia, and stomach upset. Hydrogen sulfide is used in many industries including textiles, petroleum, natural gas, wastewater treatment, and agriculture.

**Toxic Air Contaminants (TACs)**. In addition to the criteria air pollutants listed above, another group of pollutants, commonly referred to as TACs or hazardous air pollutants can result in health effects that can be quite severe. Many TACs are confirmed or suspected carcinogens or are known or suspected to cause birth defects or neurological damage. In addition, many TACs can be toxic at very low concentrations. For some chemicals, such as carcinogens, there are no thresholds below which exposure can be considered risk-free.

Industrial facilities and mobile sources are significant sources of TACs. The electronics industry, including semiconductor manufacturing, has the potential to contaminate both air and water due to the highly toxic chlorinated solvents commonly used in semiconductor production processes. Sources of TACs go beyond industry. Various common urban facilities also produce TAC emissions, such as gasoline stations (benzene), hospitals (ethylene oxide), and dry cleaners (perchloroethylene). Automobile exhaust also contains TACs such as benzene and 1,3-butadiene.

**Odors and Dust**. Other air quality issues of concern include nuisance impacts of odors and dust. Objectionable odors may be associated with a variety of pollutants. Common sources of odors include wastewater treatment plants, wastewater pump stations, landfills, composting facilities, refineries and chemical plants. Similarly, nuisance dust may be generated by a variety of sources including quarries, agriculture, grading, and construction. Odors rarely have direct health impacts, but they can be very unpleasant and can lead to anger and concern over possible health effects among the public.

## 3.2 AIR QUALITY REGULATORY FRAMEWORK

### Federal Regulations

**United States Environmental Protection Agency (USEPA)**. At the federal level, the USEPA has been charged with implementing national air quality programs. The USEPA's air quality mandates are drawn primarily from the Federal Clean Air Act (FCAA), which was enacted in 1963. The FCAA was amended in 1970, 1977, and most recently in 1990. The FCAA required the USEPA to establish primary and secondary NAAQS—concentrations of pollutants not to be exceeded—shown below in **Table 3-1**. The NAAQS were devised to protect public health, reduce smog, and prevent degradation of environmental quality. Attainment of the NAAQS is achieved by demonstrating that measured concentrations of criteria pollutants for a region remained below the designated thresholds over a period of three years. The attainment status is shown in **Table 3-1**.

The FCAA also required each state to prepare an air quality control plan referred to as a State Implementation Plan (SIP). The FCAA Amendments of 1990 (FCAAA) added requirements for states with nonattainment areas to revise their SIPs to incorporate additional control measures to reduce air pollution. The SIP is periodically modified to reflect the latest emissions inventories, planning documents, and rules and regulations of the air basins as reported by their jurisdictional agencies. USEPA has responsibility to review all state SIPs to determine conformation to the mandates of the FCAAA and determine if implementation will achieve air quality goals. If the USEPA determines a SIP to be inadequate, a Federal Implementation Plan (FIP) may be prepared for the nonattainment area that imposes additional control measures. Failure to submit an approvable SIP or to implement the plan within the mandated timeframe may result in sanctions being applied to transportation funding and stationary air pollution sources in the air basin.

The USEPA PSD applies to new major sources or major modifications at existing sources for pollutants where the source is located is in attainment or unclassifiable with the NAAQS. PSD does not prevent sources from increasing emissions. Instead, PSD is designed to:

- Protect public health and welfare;
- Preserve, protect, and enhance the air quality in national parks, national wilderness areas, national monuments, national seashores, and other areas of special national or regional natural, recreational, scenic, or historic value;

- Ensure that economic growth will occur in a manner consistent with the preservation of existing clean air resources; and
- Assure that any decision to permit increased air pollution in any area to which this section applies is made only after careful evaluation of all the consequences of such a decision and after adequate procedural opportunities for informed public participation in the decision-making process.

The relevant PSD thresholds in Hawaii relate to VOC, $NO_X$, and CO. The threshold is 250 tpy for each pollutant.

**Federal Hazardous Air Pollutant Program**. Title III of the FCAAA requires the USEPA to promulgate National Emissions Standards for Hazardous Air Pollutants (NESHAPs). The emissions standards were promulgated in two phases. In the first phase, the USEPA developed technology-based emission standards designed to produce maximum emission reductions. These standards are generally referred to as requiring Maximum Achievable Control Technology. In the second phase, the USEPA set health risk–based emissions standards to address risks remaining after implementation of the technology-based NESHAP standards. The FCAAA required the USEPA to promulgate vehicle or fuel standards containing reasonable requirements that control toxic emissions, at a minimum to benzene and formaldehyde. Performance criteria were established to limit mobile-source emissions of toxics, including benzene, formaldehyde, and 1,3-butadiene.

**Mobile Source Air Toxics (MSAT)**. The USEPA issued a Final Rule on Controlling Emissions of Hazardous Air Pollutants from Mobile Sources on March 29, 2001. The USEPA examined the impacts of existing and newly promulgated mobile source control programs, including reformulated gasoline; national low emission vehicle standards; Tier 2 motor vehicle emissions standards and gasoline sulfur control requirements; proposed heavy duty engine and vehicle standards; and on-highway diesel fuel sulfur control requirements. The Federal Highway Administration projects that even with a substantial increase in vehicle miles traveled between 2000 and 2020 that these programs will reduce on-highway emissions of benzene, formaldehyde, 1,3-butadiene, and acetaldehyde by 57 to 65 percent, and will reduce on-highway diesel particulate matter emissions by 87 percent. As a result, the USEPA concluded that no further motor vehicle emissions standards or fuel standards were necessary to further control MSATs.

### State Regulations

**Hawaii Department of Health (DOH)**. The DOH Clean Air Branch is responsible for air pollution control in the State. The primary services of the branch are provided by its three sections: Engineering, Monitoring, and Enforcement. These sections conduct engineering analysis and permitting, perform monitoring and investigations, and enforce the federal and State air pollution control laws and regulations. The DOH Hawaii Administrative Rules (HAR) include two chapters representing the Clean Air Branch. Chapter 59 identifies State ambient air quality standards (**Table 3-1**), and Chapter 60 discusses air pollution control methodology. Chapter 60 includes air permitting, sampling, modeling, and fugitive dust and motor vehicle provisions.

**TABLE 3-1: STATE AND NATIONAL AMBIENT AIR QUALITY STANDARDS AND ATTAINMENT STATUS**

| Pollutant | Averaging Period | State | | Federal | |
|---|---|---|---|---|---|
| | | **Standard** | **Attainment Status** | **Standard** | **Attainment Status** |
| Ozone ($O_3$) | 1-hour Average | -- | -- | -- | -- |
| | 8-hour Average | 0.08 ppm | Attainment | 0.07 ppm (137 µg/m$^3$) | Attainment |
| Respirable Particulate Matter ($PM_{10}$) | 24-hour Average | 150 µg/m$^3$ | Attainment | 150 µg/m$^3$ | Attainment |
| | Annual Arithmetic Mean | 50 µg/m$^3$ | Attainment | -- | -- |
| Fine Particulate Matter ($PM_{2.5}$) | 24-hour Average | -- | -- | 35 µg/m$^3$ | Attainment |
| | Annual Arithmetic Mean | -- | -- | 15 µg/m$^3$ | Attainment |
| Carbon Monoxide (CO) | 8-hour Average | 4.4 ppm | Attainment | 9 ppm (10 mg/m$^3$) | Attainment |
| | 1-hour Average | 9 ppm | Attainment | 35 ppm (40 mg/m$^3$) | Attainment |
| Nitrogen Dioxide ($NO_2$) | Annual Arithmetic Mean | 0.04 ppm | Attainment | 53 ppb (100 µg/m$^3$) | Attainment |
| | 1-hour Average | -- | -- | 100 ppb (188 µg/m$^3$) | Attainment |
| Sulfur Dioxide ($SO_2$) | 24-hour Average | 0.14 ppm | Attainment | -- | -- |
| | 3-hour Average | 0.5 ppm | Attainment | 0.5 ppm (1,300 µg/m$^3$) | Attainment |
| | 1-hour Average | -- | -- | 75 ppb (196 µg/m$^3$) | Attainment |
| | Annual Arithmetic Mean | 0.03 ppm | Attainment | -- | -- |
| Lead (Pb) | 30-day average | -- | -- | -- | -- |
| | Calendar Quarter | -- | -- | 1.5 µg/m$^3$ | -- |
| | Rolling 3-Month Average | 1.5 µg/m$^3$ | -- | 0.15 µg/m$^3$ | -- |
| Hydrogen Sulfide ($H_2S$) | 1-hour Average | 0.025 ppm | Attainment | -- | -- |

**SOURCE**: State of Hawaii Department of Health, *State of Hawaii Annual Summary 2022 Air Quality Data*, September 2023.

Chapter 60 §11-60.1-33 of the HAR includes the following fugitive dust prohibitions:

- No person shall cause or permit visible fugitive dust to become airborne without taking reasonable precautions. Examples of reasonable precautions are:
  - Use of water or suitable chemicals for control of fugitive dust in the demolition of any buildings or structures, construction operations, the grading of roads, or the clearing of land;
  - Application of asphalt, water, or suitable chemicals on roads, material stockpiles, and other surfaces which may result in fugitive dust;

  - Installation and use of hoods, fans, and fabric filters to enclose and vent the handling of dusty materials. Reasonable containment methods shall be employed during sandblasting or other similar operations;
  - Covering all moving, open-bodied trucks transporting materials which may result in fugitive dust;
  - Conducting agricultural operations, such as tilling of land and the application of fertilizers, in such manner as to reasonably minimize fugitive dust;
  - Maintenance of roadways in a clean manner; and
  - Prompt removal of earth or other materials from paved streets which have been transported there by trucking, earth-moving equipment, erosion, or other means.
- Except for persons engaged in agricultural operations or persons who can demonstrate to the director that the best practical operation or treatment is being implemented, no person shall cause or permit the discharge of visible fugitive dust beyond the property lot line on which the fugitive dust originates.

In regard to motor vehicles, Chapter 60 §11-60.1-34 includes the following:

- No person shall operate a gasoline-powered motor vehicle which emits visible smoke while upon streets, roads, or highways.
- No person shall operate a diesel-powered motor vehicle which emits visible smoke for a period of more than five consecutive seconds while upon streets, roads, or highways.
- No person shall cause, suffer, or allow any engine to be in operation while the motor vehicle is stationary at a loading zone, parking or servicing area, route terminal, or other off-street areas, except:
  - During adjustment or repair of the engine at a garage or similar place of repair;
  - During operation of ready-mix trucks, cranes, hoists, and certain bulk carriers, or other auxiliary equipment built onto the vehicle or equipment that require power take-off from the engine, provided that there is no visible discharge of smoke and the equipment is being used and operated for the purposes as originally designed and intended. This exception shall not apply to operations of air conditioning equipment or systems;
  - During the loading or unloading of passengers, not to exceed three minutes; and
  - During the buildup of pressure at the startup and cooling down at the closing down of the engine for a period of not more than three minutes.
- No person shall remove, dismantle, fail to maintain, or otherwise cause to be inoperative any equipment or feature constituting an operational element of the air pollution control system or mechanism of a motor vehicle as required by the provisions of the Act except as permitted or authorized by law.

# 4.0 EXISTING ENVIRONMENTAL SETTING

## 4.1 CLIMATOLOGY

Maui is characterized by a semi-tropical climate containing a multitude of individual microclimates. The mean annual temperature of the island at all locations near sea level is approximately 75 degrees Fahrenheit. A high proportion of the rainfall that Maui receives each year falls on the northeast facing shores leaving the south and southwest coastal areas relatively dry.

## 4.2 AIR MONITORING DATA

The closest DOH air monitoring site is located in Kahului, which is approximately two miles to the north of the project site. This station only monitors $PM_{2.5}$ concentrations. **Table 4-1** shows that pollutant levels are significantly below the applicable State standards from 2020 to 2022.

**TABLE 4-1: AIR MONITORING DATA SUMMARY**

| Pollutant | Standard | Maximum 2020 | Maximum 2021 | Maximum 2022 |
|---|---|---|---|---|
| $PM_{2.5}$ | 35 µg/m$^3$ (24-hour)<br>12 µg/m$^3$ (Annual) | 9.2 µg/m$^3$<br>3.9 µg/m$^3$ | 9.1µg/m$^3$<br>3.9 µg/m$^3$ | 13.0 µg/m$^3$<br>4.0 µg/m$^3$ |

Note: Excludes exceptional events data.
**SOURCE**: USEPA, *Monitor Values Reports*, August 22, 2023.

## 4.3 AIR QUALITY SENSITIVE RECEPTORS

Sensitive land uses are locations where people reside or where the presence of substantial air pollutant concentrations could adversely affect the use of the land. Residences, schools, hospitals, guest lodging, libraries, and some passive recreation areas are typically sensitive and may warrant unique measures for protection from pollutant emissions. Construction of the wastewater pipeline would occur along Waiale Road, which is adjacent to residential land uses.

# 5.0 SIGNIFICANCE CRITERIA

The HEPA has not established quantitative significance criteria related to air quality. Accordingly, the air quality emissions are assessed against the USEPA PSD program for new major sources or major modifications at existing sources for pollutants where the source is located is in attainment or unclassifiable with the NAAQS. The relevant PSD threshold in Hawaii relates to VOC, $NO_X$, and CO. The threshold is 250 tpy for each pollutant.

# 6.0 ENVIRONMENTAL EFFECTS

## 6.1 CONSTRUCTION AIR POLLUTANT EMISSIONS

Common sources of construction-related air pollution include equipment engine exhaust, as well as mobile source vehicle trips, all of which are temporary in nature and do not represent permanent sources of air pollutants. Hawaii does not have guidance or limitations related to exhaust emissions generated by heavy-duty equipment. Building and road construction are two examples of construction activities with high emissions potential. Emissions during the construction of a building, pipeline, or road can be associated with land clearing, ground excavation, cut and fill operations (i.e., earth moving), and construction of a particular facility itself. Emissions often vary substantially from day to day, depending on the level of activity, the specific operations, and the prevailing meteorological conditions.

The emissions analysis assumes the WWRF, WWPS, and access road would be constructed June 2027 to May 2029, and the pipelines would be constructed October 2025 to October 2027. Neither Hawaii nor the USEPA have created a model for efficiently estimating construction emissions. Equipment inventories for each phase of construction were populated in the California Emissions Estimator Model (CalEEMod, Version 2022.1.1.24), and the model was used to produce estimated emissions of VOC, $NO_X$, and CO during each year of construction activities. This model provides a reasonable estimation of construction emissions in Hawaii for planning only purposes as the equipment fleet in the model includes varying levels of engine emission controls. Detailed modeling output files containing schedule and equipment information can be found in the Appendix.

**Table 6-1** presents the estimated annual criteria pollutant and ozone precursor emissions that would be generated during each year of proposed project construction. As shown in the results of the emissions modeling in **Table 6-1**, construction of the proposed project would generate maximum annual emissions of VOC, $NO_X$, and CO that would remain substantially below all of the USEPA PSD thresholds.

**TABLE 6-1: CONSTRUCTION EMISSIONS FOR CRITERIA POLLUTANTS AND OZONE PRECURSORS**

| | Annual Emissions (Tons per Year) | | |
|---|---|---|---|
| **Year** | **VOC** | **$NO_X$** | **CO** |
| 2025 | <0.1 | 0.2 | 0.5 |
| 2026 | 0.2 | 1.0 | 2.8 |
| 2027 | 0.5 | 3.6 | 5.8 |
| 2028 | 0.5 | 4.3 | 6.4 |
| 2029 | 7.6 | 0.8 | 1.3 |
| ***Maximum Annual*** | **7.6** | **4.3** | **6.4** |
| USEPA PSD Threshold | 250 | 250 | 250 |

**SOURCE**: TAHA, 2024.

Earthwork activities typically generate fugitive dust emissions. The proposed project would implement best management practices, such as periodic application of water onto exposed or disturbed ground areas and material stockpiles, dust and silt fencing for erosion control,

maintaining equipment in accordance with manufacturer specifications, sweeping of dust track-out on surrounding roadways, and prompt revegetation of graded areas.

Furthermore, the DOH Clean Air Branch published a Fugitive Dust Fact Sheet, which was last revised in April 2019. The following are examples of reasonable precautions to reduce fugitive dust that could be implemented by the construction contractor. The examples are noted as not being requirements and are solely intended to aid in complying with the fugitive dust rules. The examples are common precautions used for various activities that may generate visible fugitive dust and are not meant to be exclusive nor comprehensive.

- General Measures
  - Design, develop and implement a dust control plan.
  - Use water or suitable chemical compounds in the demolition of existing structures, construction operations, and grading or clearing of land.
  - Apply water, dust suppressants, or suitable compounds on roads and material stockpiles.
  - Pave ingress and egress points to the site.
  - Establish and monitor speed limits for on-site vehicles.
  - Cover all moving, open-bodied trucks transporting dusty materials.
  - Install and use enclosures, screens, hoods, vacuums, and filters to control the handling, sanding, or finishing of dusty materials.
  - Use trash chutes to direct waste downwards to the ground from upper levels.
  - Clean up material spills as soon as possible.
  - Promptly remove soil or other “carry out” materials from roads adjacent to the site.
  - Install dust screens or wind barriers around construction site.
  - Where practical, provide a buffer zone between fugitive dust activities and residential areas.
- Earth-moving Activities
  - Pre-apply and re-apply water as necessary to maintain soils in a damp condition.
  - Limit the amount of exposed areas through planning and timing of project phases.
  - Cover temporarily exposed areas with mulch.
- Stockpiles
  - Stabilize stockpile materials.
  - Keep stockpiles wet or damp as needed.
  - Keep drop or pile height as low as possible.
  - Install wind barriers.
  - Add or remove material from downwind portion of stockpile.
  - Maintain storage piles to avoid steep sides or faces.
- Trucking

- Provide water while loading and unloading to prevent fugitive dust.
- Maintain at least six inches of freeboard on haul vehicles.
- Level the height of load.
- Limit vehicular speed while traveling onsite.
- Cover loads while travelling.
- Install a gravel pad at the exit.
- Reduce carry out with a tire wash or spray system.

The Clean Air Branch does not require specific precautions. Which precaution(s) to implement is/are the responsibility of the owner, project manager, or operator of the site. Reasonable precautions to control fugitive dust are determined on a case-by-case basis. The site topography and surroundings, soil conditions, meteorological conditions, site activities, site equipment, and types of material processed must be considered. The use of any or all of the example measures does not automatically indicate compliance with the fugitive dust requirements. The owner, project manager, or operator should assess the project activities and conditions daily and make adjustments so that reasonable precautions are taken to prevent fugitive dust from becoming airborne and crossing the property line. Generally, dry and windy conditions would require more control measures than rainy and calm periods.

## 6.2 OPERATIONAL AIR POLLUTANT EMISSIONS

### Criteria Pollutant Emissions

The predominant source of permanent stationary pollutant emissions would be electricity generation. It is estimated that the operation of the proposed project would require 11.7 million kWh annually. Another source of emissions would be tailpipe emissions from on-road vehicle trips produced by worker trips to and from the WWRF. Emissions from which would be distributed along the surrounding roadway network and would not be heavily concentrated in one location. The transportation analysis concluded the proposed project would generate 16 AM peak hour trips and 16 PM peak hour trips.[1] The projected national average emission rates from the Bureau of Transportation Statistics were used to estimate annual air pollutant emissions from proposed project vehicle trips based on a conservative assumption of 9.6 miles per trip and a constant trip rate for 365 days per year.[2] **Table 6-2** presents the results of the operational emissions modeling associated with the proposed project in the full build-out year of 2029.

Operational emissions associated with the proposed project would remain substantially below the USEPA PSD thresholds. The entirety of Maui is designated as attainment of the ambient air quality standards, and mobile source emissions from the proposed project vehicle trips would not have the potential to compromise the attainment designations by deteriorating air quality.

[1]Austin, Tsutsumi & Associates, Inc., Traffic Impact Analysis Report – Central Maui Wastewater Reclamation Facility, August 23, 2023.

[2]U.S. Department of Transportation Bureau of Transportation Statistics, *National Transportation Statistics 2021*, November 29, 2021.

**TABLE 6-2: PROPOSED PROJECT OPERATIONAL EMISSIONS**

| Parameter | Annual Emissions (Tons per Year) | | |
|---|---|---|---|
| | VOC | $NO_X$ | CO |
| Operational Emissions | 3.3 | 1.2 | 3.6 |
| USEPA PSD Threshold | 250 | 250 | 250 |

**SOURCE**: TAHA, 2024.

Regarding localized mobile source emissions, CO concentrations are often used as one indicator of pollutant exposure to sensitive receptors. USEPA has published guidance on prevention of CO "hot spots" at congested traffic intersections resulting from idling and slow-moving vehicles. The guidance focuses on the avoidance of localized spikes in CO concentrations causing violations of the ambient air quality standards that may occur at heavily trafficked and highly congested intersections. In response to the guidance promulgated by the USEPA, numerous regulatory agencies throughout the country undertook research to determine the types of intersections that may pose air quality concerns with regards to CO hot spots. Since the island of Maui has always been in attainment of the ambient air quality standards, local regulatory agencies did not have a need to conduct research to satisfy the air quality plan requirements. However, mobile source emissions of CO are of particular concern in California, where the South Coast Air Quality Management (SCAQMD) engaged in extensive research to demonstrate how the CO NAAQS could be attained for the region.

Research published in 2003 by the SCAQMD to support SIP documentation involved air dispersion modeling of mobile CO emissions at some of the busiest intersections in Southern California, where regional mobile source emissions are substantially higher than the project area on a per-square-mile basis. Results of the CO dispersion modeling exercise determined that an intersection experiencing a peak hour volume of approximately 10,000 vehicles per hour —would generate a maximum 1-hour CO concentration of approximately 4.6 ppm.[3] The traffic analysis prepared for the proposed project demonstrates that local intersection volumes do not approach 10,000 vehicles per hour.[4] There is no potential for the proposed project to result in a CO hotspot and, therefore, no potential for the proposed project to result in substantial concentrations of related exhaust pollutants.

### Odors

Wastewater treatment plants can be a source of nuisance odors to the surrounding community if not properly designed and/or operated. Not all processes with a wastewater treatment plant generate odors; nuisance odors are most commonly associated with anaerobic (without oxygen) conditions and with residual solids processing. The most common nuisance odor-producing compound for a typical municipal system like the proposed project is $H_2S$. Foul air collection and treatment would be provided for treatment processes that can generate nuisance odors. Standard best management practices would also be implemented to control odors.

The headworks is commonly an odorous process area at wastewater treatment plants because incoming raw wastewater can be anaerobic, and the screening and grit removal processes involve solids processing. The WWRF headworks would be covered or enclosed to facilitate foul odor

[3]South Coast Air Quality Management District, Final 2003 AQMP Appendix V: Modeling and Attainment Demonstrations, August 2003.

[4]Austin, Tsutsumi & Associates, Inc., Traffic Impact Analysis Report – Central Maui Wastewater Reclamation Facility, August 23, 2023.

collection. The air removed from the process would be treated in an odor control biotrickling filter (or similar process). Biotrickling filters consist of a vessel filled with plastic or ceramic media. Recycled water is distributed over the media using distribution piping. The foul air is treated as it flows through the media. Biotrickling filters are capable of removing $H_2S$ and a wide variety of other odorous compounds from the air. The solids dewatering process would be another potential source of odors. The dewatering equipment would be enclosed in a room to facilitate foul air collection. The foul air would be routed to a biotrickling filter for treatment. Additionally, the WWRF would be located approximately one mile southeast of the nearest residential land use. At such a distance, odors from the WWRF would likely dissipate and not cause nuisance.

The collection system feeding the WWPS would be at the upstream end of the tributary area where sewage is still fresh. Resulting sulfide generation and the potential for $H_2S$ release at the pump station where the incoming sewer enters the wet well is anticipated to be low, but odor control would be provided because the WWPS would be in a sensitive residential area. Activated carbon is recommended for odor control due to the low anticipated $H_2S$ levels.

Low velocities in long pipelines provide a high residence time for sewage, which results in formation of dissolved sulfides that can be released as highly concentrated $H_2S$ when the force main breaks to gravity. In the WWPS system, the potential for $H_2S$ release would be present at the Combination Air Release Valve (CARV) vault structure located at the force main high point and at the WWRF where the pipeline discharges. While the force main does break to gravity at the high point, the pipeline will be a sealed system. Air release will only occur at the hydraulic structure through the CARVs when air pressure buildup in the force main is released to atmosphere. Although the potential for high $H_2S$ concentrations will be present in the pipe headspace at this location, the air discharges are anticipated to be non-continuous and short in duration. Carbon cannisters will be used for odor control at the hydraulic structure because they are suitable for the nature and frequency of discharge. Therefore, there is no potential for the proposed project to result in substantial impacts relating to odors.

# 7.0 CUMULATIVE EFFECTS

Section 11-200-2 of the HAR contains the definition of a cumulative impact. A cumulative impact is 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 or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

By its very nature, air pollution is largely a cumulative impact. Ambient air quality standards are violated or approach nonattainment levels due to past development that has formed the urban fabric, and attainment of standards can be jeopardized by increasing emissions-generating activity in the region. The proposed site is located in an Attainment/Unclassified area for all NAAQS. The regional air quality in Hawaii is considered to be healthy. There is no existing cumulative air quality impact, and there is no potential for the project to significantly contribute to a cumulative air quality impact.

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# 1. Basic Project Information

## 1.1. Basic Project Information

| Data Field | Value |
|---|---|
| Project Name | Maui WWRF |
| Construction Start Date | 6/7/2027 |
| Operational Year | 2029 |
| Lead Agency | — |
| Land Use Scale | Project/site |
| Analysis Level for Defaults | Statewide |
| Windspeed (m/s) | 2.70 |
| Precipitation (days) | 8.20 |
| Location | 34.02592335521025, -118.38166400346476 |
| County | Los Angeles-South Coast |
| City | Culver City |
| Air District | South Coast AQMD |
| Air Basin | South Coast |
| TAZ | 4457 |
| EDFZ | 16 |
| Electric Utility | Statewide Average |
| Gas Utility | Southern California Gas |
| App Version | 2022.1.1.24 |

## 1.2. Land Use Types

| Land Use Subtype | Size | Unit | Lot Acreage | Building Area (sq ft) | Landscape Area (sq ft) | Special Landscape Area (sq ft) | Population | Description |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| General Heavy Industry | 649 | 1000sqft | 14.9 | 649,045 | 0.00 | — | — | — |

### 1.3. User-Selected Emission Reduction Measures by Emissions Sector

| Sector | # | Measure Title |
|---|---|---|
| Construction | C-2* | Limit Heavy-Duty Diesel Vehicle Idling |

* Qualitative or supporting measure. Emission reductions not included in the mitigated emissions results.

# 2. Emissions Summary

### 2.1. Construction Emissions Compared Against Thresholds

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

| Un/Mit. | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 753 | 753 | 28.4 | 29.5 | 0.06 | 1.18 | 7.97 | 9.15 | 1.08 | 4.01 | 5.10 | — | 7,723 | 7,723 | 0.28 | 0.57 | 15.0 | 7,912 |
| Mit. | 753 | 753 | 28.4 | 29.5 | 0.06 | 1.18 | 7.97 | 9.15 | 1.08 | 4.01 | 5.10 | — | 7,723 | 7,723 | 0.28 | 0.57 | 15.0 | 7,912 |
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 1.96 | 1.62 | 13.2 | 21.9 | 0.05 | 0.35 | 3.01 | 3.37 | 0.33 | 0.74 | 1.07 | — | 7,568 | 7,568 | 0.22 | 0.57 | 0.39 | 7,744 |
| Mit. | 1.96 | 1.62 | 13.2 | 21.9 | 0.05 | 0.35 | 3.01 | 3.37 | 0.33 | 0.74 | 1.07 | — | 7,568 | 7,568 | 0.22 | 0.57 | 0.39 | 7,744 |
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unmit. | 41.5 | 41.5 | 8.90 | 15.5 | 0.03 | 0.23 | 2.15 | 2.38 | 0.21 | 0.53 | 0.74 | — | 5,360 | 5,360 | 0.14 | 0.39 | 4.18 | 5,484 |
| Mit. | 41.5 | 41.5 | 8.90 | 15.5 | 0.03 | 0.23 | 2.15 | 2.38 | 0.21 | 0.53 | 0.74 | — | 5,360 | 5,360 | 0.14 | 0.39 | 4.18 | 5,484 |
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Annual (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 7.58 | 7.57 | 1.62 | 2.83 | 0.01 | 0.04 | 0.39 | 0.43 | 0.04 | 0.10 | 0.14 | — | 887 | 887 | 0.02 | 0.06 | 0.69 | 908 |
| Mit. | 7.58 | 7.57 | 1.62 | 2.83 | 0.01 | 0.04 | 0.39 | 0.43 | 0.04 | 0.10 | 0.14 | — | 887 | 887 | 0.02 | 0.06 | 0.69 | 908 |
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

## 2.2. Construction Emissions by Year, Unmitigated

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

| Year | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily - Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 3.72 | 3.12 | 28.4 | 29.5 | 0.06 | 1.18 | 7.97 | 9.15 | 1.08 | 4.01 | 5.10 | — | 7,723 | 7,723 | 0.28 | 0.57 | 15.0 | 7,912 |
| 2028 | 1.92 | 1.60 | 12.2 | 23.2 | 0.05 | 0.32 | 3.01 | 3.33 | 0.30 | 0.74 | 1.04 | — | 7,603 | 7,603 | 0.19 | 0.54 | 13.5 | 7,784 |
| 2029 | 753 | 753 | 6.50 | 10.7 | 0.01 | 0.24 | 0.71 | 0.73 | 0.22 | 0.17 | 0.27 | — | 1,705 | 1,705 | 0.06 | 0.03 | 1.93 | 1,713 |
| Daily - Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 1.96 | 1.62 | 13.2 | 21.9 | 0.05 | 0.35 | 3.01 | 3.37 | 0.33 | 0.74 | 1.07 | — | 7,568 | 7,568 | 0.22 | 0.57 | 0.39 | 7,744 |
| 2028 | 1.83 | 1.57 | 12.5 | 21.3 | 0.05 | 0.32 | 3.01 | 3.33 | 0.30 | 0.74 | 1.04 | — | 7,452 | 7,452 | 0.20 | 0.54 | 0.35 | 7,619 |
| 2029 | 1.77 | 1.43 | 11.9 | 20.8 | 0.05 | 0.29 | 3.01 | 3.31 | 0.27 | 0.74 | 1.02 | — | 7,330 | 7,330 | 0.19 | 0.54 | 0.31 | 7,497 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 0.99 | 0.82 | 6.80 | 9.75 | 0.02 | 0.22 | 1.43 | 1.66 | 0.21 | 0.45 | 0.66 | — | 3,004 | 3,004 | 0.09 | 0.18 | 1.99 | 3,062 |
| 2028 | 1.31 | 1.12 | 8.90 | 15.5 | 0.03 | 0.23 | 2.15 | 2.38 | 0.21 | 0.53 | 0.74 | — | 5,360 | 5,360 | 0.14 | 0.39 | 4.18 | 5,484 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2029 | 41.5 | 41.5 | 1.99 | 3.58 | 0.01 | 0.05 | 0.45 | 0.50 | 0.05 | 0.11 | 0.16 | — | 1,116 | 1,116 | 0.03 | 0.07 | 0.75 | 1,140 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 0.18 | 0.15 | 1.24 | 1.78 | < 0.005 | 0.04 | 0.26 | 0.30 | 0.04 | 0.08 | 0.12 | — | 497 | 497 | 0.02 | 0.03 | 0.33 | 507 |
| 2028 | 0.24 | 0.20 | 1.62 | 2.83 | 0.01 | 0.04 | 0.39 | 0.43 | 0.04 | 0.10 | 0.14 | — | 887 | 887 | 0.02 | 0.06 | 0.69 | 908 |
| 2029 | 7.58 | 7.57 | 0.36 | 0.65 | < 0.005 | 0.01 | 0.08 | 0.09 | 0.01 | 0.02 | 0.03 | — | 185 | 185 | < 0.005 | 0.01 | 0.12 | 189 |

## 2.3. Construction Emissions by Year, Mitigated

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

| Year | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily - Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 3.72 | 3.12 | 28.4 | 29.5 | 0.06 | 1.18 | 7.97 | 9.15 | 1.08 | 4.01 | 5.10 | — | 7,723 | 7,723 | 0.28 | 0.57 | 15.0 | 7,912 |
| 2028 | 1.92 | 1.60 | 12.2 | 23.2 | 0.05 | 0.32 | 3.01 | 3.33 | 0.30 | 0.74 | 1.04 | — | 7,603 | 7,603 | 0.19 | 0.54 | 13.5 | 7,784 |
| 2029 | 753 | 753 | 6.50 | 10.7 | 0.01 | 0.24 | 0.71 | 0.73 | 0.22 | 0.17 | 0.27 | — | 1,705 | 1,705 | 0.06 | 0.03 | 1.93 | 1,713 |
| Daily - Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 1.96 | 1.62 | 13.2 | 21.9 | 0.05 | 0.35 | 3.01 | 3.37 | 0.33 | 0.74 | 1.07 | — | 7,568 | 7,568 | 0.22 | 0.57 | 0.39 | 7,744 |
| 2028 | 1.83 | 1.57 | 12.5 | 21.3 | 0.05 | 0.32 | 3.01 | 3.33 | 0.30 | 0.74 | 1.04 | — | 7,452 | 7,452 | 0.20 | 0.54 | 0.35 | 7,619 |
| 2029 | 1.77 | 1.43 | 11.9 | 20.8 | 0.05 | 0.29 | 3.01 | 3.31 | 0.27 | 0.74 | 1.02 | — | 7,330 | 7,330 | 0.19 | 0.54 | 0.31 | 7,497 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 0.99 | 0.82 | 6.80 | 9.75 | 0.02 | 0.22 | 1.43 | 1.66 | 0.21 | 0.45 | 0.66 | — | 3,004 | 3,004 | 0.09 | 0.18 | 1.99 | 3,062 |
| 2028 | 1.31 | 1.12 | 8.90 | 15.5 | 0.03 | 0.23 | 2.15 | 2.38 | 0.21 | 0.53 | 0.74 | — | 5,360 | 5,360 | 0.14 | 0.39 | 4.18 | 5,484 |
| 2029 | 41.5 | 41.5 | 1.99 | 3.58 | 0.01 | 0.05 | 0.45 | 0.50 | 0.05 | 0.11 | 0.16 | — | 1,116 | 1,116 | 0.03 | 0.07 | 0.75 | 1,140 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 0.18 | 0.15 | 1.24 | 1.78 | < 0.005 | 0.04 | 0.26 | 0.30 | 0.04 | 0.08 | 0.12 | — | 497 | 497 | 0.02 | 0.03 | 0.33 | 507 |
| 2028 | 0.24 | 0.20 | 1.62 | 2.83 | 0.01 | 0.04 | 0.39 | 0.43 | 0.04 | 0.10 | 0.14 | — | 887 | 887 | 0.02 | 0.06 | 0.69 | 908 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2029 | 7.58 | 7.57 | 0.36 | 0.65 | < 0.005 | 0.01 | 0.08 | 0.09 | 0.01 | 0.02 | 0.03 | — | 185 | 185 | < 0.005 | 0.01 | 0.12 | 189 |

## 2.4. Operations Emissions Compared Against Thresholds

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

| Un/Mit. | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 21.4 | 20.6 | 6.49 | 34.3 | 0.04 | 0.52 | 0.22 | 0.74 | 0.51 | 0.06 | 0.56 | 721 | 23,107 | 23,829 | 74.6 | 0.86 | 170 | 26,121 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 16.3 | 16.0 | 6.26 | 5.99 | 0.04 | 0.47 | 0.22 | 0.69 | 0.47 | 0.06 | 0.53 | 721 | 22,978 | 23,699 | 74.6 | 0.86 | 169 | 25,990 |
| Average Daily (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 18.8 | 18.3 | 6.37 | 19.9 | 0.04 | 0.49 | 0.22 | 0.71 | 0.49 | 0.06 | 0.54 | 721 | 23,038 | 23,759 | 74.6 | 0.86 | 169 | 26,051 |
| Annual (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 3.43 | 3.33 | 1.16 | 3.64 | 0.01 | 0.09 | 0.04 | 0.13 | 0.09 | 0.01 | 0.10 | 119 | 3,814 | 3,934 | 12.4 | 0.14 | 28.0 | 4,313 |

## 2.5. Operations Emissions by Sector, Unmitigated

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

| Sector | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Mobile | 0.12 | 0.11 | 0.09 | 0.91 | < 0.005 | < 0.005 | 0.22 | 0.22 | < 0.005 | 0.06 | 0.06 | — | 239 | 239 | 0.01 | 0.01 | 0.62 | 242 |
| Area | 20.6 | 20.2 | 0.24 | 28.2 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 116 | 116 | < 0.005 | < 0.005 | — | 116 |
| Energy | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 21,878 | 21,878 | 1.71 | 0.14 | — | 21,963 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Waste | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Refrig. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Total | 21.4 | 20.6 | 6.49 | 34.3 | 0.04 | 0.52 | 0.22 | 0.74 | 0.51 | 0.06 | 0.56 | 721 | 23,107 | 23,829 | 74.6 | 0.86 | 170 | 26,121 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Mobile | 0.11 | 0.10 | 0.10 | 0.82 | < 0.005 | < 0.005 | 0.22 | 0.22 | < 0.005 | 0.06 | 0.06 | — | 225 | 225 | 0.01 | 0.01 | 0.02 | 228 |
| Area | 15.5 | 15.5 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Energy | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 21,878 | 21,878 | 1.71 | 0.14 | — | 21,963 |
| Water | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Waste | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Refrig. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Total | 16.3 | 16.0 | 6.26 | 5.99 | 0.04 | 0.47 | 0.22 | 0.69 | 0.47 | 0.06 | 0.53 | 721 | 22,978 | 23,699 | 74.6 | 0.86 | 169 | 25,990 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Mobile | 0.11 | 0.10 | 0.10 | 0.83 | < 0.005 | < 0.005 | 0.22 | 0.22 | < 0.005 | 0.06 | 0.06 | — | 228 | 228 | 0.01 | 0.01 | 0.27 | 232 |
| Area | 18.0 | 17.8 | 0.12 | 13.9 | < 0.005 | 0.02 | — | 0.02 | 0.02 | — | 0.02 | — | 57.2 | 57.2 | < 0.005 | < 0.005 | — | 57.5 |
| Energy | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 21,878 | 21,878 | 1.71 | 0.14 | — | 21,963 |
| Water | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Waste | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Refrig. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Total | 18.8 | 18.3 | 6.37 | 19.9 | 0.04 | 0.49 | 0.22 | 0.71 | 0.49 | 0.06 | 0.54 | 721 | 23,038 | 23,759 | 74.6 | 0.86 | 169 | 26,051 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Mobile | 0.02 | 0.02 | 0.02 | 0.15 | < 0.005 | < 0.005 | 0.04 | 0.04 | < 0.005 | 0.01 | 0.01 | — | 37.7 | 37.7 | < 0.005 | < 0.005 | 0.04 | 38.3 |
| Area | 3.29 | 3.25 | 0.02 | 2.54 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 9.48 | 9.48 | < 0.005 | < 0.005 | — | 9.51 |
| Energy | 0.12 | 0.06 | 1.12 | 0.94 | 0.01 | 0.09 | — | 0.09 | 0.09 | — | 0.09 | — | 3,622 | 3,622 | 0.28 | 0.02 | — | 3,636 |
| Water | — | — | — | — | — | — | — | — | — | — | — | 47.6 | 145 | 192 | 4.89 | 0.12 | — | 350 |
| Waste | — | — | — | — | — | — | — | — | — | — | — | 71.8 | 0.00 | 71.8 | 7.18 | 0.00 | — | 251 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refrig. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 28.0 | 28.0 |
| Total | 3.43 | 3.33 | 1.16 | 3.64 | 0.01 | 0.09 | 0.04 | 0.13 | 0.09 | 0.01 | 0.10 | 119 | 3,814 | 3,934 | 12.4 | 0.14 | 28.0 | 4,313 |

## 2.6. Operations Emissions by Sector, Mitigated

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

| Sector | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Mobile | 0.12 | 0.11 | 0.09 | 0.91 | < 0.005 | < 0.005 | 0.22 | 0.22 | < 0.005 | 0.06 | 0.06 | — | 239 | 239 | 0.01 | 0.01 | 0.62 | 242 |
| Area | 20.6 | 20.2 | 0.24 | 28.2 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 116 | 116 | < 0.005 | < 0.005 | — | 116 |
| Energy | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 21,878 | 21,878 | 1.71 | 0.14 | — | 21,963 |
| Water | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Waste | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Refrig. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Total | 21.4 | 20.6 | 6.49 | 34.3 | 0.04 | 0.52 | 0.22 | 0.74 | 0.51 | 0.06 | 0.56 | 721 | 23,107 | 23,829 | 74.6 | 0.86 | 170 | 26,121 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Mobile | 0.11 | 0.10 | 0.10 | 0.82 | < 0.005 | < 0.005 | 0.22 | 0.22 | < 0.005 | 0.06 | 0.06 | — | 225 | 225 | 0.01 | 0.01 | 0.02 | 228 |
| Area | 15.5 | 15.5 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Energy | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 21,878 | 21,878 | 1.71 | 0.14 | — | 21,963 |
| Water | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Waste | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Refrig. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Total | 16.3 | 16.0 | 6.26 | 5.99 | 0.04 | 0.47 | 0.22 | 0.69 | 0.47 | 0.06 | 0.53 | 721 | 22,978 | 23,699 | 74.6 | 0.86 | 169 | 25,990 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Mobile | 0.11 | 0.10 | 0.10 | 0.83 | < 0.005 | < 0.005 | 0.22 | 0.22 | < 0.005 | 0.06 | 0.06 | — | 228 | 228 | 0.01 | 0.01 | 0.27 | 232 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Area | 18.0 | 17.8 | 0.12 | 13.9 | < 0.005 | 0.02 | — | 0.02 | 0.02 | — | 0.02 | — | 57.2 | 57.2 | < 0.005 | < 0.005 | — | 57.5 |
| Energy | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 21,878 | 21,878 | 1.71 | 0.14 | — | 21,963 |
| Water | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Waste | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Refrig. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Total | 18.8 | 18.3 | 6.37 | 19.9 | 0.04 | 0.49 | 0.22 | 0.71 | 0.49 | 0.06 | 0.54 | 721 | 23,038 | 23,759 | 74.6 | 0.86 | 169 | 26,051 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Mobile | 0.02 | 0.02 | 0.02 | 0.15 | < 0.005 | < 0.005 | 0.04 | 0.04 | < 0.005 | 0.01 | 0.01 | — | 37.7 | 37.7 | < 0.005 | < 0.005 | 0.04 | 38.3 |
| Area | 3.29 | 3.25 | 0.02 | 2.54 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 9.48 | 9.48 | < 0.005 | < 0.005 | — | 9.51 |
| Energy | 0.12 | 0.06 | 1.12 | 0.94 | 0.01 | 0.09 | — | 0.09 | 0.09 | — | 0.09 | — | 3,622 | 3,622 | 0.28 | 0.02 | — | 3,636 |
| Water | — | — | — | — | — | — | — | — | — | — | — | 47.6 | 145 | 192 | 4.89 | 0.12 | — | 350 |
| Waste | — | — | — | — | — | — | — | — | — | — | — | 71.8 | 0.00 | 71.8 | 7.18 | 0.00 | — | 251 |
| Refrig. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 28.0 | 28.0 |
| Total | 3.43 | 3.33 | 1.16 | 3.64 | 0.01 | 0.09 | 0.04 | 0.13 | 0.09 | 0.01 | 0.10 | 119 | 3,814 | 3,934 | 12.4 | 0.14 | 28.0 | 4,313 |

# 3. Construction Emissions Details

## 3.1. Site Preparation (2027) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 3.63 | 3.05 | 28.0 | 28.3 | 0.05 | 1.17 | — | 1.17 | 1.08 | — | 1.08 | — | 5,298 | 5,298 | 0.21 | 0.04 | — | 5,316 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dust From Material Movement | — | — | — | — | — | — | 7.67 | 7.67 | — | 3.94 | 3.94 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.10 | 0.08 | 0.77 | 0.77 | < 0.005 | 0.03 | — | 0.03 | 0.03 | — | 0.03 | — | 145 | 145 | 0.01 | < 0.005 | — | 146 |
| Dust From Material Movement | — | — | — | — | — | — | 0.21 | 0.21 | — | 0.11 | 0.11 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.02 | 0.02 | 0.14 | 0.14 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 24.0 | 24.0 | < 0.005 | < 0.005 | — | 24.1 |
| Dust From Material Movement | — | — | — | — | — | — | 0.04 | 0.04 | — | 0.02 | 0.02 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.08 | 0.07 | 0.06 | 1.09 | 0.00 | 0.00 | 0.23 | 0.23 | 0.00 | 0.05 | 0.05 | — | 236 | 236 | < 0.005 | 0.01 | 0.77 | 239 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.02 | < 0.005 | 0.32 | 0.10 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 267 | 267 | 0.01 | 0.04 | 0.60 | 281 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.02 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 6.09 | 6.09 | < 0.005 | < 0.005 | 0.01 | 6.17 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 7.32 | 7.32 | < 0.005 | < 0.005 | 0.01 | 7.68 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | < 0.005 | 0.00 | 0.00 | < 0.005 | < 0.005 | 0.00 | < 0.005 | < 0.005 | — | 1.01 | 1.01 | < 0.005 | < 0.005 | < 0.005 | 1.02 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 1.21 | 1.21 | < 0.005 | < 0.005 | < 0.005 | 1.27 |

## 3.2. Site Preparation (2027) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 3.63 | 3.05 | 28.0 | 28.3 | 0.05 | 1.17 | — | 1.17 | 1.08 | — | 1.08 | — | 5,298 | 5,298 | 0.21 | 0.04 | — | 5,316 |
| Dust From Material Movement | — | — | — | — | — | — | 7.67 | 7.67 | — | 3.94 | 3.94 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.10 | 0.08 | 0.77 | 0.77 | < 0.005 | 0.03 | — | 0.03 | 0.03 | — | 0.03 | — | 145 | 145 | 0.01 | < 0.005 | — | 146 |
| Dust From Material Movement | — | — | — | — | — | — | 0.21 | 0.21 | — | 0.11 | 0.11 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.02 | 0.02 | 0.14 | 0.14 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 24.0 | 24.0 | < 0.005 | < 0.005 | — | 24.1 |
| Dust From Material Movement | — | — | — | — | — | — | 0.04 | 0.04 | — | 0.02 | 0.02 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.08 | 0.07 | 0.06 | 1.09 | 0.00 | 0.00 | 0.23 | 0.23 | 0.00 | 0.05 | 0.05 | — | 236 | 236 | < 0.005 | 0.01 | 0.77 | 239 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.02 | < 0.005 | 0.32 | 0.10 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 267 | 267 | 0.01 | 0.04 | 0.60 | 281 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.02 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 6.09 | 6.09 | < 0.005 | < 0.005 | 0.01 | 6.17 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hauling | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 7.32 | 7.32 | < 0.005 | < 0.005 | 0.01 | 7.68 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | < 0.005 | 0.00 | 0.00 | < 0.005 | < 0.005 | 0.00 | < 0.005 | < 0.005 | — | 1.01 | 1.01 | < 0.005 | < 0.005 | < 0.005 | 1.02 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 1.21 | 1.21 | < 0.005 | < 0.005 | < 0.005 | 1.27 |

## 3.3. Grading (2027) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 3.51 | 2.95 | 25.6 | 27.3 | 0.06 | 1.04 | — | 1.04 | 0.96 | — | 0.96 | — | 6,598 | 6,598 | 0.27 | 0.05 | — | 6,621 |
| Dust From Material Movement | — | — | — | — | — | — | 3.59 | 3.59 | — | 1.42 | 1.42 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.29 | 0.24 | 2.10 | 2.24 | 0.01 | 0.09 | — | 0.09 | 0.08 | — | 0.08 | — | 542 | 542 | 0.02 | < 0.005 | — | 544 |
| Dust From Material Movement | — | — | — | — | — | — | 0.30 | 0.30 | — | 0.12 | 0.12 | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.05 | 0.04 | 0.38 | 0.41 | < 0.005 | 0.02 | — | 0.02 | 0.01 | — | 0.01 | — | 89.8 | 89.8 | < 0.005 | < 0.005 | — | 90.1 |
| Dust From Material Movement | — | — | — | — | — | — | 0.05 | 0.05 | — | 0.02 | 0.02 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.09 | 0.08 | 0.07 | 1.24 | 0.00 | 0.00 | 0.26 | 0.26 | 0.00 | 0.06 | 0.06 | — | 269 | 269 | < 0.005 | 0.01 | 0.88 | 273 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.02 | < 0.005 | 0.32 | 0.10 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 267 | 267 | 0.01 | 0.04 | 0.60 | 281 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.09 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | 0.01 | 0.01 | — | 20.9 | 20.9 | < 0.005 | < 0.005 | 0.03 | 21.1 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.03 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 22.0 | 22.0 | < 0.005 | < 0.005 | 0.02 | 23.0 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.02 | 0.00 | 0.00 | < 0.005 | < 0.005 | 0.00 | < 0.005 | < 0.005 | — | 3.46 | 3.46 | < 0.005 | < 0.005 | 0.01 | 3.50 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 3.64 | 3.64 | < 0.005 | < 0.005 | < 0.005 | 3.81 |

## 3.4. Grading (2027) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 3.51 | 2.95 | 25.6 | 27.3 | 0.06 | 1.04 | — | 1.04 | 0.96 | — | 0.96 | — | 6,598 | 6,598 | 0.27 | 0.05 | — | 6,621 |
| Dust From Material Movement | — | — | — | — | — | — | 3.59 | 3.59 | — | 1.42 | 1.42 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.29 | 0.24 | 2.10 | 2.24 | 0.01 | 0.09 | — | 0.09 | 0.08 | — | 0.08 | — | 542 | 542 | 0.02 | < 0.005 | — | 544 |
| Dust From Material Movement | — | — | — | — | — | — | 0.30 | 0.30 | — | 0.12 | 0.12 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.05 | 0.04 | 0.38 | 0.41 | < 0.005 | 0.02 | — | 0.02 | 0.01 | — | 0.01 | — | 89.8 | 89.8 | < 0.005 | < 0.005 | — | 90.1 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dust From Material Movement | — | — | — | — | — | — | 0.05 | 0.05 | — | 0.02 | 0.02 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.09 | 0.08 | 0.07 | 1.24 | 0.00 | 0.00 | 0.26 | 0.26 | 0.00 | 0.06 | 0.06 | — | 269 | 269 | < 0.005 | 0.01 | 0.88 | 273 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.02 | < 0.005 | 0.32 | 0.10 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 267 | 267 | 0.01 | 0.04 | 0.60 | 281 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.09 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | 0.01 | 0.01 | — | 20.9 | 20.9 | < 0.005 | < 0.005 | 0.03 | 21.1 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.03 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 22.0 | 22.0 | < 0.005 | < 0.005 | 0.02 | 23.0 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.02 | 0.00 | 0.00 | < 0.005 | < 0.005 | 0.00 | < 0.005 | < 0.005 | — | 3.46 | 3.46 | < 0.005 | < 0.005 | 0.01 | 3.50 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 3.64 | 3.64 | < 0.005 | < 0.005 | < 0.005 | 3.81 |

## 3.5. Building Construction (2027) - Unmitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.11 | 0.93 | 8.60 | 12.4 | 0.02 | 0.31 | — | 0.31 | 0.28 | — | 0.28 | — | 2,293 | 2,293 | 0.09 | 0.02 | — | 2,301 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.11 | 0.93 | 8.60 | 12.4 | 0.02 | 0.31 | — | 0.31 | 0.28 | — | 0.28 | — | 2,293 | 2,293 | 0.09 | 0.02 | — | 2,301 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.33 | 0.28 | 2.56 | 3.69 | 0.01 | 0.09 | — | 0.09 | 0.08 | — | 0.08 | — | 682 | 682 | 0.03 | 0.01 | — | 684 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.06 | 0.05 | 0.47 | 0.67 | < 0.005 | 0.02 | — | 0.02 | 0.02 | — | 0.02 | — | 113 | 113 | < 0.005 | < 0.005 | — | 113 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.70 | 0.62 | 0.56 | 10.0 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,168 | 2,168 | 0.02 | 0.08 | 7.07 | 2,199 |
| Vendor | 0.20 | 0.10 | 3.67 | 1.45 | 0.02 | 0.05 | 0.91 | 0.96 | 0.05 | 0.25 | 0.30 | — | 3,261 | 3,261 | 0.10 | 0.47 | 7.90 | 3,412 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.68 | 0.60 | 0.71 | 8.04 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,011 | 2,011 | 0.03 | 0.08 | 0.18 | 2,036 |
| Vendor | 0.17 | 0.09 | 3.86 | 1.47 | 0.02 | 0.05 | 0.91 | 0.96 | 0.05 | 0.25 | 0.30 | — | 3,263 | 3,263 | 0.10 | 0.47 | 0.20 | 3,407 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.20 | 0.18 | 0.19 | 2.48 | 0.00 | 0.00 | 0.62 | 0.62 | 0.00 | 0.15 | 0.15 | — | 608 | 608 | 0.01 | 0.02 | 0.91 | 616 |
| Vendor | 0.06 | 0.03 | 1.14 | 0.44 | 0.01 | 0.01 | 0.27 | 0.28 | 0.01 | 0.07 | 0.09 | — | 970 | 970 | 0.03 | 0.14 | 1.01 | 1,014 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.04 | 0.03 | 0.03 | 0.45 | 0.00 | 0.00 | 0.11 | 0.11 | 0.00 | 0.03 | 0.03 | — | 101 | 101 | < 0.005 | < 0.005 | 0.15 | 102 |
| Vendor | 0.01 | 0.01 | 0.21 | 0.08 | < 0.005 | < 0.005 | 0.05 | 0.05 | < 0.005 | 0.01 | 0.02 | — | 161 | 161 | < 0.005 | 0.02 | 0.17 | 168 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.6. Building Construction (2027) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.11 | 0.93 | 8.60 | 12.4 | 0.02 | 0.31 | — | 0.31 | 0.28 | — | 0.28 | — | 2,293 | 2,293 | 0.09 | 0.02 | — | 2,301 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Off-Road Equipment | 1.11 | 0.93 | 8.60 | 12.4 | 0.02 | 0.31 | — | 0.31 | 0.28 | — | 0.28 | — | 2,293 | 2,293 | 0.09 | 0.02 | — | 2,301 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.33 | 0.28 | 2.56 | 3.69 | 0.01 | 0.09 | — | 0.09 | 0.08 | — | 0.08 | — | 682 | 682 | 0.03 | 0.01 | — | 684 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.06 | 0.05 | 0.47 | 0.67 | < 0.005 | 0.02 | — | 0.02 | 0.02 | — | 0.02 | — | 113 | 113 | < 0.005 | < 0.005 | — | 113 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.70 | 0.62 | 0.56 | 10.0 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,168 | 2,168 | 0.02 | 0.08 | 7.07 | 2,199 |
| Vendor | 0.20 | 0.10 | 3.67 | 1.45 | 0.02 | 0.05 | 0.91 | 0.96 | 0.05 | 0.25 | 0.30 | — | 3,261 | 3,261 | 0.10 | 0.47 | 7.90 | 3,412 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.68 | 0.60 | 0.71 | 8.04 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,011 | 2,011 | 0.03 | 0.08 | 0.18 | 2,036 |
| Vendor | 0.17 | 0.09 | 3.86 | 1.47 | 0.02 | 0.05 | 0.91 | 0.96 | 0.05 | 0.25 | 0.30 | — | 3,263 | 3,263 | 0.10 | 0.47 | 0.20 | 3,407 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.20 | 0.18 | 0.19 | 2.48 | 0.00 | 0.00 | 0.62 | 0.62 | 0.00 | 0.15 | 0.15 | — | 608 | 608 | 0.01 | 0.02 | 0.91 | 616 |
| Vendor | 0.06 | 0.03 | 1.14 | 0.44 | 0.01 | 0.01 | 0.27 | 0.28 | 0.01 | 0.07 | 0.09 | — | 970 | 970 | 0.03 | 0.14 | 1.01 | 1,014 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.04 | 0.03 | 0.03 | 0.45 | 0.00 | 0.00 | 0.11 | 0.11 | 0.00 | 0.03 | 0.03 | — | 101 | 101 | < 0.005 | < 0.005 | 0.15 | 102 |
| Vendor | 0.01 | 0.01 | 0.21 | 0.08 | < 0.005 | < 0.005 | 0.05 | 0.05 | < 0.005 | 0.01 | 0.02 | — | 161 | 161 | < 0.005 | 0.02 | 0.17 | 168 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.7. Building Construction (2028) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.07 | 0.89 | 8.14 | 12.4 | 0.02 | 0.27 | — | 0.27 | 0.25 | — | 0.25 | — | 2,294 | 2,294 | 0.09 | 0.02 | — | 2,301 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.07 | 0.89 | 8.14 | 12.4 | 0.02 | 0.27 | — | 0.27 | 0.25 | — | 0.25 | — | 2,294 | 2,294 | 0.09 | 0.02 | — | 2,301 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.76 | 0.64 | 5.83 | 8.89 | 0.02 | 0.19 | — | 0.19 | 0.18 | — | 0.18 | — | 1,643 | 1,643 | 0.07 | 0.01 | — | 1,648 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Off-Road Equipment | 0.14 | 0.12 | 1.06 | 1.62 | < 0.005 | 0.04 | — | 0.04 | 0.03 | — | 0.03 | — | 272 | 272 | 0.01 | < 0.005 | — | 273 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.68 | 0.60 | 0.56 | 9.35 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,129 | 2,129 | 0.02 | 0.08 | 6.38 | 2,158 |
| Vendor | 0.18 | 0.10 | 3.51 | 1.40 | 0.02 | 0.05 | 0.91 | 0.96 | 0.05 | 0.25 | 0.30 | — | 3,181 | 3,181 | 0.07 | 0.45 | 7.15 | 3,324 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.59 | 0.58 | 0.64 | 7.49 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 1,975 | 1,975 | 0.03 | 0.08 | 0.17 | 1,998 |
| Vendor | 0.17 | 0.09 | 3.71 | 1.41 | 0.02 | 0.05 | 0.91 | 0.96 | 0.05 | 0.25 | 0.30 | — | 3,183 | 3,183 | 0.07 | 0.45 | 0.19 | 3,319 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.42 | 0.41 | 0.45 | 5.59 | 0.00 | 0.00 | 1.50 | 1.50 | 0.00 | 0.35 | 0.35 | — | 1,438 | 1,438 | 0.02 | 0.05 | 1.97 | 1,457 |
| Vendor | 0.12 | 0.07 | 2.61 | 1.00 | 0.02 | 0.03 | 0.65 | 0.68 | 0.03 | 0.18 | 0.21 | — | 2,279 | 2,279 | 0.05 | 0.32 | 2.21 | 2,379 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.08 | 0.07 | 0.08 | 1.02 | 0.00 | 0.00 | 0.27 | 0.27 | 0.00 | 0.06 | 0.06 | — | 238 | 238 | < 0.005 | 0.01 | 0.33 | 241 |
| Vendor | 0.02 | 0.01 | 0.48 | 0.18 | < 0.005 | 0.01 | 0.12 | 0.12 | 0.01 | 0.03 | 0.04 | — | 377 | 377 | 0.01 | 0.05 | 0.37 | 394 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.8. Building Construction (2028) - Mitigated

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

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

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.07 | 0.89 | 8.14 | 12.4 | 0.02 | 0.27 | — | 0.27 | 0.25 | — | 0.25 | — | 2,294 | 2,294 | 0.09 | 0.02 | — | 2,301 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.07 | 0.89 | 8.14 | 12.4 | 0.02 | 0.27 | — | 0.27 | 0.25 | — | 0.25 | — | 2,294 | 2,294 | 0.09 | 0.02 | — | 2,301 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.76 | 0.64 | 5.83 | 8.89 | 0.02 | 0.19 | — | 0.19 | 0.18 | — | 0.18 | — | 1,643 | 1,643 | 0.07 | 0.01 | — | 1,648 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.14 | 0.12 | 1.06 | 1.62 | < 0.005 | 0.04 | — | 0.04 | 0.03 | — | 0.03 | — | 272 | 272 | 0.01 | < 0.005 | — | 273 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.68 | 0.60 | 0.56 | 9.35 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,129 | 2,129 | 0.02 | 0.08 | 6.38 | 2,158 |
| Vendor | 0.18 | 0.10 | 3.51 | 1.40 | 0.02 | 0.05 | 0.91 | 0.96 | 0.05 | 0.25 | 0.30 | — | 3,181 | 3,181 | 0.07 | 0.45 | 7.15 | 3,324 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.59 | 0.58 | 0.64 | 7.49 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 1,975 | 1,975 | 0.03 | 0.08 | 0.17 | 1,998 |
| Vendor | 0.17 | 0.09 | 3.71 | 1.41 | 0.02 | 0.05 | 0.91 | 0.96 | 0.05 | 0.25 | 0.30 | — | 3,183 | 3,183 | 0.07 | 0.45 | 0.19 | 3,319 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.42 | 0.41 | 0.45 | 5.59 | 0.00 | 0.00 | 1.50 | 1.50 | 0.00 | 0.35 | 0.35 | — | 1,438 | 1,438 | 0.02 | 0.05 | 1.97 | 1,457 |
| Vendor | 0.12 | 0.07 | 2.61 | 1.00 | 0.02 | 0.03 | 0.65 | 0.68 | 0.03 | 0.18 | 0.21 | — | 2,279 | 2,279 | 0.05 | 0.32 | 2.21 | 2,379 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.08 | 0.07 | 0.08 | 1.02 | 0.00 | 0.00 | 0.27 | 0.27 | 0.00 | 0.06 | 0.06 | — | 238 | 238 | < 0.005 | 0.01 | 0.33 | 241 |
| Vendor | 0.02 | 0.01 | 0.48 | 0.18 | < 0.005 | 0.01 | 0.12 | 0.12 | 0.01 | 0.03 | 0.04 | — | 377 | 377 | 0.01 | 0.05 | 0.37 | 394 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.9. Building Construction (2029) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.04 | 0.87 | 7.80 | 12.4 | 0.02 | 0.24 | — | 0.24 | 0.23 | — | 0.23 | — | 2,293 | 2,293 | 0.09 | 0.02 | — | 2,301 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.14 | 0.12 | 1.04 | 1.65 | < 0.005 | 0.03 | — | 0.03 | 0.03 | — | 0.03 | — | 305 | 305 | 0.01 | < 0.005 | — | 306 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.03 | 0.02 | 0.19 | 0.30 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 50.5 | 50.5 | < 0.005 | < 0.005 | — | 50.7 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.56 | 0.49 | 0.56 | 7.01 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 1,940 | 1,940 | 0.03 | 0.08 | 0.15 | 1,964 |
| Vendor | 0.17 | 0.07 | 3.55 | 1.36 | 0.02 | 0.05 | 0.91 | 0.96 | 0.05 | 0.25 | 0.30 | — | 3,096 | 3,096 | 0.07 | 0.45 | 0.17 | 3,232 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.08 | 0.07 | 0.07 | 0.98 | 0.00 | 0.00 | 0.28 | 0.28 | 0.00 | 0.07 | 0.07 | — | 262 | 262 | < 0.005 | 0.01 | 0.33 | 266 |
| Vendor | 0.02 | 0.01 | 0.46 | 0.18 | < 0.005 | 0.01 | 0.12 | 0.13 | 0.01 | 0.03 | 0.04 | — | 412 | 412 | 0.01 | 0.06 | 0.37 | 430 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.18 | 0.00 | 0.00 | 0.05 | 0.05 | 0.00 | 0.01 | 0.01 | — | 43.5 | 43.5 | < 0.005 | < 0.005 | 0.05 | 44.0 |
| Vendor | < 0.005 | < 0.005 | 0.08 | 0.03 | < 0.005 | < 0.005 | 0.02 | 0.02 | < 0.005 | 0.01 | 0.01 | — | 68.2 | 68.2 | < 0.005 | 0.01 | 0.06 | 71.2 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.10. Building Construction (2029) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.04 | 0.87 | 7.80 | 12.4 | 0.02 | 0.24 | — | 0.24 | 0.23 | — | 0.23 | — | 2,293 | 2,293 | 0.09 | 0.02 | — | 2,301 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.14 | 0.12 | 1.04 | 1.65 | < 0.005 | 0.03 | — | 0.03 | 0.03 | — | 0.03 | — | 305 | 305 | 0.01 | < 0.005 | — | 306 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.03 | 0.02 | 0.19 | 0.30 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 50.5 | 50.5 | < 0.005 | < 0.005 | — | 50.7 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Worker | 0.56 | 0.49 | 0.56 | 7.01 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 1,940 | 1,940 | 0.03 | 0.08 | 0.15 | 1,964 |
| Vendor | 0.17 | 0.07 | 3.55 | 1.36 | 0.02 | 0.05 | 0.91 | 0.96 | 0.05 | 0.25 | 0.30 | — | 3,096 | 3,096 | 0.07 | 0.45 | 0.17 | 3,232 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.08 | 0.07 | 0.07 | 0.98 | 0.00 | 0.00 | 0.28 | 0.28 | 0.00 | 0.07 | 0.07 | — | 262 | 262 | < 0.005 | 0.01 | 0.33 | 266 |
| Vendor | 0.02 | 0.01 | 0.46 | 0.18 | < 0.005 | 0.01 | 0.12 | 0.13 | 0.01 | 0.03 | 0.04 | — | 412 | 412 | 0.01 | 0.06 | 0.37 | 430 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.18 | 0.00 | 0.00 | 0.05 | 0.05 | 0.00 | 0.01 | 0.01 | — | 43.5 | 43.5 | < 0.005 | < 0.005 | 0.05 | 44.0 |
| Vendor | < 0.005 | < 0.005 | 0.08 | 0.03 | < 0.005 | < 0.005 | 0.02 | 0.02 | < 0.005 | 0.01 | 0.01 | — | 68.2 | 68.2 | < 0.005 | 0.01 | 0.06 | 71.2 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.11. Paving (2029) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.80 | 0.67 | 6.46 | 9.92 | 0.01 | 0.24 | — | 0.24 | 0.22 | — | 0.22 | — | 1,511 | 1,511 | 0.06 | 0.01 | — | 1,516 |
| Paving | 0.00 | 0.00 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.80 | 0.67 | 6.46 | 9.92 | 0.01 | 0.24 | — | 0.24 | 0.22 | — | 0.22 | — | 1,511 | 1,511 | 0.06 | 0.01 | — | 1,516 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Paving | 0.00 | 0.00 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.04 | 0.04 | 0.35 | 0.54 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 82.8 | 82.8 | < 0.005 | < 0.005 | — | 83.1 |
| Paving | 0.00 | 0.00 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.01 | 0.01 | 0.06 | 0.10 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 13.7 | 13.7 | < 0.005 | < 0.005 | — | 13.8 |
| Paving | 0.00 | 0.00 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.05 | 0.05 | 0.05 | 0.82 | 0.00 | 0.00 | 0.20 | 0.20 | 0.00 | 0.05 | 0.05 | — | 195 | 195 | < 0.005 | 0.01 | 0.53 | 198 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.05 | 0.05 | 0.05 | 0.65 | 0.00 | 0.00 | 0.20 | 0.20 | 0.00 | 0.05 | 0.05 | — | 181 | 181 | < 0.005 | 0.01 | 0.01 | 183 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.04 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 10.1 | 10.1 | < 0.005 | < 0.005 | 0.01 | 10.2 |

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| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.01 | 0.00 | 0.00 | < 0.005 | < 0.005 | 0.00 | < 0.005 | < 0.005 | — | 1.67 | 1.67 | < 0.005 | < 0.005 | < 0.005 | 1.69 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.12. Paving (2029) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.80 | 0.67 | 6.46 | 9.92 | 0.01 | 0.24 | — | 0.24 | 0.22 | — | 0.22 | — | 1,511 | 1,511 | 0.06 | 0.01 | — | 1,516 |
| Paving | 0.00 | 0.00 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.80 | 0.67 | 6.46 | 9.92 | 0.01 | 0.24 | — | 0.24 | 0.22 | — | 0.22 | — | 1,511 | 1,511 | 0.06 | 0.01 | — | 1,516 |
| Paving | 0.00 | 0.00 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.04 | 0.04 | 0.35 | 0.54 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 82.8 | 82.8 | < 0.005 | < 0.005 | — | 83.1 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Paving | 0.00 | 0.00 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.01 | 0.01 | 0.06 | 0.10 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 13.7 | 13.7 | < 0.005 | < 0.005 | — | 13.8 |
| Paving | 0.00 | 0.00 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.05 | 0.05 | 0.05 | 0.82 | 0.00 | 0.00 | 0.20 | 0.20 | 0.00 | 0.05 | 0.05 | — | 195 | 195 | < 0.005 | 0.01 | 0.53 | 198 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.05 | 0.05 | 0.05 | 0.65 | 0.00 | 0.00 | 0.20 | 0.20 | 0.00 | 0.05 | 0.05 | — | 181 | 181 | < 0.005 | 0.01 | 0.01 | 183 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.04 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 10.1 | 10.1 | < 0.005 | < 0.005 | 0.01 | 10.2 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.01 | 0.00 | 0.00 | < 0.005 | < 0.005 | 0.00 | < 0.005 | < 0.005 | — | 1.67 | 1.67 | < 0.005 | < 0.005 | < 0.005 | 1.69 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

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| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.13. Architectural Coating (2029) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.12 | 0.10 | 0.79 | 1.11 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 134 | 134 | 0.01 | < 0.005 | — | 134 |
| Architectural Coatings | 752 | 752 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.01 | 0.01 | 0.04 | 0.06 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 7.32 | 7.32 | < 0.005 | < 0.005 | — | 7.34 |
| Architectural Coatings | 41.2 | 41.2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 1.21 | 1.21 | < 0.005 | < 0.005 | — | 1.22 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Architectural Coatings | 7.52 | 7.52 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.20 | 0.20 | 0.16 | 2.97 | 0.00 | 0.00 | 0.71 | 0.71 | 0.00 | 0.17 | 0.17 | — | 708 | 708 | 0.01 | 0.03 | 1.93 | 718 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.14 | 0.00 | 0.00 | 0.04 | 0.04 | 0.00 | 0.01 | 0.01 | — | 36.6 | 36.6 | < 0.005 | < 0.005 | 0.05 | 37.1 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.02 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 6.06 | 6.06 | < 0.005 | < 0.005 | 0.01 | 6.14 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.14. Architectural Coating (2029) - Mitigated

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

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

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.12 | 0.10 | 0.79 | 1.11 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 134 | 134 | 0.01 | < 0.005 | — | 134 |
| Architectural Coatings | 752 | 752 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.01 | 0.01 | 0.04 | 0.06 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 7.32 | 7.32 | < 0.005 | < 0.005 | — | 7.34 |
| Architectural Coatings | 41.2 | 41.2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 1.21 | 1.21 | < 0.005 | < 0.005 | — | 1.22 |
| Architectural Coatings | 7.52 | 7.52 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.20 | 0.20 | 0.16 | 2.97 | 0.00 | 0.00 | 0.71 | 0.71 | 0.00 | 0.17 | 0.17 | — | 708 | 708 | 0.01 | 0.03 | 1.93 | 718 |

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| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.14 | 0.00 | 0.00 | 0.04 | 0.04 | 0.00 | 0.01 | 0.01 | — | 36.6 | 36.6 | < 0.005 | < 0.005 | 0.05 | 37.1 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.02 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 6.06 | 6.06 | < 0.005 | < 0.005 | 0.01 | 6.14 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

# 4. Operations Emissions Details

## 4.1. Mobile Emissions by Land Use

### 4.1.1. Unmitigated

Mobile source emissions results are presented in Sections 2.6. No further detailed breakdown of emissions is available.

### 4.1.2. Mitigated

Mobile source emissions results are presented in Sections 2.5. No further detailed breakdown of emissions is available.

## 4.2. Energy

### 4.2.1. Electricity Emissions By Land Use - Unmitigated

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

| Land Use | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
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| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | 14,528 | 14,528 | 1.06 | 0.13 | — | 14,592 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | 14,528 | 14,528 | 1.06 | 0.13 | — | 14,592 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | 14,528 | 14,528 | 1.06 | 0.13 | — | 14,592 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | 14,528 | 14,528 | 1.06 | 0.13 | — | 14,592 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | 2,405 | 2,405 | 0.18 | 0.02 | — | 2,416 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | 2,405 | 2,405 | 0.18 | 0.02 | — | 2,416 |

### 4.2.2. Electricity Emissions By Land Use - Mitigated

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

| Land Use | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | 14,528 | 14,528 | 1.06 | 0.13 | — | 14,592 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | 14,528 | 14,528 | 1.06 | 0.13 | — | 14,592 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | 14,528 | 14,528 | 1.06 | 0.13 | — | 14,592 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | 14,528 | 14,528 | 1.06 | 0.13 | — | 14,592 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | 2,405 | 2,405 | 0.18 | 0.02 | — | 2,416 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | 2,405 | 2,405 | 0.18 | 0.02 | — | 2,416 |

### 4.2.3. Natural Gas Emissions By Land Use - Unmitigated

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

| Land Use | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 7,350 | 7,350 | 0.65 | 0.01 | — | 7,371 |
| Total | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 7,350 | 7,350 | 0.65 | 0.01 | — | 7,371 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 7,350 | 7,350 | 0.65 | 0.01 | — | 7,371 |
| Total | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 7,350 | 7,350 | 0.65 | 0.01 | — | 7,371 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | 0.12 | 0.06 | 1.12 | 0.94 | 0.01 | 0.09 | — | 0.09 | 0.09 | — | 0.09 | — | 1,217 | 1,217 | 0.11 | < 0.005 | — | 1,220 |
| Total | 0.12 | 0.06 | 1.12 | 0.94 | 0.01 | 0.09 | — | 0.09 | 0.09 | — | 0.09 | — | 1,217 | 1,217 | 0.11 | < 0.005 | — | 1,220 |

### 4.2.4. Natural Gas Emissions By Land Use - Mitigated

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

| Land Use | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 7,350 | 7,350 | 0.65 | 0.01 | — | 7,371 |
| Total | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 7,350 | 7,350 | 0.65 | 0.01 | — | 7,371 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 7,350 | 7,350 | 0.65 | 0.01 | — | 7,371 |
| Total | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 7,350 | 7,350 | 0.65 | 0.01 | — | 7,371 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | 0.12 | 0.06 | 1.12 | 0.94 | 0.01 | 0.09 | — | 0.09 | 0.09 | — | 0.09 | — | 1,217 | 1,217 | 0.11 | < 0.005 | — | 1,220 |
| Total | 0.12 | 0.06 | 1.12 | 0.94 | 0.01 | 0.09 | — | 0.09 | 0.09 | — | 0.09 | — | 1,217 | 1,217 | 0.11 | < 0.005 | — | 1,220 |

## 4.3. Area Emissions by Source

### 4.3.1. Unmitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Consum Products | 13.9 | 13.9 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Architectural Coatings | 1.65 | 1.65 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Landscape Equipment | 5.03 | 4.64 | 0.24 | 28.2 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 116 | 116 | < 0.005 | < 0.005 | — | 116 |
| Total | 20.6 | 20.2 | 0.24 | 28.2 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 116 | 116 | < 0.005 | < 0.005 | — | 116 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Consumer Products | 13.9 | 13.9 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Architectural Coatings | 1.65 | 1.65 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Total | 15.5 | 15.5 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Consumer Products | 2.53 | 2.53 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Architectural Coatings | 0.30 | 0.30 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Landscape Equipment | 0.45 | 0.42 | 0.02 | 2.54 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 9.48 | 9.48 | < 0.005 | < 0.005 | — | 9.51 |
| Total | 3.29 | 3.25 | 0.02 | 2.54 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 9.48 | 9.48 | < 0.005 | < 0.005 | — | 9.51 |

### 4.3.2. Mitigated

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

| Source | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Consumer Products | 13.9 | 13.9 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Architectural Coatings | 1.65 | 1.65 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Landscape Equipment | 5.03 | 4.64 | 0.24 | 28.2 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 116 | 116 | < 0.005 | < 0.005 | — | 116 |
| Total | 20.6 | 20.2 | 0.24 | 28.2 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 116 | 116 | < 0.005 | < 0.005 | — | 116 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Consumer Products | 13.9 | 13.9 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Architectural Coatings | 1.65 | 1.65 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Total | 15.5 | 15.5 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Consumer Products | 2.53 | 2.53 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Architectural Coatings | 0.30 | 0.30 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Landscape Equipme | 0.45 | 0.42 | 0.02 | 2.54 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 9.48 | 9.48 | < 0.005 | < 0.005 | — | 9.51 |
| Total | 3.29 | 3.25 | 0.02 | 2.54 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 9.48 | 9.48 | < 0.005 | < 0.005 | — | 9.51 |

## 4.4. Water Emissions by Land Use

### 4.4.1. Unmitigated

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

| Land Use | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Total | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Total | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 47.6 | 145 | 192 | 4.89 | 0.12 | — | 350 |
| Total | — | — | — | — | — | — | — | — | — | — | — | 47.6 | 145 | 192 | 4.89 | 0.12 | — | 350 |

### 4.4.2. Mitigated

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

| Land Use | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Total | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Total | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 47.6 | 145 | 192 | 4.89 | 0.12 | — | 350 |
| Total | — | — | — | — | — | — | — | — | — | — | — | 47.6 | 145 | 192 | 4.89 | 0.12 | — | 350 |

## 4.5. Waste Emissions by Land Use

### 4.5.1. Unmitigated

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

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

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Total | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Total | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 71.8 | 0.00 | 71.8 | 7.18 | 0.00 | — | 251 |
| Total | — | — | — | — | — | — | — | — | — | — | — | 71.8 | 0.00 | 71.8 | 7.18 | 0.00 | — | 251 |

### 4.5.2. Mitigated

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

| Land Use | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Total | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 71.8 | 0.00 | 71.8 | 7.18 | 0.00 | — | 251 |
| Total | — | — | — | — | — | — | — | — | — | — | — | 71.8 | 0.00 | 71.8 | 7.18 | 0.00 | — | 251 |

## 4.6. Refrigerant Emissions by Land Use

### 4.6.1. Unmitigated

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

| Land Use | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 28.0 | 28.0 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 28.0 | 28.0 |

### 4.6.2. Mitigated

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

| Land Use | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 28.0 | 28.0 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 28.0 | 28.0 |

## 4.7. Offroad Emissions By Equipment Type

### 4.7.1. Unmitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

### 4.7.2. Mitigated

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

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

## 4.8. Stationary Emissions By Equipment Type

### 4.8.1. Unmitigated

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

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

### 4.8.2. Mitigated

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

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

## 4.9. User Defined Emissions By Equipment Type

### 4.9.1. Unmitigated

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

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

### 4.9.2. Mitigated

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

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

## 4.10. Soil Carbon Accumulation By Vegetation Type

### 4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated

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

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

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

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

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

## 4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sequest | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Removed | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

### 4.10.4. Soil Carbon Accumulation By Vegetation Type - Mitigated

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

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

### 4.10.5. Above and Belowground Carbon Accumulation by Land Use Type - Mitigated

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

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

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

## 4.10.6. Avoided and Sequestered Emissions by Species - Mitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Removed | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Avoided | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Sequestered | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Removed | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

# 5. Activity Data

## 5.1. Construction Schedule

| Phase Name | Phase Type | Start Date | End Date | Days Per Week | Work Days per Phase | Phase Description |
|---|---|---|---|---|---|---|
| Site Preparation | Site Preparation | 6/7/2027 | 6/18/2027 | 5.00 | 10.0 | — |
| Grading | Grading | 6/21/2027 | 7/30/2027 | 5.00 | 30.0 | — |
| Building Construction | Building Construction | 8/2/2027 | 3/9/2029 | 5.00 | 420 | — |
| Paving | Paving | 3/12/2029 | 4/6/2029 | 5.00 | 20.0 | — |
| Architectural Coating | Architectural Coating | 4/9/2029 | 5/4/2029 | 5.00 | 20.0 | — |

## 5.2. Off-Road Equipment

### 5.2.1. Unmitigated

| Phase Name | Equipment Type | Fuel Type | Engine Tier | Number per Day | Hours Per Day | Horsepower | Load Factor |
|---|---|---|---|---|---|---|---|
| Site Preparation | Rubber Tired Dozers | Diesel | Average | 3.00 | 8.00 | 367 | 0.40 |
| Site Preparation | Tractors/Loaders/Backhoes | Diesel | Average | 4.00 | 8.00 | 84.0 | 0.37 |
| Grading | Graders | Diesel | Average | 1.00 | 8.00 | 148 | 0.41 |
| Grading | Excavators | Diesel | Average | 2.00 | 8.00 | 36.0 | 0.38 |
| Grading | Tractors/Loaders/Backhoes | Diesel | Average | 2.00 | 8.00 | 84.0 | 0.37 |
| Grading | Scrapers | Diesel | Average | 2.00 | 8.00 | 423 | 0.48 |
| Grading | Rubber Tired Dozers | Diesel | Average | 1.00 | 8.00 | 367 | 0.40 |
| Building Construction | Forklifts | Diesel | Average | 3.00 | 8.00 | 82.0 | 0.20 |
| Building Construction | Cranes | Diesel | Average | 1.00 | 7.00 | 367 | 0.29 |
| Building Construction | Welders | Diesel | Average | 1.00 | 8.00 | 46.0 | 0.45 |
| Building Construction | Tractors/Loaders/Backhoes | Diesel | Average | 3.00 | 7.00 | 84.0 | 0.37 |
| Paving | Pavers | Diesel | Average | 2.00 | 8.00 | 81.0 | 0.42 |
| Paving | Paving Equipment | Diesel | Average | 2.00 | 8.00 | 89.0 | 0.36 |
| Paving | Rollers | Diesel | Average | 2.00 | 8.00 | 36.0 | 0.38 |
| Architectural Coating | Air Compressors | Diesel | Average | 1.00 | 6.00 | 37.0 | 0.48 |

### 5.2.2. Mitigated

| Phase Name | Equipment Type | Fuel Type | Engine Tier | Number per Day | Hours Per Day | Horsepower | Load Factor |
|---|---|---|---|---|---|---|---|
| Site Preparation | Rubber Tired Dozers | Diesel | Average | 3.00 | 8.00 | 367 | 0.40 |
| Site Preparation | Tractors/Loaders/Backhoes | Diesel | Average | 4.00 | 8.00 | 84.0 | 0.37 |
| Grading | Graders | Diesel | Average | 1.00 | 8.00 | 148 | 0.41 |
| Grading | Excavators | Diesel | Average | 2.00 | 8.00 | 36.0 | 0.38 |
| Grading | Tractors/Loaders/Backhoes | Diesel | Average | 2.00 | 8.00 | 84.0 | 0.37 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Grading | Scrapers | Diesel | Average | 2.00 | 8.00 | 423 | 0.48 |
| Grading | Rubber Tired Dozers | Diesel | Average | 1.00 | 8.00 | 367 | 0.40 |
| Building Construction | Forklifts | Diesel | Average | 3.00 | 8.00 | 82.0 | 0.20 |
| Building Construction | Cranes | Diesel | Average | 1.00 | 7.00 | 367 | 0.29 |
| Building Construction | Welders | Diesel | Average | 1.00 | 8.00 | 46.0 | 0.45 |
| Building Construction | Tractors/Loaders/Backhoes | Diesel | Average | 3.00 | 7.00 | 84.0 | 0.37 |
| Paving | Pavers | Diesel | Average | 2.00 | 8.00 | 81.0 | 0.42 |
| Paving | Paving Equipment | Diesel | Average | 2.00 | 8.00 | 89.0 | 0.36 |
| Paving | Rollers | Diesel | Average | 2.00 | 8.00 | 36.0 | 0.38 |
| Architectural Coating | Air Compressors | Diesel | Average | 1.00 | 6.00 | 37.0 | 0.48 |

## 5.3. Construction Vehicles

### 5.3.1. Unmitigated

| Phase Name | Trip Type | One-Way Trips per Day | Miles per Trip | Vehicle Mix |
|---|---|---|---|---|
| Site Preparation | — | — | — | — |
| Site Preparation | Worker | 17.5 | 18.5 | LDA,LDT1,LDT2 |
| Site Preparation | Vendor | — | 10.2 | HHDT,MHDT |
| Site Preparation | Hauling | 4.00 | 20.0 | HHDT |
| Site Preparation | Onsite truck | — | — | HHDT |
| Grading | — | — | — | — |
| Grading | Worker | 20.0 | 18.5 | LDA,LDT1,LDT2 |
| Grading | Vendor | — | 10.2 | HHDT,MHDT |
| Grading | Hauling | 4.00 | 20.0 | HHDT |
| Grading | Onsite truck | — | — | HHDT |
| Building Construction | — | — | — | — |
| Building Construction | Worker | 161 | 18.5 | LDA,LDT1,LDT2 |

| | | | | |
|---|---|---|---|---|
| Building Construction | Vendor | 106 | 10.2 | HHDT,MHDT |
| Building Construction | Hauling | 0.00 | 20.0 | HHDT |
| Building Construction | Onsite truck | — | — | HHDT |
| Paving | — | — | — | — |
| Paving | Worker | 15.0 | 18.5 | LDA,LDT1,LDT2 |
| Paving | Vendor | — | 10.2 | HHDT,MHDT |
| Paving | Hauling | 0.00 | 20.0 | HHDT |
| Paving | Onsite truck | — | — | HHDT |
| Architectural Coating | — | — | — | — |
| Architectural Coating | Worker | 54.5 | 18.5 | LDA,LDT1,LDT2 |
| Architectural Coating | Vendor | — | 10.2 | HHDT,MHDT |
| Architectural Coating | Hauling | 0.00 | 20.0 | HHDT |
| Architectural Coating | Onsite truck | — | — | HHDT |

### 5.3.2. Mitigated

| Phase Name | Trip Type | One-Way Trips per Day | Miles per Trip | Vehicle Mix |
|---|---|---|---|---|
| Site Preparation | — | — | — | — |
| Site Preparation | Worker | 17.5 | 18.5 | LDA,LDT1,LDT2 |
| Site Preparation | Vendor | — | 10.2 | HHDT,MHDT |
| Site Preparation | Hauling | 4.00 | 20.0 | HHDT |
| Site Preparation | Onsite truck | — | — | HHDT |
| Grading | — | — | — | — |
| Grading | Worker | 20.0 | 18.5 | LDA,LDT1,LDT2 |
| Grading | Vendor | — | 10.2 | HHDT,MHDT |
| Grading | Hauling | 4.00 | 20.0 | HHDT |
| Grading | Onsite truck | — | — | HHDT |
| Building Construction | — | — | — | — |

| | | | | |
|---|---|---|---|---|
| Building Construction | Worker | 161 | 18.5 | LDA,LDT1,LDT2 |
| Building Construction | Vendor | 106 | 10.2 | HHDT,MHDT |
| Building Construction | Hauling | 0.00 | 20.0 | HHDT |
| Building Construction | Onsite truck | — | — | HHDT |
| Paving | — | — | — | — |
| Paving | Worker | 15.0 | 18.5 | LDA,LDT1,LDT2 |
| Paving | Vendor | — | 10.2 | HHDT,MHDT |
| Paving | Hauling | 0.00 | 20.0 | HHDT |
| Paving | Onsite truck | — | — | HHDT |
| Architectural Coating | — | — | — | — |
| Architectural Coating | Worker | 54.5 | 18.5 | LDA,LDT1,LDT2 |
| Architectural Coating | Vendor | — | 10.2 | HHDT,MHDT |
| Architectural Coating | Hauling | 0.00 | 20.0 | HHDT |
| Architectural Coating | Onsite truck | — | — | HHDT |

## 5.4. Vehicles

### 5.4.1. Construction Vehicle Control Strategies

| Control Strategies Applied | PM10 Reduction | PM2.5 Reduction |
|---|---|---|
| Water unpaved roads twice daily | 55% | 55% |
| Limit vehicle speeds on unpaved roads to 25 mph | 44% | 44% |
| Sweep paved roads once per month | 9% | 9% |

## 5.5. Architectural Coatings

| Phase Name | Residential Interior Area Coated (sq ft) | Residential Exterior Area Coated (sq ft) | Non-Residential Interior Area Coated (sq ft) | Non-Residential Exterior Area Coated (sq ft) | Parking Area Coated (sq ft) |
|---|---|---|---|---|---|
| Architectural Coating | 0.00 | 0.00 | 973,568 | 324,523 | — |

## 5.6. Dust Mitigation

### 5.6.1. Construction Earthmoving Activities

| Phase Name | Material Imported (cy) | Material Exported (cy) | Acres Graded (acres) | Material Demolished (sq. ft.) | Acres Paved (acres) |
|---|---|---|---|---|---|
| Site Preparation | — | — | 15.0 | 0.00 | — |
| Grading | — | — | 90.0 | 0.00 | — |
| Paving | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

### 5.6.2. Construction Earthmoving Control Strategies

| Control Strategies Applied | Frequency (per day) | PM10 Reduction | PM2.5 Reduction |
|---|---|---|---|
| Water Exposed Area | 2 | 61% | 61% |

## 5.7. Construction Paving

| Land Use | Area Paved (acres) | % Asphalt |
|---|---|---|
| General Heavy Industry | 0.00 | 0% |

## 5.8. Construction Electricity Consumption and Emissions Factors

kWh per Year and Emission Factor (lb/MWh)

| Year | kWh per Year | CO2 | CH4 | N2O |
|---|---|---|---|---|
| 2027 | 0.00 | 453 | 0.03 | < 0.005 |
| 2028 | 0.00 | 453 | 0.03 | < 0.005 |
| 2029 | 0.00 | 453 | 0.03 | < 0.005 |

## 5.9. Operational Mobile Sources

### 5.9.1. Unmitigated

| Land Use Type | Trips/Weekday | Trips/Saturday | Trips/Sunday | Trips/Year | VMT/Weekday | VMT/Saturday | VMT/Sunday | VMT/Year |
|---|---|---|---|---|---|---|---|---|
| Total all Land Uses | 32.0 | 32.0 | 32.0 | 11,680 | 308 | 308 | 308 | 112,420 |

### 5.9.2. Mitigated

| Land Use Type | Trips/Weekday | Trips/Saturday | Trips/Sunday | Trips/Year | VMT/Weekday | VMT/Saturday | VMT/Sunday | VMT/Year |
|---|---|---|---|---|---|---|---|---|
| Total all Land Uses | 32.0 | 32.0 | 32.0 | 11,680 | 308 | 308 | 308 | 112,420 |

## 5.10. Operational Area Sources

### 5.10.1. Hearths

#### 5.10.1.1. Unmitigated

#### 5.10.1.2. Mitigated

### 5.10.2. Architectural Coatings

| Residential Interior Area Coated (sq ft) | Residential Exterior Area Coated (sq ft) | Non-Residential Interior Area Coated (sq ft) | Non-Residential Exterior Area Coated (sq ft) | Parking Area Coated (sq ft) |
|---|---|---|---|---|
| 0 | 0.00 | 973,568 | 324,523 | — |

### 5.10.3. Landscape Equipment

| Season | Unit | Value |
|---|---|---|
| Snow Days | day/yr | 0.00 |
| Summer Days | day/yr | 180 |

### 5.10.4. Landscape Equipment - Mitigated

| Season | Unit | Value |
|---|---|---|
| Snow Days | day/yr | 0.00 |

| | | |
|---|---|---|
| Summer Days | day/yr | 180 |

## 5.11. Operational Energy Consumption

### 5.11.1. Unmitigated

Electricity (kWh/yr) and CO2 and CH4 and N2O and Natural Gas (kBTU/yr)

| Land Use | Electricity (kWh/yr) | CO2 | CH4 | N2O | Natural Gas (kBTU/yr) |
|---|---|---|---|---|---|
| General Heavy Industry | 11,700,000 | 453 | 0.0330 | 0.0040 | 22,934,978 |

### 5.11.2. Mitigated

Electricity (kWh/yr) and CO2 and CH4 and N2O and Natural Gas (kBTU/yr)

| Land Use | Electricity (kWh/yr) | CO2 | CH4 | N2O | Natural Gas (kBTU/yr) |
|---|---|---|---|---|---|
| General Heavy Industry | 11,700,000 | 453 | 0.0330 | 0.0040 | 22,934,978 |

## 5.12. Operational Water and Wastewater Consumption

### 5.12.1. Unmitigated

| Land Use | Indoor Water (gal/year) | Outdoor Water (gal/year) |
|---|---|---|
| General Heavy Industry | 150,091,656 | 0.00 |

### 5.12.2. Mitigated

| Land Use | Indoor Water (gal/year) | Outdoor Water (gal/year) |
|---|---|---|
| General Heavy Industry | 150,091,656 | 0.00 |

## 5.13. Operational Waste Generation

### 5.13.1. Unmitigated

| Land Use | Waste (ton/year) | Cogeneration (kWh/year) |
|---|---|---|
| General Heavy Industry | 805 | — |

### 5.13.2. Mitigated

| Land Use | Waste (ton/year) | Cogeneration (kWh/year) |
|---|---|---|
| General Heavy Industry | 805 | — |

## 5.14. Operational Refrigeration and Air Conditioning Equipment

### 5.14.1. Unmitigated

| Land Use Type | Equipment Type | Refrigerant | GWP | Quantity (kg) | Operations Leak Rate | Service Leak Rate | Times Serviced |
|---|---|---|---|---|---|---|---|
| General Heavy Industry | Other commercial A/C and heat pumps | R-410A | 2,088 | 0.30 | 4.00 | 4.00 | 18.0 |

### 5.14.2. Mitigated

| Land Use Type | Equipment Type | Refrigerant | GWP | Quantity (kg) | Operations Leak Rate | Service Leak Rate | Times Serviced |
|---|---|---|---|---|---|---|---|
| General Heavy Industry | Other commercial A/C and heat pumps | R-410A | 2,088 | 0.30 | 4.00 | 4.00 | 18.0 |

## 5.15. Operational Off-Road Equipment

### 5.15.1. Unmitigated

| Equipment Type | Fuel Type | Engine Tier | Number per Day | Hours Per Day | Horsepower | Load Factor |
|---|---|---|---|---|---|---|

### 5.15.2. Mitigated

| Equipment Type | Fuel Type | Engine Tier | Number per Day | Hours Per Day | Horsepower | Load Factor |
|---|---|---|---|---|---|---|

## 5.16. Stationary Sources

### 5.16.1. Emergency Generators and Fire Pumps

| Equipment Type | Fuel Type | Number per Day | Hours per Day | Hours per Year | Horsepower | Load Factor |
|---|---|---|---|---|---|---|

### 5.16.2. Process Boilers

| Equipment Type | Fuel Type | Number | Boiler Rating (MMBtu/hr) | Daily Heat Input (MMBtu/day) | Annual Heat Input (MMBtu/yr) |
|---|---|---|---|---|---|

## 5.17. User Defined

| Equipment Type | Fuel Type |
|---|---|

## 5.18. Vegetation

### 5.18.1. Land Use Change

#### 5.18.1.1. Unmitigated

| Vegetation Land Use Type | Vegetation Soil Type | Initial Acres | Final Acres |
|---|---|---|---|

#### 5.18.1.2. Mitigated

| Vegetation Land Use Type | Vegetation Soil Type | Initial Acres | Final Acres |
|---|---|---|---|

### 5.18.1. Biomass Cover Type

#### 5.18.1.1. Unmitigated

| Biomass Cover Type | Initial Acres | Final Acres |
|---|---|---|

#### 5.18.1.2. Mitigated

| Biomass Cover Type | Initial Acres | Final Acres |
|---|---|---|

### 5.18.2. Sequestration

#### 5.18.2.1. Unmitigated

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

#### 5.18.2.2. Mitigated

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

# 6. Climate Risk Detailed Report

## 6.1. Climate Risk Summary

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

| Climate Hazard | Result for Project Location | Unit |
|---|---|---|
| Temperature and Extreme Heat | 5.68 | annual days of extreme heat |
| Extreme Precipitation | 5.50 | annual days with precipitation above 20 mm |
| Sea Level Rise | — | meters of inundation depth |
| Wildfire | 0.00 | annual hectares burned |

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

Wildfire data are for the grid cell in which your project are located. The projections are from UC Davis, as reported in Cal-Adapt (2040–2059 average under RCP 8.5), and consider historical data of climate, vegetation, population density, and large (> 400 ha) fire history. Users may select from four model simulations to view the range in potential wildfire probabilities for the grid cell. The four simulations make different assumptions about expected rainfall and temperature are: Warmer/drier (HadGEM2-ES), Cooler/wetter (CNRM-CM5), Average conditions (CanESM2), Range of different rainfall and temperature possibilities (MIROC5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.

## 6.2. Initial Climate Risk Scores

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

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

## 6.3. Adjusted Climate Risk Scores

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

| | | | | |
|---|---|---|---|---|
| Air Quality Degradation | N/A | N/A | N/A | N/A |

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

### 6.4. Climate Risk Reduction Measures

# 7. Health and Equity Details

## 7.1. CalEnviroScreen 4.0 Scores

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

| Indicator | Result for Project Census Tract |
|---|---|
| Exposure Indicators | — |
| AQ-Ozone | 45.0 |
| AQ-PM | 68.0 |
| AQ-DPM | 91.2 |
| Drinking Water | 61.5 |
| Lead Risk Housing | 64.6 |
| Pesticides | 17.7 |
| Toxic Releases | 79.4 |
| Traffic | 68.5 |
| Effect Indicators | — |
| CleanUp Sites | 88.6 |
| Groundwater | 92.5 |
| Haz Waste Facilities/Generators | 91.0 |
| Impaired Water Bodies | 66.7 |
| Solid Waste | 93.4 |

| | |
|---|---|
| Sensitive Population | — |
| Asthma | 45.1 |
| Cardio-vascular | 53.6 |
| Low Birth Weights | 37.6 |
| Socioeconomic Factor Indicators | — |
| Education | 19.3 |
| Housing | 58.8 |
| Linguistic | 42.1 |
| Poverty | 27.9 |
| Unemployment | 23.8 |

## 7.2. Healthy Places Index Scores

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

| Indicator | Result for Project Census Tract |
|---|---|
| Economic | — |
| Above Poverty | 83.72898755 |
| Employed | 79.36609778 |
| Median HI | 78.76299243 |
| Education | — |
| Bachelor's or higher | 79.63557038 |
| High school enrollment | 100 |
| Preschool enrollment | 40.65186706 |
| Transportation | — |
| Auto Access | 46.70858463 |
| Active commuting | 73.66867702 |
| Social | — |
| 2-parent households | 44.68112409 |

| | |
|---|---|
| Voting | 75.93994611 |
| Neighborhood | — |
| Alcohol availability | 33.40177082 |
| Park access | 81.35506224 |
| Retail density | 65.99512383 |
| Supermarket access | 75.70896959 |
| Tree canopy | 71.79520082 |
| Housing | — |
| Homeownership | 30.71987681 |
| Housing habitability | 49.09534197 |
| Low-inc homeowner severe housing cost burden | 67.79160785 |
| Low-inc renter severe housing cost burden | 74.88771975 |
| Uncrowded housing | 53.4838958 |
| Health Outcomes | — |
| Insured adults | 78.05723085 |
| Arthritis | 0.0 |
| Asthma ER Admissions | 64.1 |
| High Blood Pressure | 0.0 |
| Cancer (excluding skin) | 0.0 |
| Asthma | 0.0 |
| Coronary Heart Disease | 0.0 |
| Chronic Obstructive Pulmonary Disease | 0.0 |
| Diagnosed Diabetes | 0.0 |
| Life Expectancy at Birth | 35.0 |
| Cognitively Disabled | 36.6 |
| Physically  Disabled | 63.7 |
| Heart Attack ER Admissions | 49.8 |

| | |
|---|---|
| Mental Health Not Good | 0.0 |
| Chronic Kidney Disease | 0.0 |
| Obesity | 0.0 |
| Pedestrian Injuries | 98.1 |
| Physical Health Not Good | 0.0 |
| Stroke | 0.0 |
| Health Risk Behaviors | — |
| Binge Drinking | 0.0 |
| Current Smoker | 0.0 |
| No Leisure Time for Physical Activity | 0.0 |
| Climate Change Exposures | — |
| Wildfire Risk | 0.0 |
| SLR Inundation Area | 0.0 |
| Children | 61.0 |
| Elderly | 47.3 |
| English Speaking | 58.4 |
| Foreign-born | 48.4 |
| Outdoor Workers | 81.7 |
| Climate Change Adaptive Capacity | — |
| Impervious Surface Cover | 18.0 |
| Traffic Density | 72.7 |
| Traffic Access | 74.7 |
| Other Indices | — |
| Hardship | 15.8 |
| Other Decision Support | — |
| 2016 Voting | 56.9 |

## 7.3. Overall Health & Equity Scores

| Metric | Result for Project Census Tract |
|---|---|
| CalEnviroScreen 4.0 Score for Project Location (a) | 68.0 |
| Healthy Places Index Score for Project Location (b) | 77.0 |
| Project Located in a Designated Disadvantaged Community (Senate Bill 535) | No |
| Project Located in a Low-Income Community (Assembly Bill 1550) | No |
| Project Located in a Community Air Protection Program Community (Assembly Bill 617) | No |

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

## 7.4. Health & Equity Measures

No Health & Equity Measures selected.

## 7.5. Evaluation Scorecard

Health & Equity Evaluation Scorecard not completed.

## 7.6. Health & Equity Custom Measures

No Health & Equity Custom Measures created.

# 8. User Changes to Default Data

| Screen | Justification |
|---|---|
| Characteristics: Project Details | Adjusted for project location |
| Characteristics: Utility Information | Adjusted for project location |
| Land Use | client provided project details |
| Construction: Construction Phases | project specific estimates |
| Construction: Off-Road Equipment | project specific estimates |
| Operations: Energy Use | Client provided data |
| Construction: Trips and VMT | project specific estimates |

# Maui WWRF - Access Roads Detailed Report

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8. User Changes to Default Data

# 1. Basic Project Information

## 1.1. Basic Project Information

| Data Field | Value |
|---|---|
| Project Name | Maui WWRF - Access Roads |
| Construction Start Date | 6/7/2027 |
| Lead Agency | — |
| Land Use Scale | Project/site |
| Analysis Level for Defaults | Statewide |
| Windspeed (m/s) | 2.70 |
| Precipitation (days) | 8.20 |
| Location | 34.02592312858927, -118.38165785203286 |
| County | Los Angeles-South Coast |
| City | Culver City |
| Air District | South Coast AQMD |
| Air Basin | South Coast |
| TAZ | 4457 |
| EDFZ | 16 |
| Electric Utility | Statewide Average |
| Gas Utility | Southern California Gas |
| App Version | 2022.1.1.24 |

## 1.2. Land Use Types

| Land Use Subtype | Size | Unit | Lot Acreage | Building Area (sq ft) | Landscape Area (sq ft) | Special Landscape Area (sq ft) | Population | Description |
|---|---|---|---|---|---|---|---|---|
| Road Construction | 0.35 | Mile | 4.13 | 0.00 | — | — | — | — |

### 1.3. User-Selected Emission Reduction Measures by Emissions Sector

| Sector | # | Measure Title |
|---|---|---|
| Construction | C-2* | Limit Heavy-Duty Diesel Vehicle Idling |

* Qualitative or supporting measure. Emission reductions not included in the mitigated emissions results.

# 2. Emissions Summary

### 2.1. Construction Emissions Compared Against Thresholds

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

| Un/Mit. | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 3.54 | 2.97 | 24.3 | 31.1 | 0.06 | 1.00 | 1.79 | 2.79 | 0.92 | 0.27 | 1.19 | — | 7,464 | 7,464 | 0.29 | 0.15 | 2.58 | 7,520 |
| Mit. | 3.54 | 2.97 | 24.3 | 31.1 | 0.06 | 1.00 | 1.79 | 2.79 | 0.92 | 0.27 | 1.19 | — | 7,464 | 7,464 | 0.29 | 0.15 | 2.58 | 7,520 |
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 3.54 | 2.96 | 24.3 | 30.7 | 0.06 | 1.00 | 1.79 | 2.79 | 0.92 | 0.27 | 1.19 | — | 7,435 | 7,435 | 0.29 | 0.16 | 0.07 | 7,489 |
| Mit. | 3.54 | 2.96 | 24.3 | 30.7 | 0.06 | 1.00 | 1.79 | 2.79 | 0.92 | 0.27 | 1.19 | — | 7,435 | 7,435 | 0.29 | 0.16 | 0.07 | 7,489 |
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 2.20 | 1.85 | 14.8 | 19.6 | 0.04 | 0.58 | 1.12 | 1.70 | 0.53 | 0.16 | 0.69 | — | 4,796 | 4,796 | 0.19 | 0.08 | 0.51 | 4,823 |
| Mit. | 2.20 | 1.85 | 14.8 | 19.6 | 0.04 | 0.58 | 1.12 | 1.70 | 0.53 | 0.16 | 0.69 | — | 4,796 | 4,796 | 0.19 | 0.08 | 0.51 | 4,823 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Annual (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 0.40 | 0.34 | 2.71 | 3.57 | 0.01 | 0.11 | 0.21 | 0.31 | 0.10 | 0.03 | 0.13 | — | 794 | 794 | 0.03 | 0.01 | 0.08 | 799 |
| Mit. | 0.40 | 0.34 | 2.71 | 3.57 | 0.01 | 0.11 | 0.21 | 0.31 | 0.10 | 0.03 | 0.13 | — | 794 | 794 | 0.03 | 0.01 | 0.08 | 799 |
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

## 2.2. Construction Emissions by Year, Unmitigated

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

| Year | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily - Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 3.54 | 2.97 | 24.3 | 31.1 | 0.06 | 1.00 | 1.79 | 2.79 | 0.92 | 0.27 | 1.19 | — | 7,464 | 7,464 | 0.29 | 0.15 | 2.58 | 7,520 |
| 2028 | 3.41 | 2.85 | 22.8 | 30.8 | 0.06 | 0.91 | 1.79 | 2.70 | 0.84 | 0.27 | 1.10 | — | 7,442 | 7,442 | 0.29 | 0.15 | 2.35 | 7,498 |
| 2029 | 0.97 | 0.82 | 6.83 | 11.7 | 0.01 | 0.23 | 0.23 | 0.46 | 0.21 | 0.05 | 0.26 | — | 1,846 | 1,846 | 0.07 | 0.02 | 0.62 | 1,855 |
| Daily - Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 3.54 | 2.96 | 24.3 | 30.7 | 0.06 | 1.00 | 1.79 | 2.79 | 0.92 | 0.27 | 1.19 | — | 7,435 | 7,435 | 0.29 | 0.16 | 0.07 | 7,489 |
| 2028 | 3.39 | 2.85 | 22.8 | 30.4 | 0.06 | 0.91 | 1.79 | 2.70 | 0.84 | 0.27 | 1.10 | — | 7,414 | 7,414 | 0.29 | 0.15 | 0.06 | 7,467 |
| 2029 | 2.68 | 2.25 | 17.6 | 23.9 | 0.05 | 0.65 | 1.36 | 2.01 | 0.60 | 0.19 | 0.79 | — | 5,991 | 5,991 | 0.24 | 0.06 | 0.02 | 6,014 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 1.01 | 0.84 | 7.02 | 8.78 | 0.02 | 0.29 | 0.54 | 0.83 | 0.27 | 0.08 | 0.35 | — | 2,144 | 2,144 | 0.08 | 0.05 | 0.38 | 2,163 |
| 2028 | 2.20 | 1.85 | 14.8 | 19.6 | 0.04 | 0.58 | 1.12 | 1.70 | 0.53 | 0.16 | 0.69 | — | 4,796 | 4,796 | 0.19 | 0.08 | 0.51 | 4,823 |
| 2029 | 0.32 | 0.27 | 2.23 | 3.50 | 0.01 | 0.08 | 0.11 | 0.19 | 0.07 | 0.02 | 0.09 | — | 658 | 658 | 0.03 | 0.01 | 0.07 | 661 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2027 | 0.18 | 0.15 | 1.28 | 1.60 | < 0.005 | 0.05 | 0.10 | 0.15 | 0.05 | 0.02 | 0.06 | — | 355 | 355 | 0.01 | 0.01 | 0.06 | 358 |
| 2028 | 0.40 | 0.34 | 2.71 | 3.57 | 0.01 | 0.11 | 0.21 | 0.31 | 0.10 | 0.03 | 0.13 | — | 794 | 794 | 0.03 | 0.01 | 0.08 | 799 |
| 2029 | 0.06 | 0.05 | 0.41 | 0.64 | < 0.005 | 0.01 | 0.02 | 0.03 | 0.01 | < 0.005 | 0.02 | — | 109 | 109 | < 0.005 | < 0.005 | 0.01 | 109 |

## 2.3. Construction Emissions by Year, Mitigated

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

| Year | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily - Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 3.54 | 2.97 | 24.3 | 31.1 | 0.06 | 1.00 | 1.79 | 2.79 | 0.92 | 0.27 | 1.19 | — | 7,464 | 7,464 | 0.29 | 0.15 | 2.58 | 7,520 |
| 2028 | 3.41 | 2.85 | 22.8 | 30.8 | 0.06 | 0.91 | 1.79 | 2.70 | 0.84 | 0.27 | 1.10 | — | 7,442 | 7,442 | 0.29 | 0.15 | 2.35 | 7,498 |
| 2029 | 0.97 | 0.82 | 6.83 | 11.7 | 0.01 | 0.23 | 0.23 | 0.46 | 0.21 | 0.05 | 0.26 | — | 1,846 | 1,846 | 0.07 | 0.02 | 0.62 | 1,855 |
| Daily - Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 3.54 | 2.96 | 24.3 | 30.7 | 0.06 | 1.00 | 1.79 | 2.79 | 0.92 | 0.27 | 1.19 | — | 7,435 | 7,435 | 0.29 | 0.16 | 0.07 | 7,489 |
| 2028 | 3.39 | 2.85 | 22.8 | 30.4 | 0.06 | 0.91 | 1.79 | 2.70 | 0.84 | 0.27 | 1.10 | — | 7,414 | 7,414 | 0.29 | 0.15 | 0.06 | 7,467 |
| 2029 | 2.68 | 2.25 | 17.6 | 23.9 | 0.05 | 0.65 | 1.36 | 2.01 | 0.60 | 0.19 | 0.79 | — | 5,991 | 5,991 | 0.24 | 0.06 | 0.02 | 6,014 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 1.01 | 0.84 | 7.02 | 8.78 | 0.02 | 0.29 | 0.54 | 0.83 | 0.27 | 0.08 | 0.35 | — | 2,144 | 2,144 | 0.08 | 0.05 | 0.38 | 2,163 |
| 2028 | 2.20 | 1.85 | 14.8 | 19.6 | 0.04 | 0.58 | 1.12 | 1.70 | 0.53 | 0.16 | 0.69 | — | 4,796 | 4,796 | 0.19 | 0.08 | 0.51 | 4,823 |
| 2029 | 0.32 | 0.27 | 2.23 | 3.50 | 0.01 | 0.08 | 0.11 | 0.19 | 0.07 | 0.02 | 0.09 | — | 658 | 658 | 0.03 | 0.01 | 0.07 | 661 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 0.18 | 0.15 | 1.28 | 1.60 | < 0.005 | 0.05 | 0.10 | 0.15 | 0.05 | 0.02 | 0.06 | — | 355 | 355 | 0.01 | 0.01 | 0.06 | 358 |
| 2028 | 0.40 | 0.34 | 2.71 | 3.57 | 0.01 | 0.11 | 0.21 | 0.31 | 0.10 | 0.03 | 0.13 | — | 794 | 794 | 0.03 | 0.01 | 0.08 | 799 |
| 2029 | 0.06 | 0.05 | 0.41 | 0.64 | < 0.005 | 0.01 | 0.02 | 0.03 | 0.01 | < 0.005 | 0.02 | — | 109 | 109 | < 0.005 | < 0.005 | 0.01 | 109 |

# 3. Construction Emissions Details

## 3.1. Linear, Grubbing & Land Clearing (2027) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.40 | 0.34 | 3.00 | 3.45 | < 0.005 | 0.16 | — | 0.16 | 0.15 | — | 0.15 | — | 491 | 491 | 0.02 | < 0.005 | — | 492 |
| Dust From Material Movement | — | — | — | — | — | — | 0.21 | 0.21 | — | 0.02 | 0.02 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.05 | 0.05 | 0.41 | 0.47 | < 0.005 | 0.02 | — | 0.02 | 0.02 | — | 0.02 | — | 67.2 | 67.2 | < 0.005 | < 0.005 | — | 67.5 |
| Dust From Material Movement | — | — | — | — | — | — | 0.03 | 0.03 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.01 | 0.01 | 0.07 | 0.09 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 11.1 | 11.1 | < 0.005 | < 0.005 | — | 11.2 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dust From Material Movement | — | — | — | — | — | — | 0.01 | 0.01 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.02 | 0.02 | 0.02 | 0.31 | 0.00 | 0.00 | 0.07 | 0.07 | 0.00 | 0.02 | 0.02 | — | 67.3 | 67.3 | < 0.005 | < 0.005 | 0.22 | 68.3 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.03 | 0.01 | 0.64 | 0.20 | < 0.005 | 0.01 | 0.15 | 0.16 | 0.01 | 0.04 | 0.05 | — | 535 | 535 | 0.02 | 0.08 | 1.19 | 561 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.04 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 8.70 | 8.70 | < 0.005 | < 0.005 | 0.01 | 8.81 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.09 | 0.03 | < 0.005 | < 0.005 | 0.02 | 0.02 | < 0.005 | 0.01 | 0.01 | — | 73.2 | 73.2 | < 0.005 | 0.01 | 0.07 | 76.8 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.01 | 0.00 | 0.00 | < 0.005 | < 0.005 | 0.00 | < 0.005 | < 0.005 | — | 1.44 | 1.44 | < 0.005 | < 0.005 | < 0.005 | 1.46 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.02 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 12.1 | 12.1 | < 0.005 | < 0.005 | 0.01 | 12.7 |

## 3.2. Linear, Grubbing & Land Clearing (2027) - Mitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.40 | 0.34 | 3.00 | 3.45 | < 0.005 | 0.16 | — | 0.16 | 0.15 | — | 0.15 | — | 491 | 491 | 0.02 | < 0.005 | — | 492 |
| Dust From Material Movement | — | — | — | — | — | — | 0.21 | 0.21 | — | 0.02 | 0.02 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.05 | 0.05 | 0.41 | 0.47 | < 0.005 | 0.02 | — | 0.02 | 0.02 | — | 0.02 | — | 67.2 | 67.2 | < 0.005 | < 0.005 | — | 67.5 |
| Dust From Material Movement | — | — | — | — | — | — | 0.03 | 0.03 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.01 | 0.01 | 0.07 | 0.09 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 11.1 | 11.1 | < 0.005 | < 0.005 | — | 11.2 |
| Dust From Material Movement | — | — | — | — | — | — | 0.01 | 0.01 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.02 | 0.02 | 0.02 | 0.31 | 0.00 | 0.00 | 0.07 | 0.07 | 0.00 | 0.02 | 0.02 | — | 67.3 | 67.3 | < 0.005 | < 0.005 | 0.22 | 68.3 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.03 | 0.01 | 0.64 | 0.20 | < 0.005 | 0.01 | 0.15 | 0.16 | 0.01 | 0.04 | 0.05 | — | 535 | 535 | 0.02 | 0.08 | 1.19 | 561 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.04 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 8.70 | 8.70 | < 0.005 | < 0.005 | 0.01 | 8.81 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.09 | 0.03 | < 0.005 | < 0.005 | 0.02 | 0.02 | < 0.005 | 0.01 | 0.01 | — | 73.2 | 73.2 | < 0.005 | 0.01 | 0.07 | 76.8 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.01 | 0.00 | 0.00 | < 0.005 | < 0.005 | 0.00 | < 0.005 | < 0.005 | — | 1.44 | 1.44 | < 0.005 | < 0.005 | < 0.005 | 1.46 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.02 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 12.1 | 12.1 | < 0.005 | < 0.005 | 0.01 | 12.7 |

## 3.3. Linear, Grading & Excavation (2027) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 3.38 | 2.84 | 23.5 | 29.0 | 0.06 | 0.99 | — | 0.99 | 0.91 | — | 0.91 | — | 6,495 | 6,495 | 0.26 | 0.05 | — | 6,517 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dust From Material Movement | — | — | — | — | — | — | 1.24 | 1.24 | — | 0.13 | 0.13 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 3.38 | 2.84 | 23.5 | 29.0 | 0.06 | 0.99 | — | 0.99 | 0.91 | — | 0.91 | — | 6,495 | 6,495 | 0.26 | 0.05 | — | 6,517 |
| Dust From Material Movement | — | — | — | — | — | — | 1.24 | 1.24 | — | 0.13 | 0.13 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.91 | 0.76 | 6.30 | 7.77 | 0.02 | 0.26 | — | 0.26 | 0.24 | — | 0.24 | — | 1,741 | 1,741 | 0.07 | 0.01 | — | 1,747 |
| Dust From Material Movement | — | — | — | — | — | — | 0.33 | 0.33 | — | 0.04 | 0.04 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.17 | 0.14 | 1.15 | 1.42 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 288 | 288 | 0.01 | < 0.005 | — | 289 |
| Dust From Material Movement | — | — | — | — | — | — | 0.06 | 0.06 | — | 0.01 | 0.01 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.13 | 0.12 | 0.10 | 1.86 | 0.00 | 0.00 | 0.39 | 0.39 | 0.00 | 0.09 | 0.09 | — | 404 | 404 | < 0.005 | 0.01 | 1.32 | 410 |
| Vendor | < 0.005 | < 0.005 | 0.03 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 30.7 | 30.7 | < 0.005 | < 0.005 | 0.07 | 32.1 |
| Hauling | 0.03 | 0.01 | 0.64 | 0.20 | < 0.005 | 0.01 | 0.15 | 0.16 | 0.01 | 0.04 | 0.05 | — | 535 | 535 | 0.02 | 0.08 | 1.19 | 561 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.13 | 0.11 | 0.13 | 1.50 | 0.00 | 0.00 | 0.39 | 0.39 | 0.00 | 0.09 | 0.09 | — | 375 | 375 | 0.01 | 0.01 | 0.03 | 379 |
| Vendor | < 0.005 | < 0.005 | 0.04 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 30.7 | 30.7 | < 0.005 | < 0.005 | < 0.005 | 32.0 |
| Hauling | 0.03 | 0.01 | 0.67 | 0.20 | < 0.005 | 0.01 | 0.15 | 0.16 | 0.01 | 0.04 | 0.05 | — | 535 | 535 | 0.02 | 0.08 | 0.03 | 560 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.03 | 0.03 | 0.03 | 0.42 | 0.00 | 0.00 | 0.10 | 0.10 | 0.00 | 0.02 | 0.02 | — | 102 | 102 | < 0.005 | < 0.005 | 0.15 | 103 |
| Vendor | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 8.22 | 8.22 | < 0.005 | < 0.005 | 0.01 | 8.59 |
| Hauling | 0.01 | < 0.005 | 0.18 | 0.05 | < 0.005 | < 0.005 | 0.04 | 0.04 | < 0.005 | 0.01 | 0.01 | — | 143 | 143 | < 0.005 | 0.02 | 0.14 | 150 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.08 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | < 0.005 | < 0.005 | — | 16.9 | 16.9 | < 0.005 | < 0.005 | 0.03 | 17.1 |
| Vendor | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 1.36 | 1.36 | < 0.005 | < 0.005 | < 0.005 | 1.42 |
| Hauling | < 0.005 | < 0.005 | 0.03 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 23.7 | 23.7 | < 0.005 | < 0.005 | 0.02 | 24.9 |

## 3.4. Linear, Grading & Excavation (2027) - Mitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Off-Road Equipment | 3.38 | 2.84 | 23.5 | 29.0 | 0.06 | 0.99 | — | 0.99 | 0.91 | — | 0.91 | — | 6,495 | 6,495 | 0.26 | 0.05 | — | 6,517 |
| Dust From Material Movement | — | — | — | — | — | — | 1.24 | 1.24 | — | 0.13 | 0.13 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 3.38 | 2.84 | 23.5 | 29.0 | 0.06 | 0.99 | — | 0.99 | 0.91 | — | 0.91 | — | 6,495 | 6,495 | 0.26 | 0.05 | — | 6,517 |
| Dust From Material Movement | — | — | — | — | — | — | 1.24 | 1.24 | — | 0.13 | 0.13 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.91 | 0.76 | 6.30 | 7.77 | 0.02 | 0.26 | — | 0.26 | 0.24 | — | 0.24 | — | 1,741 | 1,741 | 0.07 | 0.01 | — | 1,747 |
| Dust From Material Movement | — | — | — | — | — | — | 0.33 | 0.33 | — | 0.04 | 0.04 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.17 | 0.14 | 1.15 | 1.42 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 288 | 288 | 0.01 | < 0.005 | — | 289 |
| Dust From Material Movement | — | — | — | — | — | — | 0.06 | 0.06 | — | 0.01 | 0.01 | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.13 | 0.12 | 0.10 | 1.86 | 0.00 | 0.00 | 0.39 | 0.39 | 0.00 | 0.09 | 0.09 | — | 404 | 404 | < 0.005 | 0.01 | 1.32 | 410 |
| Vendor | < 0.005 | < 0.005 | 0.03 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 30.7 | 30.7 | < 0.005 | < 0.005 | 0.07 | 32.1 |
| Hauling | 0.03 | 0.01 | 0.64 | 0.20 | < 0.005 | 0.01 | 0.15 | 0.16 | 0.01 | 0.04 | 0.05 | — | 535 | 535 | 0.02 | 0.08 | 1.19 | 561 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.13 | 0.11 | 0.13 | 1.50 | 0.00 | 0.00 | 0.39 | 0.39 | 0.00 | 0.09 | 0.09 | — | 375 | 375 | 0.01 | 0.01 | 0.03 | 379 |
| Vendor | < 0.005 | < 0.005 | 0.04 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 30.7 | 30.7 | < 0.005 | < 0.005 | < 0.005 | 32.0 |
| Hauling | 0.03 | 0.01 | 0.67 | 0.20 | < 0.005 | 0.01 | 0.15 | 0.16 | 0.01 | 0.04 | 0.05 | — | 535 | 535 | 0.02 | 0.08 | 0.03 | 560 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.03 | 0.03 | 0.03 | 0.42 | 0.00 | 0.00 | 0.10 | 0.10 | 0.00 | 0.02 | 0.02 | — | 102 | 102 | < 0.005 | < 0.005 | 0.15 | 103 |
| Vendor | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 8.22 | 8.22 | < 0.005 | < 0.005 | 0.01 | 8.59 |
| Hauling | 0.01 | < 0.005 | 0.18 | 0.05 | < 0.005 | < 0.005 | 0.04 | 0.04 | < 0.005 | 0.01 | 0.01 | — | 143 | 143 | < 0.005 | 0.02 | 0.14 | 150 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.08 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | < 0.005 | < 0.005 | — | 16.9 | 16.9 | < 0.005 | < 0.005 | 0.03 | 17.1 |
| Vendor | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 1.36 | 1.36 | < 0.005 | < 0.005 | < 0.005 | 1.42 |
| Hauling | < 0.005 | < 0.005 | 0.03 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 23.7 | 23.7 | < 0.005 | < 0.005 | 0.02 | 24.9 |

## 3.5. Linear, Grading & Excavation (2028) - Unmitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 3.25 | 2.73 | 22.0 | 28.8 | 0.06 | 0.90 | — | 0.90 | 0.82 | — | 0.82 | — | 6,494 | 6,494 | 0.26 | 0.05 | — | 6,517 |
| Dust From Material Movement | — | — | — | — | — | — | 1.24 | 1.24 | — | 0.13 | 0.13 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 3.25 | 2.73 | 22.0 | 28.8 | 0.06 | 0.90 | — | 0.90 | 0.82 | — | 0.82 | — | 6,494 | 6,494 | 0.26 | 0.05 | — | 6,517 |
| Dust From Material Movement | — | — | — | — | — | — | 1.24 | 1.24 | — | 0.13 | 0.13 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.14 | 0.96 | 7.71 | 10.1 | 0.02 | 0.31 | — | 0.31 | 0.29 | — | 0.29 | — | 2,275 | 2,275 | 0.09 | 0.02 | — | 2,283 |
| Dust From Material Movement | — | — | — | — | — | — | 0.43 | 0.43 | — | 0.05 | 0.05 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.21 | 0.17 | 1.41 | 1.84 | < 0.005 | 0.06 | — | 0.06 | 0.05 | — | 0.05 | — | 377 | 377 | 0.02 | < 0.005 | — | 378 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dust From Material Movement | — | — | — | — | — | — | 0.08 | 0.08 | — | 0.01 | 0.01 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.13 | 0.11 | 0.10 | 1.74 | 0.00 | 0.00 | 0.39 | 0.39 | 0.00 | 0.09 | 0.09 | — | 397 | 397 | < 0.005 | 0.01 | 1.19 | 402 |
| Vendor | < 0.005 | < 0.005 | 0.03 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 29.9 | 29.9 | < 0.005 | < 0.005 | 0.07 | 31.2 |
| Hauling | 0.03 | 0.01 | 0.62 | 0.20 | < 0.005 | 0.01 | 0.15 | 0.16 | 0.01 | 0.04 | 0.05 | — | 521 | 521 | 0.02 | 0.08 | 1.10 | 548 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.11 | 0.11 | 0.12 | 1.40 | 0.00 | 0.00 | 0.39 | 0.39 | 0.00 | 0.09 | 0.09 | — | 368 | 368 | 0.01 | 0.01 | 0.03 | 372 |
| Vendor | < 0.005 | < 0.005 | 0.03 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 29.9 | 29.9 | < 0.005 | < 0.005 | < 0.005 | 31.2 |
| Hauling | 0.03 | 0.01 | 0.66 | 0.20 | < 0.005 | 0.01 | 0.15 | 0.16 | 0.01 | 0.04 | 0.05 | — | 522 | 522 | 0.02 | 0.08 | 0.03 | 547 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.04 | 0.04 | 0.04 | 0.51 | 0.00 | 0.00 | 0.14 | 0.14 | 0.00 | 0.03 | 0.03 | — | 131 | 131 | < 0.005 | < 0.005 | 0.18 | 133 |
| Vendor | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 10.5 | 10.5 | < 0.005 | < 0.005 | 0.01 | 10.9 |
| Hauling | 0.01 | < 0.005 | 0.23 | 0.07 | < 0.005 | < 0.005 | 0.05 | 0.06 | < 0.005 | 0.01 | 0.02 | — | 183 | 183 | 0.01 | 0.03 | 0.17 | 192 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.09 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | 0.01 | 0.01 | — | 21.7 | 21.7 | < 0.005 | < 0.005 | 0.03 | 22.0 |
| Vendor | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 1.73 | 1.73 | < 0.005 | < 0.005 | < 0.005 | 1.81 |
| Hauling | < 0.005 | < 0.005 | 0.04 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 30.2 | 30.2 | < 0.005 | < 0.005 | 0.03 | 31.7 |

## 3.6. Linear, Grading & Excavation (2028) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 3.25 | 2.73 | 22.0 | 28.8 | 0.06 | 0.90 | — | 0.90 | 0.82 | — | 0.82 | — | 6,494 | 6,494 | 0.26 | 0.05 | — | 6,517 |
| Dust From Material Movement | — | — | — | — | — | — | 1.24 | 1.24 | — | 0.13 | 0.13 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 3.25 | 2.73 | 22.0 | 28.8 | 0.06 | 0.90 | — | 0.90 | 0.82 | — | 0.82 | — | 6,494 | 6,494 | 0.26 | 0.05 | — | 6,517 |
| Dust From Material Movement | — | — | — | — | — | — | 1.24 | 1.24 | — | 0.13 | 0.13 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.14 | 0.96 | 7.71 | 10.1 | 0.02 | 0.31 | — | 0.31 | 0.29 | — | 0.29 | — | 2,275 | 2,275 | 0.09 | 0.02 | — | 2,283 |
| Dust From Material Movement | — | — | — | — | — | — | 0.43 | 0.43 | — | 0.05 | 0.05 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.21 | 0.17 | 1.41 | 1.84 | < 0.005 | 0.06 | — | 0.06 | 0.05 | — | 0.05 | — | 377 | 377 | 0.02 | < 0.005 | — | 378 |
| Dust From Material Movement | — | — | — | — | — | — | 0.08 | 0.08 | — | 0.01 | 0.01 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.13 | 0.11 | 0.10 | 1.74 | 0.00 | 0.00 | 0.39 | 0.39 | 0.00 | 0.09 | 0.09 | — | 397 | 397 | < 0.005 | 0.01 | 1.19 | 402 |
| Vendor | < 0.005 | < 0.005 | 0.03 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 29.9 | 29.9 | < 0.005 | < 0.005 | 0.07 | 31.2 |
| Hauling | 0.03 | 0.01 | 0.62 | 0.20 | < 0.005 | 0.01 | 0.15 | 0.16 | 0.01 | 0.04 | 0.05 | — | 521 | 521 | 0.02 | 0.08 | 1.10 | 548 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.11 | 0.11 | 0.12 | 1.40 | 0.00 | 0.00 | 0.39 | 0.39 | 0.00 | 0.09 | 0.09 | — | 368 | 368 | 0.01 | 0.01 | 0.03 | 372 |
| Vendor | < 0.005 | < 0.005 | 0.03 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 29.9 | 29.9 | < 0.005 | < 0.005 | < 0.005 | 31.2 |
| Hauling | 0.03 | 0.01 | 0.66 | 0.20 | < 0.005 | 0.01 | 0.15 | 0.16 | 0.01 | 0.04 | 0.05 | — | 522 | 522 | 0.02 | 0.08 | 0.03 | 547 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.04 | 0.04 | 0.04 | 0.51 | 0.00 | 0.00 | 0.14 | 0.14 | 0.00 | 0.03 | 0.03 | — | 131 | 131 | < 0.005 | < 0.005 | 0.18 | 133 |
| Vendor | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 10.5 | 10.5 | < 0.005 | < 0.005 | 0.01 | 10.9 |
| Hauling | 0.01 | < 0.005 | 0.23 | 0.07 | < 0.005 | < 0.005 | 0.05 | 0.06 | < 0.005 | 0.01 | 0.02 | — | 183 | 183 | 0.01 | 0.03 | 0.17 | 192 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.09 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | 0.01 | 0.01 | — | 21.7 | 21.7 | < 0.005 | < 0.005 | 0.03 | 22.0 |
| Vendor | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 1.73 | 1.73 | < 0.005 | < 0.005 | < 0.005 | 1.81 |
| Hauling | < 0.005 | < 0.005 | 0.04 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 30.2 | 30.2 | < 0.005 | < 0.005 | 0.03 | 31.7 |

## 3.7. Linear, Drainage, Utilities, & Sub-Grade (2028) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 2.68 | 2.24 | 18.6 | 23.1 | 0.05 | 0.70 | — | 0.70 | 0.65 | — | 0.65 | — | 5,691 | 5,691 | 0.23 | 0.05 | — | 5,711 |
| Dust From Material Movement | — | — | — | — | — | — | 1.03 | 1.03 | — | 0.11 | 0.11 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 2.68 | 2.24 | 18.6 | 23.1 | 0.05 | 0.70 | — | 0.70 | 0.65 | — | 0.65 | — | 5,691 | 5,691 | 0.23 | 0.05 | — | 5,711 |
| Dust From Material Movement | — | — | — | — | — | — | 1.03 | 1.03 | — | 0.11 | 0.11 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.98 | 0.82 | 6.82 | 8.44 | 0.02 | 0.26 | — | 0.26 | 0.24 | — | 0.24 | — | 2,083 | 2,083 | 0.08 | 0.02 | — | 2,090 |
| Dust From Material Movement | — | — | — | — | — | — | 0.38 | 0.38 | — | 0.04 | 0.04 | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.18 | 0.15 | 1.24 | 1.54 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 345 | 345 | 0.01 | < 0.005 | — | 346 |
| Dust From Material Movement | — | — | — | — | — | — | 0.07 | 0.07 | — | 0.01 | 0.01 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.11 | 0.09 | 0.09 | 1.45 | 0.00 | 0.00 | 0.33 | 0.33 | 0.00 | 0.08 | 0.08 | — | 331 | 331 | < 0.005 | 0.01 | 0.99 | 335 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.09 | 0.09 | 0.10 | 1.16 | 0.00 | 0.00 | 0.33 | 0.33 | 0.00 | 0.08 | 0.08 | — | 307 | 307 | < 0.005 | 0.01 | 0.03 | 310 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.03 | 0.03 | 0.04 | 0.44 | 0.00 | 0.00 | 0.12 | 0.12 | 0.00 | 0.03 | 0.03 | — | 114 | 114 | < 0.005 | < 0.005 | 0.16 | 116 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.08 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | 0.01 | 0.01 | — | 18.9 | 18.9 | < 0.005 | < 0.005 | 0.03 | 19.1 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

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| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.8. Linear, Drainage, Utilities, & Sub-Grade (2028) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 2.68 | 2.24 | 18.6 | 23.1 | 0.05 | 0.70 | — | 0.70 | 0.65 | — | 0.65 | — | 5,691 | 5,691 | 0.23 | 0.05 | — | 5,711 |
| Dust From Material Movement | — | — | — | — | — | — | 1.03 | 1.03 | — | 0.11 | 0.11 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 2.68 | 2.24 | 18.6 | 23.1 | 0.05 | 0.70 | — | 0.70 | 0.65 | — | 0.65 | — | 5,691 | 5,691 | 0.23 | 0.05 | — | 5,711 |
| Dust From Material Movement | — | — | — | — | — | — | 1.03 | 1.03 | — | 0.11 | 0.11 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.98 | 0.82 | 6.82 | 8.44 | 0.02 | 0.26 | — | 0.26 | 0.24 | — | 0.24 | — | 2,083 | 2,083 | 0.08 | 0.02 | — | 2,090 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dust From Material Movement | — | — | — | — | — | — | 0.38 | 0.38 | — | 0.04 | 0.04 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.18 | 0.15 | 1.24 | 1.54 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 345 | 345 | 0.01 | < 0.005 | — | 346 |
| Dust From Material Movement | — | — | — | — | — | — | 0.07 | 0.07 | — | 0.01 | 0.01 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.11 | 0.09 | 0.09 | 1.45 | 0.00 | 0.00 | 0.33 | 0.33 | 0.00 | 0.08 | 0.08 | — | 331 | 331 | < 0.005 | 0.01 | 0.99 | 335 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.09 | 0.09 | 0.10 | 1.16 | 0.00 | 0.00 | 0.33 | 0.33 | 0.00 | 0.08 | 0.08 | — | 307 | 307 | < 0.005 | 0.01 | 0.03 | 310 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.03 | 0.03 | 0.04 | 0.44 | 0.00 | 0.00 | 0.12 | 0.12 | 0.00 | 0.03 | 0.03 | — | 114 | 114 | < 0.005 | < 0.005 | 0.16 | 116 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

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| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.08 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | 0.01 | 0.01 | — | 18.9 | 18.9 | < 0.005 | < 0.005 | 0.03 | 19.1 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.9. Linear, Drainage, Utilities, & Sub-Grade (2029) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 2.59 | 2.17 | 17.5 | 22.8 | 0.05 | 0.65 | — | 0.65 | 0.60 | — | 0.60 | — | 5,690 | 5,690 | 0.23 | 0.05 | — | 5,709 |
| Dust From Material Movement | — | — | — | — | — | — | 1.03 | 1.03 | — | 0.11 | 0.11 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.12 | 0.10 | 0.82 | 1.07 | < 0.005 | 0.03 | — | 0.03 | 0.03 | — | 0.03 | — | 267 | 267 | 0.01 | < 0.005 | — | 268 |
| Dust From Material Movement | — | — | — | — | — | — | 0.05 | 0.05 | — | 0.01 | 0.01 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

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| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.02 | 0.02 | 0.15 | 0.20 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 44.2 | 44.2 | < 0.005 | < 0.005 | — | 44.4 |
| Dust From Material Movement | — | — | — | — | — | — | 0.01 | 0.01 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.09 | 0.08 | 0.09 | 1.09 | 0.00 | 0.00 | 0.33 | 0.33 | 0.00 | 0.08 | 0.08 | — | 301 | 301 | < 0.005 | 0.01 | 0.02 | 305 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.05 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | < 0.005 | < 0.005 | — | 14.4 | 14.4 | < 0.005 | < 0.005 | 0.02 | 14.6 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.01 | 0.00 | 0.00 | < 0.005 | < 0.005 | 0.00 | < 0.005 | < 0.005 | — | 2.38 | 2.38 | < 0.005 | < 0.005 | < 0.005 | 2.41 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.10. Linear, Drainage, Utilities, & Sub-Grade (2029) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 2.59 | 2.17 | 17.5 | 22.8 | 0.05 | 0.65 | — | 0.65 | 0.60 | — | 0.60 | — | 5,690 | 5,690 | 0.23 | 0.05 | — | 5,709 |
| Dust From Material Movement | — | — | — | — | — | — | 1.03 | 1.03 | — | 0.11 | 0.11 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.12 | 0.10 | 0.82 | 1.07 | < 0.005 | 0.03 | — | 0.03 | 0.03 | — | 0.03 | — | 267 | 267 | 0.01 | < 0.005 | — | 268 |
| Dust From Material Movement | — | — | — | — | — | — | 0.05 | 0.05 | — | 0.01 | 0.01 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.02 | 0.02 | 0.15 | 0.20 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 44.2 | 44.2 | < 0.005 | < 0.005 | — | 44.4 |
| Dust From Material Movement | — | — | — | — | — | — | 0.01 | 0.01 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.09 | 0.08 | 0.09 | 1.09 | 0.00 | 0.00 | 0.33 | 0.33 | 0.00 | 0.08 | 0.08 | — | 301 | 301 | < 0.005 | 0.01 | 0.02 | 305 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.05 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | < 0.005 | < 0.005 | — | 14.4 | 14.4 | < 0.005 | < 0.005 | 0.02 | 14.6 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.01 | 0.00 | 0.00 | < 0.005 | < 0.005 | 0.00 | < 0.005 | < 0.005 | — | 2.38 | 2.38 | < 0.005 | < 0.005 | < 0.005 | 2.41 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.11. Linear, Paving (2029) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.90 | 0.76 | 6.78 | 10.8 | 0.01 | 0.23 | — | 0.23 | 0.21 | — | 0.21 | — | 1,619 | 1,619 | 0.07 | 0.01 | — | 1,624 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.90 | 0.76 | 6.78 | 10.8 | 0.01 | 0.23 | — | 0.23 | 0.21 | — | 0.21 | — | 1,619 | 1,619 | 0.07 | 0.01 | — | 1,624 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.19 | 0.16 | 1.39 | 2.21 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 333 | 333 | 0.01 | < 0.005 | — | 334 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.03 | 0.03 | 0.25 | 0.40 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 55.1 | 55.1 | < 0.005 | < 0.005 | — | 55.3 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.06 | 0.06 | 0.05 | 0.95 | 0.00 | 0.00 | 0.23 | 0.23 | 0.00 | 0.05 | 0.05 | — | 227 | 227 | < 0.005 | 0.01 | 0.62 | 230 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.06 | 0.05 | 0.06 | 0.76 | 0.00 | 0.00 | 0.23 | 0.23 | 0.00 | 0.05 | 0.05 | — | 211 | 211 | < 0.005 | 0.01 | 0.02 | 213 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

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| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.16 | 0.00 | 0.00 | 0.05 | 0.05 | 0.00 | 0.01 | 0.01 | — | 44.1 | 44.1 | < 0.005 | < 0.005 | 0.06 | 44.6 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.03 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 7.29 | 7.29 | < 0.005 | < 0.005 | 0.01 | 7.39 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.12. Linear, Paving (2029) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.90 | 0.76 | 6.78 | 10.8 | 0.01 | 0.23 | — | 0.23 | 0.21 | — | 0.21 | — | 1,619 | 1,619 | 0.07 | 0.01 | — | 1,624 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.90 | 0.76 | 6.78 | 10.8 | 0.01 | 0.23 | — | 0.23 | 0.21 | — | 0.21 | — | 1,619 | 1,619 | 0.07 | 0.01 | — | 1,624 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Off-Road Equipment | 0.19 | 0.16 | 1.39 | 2.21 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 333 | 333 | 0.01 | < 0.005 | — | 334 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.03 | 0.03 | 0.25 | 0.40 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 55.1 | 55.1 | < 0.005 | < 0.005 | — | 55.3 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.06 | 0.06 | 0.05 | 0.95 | 0.00 | 0.00 | 0.23 | 0.23 | 0.00 | 0.05 | 0.05 | — | 227 | 227 | < 0.005 | 0.01 | 0.62 | 230 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.06 | 0.05 | 0.06 | 0.76 | 0.00 | 0.00 | 0.23 | 0.23 | 0.00 | 0.05 | 0.05 | — | 211 | 211 | < 0.005 | 0.01 | 0.02 | 213 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.16 | 0.00 | 0.00 | 0.05 | 0.05 | 0.00 | 0.01 | 0.01 | — | 44.1 | 44.1 | < 0.005 | < 0.005 | 0.06 | 44.6 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.03 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 7.29 | 7.29 | < 0.005 | < 0.005 | 0.01 | 7.39 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

# 4. Operations Emissions Details

## 4.10. Soil Carbon Accumulation By Vegetation Type

### 4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated

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

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

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

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

## 4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Avoided | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Sequestered | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Removed | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

### 4.10.4. Soil Carbon Accumulation By Vegetation Type - Mitigated

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

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

### 4.10.5. Above and Belowground Carbon Accumulation by Land Use Type - Mitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

### 4.10.6. Avoided and Sequestered Emissions by Species - Mitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sequest | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Removed | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Avoided | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Sequestered | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Removed | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

# 5. Activity Data

## 5.1. Construction Schedule

| Phase Name | Phase Type | Start Date | End Date | Days Per Week | Work Days per Phase | Phase Description |
|---|---|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | Linear, Grubbing & Land Clearing | 6/7/2027 | 8/16/2027 | 5.00 | 50.0 | — |
| Linear, Grading & Excavation | Linear, Grading & Excavation | 8/17/2027 | 6/27/2028 | 5.00 | 225 | — |
| Linear, Drainage, Utilities, & Sub-Grade | Linear, Drainage, Utilities, & Sub-Grade | 6/28/2028 | 1/24/2029 | 5.00 | 150 | — |
| Linear, Paving | Linear, Paving | 1/25/2029 | 5/10/2029 | 5.00 | 75.0 | — |

## 5.2. Off-Road Equipment

### 5.2.1. Unmitigated

| Phase Name | Equipment Type | Fuel Type | Engine Tier | Number per Day | Hours Per Day | Horsepower | Load Factor |
|---|---|---|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | Crawler Tractors | Diesel | Average | 1.00 | 8.00 | 87.0 | 0.43 |
| Linear, Grubbing & Land Clearing | Excavators | Diesel | Average | 1.00 | 8.00 | 36.0 | 0.38 |
| Linear, Grading & Excavation | Excavators | Diesel | Average | 3.00 | 8.00 | 36.0 | 0.38 |
| Linear, Grading & Excavation | Crawler Tractors | Diesel | Average | 1.00 | 8.00 | 87.0 | 0.43 |
| Linear, Grading & Excavation | Graders | Diesel | Average | 1.00 | 8.00 | 148 | 0.41 |
| Linear, Grading & Excavation | Rollers | Diesel | Average | 2.00 | 8.00 | 36.0 | 0.38 |
| Linear, Grading & Excavation | Tractors/Loaders/Backhoes | Diesel | Average | 2.00 | 8.00 | 84.0 | 0.37 |
| Linear, Grading & Excavation | Rubber Tired Loaders | Diesel | Average | 1.00 | 8.00 | 150 | 0.36 |
| Linear, Grading & Excavation | Scrapers | Diesel | Average | 2.00 | 8.00 | 423 | 0.48 |
| Linear, Drainage, Utilities, & Sub-Grade | Scrapers | Diesel | Average | 2.00 | 8.00 | 423 | 0.48 |
| Linear, Drainage, Utilities, & Sub-Grade | Rough Terrain Forklifts | Diesel | Average | 1.00 | 8.00 | 96.0 | 0.40 |
| Linear, Drainage, Utilities, & Sub-Grade | Tractors/Loaders/Backhoes | Diesel | Average | 2.00 | 8.00 | 84.0 | 0.37 |
| Linear, Drainage, Utilities, & Sub-Grade | Plate Compactors | Diesel | Average | 1.00 | 8.00 | 8.00 | 0.43 |
| Linear, Drainage, Utilities, & Sub-Grade | Pumps | Diesel | Average | 1.00 | 8.00 | 11.0 | 0.74 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Linear, Drainage, Utilities, & Sub-Grade | Graders | Diesel | Average | 1.00 | 8.00 | 148 | 0.41 |
| Linear, Drainage, Utilities, & Sub-Grade | Air Compressors | Diesel | Average | 1.00 | 8.00 | 37.0 | 0.48 |
| Linear, Drainage, Utilities, & Sub-Grade | Generator Sets | Diesel | Average | 1.00 | 8.00 | 14.0 | 0.74 |
| Linear, Paving | Rollers | Diesel | Average | 3.00 | 8.00 | 36.0 | 0.38 |
| Linear, Paving | Paving Equipment | Diesel | Average | 1.00 | 8.00 | 89.0 | 0.36 |
| Linear, Paving | Pavers | Diesel | Average | 1.00 | 8.00 | 81.0 | 0.42 |
| Linear, Paving | Tractors/Loaders/Backhoes | Diesel | Average | 2.00 | 8.00 | 84.0 | 0.37 |

### 5.2.2. Mitigated

| Phase Name | Equipment Type | Fuel Type | Engine Tier | Number per Day | Hours Per Day | Horsepower | Load Factor |
|---|---|---|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | Crawler Tractors | Diesel | Average | 1.00 | 8.00 | 87.0 | 0.43 |
| Linear, Grubbing & Land Clearing | Excavators | Diesel | Average | 1.00 | 8.00 | 36.0 | 0.38 |
| Linear, Grading & Excavation | Excavators | Diesel | Average | 3.00 | 8.00 | 36.0 | 0.38 |
| Linear, Grading & Excavation | Crawler Tractors | Diesel | Average | 1.00 | 8.00 | 87.0 | 0.43 |
| Linear, Grading & Excavation | Graders | Diesel | Average | 1.00 | 8.00 | 148 | 0.41 |
| Linear, Grading & Excavation | Rollers | Diesel | Average | 2.00 | 8.00 | 36.0 | 0.38 |
| Linear, Grading & Excavation | Tractors/Loaders/Backhoes | Diesel | Average | 2.00 | 8.00 | 84.0 | 0.37 |
| Linear, Grading & Excavation | Rubber Tired Loaders | Diesel | Average | 1.00 | 8.00 | 150 | 0.36 |
| Linear, Grading & Excavation | Scrapers | Diesel | Average | 2.00 | 8.00 | 423 | 0.48 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Linear, Drainage, Utilities, & Sub-Grade | Scrapers | Diesel | Average | 2.00 | 8.00 | 423 | 0.48 |
| Linear, Drainage, Utilities, & Sub-Grade | Rough Terrain Forklifts | Diesel | Average | 1.00 | 8.00 | 96.0 | 0.40 |
| Linear, Drainage, Utilities, & Sub-Grade | Tractors/Loaders/Backhoes | Diesel | Average | 2.00 | 8.00 | 84.0 | 0.37 |
| Linear, Drainage, Utilities, & Sub-Grade | Plate Compactors | Diesel | Average | 1.00 | 8.00 | 8.00 | 0.43 |
| Linear, Drainage, Utilities, & Sub-Grade | Pumps | Diesel | Average | 1.00 | 8.00 | 11.0 | 0.74 |
| Linear, Drainage, Utilities, & Sub-Grade | Graders | Diesel | Average | 1.00 | 8.00 | 148 | 0.41 |
| Linear, Drainage, Utilities, & Sub-Grade | Air Compressors | Diesel | Average | 1.00 | 8.00 | 37.0 | 0.48 |
| Linear, Drainage, Utilities, & Sub-Grade | Generator Sets | Diesel | Average | 1.00 | 8.00 | 14.0 | 0.74 |
| Linear, Paving | Rollers | Diesel | Average | 3.00 | 8.00 | 36.0 | 0.38 |
| Linear, Paving | Paving Equipment | Diesel | Average | 1.00 | 8.00 | 89.0 | 0.36 |
| Linear, Paving | Pavers | Diesel | Average | 1.00 | 8.00 | 81.0 | 0.42 |
| Linear, Paving | Tractors/Loaders/Backhoes | Diesel | Average | 2.00 | 8.00 | 84.0 | 0.37 |

## 5.3. Construction Vehicles

### 5.3.1. Unmitigated

| Phase Name | Trip Type | One-Way Trips per Day | Miles per Trip | Vehicle Mix |
|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | — | — | — | — |
| Linear, Grubbing & Land Clearing | Worker | 5.00 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Grubbing & Land Clearing | Vendor | 0.00 | 10.2 | HHDT,MHDT |
| Linear, Grubbing & Land Clearing | Hauling | 8.00 | 20.0 | HHDT |
| Linear, Grubbing & Land Clearing | Onsite truck | — | — | HHDT |

| | | | | |
|---|---|---|---|---|
| Linear, Grading & Excavation | — | — | — | — |
| Linear, Grading & Excavation | Worker | 30.0 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Grading & Excavation | Vendor | 1.00 | 10.2 | HHDT,MHDT |
| Linear, Grading & Excavation | Hauling | 8.00 | 20.0 | HHDT |
| Linear, Grading & Excavation | Onsite truck | — | — | HHDT |
| Linear, Drainage, Utilities, & Sub-Grade | — | — | — | — |
| Linear, Drainage, Utilities, & Sub-Grade | Worker | 25.0 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Drainage, Utilities, & Sub-Grade | Vendor | 0.00 | 10.2 | HHDT,MHDT |
| Linear, Drainage, Utilities, & Sub-Grade | Hauling | 0.00 | 20.0 | HHDT |
| Linear, Drainage, Utilities, & Sub-Grade | Onsite truck | — | — | HHDT |
| Linear, Paving | — | — | — | — |
| Linear, Paving | Worker | 17.5 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Paving | Vendor | 0.00 | 10.2 | HHDT,MHDT |
| Linear, Paving | Hauling | 0.00 | 20.0 | HHDT |
| Linear, Paving | Onsite truck | — | — | HHDT |

### 5.3.2. Mitigated

| Phase Name | Trip Type | One-Way Trips per Day | Miles per Trip | Vehicle Mix |
|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | — | — | — | — |
| Linear, Grubbing & Land Clearing | Worker | 5.00 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Grubbing & Land Clearing | Vendor | 0.00 | 10.2 | HHDT,MHDT |
| Linear, Grubbing & Land Clearing | Hauling | 8.00 | 20.0 | HHDT |
| Linear, Grubbing & Land Clearing | Onsite truck | — | — | HHDT |
| Linear, Grading & Excavation | — | — | — | — |
| Linear, Grading & Excavation | Worker | 30.0 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Grading & Excavation | Vendor | 1.00 | 10.2 | HHDT,MHDT |
| Linear, Grading & Excavation | Hauling | 8.00 | 20.0 | HHDT |

| | | | | |
|---|---|---|---|---|
| Linear, Grading & Excavation | Onsite truck | — | — | HHDT |
| Linear, Drainage, Utilities, & Sub-Grade | — | — | — | — |
| Linear, Drainage, Utilities, & Sub-Grade | Worker | 25.0 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Drainage, Utilities, & Sub-Grade | Vendor | 0.00 | 10.2 | HHDT,MHDT |
| Linear, Drainage, Utilities, & Sub-Grade | Hauling | 0.00 | 20.0 | HHDT |
| Linear, Drainage, Utilities, & Sub-Grade | Onsite truck | — | — | HHDT |
| Linear, Paving | — | — | — | — |
| Linear, Paving | Worker | 17.5 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Paving | Vendor | 0.00 | 10.2 | HHDT,MHDT |
| Linear, Paving | Hauling | 0.00 | 20.0 | HHDT |
| Linear, Paving | Onsite truck | — | — | HHDT |

## 5.4. Vehicles

### 5.4.1. Construction Vehicle Control Strategies

| Control Strategies Applied | PM10 Reduction | PM2.5 Reduction |
|---|---|---|
| Water unpaved roads twice daily | 55% | 55% |
| Limit vehicle speeds on unpaved roads to 25 mph | 44% | 44% |
| Sweep paved roads once per month | 9% | 9% |

## 5.5. Architectural Coatings

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

## 5.6. Dust Mitigation

### 5.6.1. Construction Earthmoving Activities

| Phase Name | Material Imported (cy) | Material Exported (cy) | Acres Graded (acres) | Material Demolished (sq. ft.) | Acres Paved (acres) |
|---|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | — | — | 4.13 | 0.00 | — |
| Linear, Grading & Excavation | — | — | 4.13 | 0.00 | — |
| Linear, Drainage, Utilities, & Sub-Grade | — | — | 4.13 | 0.00 | — |

### 5.6.2. Construction Earthmoving Control Strategies

| Control Strategies Applied | Frequency (per day) | PM10 Reduction | PM2.5 Reduction |
|---|---|---|---|
| Water Exposed Area | 2 | 61% | 61% |

## 5.7. Construction Paving

| Land Use | Area Paved (acres) | % Asphalt |
|---|---|---|
| Road Construction | 4.13 | 100% |

## 5.8. Construction Electricity Consumption and Emissions Factors

### kWh per Year and Emission Factor (lb/MWh)

| Year | kWh per Year | CO2 | CH4 | N2O |
|---|---|---|---|---|
| 2027 | 0.00 | 453 | 0.03 | < 0.005 |
| 2028 | 0.00 | 453 | 0.03 | < 0.005 |
| 2029 | 0.00 | 453 | 0.03 | < 0.005 |

## 5.18. Vegetation

### 5.18.1. Land Use Change

#### 5.18.1.1. Unmitigated

| Vegetation Land Use Type | Vegetation Soil Type | Initial Acres | Final Acres |
|---|---|---|---|

#### 5.18.1.2. Mitigated

| Vegetation Land Use Type | Vegetation Soil Type | Initial Acres | Final Acres |
|---|---|---|---|

### 5.18.1. Biomass Cover Type

#### 5.18.1.1. Unmitigated

| Biomass Cover Type | Initial Acres | Final Acres |
|---|---|---|

#### 5.18.1.2. Mitigated

| Biomass Cover Type | Initial Acres | Final Acres |
|---|---|---|

### 5.18.2. Sequestration

#### 5.18.2.1. Unmitigated

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

#### 5.18.2.2. Mitigated

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

# 6. Climate Risk Detailed Report

## 6.1. Climate Risk Summary

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

| Climate Hazard | Result for Project Location | Unit |
|---|---|---|
| Temperature and Extreme Heat | 5.68 | annual days of extreme heat |
| Extreme Precipitation | 5.50 | annual days with precipitation above 20 mm |
| Sea Level Rise | — | meters of inundation depth |
| Wildfire | 0.00 | annual hectares burned |

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

## 6.2. Initial Climate Risk Scores

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

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

## 6.3. Adjusted Climate Risk Scores

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

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

## 6.4. Climate Risk Reduction Measures

# 7. Health and Equity Details

## 7.1. CalEnviroScreen 4.0 Scores

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

| Indicator | Result for Project Census Tract |
|---|---|
| Exposure Indicators | — |
| AQ-Ozone | 45.0 |
| AQ-PM | 68.0 |
| AQ-DPM | 91.2 |
| Drinking Water | 61.5 |
| Lead Risk Housing | 64.6 |

| | |
|---|---|
| Pesticides | 17.7 |
| Toxic Releases | 79.4 |
| Traffic | 68.5 |
| Effect Indicators | — |
| CleanUp Sites | 88.6 |
| Groundwater | 92.5 |
| Haz Waste Facilities/Generators | 91.0 |
| Impaired Water Bodies | 66.7 |
| Solid Waste | 93.4 |
| Sensitive Population | — |
| Asthma | 45.1 |
| Cardio-vascular | 53.6 |
| Low Birth Weights | 37.6 |
| Socioeconomic Factor Indicators | — |
| Education | 19.3 |
| Housing | 58.8 |
| Linguistic | 42.1 |
| Poverty | 27.9 |
| Unemployment | 23.8 |

## 7.2. Healthy Places Index Scores

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

| Indicator | Result for Project Census Tract |
|---|---|
| Economic | — |
| Above Poverty | 83.72898755 |
| Employed | 79.36609778 |
| Median HI | 78.76299243 |

| | |
|---|---|
| Education | — |
| Bachelor's or higher | 79.63557038 |
| High school enrollment | 100 |
| Preschool enrollment | 40.65186706 |
| Transportation | — |
| Auto Access | 46.70858463 |
| Active commuting | 73.66867702 |
| Social | — |
| 2-parent households | 44.68112409 |
| Voting | 75.93994611 |
| Neighborhood | — |
| Alcohol availability | 33.40177082 |
| Park access | 81.35506224 |
| Retail density | 65.99512383 |
| Supermarket access | 75.70896959 |
| Tree canopy | 71.79520082 |
| Housing | — |
| Homeownership | 30.71987681 |
| Housing habitability | 49.09534197 |
| Low-inc homeowner severe housing cost burden | 67.79160785 |
| Low-inc renter severe housing cost burden | 74.88771975 |
| Uncrowded housing | 53.4838958 |
| Health Outcomes | — |
| Insured adults | 78.05723085 |
| Arthritis | 0.0 |
| Asthma ER Admissions | 64.1 |
| High Blood Pressure | 0.0 |

| | |
|---|---|
| Cancer (excluding skin) | 0.0 |
| Asthma | 0.0 |
| Coronary Heart Disease | 0.0 |
| Chronic Obstructive Pulmonary Disease | 0.0 |
| Diagnosed Diabetes | 0.0 |
| Life Expectancy at Birth | 35.0 |
| Cognitively Disabled | 36.6 |
| Physically  Disabled | 63.7 |
| Heart Attack ER Admissions | 49.8 |
| Mental Health Not Good | 0.0 |
| Chronic Kidney Disease | 0.0 |
| Obesity | 0.0 |
| Pedestrian Injuries | 98.1 |
| Physical Health Not Good | 0.0 |
| Stroke | 0.0 |
| Health Risk Behaviors | — |
| Binge Drinking | 0.0 |
| Current Smoker | 0.0 |
| No Leisure Time for Physical Activity | 0.0 |
| Climate Change Exposures | — |
| Wildfire Risk | 0.0 |
| SLR Inundation Area | 0.0 |
| Children | 61.0 |
| Elderly | 47.3 |
| English Speaking | 58.4 |
| Foreign-born | 48.4 |
| Outdoor Workers | 81.7 |

| | |
|---|---|
| Climate Change Adaptive Capacity | — |
| Impervious Surface Cover | 18.0 |
| Traffic Density | 72.7 |
| Traffic Access | 74.7 |
| Other Indices | — |
| Hardship | 15.8 |
| Other Decision Support | — |
| 2016 Voting | 56.9 |

## 7.3. Overall Health & Equity Scores

| Metric | Result for Project Census Tract |
|---|---|
| CalEnviroScreen 4.0 Score for Project Location (a) | 68.0 |
| Healthy Places Index Score for Project Location (b) | 77.0 |
| Project Located in a Designated Disadvantaged Community (Senate Bill 535) | No |
| Project Located in a Low-Income Community (Assembly Bill 1550) | No |
| Project Located in a Community Air Protection Program Community (Assembly Bill 617) | No |

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

## 7.4. Health & Equity Measures

No Health & Equity Measures selected.

## 7.5. Evaluation Scorecard

Health & Equity Evaluation Scorecard not completed.

## 7.6. Health & Equity Custom Measures

No Health & Equity Custom Measures created.

# 8. User Changes to Default Data

| Screen | Justification |
|---|---|
| Characteristics: Project Details | adjusted for project location |
| Characteristics: Utility Information | adjusted for project location |
| Construction: Off-Road Equipment | project specific adjustments |
| Construction: Trips and VMT | client provided info |

# Maui WWRF - Pipelines Detailed Report

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# 1. Basic Project Information

## 1.1. Basic Project Information

| Data Field | Value |
|---|---|
| Project Name | Maui WWRF - Pipelines |
| Construction Start Date | 10/6/2025 |
| Lead Agency | — |
| Land Use Scale | Project/site |
| Analysis Level for Defaults | Statewide |
| Windspeed (m/s) | 2.70 |
| Precipitation (days) | 8.20 |
| Location | 34.025877767512654, -118.38163287131451 |
| County | Los Angeles-South Coast |
| City | Culver City |
| Air District | South Coast AQMD |
| Air Basin | South Coast |
| TAZ | 4457 |
| EDFZ | 16 |
| Electric Utility | Statewide Average |
| Gas Utility | Southern California Gas |
| App Version | 2022.1.1.29 |

## 1.2. Land Use Types

| Land Use Subtype | Size | Unit | Lot Acreage | Building Area (sq ft) | Landscape Area (sq ft) | Special Landscape Area (sq ft) | Population | Description |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Road Widening | 0.80 | Mile | 0.80 | 0.00 | — | — | — | Recycled water pipeline, roadways will remain the same width |
| Road Widening | 3.50 | Mile | 3.50 | 0.00 | 0.00 | — | — | Sewage pipeline, roadways will remain the same width |

### 1.3. User-Selected Emission Reduction Measures by Emissions Sector

| Sector | # | Measure Title |
|---|---|---|
| Construction | C-2* | Limit Heavy-Duty Diesel Vehicle Idling |

* Qualitative or supporting measure. Emission reductions not included in the mitigated emissions results.

## 2. Emissions Summary

### 2.1. Construction Emissions Compared Against Thresholds

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

| Un/Mit. | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 2.25 | 1.92 | 11.1 | 26.5 | 0.02 | 0.43 | 2.52 | 2.95 | 0.40 | 0.54 | 0.94 | — | 4,601 | 4,601 | 0.18 | 0.14 | 8.62 | 4,640 |
| Mit. | 2.25 | 1.92 | 11.1 | 26.5 | 0.02 | 0.43 | 2.52 | 2.95 | 0.40 | 0.54 | 0.94 | — | 4,601 | 4,601 | 0.18 | 0.14 | 8.62 | 4,640 |
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 2.33 | 1.98 | 12.1 | 25.0 | 0.02 | 0.49 | 2.52 | 3.00 | 0.45 | 0.54 | 0.99 | — | 4,481 | 4,481 | 0.19 | 0.15 | 0.24 | 4,515 |
| Mit. | 2.33 | 1.98 | 12.1 | 25.0 | 0.02 | 0.49 | 2.52 | 3.00 | 0.45 | 0.54 | 0.99 | — | 4,481 | 4,481 | 0.19 | 0.15 | 0.24 | 4,515 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 1.19 | 1.02 | 5.94 | 15.5 | 0.01 | 0.22 | 1.59 | 1.79 | 0.21 | 0.37 | 0.56 | — | 3,089 | 3,089 | 0.09 | 0.10 | 2.62 | 3,123 |
| Mit. | 1.19 | 1.02 | 5.94 | 15.5 | 0.01 | 0.22 | 1.59 | 1.79 | 0.21 | 0.37 | 0.56 | — | 3,089 | 3,089 | 0.09 | 0.10 | 2.62 | 3,123 |
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Annual (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 0.22 | 0.19 | 1.08 | 2.83 | < 0.005 | 0.04 | 0.29 | 0.33 | 0.04 | 0.07 | 0.10 | — | 511 | 511 | 0.01 | 0.02 | 0.43 | 517 |
| Mit. | 0.22 | 0.19 | 1.08 | 2.83 | < 0.005 | 0.04 | 0.29 | 0.33 | 0.04 | 0.07 | 0.10 | — | 511 | 511 | 0.01 | 0.02 | 0.43 | 517 |
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

## 2.2. Construction Emissions by Year, Unmitigated

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

| Year | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily - Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2026 | 1.59 | 1.37 | 6.80 | 22.9 | 0.02 | 0.25 | 2.20 | 2.45 | 0.23 | 0.52 | 0.75 | — | 4,419 | 4,419 | 0.18 | 0.14 | 8.62 | 4,475 |
| 2027 | 2.25 | 1.92 | 11.1 | 26.5 | 0.02 | 0.43 | 2.52 | 2.95 | 0.40 | 0.54 | 0.94 | — | 4,601 | 4,601 | 0.12 | 0.10 | 7.07 | 4,640 |
| Daily - Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2025 | 1.65 | 1.41 | 7.65 | 21.4 | 0.02 | 0.30 | 2.20 | 2.49 | 0.27 | 0.52 | 0.79 | — | 4,307 | 4,307 | 0.19 | 0.15 | 0.24 | 4,356 |
| 2026 | 2.33 | 1.98 | 12.1 | 25.0 | 0.02 | 0.49 | 2.52 | 3.00 | 0.45 | 0.54 | 0.99 | — | 4,481 | 4,481 | 0.13 | 0.15 | 0.22 | 4,515 |
| 2027 | 2.22 | 1.89 | 11.3 | 24.5 | 0.02 | 0.43 | 2.52 | 2.95 | 0.40 | 0.54 | 0.94 | — | 4,445 | 4,445 | 0.13 | 0.10 | 0.18 | 4,478 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2025 | 0.21 | 0.18 | 0.84 | 2.80 | < 0.005 | 0.03 | 0.37 | 0.40 | 0.02 | 0.09 | 0.11 | — | 586 | 586 | 0.03 | 0.02 | 0.68 | 594 |
| 2026 | 1.19 | 1.02 | 5.43 | 15.5 | 0.01 | 0.20 | 1.59 | 1.79 | 0.19 | 0.37 | 0.56 | — | 3,089 | 3,089 | 0.09 | 0.10 | 2.62 | 3,123 |
| 2027 | 1.14 | 0.97 | 5.94 | 13.3 | 0.01 | 0.22 | 1.27 | 1.50 | 0.21 | 0.28 | 0.49 | — | 2,418 | 2,418 | 0.07 | 0.05 | 1.66 | 2,437 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2025 | 0.04 | 0.03 | 0.15 | 0.51 | < 0.005 | < 0.005 | 0.07 | 0.07 | < 0.005 | 0.02 | 0.02 | — | 96.9 | 96.9 | < 0.005 | < 0.005 | 0.11 | 98.3 |
| 2026 | 0.22 | 0.19 | 0.99 | 2.83 | < 0.005 | 0.04 | 0.29 | 0.33 | 0.03 | 0.07 | 0.10 | — | 511 | 511 | 0.01 | 0.02 | 0.43 | 517 |
| 2027 | 0.21 | 0.18 | 1.08 | 2.43 | < 0.005 | 0.04 | 0.23 | 0.27 | 0.04 | 0.05 | 0.09 | — | 400 | 400 | 0.01 | 0.01 | 0.27 | 403 |

## 2.3. Construction Emissions by Year, Mitigated

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

| Year | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily - Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2026 | 1.59 | 1.37 | 6.80 | 22.9 | 0.02 | 0.25 | 2.20 | 2.45 | 0.23 | 0.52 | 0.75 | — | 4,419 | 4,419 | 0.18 | 0.14 | 8.62 | 4,475 |
| 2027 | 2.25 | 1.92 | 11.1 | 26.5 | 0.02 | 0.43 | 2.52 | 2.95 | 0.40 | 0.54 | 0.94 | — | 4,601 | 4,601 | 0.12 | 0.10 | 7.07 | 4,640 |
| Daily - Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2025 | 1.65 | 1.41 | 7.65 | 21.4 | 0.02 | 0.30 | 2.20 | 2.49 | 0.27 | 0.52 | 0.79 | — | 4,307 | 4,307 | 0.19 | 0.15 | 0.24 | 4,356 |
| 2026 | 2.33 | 1.98 | 12.1 | 25.0 | 0.02 | 0.49 | 2.52 | 3.00 | 0.45 | 0.54 | 0.99 | — | 4,481 | 4,481 | 0.13 | 0.15 | 0.22 | 4,515 |
| 2027 | 2.22 | 1.89 | 11.3 | 24.5 | 0.02 | 0.43 | 2.52 | 2.95 | 0.40 | 0.54 | 0.94 | — | 4,445 | 4,445 | 0.13 | 0.10 | 0.18 | 4,478 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2025 | 0.21 | 0.18 | 0.84 | 2.80 | < 0.005 | 0.03 | 0.37 | 0.40 | 0.02 | 0.09 | 0.11 | — | 586 | 586 | 0.03 | 0.02 | 0.68 | 594 |
| 2026 | 1.19 | 1.02 | 5.43 | 15.5 | 0.01 | 0.20 | 1.59 | 1.79 | 0.19 | 0.37 | 0.56 | — | 3,089 | 3,089 | 0.09 | 0.10 | 2.62 | 3,123 |
| 2027 | 1.14 | 0.97 | 5.94 | 13.3 | 0.01 | 0.22 | 1.27 | 1.50 | 0.21 | 0.28 | 0.49 | — | 2,418 | 2,418 | 0.07 | 0.05 | 1.66 | 2,437 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2025 | 0.04 | 0.03 | 0.15 | 0.51 | < 0.005 | < 0.005 | 0.07 | 0.07 | < 0.005 | 0.02 | 0.02 | — | 96.9 | 96.9 | < 0.005 | < 0.005 | 0.11 | 98.3 |
| 2026 | 0.22 | 0.19 | 0.99 | 2.83 | < 0.005 | 0.04 | 0.29 | 0.33 | 0.03 | 0.07 | 0.10 | — | 511 | 511 | 0.01 | 0.02 | 0.43 | 517 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2027 | 0.21 | 0.18 | 1.08 | 2.43 | < 0.005 | 0.04 | 0.23 | 0.27 | 0.04 | 0.05 | 0.09 | — | 400 | 400 | 0.01 | 0.01 | 0.27 | 403 |

# 3. Construction Emissions Details

## 3.1. Linear, Grubbing & Land Clearing (2025) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.38 | 0.32 | 3.30 | 5.73 | 0.01 | 0.13 | — | 0.13 | 0.12 | — | 0.12 | — | 871 | 871 | 0.04 | 0.01 | — | 874 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.05 | 0.05 | 0.47 | 0.82 | < 0.005 | 0.02 | — | 0.02 | 0.02 | — | 0.02 | — | 124 | 124 | 0.01 | < 0.005 | — | 125 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.01 | 0.01 | 0.09 | 0.15 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 20.6 | 20.6 | < 0.005 | < 0.005 | — | 20.6 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.74 | 0.65 | 0.85 | 9.32 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,090 | 2,090 | 0.10 | 0.08 | 0.22 | 2,117 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.02 | 0.01 | 0.36 | 0.11 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 279 | 279 | 0.01 | 0.04 | 0.02 | 292 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.10 | 0.09 | 0.11 | 1.38 | 0.00 | 0.00 | 0.30 | 0.30 | 0.00 | 0.07 | 0.07 | — | 303 | 303 | 0.01 | 0.01 | 0.53 | 307 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.05 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 39.7 | 39.7 | < 0.005 | 0.01 | 0.04 | 41.7 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.02 | 0.02 | 0.02 | 0.25 | 0.00 | 0.00 | 0.05 | 0.05 | 0.00 | 0.01 | 0.01 | — | 50.1 | 50.1 | < 0.005 | < 0.005 | 0.09 | 50.8 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 6.58 | 6.58 | < 0.005 | < 0.005 | 0.01 | 6.90 |

## 3.2. Linear, Grubbing & Land Clearing (2025) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.38 | 0.32 | 3.30 | 5.73 | 0.01 | 0.13 | — | 0.13 | 0.12 | — | 0.12 | — | 871 | 871 | 0.04 | 0.01 | — | 874 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.05 | 0.05 | 0.47 | 0.82 | < 0.005 | 0.02 | — | 0.02 | 0.02 | — | 0.02 | — | 124 | 124 | 0.01 | < 0.005 | — | 125 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Off-Road Equipment | 0.01 | 0.01 | 0.09 | 0.15 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 20.6 | 20.6 | < 0.005 | < 0.005 | — | 20.6 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.74 | 0.65 | 0.85 | 9.32 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,090 | 2,090 | 0.10 | 0.08 | 0.22 | 2,117 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.02 | 0.01 | 0.36 | 0.11 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 279 | 279 | 0.01 | 0.04 | 0.02 | 292 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.10 | 0.09 | 0.11 | 1.38 | 0.00 | 0.00 | 0.30 | 0.30 | 0.00 | 0.07 | 0.07 | — | 303 | 303 | 0.01 | 0.01 | 0.53 | 307 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.05 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 39.7 | 39.7 | < 0.005 | 0.01 | 0.04 | 41.7 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.02 | 0.02 | 0.02 | 0.25 | 0.00 | 0.00 | 0.05 | 0.05 | 0.00 | 0.01 | 0.01 | — | 50.1 | 50.1 | < 0.005 | < 0.005 | 0.09 | 50.8 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 6.58 | 6.58 | < 0.005 | < 0.005 | 0.01 | 6.90 |

## 3.3. Linear, Grading & Excavation (2025) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.89 | 0.75 | 6.36 | 12.0 | 0.02 | 0.29 | — | 0.29 | 0.27 | — | 0.27 | — | 1,874 | 1,874 | 0.08 | 0.02 | — | 1,880 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.02 | 0.02 | 0.17 | 0.33 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 51.3 | 51.3 | < 0.005 | < 0.005 | — | 51.5 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | < 0.005 | < 0.005 | 0.03 | 0.06 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 8.50 | 8.50 | < 0.005 | < 0.005 | — | 8.53 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.74 | 0.65 | 0.85 | 9.32 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,090 | 2,090 | 0.10 | 0.08 | 0.22 | 2,117 |
| Vendor | < 0.005 | < 0.005 | 0.08 | 0.03 | < 0.005 | < 0.005 | 0.02 | 0.02 | < 0.005 | < 0.005 | 0.01 | — | 63.8 | 63.8 | < 0.005 | 0.01 | < 0.005 | 66.6 |
| Hauling | 0.02 | 0.01 | 0.36 | 0.11 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 279 | 279 | 0.01 | 0.04 | 0.02 | 292 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.02 | 0.02 | 0.02 | 0.26 | 0.00 | 0.00 | 0.06 | 0.06 | 0.00 | 0.01 | 0.01 | — | 58.2 | 58.2 | < 0.005 | < 0.005 | 0.10 | 59.0 |
| Vendor | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 1.75 | 1.75 | < 0.005 | < 0.005 | < 0.005 | 1.83 |
| Hauling | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 7.64 | 7.64 | < 0.005 | < 0.005 | 0.01 | 8.01 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.05 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 9.64 | 9.64 | < 0.005 | < 0.005 | 0.02 | 9.78 |
| Vendor | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 0.29 | 0.29 | < 0.005 | < 0.005 | < 0.005 | 0.30 |
| Hauling | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 1.27 | 1.27 | < 0.005 | < 0.005 | < 0.005 | 1.33 |

## 3.4. Linear, Grading & Excavation (2025) - Mitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.89 | 0.75 | 6.36 | 12.0 | 0.02 | 0.29 | — | 0.29 | 0.27 | — | 0.27 | — | 1,874 | 1,874 | 0.08 | 0.02 | — | 1,880 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.02 | 0.02 | 0.17 | 0.33 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 51.3 | 51.3 | < 0.005 | < 0.005 | — | 51.5 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | < 0.005 | < 0.005 | 0.03 | 0.06 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 8.50 | 8.50 | < 0.005 | < 0.005 | — | 8.53 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.74 | 0.65 | 0.85 | 9.32 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,090 | 2,090 | 0.10 | 0.08 | 0.22 | 2,117 |
| Vendor | < 0.005 | < 0.005 | 0.08 | 0.03 | < 0.005 | < 0.005 | 0.02 | 0.02 | < 0.005 | < 0.005 | 0.01 | — | 63.8 | 63.8 | < 0.005 | 0.01 | < 0.005 | 66.6 |
| Hauling | 0.02 | 0.01 | 0.36 | 0.11 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 279 | 279 | 0.01 | 0.04 | 0.02 | 292 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.02 | 0.02 | 0.02 | 0.26 | 0.00 | 0.00 | 0.06 | 0.06 | 0.00 | 0.01 | 0.01 | — | 58.2 | 58.2 | < 0.005 | < 0.005 | 0.10 | 59.0 |
| Vendor | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 1.75 | 1.75 | < 0.005 | < 0.005 | < 0.005 | 1.83 |
| Hauling | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 7.64 | 7.64 | < 0.005 | < 0.005 | 0.01 | 8.01 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.05 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 9.64 | 9.64 | < 0.005 | < 0.005 | 0.02 | 9.78 |
| Vendor | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 0.29 | 0.29 | < 0.005 | < 0.005 | < 0.005 | 0.30 |
| Hauling | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 1.27 | 1.27 | < 0.005 | < 0.005 | < 0.005 | 1.33 |

## 3.5. Linear, Grading & Excavation (2026) - Unmitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Off-Road Equipment | 0.84 | 0.71 | 5.76 | 12.0 | 0.02 | 0.24 | — | 0.24 | 0.22 | — | 0.22 | — | 1,874 | 1,874 | 0.08 | 0.02 | — | 1,880 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.84 | 0.71 | 5.76 | 12.0 | 0.02 | 0.24 | — | 0.24 | 0.22 | — | 0.22 | — | 1,874 | 1,874 | 0.08 | 0.02 | — | 1,880 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.52 | 0.43 | 3.54 | 7.37 | 0.01 | 0.15 | — | 0.15 | 0.14 | — | 0.14 | — | 1,151 | 1,151 | 0.05 | 0.01 | — | 1,155 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Off-Road Equipm | 0.09 | 0.08 | 0.65 | 1.35 | < 0.005 | 0.03 | — | 0.03 | 0.03 | — | 0.03 | — | 191 | 191 | 0.01 | < 0.005 | — | 191 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.73 | 0.65 | 0.63 | 10.7 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,209 | 2,209 | 0.09 | 0.08 | 7.81 | 2,242 |
| Vendor | < 0.005 | < 0.005 | 0.07 | 0.03 | < 0.005 | < 0.005 | 0.02 | 0.02 | < 0.005 | < 0.005 | 0.01 | — | 62.6 | 62.6 | < 0.005 | 0.01 | 0.16 | 65.5 |
| Hauling | 0.02 | < 0.005 | 0.33 | 0.10 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 273 | 273 | 0.01 | 0.04 | 0.64 | 287 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.70 | 0.62 | 0.78 | 8.61 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,049 | 2,049 | 0.03 | 0.08 | 0.20 | 2,074 |
| Vendor | < 0.005 | < 0.005 | 0.08 | 0.03 | < 0.005 | < 0.005 | 0.02 | 0.02 | < 0.005 | < 0.005 | 0.01 | — | 62.6 | 62.6 | < 0.005 | 0.01 | < 0.005 | 65.3 |
| Hauling | 0.02 | < 0.005 | 0.35 | 0.10 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 274 | 274 | 0.01 | 0.04 | 0.02 | 287 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.43 | 0.38 | 0.44 | 5.51 | 0.00 | 0.00 | 1.29 | 1.29 | 0.00 | 0.30 | 0.30 | — | 1,280 | 1,280 | 0.02 | 0.05 | 2.07 | 1,297 |
| Vendor | < 0.005 | < 0.005 | 0.05 | 0.02 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 38.5 | 38.5 | < 0.005 | 0.01 | 0.04 | 40.2 |
| Hauling | 0.01 | < 0.005 | 0.21 | 0.06 | < 0.005 | < 0.005 | 0.05 | 0.05 | < 0.005 | 0.01 | 0.02 | — | 168 | 168 | 0.01 | 0.03 | 0.17 | 176 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.08 | 0.07 | 0.08 | 1.01 | 0.00 | 0.00 | 0.23 | 0.23 | 0.00 | 0.06 | 0.06 | — | 212 | 212 | < 0.005 | 0.01 | 0.34 | 215 |
| Vendor | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 6.37 | 6.37 | < 0.005 | < 0.005 | 0.01 | 6.65 |
| Hauling | < 0.005 | < 0.005 | 0.04 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 27.8 | 27.8 | < 0.005 | < 0.005 | 0.03 | 29.2 |

## 3.6. Linear, Grading & Excavation (2026) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.84 | 0.71 | 5.76 | 12.0 | 0.02 | 0.24 | — | 0.24 | 0.22 | — | 0.22 | — | 1,874 | 1,874 | 0.08 | 0.02 | — | 1,880 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.84 | 0.71 | 5.76 | 12.0 | 0.02 | 0.24 | — | 0.24 | 0.22 | — | 0.22 | — | 1,874 | 1,874 | 0.08 | 0.02 | — | 1,880 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.52 | 0.43 | 3.54 | 7.37 | 0.01 | 0.15 | — | 0.15 | 0.14 | — | 0.14 | — | 1,151 | 1,151 | 0.05 | 0.01 | — | 1,155 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.09 | 0.08 | 0.65 | 1.35 | < 0.005 | 0.03 | — | 0.03 | 0.03 | — | 0.03 | — | 191 | 191 | 0.01 | < 0.005 | — | 191 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.73 | 0.65 | 0.63 | 10.7 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,209 | 2,209 | 0.09 | 0.08 | 7.81 | 2,242 |
| Vendor | < 0.005 | < 0.005 | 0.07 | 0.03 | < 0.005 | < 0.005 | 0.02 | 0.02 | < 0.005 | < 0.005 | 0.01 | — | 62.6 | 62.6 | < 0.005 | 0.01 | 0.16 | 65.5 |
| Hauling | 0.02 | < 0.005 | 0.33 | 0.10 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 273 | 273 | 0.01 | 0.04 | 0.64 | 287 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.70 | 0.62 | 0.78 | 8.61 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,049 | 2,049 | 0.03 | 0.08 | 0.20 | 2,074 |
| Vendor | < 0.005 | < 0.005 | 0.08 | 0.03 | < 0.005 | < 0.005 | 0.02 | 0.02 | < 0.005 | < 0.005 | 0.01 | — | 62.6 | 62.6 | < 0.005 | 0.01 | < 0.005 | 65.3 |
| Hauling | 0.02 | < 0.005 | 0.35 | 0.10 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 274 | 274 | 0.01 | 0.04 | 0.02 | 287 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.43 | 0.38 | 0.44 | 5.51 | 0.00 | 0.00 | 1.29 | 1.29 | 0.00 | 0.30 | 0.30 | — | 1,280 | 1,280 | 0.02 | 0.05 | 2.07 | 1,297 |
| Vendor | < 0.005 | < 0.005 | 0.05 | 0.02 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 38.5 | 38.5 | < 0.005 | 0.01 | 0.04 | 40.2 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hauling | 0.01 | < 0.005 | 0.21 | 0.06 | < 0.005 | < 0.005 | 0.05 | 0.05 | < 0.005 | 0.01 | 0.02 | — | 168 | 168 | 0.01 | 0.03 | 0.17 | 176 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.08 | 0.07 | 0.08 | 1.01 | 0.00 | 0.00 | 0.23 | 0.23 | 0.00 | 0.06 | 0.06 | — | 212 | 212 | < 0.005 | 0.01 | 0.34 | 215 |
| Vendor | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 6.37 | 6.37 | < 0.005 | < 0.005 | 0.01 | 6.65 |
| Hauling | < 0.005 | < 0.005 | 0.04 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 27.8 | 27.8 | < 0.005 | < 0.005 | 0.03 | 29.2 |

## 3.7. Linear, Drainage, Utilities, & Sub-Grade (2026) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.63 | 1.36 | 11.3 | 16.4 | 0.02 | 0.49 | — | 0.49 | 0.45 | — | 0.45 | — | 2,432 | 2,432 | 0.10 | 0.02 | — | 2,441 |
| Dust From Material Movement | — | — | — | — | — | — | 0.41 | 0.41 | — | 0.04 | 0.04 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.16 | 0.14 | 1.13 | 1.64 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 243 | 243 | 0.01 | < 0.005 | — | 244 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dust From Material Movement | — | — | — | — | — | — | 0.04 | 0.04 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.03 | 0.02 | 0.21 | 0.30 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 40.2 | 40.2 | < 0.005 | < 0.005 | — | 40.3 |
| Dust From Material Movement | — | — | — | — | — | — | 0.01 | 0.01 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.70 | 0.62 | 0.78 | 8.61 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,049 | 2,049 | 0.03 | 0.08 | 0.20 | 2,074 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.07 | 0.06 | 0.07 | 0.90 | 0.00 | 0.00 | 0.21 | 0.21 | 0.00 | 0.05 | 0.05 | — | 208 | 208 | < 0.005 | 0.01 | 0.34 | 211 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.16 | 0.00 | 0.00 | 0.04 | 0.04 | 0.00 | 0.01 | 0.01 | — | 34.4 | 34.4 | < 0.005 | < 0.005 | 0.06 | 34.9 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.8. Linear, Drainage, Utilities, & Sub-Grade (2026) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.63 | 1.36 | 11.3 | 16.4 | 0.02 | 0.49 | — | 0.49 | 0.45 | — | 0.45 | — | 2,432 | 2,432 | 0.10 | 0.02 | — | 2,441 |
| Dust From Material Movement | — | — | — | — | — | — | 0.41 | 0.41 | — | 0.04 | 0.04 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.16 | 0.14 | 1.13 | 1.64 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 243 | 243 | 0.01 | < 0.005 | — | 244 |
| Dust From Material Movement | — | — | — | — | — | — | 0.04 | 0.04 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.03 | 0.02 | 0.21 | 0.30 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 40.2 | 40.2 | < 0.005 | < 0.005 | — | 40.3 |
| Dust From Material Movement | — | — | — | — | — | — | 0.01 | 0.01 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.70 | 0.62 | 0.78 | 8.61 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,049 | 2,049 | 0.03 | 0.08 | 0.20 | 2,074 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.07 | 0.06 | 0.07 | 0.90 | 0.00 | 0.00 | 0.21 | 0.21 | 0.00 | 0.05 | 0.05 | — | 208 | 208 | < 0.005 | 0.01 | 0.34 | 211 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.16 | 0.00 | 0.00 | 0.04 | 0.04 | 0.00 | 0.01 | 0.01 | — | 34.4 | 34.4 | < 0.005 | < 0.005 | 0.06 | 34.9 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.9. Linear, Drainage, Utilities, & Sub-Grade (2027) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.55 | 1.29 | 10.6 | 16.4 | 0.02 | 0.43 | — | 0.43 | 0.40 | — | 0.40 | — | 2,433 | 2,433 | 0.10 | 0.02 | — | 2,441 |
| Dust From Material Movement | — | — | — | — | — | — | 0.41 | 0.41 | — | 0.04 | 0.04 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.55 | 1.29 | 10.6 | 16.4 | 0.02 | 0.43 | — | 0.43 | 0.40 | — | 0.40 | — | 2,433 | 2,433 | 0.10 | 0.02 | — | 2,441 |
| Dust From Material Movement | — | — | — | — | — | — | 0.41 | 0.41 | — | 0.04 | 0.04 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.51 | 0.42 | 3.48 | 5.41 | 0.01 | 0.14 | — | 0.14 | 0.13 | — | 0.13 | — | 800 | 800 | 0.03 | 0.01 | — | 803 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dust From Material Movement | — | — | — | — | — | — | 0.14 | 0.14 | — | 0.01 | 0.01 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.09 | 0.08 | 0.63 | 0.99 | < 0.005 | 0.03 | — | 0.03 | 0.02 | — | 0.02 | — | 132 | 132 | 0.01 | < 0.005 | — | 133 |
| Dust From Material Movement | — | — | — | — | — | — | 0.02 | 0.02 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.70 | 0.62 | 0.56 | 10.0 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,168 | 2,168 | 0.02 | 0.08 | 7.07 | 2,199 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.68 | 0.60 | 0.71 | 8.04 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,011 | 2,011 | 0.03 | 0.08 | 0.18 | 2,036 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.22 | 0.20 | 0.21 | 2.75 | 0.00 | 0.00 | 0.69 | 0.69 | 0.00 | 0.16 | 0.16 | — | 672 | 672 | 0.01 | 0.03 | 1.00 | 681 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

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| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.04 | 0.04 | 0.04 | 0.50 | 0.00 | 0.00 | 0.13 | 0.13 | 0.00 | 0.03 | 0.03 | — | 111 | 111 | < 0.005 | < 0.005 | 0.17 | 113 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.10. Linear, Drainage, Utilities, & Sub-Grade (2027) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.55 | 1.29 | 10.6 | 16.4 | 0.02 | 0.43 | — | 0.43 | 0.40 | — | 0.40 | — | 2,433 | 2,433 | 0.10 | 0.02 | — | 2,441 |
| Dust From Material Movement | — | — | — | — | — | — | 0.41 | 0.41 | — | 0.04 | 0.04 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.55 | 1.29 | 10.6 | 16.4 | 0.02 | 0.43 | — | 0.43 | 0.40 | — | 0.40 | — | 2,433 | 2,433 | 0.10 | 0.02 | — | 2,441 |
| Dust From Material Movement | — | — | — | — | — | — | 0.41 | 0.41 | — | 0.04 | 0.04 | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.51 | 0.42 | 3.48 | 5.41 | 0.01 | 0.14 | — | 0.14 | 0.13 | — | 0.13 | — | 800 | 800 | 0.03 | 0.01 | — | 803 |
| Dust From Material Movement | — | — | — | — | — | — | 0.14 | 0.14 | — | 0.01 | 0.01 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.09 | 0.08 | 0.63 | 0.99 | < 0.005 | 0.03 | — | 0.03 | 0.02 | — | 0.02 | — | 132 | 132 | 0.01 | < 0.005 | — | 133 |
| Dust From Material Movement | — | — | — | — | — | — | 0.02 | 0.02 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.70 | 0.62 | 0.56 | 10.0 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,168 | 2,168 | 0.02 | 0.08 | 7.07 | 2,199 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.68 | 0.60 | 0.71 | 8.04 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,011 | 2,011 | 0.03 | 0.08 | 0.18 | 2,036 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.22 | 0.20 | 0.21 | 2.75 | 0.00 | 0.00 | 0.69 | 0.69 | 0.00 | 0.16 | 0.16 | — | 672 | 672 | 0.01 | 0.03 | 1.00 | 681 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.04 | 0.04 | 0.04 | 0.50 | 0.00 | 0.00 | 0.13 | 0.13 | 0.00 | 0.03 | 0.03 | — | 111 | 111 | < 0.005 | < 0.005 | 0.17 | 113 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.11. Linear, Paving (2027) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.22 | 1.03 | 9.92 | 15.7 | 0.02 | 0.39 | — | 0.39 | 0.36 | — | 0.36 | — | 2,382 | 2,382 | 0.10 | 0.02 | — | 2,390 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.22 | 1.03 | 9.92 | 15.7 | 0.02 | 0.39 | — | 0.39 | 0.36 | — | 0.36 | — | 2,382 | 2,382 | 0.10 | 0.02 | — | 2,390 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.26 | 0.22 | 2.12 | 3.35 | < 0.005 | 0.08 | — | 0.08 | 0.08 | — | 0.08 | — | 509 | 509 | 0.02 | < 0.005 | — | 511 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.05 | 0.04 | 0.39 | 0.61 | < 0.005 | 0.02 | — | 0.02 | 0.01 | — | 0.01 | — | 84.3 | 84.3 | < 0.005 | < 0.005 | — | 84.6 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.70 | 0.62 | 0.56 | 10.0 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,168 | 2,168 | 0.02 | 0.08 | 7.07 | 2,199 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.68 | 0.60 | 0.71 | 8.04 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,011 | 2,011 | 0.03 | 0.08 | 0.18 | 2,036 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.14 | 0.13 | 0.14 | 1.78 | 0.00 | 0.00 | 0.45 | 0.45 | 0.00 | 0.10 | 0.10 | — | 437 | 437 | 0.01 | 0.02 | 0.65 | 443 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.03 | 0.02 | 0.02 | 0.33 | 0.00 | 0.00 | 0.08 | 0.08 | 0.00 | 0.02 | 0.02 | — | 72.3 | 72.3 | < 0.005 | < 0.005 | 0.11 | 73.3 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.12. Linear, Paving (2027) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.22 | 1.03 | 9.92 | 15.7 | 0.02 | 0.39 | — | 0.39 | 0.36 | — | 0.36 | — | 2,382 | 2,382 | 0.10 | 0.02 | — | 2,390 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.22 | 1.03 | 9.92 | 15.7 | 0.02 | 0.39 | — | 0.39 | 0.36 | — | 0.36 | — | 2,382 | 2,382 | 0.10 | 0.02 | — | 2,390 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.26 | 0.22 | 2.12 | 3.35 | < 0.005 | 0.08 | — | 0.08 | 0.08 | — | 0.08 | — | 509 | 509 | 0.02 | < 0.005 | — | 511 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.05 | 0.04 | 0.39 | 0.61 | < 0.005 | 0.02 | — | 0.02 | 0.01 | — | 0.01 | — | 84.3 | 84.3 | < 0.005 | < 0.005 | — | 84.6 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.70 | 0.62 | 0.56 | 10.0 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,168 | 2,168 | 0.02 | 0.08 | 7.07 | 2,199 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.68 | 0.60 | 0.71 | 8.04 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,011 | 2,011 | 0.03 | 0.08 | 0.18 | 2,036 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.14 | 0.13 | 0.14 | 1.78 | 0.00 | 0.00 | 0.45 | 0.45 | 0.00 | 0.10 | 0.10 | — | 437 | 437 | 0.01 | 0.02 | 0.65 | 443 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.03 | 0.02 | 0.02 | 0.33 | 0.00 | 0.00 | 0.08 | 0.08 | 0.00 | 0.02 | 0.02 | — | 72.3 | 72.3 | < 0.005 | < 0.005 | 0.11 | 73.3 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

# 4. Operations Emissions Details

## 4.10. Soil Carbon Accumulation By Vegetation Type

### 4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated

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

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

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

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

## 4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Sequestered | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Removed | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

### 4.10.4. Soil Carbon Accumulation By Vegetation Type - Mitigated

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

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

### 4.10.5. Above and Belowground Carbon Accumulation by Land Use Type - Mitigated

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

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

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

## 4.10.6. Avoided and Sequestered Emissions by Species - Mitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Avoided | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Sequestered | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Removed | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

# 5. Activity Data

## 5.1. Construction Schedule

| Phase Name | Phase Type | Start Date | End Date | Days Per Week | Work Days per Phase | Phase Description |
|---|---|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | Linear, Grubbing & Land Clearing | 10/6/2025 | 12/17/2025 | 5.00 | 52.0 | — |
| Linear, Grading & Excavation | Linear, Grading & Excavation | 12/18/2025 | 11/10/2026 | 5.00 | 234 | — |
| Linear, Drainage, Utilities, & Sub-Grade | Linear, Drainage, Utilities, & Sub-Grade | 11/11/2026 | 6/17/2027 | 5.00 | 156 | — |
| Linear, Paving | Linear, Paving | 6/18/2027 | 10/5/2027 | 5.00 | 78.0 | — |

## 5.2. Off-Road Equipment

### 5.2.1. Unmitigated

| Phase Name | Equipment Type | Fuel Type | Engine Tier | Number per Day | Hours Per Day | Horsepower | Load Factor |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | Tractors/Loaders/Backhoes | Diesel | Average | 3.00 | 8.00 | 84.0 | 0.37 |
| Linear, Grading & Excavation | Tractors/Loaders/Backhoes | Diesel | Average | 3.00 | 8.00 | 84.0 | 0.37 |
| Linear, Grading & Excavation | Rubber Tired Loaders | Diesel | Average | 2.00 | 8.00 | 150 | 0.36 |
| Linear, Drainage, Utilities, & Sub-Grade | Tractors/Loaders/Backhoes | Diesel | Average | 3.00 | 8.00 | 84.0 | 0.37 |
| Linear, Drainage, Utilities, & Sub-Grade | Plate Compactors | Diesel | Average | 2.00 | 8.00 | 8.00 | 0.43 |
| Linear, Drainage, Utilities, & Sub-Grade | Graders | Diesel | Average | 2.00 | 8.00 | 148 | 0.41 |
| Linear, Drainage, Utilities, & Sub-Grade | Air Compressors | Diesel | Average | 2.00 | 8.00 | 37.0 | 0.48 |
| Linear, Paving | Rollers | Diesel | Average | 2.00 | 8.00 | 36.0 | 0.38 |
| Linear, Paving | Paving Equipment | Diesel | Average | 2.00 | 8.00 | 89.0 | 0.36 |
| Linear, Paving | Pavers | Diesel | Average | 2.00 | 8.00 | 81.0 | 0.42 |
| Linear, Paving | Tractors/Loaders/Backhoes | Diesel | Average | 3.00 | 8.00 | 84.0 | 0.37 |

### 5.2.2. Mitigated

| Phase Name | Equipment Type | Fuel Type | Engine Tier | Number per Day | Hours Per Day | Horsepower | Load Factor |
|---|---|---|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | Tractors/Loaders/Backhoes | Diesel | Average | 3.00 | 8.00 | 84.0 | 0.37 |
| Linear, Grading & Excavation | Tractors/Loaders/Backhoes | Diesel | Average | 3.00 | 8.00 | 84.0 | 0.37 |
| Linear, Grading & Excavation | Rubber Tired Loaders | Diesel | Average | 2.00 | 8.00 | 150 | 0.36 |
| Linear, Drainage, Utilities, & Sub-Grade | Tractors/Loaders/Backhoes | Diesel | Average | 3.00 | 8.00 | 84.0 | 0.37 |
| Linear, Drainage, Utilities, & Sub-Grade | Plate Compactors | Diesel | Average | 2.00 | 8.00 | 8.00 | 0.43 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Linear, Drainage, Utilities, & Sub-Grade | Graders | Diesel | Average | 2.00 | 8.00 | 148 | 0.41 |
| Linear, Drainage, Utilities, & Sub-Grade | Air Compressors | Diesel | Average | 2.00 | 8.00 | 37.0 | 0.48 |
| Linear, Paving | Rollers | Diesel | Average | 2.00 | 8.00 | 36.0 | 0.38 |
| Linear, Paving | Paving Equipment | Diesel | Average | 2.00 | 8.00 | 89.0 | 0.36 |
| Linear, Paving | Pavers | Diesel | Average | 2.00 | 8.00 | 81.0 | 0.42 |
| Linear, Paving | Tractors/Loaders/Backhoes | Diesel | Average | 3.00 | 8.00 | 84.0 | 0.37 |

## 5.3. Construction Vehicles

### 5.3.1. Unmitigated

| Phase Name | Trip Type | One-Way Trips per Day | Miles per Trip | Vehicle Mix |
|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | — | — | — | — |
| Linear, Grubbing & Land Clearing | Worker | 161 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Grubbing & Land Clearing | Vendor | 0.00 | 10.2 | HHDT,MHDT |
| Linear, Grubbing & Land Clearing | Hauling | 4.00 | 20.0 | HHDT |
| Linear, Grubbing & Land Clearing | Onsite truck | — | — | HHDT |
| Linear, Grading & Excavation | — | — | — | — |
| Linear, Grading & Excavation | Worker | 161 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Grading & Excavation | Vendor | 2.00 | 10.2 | HHDT,MHDT |
| Linear, Grading & Excavation | Hauling | 4.00 | 20.0 | HHDT |
| Linear, Grading & Excavation | Onsite truck | — | — | HHDT |
| Linear, Drainage, Utilities, & Sub-Grade | — | — | — | — |
| Linear, Drainage, Utilities, & Sub-Grade | Worker | 161 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Drainage, Utilities, & Sub-Grade | Vendor | 0.00 | 10.2 | HHDT,MHDT |

| | | | | |
|---|---|---|---|---|
| Linear, Drainage, Utilities, & Sub-Grade | Hauling | 0.00 | 20.0 | HHDT |
| Linear, Drainage, Utilities, & Sub-Grade | Onsite truck | — | — | HHDT |
| Linear, Paving | — | — | — | — |
| Linear, Paving | Worker | 161 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Paving | Vendor | 0.00 | 10.2 | HHDT,MHDT |
| Linear, Paving | Hauling | 0.00 | 20.0 | HHDT |
| Linear, Paving | Onsite truck | — | — | HHDT |

### 5.3.2. Mitigated

| Phase Name | Trip Type | One-Way Trips per Day | Miles per Trip | Vehicle Mix |
|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | — | — | — | — |
| Linear, Grubbing & Land Clearing | Worker | 161 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Grubbing & Land Clearing | Vendor | 0.00 | 10.2 | HHDT,MHDT |
| Linear, Grubbing & Land Clearing | Hauling | 4.00 | 20.0 | HHDT |
| Linear, Grubbing & Land Clearing | Onsite truck | — | — | HHDT |
| Linear, Grading & Excavation | — | — | — | — |
| Linear, Grading & Excavation | Worker | 161 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Grading & Excavation | Vendor | 2.00 | 10.2 | HHDT,MHDT |
| Linear, Grading & Excavation | Hauling | 4.00 | 20.0 | HHDT |
| Linear, Grading & Excavation | Onsite truck | — | — | HHDT |
| Linear, Drainage, Utilities, & Sub-Grade | — | — | — | — |
| Linear, Drainage, Utilities, & Sub-Grade | Worker | 161 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Drainage, Utilities, & Sub-Grade | Vendor | 0.00 | 10.2 | HHDT,MHDT |
| Linear, Drainage, Utilities, & Sub-Grade | Hauling | 0.00 | 20.0 | HHDT |

| | | | | |
|---|---|---|---|---|
| Linear, Drainage, Utilities, & Sub-Grade | Onsite truck | — | — | HHDT |
| Linear, Paving | — | — | — | — |
| Linear, Paving | Worker | 161 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Paving | Vendor | 0.00 | 10.2 | HHDT,MHDT |
| Linear, Paving | Hauling | 0.00 | 20.0 | HHDT |
| Linear, Paving | Onsite truck | — | — | HHDT |

## 5.4. Vehicles

### 5.4.1. Construction Vehicle Control Strategies

| Control Strategies Applied | PM10 Reduction | PM2.5 Reduction |
|---|---|---|
| Water unpaved roads twice daily | 55% | 55% |
| Limit vehicle speeds on unpaved roads to 25 mph | 44% | 44% |
| Sweep paved roads once per month | 9% | 9% |

## 5.5. Architectural Coatings

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

## 5.6. Dust Mitigation

### 5.6.1. Construction Earthmoving Activities

| Phase Name | Material Imported (cy) | Material Exported (cy) | Acres Graded (acres) | Material Demolished (sq. ft.) | Acres Paved (acres) |
|---|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | — | — | 4.30 | 0.00 | — |
| Linear, Grading & Excavation | — | — | 4.30 | 0.00 | — |
| Linear, Drainage, Utilities, & Sub-Grade | — | — | 4.30 | 0.00 | — |

### 5.6.2. Construction Earthmoving Control Strategies

| Control Strategies Applied | Frequency (per day) | PM10 Reduction | PM2.5 Reduction |
|---|---|---|---|
| Water Exposed Area | 2 | 61% | 61% |

## 5.7. Construction Paving

| Land Use | Area Paved (acres) | % Asphalt |
|---|---|---|
| Road Widening | 0.80 | 100% |
| Road Widening | 3.50 | 100% |

## 5.8. Construction Electricity Consumption and Emissions Factors

kWh per Year and Emission Factor (lb/MWh)

| Year | kWh per Year | CO2 | CH4 | N2O |
|---|---|---|---|---|
| 2025 | 0.00 | 453 | 0.03 | < 0.005 |
| 2026 | 0.00 | 453 | 0.03 | < 0.005 |
| 2027 | 0.00 | 453 | 0.03 | < 0.005 |

## 5.18. Vegetation

### 5.18.1. Land Use Change

#### 5.18.1.1. Unmitigated

| Vegetation Land Use Type | Vegetation Soil Type | Initial Acres | Final Acres |
|---|---|---|---|

#### 5.18.1.2. Mitigated

| Vegetation Land Use Type | Vegetation Soil Type | Initial Acres | Final Acres |
|---|---|---|---|

### 5.18.1. Biomass Cover Type

#### 5.18.1.1. Unmitigated

| Biomass Cover Type | Initial Acres | Final Acres |
|---|---|---|

#### 5.18.1.2. Mitigated

| Biomass Cover Type | Initial Acres | Final Acres |
|---|---|---|

### 5.18.2. Sequestration

#### 5.18.2.1. Unmitigated

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

#### 5.18.2.2. Mitigated

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

# 6. Climate Risk Detailed Report

## 6.1. Climate Risk Summary

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

| Climate Hazard | Result for Project Location | Unit |
|---|---|---|
| Temperature and Extreme Heat | 5.68 | annual days of extreme heat |
| Extreme Precipitation | 5.50 | annual days with precipitation above 20 mm |
| Sea Level Rise | — | meters of inundation depth |
| Wildfire | 0.00 | annual hectares burned |

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

## 6.2. Initial Climate Risk Scores

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

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

## 6.3. Adjusted Climate Risk Scores

| Climate Hazard | Exposure Score | Sensitivity Score | Adaptive Capacity Score | Vulnerability Score |
|---|---|---|---|---|
| Temperature and Extreme Heat | N/A | N/A | N/A | N/A |
| Extreme Precipitation | N/A | N/A | N/A | N/A |
| Sea Level Rise | N/A | N/A | N/A | N/A |

| | | | | |
|---|---|---|---|---|
| Wildfire | N/A | N/A | N/A | N/A |
| Flooding | N/A | N/A | N/A | N/A |
| Drought | N/A | N/A | N/A | N/A |
| Snowpack Reduction | N/A | N/A | N/A | N/A |
| Air Quality Degradation | N/A | N/A | N/A | N/A |

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

### 6.4. Climate Risk Reduction Measures

# 7. Health and Equity Details

## 7.1. CalEnviroScreen 4.0 Scores

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

| Indicator | Result for Project Census Tract |
|---|---|
| Exposure Indicators | — |
| AQ-Ozone | 45.0 |
| AQ-PM | 68.0 |
| AQ-DPM | 91.2 |
| Drinking Water | 61.5 |
| Lead Risk Housing | 64.6 |
| Pesticides | 17.7 |
| Toxic Releases | 79.4 |
| Traffic | 68.5 |
| Effect Indicators | — |
| CleanUp Sites | 88.6 |
| Groundwater | 92.5 |

| | |
|---|---|
| Haz Waste Facilities/Generators | 91.0 |
| Impaired Water Bodies | 66.7 |
| Solid Waste | 93.4 |
| Sensitive Population | — |
| Asthma | 45.1 |
| Cardio-vascular | 53.6 |
| Low Birth Weights | 37.6 |
| Socioeconomic Factor Indicators | — |
| Education | 19.3 |
| Housing | 58.8 |
| Linguistic | 42.1 |
| Poverty | 27.9 |
| Unemployment | 23.8 |

## 7.2. Healthy Places Index Scores

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

| Indicator | Result for Project Census Tract |
|---|---|
| Economic | — |
| Above Poverty | 83.72898755 |
| Employed | 79.36609778 |
| Median HI | 78.76299243 |
| Education | — |
| Bachelor's or higher | 79.63557038 |
| High school enrollment | 100 |
| Preschool enrollment | 40.65186706 |
| Transportation | — |
| Auto Access | 46.70858463 |
| Active commuting | 73.66867702 |

| | |
|---|---|
| Social | — |
| 2-parent households | 44.68112409 |
| Voting | 75.93994611 |
| Neighborhood | — |
| Alcohol availability | 33.40177082 |
| Park access | 81.35506224 |
| Retail density | 65.99512383 |
| Supermarket access | 75.70896959 |
| Tree canopy | 71.79520082 |
| Housing | — |
| Homeownership | 30.71987681 |
| Housing habitability | 49.09534197 |
| Low-inc homeowner severe housing cost burden | 67.79160785 |
| Low-inc renter severe housing cost burden | 74.88771975 |
| Uncrowded housing | 53.4838958 |
| Health Outcomes | — |
| Insured adults | 78.05723085 |
| Arthritis | 0.0 |
| Asthma ER Admissions | 64.1 |
| High Blood Pressure | 0.0 |
| Cancer (excluding skin) | 0.0 |
| Asthma | 0.0 |
| Coronary Heart Disease | 0.0 |
| Chronic Obstructive Pulmonary Disease | 0.0 |
| Diagnosed Diabetes | 0.0 |
| Life Expectancy at Birth | 35.0 |
| Cognitively Disabled | 36.6 |
| Physically  Disabled | 63.7 |

| | |
|---|---|
| Heart Attack ER Admissions | 49.8 |
| Mental Health Not Good | 0.0 |
| Chronic Kidney Disease | 0.0 |
| Obesity | 0.0 |
| Pedestrian Injuries | 98.1 |
| Physical Health Not Good | 0.0 |
| Stroke | 0.0 |
| Health Risk Behaviors | — |
| Binge Drinking | 0.0 |
| Current Smoker | 0.0 |
| No Leisure Time for Physical Activity | 0.0 |
| Climate Change Exposures | — |
| Wildfire Risk | 0.0 |
| SLR Inundation Area | 0.0 |
| Children | 61.0 |
| Elderly | 47.3 |
| English Speaking | 58.4 |
| Foreign-born | 48.4 |
| Outdoor Workers | 81.7 |
| Climate Change Adaptive Capacity | — |
| Impervious Surface Cover | 18.0 |
| Traffic Density | 72.7 |
| Traffic Access | 74.7 |
| Other Indices | — |
| Hardship | 15.8 |
| Other Decision Support | — |
| 2016 Voting | 56.9 |

## 7.3. Overall Health & Equity Scores

| Metric | Result for Project Census Tract |
|---|---|
| CalEnviroScreen 4.0 Score for Project Location (a) | 68.0 |
| Healthy Places Index Score for Project Location (b) | 77.0 |
| Project Located in a Designated Disadvantaged Community (Senate Bill 535) | No |
| Project Located in a Low-Income Community (Assembly Bill 1550) | No |
| Project Located in a Community Air Protection Program Community (Assembly Bill 617) | No |

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

## 7.4. Health & Equity Measures

No Health & Equity Measures selected.

## 7.5. Evaluation Scorecard

Health & Equity Evaluation Scorecard not completed.

## 7.6. Health & Equity Custom Measures

No Health & Equity Custom Measures created.

# 8. User Changes to Default Data

| Screen | Justification |
|---|---|
| Characteristics: Project Details | Adjusted for project location |
| Characteristics: Utility Information | Adjusted for project location |
| Construction: Off-Road Equipment | Project specific estiamtes |
| Construction: Trips and VMT | project specific details |
| Construction: Construction Phases | — |

# GREENHOUSE GAS EMISSIONS IMPACT STUDY

## APPENDIX

# K

# CENTRAL MAUI WASTEWATER RECLAMATION FACILITY PROJECT

## Greenhouse Gas Emissions Study

Prepared for:
*Munekiyo Hiraga*

Prepared by:
*Terry A. Hayes Associates Inc.*

November 2024

taha
environmental planners

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# 1.0 SUMMARY OF FINDINGS

Terry A. Hayes Associates Inc. (TAHA) completed a Greenhouse Gas (GHG) Emissions Study for the Central Maui Wastewater Reclamation Facility Project (proposed project). The proposed project would generate short-term GHG emissions during construction activities (e.g., exhaust from off-road equipment and on-road trucks) and permanent GHG emissions during operational activities (e.g., exhaust from worker vehicles and emissions from electricity generation). Construction activities would generate approximately 953 metric tons of GHG emissions per year and permanent emissions would be approximately 4,285 metric tons per year. In 2019, total GHG emissions in Hawaii were approximately 22 million per year. GHG emissions generated by the proposed project would be negligible when compared to existing emissions. The proposed project would not interfere with the development of clean energy supplies.

# 2.0 INTRODUCTION

## 2.1 PURPOSE

The purpose of this Study is to evaluate the potential for GHG impacts associated with the proposed project. Pollutant emissions have been estimated for construction and operational activities.

## 2.2 PROJECT DESCRIPTION

The proposed project is located in Waikapu on the island of Maui on agricultural lands between Honoapiilani Highway and Kuihelani Highway.

The proposed project would consist of the following:

- A new Central Maui Wastewater Recycling Facility (WWRF) and soil aquifer treatment basins located on a vacant County owned parcel TMK (2) 3-8-005:023. This parcel would be subdivided to provide a separate 14.9-acre lot for the WWRF.

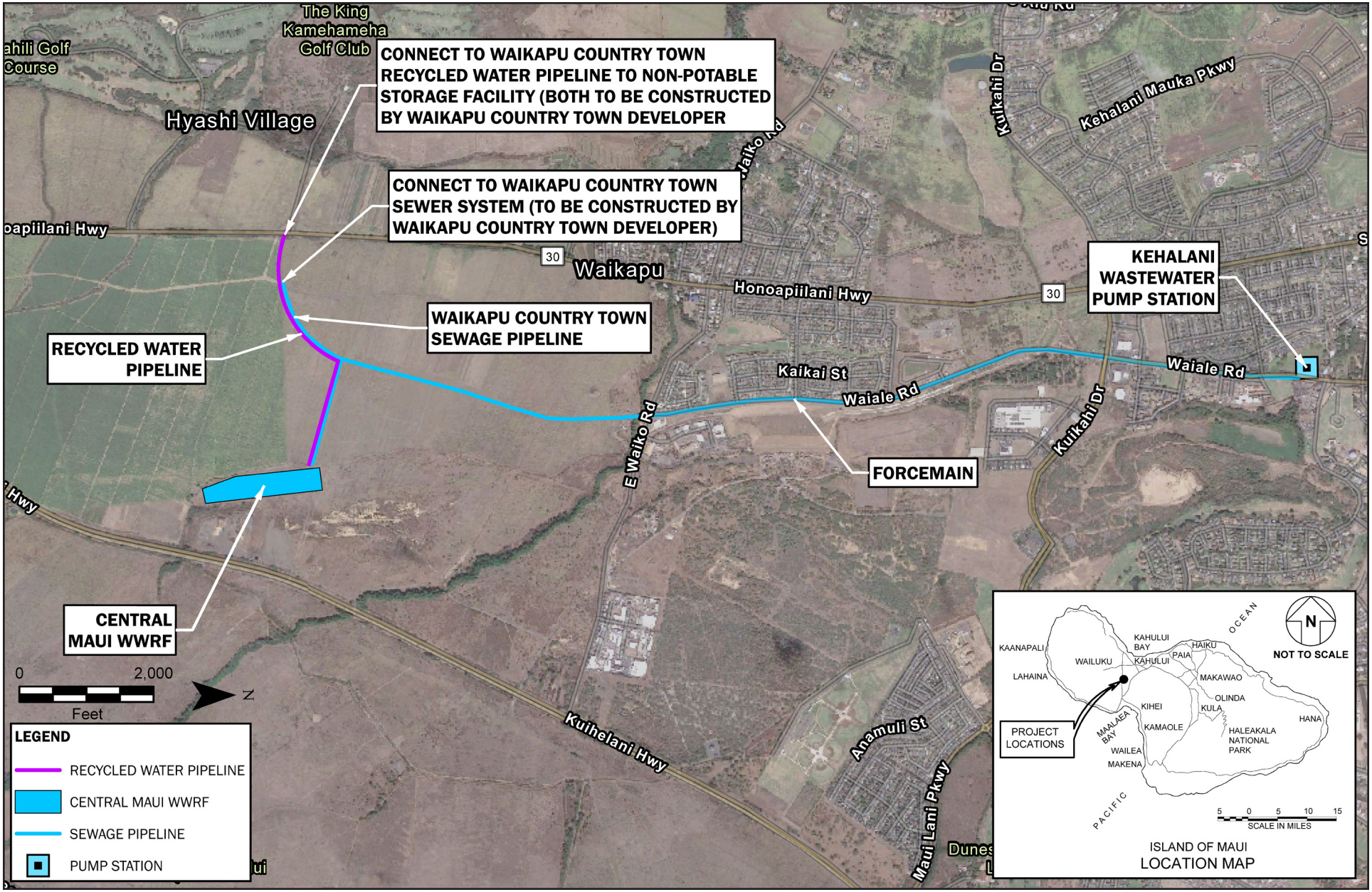
- A new Kehalani Wastewater Pump Station (WWPS) at an existing stormwater detention basin near the Waiale Road/Waiinu Road intersection.

- A new sewage pipeline that would deliver flows from the WWPS to the WWRF. This new pipeline would run along Waiale Road and the future Waiale Road Extension.

- A new 100-feet wide access and utility easement approximately 1,800 feet long, to provide access from the future Waiale Road Extension to the WWRF. This access runs through a vacant County-owned parcel TMK (2) 3-6-002:004.

- A new sewage pipeline and a new recycled water pipeline that connect the WWRF and the Waikapu Country Town (WCT) mauka development. Only a segment of these pipelines would be constructed by the County as part of this Project, up to the future Honoapiilani Highway/Waiale Road Extension intersection. The remaining segment of these pipelines would be constructed by WCT.

During construction, it is anticipated that daily traffic to the site would consist of an average of 161 workers and four delivery trucks. For full operation (post-construction), it is anticipated that trip generation to the site would be lower than it was during construction and would consist of only worker's vehicles. **Figure 2-1** shows the project location and **Figure 2-2** shows the preliminary site plan.




Source: Brown and Caldwell, 2023. TAHA, 2023.

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TAHA 2021-098

Central Maui Wastewater Reclamation Facility Project
Greenhouse Gas Emissions Study

MUNEKIYO HIRAGA

*FIGURE 2-1*

PROJECT LOCATION




Source: Brown and Caldwell, 2022.

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TAHA 2021-098

Central Maui Wastewater Reclamation Facility Project
Greenhouse Gas Emissions Study

MUNEKIYO HIRAGA

*FIGURE 2-2*

PRELIMINARY SITE PLAN

# 3.0 TOPICAL BACKGROUND & REGULATORY FRAMEWORK

This section provides a discussion of GHG emissions, how they contribute to climate change, and the regulatory framework developed to reduce GHG emissions.

## 3.1 GREENHOUSE GAS EMISSIONS AND CLIMATE CHANGE

Cumulative GHG emissions are believed to contribute to an increased greenhouse effect and global climate change, which may result in sea level rise and changes in precipitation, habitat, temperature, wildfires, air pollution levels, and in the frequency and intensity of weather-related-events. While criteria pollutants and TACs are pollutants of regional and local concern, GHG are global pollutants. The primary land-use related GHGs are carbon dioxide ($CO_2$), methane ($CH_4$), and nitrous oxide ($N_2O$). The individual pollutant's ability to retain infrared radiation represents its "global warming potential" and is expressed in terms of $CO_2$ equivalents (denoted $CO_2e$); therefore, $CO_2$ is the benchmark having a global warming potential of one. Methane has a global warming potential of 28 and thus has a 28 times greater global warming effect per metric ton of $CH_4$ than $CO_2$. $N_2O$ has a global warming potential of 265. GHG emissions are generally expressed in units of annual metric tons of $CO_2$ equivalents ($MTCO_2e$/year).

## 3.2 CLIMATE CHANGE REGULATORY FRAMEWORK

### International Regulations

An international climate change agreement was adopted at the Paris United Nations Framework Convention on Climate Change conference in December 2015. The last two climate conferences in Warsaw (2013) and Lima (2014) decided that countries were to submit their proposed emissions reduction targets for the 2015 conference as "intended nationally determined contributions" prior to the Paris conference. The European Union has committed to an economy-wide domestic GHG reduction target of 40 percent below 1990 levels by 2030. These targets are set with the goal of limiting global temperature rise to well below 2 degrees Celsius and getting to the 80 percent emission reduction by 2050. On November 4, 2019, United States President Donald Trump gave a formal notice of intention to withdraw from the Paris Agreement. The withdrawal took effect on November 4, 2020, one day after the 2020 United States presidential election. United States President Joe Biden rejoined the Paris Agreement in February 2021.

The governors of several states, including Hawaii, formed the United States Climate Alliance to continue to advance the objectives of the Paris Agreement at the state level. The Alliance is a bipartisan group of states that have pledged to uphold the 2016 Paris Agreement on climate change within their borders. The goal of the Alliance is to reduce their $CO_2$ emissions 26-28 percent from 2005 levels by 2025 and to meet or exceed the targets of the U.S. Clean Power Plan (a 32 percent reduction of $CO_2$ emissions by 2030). These actions would help fulfill the global community's goal, as set forth in the Paris Climate Agreement, to keep global warming below 2 degrees Celsius (3.6 degrees Fahrenheit). The Alliance provides a forum for its members to further develop and strengthen their existing Climate Action Plans through the sharing of information and best practices.

### Federal Regulations

The United States Supreme Court ruled in *Massachusetts v. EPA, 127 S.Ct. 1438*, that $CO_2$ and other GHGs are pollutants under the Federal Clean Air Act (FCAA), which the USEPA must regulate if it determines they pose an endangerment to public health or welfare. On

December 7, 2009, the USEPA made two distinct findings: 1) that the current and projected concentrations of the six key GHGs ($CO_2$, $CH_4$, $N_2O$, hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride) in the atmosphere threaten the public health and welfare of current and future generations; and 2) that the combined emissions of these GHGs from new motor vehicles and new motor vehicle engines contribute to the GHG pollution which threatens public health and welfare.

On June 23, 2014, the United States Supreme Court ruled in *Utility Air Regulatory Group v. EPA* that the USEPA exceeded its statutory authority under the FCAA when it determined that stationary source emissions of GHGs would trigger permitting obligations under the Prevention of Significant Deterioration (PSD) program and Title V of the FCAA. The Court, however, upheld those portions of USEPA's rulemaking that require a source to apply best available control technology (BACT) to GHG emissions where the source would otherwise trigger PSD permitting on account of its emissions of other pollutants. The Supreme Court's decision was limited to USEPA's regulation of GHG emissions under the PSD and Title V provisions of the FCAA, and it left unanswered other questions regarding USEPA's permitting and BACT authority under the PSD program, and the USEPA's efforts to regulate GHG emissions from stationary sources.

The federal government administers a wide array of public-private partnerships to reduce the GHG intensity generated in the United States. These programs focus on energy efficiency, renewable energy, $CH_4$ and other non-$CO_2$ gases, agricultural practices, and implementation of technologies to achieve GHG reductions. USEPA implements numerous voluntary programs that contribute to the reduction of GHG emissions. These programs (e.g., the ENERGY STAR labeling system for energy-efficient products) play a significant role in encouraging voluntary reductions from large corporations, consumers, industrial and commercial buildings, and many major industrial sectors.

The United States Department of Transportation's National Highway Traffic Safety Administration regulates fuel economy standards. The Corporate Average Fuel Economy standards regulate how far our vehicles must travel on a gallon of fuel. A more fuel-efficient vehicle fleet reduces mobile source GHG emissions. The standards require passenger cars, light-duty trucks, and medium-duty passenger vehicles to meet an estimated combined average fuel economy of 48.7 to 49.7 miles per gallon or higher by 2025. The standards provide flexibility to manufacturers, including the ability to earn credits for alternative fuel vehicles.

**State Regulations**

In 2007, Hawaii became the second State in the nation to set a binding cap on GHG emissions through Act 234, Hawaii's Climate Change Law, which declared a policy to reduce GHG emissions statewide to 1990 levels by the year 2020. Act 234 served as the foundation for the Hawaii Greenhouse Gas Program, which was established by the DOH to combat the threat of climate change and sea level rise. This Program utilizes the Air Pollution Control Permit process of DOH's Clean Air Branch to regulate GHG emissions statewide in conjunction with other federal and State programs to mitigate GHGs. Parts of Act 234 are codified in Chapter 342B (Air Pollution Control) of the Hawaii Revised Statutes.

Senate Bill (SB) 559, which was signed into law on June 8, 2017, expands strategies and mechanisms to reduce GHG emissions in alignment with the principles and goals adopted in the Paris Agreement, discussed above. SB 559 documents the State's commitment to combat climate change by systematically reducing GHG emissions and improving resiliency to climate change aligned with the principles and goals set by the Paris Agreement. It expands on strategies and

mechanisms to reduce GHG emissions through the reduction of energy use, adoption of renewable energy, and control of air pollution among all agencies, departments, industries, and sectors, including transportation. SB 559 states that, "Such strategies and mechanisms shall utilize the best available science, technologies, and policies to reduce GHG emissions and shall be closely aligned with the climate change principles and goals adopted in the Paris Agreement and Hawaii's share of obligations within the expectations apportioned to the United States in the Paris Agreement, regardless of federal action." In addition, "The State shall strive to formulate and communicate long-term low greenhouse gas emission development strategies and shall take actions to conserve and enhance long-term sinks and reservoirs of greenhouse gases, by prioritizing the development of parks, greenways, and restoration of native upland and coastal forests and wetlands."

In 2018, the State Legislature passed Act 15, to establish a permanent Greenhouse Gas Sequestration Task Force within the Office of Planning (now the Office of Planning and Sustainable Development). The Task Force will work to establish a baseline for GHG and short- and long-term benchmarks for increasing GHG sequestration in the agricultural and natural environment. The Act also establishes a statewide carbon net-negative goal by 2045.

In 2022, the State Legislature passed Act 238, which tasks the Hawaii State Energy Office to "analyze pathways and develop recommendations for achieving the State's economy-wide decarbonization goals." Additionally, the study will evaluate emission reduction pathways from all emitting sectors economy wide. Act 238 establishes a goal for the level of statewide GHG emissions to be at least 50 percent below 2005 levels by 2030 (including aviation emissions).

The DOH established the Hawaii GHG Program to combat the threat of climate change and sea level rise. The program utilizes the Air Pollution Control Permit process of the Clean Air Branch to regulate GHG emissions statewide. The Hawaii GHG program works in conjunction with other federal and Hawaii programs to mitigate GHG emissions. This includes the Priority Climate Action Plan (PCAP), which, when completed in 2024, will identify the most pressing areas in need of GHG reduction, and determine fitting implementation-ready measures. The PCAP will use the most recent statewide GHG inventory, which was completed in 2019, to produce an updated, more accurate inventory. The PCAP will be developed based on community engagement, and collaboration between the commission and community members throughout the planning process. The commission will host workshops to support community and stakeholder engagement and plan them in conjunction with neighborhood boards and councils. Information from these meetings will be pivotal in both gathering information to be used for the plan, developing the plan, and revising existing plans.

The Comprehensive Climate Action Plan (CCAP), when completed in 2025, will build upon the PCAP and identify all major sources and sinks of GHGs, establish short- and long-term reduction goals, and fit strategies and measures. The CCAP will examine current GHG emissions and projected emissions without any changes to status quo activities and compare these to projected emissions with economy wide GHG reduction activities fully carried out.

# 4.0 EXISTING ENVIRONMENTAL SETTING

## 4.1 CLIMATOLOGY

The proposed project is located in Waikapu on the island of Maui on agricultural lands between Honoapiilani Highway and Kuihelani Highway. Maui is characterized by a semi-tropical climate containing a multitude of individual microclimates. The mean annual temperature of the island at all locations near sea level is approximately 75 degrees Fahrenheit. A high proportion of the rainfall that Maui receives each year falls on the northeast facing shores leaving the south and southwest coastal areas relatively dry.

## 4.2 STATEWIDE GHG EMISSIONS

The State published the Hawaii GHG Emissions Report for 2005, 2018 and 2019 in April 2023. The purpose of the report is to track progress toward achieving the state's 2020, 2030, and 2045 GHG reduction goals. Based on the analysis presented in the report, net GHG emissions (excluding aviation) in 2020 are projected to be lower than net GHG emissions (excluding aviation) in 1990. Net GHG emissions (including aviation) in 2030 are projected to be greater than the target emissions level of 50 below 2005 levels (including aviation), and in 2045 are projected to be greater than the target of net-negative levels. While the development of future inventory reports as well as ongoing quantitative assessment of uncertainties will further inform whether Hawaii met the 2020 statewide target and is going to meet the 2030 and 2045 statewide targets, the report finds that, under existing policies and economic projections, Hawaii is currently expected to meet the 2020 target, but is not expected to meet the 2030 and 2045 targets.

In 2019, total GHG emissions in Hawaii were 22.01 million $MTCO_2e$/year. Emissions from the energy sector accounted for the largest portion (88.4 percent) of total emissions in Hawaii, followed by the agriculture, forestry, and other land use sector (6.0 percent), the industrial processes and product use sector (3.8 percent), and the waste sector (1.9 percent).

Total GHG emissions in Hawaii grew by 18.0 percent between 1990 and 2007 before decreasing by about 18.6 percent between 2007 and 2019. Compared to 1990, total emissions in Hawaii in 2019 were roughly 3.9 percent lower, while net emissions were lower by roughly 11.7 percent. As the largest source of emissions in Hawaii, the energy sector is a major driver of the overall emissions trends. Relative to 1990, emissions from the Energy sector in 2019 were lower by 4.0 percent. Transportation emissions—which increased between 1990 and 2007, decreased between 2007 and 2015, and then increased again between 2015 and 2019—accounted for the largest share of Energy sector emissions in all inventory years. The trend in transportation emissions is largely driven by domestic aviation and ground transportation emissions, which together account for roughly 82 percent of transportation emissions. Stationary combustion emissions—which increased between 1990 and 2005, before consistently decreasing between 2005 and 2016, and then slightly increasing again between 2016 and 2019—is the second largest share of Energy sector emissions. This trend is driven by emissions from energy industries as well as industrial and commercial emissions. Overall, the decrease in Energy sector emissions between 1990 and 2019 is due to a decrease in stationary combustion emissions from commercial and industrial sources, a decrease in emissions from oil and natural gas systems, and a decrease in domestic marine, military aviation, and military non-aviation emissions. Together, these reductions outweigh overall increases in emissions from energy industries, ground transportation, domestic aviation, and incineration of waste observed over the same period.

Emissions from the Waste sector also contributed to the overall reduction in emissions from 2007 to 2019, falling by about 49.6 percent, which was primarily driven by a decrease in emissions from landfills. These reductions more than offset growing emissions from the industrial processes and product use sector, which increased by 44.0 percent from 2007 to 2019. Relative to 1990, emissions from the Industrial Processes and Product Use sector in 2019 were more than three times higher due to the growth in refrigeration and air conditioning substances. Carbon removals from agriculture, forestry, and other land use sinks have also increased since 1990 growing by roughly 6.5 percent between 1990 and 2019.

Total GHG emissions are projected to be 18.44 million $MTCO_2e$/year in 2025, 17.49 million $MTCO_2e$/year in 2030, and 13.88 million $MTCO_2e$/year in 2045. Net emissions, which take into account carbon sinks and are relevant for tracking progress toward the 2030 GHG target pursuant to Act 238 of 2022 are projected to be 15.94 million $MTCO_2e$/year in 2025, 15.03 million $MTCO_2e$/year in 2030, and 11.25 million $MTCO_2e$/year in 2045. Net emissions, which include carbon sinks, exclude aviation, and are relevant for tracking the progress toward the 2020 GHG target pursuant to Act 234 of 2007, are projected to be 11.58 million $MTCO_2e$/year in 2020. Relative to 2019, total emissions under the baseline scenario are projected to decrease by 16 percent by 2025, 21 percent by 2030, and 37 percent by 2045. Over the same period, net emissions are projected to decrease by 18 percent, 23 percent, and 42 percent, respectively. This trend is largely driven by the projected trend in emissions from energy industries (i.e., electric power plants and petroleum refineries), which are expected to decrease substantially between 2019 and 2045.

# 5.0 SIGNIFICANCE CRITERIA

Neither the Hawaii Environmental Policy Act nor the USEPA has established quantitative significance criteria related to GHG emissions. Section 11-200.1-13(b)(13) (Significance Criteria) of the Hawaii Environmental Impact Statement Rules includes, “In determining whether an action may have a significant effect on the environment, the agency shall consider every phase of a proposed action, the expected impacts, both primary and secondary, and the cumulative as well as the short-term and long-term effects of the action. In most instances, an action shall be determined to have a significant effect on the environment if it is likely to: require substantial energy consumption or emit substantial greenhouse gases.”

# 6.0 ENVIRONMENTAL EFFECTS

## 6.1 GREENHOUSE GAS EMISSIONS

The State of Hawaii, through Act 234 and Senate Bill 559, has acknowledged that GHG emissions are a statewide impact. The proposed project would generate GHG emissions through construction activities, energy use, new vehicle trips, aerobic liquid treatment processes, and aerobic sludge digestion.

For construction activities, the emissions analysis assumes the WWRF, WWPS, and access road would be constructed June 2027 to May 2029, and the pipelines would be constructed October 2025 to October 2027. The State of Hawaii has not created a predictive model for efficiently estimating construction emissions. Equipment inventories for each phase of construction were populated in the California Emissions Estimator Model (CalEEMod, Version 2022.1.1.24), and the model was used to produce maximum annual emissions of $CO_2$, $CH_4$, $N_2O$, and $CO_2e$. This model provides a reasonable estimation of emissions in Hawaii for planning only purposes as the equipment fleet in the model includes varying levels of engine emission controls. The detailed CalEEMod output files can be found in the **Appendix**.

**Table 6-1** presents the maximum annual GHG emissions generated during each year of construction. Construction activities would generate approximately 778 metric tons of GHG emissions per year.

**TABLE 6-1: CONSTRUCTION-RELATED GHG EMISSIONS**

| Year | Annual Emissions (Metric Tons per Year) | | | |
|---|---|---|---|---|
| | $CO_2$ | $CH_4$ | $N_2O$ | $MTCO_2e$ |
| 2025 | 97 | <0.1 | <0.1 | 98 |
| 2026 | 511 | <0.1 | <0.1 | 517 |
| 2027 | 1,252 | <0.1 | 0.1 | 1,268 |
| 2028 | 1,681 | 0.1 | 0.1 | 1,707 |
| 2029 | 294 | <0.1 | <0.1 | 298 |
| ***Maximum Annual*** | **1,681** | **<0.1** | **<0.1** | **1,707** |
| ***Average Annual*** | **767** | **<1** | **<1** | **778** |

**SOURCE**: TAHA, 2024.

The primary sources of operational GHG emissions would be aerobic liquid treatment processes, aerobic sludge digestion, and the electricity generation required for these activities. Other sources of permanent emissions include electricity generation related to water distribution and waste disposal, on-road vehicles, and area sources. The proposed project is anticipated to generate approximately 16 AM and 16 PM peak-hour vehicle trips, and use approximately 11.7 million kWh of electricity annually. Maui obtains approximately 35.4 percent of electricity from renewable energy sources.[1] Therefore, the emission estimates are based on 7.56 million kWh per year of electricity generation from polluting sources. These emissions were estimated using CalEEMod.

[1]Hawaiian Electric, Power Facts, https://www.hawaiianelectric.com/about-us/power-facts, Accessed March 25, 2024.

Emissions from the aerobic liquid treatment processes and aerobic sludge digestion were calculated using methodology and formulas from the *Draft Greenhouse Gas Emissions Estimation Methodologies for Biogenic Emissions from Selected Source Categories: Solid Waste Disposal, Wastewater Treatment, Ethanol Fermentation* and can be found below.[2]

*Formulas for Wastewater Treatment Emissions:*

$$(1)\ CO_2 = 10^{-6} * Q_{WW} * OD * Eff_{OD} * CF_{CO2} * [(1 - MCF_{WW} * BG_{CH4}) * (1 - \lambda)]$$

$$(2)\ CH_4 = 10^{-6} * Q_{WW} * OD * Eff_{OD} * CF_{CH4} * [(MCF_{WW} * BG_{CH4}) * (1 - \lambda)]$$

*Where:*

$CO_2 =$ *$CO_2$ emission rate (Mg $CO_2$/hr)*

$CH_4 =$ *$CH_4$ emission rate (Mg $CH_4$/hr)*

$10^{-6} =$ *Units conversion factor (Mg/g)*

$Q_{WW} =$ *Wastewater influent flow rate ($m^3$/hr)*

$OD =$ *Oxygen demand of influent wastewater to the biological treatment unit determined as either BOD5 or COD (mg/L = g/$m^3$)*

$Eff_{OD} =$ *Oxygen demand removal efficiency of the biological treatment unit*

$CF_{CO2} =$ *Conversion factor for maximum CO2 generation per unit of oxygen demand*

$CF_{CH4} =$ *Conversion factor for maximum CH4 generation per unit of oxygen demand*

$MCF_{WW} =$ *methane correction factor for wastewater treatment unit, indicating the fraction of the influent oxygen demand that is converted anaerobically in the wastewater treatment unit*

$BG_{CH4} =$ *Fraction of carbon as CH4 in generated biogas*

$\lambda =$ *Biomass yield (g C converted to biomass/g C consumed in the wastewater treatment process)*

*Constants:*

$CF_{CO2} =$ *1.375 g $CO_2$/g oxygen demand*

$CF_{CH4} =$ *0.5 g $CH_4$/g oxygen demand*

*Assumptions:*

$Q_{WW} =$ *4.0 million gallons/day*

$OD =$ *400 mg/L of BOD5*

$Eff_{OD} =$ *98%*

$MCF_{WW} =$ *0*

$BG_{CH4} =$ *0.65*

$\lambda =$ *0.9 lbs TSS/lb BOD5*

[2] U.S. Environmental Protection Agency, *Greenhouse Gas Emissions Estimation Methodologies for Biogenic Emissions from Selected Source Categories: Solid Waste Disposal, Wastewater Treatment, Ethanol Fermentation*, December 16, 2010.

*Formulas for Sludge Digestion Emissions:*

$$(3)\ CO_2 = 10^{-6} * Q_S * MLVSS * CF_S * \left(\frac{44}{12}\right) * (1 - MCF_S * BG_{CH4})$$

$$(4)\ CH_4 = 10^{-6} * Q_S * MLVSS * CF_S * \left(\frac{16}{12}\right) * (1 - MCF_S * BG_{CH4})$$

*Where:*

$CO_2 =$ *Emissions of $CO_2$ (Mg $CO_2$/hr)*

$CH_4 =$ *Emissions of $CH_4$ (Mg $CH_4$/hr)*

$10^{-6} =$ *Units conversion factor (Mg/g)*

$Q_S =$ *Waste sludge stream flow rate ($m^3$/hr)*

$MLVSS =$ *Mixed liquor volatile suspended solids concentration of the waste sludge stream (mg/L = g/$m^3$)*

$CF_S =$ *Correction factor for carbon content of the biomass (i.e., MLVSSS)*

$MCF_S =$ *methane correction factor for sludge digestion, indicating the fraction of the treated sludge that is converted anaerobically*

$BG_{CH4} =$ *Fraction of carbon as $CH_4$ in generated biogas*

*Assumptions:*

$Q_S =$ *240,000 gallons/day*

$MLVSS =$ *4,800 mg/L*

$CF_S =$ *0.53 g C/g MLVSS*

$MCF_S =$ *0*

$BG_{CH4} =$ *0.65*

Detailed calculations can be found in the **Appendix**.

**Table 6-2** shows that operational activities would generate approximately 33,568 $MTCO_2e$ per year when the project opens in 2029 or 2030. As previously discussed, total GHG emissions in Hawaii are projected to be 18.44 million $MTCO_2e$/year in 2025, and 17.49 million $MTCO_2e$/year in 2030. The proposed project would not substantially contribute to statewide emissions.

Hawaii is committed to renewable energy production, which does not generate GHG emissions. On the Island of Maui, approximately 35 percent of electricity is from renewable sources. Hawaii has enacted a law that mandates that all of the State's electricity comes from renewable sources no later than 2045, by which time the proposed project would be fully built out. **Table 6-2** shows anticipated proposed project emissions without electricity-related emissions. Operational activities would generate approximately 29,932 $MTCO_2e$ per year in 2045.

| **TABLE 6-2: ESTIMATED ANNUAL GREENHOUSE GAS EMISSIONS** | | |
|---|---|---|
| **Scenario and Emission Source** | **Carbon Dioxide Equivalent (Metric Tons per Year)** | |
| | **2029** | **2045** |
| Aerobic Sludge Digestion (Direct) | 26,711 | 26,711 |
| Energy Source Emissions (Indirect) | 3,636 | - |
| Aerobic Liquid Treatment Process (Direct) | 2,572 | 2,572 |
| Water Distribution Emissions (Indirect) | 350 | - |
| Waste Disposal Emissions (Indirect) | 251 | 251 |
| Mobile Source Emissions (Direct) | 38 | 38 |
| Area Source Emissions (Direct) | 10 | 10 |
| **TOTAL** | **33,568** | **29,932** |
| **SOURCE**: TAHA, 2024. | | |

# 7.0 CUMULATIVE EFFECTS

Section 11-200.1-2 of the Hawaii Administrative Rules contains the definition of a cumulative impact. A cumulative impact is defined as the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes the other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The State, through Act 234 and Senate Bill 559, has acknowledged that GHG emissions are a statewide impact. Permanent emissions generated by the proposed project in combination with past, present, and reasonably probable future related projects could contribute to this impact. Although climate change is cumulative in nature, not every individual project that emits GHGs must necessarily be found to contribute to a significant cumulative impact on the environment. Hawaii is committed to renewable energy production, which does not generate GHG emissions. Hawaii has enacted a law that mandates that all of the State's electricity comes from renewable sources no later than 2045, by which time the proposed project would be fully built out. Energy-related emissions would decline as the State moves toward a fully renewable supply of energy. The proposed project would not interfere with the development of clean energy supplies. Therefore, there is no potential for a significant contribution to a cumulative GHG impact.

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# 1. Basic Project Information

## 1.1. Basic Project Information

| Data Field | Value |
|---|---|
| Project Name | Maui WWRF |
| Construction Start Date | 6/7/2027 |
| Operational Year | 2029 |
| Lead Agency | — |
| Land Use Scale | Project/site |
| Analysis Level for Defaults | Statewide |
| Windspeed (m/s) | 2.70 |
| Precipitation (days) | 8.20 |
| Location | 34.02592335521025, -118.38166400346476 |
| County | Los Angeles-South Coast |
| City | Culver City |
| Air District | South Coast AQMD |
| Air Basin | South Coast |
| TAZ | 4457 |
| EDFZ | 16 |
| Electric Utility | Statewide Average |
| Gas Utility | Southern California Gas |
| App Version | 2022.1.1.24 |

## 1.2. Land Use Types

| Land Use Subtype | Size | Unit | Lot Acreage | Building Area (sq ft) | Landscape Area (sq ft) | Special Landscape Area (sq ft) | Population | Description |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| General Heavy Industry | 649 | 1000sqft | 14.9 | 649,045 | 0.00 | — | — | — |

### 1.3. User-Selected Emission Reduction Measures by Emissions Sector

| Sector | # | Measure Title |
|---|---|---|
| Construction | C-2* | Limit Heavy-Duty Diesel Vehicle Idling |

* Qualitative or supporting measure. Emission reductions not included in the mitigated emissions results.

# 2. Emissions Summary

## 2.1. Construction Emissions Compared Against Thresholds

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

| Un/Mit. | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 753 | 753 | 28.4 | 29.5 | 0.06 | 1.18 | 7.97 | 9.15 | 1.08 | 4.01 | 5.10 | — | 7,723 | 7,723 | 0.28 | 0.57 | 15.0 | 7,912 |
| Mit. | 753 | 753 | 28.4 | 29.5 | 0.06 | 1.18 | 7.97 | 9.15 | 1.08 | 4.01 | 5.10 | — | 7,723 | 7,723 | 0.28 | 0.57 | 15.0 | 7,912 |
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 1.96 | 1.62 | 13.2 | 21.9 | 0.05 | 0.35 | 3.01 | 3.37 | 0.33 | 0.74 | 1.07 | — | 7,568 | 7,568 | 0.22 | 0.57 | 0.39 | 7,744 |
| Mit. | 1.96 | 1.62 | 13.2 | 21.9 | 0.05 | 0.35 | 3.01 | 3.37 | 0.33 | 0.74 | 1.07 | — | 7,568 | 7,568 | 0.22 | 0.57 | 0.39 | 7,744 |
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unmit. | 41.5 | 41.5 | 8.90 | 15.5 | 0.03 | 0.23 | 2.15 | 2.38 | 0.21 | 0.53 | 0.74 | — | 5,360 | 5,360 | 0.14 | 0.39 | 4.18 | 5,484 |
| Mit. | 41.5 | 41.5 | 8.90 | 15.5 | 0.03 | 0.23 | 2.15 | 2.38 | 0.21 | 0.53 | 0.74 | — | 5,360 | 5,360 | 0.14 | 0.39 | 4.18 | 5,484 |
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Annual (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 7.58 | 7.57 | 1.62 | 2.83 | 0.01 | 0.04 | 0.39 | 0.43 | 0.04 | 0.10 | 0.14 | — | 887 | 887 | 0.02 | 0.06 | 0.69 | 908 |
| Mit. | 7.58 | 7.57 | 1.62 | 2.83 | 0.01 | 0.04 | 0.39 | 0.43 | 0.04 | 0.10 | 0.14 | — | 887 | 887 | 0.02 | 0.06 | 0.69 | 908 |
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

## 2.2. Construction Emissions by Year, Unmitigated

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

| Year | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily - Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 3.72 | 3.12 | 28.4 | 29.5 | 0.06 | 1.18 | 7.97 | 9.15 | 1.08 | 4.01 | 5.10 | — | 7,723 | 7,723 | 0.28 | 0.57 | 15.0 | 7,912 |
| 2028 | 1.92 | 1.60 | 12.2 | 23.2 | 0.05 | 0.32 | 3.01 | 3.33 | 0.30 | 0.74 | 1.04 | — | 7,603 | 7,603 | 0.19 | 0.54 | 13.5 | 7,784 |
| 2029 | 753 | 753 | 6.50 | 10.7 | 0.01 | 0.24 | 0.71 | 0.73 | 0.22 | 0.17 | 0.27 | — | 1,705 | 1,705 | 0.06 | 0.03 | 1.93 | 1,713 |
| Daily - Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 1.96 | 1.62 | 13.2 | 21.9 | 0.05 | 0.35 | 3.01 | 3.37 | 0.33 | 0.74 | 1.07 | — | 7,568 | 7,568 | 0.22 | 0.57 | 0.39 | 7,744 |
| 2028 | 1.83 | 1.57 | 12.5 | 21.3 | 0.05 | 0.32 | 3.01 | 3.33 | 0.30 | 0.74 | 1.04 | — | 7,452 | 7,452 | 0.20 | 0.54 | 0.35 | 7,619 |
| 2029 | 1.77 | 1.43 | 11.9 | 20.8 | 0.05 | 0.29 | 3.01 | 3.31 | 0.27 | 0.74 | 1.02 | — | 7,330 | 7,330 | 0.19 | 0.54 | 0.31 | 7,497 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 0.99 | 0.82 | 6.80 | 9.75 | 0.02 | 0.22 | 1.43 | 1.66 | 0.21 | 0.45 | 0.66 | — | 3,004 | 3,004 | 0.09 | 0.18 | 1.99 | 3,062 |
| 2028 | 1.31 | 1.12 | 8.90 | 15.5 | 0.03 | 0.23 | 2.15 | 2.38 | 0.21 | 0.53 | 0.74 | — | 5,360 | 5,360 | 0.14 | 0.39 | 4.18 | 5,484 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2029 | 41.5 | 41.5 | 1.99 | 3.58 | 0.01 | 0.05 | 0.45 | 0.50 | 0.05 | 0.11 | 0.16 | — | 1,116 | 1,116 | 0.03 | 0.07 | 0.75 | 1,140 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 0.18 | 0.15 | 1.24 | 1.78 | < 0.005 | 0.04 | 0.26 | 0.30 | 0.04 | 0.08 | 0.12 | — | 497 | 497 | 0.02 | 0.03 | 0.33 | 507 |
| 2028 | 0.24 | 0.20 | 1.62 | 2.83 | 0.01 | 0.04 | 0.39 | 0.43 | 0.04 | 0.10 | 0.14 | — | 887 | 887 | 0.02 | 0.06 | 0.69 | 908 |
| 2029 | 7.58 | 7.57 | 0.36 | 0.65 | < 0.005 | 0.01 | 0.08 | 0.09 | 0.01 | 0.02 | 0.03 | — | 185 | 185 | < 0.005 | 0.01 | 0.12 | 189 |

## 2.3. Construction Emissions by Year, Mitigated

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

| Year | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily - Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 3.72 | 3.12 | 28.4 | 29.5 | 0.06 | 1.18 | 7.97 | 9.15 | 1.08 | 4.01 | 5.10 | — | 7,723 | 7,723 | 0.28 | 0.57 | 15.0 | 7,912 |
| 2028 | 1.92 | 1.60 | 12.2 | 23.2 | 0.05 | 0.32 | 3.01 | 3.33 | 0.30 | 0.74 | 1.04 | — | 7,603 | 7,603 | 0.19 | 0.54 | 13.5 | 7,784 |
| 2029 | 753 | 753 | 6.50 | 10.7 | 0.01 | 0.24 | 0.71 | 0.73 | 0.22 | 0.17 | 0.27 | — | 1,705 | 1,705 | 0.06 | 0.03 | 1.93 | 1,713 |
| Daily - Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 1.96 | 1.62 | 13.2 | 21.9 | 0.05 | 0.35 | 3.01 | 3.37 | 0.33 | 0.74 | 1.07 | — | 7,568 | 7,568 | 0.22 | 0.57 | 0.39 | 7,744 |
| 2028 | 1.83 | 1.57 | 12.5 | 21.3 | 0.05 | 0.32 | 3.01 | 3.33 | 0.30 | 0.74 | 1.04 | — | 7,452 | 7,452 | 0.20 | 0.54 | 0.35 | 7,619 |
| 2029 | 1.77 | 1.43 | 11.9 | 20.8 | 0.05 | 0.29 | 3.01 | 3.31 | 0.27 | 0.74 | 1.02 | — | 7,330 | 7,330 | 0.19 | 0.54 | 0.31 | 7,497 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 0.99 | 0.82 | 6.80 | 9.75 | 0.02 | 0.22 | 1.43 | 1.66 | 0.21 | 0.45 | 0.66 | — | 3,004 | 3,004 | 0.09 | 0.18 | 1.99 | 3,062 |
| 2028 | 1.31 | 1.12 | 8.90 | 15.5 | 0.03 | 0.23 | 2.15 | 2.38 | 0.21 | 0.53 | 0.74 | — | 5,360 | 5,360 | 0.14 | 0.39 | 4.18 | 5,484 |
| 2029 | 41.5 | 41.5 | 1.99 | 3.58 | 0.01 | 0.05 | 0.45 | 0.50 | 0.05 | 0.11 | 0.16 | — | 1,116 | 1,116 | 0.03 | 0.07 | 0.75 | 1,140 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 0.18 | 0.15 | 1.24 | 1.78 | < 0.005 | 0.04 | 0.26 | 0.30 | 0.04 | 0.08 | 0.12 | — | 497 | 497 | 0.02 | 0.03 | 0.33 | 507 |
| 2028 | 0.24 | 0.20 | 1.62 | 2.83 | 0.01 | 0.04 | 0.39 | 0.43 | 0.04 | 0.10 | 0.14 | — | 887 | 887 | 0.02 | 0.06 | 0.69 | 908 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2029 | 7.58 | 7.57 | 0.36 | 0.65 | < 0.005 | 0.01 | 0.08 | 0.09 | 0.01 | 0.02 | 0.03 | — | 185 | 185 | < 0.005 | 0.01 | 0.12 | 189 |

## 2.4. Operations Emissions Compared Against Thresholds

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

| Un/Mit. | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 21.4 | 20.6 | 6.49 | 34.3 | 0.04 | 0.52 | 0.22 | 0.74 | 0.51 | 0.06 | 0.56 | 721 | 23,107 | 23,829 | 74.6 | 0.86 | 170 | 26,121 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 16.3 | 16.0 | 6.26 | 5.99 | 0.04 | 0.47 | 0.22 | 0.69 | 0.47 | 0.06 | 0.53 | 721 | 22,978 | 23,699 | 74.6 | 0.86 | 169 | 25,990 |
| Average Daily (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 18.8 | 18.3 | 6.37 | 19.9 | 0.04 | 0.49 | 0.22 | 0.71 | 0.49 | 0.06 | 0.54 | 721 | 23,038 | 23,759 | 74.6 | 0.86 | 169 | 26,051 |
| Annual (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 3.43 | 3.33 | 1.16 | 3.64 | 0.01 | 0.09 | 0.04 | 0.13 | 0.09 | 0.01 | 0.10 | 119 | 3,814 | 3,934 | 12.4 | 0.14 | 28.0 | 4,313 |

## 2.5. Operations Emissions by Sector, Unmitigated

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

| Sector | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Mobile | 0.12 | 0.11 | 0.09 | 0.91 | < 0.005 | < 0.005 | 0.22 | 0.22 | < 0.005 | 0.06 | 0.06 | — | 239 | 239 | 0.01 | 0.01 | 0.62 | 242 |
| Area | 20.6 | 20.2 | 0.24 | 28.2 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 116 | 116 | < 0.005 | < 0.005 | — | 116 |
| Energy | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 21,878 | 21,878 | 1.71 | 0.14 | — | 21,963 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Waste | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Refrig. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Total | 21.4 | 20.6 | 6.49 | 34.3 | 0.04 | 0.52 | 0.22 | 0.74 | 0.51 | 0.06 | 0.56 | 721 | 23,107 | 23,829 | 74.6 | 0.86 | 170 | 26,121 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Mobile | 0.11 | 0.10 | 0.10 | 0.82 | < 0.005 | < 0.005 | 0.22 | 0.22 | < 0.005 | 0.06 | 0.06 | — | 225 | 225 | 0.01 | 0.01 | 0.02 | 228 |
| Area | 15.5 | 15.5 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Energy | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 21,878 | 21,878 | 1.71 | 0.14 | — | 21,963 |
| Water | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Waste | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Refrig. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Total | 16.3 | 16.0 | 6.26 | 5.99 | 0.04 | 0.47 | 0.22 | 0.69 | 0.47 | 0.06 | 0.53 | 721 | 22,978 | 23,699 | 74.6 | 0.86 | 169 | 25,990 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Mobile | 0.11 | 0.10 | 0.10 | 0.83 | < 0.005 | < 0.005 | 0.22 | 0.22 | < 0.005 | 0.06 | 0.06 | — | 228 | 228 | 0.01 | 0.01 | 0.27 | 232 |
| Area | 18.0 | 17.8 | 0.12 | 13.9 | < 0.005 | 0.02 | — | 0.02 | 0.02 | — | 0.02 | — | 57.2 | 57.2 | < 0.005 | < 0.005 | — | 57.5 |
| Energy | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 21,878 | 21,878 | 1.71 | 0.14 | — | 21,963 |
| Water | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Waste | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Refrig. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Total | 18.8 | 18.3 | 6.37 | 19.9 | 0.04 | 0.49 | 0.22 | 0.71 | 0.49 | 0.06 | 0.54 | 721 | 23,038 | 23,759 | 74.6 | 0.86 | 169 | 26,051 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Mobile | 0.02 | 0.02 | 0.02 | 0.15 | < 0.005 | < 0.005 | 0.04 | 0.04 | < 0.005 | 0.01 | 0.01 | — | 37.7 | 37.7 | < 0.005 | < 0.005 | 0.04 | 38.3 |
| Area | 3.29 | 3.25 | 0.02 | 2.54 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 9.48 | 9.48 | < 0.005 | < 0.005 | — | 9.51 |
| Energy | 0.12 | 0.06 | 1.12 | 0.94 | 0.01 | 0.09 | — | 0.09 | 0.09 | — | 0.09 | — | 3,622 | 3,622 | 0.28 | 0.02 | — | 3,636 |
| Water | — | — | — | — | — | — | — | — | — | — | — | 47.6 | 145 | 192 | 4.89 | 0.12 | — | 350 |
| Waste | — | — | — | — | — | — | — | — | — | — | — | 71.8 | 0.00 | 71.8 | 7.18 | 0.00 | — | 251 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refrig. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 28.0 | 28.0 |
| Total | 3.43 | 3.33 | 1.16 | 3.64 | 0.01 | 0.09 | 0.04 | 0.13 | 0.09 | 0.01 | 0.10 | 119 | 3,814 | 3,934 | 12.4 | 0.14 | 28.0 | 4,313 |

## 2.6. Operations Emissions by Sector, Mitigated

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

| Sector | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Mobile | 0.12 | 0.11 | 0.09 | 0.91 | < 0.005 | < 0.005 | 0.22 | 0.22 | < 0.005 | 0.06 | 0.06 | — | 239 | 239 | 0.01 | 0.01 | 0.62 | 242 |
| Area | 20.6 | 20.2 | 0.24 | 28.2 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 116 | 116 | < 0.005 | < 0.005 | — | 116 |
| Energy | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 21,878 | 21,878 | 1.71 | 0.14 | — | 21,963 |
| Water | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Waste | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Refrig. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Total | 21.4 | 20.6 | 6.49 | 34.3 | 0.04 | 0.52 | 0.22 | 0.74 | 0.51 | 0.06 | 0.56 | 721 | 23,107 | 23,829 | 74.6 | 0.86 | 170 | 26,121 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Mobile | 0.11 | 0.10 | 0.10 | 0.82 | < 0.005 | < 0.005 | 0.22 | 0.22 | < 0.005 | 0.06 | 0.06 | — | 225 | 225 | 0.01 | 0.01 | 0.02 | 228 |
| Area | 15.5 | 15.5 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Energy | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 21,878 | 21,878 | 1.71 | 0.14 | — | 21,963 |
| Water | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Waste | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Refrig. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Total | 16.3 | 16.0 | 6.26 | 5.99 | 0.04 | 0.47 | 0.22 | 0.69 | 0.47 | 0.06 | 0.53 | 721 | 22,978 | 23,699 | 74.6 | 0.86 | 169 | 25,990 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Mobile | 0.11 | 0.10 | 0.10 | 0.83 | < 0.005 | < 0.005 | 0.22 | 0.22 | < 0.005 | 0.06 | 0.06 | — | 228 | 228 | 0.01 | 0.01 | 0.27 | 232 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Area | 18.0 | 17.8 | 0.12 | 13.9 | < 0.005 | 0.02 | — | 0.02 | 0.02 | — | 0.02 | — | 57.2 | 57.2 | < 0.005 | < 0.005 | — | 57.5 |
| Energy | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 21,878 | 21,878 | 1.71 | 0.14 | — | 21,963 |
| Water | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Waste | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Refrig. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Total | 18.8 | 18.3 | 6.37 | 19.9 | 0.04 | 0.49 | 0.22 | 0.71 | 0.49 | 0.06 | 0.54 | 721 | 23,038 | 23,759 | 74.6 | 0.86 | 169 | 26,051 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Mobile | 0.02 | 0.02 | 0.02 | 0.15 | < 0.005 | < 0.005 | 0.04 | 0.04 | < 0.005 | 0.01 | 0.01 | — | 37.7 | 37.7 | < 0.005 | < 0.005 | 0.04 | 38.3 |
| Area | 3.29 | 3.25 | 0.02 | 2.54 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 9.48 | 9.48 | < 0.005 | < 0.005 | — | 9.51 |
| Energy | 0.12 | 0.06 | 1.12 | 0.94 | 0.01 | 0.09 | — | 0.09 | 0.09 | — | 0.09 | — | 3,622 | 3,622 | 0.28 | 0.02 | — | 3,636 |
| Water | — | — | — | — | — | — | — | — | — | — | — | 47.6 | 145 | 192 | 4.89 | 0.12 | — | 350 |
| Waste | — | — | — | — | — | — | — | — | — | — | — | 71.8 | 0.00 | 71.8 | 7.18 | 0.00 | — | 251 |
| Refrig. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 28.0 | 28.0 |
| Total | 3.43 | 3.33 | 1.16 | 3.64 | 0.01 | 0.09 | 0.04 | 0.13 | 0.09 | 0.01 | 0.10 | 119 | 3,814 | 3,934 | 12.4 | 0.14 | 28.0 | 4,313 |

# 3. Construction Emissions Details

## 3.1. Site Preparation (2027) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 3.63 | 3.05 | 28.0 | 28.3 | 0.05 | 1.17 | — | 1.17 | 1.08 | — | 1.08 | — | 5,298 | 5,298 | 0.21 | 0.04 | — | 5,316 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dust From Material Movement | — | — | — | — | — | — | 7.67 | 7.67 | — | 3.94 | 3.94 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.10 | 0.08 | 0.77 | 0.77 | < 0.005 | 0.03 | — | 0.03 | 0.03 | — | 0.03 | — | 145 | 145 | 0.01 | < 0.005 | — | 146 |
| Dust From Material Movement | — | — | — | — | — | — | 0.21 | 0.21 | — | 0.11 | 0.11 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.02 | 0.02 | 0.14 | 0.14 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 24.0 | 24.0 | < 0.005 | < 0.005 | — | 24.1 |
| Dust From Material Movement | — | — | — | — | — | — | 0.04 | 0.04 | — | 0.02 | 0.02 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.08 | 0.07 | 0.06 | 1.09 | 0.00 | 0.00 | 0.23 | 0.23 | 0.00 | 0.05 | 0.05 | — | 236 | 236 | < 0.005 | 0.01 | 0.77 | 239 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.02 | < 0.005 | 0.32 | 0.10 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 267 | 267 | 0.01 | 0.04 | 0.60 | 281 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.02 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 6.09 | 6.09 | < 0.005 | < 0.005 | 0.01 | 6.17 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 7.32 | 7.32 | < 0.005 | < 0.005 | 0.01 | 7.68 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | < 0.005 | 0.00 | 0.00 | < 0.005 | < 0.005 | 0.00 | < 0.005 | < 0.005 | — | 1.01 | 1.01 | < 0.005 | < 0.005 | < 0.005 | 1.02 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 1.21 | 1.21 | < 0.005 | < 0.005 | < 0.005 | 1.27 |

## 3.2. Site Preparation (2027) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 3.63 | 3.05 | 28.0 | 28.3 | 0.05 | 1.17 | — | 1.17 | 1.08 | — | 1.08 | — | 5,298 | 5,298 | 0.21 | 0.04 | — | 5,316 |
| Dust From Material Movement | — | — | — | — | — | — | 7.67 | 7.67 | — | 3.94 | 3.94 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.10 | 0.08 | 0.77 | 0.77 | < 0.005 | 0.03 | — | 0.03 | 0.03 | — | 0.03 | — | 145 | 145 | 0.01 | < 0.005 | — | 146 |
| Dust From Material Movement | — | — | — | — | — | — | 0.21 | 0.21 | — | 0.11 | 0.11 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.02 | 0.02 | 0.14 | 0.14 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 24.0 | 24.0 | < 0.005 | < 0.005 | — | 24.1 |
| Dust From Material Movement | — | — | — | — | — | — | 0.04 | 0.04 | — | 0.02 | 0.02 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.08 | 0.07 | 0.06 | 1.09 | 0.00 | 0.00 | 0.23 | 0.23 | 0.00 | 0.05 | 0.05 | — | 236 | 236 | < 0.005 | 0.01 | 0.77 | 239 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.02 | < 0.005 | 0.32 | 0.10 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 267 | 267 | 0.01 | 0.04 | 0.60 | 281 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.02 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 6.09 | 6.09 | < 0.005 | < 0.005 | 0.01 | 6.17 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hauling | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 7.32 | 7.32 | < 0.005 | < 0.005 | 0.01 | 7.68 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | < 0.005 | 0.00 | 0.00 | < 0.005 | < 0.005 | 0.00 | < 0.005 | < 0.005 | — | 1.01 | 1.01 | < 0.005 | < 0.005 | < 0.005 | 1.02 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 1.21 | 1.21 | < 0.005 | < 0.005 | < 0.005 | 1.27 |

## 3.3. Grading (2027) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 3.51 | 2.95 | 25.6 | 27.3 | 0.06 | 1.04 | — | 1.04 | 0.96 | — | 0.96 | — | 6,598 | 6,598 | 0.27 | 0.05 | — | 6,621 |
| Dust From Material Movement | — | — | — | — | — | — | 3.59 | 3.59 | — | 1.42 | 1.42 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.29 | 0.24 | 2.10 | 2.24 | 0.01 | 0.09 | — | 0.09 | 0.08 | — | 0.08 | — | 542 | 542 | 0.02 | < 0.005 | — | 544 |
| Dust From Material Movement | — | — | — | — | — | — | 0.30 | 0.30 | — | 0.12 | 0.12 | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.05 | 0.04 | 0.38 | 0.41 | < 0.005 | 0.02 | — | 0.02 | 0.01 | — | 0.01 | — | 89.8 | 89.8 | < 0.005 | < 0.005 | — | 90.1 |
| Dust From Material Movement | — | — | — | — | — | — | 0.05 | 0.05 | — | 0.02 | 0.02 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.09 | 0.08 | 0.07 | 1.24 | 0.00 | 0.00 | 0.26 | 0.26 | 0.00 | 0.06 | 0.06 | — | 269 | 269 | < 0.005 | 0.01 | 0.88 | 273 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.02 | < 0.005 | 0.32 | 0.10 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 267 | 267 | 0.01 | 0.04 | 0.60 | 281 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.09 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | 0.01 | 0.01 | — | 20.9 | 20.9 | < 0.005 | < 0.005 | 0.03 | 21.1 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.03 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 22.0 | 22.0 | < 0.005 | < 0.005 | 0.02 | 23.0 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.02 | 0.00 | 0.00 | < 0.005 | < 0.005 | 0.00 | < 0.005 | < 0.005 | — | 3.46 | 3.46 | < 0.005 | < 0.005 | 0.01 | 3.50 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 3.64 | 3.64 | < 0.005 | < 0.005 | < 0.005 | 3.81 |

## 3.4. Grading (2027) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 3.51 | 2.95 | 25.6 | 27.3 | 0.06 | 1.04 | — | 1.04 | 0.96 | — | 0.96 | — | 6,598 | 6,598 | 0.27 | 0.05 | — | 6,621 |
| Dust From Material Movement | — | — | — | — | — | — | 3.59 | 3.59 | — | 1.42 | 1.42 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.29 | 0.24 | 2.10 | 2.24 | 0.01 | 0.09 | — | 0.09 | 0.08 | — | 0.08 | — | 542 | 542 | 0.02 | < 0.005 | — | 544 |
| Dust From Material Movement | — | — | — | — | — | — | 0.30 | 0.30 | — | 0.12 | 0.12 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.05 | 0.04 | 0.38 | 0.41 | < 0.005 | 0.02 | — | 0.02 | 0.01 | — | 0.01 | — | 89.8 | 89.8 | < 0.005 | < 0.005 | — | 90.1 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dust From Material Movement | — | — | — | — | — | — | 0.05 | 0.05 | — | 0.02 | 0.02 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.09 | 0.08 | 0.07 | 1.24 | 0.00 | 0.00 | 0.26 | 0.26 | 0.00 | 0.06 | 0.06 | — | 269 | 269 | < 0.005 | 0.01 | 0.88 | 273 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.02 | < 0.005 | 0.32 | 0.10 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 267 | 267 | 0.01 | 0.04 | 0.60 | 281 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.09 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | 0.01 | 0.01 | — | 20.9 | 20.9 | < 0.005 | < 0.005 | 0.03 | 21.1 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.03 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 22.0 | 22.0 | < 0.005 | < 0.005 | 0.02 | 23.0 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.02 | 0.00 | 0.00 | < 0.005 | < 0.005 | 0.00 | < 0.005 | < 0.005 | — | 3.46 | 3.46 | < 0.005 | < 0.005 | 0.01 | 3.50 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 3.64 | 3.64 | < 0.005 | < 0.005 | < 0.005 | 3.81 |

## 3.5. Building Construction (2027) - Unmitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.11 | 0.93 | 8.60 | 12.4 | 0.02 | 0.31 | — | 0.31 | 0.28 | — | 0.28 | — | 2,293 | 2,293 | 0.09 | 0.02 | — | 2,301 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.11 | 0.93 | 8.60 | 12.4 | 0.02 | 0.31 | — | 0.31 | 0.28 | — | 0.28 | — | 2,293 | 2,293 | 0.09 | 0.02 | — | 2,301 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.33 | 0.28 | 2.56 | 3.69 | 0.01 | 0.09 | — | 0.09 | 0.08 | — | 0.08 | — | 682 | 682 | 0.03 | 0.01 | — | 684 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.06 | 0.05 | 0.47 | 0.67 | < 0.005 | 0.02 | — | 0.02 | 0.02 | — | 0.02 | — | 113 | 113 | < 0.005 | < 0.005 | — | 113 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.70 | 0.62 | 0.56 | 10.0 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,168 | 2,168 | 0.02 | 0.08 | 7.07 | 2,199 |
| Vendor | 0.20 | 0.10 | 3.67 | 1.45 | 0.02 | 0.05 | 0.91 | 0.96 | 0.05 | 0.25 | 0.30 | — | 3,261 | 3,261 | 0.10 | 0.47 | 7.90 | 3,412 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.68 | 0.60 | 0.71 | 8.04 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,011 | 2,011 | 0.03 | 0.08 | 0.18 | 2,036 |
| Vendor | 0.17 | 0.09 | 3.86 | 1.47 | 0.02 | 0.05 | 0.91 | 0.96 | 0.05 | 0.25 | 0.30 | — | 3,263 | 3,263 | 0.10 | 0.47 | 0.20 | 3,407 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.20 | 0.18 | 0.19 | 2.48 | 0.00 | 0.00 | 0.62 | 0.62 | 0.00 | 0.15 | 0.15 | — | 608 | 608 | 0.01 | 0.02 | 0.91 | 616 |
| Vendor | 0.06 | 0.03 | 1.14 | 0.44 | 0.01 | 0.01 | 0.27 | 0.28 | 0.01 | 0.07 | 0.09 | — | 970 | 970 | 0.03 | 0.14 | 1.01 | 1,014 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.04 | 0.03 | 0.03 | 0.45 | 0.00 | 0.00 | 0.11 | 0.11 | 0.00 | 0.03 | 0.03 | — | 101 | 101 | < 0.005 | < 0.005 | 0.15 | 102 |
| Vendor | 0.01 | 0.01 | 0.21 | 0.08 | < 0.005 | < 0.005 | 0.05 | 0.05 | < 0.005 | 0.01 | 0.02 | — | 161 | 161 | < 0.005 | 0.02 | 0.17 | 168 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.6. Building Construction (2027) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.11 | 0.93 | 8.60 | 12.4 | 0.02 | 0.31 | — | 0.31 | 0.28 | — | 0.28 | — | 2,293 | 2,293 | 0.09 | 0.02 | — | 2,301 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Off-Road Equipment | 1.11 | 0.93 | 8.60 | 12.4 | 0.02 | 0.31 | — | 0.31 | 0.28 | — | 0.28 | — | 2,293 | 2,293 | 0.09 | 0.02 | — | 2,301 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.33 | 0.28 | 2.56 | 3.69 | 0.01 | 0.09 | — | 0.09 | 0.08 | — | 0.08 | — | 682 | 682 | 0.03 | 0.01 | — | 684 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.06 | 0.05 | 0.47 | 0.67 | < 0.005 | 0.02 | — | 0.02 | 0.02 | — | 0.02 | — | 113 | 113 | < 0.005 | < 0.005 | — | 113 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.70 | 0.62 | 0.56 | 10.0 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,168 | 2,168 | 0.02 | 0.08 | 7.07 | 2,199 |
| Vendor | 0.20 | 0.10 | 3.67 | 1.45 | 0.02 | 0.05 | 0.91 | 0.96 | 0.05 | 0.25 | 0.30 | — | 3,261 | 3,261 | 0.10 | 0.47 | 7.90 | 3,412 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.68 | 0.60 | 0.71 | 8.04 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,011 | 2,011 | 0.03 | 0.08 | 0.18 | 2,036 |
| Vendor | 0.17 | 0.09 | 3.86 | 1.47 | 0.02 | 0.05 | 0.91 | 0.96 | 0.05 | 0.25 | 0.30 | — | 3,263 | 3,263 | 0.10 | 0.47 | 0.20 | 3,407 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.20 | 0.18 | 0.19 | 2.48 | 0.00 | 0.00 | 0.62 | 0.62 | 0.00 | 0.15 | 0.15 | — | 608 | 608 | 0.01 | 0.02 | 0.91 | 616 |
| Vendor | 0.06 | 0.03 | 1.14 | 0.44 | 0.01 | 0.01 | 0.27 | 0.28 | 0.01 | 0.07 | 0.09 | — | 970 | 970 | 0.03 | 0.14 | 1.01 | 1,014 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.04 | 0.03 | 0.03 | 0.45 | 0.00 | 0.00 | 0.11 | 0.11 | 0.00 | 0.03 | 0.03 | — | 101 | 101 | < 0.005 | < 0.005 | 0.15 | 102 |
| Vendor | 0.01 | 0.01 | 0.21 | 0.08 | < 0.005 | < 0.005 | 0.05 | 0.05 | < 0.005 | 0.01 | 0.02 | — | 161 | 161 | < 0.005 | 0.02 | 0.17 | 168 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.7. Building Construction (2028) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.07 | 0.89 | 8.14 | 12.4 | 0.02 | 0.27 | — | 0.27 | 0.25 | — | 0.25 | — | 2,294 | 2,294 | 0.09 | 0.02 | — | 2,301 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.07 | 0.89 | 8.14 | 12.4 | 0.02 | 0.27 | — | 0.27 | 0.25 | — | 0.25 | — | 2,294 | 2,294 | 0.09 | 0.02 | — | 2,301 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.76 | 0.64 | 5.83 | 8.89 | 0.02 | 0.19 | — | 0.19 | 0.18 | — | 0.18 | — | 1,643 | 1,643 | 0.07 | 0.01 | — | 1,648 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Off-Road Equipment | 0.14 | 0.12 | 1.06 | 1.62 | < 0.005 | 0.04 | — | 0.04 | 0.03 | — | 0.03 | — | 272 | 272 | 0.01 | < 0.005 | — | 273 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.68 | 0.60 | 0.56 | 9.35 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,129 | 2,129 | 0.02 | 0.08 | 6.38 | 2,158 |
| Vendor | 0.18 | 0.10 | 3.51 | 1.40 | 0.02 | 0.05 | 0.91 | 0.96 | 0.05 | 0.25 | 0.30 | — | 3,181 | 3,181 | 0.07 | 0.45 | 7.15 | 3,324 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.59 | 0.58 | 0.64 | 7.49 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 1,975 | 1,975 | 0.03 | 0.08 | 0.17 | 1,998 |
| Vendor | 0.17 | 0.09 | 3.71 | 1.41 | 0.02 | 0.05 | 0.91 | 0.96 | 0.05 | 0.25 | 0.30 | — | 3,183 | 3,183 | 0.07 | 0.45 | 0.19 | 3,319 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.42 | 0.41 | 0.45 | 5.59 | 0.00 | 0.00 | 1.50 | 1.50 | 0.00 | 0.35 | 0.35 | — | 1,438 | 1,438 | 0.02 | 0.05 | 1.97 | 1,457 |
| Vendor | 0.12 | 0.07 | 2.61 | 1.00 | 0.02 | 0.03 | 0.65 | 0.68 | 0.03 | 0.18 | 0.21 | — | 2,279 | 2,279 | 0.05 | 0.32 | 2.21 | 2,379 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.08 | 0.07 | 0.08 | 1.02 | 0.00 | 0.00 | 0.27 | 0.27 | 0.00 | 0.06 | 0.06 | — | 238 | 238 | < 0.005 | 0.01 | 0.33 | 241 |
| Vendor | 0.02 | 0.01 | 0.48 | 0.18 | < 0.005 | 0.01 | 0.12 | 0.12 | 0.01 | 0.03 | 0.04 | — | 377 | 377 | 0.01 | 0.05 | 0.37 | 394 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.8. Building Construction (2028) - Mitigated

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

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

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.07 | 0.89 | 8.14 | 12.4 | 0.02 | 0.27 | — | 0.27 | 0.25 | — | 0.25 | — | 2,294 | 2,294 | 0.09 | 0.02 | — | 2,301 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.07 | 0.89 | 8.14 | 12.4 | 0.02 | 0.27 | — | 0.27 | 0.25 | — | 0.25 | — | 2,294 | 2,294 | 0.09 | 0.02 | — | 2,301 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.76 | 0.64 | 5.83 | 8.89 | 0.02 | 0.19 | — | 0.19 | 0.18 | — | 0.18 | — | 1,643 | 1,643 | 0.07 | 0.01 | — | 1,648 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.14 | 0.12 | 1.06 | 1.62 | < 0.005 | 0.04 | — | 0.04 | 0.03 | — | 0.03 | — | 272 | 272 | 0.01 | < 0.005 | — | 273 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.68 | 0.60 | 0.56 | 9.35 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,129 | 2,129 | 0.02 | 0.08 | 6.38 | 2,158 |
| Vendor | 0.18 | 0.10 | 3.51 | 1.40 | 0.02 | 0.05 | 0.91 | 0.96 | 0.05 | 0.25 | 0.30 | — | 3,181 | 3,181 | 0.07 | 0.45 | 7.15 | 3,324 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.59 | 0.58 | 0.64 | 7.49 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 1,975 | 1,975 | 0.03 | 0.08 | 0.17 | 1,998 |
| Vendor | 0.17 | 0.09 | 3.71 | 1.41 | 0.02 | 0.05 | 0.91 | 0.96 | 0.05 | 0.25 | 0.30 | — | 3,183 | 3,183 | 0.07 | 0.45 | 0.19 | 3,319 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.42 | 0.41 | 0.45 | 5.59 | 0.00 | 0.00 | 1.50 | 1.50 | 0.00 | 0.35 | 0.35 | — | 1,438 | 1,438 | 0.02 | 0.05 | 1.97 | 1,457 |
| Vendor | 0.12 | 0.07 | 2.61 | 1.00 | 0.02 | 0.03 | 0.65 | 0.68 | 0.03 | 0.18 | 0.21 | — | 2,279 | 2,279 | 0.05 | 0.32 | 2.21 | 2,379 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.08 | 0.07 | 0.08 | 1.02 | 0.00 | 0.00 | 0.27 | 0.27 | 0.00 | 0.06 | 0.06 | — | 238 | 238 | < 0.005 | 0.01 | 0.33 | 241 |
| Vendor | 0.02 | 0.01 | 0.48 | 0.18 | < 0.005 | 0.01 | 0.12 | 0.12 | 0.01 | 0.03 | 0.04 | — | 377 | 377 | 0.01 | 0.05 | 0.37 | 394 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.9. Building Construction (2029) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.04 | 0.87 | 7.80 | 12.4 | 0.02 | 0.24 | — | 0.24 | 0.23 | — | 0.23 | — | 2,293 | 2,293 | 0.09 | 0.02 | — | 2,301 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.14 | 0.12 | 1.04 | 1.65 | < 0.005 | 0.03 | — | 0.03 | 0.03 | — | 0.03 | — | 305 | 305 | 0.01 | < 0.005 | — | 306 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.03 | 0.02 | 0.19 | 0.30 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 50.5 | 50.5 | < 0.005 | < 0.005 | — | 50.7 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.56 | 0.49 | 0.56 | 7.01 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 1,940 | 1,940 | 0.03 | 0.08 | 0.15 | 1,964 |
| Vendor | 0.17 | 0.07 | 3.55 | 1.36 | 0.02 | 0.05 | 0.91 | 0.96 | 0.05 | 0.25 | 0.30 | — | 3,096 | 3,096 | 0.07 | 0.45 | 0.17 | 3,232 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.08 | 0.07 | 0.07 | 0.98 | 0.00 | 0.00 | 0.28 | 0.28 | 0.00 | 0.07 | 0.07 | — | 262 | 262 | < 0.005 | 0.01 | 0.33 | 266 |
| Vendor | 0.02 | 0.01 | 0.46 | 0.18 | < 0.005 | 0.01 | 0.12 | 0.13 | 0.01 | 0.03 | 0.04 | — | 412 | 412 | 0.01 | 0.06 | 0.37 | 430 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.18 | 0.00 | 0.00 | 0.05 | 0.05 | 0.00 | 0.01 | 0.01 | — | 43.5 | 43.5 | < 0.005 | < 0.005 | 0.05 | 44.0 |
| Vendor | < 0.005 | < 0.005 | 0.08 | 0.03 | < 0.005 | < 0.005 | 0.02 | 0.02 | < 0.005 | 0.01 | 0.01 | — | 68.2 | 68.2 | < 0.005 | 0.01 | 0.06 | 71.2 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.10. Building Construction (2029) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.04 | 0.87 | 7.80 | 12.4 | 0.02 | 0.24 | — | 0.24 | 0.23 | — | 0.23 | — | 2,293 | 2,293 | 0.09 | 0.02 | — | 2,301 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.14 | 0.12 | 1.04 | 1.65 | < 0.005 | 0.03 | — | 0.03 | 0.03 | — | 0.03 | — | 305 | 305 | 0.01 | < 0.005 | — | 306 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.03 | 0.02 | 0.19 | 0.30 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 50.5 | 50.5 | < 0.005 | < 0.005 | — | 50.7 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Worker | 0.56 | 0.49 | 0.56 | 7.01 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 1,940 | 1,940 | 0.03 | 0.08 | 0.15 | 1,964 |
| Vendor | 0.17 | 0.07 | 3.55 | 1.36 | 0.02 | 0.05 | 0.91 | 0.96 | 0.05 | 0.25 | 0.30 | — | 3,096 | 3,096 | 0.07 | 0.45 | 0.17 | 3,232 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.08 | 0.07 | 0.07 | 0.98 | 0.00 | 0.00 | 0.28 | 0.28 | 0.00 | 0.07 | 0.07 | — | 262 | 262 | < 0.005 | 0.01 | 0.33 | 266 |
| Vendor | 0.02 | 0.01 | 0.46 | 0.18 | < 0.005 | 0.01 | 0.12 | 0.13 | 0.01 | 0.03 | 0.04 | — | 412 | 412 | 0.01 | 0.06 | 0.37 | 430 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.18 | 0.00 | 0.00 | 0.05 | 0.05 | 0.00 | 0.01 | 0.01 | — | 43.5 | 43.5 | < 0.005 | < 0.005 | 0.05 | 44.0 |
| Vendor | < 0.005 | < 0.005 | 0.08 | 0.03 | < 0.005 | < 0.005 | 0.02 | 0.02 | < 0.005 | 0.01 | 0.01 | — | 68.2 | 68.2 | < 0.005 | 0.01 | 0.06 | 71.2 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.11. Paving (2029) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.80 | 0.67 | 6.46 | 9.92 | 0.01 | 0.24 | — | 0.24 | 0.22 | — | 0.22 | — | 1,511 | 1,511 | 0.06 | 0.01 | — | 1,516 |
| Paving | 0.00 | 0.00 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.80 | 0.67 | 6.46 | 9.92 | 0.01 | 0.24 | — | 0.24 | 0.22 | — | 0.22 | — | 1,511 | 1,511 | 0.06 | 0.01 | — | 1,516 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Paving | 0.00 | 0.00 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.04 | 0.04 | 0.35 | 0.54 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 82.8 | 82.8 | < 0.005 | < 0.005 | — | 83.1 |
| Paving | 0.00 | 0.00 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.01 | 0.01 | 0.06 | 0.10 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 13.7 | 13.7 | < 0.005 | < 0.005 | — | 13.8 |
| Paving | 0.00 | 0.00 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.05 | 0.05 | 0.05 | 0.82 | 0.00 | 0.00 | 0.20 | 0.20 | 0.00 | 0.05 | 0.05 | — | 195 | 195 | < 0.005 | 0.01 | 0.53 | 198 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.05 | 0.05 | 0.05 | 0.65 | 0.00 | 0.00 | 0.20 | 0.20 | 0.00 | 0.05 | 0.05 | — | 181 | 181 | < 0.005 | 0.01 | 0.01 | 183 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.04 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 10.1 | 10.1 | < 0.005 | < 0.005 | 0.01 | 10.2 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.01 | 0.00 | 0.00 | < 0.005 | < 0.005 | 0.00 | < 0.005 | < 0.005 | — | 1.67 | 1.67 | < 0.005 | < 0.005 | < 0.005 | 1.69 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.12. Paving (2029) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.80 | 0.67 | 6.46 | 9.92 | 0.01 | 0.24 | — | 0.24 | 0.22 | — | 0.22 | — | 1,511 | 1,511 | 0.06 | 0.01 | — | 1,516 |
| Paving | 0.00 | 0.00 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.80 | 0.67 | 6.46 | 9.92 | 0.01 | 0.24 | — | 0.24 | 0.22 | — | 0.22 | — | 1,511 | 1,511 | 0.06 | 0.01 | — | 1,516 |
| Paving | 0.00 | 0.00 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.04 | 0.04 | 0.35 | 0.54 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 82.8 | 82.8 | < 0.005 | < 0.005 | — | 83.1 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Paving | 0.00 | 0.00 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.01 | 0.01 | 0.06 | 0.10 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 13.7 | 13.7 | < 0.005 | < 0.005 | — | 13.8 |
| Paving | 0.00 | 0.00 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.05 | 0.05 | 0.05 | 0.82 | 0.00 | 0.00 | 0.20 | 0.20 | 0.00 | 0.05 | 0.05 | — | 195 | 195 | < 0.005 | 0.01 | 0.53 | 198 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.05 | 0.05 | 0.05 | 0.65 | 0.00 | 0.00 | 0.20 | 0.20 | 0.00 | 0.05 | 0.05 | — | 181 | 181 | < 0.005 | 0.01 | 0.01 | 183 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.04 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 10.1 | 10.1 | < 0.005 | < 0.005 | 0.01 | 10.2 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.01 | 0.00 | 0.00 | < 0.005 | < 0.005 | 0.00 | < 0.005 | < 0.005 | — | 1.67 | 1.67 | < 0.005 | < 0.005 | < 0.005 | 1.69 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

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| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.13. Architectural Coating (2029) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.12 | 0.10 | 0.79 | 1.11 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 134 | 134 | 0.01 | < 0.005 | — | 134 |
| Architectural Coatings | 752 | 752 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.01 | 0.01 | 0.04 | 0.06 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 7.32 | 7.32 | < 0.005 | < 0.005 | — | 7.34 |
| Architectural Coatings | 41.2 | 41.2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 1.21 | 1.21 | < 0.005 | < 0.005 | — | 1.22 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Architectural Coatings | 7.52 | 7.52 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.20 | 0.20 | 0.16 | 2.97 | 0.00 | 0.00 | 0.71 | 0.71 | 0.00 | 0.17 | 0.17 | — | 708 | 708 | 0.01 | 0.03 | 1.93 | 718 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.14 | 0.00 | 0.00 | 0.04 | 0.04 | 0.00 | 0.01 | 0.01 | — | 36.6 | 36.6 | < 0.005 | < 0.005 | 0.05 | 37.1 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.02 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 6.06 | 6.06 | < 0.005 | < 0.005 | 0.01 | 6.14 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.14. Architectural Coating (2029) - Mitigated

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

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

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.12 | 0.10 | 0.79 | 1.11 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 134 | 134 | 0.01 | < 0.005 | — | 134 |
| Architectural Coatings | 752 | 752 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.01 | 0.01 | 0.04 | 0.06 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 7.32 | 7.32 | < 0.005 | < 0.005 | — | 7.34 |
| Architectural Coatings | 41.2 | 41.2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 1.21 | 1.21 | < 0.005 | < 0.005 | — | 1.22 |
| Architectural Coatings | 7.52 | 7.52 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.20 | 0.20 | 0.16 | 2.97 | 0.00 | 0.00 | 0.71 | 0.71 | 0.00 | 0.17 | 0.17 | — | 708 | 708 | 0.01 | 0.03 | 1.93 | 718 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.14 | 0.00 | 0.00 | 0.04 | 0.04 | 0.00 | 0.01 | 0.01 | — | 36.6 | 36.6 | < 0.005 | < 0.005 | 0.05 | 37.1 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.02 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 6.06 | 6.06 | < 0.005 | < 0.005 | 0.01 | 6.14 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

# 4. Operations Emissions Details

## 4.1. Mobile Emissions by Land Use

### 4.1.1. Unmitigated

Mobile source emissions results are presented in Sections 2.6. No further detailed breakdown of emissions is available.

### 4.1.2. Mitigated

Mobile source emissions results are presented in Sections 2.5. No further detailed breakdown of emissions is available.

## 4.2. Energy

### 4.2.1. Electricity Emissions By Land Use - Unmitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | 14,528 | 14,528 | 1.06 | 0.13 | — | 14,592 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | 14,528 | 14,528 | 1.06 | 0.13 | — | 14,592 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | 14,528 | 14,528 | 1.06 | 0.13 | — | 14,592 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | 14,528 | 14,528 | 1.06 | 0.13 | — | 14,592 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | 2,405 | 2,405 | 0.18 | 0.02 | — | 2,416 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | 2,405 | 2,405 | 0.18 | 0.02 | — | 2,416 |

### 4.2.2. Electricity Emissions By Land Use - Mitigated

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

| Land Use | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | 14,528 | 14,528 | 1.06 | 0.13 | — | 14,592 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | 14,528 | 14,528 | 1.06 | 0.13 | — | 14,592 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | 14,528 | 14,528 | 1.06 | 0.13 | — | 14,592 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | 14,528 | 14,528 | 1.06 | 0.13 | — | 14,592 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | 2,405 | 2,405 | 0.18 | 0.02 | — | 2,416 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | 2,405 | 2,405 | 0.18 | 0.02 | — | 2,416 |

### 4.2.3. Natural Gas Emissions By Land Use - Unmitigated

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

| Land Use | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 7,350 | 7,350 | 0.65 | 0.01 | — | 7,371 |
| Total | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 7,350 | 7,350 | 0.65 | 0.01 | — | 7,371 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 7,350 | 7,350 | 0.65 | 0.01 | — | 7,371 |
| Total | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 7,350 | 7,350 | 0.65 | 0.01 | — | 7,371 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | 0.12 | 0.06 | 1.12 | 0.94 | 0.01 | 0.09 | — | 0.09 | 0.09 | — | 0.09 | — | 1,217 | 1,217 | 0.11 | < 0.005 | — | 1,220 |
| Total | 0.12 | 0.06 | 1.12 | 0.94 | 0.01 | 0.09 | — | 0.09 | 0.09 | — | 0.09 | — | 1,217 | 1,217 | 0.11 | < 0.005 | — | 1,220 |

### 4.2.4. Natural Gas Emissions By Land Use - Mitigated

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

| Land Use | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 7,350 | 7,350 | 0.65 | 0.01 | — | 7,371 |
| Total | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 7,350 | 7,350 | 0.65 | 0.01 | — | 7,371 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 7,350 | 7,350 | 0.65 | 0.01 | — | 7,371 |
| Total | 0.68 | 0.34 | 6.16 | 5.17 | 0.04 | 0.47 | — | 0.47 | 0.47 | — | 0.47 | — | 7,350 | 7,350 | 0.65 | 0.01 | — | 7,371 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | 0.12 | 0.06 | 1.12 | 0.94 | 0.01 | 0.09 | — | 0.09 | 0.09 | — | 0.09 | — | 1,217 | 1,217 | 0.11 | < 0.005 | — | 1,220 |
| Total | 0.12 | 0.06 | 1.12 | 0.94 | 0.01 | 0.09 | — | 0.09 | 0.09 | — | 0.09 | — | 1,217 | 1,217 | 0.11 | < 0.005 | — | 1,220 |

## 4.3. Area Emissions by Source

### 4.3.1. Unmitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Consum Products | 13.9 | 13.9 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Architectural Coatings | 1.65 | 1.65 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Landscape Equipment | 5.03 | 4.64 | 0.24 | 28.2 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 116 | 116 | < 0.005 | < 0.005 | — | 116 |
| Total | 20.6 | 20.2 | 0.24 | 28.2 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 116 | 116 | < 0.005 | < 0.005 | — | 116 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Consumer Products | 13.9 | 13.9 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Architectural Coatings | 1.65 | 1.65 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Total | 15.5 | 15.5 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Consumer Products | 2.53 | 2.53 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Architectural Coatings | 0.30 | 0.30 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Landscape Equipment | 0.45 | 0.42 | 0.02 | 2.54 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 9.48 | 9.48 | < 0.005 | < 0.005 | — | 9.51 |
| Total | 3.29 | 3.25 | 0.02 | 2.54 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 9.48 | 9.48 | < 0.005 | < 0.005 | — | 9.51 |

### 4.3.2. Mitigated

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

| Source | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Consumer Products | 13.9 | 13.9 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Architectural Coatings | 1.65 | 1.65 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Landscape Equipment | 5.03 | 4.64 | 0.24 | 28.2 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 116 | 116 | < 0.005 | < 0.005 | — | 116 |
| Total | 20.6 | 20.2 | 0.24 | 28.2 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 116 | 116 | < 0.005 | < 0.005 | — | 116 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Consumer Products | 13.9 | 13.9 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Architectural Coatings | 1.65 | 1.65 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Total | 15.5 | 15.5 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Consumer Products | 2.53 | 2.53 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Architectural Coatings | 0.30 | 0.30 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Landscape Equipme | 0.45 | 0.42 | 0.02 | 2.54 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 9.48 | 9.48 | < 0.005 | < 0.005 | — | 9.51 |
| Total | 3.29 | 3.25 | 0.02 | 2.54 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 9.48 | 9.48 | < 0.005 | < 0.005 | — | 9.51 |

## 4.4. Water Emissions by Land Use

### 4.4.1. Unmitigated

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

| Land Use | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Total | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Total | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 47.6 | 145 | 192 | 4.89 | 0.12 | — | 350 |
| Total | — | — | — | — | — | — | — | — | — | — | — | 47.6 | 145 | 192 | 4.89 | 0.12 | — | 350 |

### 4.4.2. Mitigated

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

| Land Use | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Total | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Total | — | — | — | — | — | — | — | — | — | — | — | 288 | 875 | 1,163 | 29.6 | 0.71 | — | 2,113 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 47.6 | 145 | 192 | 4.89 | 0.12 | — | 350 |
| Total | — | — | — | — | — | — | — | — | — | — | — | 47.6 | 145 | 192 | 4.89 | 0.12 | — | 350 |

## 4.5. Waste Emissions by Land Use

### 4.5.1. Unmitigated

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

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

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Total | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Total | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 71.8 | 0.00 | 71.8 | 7.18 | 0.00 | — | 251 |
| Total | — | — | — | — | — | — | — | — | — | — | — | 71.8 | 0.00 | 71.8 | 7.18 | 0.00 | — | 251 |

### 4.5.2. Mitigated

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

| Land Use | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Total | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | — | — | — | — | — | — | — | — | — | — | — | 434 | 0.00 | 434 | 43.4 | 0.00 | — | 1,518 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | 71.8 | 0.00 | 71.8 | 7.18 | 0.00 | — | 251 |
| Total | — | — | — | — | — | — | — | — | — | — | — | 71.8 | 0.00 | 71.8 | 7.18 | 0.00 | — | 251 |

## 4.6. Refrigerant Emissions by Land Use

### 4.6.1. Unmitigated

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

| Land Use | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 28.0 | 28.0 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 28.0 | 28.0 |

### 4.6.2. Mitigated

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

| Land Use | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 169 | 169 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| General Heavy Industry | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 28.0 | 28.0 |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 28.0 | 28.0 |

## 4.7. Offroad Emissions By Equipment Type

### 4.7.1. Unmitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

### 4.7.2. Mitigated

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

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

## 4.8. Stationary Emissions By Equipment Type

### 4.8.1. Unmitigated

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

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

### 4.8.2. Mitigated

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

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

## 4.9. User Defined Emissions By Equipment Type

### 4.9.1. Unmitigated

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

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

### 4.9.2. Mitigated

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

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

## 4.10. Soil Carbon Accumulation By Vegetation Type

### 4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated

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

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

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

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

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

## 4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sequest | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Removed | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

### 4.10.4. Soil Carbon Accumulation By Vegetation Type - Mitigated

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

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

### 4.10.5. Above and Belowground Carbon Accumulation by Land Use Type - Mitigated

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

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

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

## 4.10.6. Avoided and Sequestered Emissions by Species - Mitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Removed | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Avoided | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Sequestered | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Removed | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

# 5. Activity Data

## 5.1. Construction Schedule

| Phase Name | Phase Type | Start Date | End Date | Days Per Week | Work Days per Phase | Phase Description |
|---|---|---|---|---|---|---|
| Site Preparation | Site Preparation | 6/7/2027 | 6/18/2027 | 5.00 | 10.0 | — |
| Grading | Grading | 6/21/2027 | 7/30/2027 | 5.00 | 30.0 | — |
| Building Construction | Building Construction | 8/2/2027 | 3/9/2029 | 5.00 | 420 | — |
| Paving | Paving | 3/12/2029 | 4/6/2029 | 5.00 | 20.0 | — |
| Architectural Coating | Architectural Coating | 4/9/2029 | 5/4/2029 | 5.00 | 20.0 | — |

## 5.2. Off-Road Equipment

### 5.2.1. Unmitigated

| Phase Name | Equipment Type | Fuel Type | Engine Tier | Number per Day | Hours Per Day | Horsepower | Load Factor |
|---|---|---|---|---|---|---|---|
| Site Preparation | Rubber Tired Dozers | Diesel | Average | 3.00 | 8.00 | 367 | 0.40 |
| Site Preparation | Tractors/Loaders/Backhoes | Diesel | Average | 4.00 | 8.00 | 84.0 | 0.37 |
| Grading | Graders | Diesel | Average | 1.00 | 8.00 | 148 | 0.41 |
| Grading | Excavators | Diesel | Average | 2.00 | 8.00 | 36.0 | 0.38 |
| Grading | Tractors/Loaders/Backhoes | Diesel | Average | 2.00 | 8.00 | 84.0 | 0.37 |
| Grading | Scrapers | Diesel | Average | 2.00 | 8.00 | 423 | 0.48 |
| Grading | Rubber Tired Dozers | Diesel | Average | 1.00 | 8.00 | 367 | 0.40 |
| Building Construction | Forklifts | Diesel | Average | 3.00 | 8.00 | 82.0 | 0.20 |
| Building Construction | Cranes | Diesel | Average | 1.00 | 7.00 | 367 | 0.29 |
| Building Construction | Welders | Diesel | Average | 1.00 | 8.00 | 46.0 | 0.45 |
| Building Construction | Tractors/Loaders/Backhoes | Diesel | Average | 3.00 | 7.00 | 84.0 | 0.37 |
| Paving | Pavers | Diesel | Average | 2.00 | 8.00 | 81.0 | 0.42 |
| Paving | Paving Equipment | Diesel | Average | 2.00 | 8.00 | 89.0 | 0.36 |
| Paving | Rollers | Diesel | Average | 2.00 | 8.00 | 36.0 | 0.38 |
| Architectural Coating | Air Compressors | Diesel | Average | 1.00 | 6.00 | 37.0 | 0.48 |

### 5.2.2. Mitigated

| Phase Name | Equipment Type | Fuel Type | Engine Tier | Number per Day | Hours Per Day | Horsepower | Load Factor |
|---|---|---|---|---|---|---|---|
| Site Preparation | Rubber Tired Dozers | Diesel | Average | 3.00 | 8.00 | 367 | 0.40 |
| Site Preparation | Tractors/Loaders/Backhoes | Diesel | Average | 4.00 | 8.00 | 84.0 | 0.37 |
| Grading | Graders | Diesel | Average | 1.00 | 8.00 | 148 | 0.41 |
| Grading | Excavators | Diesel | Average | 2.00 | 8.00 | 36.0 | 0.38 |
| Grading | Tractors/Loaders/Backhoes | Diesel | Average | 2.00 | 8.00 | 84.0 | 0.37 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Grading | Scrapers | Diesel | Average | 2.00 | 8.00 | 423 | 0.48 |
| Grading | Rubber Tired Dozers | Diesel | Average | 1.00 | 8.00 | 367 | 0.40 |
| Building Construction | Forklifts | Diesel | Average | 3.00 | 8.00 | 82.0 | 0.20 |
| Building Construction | Cranes | Diesel | Average | 1.00 | 7.00 | 367 | 0.29 |
| Building Construction | Welders | Diesel | Average | 1.00 | 8.00 | 46.0 | 0.45 |
| Building Construction | Tractors/Loaders/Backhoes | Diesel | Average | 3.00 | 7.00 | 84.0 | 0.37 |
| Paving | Pavers | Diesel | Average | 2.00 | 8.00 | 81.0 | 0.42 |
| Paving | Paving Equipment | Diesel | Average | 2.00 | 8.00 | 89.0 | 0.36 |
| Paving | Rollers | Diesel | Average | 2.00 | 8.00 | 36.0 | 0.38 |
| Architectural Coating | Air Compressors | Diesel | Average | 1.00 | 6.00 | 37.0 | 0.48 |

## 5.3. Construction Vehicles

### 5.3.1. Unmitigated

| Phase Name | Trip Type | One-Way Trips per Day | Miles per Trip | Vehicle Mix |
|---|---|---|---|---|
| Site Preparation | — | — | — | — |
| Site Preparation | Worker | 17.5 | 18.5 | LDA,LDT1,LDT2 |
| Site Preparation | Vendor | — | 10.2 | HHDT,MHDT |
| Site Preparation | Hauling | 4.00 | 20.0 | HHDT |
| Site Preparation | Onsite truck | — | — | HHDT |
| Grading | — | — | — | — |
| Grading | Worker | 20.0 | 18.5 | LDA,LDT1,LDT2 |
| Grading | Vendor | — | 10.2 | HHDT,MHDT |
| Grading | Hauling | 4.00 | 20.0 | HHDT |
| Grading | Onsite truck | — | — | HHDT |
| Building Construction | — | — | — | — |
| Building Construction | Worker | 161 | 18.5 | LDA,LDT1,LDT2 |

| | | | | |
|---|---|---|---|---|
| Building Construction | Vendor | 106 | 10.2 | HHDT,MHDT |
| Building Construction | Hauling | 0.00 | 20.0 | HHDT |
| Building Construction | Onsite truck | — | — | HHDT |
| Paving | — | — | — | — |
| Paving | Worker | 15.0 | 18.5 | LDA,LDT1,LDT2 |
| Paving | Vendor | — | 10.2 | HHDT,MHDT |
| Paving | Hauling | 0.00 | 20.0 | HHDT |
| Paving | Onsite truck | — | — | HHDT |
| Architectural Coating | — | — | — | — |
| Architectural Coating | Worker | 54.5 | 18.5 | LDA,LDT1,LDT2 |
| Architectural Coating | Vendor | — | 10.2 | HHDT,MHDT |
| Architectural Coating | Hauling | 0.00 | 20.0 | HHDT |
| Architectural Coating | Onsite truck | — | — | HHDT |

### 5.3.2. Mitigated

| Phase Name | Trip Type | One-Way Trips per Day | Miles per Trip | Vehicle Mix |
|---|---|---|---|---|
| Site Preparation | — | — | — | — |
| Site Preparation | Worker | 17.5 | 18.5 | LDA,LDT1,LDT2 |
| Site Preparation | Vendor | — | 10.2 | HHDT,MHDT |
| Site Preparation | Hauling | 4.00 | 20.0 | HHDT |
| Site Preparation | Onsite truck | — | — | HHDT |
| Grading | — | — | — | — |
| Grading | Worker | 20.0 | 18.5 | LDA,LDT1,LDT2 |
| Grading | Vendor | — | 10.2 | HHDT,MHDT |
| Grading | Hauling | 4.00 | 20.0 | HHDT |
| Grading | Onsite truck | — | — | HHDT |
| Building Construction | — | — | — | — |

| | | | | |
|---|---|---|---|---|
| Building Construction | Worker | 161 | 18.5 | LDA,LDT1,LDT2 |
| Building Construction | Vendor | 106 | 10.2 | HHDT,MHDT |
| Building Construction | Hauling | 0.00 | 20.0 | HHDT |
| Building Construction | Onsite truck | — | — | HHDT |
| Paving | — | — | — | — |
| Paving | Worker | 15.0 | 18.5 | LDA,LDT1,LDT2 |
| Paving | Vendor | — | 10.2 | HHDT,MHDT |
| Paving | Hauling | 0.00 | 20.0 | HHDT |
| Paving | Onsite truck | — | — | HHDT |
| Architectural Coating | — | — | — | — |
| Architectural Coating | Worker | 54.5 | 18.5 | LDA,LDT1,LDT2 |
| Architectural Coating | Vendor | — | 10.2 | HHDT,MHDT |
| Architectural Coating | Hauling | 0.00 | 20.0 | HHDT |
| Architectural Coating | Onsite truck | — | — | HHDT |

## 5.4. Vehicles

### 5.4.1. Construction Vehicle Control Strategies

| Control Strategies Applied | PM10 Reduction | PM2.5 Reduction |
|---|---|---|
| Water unpaved roads twice daily | 55% | 55% |
| Limit vehicle speeds on unpaved roads to 25 mph | 44% | 44% |
| Sweep paved roads once per month | 9% | 9% |

## 5.5. Architectural Coatings

| Phase Name | Residential Interior Area Coated (sq ft) | Residential Exterior Area Coated (sq ft) | Non-Residential Interior Area Coated (sq ft) | Non-Residential Exterior Area Coated (sq ft) | Parking Area Coated (sq ft) |
|---|---|---|---|---|---|
| Architectural Coating | 0.00 | 0.00 | 973,568 | 324,523 | — |

## 5.6. Dust Mitigation

### 5.6.1. Construction Earthmoving Activities

| Phase Name | Material Imported (cy) | Material Exported (cy) | Acres Graded (acres) | Material Demolished (sq. ft.) | Acres Paved (acres) |
|---|---|---|---|---|---|
| Site Preparation | — | — | 15.0 | 0.00 | — |
| Grading | — | — | 90.0 | 0.00 | — |
| Paving | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

### 5.6.2. Construction Earthmoving Control Strategies

| Control Strategies Applied | Frequency (per day) | PM10 Reduction | PM2.5 Reduction |
|---|---|---|---|
| Water Exposed Area | 2 | 61% | 61% |

## 5.7. Construction Paving

| Land Use | Area Paved (acres) | % Asphalt |
|---|---|---|
| General Heavy Industry | 0.00 | 0% |

## 5.8. Construction Electricity Consumption and Emissions Factors

kWh per Year and Emission Factor (lb/MWh)

| Year | kWh per Year | CO2 | CH4 | N2O |
|---|---|---|---|---|
| 2027 | 0.00 | 453 | 0.03 | < 0.005 |
| 2028 | 0.00 | 453 | 0.03 | < 0.005 |
| 2029 | 0.00 | 453 | 0.03 | < 0.005 |

## 5.9. Operational Mobile Sources

### 5.9.1. Unmitigated

| Land Use Type | Trips/Weekday | Trips/Saturday | Trips/Sunday | Trips/Year | VMT/Weekday | VMT/Saturday | VMT/Sunday | VMT/Year |
|---|---|---|---|---|---|---|---|---|
| Total all Land Uses | 32.0 | 32.0 | 32.0 | 11,680 | 308 | 308 | 308 | 112,420 |

### 5.9.2. Mitigated

| Land Use Type | Trips/Weekday | Trips/Saturday | Trips/Sunday | Trips/Year | VMT/Weekday | VMT/Saturday | VMT/Sunday | VMT/Year |
|---|---|---|---|---|---|---|---|---|
| Total all Land Uses | 32.0 | 32.0 | 32.0 | 11,680 | 308 | 308 | 308 | 112,420 |

## 5.10. Operational Area Sources

### 5.10.1. Hearths

#### 5.10.1.1. Unmitigated

#### 5.10.1.2. Mitigated

### 5.10.2. Architectural Coatings

| Residential Interior Area Coated (sq ft) | Residential Exterior Area Coated (sq ft) | Non-Residential Interior Area Coated (sq ft) | Non-Residential Exterior Area Coated (sq ft) | Parking Area Coated (sq ft) |
|---|---|---|---|---|
| 0 | 0.00 | 973,568 | 324,523 | — |

### 5.10.3. Landscape Equipment

| Season | Unit | Value |
|---|---|---|
| Snow Days | day/yr | 0.00 |
| Summer Days | day/yr | 180 |

### 5.10.4. Landscape Equipment - Mitigated

| Season | Unit | Value |
|---|---|---|
| Snow Days | day/yr | 0.00 |

| | | |
|---|---|---|
| Summer Days | day/yr | 180 |

## 5.11. Operational Energy Consumption

### 5.11.1. Unmitigated

Electricity (kWh/yr) and CO2 and CH4 and N2O and Natural Gas (kBTU/yr)

| Land Use | Electricity (kWh/yr) | CO2 | CH4 | N2O | Natural Gas (kBTU/yr) |
|---|---|---|---|---|---|
| General Heavy Industry | 11,700,000 | 453 | 0.0330 | 0.0040 | 22,934,978 |

### 5.11.2. Mitigated

Electricity (kWh/yr) and CO2 and CH4 and N2O and Natural Gas (kBTU/yr)

| Land Use | Electricity (kWh/yr) | CO2 | CH4 | N2O | Natural Gas (kBTU/yr) |
|---|---|---|---|---|---|
| General Heavy Industry | 11,700,000 | 453 | 0.0330 | 0.0040 | 22,934,978 |

## 5.12. Operational Water and Wastewater Consumption

### 5.12.1. Unmitigated

| Land Use | Indoor Water (gal/year) | Outdoor Water (gal/year) |
|---|---|---|
| General Heavy Industry | 150,091,656 | 0.00 |

### 5.12.2. Mitigated

| Land Use | Indoor Water (gal/year) | Outdoor Water (gal/year) |
|---|---|---|
| General Heavy Industry | 150,091,656 | 0.00 |

## 5.13. Operational Waste Generation

### 5.13.1. Unmitigated

| Land Use | Waste (ton/year) | Cogeneration (kWh/year) |
|---|---|---|
| General Heavy Industry | 805 | — |

### 5.13.2. Mitigated

| Land Use | Waste (ton/year) | Cogeneration (kWh/year) |
|---|---|---|
| General Heavy Industry | 805 | — |

## 5.14. Operational Refrigeration and Air Conditioning Equipment

### 5.14.1. Unmitigated

| Land Use Type | Equipment Type | Refrigerant | GWP | Quantity (kg) | Operations Leak Rate | Service Leak Rate | Times Serviced |
|---|---|---|---|---|---|---|---|
| General Heavy Industry | Other commercial A/C and heat pumps | R-410A | 2,088 | 0.30 | 4.00 | 4.00 | 18.0 |

### 5.14.2. Mitigated

| Land Use Type | Equipment Type | Refrigerant | GWP | Quantity (kg) | Operations Leak Rate | Service Leak Rate | Times Serviced |
|---|---|---|---|---|---|---|---|
| General Heavy Industry | Other commercial A/C and heat pumps | R-410A | 2,088 | 0.30 | 4.00 | 4.00 | 18.0 |

## 5.15. Operational Off-Road Equipment

### 5.15.1. Unmitigated

| Equipment Type | Fuel Type | Engine Tier | Number per Day | Hours Per Day | Horsepower | Load Factor |
|---|---|---|---|---|---|---|

### 5.15.2. Mitigated

| Equipment Type | Fuel Type | Engine Tier | Number per Day | Hours Per Day | Horsepower | Load Factor |
|---|---|---|---|---|---|---|

## 5.16. Stationary Sources

### 5.16.1. Emergency Generators and Fire Pumps

| Equipment Type | Fuel Type | Number per Day | Hours per Day | Hours per Year | Horsepower | Load Factor |
|---|---|---|---|---|---|---|

### 5.16.2. Process Boilers

| Equipment Type | Fuel Type | Number | Boiler Rating (MMBtu/hr) | Daily Heat Input (MMBtu/day) | Annual Heat Input (MMBtu/yr) |
|---|---|---|---|---|---|

## 5.17. User Defined

| Equipment Type | Fuel Type |
|---|---|

## 5.18. Vegetation

### 5.18.1. Land Use Change

#### 5.18.1.1. Unmitigated

| Vegetation Land Use Type | Vegetation Soil Type | Initial Acres | Final Acres |
|---|---|---|---|

#### 5.18.1.2. Mitigated

| Vegetation Land Use Type | Vegetation Soil Type | Initial Acres | Final Acres |
|---|---|---|---|

### 5.18.1. Biomass Cover Type

#### 5.18.1.1. Unmitigated

| Biomass Cover Type | Initial Acres | Final Acres |
|---|---|---|

#### 5.18.1.2. Mitigated

| Biomass Cover Type | Initial Acres | Final Acres |
|---|---|---|

### 5.18.2. Sequestration

#### 5.18.2.1. Unmitigated

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

#### 5.18.2.2. Mitigated

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

# 6. Climate Risk Detailed Report

## 6.1. Climate Risk Summary

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

| Climate Hazard | Result for Project Location | Unit |
|---|---|---|
| Temperature and Extreme Heat | 5.68 | annual days of extreme heat |
| Extreme Precipitation | 5.50 | annual days with precipitation above 20 mm |
| Sea Level Rise | — | meters of inundation depth |
| Wildfire | 0.00 | annual hectares burned |

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

Wildfire data are for the grid cell in which your project are located. The projections are from UC Davis, as reported in Cal-Adapt (2040–2059 average under RCP 8.5), and consider historical data of climate, vegetation, population density, and large (> 400 ha) fire history. Users may select from four model simulations to view the range in potential wildfire probabilities for the grid cell. The four simulations make different assumptions about expected rainfall and temperature are: Warmer/drier (HadGEM2-ES), Cooler/wetter (CNRM-CM5), Average conditions (CanESM2), Range of different rainfall and temperature possibilities (MIROC5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.

## 6.2. Initial Climate Risk Scores

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

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

## 6.3. Adjusted Climate Risk Scores

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

| | | | | |
|---|---|---|---|---|
| Air Quality Degradation | N/A | N/A | N/A | N/A |

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

### 6.4. Climate Risk Reduction Measures

# 7. Health and Equity Details

## 7.1. CalEnviroScreen 4.0 Scores

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

| Indicator | Result for Project Census Tract |
|---|---|
| Exposure Indicators | — |
| AQ-Ozone | 45.0 |
| AQ-PM | 68.0 |
| AQ-DPM | 91.2 |
| Drinking Water | 61.5 |
| Lead Risk Housing | 64.6 |
| Pesticides | 17.7 |
| Toxic Releases | 79.4 |
| Traffic | 68.5 |
| Effect Indicators | — |
| CleanUp Sites | 88.6 |
| Groundwater | 92.5 |
| Haz Waste Facilities/Generators | 91.0 |
| Impaired Water Bodies | 66.7 |
| Solid Waste | 93.4 |

| | |
|---|---|
| Sensitive Population | — |
| Asthma | 45.1 |
| Cardio-vascular | 53.6 |
| Low Birth Weights | 37.6 |
| Socioeconomic Factor Indicators | — |
| Education | 19.3 |
| Housing | 58.8 |
| Linguistic | 42.1 |
| Poverty | 27.9 |
| Unemployment | 23.8 |

## 7.2. Healthy Places Index Scores

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

| Indicator | Result for Project Census Tract |
|---|---|
| Economic | — |
| Above Poverty | 83.72898755 |
| Employed | 79.36609778 |
| Median HI | 78.76299243 |
| Education | — |
| Bachelor's or higher | 79.63557038 |
| High school enrollment | 100 |
| Preschool enrollment | 40.65186706 |
| Transportation | — |
| Auto Access | 46.70858463 |
| Active commuting | 73.66867702 |
| Social | — |
| 2-parent households | 44.68112409 |

| | |
|---|---|
| Voting | 75.93994611 |
| Neighborhood | — |
| Alcohol availability | 33.40177082 |
| Park access | 81.35506224 |
| Retail density | 65.99512383 |
| Supermarket access | 75.70896959 |
| Tree canopy | 71.79520082 |
| Housing | — |
| Homeownership | 30.71987681 |
| Housing habitability | 49.09534197 |
| Low-inc homeowner severe housing cost burden | 67.79160785 |
| Low-inc renter severe housing cost burden | 74.88771975 |
| Uncrowded housing | 53.4838958 |
| Health Outcomes | — |
| Insured adults | 78.05723085 |
| Arthritis | 0.0 |
| Asthma ER Admissions | 64.1 |
| High Blood Pressure | 0.0 |
| Cancer (excluding skin) | 0.0 |
| Asthma | 0.0 |
| Coronary Heart Disease | 0.0 |
| Chronic Obstructive Pulmonary Disease | 0.0 |
| Diagnosed Diabetes | 0.0 |
| Life Expectancy at Birth | 35.0 |
| Cognitively Disabled | 36.6 |
| Physically  Disabled | 63.7 |
| Heart Attack ER Admissions | 49.8 |

| | |
|---|---|
| Mental Health Not Good | 0.0 |
| Chronic Kidney Disease | 0.0 |
| Obesity | 0.0 |
| Pedestrian Injuries | 98.1 |
| Physical Health Not Good | 0.0 |
| Stroke | 0.0 |
| Health Risk Behaviors | — |
| Binge Drinking | 0.0 |
| Current Smoker | 0.0 |
| No Leisure Time for Physical Activity | 0.0 |
| Climate Change Exposures | — |
| Wildfire Risk | 0.0 |
| SLR Inundation Area | 0.0 |
| Children | 61.0 |
| Elderly | 47.3 |
| English Speaking | 58.4 |
| Foreign-born | 48.4 |
| Outdoor Workers | 81.7 |
| Climate Change Adaptive Capacity | — |
| Impervious Surface Cover | 18.0 |
| Traffic Density | 72.7 |
| Traffic Access | 74.7 |
| Other Indices | — |
| Hardship | 15.8 |
| Other Decision Support | — |
| 2016 Voting | 56.9 |

## 7.3. Overall Health & Equity Scores

| Metric | Result for Project Census Tract |
|---|---|
| CalEnviroScreen 4.0 Score for Project Location (a) | 68.0 |
| Healthy Places Index Score for Project Location (b) | 77.0 |
| Project Located in a Designated Disadvantaged Community (Senate Bill 535) | No |
| Project Located in a Low-Income Community (Assembly Bill 1550) | No |
| Project Located in a Community Air Protection Program Community (Assembly Bill 617) | No |

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

## 7.4. Health & Equity Measures

No Health & Equity Measures selected.

## 7.5. Evaluation Scorecard

Health & Equity Evaluation Scorecard not completed.

## 7.6. Health & Equity Custom Measures

No Health & Equity Custom Measures created.

# 8. User Changes to Default Data

| Screen | Justification |
|---|---|
| Characteristics: Project Details | Adjusted for project location |
| Characteristics: Utility Information | Adjusted for project location |
| Land Use | client provided project details |
| Construction: Construction Phases | project specific estimates |
| Construction: Off-Road Equipment | project specific estimates |
| Operations: Energy Use | Client provided data |
| Construction: Trips and VMT | project specific estimates |

# Maui WWRF - Access Roads Detailed Report

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8. User Changes to Default Data

# 1. Basic Project Information

## 1.1. Basic Project Information

| Data Field | Value |
|---|---|
| Project Name | Maui WWRF - Access Roads |
| Construction Start Date | 6/7/2027 |
| Lead Agency | — |
| Land Use Scale | Project/site |
| Analysis Level for Defaults | Statewide |
| Windspeed (m/s) | 2.70 |
| Precipitation (days) | 8.20 |
| Location | 34.02592312858927, -118.38165785203286 |
| County | Los Angeles-South Coast |
| City | Culver City |
| Air District | South Coast AQMD |
| Air Basin | South Coast |
| TAZ | 4457 |
| EDFZ | 16 |
| Electric Utility | Statewide Average |
| Gas Utility | Southern California Gas |
| App Version | 2022.1.1.24 |

## 1.2. Land Use Types

| Land Use Subtype | Size | Unit | Lot Acreage | Building Area (sq ft) | Landscape Area (sq ft) | Special Landscape Area (sq ft) | Population | Description |
|---|---|---|---|---|---|---|---|---|
| Road Construction | 0.35 | Mile | 4.13 | 0.00 | — | — | — | — |

### 1.3. User-Selected Emission Reduction Measures by Emissions Sector

| Sector | # | Measure Title |
|---|---|---|
| Construction | C-2* | Limit Heavy-Duty Diesel Vehicle Idling |

* Qualitative or supporting measure. Emission reductions not included in the mitigated emissions results.

# 2. Emissions Summary

### 2.1. Construction Emissions Compared Against Thresholds

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

| Un/Mit. | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 3.54 | 2.97 | 24.3 | 31.1 | 0.06 | 1.00 | 1.79 | 2.79 | 0.92 | 0.27 | 1.19 | — | 7,464 | 7,464 | 0.29 | 0.15 | 2.58 | 7,520 |
| Mit. | 3.54 | 2.97 | 24.3 | 31.1 | 0.06 | 1.00 | 1.79 | 2.79 | 0.92 | 0.27 | 1.19 | — | 7,464 | 7,464 | 0.29 | 0.15 | 2.58 | 7,520 |
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 3.54 | 2.96 | 24.3 | 30.7 | 0.06 | 1.00 | 1.79 | 2.79 | 0.92 | 0.27 | 1.19 | — | 7,435 | 7,435 | 0.29 | 0.16 | 0.07 | 7,489 |
| Mit. | 3.54 | 2.96 | 24.3 | 30.7 | 0.06 | 1.00 | 1.79 | 2.79 | 0.92 | 0.27 | 1.19 | — | 7,435 | 7,435 | 0.29 | 0.16 | 0.07 | 7,489 |
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 2.20 | 1.85 | 14.8 | 19.6 | 0.04 | 0.58 | 1.12 | 1.70 | 0.53 | 0.16 | 0.69 | — | 4,796 | 4,796 | 0.19 | 0.08 | 0.51 | 4,823 |
| Mit. | 2.20 | 1.85 | 14.8 | 19.6 | 0.04 | 0.58 | 1.12 | 1.70 | 0.53 | 0.16 | 0.69 | — | 4,796 | 4,796 | 0.19 | 0.08 | 0.51 | 4,823 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Annual (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 0.40 | 0.34 | 2.71 | 3.57 | 0.01 | 0.11 | 0.21 | 0.31 | 0.10 | 0.03 | 0.13 | — | 794 | 794 | 0.03 | 0.01 | 0.08 | 799 |
| Mit. | 0.40 | 0.34 | 2.71 | 3.57 | 0.01 | 0.11 | 0.21 | 0.31 | 0.10 | 0.03 | 0.13 | — | 794 | 794 | 0.03 | 0.01 | 0.08 | 799 |
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

## 2.2. Construction Emissions by Year, Unmitigated

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

| Year | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily - Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 3.54 | 2.97 | 24.3 | 31.1 | 0.06 | 1.00 | 1.79 | 2.79 | 0.92 | 0.27 | 1.19 | — | 7,464 | 7,464 | 0.29 | 0.15 | 2.58 | 7,520 |
| 2028 | 3.41 | 2.85 | 22.8 | 30.8 | 0.06 | 0.91 | 1.79 | 2.70 | 0.84 | 0.27 | 1.10 | — | 7,442 | 7,442 | 0.29 | 0.15 | 2.35 | 7,498 |
| 2029 | 0.97 | 0.82 | 6.83 | 11.7 | 0.01 | 0.23 | 0.23 | 0.46 | 0.21 | 0.05 | 0.26 | — | 1,846 | 1,846 | 0.07 | 0.02 | 0.62 | 1,855 |
| Daily - Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 3.54 | 2.96 | 24.3 | 30.7 | 0.06 | 1.00 | 1.79 | 2.79 | 0.92 | 0.27 | 1.19 | — | 7,435 | 7,435 | 0.29 | 0.16 | 0.07 | 7,489 |
| 2028 | 3.39 | 2.85 | 22.8 | 30.4 | 0.06 | 0.91 | 1.79 | 2.70 | 0.84 | 0.27 | 1.10 | — | 7,414 | 7,414 | 0.29 | 0.15 | 0.06 | 7,467 |
| 2029 | 2.68 | 2.25 | 17.6 | 23.9 | 0.05 | 0.65 | 1.36 | 2.01 | 0.60 | 0.19 | 0.79 | — | 5,991 | 5,991 | 0.24 | 0.06 | 0.02 | 6,014 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 1.01 | 0.84 | 7.02 | 8.78 | 0.02 | 0.29 | 0.54 | 0.83 | 0.27 | 0.08 | 0.35 | — | 2,144 | 2,144 | 0.08 | 0.05 | 0.38 | 2,163 |
| 2028 | 2.20 | 1.85 | 14.8 | 19.6 | 0.04 | 0.58 | 1.12 | 1.70 | 0.53 | 0.16 | 0.69 | — | 4,796 | 4,796 | 0.19 | 0.08 | 0.51 | 4,823 |
| 2029 | 0.32 | 0.27 | 2.23 | 3.50 | 0.01 | 0.08 | 0.11 | 0.19 | 0.07 | 0.02 | 0.09 | — | 658 | 658 | 0.03 | 0.01 | 0.07 | 661 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2027 | 0.18 | 0.15 | 1.28 | 1.60 | < 0.005 | 0.05 | 0.10 | 0.15 | 0.05 | 0.02 | 0.06 | — | 355 | 355 | 0.01 | 0.01 | 0.06 | 358 |
| 2028 | 0.40 | 0.34 | 2.71 | 3.57 | 0.01 | 0.11 | 0.21 | 0.31 | 0.10 | 0.03 | 0.13 | — | 794 | 794 | 0.03 | 0.01 | 0.08 | 799 |
| 2029 | 0.06 | 0.05 | 0.41 | 0.64 | < 0.005 | 0.01 | 0.02 | 0.03 | 0.01 | < 0.005 | 0.02 | — | 109 | 109 | < 0.005 | < 0.005 | 0.01 | 109 |

## 2.3. Construction Emissions by Year, Mitigated

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

| Year | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily - Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 3.54 | 2.97 | 24.3 | 31.1 | 0.06 | 1.00 | 1.79 | 2.79 | 0.92 | 0.27 | 1.19 | — | 7,464 | 7,464 | 0.29 | 0.15 | 2.58 | 7,520 |
| 2028 | 3.41 | 2.85 | 22.8 | 30.8 | 0.06 | 0.91 | 1.79 | 2.70 | 0.84 | 0.27 | 1.10 | — | 7,442 | 7,442 | 0.29 | 0.15 | 2.35 | 7,498 |
| 2029 | 0.97 | 0.82 | 6.83 | 11.7 | 0.01 | 0.23 | 0.23 | 0.46 | 0.21 | 0.05 | 0.26 | — | 1,846 | 1,846 | 0.07 | 0.02 | 0.62 | 1,855 |
| Daily - Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 3.54 | 2.96 | 24.3 | 30.7 | 0.06 | 1.00 | 1.79 | 2.79 | 0.92 | 0.27 | 1.19 | — | 7,435 | 7,435 | 0.29 | 0.16 | 0.07 | 7,489 |
| 2028 | 3.39 | 2.85 | 22.8 | 30.4 | 0.06 | 0.91 | 1.79 | 2.70 | 0.84 | 0.27 | 1.10 | — | 7,414 | 7,414 | 0.29 | 0.15 | 0.06 | 7,467 |
| 2029 | 2.68 | 2.25 | 17.6 | 23.9 | 0.05 | 0.65 | 1.36 | 2.01 | 0.60 | 0.19 | 0.79 | — | 5,991 | 5,991 | 0.24 | 0.06 | 0.02 | 6,014 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 1.01 | 0.84 | 7.02 | 8.78 | 0.02 | 0.29 | 0.54 | 0.83 | 0.27 | 0.08 | 0.35 | — | 2,144 | 2,144 | 0.08 | 0.05 | 0.38 | 2,163 |
| 2028 | 2.20 | 1.85 | 14.8 | 19.6 | 0.04 | 0.58 | 1.12 | 1.70 | 0.53 | 0.16 | 0.69 | — | 4,796 | 4,796 | 0.19 | 0.08 | 0.51 | 4,823 |
| 2029 | 0.32 | 0.27 | 2.23 | 3.50 | 0.01 | 0.08 | 0.11 | 0.19 | 0.07 | 0.02 | 0.09 | — | 658 | 658 | 0.03 | 0.01 | 0.07 | 661 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2027 | 0.18 | 0.15 | 1.28 | 1.60 | < 0.005 | 0.05 | 0.10 | 0.15 | 0.05 | 0.02 | 0.06 | — | 355 | 355 | 0.01 | 0.01 | 0.06 | 358 |
| 2028 | 0.40 | 0.34 | 2.71 | 3.57 | 0.01 | 0.11 | 0.21 | 0.31 | 0.10 | 0.03 | 0.13 | — | 794 | 794 | 0.03 | 0.01 | 0.08 | 799 |
| 2029 | 0.06 | 0.05 | 0.41 | 0.64 | < 0.005 | 0.01 | 0.02 | 0.03 | 0.01 | < 0.005 | 0.02 | — | 109 | 109 | < 0.005 | < 0.005 | 0.01 | 109 |

# 3. Construction Emissions Details

## 3.1. Linear, Grubbing & Land Clearing (2027) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.40 | 0.34 | 3.00 | 3.45 | < 0.005 | 0.16 | — | 0.16 | 0.15 | — | 0.15 | — | 491 | 491 | 0.02 | < 0.005 | — | 492 |
| Dust From Material Movement | — | — | — | — | — | — | 0.21 | 0.21 | — | 0.02 | 0.02 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.05 | 0.05 | 0.41 | 0.47 | < 0.005 | 0.02 | — | 0.02 | 0.02 | — | 0.02 | — | 67.2 | 67.2 | < 0.005 | < 0.005 | — | 67.5 |
| Dust From Material Movement | — | — | — | — | — | — | 0.03 | 0.03 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.01 | 0.01 | 0.07 | 0.09 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 11.1 | 11.1 | < 0.005 | < 0.005 | — | 11.2 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dust From Material Movement | — | — | — | — | — | — | 0.01 | 0.01 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.02 | 0.02 | 0.02 | 0.31 | 0.00 | 0.00 | 0.07 | 0.07 | 0.00 | 0.02 | 0.02 | — | 67.3 | 67.3 | < 0.005 | < 0.005 | 0.22 | 68.3 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.03 | 0.01 | 0.64 | 0.20 | < 0.005 | 0.01 | 0.15 | 0.16 | 0.01 | 0.04 | 0.05 | — | 535 | 535 | 0.02 | 0.08 | 1.19 | 561 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.04 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 8.70 | 8.70 | < 0.005 | < 0.005 | 0.01 | 8.81 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.09 | 0.03 | < 0.005 | < 0.005 | 0.02 | 0.02 | < 0.005 | 0.01 | 0.01 | — | 73.2 | 73.2 | < 0.005 | 0.01 | 0.07 | 76.8 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.01 | 0.00 | 0.00 | < 0.005 | < 0.005 | 0.00 | < 0.005 | < 0.005 | — | 1.44 | 1.44 | < 0.005 | < 0.005 | < 0.005 | 1.46 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.02 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 12.1 | 12.1 | < 0.005 | < 0.005 | 0.01 | 12.7 |

## 3.2. Linear, Grubbing & Land Clearing (2027) - Mitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.40 | 0.34 | 3.00 | 3.45 | < 0.005 | 0.16 | — | 0.16 | 0.15 | — | 0.15 | — | 491 | 491 | 0.02 | < 0.005 | — | 492 |
| Dust From Material Movement | — | — | — | — | — | — | 0.21 | 0.21 | — | 0.02 | 0.02 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.05 | 0.05 | 0.41 | 0.47 | < 0.005 | 0.02 | — | 0.02 | 0.02 | — | 0.02 | — | 67.2 | 67.2 | < 0.005 | < 0.005 | — | 67.5 |
| Dust From Material Movement | — | — | — | — | — | — | 0.03 | 0.03 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.01 | 0.01 | 0.07 | 0.09 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 11.1 | 11.1 | < 0.005 | < 0.005 | — | 11.2 |
| Dust From Material Movement | — | — | — | — | — | — | 0.01 | 0.01 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.02 | 0.02 | 0.02 | 0.31 | 0.00 | 0.00 | 0.07 | 0.07 | 0.00 | 0.02 | 0.02 | — | 67.3 | 67.3 | < 0.005 | < 0.005 | 0.22 | 68.3 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.03 | 0.01 | 0.64 | 0.20 | < 0.005 | 0.01 | 0.15 | 0.16 | 0.01 | 0.04 | 0.05 | — | 535 | 535 | 0.02 | 0.08 | 1.19 | 561 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.04 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 8.70 | 8.70 | < 0.005 | < 0.005 | 0.01 | 8.81 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.09 | 0.03 | < 0.005 | < 0.005 | 0.02 | 0.02 | < 0.005 | 0.01 | 0.01 | — | 73.2 | 73.2 | < 0.005 | 0.01 | 0.07 | 76.8 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.01 | 0.00 | 0.00 | < 0.005 | < 0.005 | 0.00 | < 0.005 | < 0.005 | — | 1.44 | 1.44 | < 0.005 | < 0.005 | < 0.005 | 1.46 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.02 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 12.1 | 12.1 | < 0.005 | < 0.005 | 0.01 | 12.7 |

## 3.3. Linear, Grading & Excavation (2027) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 3.38 | 2.84 | 23.5 | 29.0 | 0.06 | 0.99 | — | 0.99 | 0.91 | — | 0.91 | — | 6,495 | 6,495 | 0.26 | 0.05 | — | 6,517 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dust From Material Movement | — | — | — | — | — | — | 1.24 | 1.24 | — | 0.13 | 0.13 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 3.38 | 2.84 | 23.5 | 29.0 | 0.06 | 0.99 | — | 0.99 | 0.91 | — | 0.91 | — | 6,495 | 6,495 | 0.26 | 0.05 | — | 6,517 |
| Dust From Material Movement | — | — | — | — | — | — | 1.24 | 1.24 | — | 0.13 | 0.13 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.91 | 0.76 | 6.30 | 7.77 | 0.02 | 0.26 | — | 0.26 | 0.24 | — | 0.24 | — | 1,741 | 1,741 | 0.07 | 0.01 | — | 1,747 |
| Dust From Material Movement | — | — | — | — | — | — | 0.33 | 0.33 | — | 0.04 | 0.04 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.17 | 0.14 | 1.15 | 1.42 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 288 | 288 | 0.01 | < 0.005 | — | 289 |
| Dust From Material Movement | — | — | — | — | — | — | 0.06 | 0.06 | — | 0.01 | 0.01 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.13 | 0.12 | 0.10 | 1.86 | 0.00 | 0.00 | 0.39 | 0.39 | 0.00 | 0.09 | 0.09 | — | 404 | 404 | < 0.005 | 0.01 | 1.32 | 410 |
| Vendor | < 0.005 | < 0.005 | 0.03 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 30.7 | 30.7 | < 0.005 | < 0.005 | 0.07 | 32.1 |
| Hauling | 0.03 | 0.01 | 0.64 | 0.20 | < 0.005 | 0.01 | 0.15 | 0.16 | 0.01 | 0.04 | 0.05 | — | 535 | 535 | 0.02 | 0.08 | 1.19 | 561 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.13 | 0.11 | 0.13 | 1.50 | 0.00 | 0.00 | 0.39 | 0.39 | 0.00 | 0.09 | 0.09 | — | 375 | 375 | 0.01 | 0.01 | 0.03 | 379 |
| Vendor | < 0.005 | < 0.005 | 0.04 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 30.7 | 30.7 | < 0.005 | < 0.005 | < 0.005 | 32.0 |
| Hauling | 0.03 | 0.01 | 0.67 | 0.20 | < 0.005 | 0.01 | 0.15 | 0.16 | 0.01 | 0.04 | 0.05 | — | 535 | 535 | 0.02 | 0.08 | 0.03 | 560 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.03 | 0.03 | 0.03 | 0.42 | 0.00 | 0.00 | 0.10 | 0.10 | 0.00 | 0.02 | 0.02 | — | 102 | 102 | < 0.005 | < 0.005 | 0.15 | 103 |
| Vendor | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 8.22 | 8.22 | < 0.005 | < 0.005 | 0.01 | 8.59 |
| Hauling | 0.01 | < 0.005 | 0.18 | 0.05 | < 0.005 | < 0.005 | 0.04 | 0.04 | < 0.005 | 0.01 | 0.01 | — | 143 | 143 | < 0.005 | 0.02 | 0.14 | 150 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.08 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | < 0.005 | < 0.005 | — | 16.9 | 16.9 | < 0.005 | < 0.005 | 0.03 | 17.1 |
| Vendor | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 1.36 | 1.36 | < 0.005 | < 0.005 | < 0.005 | 1.42 |
| Hauling | < 0.005 | < 0.005 | 0.03 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 23.7 | 23.7 | < 0.005 | < 0.005 | 0.02 | 24.9 |

## 3.4. Linear, Grading & Excavation (2027) - Mitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Off-Road Equipment | 3.38 | 2.84 | 23.5 | 29.0 | 0.06 | 0.99 | — | 0.99 | 0.91 | — | 0.91 | — | 6,495 | 6,495 | 0.26 | 0.05 | — | 6,517 |
| Dust From Material Movement | — | — | — | — | — | — | 1.24 | 1.24 | — | 0.13 | 0.13 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 3.38 | 2.84 | 23.5 | 29.0 | 0.06 | 0.99 | — | 0.99 | 0.91 | — | 0.91 | — | 6,495 | 6,495 | 0.26 | 0.05 | — | 6,517 |
| Dust From Material Movement | — | — | — | — | — | — | 1.24 | 1.24 | — | 0.13 | 0.13 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.91 | 0.76 | 6.30 | 7.77 | 0.02 | 0.26 | — | 0.26 | 0.24 | — | 0.24 | — | 1,741 | 1,741 | 0.07 | 0.01 | — | 1,747 |
| Dust From Material Movement | — | — | — | — | — | — | 0.33 | 0.33 | — | 0.04 | 0.04 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.17 | 0.14 | 1.15 | 1.42 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 288 | 288 | 0.01 | < 0.005 | — | 289 |
| Dust From Material Movement | — | — | — | — | — | — | 0.06 | 0.06 | — | 0.01 | 0.01 | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.13 | 0.12 | 0.10 | 1.86 | 0.00 | 0.00 | 0.39 | 0.39 | 0.00 | 0.09 | 0.09 | — | 404 | 404 | < 0.005 | 0.01 | 1.32 | 410 |
| Vendor | < 0.005 | < 0.005 | 0.03 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 30.7 | 30.7 | < 0.005 | < 0.005 | 0.07 | 32.1 |
| Hauling | 0.03 | 0.01 | 0.64 | 0.20 | < 0.005 | 0.01 | 0.15 | 0.16 | 0.01 | 0.04 | 0.05 | — | 535 | 535 | 0.02 | 0.08 | 1.19 | 561 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.13 | 0.11 | 0.13 | 1.50 | 0.00 | 0.00 | 0.39 | 0.39 | 0.00 | 0.09 | 0.09 | — | 375 | 375 | 0.01 | 0.01 | 0.03 | 379 |
| Vendor | < 0.005 | < 0.005 | 0.04 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 30.7 | 30.7 | < 0.005 | < 0.005 | < 0.005 | 32.0 |
| Hauling | 0.03 | 0.01 | 0.67 | 0.20 | < 0.005 | 0.01 | 0.15 | 0.16 | 0.01 | 0.04 | 0.05 | — | 535 | 535 | 0.02 | 0.08 | 0.03 | 560 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.03 | 0.03 | 0.03 | 0.42 | 0.00 | 0.00 | 0.10 | 0.10 | 0.00 | 0.02 | 0.02 | — | 102 | 102 | < 0.005 | < 0.005 | 0.15 | 103 |
| Vendor | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 8.22 | 8.22 | < 0.005 | < 0.005 | 0.01 | 8.59 |
| Hauling | 0.01 | < 0.005 | 0.18 | 0.05 | < 0.005 | < 0.005 | 0.04 | 0.04 | < 0.005 | 0.01 | 0.01 | — | 143 | 143 | < 0.005 | 0.02 | 0.14 | 150 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.08 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | < 0.005 | < 0.005 | — | 16.9 | 16.9 | < 0.005 | < 0.005 | 0.03 | 17.1 |
| Vendor | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 1.36 | 1.36 | < 0.005 | < 0.005 | < 0.005 | 1.42 |
| Hauling | < 0.005 | < 0.005 | 0.03 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 23.7 | 23.7 | < 0.005 | < 0.005 | 0.02 | 24.9 |

## 3.5. Linear, Grading & Excavation (2028) - Unmitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 3.25 | 2.73 | 22.0 | 28.8 | 0.06 | 0.90 | — | 0.90 | 0.82 | — | 0.82 | — | 6,494 | 6,494 | 0.26 | 0.05 | — | 6,517 |
| Dust From Material Movement | — | — | — | — | — | — | 1.24 | 1.24 | — | 0.13 | 0.13 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 3.25 | 2.73 | 22.0 | 28.8 | 0.06 | 0.90 | — | 0.90 | 0.82 | — | 0.82 | — | 6,494 | 6,494 | 0.26 | 0.05 | — | 6,517 |
| Dust From Material Movement | — | — | — | — | — | — | 1.24 | 1.24 | — | 0.13 | 0.13 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.14 | 0.96 | 7.71 | 10.1 | 0.02 | 0.31 | — | 0.31 | 0.29 | — | 0.29 | — | 2,275 | 2,275 | 0.09 | 0.02 | — | 2,283 |
| Dust From Material Movement | — | — | — | — | — | — | 0.43 | 0.43 | — | 0.05 | 0.05 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.21 | 0.17 | 1.41 | 1.84 | < 0.005 | 0.06 | — | 0.06 | 0.05 | — | 0.05 | — | 377 | 377 | 0.02 | < 0.005 | — | 378 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dust From Material Movement | — | — | — | — | — | — | 0.08 | 0.08 | — | 0.01 | 0.01 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.13 | 0.11 | 0.10 | 1.74 | 0.00 | 0.00 | 0.39 | 0.39 | 0.00 | 0.09 | 0.09 | — | 397 | 397 | < 0.005 | 0.01 | 1.19 | 402 |
| Vendor | < 0.005 | < 0.005 | 0.03 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 29.9 | 29.9 | < 0.005 | < 0.005 | 0.07 | 31.2 |
| Hauling | 0.03 | 0.01 | 0.62 | 0.20 | < 0.005 | 0.01 | 0.15 | 0.16 | 0.01 | 0.04 | 0.05 | — | 521 | 521 | 0.02 | 0.08 | 1.10 | 548 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.11 | 0.11 | 0.12 | 1.40 | 0.00 | 0.00 | 0.39 | 0.39 | 0.00 | 0.09 | 0.09 | — | 368 | 368 | 0.01 | 0.01 | 0.03 | 372 |
| Vendor | < 0.005 | < 0.005 | 0.03 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 29.9 | 29.9 | < 0.005 | < 0.005 | < 0.005 | 31.2 |
| Hauling | 0.03 | 0.01 | 0.66 | 0.20 | < 0.005 | 0.01 | 0.15 | 0.16 | 0.01 | 0.04 | 0.05 | — | 522 | 522 | 0.02 | 0.08 | 0.03 | 547 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.04 | 0.04 | 0.04 | 0.51 | 0.00 | 0.00 | 0.14 | 0.14 | 0.00 | 0.03 | 0.03 | — | 131 | 131 | < 0.005 | < 0.005 | 0.18 | 133 |
| Vendor | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 10.5 | 10.5 | < 0.005 | < 0.005 | 0.01 | 10.9 |
| Hauling | 0.01 | < 0.005 | 0.23 | 0.07 | < 0.005 | < 0.005 | 0.05 | 0.06 | < 0.005 | 0.01 | 0.02 | — | 183 | 183 | 0.01 | 0.03 | 0.17 | 192 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.09 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | 0.01 | 0.01 | — | 21.7 | 21.7 | < 0.005 | < 0.005 | 0.03 | 22.0 |
| Vendor | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 1.73 | 1.73 | < 0.005 | < 0.005 | < 0.005 | 1.81 |
| Hauling | < 0.005 | < 0.005 | 0.04 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 30.2 | 30.2 | < 0.005 | < 0.005 | 0.03 | 31.7 |

## 3.6. Linear, Grading & Excavation (2028) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 3.25 | 2.73 | 22.0 | 28.8 | 0.06 | 0.90 | — | 0.90 | 0.82 | — | 0.82 | — | 6,494 | 6,494 | 0.26 | 0.05 | — | 6,517 |
| Dust From Material Movement | — | — | — | — | — | — | 1.24 | 1.24 | — | 0.13 | 0.13 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 3.25 | 2.73 | 22.0 | 28.8 | 0.06 | 0.90 | — | 0.90 | 0.82 | — | 0.82 | — | 6,494 | 6,494 | 0.26 | 0.05 | — | 6,517 |
| Dust From Material Movement | — | — | — | — | — | — | 1.24 | 1.24 | — | 0.13 | 0.13 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.14 | 0.96 | 7.71 | 10.1 | 0.02 | 0.31 | — | 0.31 | 0.29 | — | 0.29 | — | 2,275 | 2,275 | 0.09 | 0.02 | — | 2,283 |
| Dust From Material Movement | — | — | — | — | — | — | 0.43 | 0.43 | — | 0.05 | 0.05 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.21 | 0.17 | 1.41 | 1.84 | < 0.005 | 0.06 | — | 0.06 | 0.05 | — | 0.05 | — | 377 | 377 | 0.02 | < 0.005 | — | 378 |
| Dust From Material Movement | — | — | — | — | — | — | 0.08 | 0.08 | — | 0.01 | 0.01 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.13 | 0.11 | 0.10 | 1.74 | 0.00 | 0.00 | 0.39 | 0.39 | 0.00 | 0.09 | 0.09 | — | 397 | 397 | < 0.005 | 0.01 | 1.19 | 402 |
| Vendor | < 0.005 | < 0.005 | 0.03 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 29.9 | 29.9 | < 0.005 | < 0.005 | 0.07 | 31.2 |
| Hauling | 0.03 | 0.01 | 0.62 | 0.20 | < 0.005 | 0.01 | 0.15 | 0.16 | 0.01 | 0.04 | 0.05 | — | 521 | 521 | 0.02 | 0.08 | 1.10 | 548 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.11 | 0.11 | 0.12 | 1.40 | 0.00 | 0.00 | 0.39 | 0.39 | 0.00 | 0.09 | 0.09 | — | 368 | 368 | 0.01 | 0.01 | 0.03 | 372 |
| Vendor | < 0.005 | < 0.005 | 0.03 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 29.9 | 29.9 | < 0.005 | < 0.005 | < 0.005 | 31.2 |
| Hauling | 0.03 | 0.01 | 0.66 | 0.20 | < 0.005 | 0.01 | 0.15 | 0.16 | 0.01 | 0.04 | 0.05 | — | 522 | 522 | 0.02 | 0.08 | 0.03 | 547 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.04 | 0.04 | 0.04 | 0.51 | 0.00 | 0.00 | 0.14 | 0.14 | 0.00 | 0.03 | 0.03 | — | 131 | 131 | < 0.005 | < 0.005 | 0.18 | 133 |
| Vendor | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 10.5 | 10.5 | < 0.005 | < 0.005 | 0.01 | 10.9 |
| Hauling | 0.01 | < 0.005 | 0.23 | 0.07 | < 0.005 | < 0.005 | 0.05 | 0.06 | < 0.005 | 0.01 | 0.02 | — | 183 | 183 | 0.01 | 0.03 | 0.17 | 192 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.09 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | 0.01 | 0.01 | — | 21.7 | 21.7 | < 0.005 | < 0.005 | 0.03 | 22.0 |
| Vendor | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 1.73 | 1.73 | < 0.005 | < 0.005 | < 0.005 | 1.81 |
| Hauling | < 0.005 | < 0.005 | 0.04 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 30.2 | 30.2 | < 0.005 | < 0.005 | 0.03 | 31.7 |

## 3.7. Linear, Drainage, Utilities, & Sub-Grade (2028) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 2.68 | 2.24 | 18.6 | 23.1 | 0.05 | 0.70 | — | 0.70 | 0.65 | — | 0.65 | — | 5,691 | 5,691 | 0.23 | 0.05 | — | 5,711 |
| Dust From Material Movement | — | — | — | — | — | — | 1.03 | 1.03 | — | 0.11 | 0.11 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 2.68 | 2.24 | 18.6 | 23.1 | 0.05 | 0.70 | — | 0.70 | 0.65 | — | 0.65 | — | 5,691 | 5,691 | 0.23 | 0.05 | — | 5,711 |
| Dust From Material Movement | — | — | — | — | — | — | 1.03 | 1.03 | — | 0.11 | 0.11 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.98 | 0.82 | 6.82 | 8.44 | 0.02 | 0.26 | — | 0.26 | 0.24 | — | 0.24 | — | 2,083 | 2,083 | 0.08 | 0.02 | — | 2,090 |
| Dust From Material Movement | — | — | — | — | — | — | 0.38 | 0.38 | — | 0.04 | 0.04 | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.18 | 0.15 | 1.24 | 1.54 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 345 | 345 | 0.01 | < 0.005 | — | 346 |
| Dust From Material Movement | — | — | — | — | — | — | 0.07 | 0.07 | — | 0.01 | 0.01 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.11 | 0.09 | 0.09 | 1.45 | 0.00 | 0.00 | 0.33 | 0.33 | 0.00 | 0.08 | 0.08 | — | 331 | 331 | < 0.005 | 0.01 | 0.99 | 335 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.09 | 0.09 | 0.10 | 1.16 | 0.00 | 0.00 | 0.33 | 0.33 | 0.00 | 0.08 | 0.08 | — | 307 | 307 | < 0.005 | 0.01 | 0.03 | 310 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.03 | 0.03 | 0.04 | 0.44 | 0.00 | 0.00 | 0.12 | 0.12 | 0.00 | 0.03 | 0.03 | — | 114 | 114 | < 0.005 | < 0.005 | 0.16 | 116 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.08 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | 0.01 | 0.01 | — | 18.9 | 18.9 | < 0.005 | < 0.005 | 0.03 | 19.1 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

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| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.8. Linear, Drainage, Utilities, & Sub-Grade (2028) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 2.68 | 2.24 | 18.6 | 23.1 | 0.05 | 0.70 | — | 0.70 | 0.65 | — | 0.65 | — | 5,691 | 5,691 | 0.23 | 0.05 | — | 5,711 |
| Dust From Material Movement | — | — | — | — | — | — | 1.03 | 1.03 | — | 0.11 | 0.11 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 2.68 | 2.24 | 18.6 | 23.1 | 0.05 | 0.70 | — | 0.70 | 0.65 | — | 0.65 | — | 5,691 | 5,691 | 0.23 | 0.05 | — | 5,711 |
| Dust From Material Movement | — | — | — | — | — | — | 1.03 | 1.03 | — | 0.11 | 0.11 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.98 | 0.82 | 6.82 | 8.44 | 0.02 | 0.26 | — | 0.26 | 0.24 | — | 0.24 | — | 2,083 | 2,083 | 0.08 | 0.02 | — | 2,090 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dust From Material Movement | — | — | — | — | — | — | 0.38 | 0.38 | — | 0.04 | 0.04 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.18 | 0.15 | 1.24 | 1.54 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 345 | 345 | 0.01 | < 0.005 | — | 346 |
| Dust From Material Movement | — | — | — | — | — | — | 0.07 | 0.07 | — | 0.01 | 0.01 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.11 | 0.09 | 0.09 | 1.45 | 0.00 | 0.00 | 0.33 | 0.33 | 0.00 | 0.08 | 0.08 | — | 331 | 331 | < 0.005 | 0.01 | 0.99 | 335 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.09 | 0.09 | 0.10 | 1.16 | 0.00 | 0.00 | 0.33 | 0.33 | 0.00 | 0.08 | 0.08 | — | 307 | 307 | < 0.005 | 0.01 | 0.03 | 310 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.03 | 0.03 | 0.04 | 0.44 | 0.00 | 0.00 | 0.12 | 0.12 | 0.00 | 0.03 | 0.03 | — | 114 | 114 | < 0.005 | < 0.005 | 0.16 | 116 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.08 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | 0.01 | 0.01 | — | 18.9 | 18.9 | < 0.005 | < 0.005 | 0.03 | 19.1 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.9. Linear, Drainage, Utilities, & Sub-Grade (2029) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 2.59 | 2.17 | 17.5 | 22.8 | 0.05 | 0.65 | — | 0.65 | 0.60 | — | 0.60 | — | 5,690 | 5,690 | 0.23 | 0.05 | — | 5,709 |
| Dust From Material Movement | — | — | — | — | — | — | 1.03 | 1.03 | — | 0.11 | 0.11 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.12 | 0.10 | 0.82 | 1.07 | < 0.005 | 0.03 | — | 0.03 | 0.03 | — | 0.03 | — | 267 | 267 | 0.01 | < 0.005 | — | 268 |
| Dust From Material Movement | — | — | — | — | — | — | 0.05 | 0.05 | — | 0.01 | 0.01 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

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| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.02 | 0.02 | 0.15 | 0.20 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 44.2 | 44.2 | < 0.005 | < 0.005 | — | 44.4 |
| Dust From Material Movement | — | — | — | — | — | — | 0.01 | 0.01 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.09 | 0.08 | 0.09 | 1.09 | 0.00 | 0.00 | 0.33 | 0.33 | 0.00 | 0.08 | 0.08 | — | 301 | 301 | < 0.005 | 0.01 | 0.02 | 305 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.05 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | < 0.005 | < 0.005 | — | 14.4 | 14.4 | < 0.005 | < 0.005 | 0.02 | 14.6 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.01 | 0.00 | 0.00 | < 0.005 | < 0.005 | 0.00 | < 0.005 | < 0.005 | — | 2.38 | 2.38 | < 0.005 | < 0.005 | < 0.005 | 2.41 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.10. Linear, Drainage, Utilities, & Sub-Grade (2029) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 2.59 | 2.17 | 17.5 | 22.8 | 0.05 | 0.65 | — | 0.65 | 0.60 | — | 0.60 | — | 5,690 | 5,690 | 0.23 | 0.05 | — | 5,709 |
| Dust From Material Movement | — | — | — | — | — | — | 1.03 | 1.03 | — | 0.11 | 0.11 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.12 | 0.10 | 0.82 | 1.07 | < 0.005 | 0.03 | — | 0.03 | 0.03 | — | 0.03 | — | 267 | 267 | 0.01 | < 0.005 | — | 268 |
| Dust From Material Movement | — | — | — | — | — | — | 0.05 | 0.05 | — | 0.01 | 0.01 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.02 | 0.02 | 0.15 | 0.20 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 44.2 | 44.2 | < 0.005 | < 0.005 | — | 44.4 |
| Dust From Material Movement | — | — | — | — | — | — | 0.01 | 0.01 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.09 | 0.08 | 0.09 | 1.09 | 0.00 | 0.00 | 0.33 | 0.33 | 0.00 | 0.08 | 0.08 | — | 301 | 301 | < 0.005 | 0.01 | 0.02 | 305 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.05 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | < 0.005 | < 0.005 | — | 14.4 | 14.4 | < 0.005 | < 0.005 | 0.02 | 14.6 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.01 | 0.00 | 0.00 | < 0.005 | < 0.005 | 0.00 | < 0.005 | < 0.005 | — | 2.38 | 2.38 | < 0.005 | < 0.005 | < 0.005 | 2.41 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.11. Linear, Paving (2029) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.90 | 0.76 | 6.78 | 10.8 | 0.01 | 0.23 | — | 0.23 | 0.21 | — | 0.21 | — | 1,619 | 1,619 | 0.07 | 0.01 | — | 1,624 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.90 | 0.76 | 6.78 | 10.8 | 0.01 | 0.23 | — | 0.23 | 0.21 | — | 0.21 | — | 1,619 | 1,619 | 0.07 | 0.01 | — | 1,624 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.19 | 0.16 | 1.39 | 2.21 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 333 | 333 | 0.01 | < 0.005 | — | 334 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.03 | 0.03 | 0.25 | 0.40 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 55.1 | 55.1 | < 0.005 | < 0.005 | — | 55.3 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.06 | 0.06 | 0.05 | 0.95 | 0.00 | 0.00 | 0.23 | 0.23 | 0.00 | 0.05 | 0.05 | — | 227 | 227 | < 0.005 | 0.01 | 0.62 | 230 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.06 | 0.05 | 0.06 | 0.76 | 0.00 | 0.00 | 0.23 | 0.23 | 0.00 | 0.05 | 0.05 | — | 211 | 211 | < 0.005 | 0.01 | 0.02 | 213 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.16 | 0.00 | 0.00 | 0.05 | 0.05 | 0.00 | 0.01 | 0.01 | — | 44.1 | 44.1 | < 0.005 | < 0.005 | 0.06 | 44.6 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.03 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 7.29 | 7.29 | < 0.005 | < 0.005 | 0.01 | 7.39 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.12. Linear, Paving (2029) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.90 | 0.76 | 6.78 | 10.8 | 0.01 | 0.23 | — | 0.23 | 0.21 | — | 0.21 | — | 1,619 | 1,619 | 0.07 | 0.01 | — | 1,624 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.90 | 0.76 | 6.78 | 10.8 | 0.01 | 0.23 | — | 0.23 | 0.21 | — | 0.21 | — | 1,619 | 1,619 | 0.07 | 0.01 | — | 1,624 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Off-Road Equipment | 0.19 | 0.16 | 1.39 | 2.21 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 333 | 333 | 0.01 | < 0.005 | — | 334 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.03 | 0.03 | 0.25 | 0.40 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 55.1 | 55.1 | < 0.005 | < 0.005 | — | 55.3 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.06 | 0.06 | 0.05 | 0.95 | 0.00 | 0.00 | 0.23 | 0.23 | 0.00 | 0.05 | 0.05 | — | 227 | 227 | < 0.005 | 0.01 | 0.62 | 230 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.06 | 0.05 | 0.06 | 0.76 | 0.00 | 0.00 | 0.23 | 0.23 | 0.00 | 0.05 | 0.05 | — | 211 | 211 | < 0.005 | 0.01 | 0.02 | 213 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.16 | 0.00 | 0.00 | 0.05 | 0.05 | 0.00 | 0.01 | 0.01 | — | 44.1 | 44.1 | < 0.005 | < 0.005 | 0.06 | 44.6 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.03 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 7.29 | 7.29 | < 0.005 | < 0.005 | 0.01 | 7.39 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

# 4. Operations Emissions Details

## 4.10. Soil Carbon Accumulation By Vegetation Type

### 4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated

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

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

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

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

## 4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Avoided | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Sequestered | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Removed | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

### 4.10.4. Soil Carbon Accumulation By Vegetation Type - Mitigated

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

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

### 4.10.5. Above and Belowground Carbon Accumulation by Land Use Type - Mitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

### 4.10.6. Avoided and Sequestered Emissions by Species - Mitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sequest | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Removed | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Avoided | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Sequestered | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Removed | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

# 5. Activity Data

## 5.1. Construction Schedule

| Phase Name | Phase Type | Start Date | End Date | Days Per Week | Work Days per Phase | Phase Description |
|---|---|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | Linear, Grubbing & Land Clearing | 6/7/2027 | 8/16/2027 | 5.00 | 50.0 | — |
| Linear, Grading & Excavation | Linear, Grading & Excavation | 8/17/2027 | 6/27/2028 | 5.00 | 225 | — |
| Linear, Drainage, Utilities, & Sub-Grade | Linear, Drainage, Utilities, & Sub-Grade | 6/28/2028 | 1/24/2029 | 5.00 | 150 | — |
| Linear, Paving | Linear, Paving | 1/25/2029 | 5/10/2029 | 5.00 | 75.0 | — |

## 5.2. Off-Road Equipment

### 5.2.1. Unmitigated

| Phase Name | Equipment Type | Fuel Type | Engine Tier | Number per Day | Hours Per Day | Horsepower | Load Factor |
|---|---|---|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | Crawler Tractors | Diesel | Average | 1.00 | 8.00 | 87.0 | 0.43 |
| Linear, Grubbing & Land Clearing | Excavators | Diesel | Average | 1.00 | 8.00 | 36.0 | 0.38 |
| Linear, Grading & Excavation | Excavators | Diesel | Average | 3.00 | 8.00 | 36.0 | 0.38 |
| Linear, Grading & Excavation | Crawler Tractors | Diesel | Average | 1.00 | 8.00 | 87.0 | 0.43 |
| Linear, Grading & Excavation | Graders | Diesel | Average | 1.00 | 8.00 | 148 | 0.41 |
| Linear, Grading & Excavation | Rollers | Diesel | Average | 2.00 | 8.00 | 36.0 | 0.38 |
| Linear, Grading & Excavation | Tractors/Loaders/Backhoes | Diesel | Average | 2.00 | 8.00 | 84.0 | 0.37 |
| Linear, Grading & Excavation | Rubber Tired Loaders | Diesel | Average | 1.00 | 8.00 | 150 | 0.36 |
| Linear, Grading & Excavation | Scrapers | Diesel | Average | 2.00 | 8.00 | 423 | 0.48 |
| Linear, Drainage, Utilities, & Sub-Grade | Scrapers | Diesel | Average | 2.00 | 8.00 | 423 | 0.48 |
| Linear, Drainage, Utilities, & Sub-Grade | Rough Terrain Forklifts | Diesel | Average | 1.00 | 8.00 | 96.0 | 0.40 |
| Linear, Drainage, Utilities, & Sub-Grade | Tractors/Loaders/Backhoes | Diesel | Average | 2.00 | 8.00 | 84.0 | 0.37 |
| Linear, Drainage, Utilities, & Sub-Grade | Plate Compactors | Diesel | Average | 1.00 | 8.00 | 8.00 | 0.43 |
| Linear, Drainage, Utilities, & Sub-Grade | Pumps | Diesel | Average | 1.00 | 8.00 | 11.0 | 0.74 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Linear, Drainage, Utilities, & Sub-Grade | Graders | Diesel | Average | 1.00 | 8.00 | 148 | 0.41 |
| Linear, Drainage, Utilities, & Sub-Grade | Air Compressors | Diesel | Average | 1.00 | 8.00 | 37.0 | 0.48 |
| Linear, Drainage, Utilities, & Sub-Grade | Generator Sets | Diesel | Average | 1.00 | 8.00 | 14.0 | 0.74 |
| Linear, Paving | Rollers | Diesel | Average | 3.00 | 8.00 | 36.0 | 0.38 |
| Linear, Paving | Paving Equipment | Diesel | Average | 1.00 | 8.00 | 89.0 | 0.36 |
| Linear, Paving | Pavers | Diesel | Average | 1.00 | 8.00 | 81.0 | 0.42 |
| Linear, Paving | Tractors/Loaders/Backhoes | Diesel | Average | 2.00 | 8.00 | 84.0 | 0.37 |

### 5.2.2. Mitigated

| Phase Name | Equipment Type | Fuel Type | Engine Tier | Number per Day | Hours Per Day | Horsepower | Load Factor |
|---|---|---|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | Crawler Tractors | Diesel | Average | 1.00 | 8.00 | 87.0 | 0.43 |
| Linear, Grubbing & Land Clearing | Excavators | Diesel | Average | 1.00 | 8.00 | 36.0 | 0.38 |
| Linear, Grading & Excavation | Excavators | Diesel | Average | 3.00 | 8.00 | 36.0 | 0.38 |
| Linear, Grading & Excavation | Crawler Tractors | Diesel | Average | 1.00 | 8.00 | 87.0 | 0.43 |
| Linear, Grading & Excavation | Graders | Diesel | Average | 1.00 | 8.00 | 148 | 0.41 |
| Linear, Grading & Excavation | Rollers | Diesel | Average | 2.00 | 8.00 | 36.0 | 0.38 |
| Linear, Grading & Excavation | Tractors/Loaders/Backhoes | Diesel | Average | 2.00 | 8.00 | 84.0 | 0.37 |
| Linear, Grading & Excavation | Rubber Tired Loaders | Diesel | Average | 1.00 | 8.00 | 150 | 0.36 |
| Linear, Grading & Excavation | Scrapers | Diesel | Average | 2.00 | 8.00 | 423 | 0.48 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Linear, Drainage, Utilities, & Sub-Grade | Scrapers | Diesel | Average | 2.00 | 8.00 | 423 | 0.48 |
| Linear, Drainage, Utilities, & Sub-Grade | Rough Terrain Forklifts | Diesel | Average | 1.00 | 8.00 | 96.0 | 0.40 |
| Linear, Drainage, Utilities, & Sub-Grade | Tractors/Loaders/Backhoes | Diesel | Average | 2.00 | 8.00 | 84.0 | 0.37 |
| Linear, Drainage, Utilities, & Sub-Grade | Plate Compactors | Diesel | Average | 1.00 | 8.00 | 8.00 | 0.43 |
| Linear, Drainage, Utilities, & Sub-Grade | Pumps | Diesel | Average | 1.00 | 8.00 | 11.0 | 0.74 |
| Linear, Drainage, Utilities, & Sub-Grade | Graders | Diesel | Average | 1.00 | 8.00 | 148 | 0.41 |
| Linear, Drainage, Utilities, & Sub-Grade | Air Compressors | Diesel | Average | 1.00 | 8.00 | 37.0 | 0.48 |
| Linear, Drainage, Utilities, & Sub-Grade | Generator Sets | Diesel | Average | 1.00 | 8.00 | 14.0 | 0.74 |
| Linear, Paving | Rollers | Diesel | Average | 3.00 | 8.00 | 36.0 | 0.38 |
| Linear, Paving | Paving Equipment | Diesel | Average | 1.00 | 8.00 | 89.0 | 0.36 |
| Linear, Paving | Pavers | Diesel | Average | 1.00 | 8.00 | 81.0 | 0.42 |
| Linear, Paving | Tractors/Loaders/Backhoes | Diesel | Average | 2.00 | 8.00 | 84.0 | 0.37 |

## 5.3. Construction Vehicles

### 5.3.1. Unmitigated

| Phase Name | Trip Type | One-Way Trips per Day | Miles per Trip | Vehicle Mix |
|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | — | — | — | — |
| Linear, Grubbing & Land Clearing | Worker | 5.00 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Grubbing & Land Clearing | Vendor | 0.00 | 10.2 | HHDT,MHDT |
| Linear, Grubbing & Land Clearing | Hauling | 8.00 | 20.0 | HHDT |
| Linear, Grubbing & Land Clearing | Onsite truck | — | — | HHDT |

| | | | | |
|---|---|---|---|---|
| Linear, Grading & Excavation | — | — | — | — |
| Linear, Grading & Excavation | Worker | 30.0 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Grading & Excavation | Vendor | 1.00 | 10.2 | HHDT,MHDT |
| Linear, Grading & Excavation | Hauling | 8.00 | 20.0 | HHDT |
| Linear, Grading & Excavation | Onsite truck | — | — | HHDT |
| Linear, Drainage, Utilities, & Sub-Grade | — | — | — | — |
| Linear, Drainage, Utilities, & Sub-Grade | Worker | 25.0 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Drainage, Utilities, & Sub-Grade | Vendor | 0.00 | 10.2 | HHDT,MHDT |
| Linear, Drainage, Utilities, & Sub-Grade | Hauling | 0.00 | 20.0 | HHDT |
| Linear, Drainage, Utilities, & Sub-Grade | Onsite truck | — | — | HHDT |
| Linear, Paving | — | — | — | — |
| Linear, Paving | Worker | 17.5 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Paving | Vendor | 0.00 | 10.2 | HHDT,MHDT |
| Linear, Paving | Hauling | 0.00 | 20.0 | HHDT |
| Linear, Paving | Onsite truck | — | — | HHDT |

### 5.3.2. Mitigated

| Phase Name | Trip Type | One-Way Trips per Day | Miles per Trip | Vehicle Mix |
|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | — | — | — | — |
| Linear, Grubbing & Land Clearing | Worker | 5.00 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Grubbing & Land Clearing | Vendor | 0.00 | 10.2 | HHDT,MHDT |
| Linear, Grubbing & Land Clearing | Hauling | 8.00 | 20.0 | HHDT |
| Linear, Grubbing & Land Clearing | Onsite truck | — | — | HHDT |
| Linear, Grading & Excavation | — | — | — | — |
| Linear, Grading & Excavation | Worker | 30.0 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Grading & Excavation | Vendor | 1.00 | 10.2 | HHDT,MHDT |
| Linear, Grading & Excavation | Hauling | 8.00 | 20.0 | HHDT |

| | | | | |
|---|---|---|---|---|
| Linear, Grading & Excavation | Onsite truck | — | — | HHDT |
| Linear, Drainage, Utilities, & Sub-Grade | — | — | — | — |
| Linear, Drainage, Utilities, & Sub-Grade | Worker | 25.0 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Drainage, Utilities, & Sub-Grade | Vendor | 0.00 | 10.2 | HHDT,MHDT |
| Linear, Drainage, Utilities, & Sub-Grade | Hauling | 0.00 | 20.0 | HHDT |
| Linear, Drainage, Utilities, & Sub-Grade | Onsite truck | — | — | HHDT |
| Linear, Paving | — | — | — | — |
| Linear, Paving | Worker | 17.5 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Paving | Vendor | 0.00 | 10.2 | HHDT,MHDT |
| Linear, Paving | Hauling | 0.00 | 20.0 | HHDT |
| Linear, Paving | Onsite truck | — | — | HHDT |

## 5.4. Vehicles

### 5.4.1. Construction Vehicle Control Strategies

| Control Strategies Applied | PM10 Reduction | PM2.5 Reduction |
|---|---|---|
| Water unpaved roads twice daily | 55% | 55% |
| Limit vehicle speeds on unpaved roads to 25 mph | 44% | 44% |
| Sweep paved roads once per month | 9% | 9% |

## 5.5. Architectural Coatings

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

## 5.6. Dust Mitigation

### 5.6.1. Construction Earthmoving Activities

| Phase Name | Material Imported (cy) | Material Exported (cy) | Acres Graded (acres) | Material Demolished (sq. ft.) | Acres Paved (acres) |
|---|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | — | — | 4.13 | 0.00 | — |
| Linear, Grading & Excavation | — | — | 4.13 | 0.00 | — |
| Linear, Drainage, Utilities, & Sub-Grade | — | — | 4.13 | 0.00 | — |

### 5.6.2. Construction Earthmoving Control Strategies

| Control Strategies Applied | Frequency (per day) | PM10 Reduction | PM2.5 Reduction |
|---|---|---|---|
| Water Exposed Area | 2 | 61% | 61% |

## 5.7. Construction Paving

| Land Use | Area Paved (acres) | % Asphalt |
|---|---|---|
| Road Construction | 4.13 | 100% |

## 5.8. Construction Electricity Consumption and Emissions Factors

### kWh per Year and Emission Factor (lb/MWh)

| Year | kWh per Year | CO2 | CH4 | N2O |
|---|---|---|---|---|
| 2027 | 0.00 | 453 | 0.03 | < 0.005 |
| 2028 | 0.00 | 453 | 0.03 | < 0.005 |
| 2029 | 0.00 | 453 | 0.03 | < 0.005 |

## 5.18. Vegetation

### 5.18.1. Land Use Change

#### 5.18.1.1. Unmitigated

| Vegetation Land Use Type | Vegetation Soil Type | Initial Acres | Final Acres |
|---|---|---|---|

#### 5.18.1.2. Mitigated

| Vegetation Land Use Type | Vegetation Soil Type | Initial Acres | Final Acres |
|---|---|---|---|

### 5.18.1. Biomass Cover Type

#### 5.18.1.1. Unmitigated

| Biomass Cover Type | Initial Acres | Final Acres |
|---|---|---|

#### 5.18.1.2. Mitigated

| Biomass Cover Type | Initial Acres | Final Acres |
|---|---|---|

### 5.18.2. Sequestration

#### 5.18.2.1. Unmitigated

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

#### 5.18.2.2. Mitigated

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

# 6. Climate Risk Detailed Report

## 6.1. Climate Risk Summary

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

| Climate Hazard | Result for Project Location | Unit |
|---|---|---|
| Temperature and Extreme Heat | 5.68 | annual days of extreme heat |
| Extreme Precipitation | 5.50 | annual days with precipitation above 20 mm |
| Sea Level Rise | — | meters of inundation depth |
| Wildfire | 0.00 | annual hectares burned |

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

## 6.2. Initial Climate Risk Scores

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

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

## 6.3. Adjusted Climate Risk Scores

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

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

## 6.4. Climate Risk Reduction Measures

# 7. Health and Equity Details

## 7.1. CalEnviroScreen 4.0 Scores

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

| Indicator | Result for Project Census Tract |
|---|---|
| Exposure Indicators | — |
| AQ-Ozone | 45.0 |
| AQ-PM | 68.0 |
| AQ-DPM | 91.2 |
| Drinking Water | 61.5 |
| Lead Risk Housing | 64.6 |

| | |
|---|---|
| Pesticides | 17.7 |
| Toxic Releases | 79.4 |
| Traffic | 68.5 |
| Effect Indicators | — |
| CleanUp Sites | 88.6 |
| Groundwater | 92.5 |
| Haz Waste Facilities/Generators | 91.0 |
| Impaired Water Bodies | 66.7 |
| Solid Waste | 93.4 |
| Sensitive Population | — |
| Asthma | 45.1 |
| Cardio-vascular | 53.6 |
| Low Birth Weights | 37.6 |
| Socioeconomic Factor Indicators | — |
| Education | 19.3 |
| Housing | 58.8 |
| Linguistic | 42.1 |
| Poverty | 27.9 |
| Unemployment | 23.8 |

## 7.2. Healthy Places Index Scores

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

| Indicator | Result for Project Census Tract |
|---|---|
| Economic | — |
| Above Poverty | 83.72898755 |
| Employed | 79.36609778 |
| Median HI | 78.76299243 |

| | |
|---|---|
| Education | — |
| Bachelor's or higher | 79.63557038 |
| High school enrollment | 100 |
| Preschool enrollment | 40.65186706 |
| Transportation | — |
| Auto Access | 46.70858463 |
| Active commuting | 73.66867702 |
| Social | — |
| 2-parent households | 44.68112409 |
| Voting | 75.93994611 |
| Neighborhood | — |
| Alcohol availability | 33.40177082 |
| Park access | 81.35506224 |
| Retail density | 65.99512383 |
| Supermarket access | 75.70896959 |
| Tree canopy | 71.79520082 |
| Housing | — |
| Homeownership | 30.71987681 |
| Housing habitability | 49.09534197 |
| Low-inc homeowner severe housing cost burden | 67.79160785 |
| Low-inc renter severe housing cost burden | 74.88771975 |
| Uncrowded housing | 53.4838958 |
| Health Outcomes | — |
| Insured adults | 78.05723085 |
| Arthritis | 0.0 |
| Asthma ER Admissions | 64.1 |
| High Blood Pressure | 0.0 |

| | |
|---|---|
| Cancer (excluding skin) | 0.0 |
| Asthma | 0.0 |
| Coronary Heart Disease | 0.0 |
| Chronic Obstructive Pulmonary Disease | 0.0 |
| Diagnosed Diabetes | 0.0 |
| Life Expectancy at Birth | 35.0 |
| Cognitively Disabled | 36.6 |
| Physically  Disabled | 63.7 |
| Heart Attack ER Admissions | 49.8 |
| Mental Health Not Good | 0.0 |
| Chronic Kidney Disease | 0.0 |
| Obesity | 0.0 |
| Pedestrian Injuries | 98.1 |
| Physical Health Not Good | 0.0 |
| Stroke | 0.0 |
| Health Risk Behaviors | — |
| Binge Drinking | 0.0 |
| Current Smoker | 0.0 |
| No Leisure Time for Physical Activity | 0.0 |
| Climate Change Exposures | — |
| Wildfire Risk | 0.0 |
| SLR Inundation Area | 0.0 |
| Children | 61.0 |
| Elderly | 47.3 |
| English Speaking | 58.4 |
| Foreign-born | 48.4 |
| Outdoor Workers | 81.7 |

| | |
|---|---|
| Climate Change Adaptive Capacity | — |
| Impervious Surface Cover | 18.0 |
| Traffic Density | 72.7 |
| Traffic Access | 74.7 |
| Other Indices | — |
| Hardship | 15.8 |
| Other Decision Support | — |
| 2016 Voting | 56.9 |

## 7.3. Overall Health & Equity Scores

| Metric | Result for Project Census Tract |
|---|---|
| CalEnviroScreen 4.0 Score for Project Location (a) | 68.0 |
| Healthy Places Index Score for Project Location (b) | 77.0 |
| Project Located in a Designated Disadvantaged Community (Senate Bill 535) | No |
| Project Located in a Low-Income Community (Assembly Bill 1550) | No |
| Project Located in a Community Air Protection Program Community (Assembly Bill 617) | No |

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

## 7.4. Health & Equity Measures

No Health & Equity Measures selected.

## 7.5. Evaluation Scorecard

Health & Equity Evaluation Scorecard not completed.

## 7.6. Health & Equity Custom Measures

No Health & Equity Custom Measures created.

# 8. User Changes to Default Data

| Screen | Justification |
|---|---|
| Characteristics: Project Details | adjusted for project location |
| Characteristics: Utility Information | adjusted for project location |
| Construction: Off-Road Equipment | project specific adjustments |
| Construction: Trips and VMT | client provided info |

# Maui WWRF - Pipelines Detailed Report

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# 1. Basic Project Information

## 1.1. Basic Project Information

| Data Field | Value |
|---|---|
| Project Name | Maui WWRF - Pipelines |
| Construction Start Date | 10/6/2025 |
| Lead Agency | — |
| Land Use Scale | Project/site |
| Analysis Level for Defaults | Statewide |
| Windspeed (m/s) | 2.70 |
| Precipitation (days) | 8.20 |
| Location | 34.025877767512654, -118.38163287131451 |
| County | Los Angeles-South Coast |
| City | Culver City |
| Air District | South Coast AQMD |
| Air Basin | South Coast |
| TAZ | 4457 |
| EDFZ | 16 |
| Electric Utility | Statewide Average |
| Gas Utility | Southern California Gas |
| App Version | 2022.1.1.29 |

## 1.2. Land Use Types

| Land Use Subtype | Size | Unit | Lot Acreage | Building Area (sq ft) | Landscape Area (sq ft) | Special Landscape Area (sq ft) | Population | Description |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Road Widening | 0.80 | Mile | 0.80 | 0.00 | — | — | — | Recycled water pipeline, roadways will remain the same width |
| Road Widening | 3.50 | Mile | 3.50 | 0.00 | 0.00 | — | — | Sewage pipeline, roadways will remain the same width |

### 1.3. User-Selected Emission Reduction Measures by Emissions Sector

| Sector | # | Measure Title |
|---|---|---|
| Construction | C-2* | Limit Heavy-Duty Diesel Vehicle Idling |

* Qualitative or supporting measure. Emission reductions not included in the mitigated emissions results.

## 2. Emissions Summary

### 2.1. Construction Emissions Compared Against Thresholds

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

| Un/Mit. | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 2.25 | 1.92 | 11.1 | 26.5 | 0.02 | 0.43 | 2.52 | 2.95 | 0.40 | 0.54 | 0.94 | — | 4,601 | 4,601 | 0.18 | 0.14 | 8.62 | 4,640 |
| Mit. | 2.25 | 1.92 | 11.1 | 26.5 | 0.02 | 0.43 | 2.52 | 2.95 | 0.40 | 0.54 | 0.94 | — | 4,601 | 4,601 | 0.18 | 0.14 | 8.62 | 4,640 |
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 2.33 | 1.98 | 12.1 | 25.0 | 0.02 | 0.49 | 2.52 | 3.00 | 0.45 | 0.54 | 0.99 | — | 4,481 | 4,481 | 0.19 | 0.15 | 0.24 | 4,515 |
| Mit. | 2.33 | 1.98 | 12.1 | 25.0 | 0.02 | 0.49 | 2.52 | 3.00 | 0.45 | 0.54 | 0.99 | — | 4,481 | 4,481 | 0.19 | 0.15 | 0.24 | 4,515 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Average Daily (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 1.19 | 1.02 | 5.94 | 15.5 | 0.01 | 0.22 | 1.59 | 1.79 | 0.21 | 0.37 | 0.56 | — | 3,089 | 3,089 | 0.09 | 0.10 | 2.62 | 3,123 |
| Mit. | 1.19 | 1.02 | 5.94 | 15.5 | 0.01 | 0.22 | 1.59 | 1.79 | 0.21 | 0.37 | 0.56 | — | 3,089 | 3,089 | 0.09 | 0.10 | 2.62 | 3,123 |
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Annual (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Unmit. | 0.22 | 0.19 | 1.08 | 2.83 | < 0.005 | 0.04 | 0.29 | 0.33 | 0.04 | 0.07 | 0.10 | — | 511 | 511 | 0.01 | 0.02 | 0.43 | 517 |
| Mit. | 0.22 | 0.19 | 1.08 | 2.83 | < 0.005 | 0.04 | 0.29 | 0.33 | 0.04 | 0.07 | 0.10 | — | 511 | 511 | 0.01 | 0.02 | 0.43 | 517 |
| % Reduced | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

## 2.2. Construction Emissions by Year, Unmitigated

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

| Year | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily - Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2026 | 1.59 | 1.37 | 6.80 | 22.9 | 0.02 | 0.25 | 2.20 | 2.45 | 0.23 | 0.52 | 0.75 | — | 4,419 | 4,419 | 0.18 | 0.14 | 8.62 | 4,475 |
| 2027 | 2.25 | 1.92 | 11.1 | 26.5 | 0.02 | 0.43 | 2.52 | 2.95 | 0.40 | 0.54 | 0.94 | — | 4,601 | 4,601 | 0.12 | 0.10 | 7.07 | 4,640 |
| Daily - Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2025 | 1.65 | 1.41 | 7.65 | 21.4 | 0.02 | 0.30 | 2.20 | 2.49 | 0.27 | 0.52 | 0.79 | — | 4,307 | 4,307 | 0.19 | 0.15 | 0.24 | 4,356 |
| 2026 | 2.33 | 1.98 | 12.1 | 25.0 | 0.02 | 0.49 | 2.52 | 3.00 | 0.45 | 0.54 | 0.99 | — | 4,481 | 4,481 | 0.13 | 0.15 | 0.22 | 4,515 |
| 2027 | 2.22 | 1.89 | 11.3 | 24.5 | 0.02 | 0.43 | 2.52 | 2.95 | 0.40 | 0.54 | 0.94 | — | 4,445 | 4,445 | 0.13 | 0.10 | 0.18 | 4,478 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2025 | 0.21 | 0.18 | 0.84 | 2.80 | < 0.005 | 0.03 | 0.37 | 0.40 | 0.02 | 0.09 | 0.11 | — | 586 | 586 | 0.03 | 0.02 | 0.68 | 594 |
| 2026 | 1.19 | 1.02 | 5.43 | 15.5 | 0.01 | 0.20 | 1.59 | 1.79 | 0.19 | 0.37 | 0.56 | — | 3,089 | 3,089 | 0.09 | 0.10 | 2.62 | 3,123 |
| 2027 | 1.14 | 0.97 | 5.94 | 13.3 | 0.01 | 0.22 | 1.27 | 1.50 | 0.21 | 0.28 | 0.49 | — | 2,418 | 2,418 | 0.07 | 0.05 | 1.66 | 2,437 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2025 | 0.04 | 0.03 | 0.15 | 0.51 | < 0.005 | < 0.005 | 0.07 | 0.07 | < 0.005 | 0.02 | 0.02 | — | 96.9 | 96.9 | < 0.005 | < 0.005 | 0.11 | 98.3 |
| 2026 | 0.22 | 0.19 | 0.99 | 2.83 | < 0.005 | 0.04 | 0.29 | 0.33 | 0.03 | 0.07 | 0.10 | — | 511 | 511 | 0.01 | 0.02 | 0.43 | 517 |
| 2027 | 0.21 | 0.18 | 1.08 | 2.43 | < 0.005 | 0.04 | 0.23 | 0.27 | 0.04 | 0.05 | 0.09 | — | 400 | 400 | 0.01 | 0.01 | 0.27 | 403 |

## 2.3. Construction Emissions by Year, Mitigated

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

| Year | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily - Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2026 | 1.59 | 1.37 | 6.80 | 22.9 | 0.02 | 0.25 | 2.20 | 2.45 | 0.23 | 0.52 | 0.75 | — | 4,419 | 4,419 | 0.18 | 0.14 | 8.62 | 4,475 |
| 2027 | 2.25 | 1.92 | 11.1 | 26.5 | 0.02 | 0.43 | 2.52 | 2.95 | 0.40 | 0.54 | 0.94 | — | 4,601 | 4,601 | 0.12 | 0.10 | 7.07 | 4,640 |
| Daily - Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2025 | 1.65 | 1.41 | 7.65 | 21.4 | 0.02 | 0.30 | 2.20 | 2.49 | 0.27 | 0.52 | 0.79 | — | 4,307 | 4,307 | 0.19 | 0.15 | 0.24 | 4,356 |
| 2026 | 2.33 | 1.98 | 12.1 | 25.0 | 0.02 | 0.49 | 2.52 | 3.00 | 0.45 | 0.54 | 0.99 | — | 4,481 | 4,481 | 0.13 | 0.15 | 0.22 | 4,515 |
| 2027 | 2.22 | 1.89 | 11.3 | 24.5 | 0.02 | 0.43 | 2.52 | 2.95 | 0.40 | 0.54 | 0.94 | — | 4,445 | 4,445 | 0.13 | 0.10 | 0.18 | 4,478 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2025 | 0.21 | 0.18 | 0.84 | 2.80 | < 0.005 | 0.03 | 0.37 | 0.40 | 0.02 | 0.09 | 0.11 | — | 586 | 586 | 0.03 | 0.02 | 0.68 | 594 |
| 2026 | 1.19 | 1.02 | 5.43 | 15.5 | 0.01 | 0.20 | 1.59 | 1.79 | 0.19 | 0.37 | 0.56 | — | 3,089 | 3,089 | 0.09 | 0.10 | 2.62 | 3,123 |
| 2027 | 1.14 | 0.97 | 5.94 | 13.3 | 0.01 | 0.22 | 1.27 | 1.50 | 0.21 | 0.28 | 0.49 | — | 2,418 | 2,418 | 0.07 | 0.05 | 1.66 | 2,437 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2025 | 0.04 | 0.03 | 0.15 | 0.51 | < 0.005 | < 0.005 | 0.07 | 0.07 | < 0.005 | 0.02 | 0.02 | — | 96.9 | 96.9 | < 0.005 | < 0.005 | 0.11 | 98.3 |
| 2026 | 0.22 | 0.19 | 0.99 | 2.83 | < 0.005 | 0.04 | 0.29 | 0.33 | 0.03 | 0.07 | 0.10 | — | 511 | 511 | 0.01 | 0.02 | 0.43 | 517 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2027 | 0.21 | 0.18 | 1.08 | 2.43 | < 0.005 | 0.04 | 0.23 | 0.27 | 0.04 | 0.05 | 0.09 | — | 400 | 400 | 0.01 | 0.01 | 0.27 | 403 |

# 3. Construction Emissions Details

## 3.1. Linear, Grubbing & Land Clearing (2025) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.38 | 0.32 | 3.30 | 5.73 | 0.01 | 0.13 | — | 0.13 | 0.12 | — | 0.12 | — | 871 | 871 | 0.04 | 0.01 | — | 874 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.05 | 0.05 | 0.47 | 0.82 | < 0.005 | 0.02 | — | 0.02 | 0.02 | — | 0.02 | — | 124 | 124 | 0.01 | < 0.005 | — | 125 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.01 | 0.01 | 0.09 | 0.15 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 20.6 | 20.6 | < 0.005 | < 0.005 | — | 20.6 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.74 | 0.65 | 0.85 | 9.32 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,090 | 2,090 | 0.10 | 0.08 | 0.22 | 2,117 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.02 | 0.01 | 0.36 | 0.11 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 279 | 279 | 0.01 | 0.04 | 0.02 | 292 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.10 | 0.09 | 0.11 | 1.38 | 0.00 | 0.00 | 0.30 | 0.30 | 0.00 | 0.07 | 0.07 | — | 303 | 303 | 0.01 | 0.01 | 0.53 | 307 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.05 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 39.7 | 39.7 | < 0.005 | 0.01 | 0.04 | 41.7 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.02 | 0.02 | 0.02 | 0.25 | 0.00 | 0.00 | 0.05 | 0.05 | 0.00 | 0.01 | 0.01 | — | 50.1 | 50.1 | < 0.005 | < 0.005 | 0.09 | 50.8 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 6.58 | 6.58 | < 0.005 | < 0.005 | 0.01 | 6.90 |

## 3.2. Linear, Grubbing & Land Clearing (2025) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.38 | 0.32 | 3.30 | 5.73 | 0.01 | 0.13 | — | 0.13 | 0.12 | — | 0.12 | — | 871 | 871 | 0.04 | 0.01 | — | 874 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.05 | 0.05 | 0.47 | 0.82 | < 0.005 | 0.02 | — | 0.02 | 0.02 | — | 0.02 | — | 124 | 124 | 0.01 | < 0.005 | — | 125 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Off-Road Equipment | 0.01 | 0.01 | 0.09 | 0.15 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 20.6 | 20.6 | < 0.005 | < 0.005 | — | 20.6 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.74 | 0.65 | 0.85 | 9.32 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,090 | 2,090 | 0.10 | 0.08 | 0.22 | 2,117 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.02 | 0.01 | 0.36 | 0.11 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 279 | 279 | 0.01 | 0.04 | 0.02 | 292 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.10 | 0.09 | 0.11 | 1.38 | 0.00 | 0.00 | 0.30 | 0.30 | 0.00 | 0.07 | 0.07 | — | 303 | 303 | 0.01 | 0.01 | 0.53 | 307 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.05 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 39.7 | 39.7 | < 0.005 | 0.01 | 0.04 | 41.7 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.02 | 0.02 | 0.02 | 0.25 | 0.00 | 0.00 | 0.05 | 0.05 | 0.00 | 0.01 | 0.01 | — | 50.1 | 50.1 | < 0.005 | < 0.005 | 0.09 | 50.8 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 6.58 | 6.58 | < 0.005 | < 0.005 | 0.01 | 6.90 |

## 3.3. Linear, Grading & Excavation (2025) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.89 | 0.75 | 6.36 | 12.0 | 0.02 | 0.29 | — | 0.29 | 0.27 | — | 0.27 | — | 1,874 | 1,874 | 0.08 | 0.02 | — | 1,880 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.02 | 0.02 | 0.17 | 0.33 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 51.3 | 51.3 | < 0.005 | < 0.005 | — | 51.5 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | < 0.005 | < 0.005 | 0.03 | 0.06 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 8.50 | 8.50 | < 0.005 | < 0.005 | — | 8.53 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.74 | 0.65 | 0.85 | 9.32 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,090 | 2,090 | 0.10 | 0.08 | 0.22 | 2,117 |
| Vendor | < 0.005 | < 0.005 | 0.08 | 0.03 | < 0.005 | < 0.005 | 0.02 | 0.02 | < 0.005 | < 0.005 | 0.01 | — | 63.8 | 63.8 | < 0.005 | 0.01 | < 0.005 | 66.6 |
| Hauling | 0.02 | 0.01 | 0.36 | 0.11 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 279 | 279 | 0.01 | 0.04 | 0.02 | 292 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.02 | 0.02 | 0.02 | 0.26 | 0.00 | 0.00 | 0.06 | 0.06 | 0.00 | 0.01 | 0.01 | — | 58.2 | 58.2 | < 0.005 | < 0.005 | 0.10 | 59.0 |
| Vendor | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 1.75 | 1.75 | < 0.005 | < 0.005 | < 0.005 | 1.83 |
| Hauling | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 7.64 | 7.64 | < 0.005 | < 0.005 | 0.01 | 8.01 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.05 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 9.64 | 9.64 | < 0.005 | < 0.005 | 0.02 | 9.78 |
| Vendor | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 0.29 | 0.29 | < 0.005 | < 0.005 | < 0.005 | 0.30 |
| Hauling | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 1.27 | 1.27 | < 0.005 | < 0.005 | < 0.005 | 1.33 |

## 3.4. Linear, Grading & Excavation (2025) - Mitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.89 | 0.75 | 6.36 | 12.0 | 0.02 | 0.29 | — | 0.29 | 0.27 | — | 0.27 | — | 1,874 | 1,874 | 0.08 | 0.02 | — | 1,880 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.02 | 0.02 | 0.17 | 0.33 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 51.3 | 51.3 | < 0.005 | < 0.005 | — | 51.5 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | < 0.005 | < 0.005 | 0.03 | 0.06 | < 0.005 | < 0.005 | — | < 0.005 | < 0.005 | — | < 0.005 | — | 8.50 | 8.50 | < 0.005 | < 0.005 | — | 8.53 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.74 | 0.65 | 0.85 | 9.32 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,090 | 2,090 | 0.10 | 0.08 | 0.22 | 2,117 |
| Vendor | < 0.005 | < 0.005 | 0.08 | 0.03 | < 0.005 | < 0.005 | 0.02 | 0.02 | < 0.005 | < 0.005 | 0.01 | — | 63.8 | 63.8 | < 0.005 | 0.01 | < 0.005 | 66.6 |
| Hauling | 0.02 | 0.01 | 0.36 | 0.11 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 279 | 279 | 0.01 | 0.04 | 0.02 | 292 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.02 | 0.02 | 0.02 | 0.26 | 0.00 | 0.00 | 0.06 | 0.06 | 0.00 | 0.01 | 0.01 | — | 58.2 | 58.2 | < 0.005 | < 0.005 | 0.10 | 59.0 |
| Vendor | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 1.75 | 1.75 | < 0.005 | < 0.005 | < 0.005 | 1.83 |
| Hauling | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 7.64 | 7.64 | < 0.005 | < 0.005 | 0.01 | 8.01 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | < 0.005 | < 0.005 | < 0.005 | 0.05 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | < 0.005 | < 0.005 | — | 9.64 | 9.64 | < 0.005 | < 0.005 | 0.02 | 9.78 |
| Vendor | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 0.29 | 0.29 | < 0.005 | < 0.005 | < 0.005 | 0.30 |
| Hauling | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 1.27 | 1.27 | < 0.005 | < 0.005 | < 0.005 | 1.33 |

## 3.5. Linear, Grading & Excavation (2026) - Unmitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Off-Road Equipment | 0.84 | 0.71 | 5.76 | 12.0 | 0.02 | 0.24 | — | 0.24 | 0.22 | — | 0.22 | — | 1,874 | 1,874 | 0.08 | 0.02 | — | 1,880 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.84 | 0.71 | 5.76 | 12.0 | 0.02 | 0.24 | — | 0.24 | 0.22 | — | 0.22 | — | 1,874 | 1,874 | 0.08 | 0.02 | — | 1,880 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.52 | 0.43 | 3.54 | 7.37 | 0.01 | 0.15 | — | 0.15 | 0.14 | — | 0.14 | — | 1,151 | 1,151 | 0.05 | 0.01 | — | 1,155 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Off-Road Equipm | 0.09 | 0.08 | 0.65 | 1.35 | < 0.005 | 0.03 | — | 0.03 | 0.03 | — | 0.03 | — | 191 | 191 | 0.01 | < 0.005 | — | 191 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.73 | 0.65 | 0.63 | 10.7 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,209 | 2,209 | 0.09 | 0.08 | 7.81 | 2,242 |
| Vendor | < 0.005 | < 0.005 | 0.07 | 0.03 | < 0.005 | < 0.005 | 0.02 | 0.02 | < 0.005 | < 0.005 | 0.01 | — | 62.6 | 62.6 | < 0.005 | 0.01 | 0.16 | 65.5 |
| Hauling | 0.02 | < 0.005 | 0.33 | 0.10 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 273 | 273 | 0.01 | 0.04 | 0.64 | 287 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.70 | 0.62 | 0.78 | 8.61 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,049 | 2,049 | 0.03 | 0.08 | 0.20 | 2,074 |
| Vendor | < 0.005 | < 0.005 | 0.08 | 0.03 | < 0.005 | < 0.005 | 0.02 | 0.02 | < 0.005 | < 0.005 | 0.01 | — | 62.6 | 62.6 | < 0.005 | 0.01 | < 0.005 | 65.3 |
| Hauling | 0.02 | < 0.005 | 0.35 | 0.10 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 274 | 274 | 0.01 | 0.04 | 0.02 | 287 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.43 | 0.38 | 0.44 | 5.51 | 0.00 | 0.00 | 1.29 | 1.29 | 0.00 | 0.30 | 0.30 | — | 1,280 | 1,280 | 0.02 | 0.05 | 2.07 | 1,297 |
| Vendor | < 0.005 | < 0.005 | 0.05 | 0.02 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 38.5 | 38.5 | < 0.005 | 0.01 | 0.04 | 40.2 |
| Hauling | 0.01 | < 0.005 | 0.21 | 0.06 | < 0.005 | < 0.005 | 0.05 | 0.05 | < 0.005 | 0.01 | 0.02 | — | 168 | 168 | 0.01 | 0.03 | 0.17 | 176 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.08 | 0.07 | 0.08 | 1.01 | 0.00 | 0.00 | 0.23 | 0.23 | 0.00 | 0.06 | 0.06 | — | 212 | 212 | < 0.005 | 0.01 | 0.34 | 215 |
| Vendor | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 6.37 | 6.37 | < 0.005 | < 0.005 | 0.01 | 6.65 |
| Hauling | < 0.005 | < 0.005 | 0.04 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 27.8 | 27.8 | < 0.005 | < 0.005 | 0.03 | 29.2 |

## 3.6. Linear, Grading & Excavation (2026) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.84 | 0.71 | 5.76 | 12.0 | 0.02 | 0.24 | — | 0.24 | 0.22 | — | 0.22 | — | 1,874 | 1,874 | 0.08 | 0.02 | — | 1,880 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.84 | 0.71 | 5.76 | 12.0 | 0.02 | 0.24 | — | 0.24 | 0.22 | — | 0.22 | — | 1,874 | 1,874 | 0.08 | 0.02 | — | 1,880 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.52 | 0.43 | 3.54 | 7.37 | 0.01 | 0.15 | — | 0.15 | 0.14 | — | 0.14 | — | 1,151 | 1,151 | 0.05 | 0.01 | — | 1,155 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.09 | 0.08 | 0.65 | 1.35 | < 0.005 | 0.03 | — | 0.03 | 0.03 | — | 0.03 | — | 191 | 191 | 0.01 | < 0.005 | — | 191 |
| Dust From Material Movement | — | — | — | — | — | — | 0.00 | 0.00 | — | 0.00 | 0.00 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.73 | 0.65 | 0.63 | 10.7 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,209 | 2,209 | 0.09 | 0.08 | 7.81 | 2,242 |
| Vendor | < 0.005 | < 0.005 | 0.07 | 0.03 | < 0.005 | < 0.005 | 0.02 | 0.02 | < 0.005 | < 0.005 | 0.01 | — | 62.6 | 62.6 | < 0.005 | 0.01 | 0.16 | 65.5 |
| Hauling | 0.02 | < 0.005 | 0.33 | 0.10 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 273 | 273 | 0.01 | 0.04 | 0.64 | 287 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.70 | 0.62 | 0.78 | 8.61 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,049 | 2,049 | 0.03 | 0.08 | 0.20 | 2,074 |
| Vendor | < 0.005 | < 0.005 | 0.08 | 0.03 | < 0.005 | < 0.005 | 0.02 | 0.02 | < 0.005 | < 0.005 | 0.01 | — | 62.6 | 62.6 | < 0.005 | 0.01 | < 0.005 | 65.3 |
| Hauling | 0.02 | < 0.005 | 0.35 | 0.10 | < 0.005 | 0.01 | 0.07 | 0.08 | 0.01 | 0.02 | 0.03 | — | 274 | 274 | 0.01 | 0.04 | 0.02 | 287 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.43 | 0.38 | 0.44 | 5.51 | 0.00 | 0.00 | 1.29 | 1.29 | 0.00 | 0.30 | 0.30 | — | 1,280 | 1,280 | 0.02 | 0.05 | 2.07 | 1,297 |
| Vendor | < 0.005 | < 0.005 | 0.05 | 0.02 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 38.5 | 38.5 | < 0.005 | 0.01 | 0.04 | 40.2 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hauling | 0.01 | < 0.005 | 0.21 | 0.06 | < 0.005 | < 0.005 | 0.05 | 0.05 | < 0.005 | 0.01 | 0.02 | — | 168 | 168 | 0.01 | 0.03 | 0.17 | 176 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.08 | 0.07 | 0.08 | 1.01 | 0.00 | 0.00 | 0.23 | 0.23 | 0.00 | 0.06 | 0.06 | — | 212 | 212 | < 0.005 | 0.01 | 0.34 | 215 |
| Vendor | < 0.005 | < 0.005 | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | — | 6.37 | 6.37 | < 0.005 | < 0.005 | 0.01 | 6.65 |
| Hauling | < 0.005 | < 0.005 | 0.04 | 0.01 | < 0.005 | < 0.005 | 0.01 | 0.01 | < 0.005 | < 0.005 | < 0.005 | — | 27.8 | 27.8 | < 0.005 | < 0.005 | 0.03 | 29.2 |

## 3.7. Linear, Drainage, Utilities, & Sub-Grade (2026) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.63 | 1.36 | 11.3 | 16.4 | 0.02 | 0.49 | — | 0.49 | 0.45 | — | 0.45 | — | 2,432 | 2,432 | 0.10 | 0.02 | — | 2,441 |
| Dust From Material Movement | — | — | — | — | — | — | 0.41 | 0.41 | — | 0.04 | 0.04 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.16 | 0.14 | 1.13 | 1.64 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 243 | 243 | 0.01 | < 0.005 | — | 244 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dust From Material Movement | — | — | — | — | — | — | 0.04 | 0.04 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.03 | 0.02 | 0.21 | 0.30 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 40.2 | 40.2 | < 0.005 | < 0.005 | — | 40.3 |
| Dust From Material Movement | — | — | — | — | — | — | 0.01 | 0.01 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.70 | 0.62 | 0.78 | 8.61 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,049 | 2,049 | 0.03 | 0.08 | 0.20 | 2,074 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.07 | 0.06 | 0.07 | 0.90 | 0.00 | 0.00 | 0.21 | 0.21 | 0.00 | 0.05 | 0.05 | — | 208 | 208 | < 0.005 | 0.01 | 0.34 | 211 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.16 | 0.00 | 0.00 | 0.04 | 0.04 | 0.00 | 0.01 | 0.01 | — | 34.4 | 34.4 | < 0.005 | < 0.005 | 0.06 | 34.9 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.8. Linear, Drainage, Utilities, & Sub-Grade (2026) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.63 | 1.36 | 11.3 | 16.4 | 0.02 | 0.49 | — | 0.49 | 0.45 | — | 0.45 | — | 2,432 | 2,432 | 0.10 | 0.02 | — | 2,441 |
| Dust From Material Movement | — | — | — | — | — | — | 0.41 | 0.41 | — | 0.04 | 0.04 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.16 | 0.14 | 1.13 | 1.64 | < 0.005 | 0.05 | — | 0.05 | 0.04 | — | 0.04 | — | 243 | 243 | 0.01 | < 0.005 | — | 244 |
| Dust From Material Movement | — | — | — | — | — | — | 0.04 | 0.04 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.03 | 0.02 | 0.21 | 0.30 | < 0.005 | 0.01 | — | 0.01 | 0.01 | — | 0.01 | — | 40.2 | 40.2 | < 0.005 | < 0.005 | — | 40.3 |
| Dust From Material Movement | — | — | — | — | — | — | 0.01 | 0.01 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.70 | 0.62 | 0.78 | 8.61 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,049 | 2,049 | 0.03 | 0.08 | 0.20 | 2,074 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.07 | 0.06 | 0.07 | 0.90 | 0.00 | 0.00 | 0.21 | 0.21 | 0.00 | 0.05 | 0.05 | — | 208 | 208 | < 0.005 | 0.01 | 0.34 | 211 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.01 | 0.01 | 0.01 | 0.16 | 0.00 | 0.00 | 0.04 | 0.04 | 0.00 | 0.01 | 0.01 | — | 34.4 | 34.4 | < 0.005 | < 0.005 | 0.06 | 34.9 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.9. Linear, Drainage, Utilities, & Sub-Grade (2027) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.55 | 1.29 | 10.6 | 16.4 | 0.02 | 0.43 | — | 0.43 | 0.40 | — | 0.40 | — | 2,433 | 2,433 | 0.10 | 0.02 | — | 2,441 |
| Dust From Material Movement | — | — | — | — | — | — | 0.41 | 0.41 | — | 0.04 | 0.04 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.55 | 1.29 | 10.6 | 16.4 | 0.02 | 0.43 | — | 0.43 | 0.40 | — | 0.40 | — | 2,433 | 2,433 | 0.10 | 0.02 | — | 2,441 |
| Dust From Material Movement | — | — | — | — | — | — | 0.41 | 0.41 | — | 0.04 | 0.04 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.51 | 0.42 | 3.48 | 5.41 | 0.01 | 0.14 | — | 0.14 | 0.13 | — | 0.13 | — | 800 | 800 | 0.03 | 0.01 | — | 803 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dust From Material Movement | — | — | — | — | — | — | 0.14 | 0.14 | — | 0.01 | 0.01 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.09 | 0.08 | 0.63 | 0.99 | < 0.005 | 0.03 | — | 0.03 | 0.02 | — | 0.02 | — | 132 | 132 | 0.01 | < 0.005 | — | 133 |
| Dust From Material Movement | — | — | — | — | — | — | 0.02 | 0.02 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.70 | 0.62 | 0.56 | 10.0 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,168 | 2,168 | 0.02 | 0.08 | 7.07 | 2,199 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.68 | 0.60 | 0.71 | 8.04 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,011 | 2,011 | 0.03 | 0.08 | 0.18 | 2,036 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.22 | 0.20 | 0.21 | 2.75 | 0.00 | 0.00 | 0.69 | 0.69 | 0.00 | 0.16 | 0.16 | — | 672 | 672 | 0.01 | 0.03 | 1.00 | 681 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

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| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.04 | 0.04 | 0.04 | 0.50 | 0.00 | 0.00 | 0.13 | 0.13 | 0.00 | 0.03 | 0.03 | — | 111 | 111 | < 0.005 | < 0.005 | 0.17 | 113 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.10. Linear, Drainage, Utilities, & Sub-Grade (2027) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.55 | 1.29 | 10.6 | 16.4 | 0.02 | 0.43 | — | 0.43 | 0.40 | — | 0.40 | — | 2,433 | 2,433 | 0.10 | 0.02 | — | 2,441 |
| Dust From Material Movement | — | — | — | — | — | — | 0.41 | 0.41 | — | 0.04 | 0.04 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.55 | 1.29 | 10.6 | 16.4 | 0.02 | 0.43 | — | 0.43 | 0.40 | — | 0.40 | — | 2,433 | 2,433 | 0.10 | 0.02 | — | 2,441 |
| Dust From Material Movement | — | — | — | — | — | — | 0.41 | 0.41 | — | 0.04 | 0.04 | — | — | — | — | — | — | — |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.51 | 0.42 | 3.48 | 5.41 | 0.01 | 0.14 | — | 0.14 | 0.13 | — | 0.13 | — | 800 | 800 | 0.03 | 0.01 | — | 803 |
| Dust From Material Movement | — | — | — | — | — | — | 0.14 | 0.14 | — | 0.01 | 0.01 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.09 | 0.08 | 0.63 | 0.99 | < 0.005 | 0.03 | — | 0.03 | 0.02 | — | 0.02 | — | 132 | 132 | 0.01 | < 0.005 | — | 133 |
| Dust From Material Movement | — | — | — | — | — | — | 0.02 | 0.02 | — | < 0.005 | < 0.005 | — | — | — | — | — | — | — |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.70 | 0.62 | 0.56 | 10.0 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,168 | 2,168 | 0.02 | 0.08 | 7.07 | 2,199 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.68 | 0.60 | 0.71 | 8.04 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,011 | 2,011 | 0.03 | 0.08 | 0.18 | 2,036 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.22 | 0.20 | 0.21 | 2.75 | 0.00 | 0.00 | 0.69 | 0.69 | 0.00 | 0.16 | 0.16 | — | 672 | 672 | 0.01 | 0.03 | 1.00 | 681 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.04 | 0.04 | 0.04 | 0.50 | 0.00 | 0.00 | 0.13 | 0.13 | 0.00 | 0.03 | 0.03 | — | 111 | 111 | < 0.005 | < 0.005 | 0.17 | 113 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.11. Linear, Paving (2027) - Unmitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.22 | 1.03 | 9.92 | 15.7 | 0.02 | 0.39 | — | 0.39 | 0.36 | — | 0.36 | — | 2,382 | 2,382 | 0.10 | 0.02 | — | 2,390 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.22 | 1.03 | 9.92 | 15.7 | 0.02 | 0.39 | — | 0.39 | 0.36 | — | 0.36 | — | 2,382 | 2,382 | 0.10 | 0.02 | — | 2,390 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.26 | 0.22 | 2.12 | 3.35 | < 0.005 | 0.08 | — | 0.08 | 0.08 | — | 0.08 | — | 509 | 509 | 0.02 | < 0.005 | — | 511 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.05 | 0.04 | 0.39 | 0.61 | < 0.005 | 0.02 | — | 0.02 | 0.01 | — | 0.01 | — | 84.3 | 84.3 | < 0.005 | < 0.005 | — | 84.6 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.70 | 0.62 | 0.56 | 10.0 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,168 | 2,168 | 0.02 | 0.08 | 7.07 | 2,199 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.68 | 0.60 | 0.71 | 8.04 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,011 | 2,011 | 0.03 | 0.08 | 0.18 | 2,036 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.14 | 0.13 | 0.14 | 1.78 | 0.00 | 0.00 | 0.45 | 0.45 | 0.00 | 0.10 | 0.10 | — | 437 | 437 | 0.01 | 0.02 | 0.65 | 443 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.03 | 0.02 | 0.02 | 0.33 | 0.00 | 0.00 | 0.08 | 0.08 | 0.00 | 0.02 | 0.02 | — | 72.3 | 72.3 | < 0.005 | < 0.005 | 0.11 | 73.3 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 3.12. Linear, Paving (2027) - Mitigated

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

| Location | TOG | ROG | NOx | CO | SO2 | PM10E | PM10D | PM10T | PM2.5E | PM2.5D | PM2.5T | BCO2 | NBCO2 | CO2T | CH4 | N2O | R | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.22 | 1.03 | 9.92 | 15.7 | 0.02 | 0.39 | — | 0.39 | 0.36 | — | 0.36 | — | 2,382 | 2,382 | 0.10 | 0.02 | — | 2,390 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 1.22 | 1.03 | 9.92 | 15.7 | 0.02 | 0.39 | — | 0.39 | 0.36 | — | 0.36 | — | 2,382 | 2,382 | 0.10 | 0.02 | — | 2,390 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.26 | 0.22 | 2.12 | 3.35 | < 0.005 | 0.08 | — | 0.08 | 0.08 | — | 0.08 | — | 509 | 509 | 0.02 | < 0.005 | — | 511 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Off-Road Equipment | 0.05 | 0.04 | 0.39 | 0.61 | < 0.005 | 0.02 | — | 0.02 | 0.01 | — | 0.01 | — | 84.3 | 84.3 | < 0.005 | < 0.005 | — | 84.6 |
| Onsite truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Offsite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Daily, Summer (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.70 | 0.62 | 0.56 | 10.0 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,168 | 2,168 | 0.02 | 0.08 | 7.07 | 2,199 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Daily, Winter (Max) | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.68 | 0.60 | 0.71 | 8.04 | 0.00 | 0.00 | 2.10 | 2.10 | 0.00 | 0.49 | 0.49 | — | 2,011 | 2,011 | 0.03 | 0.08 | 0.18 | 2,036 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Daily | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.14 | 0.13 | 0.14 | 1.78 | 0.00 | 0.00 | 0.45 | 0.45 | 0.00 | 0.10 | 0.10 | — | 437 | 437 | 0.01 | 0.02 | 0.65 | 443 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Worker | 0.03 | 0.02 | 0.02 | 0.33 | 0.00 | 0.00 | 0.08 | 0.08 | 0.00 | 0.02 | 0.02 | — | 72.3 | 72.3 | < 0.005 | < 0.005 | 0.11 | 73.3 |
| Vendor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hauling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

# 4. Operations Emissions Details

## 4.10. Soil Carbon Accumulation By Vegetation Type

### 4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated

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

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

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

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

## 4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Sequestered | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Removed | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

### 4.10.4. Soil Carbon Accumulation By Vegetation Type - Mitigated

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

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

### 4.10.5. Above and Belowground Carbon Accumulation by Land Use Type - Mitigated

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

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

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

## 4.10.6. Avoided and Sequestered Emissions by Species - Mitigated

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

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

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Annual | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Avoided | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Sequestered | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Removed | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Subtotal | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

# 5. Activity Data

## 5.1. Construction Schedule

| Phase Name | Phase Type | Start Date | End Date | Days Per Week | Work Days per Phase | Phase Description |
|---|---|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | Linear, Grubbing & Land Clearing | 10/6/2025 | 12/17/2025 | 5.00 | 52.0 | — |
| Linear, Grading & Excavation | Linear, Grading & Excavation | 12/18/2025 | 11/10/2026 | 5.00 | 234 | — |
| Linear, Drainage, Utilities, & Sub-Grade | Linear, Drainage, Utilities, & Sub-Grade | 11/11/2026 | 6/17/2027 | 5.00 | 156 | — |
| Linear, Paving | Linear, Paving | 6/18/2027 | 10/5/2027 | 5.00 | 78.0 | — |

## 5.2. Off-Road Equipment

### 5.2.1. Unmitigated

| Phase Name | Equipment Type | Fuel Type | Engine Tier | Number per Day | Hours Per Day | Horsepower | Load Factor |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | Tractors/Loaders/Backhoes | Diesel | Average | 3.00 | 8.00 | 84.0 | 0.37 |
| Linear, Grading & Excavation | Tractors/Loaders/Backhoes | Diesel | Average | 3.00 | 8.00 | 84.0 | 0.37 |
| Linear, Grading & Excavation | Rubber Tired Loaders | Diesel | Average | 2.00 | 8.00 | 150 | 0.36 |
| Linear, Drainage, Utilities, & Sub-Grade | Tractors/Loaders/Backhoes | Diesel | Average | 3.00 | 8.00 | 84.0 | 0.37 |
| Linear, Drainage, Utilities, & Sub-Grade | Plate Compactors | Diesel | Average | 2.00 | 8.00 | 8.00 | 0.43 |
| Linear, Drainage, Utilities, & Sub-Grade | Graders | Diesel | Average | 2.00 | 8.00 | 148 | 0.41 |
| Linear, Drainage, Utilities, & Sub-Grade | Air Compressors | Diesel | Average | 2.00 | 8.00 | 37.0 | 0.48 |
| Linear, Paving | Rollers | Diesel | Average | 2.00 | 8.00 | 36.0 | 0.38 |
| Linear, Paving | Paving Equipment | Diesel | Average | 2.00 | 8.00 | 89.0 | 0.36 |
| Linear, Paving | Pavers | Diesel | Average | 2.00 | 8.00 | 81.0 | 0.42 |
| Linear, Paving | Tractors/Loaders/Backhoes | Diesel | Average | 3.00 | 8.00 | 84.0 | 0.37 |

### 5.2.2. Mitigated

| Phase Name | Equipment Type | Fuel Type | Engine Tier | Number per Day | Hours Per Day | Horsepower | Load Factor |
|---|---|---|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | Tractors/Loaders/Backhoes | Diesel | Average | 3.00 | 8.00 | 84.0 | 0.37 |
| Linear, Grading & Excavation | Tractors/Loaders/Backhoes | Diesel | Average | 3.00 | 8.00 | 84.0 | 0.37 |
| Linear, Grading & Excavation | Rubber Tired Loaders | Diesel | Average | 2.00 | 8.00 | 150 | 0.36 |
| Linear, Drainage, Utilities, & Sub-Grade | Tractors/Loaders/Backhoes | Diesel | Average | 3.00 | 8.00 | 84.0 | 0.37 |
| Linear, Drainage, Utilities, & Sub-Grade | Plate Compactors | Diesel | Average | 2.00 | 8.00 | 8.00 | 0.43 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Linear, Drainage, Utilities, & Sub-Grade | Graders | Diesel | Average | 2.00 | 8.00 | 148 | 0.41 |
| Linear, Drainage, Utilities, & Sub-Grade | Air Compressors | Diesel | Average | 2.00 | 8.00 | 37.0 | 0.48 |
| Linear, Paving | Rollers | Diesel | Average | 2.00 | 8.00 | 36.0 | 0.38 |
| Linear, Paving | Paving Equipment | Diesel | Average | 2.00 | 8.00 | 89.0 | 0.36 |
| Linear, Paving | Pavers | Diesel | Average | 2.00 | 8.00 | 81.0 | 0.42 |
| Linear, Paving | Tractors/Loaders/Backhoes | Diesel | Average | 3.00 | 8.00 | 84.0 | 0.37 |

## 5.3. Construction Vehicles

### 5.3.1. Unmitigated

| Phase Name | Trip Type | One-Way Trips per Day | Miles per Trip | Vehicle Mix |
|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | — | — | — | — |
| Linear, Grubbing & Land Clearing | Worker | 161 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Grubbing & Land Clearing | Vendor | 0.00 | 10.2 | HHDT,MHDT |
| Linear, Grubbing & Land Clearing | Hauling | 4.00 | 20.0 | HHDT |
| Linear, Grubbing & Land Clearing | Onsite truck | — | — | HHDT |
| Linear, Grading & Excavation | — | — | — | — |
| Linear, Grading & Excavation | Worker | 161 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Grading & Excavation | Vendor | 2.00 | 10.2 | HHDT,MHDT |
| Linear, Grading & Excavation | Hauling | 4.00 | 20.0 | HHDT |
| Linear, Grading & Excavation | Onsite truck | — | — | HHDT |
| Linear, Drainage, Utilities, & Sub-Grade | — | — | — | — |
| Linear, Drainage, Utilities, & Sub-Grade | Worker | 161 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Drainage, Utilities, & Sub-Grade | Vendor | 0.00 | 10.2 | HHDT,MHDT |

| | | | | |
|---|---|---|---|---|
| Linear, Drainage, Utilities, & Sub-Grade | Hauling | 0.00 | 20.0 | HHDT |
| Linear, Drainage, Utilities, & Sub-Grade | Onsite truck | — | — | HHDT |
| Linear, Paving | — | — | — | — |
| Linear, Paving | Worker | 161 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Paving | Vendor | 0.00 | 10.2 | HHDT,MHDT |
| Linear, Paving | Hauling | 0.00 | 20.0 | HHDT |
| Linear, Paving | Onsite truck | — | — | HHDT |

### 5.3.2. Mitigated

| Phase Name | Trip Type | One-Way Trips per Day | Miles per Trip | Vehicle Mix |
|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | — | — | — | — |
| Linear, Grubbing & Land Clearing | Worker | 161 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Grubbing & Land Clearing | Vendor | 0.00 | 10.2 | HHDT,MHDT |
| Linear, Grubbing & Land Clearing | Hauling | 4.00 | 20.0 | HHDT |
| Linear, Grubbing & Land Clearing | Onsite truck | — | — | HHDT |
| Linear, Grading & Excavation | — | — | — | — |
| Linear, Grading & Excavation | Worker | 161 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Grading & Excavation | Vendor | 2.00 | 10.2 | HHDT,MHDT |
| Linear, Grading & Excavation | Hauling | 4.00 | 20.0 | HHDT |
| Linear, Grading & Excavation | Onsite truck | — | — | HHDT |
| Linear, Drainage, Utilities, & Sub-Grade | — | — | — | — |
| Linear, Drainage, Utilities, & Sub-Grade | Worker | 161 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Drainage, Utilities, & Sub-Grade | Vendor | 0.00 | 10.2 | HHDT,MHDT |
| Linear, Drainage, Utilities, & Sub-Grade | Hauling | 0.00 | 20.0 | HHDT |

| | | | | |
|---|---|---|---|---|
| Linear, Drainage, Utilities, & Sub-Grade | Onsite truck | — | — | HHDT |
| Linear, Paving | — | — | — | — |
| Linear, Paving | Worker | 161 | 18.5 | LDA,LDT1,LDT2 |
| Linear, Paving | Vendor | 0.00 | 10.2 | HHDT,MHDT |
| Linear, Paving | Hauling | 0.00 | 20.0 | HHDT |
| Linear, Paving | Onsite truck | — | — | HHDT |

## 5.4. Vehicles

### 5.4.1. Construction Vehicle Control Strategies

| Control Strategies Applied | PM10 Reduction | PM2.5 Reduction |
|---|---|---|
| Water unpaved roads twice daily | 55% | 55% |
| Limit vehicle speeds on unpaved roads to 25 mph | 44% | 44% |
| Sweep paved roads once per month | 9% | 9% |

## 5.5. Architectural Coatings

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

## 5.6. Dust Mitigation

### 5.6.1. Construction Earthmoving Activities

| Phase Name | Material Imported (cy) | Material Exported (cy) | Acres Graded (acres) | Material Demolished (sq. ft.) | Acres Paved (acres) |
|---|---|---|---|---|---|
| Linear, Grubbing & Land Clearing | — | — | 4.30 | 0.00 | — |
| Linear, Grading & Excavation | — | — | 4.30 | 0.00 | — |
| Linear, Drainage, Utilities, & Sub-Grade | — | — | 4.30 | 0.00 | — |

### 5.6.2. Construction Earthmoving Control Strategies

| Control Strategies Applied | Frequency (per day) | PM10 Reduction | PM2.5 Reduction |
|---|---|---|---|
| Water Exposed Area | 2 | 61% | 61% |

## 5.7. Construction Paving

| Land Use | Area Paved (acres) | % Asphalt |
|---|---|---|
| Road Widening | 0.80 | 100% |
| Road Widening | 3.50 | 100% |

## 5.8. Construction Electricity Consumption and Emissions Factors

kWh per Year and Emission Factor (lb/MWh)

| Year | kWh per Year | CO2 | CH4 | N2O |
|---|---|---|---|---|
| 2025 | 0.00 | 453 | 0.03 | < 0.005 |
| 2026 | 0.00 | 453 | 0.03 | < 0.005 |
| 2027 | 0.00 | 453 | 0.03 | < 0.005 |

## 5.18. Vegetation

### 5.18.1. Land Use Change

#### 5.18.1.1. Unmitigated

| Vegetation Land Use Type | Vegetation Soil Type | Initial Acres | Final Acres |
|---|---|---|---|

#### 5.18.1.2. Mitigated

| Vegetation Land Use Type | Vegetation Soil Type | Initial Acres | Final Acres |
|---|---|---|---|

### 5.18.1. Biomass Cover Type

#### 5.18.1.1. Unmitigated

| Biomass Cover Type | Initial Acres | Final Acres |
|---|---|---|

#### 5.18.1.2. Mitigated

| Biomass Cover Type | Initial Acres | Final Acres |
|---|---|---|

### 5.18.2. Sequestration

#### 5.18.2.1. Unmitigated

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

#### 5.18.2.2. Mitigated

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

# 6. Climate Risk Detailed Report

## 6.1. Climate Risk Summary

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

| Climate Hazard | Result for Project Location | Unit |
|---|---|---|
| Temperature and Extreme Heat | 5.68 | annual days of extreme heat |
| Extreme Precipitation | 5.50 | annual days with precipitation above 20 mm |
| Sea Level Rise | — | meters of inundation depth |
| Wildfire | 0.00 | annual hectares burned |

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

## 6.2. Initial Climate Risk Scores

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

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

## 6.3. Adjusted Climate Risk Scores

| Climate Hazard | Exposure Score | Sensitivity Score | Adaptive Capacity Score | Vulnerability Score |
|---|---|---|---|---|
| Temperature and Extreme Heat | N/A | N/A | N/A | N/A |
| Extreme Precipitation | N/A | N/A | N/A | N/A |
| Sea Level Rise | N/A | N/A | N/A | N/A |

| | | | | |
|---|---|---|---|---|
| Wildfire | N/A | N/A | N/A | N/A |
| Flooding | N/A | N/A | N/A | N/A |
| Drought | N/A | N/A | N/A | N/A |
| Snowpack Reduction | N/A | N/A | N/A | N/A |
| Air Quality Degradation | N/A | N/A | N/A | N/A |

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

### 6.4. Climate Risk Reduction Measures

# 7. Health and Equity Details

## 7.1. CalEnviroScreen 4.0 Scores

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

| Indicator | Result for Project Census Tract |
|---|---|
| Exposure Indicators | — |
| AQ-Ozone | 45.0 |
| AQ-PM | 68.0 |
| AQ-DPM | 91.2 |
| Drinking Water | 61.5 |
| Lead Risk Housing | 64.6 |
| Pesticides | 17.7 |
| Toxic Releases | 79.4 |
| Traffic | 68.5 |
| Effect Indicators | — |
| CleanUp Sites | 88.6 |
| Groundwater | 92.5 |

| | |
|---|---|
| Haz Waste Facilities/Generators | 91.0 |
| Impaired Water Bodies | 66.7 |
| Solid Waste | 93.4 |
| Sensitive Population | — |
| Asthma | 45.1 |
| Cardio-vascular | 53.6 |
| Low Birth Weights | 37.6 |
| Socioeconomic Factor Indicators | — |
| Education | 19.3 |
| Housing | 58.8 |
| Linguistic | 42.1 |
| Poverty | 27.9 |
| Unemployment | 23.8 |

## 7.2. Healthy Places Index Scores

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

| Indicator | Result for Project Census Tract |
|---|---|
| Economic | — |
| Above Poverty | 83.72898755 |
| Employed | 79.36609778 |
| Median HI | 78.76299243 |
| Education | — |
| Bachelor's or higher | 79.63557038 |
| High school enrollment | 100 |
| Preschool enrollment | 40.65186706 |
| Transportation | — |
| Auto Access | 46.70858463 |
| Active commuting | 73.66867702 |

| | |
|---|---|
| Social | — |
| 2-parent households | 44.68112409 |
| Voting | 75.93994611 |
| Neighborhood | — |
| Alcohol availability | 33.40177082 |
| Park access | 81.35506224 |
| Retail density | 65.99512383 |
| Supermarket access | 75.70896959 |
| Tree canopy | 71.79520082 |
| Housing | — |
| Homeownership | 30.71987681 |
| Housing habitability | 49.09534197 |
| Low-inc homeowner severe housing cost burden | 67.79160785 |
| Low-inc renter severe housing cost burden | 74.88771975 |
| Uncrowded housing | 53.4838958 |
| Health Outcomes | — |
| Insured adults | 78.05723085 |
| Arthritis | 0.0 |
| Asthma ER Admissions | 64.1 |
| High Blood Pressure | 0.0 |
| Cancer (excluding skin) | 0.0 |
| Asthma | 0.0 |
| Coronary Heart Disease | 0.0 |
| Chronic Obstructive Pulmonary Disease | 0.0 |
| Diagnosed Diabetes | 0.0 |
| Life Expectancy at Birth | 35.0 |
| Cognitively Disabled | 36.6 |
| Physically  Disabled | 63.7 |

| | |
|---|---|
| Heart Attack ER Admissions | 49.8 |
| Mental Health Not Good | 0.0 |
| Chronic Kidney Disease | 0.0 |
| Obesity | 0.0 |
| Pedestrian Injuries | 98.1 |
| Physical Health Not Good | 0.0 |
| Stroke | 0.0 |
| Health Risk Behaviors | — |
| Binge Drinking | 0.0 |
| Current Smoker | 0.0 |
| No Leisure Time for Physical Activity | 0.0 |
| Climate Change Exposures | — |
| Wildfire Risk | 0.0 |
| SLR Inundation Area | 0.0 |
| Children | 61.0 |
| Elderly | 47.3 |
| English Speaking | 58.4 |
| Foreign-born | 48.4 |
| Outdoor Workers | 81.7 |
| Climate Change Adaptive Capacity | — |
| Impervious Surface Cover | 18.0 |
| Traffic Density | 72.7 |
| Traffic Access | 74.7 |
| Other Indices | — |
| Hardship | 15.8 |
| Other Decision Support | — |
| 2016 Voting | 56.9 |

## 7.3. Overall Health & Equity Scores

| Metric | Result for Project Census Tract |
|---|---|
| CalEnviroScreen 4.0 Score for Project Location (a) | 68.0 |
| Healthy Places Index Score for Project Location (b) | 77.0 |
| Project Located in a Designated Disadvantaged Community (Senate Bill 535) | No |
| Project Located in a Low-Income Community (Assembly Bill 1550) | No |
| Project Located in a Community Air Protection Program Community (Assembly Bill 617) | No |

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

## 7.4. Health & Equity Measures

No Health & Equity Measures selected.

## 7.5. Evaluation Scorecard

Health & Equity Evaluation Scorecard not completed.

## 7.6. Health & Equity Custom Measures

No Health & Equity Custom Measures created.

# 8. User Changes to Default Data

| Screen | Justification |
|---|---|
| Characteristics: Project Details | Adjusted for project location |
| Characteristics: Utility Information | Adjusted for project location |
| Construction: Off-Road Equipment | Project specific estiamtes |
| Construction: Trips and VMT | project specific details |
| Construction: Construction Phases | — |

# APPENDIX L

# ACOUSTIC STUDY

# ACOUSTIC STUDY FOR THE CENTRAL MAUI WASTEWATER RECLAMATION FACILITY

Prepared for:

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Prepared by:

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**APRIL 2024**

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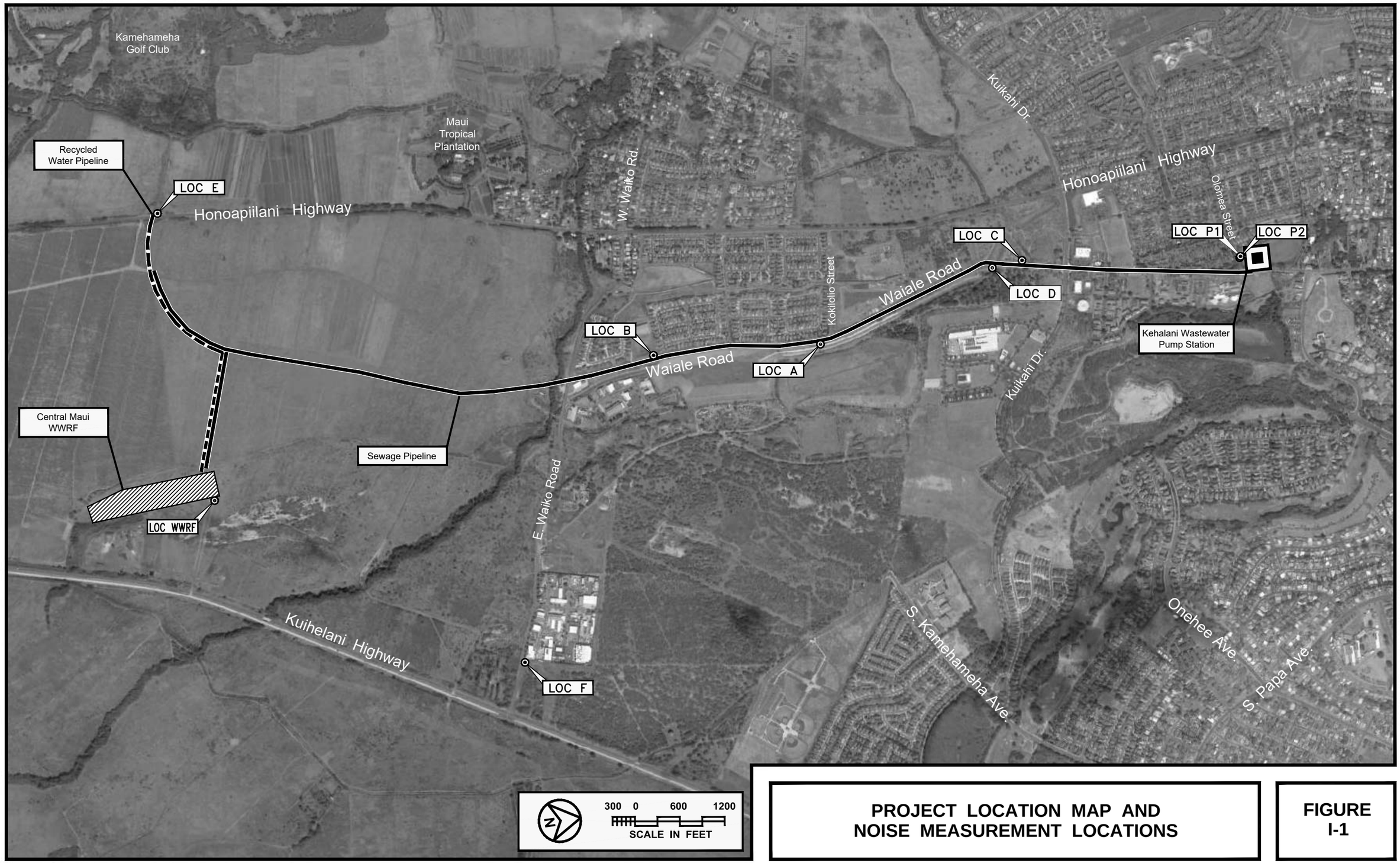
# CHAPTER I. SUMMARY

The potential construction and facility noise levels associated with the Central Maui Wastewater Reclamation Facility (WWRF) Project involving wastewater and recycled water transmission lines, a new wastewater pump station, and a new WWRF in the Central Valley area on Maui were evaluated for their potential impacts and their relationship to the current Federal Housing Administration/Housing and Urban Development (FHA/HUD) noise standard and the Hawaii State Department of Health noise regulations. The locations of these improvements are shown in Figure I-1 and include the new Kehalani Wastewater Pump Station (WWPS), a new sewage pipeline along Waiale Road from the Kehalani WWPS to the new Central Maui WWRF, a continuing sewage pipeline to the planned Waikapu Country Town Development, and a recycled water pipeline to surrounding future users and to the planned Waikapu Country Town Development. Construction noise associated with earthwork and site preparation, building erection, and open trench pipeline construction were evaluated.

It is expected that compliance with the State Department of Health (DOH) construction noise permit and/or noise variance requirements will be required, and that construction noise impacts would be minimized by the adherence to these DOH rules regarding construction noise. Following completion of the construction of the pipelines and facility buildings, compliance with the State DOH property line noise limits for fixed machinery will also be required, and it is expected that the long term noise impacts associated with the new WWPS and WWRF would be minimized by the adherence to the DOH rules regarding noise limits for fixed machinery through use of noise attenuation measures at the WWPS and the WWRF. Additional noise mitigation measures during construction are recommended.

As is the situation with all large construction projects, it will not be practical to reduce all construction noise to inaudible levels. It will not be feasible to eliminate all noise impacts during construction of the project. But because of the relatively long period of actual construction activities and the relatively low levels of background noise in the surrounding areas, special construction noise mitigation measures are recommended. These measures include: sound attenuation treatment of fixed machinery which operate continuously so as to limit their combined maximum noise levels to 55 to 60 dBA (A-Weighted decibel) at the closest residences during the daytime and to 45 or 50 dBA at the closest residences during the nighttime; selection of the open trench alignments which maximize the distances to noise sensitive structures; requiring the use of broadband back-up alarms for vehicles which operate on the construction sites in place of the more commonly used high frequency, beeper back-up alarms; and the use of the quietist construction equipment. In addition, when very small buffer distances are available between the work areas and noise sensitive receptors, the advance disclosure of those schedules as well as coordination with affected parties in scheduling work is also recommended.

Road traffic noise impacts are not expected from the proposed facility's traffic.




**PROJECT LOCATION MAP AND NOISE MEASUREMENT LOCATIONS**

**FIGURE I-1**

## CHAPTER II. PURPOSE

The primary objective of this study was to describe the existing and potential noise environment in the environs of the Central Maui Wastewater Reclamation Facility (WWRF) Project between the general area of the proposed Kehalani WWPS and the currently undeveloped lands in the general location of the proposed Central Maui WWRF. This study was focused on evaluations of potential noise impacts during construction of the project pipelines using the preferred open trench construction, during construction of the WWPS and WWRF facilities, and during operations of the WWPS and WWRF facilities. The potential noise impacts were examined along the potential alignment of the sewage pipeline along Waiale Road and along other pipe lines in currently undeveloped lands where the open trenching construction method will probably be used. The favored alignment details along the residential areas along Waiale Road were not established, but a description of the potential construction equipment noise levels, existing background noise levels, and a description of the potential noise impacts at noise sensitive receptors in the immediate vicinity of the sewage pipeline alignment were included in the noise study objectives. Recommendations for minimizing potential construction noise impacts were also to be provided as required.

# CHAPTER III. NOISE DESCRIPTORS AND THEIR RELATIONSHIP TO LAND USE COMPATIBILITY

The noise descriptor currently used by federal agencies (such as FHA/HUD) to assess environmental noise is the Day-Night Average Sound Level (DNL or Ldn). This descriptor incorporates a 24-hour average of instantaneous A-Weighted Sound Levels as read on a standard Sound Level Meter. By definition, the minimum averaging period for the DNL descriptor is 24 hours. Additionally, sound levels which occur during the nighttime hours of 10:00 PM to 7:00 AM are increased by 10 decibels (dB) prior to computing the 24-hour average by the DNL descriptor. A more complete list of noise descriptors is provided in Appendix B to this report.

Table III-1, derived from Reference 1, presents current federal noise standards and acceptability criteria for residential land uses. Table III-2, also extracted from Reference 1, presents the general effects of noise on people in residential use situations. Land use compatibility guidelines for various levels of environmental noise as measured by the DNL descriptor system are shown in Figure III-1 (from Reference 2). As a general rule, noise levels of 55 DNL or less occur in rural areas, or in areas which are removed from high volume roadways. In urbanized areas which are shielded from high volume streets, DNL levels generally range from 55 to 65 DNL, and are usually controlled by motor vehicle traffic noise. Residences which front major roadways are generally exposed to levels of 65 DNL, and as high as 75 DNL when the roadway is a high speed freeway. In the project area in the undeveloped lands near the planned WWRF and along the project conveyance system alignments, traffic noise levels (as well as background noise levels) vary over a wide range between 50 to 65 DNL.

For purposes of determining noise acceptability for funding assistance from federal agencies [FHA/HUD and Veterans Administration (VA)], an exterior noise level of 65 DNL or less is considered acceptable for residences. This standard is applied nationally (Reference 3), including Hawaii. Because of our open-living conditions, the predominant use of naturally ventilated dwellings, and the relatively low exterior-to-interior sound attenuation afforded by these naturally ventilated structures, an exterior noise level of 65 DNL does not eliminate all risks of noise impacts. Because of these factors, and as recommended in Reference 4, a lower level of 55 DNL is considered as the "Unconditionally Acceptable" (or "Near-Zero Risk") level of exterior noise. However, after considering the cost and feasibility of applying the lower level of 55 DNL, government agencies such as FHA/HUD and VA have selected 65 DNL as a more appropriate regulatory standard.

For commercial, industrial, and other non-noise sensitive land uses, exterior noise levels as high as 75 DNL are generally considered acceptable. Exceptions to this occur when naturally ventilated office and other commercial establishments are exposed to exterior levels which exceed 65 DNL.

## TABLE III-1

## EXTERIOR NOISE EXPOSURE CLASSIFICATION (RESIDENTIAL LAND USE)

| NOISE EXPOSURE CLASS | DAY–NIGHT SOUND LEVEL | EQUIVALENT SOUND LEVEL | FEDERAL (1) STANDARD |
|---|---|---|---|
| Minimal Exposure | Not Exceeding 55 DNL | Not Exceeding 55 Leq | Unconditionally Acceptable |
| Moderate Exposure | Above 55 DNL But Not Above 65 DNL | Above 55 Leq But Not Above 65 Leq | Acceptable(2) |
| Significant Exposure | Above 65 DNL But Not Above 75 DNL | Above 65 Leq But Not Above 75 Leq | Normally Unacceptable |
| Severe Exposure | Above 75 DNL | Above 75 Leq | Unacceptable |

Notes: (1) Federal Housing Administration, Veterans Administration, Department of Defense, and Department of Transportation.

(2) Federal Highway Administration (FHWA) uses the Equivalent Sound Level (Leq) instead of the DNL descriptor. For planning purposes, both are equivalent if: (a) heavy trucks do not exceed 10 percent of total traffic flow in vehicles per 24 hours, and (b) traffic between 10:00 PM and 7:00 AM does not exceed 15 percent of average daily traffic flow in vehicles per 24 hours. The noise mitigation threshold used by FHWA for residences is 67 Leq.

# TABLE III-2

## EFFECTS OF NOISE ON PEOPLE
## (Residential Land Uses Only)

| EFFECTS[1] / DAY-NIGHT AVERAGE SOUND LEVEL IN DECIBELS | Hearing Loss | Speech Interference | | Annoyance[2] | Average Community Reaction[4] | General Community Attitude Towards Area |
|---|---|---|---|---|---|---|
| | | Indoor | Outdoor | | | |
| | Qualitative Description | %Sentence Intelligibility | Distance in Meters for 95% Sentence Intelligibility | % of Population Highly Annoyed[3] | | |
| 75 and above | May Begin to Occur | 98% | 0.5 | 37% | Very Severe | Noise is likely to be the most important of all adverse aspects of the community environment. |
| 70 | Will Not Likely Occur | 99% | 0.9 | 25% | Severe | Noise is one of the most important adverse aspects of the community environment. |
| 65 | Will Not Occur | 100% | 1.5 | 15% | Significant | Noise is one of the important adverse aspects of the community environment. |
| 60 | Will Not Occur | 100% | 2.0 | 9% | Moderate to Slight | Noise may be considered an adverse aspect of the community environment. |
| 55 and below | Will Not Occur | 100% | 3.5 | 4% | | Noise considered no more important than various other environmental factors. |

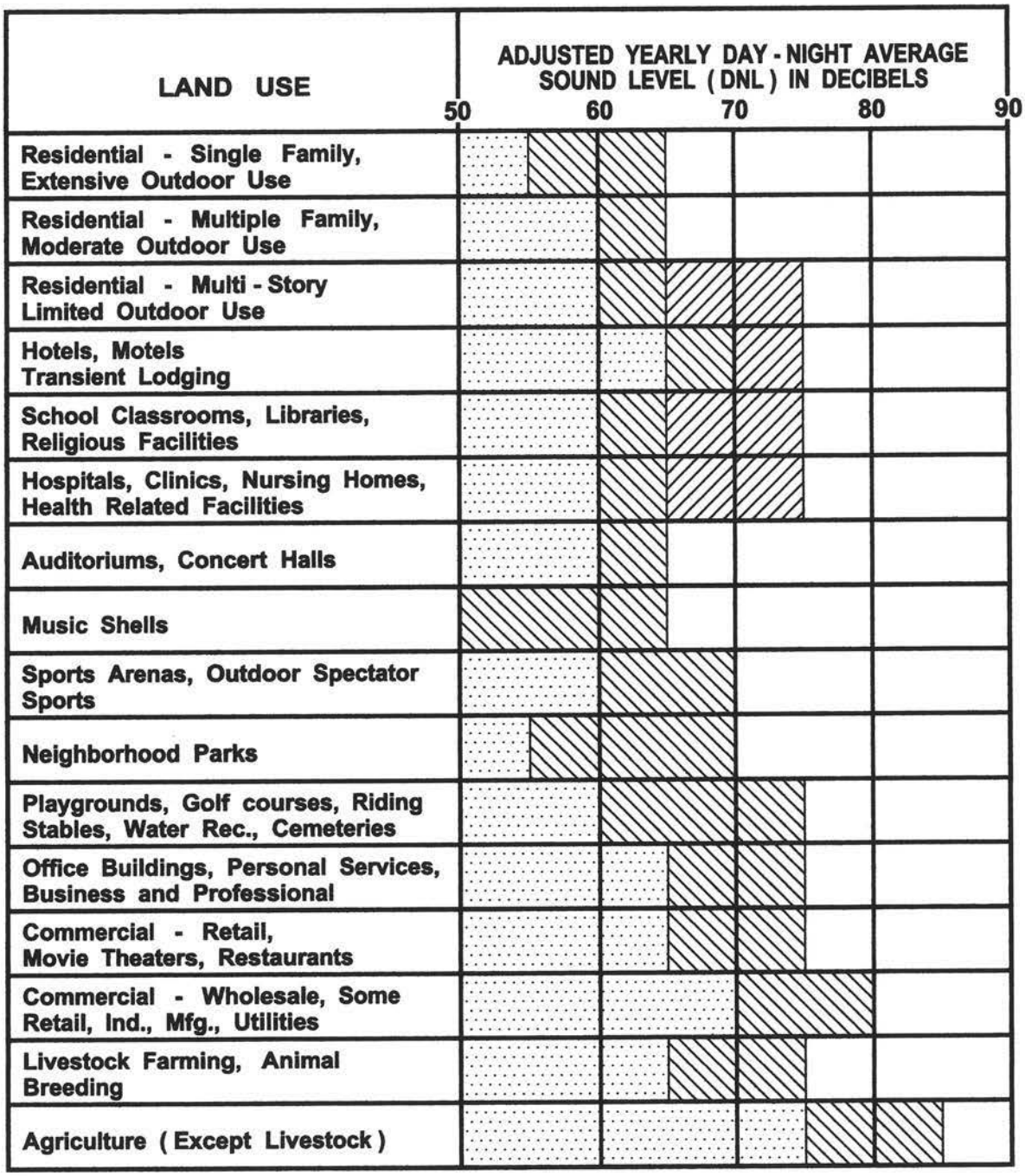
1. "Speech Interference" data are drawn from the following tables in EPA's "Levels Document": Table 3, Fig. D-1, Fig. D-2, Fig. D-3. All other data from National Academy of Science 1977 report "Guidelines for Preparing Environmental Impact Statements on Noise, Report of Working Group 69 on Evaluation of Environmental Impact of Noise."

2. Depends on attitudes and other factors.

3. The percentages of people reporting annoyance to lesser extents are higher in each case. An unknown small percentage of people will report being "highly annoyed" even in the quietest surroundings. One reason is the difficulty all people have in intergrating annoyance over a very long time.

4. Attitudes or other non-acoustic factors can modify this. Noise at low levels can still be an important problem, particularly when it intrudes into a quiet environment.

NOTE: Research implicates noise as a facor producing stress-related health effects such as heart disease, high-blood pressure and stroke, ulcers and other digestive disorders. The relationships between noise and these effects, however, have not as yet been quantified.



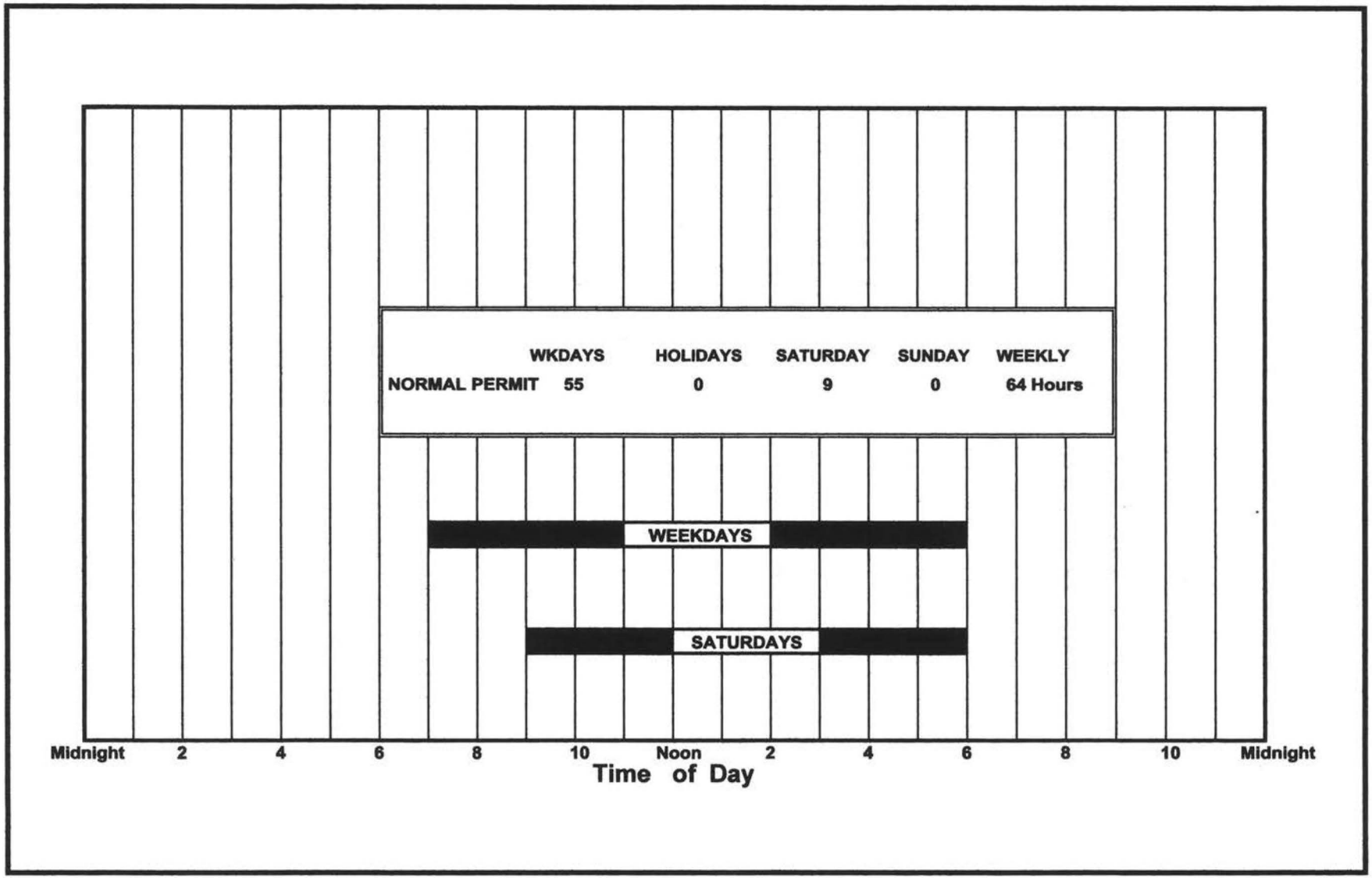

LAND USE COMPATIBILITY WITH YEARLY AVERAGE DAY - NIGHT SOUND LEVEL ( DNL ) AT A SITE FOR BUILDINGS AS COMMONLY CONSTRUCTED.
( Source: American National Standards Institute S12.9 - 1988/Part 5 )

**FIGURE III-1**

On the island of Maui, the State Department of Health (DOH) regulates noise from construction activities through the issuance of permits for allowing excessive noise during limited time periods. The limited time periods normally permitted are the daytime hours on weekdays and Saturdays, with noisy construction activities not permitted on Sundays and holidays (see Figure III-2). State DOH noise regulations are expressed in maximum allowable property line noise limits rather than DNL (see Reference 5). Although they are not directly comparable to noise criteria expressed in DNL, State DOH noise limits for residential, commercial, and industrial lands equate to approximately 55, 60, and 76 DNL, respectively.

It should be noted that the noise compatibility guidelines and relationships to the DNL noise descriptor may not be applicable to impulsive noise sources such as sheet pile driving. The use of penalty factors (such as adding 10 dB to measured sound levels or the use of C-Weighting filters) have been proposed. However, the relationships between levels of impulsive noise sources and land use compatibility have not been as firmly established as have the relationships for non-impulsive sources. The State DOH limits for impulsive sounds are 10 dB above the limits for non-impulsive sounds.

Where construction work is required during the evening or nighttime hours, or on Sundays or holidays, the granting of a noise variance is possible from the State DOH whenever the broader public interests are served by the granting of the noise variance. Examples of construction activities where noise variances have been granted for work during the nighttime, Sunday, or holiday periods are: highway repaving and reconstruction, work on bridges which cross over highways, sewer line rehabilitation, sewer manhole rehabilitation, water line rehabilitation, and electrical facility repairs and installation. In general, construction work is performed during the evening or nighttime hours, or on Sundays or holidays because of less traffic congestion during those periods, the economic impacts on property owners along the project corridor, or because of the need to perform certain types of specialized construction work (cured-in-place pipe lining, microtunneling, tunnel boring, or high voltage cable splicing) around-the-clock. At school buildings, which are not normally occupied during the night and which have large buffer distances to residences, nighttime work could be a beneficial noise mitigation measure.




**AVAILABLE WORK HOURS UNDER DOH PERMIT PROCEDURES FOR CONSTRUCTION NOISE**

**FIGURE III-2**

## CHAPTER IV. GENERAL STUDY METHODOLOGY

Reference 6 was used to describe the locations of the Kehalani Wastewater Pump Station and the Central Maui Wastewater Reclamation Facility (WWRF) where shown in Figure I-1. Also, the general alignment of the sewage pipeline between the Kehalani Wastewater Pump Station and the Central Maui WWRF along the existing Waiale Road and the planned Waiale Road Extension are also shown in Figure I-1. The planned alignment of the pipeline for recycled water from the Central Maui WWRF to planned development across Honoapiilani Highway to the west is also shown in Figure I-1. Open trench construction of both the sewage pipeline and the recycled water pipeline was assumed.

Traffic and background noise level measurements were obtained at Locations A through F, P1, P2, and WWRF where shown in Figure I-1 with results summarized in Table IV-1. Histograms of measured daytime and nighttime background noise levels are shown in Figures IV-1 through IV-7. In these histograms, the maximum, minimum, and average or equivalent sound levels are represented by the Lmax, Lmin, and Leq values, respectively. The sound levels exceeded ten and fifty percent of the time are represented by the L10 and L50 values, respectively. The background noise measurements were used to obtain estimates of the potential intrusiveness of noise from the planned Kehalani Wastewater Pump Station as well as project construction noise levels at noise sensitive receptors closest to the sewage pipeline construction activities along Waiale Road. Because construction noise levels are typically high but not normally continuous, the State DOH uses curfews rather than noise level limits when regulating noise during construction (see Reference 5). So, noise impacts resulting from construction activities can typically cause activity interference and disturbances during the daytime on weekdays and Saturdays, excluding holidays and Sundays. These noise impacts may be unavoidable, and mitigation measures can occur during the project planning purposes in selecting the project options which result in the least noise impacts, or during actual construction using the DOH's construction noise permit procedures and on-site sound attenuation measures during construction. This study identified the potential risks of adverse noise impacts from open trench construction activities along Waiale Road by comparing the potential construction noise levels to the daytime background noise levels at the closest existing residences to possible alignments of the sewage pipeline when located on the east or west side of the paved surface of Waiale Road.

Construction noise impacts during the nighttime and Sunday periods are also possible during sewage pipeline construction activities where the pipeline crosses Waiale Road or E. Waiko Road. In these situations, where potential traffic congestion impacts resulting from lane closures during the normal working hours are severe, sewage pipeline construction during the nighttime and/or on Sundays may be possible if a noise variance is granted from the DOH's construction noise permit procedures. The nighttime background noise measurements were obtained to determine the potential intrusiveness of nighttime construction work at residential locations along Waiale Road.

# TABLE IV-1
# TRAFFIC AND BACKGROUND NOISE MEASUREMENT RESULTS

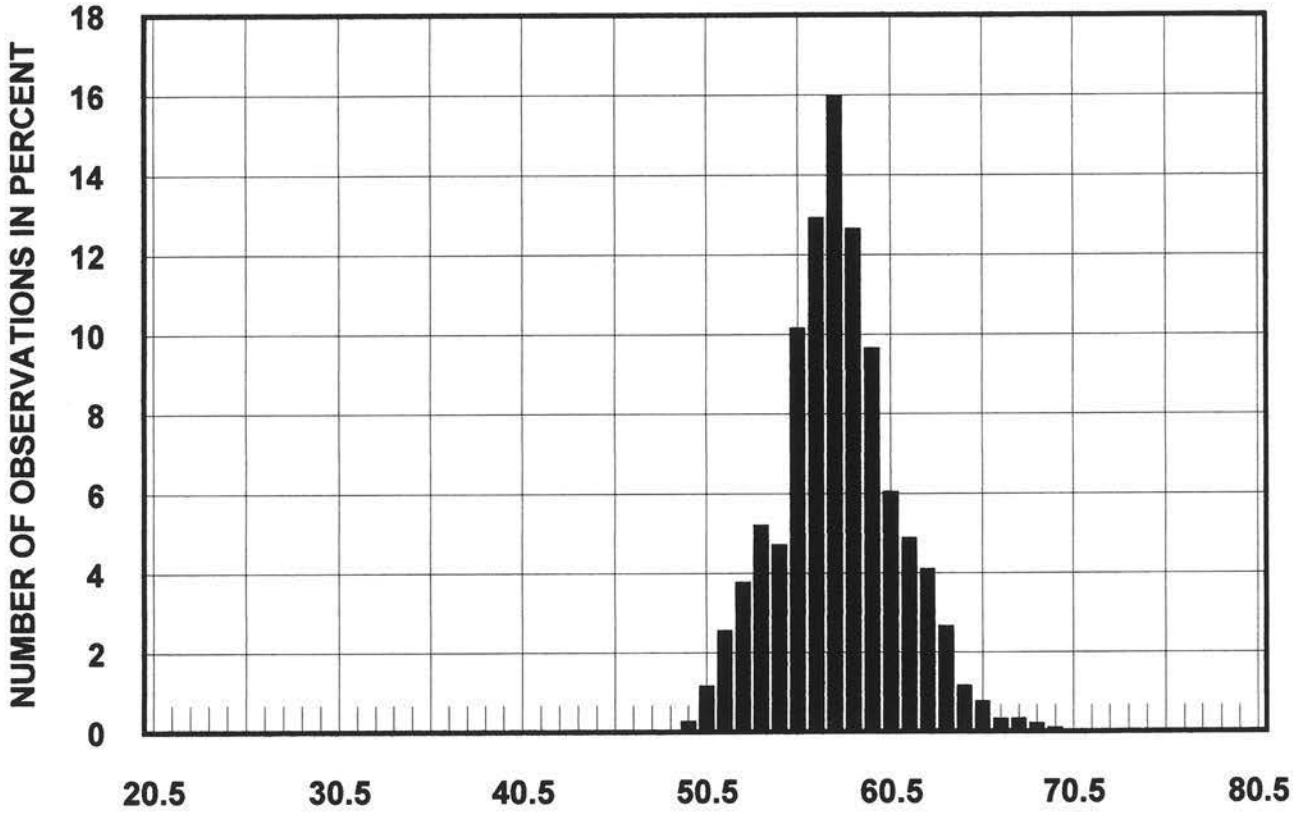
| | LOCATION | Time of Day (HRS) | Ave. Speed (MPH) | Hourly Traffic Volume AUTO | M.TRUCK | H.TRUCK | Measured Leq (dB) | Predicted Leq (dB) |
|---|---|---|---|---|---|---|---|---|
| P1 | 57 FT from centerline of Olomea St. @ future Pump Site 1 (3/27/23) | 1224 TO 1254 | N/A | N/A | N/A | N/A | 59.0 | N/A |
| WWRF | At center of existing paved pad near future WWRF (3/27/23) | 1407 TO 1437 | N/A | N/A | N/A | N/A | 49.9 | N/A |
| E | 50 FT from centerline of Honoapiilani Hwy. (3/27/23) | 1514 TO 1614 | 55 | 998 | 19 | 8 | 70.2 | 70.3 |
| A | Nightime background noise measurements on Waiale Rd. (3/28/23) | 0212 TO 0242 | N/A | N/A | N/A | N/A | 51.2 | N/A |
| C | Nightime background noise measurements on Waiale Rd. (3/28/23) | 0253 TO 0323 | N/A | N/A | N/A | N/A | 51.4 | N/A |
| P2 | Nightime background noise measurements at Pump Site 1 (3/28/23) | 0333 TO 0403 | N/A | N/A | N/A | N/A | 48.6 | N/A |

## TABLE IV-1 (CONTINUED)
## TRAFFIC AND BACKGROUND NOISE MEASUREMENT RESULTS

| | LOCATION | Time of Day (HRS) | Ave. Speed (MPH) | Hourly Traffic Volume AUTO | M.TRUCK | H.TRUCK | Measured Leq (dB) | Predicted Leq (dB) |
|---|---|---|---|---|---|---|---|---|
| B | Nightime background noise measurements on Waiale Rd. (3/28/23) | 0416 TO 0446 | N/A | N/A | N/A | N/A | 55.1 | N/A |
| D | 50 FT from centerline of Waiale Rd. (3/28/23) | 0651 TO 0751 | 40 | 449 | 15 | 22 | 64.9 | 64.7 |
| F | 60 FT from centerline of E. Waiko Rd. (3/28/23) | 1124 TO 1224 | 47 | 199 | 21 | 26 | 65.6 | 65.3 |
| D | 50 FT from centerline of Waiale Rd. (3/28/23) | 1247 TO 1347 | 40 | 255 | 10 | 9 | 62.4 | 61.8 |
| P2 | Daytime background noise measurements at Pump Site 1 (3/28/23) | 1359 TO 1459 | N/A | N/A | N/A | N/A | 62.3 | N/A |
| B | 46 FT from centerline of Waiale Rd. (3/28/23) | 1600 TO 1700 | 40 | 346 | 8 | 8 | 64.6 | 64.6 |
| B | 46 FT from centerline of Waiale Rd. (3/28/23) | 1701 TO 1731 | 40 | 264 | 4 | 6 | 63.3 | 63.5 |

## FIGURE IV-1
## HISTOGRAM OF MEASURED DAYTIME BACKGROUND NOISE LEVELS AT LOC P1

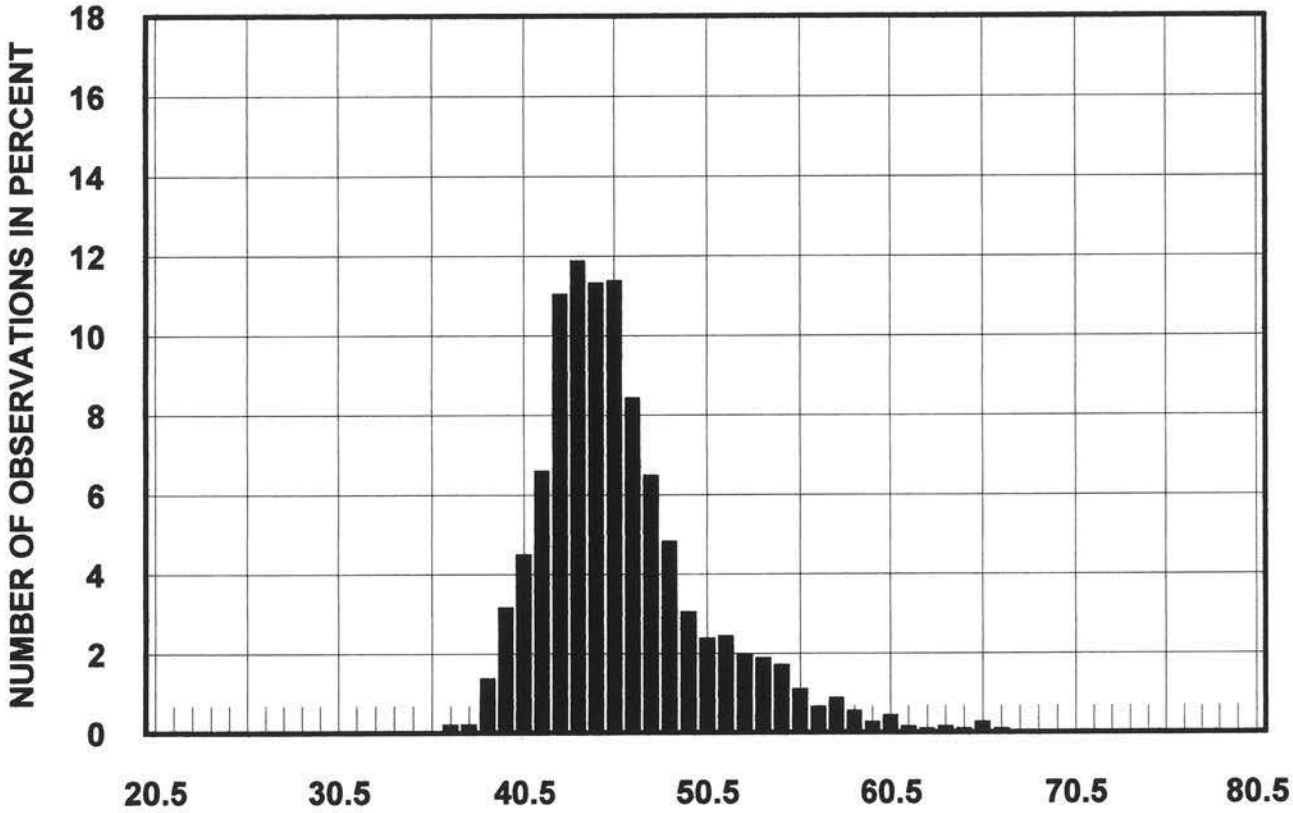
**DATE: MARCH 27, 2023**
**TIME: 1224 - 1254 HOURS**
**METER RESPONSE: LAEQ**




| | |
|---|---|
| Lmax: | 72.2 dBA |
| L10: | 62.0 dBA |
| L50: | 57.6 dBA |
| Leq: | 59.0 dBA |
| Lmin: | 48.7 dBA |

## FIGURE IV-2
## HISTOGRAM OF MEASURED DAYTIME BACKGROUND NOISE LEVELS AT LOC WWRF

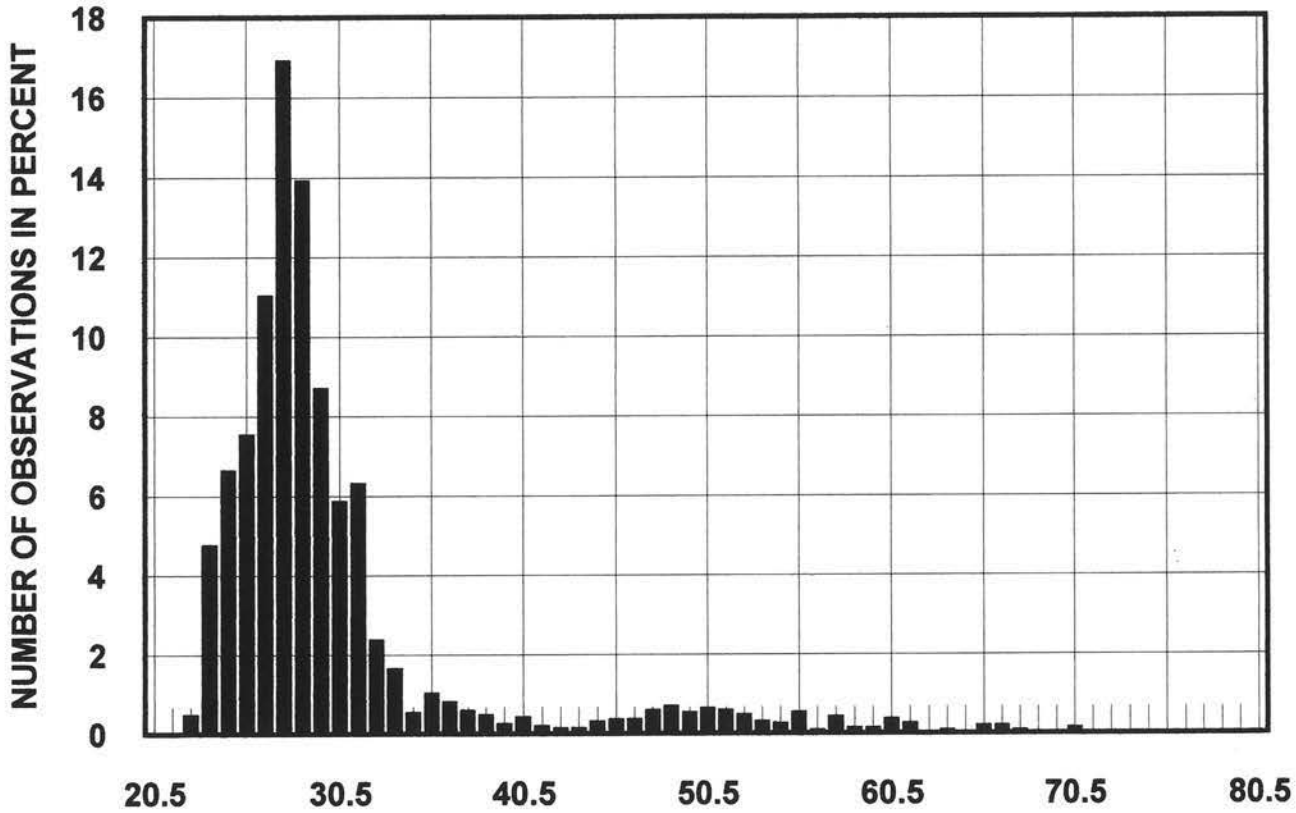
**DATE: MARCH 27, 2023**
**TIME: 1407 - 1437 HOURS**
**METER RESPONSE: LAEQ**




| | |
|---|---|
| Lmax: | 67.3 dBA |
| L10: | 52.2 dBA |
| L50: | 45.0 dBA |
| Leq: | 49.9 dBA |
| Lmin: | 36.5 dBA |

## FIGURE IV-3
## HISTOGRAM OF MEASURED NIGHTTIME BACKGROUND NOISE LEVELS AT LOC A

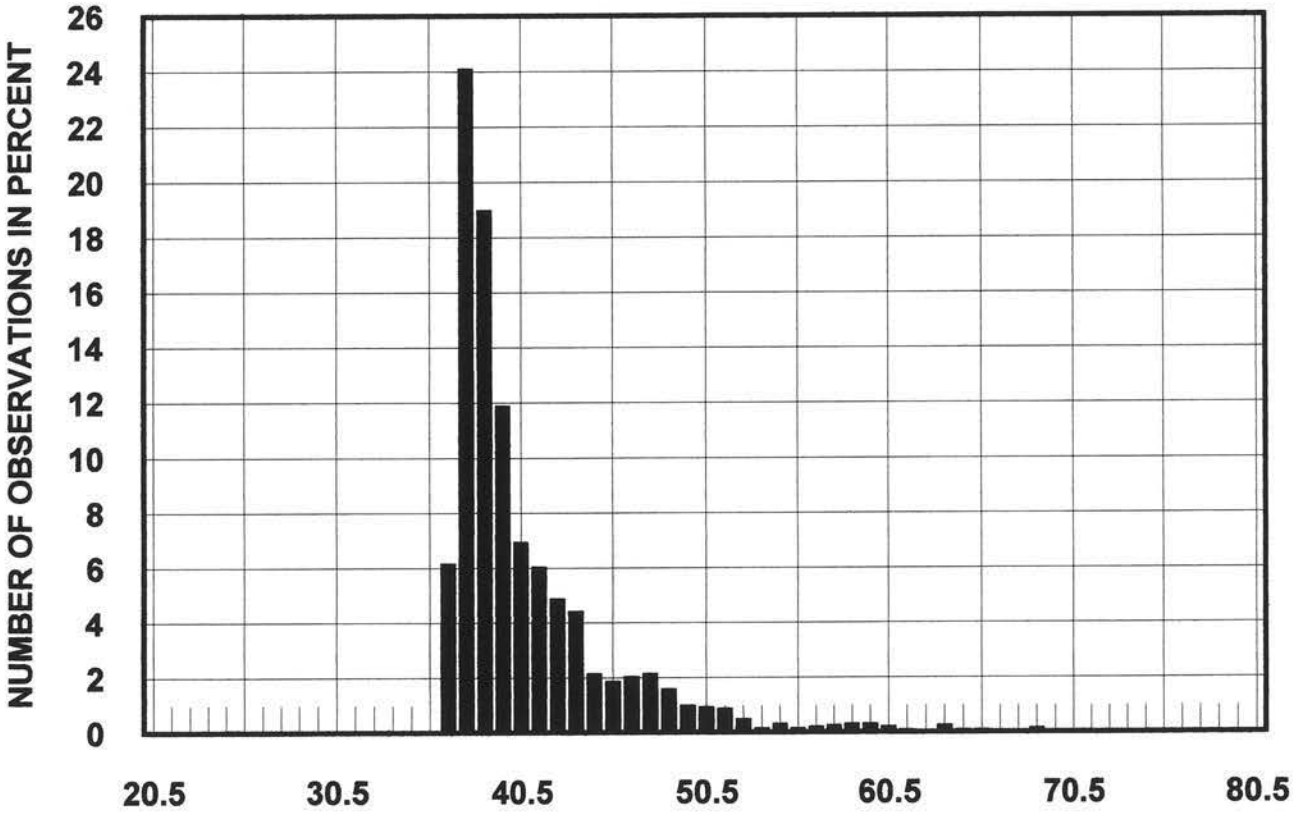
**DATE: MARCH 28, 2023**
**TIME: 0212 - 0242 HOURS**
**METER RESPONSE: LAEQ**




| | |
|---|---|
| Lmax: | 76.5 dBA |
| L10: | 39.4 dBA |
| L50: | 28.2 dBA |
| Leq: | 51.2 dBA |
| Lmin: | 22.6 dBA |

## FIGURE IV-4
## HISTOGRAM OF MEASURED NIGHTTIME BACKGROUND NOISE LEVELS AT LOC C

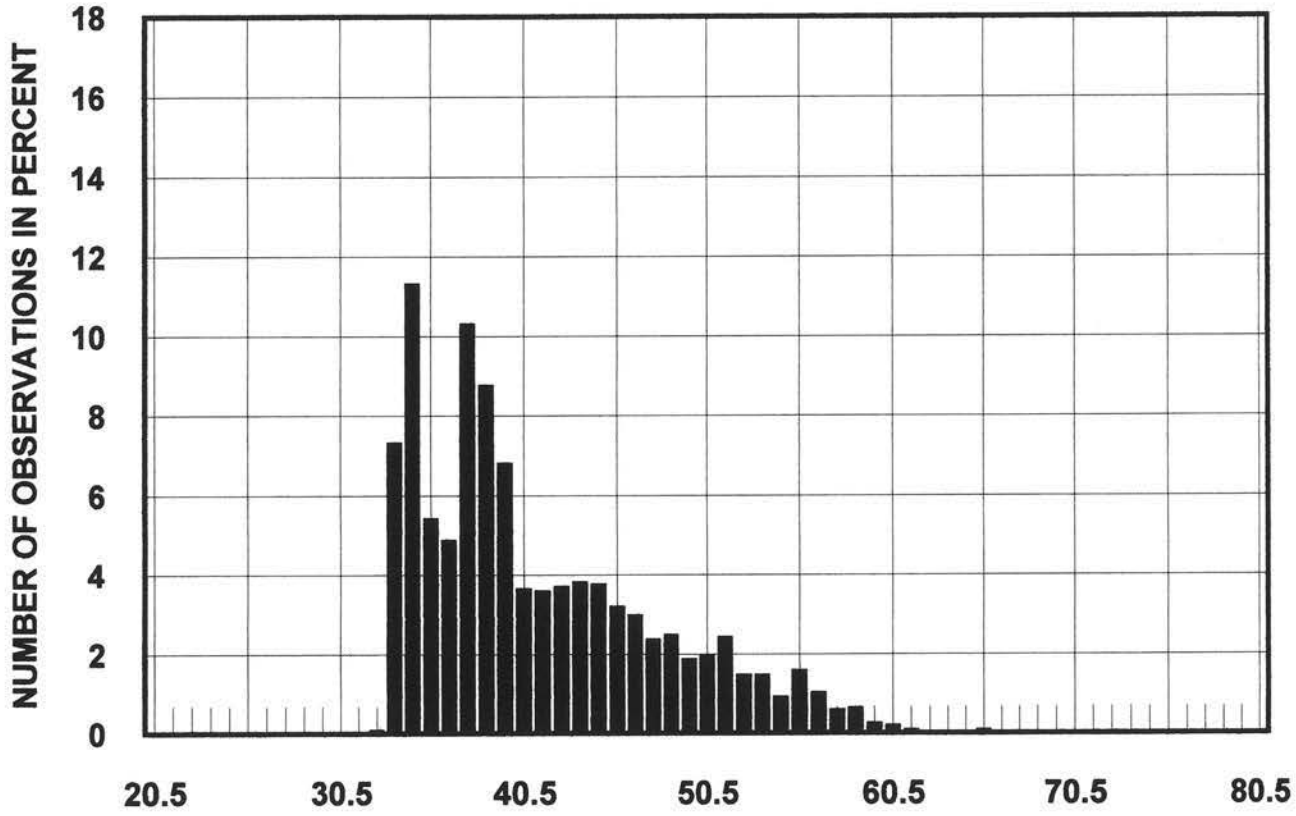
**DATE: MARCH 28, 2023**
**TIME: 0253 - 0323 HOURS**
**METER RESPONSE: LAEQ**




| | |
|---|---|
| Lmax: | 77.0 dBA |
| L10: | 47.2 dBA |
| L50: | 39.1 dBA |
| Leq: | 51.4 dBA |
| Lmin: | 36.2 dBA |

## FIGURE IV-5
## HISTOGRAM OF MEASURED NIGHTTIME BACKGROUND NOISE LEVELS AT LOC P2

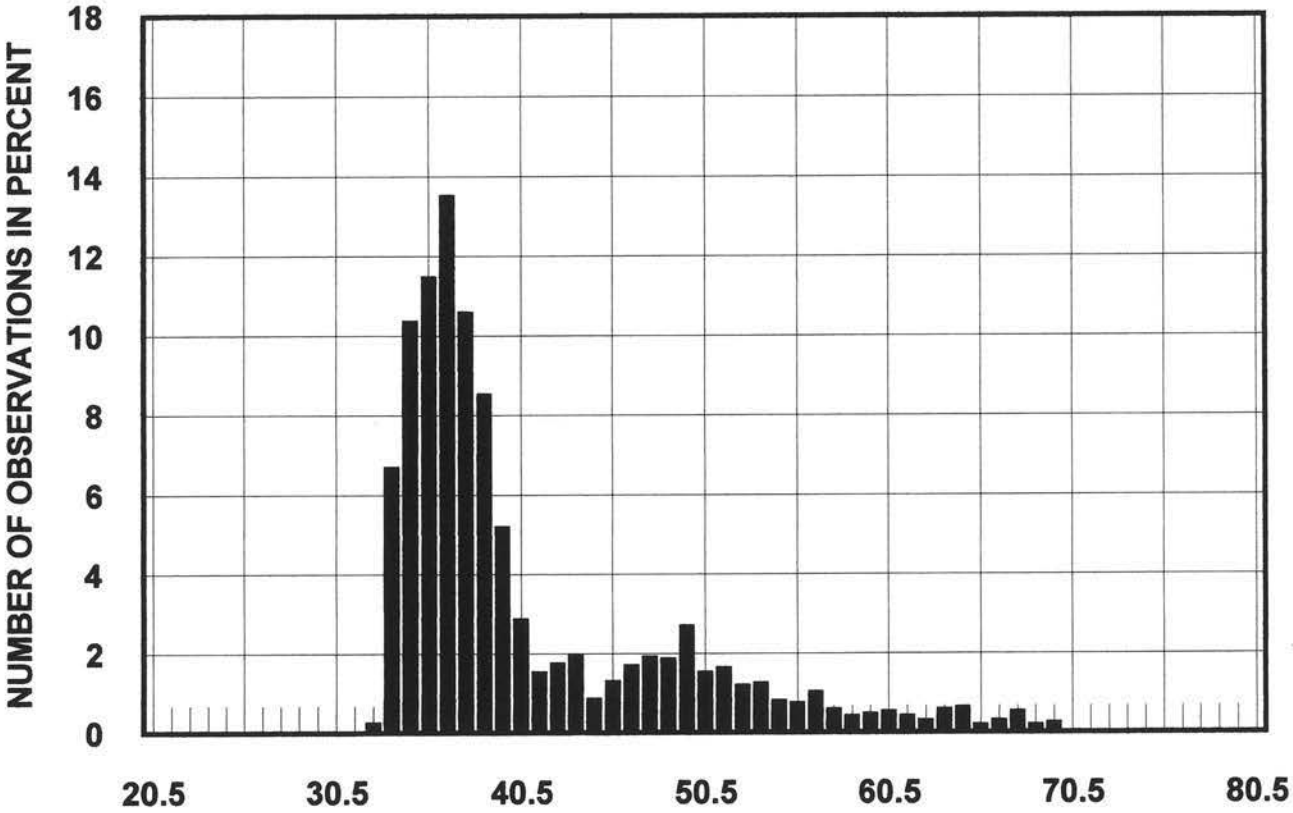
**DATE: MARCH 28, 2023**
**TIME: 0333 - 0403 HOURS**
**METER RESPONSE: LAEQ**




| | |
|---|---|
| Lmax: | 69.9 dBA |
| L10: | 51.6 dBA |
| L50: | 39.2 dBA |
| Leq: | 48.6 dBA |
| Lmin: | 32.9 dBA |

## FIGURE IV-6
## HISTOGRAM OF MEASURED NIGHTTIME BACKGROUND NOISE LEVELS AT LOC B

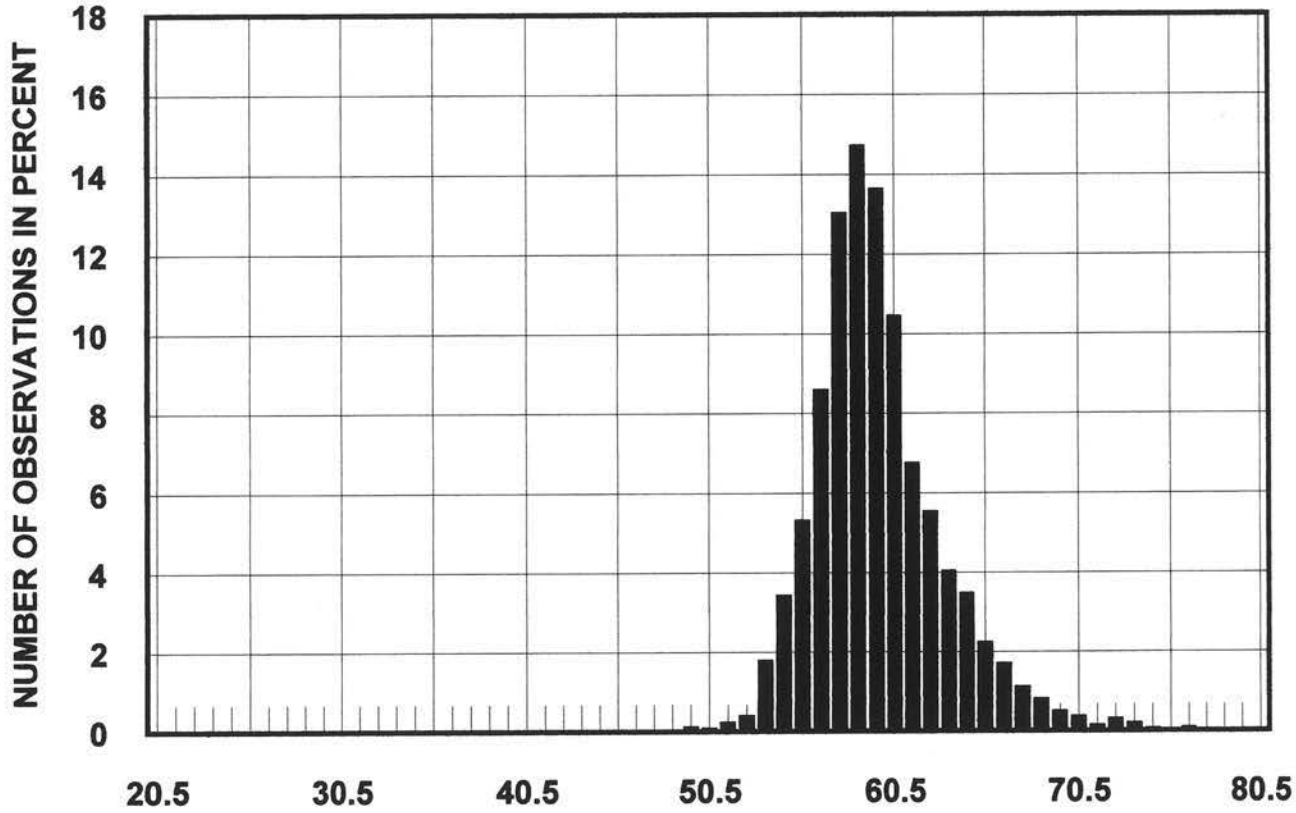
**DATE: MARCH 28, 2023**
**TIME: 0416 - 0446 HOURS**
**METER RESPONSE: LAEQ**




**Lmax: 81.1 dBA**
**L10: 53.0 dBA**
**L50: 37.7 dBA**
**Leq: 55.1 dBA**
**Lmin: 32.7 dBA**

## FIGURE IV-7
## HISTOGRAM OF MEASURED DAYTIME BACKGROUND NOISE LEVELS AT LOC P2

**DATE: MARCH 28, 2023**
**TIME: 1359 - 1459 HOURS**
**METER RESPONSE: LAEQ**




| | |
|---|---|
| Lmax: | 84.0 dBA |
| L10: | 64.5 dBA |
| L50: | 59.1 dBA |
| Leq: | 62.3 dBA |
| Lmin: | 48.9 dBA |

During the nighttime period, when most residents are asleep, there are increased risks of annoyance and sleep interference when construction occurs during the night. If the noise from construction activities does not exceed normal background noise levels or the 45 dBA nighttime noise level allowed by DOH for fixed machinery, risks of adverse noise impacts from the construction activities will tend to be much lower than if the construction noise exceeded 45 dBA during the nighttime and was much higher than the normal background noise levels. Where risks of adverse noise impacts were potentially high, the use of special noise mitigation measures (such as the construction of sound attenuating walls, or scheduling such work during the daytime hours on Saturdays and Sundays) may be necessary to avoid adverse noise impacts during nighttime work.

For this project, the State DOH noise limits of 55 dBA during the daytime (7:00 am to 10:00 pm) and 45 dBA during the nighttime (10:00 pm to 7:00 am) were also used as the minimum thresholds for evaluating potential noise impacts at single family residences. These daytime and nighttime noise thresholds are consistent with the DOH property line limits of Reference 5. It should be noted that these thresholds are being used only for the purposes of this study, since the State DOH typically applies these noise limits only to fixed machinery, and not to other mobile or portable noise sources which are used in construction, and which are regulated using the DOH construction noise permitting process.

Possible noise impacts from project road traffic were evaluated, and it was concluded that noise impacts from project traffic should not occur.

## CHAPTER V. EXISTING ACOUSTICAL ENVIRONMENT

Existing background noise levels along Waiale Road within the project environs are typically controlled by traffic noise at those receptor locations which are located on the east and west sides of that roadway. Existing residential developments are located primarily on the west side of Waiale Road with light industrial, commercial, and institutional uses on the east side of Waiale Road. Existing traffic noise levels along Waiale Road are probably at 65 DNL at 50 feet from the roadway's centerline. With existing single family residences at approximately 43 to 91 feet from that roadway's centerline and generally shielded by existing walls, existing traffic noise levels at the front row residences are probably within the 50 to 65 DNL category. The existing setback distances of the noise sensitive buildings on the east side of Waiale Road generally exceed 50 feet, but sound attenuating walls are not present on that side of the roadway, so existing traffic noise levels at the front row buildings to the east are probably in the range of 60 to 65 DNL.

At the currently undeveloped lands south of E. Waiko Road, background noise levels are relatively low and typically controlled by the sounds of natural sources and human activities, distant traffic, and aircraft flyby events (see Figure IV-2). Along E. Waiko Road, the traffic noise could include heavy truck operations associated with the light industrial establishments along that roadway. Heavy truck operations are also audible at the materials handling and storage facility east of the planned Central Maui WWRF. Between intermittent noise events from motor vehicles and aircraft flyby events, the steady background noise levels drop to the 35 dBA range, with average noise levels and DNL values probably near 50 dBA or DNL.

As indicated in Figures IV-3 to IV-6, residual background noise levels during the nighttime tend to be very low along the existing roadways and undeveloped areas to the south, and can drop to levels between 23 to 36 dBA during the quietist periods at the quietist locations. For this reason, noise producing sources are typically audible at very long distances, and would only be masked along area roadways during infrequent passes of motor vehicles. Along the areas' roadways, the intermittent passbys of motor vehicles cause short term background noise levels to rise to levels similar to those from daytime passbys of motor vehicles, and cause average nighttime noise levels to be in the order of 50 to 55 dBA rather than 23 to 36 dBA.

Traffic noise levels tend to be highest at the first row of dwellings which front the roadway, and diminish at dwellings which are further removed from the roadway or which are shielded by the terrain and structures which block the visual lines of sight between the dwelling and roadway vehicles. Because of the dominating influence of traffic noise on existing background noise levels near the major roadways, existing background noise levels in the project environs can range from 70+ DNL at locations near a major roadway such as Honoapiilani Highway, to less than 55 DNL at locations removed or shielded from the major roadways.

During the nighttime and early morning hours, background noise levels tend to be lowest due to the reductions in motor vehicle traffic along the roadways, and due to the diminished levels of human activities. Traffic noise levels tend to be highest during the daytime hours, increasing rapidly during the morning commuting period, remaining relatively constant during the daytime hours, increasing slightly during the afternoon commuting period, and decreasing during the evening and nighttime period to its lowest level at 3:30 to 4:30 am. Existing average background noise levels during the nighttime hours are typically 5 to 10 dBA lower than those during the daytime hours. Because of the lower levels of background noise at night, noise sources (such as construction equipment) tend to be audible at longer distances during the quieter nighttime periods than during the noisier daytime periods.

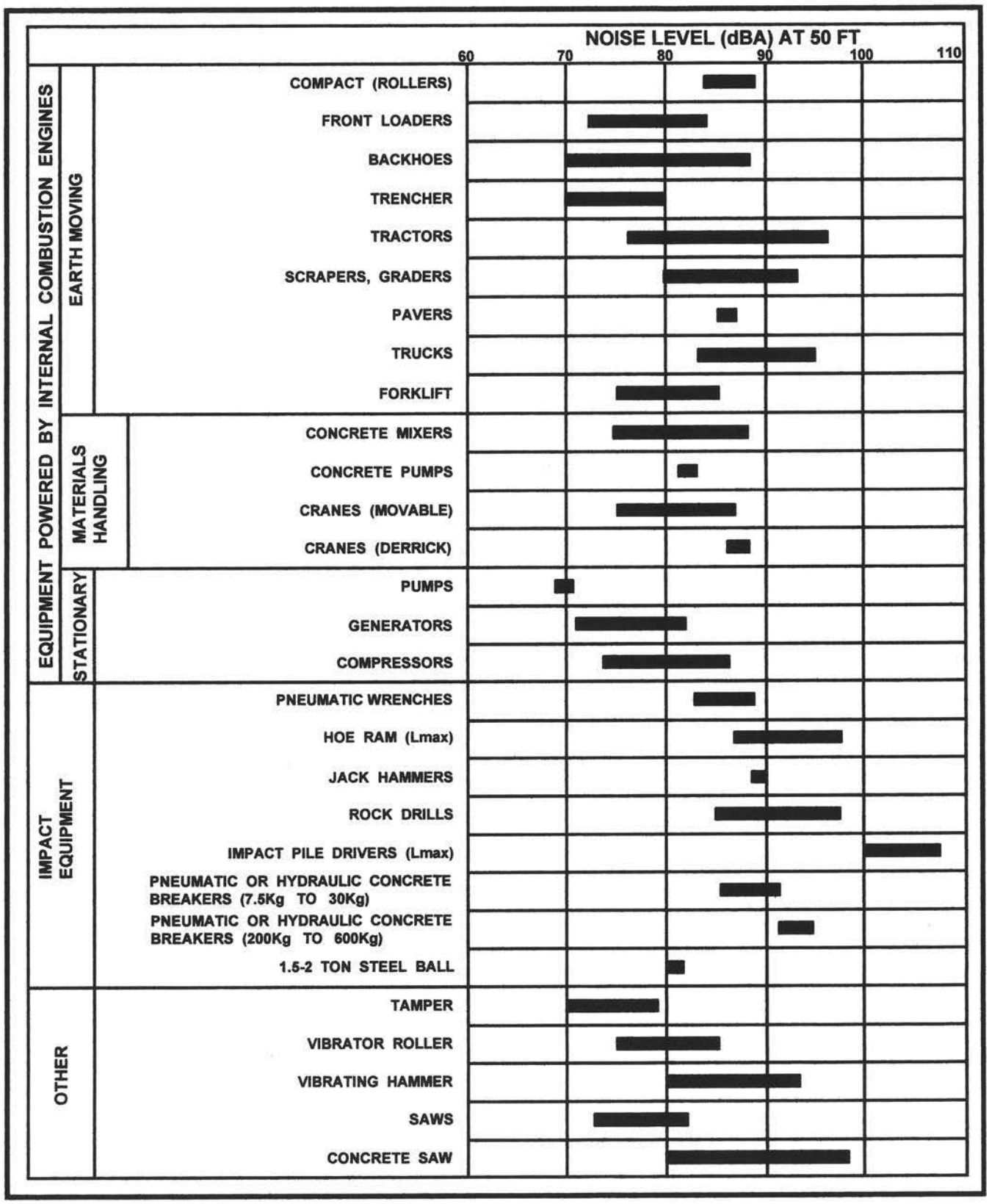
# CHAPTER VI. FUTURE NOISE ENVIRONMENT

Operations At Central Maui WWRF and Kehalani WWPS. It was assumed that adverse noise impacts associated with the normal operations of the new Kehalani WWPS and Central Maui WWRF will be mitigated during design of those facilities so as to comply with State DOH noise limits along the property lines of the two facilities. These noise limits would be 70 dBA, 24 hours per day at the Central Maui WWRF, and 55 dBA between 7:00 am and 10:00 pm and 45 dBA between 10:00 pm and 7:00 am at the Kuhalani WWPS. The loudest noise sources at these two facilities are anticipated to be: emergency diesel generators; pumps; high pressure blowers, and odor control and ventilation fans. Noise mitigation measures to comply with the State DOH noise limits are available and have been successfully applied at similar wastewater facilities. Even with a 70 dBA noise limit along the Central Maui WWRF property lines, it should be possible to not exceed 45 dBA at the closest planned residences of the Waikapu Country Town approximately 1,700 feet to the west.

Project Construction Noise. The potential noise impacts resulting from the proposed Central Maui Wastewater Reclamation Facility (WWRF) Project will be caused by the construction activities necessary to implement the project. The potential future noise levels associated with the construction of the sewage pipeline between Kehalani WWPS to the Central Maui WWRF and the sewage pipeline and the recycled water pipeline between Waikapu Country Town and the Central WWRF using the conventional open trench method are sufficiently high to cause short term noise impacts at noise sensitive receptors located within 150 feet of the sewage pipeline and recycled water pipeline alignments. At this distance, average hourly construction noise levels during an 8-hour work shift are predicted to not exceed 69 dBA, with the resulting DNL level due to construction not exceeding the 65 DNL FHA/HUD noise standard for noise sensitive receptors.

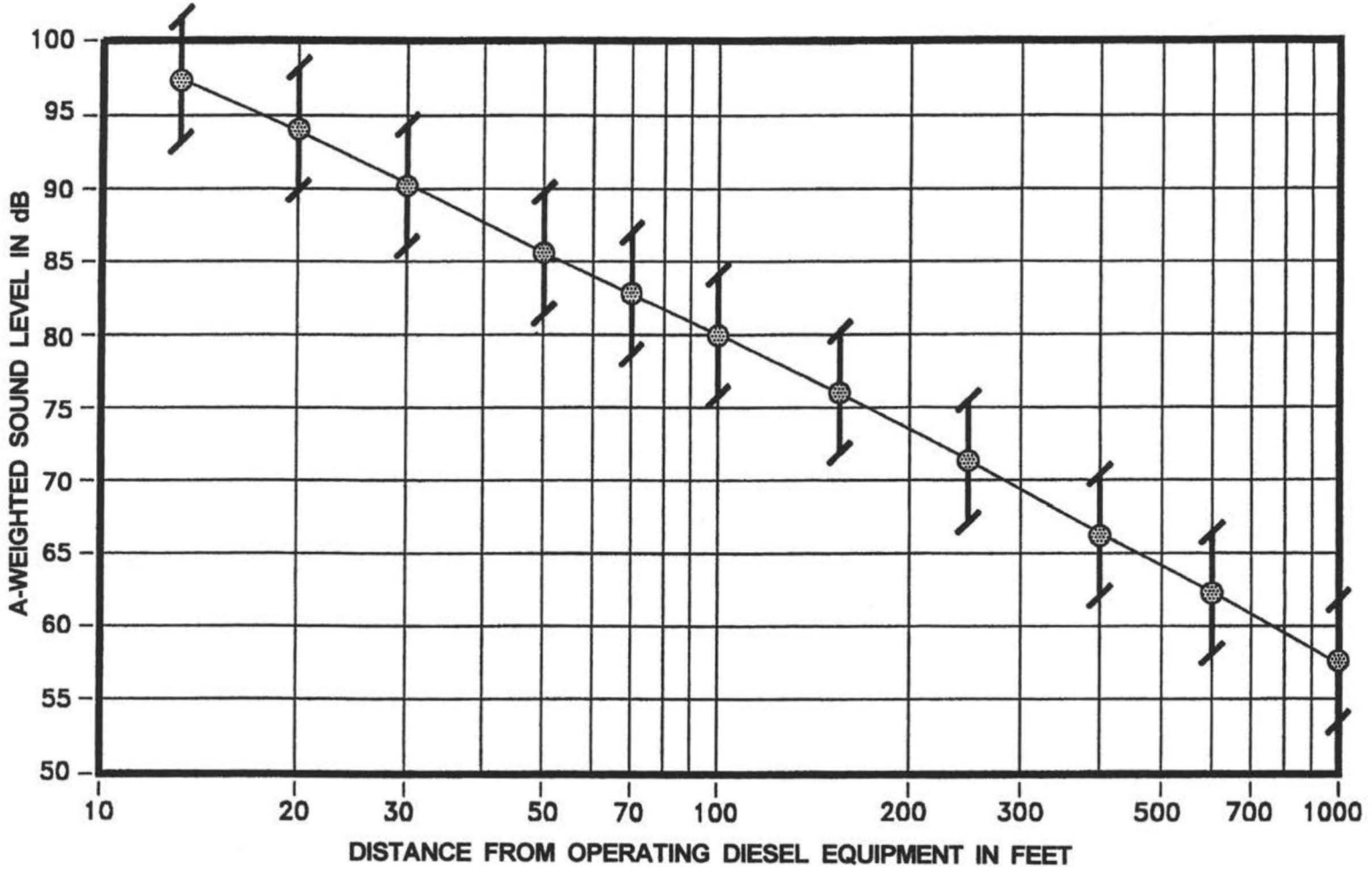
Noise during construction of the Kehalani WWPS will affect a more limited number of noise sensitive residences, and primarily during the grading and site preparation activities at that location. Noise during construction of the Central Maui WWRF facility at the south end of the project should not result in adverse noise impacts at existing noise sensitive receptors due to the very large buffer distances available between that site and existing or planned Waikapu Country Town residences. The trucking of spoils, fill material, and piping to and from the work areas will also be required and result in noise during construction of the pipelines, WWPS, and WWRF.

Typical noise levels of construction equipment which may be used are shown in Figure VI-1. The decrease in construction equipment noise with increasing distance from the noisier equipment is shown in Figure VI-2. The primary locations where these equipment noise sources may be operating are: at the WWPS and WWRF, as well as anywhere along the sewage and recycled water pipeline alignments shown in Figure I-1. Since open trench construction methods will be used along all segments of the sewage and recycled water pipelines, noisy construction equipment would operate




**RANGES OF CONSTRUCTION EQUIPMENT NOISE LEVELS**

**FIGURE VI-1**




**ANTICIPATED RANGE OF CONSTRUCTION NOISE LEVELS VS. DISTANCE**

**FIGURE VI-2**

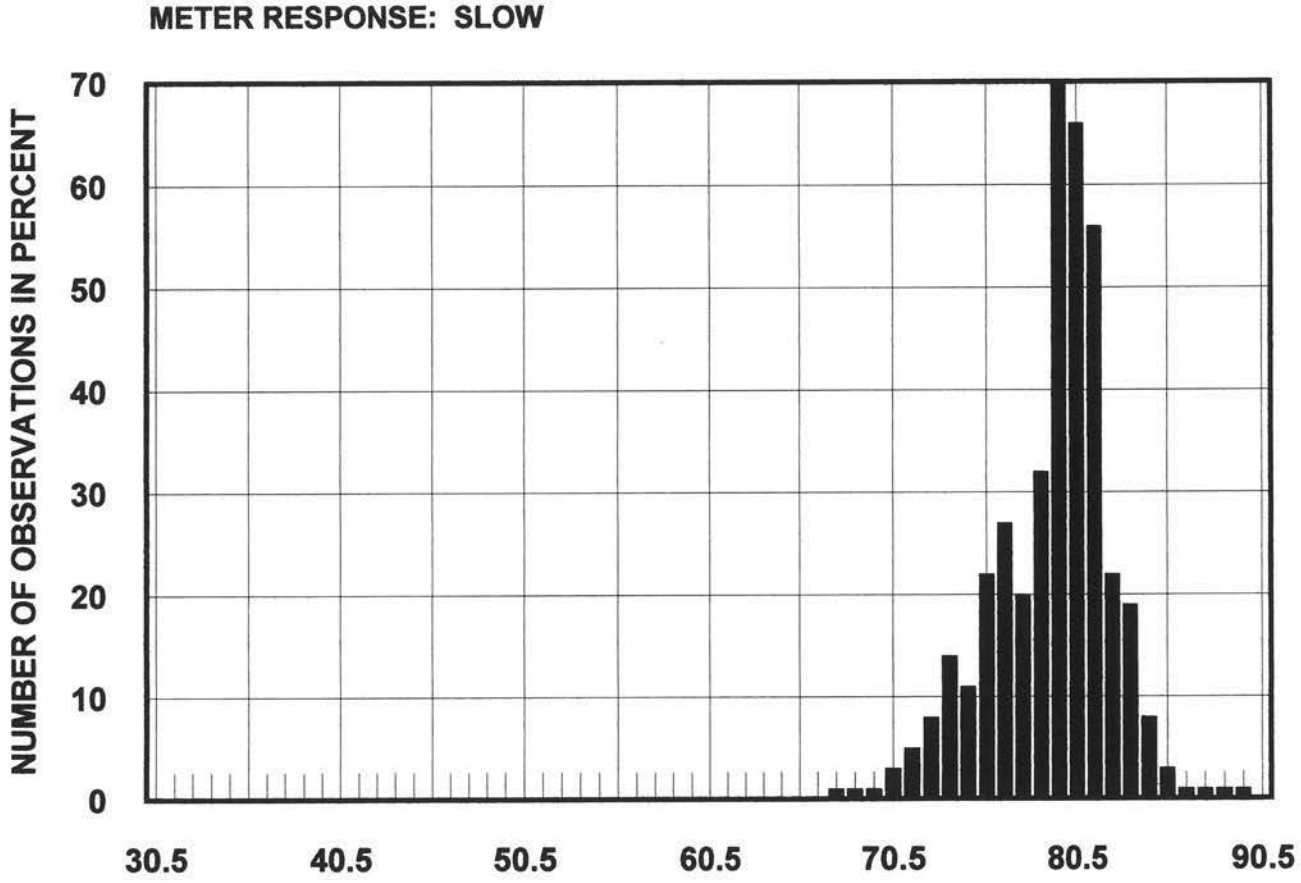
along the entire segment of each conveyance system alignment, with the highest noise levels associated with sheet pile driving, jack hammers, vacuum trucks, and concrete saws. Construction noise impacts associated with the sewage pipeline are anticipated to be concentrated at existing residences along Waiale Road and north of E. Waiko Road. Future noise sensitive developments at Waikapu Country Town south of E. Waiko Road will experience similar noise impacts during construction of the sewage pipeline along the planned Waiale Road Extension.

The available setback distances between the closest residences and the construction equipment will vary along each conveyance system alignment, and relatively high noise levels during construction may be unavoidable, particularly during operations of mobile equipment such as sheet pile drivers, concrete saws, jackhammers, excavators, loaders, diesel trucks, back hoes, vacuum trucks, and cranes. These mobile equipment would typically be used during open trench construction, and tend to operate over shorter intervals of time rather than continuously. The equipment which tend to operate continuously, such as generators, pumps, ventilation fans, air compressors, etc., are typically fixed at specific locations on the construction site, could be fitted with sound attenuation treatment (barriers, enclosures, silencers, etc.), and will typically have lower noise levels than those associated with the diesel engine powered mobile construction equipment.

Figure VI-3 presents the anticipated histogram of construction noise during open trenching operations at a separation distance of 50 feet from the trench, with average noise level of 79 dBA, and ranging between 65 to 90 dBA without noise shielding effects from a sound attenuating wall. It was assumed that the sewage pipeline could be located along Waiale Road to the east or west of the paved roadway surface at distances ranging from 12 to 60 feet from the existing residences west of the road for the near trench condition along the west shoulder of Waiale Road. If the trench is located along the east shoulder of Waiale Road, distances ranging from 72 to 125 feet from the existing residences west of the road were assumed.

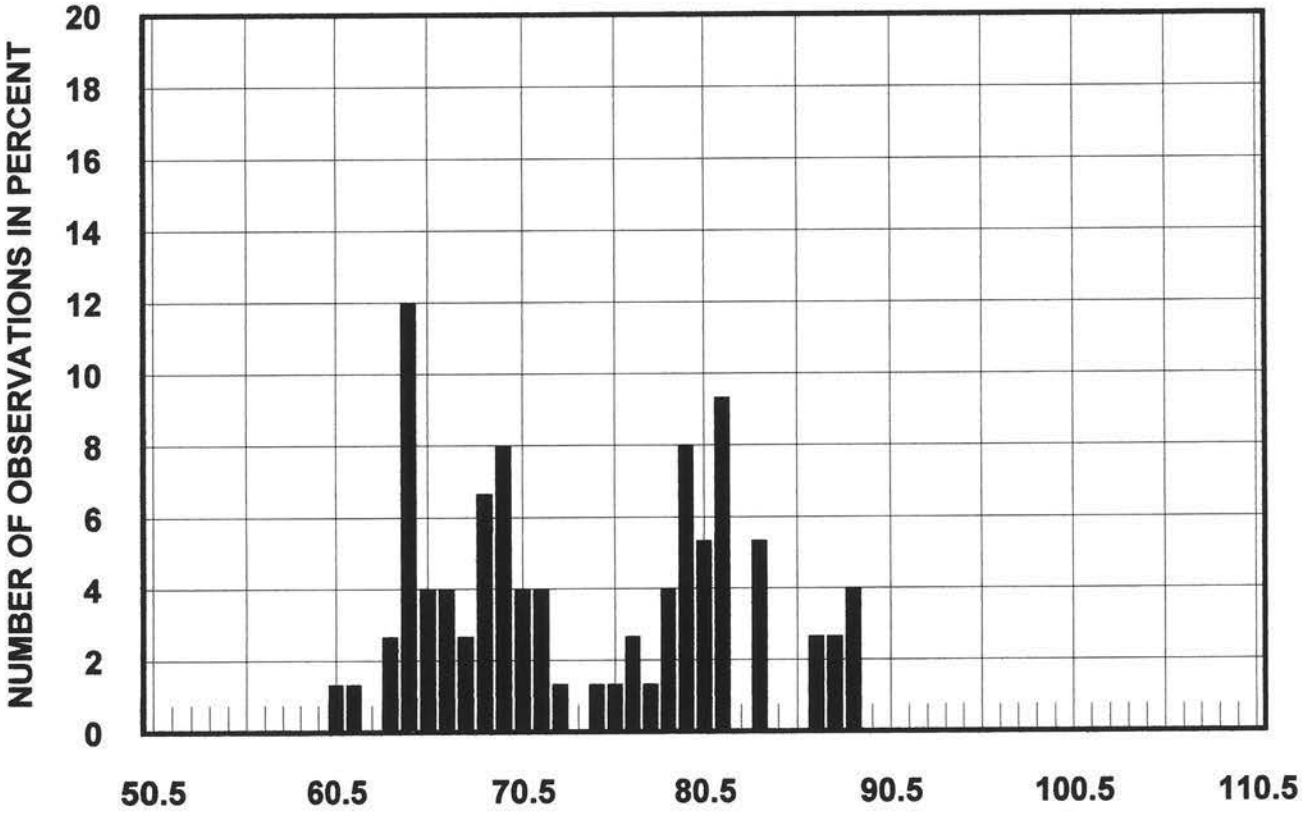
Figures VI-4 and VI-5 present the predicted average noise levels at residences west of Waiale Road during trenching operations west of Waiale Road (Figure VI-4 for near trench) and during trenching operations east of Waiale Road (and Figure VI-5 for far trench). The theoretical beneficial effects of the existing sound attenuating walls along the single family residential property lines have been included in those figures. In Figure VI-4, not all of the existing walls have sufficient heights to attenuate the noise from construction equipment located at the near trench, so the anticipated average construction noise levels are expected to range between 61 to 82 dBA for those residences with sufficiently tall walls, and between 78 to 88 dBA for those residences without walls or without sufficiently tall walls. From Figure VI-5, during trenching operations east of Waiale Road (far trench), average construction noise levels at residences west of Waiale Road during trenching operations are expected to range between 62 to 75 dBA, with the relatively smaller number of residences without walls north of Kaupo Street experiencing the higher construction noise levels of 73 to 75 dBA.

## FIGURE VI-3
## TYPICAL NOISE LEVELS FROM TRENCHING WORK AT 50 FT DISTANCE




Lmax: 89.5 dBA
L10: 79.1 dBA
Leq: 65.3 dBA
Lmin: 82.0 dBA

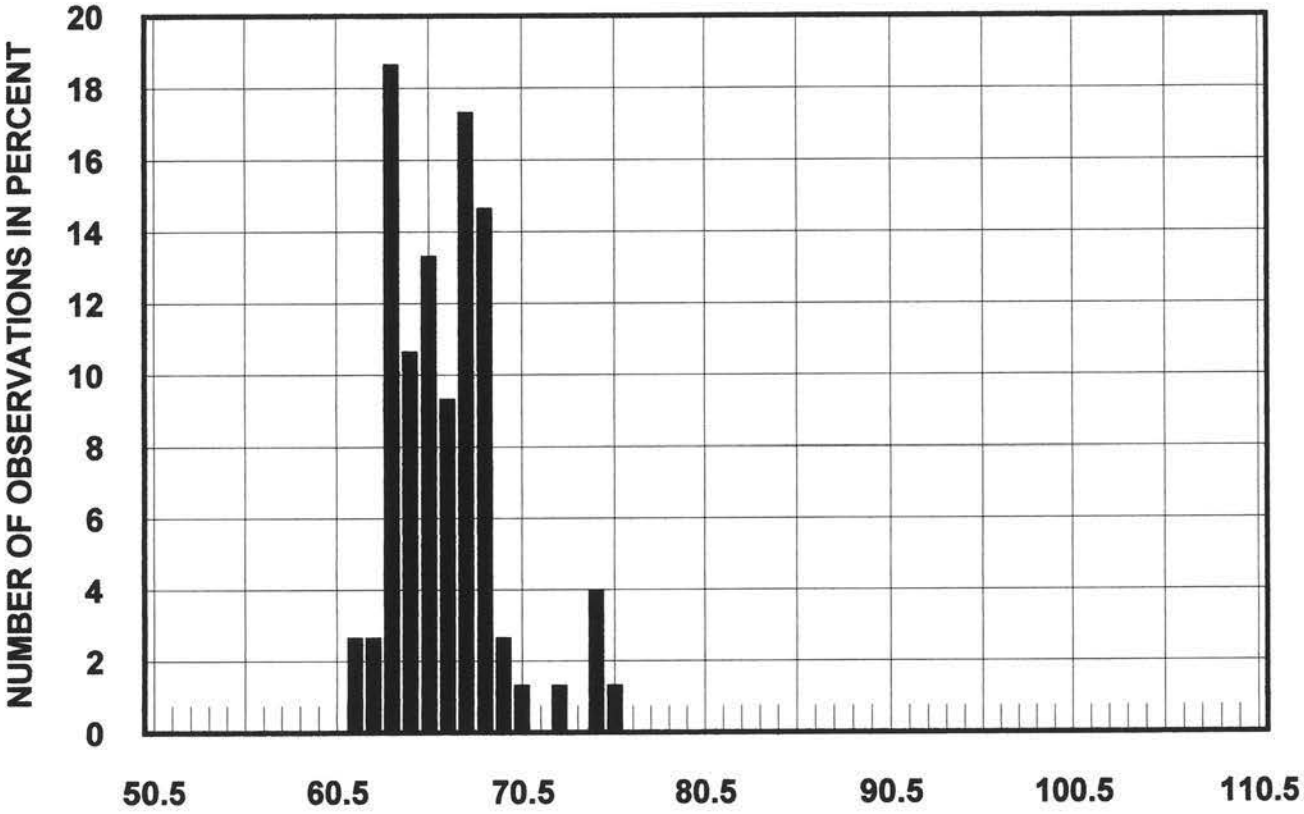
## FIGURE VI-4
## HISTOGRAM OF PREDICTED CONSTRUCTION NOISE LEVELS AT WEST RESIDENCES FROM NEAR TRENCH ALONG WAIALE RD.




TOTAL NUMBER OF RECEPTORS: 75
MIN / MAX CPA DISTANCES: 12' / 60'

Lmax: 88.3 dBA
L10: 83.5 dBA
L50: 71.7 dBA
Leq: 80.0 dBA
Lmin: 60.7 dBA

## FIGURE VI-5
## HISTOGRAM OF PREDICTED CONSTRUCTION NOISE LEVELS AT WEST RESIDENCES FROM FAR TRENCH ALONG WAIALE RD.




TOTAL NUMBER OF RECEPTORS: 75
MIN / MAX CPA DISTANCES: 72' / 125'

Lmax: 75.4 dBA
L10: 69.0 dBA
L50: 66.1 dBA
Leq: 67.7 dBA
Lmin: 61.6 dBA

In the vicinity of the Waimaluhila Lane intersection with Waiale Road, and north toward the proposed Kehalani WWPS, noise sensitive multifamily living units as well as a correctional facility are located on the east side of Waiale Road. These noise sensitive buildings are located at approximately 34 to 131 feet setback distances from the assumed location of the east trench, with anticipated average noise levels of 70 to 82 dBA during trenching operations. Distances from these noise sensitive buildings to the assumed location of the west trench range from 82 to 181 feet, with correspondingly lower noise levels of 67 to 74 dBA. At the Waimaluhila Lane intersection, available buffer distances to the assumed location of the east trench are small at 34 feet to the near trench and 82 feet to the far trench, which are similar to the available buffer distances from existing residences on the west side of Waiale Road to their near trench. However, sound attenuating walls do not exist along the east side of Waiale Road.

In summary, the noise levels during construction at existing noise sensitive receptors along Waiale Road (as well as those future residences along the Waiale Road Extension south of E. Waiko Road) will depend upon the final alignment selected for the sewage pipeline between the proposed Kehalani WWPS and the Central Maui WWRF.

Future Road Traffic Noise. Appendix C provides a summary of 2009 and 2029 traffic volumes in the project area. A review of the draft traffic study for the project (Reference 7) indicated that by 2029, relatively large increases in traffic are expected to occur along the existing sections of Waiale Road north of East Waiko Road as a result of the growth of non-project traffic. New development planned along the Waiale Road extension other than the Central Maui Wastewater Reclamation Facility will be the primary generator of this added future traffic along Waiale Road as well as along East Waiko Road and Honoapiilani Highway south of the new Waiale Road intersection. Anticipated increases in existing peak hour Leq and DNL traffic noise levels are: 5.2 dB at Waiale Road north of East Waiko Road; 1.7 to 3.6 dB along East Waiko Road; and 2.1 dB along Honapiilani Highway south of the new Waiale Road intersection. Adverse traffic noise impacts following completion of the wastewater reclamation facility are not expected, with two-way project traffic expected to be in the order 32 vehicles per hour in 2029.

## CHAPTER VII. DISCUSSION OF PROJECT RELATED NOISE IMPACTS AND POSSIBLE MITIGATION MEASURES

General Construction Noise. Audible construction noise will probably be unavoidable during the entire project construction period. The total time period for actual construction is unknown. Construction noise levels and impacts are expected to be dependent on the selected alignment of the planned force main between the proposed Kehalani WWPS and the Central Maui WWRF for those existing and planned receptors located on the west and east sides of Waiale Road. The anticipated range of average construction noise levels during trenching along the west shoulder of Waiale Road is between 61 to 88 dBA. When trenching along the east shoulder of Waiale Road, reduced noise levels of 62 to 75 dBA should result at existing residences west of Waiale Road. When trenching along the east shoulder of Waiale Road, noise sensitive receptors on the east side of Waiale Road will experience average noise levels ranging from 70 to 82 dBA.

Potential construction noise levels at the closest residences near the planned Kehalani WWPS could range between 78 to 92 dBA during the site preparation phase. During the building erection phase at the WWPS, average construction noise levels should be lower and between 65 to 79 dBA.

Typical levels of construction noise inside naturally ventilated and air conditioned structures are approximately 10 and 20 dBA less, respectively, than the expected exterior noise levels provided previously outside the closest receptors to the various work areas.

Possible Noise Mitigation Measures for General Construction Noise Sources. Mitigation of construction noise impacts is administered by the State Department of Health (DOH) through the issuance of Construction Noise Permits and through a curfew system, which limits noisy construction activities to normal work hours from Mondays through Saturdays, excluding holidays (see Reference 5). Figure III-2 depicts the hours typically allowed for construction activities on weekdays and Saturdays under the DOH permit system. For construction work (such as sheet pile driving) which could generate very high noise levels at the closest residences, the DOH may include additional curfew restrictions on early morning and late afternoon work hours to further minimize risks of adverse construction noise impacts. The DOH construction noise permit system has been in use for a very long time, and has generally been successfully applied. This is partially due to the efforts of contractors to minimize adverse noise impacts, the temporary nature of the very noisy construction activities at any one location, and the use of scheduling and resident notifications of the anticipated noisy activities.

The relatively high noise levels during construction of the project are unavoidable, particularly at the relatively short setback distances to the closest residences. Mitigation of construction noise to inaudible levels will not be practical in all cases due to the intensity of construction noise sources (80 to 90+ dBA at 50 FT distance), and due to the exterior nature of the work (excavating, grading and earth and

spoils moving, trenching, crane operations, hammering, etc.). The use of properly muffled construction equipment should be required on the job site. The anticipated noise levels during project construction activities are similar to other construction activities (exterior earthwork, open trenching, or building erection). Noise mitigation measures should be included in the various construction projects for the Central Maui Wastewater Reclamation Facility (WWRF) Project. The following noise mitigation measures are recommended for inclusion within the project construction documents:

1. Provide sound attenuation treatments (walls, enclosures, or silencers) to reduce all steady, continuous noise sources (generators, pumps, blowers, etc.) which operate during the normally permitted daytime hours so that they do not exceed an 8-hour average value of 69 dBA at the closest residences. If this can be done, the 24-hour average DNL attributable to these continuous construction noise sources would be limited to the FHA/HUD standard of 65 DNL at these residences. The use of solid 3/4" plywood panels instead of fabric dust screens at these closest residences could provide approximately 5 to 10 dBA of sound attenuation at the closest residences who are expected to experience the highest construction noise levels.

2. For fixed or stationary equipment (generators, pumps, blowers, etc.) which need to operate 24 hours per day, provide sound attenuation treatments (walls, enclosures, or silencers) to reduce their noise levels to the allowable State DOH nighttime limits of 45 or 50 dBA at the closest residences.

3. In some instances where the force main line is extremely close to noise sensitive structures which are not shielded by an existing wall, consider the use of a temporary sound barrier wall during construction. Where a large number of noise sensitive structures are involved, consider the use of the far trench alignment for the force main.

4. Require the installation and use of broadband back-up alarms in place of high pitched, beeper-type back-up alarms for all mobile equipment operating on the project work sites. The broadband alarms should be less audible at the longer distances, and should be less annoying at all distances from the mobile construction equipment. Use broadband alarms which automatically adjust the alarm sound level for changes in background noise level.

5. Maximize the separation distances between residences and the heavy truck routes to and from the construction sites which are used for materials delivery or spoils removal.

6. Include construction noise mitigation measures for the construction contractors as follows:

- Use of the quietist equipment that is readily available, particularly in respect to factory quieted portable generators, pumps, and compressors; and the use of properly muffled and enclosed heavy equipment and vehicles;

- Use of the smallest sized equipment capable of performing the work and whose engine and exhaust pipe are below the top elevation of the existing walls along the residential property lines. This would maximize the sound attenuation benefits from the existing walls along the project corridor.

- The construction contractor should attempt to develop schedules of work within 50 feet of a residence which is mutually agreeable to all parties. This could allow residents to schedule their activities so as to avoid the anticipated construction periods of very high noise levels;

- The construction contractor should not schedule very noisy construction work which occurs simultaneously on more than two sides of any residence within 50 feet of the work area. This will allow the resident to close the exterior windows and doors on the exposed sides of the home while allowing for natural ventilation via the other sides of the home;

- Provide weekly schedules of the location, date, and time of the anticipated noisy construction activities to residences within 500 feet of the scheduled work areas;

- Provide the cell phone number of the job site supervisor, who is responsible for responding to residents' complaints regarding the construction activities;

- Require the construction contractor to maintain a date and time log of all noise complaints, which includes the name and address of the complainant and the remedial measures taken; and

- Require the construction contractor to report all noise complaints received within 1 working day of the receipt of the complaint to the Officer-In-Charge.

Operations At Central Maui WWRF and Kehalani WWPS. Sound attenuation treatments should be included with the design and construction of the Central Maui WWRF and Kehalani WWPS so as to not exceed the State DOH noise limits along the property boundary lines of both facilities. Enclosure of the noisy fixed equipment within concrete structures, with acoustically treated ventilation openings, are conventional means of mitigating noise emissions from noisy fixed equipment. Sound attenuation devices (acoustically louvers, duct silencers, exhaust and inlet air silencers, interior acoustical absorptive panels, etc.) should be included in the design of these facilities with a design goal of not exceeding the State DOH noise limits applicable at each facility.

## APPENDIX A. REFERENCES

(1) "Guidelines for Considering Noise in Land Use Planning and Control;" Federal Interagency Committee on Urban Noise; June 1980.

(2) American National Standard, "Sound Level Descriptors for Determination of Compatible Land Use," ANSI S12.9-1998/ Part 5; Acoustical Society of America.

(3) "Environmental Criteria and Standards, Noise Abatement and Control, 24 CFR, Part 51, Subpart B;" U.S. Department of Housing and Urban Development; July 12, 1979.

(4) "Information on Levels of Environmental Noise Requisite to Protect the Public Health and Welfare with an Adequate Margin of Safety;" U.S. Environmental Protection Agency; EPA 550/9-74- 004; March 1974.

(5) "Title 11, Administrative Rules, Chapter 46, Community Noise Control;" Hawaii State Department of Health; September 23, 1996.

(6) "Central Maui Wastewater Reclamation Facility - Project Description for Environmental Impact Statement Preparation Notice (EISPN);" Brown and Caldwell; February 3, 2023.

(7) Final Draft, "Traffic Impact Analysis Report, Central Maui Wastewater Reclamation Facility;" Austin, Tsutsumi & Associates, Inc.; August 23, 2023.

# APPENDIX B

# EXCERPTS FROM EPA'S ACOUSTIC TERMINOLOGY GUIDE

Descriptor Symbol Usage

The recommended symbols for the commonly used acoustic descriptors based on A-weighting are contained in Table I. As most acoustic criteria and standards used by EPA are derived from the A-weighted sound level, almost all descriptor symbol usage guidance is contained in Table I.

Since acoustic nomenclature includes weighting networks other than "A" and measurements other than pressure, an expansion of Table I was developed (Table II). The group adopted the ANSI descriptor-symbol scheme which is structured into three stages. The first stage indicates that the descriptor is a level (i.e., based upon the logarithm of a ratio), the second stage indicates the type of quantity (power, pressure, or sound exposure), and the third stage indicates the weighting network (A, B, C, D, E.....). If no weighting network is specified, "A" weighting is understood. Exceptions are the A-weighted sound level and the A-weighted peak sound level which require that the "A" be specified. For convenience in those situations in which an A-weighted descriptor is being compared to that of another weighting, the alternative column in Table II permits the inclusion of the "A". For example, a report on blast noise might wish to contrast the LCdn with the LAdn.

Although not included in the tables, it is also recommended that "Lpn" and "LepN" be used as symbols for perceived noise levels and effective perceived noise levels, respectively.

It is recommended that in their initial use within a report, such terms be written in full, rather than abbreviated. An example of preferred usage is as follows:

The A-weighted sound level (LA) was measured before and after the installation of acoustical treatment. The measured LA values were 85 and 75 dB respectively.

Descriptor Nomenclature

With regard to energy averaging over time, the term "average" should be discouraged in favor of the term "equivalent". Hence, Leq, is designated the "equivalent sound level". For Ld, Ln, and Ldn, "equivalent" need not be stated since the concept of day, night, or day-night averaging is by definition understood. Therefore, the designations are "day sound level", "night sound level", and "day-night sound level", respectively.

The peak sound level is the logarithmic ratio of peak sound pressure to a reference pressure and not the maximum root mean square pressure. While the latter is the maximum sound pressure level, it is often incorrectly labelled peak. In that sound level meters have "peak" settings, this distinction is most important.

"Background ambient" should be used in lieu of "background", "ambient", "residual", or "indigenous" to describe the level characteristics of the general background noise due to the contribution of many unidentifiable noise sources near and far.

With regard to units, it is recommended that the unit decibel (abbreviated dB) be used without modification. Hence, DBA, PNdB, and EPNdB are not to be used. Examples of this preferred usage are: the Perceived Noise Level (Lpn was found to be 75 dB. Lpn = 75 dB). This decision was based upon the recommendation of the National Bureau of Standards, and the policies of ANSI and the Acoustical Society of America, all of which disallow any modification of bel except for prefixes indicating its multiples or submultiples (e.g., deci).

Noise Impact

In discussing noise impact, it is recommended that "Level Weighted Population" (LWP) replace "Equivalent Noise Impact" (ENI). The term "Relative Change of Impact" (RCI) shall be used for comparing the relative differences in LWP between two alternatives.

Further, when appropriate, "Noise Impact Index" (NII) and "Population Weighed Loss of Hearing" (PHL) shall be used consistent with CHABA Working Group 69 Report Guidelines for Preparing Environmental Impact Statements (1977).

## APPENDIX B (CONTINUED)

## TABLE I

## A-WEIGHTED RECOMMENDED DESCRIPTOR LIST

| | TERM | SYMBOL |
|---|---|---|
| 1. | A-Weighted Sound Level | $L_A$ |
| 2. | A-Weighted Sound Power Level | $L_{WA}$ |
| 3. | Maximum A-Weighted Sound Level | $L_{max}$ |
| 4. | Peak A-Weighted Sound Level | $L_{Apk}$ |
| 5. | Level Exceeded x% of the Time | $L_x$ |
| 6. | Equivalent Sound Level | $L_{eq}$ |
| 7. | Equivalent Sound Level Over Time (T) (1) | $L_{eq(T)}$ |
| 8. | Day Sound Level | $L_d$ |
| 9. | Night Sound Level | $L_n$ |
| 10. | Day-Night Sound Level | $L_{dn}$ |
| 11. | Yearly Day-Night Sound Level | $L_{dn(Y)}$ |
| 12. | Sound Exposure Level | $L_{SE}$ |

(1) Unless otherwise specified, time is in hours (e.g. the hourly equivalent level is $L_{eq(1)}$). Time may be specified in non-quantitative terms (e.g., could be speficied as $L_{eq(WASH)}$ to mean the washing cycle noise for a washing machine).

SOURCE: EPA ACCOUSTIC TERMINOLOGY GUIDE, BNA 8-14-78,

## APPENDIX B (CONTINUED)

## TABLE II

## RECOMMENDED DESCRIPTOR LIST

| | TERM | A-WEIGHTING | ALTERNATIVE[1] A-WEIGHTING | OTHER[2] WEIGHTING | UNWEIGHTED |
|---|---|---|---|---|---|
| 1. | Sound (Pressure)[3] Level | $L_A$ | $L_{pA}$ | $L_B$, $L_{pB}$ | $L_p$ |
| 2. | Sound Power Level | $L_{WA}$ | | $L_{WB}$ | $L_W$ |
| 3. | Max. Sound Level | $L_{max}$ | $L_{Amax}$ | $L_{Bmax}$ | $L_{pmax}$ |
| 4. | Peak Sound (Pressure) Level | $L_{Apk}$ | | $L_{Bpk}$ | $L_{pk}$ |
| 5. | Level Exceeded x% of the Time | $L_x$ | $L_{Ax}$ | $L_{Bx}$ | $L_{px}$ |
| 6. | Equivalent Sound Level | $L_{eq}$ | $L_{Aeq}$ | $L_{Beq}$ | $L_{peq}$ |
| 7. | Equivalent Sound Level[4] Over Time(T) | $L_{eq(T)}$ | $L_{Aeq(T)}$ | $L_{Beq(T)}$ | $L_{peq(T)}$ |
| 8. | Day Sound Level | $L_d$ | $L_{Ad}$ | $L_{Bd}$ | $L_{pd}$ |
| 9. | Night Sound Level | $L_n$ | $L_{An}$ | $L_{Bn}$ | $L_{pn}$ |
| 10. | Day-Night Sound Level | $L_{dn}$ | $L_{Adn}$ | $L_{Bdn}$ | $L_{pdn}$ |
| 11. | Yearly Day-Night Sound Level | $L_{dn(Y)}$ | $L_{Adn(Y)}$ | $L_{Bdn(Y)}$ | $L_{pdn(Y)}$ |
| 12. | Sound Exposure Level | $L_S$ | $L_{SA}$ | $L_{SB}$ | $L_{Sp}$ |
| 13. | Energy Average Value Over (Non-Time Domain) Set of Observations | $L_{eq(e)}$ | $L_{Aeq(e)}$ | $L_{Beq(e)}$ | $L_{peq(e)}$ |
| 14. | Level Exceeded x% of the Total Set of (Non-Time Domain) Observations | $L_{x(e)}$ | $L_{Ax(e)}$ | $L_{Bx(e)}$ | $L_{px(e)}$ |
| 15. | Average $L_x$ Value | $L_x$ | $L_{Ax}$ | $L_{Bx}$ | $L_{px}$ |

(1) "Alternative" symbols may be used to assure clarity or consistency.

(2) Only B-weighting shown. Applies also to C,D,E,.....weighting.

(3) The term "pressure" is used only for the unweighted level.

(4) Unless otherwise specified, time is in hours (e.g., the hourly equivalent level is Leq(1). Time may be specified in non-quantitative terms (e.g., could be specified as Leq(WASH) to mean the washing cycle noise for a washing machine.

## APPENDIX C

### SUMMARY OF YEAR 2009 AND FUTURE YEAR (2029) TRAFFIC VOLUMES ALONG ROADWAYS IN PROJECT ENVIRONS

| ROADWAY LANES | **** CY 2022 ***** AM VPH | PM VPH | CY 2029 (NO BUILD) AM VPH | PM VPH | CY 2029 (BUILD) AM VPH | PM VPH |
|---|---|---|---|---|---|---|
| Honoapiilani Hwy., North of Waiko Rd. (NB) | 573 | 723 | 613 | 881 | 613 | 882 |
| Honoapiilani Hwy., North of Waiko Rd. (SB) | 843 | 560 | 1,058 | 764 | 1,060 | 764 |
| Two-Way | 1,416 | 1,283 | 1,671 | 1,645 | 1,673 | 1,646 |
| Honoapiilani Hwy., South of Waiko Rd. (NB) | 591 | 736 | 683 | 910 | 683 | 910 |
| Honoapiilani Hwy., South of Waiko Rd. (SB) | 811 | 587 | 1,014 | 835 | 1,014 | 835 |
| Two-Way | 1,402 | 1,323 | 1,697 | 1,745 | 1,697 | 1,745 |
| Honoapiilani Hwy., North of Waiale Rd. Ext. (NB) | 591 | 736 | 524 | 801 | 524 | 801 |
| Honoapiilani Hwy., North of Waiale Rd. Ext. (SB) | 811 | 587 | 956 | 656 | 956 | 656 |
| Two-Way | 1,402 | 1,323 | 1,480 | 1,457 | 1,480 | 1,457 |
| Honoapiilani Hwy., South of Waiale Rd. Ext. (NB) | 591 | 736 | 776 | 1,107 | 784 | 1,107 |
| Honoapiilani Hwy., South of Waiale Rd. Ext. (SB) | 811 | 587 | 1,116 | 895 | 1,117 | 902 |
| Two-Way | 1,402 | 1,323 | 1,892 | 2,002 | 1,901 | 2,009 |
| Kuihelani Hwy., North of E. Waiko Rd. (NB) | 756 | 784 | 907 | 1,076 | 908 | 1,082 |
| Kuihelani Hwy., North of E. Waiko Rd. (SB) | 731 | 906 | 905 | 1,147 | 911 | 1,147 |
| Two-Way | 1,487 | 1,690 | 1,812 | 2,223 | 1,819 | 2,229 |
| Kuihelani Hwy., South of E. Waiko Rd. (NB) | 489 | 695 | 619 | 903 | 619 | 903 |
| Kuihelani Hwy., South of E. Waiko Rd. (SB) | 679 | 742 | 822 | 939 | 822 | 939 |
| Two-Way | 1,168 | 1,437 | 1,441 | 1,842 | 1,441 | 1,842 |
| W. Waiko Rd., West of Honoapiilani Hwy. (WB) | 17 | 55 | 19 | 60 | 19 | 60 |
| W. Waiko Rd., West of Honoapiilani Hwy. (EB) | 54 | 24 | 55 | 26 | 55 | 26 |
| Two-Way | 71 | 79 | 74 | 86 | 74 | 86 |
| E. Waiko Rd., East of Honoapiilani Hwy. (WB) | 97 | 120 | 138 | 208 | 138 | 209 |
| E. Waiko Rd., East of Honoapiilani Hwy. (EB) | 184 | 75 | 288 | 132 | 290 | 132 |
| Two-Way | 281 | 195 | 426 | 340 | 428 | 341 |
| E. Waiko Rd., West of Waiale Rd. (WB) | 105 | 129 | 145 | 214 | 145 | 216 |
| E. Waiko Rd., West of Waiale Rd. (EB) | 192 | 77 | 297 | 131 | 299 | 131 |
| Two-Way | 297 | 206 | 442 | 345 | 444 | 347 |
| E. Waiko Rd., East of Waiale Rd. (WB) | 92 | 249 | 203 | 531 | 209 | 531 |
| E. Waiko Rd., East of Waiale Rd. (EB) | 328 | 108 | 598 | 299 | 599 | 305 |
| Two-Way | 420 | 357 | 801 | 830 | 808 | 836 |
| E. Waiko Rd., West of Kuihelani Hwy. (WB) | 131 | 226 | 343 | 562 | 349 | 562 |
| E. Waiko Rd., West of Kuihelani Hwy. (EB) | 346 | 151 | 548 | 527 | 549 | 533 |
| Two-Way | 477 | 377 | 891 | 1,089 | 898 | 1,095 |

## APPENDIX C (CONTINUED)

### SUMMARY OF YEAR 2009 AND FUTURE YEAR (2029) TRAFFIC VOLUMES ALONG ROADWAYS IN PROJECT ENVIRONS

| ROADWAY LANES | **** CY 2022 ***** AM VPH | PM VPH | CY 2029 (NO BUILD) AM VPH | PM VPH | CY 2029 (BUILD) AM VPH | PM VPH |
|---|---|---|---|---|---|---|
| Waiale Rd., North of E. Waiko Rd. (NB) | 108 | 200 | 514 | 702 | 514 | 704 |
| Waiale Rd., North of E. Waiko Rd. (SB) | 257 | 111 | 645 | 507 | 647 | 507 |
| Two-Way | 365 | 311 | 1,159 | 1,209 | 1,161 | 1,211 |
| Waiale Rd. Extension, South of E. Waiko Rd. (NB) | N/A | N/A | 372 | 394 | 373 | 404 |
| Waiale Rd. Extension, South of E. Waiko Rd. (SB) | N/A | N/A | 260 | 348 | 270 | 348 |
| Two-Way | N/A | N/A | 632 | 742 | 643 | 752 |
| Waiale Rd. Extension, East of Honoapiilani Hwy. (E | N/A | N/A | 262 | 316 | 270 | 316 |
| Waiale Rd. Extension, East of Honoapiilani Hwy. (W | N/A | N/A | 170 | 249 | 171 | 256 |
| Two-Way | N/A | N/A | 432 | 565 | 441 | 572 |
| Waiale Rd. Extension, North of Project Access (NB) | N/A | N/A | N/A | N/A | 258 | 320 |
| Waiale Rd. Extension, North of Project Access (SB) | N/A | N/A | N/A | N/A | 175 | 244 |
| Two-Way | N/A | N/A | N/A | N/A | 433 | 564 |
| Waiale Rd. Extension, South of Project Access (NB) | N/A | N/A | N/A | N/A | 265 | 311 |
| Waiale Rd. Extension, South of Project Access (SB) | N/A | N/A | N/A | N/A | 166 | 251 |
| Two-Way | N/A | N/A | N/A | N/A | 431 | 562 |
| Project Access Rd., East of Waiale Rd. Ext. (EB) | N/A | N/A | N/A | N/A | 18 | 0 |
| Project Access Rd., East of Waiale Rd. Ext. (WB) | N/A | N/A | N/A | N/A | 2 | 16 |
| Two-Way | N/A | N/A | N/A | N/A | 20 | 16 |

# APPENDIX M

# VISUAL IMPACT ANALYSIS

# Visual Impact Analysis

for the

Proposed Central Maui
Wastewater Reclamation Facility (WWRF)
Maui, Hawaii

May 29, 2025

*Prepared for:*

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## 1. Executive Summary

This report assesses potential visual impacts on the Maui community from the proposed Central Maui Wastewater Reclamation Facility (WWRF) and the Wastewater Pump Station (WWPS), which the County of Maui Department of Environmental Management proposes to provide wastewater treatment services to growth areas in the Central Valley area, as established in the Maui Island Plan.

For the Visual Impact Assessment (VIA) three major components of visibility are considered: the public observer, the facility objects and their setting, and the interrelationships between these components. Viewpoints from which the WWRF would be visible are described, along with their landform and landcover characteristics. Each viewpoint was selected based on its present or future accessibility to the public and visual absorption within the viewshed. Both static and dynamic viewsheds are considered, where the former refers to what the public can see from a stationary location, and the latter to what travelers observe as they move through the landscape. The distance relationship between the observer, object, and setting is also detailed. The overall relationship between landscape characteristics, proposed project features, and viewer characteristics determines the project's degree of visibility.

In accordance with NEPA (40 CFR 1508.27) and Hawai‘i EIS rules (HAR 11-200.1-13(12)), the projected changes due to construction and operation of the WWRF and WWPS do not rise to the level of a ‘substantial adverse effect’ on any identified scenic vistas. All observed visual changes are limited in extent and occur in already-altered landscapes, so they meet the definition of minor or moderate impacts. No impact qualifies as ‘significant’.

## 2. Introduction

- **Purpose of the report**

This report assesses the potential visual impacts of the proposed Maui Central Valley WWRF during construction and operation at the chosen site. Visual impacts in this report refer to changes to the view or scenery caused by the proposed facilities. These impacts can be beneficial if they enhance scenic quality or adverse if they detract from it.

- **Scope of the Analysis**

A viewshed analysis using GIS for the VIAs identified the potentially affected area around the proposed WWRF project. Key observation points (KOPs), which are representative public viewpoints, were chosen within this area where people are likely to view the facility. Viewer characteristics, such as static and long-term viewers versus short-term passersby,

e.g., residents versus drivers, were considered. The methods also included visibility factors like distance from the project to the KOP, landscape screening elements, and the visual properties of the project (color, size, reflectivity, and motion) that influence the visual contrast. Specifically, we considered how far viewers are from the proposed facilities, how nearby hills or trees might block the view, and whether the project's colors and size would stand out against the background.

- **Regulatory Compliance**

This visual impact assessment for the proposed WWRF is in accordance with requirements in HRS Chapter 343-5 (9)(A): Environmental Impact Statements, Applicability, and HAR §11-200.1-13 (b)-12 Significance criteria (12) with respect to actions that affect scenic vistas and view planes identified in county or state plans or studies. No scenic vistas are affected by the proposed action, however Hawai'i law requires an environmental assessment (EA) for any new wastewater treatment plant of this scale, and this report is part of that process.

## 3. Project Description

- **Locations and site details**

There are two locations for the proposed WWRF project, both of which were included in the visual impact assessment. The first location is the proposed Central Maui WWRF itself, located on a portion of parcel TMK (2)3-8-005:023. The 209.04-acre parcel will be subdivided to provide a separate 14.9-acre parcel for the WWRF.

The second location is for the proposed Kehalani Wastewater Pump Station (WWPS), which would be located near the junction of Waiale Road and Olomea Street, on parcel tax map key (TMK) (2)3-5-020:036, in a stormwater detention basin that serves the Kehalani development. The new WWPS would be constructed on the southwest side of the detention basin, with modifications to the detention basin to retain its full function as originally designed.

Munekiyo Hiraga and Brown and Caldwell Engineers provided KC Environmental Inc. with preliminary designs for both proposed facilities to support the development of 3D computer models and visualizations within the defined viewshed corridors, and this VIA assumes no significant changes to overall form and height of structures in the preliminary designs. The designs incorporated all necessary structural components for wastewater treatment and conveyance. The WWRF will include several multi-level tanks and buildings, with cranes up to 250' potentially operating during construction. The WWPS would be

single-story within an existing basin. All structures will use pale, earth-tone colors to blend with the landscape.

## 4. Existing Visual Conditions

For the purpose of viewshed assessment, the following visual characteristics were considered.

### Geography and Setting

The Central Valley of Maui lies between the island's two volcanic masses: Mauna Kahalawai (West Maui Mountains) and Haleakalā (East Maui Volcano). The valley runs roughly from Kahului (north shore) to Ma'alaea (south shore), forming a low-lying isthmus that connects the two major landmasses.

### Topography

The topography in this area reflects general topographical patterns of the Central Maui isthmus, characterized by generally flat land that is slightly sloping easterly towards the ocean. Viewers in the valley mostly see flat or gently rolling grasslands and farmland. There are some distant mountain backdrops (West Maui Mountains to the west, Haleakalā to the east) and clumps of trees. On higher ground (e.g. Wailuku Heights Park), the elevation (~820 ft) gives a broader view over the Central Valley.

### Soils

Soils that can be seen from any of the viewpoints are primarily volcanic in origin, formed from weathered basalt and volcanic ash.

### Vegetation

Much of the valley's original vegetation has been cleared for agriculture. Today, the area is under some agricultural use, but is still mostly former sugar fields with grasses (Guinea, Buffel) and scattered exotic trees (coconut palms, kiawe, monkeypod, etc.).

### WWRF Area Land Use

Historically, the Central Valley was dominated by sugarcane plantations (notably Hawaiian Commercial & Sugar Company), but those ceased operations in 2016. Outside of the 209.04 parcel that includes the 14.9-acre WWRF site, much of the land within the viewshed is transitioning to diversified agriculture: taro, tropical fruits, flowers, cattle grazing and experimental and regenerative agricultural practices. There are also a number

of light industrial sites as well within the Central Valley viewshed, e.g., on E. Waiko Road about 0.9 miles north of the WWRF site.

### WWPS Area Land Use

The WWPS is planned for the Kehalani storm water detention basin. The proposed site is located at the eastern edge of the Kehalani community of 2,400 residences on 550 acres, located immediately south of Wailuku. Located on the east side of the West Maui Mountains, the property includes bike and pedestrian pathways, pocket parks and a 13-acre County of Maui park, Pu'u Kukui Elementary School and the Kehalani Village Center.

## 5. Significance Criteria

Methodology for determining significance (e.g., level of contrast, change in visual VIAs for this report) follows National Environmental Policy Act guidelines. VIAs are generally conducted as follows:

**1. Viewer Sensitivity (Receptor Sensitivity), which is scored as follows:**

High Sensitivity – Residential viewers, recreational users, scenic byways, historic/cultural sites. These viewers tend to care more about visual changes than transient viewers.

Moderate Sensitivity – Travelers on highways, employees at work.

Low Sensitivity – Industrial workers, utility corridors, transient viewers.

**2. Visual Change (Magnitude of Impact) that describes the extent and character of visible change in the landscape, which is characterized as:**

Strong/High – Significant contrast in line, form, color, or scale.

Moderate – Noticeable changes that somewhat blend with surroundings.

Low/Weak – Minor visual changes with high visual integration.

None – No discernible change.

### 3. Impact Level (Qualitative Determination)

The assessments synthesize the above into qualitative impact levels as follows

- No Impact
- Negligible
- Minor
- Moderate
- Major (or Significant)

These outcomes are usually presented in narrative form and address the context – The significance of the affected environment and intensity – The severity of the visual impact. By combining viewer sensitivity levels with the extent of visual changes, we can employ the following matrix to assess these factors and arrive at an impact level.

| Viewer Sensitivity | Visual Change | Impact Level |
|---|---|---|
| High | High | Major (Significant) |
| High | Low | Minor |
| Moderate | Moderate | Moderate |
| Low | High | Moderate |

## 6. Visual Impact Assessment

### Digital Viewshed Analysis

A digital viewshed analysis was the first of two standard processes used to conduct an analysis of potential impacts on the Maui Central Valley viewshed by the proposed WWRF and WWPS. The first process employed ArcMap software (now ArcGIS Pro) and a viewing radius of approximately 2.5 miles. The results were six viewshed corridors that display likely visibility of the WWRF from six different locations, assessed for visibility to the site from a human height of 5', as shown in Figures 1-6. These six viewpoints to the WWRF were chosen for the next stage of analysis, with an additional viewpoint chosen for the WWPS.

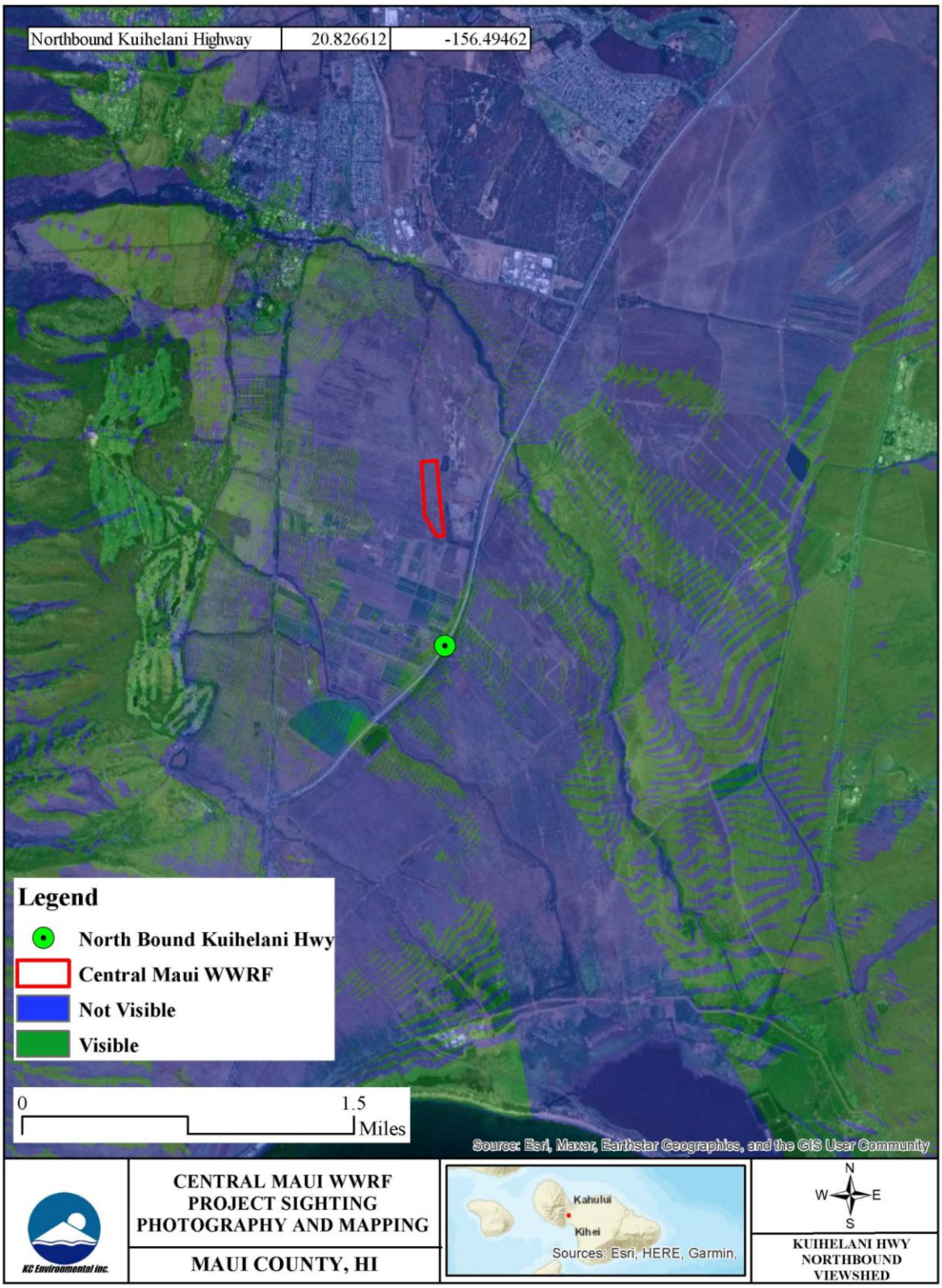



*Figure 1. Viewshed Northbound Kuihelani Highway.*

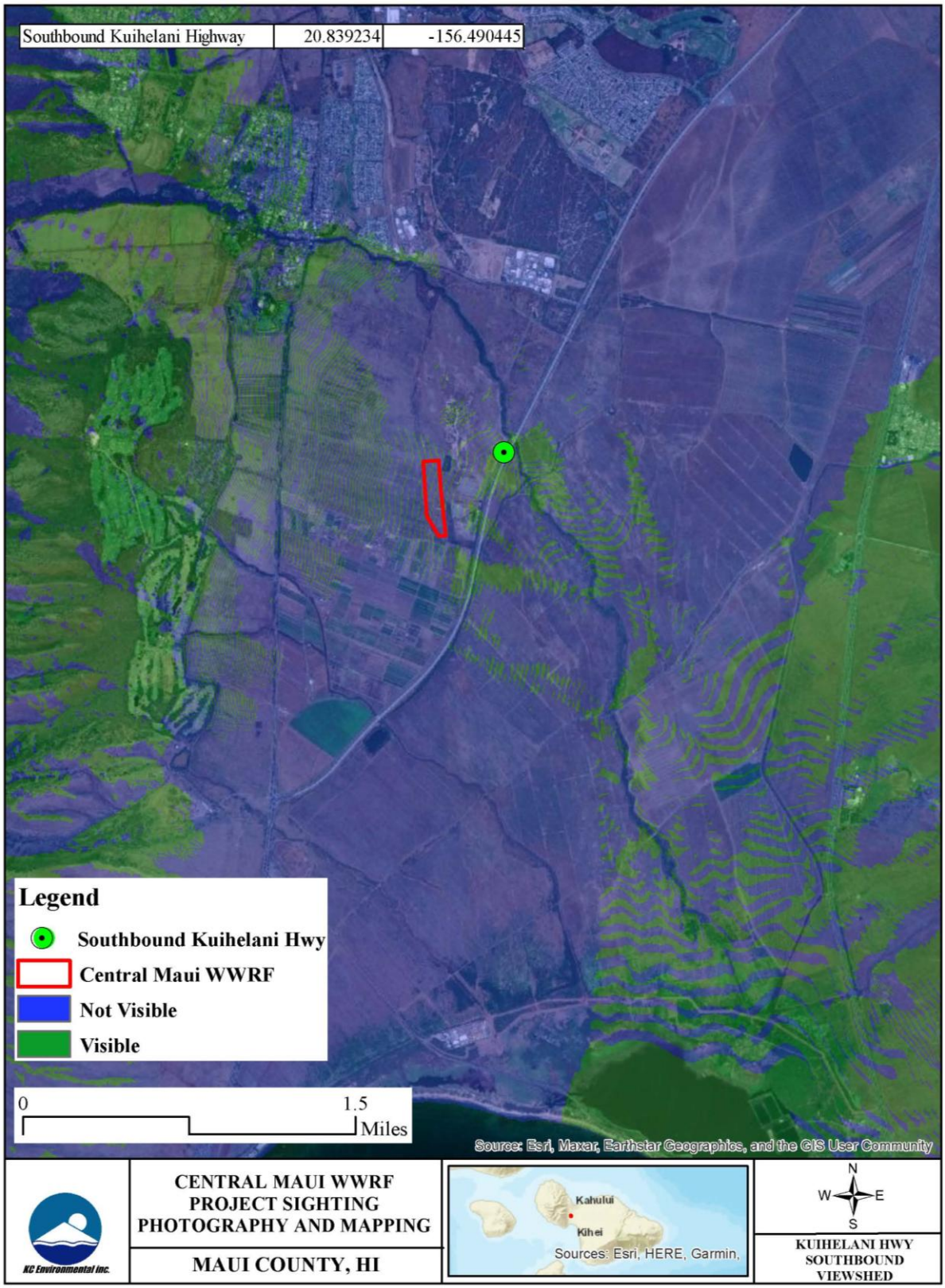



*Figure 2. Viewshed Southbound Kuihelani Highway.*




*Figure 3. Viewshed Northbound Honoapi'ilani Highway.*

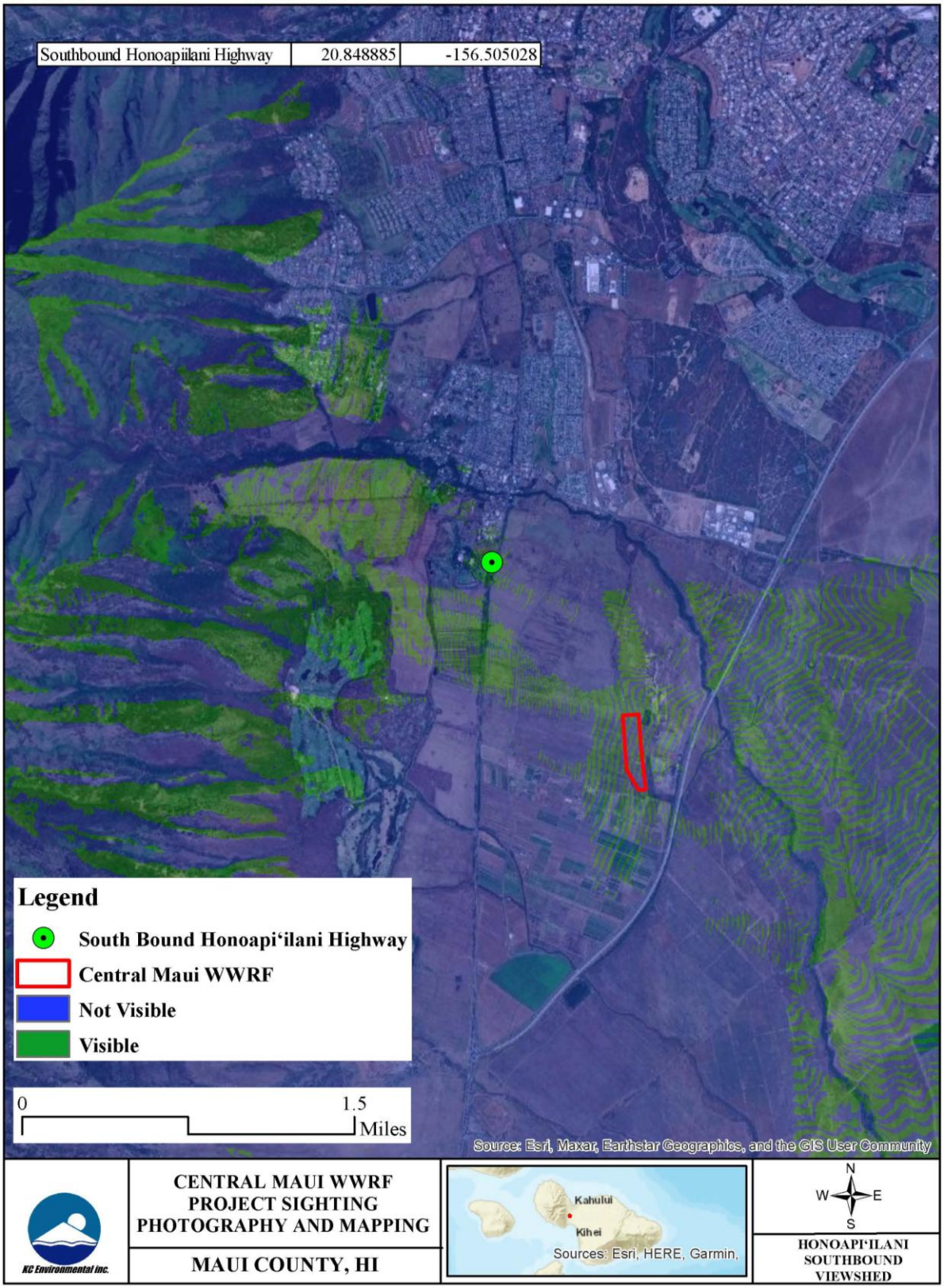



*Figure 4. Viewshed Southbound Honoapi'ilani Highway.*

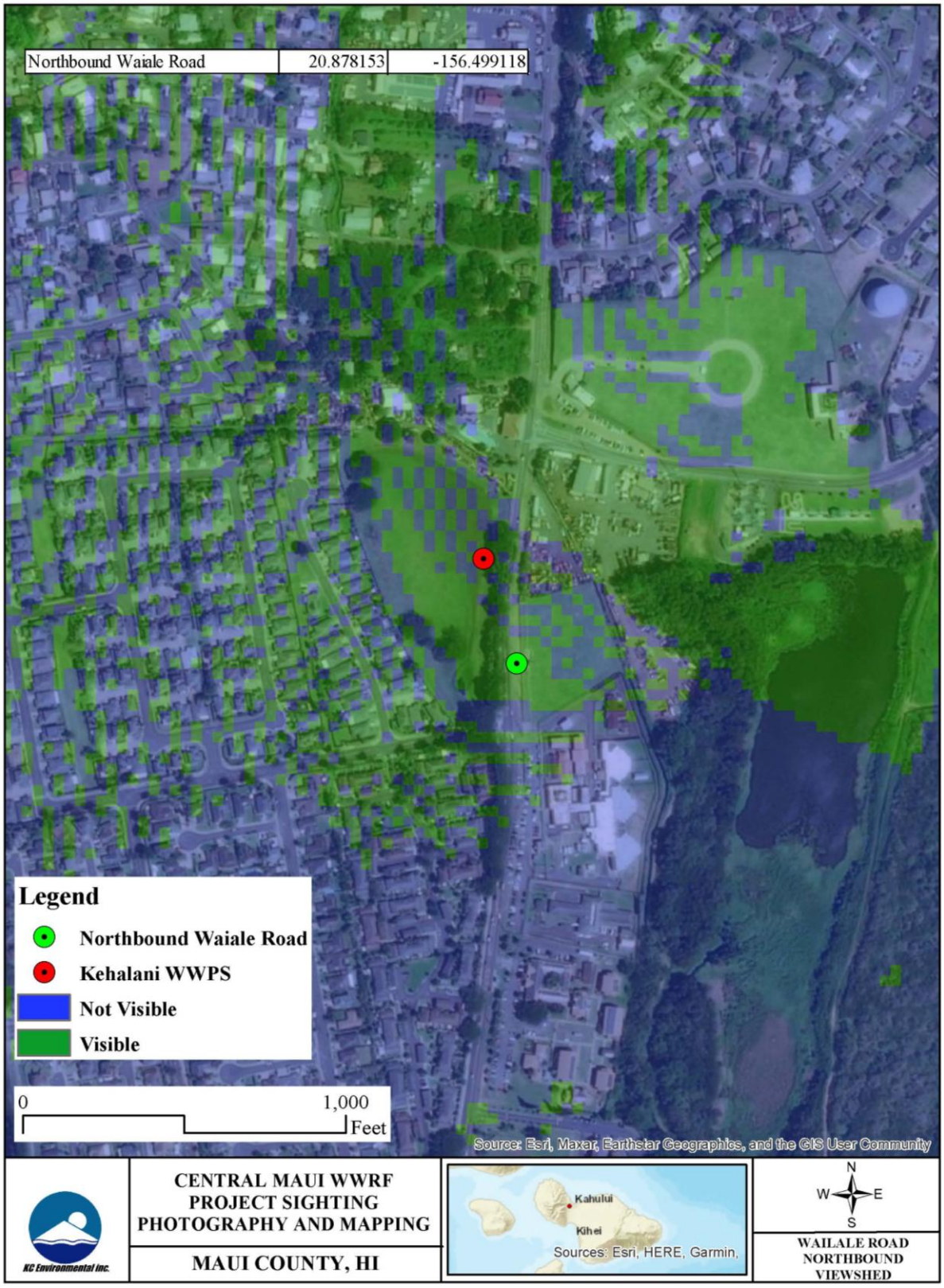



*Figure 5. Viewshed Northbound Waiale Road.*

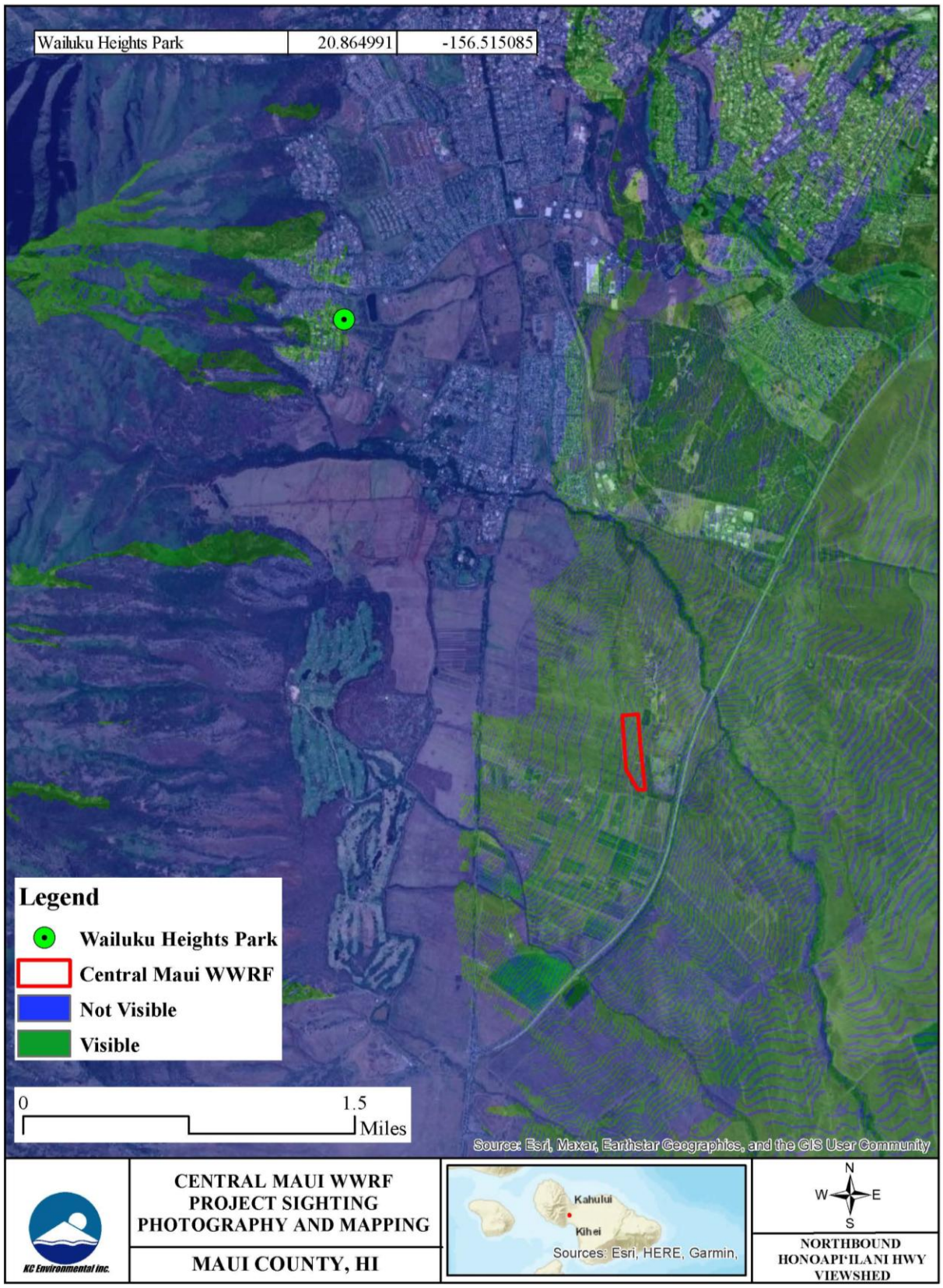



*Figure 6. Viewshed Wailuku Heights Park.*

The second analysis process to evaluate potential impacts on the Maui Central Valley viewshed was the use of photographic renderings. Digital photos from the chosen viewpoint locations within the 2.5-mile radius were taken and were then layered with 3D modeled visual simulations (also known as montages) of the proposed facilities. The "before" and "after" montages were assessed to determine visibility relative to the terrain, and an analysis was conducted to determine contrast with existing landscape character, i.e., form, color, texture. The photomontage of before construction and after proposed construction from the seven viewpoint locations is shown in Figures 7-13 (before labeled "a" and after labeled "b"). Where the viewshed or field check showed no line of sight (e.g. NB Honoapiʻilani Hwy, Figure 9), no simulation was possible, and there is no visual simulation for the northbound Honoapi'ilani corridor, and therefore the one photograph in Figure 9 is labeled as both before and after ("a" and "b"). Figure 14 is a map of all seven viewpoints along with a single point location for the WWPS.

**WWRF Assessment**

The KOPs selected from those locations have the least topographic and vegetative screening around the proposed WWRF location in the Central Valley. Limiting KOPs to those portions of the viewshed with daily public access, five of the KOPs were in currently accessible roadside locations, and the sixth was in a public park.

A seventh viewpoint that will have largely unobstructed line-of-sight to the WWRF, but no current public access was also selected by field measurements without assistance from viewshed software. Figure 11 is a photo of the location at the junction of the proposed Waiale Road extension and the proposed WWRF access road. While this location does not currently have public access it will be a KOP when the Waiale Road extension and the WWRF access road are completed in the future.

**WWPS Assessment**

In addition to the WWRF viewpoints, a viewpoint for the WWPS is also shown in map Figure 14. It was selected from a much smaller visual corridor, considering the pump station location will be within the Kehalani detention basin, and is largely screened by residential elements, including the master-planned housing community, trees, vegetation, and roadways. The viewpoint in the map provided sufficient visibility to the WWPS location to assess the visual impacts.



*Figure 7a. Before Image from Northbound Kuihelani Highway.*



*Figure 7b. Visual Simulation from Northbound Kuihelani Highway with the proposed WWRF.*



*Figure 8a. Before Image from Southbound Kuihelani Highway.*



*Figure 8b. Visual Simulation of Southbound Kuihelani Highway with the proposed WWRF.*



*Figure 9a & 9b. Image from Northbound Honoapi'ilani Highway - no visibility of the proposed WWRF from this view.*



*Figure 10a. Before Image from Southbound Honoapi'ilani Highway.*



*Figure 10b. Visual Simulation from Southbound Honoapi'ilani Highway with the proposed WWRF.*



*Figure 11a. Before Image from future Waiale Road extension.*



*Figure 11b. Visual Simulation from future Waiale Road Extension and future Access Road to WWRF.*



*Figure 12a. Before Image from Wailuku Heights Park*



*Figure 12b. Visual Simulation from Wailuku Heights Park with the Proposed WWRF, future Waiale Road extension and future WWRF Access Road*



*Figure 13a. Before Image of Proposed Kehalani WWPS Location from Northbound Waiale Road*



*Figure 13b. Visual Simulation of the Proposed Kehalani WWPS from Northbound Waiale Road*

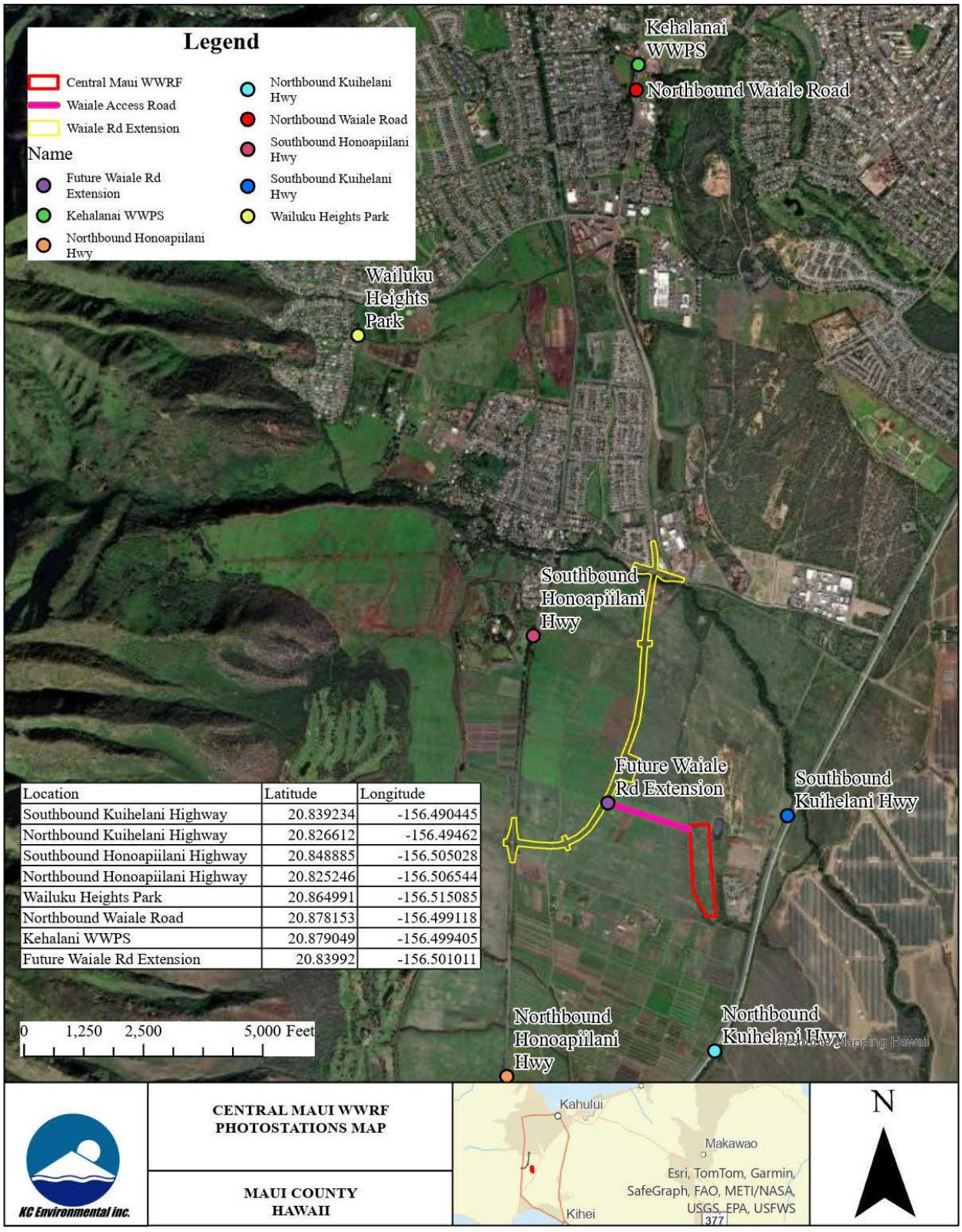



*Figure 14. Viewshed and Photostations Location Map.*

## 7. Visual Impact Findings For the WWRF

- Temporary impacts during construction

  Construction of the ten structural elements of the WWRF will not require unusual or extremely large equipment, with the exception of lattice cranes that may be positioned for some time. The cranes will be visible, but these structures are narrow, temporary, and occur in an industrial context. Therefore, we anticipate short-term minor visual changes during peak construction.

- Permanent operational impacts on highway viewpoints

  The four roadside visualizations of the WWRF from north and southbound Kuihelani Highway, and north and southbound Honoapi'ilani Highway (route 30), would be viewed by passing motorists and therefore viewer sensitivity would be moderate at most. However, the screening by vegetation and topographic changes along parts of both routes, as shown in Figures 9 and 10, would result in low visual changes, e.g., minor visual changes with high visual integration. The overall visual impact moving through these road viewpoints would vary from **minor to none**, considering the intermittent visibility within the viewsheds of both roads in either northbound or southbound directions.

  At the future intersection between Waiale Road extension and the WWRF access road, access would be almost entirely drivers, and therefore viewer sensitivity would be low. The visual change, as shown in Figures 11a and b would be moderate, with the WWRF structures only about 0.3 miles away and fewer obstructions than elsewhere. Therefore, we anticipate the overall visual impact at this road junction to be **moderate**.

- Permanent operational impacts on residential viewpoints

  Figure 12 contains a photo of the viewshed before construction of the WWRF from Wailuku Heights and the accompanying computer visualization of the WWRF and future access road are from the maximum radius of 2.5 miles from the proposed action. Considering the static residential and recreational receptors sensitivity would be high in this location. However, the overall visible change to the landscape would be minor, considering existing light industrial and agricultural activities within the 209.04-acre parcel, pale exterior colors on structural elements and the low

reflectivity of the structural components and in-ground elements of the WWRF. Therefore, the visual impact level from Wailuku Heights would be minor.

## 8. Visual Impact Findings For the WWPS

The photograph from Waiale Road of the current walled Kehalani detention basin with attendant vegetation and access from Olomea Street and a computer visualization of the WWPS as it would appear within the southwestern end of the detention basin walls after construction (Figure 13) shows that all WWPS structural heights within the southwest part of the basin will be limited to one story, with no new obstruction to views, and exterior paints will be closely matching those within the Kehalani residential community. With primarily residential viewers and a moderate visual change to the detention basin site, the visual impact on viewers on Waiale Road and Olomea Street will be at most **moderate**.

## 9. Conclusion

A systematic, transparent, and context-based analysis of visual impacts that may result from the proposed WWRF and WWPS indicates that the project is not likely to create substantial adverse effect, e.g., impose significant visual impacts on viewers traveling on roads within the Central Valley or on residential viewers on Wailuku Heights.

At the four highway KOPs (north/south Kuihelani and Honoapi‘ilani), viewer sensitivity is moderate (passing motorists). Existing vegetation and topography screen much of the site (as shown in Figures 9–10), so the visual change is low. Hence the overall impact is **minor or negligible** for drivers.

At the future intersection between Waiale Road extension and the WWRF access road our assessment is that the visual impact would be at most moderate to the drivers who will have access to that site.

Residential viewers in Wailuku Heights will be high-sensitivity receptors, but the WWRF site will be about 2.5 miles away, and the simulation (Figure 12) shows the WWRF integrated into the landscape with muted colors. We assess the magnitude of change as low (the facility blends into the distant background), so even with high viewer sensitivity the impact is **minor**.

Vegetative and topographic screening, low structural components, landscape compatible colors, adherence to Maui lighting codes, and distance from public access would contribute to minor visual impacts from the WWRF. The WWPS would be visible from a section of Waiale Road and other locations within the Kehalani community. Its low structural heights, walled surroundings, and compatible residential colors within the detention basin would pose a moderate visual impact.

## 10. References


1. Hawaiʻi Administrative Rules (HAR) Chapter 11-200.1 – Environmental Impact Statement Rules

2. Hawai'i Environmental Review Program – EA and EIS (New Rules) Department of Planning and Permitting – Environmental Impact Statement Instructions

3. Hawai'i Environmental Planning Office – Environmental Geographic Information System (EGIS)

4. Brown and Caldwell, Central Maui Wastewater Reclamation Facility Plan FINAL REPORT County of Maui Department of Environmental Management Wastewater Reclamation Division Wailuku, Maui, Hawaii

5. Draft Environmental Assessment WAIALE ROAD EXTENSION PROJECT WAIKAPU, MAUI, HAWAII Federal Project No: STP-3180 (001) Federal Highway Administration Prepared for: U.S. Department of Transportation Federal Highway Administration, State of Hawaii Department of Transportation, and County of Maui Department of Public Works November 2024

6. Final Environmental Assessment for the Pāhala Large Capacity Cesspool Replacement Project, Chapter 8.19, Visual Considerations and Light Pollution

# ARCHAEOLOGICAL INVENTORY SURVEY

# APPENDIX N

# Draft

# Archaeological Inventory Survey Report for the Central Maui Wastewater Reclamation Facility Project, Waikapū, Wailuku, and Pūlehunui Ahupua‘a, Pū‘ali Komohana District, Maui Island, TMKs: [2] 3-5-001:017 and 120 pors., [2] 3-5-002:014 por., [2] 3-5-020:036 por., [2] 3-6-002:003 and 004 pors., [2] 3-8-005:023 por., Wai‘ale Road Right-of-Way, Waiko Road Right-of-Way, and Waikapū Stream

## Volume I of II

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# Management Summary

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|---|---|
| **Reference** | Archaeological Inventory Survey Report for the Central Maui Wastewater Reclamation Facility Project, Waikapū, Wailuku, and Pūlehunui Ahupua‘a, Pū‘ali Komohana District, Maui Island, TMKs: [2] 3-5-001:017 and 120 pors., [2] 3-5-002:014 por., [2] 3-5-020:036 por., [2] 3-6-002:003 and 004 pors., [2] 3-8-005:023 por., Wai‘ale Road Right-of-Way, Waiko Road Right-of-Way, and Waikapū Stream (Yucha et al. 2025) |
| **Date** | October 2025 |
| **Project Numbers** | Cultural Surveys Hawai‘i, Inc. (CSH) Job Code: WAIKAPU 35<br>Hawai‘i Cultural Resource Information System (HICRIS): 2023PR01312 |
| **Investigation Permit Number** | CSH completed the archaeological inventory survey (AIS) fieldwork under archaeological fieldwork permit numbers 23-30 and 24-30, issued by the Hawai‘i State Historic Preservation Division (SHPD) per Hawai‘i Administrative Rules (HAR) §13-282. |
| **Agencies** | SHPD; County of Maui, Department of Environmental Management (DEM) |
| **Land Jurisdiction** | County of Maui and Private (Waiale 905 Partners, LLC; Kehalani Holdings Company, Inc.; Waiko Baseyard LLC) |
| **Project Proponent and Funding** | DEM |
| **Project Location** | The proposed project includes the construction of a new wastewater recycling facility (WWRF), termed the Central Maui WWRF, a new wastewater pump station (WWPS), termed the Kehalani WWPS, new sewage pipelines, and a new recycled water (R-1) pipeline. The Central Maui WWRF will be located within a presently undeveloped portion of the County of Maui baseyard along Kuihelani Highway. The Kehalani WWPS will be installed within the Wai‘ale Reservoir stormwater detention basin nearest the intersection of Wai‘ale Road and Wai‘inu Road.<br><br>The new sewage pipeline will connect between the Central Maui WWRF and the Kehalani WWPS and will extend along a portion of the existing corridor of Wai‘ale Road and the future corridor of the Wai‘ale Road Extension to a connection to the proposed Waikapū Country Town Project. The R-1 pipeline will extend west from the Central Maui WWRF to the future corridor of the Wai‘ale Road Extension and a connection to the proposed Waikapū Country Town Project along Honoapi‘ilani Highway. The project area is depicted on a portion of the |

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| | 2017 Wailuku U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle. |
| **Project Description and Related Ground Disturbance** | The proposed project will provide wastewater treatment service to the Central Valley area of Maui. The construction of the new Kehalani WWPS and sewage pipeline will divert wastewater from the Wailuku-Kahului WWRF thereby reducing the volume of treated effluent disposal at the facility. The project will also provide recycled water irrigation for non-potable reuse for residences of the proposed Waikapū Country Town Project as well as agricultural fields, regional parks, and County facilities in the area. The increased use of recycled water will therefore increase freshwater and raw water resources available for potable and other uses.<br><br>A backup wastewater effluent disposal system is required for water reuse and will be accomplished through soil aquifer treatment (SAT) at the new Central Maui WWRF. The proposed facility plan contains four SAT basins, four secondary clarifiers, a headworks station, a dewatering and blower building, effluent pump station and RAS pump station, operations building, and facilities to process activated sludge, R-1 recycled water treatment, and aerobic digesters.<br><br>Project ground disturbance for the construction of the new Central Maui WWRF is expected to have a maximum excavation depth of 25 ft (7.62 m). The construction of the new Kehalani WWPS is expected to have a maximum excavation depth of 20 ft (6.10 m). The sewage pipeline trench along Wai‘ale Road and the future Wai‘ale Road Extension is expected to be 4 ft (1.22 m) wide with an estimated length of 17,000 linear feet (5.18 km) and a maximum excavation depth of 15 ft (4.57 m). The R-1 pipeline from the WWRF to the Waikapu Country Town Storage Facility is estimated to be 10,000 linear feet (3.05 km) with a maximum depth of 6 ft (1.83 m). An access and utility easement will be 1,800 ft (548.64 m) long and 100 ft (30.48 m) wide to connect the Central Maui WWRF to the Wai‘ale Road Extension. |
| **Project Acreage** | The proposed Central Maui WWRF is approximately 14.9 acres (6.03 hectares), and the proposed Kehalani WWPS is 0.25 acres (0.10 hectares), which covers a total area of approximately 15.15 acres (6.13 hectares).<br><br>The sewage pipeline connecting the two facilities is estimated to be 16,162 linear feet (4.93 km). The R-1 Pipeline connection extends an additional 2,118 linear feet along the Wai‘ale Road Extension to Honoapi‘ilani Highway. The project area will include a total of approximately 18,280 linear feet (5.57 km). Based on a 4-ft wide trench for the pipelines, the excavation area for these alignments would be approximately 73,120 ft or a total of 1.68 acres (0.68 hectares). |

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| | The total project acreage, including offsite improvements, is approximately 21.5 acres (8.70 hectares). |
| **Historic Preservation Regulatory Context** | This AIS investigation fulfills the requirements of HAR §13-276 and was conducted to identify, document, and assess significance of any historic properties. This document is intended to support the proposed project's historic preservation review under Hawai‘i Revised Statutes (HRS) §6E-8 and HAR §13-275. It is also intended to support any project-related historic preservation consultation with stakeholders, such as state and county agencies and interested Native Hawaiian Organizations (NHOs) and community groups, if the need for consultation occurs.<br><br>In October 2023, CSH completed an archaeological literature review and field inspection (LRFI) of the proposed project area (Yucha et al. 2023). Three historic properties consisting of human skeletal remains (SIHP #s 50-50-04-05965 and -05966) and a post-Contact terrace (SIHP # -06668) were previously identified during archaeological studies that have included portions of the current project area. A reconnaissance-level pedestrian inspection during the LRFI identified four potential historic properties consisting of CSH 1, a concrete culvert; CSH 2, a road portion; CSH 3, a ditch; and CSH 4, retaining walls. The LRFI was submitted to HICRIS on 3 November 2023 in order to assist the SHPD in their initial HRS §6E-8 project review.<br><br>On 3 April 2024, CSH submitted a proposed AIS fieldwork strategy to HICRIS for preliminary review by the SHPD. The SHPD agreed with the AIS fieldwork strategy on 11 September 2024 via HICRIS comment, allowing the AIS fieldwork to proceed. The accepted AIS fieldwork strategy included the completion of a 100% coverage pedestrian inspection, documentation of surface historic properties, and the investigation of 90 AIS test excavations and eight ground penetrating radar (GPR) survey transects that will occur within the proposed Central Maui WWRF segment and the connection corridor segment of the project area.<br><br>In December 2024, CSH completed a separate AIS for the Wai‘ale Road Extension segment of the project area (Ueki et al. 2025) (HICRIS 2023PR00443), which included a 100% coverage pedestrian inspection, 60 test excavations, and ten GPR transects. The project area contained a previously identified post-Contact boulder terrace (SIHP # -06668), and two historic properties were newly identified: an irrigation ditch complex (SIHP # -09167) and a subsurface cultural deposit (SIHP # -09168). The draft AIS report has not yet been reviewed by the SHPD. |
| **Fieldwork Effort** | Fieldwork for geotechnical boring operations and double ring infiltrometer tests was accomplished between 5 and 21 September 2023 |

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| | by CSH archaeologists Jonas Madeus, B.A., and Jennifer J. Frey, B.A. This work required approximately nine person-days to complete.<br><br>Fieldwork for AIS subsurface testing was conducted between 11 September and 4 November 2024 by CSH archaeologists Jennifer Frey, B.A., Elwyn Leibold, B.A., Jonas Madeus, B.A., Allyson Ueki, M.A., Josephine Yucha, M.S., and Trevor Yucha, B.S. This work required approximately 123 person-days to complete and was conducted under the general supervision of principal investigators Josephine Yucha, M.S., and Hallett H. Hammatt, Ph.D. |
| **Historic Properties Identified and Historic Property Significance** | There are or were three previously documented historic properties within the project area that include: SIHP # 50-50-04-05965, disturbed human remains consisting of an adult humerus portion believed to have been disinterred during a previous archaeological study; SIHP # 50-50-04-05966, incomplete and previously disturbed subadult burial believed to have been disinterred during a previous archaeological study; and SIHP # 50-50-04-06668, a post-Contact boulder terrace that remains extant. There are also two historic properties recently identified during the AIS for the Wai‘ale Road Extension Project that are within the current project area. These include SIHP # 50-50-04-09167, an irrigation ditch complex, and SIHP # 50-50-04-09168, a subsurface cultural deposit.<br><br>SIHP # 50-50-04-05965 is a partial human humerus that was documented by Scientific Consultant Services, Inc. (SCS) during archaeological monitoring within Wai‘ale Road (Morawski et al. 2006). CSH is unable to confirm whether SIHP # -05965 was previously assessed for significance. It is likely that SIHP # -05965 was significant pursuant to Criterion “e” (have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with 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). Based on the information provided by Morawski et al. (2006), SIHP # -05965 was collected from the location of discovery for temporary curation and relocation to a burial preserve. The historic property is no longer located within the project area.<br><br>SIHP # 50-50-04-05966 is a partial subadult burial that was documented by SCS during archaeological monitoring within Wai‘ale Road (Morawski et al. 2006). CSH is unable to confirm whether SIHP # -05966 was previously assessed for significance. It is likely that SIHP # -05966 was significant pursuant to Criterion “e” (have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with 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 |

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| | group’s history and cultural identity). Based on the information provided by Morawski et al. (2006), SIHP # -05966 was collected from the location of discovery for temporary curation and relocation to a burial preserve. The historic property is no longer located within the project area.<br><br>SIHP # 50-50-04-06668, a post-Contact boulder terrace, was redocumented by CSH during the separate AIS for the Wai‘ale Road Extension Project (Ueki et al. 2025). SIHP # -06668 was previously assessed by SCS as significant pursuant to HAR §13-275-6, Criterion “d” (have yielded, or is likely to yield, information important for research on prehistory or history) (Perzinski and Dega 2010). The additional documentation of the historic property supports this assessment. The historic property retains the integrity of location, design, setting, materials, and workmanship, and has provided information important to research on historic land use.<br><br>SIHP # 50-50-04-09167 is an irrigation ditch complex identified by CSH during the AIS for the Wai‘ale Road Extension Project (Ueki et al. 2025). As an architectural historic property, a determination of historic property significance and eligibility was completed by a qualified architectural professional. Mr. Stanley Solamillo, an architectural historian, completed a site inspection of SIHP # -09167 on 17 January 2025 and later provided a written assessment of the historic property. Mr. Solamillo determined that, based on alterations or changes to design, setting, materials, and workmanship, the historic property is no longer significant.<br><br>SIHP # 50-50-04-09168 is a subsurface cultural deposit identified by CSH during the AIS for the Wai‘ale Road Extension Project (Ueki et al. 2025). It was assessed as significant pursuant to HAR §13-284-6, Criterion “d” (have yielded, or is likely to yield, information important for research on prehistory or history). The historic property retains the integrity of location, materials, and workmanship, and has provided information important to research on historic land use. |
| **Effect Recommendation** | Based on all available information, there are presently two significant historic properties (SIHP # -06668 and -09168) located within the current project area. The project has the potential to affect these significant historic properties during project-related ground disturbance. In accordance with HAR §13-275-7, the effect recommendation for this project is “effect, with proposed mitigation commitments.” |
| **Mitigation Recommendations** | As described in HAR §13-275-8, “If a project will have an “effect” (impact) on significant historic properties, then a mitigation commitment proposing the form of mitigation to be undertaken for each significant historic property shall be submitted by the agency to the SHPD for |

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| | review and approval." Mitigation recommendations are included in this AIS for the review and approval of the SHPD.<br><br>**<u>Archaeological Monitoring</u>**<br>As described in HAR §13-279-3, "archaeological monitoring may be an identification, mitigation, or post-mitigation contingency measure. Monitoring shall entail the archaeological observation of, and possible intervention with, on-going activities which may adversely affect historic properties." It is proposed that an archaeological monitoring program, beginning with the preparation of an archaeological monitoring plan, be developed to minimally include the following objectives:<br>• On-site archaeological monitoring for all project-related ground disturbance within or adjacent to the Central Maui Wastewater Treatment Facility due to the area being entirely comprised of Jaucus Sand, which has a high potential for containing burials and buried A soil horizons containing cultural deposits.<br>• On-site archaeological monitoring for all project-related ground disturbance within or adjacent to the SIHP # -09168 historic property boundary (Wai‘ale Road Extension TE-4 location). On-site archaeological monitoring will provide an opportunity to document project-related impacts on the historic property and, if applicable, record any additional significant information.<br>• On-site archaeological monitoring for all project-related ground disturbance within the SIHP # -06668 historic property boundary (Wai‘ale Road Extension Waikapū Stream bank). While SIHP # -06668 has been previously documented and recommended for no further work by Perzinski and Dega (2010), on-site archaeological monitoring will provide an opportunity to document project-related impacts on the historic property and, if applicable, record any additional significant information.<br>• On-site archaeological monitoring for all project-related ground disturbance within Waikapū Stream. The stream corridor and associated deposits are culturally sensitive. Archaeological monitoring will ensure appropriate interim protection, notification to the SHPD, and subsequent mitigation for any potential inadvertent discoveries within Waikapū Stream.<br>• On-site archaeological monitoring for all project-related ground disturbance occurring within the existing footprint of the Wai‘ale Road portion of the current project area. |

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| | Archaeological monitoring within this corridor previously documented and removed SIHP #s -05965 (human skeletal remains) and -05966 (human skeletal remains), and there is the potential for additional human skeletal remains to be identified in this portion of the project area.<br>• On-call archaeological monitoring for the remainder of project-related excavation. An archaeologist will remain on-call and available to conduct archaeological monitoring in the event of significant findings. Additionally, the on-call archaeologist will conduct periodic site visits to inspect any changes in stratigraphy and document the construction process.<br><br>Archaeological monitoring shall be undertaken in accordance with an archaeological monitoring plan that shall be reviewed and accepted by the SHPD prior to the monitoring project in accordance with HAR §13-279-4.<br><br>**No Further Work**<br>No mitigation is recommended for SIHP # 50-50-04-09167. This historic property has been assessed by an architectural professional (Mr. Stanley Solamillo) as no longer significant. |

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# Section 1 Introduction

## 1.1 Project Background

At the request Munekiyo Hiraga, and on behalf of the County of Maui Department of Environmental Management (DEM), Cultural Surveys Hawai‘i, Inc. (CSH) has prepared this archaeological inventory survey (AIS) report for the Central Maui Wastewater Reclamation Facility Project, Waikapū, Wailuku, and Pūlehunui Ahupua‘a, Pū‘ali Komohana District, Maui Island, TMKs: [2] 3-5-001:017 and 120 pors., [2] 3-5-002:014 por., [2] 3-5-020:036 por., [2] 3-6-002:003 and 004 pors., [2] 3-8-005:023 por., Wai‘ale Road Right-of-Way (ROW), Waiko Road ROW, and Waikapū Stream. The project area is depicted on a portion of the 2017 Wailuku U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle (Figure 1), tax map plats (Figure 2 through Figure 6), and a 2020 aerial image (Figure 7).

The project area encompasses approximately 21.5 acres (8.70 hectares) of land owned by the County of Maui and private landowners (Table 1). The proposed project includes the construction of a new wastewater recycling facility, termed the Central Maui WWRF, a new wastewater pump station (WWPS), termed the Kehalani WWPS, new sewer sewage pipeline, and a new recycled water (R-1) pipelines (Figure 8 through Figure 10). The Central Maui WWRF will be located within a presently undeveloped portion of the County of Maui baseyard along Kuihelani Highway. The Kehalani WWPS will be installed within the Wai‘ale Reservoir stormwater detention basin nearest the intersection of Wai‘ale Road and Wai‘inu Road. The new sewage pipeline will connect between the Central Maui WWRF and the Kehalani WWPS, and it will extend along a portion of the existing corridor of Wai‘ale Road and the future corridor of the Wai‘ale Road Extension to a connection to the proposed Waikapū Country Town Project. The R-1 pipeline will extend west from the Central Maui WWRF to the future corridor of the Wai‘ale Road Extension and a connection to the proposed Waikapū Country Town Project along Honoapi‘ilani Highway (see Figure 8).

The proposed project will provide wastewater treatment service to the Central Valley area of Maui. The construction of the new Kehalani WWPS and sewage pipeline will divert wastewater from the Wailuku-Kahului WWRF thereby reducing the volume of treated effluent disposal at the facility. The project will also provide recycled water irrigation for non-potable reuse for residences of the proposed Waikapū Country Town Project as well as agricultural fields, regional parks, and County facilities in the area (see Figure 9). The increased use of recycled water will therefore increase freshwater and raw water resources available for potable and other uses.

A backup wastewater effluent disposal system is required for water reuse and will be accomplished through soil aquifer treatment (SAT) at the new Central Maui WWRF. The proposed facility plan contains SAT basins, secondary clarifiers, a headworks station, a dewatering and blower building, effluent pump station and RAS pump station, operations building, and facilities to process activated sludge, R-1 recycled water treatment, and aerobic digesters (see Figure 10).

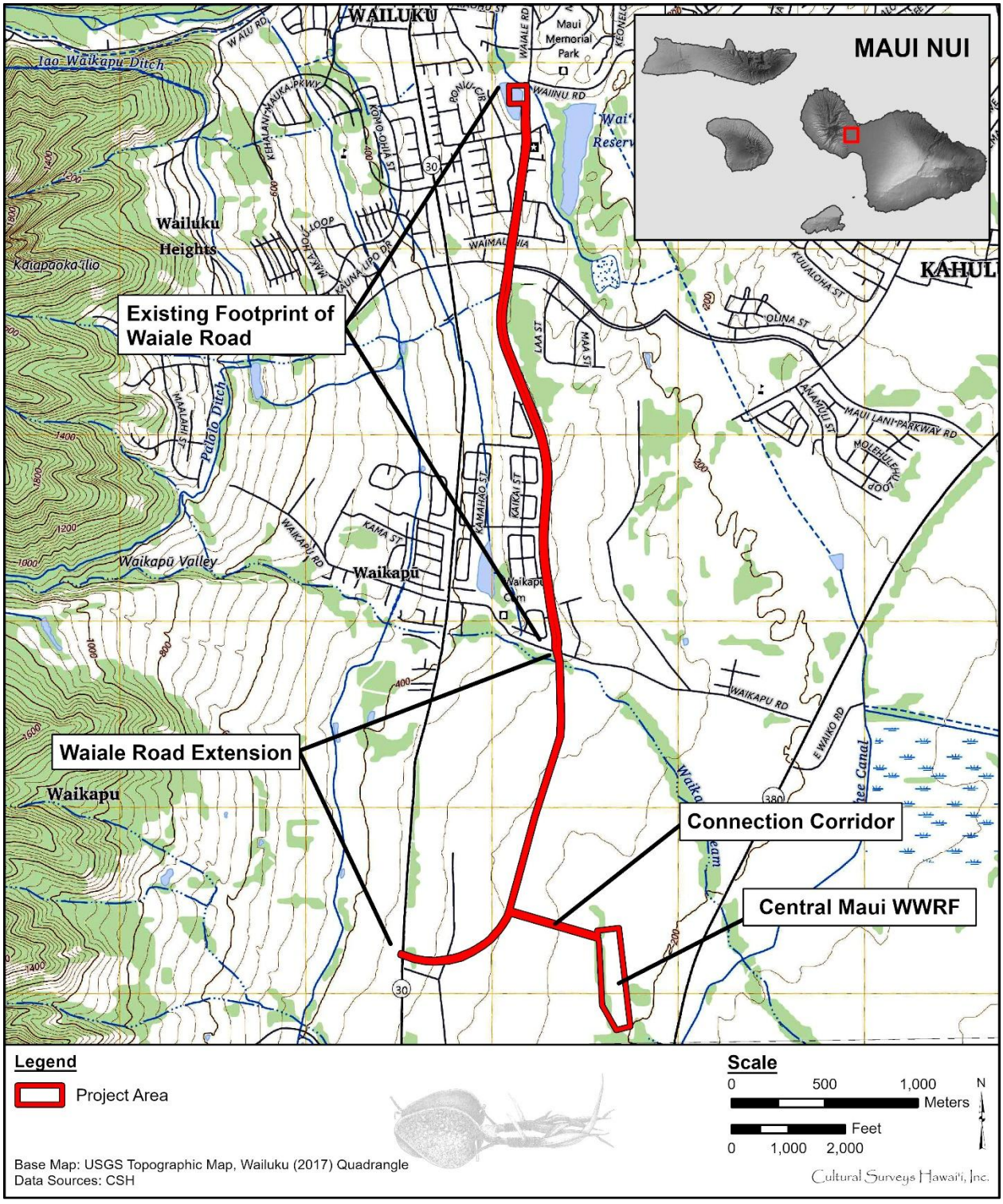



Figure 1. Portion of the 2017 Wailuku USGS 7.5-minute topographic quadrangle showing the location of the project area (U.S. Geological Survey 2017b)

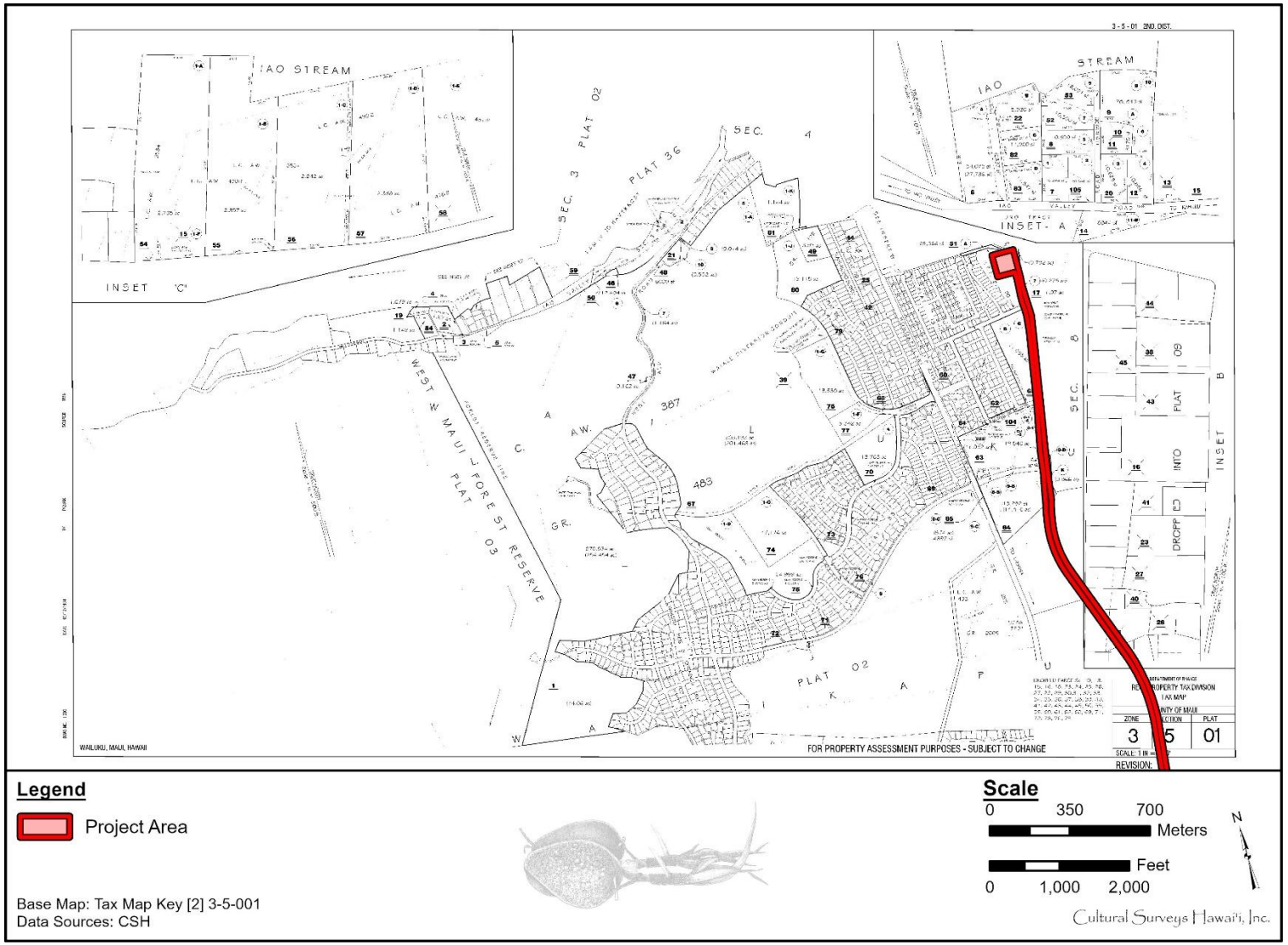



Figure 2. Tax Map Key (TMK) [2] 3-5-001 showing a portion of the project area (Hawaii TMK Service 2014a)

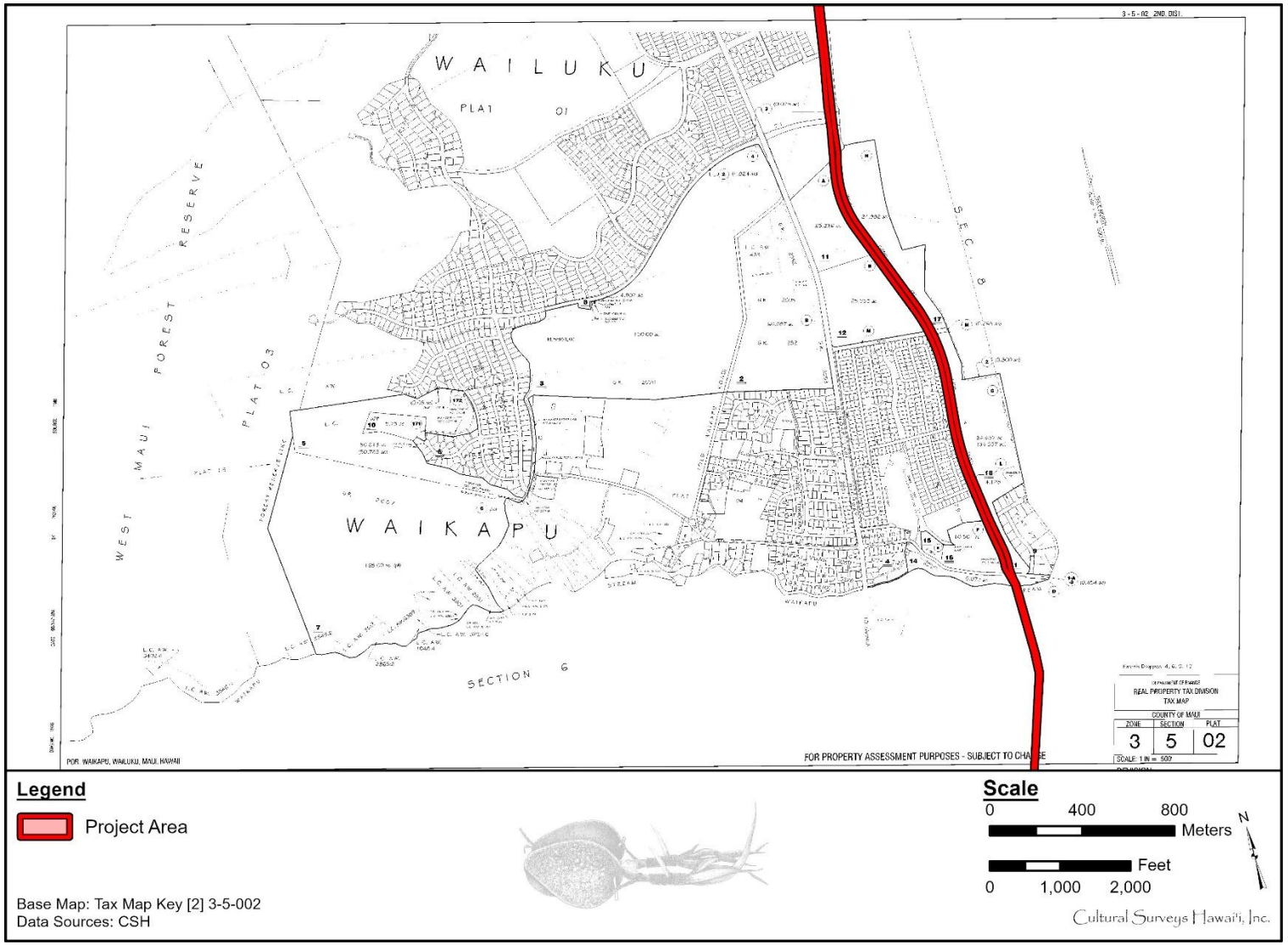



Figure 3. Tax Map Key (TMK) [2] 3-5-002 showing a portion of the project area (Hawaii TMK Service 2014b)

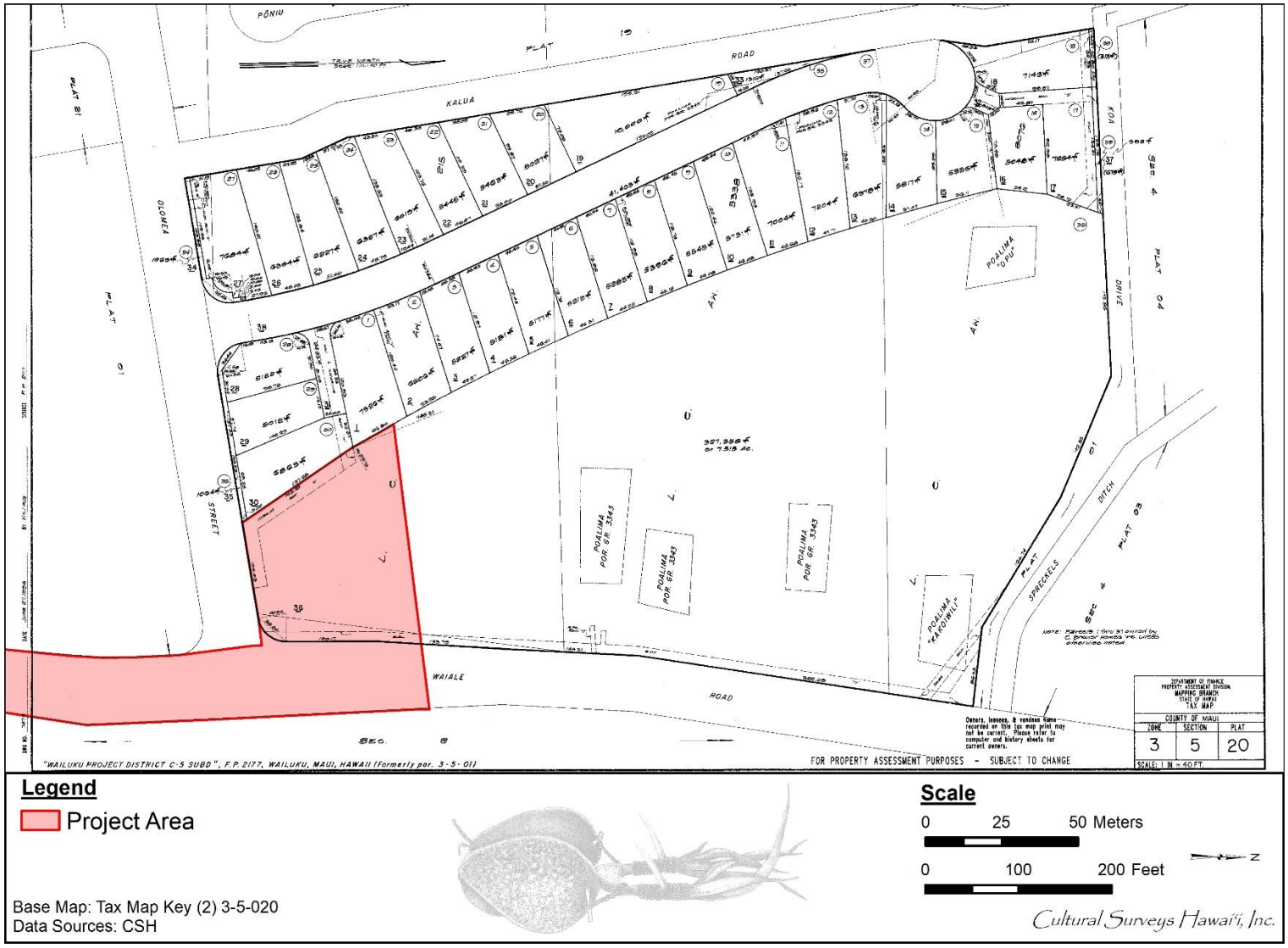



Figure 4. Tax Map Key (TMK) [2] 3-5-020 showing a portion of the project area (Hawaii TMK Service 2014c)

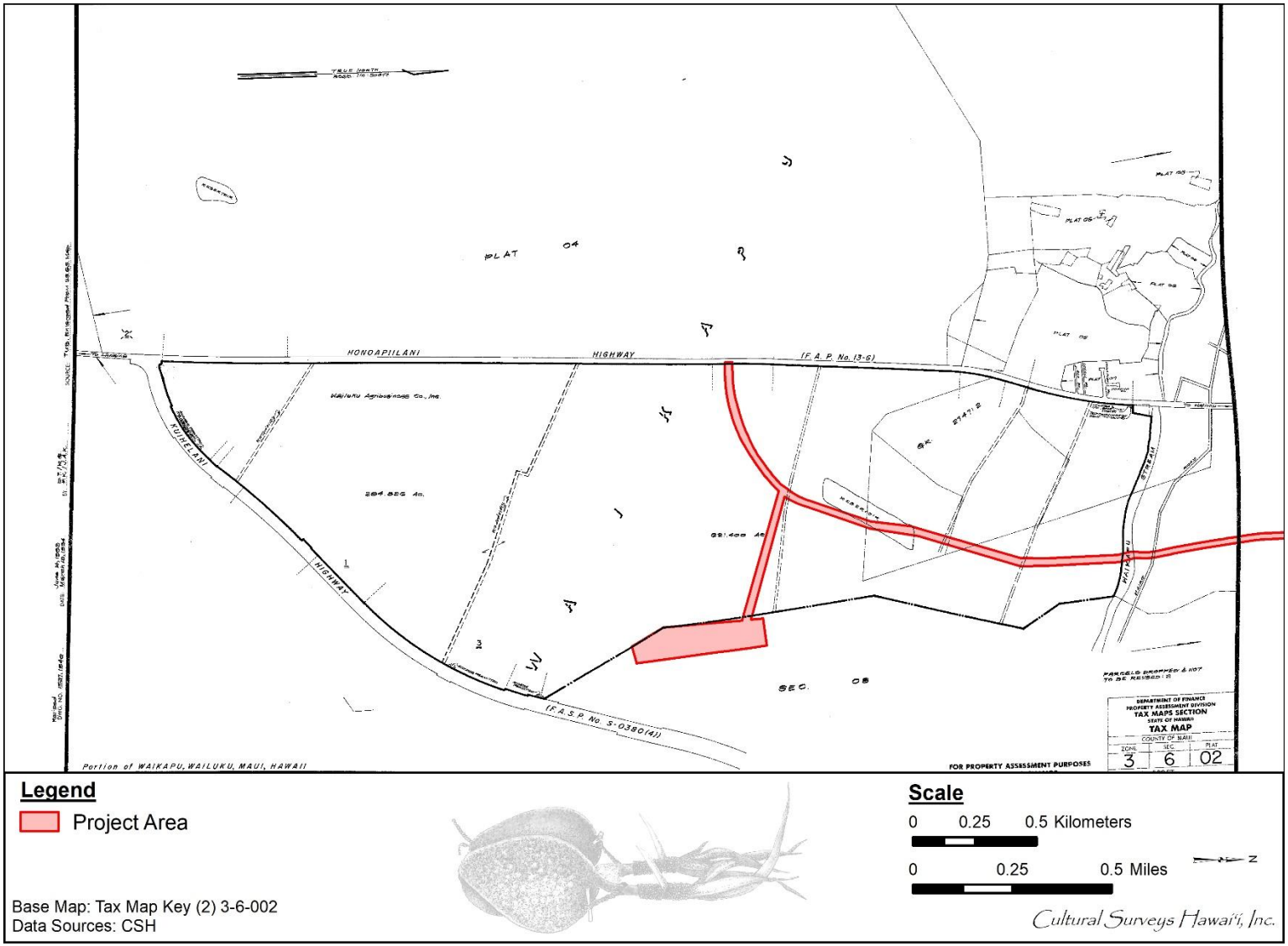



Figure 5. Tax Map Key (TMK) [2] 3-6-002 showing a portion of the project area (Hawaii TMK Service 2014d)

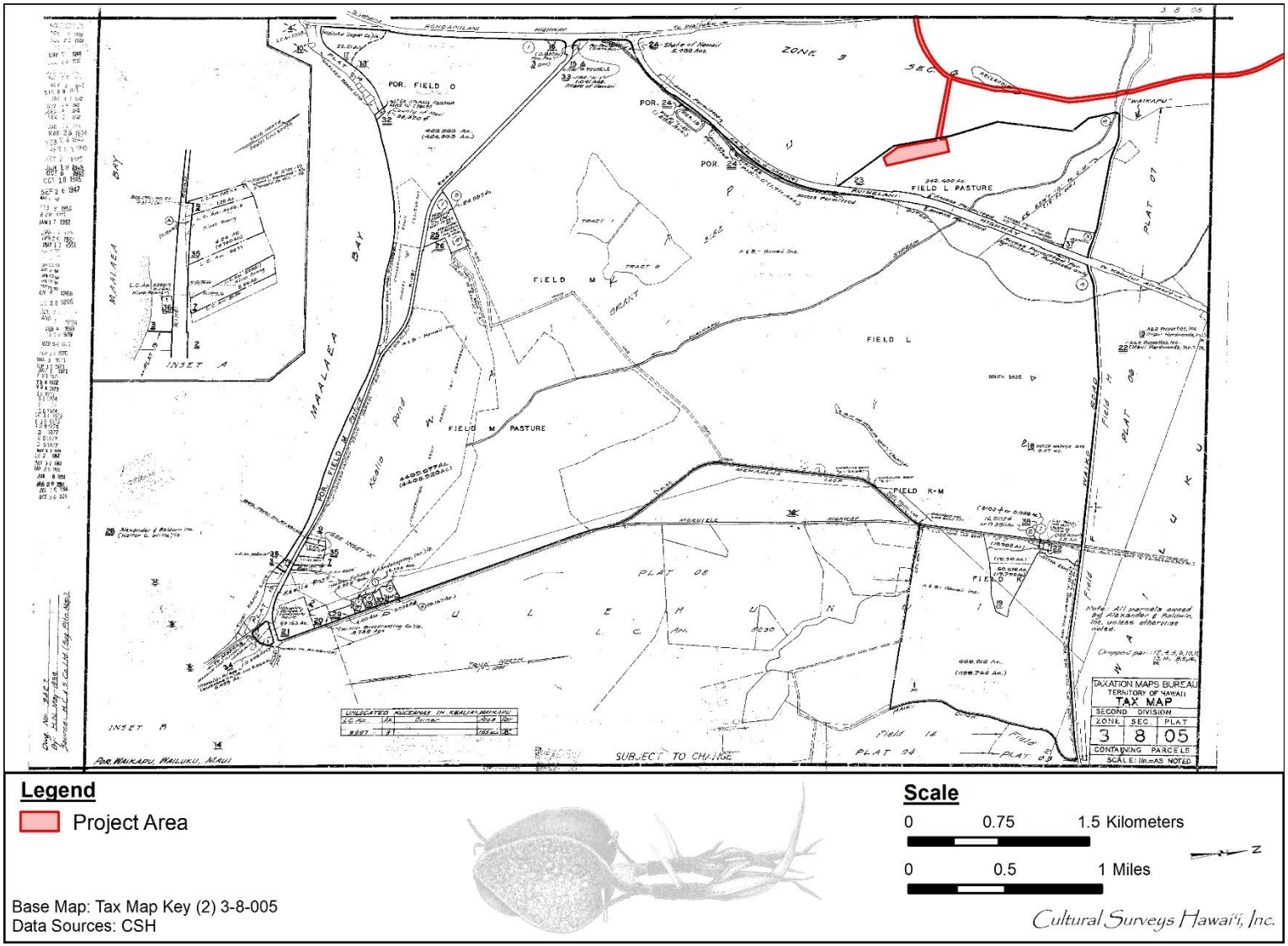



Figure 6. Tax Map Key (TMK) [2] 3-8-005 showing a portion of the project area (Hawaii TMK Service 2014e)

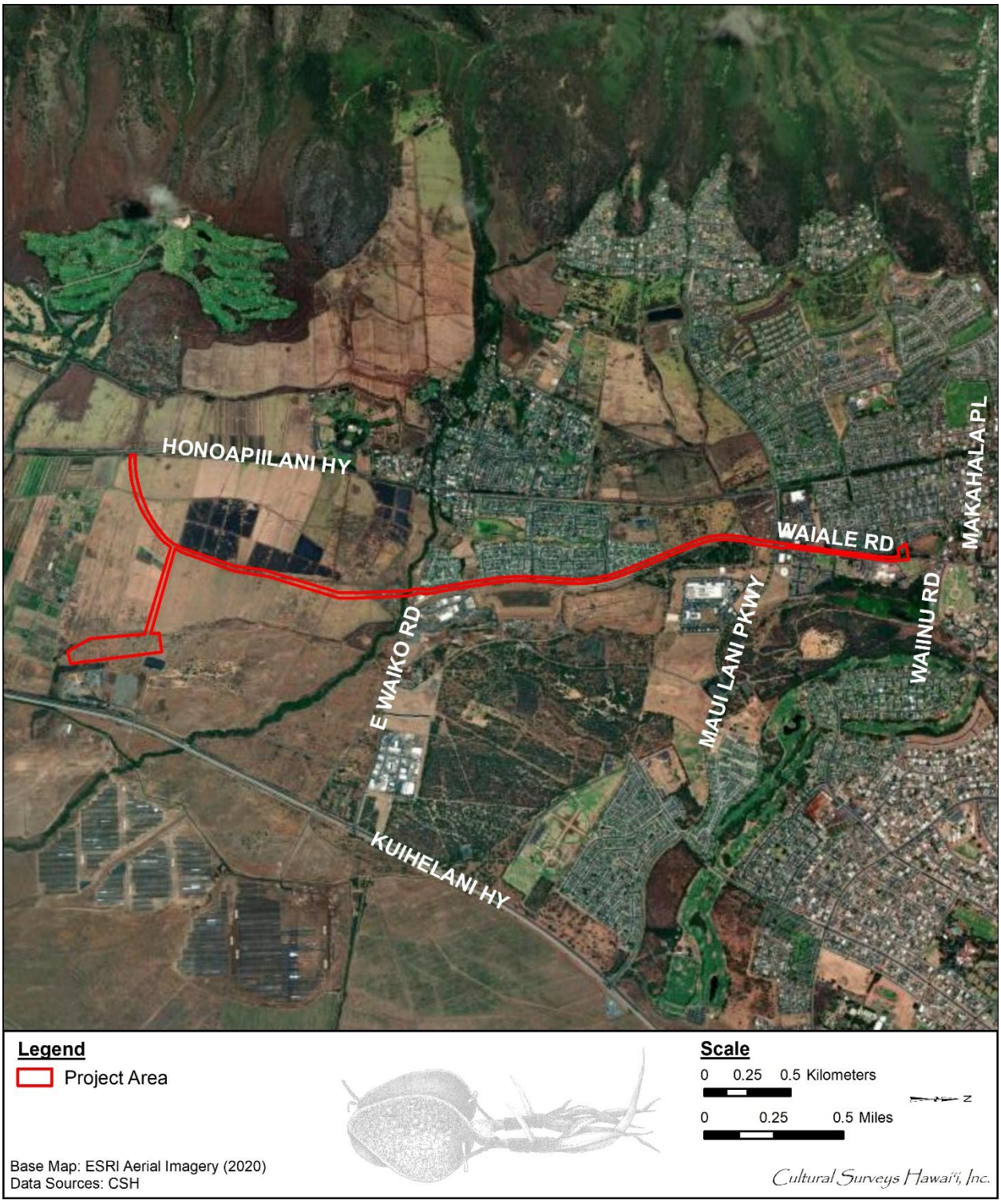



Figure 7. Esri (2020) aerial image showing the location of the project area

Table 1. Project land ownership

| Project Component | Location | Land Ownership | Existing Use |
|---|---|---|---|
| Central Maui WWRF | TMK: [2] 3-8-005:023 por. | County of Maui | Vacant |
| Kehalani WWPS | TMK: [2] 3-5-020:036 | County of Maui | Stormwater Basin |
| Sewage Pipeline and R-1 Pipeline | TMK: [2] 3-5-001:017 por. | Kehalani Holdings Company, Inc. | Roadway |
| | TMK: [2] 3-5-001:120 por. | Kehalani Holdings Company, Inc. | Roadway |
| | TMK: [2] 3-5-002:014 | Waiko Baseyard LLC | Vacant |
| | Future Waiale Rd extension; TMK: [2] 3-6-002:003 por. | Waiale 905 Partners, LLC | Vacant |
| | Future Waiale Rd extension; TMK: [2] 3-6-002:004 por. | County of Maui | Vacant |
| | TMK: [2] 3-8-005:023 por. | County of Maui | Vacant |
| | Waiale Rd ROW | County of Maui | Roadway |
| | Waikapū Stream; TMK: [2] 3-5-002:888 | Owner is currently unknown | Stream |

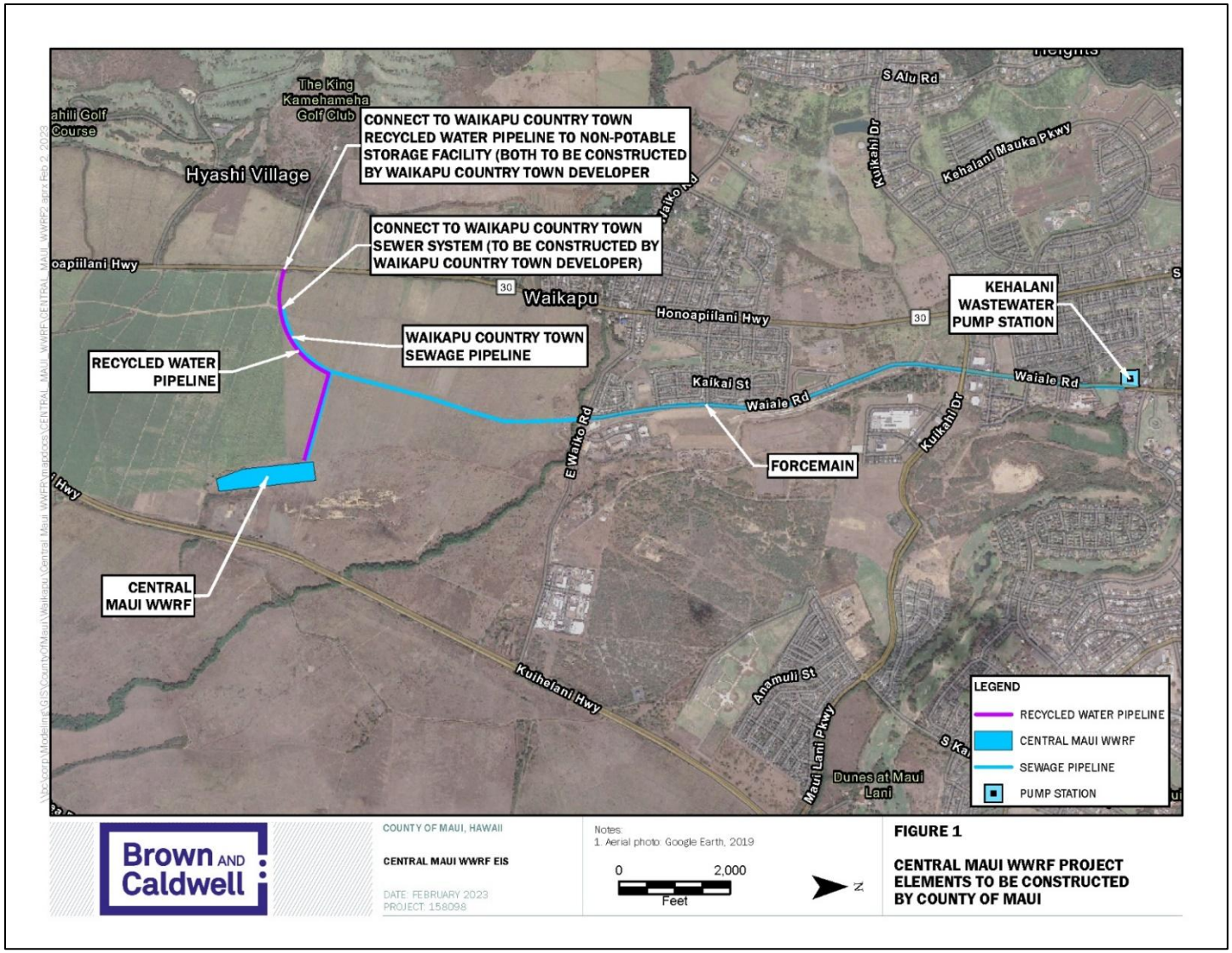



Figure 8. Schematic of the project area to illustrate the Central Maui WWRF elements

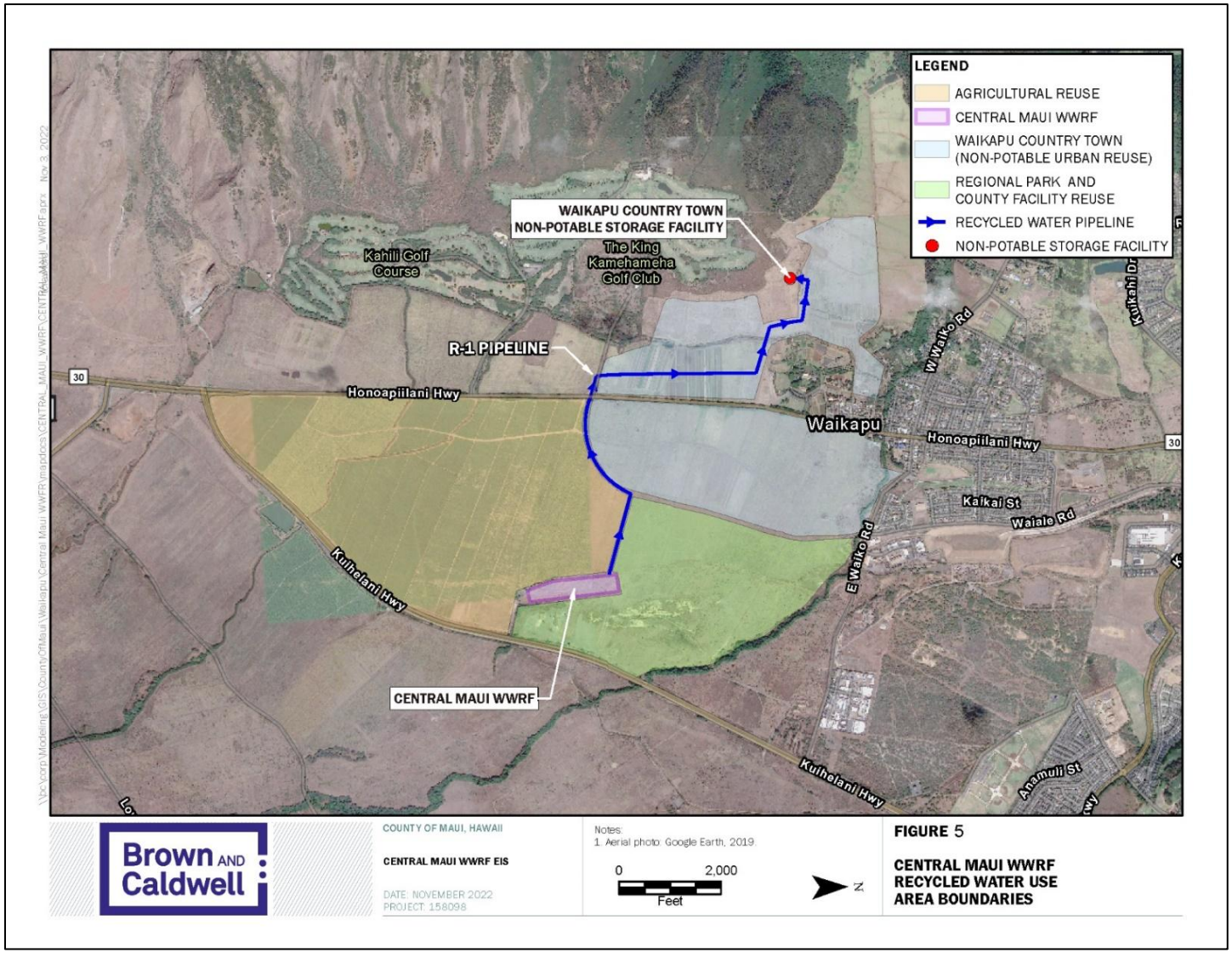



Figure 9. Plan of the Central Maui WWRF showing recycled water use area boundaries




Figure 10. Preliminary site plan of the proposed Central Maui WWRF

Archaeological testing for this AIS included a pedestrian inspection, the excavation of 90 trenches, and eight ground penetrating radar (GPR) survey transects within the proposed connection corridor segment and the Central Maui WWRF segment of the project area. CSH also observed 11 geotechnical boring tests conducted by Yogi Kwong Engineers and nine double ring infiltrometer tests conducted by Geosyntech within the proposed connection corridor segment and the Central Maui WWRF segment of the project area.

CSH completed a separate AIS for the Wai‘ale Road Extension segment of the project area (Ueki et al. 2025), which included a 100% coverage pedestrian inspection, 60 test excavations, and ten GPR transects. Per the accepted AIS fieldwork strategy (Yucha 2024), no AIS test excavations or GPR survey transects were proposed within the active corridor of Wai‘ale Road and the Kehalani WWPS Site since these areas have been previously studied and consist of an active roadway and detention basin that have required significant previous ground disturbance.

There are three previously documented historic properties within the project area that include State Inventory of Historic Places (SIHP) # 50-50-04-05965, disturbed human remains consisting of an adult humerus portion, SIHP # 50-50-04-05966, incomplete and previously disturbed subadult burial; and SIHP # 50-50-04-06668, a post-Contact boulder terrace. CSH identified SIHP # 50-50-04-09167, an irrigation ditch complex, and SIHP # 50-50-04-09168, a subsurface cultural deposit, during the AIS for the Wai‘ale Road Extension Project. No additional historic properties were identified within the proposed connection corridor and the Central Maui WWRF segments of the project area.

## 1.2 **Historic Preservation Regulatory Context**

This AIS investigation fulfills the requirements of Hawai‘i Administrative Rules (HAR) §13-276 and was conducted to identify, document, and assess significance of any historic properties. This document is intended to support the proposed project’s historic preservation review under Hawai‘i Revised Statutes (HRS) §6E-8 and HAR §13-275. It is also intended to support any project-related historic preservation consultation with stakeholders, such as state and county agencies and interested Native Hawaiian Organizations (NHOs) and community groups.

A cultural impact assessment for the Central Maui WWRF was conducted by CSH and involved cultural, traditional, and historical background research, as well as community consultation (Baculpo et al. 2024). Community outreach letters were sent to 45 individuals or groups; nine responded, one provided written testimony, and one met with CSH for a more in-depth interview. While testimonies revealed there were no ongoing cultural practices within the proposed Central Maui WWRF project area, there were concerns for environmental impacts to Waikapū Stream with indirect impacts to Keālia Pond and concerns regarding the potential to discover human skeletal remains or burial sites. Community consultants have recommended a thorough AIS prior to construction to avoid inadvertently discovering burials within the project area.

In October 2023, CSH completed an archaeological literature review and field inspection (LRFI) of the proposed project area (Yucha et al. 2023). The LRFI was submitted to the Hawai‘i Cultural Resource Information System (HICRIS) on 3 November 2023 in order to assist the Hawai‘i State Historic Preservation Division (SHPD) in their initial HRS §6E-8 project review. Previous archaeological studies that included portions of the current project area have identified

three historic properties: SIHP #s 50-50-04-05965 and -05966 consist of human skeletal remains and SIHP # -06668 is a post-Contact terrace. There are also two previously documented burials that are outside the project corridor but are within close proximity of the project area: SIHP # 50-50-04-5680, identified by Morawski et al. (2006), is approximately 16 m west and 50-50-04-08659, identified by Yucha et al. (2020), is approximately 30 m east of the northern portion of the project corridor. A reconnaissance-level pedestrian inspection during the LRFI identified four potential historic properties consisting of CSH 1, a concrete culvert; CSH 2, a road portion; CSH 3, a ditch; and CSH 4, retaining walls. Further inspection and research conducted as part of the current AIS and overlapping studies have confirmed that CSH 1, CSH 2, and CSH 4 do not meet the criteria for archaeologically significant historic properties. CSH 3 (now designated SIHP # -09167) was documented as a potentially significant historic property, subject to assessment by a qualified architectural professional.

On 3 April 2024, CSH submitted a proposed AIS fieldwork strategy to HICRIS for preliminary review by the SHPD (Yucha 2024) (Appendix A). The SHPD agreed with the AIS fieldwork strategy on 11 September 2024 via HICRIS comment, allowing the AIS fieldwork to proceed. The accepted AIS fieldwork strategy included the completion of a 100% coverage pedestrian inspection and the investigation of 90 AIS test excavations and eight GPR survey transects that will occur within the proposed Central Maui WWRF segment and the connection corridor segment of the project area.

In December 2024, CSH completed a separate AIS for the Wai‘ale Road Extension segment of the project area (Ueki et al. 2025) (HICRIS 2023PR00443), which included a 100% coverage pedestrian inspection, 60 test excavations, and ten GPR transects. The project area contained a previously identified post-Contact boulder terrace (SIHP # -06668), and two historic properties were newly identified: an irrigation ditch complex (SIHP # -09167) and a subsurface historic cultural deposit (SIHP # -09168). The draft AIS report has not yet been reviewed by the SHPD.

## 1.3 Environmental Setting

### 1.3.1 Natural Environment

The project area extends eastward and southward from the eastern base of the West Maui Mountains into Maui’s central isthmus. The elevation of land within the project area ranges from approximately 61 to 112 m (approximately 200 to 367 ft) above mean sea level (AMSL). The proposed Kehalani WWPS is approximately 2.78 km (1.73 miles) from the north shore at Kahului Harbor, and the proposed Central Maui WWRF is approximately 4.17 km (2.59 miles) from the south shore at Ma‘alaea Harbor. Waikapū Stream crosses the proposed forcemain pipeline on the southern side of East Waiko Road then, the stream traverses southeast, away from East Waiko Road, as it crosses Kuihelani Highway, which is approximately 510 m northeast of the proposed Central Maui WWRF segment of the project area.

The project area includes undeveloped and heavily vegetated former agricultural lands utilized for sugarcane cultivation until the end of 2016, at which time the last commercial sugarcane operations on Maui closed. The primary vegetation in the project area includes *koa haole* (*Leucaena leucocephala*), cane grass (*Pennisetum purpureum*) and other unidentified grasses.

Waikapū is located at the southern extent of an area known as Wailuku Sandhills, or also the Sand Hills, which is a geologic sand dune formed when the sea level was likely up to 12 m lower than it is today. Windblown sand from large beaches on the northern coast of Maui was deposited inland over most of the western portion of the central isthmus (Macdonald et al. 1983:388). These aeolian dunes partially cover the area's largest alluvial fan created by Waikapū Stream (Stearns and Macdonald 1942:148). For over a century, the surface soils within most of the project area have been significantly disturbed by plowing and intermixed with imported material to increase the viability of agriculture in the region.

According to the U.S. Department of Agriculture (USDA) (2001) Soil Survey Geographic (SSURGO) database and soil survey data gathered by Foote et al. (1972), soils within the project area are comprised of Jaucas sand, 0 to 15 percent slopes (JaC) and Puuone sand, 7 to 30 percent slopes (PZUE) in addition to areas of Ewa silty clay, 0 to 3 percent slopes (EsA), Ewa silty clay loam, 0 to 3 percent slopes (EaA), and Ewa cobbly silty clay loam, 3 to 7 percent slopes (EcA) (Figure 11). The soils along Wai‘ale Road and the extension road primarily consist of alluvial soil types as the topography inclines from the Central Isthmus toward the eastern slope of the West Maui Mountains, or Mauna Kahālāwai. These soils include Iao clay, 3 to 7 percent slopes (IcB); Iao silty clay, 0 to 3 percent slopes (IaA); Pulehu clay loam, 0 to 3 percent slopes (PsA); Pulehu cobbly clay loam, 0 to 3 percent slopes (PtA); Pulehu silt loam, 0 to 3 percent slopes (PpA); Pulehu silt loam, 3 to 7 percent slopes (PpB); and Pulehu cobbly silt loam, 3 to 7 percent slopes (PrB).

Jaucas sand, 0 to 15 percent slopes (JaC) is described as follows:

> This series consists of excessively drained, calcareous soils that occur as narrow strips on coastal plains, adjacent to the ocean. These soils occur on all islands of this survey area. They developed in wind- and water-deposited sand from coral and seashells. … Jaucas soils are geographically associated with Pulehu, Mokuleia, Kaloko, and Lualualei soils.
>
> In many places the surface layer is dark brown as a result of accumulation of organic matter and alluvium. The soil is neutral to moderately alkaline throughout the profile.
>
> Permeability is rapid, and runoff is very slow to slow. The hazard of water erosion is slight, but wind erosion is a severe hazard where vegetation has been removed. The available water capacity is 0.5 to 1.0 inch per foot of soil. In places roots penetrate to a depth of 5 feet or more. Workability is slightly difficult because the soil is loose and lacks stability for use of equipment. (Foote et al. 1972:48)

Puuone sand, 7 to 30 percent slopes (PZUE) is described as follows:

> This series consists of somewhat excessively drained soils on low uplands on the island of Maui. These soils developed in material derived from coral and seashells.
>
> They are moderately sloping to moderately steep. …Puuone soils are geographically associated with Iao and Jaucas soils.
>
> …This soil is on sandhills near the ocean. Included in mapping were small areas of Iao and Jaucas soils. Also included were small areas where the cemented layer is less than 20 inches below the surface.

> In a representative profile the surface layer is grayish-brown, calcareous sand about 20 inches thick. This is underlain by grayish-brown, cemented sand. The soil is moderately alkaline in the surface layer.
>
> Permeability is rapid above the cemented layer. Runoff is slow, and the hazard of wind erosion is moderate to severe. The available water capacity is about 0.7 inches per foot in the surface layer and subsoil. In places roots penetrate to the cemented layer. (Foote et al. 1972:117)

The Ewa Series soils are described as follows:

> This series consists of well-drained soils in basins and on alluvial fans on the islands of Maui and Oahu. These soils developed in alluvium derived from basic igneous rock. They are nearly level to moderately sloping. Elevations range from near sea level to 150 feet. The annual rainfall amounts to 10 to 30 inches. Most of it occurs between November and April. The mean annual soil temperature is 73° F. Ewa soils are geographically associated with Honouliuli, Mamala, Molokai, Pulehu, and Waiakoa soils.
>
> These soils are used for sugarcane, truck crops, and pasture. The natural vegetation consists of fingergrass, kiawe, koa haole, klu, and uhaloa. (Foote et al. 1972:29) ….
>
> **Ewa silty clay loam, 0 to 3 percent slopes** (EaA).—On this soil, runoff is very slow and the erosion hazard is no more than slight. In a few places small, gently sloping areas were included in mapping.
>
> This soil is used for sugarcane and homesites. (Capability classification I if irrigated IVc if nonirrigated; sugarcane group 1; pineapple group 1; pasture group 2) ….
>
> **Ewa cobbly silty clay loam, 0 to 3 percent slopes.** (EcA) — This soil has a profile like that of Ewa silty clay loam, 3 to 6 percent slopes, except that it is cobbly on the surface. Runoff is very slow, and the erosion hazard is no more than slight.
>
> Most of this soil is used for sugarcane. A small acreage is used for pasture. (Capability classification IIs if irrigated, IVs if nonirrigated; sugarcane group 1; pasture group 2) ….
>
> **Ewa silty clay, 0 to 3 percent slopes** (EsA).—This soil has a profile like that of Ewa silty clay loam, 3 to 6 percent slopes, except for the texture of the surface layer. Runoff is very slow, and the erosion hazard is no more than slight.
>
> This soil is used for sugarcane. (Capability classification I if irrigated, IVc if nonirrigated; sugarcane group 1 ; pineapple group 1; pasture group 2) (Foote et al. 1972:29-30)

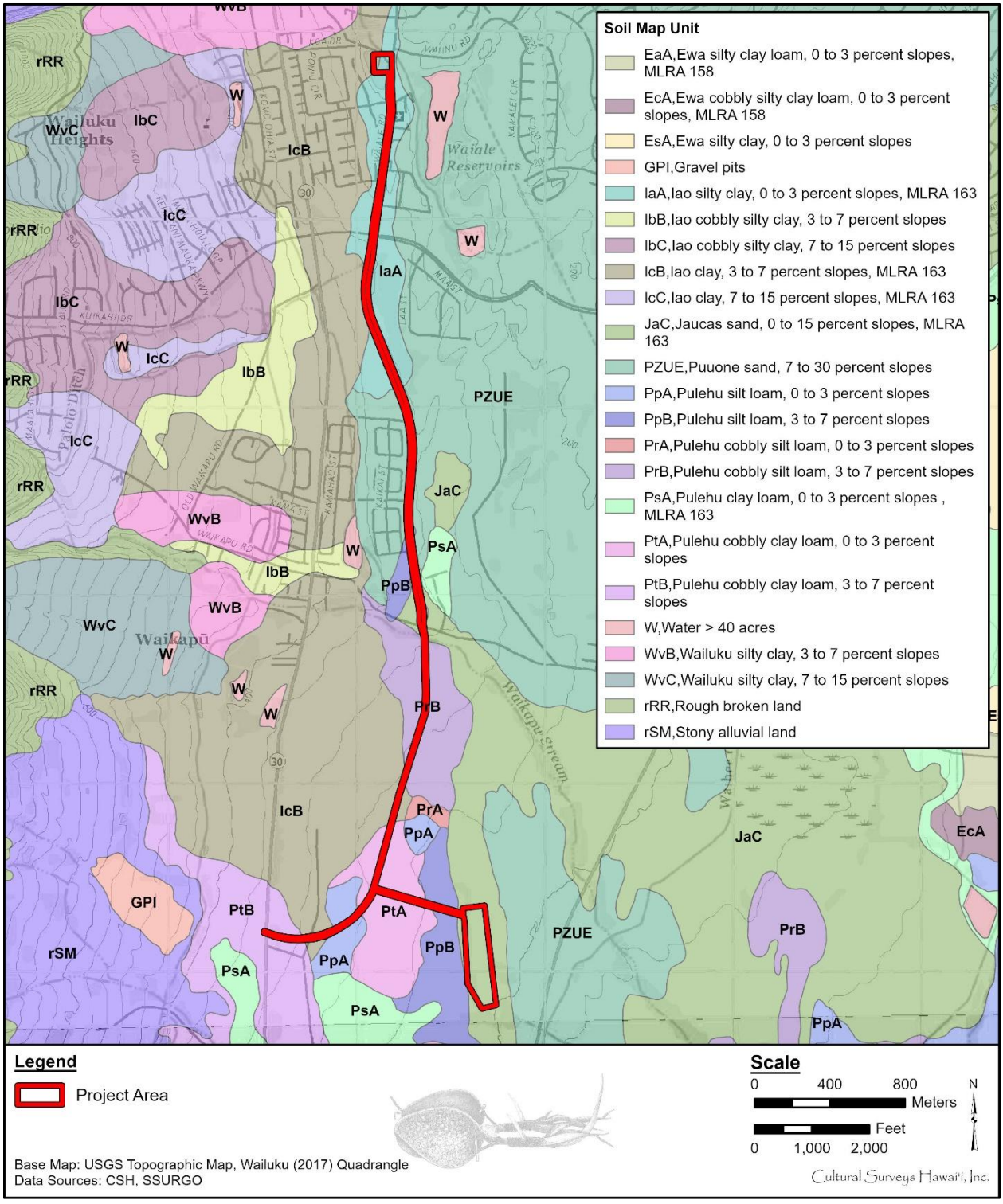



Figure 11. Overlay of Soil Survey of the State of Hawaii (Foote et al. 1972) indicating soil types within and surrounding the project area (U.S. Department of Agriculture 2001)

The Iao Series soils are described as follows:

> This series consists of well-drained soils on valley fill and alluvial fans. These soils developed in alluvium derived from basic igneous rock. They are nearly level to moderately sloping. Elevations range from 100 to 500 feet. The rainfall amounts to 25 to 40 inches. The mean annual soil temperature is 74° F. Iao soils are geographically associated with Paia, Pulehu, and Wailuku soils.
>
> These soils are used for sugarcane. Small acreages are used for pastures and homesites. The natural vegetation consists of bermudagrass, feather fingergrass, koa haole, lantana, and Natal redtop.
>
> **Iao clay, 3 to 7 percent slopes** (IcB).—This soil is on smooth alluvial fans and valley fill. Included in mapping were small areas of Paia and Wailuku soils. Also included were small, nearly level areas.
>
> In a representative profile the surface layer is dark-brown clay about 15 inches thick. The subsoil, about 45 inches thick, is very dark brown, dark-brown, and very dark grayish-brown clay and silty clay. The substratum is clayey alluvium. The soil is neutral in the surface layer and subsoil.
>
> Permeability is moderately slow. Runoff is medium, and the erosion hazard is slight to moderate. The available water capacity is about 1.7 inches per foot in the surface layer and subsoil. In places roots penetrate to a depth of 5 feet or more. (Foote et al. 1972:46) ….
>
> **Iao silty clay, 0 to 3 percent slopes** (IaA).—On this soil, runoff is slow and the erosion hazard is no more than slight.
>
> This soil is used for sugarcane. (Capability classification I if irrigated, IIIc if nonirrigated; sugarcane group 1; pasture group 3) (Foote et al. 1972:46-47)

The Pulehu series soils are described as follows:

> This series consists of well-drained soils on alluvial fans and stream terraces and in basins. …They developed in alluvium washed from basic igneous rock. The soils are nearly level to moderately sloping. Elevations range from nearly sea level to 300 feet. …
>
> The soils are used for sugarcane, truck crops, pasture, homesites, and wildlife habitat. The natural vegetation consists of bermudagrass, bristly foxtail, fingergrass, kiawe, klu, lantana, koa haole, and sandbur.
>
> **Pulehu clay loam, 0 to 3 percent slopes** (PsA). —This soil is on alluvial fans and stream terraces and in basins. Included in mapping were small areas of Ewa, Mala, and Waialua soils. Also included were small areas of gravelly, stony, and gently sloping soils.
>
> In a representative profile the surface layer is dark-brown clay loam about 21 inches thick. This is underlain by dark-brown, dark grayish-brown, and brown, massive and single grain, stratified loam, loamy sand, fine sandy loam, and silt loam about

> 39 inches thick. Below this is coarse, gravelly or sandy alluvium. The soil is neutral in the surface layer and neutral to mildly alkaline below the surface layer.
>
> Permeability is moderate. Runoff is slow, and the erosion hazard is no more than slight. The available water capacity is about 1.4 inches per foot in the surface layer and subsoil. In places roots penetrate to a depth of 5 feet or more. Low areas are subject to flooding. ….
>
> **Pulehu cobbly clay loam, 0 to 3 percent slopes** (PtA). —This soil is similar to Pulehu clay loam, 0 to 3 percent slopes, except that it is cobbly.
>
> This soil is used for sugarcane. Small acreages are used for pasture. (Capability classification IIs if irrigated, IVs if nonirrigated; sugarcane group 1; pasture group 2) (Foote et al. 1972:115-116) ….
>
> **Pulehu silt loam, 0 to 3 percent slopes** (PpA).—This soil is similar to Pulehu clay loam, 0 to 3 percent slopes, except that the texture is silt loam. This soil is used for sugarcane. Small acreages are used for homesites. (Capability classification I if irrigated, IVc if nonirrigated; sugarcane group 1; pasture group 2)
>
> **Pulehu silt loam, 3 to 7 percent slopes** (PpB).—This soil is similar to Pulehu clay loam, 0 to 3 percent slopes, except that the texture is silt loam. Runoff is slow, and the erosion hazard is slight. Included in mapping were small areas underlain by coral sand at a depth of 20 to 36 inches.
>
> This soil is used for sugarcane. (Capability classification IIe if irrigated, IVc if nonirrrgated; sugarcane group 1; pasture group 2) ….
>
> **Pulehu cobbly silt loam, 3 to 7 percent slopes** (PrB).—This soil is similar to Pulehu clay loam, 0 to 3 percent slopes, except that the texture is silt loam, and the surface layer is cobbly. Runoff is slow, and the erosion hazard is slight. Included in mapping were small areas underlain by coral sand at a depth of 20 to 36 inches.
>
> This soil is used for sugarcane. Small areas are used for pasture. (Capability classification IIe if irrigated, IVs if nonirrrgated; sugarcane group 1; pasture group 2) (Foote et al. 1972:116)

In 2014, the average monthly air temperature for the project area was between 21.5°C (67.2°F) in February and 25.5°C (74.4°F) in August with an average annual air temperature of 23.5°C (74.3°F) (Giambelluca et al. 2014). The vicinity of the project area received a mean annual rainfall of 394.8 mm (15.5 inches) between 1978 and 2007, according to the University of Hawai‘i 2011 *Rainfall Atlas of Hawaii* (Giambelluca et al. 2013). The mean monthly rainfall varied between 2.2 mm (0.08 inches) in June to 101.5 mm (4.00 inches) in January as measured from a Hawaiian Commercial and Sugar Company (HC&S) field station (Field 719) within the project area.

### 1.3.2 Built Environment

The built environment of the project area includes areas of residential housing and retail businesses, with some peripheral developments consisting of light industrial yards, cemeteries, and paved roadways along the existing Wai‘ale Road. The Wai‘ale Road Extension and new

WWRF are within fallow fields of sugarcane and overgrown field access roads. Any structures within those portions primarily relate to commercial agriculture and/or water control infrastructure.

# Section 2 Methods

## 2.1 Research Methods

Background research included a review of previous archaeological studies on file at the SHPD; review of documents at Hamilton Library of the University of Hawai‘i, the Hawai‘i State Archives, the Mission Houses Museum Library, the Hawai‘i Public Library, and the Bishop Museum Archives; study of historic photographs at the Hawai‘i State Archives and the Bishop Museum Archives; and study of historic maps at the Survey Office of the Department of Land and Natural Resources (DLNR). Historic maps and photographs from the CSH library were also consulted. In addition, Māhele records were examined from the Waihona ‘Aina (2000) database. This research provided the environmental, cultural, historic, and archaeological background for the project area. The sources studied were used to formulate a predictive model regarding the expected types and locations of historic properties in the project area.

## 2.2 Field Methods

In general, fieldwork included 100% pedestrian inspection of the project area, observation of geotechnical boring tests and double ring infiltrometer tests, a GPR survey, subsurface testing, and GPS data collection. CSH completed the fieldwork component of this AIS under archaeological permit numbers 23-30 and 24-30, issued by the SHPD pursuant to HAR §13-13-282. Fieldwork for geotechnical boring operations was accomplished between 5 and 21 September 2023 by CSH archaeologists Jonas Madeus, B.A., and Jennifer J. Frey, B.A. This work required approximately nine person-days to complete. Fieldwork for the AIS subsurface testing was conducted between 11 September and 4 November 2024 by CSH archaeologists Jennifer Frey, B.A., Elwyn Leibold, B.A., Jonas Madeus, B.A., Allyson Ueki, M.A., Josephine Yucha, M.S., and Trevor Yucha, B.S. This work required approximately 123 person-days to complete. All fieldwork was conducted under the general supervision of principal investigators Josephine Yucha, M.S., and Hallett H. Hammatt, Ph.D.

### 2.2.1 Pedestrian Survey

CSH conducted a 100% coverage pedestrian survey of the project area. The survey was accomplished by CSH archaeologists conducting systematic pedestrian transects. Transect spacing varied depending on ground visibility. For open, plowed fields where ground visibility was excellent, spacing was approximately 10.0 m. For vegetated or unmaintained areas where ground visibility was poor, spacing was approximately 5.0 m.

### 2.2.2 Ground Penetrating Radar Survey

CSH utilized GPR survey during the AIS in an effort to increase survey coverage throughout the project area without further increasing the amount of invasive testing. In accordance with the project’s AIS fieldwork strategy, CSH completed eight GPR transects (GPR-1 through GPR-8) that each measure 100.0 m long by 1.0 m wide and were distributed throughout the proposed connection corridor and the Central Maui WWRF segments of the project area.

The GPR survey was performed using a Geophysical Survey Systems, Inc. (GSSI) SIR-3000 system equipped with a 400 MHz antenna. This is a bistatic system in which electromagnetic

energy in the radar frequency range is transmitted into the ground via a sending antenna. Radar energy is reflected off the subsurface matrix, then received by another, paired antenna. Reflected energy is sampled, and the travel time (in nanoseconds) of the individual reflection waves is recorded. Wave propagation speed varies depending on the nature of the subsurface medium. Any changes in density or electromagnetic properties within the stratigraphic column may cause observable variations in reflection intensity. Reflection features may include discrete objects, stratigraphic layering, or other natural and/or man-made subsurface anomalies.

GPR data collection parameters were held constant throughout the survey under the assumption that soil characteristics are relatively consistent throughout the survey area. The maximum depth of interest generally was set at 3.0 m. The soil type for this area was determined to be “loamy soil” and assigned GSSI Soil Type 2 with a dielectric constant of 8. The scans per unit option was set at 50 scans per meter. The settings used for this survey were based on the recommendations of GSSI (GPR manufacturer) for this soil type. The survey used the GSSI Quick3D collection mode for 3D scans of the survey areas. The survey was conducted from the X-axis traveling along the Y-axis with each GPR transect spaced every 25 cm.

Post-processing of the data was completed using GSSI RADAN 7 software to produce a 3D grid file or GPR profile slice for each location. Post-processing included an adjustment of the Time-Zero line to eliminate the GPR signal that is recorded between the base of the antenna and the ground surface. No other post-processing techniques were utilized.

### 2.2.3 Subsurface Testing

The subsurface testing program was backhoe assisted and involved 90 test excavations. Additional subsurface testing was conducted within the project area as part of the overlapping Wai‘ale Road Extension Project. Linear trenches measuring approximately 6.0 m (20.0 ft) long and 1.0 m (3.3 ft) wide were excavated within the proposed connection corridor and the Central Maui WWRF segments of the project area. A backhoe contractor from Atlas Archaeology slowly excavated each trench with a custom bladed bucket or a toothed bucket as necessary for rocky and extremely compacted areas. Archaeologists first investigated any buried sand deposits by hand (via shovel, trowel, etc.) primarily by excavating a shallow slit trench (a shovel’s width) through the center of the excavation, then incrementally utilizing the backhoe to remove the slit trench backdirt and sediment from the edges, then proceed to excavate in 6-inch lifts with short draws while the archaeologists safely managed the backfill pile.

Following excavation, archaeologists used hand tools to scrape the sidewalls in order to smooth the surface to assess and document the stratigraphy. Documentation included descriptions and photographs of any potential findings as well as descriptions of the natural and built environment observed throughout the project area. Descriptions and photographs were recorded using Apple Ipads equipped with standard digital form software and digital cameras. Following the documentation of each excavation, the area was backfilled, compacted, and restored to near original condition.

A stratigraphic profile of each test excavation was drawn and photographed. The observed sediments were described using standard USDA soil description observations/terminology. Sediment descriptions included Munsell color; texture; consistency; structure; plasticity; cementation; origin of sediments; descriptions of any inclusions, such as cultural material and/or

roots; lower boundary distinctiveness and topography; and other general observations. Any stratigraphic anomalies, potential features, and screened sediment sample locations were depicted on test excavation profile maps.

Sediment samples were collected from the buried A horizon and any potential features and screened in the field to aid in the characterization and significance of the deposits. The sample locations were recorded on the profile maps. The volumes were recorded then, the material was sifted through a 1/8-inch mesh screen. Two faunal elements were encountered and identified in the field as a partial crab claw from the buried A horizon in TE-50 and a probable bird bone shaft from a screened sediment sample from a charcoal stain in the buried A horizon of TE-51. However, both elements were thin, dry, and brittle and disintegrated prior to laboratory analysis. Some screened samples also contained naturally occurring land snail shells, which are not considered to be midden and not further analyzed. Very little charcoal or charcoal particles were identified within the screens, therefore many of the potential features were assessed as charcoal stains likely related to historic sugarcane burning and not designated as significant archaeological features due to the lack of any associated cultural content. No laboratory analyses were conducted for the screened sediment samples.

### 2.2.4 GPS Data Collection

Test excavations and GPR survey areas were recorded with a Trimble Geo XH mapping grade GPS unit with a TSCI Datalogger and real-time differential correction. This unit provides sub-meter horizontal accuracy in the field. GPS field data was postprocessed, yielding horizontal accuracy between 0.5 and 0.3 m. GPS location information was converted into GIS shape files using GPS Pathfinder Office Software, Version 5.9, and graphically displayed using ArcGIS Desktop 10.6.1.9270.

### 2.2.5 Disposition of Materials

Materials collected during the current AIS will remain temporarily curated at the CSH office in Wailuku, Maui. CSH will make arrangements with the landowner regarding the disposition of this material. Should the landowner request different archiving of material, an archive location will be determined in consultation with the SHPD. All data generated during the course of the AIS are stored at the CSH offices.

# Section 3 Background Research

## 3.1 Traditional and Historical Background

The division of Maui's lands into political districts occurred during the rule of Kaka‘alaneo, under the direction of his *kahuna* (chief), Kalaiha‘ōhi‘a (Beckwith 1970:383). This division resulted in 12 districts, or *moku*, during traditional times: Kula, Honua‘ula, Kahikinui, Kaupō, Kīpahulu, Hāna, Ko‘olau, Hāmākualoa, Hāmākuapoko, Wailuku, Kā‘anapali, and Lāhainā. The current project area is located between Wailuku and Waikapū Ahupua‘a in the Wailuku Moku in the isthmus of Central Maui between the northwest slopes of Haleakalā and the southeast slopes of Mauna Kahālāwai (West Maui Mountains). Overall, Wailuku and Waikapū Ahupua‘a share an east-west boundary and collectively constitute the entirety of the central isthmus of Maui, which is bounded by ‘Īao Valley to the west, Kahului Harbor to the north, Pā‘ia and Hāli‘imaile to the east, and Mā‘alaea Harbor to the south. These combined lands encompass a total of approximately 43,779 acres.

Wailuku and Waikapū are two of four *ahupua‘a* that traditionally comprise the *‘okana* (sub-district) of Maui known as "Nā Wai ‘Ehā," or "The Four Waters," so named for the four major deep-valley streams emanating from the West Maui Mountains (Handy et al. 1991:469; Moffat and Fitzpatrick 1995:23). Geographically and culturally, Nā Wai ‘Ehā consisted of four deep valley streams (Waikapu, Wailuku, Waiehu, and Waihee) that watered four distinct areas of taro land that spread out fanwise to the shoreline (Handy et al. 1991:272) with the *ahupua‘a* of both Wailuku and Waikapū extending across the isthmus of Maui to meet the traditional land boundaries of Hamakuapoko and Kula Moku. These two land divisions were of primary importance due to their location across "the whole of the central isthmus so as to cut off half of the lands in the district of Kula from access to the sea," and were sometimes referred to as Na Poko (W.D. Alexander in Sterling 1998:63).

### 3.1.1 Traditional Accounts

In ancient times, Waikapū and Wailuku were agriculturally abundant lands that were known for their extensive *lo‘i,* or wetland taro cultivation (Handy et al. 1991:497). In an excerpt from C.T. Cheever (in Sterling 1998:75) the remnants of the pre-Contact cultivation of ‘Īao Valley in Wailuku is described:

> As you get into the valley and vega of Wailuku, you see numerous remains of old kihapais, or cultivated lots, and divisions of land now waste, showing how much more extensive formerly was the cultivation, and proportionately numerous the people, than now…
>
> The whole valley of Wailuku, cultivated terrace after terrace, gleaming with running waters and standing pools, is a spectacle of uncommon beauty to one that has a position a little above it. (C.T. Cheevers in Sterling 1998:75)

Similar observations were made regarding the deep valley of Waikapū, lying immediately southwest of the paramount valley of the West Maui range in Wailuku. Writing his observations from long after the period of active *lo‘i* cultivation, E.S.C. Handy observed:

> Spreading north and south from the base of Waikapu to a considerable distance below the valley are the vestiges of extensive wet plantations, now almost obliterated by sugar cane cultivation; a few here and there are preserved in plantation camps and under house garden sites along the roads. … Far on the north side, just above the main road and at least half a mile below the entrance to the canyon, an extensive truck garden on old terrace ground shows the large area and the distance below and away from the valley that was anciently developed in terraced taro culture. On the south side there are likewise several sizeable *kuleana* where terraces are now used for truck gardening. (E.S.C. Handy in Sterling 1998:94)

Handy et al. (1991) in *Native Planters in Old Hawaii Their Life, Lore, and Environment*, describes Waikapū Stream as land bound, as opposed to emptying into the ocean, with the water diverted into *loʻi* and the overflow dissipating on the dry plains of the central isthmus between West and East Maui (Handy et al. 1991:496) feeding the wetland of Keālia. Though there has been some speculation on the establishment of small fishing settlements with cultivation of sweet potatoes in the sandy soil or red *lepo* (dirt) near the shore, E.S.C. Handy stated that:

> … From Waihee to Waikapu there is much good land below and bounding the ancient terrace area on the *kula* and in the lower valleys which would be ideal for sweet potato culture, but it is said that little was grown in this section because there was so much taro. (Sterling 1998:63)

#### 3.1.1.1 The Naming of Wailuku and Waikapu

In the preface of Place Names of Hawaii (Pukui et al. 1974:x), Samuel Elbert states that:

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

Inherent in the statements of Elbert is the knowledge that the oldest place names held meaning and told the story of an area prior to European contact.

An early legend surrounding the naming of Wailuku comes from the legend of Hiʻiaka, sister of the volcano goddess Pele, as she travelled through the Hawaiian Islands. When Hiʻiaka's companion, Wahineʻōmaʻo complains of hunger during their travels along a *kaha* (hot dry shore) portion of northern Maui, Hiʻiaka offers a chant of supplication for nourishment from the local residents. Hiʻiaka and Wahineʻōmaʻo were met with little hospitality after their appeal for food was largely ignored by the areas residents (Emerson 1993:74). Hiʻiaka then offered another chant making "known her wish, concluding her appeal with ominous threats against the life of the king, in case her demands were not met" (Emerson 1993:75). A portion of this chant reads:

| | |
|---|---|
| *Haki kepakepa na moku;* | What wailing and beating of breast! |
| *Pa‘iauma ka aina;* | Wild anguish of child and of ghost |
| *Uwē kamali‘i, uwē ka hanehane —* | O‘er the sandy plain of Kama‘o. |
| *Ke uwē la i ka pili,* | The districts are frenzied with grief |
| *I ke kula o Ka-ma‘o-ma‘o;* | Tearing of hair and breaking of teeth |
| *Ka‘a kumakena o Maui, e!* | One wail that lifts to heaven. |
| *la wai Maui?* | Who shall be heir to this Maui land? |

(Emerson 1993:75-76)

The mention of Ka-ma‘o-ma‘o is in reference to the area known as Ke Kula o Kama‘oma‘o, or the Plains of Kama‘oma‘o (*lit.,* “greenness”), a region of sandy plains between Kahului and Wailuku, and the location of the current project area (Pukui et al. 1974:81).

The place name “Waikapū”, according to (Pukui et al. 1974:223), literally translates to “Water of the Conch.” This is due to a cave within Waikapū Valley that supposedly housed a supernatural conch shell (named Kīhapū, blessed with the breath of Lono) that resided there until it was stolen by a supernatural dog named Puapualenalena. This conch shell, when blown, was said to resound throughout all the Hawaiian Islands (Beckwith 1970:349; Pukui et al. 1974:223). According to W.K. Kaualililehua (in Sterling 1998:93):

> On the left side of the stream is a cave and in the cave was the conch. It sounded all the time, unseen by the public…
>
> On the northeast side of the stream on the opposite side of the conch that sounded, on the cliff, was a dog named Puapualenalena. Because he heard it he sought diligently to find it but did not succeed. Those who guarded the conch were very watchful. …
>
> The owners of the conch did not believe, perhaps, that a supernatural being would succeed in taking it away, so they tried to be a little careless. It was not taken, but on the day that Puapualenalena did get it away, they had been utterly careless. After he took it, it sounded no more to this day. (W.K. Kaualilileua in Sterling 1998:93)

Elspeth Sterling (1998) provides several additional accounts of the naming of the waters of Nā Wai ‘Ehā, specifically Wailuku and Waikapū, that have a grounding in the affairs of the Hawaiian people. According to H.T. Cheever (in Sterling 1998:63), the waters of Nā Wai ‘Ehā were named after successive events during a famous, albeit unnamed, battle:

> Waikapu—The water where the conch was blown, and the engagement began. Waiehu—The water where the combatants smoked with dust and perspiration. Wailuku—The water of destruction, where the battle began to be fierce and fatal. Waihee—The water of total rout and defeat, where the army melted away. (H.T. Cheever in Sterling 1998:63)

C.W. Stoddard expanded on this interpretation of the place names Waikapū and Wailuku in Nā Wai ‘Ehā by relating them to the landing of Kamehameha I at Kalepolepo in the late 1700s (Sterling 1998:63) by relating that:

> Kamehameha landed at Kalepolepo and a *kapu* [taboo] was put upon the nearest stream. It became sacred to royalty, as was the custom and is known as Waikapu to this hour—that is, forbidden water.
>
> Presently the monarch began his march; and at the second stream a great battle raged, so those waters were called Luku—“to slaughter, to slay as in war, the destruction of many at once.” (C.W. Stoddard in Sterling 1998:63)

The names and legends of the region may have their origins in one, or many, notable events that occurred in the time before Western contact. Though opinions vary, the central isthmus of Maui was nonetheless utilized by forces entering these battles.

#### 3.1.1.2 The Plains of Kama‘oma‘o

Ke Kula o Kama‘oma‘o, or the Plains of Kama‘oma‘o, is the name given to a region of sandy plains spanning portions of Wailuku and Waikapū Ahupua‘a (Emerson 1993). This area was known by Hawaiians in traditional times as a wandering place of the souls (Beckwith 1970), a place where dead spirits waited for a friendly escort, perhaps a family *‘aumakua*, to show them the way to eternity:

> The worst fate that can befall a soul is to be abandoned by its aumakua and left to stray, a wandering spirit (*kuewa*) in some barren and desolate place, feeding upon spiders and night moths. Such spirits are believed to be malicious and to take delight in leading travelers astray; hence the wild places which they haunt on each island are feared and avoided. Such are the plains of Kama‘oma‘o on the island of Maui. (Beckwith 1970:154)

According to Helen P. Hoyt (1976), Kama‘oma‘o is also a region where the “Marchers of the Night,” or *Ka huaka‘i o ka Po*, are sometimes heard and seen. When these spiritual “Night Marchers” appear, according to Beckwith (1932:199), “It is said that such a sight is fatal unless one has a relative among the dead to intercede for him.”

> The marchers carried candlenut torches which burned brightly even on a rainy night. They might even be seen in broad daylight and were followed by whirlwinds such as come one after another in columns. They cried “Kapu o moe!” as a warning to stragglers to get out of the way or to prostrate themselves with closed eyes until the marchers passed. (Beckwith 1932:199)

Ms. Holt-Padilla, Cultural Historian for the Maui Arts and Cultural Center, explains that the central isthmus was a dry, hot place with trails leading west toward Waikapū, and east along the Kīhei coastline. She stated that the guardian spirits of men, the *‘aumakua* spirits, were known to wander on the lower, sandy plains of Waikapū. Ke Kula o Kama‘oma‘o is also described as a special place for the souls of the soldiers killed at Kakanilua, or the Battle of Wailuku Common (Hokulani Holt Padilla in Hill et al. 2006).

3.1.1.3 Warfare in the Sand Hills of Nā Wai ‘Ehā

As a political center for the chiefly class (*ali‘i)* of Hawaiian society, several large battles took place in the general vicinity of Wailuku, many of which entailed the marching of foreign armies through the *ahupua‘a* of Waikapū after landing their canoes on the leeward shores of the central isthmus, near Kealia. One example was the Battle of Waikapū Common, or the Ahulau ka pi‘ipi‘i i Kakanilua. This battle entailed the clash of invading Hawai‘i Island forces, headed by Kalaniopu‘u, with the Maui forces under Kahekili in 1776. According to (Fornander 1969:153), following the plunder of the leeward east Maui coastline, Kalaniopu‘u landed his invading troops at Mā‘alaea. The following account describes the battle on the sand hills south of Wailuku:

> The landing being effected early in the day, it was resolved to push forward at once, and ‘on to Wailuku!’ where Kahekili was residing, became the war cry of the day. The detachment or regiment known as the Alapa, mustering with several hundred men, was selected for this hazardous expedition, and with high courage they started across the isthmus of Kamaomao, known as the Waikapu common, determined, as the legend says, ‘to drink the waters of the Wailuku that day.’ This regiment was considered to be the bravest and best. …They are said to have all been of equal stature and their spears of equal length; and the legend represents their appearance—with their feather cloaks reflecting the sunshine and the plumes of their helmets tossing in the wind—as a gorgeous and magnificent spectacle.
>
> Little did this gallant troop apprehend the terrible fate that awaited them. Little did Kalaniopuu know the wily warrior with whom he was contending. Offering no resistance to the enemy while crossing the common, Kahekili distributed his forces in various directions of the Wailuku side of the common and fell upon the [Alapa] as it was entering among the sandhills southeast of Kalua, near Wailuku. The gallant and devoted Alapa were literally annihilated; only two out of the eight hundred escaped alive. (Fornander 1969:153)

According to Ms. Holt-Padilla, the outcome of the battle for Kakanilua was not decided on the first day. The day following the “Slaughter of the Pi‘ipi‘i at Kakanilua,” the remaining forces of Kalani‘ōpu‘u were again sent to battle Kahekili’s forces, which were expected to be in Wailuku (Hokulani Holt Padilla in Hill et al. 2006). Following the humiliating defeat, Kalaniopu‘u consulted his remaining fighters and his war leaders, including his favorite, the young Kamehameha. After this Kalaniopu‘u and his forces proclaimed “Tomorrow we will drink the waters of Wailuku and rest in the shade of Hekuawa” (Speakman 1978:13). In response to the invader’s renewed vigor for battle:

> Ka-hekili and his ally and nephew, the ruling chief of O‘ahu, prepared another fish net [ambush], and the fish [Hawai‘i Island warriors] swam into it. Ka-hekili’s men rose before dawn and took their stand in the sand hills, some toward the Waikapu turn. The invading force from Hawai‘i found a divided front from which the spears poured down on them “like a swift rainstorm.” The terrified soldiers were surrounded and fled. (Speakman 1978:13-14)

The Big Island army was ambushed at an area close to Waikapū and was destroyed by the army of Kahekili on the plains of Kama‘oma‘o (Hokulani Holt Padilla in Hill et al. 2006). This second

day of fighting was known as the battle of Kamoku‘ilima (Kamakau 1992:132). Kalaniopu‘u never succeeded in taking Wailuku, and died shortly after the battle of Wailuku common. Upon the death of Kalaniopu‘u, and the death of his sons, the young Kamehameha became the ruling chief of Hawai‘i and the mortal enemy of the now aged Kahekili (Speakman 1978:12). Kamehameha would return to Wailuku and succeed where Kalaniopu‘u had failed. By 1786, Kahekili controlled Maui, Moloka‘i, Lāna‘i, and O‘ahu. This undisputed political control lasted for only a short period of time. In 1790, the last great conflict on Maui – the battle of Kepaniwai – was fought in ‘Īao Valley in Wailuku. The battle of Kepaniwai marked the end of the reign of Kahekili and the beginning of the early Historic period and a politically unified Hawai‘i (Pukui et al. 1974).

An 1841 account of Commodore Charles Wilkes of the American Navy published in the 7 January 1927 edition of the Honolulu Advertiser provides an early description of “a mound of human bones” thought to be the bodies of fallen warriors in the Sand Hills of Wailuku (Figure 12). The article refers to the accounts of past battles fought in Central Maui.

### 3.1.2 Early Historic Period

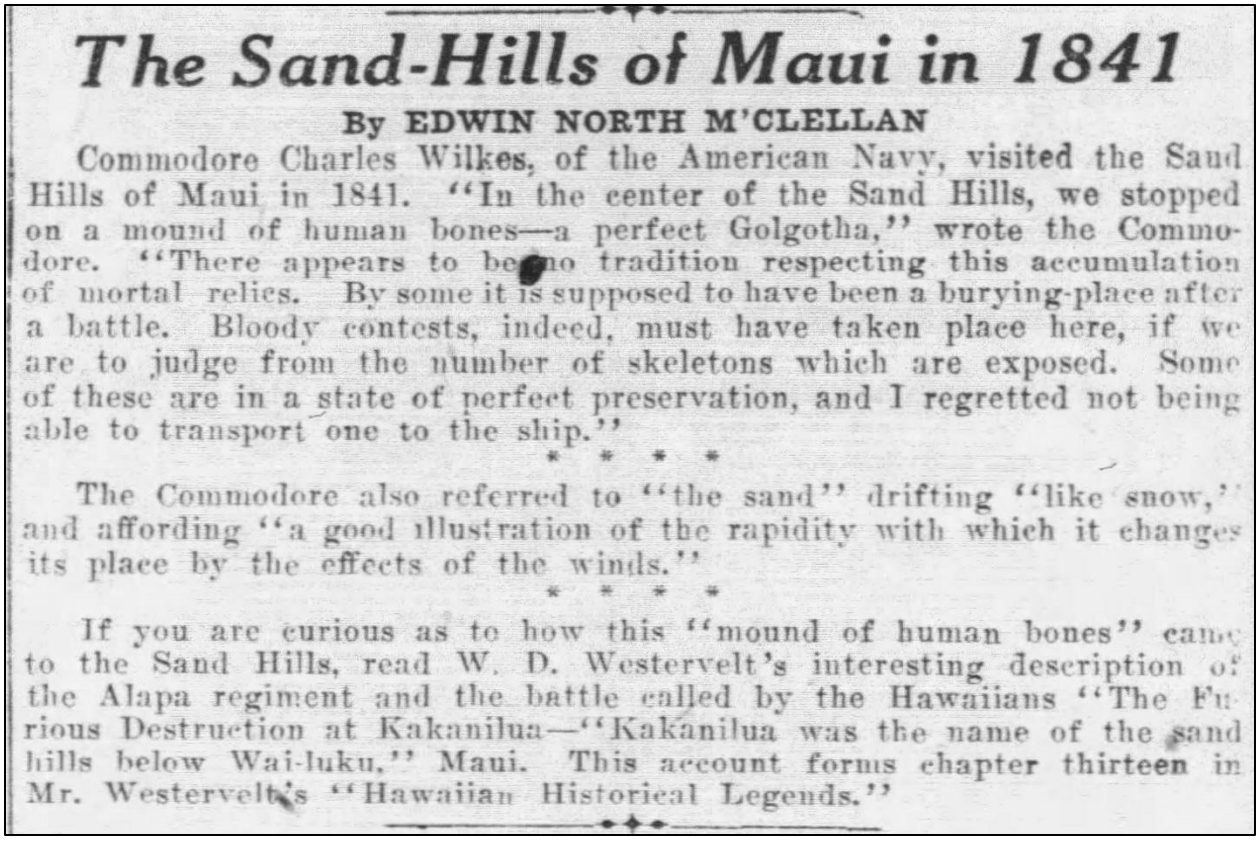
The nineteenth century brought to Maui a multitude of commercial, demographic, social, and religious changes encouraged by the burgeoning foreign influx. In 1819, the first whaling ships arrived in Hawaiian waters and Lāhainā Harbor became a primary port of call for provisioning ships in the Islands. Closely following the arrival of the first whaling ships, the first Protestant missionaries and their families arrived in Lāhainā in 1823 (Bingham 1824). One of the first records regarding the number of residents living in the regions of Wailuku and Waikapū come from population statistics compiled by the early missionaries who settled there. In 1829, Protestant missionaries recorded school attendance figures for the out-stations of Wailuku as consisting of 612 students, with an additional 329 students in Waikapū. Just a few years later, the mission census data of 1831-1832 records the population of Waikapū at 733 inhabitants (Schmitt 1973:18).

The use of the northern coastline landing at Kahului by early Europeans proved difficult, for far more records exist of early explorers and merchant ships at anchor off the southern, more protected coastline of Maui than along the exposed, northern coast. An account by the American missionary Rufus Anderson (1865) portrays the obstacle of landing in Wailuku District:

> We were bound to Wailuku, situated near the western side of the isthmus connecting West and east Maui. After crossing the channel the wind increased, and so rough was the sea that our landing seemed not quite safe. Mr. Alexander met us on the shore, but in such a stand-storm that we were obliged to veil our faces. We breasted the gale for a dozen miles, and near Wailuku were wet to the skin by a storm of rain. (Anderson 1865:176)

A landing on leeward coast of the central isthmus meant that the people and commerce that reached European ships came through the trails that transect the Plains of Kama‘oma‘o.

During the early and mid-1800s, the Hawaiian demography was affected by two dramatic factors: radical depopulation resulting from Western disease and nucleation around the developing port towns. Traditional Hawaiian populations lived in a largely dispersed settlement pattern.



# The Sand-Hills of Maui in 1841

By EDWIN NORTH M'CLELLAN

Commodore Charles Wilkes, of the American Navy, visited the Saud Hills of Maui in 1841. "In the center of the Sand Hills, we stopped on a mound of human bones—a perfect Golgotha," wrote the Commodore. "There appears to be no tradition respecting this accumulation of mortal relics. By some it is supposed to have been a burying-place after a battle. Bloody contests, indeed, must have taken place here, if we are to judge from the number of skeletons which are exposed. Some of these are in a state of perfect preservation, and I regretted not being able to transport one to the ship."

* * * *

The Commodore also referred to "the sand" drifting "like snow," and affording "a good illustration of the rapidity with which it changes its place by the effects of the winds."

* * * *

If you are curious as to how this "mound of human bones" came to the Sand Hills, read W. D. Westervelt's interesting description of the Alapa regiment and the battle called by the Hawaiians "The Furious Destruction at Kakanilua—"Kakanilua was the name of the sand hills below Wai-luku," Maui. This account forms chapter thirteen in Mr. Westervelt's "Hawaiian Historical Legends."

Figure 12. Newspaper clipping from the 7 January1927 edition of the Honolulu Advertiser describing an 1841 discovery of human remains in the Sand Hills of Maui (The Honolulu Advertiser 1927)

Although there were royal centers and areas of more concentrated population, these areas never came close to rivaling the populations of the historic port towns that developed on Hawai‘i’s shorelines during the 1800s. Foreign commercialism initially came to Waikapū in the form of sugar processing and coffee production (Wyllie 1854). A man by the name of Antone (Anthony) Catalena was running a cane syrup factory at Waikapū ca. 1823 and is credited with being the founder of the industry in Hawai‘i (Thrum 1874) while Antonio Silva set up a plantation and a mill in Waikapū ca. 1828 (Thurston 1906). At about the same time Antonio was also engaged in coffee agriculture with trees that reportedly produced above 20 pounds annually (Wyllie 1854). The Reverend Hiram Bingham (1824) wrote the following description about an excursion he took with the Reverend William Richards, in a letter sent to the American Board of Commissioners of Foreign Missions (ABCFM) in Boston, dated 30 August 1823.

> The principal plantation in this district, called Waikapu (Wy-kah-poo) lies about midway between the two bays, watered by a small stream, descending in a south-eastern direction from the lofty mountains, that lie between Lahinah [sic] and that place. At this plantation which belongs to Cox [Kahekili Ke‘eaumoku] and Kaahoomanoo [Ka‘ahumanu], there are about 100 houses, six head of neat cattle, and eight horses. This is the most important, and almost the only inland settlement that I have seen in the islands. Its situation is very pleasant. You stand upon the bank of this little rivulet in the midst of the bananas, sugarcane, and taro; and the plains that lie upon the two bays spread upon your right and left, containing perhaps 100 or 150 square miles. Before you, at the distance of 15. (Bingham 1824:111)

These early commercial developments along with the establishment of the branch station of the ABCFM at Wailuku in November 1831 (Edwards 1832:403) would alter the traditional lifeways of Nā Wai ‘Ehā and Waikapū in a manner best described by Kuykendall (1938), noting that from 1830 to 1854:

> The commercial development during this period, by magnifying the importance of a few ports, gave momentum and direction to a townward drift of population; the population of the kingdom as a whole was steadily going down, but the population of Honolulu, Lahaina and Hilo was growing. (Kuykendall 1938:313)

Following this trend in the commercialization of agricultural pursuits across all islands, the remnants of indigenous agriculture either fell into disrepair or were absorbed by the developing plantations. Vestiges of extensive *lo‘i* cultivation, which spread to the north and south from the base of Waikapū to a considerable distance below the valley, remained through the 1930s. Although most of the *lo‘i* terraces in Waikapū had been plowed under by the expansion of commercial sugarcane cultivation, a few of the ancient terraces were preserved in plantation camps and under house sites as well as reused as garden sites, among which, and in addition to Hawaiian wet-taro, included Japanese dry-taro, truck gardens, and lotus for their seeds (Handy et al. 1991:497) (Figure 13).



Figure 13. Early photograph of Waikapū Valley showing *lo‘i*, *‘auwai*, and dispersed homes (Waikapū Community Association 2018)

### 3.1.3 The Māhele and the Kuleana Act

The most significant change in land-use patterns and land allocation came with the Māhele and the privatization of land in Hawai‘i. The establishment in 1839 by Kamehameha III (Kauikeaouli) of a Bill of Rights for the people of Hawai‘i, followed by a formal constitution in 1840, hastened the shift of the Hawaiian economy from that of a subsistence-based economy to that of a market-based economy. The Organic Acts of 1845 and 1846 initiated the process of the Māhele, the division of Hawaiian lands, which introduced private property into Hawaiian society. During the Māhele, all of the lands in the Kingdom of Hawai‘i were divided between the *mō‘ī* (king), *ali‘i* (royalty), *konohiki* (overseer of an *ahupua‘a*), and *maka‘āinana* (common people/tenants of the land) and passed into the Western land tenure model of private ownership (Chinen 1958).

On 27 January 1848, the Crown and the *ali‘i* began to receive their land titles as *konohiki* awards. For *konohiki* lands, a claim first had to be approved by the Land Commissioners. Upon confirmation of the claim, a certificate was awarded to the claimant. This certificate was called a Land Commission Award (LCA), which confirmed the claim of an individual for a parcel. The awardee could then obtain a Royal Patent (RP) from the Minister of the Interior, which indicated the government's interest in the land had been settled by the payment of a commutation fee. Commutation means "an exchange, or replacement." The commutation fee was usually set at a maximum of one-third of the value of the unimproved land. The fee could be settled by the exchange of cash but was usually settled by the return of one-third of the lands (or cumulative value of the lands) originally awarded to the claimant (Chinen 1958:13).

On 8 March 1848, Kauikeaouli (Kamehameha III) further divided his personal holdings into lands he would retain as private holdings and parcels he would give to the government. This act paved the way for government land sales to foreigners. In 1850, the legislature granted resident aliens the right to acquire fee simple land rights (Moffat and Fitzpatrick 1995).

On 19 October 1849, the Hawaiian Privy Council adopted resolutions to protect the rights of Native tenants, the *maka‘āinana* (common people/tenants of the land). The Kuleana Act of 1850 confirmed these rights. Under this act, the claimant was required to produce two witnesses who knew the claimant and the boundaries of the land, knew that the claimant had lived on the land for a minimum of two years, and knew that no one had challenged the claim. The land also had to be surveyed. Native tenants or naturalized foreigners who could prove occupancy on the parcels before 1845 could be awarded lands they occupied or that they cultivated as *kuleana* (land holding of a tenant or *hoa‘āina* residing in the *ahupua‘a*) awards. No commutation fee was necessary to apply for a Royal Patent for a *kuleana* award, as the commutation fee had presumably already been paid by the *ali‘i*/*konohiki* who had been awarded the entire *ahupua‘a*, or an *‘ili* (a land division within an *ahupua‘a*) in which the native tenant claimed his own small parcels (Chinen 1958:29-30).

Crown Lands were defined as: "…private lands of His Majesty Kamehameha III, to have and to hold for himself, his heirs and successors forever; and said lands shall be regulated and disposed of according to his royal will and pleasure subject only to the rights of tenants" (Kingdom of Hawaii 1848). Wailuku was declared as "Crown Land" to be used to support the Kingdom of Hawai‘i. Ruth Ke‘elikolani, half-sister of Kamehameha V (Lot Kapuāiwa), inherited the *ahupua‘a* of Wailuku from Lot Kapuāiwa on his death in 1872. Ruth Ke‘elikolani then sold a portion of her

Wailuku land holdings to the sugar-industrialist Claus Spreckels in 1882. Spreckels subsequently received Land Grant 3343 from King Kalakaua, that consisted of 24,000 acres of the southeastern portion of the Wailuku Ahupua‘a (Zambucka 1977:48).

The current project area extends through Land Grant 3343 and Land Grant 3152 to Henry Cornwell (Figure 14). During the Māhele, the lands surrounding Waikapū Commons were sold by the Department of Education in ten parcels, each amounting to more than 1,317 acres, and had Royal Patents issued for the sales in 1854. Later, all ten of these Royal Patents were surrendered and cancelled, and the land was quit-claimed back to the Board of Education in August 1860. In 1875 the Board of Education sold at auction the "Land known as the ahupuaa of Waikapu, saving grants hitherto made within said ahupuaa, or sales by the board of education" to Mr. Henry Cornwell, lands extending out from Waikapū Valley to the northwestern boundary of Pulehunui Ahupua‘a. (The Pacific Commercial Advertiser 1879:5). Cornwell acquired the lands in fee-simple under Royal Patent No. 3152. The lands purchased by Cornwell were added to the holdings of the Waikapū Sugar Plantation, originally started by Henry Cornwell and James Louzada on Grant 2951, before the plantation was sold in 1876.

### 3.1.4 Mid- to Late 1800s

A common crop on nearly all major Hawaiian Islands was sugarcane. With the passage of Hawaiian lands into the Western model of privatization, coupled with the decline of the indigenous population, the wet valleys on Nā Wai ‘Ehā began to shift away from subsistence farming toward plantation style sugarcane cultivation. The fertility of the river valleys of Nā Wai ‘Ehā were readily observed by visitors of the period. While traveling from Mā‘alaea to Waikapū a late nineteenth century observer describes the following scenic views:

> It took us about an hour to drive from Maalea to Waikapu and we began to see some indications of the beauty which the inhabitants of Maui ascribe to their beloved isle. The mountain mass that seemed shapeless is rent by a series of deep gorges—each, we were told, a scene of bewildering beauty, both in rock-scenery and foliage. (Cummings 1881)

In general, it appears the most agriculturally fertile lands of Waikapū Ahupua‘a did not extend beyond the alluvial sediments of the stream valley as the lower elevations leading into the central isthmus of Maui are dominated by windswept Pleistocene sand dune deposits (Foote et al. 1972:48, 115) (Figure 15).

#### 3.1.4.1 Waikapū Congregational Church

Prior to the surge in commercial sugarcane cultivation, Waikapū was inhabited by dominantly Hawaiian homes with nearby taro patches feeding from the waters of Waikapū Valley. The small community residing here established the Waikapū Congregational Church in 1838 as a home-based Christian service, sometimes utilizing the facilities of the distant Ka‘ahumanu Church in Wailuku. In 1868, the community was able to erect and dedicate a permanent structure (Figure 16). Residents moving to the region in 1908 recall that "we used to have ‘hoikes’, (rally days) there and folk from all Central Maui used to attend." According to residents, both the Wednesday night prayer services and Sunday all-day services would fill the church building to capacity (Head 1960).

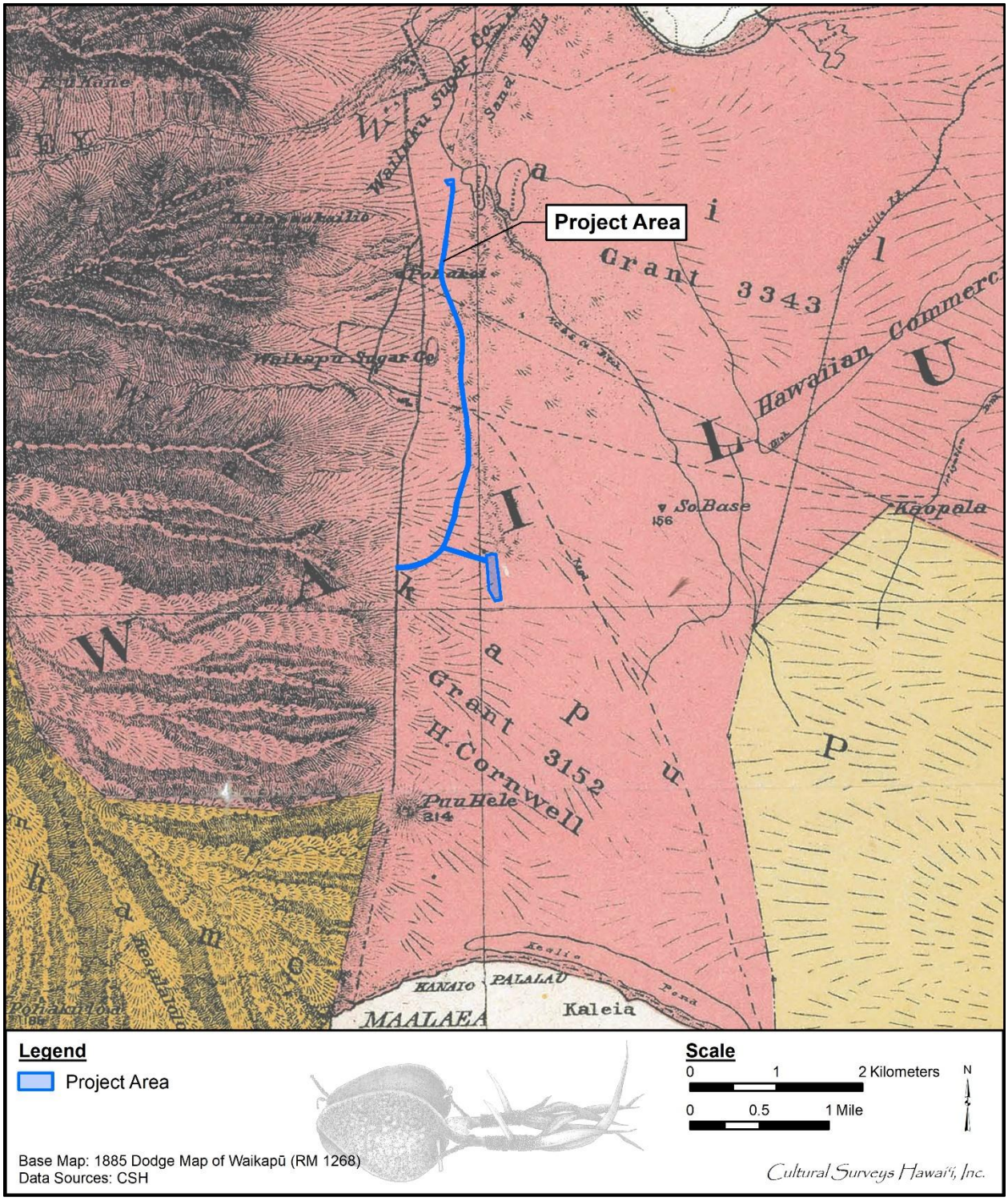



Figure 14. Portion of Dodge (1885) map showing the current project area within Grants 3152 and 3343

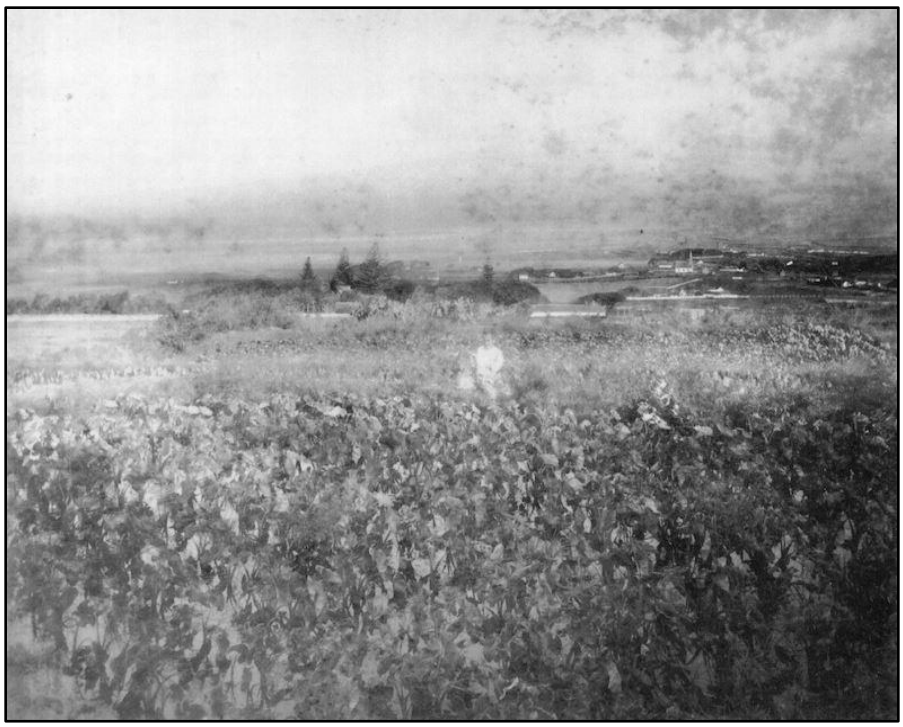


Figure 15. Historic photograph of the plains of Kama‘oma‘o (background) as viewed from the vegetated alluvial slopes of Waikapū Valley (Waikapu Community Association 2018)

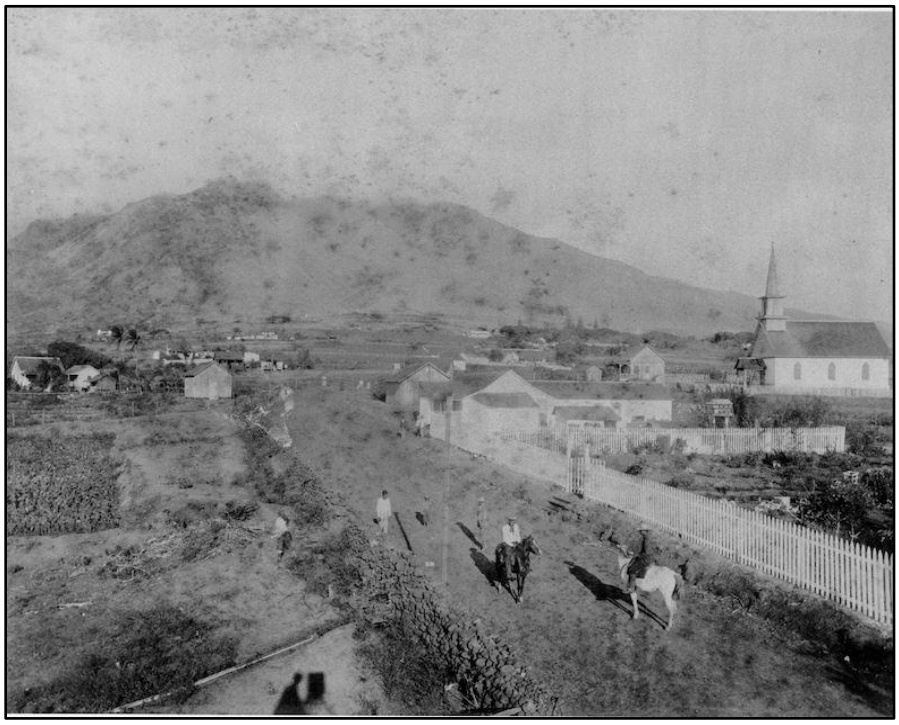


Figure 16. Historic photograph of Waikapū Congregational Church, Waiko Road, and the surrounding community (Waikapu Community Association 2018)

During World War II, Waikapū Congregational Church was turned over to the military and used as a surgical hospital. The Church building was used as a ward with an additional ‘nurses quarters’ built off to the side of the main structure. It was during this period that the church had its steeple removed for being too clear a target for potential marauding enemy submarine gunners (Figure 16). Although the steeple was re-erected after the war, it continuously leaked and was again removed from the building. As sugarcane cultivation began to dominate the region in the early to mid-twentieth century, residential dwellings dwindled, as did the attendees of the Waikapū Congregational Church. As full-time pastors became unnecessary, the church members voted to merge with the Kahului Church, and the Waikapū Congregational Church was abandoned to the sugarcane fields that surround it (Head 1960).

#### 3.1.4.1 Development of Commercial Sugar in Waikapū

Henry Cornwell arrived on Maui from New York and started the Waikapu Sugar Company with James Louzada (his brother-in law) in 1864. The two partners constructed a steam-powered sugar mill situated on a 17-acre parcel that had been part of Land Grant 2951; land originally purchased by Henry Cornwell and J. Louzada in Waikapū (Wilcox 1996:61) (Figure 18).

In 1878, Claus Spreckels bought an undivided interest in 12,000 acres of the Waikapū Commons from W.H. Cornwell and leased an additional 24,000 acres of adjacent Wailuku Commons crown lands from the government (Wilcox 1996:61). These lands would form a large portion of Hawaiian Commercial and Sugar Company (HC&S). The economic boom resulting from the passage of the Reciprocity Treaty in 1876 encouraged sugar baron Spreckels and other Hawaiian sugar planters to invest heavily in capital improvements such as irrigation systems, mills, and railroads. The reciprocity agreement with the U.S. brought down the heavy cost of high tariffs on sugar. In 1876, Henry Cornwell retired, and the remaining plantation lands were sold to the new partners Colonel W.H. Cornwell (Figure 19) and Colonel G.W. Macfarlane (The Honolulu Advertiser 1903:8). Henry Cornwell, originally born on Long Island in 1815, died in Waikapū in 1886 and was buried at Nu‘uanu Valley Cemetery on O‘ahu (The Honolulu Advertiser 1886:3)

During his time at the head of the Waikapū plantation the Col. William H. Cornwell nourished a healthy relationship with Hawaiian Royalty. As a close friend of King Kalakaua (Kamehameha V) and Queen Regent Liliuokalani, Col. Cornwell would host events for the monarchs on his Maui properties, including celebrations for the Kalakaua’s birthday that entailed festivities and horse races (Evening Bulletin 1888:3) (Figure 20). Kalakaua’s annual celebrations on November 16 would be remembered well into the early twentieth century for the excitement of the horse races and the occasional after-race polo match (The Honolulu Advertiser 1916). Col. Cornwell also was appointed a member of the king’s staff in the Revolution of 1887, elected to a four-year term as a member in the House of Nobles in 1890, and served a very short stint as the Minister of Finance in the cabinet of Queen Regent Liliuokalani (The Honolulu Advertiser 1903:8).

Most of the Waikapu Commons and across the isthmus was covered with sugarcane by the mid-nineteenth century. Waikapu Sugar Company operated from 1862 to 1894, when it was purchased and incorporated into the holdings of Wailuku Sugar Company (Kaukali and Subica 2010).

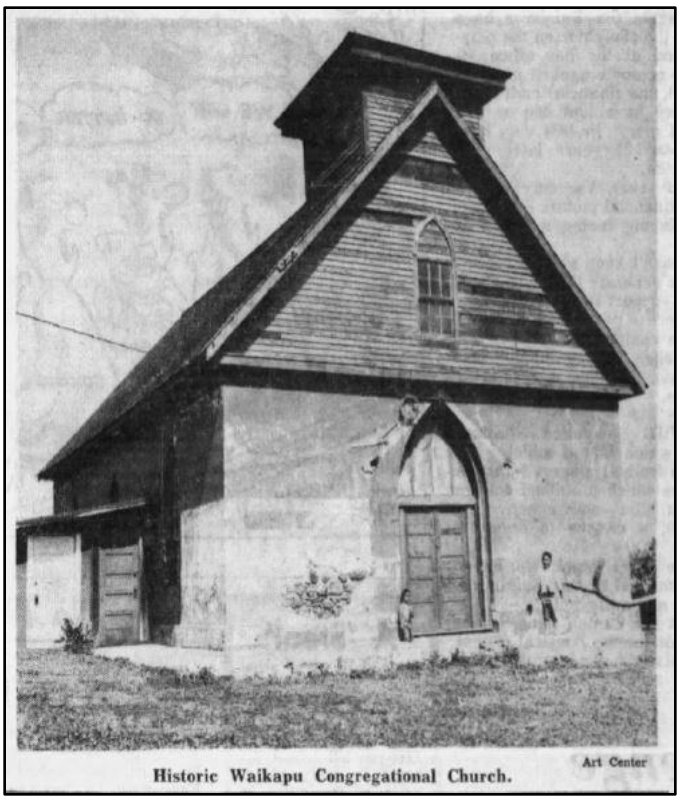


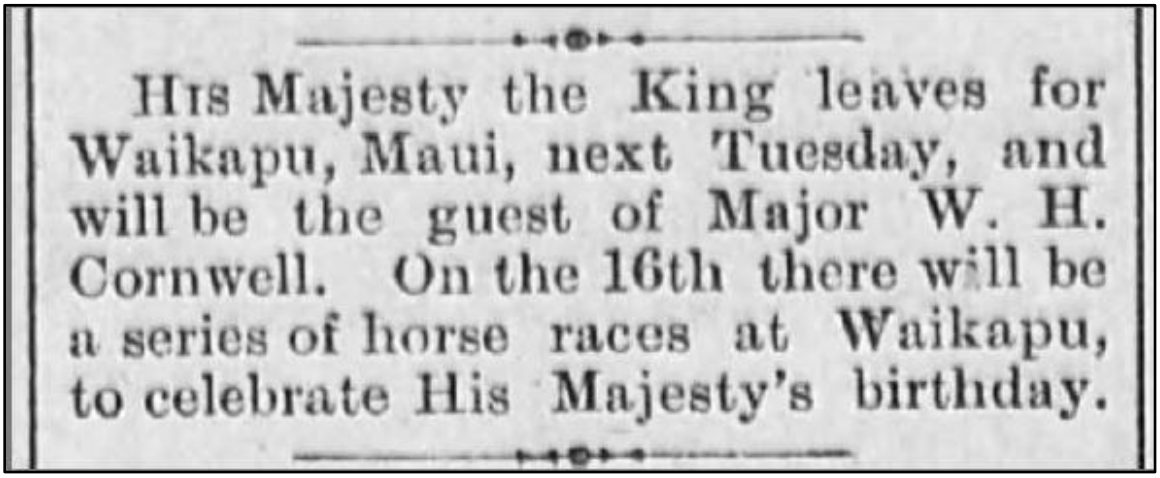

Figure 17. Waikapū Congregational Church after having its steeple removed during WWII (Waikapu Community Association 2018)




Figure 18. Waikapu Sugar Company mill, ca. 1890 (Waikapu Community Association 2018)



Figure 19. Colonel William H. Cornwell in the garb of the Hawaiian Royal Court (Unknown 1893)



His Majesty the King leaves for Waikapu, Maui, next Tuesday, and will be the guest of Major W. H. Cornwell. On the 16th there will be a series of horse races at Waikapu, to celebrate His Majesty's birthday.

Figure 20. Newspaper announcement for the arrival of Kamehameha V visit to W. H. Cornwell on Maui for the King's birthday (Evening Bulletin 1888)

3.1.4.1 Organization of the Wailuku Sugar Company

A Chinese planter, Hungtai, is reputed to have operated the first sugar mill at Wailuku in 1823. As early as 1840, the first sugar venture organized by the Kingdom of Hawaii was begun by Kamehameha III (Kauikeaouli), at Wailuku (Moffat and Fitzpatrick 2004:54). The king's Wailuku plantation and mill were described by the Protestant missionary, Richard Armstrong:

> The King has given out small lots of land, from one to two acres, to individuals for the cultivation of cane. When the cane is ripe, the king finds all the apparatus for manufacturing and when manufactured takes the half. Of his half, one fifth is regarded as the tax due to the aupuni (Hawaii Department of Survey) & the remaining four fifths is his compensation for the manufacture. These cane cultivators are released from all other demands of every description on the part of the chiefs [from Hawaiian Mission Children's Society Wailuku Station Report 1839]. (MacLennan 1997:33)

The modern plantation framework for the Wailuku Sugar Company began in the 1850s by the Protestant missionary Edward Bailey and one of his sons. Their early water-run mill was eventually merged with sugar cultivation performed by Bal and Adams. These pioneer sugar partners later began the Wailuku Sugar Company. In 1862, the partners of the Wailuku Sugar Company grew to include James Robinson & Company, Thomas Cummins, and J. Fuller (Wilcox 1996:122). In 1863, Charles Brewer became a major partner in the operation of the Wailuku Sugar Company. By 1867, the Wailuku Sugar Company had 2,250 acres planted in cane. The Wailuku Sugar Company incorporated in 1875 and began to become profitable. In 1877, the Baileys were bought out (Nellist 1925:70).

3.1.4.2 The Waikapū Division of the Wailuku Sugar Company

The Waikapū sugar lands became a part of the Wailuku Sugar Company in 1894. Beginning in 1880, the Waikapū plantation lands began to be merged with those of the Wailuku and Waihee plantations. During the 1880s, F.L. Hoogs was named the head overseer of the Waikapu Division of the Wailuku Sugar Company. In 1887, American sugar growers revolted against the Hawaiian Monarchy and demanded a more liberal Constitution, which was granted, under duress, by Kalākaua. In 1905, a new sugar mill was constructed in Wailuku to accommodate the sugar brought in from the new outlying plantations, including Waikapū (Kaukali and Subica 2010:98).

The economic progress of the Wailuku Sugar Company required the importation of foreign labor. The increase in the labor population at the plantations required larger laborer camps. By the 1890s, a network of plantation housing camps had been established at the Waikapu Division of the Wailuku Sugar Company. These included Hopoi Camp, located at the Hopoi Reservoir, upland of the Wai‘ale Reservoir; Waikapu Camp, located downslope of the Palolo Ditch and the south side Waikapū Ditch, on the Waikapū Stream; Hyashi Camp, located just west of Waikapu Camp, toward the Pu‘u Hele cinder cone; Kimura Camp, located further west from Hyashi Camp; Pu‘u Hele Camp, located at the base of a cinder cone downslope of the Pohakea Gulch, where today the North Kīhei Road meets the Honoapi‘ilani Highway and the Pu‘u Hele Cemetery (Figure 21). In the 1880s, immigrants from South America began to settle in Waikapū. They worked the sugar fields and brought their love of horseracing to the plantation culture of Maui (Kaukali and Subica 2010:98).

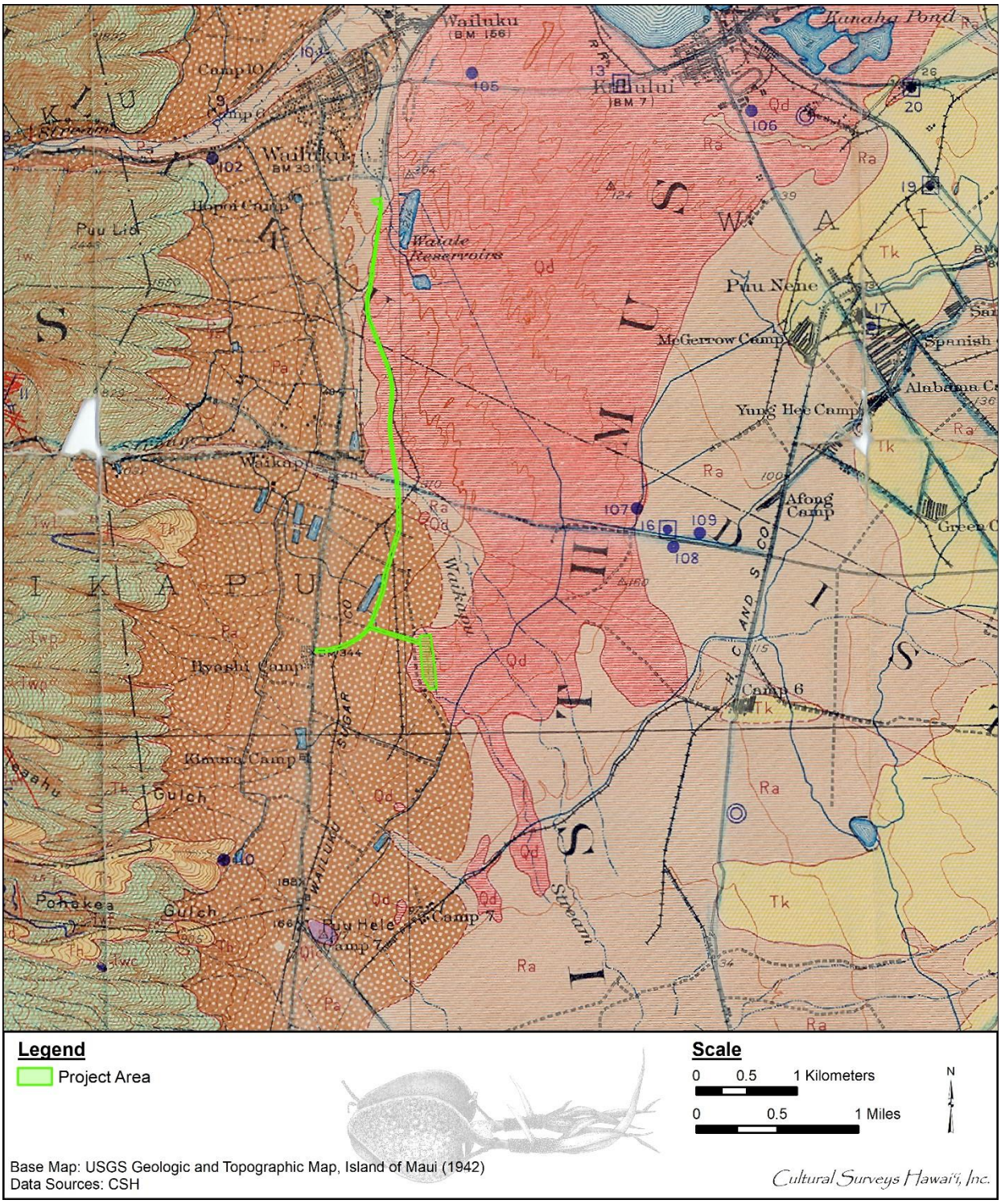



Figure 21. Portion of a 1942 Island of Maui USGS geologic and topographic map showing testing locations, calcareous sand dunes, unconsolidated deposits of younger alluvium, consolidated earthy deposits of older alluvium, and erosional unconformity of Kula volcanic series flows (U.S. Geological Survey 1942)

The traditional *konohiki* system of water division was evident at the Waikapu Division of the Wailuku Sugar Company. In an 1896 lawsuit (Cornwell v. Wailuku Sugar Company), testimony was entered regarding the destruction of traditional *kuāuna* (embankments of taro patches). This testimony established that, along with the growing of cane in the region, the traditional farming of taro had continued based on the customary rights of landowners under the old Hawaiian tenure. The Wailuku Sugar Company brought the action to stop traditional landowners from diverting irrigation water for raising taro (Hawaii Supreme Court 1896).

3.1.4.1 Hawaiian Commercial and Sugar in the Central Isthmus

The success of sugar grown in the region resulted in a second large plantation, in Waihe‘e, producing over 757 tons of sugar and 45,000 gallons of molasses in 1865. The Waihe‘e Mill manager was Samuel T. Alexander, and the mill’s head foreman was Henry P. Baldwin, both of whom would resign in the late 1860s to establish a small sugar enterprise of their own in upper Pā‘ia (Gilmore 1936).

In 1869, on land located directly west of Pā‘ia, a small *kuleana* of 11.94 acres was purchased by S.T. Alexander and his business partner, H.P. Baldwin, both descended from Lāhainā missionary families, who were eager to apply their agricultural experience to their own plantation. This initial land purchase was the beginning of the development of the entire central isthmus for sugar cultivation. In rapid succession, Alexander & Baldwin expanded its operations by purchasing other small *kuleana*, setting up a mill, and attracting more investment capital (Dean 1950).

In 1876, a treaty was signed between the Kingdom of Hawai‘i and the United States, the Reciprocity Treaty, which opened larger and more lucrative markets for Hawaiian sugar. Plans were immediately drawn up by Alexander & Baldwin to finance a ditch to bring water from the Hāna region of East Maui to the arid plains of Pā‘ia. The Kingdom of Hawai‘i issued a lease for the construction right-of-way, and in 1879, the successful venture delivered millions of gallons of water to the central isthmus via the Hamakua Ditch (Wilcox 1996).

Competition was supplied by Claus Spreckels who engineered a similar irrigation ditch from Honomanū in East Maui to lands located just inland of Kahului, where the Spreckelsville Mill and plantation camp were built. Spreckels invested three million dollars in the HC&S and competed for sugar lands, wharf and warehouse space, railway lines, and shipping schedules with Alexander & Baldwin (Dorrance and Morgan 2000).

In 1882, Spreckels, following his success in building the Honomanu Ditch linking East Maui water sources with his sugar fields in the central isthmus, further capitalized on that success to engineer the Waihe‘e Ditch [also named the Spreckels Ditch] in West Maui. The 15-mile-long ditch started at the 435 foot elevation of Waihe‘e Stream, and carried 60 million gallons of water (per 24-hour day) to the Wai‘ale Reservoir at the 214 foot elevation of Wailuku. Spreckels became the first plantation owner to irrigate his fields by water from both Haleakalā and the West Maui mountains (Wilcox 1996). By 1888, the Spreckels plantation covered 28,000 acres, making it the largest sugar plantation in the world. Financial pressures forced Spreckels to give up control of HC&S to Alexander & Baldwin in 1898 after a long and fierce battle (Dean 1950). An 1885 Dodge map of Maui shows early encroachment of HC&S cultivation lands into the Waikapū area (Grant

3343) (see Figure 14) and a 1920s USGS map shows the extent of HC&S sugar lands and the associated sugar plantation infrastructure, such as irrigation ditches and labor camps, in the vicinity of the project area (Figure 22).

In 1899, HC&S determined that cultivating the Pu‘unēnē plains required far more water than the original Hamakua Ditch could provide. The Lowrie Ditch project, completed in 1900, was undertaken to provide an additional source of water to the central Maui plains. The ditch began at the Pāpa‘a‘ea Reservoir, at 1,000 ft elevation, and maintained a four-foot drop per mile following the ditch's initial plunge from the Kailua reservoir. Steep mountain gulches were traversed using the force of the constant weight of water flowing in a series of siphons. The Halehaku Gulch, at 250 ft deep, and the Māliko Gulch, at over 350 ft deep, were both crossed by giant siphons fabricated of three-eighths-inch iron and set in place by Japanese laborers (Thrum 1900).

### 3.1.5 1900s

In 1912, HC&S began to modernize the existing plantation camps. Between a huge influx of immigrant workers in 1909, and the burning of village areas of Pā‘ia and Kahului to control smallpox in 1910, changes to the camp system were in full swing. The plantation workforce continued to expand until 1917, when the U.S. declared war on Germany, and the accompanying draft seriously depleted the labor pool. By 1919, postwar requirements for sugar had driven the price to an all-time high of $471.40 per ton (Burns 1991). The post-WWI years saw the sugar industry, and companies like HC&S, add electricity to some villages. HC&S completed the Waikapū well [Well 7] in 1926; one of the largest deep wells in the world. The additional capacity of 40 million gallons per day (mgd) provided by this well was instrumental in planning more sugar and industry within Maui's central plains (Stearns and Macdonald 1942:216).

On 11 November 1929, Inter-Island Airways, Ltd. (later Hawaiian Airlines) began flying regularly scheduled flights between the Hawaiian Islands. Amphibious eight-passenger Sikorsky S-38 aircraft landed at Mā‘alaea Bay, taxied up a concrete ramp, and delivered passengers to waiting automobiles for the trip through Waikapū to Wailuku, and points beyond (Saito 2009). By 1936, the airline had purchased three new sixteen-passenger Sikorsky S-43 aircraft to supplement their four S-38s (Kennedy 1937). With air travel between islands increasing, plans were underway to build a land-based air strip at Pu‘unēnē in Pūlehu Nui Ahupua‘a in lieu of the smaller airport located at Mā‘alaea Harbor.

#### 3.1.5.1 Pre-WWII Aviation History

The Civil Aviation Authority (CAA) for the Territory had recommended an airport for Pu‘unēnē to accommodate the growth of commercial service in the early 1930s. The site was approved by the U.S. Army, Inter-Island Airways, the HC&S, the Kahului Railroad Company, and the CAA. Three intersecting runways were designed alongside the existing government roadway and railway lines connecting Kīhei Village to the HC&S mill and village at Pu‘unēnē.

By the mid-1930s, it was clear that Japanese aggression against mainland China was jeopardizing the political stability of the Pacific region (Morison 1951). Pacific Naval Air Bases (PNAB) construction engineers were assigned to reinforce United States military outposts across the Pacific. In Hawai‘i, the construction of new civilian airports at Kane‘ohe, (O‘ahu) and Pu‘unēnē (Maui) was undertaken by the U.S. Engineer Department (later U.S. Army Corps of

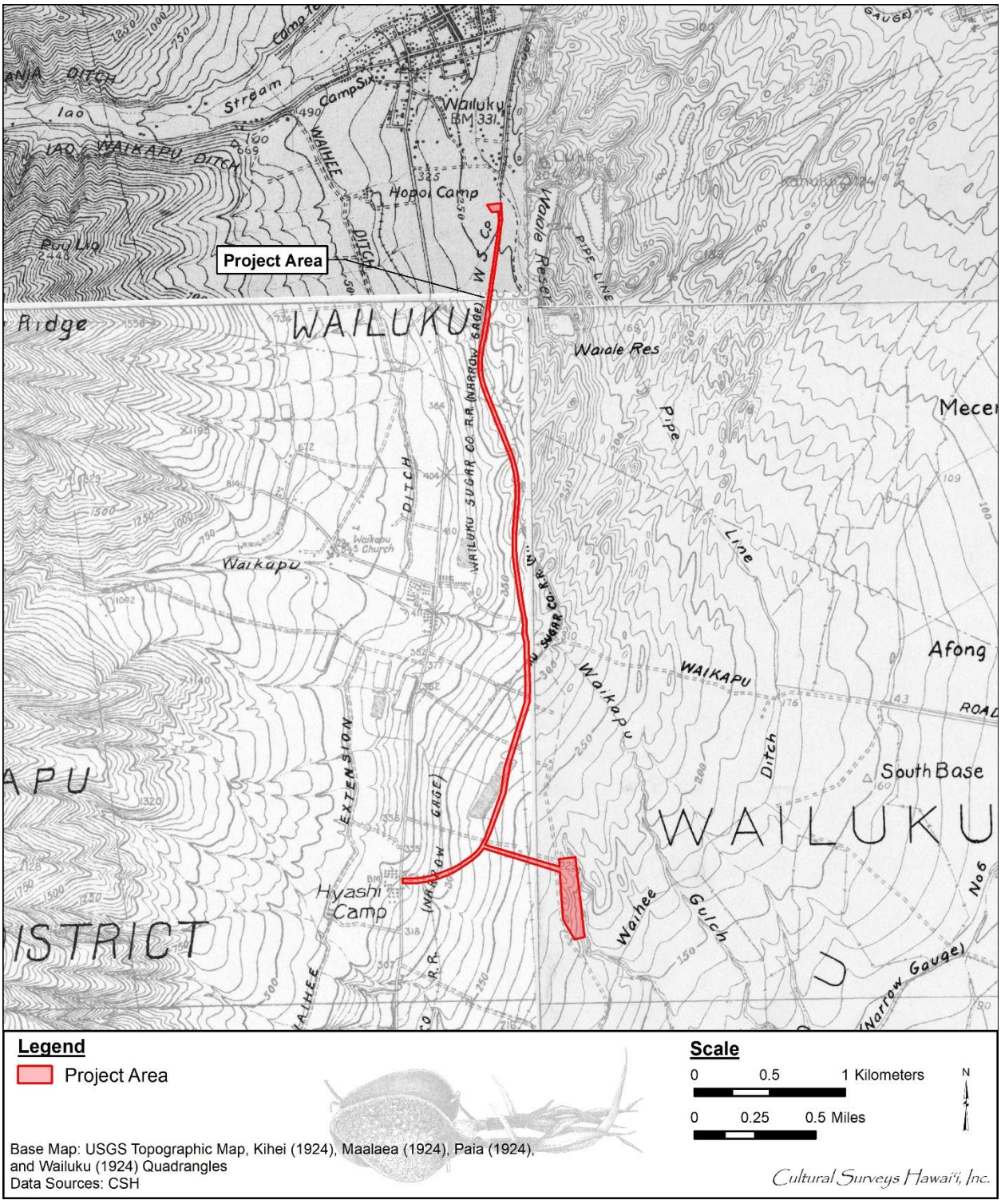



Figure 22. Portions 1922 Kihei, 1923 Maalaea, 1924 Paia, and 1924 Wailuku USGS topographic quadrangles showing plantation camps, railways, and unimproved cane roads around the project area (U.S. Geological Survey 1922, 1924a, 1924b, 1924c)

Engineers [USACE]) contractors. Prior to 1940, 13 separate defense-related construction projects were begun in the Hawaiian Islands, primarily at Pearl Harbor (Woodbury 1947).

The Hepburn Board, a commission of six officers and engineers reporting to the U.S. Navy, authorized the immediate military-backed expansion of an existing design for a civilian airfield at Pu‘unēnē. Quarters for a permanent utility squadron, as well as for rotating Carrier Air Service Units (CASU) crews, were hastily approved (Woodbury 1947). the U.S. Engineer Department and PNAB construction crews began work on 17 June 1940, building quarters and messing facilities for 500 men. The Navy used barracks at the National Guard Camp in Paukūkalo while completing buildings at Naval Air Station (NAS) Pu‘unene (Shettle 1997).

Two 50,000-gallon above-ground gasoline tanks were erected, and railroad spurs were laid to facilitate a direct supply line with the Kahului Harbor. As work progressed, a slew of change orders added bombproof revetments for aircraft storage, as well as bomb and ammunition magazines. By the time Pearl Harbor, on the island of O‘ahu was attacked, NAS Pu‘unene was an active training base (United States Department of the Navy 1947).

The location of Utility Squadron Three (VJ-3) at the Pu‘unēnē airfield was found to be ideal for operations involving the use of radio-controlled aircraft for anti-aircraft training. The development of radio-controlled full-scale aircraft was code-named “Project Dog,” and began as a military program located on the east coast of the United States in the mid-1930s (Farhney 1982). “Project Dog” was moved to San Diego in 1938, and finally to the Navy’s Maui Airport at Pu‘unēnē early in 1940, in order to prove the practicality of radio-controlled assault drones. These tests were the earliest experiments leading towards the development of the guided missile.

Full-scale fortification of the Hawaiian Islands began January 1940, immediately after President Franklin D. Roosevelt cancelled all trade agreements with Japan. On 7 May 1940, the U.S. Pacific Fleet was ordered out of the port of Los Angeles, to be based at Pearl Harbor, in the Territory of Hawai‘i. This action was designed as a deterrent against further aggression by Japan in the Pacific region (Morison 1951).

Lieutenant Robert F. Jones commanded VJ-3 at NAS Pu‘unene, and advanced the syllabus of testing radio-controlled aircraft to the point where a radio-controlled aerial torpedo was thought to be possible. By April 1941, the Navy’s efforts to develop a practical way to control drone aircraft from greater distances was in full swing (Foundation 2002). In the middle of this research program, Navy Fighting Squadron VF-2 arrived at the Pu‘unēnē aerodrome for training purposes in April 1941.

Based aboard the aircraft carrier *U.S.S. Lexington*, the “Flying Chiefs” of VF-2 trained on Maui for approximately two months, returning to sea with the *U.S.S. Lexington* to take part in operations to ferry aircraft and supplies to Midway Island. The training regime of VF-2 included the use of “unrestricted air space for gunnery and tactics and many nearby bombing and strafing targets” (Lacouture 1989). The target range was located at lower ‘Ulupalakua, and the aircraft used practice bombs filled with lime powder and beach sand to mark their accuracy.

In May 1941, the 1st Battalion of the Army’s 299th Infantry Regiment was assigned to establish defensive positions along the exposed coastal areas of Maui. Tents housing the administrative section for the Army’s 24th Infantry Division, and the 4th Platoon Signal Company, Aircraft

Warning Air Corps Detachment, were located within a 14-acre section at the Maui Airport at Pu‘unēnē (Allen 1950).

Plans were drawn up to expand the airfield to a size large enough to support both a U.S. Navy carrier air group and an U.S. Army Air Corps bombardment group. On average, pre-war U.S. Navy air groups consisted of 90 aircraft, made up of scout, dive-bomber, fighter, and torpedo divisions. A pre-WWII U.S. Army Air Corps bombardment group, consisting of three squadrons of medium or heavy bombers, would have numbered about 30 aircraft (Morison 1953).

#### 3.1.5.2 World War II

With the outbreak of war between Japan and the U.S., NAS Pu‘unene became the command headquarters for both Navy and Army units on the island of Maui. Plantation heavy equipment and plantation operators worked side-by-side with U.S. Engineering Department personnel to accelerate construction of defensive positions and immediately lengthen runways at the base. The call for an immediate extension of the runways to military specifications involved extensive engineering to reroute miles of irrigation culverts for the HC&S. The dispersion of facilities planned for NAS Pu‘unene would come to utilize over 2,500 acres of land, and involve housing for over 5,000 men (Command History 1945).

The 7 December 1941 attack on Pearl Harbor forced the “Project Dog” program at NAS Pu‘unene to assign its research to safer bases in the mainland United States. Wartime operations for VJ-3 would concentrate exclusively on providing radio-controlled aircraft as realistic targets for fleet anti-aircraft gunnery training exercises (Foundation 2002). Under wartime conditions, responsibilities for VJ-3 included maintaining an intense schedule of weather flights, rescue flights, and anti-submarine reconnaissance flights in the waters surrounding Maui.

Early in 1942, the first Carrier Air Service Unit, CASU-4, was commissioned at NAS Pu‘unene, and the utility squadron personnel of VJ-3 were reinforced by Naval Air Station Officers. In June 1942, U.S. Navy Fighting Squadron 72 (VF-72), the first of over 150 squadrons of U.S. Navy fighter, bomber, and scout aircraft, arrived for advanced training prior to moving into forward combat areas (Wilcox 2004). For four days in early June 1942, as the Battle of Midway raged 600 miles to the northwest, NAS Pu‘unene personnel were ordered into shelters and revetments, expecting bombing raids by Japanese aircraft sweeping across the Hawaiian archipelago (Paul Vint in Hill et al. 2007). With the success of American naval forces at Midway, the threat of a Japanese invasion of the Hawaiian Islands was postponed, and U.S. efforts to outfit military bases in the Hawaiian Islands for wartime training were redoubled.

Anti-aircraft gun emplacements and protective aircraft revetments were given top construction priority by the U.S. Pacific Naval Air Bases supervisors. Heavy equipment and civilian operators from Wailuku Sugar Company and Hawaiian Commercial & Sugar Company were employed at NAS Pu‘unene with their pay charged back to the U.S. government. Sugar milling at plantations across the Hawaiian Islands was confined to daylight hours until “blackout” procedures for night operations were approved (HC&S Archives).

U.S. Engineering Department construction contractors were reinforced at NAS Pu‘unene by additional PNAB personnel in July 1942. Domestic water pipelines were laid by HC&S to supply military camps being constructed at ten separate locations across the central Maui plains, including

the Camp 6 location proximate to NAS Pu‘unene. The main government road and the railroad lines that served the wharf at North Kīhei were rerouted, as NAS Pu‘unene expanded. The U.S. Army National Guard 108th Regiment, 27th Infantry Division, took up defensive duties along Maui’s coastlines beginning in March 1942, and occupied formal headquarters at NAS Pu‘unene.

On 16 November 1942, 400 men forming an advance echelon of the U.S. Navy 39th Construction Battalion (“SeaBee”) arrived at NAS Pu‘unene to begin construction of underground fuel bunkers, bombproof buildings, ammunition magazines, and an aviation ground school. By 20 September 1943, the first aircraft of Composite Squadron 23 (VC-23) landed with personnel and gear on hand for duty. Carrier Air Service Unit 32 assumed command of modifying and maintaining the aircraft of each visiting training squadron for combat duty in the Pacific Theater of Operations (Eggertsen 1947). The 39th SeaBees built 19 concrete ammunition storage magazines in Kanahā Pond, structures that remain today as storage bunkers for the County of Maui and the State of Hawai‘i. Construction of NAS Kahului continued in mid-June 1944 with the arrival of the 142nd SeaBees (United States Department of the Navy 1947).

In full operation, both NAS Pu‘unene and NAS Kahului were virtual cities in themselves. Each employed several hundred of civilian clerical and maintenance workers and provided housing to thousands of U.S. military personnel. At NAS Kahului, Construction Battalion Maintenance Unit (CBMU) personnel from CBMU 563 arrived 29 December 1943. The unit was responsible for the continued operation of refrigeration, water purification and electrical components in kitchens, hospitals, churches, barracks, and offices. The open coastline at NAS Kahului allowed for live-fire training areas, where gunners practiced firing machine guns from turrets constructed to duplicate those on board scout-bombers and torpedo bombers (U.S. Navy 1945).

Immediately following the August 1945 surrender of Japan to the military forces of the U.S., additional facilities essential to the operation of NAS Kahului were removed from NAS Puunene. A bowling alley, bakery, and other specialized structures at NAS Puunene were relocated to NAS Kahului, only to be partially or entirely destroyed by a series of tidal waves that struck NAS Kahului facilities in 1946. On 1 April 1946, the Kahului Harbor and NAS Kahului suffered serious damage after a tidal wave generated in the Aleutian Islands, Alaska, struck the north coast of Maui. Kahului Harbor was left empty when the water receded. The Coast Survey tide gage recorded five waves with heights in excess of 9 ft during the first 90 minutes of the tsunami, two of the waves being greater than 11 ft (Green 1946).

At the end of World War II, the small harbor landing at Kā‘anapali closed. All pineapple shipments from the Baldwin Packers Cannery in Lāhainā were trucked to the port of Kahului for shipment. The systematic closing of all military installations on Maui saw the departure of over 15,000 men from “Maui’s Own” 4th Marine Division. During October and November 1945, Marines of the 23rd, 24th, and 25th Regimental Combat Teams, plus their attached support groups, boarded aircraft carriers docked at the port of Kahului for deactivation in California (Proehl 1946). By 30 June 1947, the transfer of NAS Kahului to the CAA for the Territory of Hawai‘i was well underway, and virtually all military equipment of NAS Kahului had been shipped to military installations in Guam, Okinawa, or Midway Island (Eggertsen 1947). By the end of 1948, the site of the former NAS Kahului had been chosen to replace the Pu‘unēnē site for all future civilian flight operations.

By quitclaim deed dated 31 December 1948, the lands of the former air base were transferred from the United States back to the Territory of Hawai‘i. The remaining base facilities, most of which were wooden structures, had, by that time, been abandoned or demolished. In May 1951, the operations of Hawaiian Airlines and Trans-Pacific Airlines (formerly Aloha Airlines) were moved to the new civilian airport at Kahului, which utilized the runways of the former Naval Air Station Kahului. Thereafter, the airfield at Pu‘unēnē was placed on “caretaker status”, and sugar cultivation reclaimed much of the land area formerly dedicated to the aerodrome.

In addition to sugarcane cultivation, much of the lands of Waikapū in the mid-twentieth century were also tied-up in pastural endeavors (Figure 23). In 1952, over 7,000 acres of land along the base of the West Maui Mountains, spanning from Waikapū to Ukumehame, were sold at auction in two leases (15- to 21-year lease terms) for $16,582. These land tracts served as hog and cattle pasturage (Honolulu Star Bulletin 1952:5).

### 3.1.6 Contemporary Land Use

Following World War II, buildings erected during reconstruction of Kahului in the 1910s and 1920s slowly gave way to post-war modernization. HC&S Company camp housing for the Kahului Store, including housing along Mill Street and Pu‘unēnē Avenue for stevedores and railroad workers, began to be dismantled. Areas once occupied by the military returned to cattle ranching, pineapple, and sugar cultivation. Maps and aerial images depict the changing development of the project area (Figure 24 through Figure 27).

The pace of social change began to accelerate. The political power base of the County of Maui began to include *Nisei*, second-generation Japanese Americans who had returned from service in Europe during World War II. Their involvement in county politics began to swing political power from the large agribusiness owners to the union leaders representing plantation workers eager for a change (Speakman 1978). Trucks and buses had replaced passenger transportation once provided by railroads. Cars that had been set up on blocks and stripped of their rubber tires as a wartime rationing measure were back on Maui’s roads (Bartholomew and Bailey 1994).

Early post-war years (1946-1950) saw the construction of H.P. Baldwin High School and Maui Memorial Hospital in Wailuku. In 1947, plans began for wholesale development of Kahului as a master-planned community providing fee-simple ownership of single-family homes (The Honolulu Advertiser 1956). The majority of homes, which were located between Baldwin High School and Pu‘unēnē Avenue, were purchased by plantation employees and servicemen returning from duty overseas. This trend continued throughout the 1950s, with plantation camp populations falling in the outlying communities, including Pu‘unēnē, and rising in the central town site of Kahului’s new “Dream City” (Dean 1950).

During the Korean War years (1950-1953), modernization of the workforce and stronger unions brought a host of changes to the central region of Maui. The railroads of the prewar age were replaced by trucks and mechanized sugar and pineapple harvesters. Modern facilities at Kahului Harbor meant that canned pineapple, bulk sugar, and molasses could be loaded onto ships faster.

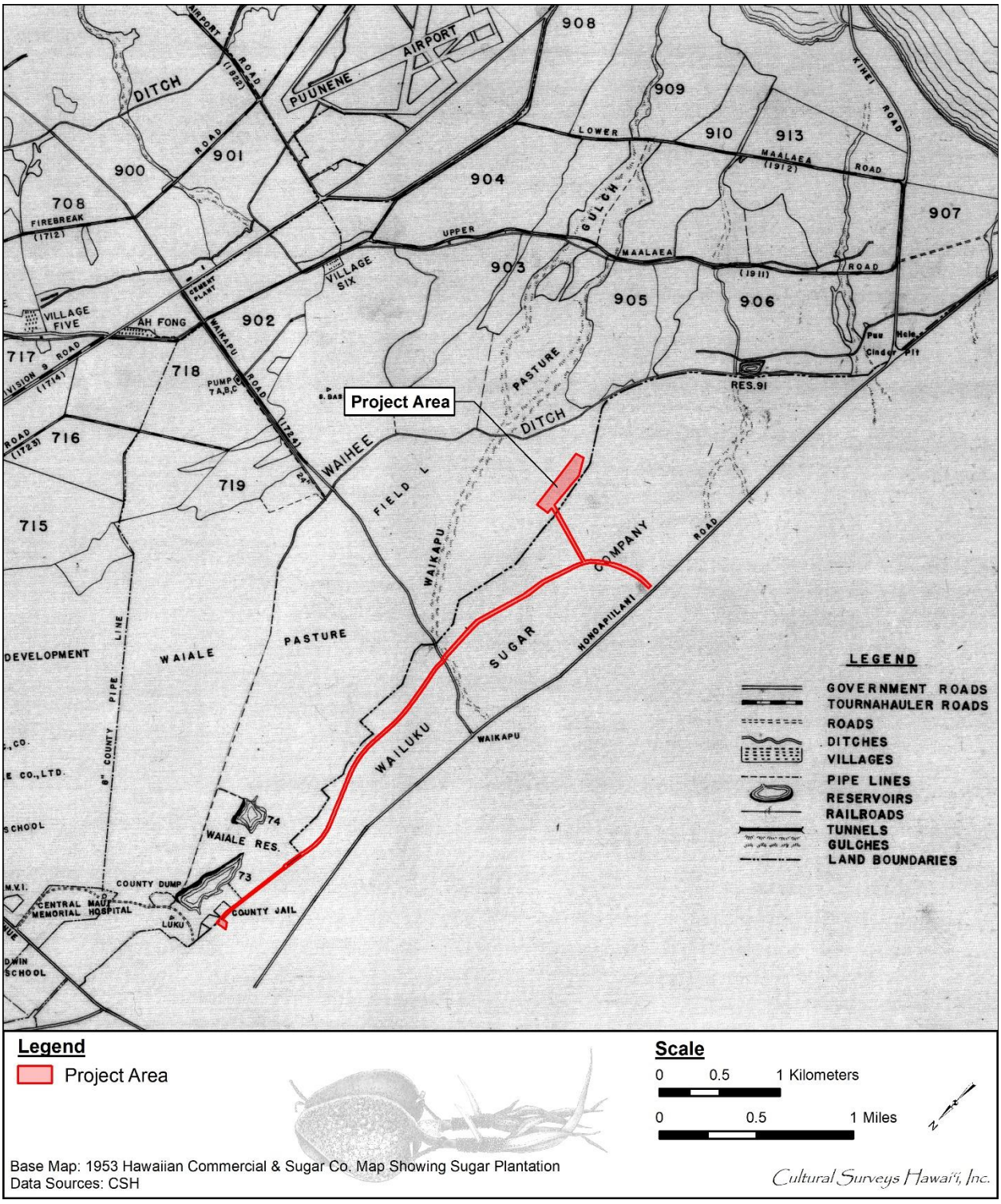



Figure 23. Hawaiian Commercial & Sugar Co. (1953) map showing the sugar plantation fields, Waikapu Pasture, Waikapu Road, and Waihe‘e Ditch

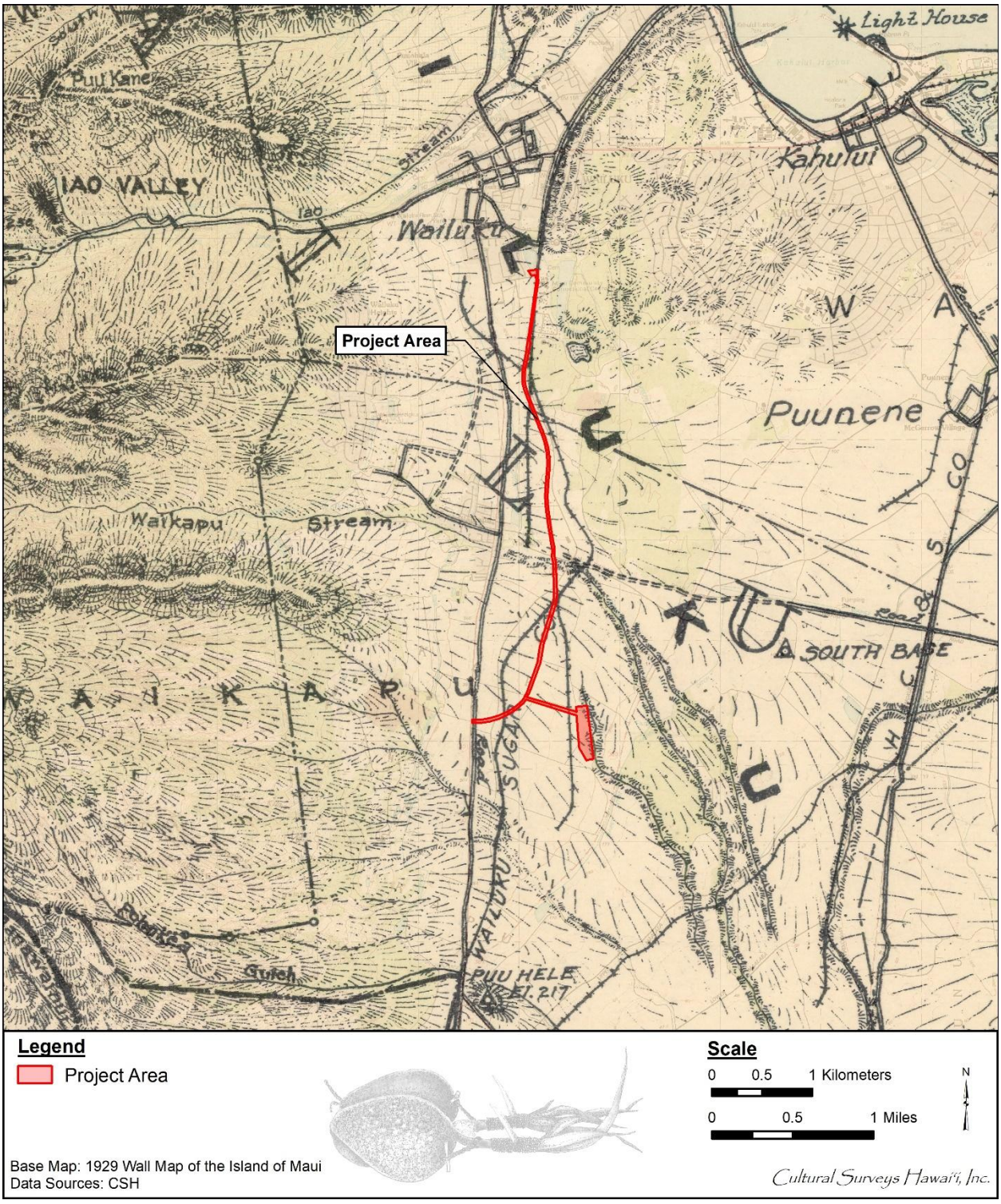



Figure 24. Portion of the Wall (1929) map of Maui showing the limited development surrounding the project area

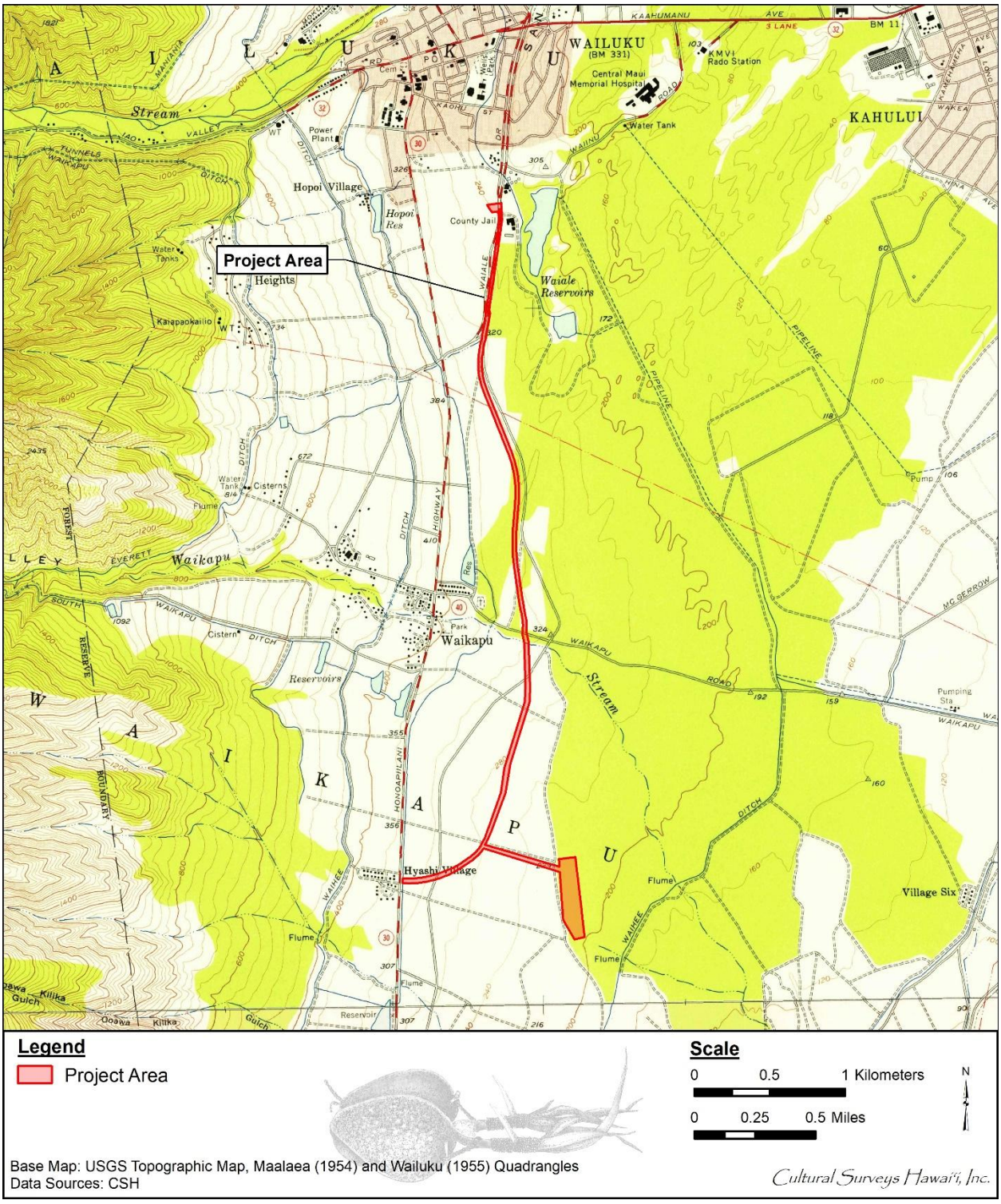



Figure 25. Portions of the 1954 Maalaea and 1955 Wailuku USGS 7.5-minute topographic quadrangles showing the project area and surrounding ditches, roads, and plantation camps (U.S. Geological Survey 1954, 1955)

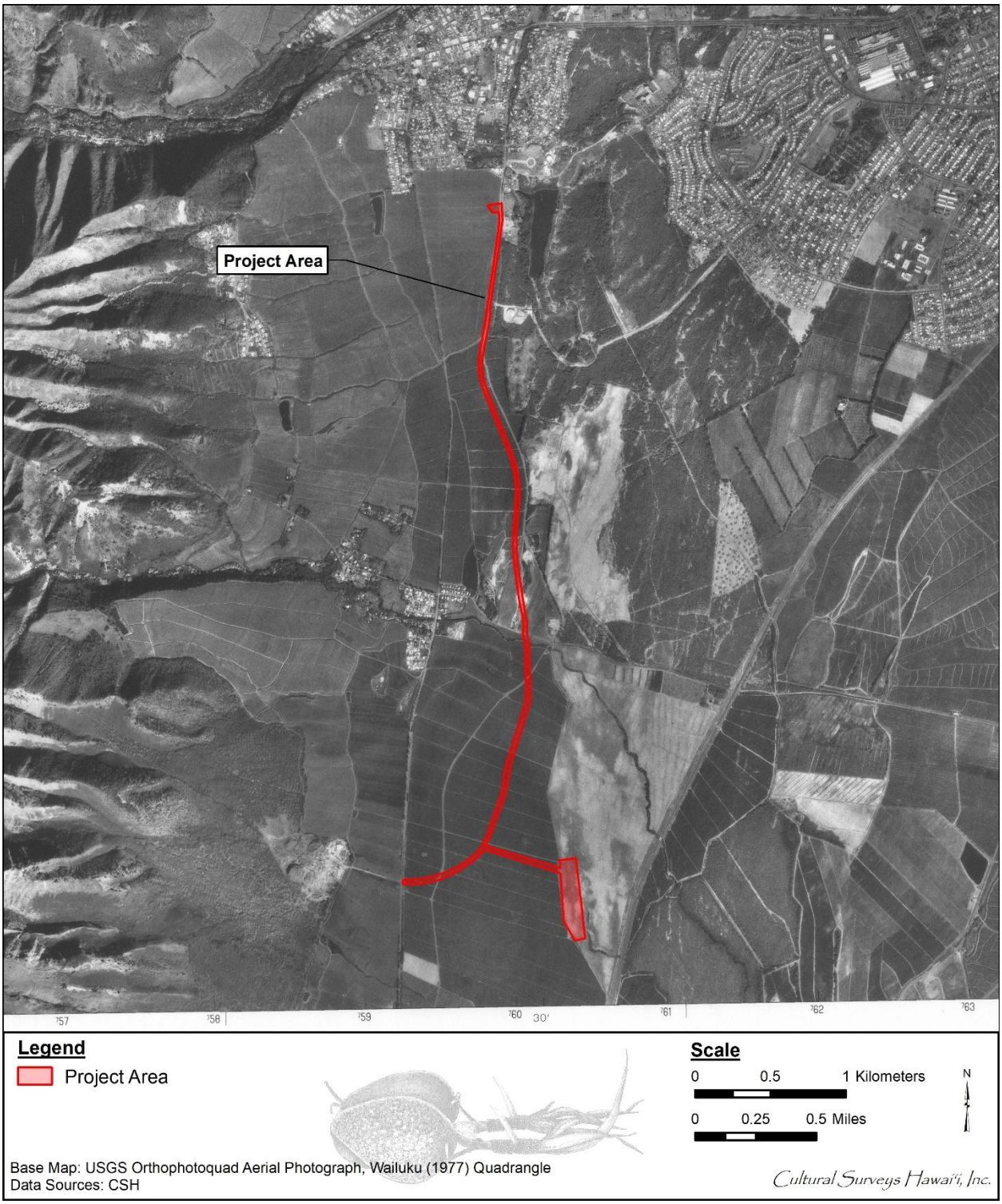



Figure 26. Portion of the 1977 Wailuku orthophotoquad showing the extent of sugar cultivation around the current project area (U.S. Geological Survey 1977)

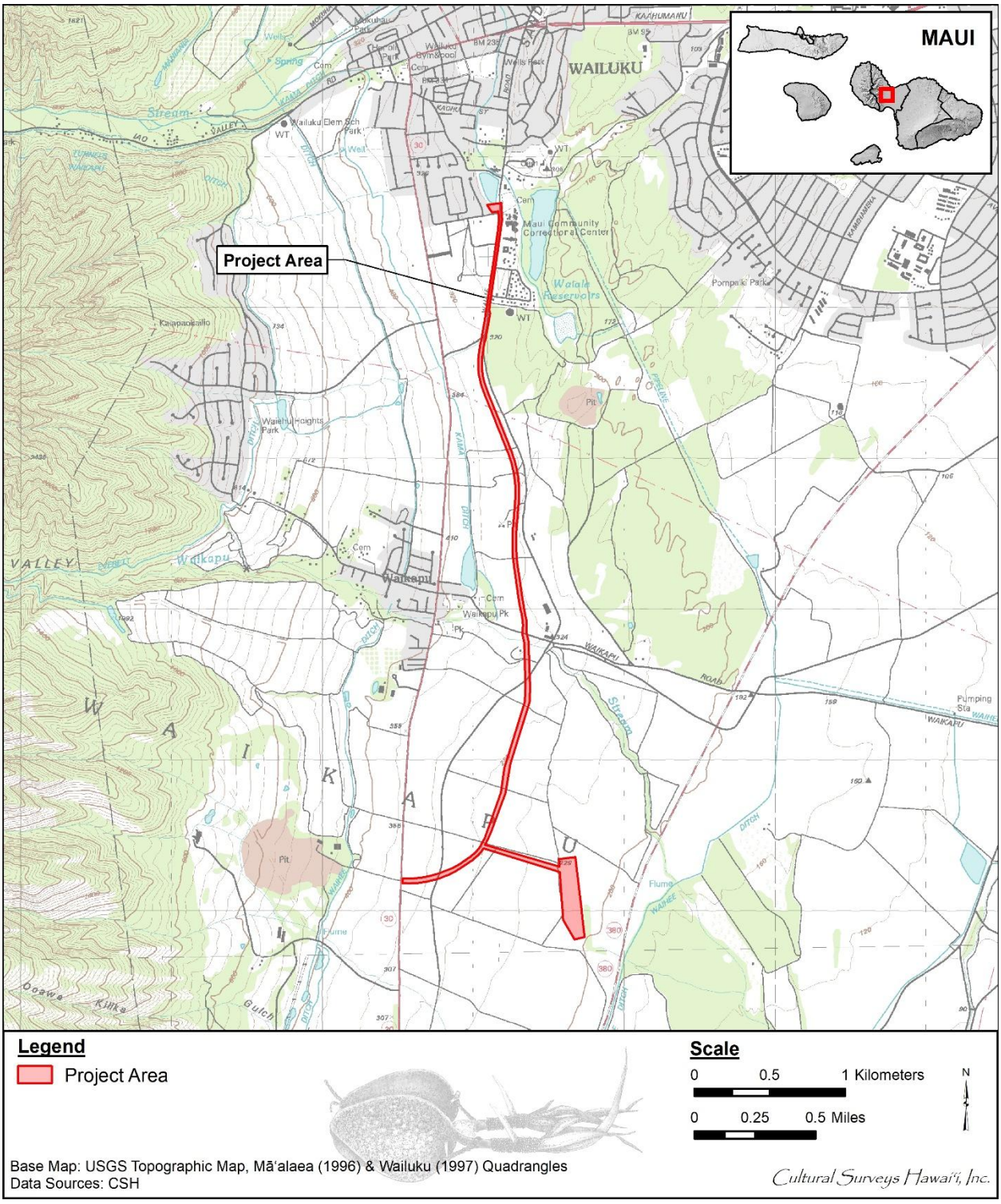



Figure 27. Portions of the 1996 Maalaea and 1997 Wailuku USGS 7.5-minute topographic quadrangles showing the current project area (U.S. Geological Survey 1996, 1997)

On 12 March 1959, Hawai‘i became the 50th State of the Union. With labor costs for both sugar and pineapple steadily rising in the post-war years, driven primarily by labor union demands, both industries responded by adopting new technical innovations. Containerized shipping revolutionized the freight industry in the early 1960s, leading to the redesign of gantry systems and hardstand support areas to facilitate the moving and storage of the new containers at Kahului Harbor. Matson Navigation Company, a subsidiary of Alexander & Baldwin, became the leader in the development of an industry-wide standard for intermodal containers (Dean 1950).

Kahului Railroad Company sold off its locomotives and rolling stock and became Kahului Trucking and Storage Company in 1966. Haleakala Storage & Transfer Company, a privately-owned company, took over much of the specialized freight-forwarding operations once performed by the railroad (Hawaii Business and Industry 1966).

In the latter half of the 1900s, residential tracts were constructed along both the Kuihelani Highway and Honoapiilani Highway corridors that traverse Waikapū. Alexander & Baldwin Inc., the largest landowner in Kahului, continued to expand residential housing in the "Dream City" incrementally between 1970 and 1990 (Hooser and Stewart 1995). Large-scale construction projects in Central Maui, such as The Maui Arts and Cultural Center (MACC) (constructed in 1993), Keopuolani Park (constructed in 1999), Maui Lani Dunes golf course (constructed in 1989) and the residential build-out of Maui Lani (1996-present) were precursors for light industrial development in Wailuku Town.

Following the closing of the Wailuku Sugar Company Mill in 1989, much of the former agricultural land along the eastern banks of the ʻĪao Stream was developed as the Iao Parkside Condominium while large-scale light industrial development utilized much of the remainder of the former sugar lands of Wailuku along the western bank of the ʻĪao Stream (Hooser and Stewart 1995). HC&S closed Puʻunēnē Mill, its last operable mill and the last sugar plantation in Hawaii in 2016 (Cataluna 2016). The surrounding former sugarcane lands are primarily fallow with some new commercial development and plans for renewed agricultural production.

## 3.2 Previous Archaeological Research

The earliest archaeological studies on the island of Maui were part of island-wide surveys conducted in the early 1900s (Stokes 1917; Walker 1931). These studies tended to focus on the generation of descriptive lists of large-scale architectural features or traditional ceremonial *heiau* sites. No *heiau* were documented in the immediate vicinity of the current project area.

Between 1931 and 1976, only sporadic archaeological studies were undertaken in the area. Following the passage of the National Historic Preservation Act in 1966 and HRS Chapter 6E, which established the historic preservation program in 1976, archaeological studies occurred as a condition of development on a more frequent basis. Previous archaeological research of studies adjacent to the proposed project corridor includes reconnaissance surveys and LRFIs, GPR surveys, AIS investigations (termed “archaeological surveys” pre-2002, before HAR §13-276-5), archaeological data recoveries, and archaeological monitoring programs (Figure 28 and Table 2). Historic properties identified during previous studies in the vicinity of the project area include large clusters of human burials within the Sand Hills region, a late pre-Contact to early post-Contact temporary habitation site (SIHP # 50-50-04-04202), and various historic plantation and ranching features (Figure 29). Note, the SIHP designation refers to the state of Hawai‘i (50), the island code for Maui (50), the topographic quadrangle for Wailuku (04), and a unique five digit number.

### 3.2.1 Barrera (1976)

On 23 and 24 August 1976, Chiniago Enterprises conducted an archaeological walk-through survey of approximately 1,020 acres at Wai‘ale, formerly in agricultural orchard land (Barrera 1976). The survey was conducted along areas of known and observable ground disturbance, such as recent plantings and pipeline routes, in addition to overgrown areas of *kiawe* and lantana scrub. No historic properties were identified. The survey of the disturbed areas revealed no subsurface cultural remains except for two possible artifacts (a hammerstone and a possible basalt flake) on the surface of the parcel beneath dense vegetation. On-site monitoring was recommended due to known deposits of human skeletal remains in the nearby Sand Hills region of Wailuku.

### 3.2.2 Rotunno and Cleghorn (1990)

Between 16 and 31 January 1990, an archaeological reconnaissance survey was conducted by the Public Archaeology Section of the Applied Research Group of the Bernice Pauahi Bishop Museum on an approximately 1,000-acre parcel for the Horita Homes project area (TMKs: [2] 3-8-007:002 and 110) (Rotunno and Cleghorn 1990). Systematic sweeps, placed no less than 50 m apart, were taken across the five land sections (Zones 1 through 5) of the project area delineated by the survey team. Three temporary archaeological sites (labelled Temporary Site Numbers 1 through 3) between Zones 1 and 3. Temporary Site No. 1 consists of a pathway of compacted sand cobbles in a parallel alignment, seemingly delineating a pathway through the parcel with no discernable starting or ending point. Researchers noted the possibility of this path being a somewhat recent construction. Temporary Site No. 2 was initially identified as a disturbed rock wall but was later found to be the remnant of bulldozer tailings. Temporary Site No. 3 consists of a rock mound constructed of piled and compacted cobblestones that did not extend below the ground surface. Additional archaeological surveying and monitoring were recommended due to dense ground cover and the possibility of subsurface cultural remains and human skeletal remains.

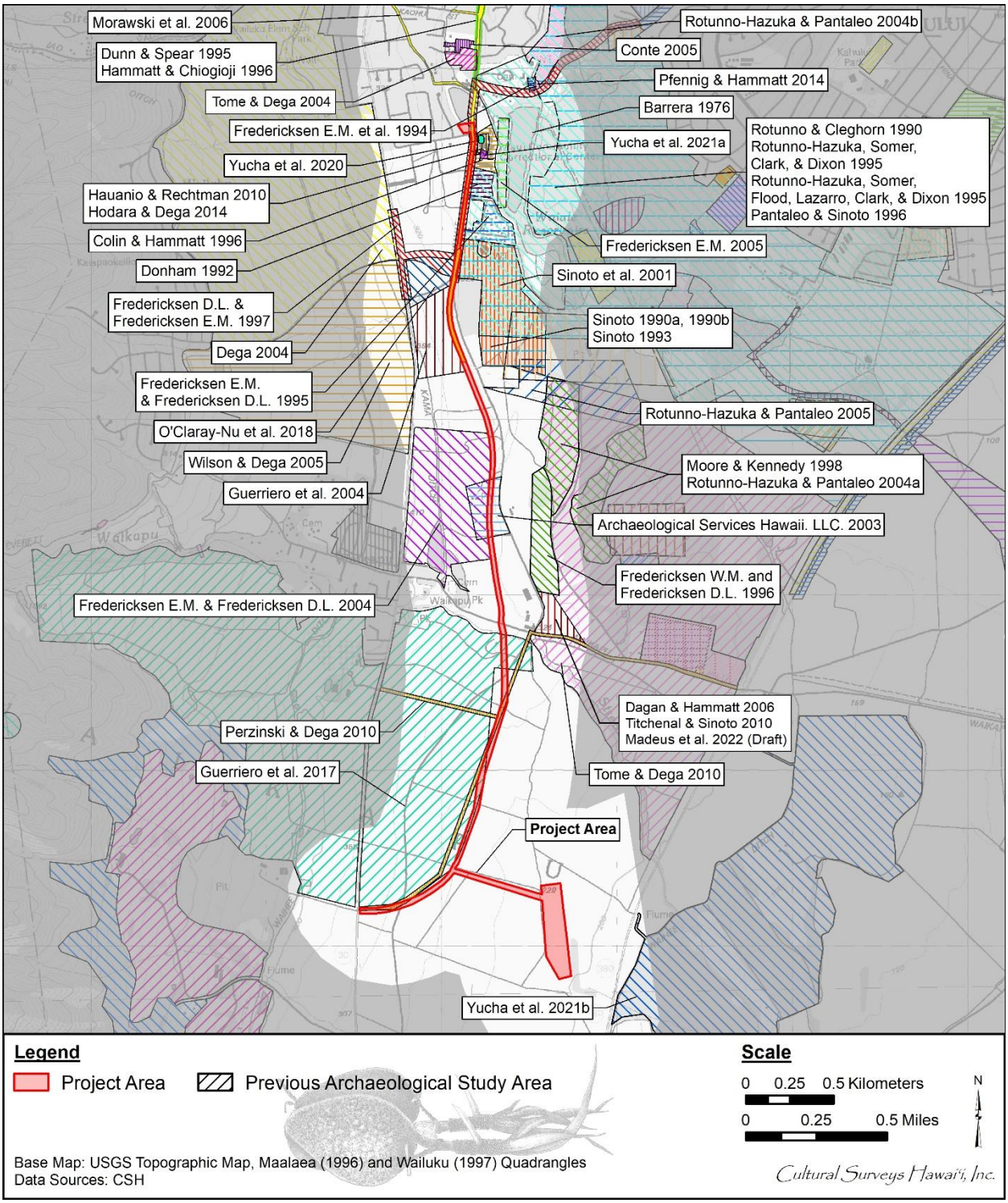



Figure 28. Portions of the 1996 Maalaea and 1997 Wailuku USGS 7.5-minute topographic quadrangles showing previous archaeological studies in the vicinity of the project area (U.S. Geological Survey 1996, 1997)

Table 2. Previous archaeological studies in the vicinity of the project area

| Reference | Type of Study | Location | Results (SIHP # 50-50-04) |
|---|---|---|---|
| Barrera (1976) | Archaeological walk-through survey | Upper Maui Lani area; multiple TMKs | No historic properties identified |
| Rotunno and Cleghorn (1990) | Archaeological reconnaissance survey | Horita Homes; TMKs: [2] 3-8-007:002 and 110 | Identified two potential historic properties: a sandstone cobble-lined trail (Temp. Site No. 1) and a piled and compacted cobblestone mound (Temp. Site No. 3) |
| Sinoto (1990a, 1990b) | Archaeological surface survey, subsurface assessment, and archaeological monitoring | Maui Lani Sand Borrow Site; TMK: [2] 3-8-007:103 | No historic properties identified |
| Donham (1992) | Archaeological data recovery | Maui Homeless Shelter; TMK: [2] 3-8-046:021 | Identified and recovered SIHP # -02916, two human burials; a buried water channel had also been reported at the construction site |
| Sinoto (1993) | Archaeological monitoring | Maui Lani Sand Borrow Site; TMK: [2] 3-8-007:103 | No historic properties identified |
| Fredericksen et al. (1994) | Archaeological survey | Maui Memorial Park; TMK: [2] 3-8-046:030 | No historic properties identified |
| Fredericksen and Fredericksen (1995) | Archaeological survey | Parcel on eastern side of Wai‘ale Rd; TMK: [2] 3-8-046:021 | No historic properties identified |
| Dunn and Spear (1995) | Archaeological monitoring | Wai‘ale Rd; TMKs: [2] 3-4-002:036, [2] 3-4-003:019; [2] 3-4-004:002 | Identified three historic properties: SIHP # -04005, a human burial; SIHP # -04067, an isolated hearth; and SIHP # -04068, a cultural layer containing 13 burials and 21 habitation features; also identified a scatter of previously |

| Reference | Type of Study | Location | Results (SIHP # 50-50-04) |
|---|---|---|---|
| | | | disturbed human remains on the eastern shoulder of Wai‘ale Rd (no SIHP #) |
| Rotunno-Hazuka et al. (1995a) | Archaeological test excavations | Maui Lani Subdivision and Sand Borrow Site; TMKs: [2] 3-8-007:002 and 110 | Determined insignificance for two temporary sites (T-1 and T-3) previously recorded by Rotunno and Cleghorn (1990); identified and determined an additional temporary site (T-4) insignificant; documented at least three additional human burials associated with SIHP # -02797 |
| Rotunno-Hazuka et al. (1995b) | Archaeological research, test excavations, and burial investigations | Maui Lani Subdivision; TMKs: [2] 3-8-007:002 and 110 | Newly identified 10 burial features with an MNI of 12 associated with SIHP # -02797 |
| Pantaleo and Sinoto (1996) | Archaeological subsurface sampling | Maui Lani Subdivision Phase 1 and 1A parcels; TMKs: [2] 3-8-007:002, 110 | Identified four additional burials of SIHP # -02797, burial complex; identified two additional human burials designated as SIHP #s -04146 and -04147 |
| Fredericksen and Fredericksen (1996) | Archaeological data recovery | Waikapu Borrow Site; TMK: [2] 3-8-007:104 | Identified at least 22 individuals and associated artifacts disturbed from the sand mine; reinterred in a burial preserve, SIHP # -03525 |
| Colin and Hammatt (1996) | Archaeological monitoring | MCCC Work Furlough Center; TMK: [2] 3-8-046:006 | No historic properties identified |
| Hammatt and Chiogioji (1996) | Archaeological and historical assessment and field inspection | Wai‘ale Rd at Lower Maui St; TMK: [2] 3-4 | No historic properties identified |
| Fredericksen and | Archaeological survey | Wai‘ale Dr and Mahalani St; | No historic properties identified |

| Reference | Type of Study | Location | Results (SIHP # 50-50-04) |
|---|---|---|---|
| Fredericksen (1997b) | | TMKs: [2] 3-8-046:001, 002, 004, 004, 017, 018, 030 pors., and [2] 3-8-007:121 por. | |
| Moore and Kennedy (1998) | Archaeological survey | Multiple locations; TMK: [2] 3-8-007:101 por. | Identified three historic properties: SIHP # -04200, four human burials; SIHP # -04201, human burial; and SIHP # -04202, temporary habitation site |
| Sinoto et al. (2001) | Supplemental archaeological sampling | Maui Lani Light Industrial Park; TMK: [2] 3-8-007:131 por. | No historic properties identified |
| Archaeological Services Hawaii (2003) | Interim archaeological monitoring | Wailuku Agribusiness, Inc. sand mining operations; TMK: [2] 3-05-002:001 | No historic properties identified |
| Dega (2004) | AIS | 348.6-acre parcel; TMK: [2] 3-5-001:001 por. | Identified eight historic properties:<br>SIHP # -05473, Hopoi Reservoir;<br>SIHP # -05474, Kama Ditch;<br>SIHP # -05197, Waihe‘e Ditch;<br>SIHP # -05490, three small drainage ditches;<br>SIHP # -05491, historic artifact scatter;<br>SIHP # -05492, six field-clearing mounds;<br>SIHP # -05493, an unnamed irrigation ditch; and<br>SIHP # -05498, a network of roadways |
| Fredericksen and Fredericksen (2004) | AIS | Waikapu Affordable Housing Subdivision; TMKs: [2] 3-5-002:001 por. and 3-8-007:101 | Documented a previously identified historic property, SIHP # -05474, Kama Ditch with associated Reservoir No. 6 |

| Reference | Type of Study | Location | Results (SIHP # 50-50-04) |
|---|---|---|---|
| Guerriero et al. (2004) | AIS | 50-acre parcel; TMK: [2] 3-5-002:001 por. | Documented SIHP # -05474, Kama Ditch |
| Rotunno-Hazuka and Pantaleo (2004a) | Interim archaeological monitoring | Hawaiian Cement Sand Mining Operations adjacent to Waiko Rd; TMK: [2] 3-8-007:101 por. | Identified two burial features within completed Phase B and 30 additional burial features within the ongoing Phase A operations (features not assigned SIHP #s at time of report) |
| Rotunno-Hazuka and Pantaleo (2004b) | AIS | New Sand Hills parcel; TMKs: [2] 3-8-007:121, 136 and 137 por. | No historic properties identified |
| Tome and Dega (2004) | AIS | 4.3-acre parcel in Wailuku; TMKs: 3-4-003:005, 006, 011, 014, 026, and 033–042 | Documented a portion of SIHP # -01508, Spreckels Ditch and identified SIHP # -05569, historic bottle deposit |
| Conte (2005a) | AIS | 391 Wai‘ale Rd; TMK: [2] 3-4-03:004 | No historic properties identified |
| Fredericksen (2005) | AIS | Wai‘ale Surface Water Treatment Facility; TMK: [2] 3-8-046:020 | No historic properties identified |
| Rotunno-Hazuka and Pantaleo (2005) | AIS | Maui Lani Elementary School; TMK: [2] 3-8-007:137 | No historic properties identified |
| Wilson and Dega (2005) | AIS | 215.8-acre parcel in Wailuku and Waikapū; TMKs: [2] 3-5-002 and [2] 3-5-003 | Documented components of SIHP # -05179, Waihe‘e Ditch and SIHP # -05493, Waikapū Ditch, identified five new historic properties: SIHP # -05726, an earthen ditch; SIHP # -05727, a large reservoir; SIHP # -05728, 14 erosion control berms; SIHP # -05729, a lesser stone and mortar ditch; and SIHP # -05730, Old Waikapu Rd |

| Reference | Type of Study | Location | Results (SIHP # 50-50-04) |
|---|---|---|---|
| Dagan and Hammatt (2006) | LRFI | Maui Scrap Yard; TMK: [2] 3-8-007:105 | No historic properties identified |
| Morawski et al. (2006) | Archaeological monitoring | Off-site construction near proposed Kehalani Mauka Subdivision in Wailuku and Waikapū; TMKs: [2] 3-5-002:001 por. and [2] 3-5-001:017 por. | Identified five historic properties:<br>SIHP # -05680, human burial;<br>SIHP #s -05965 and -05966, isolated and disturbed human remains;<br>SIHP # -05963, historic roadbed;<br>SIHP # -05964, sugarcane flume portion |
| Hauanio and Rechtman (2010) | Archaeological monitoring | MCCC; TMK: [2] 3-8-046:005 | No historic properties identified |
| Tome and Dega (2010) | AIS | 607 acres of land spanning Wai‘ale, Wailuku, and Waikapū; TMKs: [2] 3-8-005:023 por. and 037; [2] 3-8-007:071, 101, 102, and 104 | Confirmed previously identified locations of SIHP # -01508, portion of Spreckels/Waihe‘e Ditch and SIHP # -05504, three human burials; identified SIHP # -06578, a buried fire pit/*imu* |
| Perzinski and Dega (2010) | AIS | Proposed Wai‘ale Rd extension and section of Waiko Rd; TMKs: [2] 3-5-002:014, 018, 888; [2] 3-5-027:021; [2] 3-6-002:003; and [2] 3-8-005:999 | Documented SIHP # -06668, a historic boulder terrace for either water diversion or a former footbridge footing on the southern bank of Waikapū Stream |
| Titchenal and Sinoto (2010) | AIS | Maui Scrap Yard; TMK: [2] 3-8-007:105 | No historic properties identified |
| Pfennig and Hammatt (2014) | Archaeological monitoring | Flores Family Residence; TMK: [2] 3-8-089:098 | No historic properties identified |
| Hodara and Dega (2014) | Archaeological monitoring | MCCC; TMK: [2] 3-8-046:005 | Identified SIHP # -08017, a historic trash pit associated with cattle ranching activities in the area |

| Reference | Type of Study | Location | Results (SIHP # 50-50-04) |
|---|---|---|---|
| Guerriero et al. (2017) | AIS | Waikapū Country Town Project; TMKs: [2] 3-6-002:003; [2] 3-6-004:003; and [2] 3-6-005:007 | Identified four historic properties: SIHP # -07881, 18 commercial sugarcane irrigation features; SIHP # -07882, remnant L-shaped retaining wall; SIHP # -07883 WWII bunker; and SIHP # -07884, three historic artifact scatters; also documented a portion of a previously identified historic property, SIHP # -05197, the historic Waihe‘e Ditch |
| O’Claray-Nu et al. (2018) | AIS | Parcel northwest of Wai‘ale Rd and Kuikahi Dr; TMK: [2] 3-5-001:064 | No historic properties identified |
| Yucha et al. (2020) | Archaeological monitoring | MCCC; TMK: [2] 3-8-046:005 por. | Identified SIHP # -08659, a historic coffin burial, preserved in place |
| Yucha et al. (2021b) | AIS and GPR survey | Former sugarcane fields east of Kuihelani Hwy; TMK: [2] 3-8-005:002 por. | Identified six new historic properties, SIHP #s -08800 through -08805, buildings, structures, and deposits associated with the historic use of commercial sugarcane agriculture; and documented components a previously identified historic property, SIHP # -01508, the Spreckels/Waihe‘e Ditch Complex |
| Yucha et al. (2021a) | AIS and GPR survey | MCCC; TMK: [2] 3-8-046:005 por. | No historic properties identified |
| Madeus et al. (2022) | Archaeological monitoring | 109 E. Waiko Rd (former Maui Scrap Yard); TMK: [2] 3-8-007:105 | Identified SIHP # -08812, a human burial complex consisting of two *in situ* burials (Feature A and Feature C) and one isolated femur portion (Feature B) |

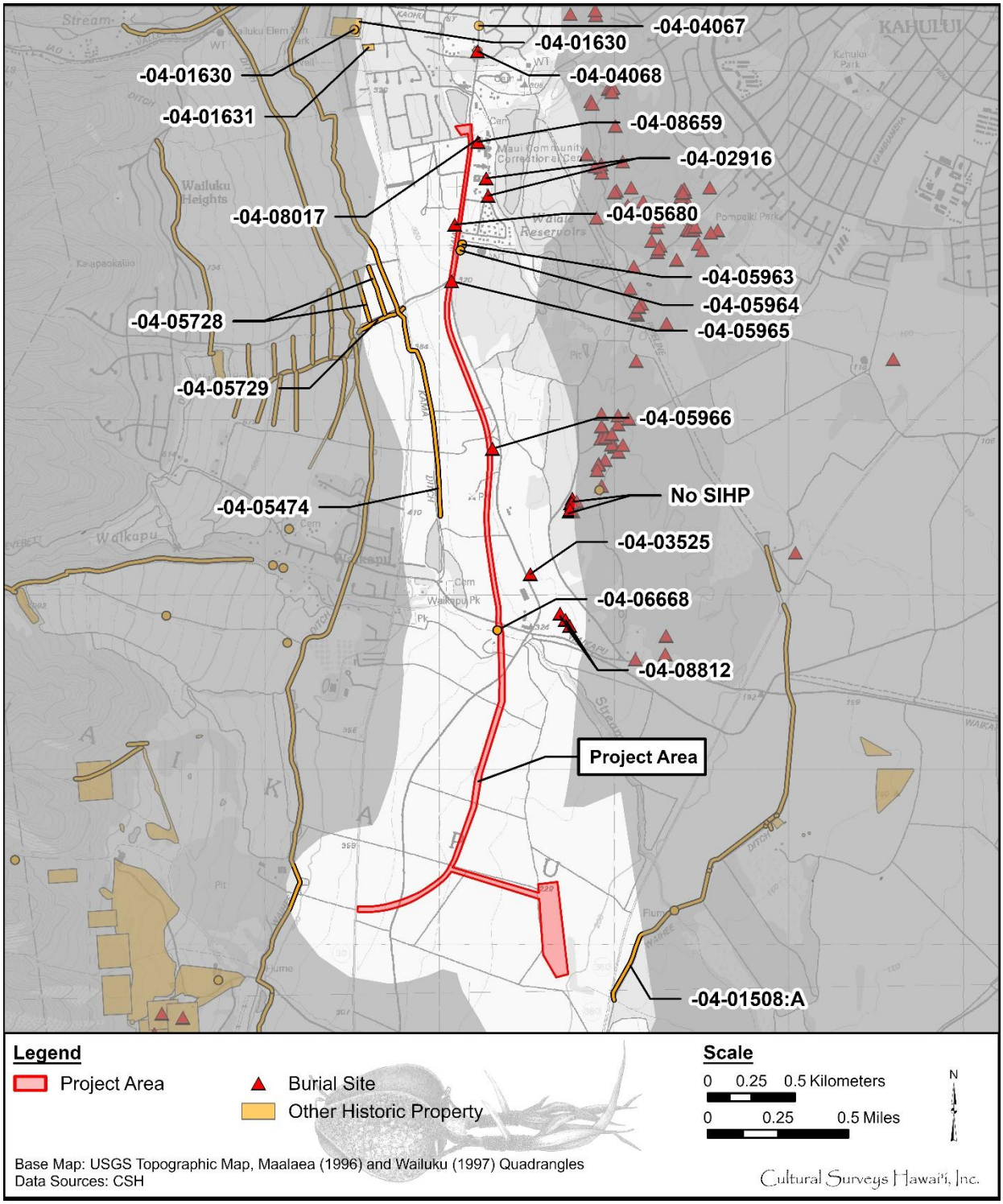



Figure 29. Portions of the 1996 Maalaea and 1997 Wailuku USGS 7.5-minute topographic quadrangles depicting the location of historic properties identified within and near the current project area (U.S. Geological Survey 1996, 1997) (Note: historic properties and burial sites recorded as a single point on this map are not to scale)

### 3.2.3 Sinoto (1990a, 1990b, 1993)

From 2 through 8 May 1990, the B.P. Bishop Museum conducted a pedestrian survey of 70 acres for the Maui Lani Sand Borrowing Project at TMK: [2] 3-007:103. No historic properties were observed, however, the “dense vegetation cover hindered observation” (Sinoto 1990a:1). Archaeological monitoring was recommended for future excavations in sand deposits.

On 12 July 1990, the Bishop Museum conducted an archaeological subsurface assessment and continued archaeological monitoring of a portion of the Maui Lani Sand Borrow Project at TMK: [2] 3-007:103 (Sinoto 1990b). The field assessment part of the study included a survey of approximately one third of the existing ground surface, which had been previously grubbed and graded without an archaeologist present and prior to issuance of a grading and grubbing permit. Following the surface survey, archaeologists were assigned to monitor further ground disturbances at the project area. At the time of the interim field report (30 September 1990), no historic properties had been identified.

In a letter report dated 24 September 1993, Aki Sinoto of Aki Sinoto Consulting, summarized the archaeological monitoring of sand borrowing activities conducted during the previous four years at the Maui Lani Sand Borrow Site (Sinoto 1993). The report included the results of the surface survey and field assessment conducted by Public Archaeology Section, Applied Research Group of the B. P. Bishop Museum in May 1990 (Sinoto 1990a) and July 1990 (Sinoto 1990b), respectively. Results of subsequent archaeological monitoring were also reported.

Between July and November 1990, full-time archaeological monitoring was conducted by the Bishop Museum. Following a year long hiatus, archaeological monitoring resumed during March 1992, but was conducted by Aki Sinoto Consulting. Between May and November 1992, Aki Sinoto Consulting conducted periodic archaeological monitoring of the sand borrowing activities No historic properties were identified during any archaeological monitoring. Cow bones were encountered, though were expected due to previous pasture uses associated with the project area. During the time of the report, sand borrowing had temporarily ceased; archaeological monitoring was expected to resume with future sand moving activities.

### 3.2.4 Donham (1992)

Between 6 May and 8 June 1992, the SHPD conducted an archaeological data recovery on two separate inadvertent discoveries of human skeletal remains found during construction activities at the Maui Homeless Shelter construction site (TMK: [2] 3-8-046:021) (Donham 1992). Burial 1 was discovered during grading activities in the location of Building 4, approximately two feet below the natural surface. Most of the remains were crushed by machinery, however, the remnant of the in-situ burial was discovered nearby. No burial pit, soil discolorations, or portable artifacts were observed in association with Burial 1. Burial 1 was recorded, disinterred, and stored on-site for re-interment following the completion of construction. Burial 2 was discovered during the excavation of a desilting basin on the southeast corner of the property and consisted of an exposed partial cranium. Excavations around the cranium revealed additional subsurface skeletal remains scattered within a 26-sq m area, up to 75 cm below surface (cmbs). No primary burial site for Burial 2 was identified during excavation. Researchers noted that the matrix encasing Burial 2 appeared to be a disturbed layer that predated the current construction and was likely associated

with the bulldozing of nearby access roads to the surrounding parcels. Researchers recommended monitoring of any further work in or around the location of Burial 2 involving heavy machinery (as work had not yet been completed).

### 3.2.5 Frederickson et al. (1994)

In June 1994, Xamanek Researches conducted an archaeological survey on a portion of Maui Memorial Park for the construction of a new subterranean burial vault (TMK: [2] 3-8-046:030) (Fredericksen et al. 1994). A pedestrian survey of the project area revealed no surface sites on the graded surface of the cemetery. Subsurface testing consisted of 14 mechanically assisted trench excavations. Spot screening of the excavated materials revealed that the bulk of the project area had been filled with modern debris and sediments and contained modern and late historic refuse in all 14 excavated trenches, up to 2.5 m below surface. All additional sediments observed within the trenches were undisturbed and sterile. Additional archaeological monitoring was recommended for all future excavations in and around the concrete vault.

### 3.2.6 Rotunno-Hazuka et al. (1995a)

Between 23 May and 14 June 1990, Applied Research Group of the B. P. Bishop Museum conducted test excavations at two possible historic properties previously documented by Rotunno and Cleghorn (1990) as temporary site numbers TS1 and TS3 (TMKs: [2] 3-8-007:002 and 110) (Rotunno-Hazuka et al. 1995a). An additional potential historic property was recorded as temporary site T-4 and tested. Test excavations also occurred at the established SIHP # -02797 burial complex.

Significant cultural resources were not identified on the surface or within test excavations at the three temporary sites. Therefore, these features were determined archaeologically insignificant. T-1 represents parallel cobble alignments that were interpreted as features recently constructed, possibly by people using off-road vehicles in the sand dunes. T-3, consisting of two rock mounds, was explained as most likely natural features created by sand dune erosion. The mound features were not consistent with known traditional Hawaiian burial markers or trail markers (*ahu*). T-4 appeared to be a recent campfire remnant based on the observed piled of rocks covering a modern trash pit proximal to dirt bike trails.

No human burial features were identified during the subsurface testing at SIHP # -02797. However, varying concentrations of fragmented human skeletal remains were observed both on the surface and within test excavations at the western periphery of the sand borrow pit near the approximate location of where Neller (1984) first documented burials at SIHP # -02797. The recovered fragmented remains represented a minimum number of individuals (MNI) of at least three individuals. Rotunno-Hazuka et al. (1995a) recommended SIHP # -02797 be considered significant. Additional recommendations included that all construction related to the project area cease until formulation of a burial treatment plan, future ground disturbance in the project area be monitored by an archaeologist, and that a burial preserve plan be created and implemented for future development of the project area.

### 3.2.7 Rotunno-Hazuka et al. (1995b)

In 1992, the B. P. Bishop Museum researched historical documents and maps for the Maui Lani Development area and conducted archaeological test excavations for burial investigations near SIHP # -02797, a burial complex previously identified at the western periphery of a sand borrow site on the development parcel's eastern boundary (TMKs: [2] 3-8-007:002 and 110) (Rotunno-Hazuka et al. 1995b). The test excavations resulted in the identification of ten burial features representing at least 12 additional human burials associated with SIHP # -02797. Six of the burial features were preserved *in situ*, while one individual was disinterred because it had already been exposed in the sandpit. Recovered skeletal remains were handled by the SHPD on Maui. The documentation of additional skeletal remains at SIHP # -02797 prompted the SHPD to request a more intensive AIS of the proposed development area. The results of this AIS are presented by Pantaleo and Sinoto (1996).

### 3.2.8 Fredericksen and Fredericksen (1995)

In November 1994, Xamanek Researches conducted an archaeological survey on an approximate 15-acre parcel located along the eastern side of Wai‘ale Road for the construction of a 180 to 200-unit affordable rental housing project at TMK: [2] 3-8-046:021 (Fredericksen and Fredericksen 1995). A 100% pedestrian survey was conducted across the surface of the parcel at 5 m intervals, revealing a complete absence of surface sites. The second portion of the survey involved a subsurface testing regimen consisting of 43 backhoe trenches, 21 auger tests, and two manually excavated test units. Excavations generally revealed buried sterile sand layers up to 4.5 m deep, overlying a lithified layer of dune material. No *in situ* cultural remains were observed during subsurface testing. Due to the encroachment of Pu‘uone sand deposits onto the eastern portion of the project area, and the earlier discovery of human skeletal remains (SIHP # 50-50-04-02916) on an adjacent property by Donham (1992), researchers recommended archaeological monitoring for all ground disturbing activities within the project area.

### 3.2.9 Dunn and Spear (1995)

Between 18 February and 7 April 1995, Scientific Consultant Services, Inc. (SCS), conducted archaeological monitoring for sewer line trench excavations along the western shoulder of Wai‘ale Road (TMKs: [2] 3-4-002:036, [2] 3-4-003:019, [2] 3-4-010:002) (Dunn and Spear 1995). Monitoring of trenching activity, in addition to pothole testing for existing subsurface utilities, identified three historic properties and a scatter of human remains associated with a historic fill layer.

SIHP # 50-50-04-04005, human skeletal remains of one adult individual, were observed within the backfill of a trench excavated and filled prior to the 1995 sewer line project. No primary burial site was identified for SIHP # -04005, lending to the interpretation of having been previously disturbed. SIHP # 50-50-04-04067, an isolated hearth feature, was identified in the western sidewall of trench generally located at the intersection of Wai‘ale Road and Kaohu Street. SIHP # -04067 was approximately 1.2 m below surface and measured 70 cm across with subangular basalt cobbles on either side and showing evidence of having been cleaned out multiple times prior to its burial. Charcoal samples from SIHP # -04067 returned calibrated dates of A.D. 1434-1669 and A.D. 1772-1794. SIHP # -04068, consisting of a cultural layer containing 13 burials and 21

habitation features (postholes, hearths, and midden deposits), was identified near the intersection of Wai‘ale Road and Naniloa Drive. Six shovel probes were excavated into SIHP # -04067 revealing a widespread cultural deposit capping the observed burial features of the site, indicating that the cultural deposit post-dates the skeletal remains. The cultural layer contained mostly pre-Contact artifacts and midden, occasionally producing isolated historic deposits, and returned a radiocarbon date of A.D. 1622 to 1807.

In addition to the three identified historic properties, researchers also observed human skeletal remains on the eastern shoulder of the Wai‘ale Road ROW. Three backhoe trenches were excavated into this area to test for subsurface historic properties. These excavations encountered over 288 individual fragments of human remains within a reddish-brown historic fill layer with no evidence of a primary burial. Researchers concluded that these remains represent previously disturbed burials incorporated into fill materials used in either the construction of the Wai‘ale Road ROW or the historic Wailuku Sugar Co. Railroad ROW. The burial deposits on the eastern shoulder were not assigned a site number during this study.

### 3.2.10 Fredericksen and Fredericksen (1996)

Between May 1994 and March 1995, Xamanek Researches, LLC conducted an archaeological data recovery at the location of a sand mining operation in Waikapū known as the Waikapu Borrow Site (TMK: [2] 3-8-007:104) (Fredericksen and Fredericksen 1996). In May 1994, sand used as fill for the Lahaina Wastewater Facility that was originally taken from the sand borrow site was discovered to contain human skeletal remains. The SHPD required the fill to be returned to its original location and examined for human skeletal materials. Careful sifting and cataloging of the sand revealed that a MNI of at least 22 had occupied the former burial site that was disturbed by the mining operation. In addition to human remains, multiple artifacts also were observed including ornamental, polished, and drilled dog and pig teeth and a few basalt stones. All artifacts and human remains were without provenience and were reinterred in March 1995 by representatives of the Maui/Lāna‘i Islands Burial Council (MLIBC) in a burial preserve assigned SIHP # 50-50-04-03525.

### 3.2.11 Pantaleo and Sinoto (1996)

Between 8 and 28 March 1995, Aki Sinoto Consulting conducted a supplemental surface survey and archaeological subsurface testing for Maui Lani Partners, Ltd. for development in the Maui Lani area of Wailuku (TMKs: [2] 3-8-007:002 and 110) (Pantaleo and Sinoto 1996). Intensive subsurface testing occurred at Maui Lani Development Phase 1 parcel, Phase 1A parcel, and SIHP # -02797, a human burial complex. A total of 90 machine excavated trenches, two shovel scrapes, and 1 manually excavated trench were tested in a total of 58 localities. During the archaeological investigation, six human burials were identified and designated as SIHP #s -04146 and -04147 and four additional burials were designated as components of SIHP # -02797.

Eighty acres proposed for residential development comprised the Phase 1 parcel, located near the Maui Waena Intermediate School. Ten trenches were manually excavated in the Phase 1 parcel. No historic properties were identified in the Phase 1 parcel.

The Phase 1A parcel was 172 acres proposed for an 18-hole golf course south of the Phase 1 parcel border. Sixty-eight backhoe excavated trenches, two shovel scrapes, and one manually

excavated trench were tested in the Phase 1A parcel. Two distinct, previously undocumented human burials were identified during testing in this parcel. One burial, SIHP # -04146 was identified at Locality 12. The other burial, SIHP # -04147, was exposed in a road cut along the slope of a dune at Locality 21.

Twelve trenches were placed in and around a sand borrowing pit and known burial complex SIHP # -02797. Four additional human burials were identified in association with SIHP # -02797 Additionally, scattered surface human remains were identified in association with SIHP # -02797. Six machine excavated trenches were tested to investigate the origin of the scattered surface human remains; neither human burials nor non-burial cultural deposits were identified within any of these six test excavations.

The lack of apparent predictability in locating subsurface cultural remains, specifically human burials, based upon surface features (man-made or natural), led researchers to conclude no effective predictive method for avoiding burials, and thus the parcel was cleared for continued development with an archaeological monitor present to help mitigate potential impacts. Archaeological monitoring was recommended for future ground disturbance associated with development within the project area due to the high potential for encountering burials.

### 3.2.12 Colin and Hammatt (1996)

Between 20 March and 19 April 1995, CSH conducted archaeological monitoring accompanying the construction of the Maui County Correctional Center (MCCC), Work Furlough Center (TMK: [2] 3-8-046:006) (Colin and Hammatt 1996). Monitoring for this project was completed on an on-call basis, as recommended by the SHPD, and consisted of four separate field inspections of the project area at intervals during the grubbing, grading, and mass excavation phases of the project to determine potential impact on any historic properties. The four field inspections revealed no new historic properties.

### 3.2.13 Hammatt and Chiogioji (1996)

On 13 October 1996, CSH conducted an archaeological field inspection, as a component study for an archaeological and historical assessment, of an approximate 500-ft-long corridor of the Wai‘ale Road/Lower Main Street ROW (TMK: [2] 3-4) (Hammatt and Chiogioji 1996). A surface survey conducted along the project area did not identify any new historic properties on the shoulder of the developed roadway comprising the project corridor. A berm was observed along the eastern extent of the project area, identified as a remnant berm servicing the now out-of-use Wailuku Sugar Co. railroad line. The interpretation of the berm was confirmed by discarded rail segments lying along the base of the berm; however, the discarded rails were the only remainder of the historic era feature. Researchers recommended an archaeologist remain on site for all ground disturbing activities associated with this project due to known subsurface historic properties previously identified by Dunn and Spear (1995), for the potential to encounter human burials, and because the project was to be conducted near the historic Wai‘ale Road Bridge.

### 3.2.14 Fredericksen and Fredericksen (1997b)

In February 1997, Xamanek Researches conducted an archaeological survey in advance of the ca. 990-m-long Mahalani Street and Wai‘ale Drive extension project (TMKs: [2] 3-8-046:001,

002, 003, 004, 017, 018, 030, and 032 pors. and [2] 3-8-007:121 por.) (Fredericksen and Fredericksen 1997b). A 100% pedestrian survey was conducted with no significant findings. The surface appeared to have been impacted by recent ground disturbance. Subsurface testing consisted of eight backhoe test trenches along the corridor. No historic properties were identified during subsurface testing. Buried sand dune deposits were noted in areas. Archaeological monitoring was recommended for any ground disturbance in areas containing dune sand.

### 3.2.15 Moore and Kennedy (1998)

Between 1996 and 1998, Archaeological Consultants of the Pacific, Inc. conducted an archaeological survey with subsurface testing on two neighboring parcels within the Wailuku Sand Dunes proposed for sand mining by Hawaiian Cement (TMK: [2] 3-8-007:101 por.) (Moore and Kennedy 1998). The study included a 100% pedestrian survey in addition to the mechanical excavation of 117 trenches. Three historic properties were identified during the study, SIHP #s 50-50-04-04200, -04201, and -04202.

SIHP # -04200 consists of a complex of four *in situ* burials, designated as Features A, B, C, and D. SIHP # -04200 Feature A was identified as an adult burial within Trench 2a at approximately 175 cmbs with two associated basalt stones, a grinding stone, and a waste-flake. SIHP # -04200 Feature B was identified as an adult male within a burial pit in Trench 5a at approximately 150 cmbs. SIHP # -04200 Feature C was identified as an adult burial within Trench 6a with no associated pit or artifacts. SIHP # -04200 Feature D was identified as an infant within a burial pit in Trench 7a at approximately 50 cmbs. Feature D contained sparse osteological remains and several waterworn stones and basalt flakes.

SIHP # -04201 was identified as an *in situ* adult burial within Trench 49a at approximately 160 cmbs. No burial pit or cultural materials were observed. SIHP # -04202 consists of three tiers of terraces in a deteriorated condition alongside a dry stream bed. The upper tier showed evidence of a loose stone paving with bulldozing disturbance, and the middle and lower tiers were deteriorated due to livestock trampling, although the lower two terraces still had intact portions of faced walls. A test unit (TU) was excavated into the loosely paved upper terrace and contained one artifact, a single waterworn stone used as an abrader. SIHP # -04202 was determined to be a sparsely used temporary habitation site from the late pre-Contact to early post-Contact periods.

All burials encountered during the study were recommended for in-place preservation. Additional archaeological monitoring was recommended for the grading, grubbing, and initial excavation of the project area, in addition to having an on-call monitor for all future work in these parcels.

### 3.2.16 Sinoto et al. (2001)

In 2001, Archaeological Services Hawaii (ASH) conducted supplementary archaeological subsurface sampling of an approximate 56-acre parcel within the Maui Lani subdivision for the construction of a light industrial park (TMK: [2] 3-8-007:131 por.) (Sinoto et al. 2001). A pedestrian survey was conducted with no historic properties observed. Subsurface testing consisted of 20 backhoe trenches, and no historic properties were identified. Archaeological monitoring was recommended for future construction based on the potential of human burials present in the area.

### 3.2.17 Archaeological Services Hawaii (2003)

In January 2003, ASH submitted an interim archaeological monitoring report to the SHPD for Wailuku Agribusiness, Inc. sand mining operations at TMK: [2] 3-05-002:001 (Archaeological Services Hawaii 2003). The report summarizes over 16 hours of archaeological monitoring that took place during 1999 through 2002. At the time of the report, no cultural materials or historic properties had been identified. Archaeological monitoring was recommended to continue for the remainder of the project, which was expected to end by 2005.

### 3.2.18 Rotunno-Hazuka and Pantaleo (2004b)

Between 28 and 29 July 2003, ASH conducted an AIS of an approximate 29-acre parcel located adjacent to Maui Lani Parkway and the Maui Lani Golf Course 11th Fairway (TMKs: [2] 3-8-007:121, 136 and 137 por.) (Rotunno-Hazuka and Pantaleo 2004b). A pedestrian survey of the project area revealed that portions of the parcel had been recently disturbed by road development, and no historic properties were identified. Subsurface testing included 20 backhoe trenches distributed throughout the project area. Subsurface testing revealed deep sand stratigraphy and late historic construction debris, further attesting to the disturbed nature of the sediments. Archaeological monitoring was recommended for all ground disturbing activities within the parcel due to the potential for subsurface historic properties within undisturbed portions of the project area.

### 3.2.19 Fredericksen and Fredericksen (2004)

In August, September, and December 2003, Xamanek Researches conducted an AIS of approximately 100 acres for the Waikapu Affordable Housing Subdivision project (TMKs: [2] 3-5-002:001 por. and 3-8-007:101) (Fredericksen and Fredericksen 2004). Nearly half of the study area had been disturbed by former sand mining activities. A previously identified historic property, SIHP # 50-50-04-05474, Kama Ditch with associated Reservoir No. 6, was documented within the project area. The SHPD collected architectural data for SIHP # -05474, which was to be mostly demolished during the project. Archaeological monitoring was recommended for the project.

### 3.2.20 Dega (2004)

Between 28 September and 10 October 2003, SCS conducted an AIS of an approximate 348.6-acre parcel within a portion of TMK: [2] 3-5-001:001, situated on lands that border the traditional *ahupua‘a* of Wailuku and Waikapū (Dega 2004). Surface survey of the project area led to the identification of eight historic properties across the 23 constituent lots of the project area. SIHP # -05473 consists of the Hopoi Reservoir, belonging to the former site of the Hopoi Camp within Lot 21. SIHP # -05474 consists of portions of the Kama Ditch within Lots 20 and 21. SIHP # -05493 consists of a section of an unnamed irrigation ditch within Lots 3 and 7. SIHP # -05197 consists of a section of the Waihe‘e Ditch spanning Lots 9, 12, 14, 12/16, and 11/15. SIHP # -05498 consists of six roadways utilized during the historic plantation period spanning a multitude of lots and connecting several of the other historic properties identified. SIHP # -05490 consists of three smaller drainage ditches also spanning a multitude of Lots. SIHP # -05491 consists of a historic artifact scatter adjacent to a Quonset hut within Lot 19 containing historic glass fragments, historic ceramic sherds, coral fragments, marine shell, and several non-diagnostic pieces of iron.

SIHP # -05492 consists of six clearing mounds across various lots associated with agricultural activities within the former cane land. Following the surface survey, 27 backhoe assisted trenches were excavated to test the subsurface potential of the project area. No new historic properties were identified during the subsurface testing portion of this study. No further archaeological work was recommended for the project area.

### 3.2.21 Guerriero et al. (2004)

ASH conducted an AIS of a 50-acre parcel for proposed development at the Emmanuel Lutheran Church (TMK: [2] 3-5-002:001 por.) (Guerriero et al. 2004). At this time, CSH has not been able to locate a copy of the report. The following was described by O'Claray-Nu et al. (2018:22):

> The AIS included a pedestrian survey with subsurface backhoe testing of a total of 25 backhoe trenches (TRl-25). Results of the pedestrian survey identified one historic property, a disturbed segment of State Site 50-50-04-5474, the Kama Ditch, situated within the southwestern portion of the project area. Also noted was a metal sluice gate, designated Feature 1 of Site 5474. The ditch, also known as *kamaauwai* was constructed around 1905 to 1907 and provided water to irrigate the sugar cane fields surrounding the project area. Site 5474 was assessed as significant under Criterion "a" because of its association with the plantation era and Criterion "d" for its information content under the Federal and State historic preservation guidelines (O'Claray-Nu et al. 2018:22)

### 3.2.22 Rotunno-Hazuka and Pantaleo (2004a)

In April 2004, ASH prepared an interim monitoring report to present an update of the burial finds encountered during a Hawaiian Cement Sand Mining Operation consisting of long-term grading of an approximate 6-acre portion of a 59-acre project area near Waiko Road and Kuihelani Highway (TMK: [2] 3-8-007:101 por.) (Rotunno-Hazuka and Pantaleo 2004a). This study involved the continuous monitoring of ground disturbing activities associated with the removal of sand for construction aggregate uses. The project area consisted of two separate sections documented as Phases A and B. At the time of the report, Phase B was complete, while Phase A was ongoing.

In January 2000 and April 2001, two burials had been documented in Phase B. Burial 1B was a previously and possible recently disturbed burial and was preserved with the *in situ* location of Burial 2B. Monitoring in Phase A began in late 2001 and was on-going at the time of the report. The update reported that 30 burial features with an MNI of 41 individuals had been documented in Phase A. Two previously identified historic properties were also within Phase A: SIHP # -04200, four burials, and SIHP # -04201, one burial. Since this work was ongoing, additional discoveries were anticipated. All observed burials were to be petitioned for preservation in place by the property owner and reviewed by the MLIBC.

### 3.2.23 Tome and Dega (2004)

In June 2004, SCS conducted an AIS of an approximate 4.3-acre area bisected by Makahala Place and bordered by Wai‘ale Road in Wailuku (TMKs: 3-4-003:005, 006, 011, 014, 026, and

033 through 042) (Tome and Dega 2004). The land had been extensively altered and with modern debris and imported sand fill over most of the surface. The study included 16 machine excavated trenches and identified a historic bottle deposit designated as SIHP # -05569. In addition, Spreckles Ditch, previously identified as SIHP # -01508, was documented on the western side of the project area. Continued site preservation of Spreckles Ditch and archaeological monitoring for future ground disturbance was recommended.

### 3.2.24 Fredericksen (2005)

Between February and April 2005, Xamanek Researches conducted an AIS on a parcel where the Wai‘ale Surface Water Treatment Facility was to be constructed (TMK: [2] 3-8-046:020) (Fredericksen 2005). Surface survey of the project area revealed that the surface had been heavily modified by non-permitted dumping, the construction of HC&S access roads, and the construction of a County of Maui water tank. No surface sites were observed within the project area, however, SIHP # -01508, Spreckels Ditch, was relocated adjacent to the west side of the project area. The subsurface portion of the study included the excavation of nine backhoe trenches within the footprint of the proposed water line alignment and treatment building site. Additionally, 18 soil cores were excavated into the proposed pathway of the water line alignment, and archaeological monitors were present to oversight this activity. The ‘no findings’ result led to the reclassification of this study as an archaeological assessment. No historic properties were identified during the backhoe test trenching or during the soil coring activities. Monitoring was recommended for all future ground disturbing activities.

### 3.2.25 Rotunno-Hazuka and Pantaleo (2005)

In February 2005, ASH conducted additional AIS subsurface testing prior to development at the proposed site for Maui Lani Elementary School (TMK: [2] 3-8-007:137) (Rotunno-Hazuka and Pantaleo 2005). The study included a pedestrian survey of the 29-acre project area and 15 machine-excavated test trenches, which were concentrated mostly in the northern half of the project area where development was proposed. No historic properties were identified during the surface survey or subsurface testing, so the study was termed an archaeological assessment. No further archaeological testing was recommended, but archaeological monitoring was recommended for future ground disturbance associated with the project area due to the high probability of human burials near the project area.

### 3.2.26 Conte (2005a)

On 14 May 2005, CRM Solutions Hawai‘i, LLC, conducted an AIS of an approximate 1.69-acre project area at 391 Wai‘ale Road to subdivide and develop the property (TMK: [2] 3-4-003:004) (Conte 2005a). A surface survey of the project area revealed sediments that had been continuously disturbed during long periods of residential and commercial development. Six backhoe trenches were excavated in a portion of the project area where deposits were likely to still be intact and not recently disturbed. The surface survey and subsurface testing had negative results, and the study was termed an archaeological assessment.

### 3.2.27 Wilson and Dega (2005)

In August 2005, SCS conducted an AIS on two parcels of land totaling 215.8 acres for the ‘Alaneo Development Project on the boundary between Waikapū and Wailuku Ahupua‘a (TMKs: [2] 3-5-002 and [2] 3-5-003) (Wilson and Dega 2005). The AIS included a systematic pedestrian survey and 21 backhoe test trenches. Seven historic properties were documented during the surface survey and all relate to historic sugarcane cultivation. Two historic properties, SIHP #s -05179 and -05493, were previously identified. SIHP # -05179 consists of a surface portion of the Waihe‘e Ditch and SIHP # -05493 is a surface portion of the Waikapū Ditch. Five historic properties were newly identified. SIHP # -05726 consists of a historic earthen berm ditch. SIHP # -05727 consists of an active and maintained rectangular reservoir. SIHP # -05728 consists of 14 earthen erosion control berms, all running parallel to one another in a cross-slope orientation. SIHP # -05729 consists of a stone and mortar irrigation ditch, possibly representing a recently widened former irrigation ditch. SIHP # -05730 consists of a 945-m portion of the alignment of Old Waikapū Road, observed to be running roughly between the two parcels making up the project area.

Only one trench (ST-6) encountered a historic property, largely because it was excavated across one of the earthen berms comprising SIHP # -05728 to gain insight into its construction. No subsurface historic properties were identified during trenching portions of this study. No further archaeological work for the project.

### 3.2.28 Morawski et al. (2006)

Between December 2003 and July 2005, SCS and ASH conducted archaeological monitoring of off-site construction near the proposed Kehalani Mauka Subdivision Project in Wailuku and Waikapū (TMKs: [2] 3-5-002:001 por. and [2] 3-5-001:017 por.) (Morawski et al. 2006). Five historic properties were identified during the 20 months of monitoring. SIHP # -05680 is a complete, *in situ* human burial located along Wai‘ale Road. The burial was preserved in place and capped with a buried concrete slab. SIHP # -05965 consists of disturbed human remains (an adult humerus portion). SIHP # -05966 consists of an incomplete and previously disturbed subadult burial. The human remains of SIHP #s -05965 and -05966 were assessed at the Maui SHPD Office and temporarily curated there pending long-term mitigation. SIHP # -05963 is a historic roadbed associated with early use of Wai‘ale Road. SIHP # -05964 is a portion of a historic sugarcane irrigation flume consisting of concrete and corrugated metal.

The previous archaeological sites map (Morawski et al. 2006:5) mistakenly labels SIHP # 50-50-04-05964 as 50-50-04-05967, as there is no description in their report for SIHP # -05967, the description of the location for -05964 aligns with the location of -05967 on the map. The map is also the only place in the entire report that mentions -05967. Additionally, the SIHP number for this feature in the HICRIS database is SIHP # -05964.

### 3.2.29 Dagan and Hammatt (2006)

On 22 November 2006, CSH conducted a Due Diligence Letter Report and Field Inspection on the proposed site for the Maui Scrap Yard Project (TMK: [2] 3-8-007:105) (Dagan and Hammatt 2006). This study included a field inspection of the project area to determine the presence/absence of any surface historic properties and to determine if any such historic properties would be adversely affected by the proposed development. No historic properties were identified during this

study, however, the observed presence of two sand piles of unknown origin in a corner of the project area raised suspicions regarding the potential for subsurface findings. A complete AIS, in addition to archaeological monitoring provisions, were recommended prior to and during all future ground disturbances on the parcel.

### 3.2.30 Tome and Dega (2010)

Between 13 June 2008 and 16 September 2009, SCS conducted an AIS of approximately 607 acres of undeveloped land spanning the aeolian sand dunes crossing Wai‘ale, Wailuku, and Waikapū (TMKs: [2] 3-8-005:023 por. and 037; [2] 3-8-007:071, 101, 102, and 104) (Tome and Dega 2010). The investigation included a 100% pedestrian survey and the excavation of 282 backhoe trenches and five manually excavated test units. Area A of the project area contained two previously identified historic properties, SIHP # 50-50-04-01508, a portion of the Spreckels Ditch, and SIHP # -05504, a locale consisting of at least three human burials. These sites had been designated by the SHPD outside of any previous archaeological study (Tome and Dega 2010:38). The human remains were identified by an archaeologist from ASH in 2003 during a casual observation while monitoring at a nearby Maui Lani project area. The pedestrian survey relocated the two previously identified site locales.

Further testing near SIHP # -05504, which did not result in the discovery of additional human remains, helped to define the site boundaries. One newly identified historic property was documented in one excavation during subsurface testing. SIHP # -06578 designates a buried fire pit/*imu* (underground oven) observed within Trench ST-90 located in Area A. Archaeological monitoring was recommended for all ground disturbing activities associated with the development of the project area.

### 3.2.31 Perzinski and Dega (2010)

In August 2009, SCS conducted an AIS of an approximate 2.5 km long corridor for the proposed Wai‘ale Road extension and a 1.3 km long by 0.2 km wide corridor for the proposed Waiko Road improvement in Waikapū (TMKs: [2] 3-5-002:014, 018, 888; [2] 3-5-027:021; [2] 3-6-002:003; and [2] 3-8-005:999) (Perzinski and Dega 2010). The investigation included a pedestrian survey and 64 backhoe trenches. No cultural materials were encountered within the backhoe trenches. One historic property was documented during the pedestrian survey. SIHP # 50-50-04-06668 is a historic boulder terrace on the southern bank of Waikapū Stream. The terrace was interpreted as functioning for either water diversion or as a former footbridge footing. No sediments were present within the boulder terrace. SIHP # 50-50-04-06668 was assessed as significant per Criterion “d” (have yielded, or have the potential to yield significant information to the history of the area) of the Hawai‘i State Register, and no additional testing was recommended.

### 3.2.32 Hauanio and Rechtman (2010)

Between 6 July and 26 August 2010, Rechtman Consulting, LLC, conducted archaeological monitoring related to sewer, storm drain, and fence improvements at the MCCC (TMK: [2] 3-8-046:005) (Hauanio and Rechtman 2010). Ground disturbances for this project included the excavation of existing storm drain boxes and associated sewer lines and the excavation of 85 post holes that would eventually be connected via continuous trenching for the placement of new fence

posts. No historic properties were identified. The stratigraphy revealed buried sand dune deposits in the eastern portion of the project area.

### 3.2.33 Titchenal and Sinoto (2010)

In March 2010, Aki Sinoto Consulting conducted an AIS of 8.552 acres of a former scrapyard for the proposed light industrial subdivision at the junction of Waiko Road and Pakana Street in Waikapū (TMK: [2] 3-8-007:105) (Titchenal and Sinoto 2010). The study included a 100% pedestrian survey of the project study area, the excavation of nine backhoe-assisted test excavations, and the excavation of 11 subsurface inspection units. Depths of the excavations ranged between 1.5 and 2.6 m. No historic properties were identified during the study. Due to the negative findings of the AIS, the study was termed an archaeological assessment. The authors note extensive physical evidence of compounded ground disturbance, including sand mining, throughout the project area. Other noted disturbances are likely related to the parcel's former use as a scrap yard.

### 3.2.34 Pfennig and Hammatt (2014)

Between 14 and 28 July 2014, CSH conducted archaeological monitoring associated to the construction of a two-story single family residence in the Sandhills area of Wailuku (TMK: [2] 3-8-089:098) (Pfennig and Hammatt 2014). Ground disturbances for this project included excavation of the residence foundation, three dry wells, and all associated utility excavations. No historic properties were identified during ground disturbing activities related to the home construction project. Most of the excavations monitored across the parcel terminated in a natural and undisturbed sand layer. Due to the presence of the undisturbed sand, and the known potential for subsurface historic properties within those sediments, further monitoring of all ground disturbing activities beyond the scope and depth of those undertaken during this project was recommended.

### 3.2.35 Hodara and Dega (2014)

On 10 and 11 September 2014, SCS conducted archaeological monitoring at the MCCC following the discovery of faunal bones during construction related ground disturbances for the installation of a new subsurface cable line (TMK: [2] 3-8-046:005) (Hodara and Dega 2014). During monitoring researchers observed an amorphous deposit of cultural debris buried beneath sandy deposits in the bottom of a utility trench. The deposit was designated as SIHP # 50-50-04-08017, a refuse deposit containing iron nails, metal rods, glass shards, unidentifiable metal fragments, concrete fragments, coral fragments, lithified sandstone cobbles, basalt cobbles, and additional saw-cut faunal bone fragments. No further archaeological work was required at the SIHP # -08017, and no additional recommendations were made for the project area.

### 3.2.36 Guerriero et al. (2017)

From February through June 2013, ASH conducted an AIS for the Waikapū Country Town Project (TMKs: [2] 3-6-002:003; [2] 3-6-004:003; and [2] 3-6-005:007) (Guerriero et al. 2017). The project area was divided into five parcels: Parcel 3 Mauka, Parcel 3 Waena, Parcel 3 Makai, Parcel 7, and Parcel 6. Fieldwork included a 100 percent coverage pedestrian survey followed by a subsurface testing program consisting of 150 mechanically excavated test excavations. The testing methods employed by the survey was systematic random sampling to obtain information about the subsurface conditions across the project area and to determine future or additional

excavation strategies as needed. No historic properties were identified during subsurface test excavation.

During the AIS, four historic properties were identified during the surface survey: SIHP #s 50-50-04-07881 through -07884. SIHP 50-50-04-07881 consists of 18 component features associated with historic commercial sugarcane irrigation (e.g., concrete-lined ditches and headwalls, dirt culverts, and sluice gates). SIHP # 50-50-04-07882 is a remnant L-shaped retaining wall. SIHP # 50-50-04-07883 was interpreted as a World War II bunker. SIHP # 50-50-04-07884 consists of three discrete scatters of historic materials including ceramic sherds and glass bottle fragments. Additionally, previously identified SIHP # 50-50-04-05197, the historic Waihe‘e Ditch, runs north/south through the northwest portion of the project area.

All 18 feature components of SIHP # 50-50-04-07881 were identified along the northwestern boundary of the project area, south of Waikapū Stream, in Parcel 3 Mauka. Irrigation features comprising SIHP # 50-50-04-07881, including the reservoir (Feature 3) at the project area's western extent, were recorded historically on a U.S. Geological Survey (1955) map. SIHP # 50-50-04-07882 is located near SIHP # -07881 Feature 2 (ditch) and the Parcel 3 Mauka and Parcel 6 boundary.

SIHP # 50-50-04-07883 was identified on the southern side of an access road transecting east/west Parcel 3 Mauka. The three distinct historic artifact scatters (Features 1–3) of SIHP # 50-50-04-07884 were documented near SIHP # -7881 Feature 2 (ditch) in the northeastern corner of Parcel 3 Mauka (Feature 1), in the northern-central portion of Parcel 6 (Feature 2), and at the southeastern corner of Parcel 7 (Feature 3).

In addition to the SIHP #s identified, six other features were recorded and designated temporary site numbers. These temporary sites include a concrete slab of early to mid-1900s construction (TS4), and five rock piles (TS21, TS22, and TS23 through TS25). TS4 (slab) was identified with Parcel 3 Mauka approximately 81 m (265.75 ft) east of the reservoir at the western extent of the project area. TS21 and TS22 (rock piles) were recorded within Parcel 3 Mauka, while the other TS23 through TS25 (rock piles) were documented within Parcel 3 Waena. None of these features were determined to meet significance criteria. Other than archaeological monitoring during the project, additional archaeological work was not recommended for these temporary sites.

SIHP #s 50-50-04-07881 through -07884 were assessed as significant under Criterion D, since "they have yielded, or have the potential to yield significant information to the history of the area;" SIHP # 50-50-04-07883 (bunker) was additionally assessed with significance Criterion C for having "a distinct method or style of construction during a certain era (Guerriero et al. 2017:2). Guerriero et al. (2017) recommended preservation in place for SIHP # 50-50-04-07883 (bunker); alternatively, recommendation was presented for replacement of SIHP # 50-50-04-07883 with an interpretative commemorative plaque if preservation is not viable. Archaeological monitoring was recommended for the project.

### 3.2.37 O'Claray-Nu et al. (2018)

From 17 to 22 March 2017, ASH conducted an AIS for a proposed Wailuku Apartment Rental Housing Project in the lot on the northwestern side of the Wai‘ale Road and Kuikahi Drive intersection (TMK: [2] 3-5-001:064) (O'Claray-Nu et al. 2018). The AIS consisted of a 100%

pedestrian survey and the excavation of 11 test trenches. No historic properties were discovered during the investigation. ASH suggested that the lack of observed cultural resources may have resulted from extensive ground disturbance that has occurred in the project area during previous sugarcane cultivation, sand mining, and recent construction.

### 3.2.38 Yucha et al. (2020)

On 29 January 2019, portions of a human cranium were encountered during unmonitored hand excavation of the new Dorm 3 dry well at MCCC (TMK: [2] 3-8-046:005 por.) (Yucha et al. 2020). CSH was contracted to investigate the findings, assist with burial treatment, and conduct archaeological monitoring for the duration of the project. On 28 March 2019, CSH completed a preliminary investigation of the inadvertent discovery location. During the clean-up of loose sediment within the excavation, CSH staff observed that the lithified sand layer in the base of the excavation had been previously cut and excavated. An inspection of this area quickly revealed the presence of a faint wooden coffin outline and additional coffin nails at approximately 110 cm (3.5 ft) below surface. The orientation of the coffin (west/east) extended directly through the center of the dry well excavation and into the sidewall nearest to Dorm 3. No further investigation of the coffin area was conducted. The coffin burial was assigned SIHP # 50-50-04-08659 and was preserved in place beneath a concrete cap. The Dorm 3 drywell location was moved and installed with no further finds. CSH prepared a burial site component of a preservation plan for SIHP # 50-50-04-08659 (J. M. Yucha and H. H. Hammatt 2019) and an archaeological monitoring report (Yucha et al. 2020) that were both reviewed and accepted by the SHPD.

### 3.2.39 Yucha et al. (2021b)

Between January and September 2020, CSH conducted an AIS of approximately 451.48 acres of former (fallow) commercial agricultural fields on the eastern side of Kuihelani Highway for the AES Kuihelani Solar Plus Storage Project (TMK: [2] 3-8-005:002 por.) (Yucha et al. 2021b). The proposed project would involve installing rows of solar panels and constructing a battery energy storage system. The AIS involved a 100% pedestrian inspection, representative subsurface testing of 258 backhoe-assisted excavations, a ground penetrating radar (GPR) survey of 17 transects, and the observation of 25 geotechnical test bores, which had been conducted by Geolabs, Inc. in May and September 2019. Overall, the observed stratigraphy included a mix of aeolian sand, lithified sand, and alluvial loams.

The AIS identified six new historic properties, SIHP #s 50-50-04-08800 through -08805, and identified eight new components of a previously identified historic property, SIHP # -01508, Spreckels/Waihe‘e Ditch. The historic properties are all post-Contact and related, directly or indirectly, to the use of the property for commercial sugarcane cultivation. The six newly identified historic properties consist of two historic water control complexes (SIHP #s -08800 and -08804), two water control structures (SIHP #s -08801 and -08803), a storage building (SIHP # -08802), and a subsurface cultural deposit (SIHP # -08805).

Notably, CSH had preceded the project with a reconnaissance-level pedestrian inspection during an LRFI in November 2018, which first noted the presence of the potential historic properties (Yucha et al. 2018). Also, in April and August 2019, CSH had conducted a preliminary GPR survey followed by ground-truthing excavations of the 21 detected GPR anomalies (T. M. Yucha and H. H. Hammatt 2019).

### 3.2.40 Yucha et al. (2021a)

In August and October 2021, CSH conducted an AIS and GPR survey of approximately 0.51 acres of the MCCC property for new medium security housing and chiller plant improvements (TMK: [2] 3-8-046:005 and 006 pors.) (Yucha et al. 2021a). A GPR survey covered the majority of the accessible portions (approximately 55%) of the project area and produced four GPR anomalies (GPR Anomaly 1 through 4), which were each ground-truthed via 1.0-by-1.0-sq-m test units. Four additional test units were distributed throughout the survey area to assess the stratigraphy. Ground-truthing of the GPR anomalies produced no significant findings. GPR Anomaly 1 was attributed to basalt boulders and concrete fragments, and GPR Anomaly 4 may have been related to changes in fill strata or the presence of asphalt fragments. The origins of GPR Anomalies 2 and 3 were not discernible.

No archaeological historic properties were identified during the AIS testing, and the study was termed an archaeological assessment (AA) in accordance with HAR §13-275-5(5)(A). CSH expected to encounter natural Puuone sand deposits, similar to those found during excavations for a dry well at Dorm 3 (Yucha et al. 2020). Instead, subsurface excavation in the project area identified heavily compacted fill strata comprised of a mix of locally procured sand and clay-based sediment containing cobbles, boulders, construction debris, and sparse cultural material. In many instances, manual excavations could not penetrate the fill strata beyond approximately 1.2 m below surface. Archaeological monitoring was recommended for all project-related ground disturbance due to the potential for subsurface historic properties, including human burials, to be present within the project area beneath thick fill deposits.

### 3.2.41 Madeus et al. (2022)

From December 2020 through November 2021, CSH conducted archaeological monitoring for the Lot 1-A Condominium Site Improvements Project at 109 E. Waiko Road, formerly occupied by the Maui Scrap Yard (TMK: [2] 3-8-007:105) (Madeus et al. 2022). The project entailed grubbing and tree clearance, grading, and excavations for drainage boxes and trenches, a drainage basin with soil swales, utility line (e.g., electric and water) trenches, post holes for fence installation, and backfilling. One new historic property was encountered and identified as SIHP # 50-50-04-08812, a human burial complex consisting of three separate burial features (Feature A through Feature C), including two *in situ* burials (Feature A and Feature C) and one isolated femur portion (Feature B). The skeletal remains of SIHP # -08812 represented a MNI of three individuals. Based on available evidence, CSH believes that these individuals are most likely Native Hawaiian of pre- to early post-Contact origin. In accordance with the SHPD’s treatment determinations for these finds, SIHP # -08812 Features A through C were preserved in place in perpetuity.

Natural dune sand deposits were documented along the eastern and southern boundaries of the project area. The remainder of the project area, which is proposed for future commercial subdivision, was determined to contain imported modern fill sediment believed to have been imported from excavations at the Kehalani Village Commercial Subdivision. These fill deposits consisted of extremely gravelly and cobbly loam to depths of 1.35 to 2.5 m (4.4 to 8.2 ft) below surface and were negative for subsurface historic properties.

## 3.3 **Predictive Model**

The proposed Central Maui WWRF section of the project area is located at the southern extent of an area known as Wailuku Sandhills, or also the Sand Hills, which is a geologic sand dune and a culturally sensitive area that is commonly associated with clusters of pre-Contact burials. No previous archaeological studies have been conducted within the Connection Corridor segment or the Central Maui WWRF section of the project area. As such, no burials or historic properties have been previously encountered within these portions of the project area nor on the southern side of Waikapū Stream and east of Honoapi‘ilani Highway. This area is within the alluvial fan created by Waikapū Stream, therefore intermittent alluvial deposits are expected among the aeolian sand deposits. Evidence of pre-Contact to early post-Contact temporary habitation sites may be expected in this section, similar to historic properties identified by previous archeological studies on the northern side of Waikapū Stream.

A review of previous archaeological studies in the vicinity of the entire project area indicates that potential near-surface and subsurface historic properties in the region have included historic artifact scatters on the surface of agricultural soils (SIHP # 50-50-04-07884), garden plots within agricultural soils (features of SIHP # 50-50-04-02020 and -02024), and human burials primarily associated with sand deposits (SIHP # 50-50-04-05504 and -06226).

For over a century, surface soils within most of the project area have been significantly disturbed by commercial agricultural plowing and intermixed with imported material to increase the viability of agriculture in the region. Any historic properties that may have been present within the agricultural plow zone have likely been impacted or destroyed by plowing. Features associated with historic agriculture cultivation, production, and transportation may be expected.

The project’s LRFI study confirmed that three previously documented historic properties were identified within the entirety of the project area. These historic properties include SIHP # 50-50-04-05965, disturbed human remains consisting of an adult humerus portion, SIHP # 50-50-04-05966, incomplete and previously disturbed subadult burial; and SIHP # 50-50-04-06668, a post-Contact terrace. There are also two previously documented burials that are outside the project corridor but are within close proximity of the project area: SIHP # 50-50-04-5680, identified by Morawski et al. (2006), is approximately 16 m west and 50-50-04-08659, identified by Yucha et al. (2020), is approximately 30 m east of the northern portion of the project corridor.

The project’s LRFI field inspection conducted by CSH identified potential historic properties that included: a concrete culvert (CSH 1); a road portion and former railroad corridor (CSH 2); a ditch (CSH 3); and retaining walls (CSH 4).

Previously documented historic properties within the project area will be included and further assessed within the AIS study. Potential historic properties will be assessed to determine if they meet the definition of a significant historic property and, if applicable, included within the AIS study.

# Section 4 Results of Fieldwork

## 4.1 Wai‘ale Road Extension Project AIS Results

Between 29 April and 21 May 2024, CSH conducted AIS testing for the Wai‘ale Road Extension segment of the project area (Ueki et al. 2025). A draft AIS report for the project is currently being prepared for review by the SHPD. The AIS included a 100% coverage pedestrian inspection, 60 test excavations, and ten GPR transects (Figure 30). In addition, Perzinski and Dega (2010) had completed an AIS for an earlier proposed Wai‘ale Road extension project, and 25 of their 64 test excavations were located within the new project area. In general, the stratigraphy observed during subsurface testing consisted of a former agricultural plow zone (Ap horizon) overlying deposits that included previously disturbed mixed sand deposits, natural wind-blown (aeolian) sand deposits, natural cemented or lithified sand deposits, and water-deposited (alluvial) soils including cobbly and bouldery streambed deposits. No significant GPR anomalies were detected.

The project area contained a post-Contact boulder terrace (SIHP # 50-50-04-06668) that was previously identified by Perzinski and Dega (2010) and redocumented by CSH during the project. Two historic properties were newly identified: a post-Contact irrigation ditch complex (SIHP # 50-50-04-09167) and a subsurface historic cultural deposit (SIHP # 50-50-04-09168) (Figure 31 and Figure 32). SIHP # -09167 is a water control complex that parallels the eastern side of Honoapi‘ilani Highway and contains eight feature components: the ditch itself (Feature A), a culvert extending beneath a driveway (Feature B), a stacked stone terrace (Feature C), three sluice gates (Features D, F, and H), and two pedestrian crossings or walkways (Features E and G). One of the sluice gates, Feature D, includes the date inscription “1967”, indicating that portions of the complex are at least 57 years old. SIHP # -09168 is a historic refuse disposal deposit identified within TE-4 and containing an artifact assemblage of approximately 1,092 items including glass bottle fragments, ceramic fragments, metal fragments, buttons, and various other materials ranging from the early to mid-1900s. Full documentation of these historic properties is provided in Section 5.

## 4.2 Pedestrian Inspection Results

CSH conducted a 100% coverage pedestrian survey of the project area. The survey was accomplished by CSH archaeologists conducting systematic pedestrian transects. Transect spacing varied depending on ground visibility. For open, plowed fields where ground visibility was excellent, spacing was approximately 10.0 m. For vegetated or unmaintained areas where ground visibility was poor, spacing was approximately 5.0 m. As a result of the pedestrian survey, the two historic properties (SIHP # -06668 and -09167) that were documented by CSH during the AIS for the Wai‘ale Road Extension Project (Ueki et al. 2025) were confirmed to be within or immediately adjacent to the current project area. Of the four potential historic properties identified during the project’s LRFI study, CSH 1 (concrete culvert), CSH 2 (road portion), and CSH 4 (retaining walls) did not meet the criteria for archaeologically significant historic properties and did not require additional documentation. CSH 3 (irrigation ditch) was designated as SIHP # -09167 by Ueki et al. (2024) as a potentially significant historic property, subject to assessment by a qualified architectural professional.

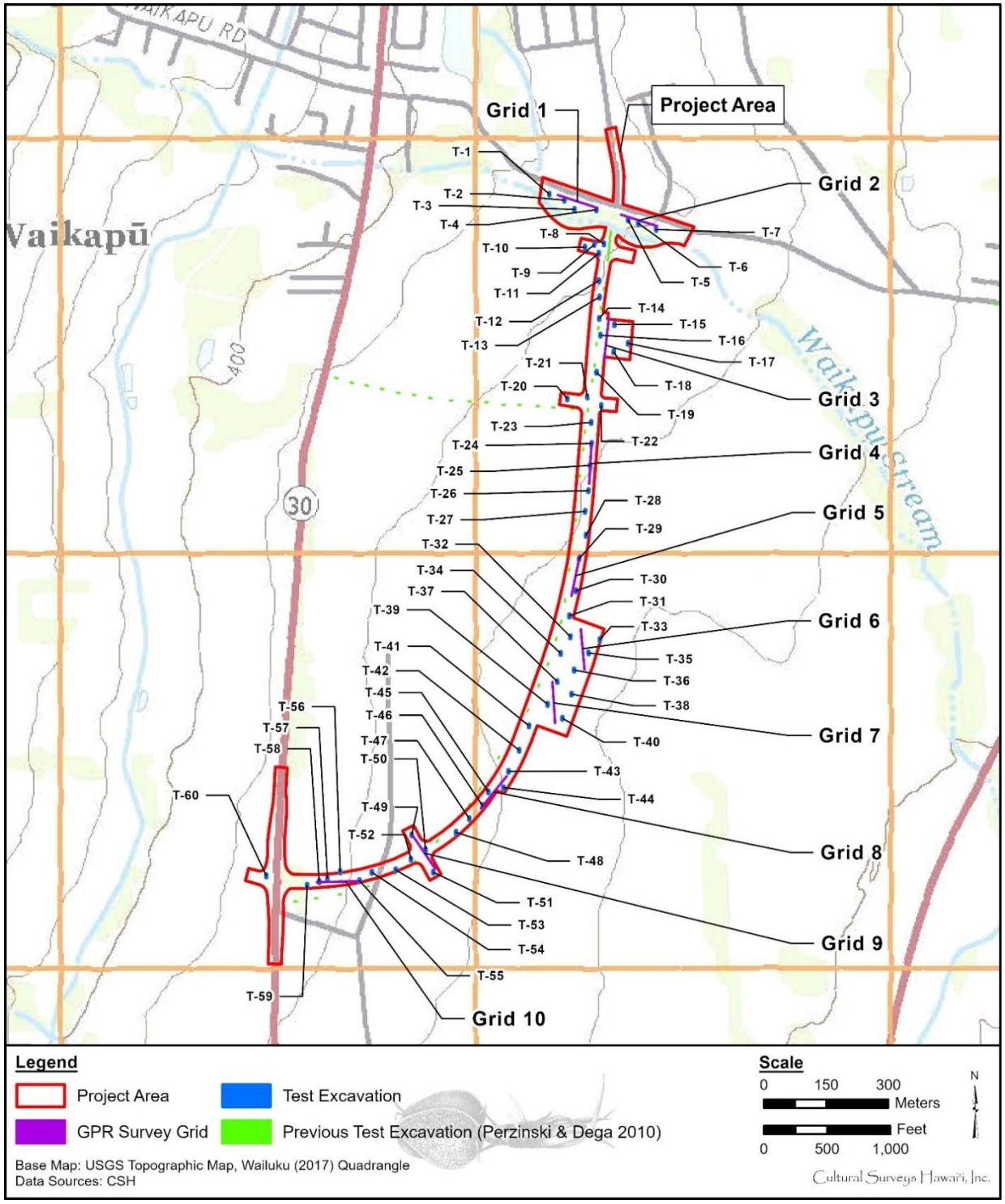



Figure 30. Portion of the 2017 Wailuku USGS 7.5-minute topographic quadrangle showing the Wai‘ale Road Extension AIS project area and the locations of the 60 AIS test excavations, ten GPR grids, and 64 previous trench locations from Perzinski and Dega (2010) (Ueki et al. 2025:63)

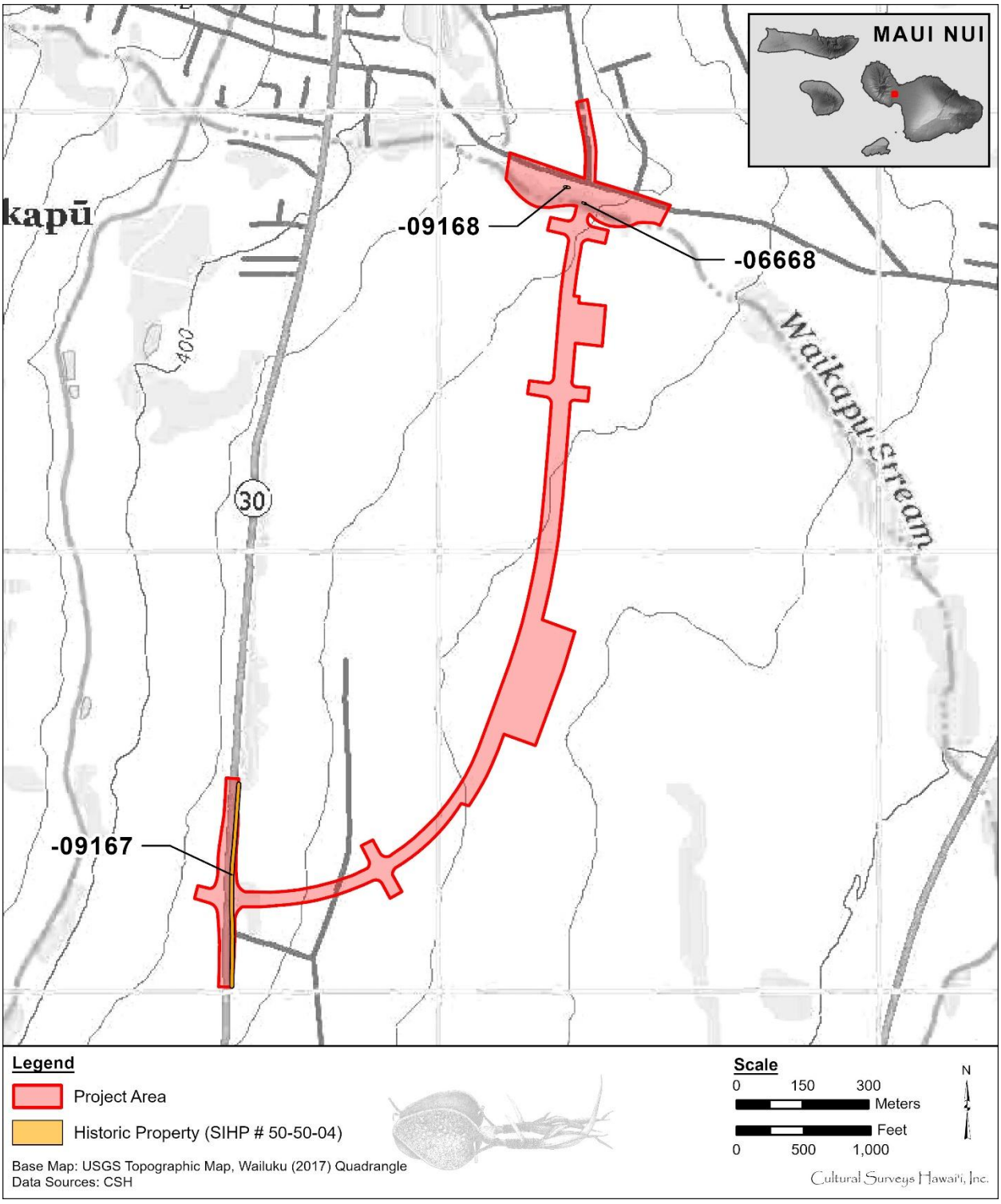



Figure 31. Portion of the 2017 Wailuku USGS 7.5-minute topographic quadrangle showing the locations of historic properties identified within the Wai‘ale Road Extension AIS project area (U.S. Geological Survey 2017b; Ueki et al. 2025:61)

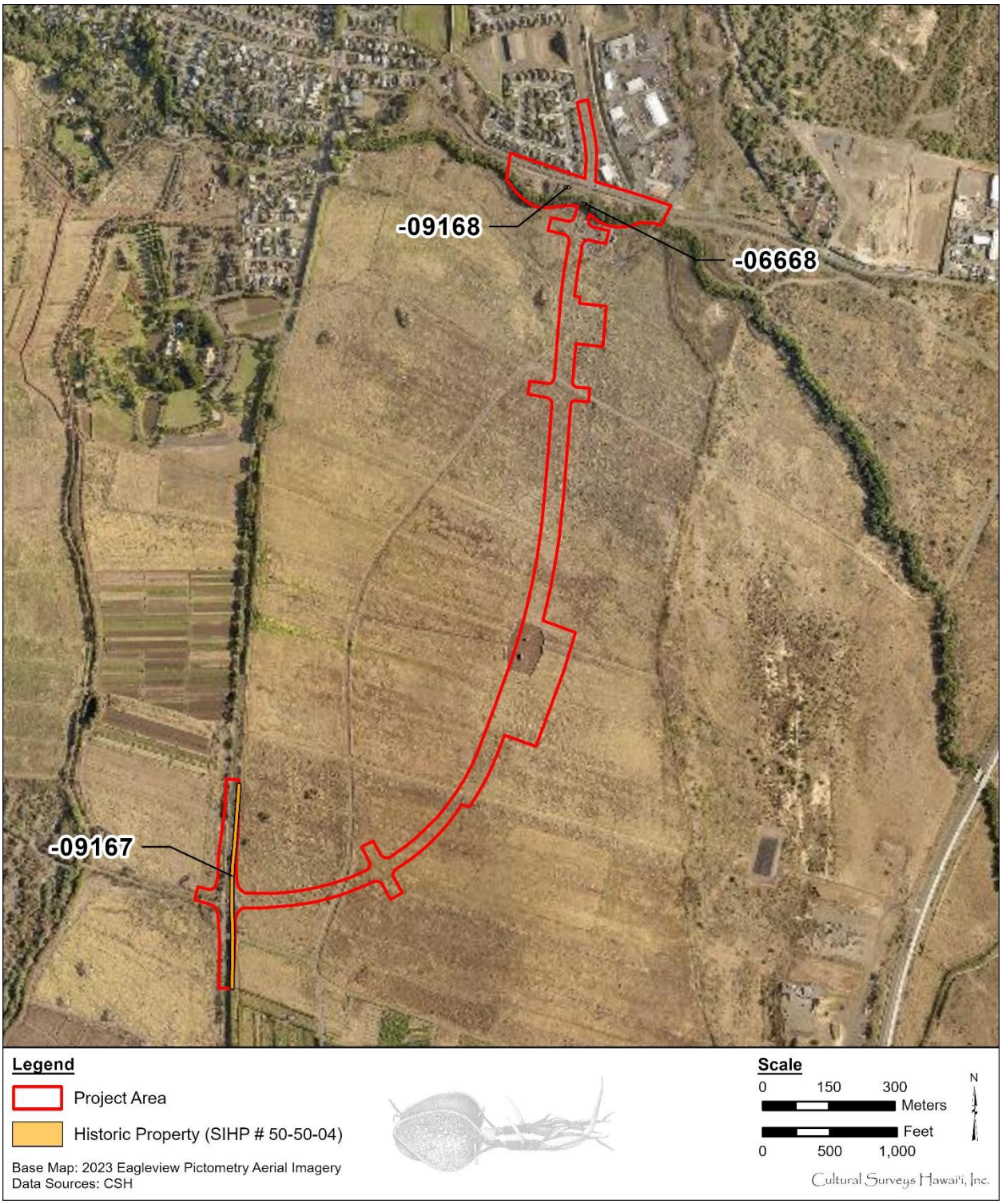



Figure 32. Aerial image showing the locations of historic properties identified within the Wai‘ale Road Extension AIS project area (EagleView Technologies Inc. 2023; Ueki et al. 2025:62)

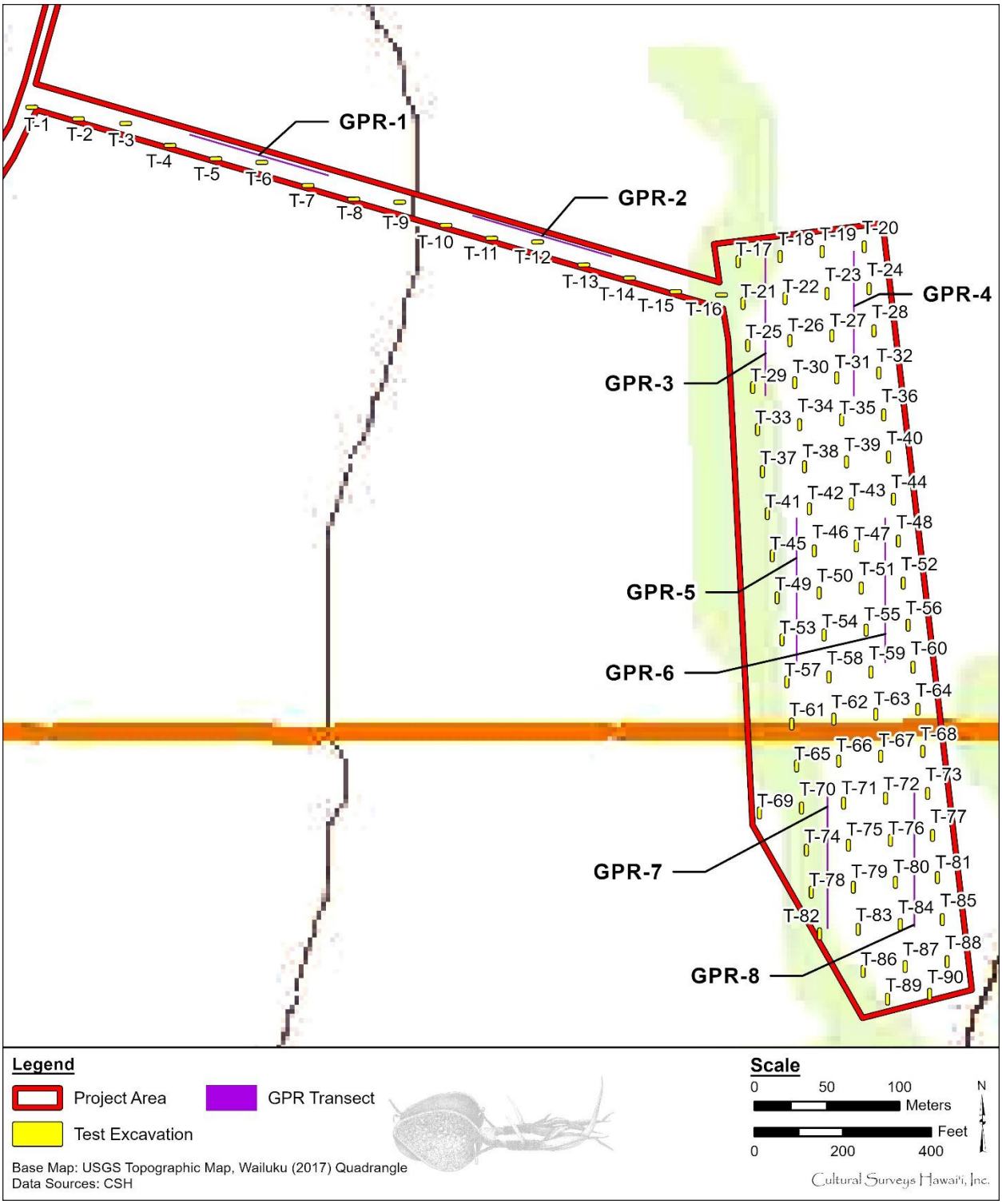



Figure 33. Portion of the 2017 Wailuku USGS 7.5-minute topographic quadrangle showing the locations of the AIS test excavations and GPR survey transects within the project area (U.S. Geological Survey 2017a, 2017b)

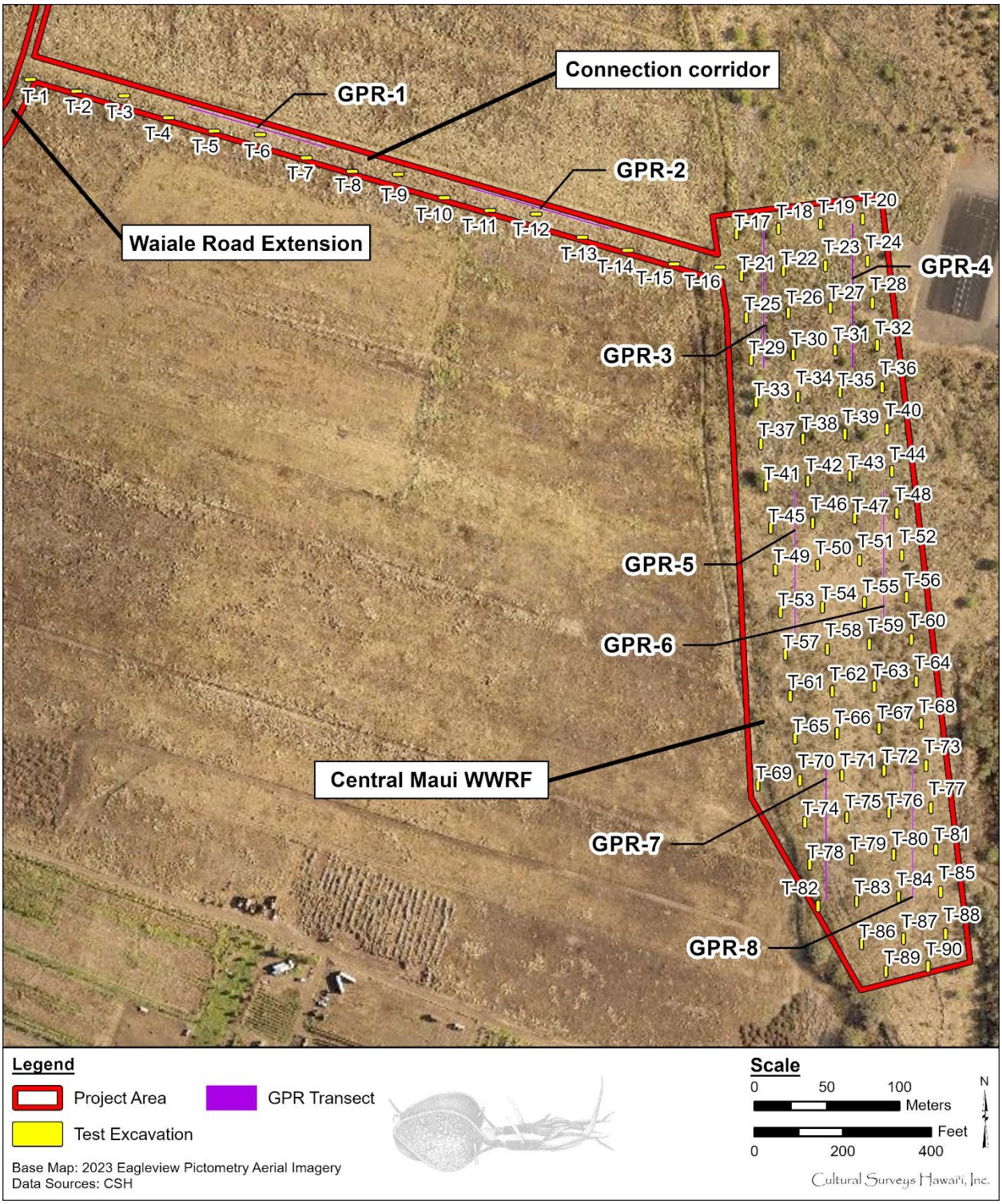



Figure 34. Aerial image showing the locations of the AIS test excavations and GPR survey transects within the project area (EagleView Technologies Inc. 2023)

# 4.3 GPR Results

CSH utilized GPR survey during the AIS in an effort to increase survey coverage throughout the project area without further increasing the amount of invasive testing. Prior to surveying GPR-3 through GPR-8, each transect grid was cleared of surface vegetation using the backhoe to ensure surface factors did not limit the effectiveness of the GPR survey. GPR-1 and GPR-2 were not cleared of vegetation because the backhoe was not on-site at the time; however, this did not impact the accuracy of the GPR results. CSH completed eight GPR transect grids, GPR-1 through GPR-8, that were randomly distributed throughout the project area (Figure 33 and Figure 34). Each GPR grid was 100.0 m (328.0 ft) long and 1.0 m wide consisting of five transects spaced 25 cm apart to produce reflection profiles of subsurface conditions. In general, the reflections that were collected during the GPR survey for this AIS are consistent with the findings of subsurface test excavation within the project area. Where present, the GPR reflection profiles show the interface between plow zone sediment and underlying natural deposits occurring at approximately 1.0 to 1.2 m (3.2 to 3.9 ft) below the surface (mbs). No GPR anomalies were identified within the project area that would merit avoidance or ground-truthing excavation, however highly reflective surfaces were observed in the southern portions of GPR-3 and GPR-8 that likely correspond with a change in stratigraphy or sediment compaction.

### 4.3.1 GPR-1

GPR-1 was placed in the western half of the proposed connection corridor segment of the project area (Figure 35). The grid was oriented southeast to northwest on the northern side between TE-4 and TE-8. The surface of the area was partly uneven and grassy with vegetation clumps and dried sugarcane pieces. No anomalies were detected in the reflection profiles of GPR-1 (Figure 36). The reflections are consistent with the results of the adjacent AIS test excavations that identified the plow zone and the interface of the underlying substrate.

### 4.3.2 GPR-2

GPR-2 was placed in the eastern half of the proposed connection corridor segment of the project area (Figure 37). The grid was oriented southeast to northwest on the northern side between TE-10 and TE-14. The surface of the area was partly uneven and grassy with vegetation clumps and dried sugarcane pieces. No anomalies were detected in the reflection profiles of GPR-2 (Figure 38). The reflections are consistent with the results of the adjacent AIS test excavations that identified the plow zone and the interface of the underlying substrate.

### 4.3.3 GPR-3

GPR-3 was placed in the northwestern section of the Central Maui WWRF segment of the project area (Figure 39). The grid was oriented north to south extending between the length of eight trenches: TE-17/18, TE-21/22, TE-25/26, and TE-29/30. The surface of the area was cleared with the backhoe and relatively level. The grid included a tree root near the center. No anomalies were detected in the reflection profiles of GPR-3, however a highly reflective surface was observed in the southern portion of the grid that likely corresponds with a change in stratigraphy or sediment compaction (Figure 40). The reflection profile appears to be consistent with the stratigraphy and findings of the nearby AIS test excavations, where the reflection is at approximately 1.5 mbs which is approximately where structureless sand or loamy sand stratum layers transition to a silty clay/ clay loam in test excavations near the southern portion of GPR-3 (TE-25/26 and TE-29/30).



Figure 35. GPR-1, general view of the GPR grid area, view to southeast

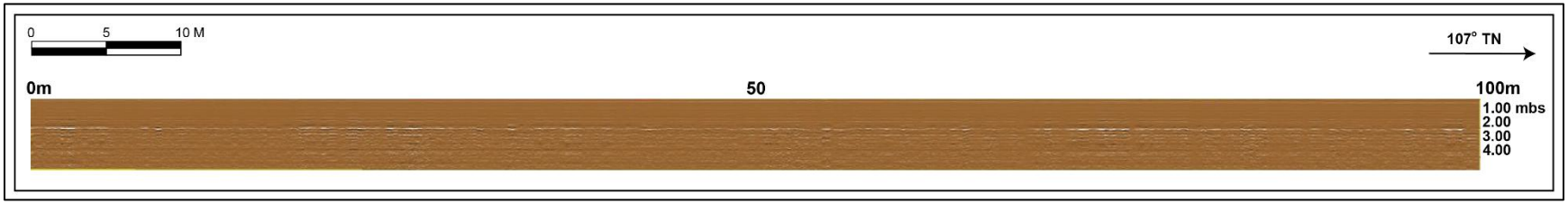



Figure 36. GPR-1 reflection profile (0-100 m)



Figure 37. GPR-2, general view of the GPR grid area, view to southeast

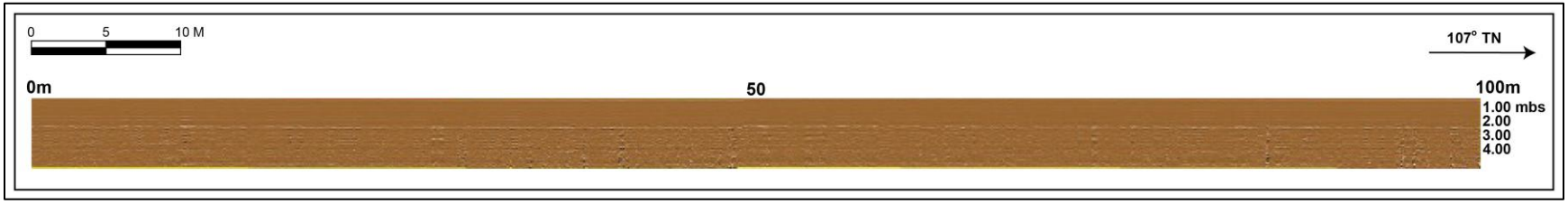



Figure 38. GPR-2 reflection profile (0-100 m)

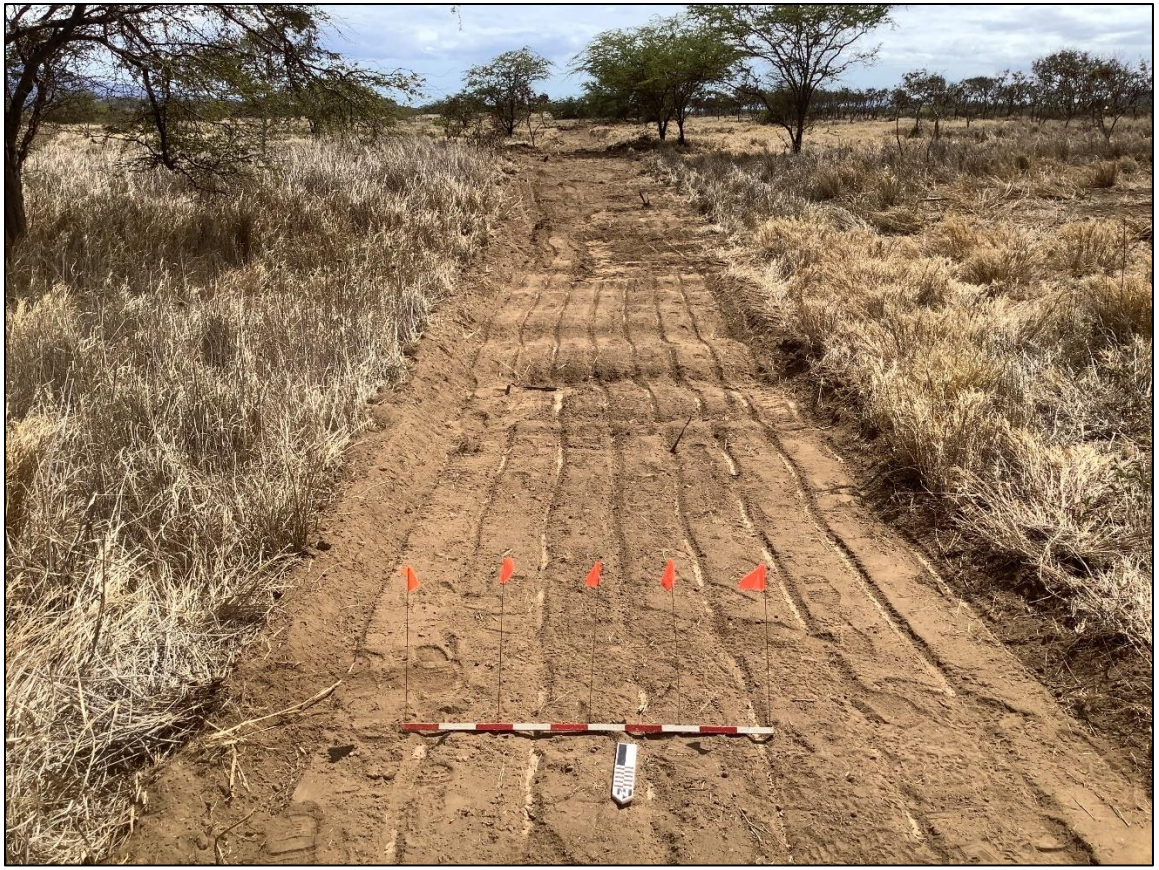


Figure 39. GPR-3, general view of the GPR grid area, view to south

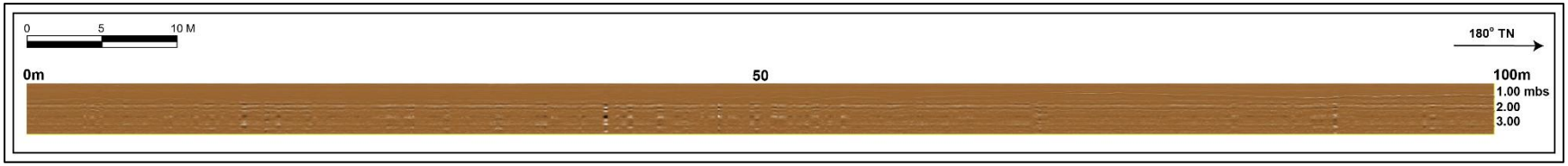



Figure 40. GPR-3 reflection profile (0-100 m)

### 4.3.4 GPR-4

GPR-4 was placed in the northeastern section of the Central Maui WWRF segment of the project area (Figure 41). The grid was oriented north to south extending between the length of eight trenches: TE-19/20, TE-23/24, TE-27/28, and TE-31/32. The surface of the area was cleared with the backhoe and used for vehicle access in the field, although the eastern edge was partly within a grassy area. No anomalies were detected in the reflection profiles of GPR-4, however a highly reflective surface was observed in the southern portion of the grid that likely corresponds with a change in stratigraphy or sediment compaction (Figure 42). The reflection is likely showing the transition between sand and silty/sandy clay loam between 1.50 and 2.00 mbs, as observed in TE-49, TE-50, and TE-54. The reflections are consistent with the results of the adjacent AIS test excavations that identified the plow zone and the interface of the underlying substrate.

### 4.3.5 GPR-5

GPR-5 was placed in the central-western of the Central Maui WWRF segment of the project area (Figure 43). The grid was oriented north to south extending between the length of eight trenches: TE-41/42, TE-45/46, TE-49/50, and TE-53/54. The surface of the area was cleared with the backhoe first and relatively level. No anomalies were detected in the reflection profiles of GPR-5, however a highly reflective surface was observed in the southern portion of the grid that likely corresponds with a change in stratigraphy or sediment compaction (Figure 44). This is likely showing the transition from sandy sediment to silty/sandy clay loam observed at the bottom of TE-49, 50, and 54 from 147 and 224 cmbs.

### 4.3.6 GPR-6

GPR-6 was placed in the central-eastern section of the Central Maui WWRF segment of the project area (Figure 45). The grid was oriented north to south extending between the length of six trenches: TE-47/48, TE-51/52, and TE-55/56. The surface of the area was cleared with the backhoe first and relatively level except for a few areas with vegetation clumps. No anomalies were detected in the reflection profiles of GPR-6 (Figure 46). The reflections are consistent with the results of the adjacent AIS test excavations that identified the plow zone and the interface of the underlying substrate.

### 4.3.7 GPR-7

GPR-7 was placed in the southwestern section of the Central Maui WWRF segment of the project area (Figure 47). The grid was oriented north to south extending between the length of eight trenches: TE-70/71, TE-74/75, TE-78/79, and TE-82/83. The surface of the area was cleared with the backhoe first and relatively level except for a few tree stumps. No anomalies were detected in the reflection profiles of GPR-7 (

Figure 48). The reflections are consistent with the results of the adjacent AIS test excavations that identified the plow zone and the interface of the underlying substrate.

### 4.3.8 GPR-8

GPR-8 was placed in the southeastern section of the Central Maui WWRF segment of the project area (Figure 49). The grid was oriented north to south extending between the length of eight trenches: TE-72/73, TE-76/77, TE-80/81, and TE-84/85. The surface of the area was cleared with the backhoe first and relatively level. No anomalies were detected in the reflection profiles of GPR-8, however a highly reflective surface was observed in the southern portion of the grid that likely corresponds with a change in stratigraphy or sediment compaction (Figure 50). The reflection profile appears to be consistent with the stratigraphy and findings of the nearby AIS test excavations, such as in TE-80, Stratum IV, the sediment is described as having extremely firm consistence at a depth from 94–157 cmbs. The reflective surface appears to be increasing in depth to approximately 2 mbs going south where the maximum depths of TE-84 and TE-85 are 161 and 157 cmbs, respectively.



Figure 41. GPR-4, general view of the GPR grid area, view to north

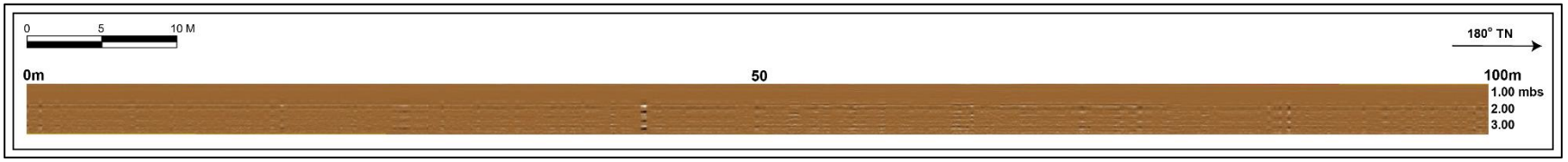



Figure 42. GPR-4 reflection profile (0-100 m)



Figure 43. GPR-5, general view of the GPR grid area, view to north

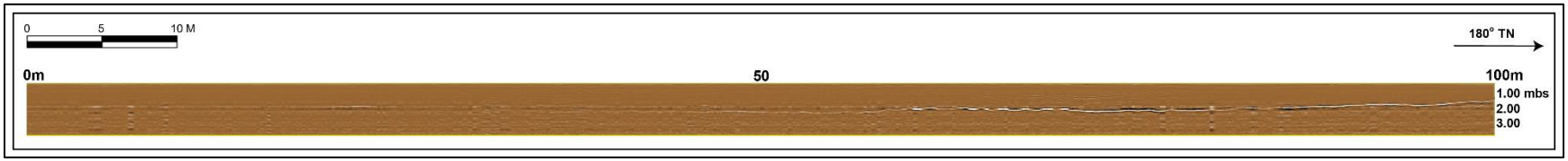



Figure 44. GPR-5 reflection profile (0-100 m)



Figure 45. GPR-6, general view of the GPR grid area, view to south

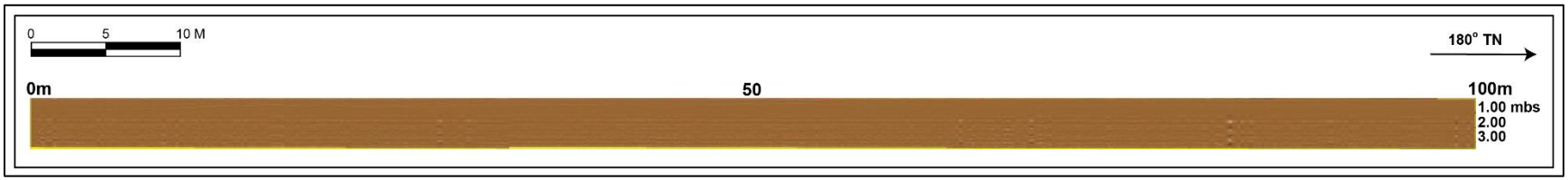



Figure 46. GPR-6 reflection profile (0-100 m)



Figure 47. GPR-7, general view of the GPR grid area, view to north

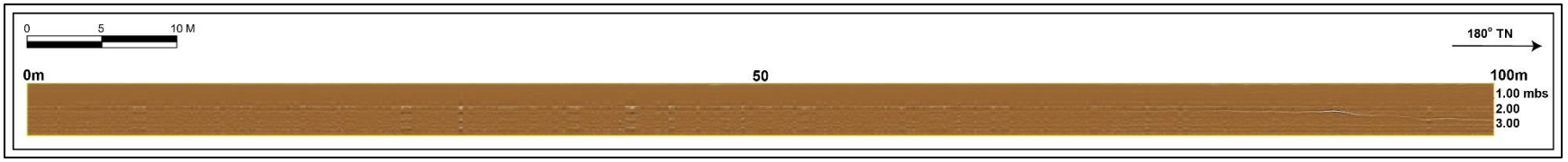



Figure 48. GPR-7 reflection profile (0-100 m)



Figure 49. GPR-8, general view of the GPR grid area, view to south

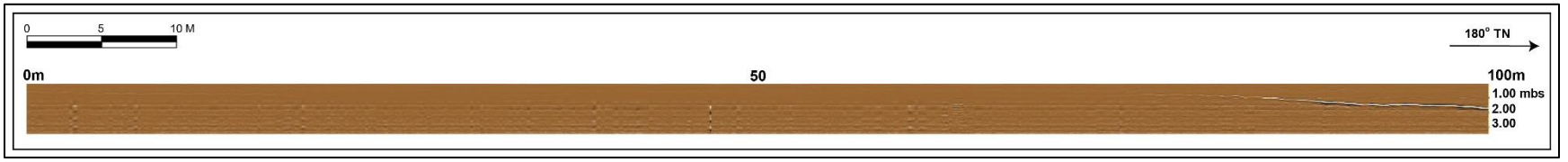



Figure 50. GPR-8 reflection profile (0-100 m)

## 4.4 Geotechnical Boring Results

Between 5 and 21 September 2023, geotechnical boring operations and double ring infiltrometer tests were monitored by CSH archaeologists Jonas Madeus, B.A., and Jennifer Frey, B.A., under the general supervision of Hallett Hammatt, Ph.D. This work required approximately nine person-days to complete. CSH observed a total of 12 bore holes. Geotechnical boring operations were conducted by Yogi Kwong Engineers at one location within the connection corridor segment and at seven locations in the northern half of the Central Maui WWRF segment of the project area (Figure 51). Geosyntec Consultants, Inc. conducted geotechnical boring operations at four locations in the central and southern portions of the Central Maui WWRF segment of the project area.

Each bore hole was drilled to a targeted depth of 30 ft to 60 ft (9.14 m to 18.29 m). The bore holes were approximately 10.16 cm in diameter unless otherwise noted. The bore holes were completed with a truck-mounted direct-push drilling probe (Figure 52). The archaeologist watched as the machine drilled each bore hole and inspected the back dirt and sediment as column samples were removed for collection (Figure 53). Yogi Kwong personnel collected the column samples at 1.5-ft (0.46-m) intervals during the drilling.

Due to the small size of the bore holes, which used a 4-inch diameter drill bit, the underlying stratigraphy was not visible for the archaeologist to create a profile map. However, a profile map of a bulk sample bore hole (B-1A) was recorded 0.75 m south of the Boring B-1 location. A 10-inch diameter drill bit was used for this bulk sample hole. No samples were collected by CSH, and no cultural materials were observed during the geotechnical boring operations. Observations of the geotechnical boring provided documentation of the general types and variation of stratigraphy within the project area, which included a mix of aeolian sand, lithified sand, and alluvial loams.

### 4.4.1 Boring B-1 and Boring B-1A

Boring B-1 was in the central-western portion of the Central Maui WWRF segment of the project area (see Figure 52). Yogi Kwong Engineers collected eight column samples 3.66 m (12.0 ft) (Table 3, Figure 54, and Figure 55). Sample 1 was interpreted by CSH as the Ap horizon, while Sample 2 (sandy loam) and below were interpreted as natural soil depositions.

A bulk sample hole, Boring B-1A, was drilled directly 0.75 m south of the Boring B-1 location. The profiled area had a maximum depth of 80.0 cmbs. The stratigraphy observed at Profile 1 consisted of a gravelly sandy clay loam Ap horizon (Stratum I) (Figure 56 through Figure 57 and Table 4).

### 4.4.2 Boring B-2

Boring B-2 was in the central-eastern portion of the Central Maui WWRF segment of the project area (Figure 58). Yogi Kwong Engineers collected eight column samples 3.66 m (12.0 ft) (Table 5 and Figure 59 through Figure 66). Sample 1 and top of Sample 2 were interpreted by CSH as the Ap horizon, while the bottom of Sample 2 (sand) and below were interpreted as natural soil depositions.




Figure 51. Aerial image showing the locations of the boring tests and double ring infiltrometer tests within the project area; note DR-3 was not tested (EagleView Technologies Inc. 2023)



Figure 52. Overview of Boring B-1 location and equipment, view to southeast



Figure 53. CSH archaeologists observed the backdirt sediment during the geotechnical boring operations, view to northeast

Table 3. Samples collected from Boring B-1

| Sample | Depth Interval | | Sediment |
|---|---|---|---|
| 1 | 0–1.5 ft | 0–0.46 m | Sandy clay loam Ap horizon |
| 2 | 1.5–3.0 ft | 0.46–0.91 m | Natural sandy loam |
| 3 | 3.0–4.5 ft | 0.91–1.37 m | Natural sandy clay loam and sandy loam |
| 4 | 4.5–6.0 ft | 1.37–1.83 m | Natural sandy loam |
| 5 | 6.0–7.5 ft | 1.83–2.29 m | Natural sandy loam and sandy clay loam |
| 6 | 7.5–9.0 ft | 2.29–2.74 m | Natural sandy clay loam |
| 7 | 9.0–10.5 ft | 2.74–3.20 m | Natural sandy clay loam |
| 8 | 10.5–12.0 ft | 3.20–3.66 m | Natural gravelly and compacted silty clay |




Figure 54. Boring B-1, Sample 1, sandy clay loam




Figure 55. Boring B-1, Sample 3, sandy clay loam and sandy loam



Figure 56. Boring B-1A, profile of the southeast wall, view to southeast

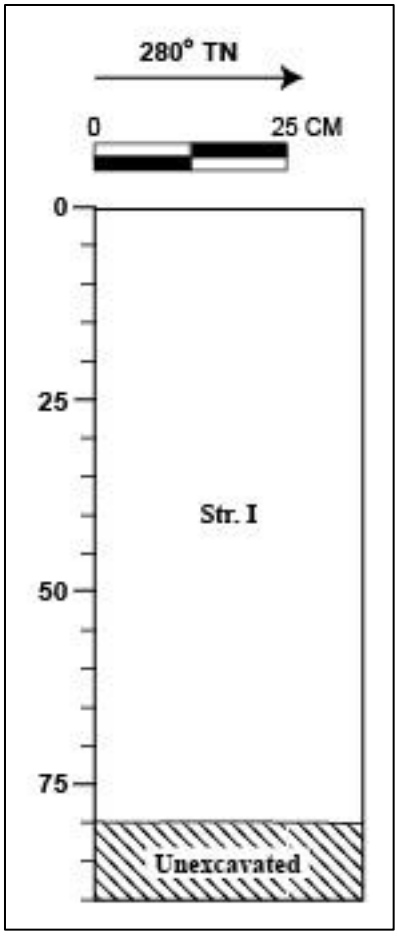



Figure 57. Boring B-1A, stratigraphy of the southeast wall

Table 4. Boring B-1A, stratigraphic description

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–80 | Fill; 10YR 4/2, dark grayish brown; sandy clay loam; medium, weak, granular structure; dry, firm consistence; no cementation; plastic; mixed origin; many fine to medium roots; lower boundary not observed |



Figure 58. Overview of Boring B-2 location, view to east

Table 5. Samples collected from Boring B-2

| Sample | Depth Interval | | Sediment |
|---|---|---|---|
| 1 | 0–1.5 ft | 0–0.46 m | Sandy clay loam Ap horizon |
| 2 | 1.5–3.0 ft | 0.46–0.91 m | Sandy clay loam Ap horizon and natural sand |
| 3 | 3.0–4.5 ft | 0.91–1.37 m | Natural sandy loam and silt loam |
| 4 | 4.5–6.0 ft | 1.37–1.83 m | Natural sandy loam |
| 5 | 6.0–7.5 ft | 1.83–2.29 m | Natural sandy loam and silt loam |
| 6 | 7.5–9.0 ft | 2.29–2.74 m | Natural gravelly silty clay loam |
| 7 | 9.0–10.5 ft | 2.74–3.20 m | Natural gravelly sandy clay loam and silty clay loam |
| 8 | 10.5–12.0 ft | 3.20–3.66 m | Natural gravelly silty clay |




Figure 59. Boring B-2, Sample 1, sandy clay loam




Figure 60. Boring B-2, Sample 2, sandy clay loam and sand




Figure 61. Boring B-2, Sample 3, sandy loam and silt




Figure 62. Boring B-2, Sample 4, sandy loam




Figure 63. Boring B-2, Sample 5, sandy loam and silt




Figure 64. Boring B-2, Sample 6, gravelly silty clay loam




Figure 65. Boring B-2, Sample 7, gravelly sandy clay loam and silty clay loam




Figure 66. Boring B-2, Sample 8, gravelly silty clay

### 4.4.3 Boring B-3

Boring B-3 was in the northwestern portion of the Central Maui WWRF segment of the project area (Figure 67). Yogi Kwong Engineers collected eight column samples 3.66 m (12.0 ft) (Table 6 and Figure 68 through Figure 75). Sample 1 and the top of Sample 2 were interpreted by CSH as the Ap horizon, while the bottom of Sample 2 (sand) and below were interpreted as natural soil depositions.

### 4.4.4 Boring B-4

Boring B-4 was near the northeastern boundary of the Central Maui WWRF segment of the project area (Figure 76). Yogi Kwong Engineers collected nine column samples 4.66 m (15.3 ft) (Table 7 and Figure 77 through Figure 85). The top of Sample 1 was interpreted by CSH as the Ap horizon, while the bottom of Sample 1 (sand) and below were interpreted as natural soil depositions.

### 4.4.5 Boring B-5

Boring B-5 was near the northwest corner of the Central Maui WWRF segment of the project area (Figure 86). Yogi Kwong Engineers collected nine column samples 4.66 m (15.3 ft) (Table 8 and Figure 87 through Figure 95). Sample 1 was interpreted by CSH as the Ap horizon, while Sample 2 (sandy loam) and below were interpreted as natural soil depositions.

### 4.4.6 Boring B-6

Boring B-6 was near the northeast corner of the Central Maui WWRF segment of the project area (Figure 96). Yogi Kwong Engineers collected eight column samples extending to 3.66 m (12.0 ft) (Table 9 and Figure 97 through Figure 104). The top of Sample 1 was interpreted by CSH as the Ap horizon, while the bottom of Sample 1 (silt loam) and below were interpreted as natural soil depositions.

### 4.4.7 Boring B-7

Boring B-7 was in the central portion of the proposed connection corridor segment of the project area (Figure 105). Yogi Kwong Engineers collected eight column samples extending to 3.66 m (12.0 ft) (Table 10 and Figure 106 through Figure 113). Sample 1 was interpreted by CSH as the Ap horizon, while Sample 2 (sandy loam) and below were interpreted as natural soil depositions.

### 4.4.8 Boring G-1

Boring G-1 was outside of the southern boundary of the Central Maui WWRF segment of the project area (Figure 114). Geosyntec Consultants drilled the boring to 60 ft (18.29 m). The sample from 0–5 ft (0–1.52 m) consisted of silt and 10% rocks and contained plastic. The sample from 5–10 ft (1.52–3.05 m) consisted of silt, and the sample from 10–15 ft (3.05–4.58 m) consisted of silt with mottles of sand.



Figure 67. Overview of Boring B-3, view to west

Table 6. Samples collected from Boring B-3

| Sample | Depth Interval | | Sediment |
|---|---|---|---|
| 1 | 0–1.5 ft | 0–0.46 m | Sandy loam and silty clay loam Ap horizon |
| 2 | 1.5–3.0 ft | 0.46–0.91 m | Silty clay loam Ap horizon and natural sand |
| 3 | 3.0–4.5 ft | 0.91–1.37 m | Natural sandy loam and silt clay loam |
| 4 | 4.5–6.0 ft | 1.37–1.83 m | Natural sandy loam, sand, gravelly sandy loam, and silty clay loam |
| 5 | 6.0–7.5 ft | 1.83–2.29 m | Natural sandy loam and silt loam |
| 6 | 7.5–9.0 ft | 2.29–2.74 m | Natural sandy loam and silt |
| 7 | 9.0–10.5 ft | 2.74–3.20 m | Natural sandy clay loam and silty clay loam |
| 8 | 10.5–12.0 ft | 3.20–3.66 m | Natural gravelly sandy loam and silty clay |




Figure 68. Boring B-3, Sample 1, sandy loam and silty clay loam




Figure 69. Boring B-3, Sample 2, silty clay loam and sand




Figure 70. Boring B-3, Sample 3, sandy loam and silty clay loam




Figure 71. Boring B-3, Sample 4, sandy loam, sand, gravelly sandy loam, and silty clay loam




Figure 72. Boring B-3, Sample 5, sandy loam and silt loam




Figure 73. Boring B-3, Sample 6, sandy loam and silt




Figure 74. Boring B-3, Sample 7, sandy clay loam and silty clay loam




Figure 75. Boring B-3, Sample 8, gravelly sandy loam and silty clay



Figure 76. Overview of the Boring B-4 location, view to northeast

Table 7. Samples collected from Boring B-4

| Sample | Depth Interval | | Sediment |
|---|---|---|---|
| 1 | 0–1.5 ft | 0–0.46 m | Sandy loam Ap horizon and natural sand |
| 2 | 1.5–3.0 ft | 0.46–0.91 m | Natural sand |
| 3 | 3.0–4.5 ft | 0.91–1.37 m | Natural sandy loam and silty clay loam |
| 4 | 4.5–6.0 ft | 1.37–1.83 m | Natural sandy loam and gravelly silty clay loam |
| 5 | 6.0–7.5 ft | 1.83–2.29 m | Natural sandy loam and silt |
| 6 | 7.5–9.0 ft | 2.29–2.74 m | Natural very compacted silty clay |
| 7 | 9.0–10.5 ft | 2.74–3.20 m | Natural sandy clay loam and silty clay loam |
| 8 | 10.5–12.0 ft | 3.20–3.66 m | Natural gravelly sandy loam |
| 9 | 15.0–15.3 ft | 4.57–4.66 m | Natural silty clay |




Figure 77. Boring B-4, Sample 1, sandy loam and sand




Figure 78. Boring B-4, Sample 2, sand




Figure 79. Boring B-4, Sample 3, sandy loam and silt clay loam




Figure 80. Boring B-4, Sample 4, sandy loam and gravelly silty clay loam




Figure 81. Boring B-4, Sample 5, sandy loam and silt




Figure 82. Boring B-4, Sample 6, very compacted silty clay




Figure 83. Boring B-4, Sample 7, sandy clay loam and silty clay loam




Figure 84. Boring B-4, Sample 8, gravelly sandy loam




Figure 85. Boring B-4, Sample 9, silty clay



Figure 86. Overview of the Boring B-5 location, view to southwest

Table 8. Samples collected from Boring B-5

| Sample | Depth Interval | | Sediment |
|---|---|---|---|
| 1 | 0–1.5 ft | 0–0.46 m | Sandy clay loam and sandy loam Ap horizon |
| 2 | 1.5–3.0 ft | 0.46–0.91 m | Natural loamy sand |
| 3 | 3.0–4.5 ft | 0.91–1.37 m | Natural loamy sand and sandy loam |
| 4 | 4.5–6.0 ft | 1.37–1.83 m | Natural sand and gravelly silty clay loam |
| 5 | 6.0–7.5 ft | 1.83–2.29 m | Natural gravelly sandy loam and silty clay |
| 6 | 7.5–9.0 ft | 2.29–2.74 m | Natural compacted silty clay loam |
| 7 | 9.0–10.5 ft | 2.74–3.20 m | Natural silt loam and silty clay |
| 8 | 10.5–12.0 ft | 3.20–3.66 m | Natural silty clay |
| 9 | 15.0–15.3 ft | 4.57–4.66 m | Natural silty clay and gravelly sandy loam |




Figure 87. Boring B-5, Sample 1, sandy clay loam and sandy loam




Figure 88. Boring B-5, Sample 2, loamy sand




Figure 89. Boring B-5, Sample 3, loamy sand and sandy loam




Figure 90. Boring B-5, Sample 4, sand and gravelly silty clay loam




Figure 91. Boring B-5, Sample 5, gravelly sandy loam and silty clay




Figure 92. Boring B-5, Sample 6, compacted silty clay loam




Figure 93. Boring B-5, Sample 7, silt loam and silty clay




Figure 94. Boring B-5, Sample 8, silty clay




Figure 95. Boring B-5, Sample 9, silty clay and gravelly sandy loam



Figure 96. Overview of the Boring B-6 location, view to southeast

Table 9. Samples collected from Boring B-6

| Sample | Depth Interval | | Sediment |
|---|---|---|---|
| 1 | 0–1.5 ft | 0–0.46 m | Sandy loam and silty clay loam Ap horizon and natural silt loam |
| 2 | 1.5–3.0 ft | 0.46–0.91 m | Natural silty clay loam and extremely gravelly loamy sand (alluvial streambed deposit) |
| 3 | 3.0–4.5 ft | 0.91–1.37 m | Natural sandy clay loam and extremely gravelly loamy sand (alluvial streambed deposit) |
| 4 | 4.5–6.0 ft | 1.37–1.83 m | Natural gravelly loamy sand and silty clay loam |
| 5 | 6.0–7.5 ft | 1.83–2.29 m | Natural gravelly silty loam and silty clay |
| 6 | 7.5–9.0 ft | 2.29–2.74 m | Natural compacted silty clay loam |
| 7 | 9.0–10.5 ft | 2.74–3.20 m | Natural silt loam and silty clay |
| 8 | 10.5–12.0 ft | 3.20–3.66 m | Natural gravelly silty clay |




Figure 97. Boring B-6, Sample 1, sandy loam, silty clay loam, and silt loam




Figure 98. Boring B-6, Sample 2, silty clay loam and extremely gravelly loamy sand




Figure 99. Boring B-6, Sample 3, sandy clay loam and extremely gravelly loamy sand




Figure 100. Boring B-6, Sample 4, gravelly loamy sand and silty clay loam




Figure 101. Boring B-6, Sample 5, gravelly silt loam and silty clay




Figure 102. Boring B-6, Sample 6 (incorrectly noted in photo), compacted silty clay loam




Figure 103. Boring B-6, Sample 7, silt loam and silty clay




Figure 104. Boring B-6, Sample 8, gravelly silty clay




Figure 105. Overview of the Boring B-7 location, view to southeast

Table 10. Samples collected from Boring B-7

| Sample | Depth Interval | | Sediment |
|---|---|---|---|
| 1 | 0–1.5 ft | 0–0.46 m | Gravelly silty clay loam Ap horizon |
| 2 | 1.5–3.0 ft | 0.46–0.91 m | Natural silty clay loam |
| 3 | 3.0–4.5 ft | 0.91–1.37 m | Natural sandy clay loam and silty clay loam |
| 4 | 4.5–6.0 ft | 1.37–1.83 m | Natural gravelly sandy clay loam |
| 5 | 6.0–7.5 ft | 1.83–2.29 m | Natural silty clay loam |
| 6 | 7.5–9.0 ft | 2.29–2.74 m | Natural compacted silty clay loam |
| 7 | 9.0–10.5 ft | 2.74–3.20 m | Natural silt loam and silty clay |
| 8 | 10.5–12.0 ft | 3.20–3.66 m | Natural compacted silty clay |




Figure 106. Boring B-7, Sample 1, gravelly silty clay loam




Figure 107. Boring B-7, Sample 2, silty clay loam




Figure 108. Boring B-7, Sample 3, sandy clay loam and silty clay loam




Figure 109. Boring B-7, Sample 4, gravelly sandy clay loam

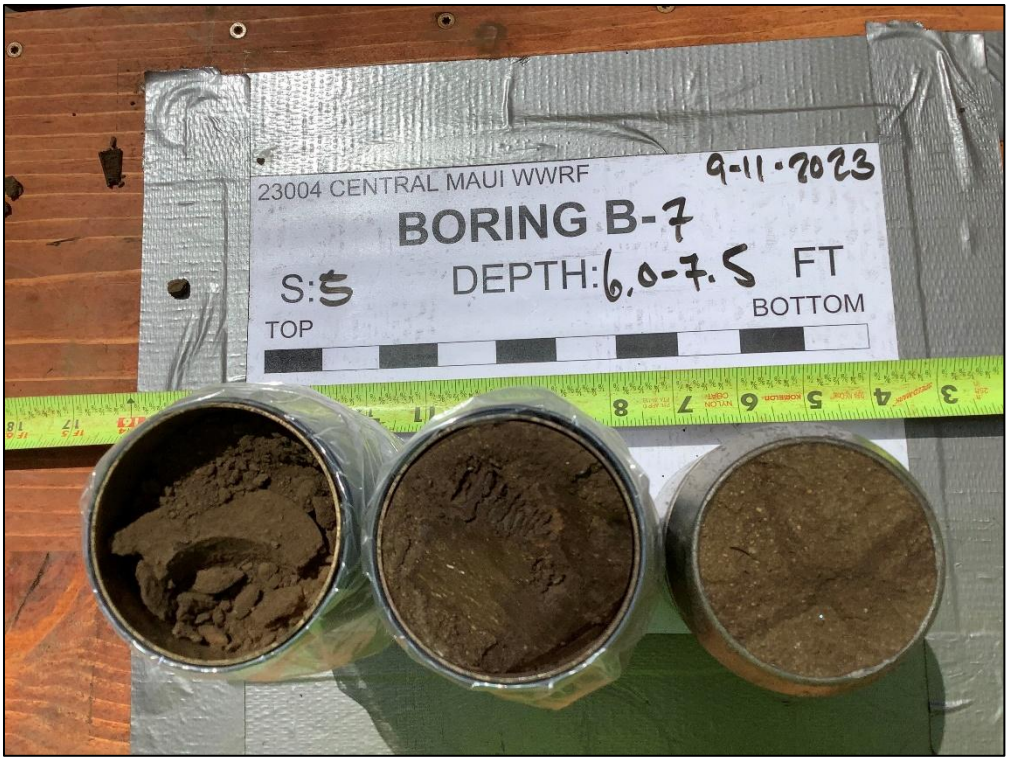



Figure 110. Boring B-7, Sample 5, silty clay loam




Figure 111. Boring B-7, Sample 6, compacted silty clay loam




Figure 112. Boring B-7, Sample 7, silt loam and silty clay




Figure 113. Boring B-7, Sample 8, compacted silty clay

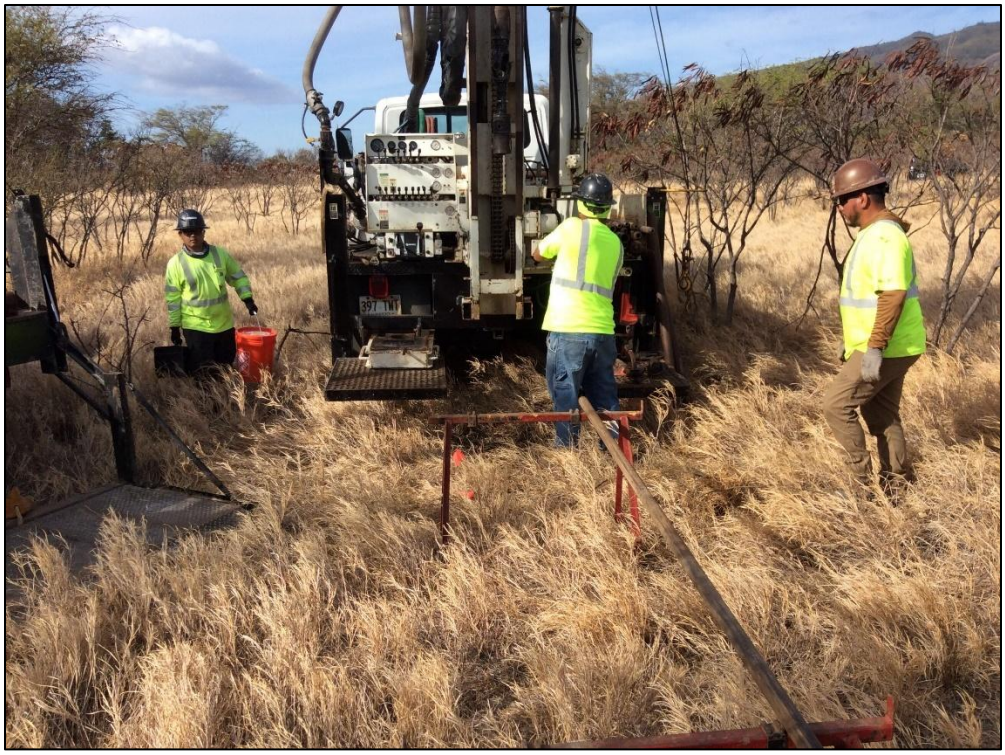


Figure 114. Overview of the Boring G-1 location, view to southwest

### 4.4.9 Boring G-2

Boring G-2 was near the southwestern boundary of the proposed Central Maui WWRF segment of the project area (Figure 115). Geosyntec Consultants collected 11 column samples between 1.52 m (5.0 ft) and 17.22 m (56.5 ft) (Table 11 and Figure 116 through Figure 126). All the samples are interpreted as natural.

### 4.4.10 Boring G-3 and Boring G-3B

Boring G-3 was in the central-western portion of the proposed Central Maui WWRF segment of the project area (Figure 127). Geosyntec Consultants used a 7-inch (17.8-cm) drill bit at this location. The archaeologist recorded four samples between 5 ft (1.52 m) and 21.5 ft (6.55 m) (Table 12 and Figure 128 through Figure 131). All the samples are interpreted as natural.

Boring G-3B was 1.5 m east of Boring G-3 (Figure 133). Geosyntec Consultants drilled the boring to 14.5 ft (4.42 m) with a 7-inch (17.8-cm) drill bit. The observed sediment from 0–5 ft (0–1.52 m) consisted of sandy loam, and from 5–10 ft (1.52–3.05 m), it was silty clay loam (Figure 132 and Figure 133). The observed sediment between approximately 10 ft and 15 ft (3.05 m and 4.57 m) consisted of extremely cobbly silty clay loam.



Figure 115. Overview of the Boring G-2 location, view to southeast

Table 11. Samples collected from Boring G-2

| Sample | Depth Interval | | Sediment |
|---|---|---|---|
| 1 | 5.0–6.5 ft | 1.52–1.98 m | Sandy loam, sand, silty clay loam, and extremely gravelly loamy sand |
| 2 | 10.0–11.5 ft | 3.05–3.51 m | Silt loam, silty clay loam, and gravelly silt loam |
| 3 | 15.0–16.5 ft | 4.57–5.03 m | Silty clay loam |
| 4 | 20.0–21.5 ft | 6.10–6.55 m | Gravelly silty clay loam |
| 5 | 25.0–26.5 ft | 7.62–8.08 m | Silty clay loam, extremely gravelly loamy sand (alluvial streambed deposit), and silt loam |
| 6 | 30.0–31.5 ft | 9.14–9.60 m | Silty clay loam |
| 7 | 35.0–36.5 ft | 10.67–11.13 m | Silty clay loam |
| 8 | 40.0–41.5 ft | 12.19–12.65 m | Silty clay loam |
| 9 | 45.0–46.5 ft | 13.72–14.17 m | Silty clay loam |
| 10 | 50.0–51.5 ft | 15.24–15.70 m | Clay loam |
| 11 | 55.0–56.5 ft | 16.76–17.22 m | Clay loam |




Figure 116. Boring G-2, Sample 1, sandy loam, sand, silty clay loam, and extremely gravelly loamy sand




Figure 117. Boring G-2, Sample 2, silt loam, silty clay loam, and gravelly silt loam




Figure 118. G-2, Sample 3, silty clay loam




Figure 119. G-2, Sample 4, gravelly silty clay loam




Figure 120. G-2, Sample 5, silty clay loam, extremely gravelly loamy sand, and silt loam




Figure 121. G-2, Sample 6, silty clay loam




Figure 122. G-2, Sample 7, silty clay loam




Figure 123. G-2, Sample 8, silty clay loam




Figure 124. G-2, Sample 9, silty clay loam




Figure 125. G-2, Sample 10, clay loam




Figure 126. G-2, Sample 11, clay loam



Figure 127. Overview of the Boring G-3 location, view to east

Table 12. Samples collected from Boring G-3

| Sample | Depth Interval | | Sediment |
|---|---|---|---|
| 1 | 5.0–6.5 ft | 1.52–1.98 m | Sandy loam |
| 2 | 10.0–11.5 ft | 3.05–3.51 m | Extremely cobbly sandy loam and silt loam |
| 3 | 15.0–16.5 ft | 4.57–5.03 m | Silt loam |
| 4 | 20.0–21.5 ft | 6.10–6.55 m | Silt loam |




Figure 128. Boring G-3, Sample 1, sandy loam




Figure 129. Boring G-3, Sample 2, extremely cobbly sandy loam and silt loam




Figure 130. Boring G-3, Sample 3, silt loam




Figure 131. Boring G-3, Sample 4, silt loam



Figure 132. Boring G-3B, overview of observed sandy loam sediment from 0–5 ft (0–1.52 m), view to northeast



Figure 133. Boring G-3B, overview of observed silty clay loam sediment from 5–10 ft (1.52–3.05 m), view to northeast

# 4.5 **Double Ring Infiltrometer Test Results**

CSH monitored the operations of eight double ring infiltrometer tests, DR-1 through DR-9 excluding DR-3 which was not tested, conducted by Geosyntec Consultants, Inc. in the southern half of the project area (see Figure 51). A double ring infiltrometer test is used for field measurements of liquid infiltration rates in the soil. The test is also used to determine how fast water waste disposal infiltrates into the soil for septic-tank disposal fields, leaching and drainage, and wastewater reclamation plans. For the process, a 1.0-sq m area was hand excavated to an approximate depth of 1 ft or 30 cm and, the two metal infiltration rings were installed in the center. Then, two Mariotte tubes were installed to the two infiltration rings (Figure 134). The two metal rings were partially filled with water, and the Mariotte tubes maintain the water at a constant level to measure the drawdown and determine the infiltration rate of the soil. The infiltration test usually takes six hours.

### 4.5.1 DR-1

DR-1 was excavated on 15 September 2023 outside the southern boundary of the Central Maui WWRF segment of the project area (Figure 135 and Figure 136). The excavated area had a maximum depth of 26.0 cmbs. A profile of the northwest wall was documented, and the observed stratigraphy consisted of a dark grayish brown, cobbly sandy loam Ap horizon (Stratum I) (Figure 137, Figure 138, and Table 13).

### 4.5.2 DR-2

DR-2 was excavated on 12 September 2023 in the southern portion of the Central Maui WWRF segment of the project area (Figure 139). The excavated area had a maximum depth of 30.0 cmbs and consisted of a dark brown, gravelly silt loam modern A horizon.

### 4.5.3 DR-4

DR-3 was not tested.

DR-4 was excavated on 14 September 2023 near the southwestern boundary of the proposed Central Maui WWRF segment of the project area (Figure 140 and Figure 141). The excavated area had a maximum depth of 25 cmbs. A profile of the southeast wall was documented, and the observed stratigraphy consisted of a dark grayish brown, sandy loam modern A horizon (Stratum I) overlying gravelly sand fill (Stratum II) (Figure 142, Figure 143, and Table 14).

### 4.5.4 DR-5

DR-5 was excavated on 13 September 2023 in the southeastern portion of the proposed Central Maui WWRF segment of the project area (Figure 144 and Figure 145). The excavated area had a maximum depth of 20 cmbs. A profile of the south wall was documented, and the observed stratigraphy consisted of a dark grayish brown, very gravelly sandy loam A horizon (Stratum I) overlying gravelly sand fill (Stratum II) (Figure 146, Figure 147, and Table 15).



Figure 134. General view of the metal double rings and two Mariotte tubes, view to northeast



Figure 135. Overview of the DR-1 location, view to northwest




Figure 136. General view of DR-1 showing the collection of a bulk sample by Geosyntec Consultants, view to east




Figure 137. Close-up of the northwest wall of DR-1, view to northwest

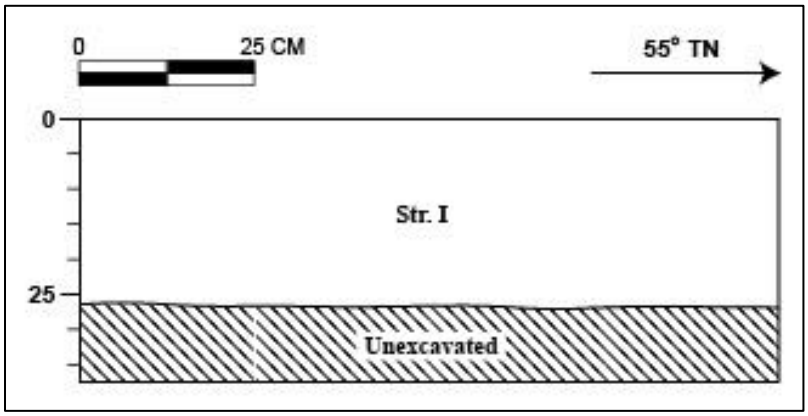



Figure 138. DR-1, stratigraphy of the northwest wall

Table 13. DR-1 stratigraphic description

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–26 | Ap horizon; 10YR 4/2, dark grayish brown; cobbly loamy sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; mixed origin; many fine to coarse roots; lower boundary not observed |



Figure 139. General view of the DR-2 location, view to west




Figure 140. General view of the DR-4 location, view to southeast



Figure 141. General view of the double-ring infiltrometer test at DR-4, view to northeast



Figure 142. Close-up of the southeast wall of DR-4, view to southeast

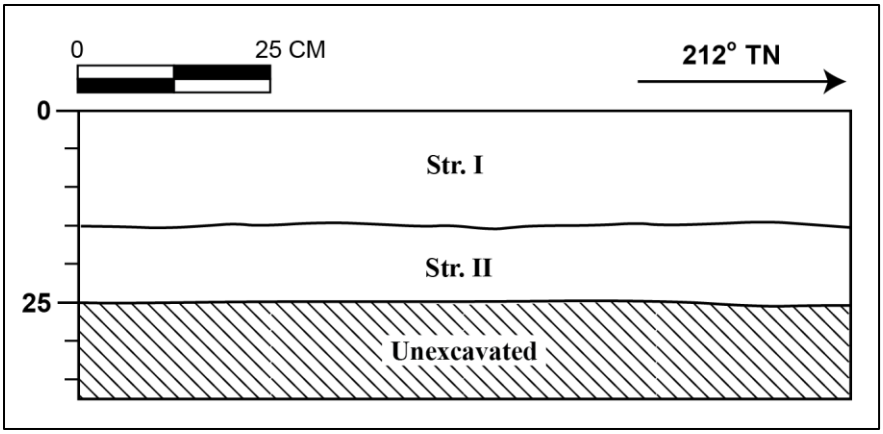



Figure 143. DR-4, stratigraphy of the southeast wall

Table 14. DR-4 stratigraphic description

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–15 | A horizon; 10YR 4/2, dark grayish brown; sandy loam; weak, fine granular structure; dry, weakly coherent consistence; no cementation; non-plastic; mixed origin; many fine roots; clear, smooth lower boundary |
| II | 15–25 | Fill; 10YR 6/4, light yellowish brown; gravelly sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; marine origin; no roots; lower boundary not observed |




Figure 144. General view of the DR-5 location and excavation area, view to southeast



Figure 145. General view of the DR-5 location, view to east



Figure 146. Close-up of the south wall of DR-5, view to south

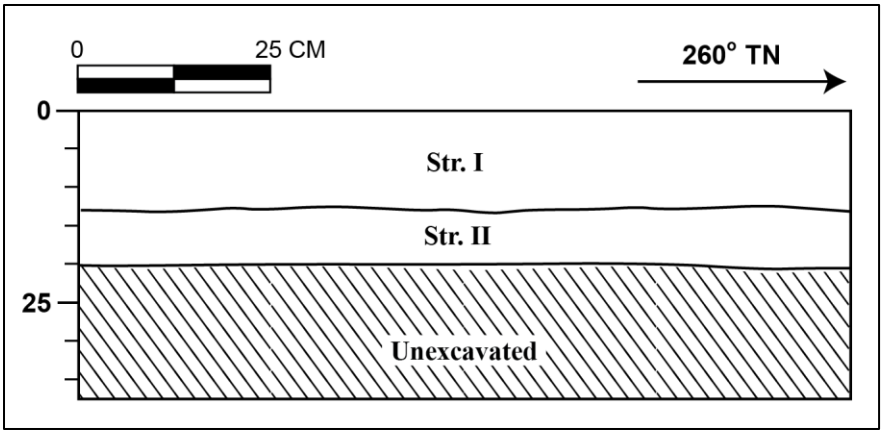



Figure 147. DR-5, stratigraphy of the south wall

Table 15. DR-5 stratigraphic description

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–13 | A horizon; 10YR 4/2, dark grayish brown; very gravelly and cobbly sandy loam; medium, weak, granular structure; dry, firm consistence; no cementation; slightly plastic; mixed origin; many fine to medium roots; clear, smooth lower boundary |
| II | 13–20 | Fill; 10YR 7/6, yellow; gravelly sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; mixed origin; no roots; lower boundary not observed |

### 4.5.5 DR-6

DR-6 was excavated on 18 September 2023 in the southwestern section of the Central Maui WWRF segment of the project area (Figure 148). The excavated area had a maximum depth of 26 cmbs. A profile of the southwest wall was documented, and the observed stratigraphy consisted of a very dark grayish brown, loamy sand A horizon (Stratum I) overlying light gray, loamy sand fill (Stratum II) (Figure 149, Figure 150, and Table 16).

### 4.5.6 DR-7

DR-7 was excavated on 19 September 2023 in the central-southern section of the Central Maui WWRF segment of the project area (Figure 151 and Figure 152). The excavated area had a maximum depth of 21 cmbs. A profile of the northwest wall was documented, and the observed stratigraphy consisted of a very dark grayish brown, cobbly silty clay loam A horizon (Stratum I) overlying light gray, loamy sand fill (Stratum II) (Figure 153, Figure 154, and Table 17).

### 4.5.7 DR-8

DR-8 was recorded on 21 September 2023 in the western-central section of the Central Maui WWRF segment of the project area (Figure 155 and Figure 156). The excavated area had a maximum depth of 23 cmbs. A profile of the north wall was documented, and the observed stratigraphy consisted of a very dark grayish brown, cobbly silty clay loam A horizon (Stratum I) overlying light gray, loamy sand fill (Stratum II) (Figure 157, Figure 158, and Table 18).

### 4.5.8 DR-9

DR-9 was excavated on the 20 September 2023 in the eastern-central section of the Central Maui WWRF segment of the project area (Figure 159). The excavated area had a maximum depth of 21 cmbs. A profile of the south wall was documented, and the observed stratigraphy consisted of a very dark grayish brown, cobbly silty clay loam A horizon (Stratum I) overlying light gray, loamy sand fill (Stratum II) (Figure 160, Figure 161, and Table 19).



Figure 148. General view of the DR-6 location, view to southwest



Figure 149. Close-up of the southwest wall of DR-6, view to southwest

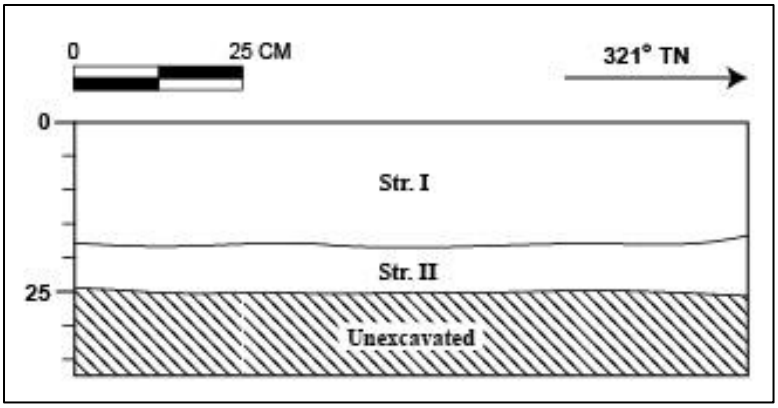



Figure 150. DR-6, stratigraphy of the southwest wall

Table 16. DR-6 stratigraphic description

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–18 | A horizon; 10YR 4/2, very dark grayish brown; cobbly silty clay loam; medium, moderate, blocky structure; dry, weakly coherent consistence; no cementation; plastic; terrigenous origin; many fine to medium roots; clear, smooth lower boundary |
| II | 18–25 | Fill; 10YR 3/2, very dark grayish brown; loamy sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; mixed origin; fine-medium roots common; lower boundary not observed |



Figure 151. General view of the DR-7 location, view to northwest



Figure 152. General view of the double-ring infiltrometer test at DR-7, view to east



Figure 153. Close-up of the northwest wall of DR-6, view to northwest

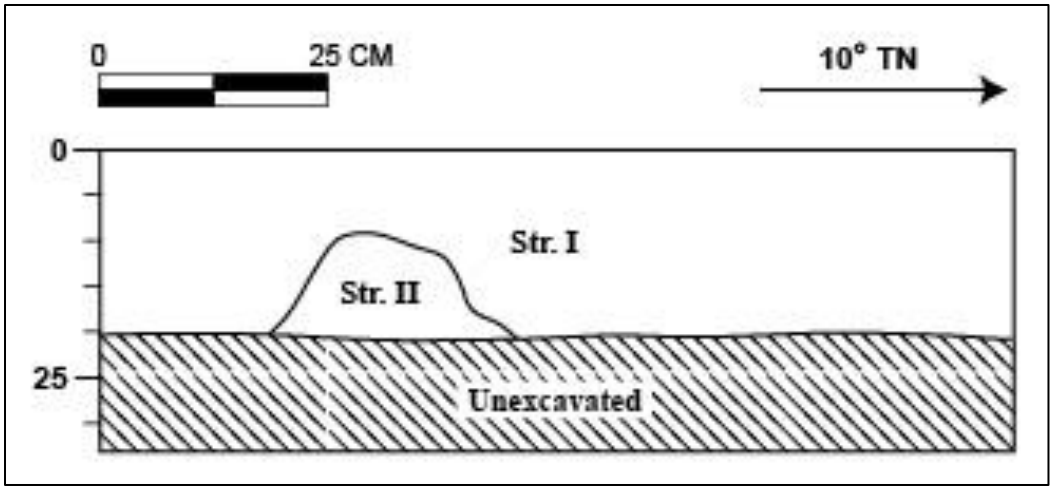



Figure 154. DR-7, stratigraphy of the northwest wall

Table 17. DR-7 stratigraphic description

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–21 | A horizon; 10YR 4/2, very dark grayish brown; cobbly silty clay loam; medium, moderate, blocky structure; dry, weakly coherent consistence; no cementation; plastic; terrigenous origin; many fine to medium roots; lower boundary not observed |
| II | 17–21 | Fill; 10YR 7/2, light gray; loamy sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; mixed origin; fine-medium roots common; lower boundary not observed |




Figure 155. General view of the DR-8 location, view to southwest



Figure 156. General view of DR-8 showing the collection of a bulk sample by Geosyntec Consultants, view to east



Figure 157. Close-up of the north wall of DR-8, view to north

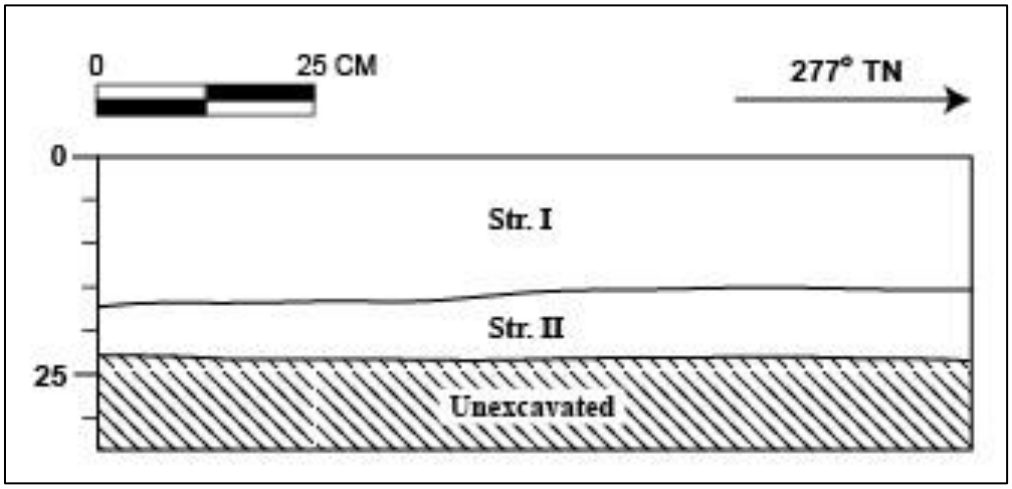



Figure 158. DR-8, stratigraphy of the north wall

Table 18. DR-8 stratigraphic description

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–17 | A horizon; 10YR 3/2, very dark grayish brown; cobbly silty clay loam; medium, moderate, blocky structure; dry, hard consistence; no cementation; plastic; terrigenous origin; many fine to medium roots; clear, smooth lower boundary |
| II | 15–23 | Fill; 10YR 7/2, light gray; loamy sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; mixed origin; fine-medium roots common; lower boundary not observed |



Figure 159. General view of the DR-9 location, view to southeast



Figure 160. Close-up of the south wall of DR-9, view to south

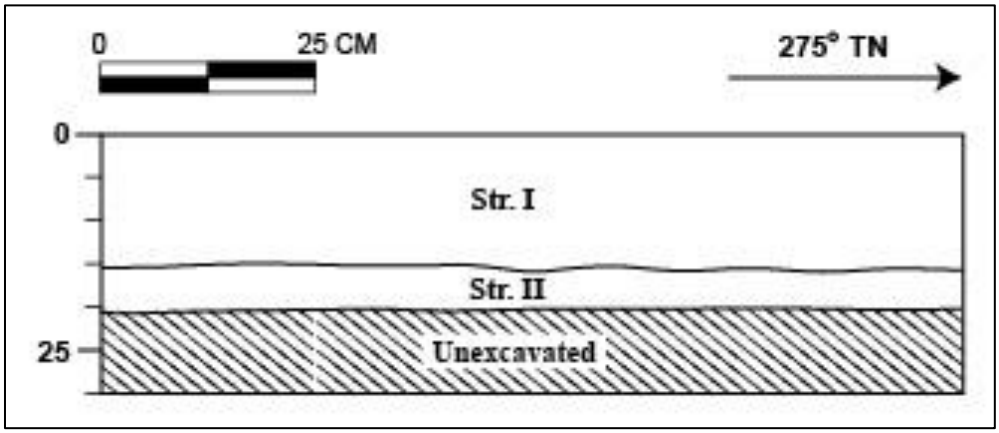



Figure 161. DR-9, stratigraphy of the south wall

Table 19. DR-9 stratigraphic description

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–17 | A horizon; 10YR 4/2, very dark grayish brown; cobbly silty clay loam; medium, moderate, blocky structure; dry, weakly coherent consistence; no cementation; plastic; terrigenous origin; not observed lower boundary; many fine to medium roots; no cultural materials observed |
| II | 15–21 | Fill; 10YR 7/2, light gray; loamy sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; mixed origin; fine-medium roots common; lower boundary not observed |

## 4.6 **Subsurface Testing**

Fieldwork for AIS subsurface testing was conducted between 11 September and 4 November 2024 by CSH archaeologists Jennifer Frey, B.A., Elwyn Leibold, B.A., Jonas Madeus, B.A., Allyson Ueki, M.A., Josephine Yucha, M.S., and Trevor Yucha, B.S. This work required approximately 123 person-days to complete. All fieldwork was conducted under the general supervision of principal investigators Josephine Yucha, M.S., and Hallett H. Hammatt, Ph.D.

Subsurface testing for this AIS included the excavation of 90 test excavations (TE-1 through TE-90) that were each approximately 6.0 m long and 1.0 m wide and distributed throughout the project area in a systematic gridded pattern (see Figure 33 and Figure 34). Test excavations were spaced approximately 30 m apart on the eastern and western sides, and approximately 20 m apart on the northern and southern sides. The testing coverage was consistent with the project's AIS fieldwork strategy that was accepted by the SHPD on 11 September 2024 via HICRIS comment.

The documentation of each test excavation is presented in Volume II of this report. No historic properties were identified during subsurface testing. Screened sediment samples were collected from areas of buried non-cultural A horizon soils and any potential features. There were five screened sediment samples from darkened lenses within the sandy buried A horizons within trenches TE-30, TE-42, TE-50, TE-51, and TE-55. Very little charcoal or charcoal particles were identified within the screens, therefore many of the potential features were assessed as charcoal stains likely related to historic sugarcane burning and not designated as significant archaeological features due to the lack of any associated cultural content. A crab claw was encountered within the buried A horizon in TE-50 and a probable bird bone shaft was in a screened sediment sample from a charcoal stain in the buried A horizon of TE-51. However, both elements were brittle and disintegrated prior to laboratory analysis.

Overall, the stratigraphy observed throughout the project area consisted of a widespread agricultural plow zone (Ap horizon), which either was at the surface or intermittently below a developing A horizon, overlying varying sequences of natural alluvial deposits and natural aeolian sand with the intermittent presence of a non-cultural, buried A horizon. Notably, no aeolian sand deposits were encountered in the connection corridor segment of the project area.

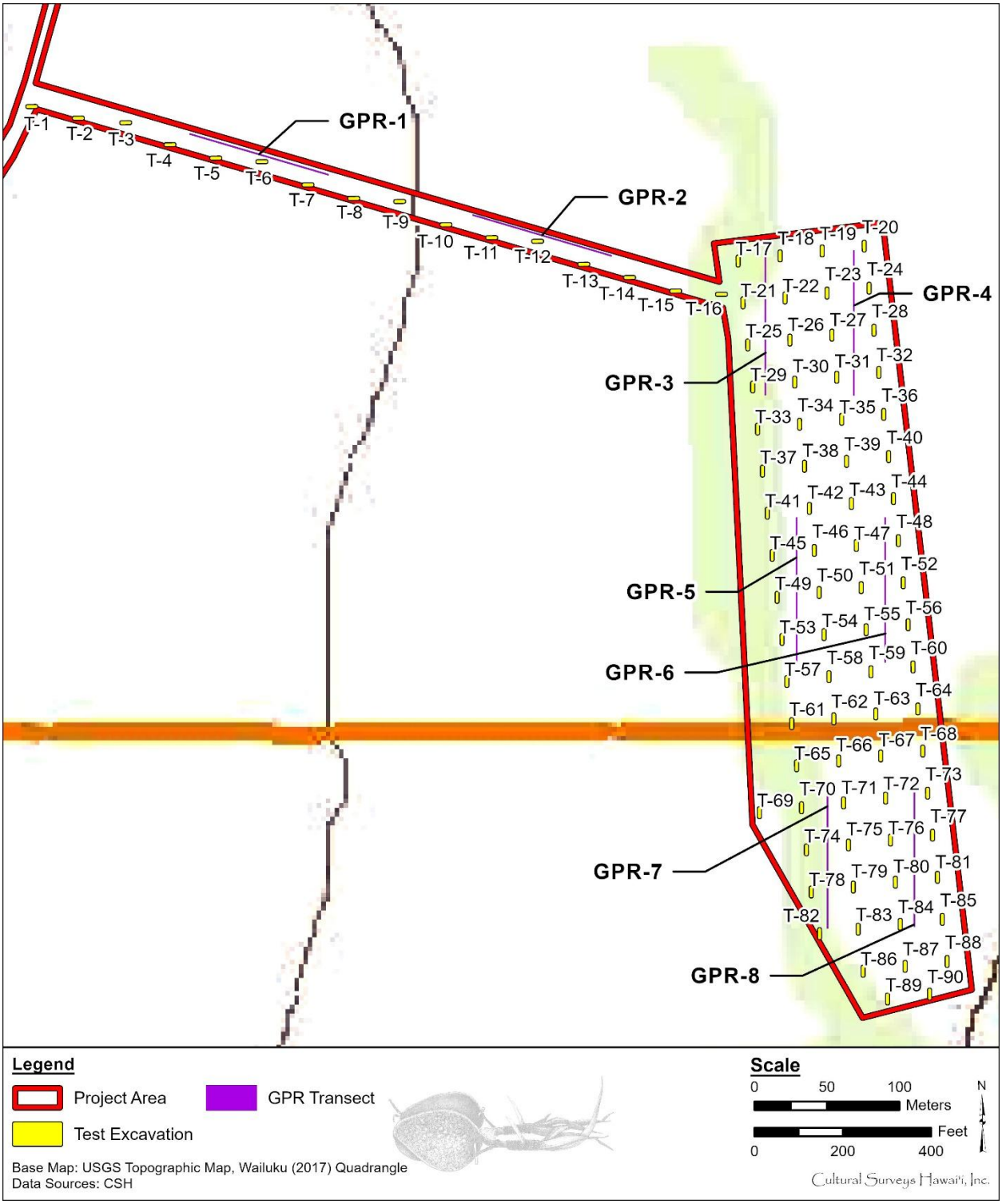



Figure 162. Portion of the 2017 Wailuku USGS 7.5-minute topographic quadrangle showing the locations of the AIS test excavations and GPR survey transects within the project area (U.S. Geological Survey 2017b)

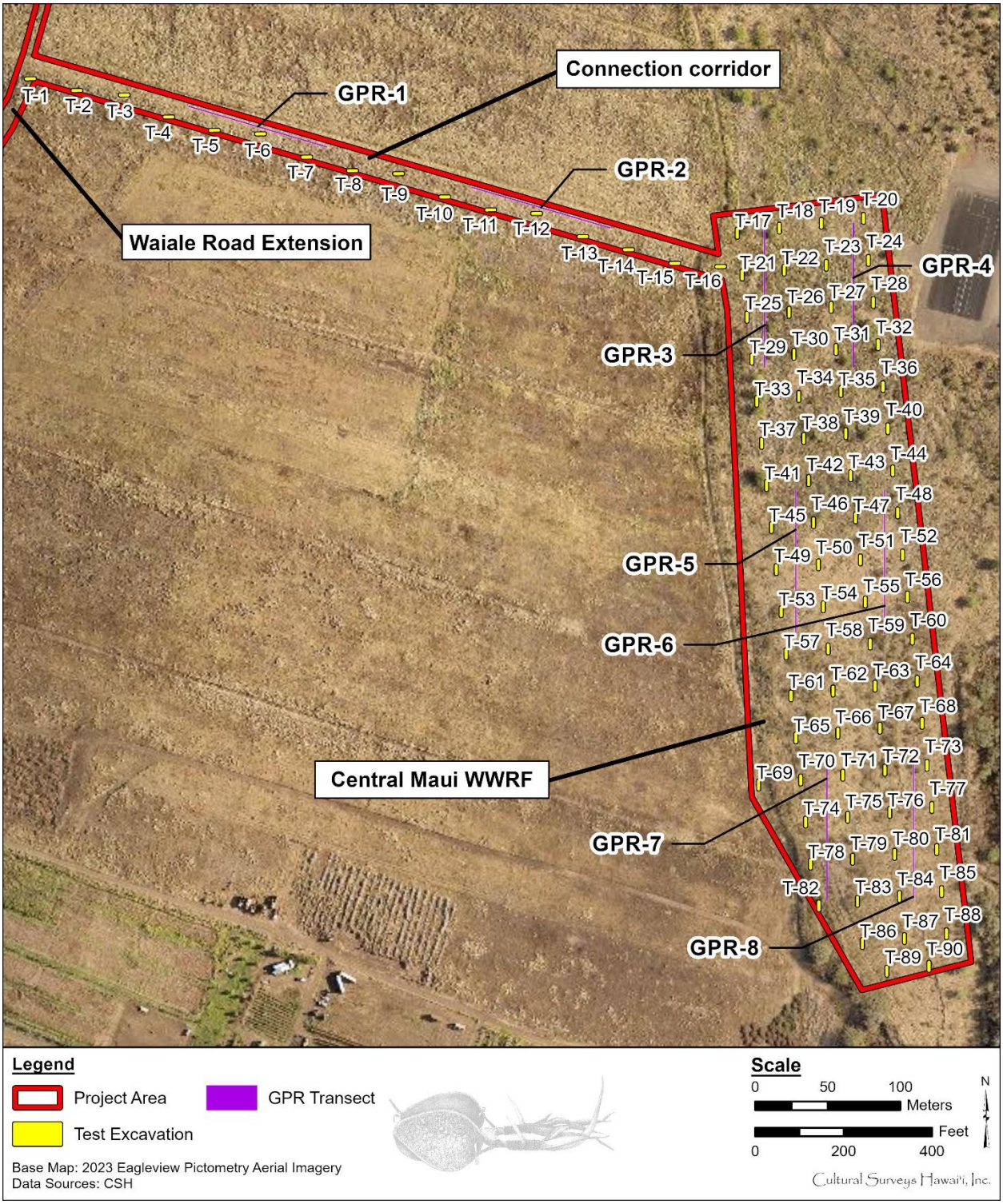



Figure 163. Aerial image showing the locations of the AIS test excavations and GPR survey transects within the project area (EagleView Technologies Inc. 2023)

# Section 5 Historic Property Descriptions

A total of five historic properties have been identified within the Central Maui WWRF project area during previous archaeological studies by Morawski et al. (2006), Perzinski and Dega (2010), and Ueki et al. (2025) (Table 20, Figure 164, and Figure 165).

SIHP #s 50-50-04-05965 and -05966 are previously disturbed human skeletal remains that were discovered and removed during archaeological monitoring within Wai‘ale Road for the Kehalani Mauka Subdivision Project documented by Morawski et al. (2006).

SIHP # 50-50-04-06668 is a post-Contact terrace that was previously documented by Perzinski and Dega (2010) and reidentified by Ueki et al. (2025) during the AIS for the Wai‘ale Road Extension. SIHP # 50-50-04-09167 (water control complex) and SIHP # 50-50-04-09168 (subsurface cultural deposits) also were identified during the AIS for the Wai‘ale Road Extension.

Table 20. Historic properties identified within the project area

| SIHP # | Formal Type (# of Features) | Function | Project Area Segment |
|---|---|---|---|
| 50-50-04-05965 | Human skeletal remains | Burial | Wai‘ale Road |
| 50-50-04-05966 | Human skeletal remains | Burial | Wai‘ale Road |
| 50-50-04-06668 | Terrace (1) | Transportation, Water control | Wai‘ale Road Extension |
| 50-50-04-09167 | Complex (8) | Water control | Wai‘ale Road Extension |
| 50-50-04-09168 | Subsurface cultural deposit (1) | Refuse disposal | Wai‘ale Road Extension |

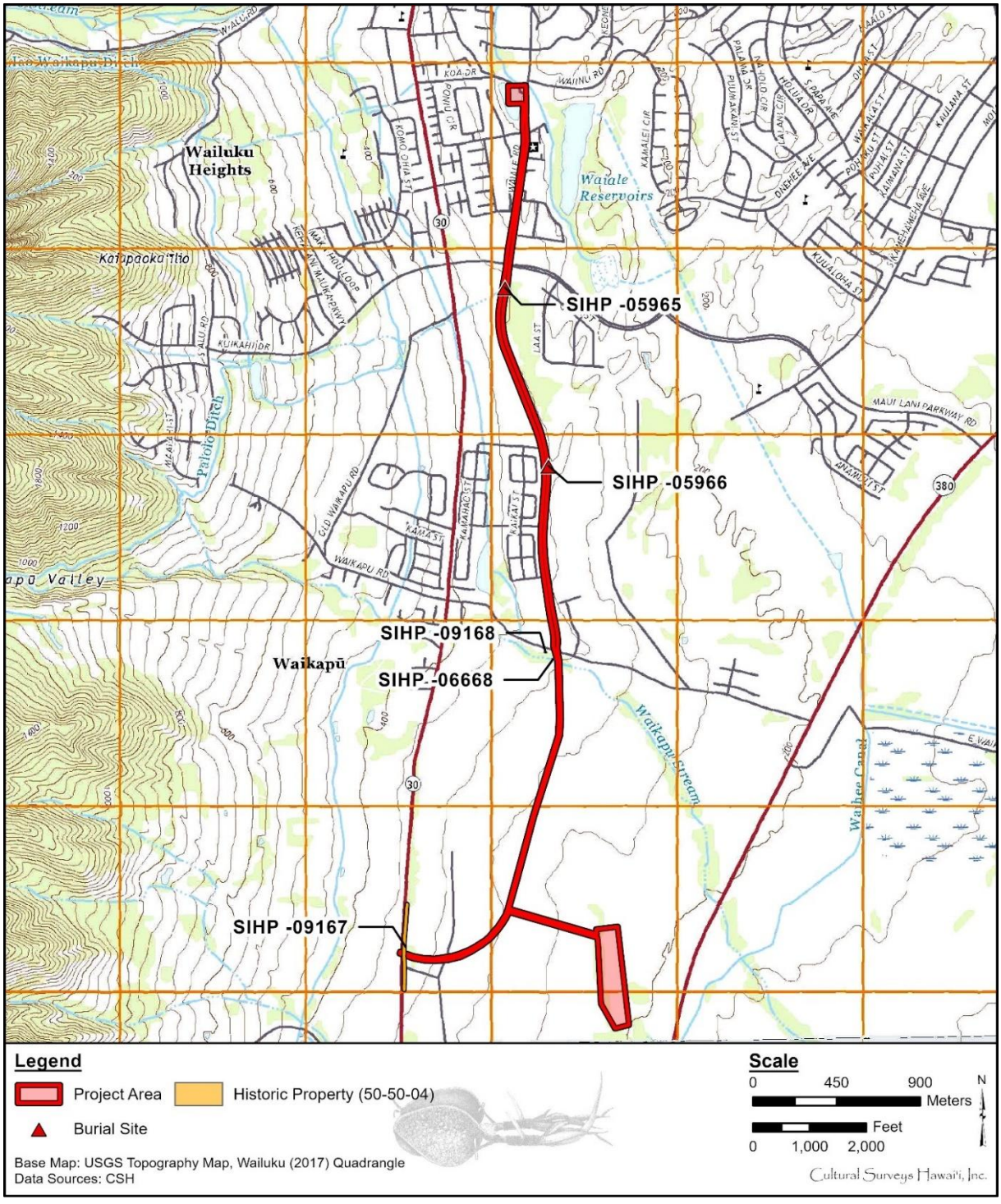



Figure 164. Portion of the 2017 Wailuku USGS 7.5-minute topographic quadrangle showing the locations of historic properties identified within the project area; note that SIHP #s -05965 and -05966 were disinterred during a previous archaeological study and are no longer present within the project area (U.S. Geological Survey 2017b)




Figure 165. Aerial image showing the locations of historic properties identified within the project area; note that SIHP #s -05965 and -05966 were disinterred during a previous archaeological study and are no longer present within the project area (EagleView Technologies Inc. 2023)

## 5.1 **SIHP # 50-50-04-05965**

| | |
|---|---|
| **FORMAL TYPE:** | Human skeletal remains |
| **FUNCTION:** | Burial |
| **NUMBER OF FEATURES:** | 1 |
| **AGE:** | Pre-Contact |
| **TAX MAP KEY:** | Wai‘ale Road ROW |
| **LAND JURISDICTION:** | County of Maui |
| **PREVIOUS DOCUMENTATION:** | Morawski et al. (2006) |

SIHP # 50-50-04-05965 consists of previously disturbed human skeletal remains that were inadvertently discovered during archaeological monitoring of off-site construction near the Kehalani Mauka Subdivision Project in Wailuku and Waikapū (Morawski et al. 2006). SIHP # -05965 is described by Morawski et al. (2006:15) as follows:

> Site 5965 consisted of the identification of an incomplete human left proximal humerus. This site was identified in the disturbed soils associated with the manhole and sewer line that parallels Waiale Road. This secondary burial element was likely disturbed during these aforementioned construction activities, as it was identified in soils associated the removal of a pre-existing manhole. This secondary burial element was also analyzed by both Diane Guerriero M.A. of ASH, and Chris Monahan Ph.D., of SCS and was concurrently determined to be the left proximal portion of a human humerus. This burial element also awaits reinterment at the Maui SHPD until a protected location in an appropriate area is decided upon.
>
> In addition to these areas of isolated human remains several animal and non-diagnostic bone fragments were identified. These include a proximal ulna from a horse and several small, non-diagnostic rib fragments which were found in association with the secondary juvenile burial. The unidentified rib fragments may be from one of several small mammals, especially pig *(sus scrofa).* However, the fragments were too small to determine species with certainty. [Morawski et al. 2006:15]

Based on the information provided by Morawski et al. (2006), SIHP # -05965 was collected from the location of discovery for temporary curation and relocation to a burial preserve. The historic property is no longer located within the project area. The final treatment of this burial site is presently unknown to CSH.

CSH is unable to confirm whether SIHP # -05965 was previously assessed for significance. It is likely that SIHP # -05965 was significant pursuant to Criterion “e” (have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with 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).

## 5.2 **SIHP # 50-50-04-05966**

| | |
|---|---|
| **FORMAL TYPE:** | Human skeletal remains |
| **FUNCTION:** | Burial |
| **NUMBER OF FEATURES:** | 1 |
| **AGE:** | Pre-Contact |
| **TAX MAP KEY:** | Wai‘ale Road ROW |
| **LAND JURISDICTION:** | County of Maui |
| **PREVIOUS DOCUMENTATION:** | Morawski et al. (2006) |

SIHP # 50-50-04-05966 consists of an incomplete and previously disturbed subadult burial that was inadvertently discovered during archaeological monitoring of off-site construction near the Kehalani Mauka Subdivision Project in Wailuku and Waikapū (Morawski et al. 2006). SIHP # -05966 is described by Morawski et al. (2006:13) as follows:

> This area of isolated human remains was identified in an area of previously disturbed fill soils likely associated with the initial construction of the manhole and sewer main along Waiale Rd. This incomplete and previously disturbed secondary burial consisted of several disarticulated human bones. The remains associated with this site included an immature tibia with epiphyses un-fused and not present, a fragmentary fibula shaft, and two un-fused distal metatarsals. Also, several rib fragments were associated with this burial, two of which were nondiagnostic and could not be positively identified as human.
>
> Initial analysis of the remains was undertaken by Diane Guerriero M.A. of ASH, Chris Monahan Ph.D., of SCS later performed additional analysis and confirmed that the remains were human, and likely those of a child, 3 to 4 years of age. The remains associated with this site are currently being curated at Maui SHPD and await reinterment in a protected environment in the general area in which they were identified. [Morawski et al. 2006:13]

Based on the information provided by Morawski et al. (2006), SIHP # -05966 was collected from the location of discovery for temporary curation and relocation to a burial preserve. The historic property is no longer located within the project area. The final treatment of this burial site is presently unknown to CSH.

CSH is unable to confirm whether SIHP # -05966 was previously assessed for significance. It is likely that SIHP # -05966 was significant pursuant to Criterion “e” (have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with 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).

## 5.3 **SIHP # 50-50-04-06668**

| | |
|---|---|
| **FORMAL TYPE:** | Terrace |
| **FUNCTION:** | Transportation, water control |
| **NUMBER OF FEATURES:** | 1 |
| **AGE:** | Post-Contact (historic) |
| **TAX MAP KEY:** | TMK: [2] 3-5-002:888 |
| **LAND JURISDICTION:** | State of Hawai‘i (Waikapū Stream) |
| **PREVIOUS DOCUMENTATION:** | Perzinski and Dega (2010); Ueki et al. (2025) |

SIHP # 50-50-04-06668 is a stacked basalt stone terrace that is located on the southern bank of the Waikapū Stream (Figure 166 and Figure 169). SIHP # -06668 was first documented by SCS during an AIS of a previously proposed alignment of the Waiale Road extension project (Perzinski and Dega 2010). Perzinski and Dega (2010:31) described SIHP # -06668 as follows:

> Site -6668 consists of a 6 m long terrace feature located along the south bank of Waikapū Stream within the corridor for the proposed Wai‘ale Road extension. The terrace is constructed of waterworn basalt boulders with a maximum height of 110 cm and width of 40-80 cm. The terrace is stacked a maximum of 4 courses and contains no sediment or soil deposit. A 1 m by 1 m manually excavated test unit was attempted, but efforts were halted when it became apparent that no subsurface sediments existed with boulders visible through the terrace to the base of the slope. No cultural materials or layers were encountered.
>
> The terrace is in fair to good condition and is suggested to be of an historic age. Its function is indeterminate, but could have been used as a footing for a small footbridge over the stream or possible as a flood control measure. (Perzinski and Dega 2010:31)

During the AIS for the Wai‘ale Road Extension, CSH returned to the location of SIHP # -06668 in order to assess the current condition of the historic property compared to previous documentation. In general, the terrace remained in the same condition as documented by Perzinski and Dega (2010). However, Ueki et al. (2024:293) noted that the length of the terrace is currently 14.0 m long as compared to the 2010 documented length of the terrace at 6.0 m long and stated: “It is possible that an additional portion of the terrace has been exposed by erosion since 2010.” The remainder of the description of SIHP # -06668 provided by Perzinski and Dega (2010) remained accurate.

SIHP # 50-50-04-06668 was previously assessed by Perzinski and Dega (2010) as significant pursuant to HAR §13-275-6, Criterion “d” (have yielded, or is likely to yield, information important for research on prehistory or history). The additional documentation of the historic property during the AIS for the Wai‘ale Road Extension supports this assessment. The historic property retains the integrity of location, design, setting, materials, and workmanship, and has provided information important to research on historic land use.

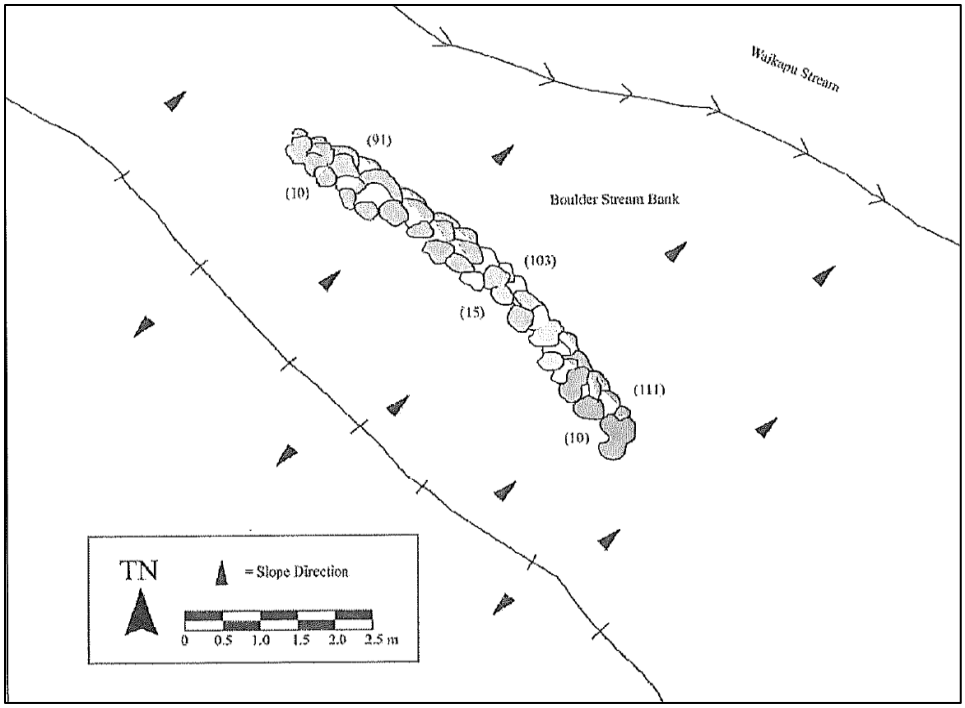



Figure 166. SIHP # -06668 plan map from Perzinski and Dega (2010:33)

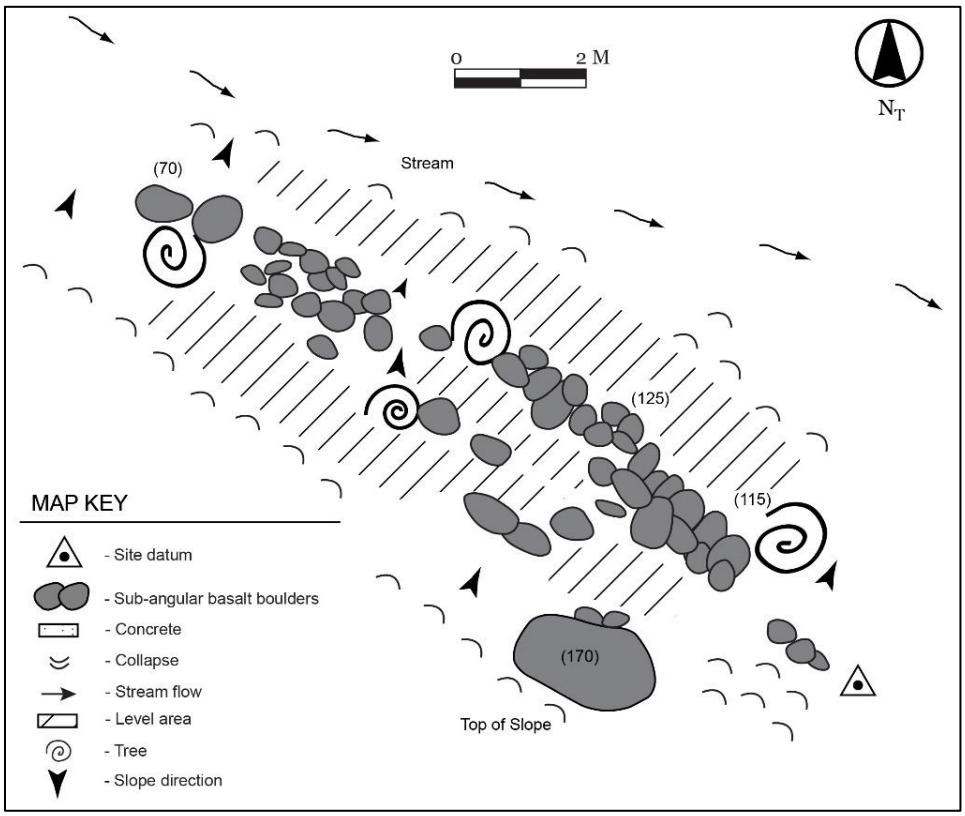



Figure 167. SIHP # -06668 plan map showing the updated condition (Ueki et al. 2024:294)



Figure 168. General view of SIHP # -06668, view to southwest (Ueki et al. 2024:295)



Figure 169. Cross-section view of SIHP # -06668, view to west (Ueki et al. 2024:295)

## 5.4 **SIHP # 50-50-04-09167**

| | |
|---|---|
| **FORMAL TYPE:** | Complex |
| **FUNCTION:** | Water control |
| **NUMBER OF FEATURES:** | 8 |
| **AGE:** | Post-Contact (historic) |
| **TAX MAP KEY:** | [2] 3-6-002:003 |
| **LAND JURISDICTION:** | Waiale 905 Partners LLC (private) |
| **PREVIOUS DOCUMENTATION:** | Ueki et al. (2025) |

SIHP # 50-50-04-09167 is an irrigation ditch complex located along the eastern side of Honoapi‘ilani Highway within the Wai‘ale Road Extension segment of the project area (see Figure 164 and Figure 165). The complex is believed to be more than 50 years old and was newly identified during the AIS for the Wai‘ale Road Extension by Ueki et al. (2025). The portion of the historic property that is located within the project area is 460.0 m long with a maximum width of 6.6 m and an approximate depth below modern ground surface of 1.3 m. The ditch continues outside the limits of the current project area to the north and to the south. The ditch does not appear on historic maps and is difficult to identify in historic aerial imagery due to the presence of vegetation alongside Honoapi‘ilani Highway. There is no indication that the ditch is directly connected to other prominent ditch systems such as the Kama Ditch and aqueduct (SIHP # 50-50-04-05474) or the Spreckels/Waihe‘e Ditch (SIHP # 50-50-04-01508).

CSH documented a total of eight components or features that comprise the historic property, including the ditch itself (Feature A), a culvert extending beneath a driveway (Feature B), a stacked stone terrace (Feature C), three sluice gates (Features D, F, and H), and two pedestrian crossings or walkways (Features E and G). One of the sluice gates, Feature D, includes the date inscription “1967”, indicating that portions of the complex are at least 57 years old. The presence of PVC pipes throughout the ditch suggests that there was likely continued use of the system for water control related to commercial agriculture, however, at present the ditch system appears to be abandoned and overgrown.

SIHP # -09167 Feature A is assigned to the irrigation ditch that parallels the eastern side of Honoapi‘ilani Highway (Figure 170 through Figure 172). A minimum of two construction styles were observed throughout the portion of the ditch within the project area that may represent distinct construction phases or ongoing use and rehabilitation of the structure (Figure 173). One construction style consists of poured and formed concrete that utilizes crushed basalt aggregate. The other construction style appears more haphazard and consists of dry-stacked or lightly cemented basalt cobbles and small boulders that are then partially or fully covered with cement. While the ditch likely initially carried open water, 10-inch and 4-inch PVC pipes were later installed through the center of the ditch. The PVC pipes are broken and disconnected in several places, further indicating that the ditch system is no longer in use.

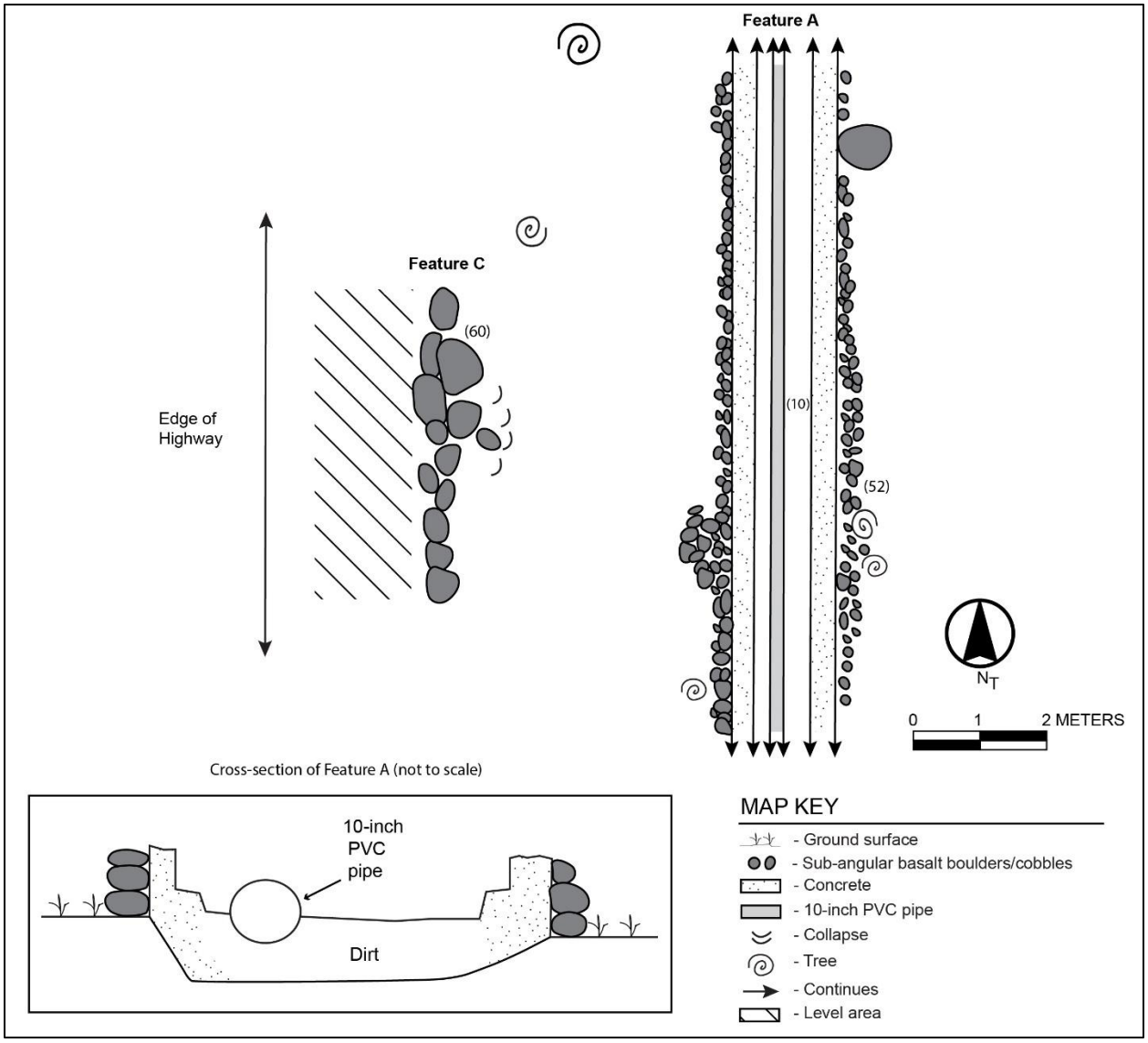



Figure 170. SIHP # -09167 Feature A (ditch) and Feature C (terrace) plan map and representative cross-section (Ueki et al. 2024:297)



Figure 171. Exterior view of SIHP # -09167 Feature A (ditch), view to east (Ueki et al. 2024:298)



Figure 172. Interior view of SIHP # -09167 Feature A (ditch), view to north (Ueki et al. 2024:298)



Figure 173. Close-up depicting two separate construction styles visible in the sidewall of SIHP # -09167 Feature A (ditch), view to west (Ueki et al. 2024:299)

SIHP # -09167 Feature B is a culvert along the Feature A irrigation ditch that was constructed beneath a driveway that extends from Honoapi‘ilani Highway to an adjacent farm property (Figure 174). The culvert consists of two cement headwalls that support a 20-inch metal pipe. Overall, Feature B is 6.0 m long by 2.6 m wide, with a maximum depth of 1.3 m beneath the surrounding ground surface (Figure 175). The northern headwall is damaged and collapsed while the southern headwall remains intact (Figure 176 and Figure 177). Each headwall measures 2.6 m long by 0.2 m wide, with a maximum height of 1.4 m. There are no wingwalls or other structures associated with the culvert. There are no inscriptions or other design details on the structure.

SIHP # -09167 Feature C is a dry-stacked basalt stone terrace that is located between the Feature A irrigation ditch and Honoapi‘ilani Highway (see Figure 170). The terrace is 4.4 m long by 1.2 m wide, with an average height of 0.6 m above ground surface. The terrace includes a minimum of two courses of stone and supports a level sediment area along the edge of the highway (Figure 178).

SIHP # -09167 Feature D is a sluice gate structure along the Feature A irrigation ditch that is located 132.6 m north of Feature B (culvert). The sluice gate structure is comprised of cemented hollow tile concrete blocks supporting an intact milled wood gate (Figure 179 and Figure 180). Overall, the structure is 1.9 m long by 0.9 m wide, with a maximum height of 1.1 m above the base of the ditch. The cement along the top of the sluice gate structure is inscribed with the date “1967”, which is inferred to be the date of construction (Figure 181).

SIHP # -09167 Feature E is a walkway or pedestrian crossing that spans the Feature A irrigation ditch in the vicinity of the Feature D sluice gate structure (see Figure 179). The walkway consists of a rectangular formed concrete slab that is 3.8 m long by 0.5 m wide and 0.1 m thick (Figure 182). The slab is positioned approximately 0.4 m above the base of the ditch. The eastern end of the slab is broken into several pieces.

SIHP # -09167 Feature F is a sluice gate structure within the eastern sidewall of the Feature A irrigation ditch, approximately 17.5 m north of the Feature E walkway (Figure 183 and Figure 184). The sluice gate structure is comprised of mortared basalt boulders and formed concrete. The gate itself is aluminum. The gate opening has been sealed off with a concrete slab. The sluice gate structure is 2.5 m long by 1.8 m wide and extends 0.5 m above the base of the irrigation ditch. Portions of the ditch at this location appear to be earthen. There are 10-inch and 4-inch PVC pipes within and along the ditch, and a metal water valve.

SIHP # -09167 Feature G is a walkway or pedestrian crossing that spans the Feature A irrigation ditch that is located approximately 41.8 m north of the Feature F sluice gate structure (Figure 185 and Figure 186). The walkway consists of a rectangular formed concrete slab that is 2.0 m long by 1.2 m wide and 0.1 m thick. The slab is positioned approximately 0.4 m above the base of the ditch. There is a metal frame on the northern side of the walkways within the ditch that may have been used to catch vegetation debris.

SIHP # -09167 Feature H is a sluice gate structure within the eastern wall of the Feature A irrigation ditch, in the vicinity of the Feature G walkway (see Figure 185). This sluice gate structure consists of a base layer of formed concrete and a top layer of mortared basalt boulders (Figure 187). The sluice gate itself is comprised of milled wood. The structure is 2.8 m long by 2.1 m wide

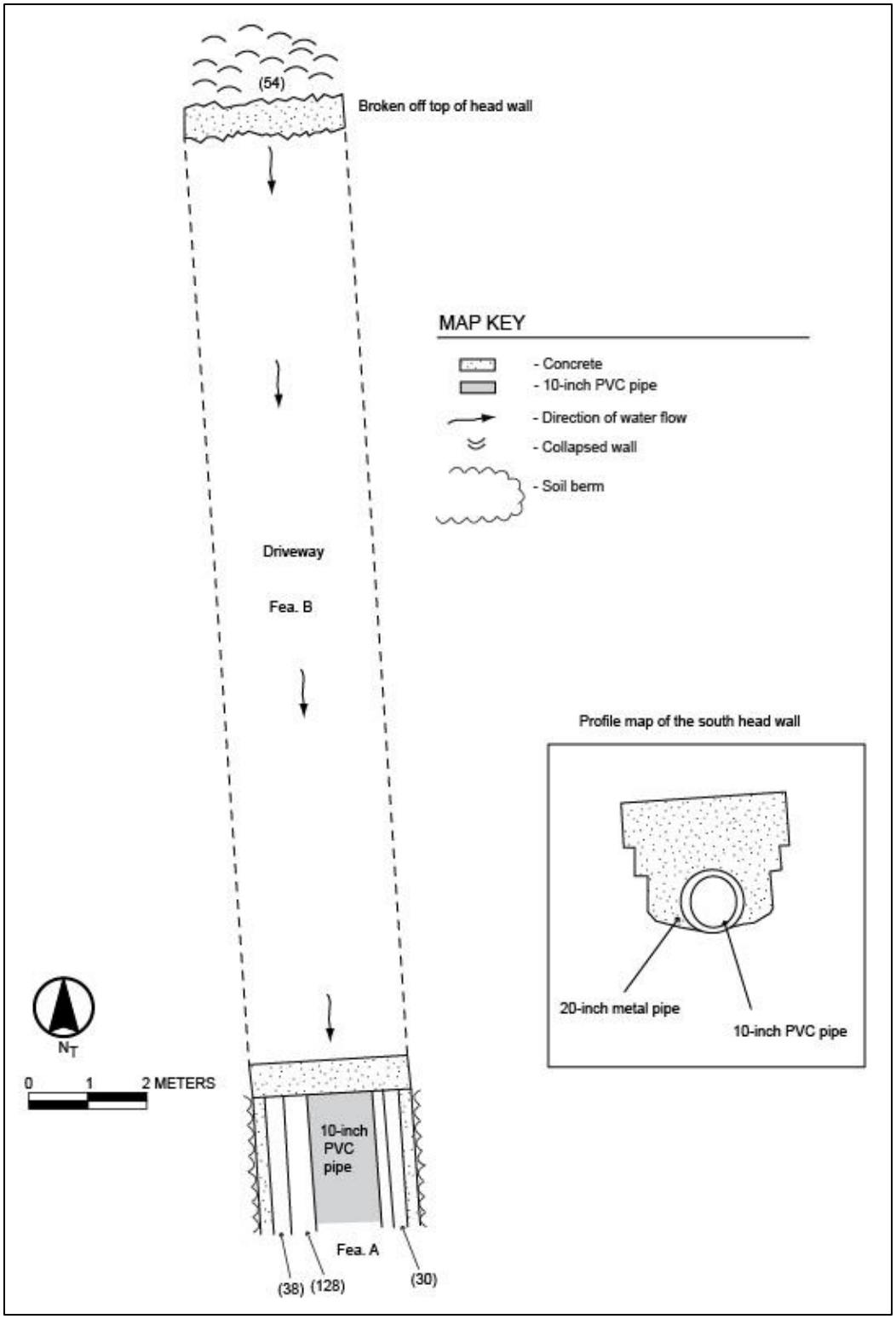



Figure 174. SIHP # -09167 Feature B (culvert) plan map and representative cross-section (Ueki et al. 2025:301)



Figure 175. General view of SIHP # -09167 Feature B (culvert), view to north (Ueki et al. 2024:302)



Figure 176. Close-up of the northern headwall of SIHP # -09167 Feature B (culvert), view to southwest (Ueki et al. 2024:302)



Figure 177. Close-up of the southern headwall of SIHP # -09167 Feature B (culvert), view to north (Ueki et al. 2024:303)



Figure 178. General view of SIHP # -09167 Feature C (terrace), view to northwest (Ueki et al. 2024:303)

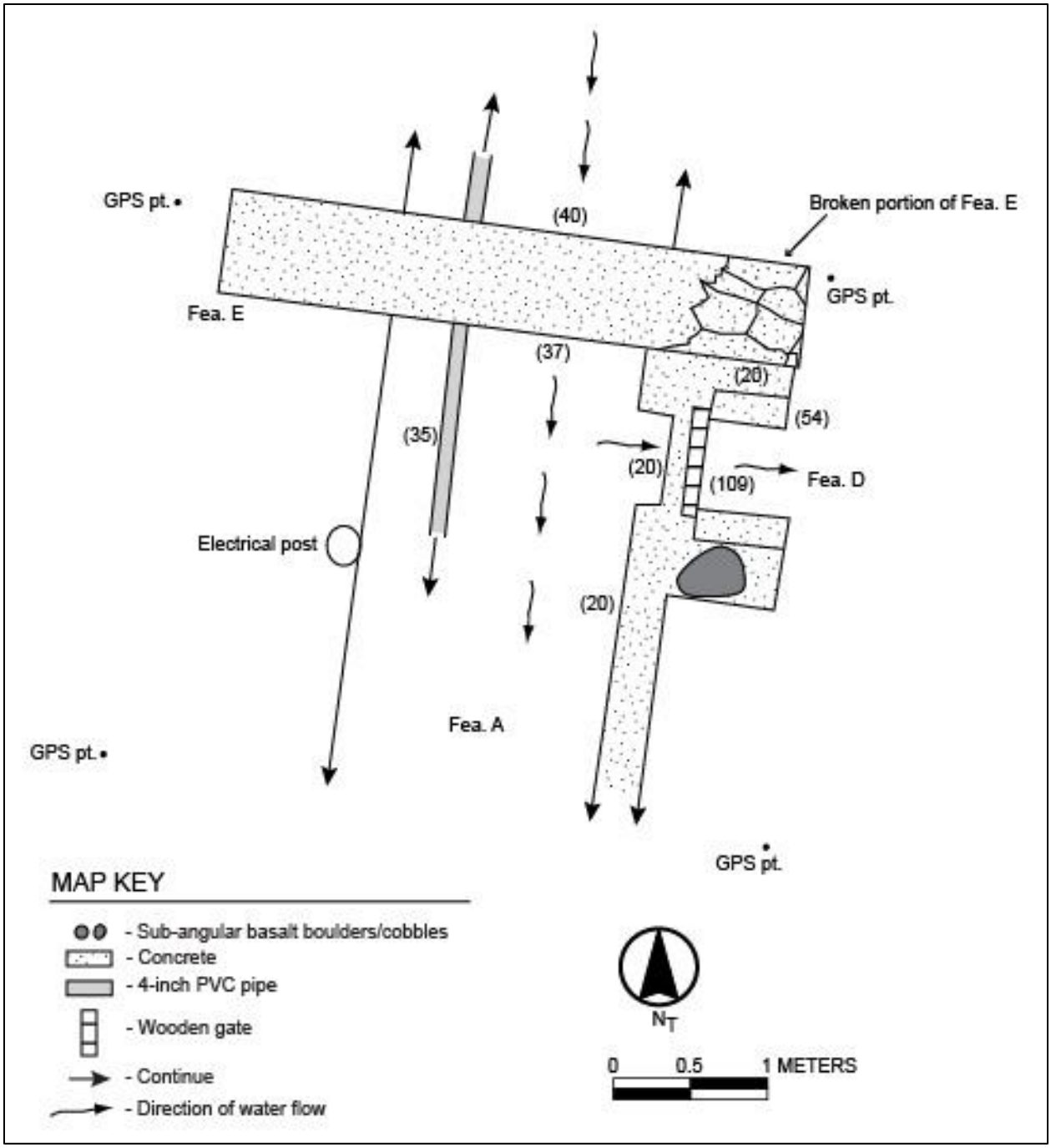



Figure 179. SIHP # -09167 Feature D (sluice gate) and Feature E (walkway) plan view map (Ueki et al. 2024:304)



Figure 180. General view of SIHP # -09167 Feature D (sluice gate) with Feature E (walkway) in background, view to west (Ueki et al. 2024:305)




Figure 181. Close-up of the “1967” inscription observed within the cement on the top of SIHP # -09167 Feature D (sluice gate), view to west (Ueki et al. 2024:305)



Figure 182. General view of SIHP # -09167 Feature E (walkway), view to north (Ueki et al. 2024:306)



Figure 183. General view of SIHP # -09167 Feature F (sluice gate), view to northeast (Ueki et al. 2024:306)

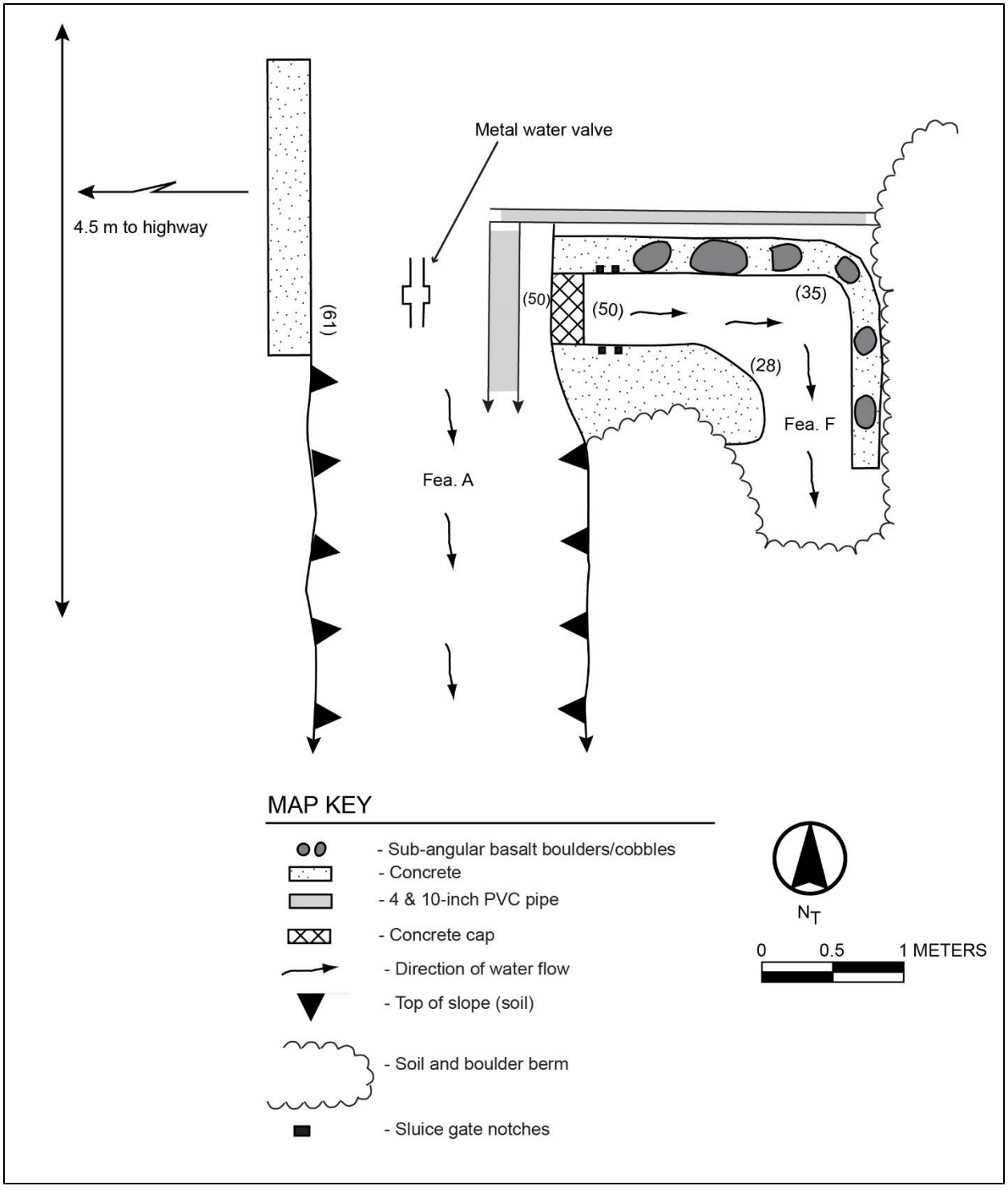



Figure 184. SIHP # -09167 Feature F (sluice gate) plan view map (Ueki et al. 2024:307)

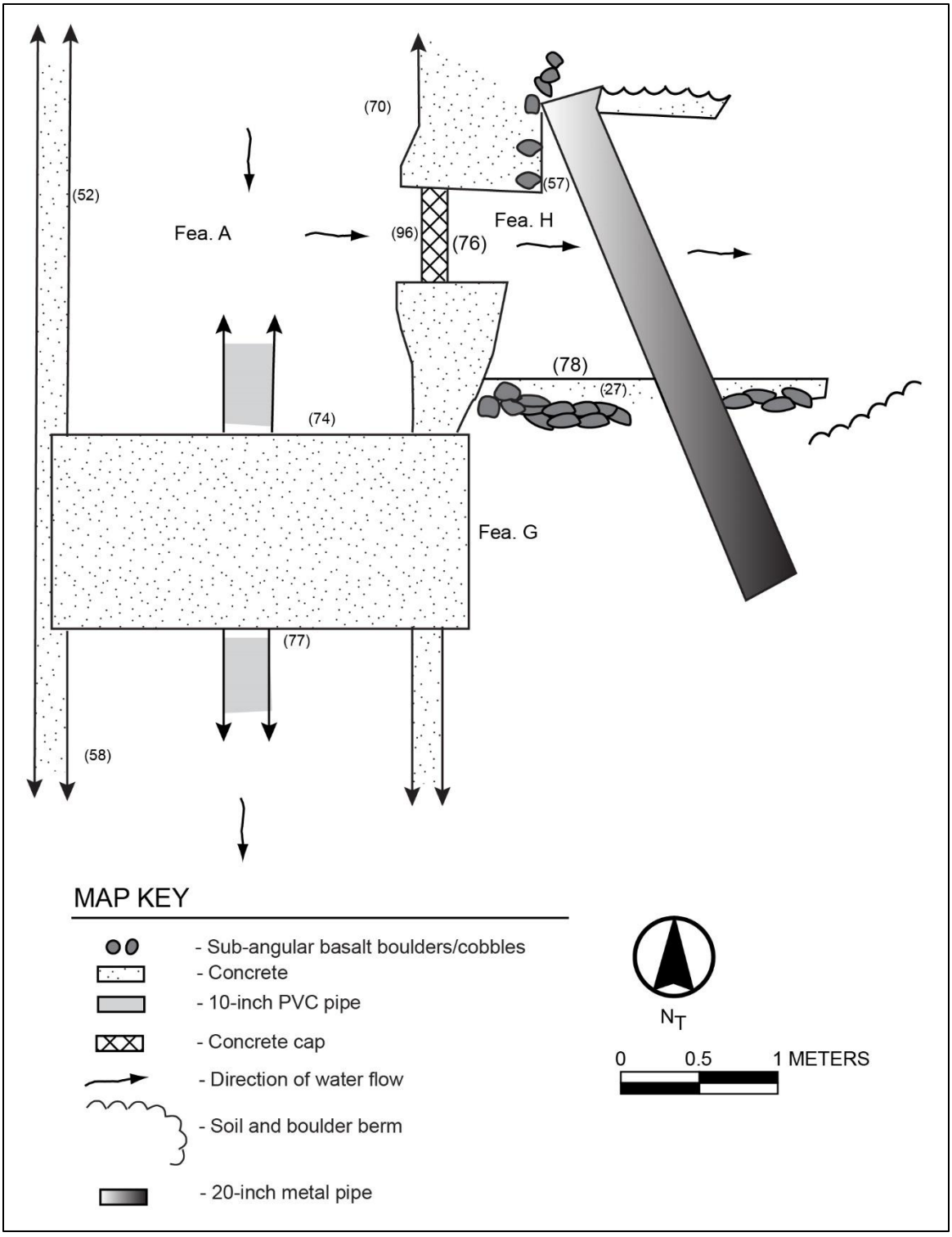



Figure 185. SIHP # -09167 Feature G (walkway) and Feature H (sluice gate) plan view map (Ueki et al. 2024:308)



Figure 186. General view of SIHP # -09167 Feature G (walkway), view to south (Ueki et al. 2024:309)



Figure 187. General view of SIHP # -09167 Feature H (sluice gate), view to southwest (Ueki et al. 2024:309)

and extends 0.8 m above the base of the ditch. The sluice gate opening has been capped with concrete. There is a 20-inch metal pipe placed along the edge of the sluice gate structure.

SIHP # 50-50-04-09167 is an irrigation ditch complex that was documented by CSH during the AIS as a potentially significant historic property. As an architectural historic property, a determination of historic property significance and eligibility was completed by a qualified architectural professional. Mr. Stanley Solamillo, an architectural historian, completed a site inspection of SIHP # -09167 on 17 January 2025 and later provided a written assessment of the historic property (Appendix C). Mr. Solamillo determined that, based on alterations or changes to design, setting, materials, and workmanship, the historic property is no longer significant.

## 5.5 SIHP # 50-50-04-09168

| | |
|---|---|
| **FORMAL TYPE:** | Subsurface cultural deposit |
| **FUNCTION:** | Refuse disposal |
| **NUMBER OF FEATURES:** | 1 |
| **AGE:** | Post-Contact (historic) |
| **TAX MAP KEY:** | [2] 3-5-002:014 |
| **LAND JURISDICTION:** | Waiko Baseyard, LLC (private) |
| **PREVIOUS DOCUMENTATION:** | Ueki et al. (2025) |

SIHP # 50-50-04-09168 is a subsurface cultural deposit that was newly identified during the AIS for the Wai‘ale Road Extension by Ueki et al. (2025) (see Figure 164 and Figure 165). The deposit was located within trench TE-4 of the AIS. A total of approximately 1,092 items were collected from the cultural deposit for additional laboratory analysis including glass bottle fragments, ceramic fragments, metal fragments, buttons, and various other materials. All the collected material was identified as historic with manufacturer dates ranging from the early to mid-1900s. While some additional artifacts were collected from the surface and AIS excavations in the vicinity of TE-4, these additional artifacts were sparse and not included within the boundary of the historic property. Therefore, based on AIS testing, the historic property boundary is limited to the location of TE-4, which is 6.0 m long and 0.8 m wide.

TE-4 was located north of Waikapū Stream and near the intersection of Wai‘ale Road and E. Waiko Road (see Figure 30). A review of modern aerial imagery indicates that this portion of the project area was utilized circa 2011-2013 as a construction stockpile and baseyard associated with the development of nearby housing subdivisions. While it is possible that the cultural deposit was imported within fill sediment during the stockpiling process, it seems more likely that, based on the depth of the deposit and variation of associated stratigraphy, that the cultural deposit was already present. Cultural material was identified in four strata (Stratum I, III, V/VI interface) and extended from near the surface of the excavation to approximately 1.4 mbs (Figure 188 through Figure 190 and Table 21). Excavation was terminated upon reaching a layer of compacted basalt boulders in clay (Stratum VI) that could not be further penetrated by the backhoe.

Of the 1,092 items collected from SIHP # -09168, 71 were collected from Stratum I, 973 were identified from Stratum III, and 48 were collected from the interface of Stratum V/VI. A catalogue of the artifacts accessioned from TE-4 is presented within Appendix B.

SIHP # 50-50-04-09168 is a subsurface cultural deposit that is assessed as significant pursuant to HAR §13-275-6, Criterion “d” (have yielded, or is likely to yield, information important for research on prehistory or history). The historic property retains the integrity of location, materials, and workmanship, and has provided information important to research on historic land use.



Figure 188. Wai‘ale Road Extension AIS TE-4 oblique profile view depicting the SIHP # -09168 cultural deposit, view to south (Ueki et al. 2024:312)



Figure 189. Wai‘ale Road Extension AIS TE-4 profile view depicting the SIHP # -09168 cultural deposit, view to east (Ueki et al. 2024:312)

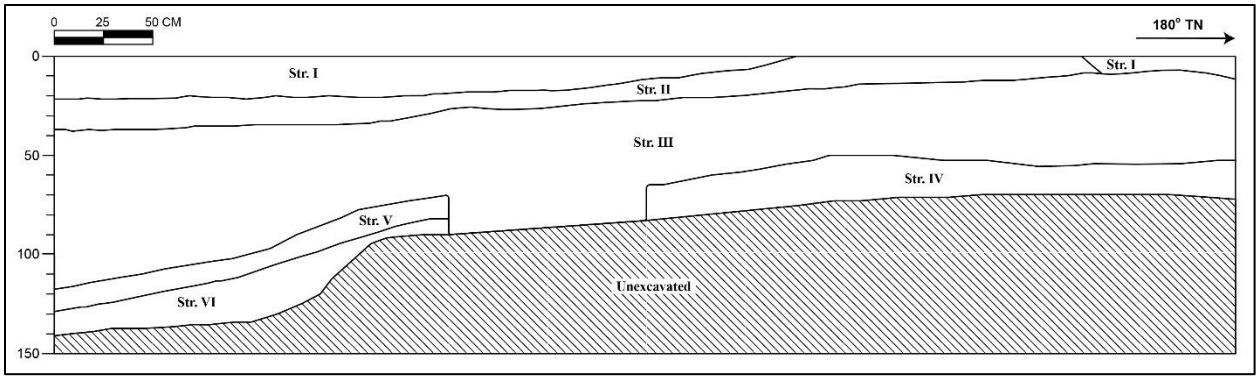



Figure 190. Wai‘ale Road Extension AIS TE-4, stratigraphy of the east wall; note that SIHP # -09168 was primarily identified within Stratum III, but also included artifacts collected from Stratum I and the Stratum V/VI interface (Ueki et al. 2024:313)

Table 21. Strata observed at Wai‘ale Road Extension AIS TE-4 (Ueki et al. 2024:313)

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–23 | A horizon; 10YR 3/3, dark brown; very gravelly silt loam; strong, fine granular structure; dry, hard consistence; strong cementation; non-plastic; terrigenous origin; fine roots common; smooth, clear lower boundary; developing A horizon; contained historic artifacts (collected) |
| II | 0–38 | Asphaltic concrete (excess material pour) |
| III | 6–118 | Fill; 10YR 4/3, brown; gravelly sandy loam; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; non-plastic; mixed origin; smooth, clear lower boundary; contained numerous historic artifacts (collected) |
| IV | 49–83 | Fill; 10YR 3/2, very dark grayish brown; extremely cobbly sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; terrigenous origin; wavy abrupt lower boundary; possible redeposited river/streambed sediment |
| V | 70–130 | Fill; 10YR 6/3, pale brown; sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; marine origin; smooth, clear lower boundary; contained historic artifacts (collected) |
| VI | 83–142 | Natural; 10YR 3/2, very dark grayish brown; stony sandy clay; moderate, fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; lower boundary not observed; contained historic artifacts (collected) near upper interface with Stratum V indicated previous disturbance |

# Section 6 Summary and Interpretation

At the request Munekiyo Hiraga, and on behalf of the County of Maui DEM, CSH has prepared this AIS report for the Central Maui Wastewater Reclamation Facility Project, located within Waikapū, Wailuku, and Pūlehunui Ahupua‘a, Pū‘ali Komohana District, Maui Island. The proposed project includes the construction of the Central Maui WWRF, the Kehalani WWPS, new sewer pipeline, and a new R-1 pipelines as well as an access and utility easement. The proposed project will provide wastewater treatment service to the Central Valley area of Maui. The project area encompasses approximately 21.5 acres (8.70 hectares) of land owned by the County of Maui and private landowners.

The project area is located on the periphery of the inland dune system of Central Maui. Most of the area across the isthmus was covered with sugarcane by the mid-nineteenth century. According to the USDA SSURGO (2001) database and soil survey data gathered by Foote et al. (1972), soils within the project area include deposits of Jaucas and Puuone sands and various alluvial sediments within the higher elevations.

The central plain of the isthmus was traditionally referred to as Ke Kula o Kama‘oma‘o, a region known as a wandering place of the souls (Beckwith 1970). There are few records of traditional land use within the project area, however, the central isthmus has been documented through historical and ethnographic accounts as a place of warfare between the forces of Maui and Hawai‘i Island.

Previous archaeological research of studies adjacent to the proposed project corridor have documented historic properties including large clusters of human burials within the Sand Hills region, a late pre-Contact to early post-Contact temporary habitation site (SIHP # 50-50-04-04202), and various historic plantation and ranching features. There are or were three previously documented historic properties within the project area that include: SIHP # 50-50-04-05965, disturbed human remains consisting of an adult humerus portion believed to have been disinterred during a previous archaeological study; SIHP # 50-50-04-05966, incomplete and previously disturbed subadult burial believed to have been disinterred during a previous archaeological study; and SIHP # 50-50-04-06668, a post-Contact boulder terrace that remains extant. The presence of previously documented pre-Contact burial sites within the project area is consistent with the history of land use of this portion of Wailuku Ahupua‘a, known as Wailuku Sandhills, where numerous pre-Contact burials have been recorded.

In December 2024, CSH completed a separate AIS for the Wai‘ale Road Extension segment of the project area (Ueki et al. 2025) (HICRIS 2023PR00443), which included a 100% coverage pedestrian inspection, 60 test excavations, and ten GPR transects. The project area contained a previously identified post-Contact boulder terrace, which was redocumented (SIHP # 50-50-04-06668), and two historic properties were newly identified: an irrigation ditch complex (SIHP # 50-50-04-09167) and a subsurface historic cultural deposit (SIHP # 50-50-04-09168). The draft AIS report has not yet been reviewed by the SHPD.

Between 5 and 21 September 2023, CSH monitored 12 geotechnical boring tests and nine double ring infiltrometer tests for the project. Fieldwork for the current AIS subsurface testing component was conducted between 11 September and 4 November 2024 and included the

completion of a 100% coverage pedestrian inspection and the investigation of 90 AIS test excavations and eight GPR survey transects within the proposed Central Maui WWRF and the connection corridor segments of the project area. Overall, the stratigraphy observed throughout the project area consisted of a widespread agricultural plow zone (Ap horizon), which either was at the surface or intermittently below a developing A horizon, overlying varying sequences of natural alluvial deposits and natural aeolian sand with the intermittent presence of a non-cultural, buried A horizon. Notably, no aeolian sand deposits were encountered in the connection corridor segment of the project area. The presence of an Ap horizon throughout the project area supports the land use history of widespread sugarcane cultivation throughout Waikapū Ahupua‘a, specifically in the connection corridor where there are still remnant sugarcane stalks observed on the surface. Historic commercial agricultural land use in the project area is further indicated by the presence of a post-Contact boulder terrace (SIHP # -06668), an irrigation ditch complex (SIHP # -09167) and a subsurface historic cultural deposit (SIHP # -09168) within the project area. The findings during the AIS are consistent with prior land use histories of Waikapū Ahupua‘a.

# Section 7 Significance Assessments

Historic property significance is evaluated and assessed based on the five State of Hawai‘i historic property significance criteria. To be considered significant, a historic property must possess integrity of location, design, setting, materials, workmanship, feeling, and/or association and meet one or more of the following broad cultural/historic significance criteria in accordance with HAR §13-275-6:

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; or

e. Have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with 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.

Five historic properties have been identified during previous archaeological studies within the current project area. Table 22 lists the historic properties along with their significance/eligibility assessments and mitigation recommendations. These significance recommendations are included in this AIS for the review and concurrence of the SHPD.

SIHP # 50-50-04-05965 is a partial human humerus that was documented by Scientific Consultant Services, Inc. (SCS) during archaeological monitoring within Wai‘ale Road (Morawski et al. 2006). CSH is unable to confirm whether SIHP # -05965 was previously assessed for significance. It is likely that SIHP # -05965 was significant pursuant to Criterion “e” (have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with 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). Based on the information provided by Morawski et al. (2006), SIHP # -05965 was collected from the location of discovery for temporary curation and relocation to a burial preserve. The historic property is no longer located within the project area.

SIHP # 50-50-04-05966 is a partial subadult burial that was documented by SCS during archaeological monitoring within Wai‘ale Road (Morawski et al. 2006). CSH is unable to confirm whether SIHP # -05966 was previously assessed for significance. It is likely that SIHP # -05966 was significant pursuant to Criterion “e” (have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with 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). Based

on the information provided by Morawski et al. (2006), SIHP # -05966 was collected from the location of discovery for temporary curation and relocation to a burial preserve. The historic property is no longer located within the project area.

SIHP # 50-50-04-06668, a post-Contact boulder terrace, was redocumented by CSH during the separate AIS for the Wai‘ale Road Extension Project (Ueki et al. 2025). SIHP # -06668 was previously assessed by SCS as significant pursuant to HAR §13-275-6, Criterion “d” (have yielded, or is likely to yield, information important for research on prehistory or history) (Perzinski and Dega 2010). The additional documentation of the historic property supports this assessment. The historic property retains the integrity of location, design, setting, materials, and workmanship, and has provided information important to research on historic land use.

SIHP # 50-50-04-09167 is an irrigation ditch complex identified by CSH during the AIS for the Wai‘ale Road Extension Project (Ueki et al. 2025). As an architectural historic property, a determination of historic property significance and eligibility was completed by a qualified architectural professional. Mr. Stanley Solamillo, an architectural historian, completed a site inspection of SIHP # -09167 on 17 January 2025 and later provided a written assessment of the historic property (see Appendix C). Mr. Solamillo determined that, based on alterations or changes to design, setting, materials, and workmanship, the historic property is no longer significant.

SIHP # 50-50-04-09168 is a subsurface cultural deposit identified by CSH during the AIS for the Wai‘ale Road Extension Project (Ueki et al. 2024). It was assessed as significant pursuant to Criterion “d”. The historic property retains the integrity of location, materials, and workmanship, and has provided information important to research on historic land use.

Table 22. Archaeological Historic Property Integrity, Significance, and Mitigation Recommendations

| SIHP # 50-50-04 | Previous Documentation | Formal Type/ Description | Integrity | | | | | | | Significance | Mitigation Recommendation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Location | Design | Setting | Materials | Workmanship | Feeling | Association | | |
| -05965 | Morawski et al. (2006) | Human skeletal remains | Not provided by Morawski et al. (2006) | | | | | | | e | Disinterred (no longer located within the project area); Archaeological monitoring |
| -05966 | Morawski et al. (2006) | Human skeletal remains | Not provided by Morawski et al. (2006) | | | | | | | e | Disinterred (no longer located within the project area); Archaeological monitoring |
| -06668 | Perzinski and Dega (2010); Ueki et al. (2025) | Terrace | Y | Y | Y | Y | Y | N | N | d | Archaeological monitoring |
| -09167 | Ueki et al. (2025) | Water control complex (8) | Y | Y | Y | Y | Y | N | N | No longer significant | No further work |
| -09168 | Ueki et al. (2025) | Subsurface cultural deposit | Y | N | N | Y | Y | N | N | d | Archaeological monitoring |

# Section 8 Project Effect and Mitigation Recommendations

## 8.1 Project Effect

Based on all available information, there are presently two significant historic properties (SIHP # -06668 and -09168) located within the current project area. The project has the potential to affect these significant historic properties during project-related ground disturbance as SIHP # -06668 and -09168 are within approximately 50 m of where a roundabout is proposed for the Wai‘ale Road Extension and will likely be impacted by excavation. In accordance with HAR §13-275-7, the effect recommendation for this project is “effect, with proposed mitigation commitments.”

## 8.2 Mitigation Recommendations

As described in HAR §13-275-8, “If a project will have an “effect” (impact) on significant historic properties, then a mitigation commitment proposing the form of mitigation to be undertaken for each significant historic property shall be submitted by the agency to the SHPD for review and approval.” Mitigation recommendations are included in this AIS for the review and approval of the SHPD.

### 8.2.1 Archaeological Monitoring

As described in HAR §13-279-3, “archaeological monitoring may be an identification, mitigation, or post-mitigation contingency measure. Monitoring shall entail the archaeological observation of, and possible intervention with, on-going activities which may adversely affect historic properties.”

It is proposed that an archaeological monitoring program, beginning with the preparation of an archaeological monitoring plan, be developed to minimally include the following objectives:

- On-site archaeological monitoring for all project-related ground disturbance within or adjacent to the Central Maui Wastewater Treatment Facility due to the area being entirely comprised of Jaucus Sand, which has a high potential for containing burials and buried A soil horizons containing cultural deposits.
- On-site archaeological monitoring for all project-related ground disturbance within or adjacent to the SIHP # -09168 historic property boundary (Wai‘ale Road Extension TE-4 location). On-site archaeological monitoring will provide an opportunity to document project-related impacts on the historic property and, if applicable, record any additional significant information.
- On-site archaeological monitoring for all project-related ground disturbance within the SIHP # -06668 historic property boundary (Wai‘ale Road Extension Waikapū Stream bank). While SIHP # -06668 has been previously documented and recommended for no further work by Perzinski and Dega (2010), on-site archaeological monitoring will provide an opportunity to document project-related impacts on the historic property and, if applicable, record any additional significant information.
- On-site archaeological monitoring for all project-related ground disturbance within Waikapū Stream. The stream corridor and associated deposits are culturally sensitive. Archaeological monitoring will ensure appropriate interim protection, notification to the

SHPD, and subsequent mitigation for any potential inadvertent discoveries within Waikapū Stream.

- On-site archaeological monitoring for all project-related ground disturbance occurring within the existing footprint of the Wai‘ale Road portion of the current project area. Archaeological monitoring within this corridor previously documented and removed SIHP #s -05965 (human skeletal remains) and -05966 (human skeletal remains), and there is the potential for additional human skeletal remains to be identified in this portion of the project area.
- On-call archaeological monitoring for the remainder of project-related excavation. An archaeologist will remain on-call and available to conduct archaeological monitoring in the event of significant findings. Additionally, the on-call archaeologist will conduct periodic site visits to inspect any changes in stratigraphy and document the construction process.

Archaeological monitoring shall be undertaken in accordance with an archaeological monitoring plan that shall be reviewed and accepted by the SHPD prior to the monitoring project in accordance with HAR §13-279-4.

### 8.2.2 No Further Work

No mitigation is recommended for SIHP # 50-50-04-09167. This historic property has been assessed by an architectural professional (Mr. Stanley Solamillo) as no longer significant.

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# Appendix A AIS Fieldwork Strategy Review

## A.1 AIS Fieldwork Strategy Document

CULTURAL SURVEYS HAWAI'I

ARCHAEOLOGICAL, CULTURAL, AND HISTORICAL DOCUMENTATION SERVICES - SINCE 1982





April 3, 2024

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Subject: Consultation for Archaeological Inventory Survey Fieldwork Strategy for the Central Maui Wastewater Reclamation Facility Project, Waikapū and Wailuku Ahupua‘a, Pū‘ali Komohana District, Maui, TMKs: [2] 3-5-001:017 por. and 120 por., [2] 3-5-002:014 por., [2] 3-5-020:036 por., [2] 3-6-002:003 por. and 004 por., [2] 3-8-005:023 por., Wai‘ale Road Right-of-Way, Waiko Road Right-of-Way, and Waikapū Stream

CSH Job Code: WAIKAPU 35
HICRIS Project: 2023PR01312
Permits: TBD

Aloha:

On behalf of the County of Maui, Department of Environmental Management (DEM), Cultural Surveys Hawai‘i, Inc. (CSH) would like to consult with the State Historic Preservation Division (SHPD) regarding an appropriate archaeological inventory survey (AIS) testing strategy for the Central Maui Wastewater Reclamation Facility (WWRF) Project (Figure 1). On November 3, 2023, the project was submitted to the SHPD for initial review under HRS 6E-8 with a request by DEM to proceed with an AIS (HICRIS 2023PR01312). Due to the project timeline and other factors, consultation with the SHPD on an appropriate AIS strategy is being requested concurrently with this initial review.

**Project Background**

The proposed project will provide wastewater treatment service to the Central Valley area of Maui. The construction of the new Kehalani WWPS and sewage pipeline will divert wastewater from the Wailuku-Kahului WWRF thereby reducing the volume of treated effluent disposal at the facility. The project will also provide recycled water irrigation for non-potable reuse the proposed



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Waikapū Country Town Project as well as agricultural fields, regional parks, and County facilities in the area. The increased use of recycled water will therefore increase freshwater and raw water resources available for potable and other uses.

A backup wastewater effluent disposal system is required for water reuse and will be accomplished through soil aquifer treatment (SAT) at the new Central Maui WWRF. The proposed facility plan contains four SAT basins, four secondary clarifiers, a headworks station, a dewatering and blower building, effluent pump station and RAS pump station, operations building, and facilities to process activated sludge, R-1 recycled water treatment, and aerobic digesters.

Project ground disturbance for the construction of the new Central Maui WWRF is expected to have a maximum excavation depth of 25 ft (7.62 m). The construction of the new Kehalani WWPS is expected to have a maximum excavation depth of 20 ft (6.10 m). The sewage pipeline trench along Wai‘ale Road and the future Wai‘ale Road Extension is expected to be 4 ft (1.22 m) wide with an estimated length of 17,000 linear feet (5.18 km) and a maximum excavation depth of 15 ft (4.57 m). The R-1 pipeline from the WWRF to the Waikapū Country Town Storage Facility is estimated to be 10,000 linear feet (3.05 km) with a maximum depth of 6 ft (1.83 m). An access and utility easement will be 1,800 ft (548.64 m) long and 100 ft (30.48 m) wide to connect the Central Maui WWRF to the Wai‘ale Road Extension.

In an effort to provide the SHPD with detailed information on the historic, cultural, and archaeological background of the project area and to determine the likelihood that historic properties may be affected by the project, CSH has prepared an archaeological literature review and field inspection (LRFI) study that was submitted to the SHPD as part of the initial review process (HICRIS 2023PR01312). For convenience, the LRFI can also be accessed here: Central Maui WWRF LRFI. The LRFI confirmed that there are three previously documented historic properties within the project area that include SIHP # 50-50-04-05965, disturbed human remains consisting of an adult humerus portion, SIHP # 50-50-04-05966, incomplete and previously disturbed subadult burial; and SIHP # 50-50-04-06668, a post-Contact terrace. The LRFI field inspection conducted by CSH also identified four other potential historic properties that include CSH 1, a concrete culvert; CSH 2, a road portion; CSH 3, a ditch; and CSH 4, retaining walls.

**Pedestrian Inspection**

The AIS fieldwork will include a 100 percent coverage pedestrian survey of the surface of the study area to identify any surface historic properties that may be present. The survey will be completed by a team of archaeologists conducting pedestrian transects. Transect spacing will depend on ground visibility. For open, plowed fields where ground visibility is excellent, spacing will be 10.0 m. For vegetated or unmaintained areas where ground visibility is poor, spacing will be 5.0 m. All surface historic properties will be located using a GPS receiver that is capable of sub-meter accuracy.

**Documentation of Surface Historic Properties**

If surface archaeological historic properties are identified, these properties will be inventoried and documented in accordance with Hawai‘i Administrative Rules (HAR) 13-276-5(d) and other pertinent law. Documentation will generally include photographs (with scale and north arrow), written descriptions, scaled plan or profile maps, and sub-meter accurate GPS location.

SIHP # -06668 was previously assessed by Perzinski and Dega (2010) as significant per Criterion "d" (have yielded, or have the potential to yield significant information to the history of the area) of the Hawai‘i State Register, and no additional testing was recommended. As part of the current AIS process, documentation of SIHP # 50-50-04-06668, a post-Contact terrace, will include a review and update of previous AIS-level documentation (description, photographs, maps, and GPS location) provided by Perzinski and Dega (2010), including confirmation that the historic property has been properly assessed for significance.

The potential historic properties that were identified by CSH during the project's 2023 LRFI study (CSH 1 through CSH 4) will be assessed to confirm they are indeed more than 50 years old and archaeologically significant. If these potential historic properties meet the criteria for a significant historic property then they will be documented to AIS standards per HAR 13-276-5(d).

If architectural historic properties are identified, CSH proposes to document these historic properties to be consistent with the documentation of archaeological historic properties. This documentation can then be used by the SHPD Architecture Branch or a qualified architectural historian to complete an assessment of significance.

**Subsurface Testing**

The project area is comprised of a portion of an existing stormwater detention basin serving the master-planned Kehalani Community, the existing footprint of Wai‘ale Road, the future footprint of the Wai‘ale Road Extension Project, and the undeveloped footprint of the Central Maui WWRF and utility connection. Specific methodology is proposed for each distinct area as follows:

Existing Footprint of Wai‘ale Road and Kehalani WWPS Site

No AIS test excavations are proposed within the active corridor of Wai‘ale Road and Kehalani WWPS Site since these areas have been previously studied and consists of an active roadway and detention basin that have required significant previous ground disturbance.

No ground penetrating radar (GPR) analysis is proposed within the active corridor of Wai‘ale Road and Kehalani WWPS Site. The extent of previous excavation and disturbance within this portion of the project area combined with the presence of metal and plastic utility lines beneath the roadway would create numerous false readings and interference within the returned radar signal. The false readings and interference caused by previous land disturbance and existing utilities would severely limit the ability of the GPR equipment to identify potential archaeological anomalies.

Instead, additional documentation of previous land disturbance, stratigraphy, previous AIS test locations, and previous findings within the existing corridor of Wai‘ale Road will be conducted as part of the AIS in order to provide "supportive evidence documenting any land altering activities and the likely nature and depth of historic properties that may have once existed in the area" in accordance with HAR §13-275-5 and, where feasible, to provide "supportive documentation, that historic properties are not anticipated to be present in accordance with HAR § 13-276-4(b). This portion of the project area extends from E. Waiko Road to the northern terminus of the project area at the Kehalani WWPS, which is a portion of the parcel utilized as a detention basin for the Kehalani Community. Additional documentation is anticipated to include observation and reporting of geotechnical testing, mapping the location of existing utilities and past land

disturbance, mapping of previous AIS testing or monitoring locations, and further assessment of the stratigraphy and findings documented in previous archaeological studies.

Future Footprint of Wai‘ale Road Extension

The Wai‘ale Road Extension Project is a separate County project that was submitted to the SHPD for initial HRS 6E-8 review in April 2023 (HICRIS 2023PR00443). In their June 28, 2023 Chapter 6E-8 historic preservation review letter (Doc. No.: 2306AM15), the SHPD concurred with the completion of a AIS with a subsurface testing component for the project. On November 8, 2023, CSH submitted an AIS testing strategy document for the project that proposes the excavation of 60 AIS test excavations and ten GPR survey transects in order to supplement a previous AIS that included 25 AIS test excavations within the road extension footprint (Perzinski and Dega 2010). For convenience, the Wai‘ale Road Extension Project AIS testing strategy can be accessed here: Wai‘ale Road Extension Project AIS Testing Strategy. The SHPD accepted the Wai‘ale Road Extension Project AIS testing strategy on February 2, 2024 via HICRIS comment and this fieldwork is tentatively scheduled to begin in late April 2024.

Since the Wai‘ale Road Extension Project and Central Maui WWRF Project share the same footprint, the results of the subsurface testing conducted as part of the Wai‘ale Road Extension Project AIS will be included in the Central Maui WWRF Project AIS.

Central Maui WWRF Footprint and Connection

Focused non-invasive archaeological investigation and subsequent archaeological testing are recommended within the footprint of the Central Maui WWRF (located in the County of Maui baseyard along Kuihelani Highway) and the utility corridor that extends from the Central Maui WWRF facility west to the proposed Wai‘ale Road extension corridor. These portions of the project area are located within Puuone and Jaucas sand deposits and have not been subject to archaeological testing.

As part of the AIS, CSH proposes to complete an initial GPR survey of selected transects within portions of the WWRF footprint and connection in an effort to increase survey coverage throughout the project area without further increasing the amount of invasive testing. CSH proposes to complete eight GPR transects (GPR 1 through GPR 8) that each measure 100.0 m long by 1.0 m wide (Figure 2 and Figure 3). The findings of the GPR survey may prompt some exploratory excavation of GPR anomaly locations in an effort to identify historic properties. The results of the GPR survey and any related exploratory testing will be presented within the draft AIS report.

To provide overall coverage of this area, CSH proposes a systematic grided pattern sampling strategy that will include 90 AIS test excavations (see Figure 2 and Figure 3). Trenches will measure approximately 6.0 m (20 ft) long by 0.8 m (3 ft) wide and will extend to culturally sterile sediment layers or bedrock, unless prohibited by safety concerns.

Fieldwork will be directed by CSH principal investigator and qualified osteologist, Josephine Yucha, M.S. along with a field crew of 2-3 archaeologists. A backhoe contractor will be used to slowly excavate and backfill each trench. If sand deposits or other potentially significant deposits are encountered, these deposits will be excavated in 6-inch lifts with short draws using the backhoe in order to minimize any potential disturbance to subsurface historic properties.

A review of previous archaeological studies in the vicinity of the project area indicates that potential near-surface and subsurface historic properties in the region have included historic artifact scatters on the surface of agricultural soils (SIHP # 50-50-04-07884), garden plots within agricultural soils (features of SIHP # 50-50-04-02020 and -02024), and human burials primarily associated with sand deposits (SIHP # 50-50-04-05504 and -06226). If subsurface potential historic properties or significant deposits are encountered, they will be exposed using hand excavation and any sediment matrix associated with the historic property will be screened through 1/8$^{th}$ inch wire mesh.

In summary, the AIS for the proposed Central Maui WWRF will include additional documentation of previous land disturbance within the active corridor of Wai‘ale Road, the documentation of the 60 AIS test excavations and ten GPR transects that will be conducted for the Wai‘ale Road Extension Project, and the documentation of 90 AIS test excavations and eight GPR survey transects that will occur within the Central Maui WWRF footprint.

**Documentation of Subsurface Historic Properties**

Documentation of each excavation will include the recordation of soils, a stratigraphic profile of the entire length of the excavation, photographs, and sub-meter accurate GPS location.

If non-burial subsurface historic properties are identified, then CSH will document these historic properties in accordance with HAR §13-276-5(d) and other pertinent law. Archaeological historic properties and/or cultural deposits that are encountered require specific documentation including written descriptions and recording their geographic location with a GPS and plotting them on project area maps. Documentation may include, as appropriate, section drawings and stratigraphic profile maps, plan view maps, and photographs. Required analysis of located archaeological historic properties (or potential archaeological historic properties) may include any or all of the following:

- Analysis of recovered artifacts and midden from traditional Hawaiian deposits;
- Analysis of historic artifacts from historic-era deposits; and
- Radiocarbon dating of samples from cultural contexts.

Collected samples will be identified, catalogued, and analyzed in CSH’s laboratory facilities in Wailuku, Maui, and the results will be documented in the project’s AIS report.

If non-burial subsurface historic properties are identified, then CSH will document these historic properties in accordance with HAR 13-276-5(d) and other pertinent law. If human skeletal remains are identified, they will be treated as previously identified finds. CSH will stop work, notify the SHPD and representatives of the Maui/Lāna‘i Islands Burial Council (MLIBC), and ensure that the remains are secured in place and maintained, so as not be impacted by human activity or by natural weather events pending an MLIBC treatment determination.

Following each excavation, the area will be backfilled, compacted, and restored to near original condition. At the conclusion of fieldwork, CSH will prepare and submit a draft AIS report for the review and acceptance of the SHPD.

If you have any questions or comments regarding this strategy, please feel free to call me at (808) 242-9882 on Maui or toll free at 1-800-599-9962. You may also reach me by e-mail at tyucha@culturalsurveys.com.

Sincerely,

Trevor Yucha

Cultural Surveys Hawai‘i, Inc.

To: SHPD **Page 7**

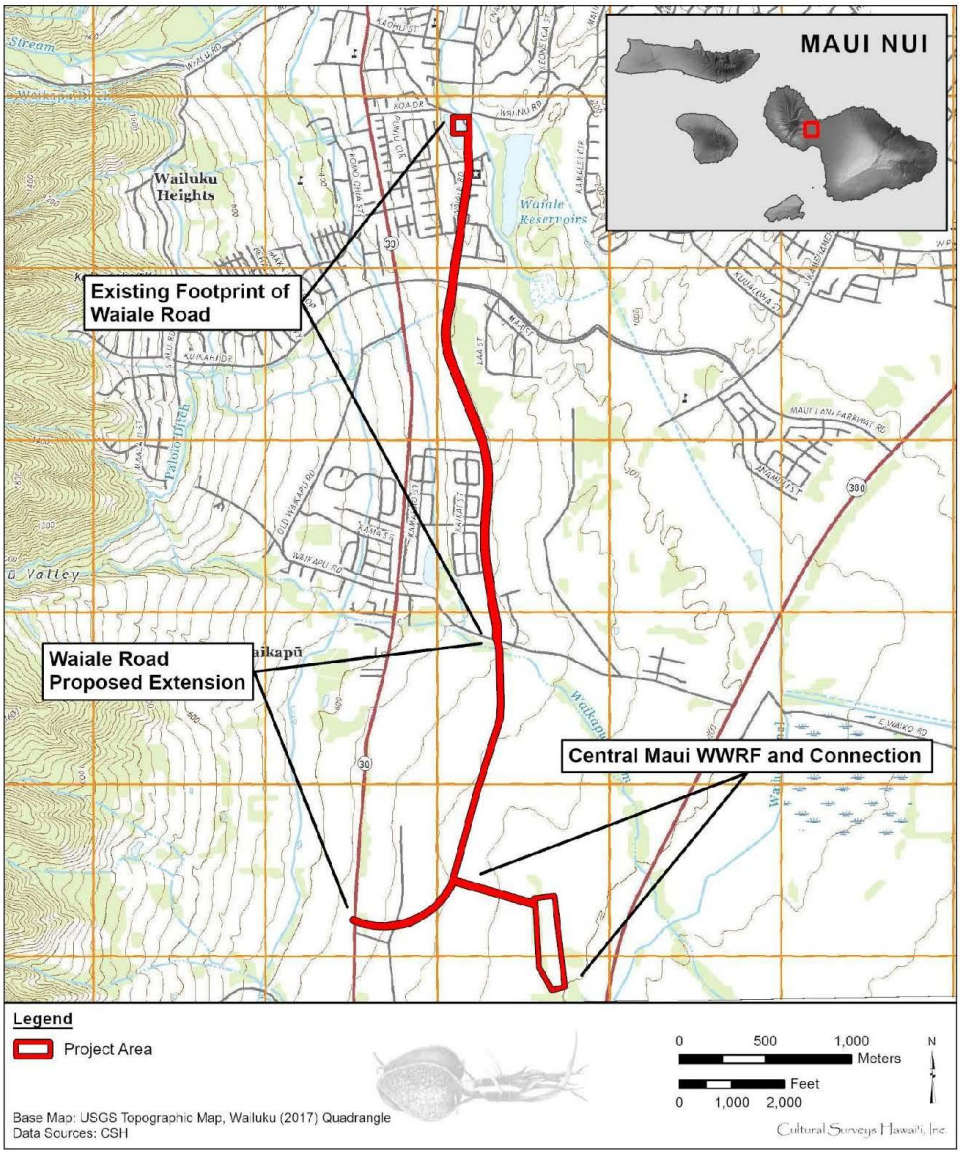



Figure 1. Portion of the 2017 Wailuku U.S. Geological Survey 7.5-Minute Topographic Quadrangles depicting the location of the current project area

Re: Central Maui Wastewater Reclamation Facility Project

CULTURAL SURVEYS HAWAI'I

To: SHPD **Page 8**

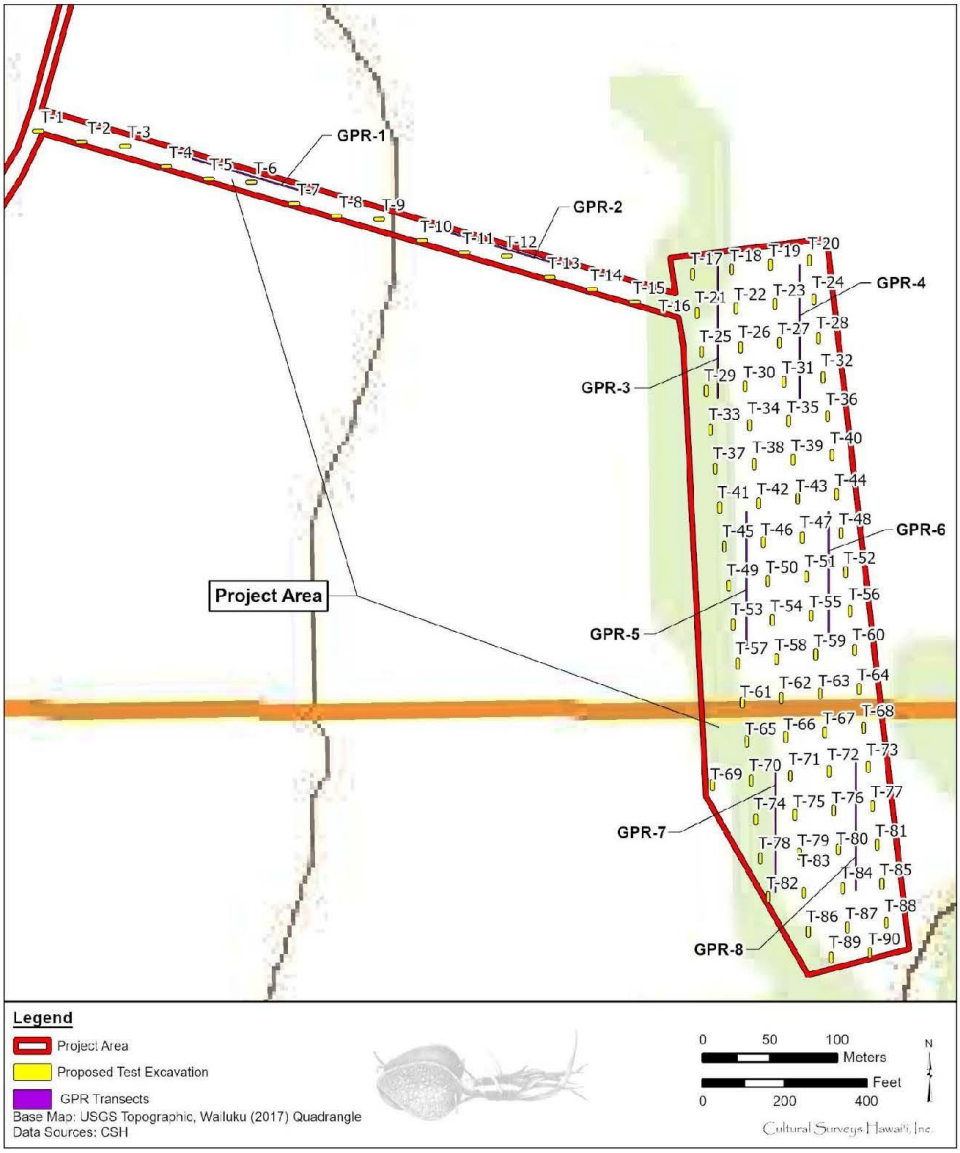



Figure 2. Portion of the 2017 Wailuku U.S. Geological Survey 7.5-Minute Topographic Quadrangle depicting the proposed location of 90 AIS test excavations (yellow) and eight GPR transects (purple) within the Central Maui WWRF footprint (red)

Re: Central Maui Wastewater Reclamation Facility Project

CULTURAL SURVEYS HAWAI'I

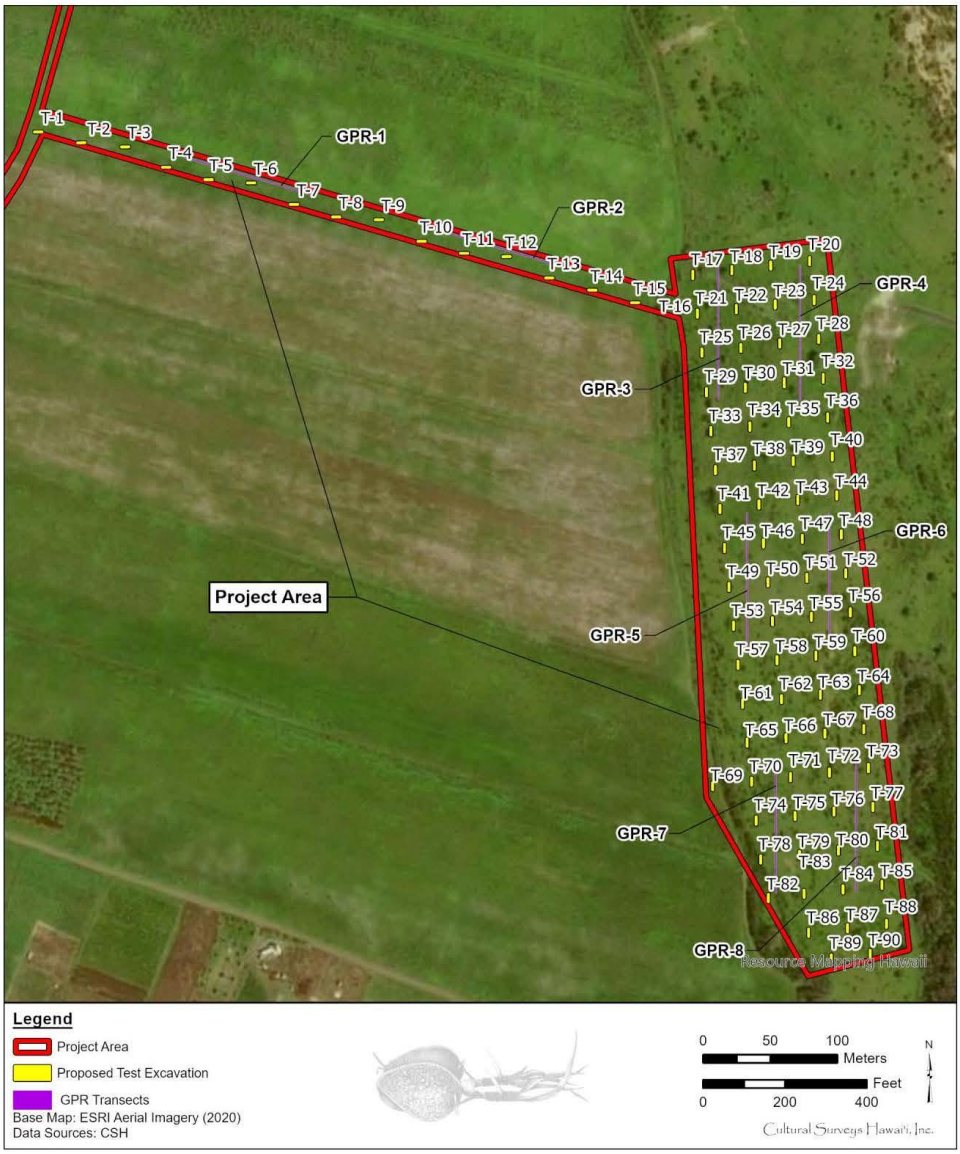



Figure 3. 2020 aerial photograph depicting the proposed location of 90 AIS test excavations (yellow) and eight GPR transects (purple) within the Central Maui WWRF footprint (red)

Re: Central Maui Wastewater Reclamation Facility Project

CULTURAL SURVEYS HAWAI'I

## A.2 SHPD Review Comments Regarding AIS Fieldwork Strategy

Iolani Kauhane
03/25/2024
2023PR01312

**SHPD Comments:** *Consultation for Archaeological Inventory Survey Fieldwork Strategy for the Central Maui Wastewater Reclamation Facility Project, Waikapū and Wailuku Ahupua‘a, Pū‘ali Komohana District, Maui, TMKs: [2] 3-5-001:017 por. and 120 por., [2] 3-5-002:014 por., [2] 3-5-020:036 por., [2] 3-6-002:003 por. and 004 por., [2] 3-8-005:023 por., Wai‘ale Road Right-of-Way, Waiko Road Right-of-Way, and Waikapū Stream*

Pedestrian Inspection

- Provide a documentation method regarding the identified historic properties within the project area specifically SIHP # -06668 and CSH 4.

Existing Footprint of Wai‘ale Road and Kehalani WWPS Site

- “additional documentation of previous land disturbance, stratigraphy, previous AIS test locations, and previous findings within the existing corridor of Wai‘ale Road will be conducted as part of the AIS in order to provide “supportive evidence documenting any land altering activities and the likely nature and depth of historic properties that may have once existed in the area” in accordance with HAR §13-275-5 and, where feasible, to provide ‘supportive documentation, that historic properties are not anticipated to be present in accordance with HAR § 13-276-4(b).’”
    a. Can this section be surveyed by GPR to identified anomalies that may be possible burials?

Central Maui WWRF Footprint and Connection

- Clarify your method on the following “CSH proposes to conduct GPR survey at selected and accessible locations”. Describe how this will be decided, will this be decided in the field?
- Provide the size of the backhoe trenches (L x W x D). SHPD recommends the testing be conducted to sterile soils or bedrock.
- Are trenches T-1 through 16 aligned with the proposed pipeline? If not, please align the test trenches with the proposed alignment. Will the pipeline be in the middle of the road or along it?
- Describe what other potentially significant deposits could be encountered. SHPD also recommends doing short draws along with 6-inch lifts.
- Provide method on encountering potential historic properties and significant deposits. SHPD recommends manual excavations be conducted and screening.
-

Documentation of Subsurface Historic Properties

- Include plan view maps will be produced
- Include the human skeletal remains will also be secured in place, maintained, and ensured it will not be impacted by human activity or by natural weather events.

## A.3 SHPD Email Excerpt Approving AIS Fieldwork Strategy

**From:** Kauhane, Iolani K
**To:** Trevor Yucha
**Cc:** Lebo, Susan A
**Subject:** Re: 2023PR01312 AIS Fieldwork Strategy for Central Maui Wastewater Reclamation Facility
**Date:** Monday, May 6, 2024 9:12:49 AM

Aloha mai,

I apologize for the delay. SHPD agrees to the revised AIS testing strategy and that the AIS fieldwork may proceed.

SHPD requests written notification via email and HICRIS at the start of the AIS fieldwork. Within 30 days of completion of the AIS fieldwork, SHPD looks forward to receiving for review a brief archaeological end-of-fieldwork letter report summarizing the findings as specified in HAR §13-282-3(f)(1). Subsequently, SHPD looks forward to receipt of an AIS report meeting the requirements of HAR §13-276-5 for review and acceptance.

Mahalo

'Iolani Kauhane
Maui Island Archaeologist III
State Historic Preservation Division
Department of Land and Natural Resources
40 Po'okela Street
Hilo, HI 96720
(808) 694-9435

SHPD initiated "I MUA MONDAYS" in April 2019. Every Monday, SHPD is closed to the public, allowing staff to focus exclusively on project reviews. Staff will not accept meetings, phone calls, emails, or "walk-ins" on Mondays. The SHPD Library will be closed to the public. This policy has been approved at the highest levels of the Administration.

## A.4 HICRIS Comment Approving AIS Fieldwork Strategy



Having trouble in HICRIS? We recommend using Chrome, Firefox, or Edge web browsers for the best user experience.

HICRIS Home Submit Search Version 1.2.1

RESPONSE Central Maui Wastewater Reclamation Facility related off-site improvements ...

2023PR01312.004
Project Review

Submission Details

**Submission Type**
Requested

**Submission Description**
SHPD agrees to the revised AIS testing strategy and that the AIS fieldwork may proceed. SHPD requests written notification via email and HICRIS at the start of the AIS fieldwork. Within 30 days of completion of the AIS fieldwork, SHPD looks forward to receiving for review a brief archaeological end-of-fieldwork letter report summarizing the findings as specified in HAR §13-282-3(f)(1). Subsequently, SHPD looks forward to receipt of an AIS report meeting the requirements of HAR §13-276-5 for review and acceptance.

**SHPD Requests**
0 has been processed, no open requests remaining

**SHPD Responses**
1

**Submitted By**
Trevor Yucha

**Closed By**
Iolani Kauhane

GO TO PROJECT

Status

**Submission Status**
Closed

**Status**
Over

**Submitted Date**
09/11/2024

**Closed Date**
10/02/2024

SHPD Requests

| Process | Status | Type | Submission | Description |
|---|---|---|---|---|
| No records have been added. Click the button above to begin adding. | | | | |

SHPD Requests: 0

SHPD Responses

| Status | Reviewer | Type | Decision | Assigned |
|---|---|---|---|---|
| Complete | Iolani Kauhane | Archaeology Branch | Requested Items Received | 09/13/2024 |

Reviews: 1

# Appendix B SIHP # 50-50-04-09168 Artifact Catalogue

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 4 | I | 0–23 | Aqua glass bottle, base (2) and body (5) fragments, round base, two-piece mold, tiny bubbles in glass, embossed "W" on base, embossed "WOR" partial on body fragment, Maui Soda Works bottle | 3.06–9.33 | 1.90–4.79 | 0.36–0.95 | 7 | 159.2 |
| 5 | I | 0–23 | Aqua glass bottle, finish and neck fragment, lightning stopper closure | 6.37 | 3.05 | 0.79 | 1 | 51.2 |
| 6 | I | 0–23 | Colorless glass bottle, finish and partial neck fragment, crown finish, crown cap closure, two-part mold lines | 5.16 | 2.9 | 0.63 | 1 | 25.8 |
| 7 | I | 0–23 | Cobalt blue bottle, finish and neck fragment, bead finish, two-part mold lines | 2.82 | 1.9 | 0.48 | 1 | 7.8 |
| 8 | I | 0–23 | Aqua glass bottle, base, heel to body fragment, square or rectangle base/bottle shape, internal domed center on base | 5.89 | 8.5 | 0.47 | 1 | 56 |
| 9 | I | 0–23 | Green glass bottle, neck fragment | 5.99 | 3.5 | 0.41 | 1 | 18 |
| 10 | I | 0–23 | Aqua blue glass, jar or bottle body fragment | 3.16 | 4.14 | 0.51 | 1 | 11.4 |
| 11 | I | 0–23 | Lavender (amethyst) glass bottle, body fragment | 3.76 | 4.63 | 0.56 | 1 | 13.4 |
| 12 | I | 0–23 | Colorless glass bottle, shoulder fragment | 3.02 | 3.07 | 0.65 | 1 | 12.6 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 13 | I | 0–23 | Light aqua blue glass bottle, body fragment (3) | 2.29–4.97 | 1.29–3.17 | 0.35–0.52 | 3 | 18.2 |
| 14 | I | 0–23 | Light aqua green glass, bottle, body fragment, one seam mark | 4.67 | 2.85 | 0.53 | 1 | 9 |
| 15 | I | 0–23 | Light aqua green glass, bottle (?) body fragment | 4.23 | 1.66 | 0.34 | 1 | 4.6 |
| 16 | I | 0–23 | Very light aqua glass, unknown fragment | 3.11 | 1.41 | 0.74 | 1 | 4.8 |
| 17 | I | 0–23 | Amber glass bottle body fragment, mold seam present | 3.02 | 2.29 | 0.36 | 1 | 4 |
| 18 | I | 0–23 | Colorless glass bottle body fragment, mold seam present | 2 | 2.19 | 0.31 | 1 | 1.8 |
| 19 | I | 0–23 | Colorless glass unknown fragments (3) | 1.89–3.21 | 0.94–1.24 | 0.37–0.61 | 3 | 3.8 |
| 20 | I | 0–23 | Whiteware, holloware, base, foot, cheek and body fragments, 3 articulated pieces, transparent glaze, underglaze blue botanical hand painted design exterior, teacup | 6.74 | 6.05 | 0.6 | 3 | 113 |
| 21 | I | 0–23 | Whiteware, holloware, rim and body fragment, transparent glaze, no design on fragment | 5.4 | 6.17 | 0.52 | 1 | 16.8 |
| 22 | I | 0–23 | Whiteware, holloware, rim to body fragments (3), transparent glaze, underglaze blue transfer print botanical design on exterior | 3.94 | 8.56 | 0.81 | 3 | 23.8 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 23 | I | 0–23 | Whiteware, holloware, body fragment, transparent glaze, underglaze blue transfer print design on exterior | 3.55 | 3.44 | 0.42 | 1 | 9.8 |
| 24 | I | 0–23 | Whiteware, holloware, body fragment, transparent glaze, underglaze blue transfer print design on exterior | 3.49 | 3.2 | 0.61 | 1 | 9.6 |
| 25 | I | 0–23 | Whiteware, holloware, rim to body fragment, transparent glaze, underglaze blue transfer print design on exterior | 3.12 | 3.93 | 0.29 | 1 | 4.6 |
| 26 | I | 0–23 | Whiteware, holloware, rim to body fragment, transparent glaze, underglaze blue transfer print design on exterior | 1.81 | 3.25 | 0.28 | 1 | 2.8 |
| 27 | I | 0–23 | Whiteware, tableware, articulated foot to base fragments (2), transparent glaze, underglaze blue makers mark design on base, "Made in Japan" with a lotus flower or rising sun design | 1.22 | 2.88 | 0.54 | 2 | 12.6 |
| 28 | I | 0–23 | Whiteware, holloware, body fragment, transparent glaze, underglaze blue transfer botanical print on interior, light blue hand painted lines on exterior | 2.7 | 2.36 | 0.64 | 1 | 5.8 |
| 29 | I | 0–23 | Whiteware, tableware, body fragment, transparent glaze, underglaze blue transfer print architectural design interior, unknown design exterior | 1.81 | 1.65 | 0.34 | 1 | 2 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 30 | I | 0–23 | Whiteware, tableware, body fragment, transparent glaze, unglaze blue hand painted print unknown design exterior | 2.14 | 1.44 | 0.38 | 1 | 1.8 |
| 31 | I | 0–23 | Whiteware, holloware, body fragment, transparent glaze, underglaze blue flow transfer print unknown design exterior | 2.13 | 1.45 | 0.26 | 1 | 1.2 |
| 32 | I | 0–23 | Whiteware, holloware, body fragments, transparent glaze, underglaze blue transfer print bamboo/botanical design exterior | 1 | 1.73 | 0.31 | 2 | 2.4 |
| 33 | I | 0–23 | Refined earthenware, tableware, body fragments (1), transparent glaze, underglaze grey, blue hand painted unknown design exterior, orange peel texture on interior | 2.04 | 2 | 0.4 | 1 | 8.8 |
| 34 | I | 0–23 | Refined earthenware, tableware, body fragments (2), transparent glaze | 3.88 | 2.17 | 0.51 | 2 | 16.8 |
| 35 | I | 0–23 | Stoneware, vessel, body fragment, brown glaze interior and exterior | 1.57 | 1.74 | 0.44 | 1 | 1.8 |
| 36 | I | 0–23 | Whiteware, tableware, body fragment (5), rim fragment (1), base or marly fragments (3), transparent glaze | 1.66–4.17 | 1.27–3.84 | 0.32–0.49 | 9 | 40.2 |
| 37 | I | 0–23 | Whiteware, tableware, body fragment (3), rim fragment (1), greyish transparent glaze | 1.48–2.81 | 1.23–2.09 | 0.17–0.32 | 4 | 6.4 |
| 38 | I | 0–23 | Whiteware, tableware, body fragment (3), greyish transparent glaze | 1.85–3.58 | 1.04–2.37 | 0.26–0.54 | 3 | 10.8 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 39 | I | 0–23 | Rusted, corroded flat metal fragments (3), unknown object | 10.61 | 3.94 | 0.61 | 3 | 81 |
| 40 | I | 0–23 | Rusted, corroded bent wire, unknown use | 7.34 | 3.82 | 0.45 | 2 | 30.6 |
| 41 | I | 0–23 | Rusted, corroded metal latch, hook portion | 3.07 | 1.63 | 0.36 | 1 | 2 |
| 42 | III | 37–122 | Rusted, corroded metal tool, unknown use | 23 | 14.5 | 6.18 | 1 | 1494.6 |
| 43 | III | 37–122 | Rusted, corroded metal tool, unknown use | 24.5 | 6.23 | 4.27 | 1 | 824.2 |
| 85 | III | 37–122 | Cobalt blue glass bottle fragment, body fragment, portion of a 6- or 8- sided bottle, embossed with Asian writing, last two characters translate to "medicine" | 2.57 | 1.91 | 0.22 | 1 | 1.8 |
| 86 | III | 37–122 | Cobalt blue glass bottle fragment, body fragment, portion is round | 1.33 | 1.63 | 0.12 | 1 | 0.4 |
| 87 | III | 37–122 | Cobalt blue glass bottle fragment, body fragment | 1.11 | 1.02 | 0.26 | 1 | 0.4 |
| 88 | III | 37–122 | Aqua green, glass bottle fragment, curved body fragment | 3.14 | 2.93 | 0.43 | 1 | 5.8 |
| 89 | III | 37–122 | Aqua blue, glass bottle fragments (17), lip to neck fragment (2), base to heel fragments (2), neck fragments (2), body fragments (8), lightning-type closure | 1.71–5.76 | 1.37–4.00 | 0.23–0.53 | 31 | 169.2 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 90 | III | 37–122 | Light aqua, glass bottle fragments (10), lip fragment (1), base to body fragment (1), body fragments (8), blob finish, embossing on body fragments; "AWORKS" and "MAU" and "KS" (3 fragments), mold seam, small bubbles present | 1.88–9.36 | 1.20–5.59 | 0.26–0.94 | 10 | 245.6 |
| 91 | III | 37–122 | Light green, glass bottle body fragment, embossed "NET CON / 9 FLUID O" | 6.76 | 4.82 | 0.47 | 1 | 36.4 |
| 92 | III | 37–122 | Aqua, glass bottle body fragments (10), lip to neck fragments (2), neck fragments (2), neck to shoulder (1), body fragments (4), body to heel fragment (1) | 2.13–6.08 | 1.78–4.43 | 0.34–0.60 | 10 | 134.8 |
| 93 | III | 37–122 | Aqua, glass bottle fragments (2), lip to neck fragments (1), base to heel fragments (1) | 3.75–5.65 | 2.21–2.85 | 0.47–0.91 | 2 | 40.4 |
| 94 | III | 37–122 | Aqua, glass bottle, base fragment | 5.89 | 1.5 | 1.1 | 1 | 14.4 |
| 95 | III | 37–122 | Aqua, glass bottle, body fragment, embossed "HON" on body fragment | 2.69 | 3.27 | 0.36 | 1 | 4.8 |
| 96 | III | 37–122 | Aqua, glass bottle, body fragment, possibly rectangular shaped bottle, embossed "I" on body fragment | 3.19 | 2.44 | 0.6 | 1 | 7.2 |
| 97 | III | 37–122 | Aqua green, glass body fragment | 2.48 | 2.34 | 0.42 | 1 | 4.4 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 98 | III | 37–122 | Aqua glass base, heel to body fragment (1), body fragment (1), rectangle shape, flat sides | 8.17 | 7.68 | 2.62 | 1 | 63.2 |
| 99 | III | 37–122 | Milk glass, body fragment | 1.21 | 1.04 | 0.41 | 1 | 0.6 |
| 100 | III | 37–122 | Colorless glass, base to heel fragment, round base, beaded pattern along interior base | 7.19 | 3.24 | 1.71 | 1 | 32 |
| 101 | III | 37–122 | Colorless glass, rim to body fragment, decorative scalloped rim, unknown use | 3.44 | 1.63 | 0.36 | 1 | 2.4 |
| 128 | III | 37–122 | Whiteware, holloware, foot to body fragments, transparent glaze, underglaze (polychrome) blue and pink botanical transfer print design on exterior, refits with Acc. # 298 | 6.68 | 1.52–4.03 | 0.26–0.82 | 4 | 29.8 |
| 129 | III | 37–122 | Whiteware, holloware, heel to body fragments (3), transparent glaze, underglaze (polychrome) blue and green floral transfer print design on exterior | 1.43–3.21 | 1.20–3.84 | 0.32–0.88 | 3 | 15.2 |
| 130 | III | 37–122 | Whiteware, holloware, rim to body fragments, 2 articulated pieces, transparent glaze, underglaze, blue geometric and floral print transfer print design on exterior | 4.33 | 5.65 | 0.49 | 2 | 9.2 |
| 131 | III | 37–122 | Whiteware, holloware, foot to body fragment, transparent glaze, underglaze, (polychrome) blue and brown, hand painted geometric print design on exterior | 4.34 | 2.48 | 0.81 | 1 | 8.4 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 132 | III | 37–122 | Whiteware, flatware, foot to marly fragment, transparent glaze, underglaze, blue and white transfer print, landscape print design | 8.78 | 5.88 | 1.13 | 1 | 46.8 |
| 133 | III | 37–122 | Whiteware, holloware, heel to body fragment, transparent glaze, underglaze, blue, green, and white hand painted vertical line print design | 4.98 | 4.28 | 1.28 | 1 | 32.4 |
| 134 | III | 37–122 | Whiteware, holloware, rim to body fragment, transparent glaze, underglaze, blue hand painted geometric line print design | 3.51 | 2.73 | 0.41 | 1 | 6.8 |
| 135 | III | 37–122 | Whiteware, holloware, foot to body fragment, transparent glaze, underglaze blue transfer print design on exterior | 2.52 | 3.14 | 1.12 | 1 | 8 |
| 136 | III | 37–122 | Whiteware, holloware, articulated rim to body fragments (2), transparent glaze, underglaze blue transfer print monstera design on exterior | 2.74 | 6.81 | 0.33 | 2 | 6.6 |
| 137 | III | 37–122 | Whiteware, tableware, body fragment, transparent glaze, underglaze, blue unknown print design on exterior | 1.84 | 3.14 | 0.53 | 1 | 2.8 |
| 138 | III | 37–122 | Whiteware, holloware, rim fragment, transparent glaze, underglaze blue geometric transfer print design on exterior, double horizontal lines on interior | 1.69 | 3 | 0.36 | 1 | 2.4 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 139 | III | 37–122 | Whiteware, holloware, body fragment, transparent glaze, underglaze blue botanical print design on exterior | 2.46 | 2.47 | 0.35 | 1 | 2.8 |
| 140 | III | 37–122 | Whiteware, flatware, base fragment, transparent glaze, underglaze blue botanical transfer print design on interior | 5.2 | 2.52 | 0.72 | 1 | 8.4 |
| 141 | III | 37–122 | Whiteware, holloware, body fragment, transparent glaze, underglaze blue stripe hand painted print design on exterior, refits with Acc. #s 142, 168, 296, 307, 310 | 2.74 | 2.15 | 0.72 | 1 | 5.6 |
| 142 | III | 37–122 | Whiteware, holloware, body fragment, transparent glaze, underglaze blue stripe print design on exterior, refits with Acc. #s 141, 168, 296, 307, 310 | 2.1 | 2.45 | 0.66 | 1 | 4.4 |
| 143 | III | 37–122 | Whiteware, holloware, base, foot, heel and body fragment, transparent glaze, underglaze blue geometric and striped design on exterior | 4.65 | 4.84 | 1.04 | 1 | 36 |
| 144 | III | 37–122 | Whiteware, holloware, rim to body fragments (5), 3 articulated pieces, transparent glaze, underglaze blue square geometric and green banded stripes design on exterior | 4.57 | 8.65 | 0.4 | 5 | 17.8 |
| 145 | III | 37–122 | Whiteware, tableware, rim to body fragments (4), transparent glaze, underglaze blue and brown botanic design on interior | 5.08 | 7.47 | 0.83 | 4 | 46.4 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 146 | III | 37–122 | Whiteware, holloware, body fragment, transparent glaze, underglaze blue botanical design on exterior | 1.95 | 2.66 | 0.44 | 1 | 3 |
| 147 | III | 37–122 | Whiteware, tableware, body fragments (5) and rim fragments (2), transparent glaze, underglaze blue botanical designs on exterior, mixed vessels | 2.25 | 1.62 | 0.35 | 7 | 8 |
| 148 | III | 37–122 | Whiteware, ceramicware, body fragment, transparent glaze, underglaze blue unknown flow blue design on exterior | 4.63 | 3.83 | 0.37 | 1 | 6.8 |
| 149 | III | 37–122 | Whiteware, ceramicware, body fragment, transparent glaze, underglaze blue unknown flow blue design on exterior | 3.58 | 2.93 | 0.7 | 1 | 8 |
| 150 | III | 37–122 | Whiteware, holloware, body fragment, transparent glaze, underglaze blue unknown design on exterior | 2.53 | 2.77 | 0.43 | 1 | 3.2 |
| 151 | III | 37–122 | Whiteware, holloware, foot to heel fragment, transparent glaze, underglaze blue transfer print botanical design on exterior, cup or bowl | 1.47 | 2.86 | 0.82 | 1 | 7.8 |
| 152 | III | 37–122 | Whiteware, holloware, heel fragments (3), 2 articulating pieces, transparent glaze, underglaze flow blue geometric design on exterior, refits with Acc. # 297 | 3.05 | 3.59 | 1.57 | 3 | 14.2 |
| 153 | III | 37–122 | Whiteware, holloware, rim fragments. 2 articulating pieces, transparent glaze, underglaze blue on interior and exterior, botanic transfer print design on exterior | 1.27 | 3.14 | 0.33 | 2 | 1.4 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 154 | III | 37–122 | Whiteware, holloware, rim fragment (1), body fragments (4), transparent glaze, underglaze flow blue on exterior | 3.04 | 2.47 | 0.41 | 5 | 6.2 |
| 155 | III | 37–122 | Whiteware, holloware, body fragments (2), transparent glaze, underglaze flow blue on exterior | 3.68 | 3.14 | 0.6 | 2 | 8.6 |
| 156 | III | 37–122 | Whiteware, holloware, body fragment, transparent glaze, underglaze blue hand painted design on exterior | 2.39 | 0.98 | 0.51 | 1 | 2 |
| 157 | III | 37–122 | Whiteware, tableware, 2 rim fragments, transparent glaze, underglaze blue hand painted design on exterior, blue and brown geometric design on rip lip | 4.47 | 6.77 | 0.95 | 2 | 42.6 |
| 158 | III | 37–122 | Whiteware, holloware, rim fragment, transparent glaze, underglaze blue hand painted design along exterior edge, blue geometric design on body | 1.15 | 0.98 | 0.32 | 1 | 0.6 |
| 159 | III | 37–122 | Whiteware, tableware, rim fragment, and body fragment, transparent glaze, underglaze blue hand painted geometric design along edge, blue stripe on the other side, refits with Acc. #s 170 snd 306 | 1.73 | 2.77 | 0.93 | 2 | 5.8 |
| 160 | III | 37–122 | Whiteware, hollowware, foot heel fragment, transparent glaze, underglaze blue unknown design on the exterior | 1.73 | 2.83 | 0.78 | 1 | 4.4 |
| 161 | III | 37–122 | Whiteware, hollowware, body fragment, transparent glaze, underglaze blue unknown design on the exterior | 2.07 | 2.42 | 0.48 | 1 | 3 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 162 | III | 37–122 | Whiteware, hollowware, rim fragment, transparent glaze, underglaze blue botanical design on the interior | 1.6 | 2.65 | 0.47 | 1 | 2.6 |
| 163 | III | 37–122 | Whiteware, hollowware, body fragment, transparent glaze, underglaze blue and green botanical design on the exterior | 3.56 | 3.38 | 0.66 | 1 | 6.6 |
| 164 | III | 37–122 | Whiteware, hollowware, foot to body fragment, transparent glaze, underglaze blue botanical transfer print design on the exterior | 4.21 | 4.19 | 1.11 | 1 | 17 |
| 165 | III | 37–122 | Whiteware, hollowware, body fragment, transparent glaze, underglaze green double stripe, flow blue design on the exterior | 3.04 | 2.28 | 0.7 | 1 | 4.4 |
| 166 | III | 37–122 | Whiteware, hollowware, body fragment, transparent glaze, underglaze unknown blue design on the exterior | 2.7 | 2.29 | 0.47 | 1 | 4.2 |
| 167 | III | 37–122 | Whiteware, hollowware, body fragment, transparent glaze, underglaze bamboo blue design on the exterior | 3.44 | 3.87 | 0.34 | 1 | 5.8 |
| 168 | III | 37–122 | Whiteware, hollowware, foot and heel fragments, 4 articulated pieces, transparent glaze, underglaze flow blue on interior, three blue stripes on the exterior, refits with Acc. #s 141, 142, 296, 307, 310 | 4.68 | 6.86 | 1.94 | 4 | 123.6 |
| 169 | III | 37–122 | Whiteware, tableware, 3 rim fragments, transparent glaze, underglaze blue unknown design, brown scalloped rim | 3.12 | 4.36 | 0.52 | 3 | 23.4 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 170 | III | 37–122 | Whiteware, tableware, body fragments (2), transparent glaze, underglaze blue unknown design on interior, blue feather design on exterior, refits with Acc. #s 159 and 306 | 2.36 | 1.96 | 0.9 | 2 | 6.2 |
| 171 | III | 37–122 | Whiteware, holloware, foot to heel fragment, transparent glaze, underglaze no design, partial makers mark on base | 4.22 | 2.79 | 1.36 | 1 | 11.4 |
| 172 | III | 37–122 | Whiteware, holloware, one rim, 2 body fragments, transparent glaze, underglaze very partial unknown designs | 1.99 | 2.62 | 0.46 | 3 | 8.2 |
| 173 | III | 37–122 | Whiteware, holloware, two rim fragments, transparent glaze, underglaze grayish with hand painted blue geometric design | 2.4 | 2.66 | 0.43 | 2 | 4.8 |
| 174 | III | 37–122 | Whiteware, holloware, one rim fragment, one body fragment, transparent glaze, underglaze grayish with hand painted blue geometric design on exterior | 2.31 | 2.84 | 0.36 | 2 | 4.8 |
| 175 | III | 37–122 | Whiteware, holloware, foot to body fragment (1), and body fragments (2), transparent glaze, underglaze grayish with hand painted blue geometric design on exterior | 4.35 | 6.77 | 2.58 | 3 | 41.4 |
| 176 | III | 37–122 | Whiteware, holloware, foot to body fragment, transparent glaze, underglaze blue transfer print botanical design on exterior | 4.69 | 3.67 | 1.9 | 1 | 19.8 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 177 | III | 37–122 | Whiteware, holloware, foot to body fragment, transparent glaze, underglaze contains a slight fade blue unknown design on exterior | 3.82 | 4.43 | 1.87 | 1 | 23.4 |
| 178 | III | 37–122 | Whiteware, holloware, foot to heel fragment, transparent glaze | 4.99 | 4.62 | 1.38 | 1 | 20.2 |
| 179 | III | 37–122 | Whiteware, holloware, foot, base, to heel fragment, transparent glaze, underglaze hand painted green and white botanical design on interior fragment | 5.42 | 3.87 | 1.07 | 1 | 16.4 |
| 180 | III | 37–122 | Whiteware, holloware, rim fragments (2), transparent glaze, underglaze gray with gray hand painted unknown design on exterior | 2.4 | 3.1 | 0.36 | 2 | 4.4 |
| 181 | III | 37–122 | Whiteware, holloware, rim fragment, transparent glaze, underglaze blue unknown design on exterior | 2.51 | 2.15 | 0.39 | 1 | 3.8 |
| 182 | III | 37–122 | Whiteware, flatware, rim fragment, transparent glaze, underglaze green and red linear stripes | 3.94 | 5.36 | 0.43 | 1 | 10 |
| 183 | III | 37–122 | Whiteware, flatware, foot fragment, transparent glaze, underglaze slight blue hand painted unknown design | 2.94 | 1.76 | 0.7 | 1 | 3.6 |
| 184 | III | 37–122 | Whiteware, holloware, body fragments (3), 2 articulated pieces, transparent glaze, underglaze black and pink stencil or transfer print design on exterior | 3.19 | 6 | 0.68 | 3 | 10.4 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 185 | III | 37–122 | Whiteware, tableware, body fragment with handle (2), articulated pieces, transparent glaze, underglaze unknown blue design | 2.41 | 1.78 | 0.81 | 2 | 5.6 |
| 186 | III | 37–122 | Whiteware, holloware, body fragment, transparent glaze, underglaze green botanical design on interior | 2.54 | 1.29 | 0.4 | 1 | 2 |
| 187 | III | 37–122 | Whiteware, holloware, body fragment, transparent glaze, underglaze green botanical design on exterior, blue lineal design on interior | 1.76 | 1.45 | 0.41 | 1 | 1.8 |
| 188 | III | 37–122 | Whiteware, holloware, foot to body fragment, transparent glaze, underglaze | 3.51 | 5.45 | 1.84 | 1 | 31.6 |
| 189 | III | 37–122 | Whiteware, holloware, rim and body fragments (2), transparent glaze, underglaze solid green on both sides | 1.51 | 1.52 | 0.31 | 2 | 2.2 |
| 190 | III | 37–122 | Porcelain, holloware, body fragments, transparent glaze, underglaze light green on both sides, high gloss | 1.86 | 1.92 | 0.32 | 1 | 2.2 |
| 191 | III | 37–122 | Porcelain, holloware, rim fragments (8), body fragments (6), and foot/base fragment, transparent glaze, underglaze high gloss | 2.83 | 4.49 | 1.21 | 15 | 28 |
| 192 | III | 37–122 | Refined earthenware, kitchenware, foot and base fragment, slight crackle transparent glaze | 2.49 | 4.66 | 1.36 | 1 | 7 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 193 | III | 37–122 | Refined earthenware, flatware, 16 articulated pieces of foot, base, marly and rim fragments, salt glaze, transparent glaze on top, no glaze on foot and base, Japanese or Chinese figure design | 13.35 | 13.35 | 1.59 | 16 | 134.2 |
| 194 | III | 37–122 | Refined earthenware, holloware, articulated base fragments (2), transparent glaze, cream color paste, no glaze on base, refits with Acc. # 318 | 1.51 | 3 | 0.86 | 2 | 4.8 |
| 195 | III | 37–122 | Stoneware, unknown vessel, base fragment, salt glaze, brown color paste, no glaze on base, refits with Acc. # 319 | 1.51 | 1.39 | 0.51 | 1 | 1.8 |
| 196 | III | 37–122 | Refined earthenware, holloware, articulating body fragments (2), transparent glaze, gray color paste | 2.45 | 3.79 | 0.36 | 2 | 4.4 |
| 197 | III | 37–122 | Whiteware, holloware, rim fragment, transparent glaze, underglaze green graphic design on exterior | 1.76 | 0.92 | 0.2 | 1 | 0.8 |
| 198 | III | 37–122 | Whiteware, tableware, body fragment, transparent glaze, underglaze orange sunburst design | 1.49 | 1.16 | 0.31 | 1 | 1 |
| 199 | III | 37–122 | Stoneware, common pottery (pot?), base fragment, transparent glaze, underglaze small blue smudge design, gray paste color | 5.49 | 3.9 | 0.83 | 1 | 19 |
| 200 | III | 37–122 | Refined stoneware, household pottery, base fragments (4), 2 articulated pieces, transparent glaze | 1.85 | 4.64 | 0.66 | 4 | 20.2 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 201 | III | 37–122 | Whiteware, holloware, base-foot-heel fragment, transparent glaze | 3.14 | 3.97 | 2.45 | 1 | 14.8 |
| 202 | III | 37–122 | Whiteware, tableware, base-foot-heel fragments (2), transparent glaze, remnant of blue stripe on one fragment | 3.96 | 1.48 | 0.9 | 2 | 6.6 |
| 203 | III | 37–122 | Various fragments of whiteware ceramic fragments | 1.26–3.22 | 0.87–2.75 | 0.22–0.49 | 16 | 36 |
| 204 | III | 37–122 | Various fragments of whiteware ceramic fragments | 1.85–4.37 | 1.35–3.49 | 0.28–0.47 | 8 | 33.6 |
| 205 | III | 37–122 | Various fragments of whiteware ceramic fragments | 1.15–9.11 | 0.81–5.81 | 0.31–0.60 | 42 | 190.8 |
| 206 | III | 37–122 | Light green glass bottle, base, heel to body fragment, square or rectangle base/bottle shape, internal domed center on base | 5.51 | 8.09 | 1.05 | 1 | 60 |
| 207 | III | 37–122 | Amethyst (lavender) glass rim and body fragments (3), probable drinking glass or decorative container | 4.69 | 3.6 | 0.41 | 3 | 19 |
| 208 | III | 37–122 | Dark green glass bottle, base to heel, and body fragments (2), partial embossing on base | 4.51 | 6.14 | 0.5 | 2 | 43.4 |
| 209 | III | 37–122 | Dark green glass bottle, base to heel, and body fragments (2) | 3.58 | 4 | 0.85 | 2 | 31.8 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 210 | III | 37–122 | Light green glass bottle, neck and finish, and body fragments (2) | 5 | 4.82 | 0.77 | 2 | 29.2 |
| 211 | III | 37–122 | Green glass bottle, body fragment, no embossing, no identifying marks | 7.56 | 4.87 | 0.7 | 1 | 40 |
| 212 | III | 37–122 | Green glass bottle, body fragment | 3.55 | 3.18 | 0.38 | 1 | 6.6 |
| 213 | III | 37–122 | Green glass bottle, body fragments (2) | 4.8 | 3.38 | 0.44 | 2 | 14 |
| 214 | III | 37–122 | Green glass bottle, body fragment | 3.68 | 2.57 | 0.33 | 1 | 5.8 |
| 215 | III | 37–122 | Amber (brown) glass bottle, 2 body fragments, 3 base fragments, two refit | 4.98 | 5.91 | 0.54 | 5 | 82 |
| 216 | III | 37–122 | Amber (brown) glass bottle, body fragments (4) | 2.74 | 4.98 | 0.27 | 4 | 11.4 |
| 217 | III | 37–122 | Amethyst (lavender) bottle glass, body fragment | 5.52 | 4.21 | 0.45 | 1 | 22.6 |
| 218 | III | 37–122 | Amethyst (lavender) bottle glass, body fragments (7) | 3.88 | 3.57 | 0.36 | 7 | 12.4 |
| 219 | III | 37–122 | Amethyst (lavender) bottle glass, body fragment | 3.53 | 2.24 | 0.83 | 1 | 7.4 |
| 220 | III | 37–122 | Light amethyst (lavender) bottle glass, finish, neck and shoulder fragment | 3.34 | 3.27 | 2.83 | 1 | 12.4 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 221 | III | 37–122 | Aqua bottle glass, finish, neck and shoulder fragment, vertical seam, crown closure finish | 14.92 | 4.07 | 0.71 | 1 | 106.8 |
| 222 | III | 37–122 | Amber (brown) bottle glass, finish portion, mineral finish fragment, no seam | 3.55 | 2.99 | 0.63 | 1 | 10.6 |
| 223 | III | 37–122 | Amber (brown) bottle glass, finish portion, mineral finish fragment, no seam | 2.12 | 2.82 | 0.73 | 1 | 9.8 |
| 224 | III | 37–122 | Amber (brown) bottle glass, finish portion, mineral finish fragment, horizontal seam around finish | 2.89 | 2.43 | 0.65 | 1 | 7.2 |
| 225 | III | 37–122 | Amber (brown) bottle glass, base fragments (2) | 2.09 | 3.72 | 0.59 | 2 | 9.2 |
| 226 | III | 37–122 | Amber (brown) bottle glass, body fragments (24), various fragments of indistinct brown bottle glass | 1.34–6.30 | 0.97–5.07 | 0.25–0.50 | 24 | 123.4 |
| 227 | III | 37–122 | Olive bottle glass, body fragment | 2.91 | 1.85 | 0.46 | 1 | 4 |
| 228 | III | 37–122 | Colorless glass bottle base, two articulated pieces, embossed "4" on base | 2.79 | 5.6 | 0.63 | 2 | 33.4 |
| 229 | III | 37–122 | Colorless glass, rim fragment, vertical ribbed design on the interior | 5.37 | 3.15 | 0.26 | 1 | 8.6 |
| 230 | III | 37–122 | Colorless glass (ink) bottle shoulder to finish, wide, flat finish, beveled shoulder, square shaped bottle, probable ink bottle | 2.52 | 4.36 | 0.65 | 1 | 26.8 |
| 231 | III | 37–122 | Colorless glass hurricane lantern rim and partial body fragment, ribboned rim | 3.63 | 3.7 | 0.28 | 1 | 5.6 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 232 | III | 37–122 | Colorless glass drinking cup rim and partial body fragment, beveled rim | 4.16 | 5.18 | 0.99 | 2 | 25.8 |
| 233 | III | 37–122 | Colorless glass unknown use or portion, rippled or "hammered" surface | 3.91 | 3.81 | 0.54 | 1 | 10.8 |
| 234 | III | 37–122 | Very light aqua glass bottle fragment, base and body fragments, small diameter bottle base, indented base pontil mark, size of bottle suggests medicinal or household use | 1.54 | 3.13 | 0.27 | 2 | 5.2 |
| 235 | III | 37–122 | Light aqua glass bottle, lip and finish portion, 2 articulated pieces, crown finish, vertical seam from finish to neck | 3.74 | 2.89 | 0.63 | 2 | 12.8 |
| 236 | III | 37–122 | Colorless glass bottle, threaded finish and partial neck | 3.97 | 2.72 | 0.53 | 1 | 7 |
| 237 | III | 37–122 | Colorless glass bottle, lip fragment, crown finish, vertical and horizontal mold seams, two refit pieces | 2.15 | 2.62 | 0.56 | 2 | 11.4 |
| 238 | III | 37–122 | Very light aqua bottle glass, body fragments, some with vertical seam, some tiny bubbles, all fragments from similar or same bottles, 35 fragments | 6.04 | 4.32 | 0.47 | 35 | 293.2 |
| 239 | III | 37–122 | Very light aqua bottle glass, base and body fragments, embossed ""I" on base and "OD" on body fragment, soda bottle | 4.28 | 4.54 | 0.75 | 3 | 32.8 |
| 240 | III | 37–122 | Very light aqua bottle glass, base and body fragments, mold seam on two fragments, soda bottle | 5.19 | 2.58 | 0.34 | 8 | 38.6 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 241 | III | 37–122 | Very light aqua, flat glass fragments, possible window glass | 4.52 | 3.59 | 0.22 | 4 | 17 |
| 242 | III | 37–122 | Colorless, flat glass fragments | 3.8 | 1.57 | 0.2 | 5 | 5.6 |
| 243 | III | 37–122 | Very light aqua bottle glass, base and heel fragment, embossed "17 5 8" | 3.2 | 2.72 | 0.76 | 1 | 16 |
| 244 | III | 37–122 | Colorless glass bottle fragment, base to body, and body fragments (2), square shaped bottle | 3.84 | 4.43 | 0.42 | 2 | 15.2 |
| 245 | III | 37–122 | Colorless glass bottle fragment, base fragment, stippled base edges, embossed "20" | 4.48 | 1.75 | 0.39 | 1 | 5.4 |
| 246 | III | 37–122 | Colorless glass bottle fragment, threaded finish fragment | 1.54 | 2.42 | 0.52 | 1 | 2.8 |
| 247 | III | 37–122 | Colorless glass fragments (2), beveled, body fragments | 2.53 | 1.7 | 0.34 | 2 | 3.6 |
| 248 | III | 37–122 | Aqua glass bottle base-heel fragment | 1.96 | 3.09 | 0.86 | 1 | 7 |
| 249 | III | 37–122 | Colorless glass bottle base fragment, pitted (orange peel) texture | 5.2 | 3.92 | 0.4 | 1 | 10.4 |
| 250 | III | 37–122 | Aqua glass bottle body fragment, embossed "NT" | 2.93 | 2.67 | 0.67 | 1 | 3.2 |
| 251 | III | 37–122 | Colorless glass fragments, very thin and lightweight, possible hurricane lantern glass | 4.29 | 3.23 | 0.06 | 4 | 3.6 |
| 252 | III | 37–122 | Aqua glass bottle body fragments (4)s | 2.48 | 1.88 | 0.43 | 4 | 5.2 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 253 | III | 37–122 | Colorless glass bottle glass, multiple pieces, base and heel (5), neck and finish (1), articulated heel to body (2), embossed body fragments (4), and 11 body fragments, embossing on body fragments "SODA WORKS"/ "M" / "AU" / "I" and "KS", embossed on heel fragment "ID" / "ES" and embossed on base "M" or "W" | 1.80–6.95 | 1.14–4.34 | 0.39–1.19 | 23 | 280 |
| 254 | III | 37–122 | Aqua glass bottle glass, multiple pieces, body fragments (6), mold seam on one fragment | 6.66 | 4.59 | 0.51 | 6 | 43.4 |
| 255 | III | 37–122 | Aqua glass bottle glass, multiple pieces, body fragments (2), mold seam on one fragment | 4.91 | 5.83 | 0.49 | 2 | 28.4 |
| 256 | III | 37–122 | Aqua glass bottle glass, multiple pieces, body fragments (1), neck fragment (1), and heel fragment (1), mold seam on one fragment | 3.94 | 3.3 | 0.47 | 3 | 25.6 |
| 257 | III | 37–122 | Aqua glass bottle glass, multiple pieces, body fragments (2) | 3.17 | 3.08 | 0.46 | 2 | 13 |
| 258 | III | 37–122 | Aqua glass bottle glass, multiple pieces, body fragment, and partial base fragment | 4.47 | 4.98 | 0.55 | 2 | 35.2 |
| 259 | III | 37–122 | Aqua glass bottle glass, multiple pieces, body fragments | 3.67 | 3.78 | 0.55 | 2 | 15.2 |
| 260 | III | 37–122 | Aqua glass bottle glass, body fragments | 4.98 | 3.2 | 0.67 | 1 | 17.8 |
| 261 | III | 37–122 | Aqua glass bottle glass, body fragments | 3.77 | 2.57 | 0.31 | 2 | 7.2 |
| 262 | III | 37–122 | Light aqua glass bottle, body fragments (8), 2 with mold seams | 1.14–4.07 | 0.95–2.98 | 0.29–0.45 | 8 | 26.2 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 263 | III | 37–122 | Light aqua glass bottle, body fragments (70), various bottles represented | 1.45–4.71 | 0.68–4.21 | 0.20–0.63 | 70 | 226.2 |
| 264 | III | 37–122 | Light aqua glass bottle, body fragments (8), one partial rim fragment (1), frosted patina | 1.15–4.96 | 1.01–3.75 | 0.22–0.53 | 9 | 48.4 |
| 265 | III | 37–122 | Aqua glass bottle, body fragments (2), one partial rim fragment (1) | 3.36 | 2.15 | 0.57 | 3 | 12.8 |
| 266 | III | 37–122 | Aqua glass, tempered, angular fragments | 4.22 | 1.03 | 0.93 | 4 | 10.6 |
| 267 | III | 37–122 | Aqua bottle glass, rounded base fragment, body fragment | 1.86–3.59 | 1.33–2.12 | 0.49–0.81 | 2 | 7.8 |
| 268 | III | 37–122 | Aqua bottle glass, rounded base fragment, body fragment | 3.15 | 1.99 | 0.32 | 2 | 3.4 |
| 269 | III | 37–122 | Colorless bottle glass body fragment, embossed "WO" | 4.96 | 2.31 | 0.5 | 1 | 8.2 |
| 270 | III | 37–122 | Colorless glass bottle body fragments | 2.40–3.44 | 1.08–3.19 | 0.28–0.50 | 4 | 19.4 |
| 271 | III | 37–122 | Amethyst bottle glass fragments, body fragments | 6 | 6.62 | 0.41 | 3 | 18.6 |
| 272 | III | 37–122 | Light green bottle glass fragments, body fragments | 2.53 | 2.53 | 0.56 | 2 | 5.6 |
| 273 | III | 37–122 | Colorless glass bottle fragments (30) | 1.04–3.43 | 0.60–2.74 | 0.21–0.61 | 30 | 85 |
| 274 | III | 37–122 | Colorless glass fragments, probable hurricane lantern fragments | 2.1–4.15 | 1.21–3.94 | 0.11–0.26 | 4 | 5.2 |
| 275 | III | 37–122 | Colorless glass fragments, slightly beveled, probable drinking glass fragments | 2.28–4.76 | 1.42–2.88 | 0.18–0.61 | 3 | 12.6 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 276 | III | 37–122 | Colorless bottle glass, base fragments | 3.39 | 3.94 | 0.55 | 2 | 16.6 |
| 277 | III | 37–122 | Colorless bottle glass, body fragments | 1.44–2.81 | 1.05–1.37 | 0.12–0.42 | 4 | 5 |
| 278 | III | 37–122 | Colorless bottle glass body fragment, embossed "NT" | 4.35 | 2.01 | 0.7 | 1 | 6.4 |
| 279 | III | 37–122 | White opaque jar glass fragment, milk glass | 1.63 | 0.52 | 0.34 | 1 | 0.4 |
| 280 | III | 37–122 | Coconut button, cut/carved, organic material, round shape, 4 sewing eye holes | 1.4 | 1.4 | 0.29 | 1 | 0.6 |
| 281 | III | 37–122 | Two tiny nails embedded in unknown substance, possibly from a shoe | 1.19 | 1.11 | 0.55 | 1 | 0.6 |
| 282 | III | 37–122 | Small fragment of red brick | 1.93 | 2.11 | 0.56 | 1 | 2.4 |
| 283 | III | 37–122 | Concrete fragment | 2.58 | 2.36 | 0.78 | 1 | 6.8 |
| 284 | III | 37–122 | Kukui nutshell fragment | 2.07 | 1.72 | 0.32 | 1 | 1.2 |
| 285 | III | 37–122 | Cow tooth, lower molar | 6.11 | 2.9 | 1.6 | 1 | 23.8 |
| 286 | III | 37–122 | Metal, rusted, corroded, hoe | 13.27 | 15.03 | 1.84 | 1 | 398.6 |
| 287 | III | 37–122 | Metal, rusted, corroded, bolt | 21 | 2.24 | 1.12 | 1 | 177 |
| 288 | III | 37–122 | Metal, rusted, corroded, jack wrench | 21 | 3 | 1.73 | 1 | 169.8 |
| 289 | III | 37–122 | Metal, rusted, corroded, wire | 4.64–43.50 | n/a | 0.23–0.53 | 6 | 163.8 |
| 290 | III | 37–122 | Metal, rusted, corroded, flat, unknown fragments | 4.75–12.14 | 2.11–5.93 | 0.13–0.75 | 5 | 193.2 |
| 291 | III | 37–122 | Metal, tin cup, rusted base | 10.72 | 5.5 | 0.19 | 1 | 36 |
| 292 | III | 37–122 | Tin metal | 12.34 | 6.37 | 0.04 | 1 | 16 |
| 293 | III | 37–122 | Coconut button, cut/carved, organic material, round shape, 4 sewing eye holes | 1.76 | n/a | 0.3 | 1 | 1 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 294 | III | 37–122 | Coconut button, cut/carved, organic material, round shape, 4 sewing eye holes | 1.29 | n/a | 0.3 | 1 | 0.6 |
| 295 | III | 37–122 | Shell button, 4 sewing eye holes | 1 | n/a | 0.22 | 1 | 0.4 |
| 296 | III | 37–122 | Whiteware tableware, base to heel fragments, 6 articulated fragments, transparent glaze, underglaze blue and pink, mountain design on interior, exterior three stripes around base, refits with Acc. #s 141, 142, 168, 307, 310 | 12.93 | 12.21 | 1.75 | 6 | 252 |
| 297 | III | 37–122 | Whiteware holloware, base to heel fragments, 3 articulated fragments, base and body fragments (4), one body to rim fragment, transparent glaze, underglaze flow blue floral and geometric design, on exterior, refits with Acc. # 152 | 5.77 | 3.93 | 0.45 | 8 | 79.8 |
| 298 | III | 37–122 | Whiteware holloware, base, heel, body, and rim fragments, 2 articulated fragments, transparent glaze, underglaze blue and pink floral design on exterior, refits with Acc. # 128 | 4.65 | 5.43 | 0.48 | 4 | 30 |
| 299 | III | 37–122 | Whiteware kitchenware, base to heel fragment, transparent glaze, underglaze double blue stripe around base, outer base and foot unglazed | 3.25 | 4.71 | 0.82 | 1 | 13.4 |
| 300 | III | 37–122 | Whiteware holloware, scalloped rim fragment, transparent glaze, underglaze brown on the rim, blue transfer print design on interior | 3.41 | 5.51 | 0.73 | 1 | 15.4 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 301 | III | 37–122 | Whiteware holloware, rim and body fragment, transparent glaze, underglaze blue geometric spiral design on exterior | 2.54 | 2.77 | 0.45 | 2 | 5 |
| 302 | III | 37–122 | Whiteware holloware, rim fragment, transparent glaze, underglaze blue with dark blue print, other side not glazed | 1.73 | 2.27 | 0.72 | 1 | 2.4 |
| 303 | III | 37–122 | Whiteware holloware, body fragment, transparent glaze, underglaze blue and green partial human form (possibly a fisherman) design on exterior | 2.52 | 3.57 | 0.56 | 1 | 5.2 |
| 304 | III | 37–122 | Whiteware tableware, foot fragment, transparent glaze, underglaze blue stripe design on exterior, no glaze on base | 2.83 | 1.93 | 0.72 | 1 | 4.8 |
| 305 | III | 37–122 | Whiteware holloware, rim fragment, transparent glaze, underglaze blue transfer print design on exterior | 2.54 | 3.29 | 0.33 | 1 | 3 |
| 306 | III | 37–122 | Whiteware tableware, body fragment, transparent glaze, underglaze blue transfer print design on interior and exterior, refits with Acc. #s 159 and 170 | 2.89 | 1.25 | 0.67 | 1 | 3.4 |
| 307 | III | 37–122 | Whiteware tableware, body fragment, transparent glaze, underglaze blue hand painted design exterior refits with Acc. #s 141, 142, 168, 296, 310 | 2.28 | 2.75 | 0.53 | 1 | 3.8 |
| 308 | III | 37–122 | Whiteware holloware, rim fragment, transparent glaze, underglaze blue design exterior, unknown design | 1.14 | 3.78 | 0.26 | 1 | 1.6 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 309 | III | 37–122 | Whiteware holloware, rim/body fragment, transparent glaze, underglaze orange design exterior, unknown design | 3.05 | 3.38 | 0.41 | 1 | 5.6 |
| 310 | III | 37–122 | Whiteware tableware, body fragment, transparent glaze, underglaze blue stripe design exterior, refits with Acc. #s 141, 142, 168, 296, 307 | 2.78 | 2.43 | 0.53 | 1 | 4.8 |
| 311 | III | 37–122 | Whiteware holloware, body fragment, transparent glaze, underglaze brown hand painted stripes design exterior | 2.25 | 2.14 | 0.76 | 1 | 4.4 |
| 312 | III | 37–122 | Grayware holloware, 4 articulating rim and body fragments with 1 non-articulating sherd, transparent glaze, underglaze gray hand painted design exterior | 1.61–3.54 | 1.13–2.38 | 0.24–0.36 | 3 | 3 |
| 313 | III | 37–122 | Whiteware tableware, body, rim, and various fragments, transparent glaze, underglaze blue transfer print design on exterior | 0.72–1.73 | 0.24–1.38 | 0.19–0.63 | 8 | 3.2 |
| 314 | III | 37–122 | Whiteware maybe porcelain, body fragments, transparent glaze | 1.20–2.61 | 0.55–1.59 | 0.15–0.63 | 15 | 13.8 |
| 315 | III | 37–122 | Refined whiteware, unknown vessel, body and foot rim fragments, transparent overglaze, white underglaze | 0.96–4.77 | 0.80–3.10 | 0.28–0.65 | 9 | 32 |
| 316 | III | 37–122 | Porcelain, unknown ceramicware, body fragment, transparent overglaze, light green underglaze | 2.12 | 1.15 | 0.45 | 1 | 1.2 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 317 | III | 37–122 | Grayware, holloware, body fragment, transparent overglaze, gray underglaze | 1.95 | 1.48 | 0.37 | 1 | 1.4 |
| 318 | III | 37–122 | Refined earthenware, unknown ceramic, body fragments, transparent glaze, refits with Acc. # 194 | 1.14–1.62 | 0.94–1.31 | 0.26–0.32 | 3 | 1.8 |
| 319 | III | 37–122 | Stoneware, unknown ceramic, body fragment, salt glaze, brown underglaze, refits with Acc. # 195 | 1.49 | 1.53 | 0.41 | 1 | 1 |
| 320 | III | 37–122 | Stoneware, unknown vessel, body fragment, Bristol glaze, interior and exterior portions not glazed | 3.09 | 1.76 | 0.56 | 1 | 2.6 |
| 321 | III | 37–122 | Light aqua bottle glass, 1 fragment with mold seam, glass is very translucent, all with similar fracture marks | 1.25–3.55 | 0.95–2.95 | 0.41–0.69 | 10 | 46.4 |
| 322 | III | 37–122 | Light aqua bottle glass, multiple body fragments, 2 embossed; "AU" on larger piece and a partial unknown letter on the smaller fragment | 3.21 | 3.65 | 0.41 | 44 | 137 |
| 323 | III | 37–122 | Light aqua green bottle glass, body fragment, embossed with a star logo | 3.5 | 2.6 | 0.6 | 1 | 5.4 |
| 324 | III | 37–122 | Colorless, slightly smokey colored bottle glass, shoulder to complete finish fragment, blob top finish (1880–1920) | 4.83 | 5.11 | 0.91 | 1 | 42.2 |
| 325 | III | 37–122 | Cobalt blue glass, bottle or jar body fragment, embossed "SH" | 1.04 | 1.4 | 0.19 | 1 | 0.4 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 326 | III | 37–122 | Cobalt blue glass, bottle or jar body fragments (3) | 4.14 | 2.2 | 0.4 | 3 | 5.4 |
| 327 | III | 37–122 | Olive green bottle glass, body fragment | 1.94 | 2.02 | 0.38 | 1 | 2.4 |
| 328 | III | 37–122 | Light olive-green bottle glass, body fragments | 3.96 | 1.96 | 0.56 | 2 | 6 |
| 329 | III | 37–122 | Light green bottle glass, lip (finish) fragment | 1.24 | 1.43 | 0.47 | 1 | 1 |
| 330 | III | 37–122 | Green bottle glass, body fragment | 3.19 | 2.02 | 0.47 | 1 | 6.2 |
| 331 | III | 37–122 | Green/aqua bottle glass, body fragment | 3.43 | 1.53 | 0.36 | 1 | 4.2 |
| 332 | III | 37–122 | Aqua (Ball Jar blue) bottle or jar glass, body fragment | 1.05–2.76 | 0.46–2.01 | 0.20–0.61 | 9 | 13.6 |
| 333 | III | 37–122 | Aqua bottle glass, body and one neck/shoulder fragments | 5.77 | 3.38 | 0.62 | 6 | 43.6 |
| 334 | III | 37–122 | Aqua, slightly green, bottle glass, body fragments | 4.75 | 3.88 | 0.64 | 4 | 38.2 |
| 335 | III | 37–122 | Colorless bottle glass, heel to foot fragment | 1.88 | 4.69 | 0.95 | 1 | 13.4 |
| 336 | III | 37–122 | Colorless bottle glass, body fragment, embossed "T CO" | 3.61 | 1.85 | 0.57 | 1 | 5.2 |
| 337 | III | 37–122 | Colorless bottle glass, base fragments, embossed "3" on heel | 2.36 | 3.54 | 1.02 | 2 | 34.8 |
| 338 | III | 37–122 | Colorless bottle glass, finish lip fragment, crown top | 4.39 | 2.03 | 0.61 | 1 | 7.6 |
| 339 | III | 37–122 | Colorless bottle glass, finish lip fragment, threaded finish | 3.31 | 1.68 | 0.51 | 1 | 4.4 |
| 340 | III | 37–122 | Colorless (light lavender) bottle glass, body fragments | 2.09–2.71 | 1.13–2.53 | 0.18–0.51 | 4 | 10.8 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 341 | III | 37–122 | Colorless glass, body fragment, decorative item | 2.71 | 0.81 | 0.61 | 1 | 1.4 |
| 342 | III | 37–122 | Colorless glass, body fragments, numerous bottle fragments | 1.11–5.22 | 0.54–3.43 | 0.06–0.55 | 55 | 106.4 |
| 343 | III | 37–122 | Colorless (translucent) glass, body fragments, numerous bottle fragments, 1 lip, crown top finish | 0.83–5.74 | 0.53–2.1 | 0.10–0.41 | 31 | 43.2 |
| 344 | III | 37–122 | Colorless (translucent) glass, neck fragment, small bottle, medicine or personal | 1.79 | 1.52 | 0.29 | 1 | 1.8 |
| 345 | III | 37–122 | Colorless glass, body fragments, probable hurricane lantern glass | 1.39–3.68 | 0.92–2.67 | 0.05–0.13 | 8 | 12.6 |
| 346 | III | 37–122 | Colorless glass, body fragments, very thin glass | 1.12–2.02 | 0.57–1.37 | 0.04–0.07 | 7 | 6 |
| 347 | III | 37–122 | Colorless glass, flat, pressed glass, unknown use | 1.57–2.12 | 0.65–1.76 | 0.17–0.24 | 4 | 7.6 |
| 348 | III | 37–122 | Aqua bottle glass, body fragments | 1.00–2.53 | 0.64–1.96 | 0.12–0.46 | 15 | 16.8 |
| 349 | III | 37–122 | Very dark amber (brown) bottle glass, body fragment, striation marks | 3.79 | 1.49 | 0.49 | 1 | 3.4 |
| 350 | III | 37–122 | Dark amber (brown) bottle glass, body fragment | 2.73–2.99 | 1.54–2.86 | 0.36–0.64 | 3 | 15.2 |
| 351 | III | 37–122 | Dark amber (brown) bottle glass, body fragments | 1.46–2.12 | 1.12–1.47 | 0.24–0.26 | 3 | 2.8 |
| 352 | III | 37–122 | Amber (brown) bottle glass, body fragments | 1.53–3.48 | 0.52–1.37 | 0.29–0.41 | 5 | 6.8 |
| 353 | III | 37–122 | Amber (brown) bottle glass, body fragments, beer bottle | 2.67–4.29 | 1.33–2.84 | 0.16–0.26 | 3 | 8.8 |

| Acc. # | Stratum | Depth (cm) | Description | Length (cm) | Width (cm) | Thickness (cm) | Count | Weight (g) |
|---|---|---|---|---|---|---|---|---|
| 354 | III | 37–122 | Amber/green bottle glass, mold seam | 2.95 | 1.77 | 0.9 | 1 | 5.4 |
| 355 | III | 37–122 | Colorless glass nugget, heat affected | 2.59 | 2.16 | 1.41 | 1 | 8.4 |
| 356 | V-VI | 37–122 | Very rusted and corroded nail, possibly square shaft, round head | 6.13 | 1.16 | 0.77 | 1 | 8.6 |
| 357 | V-VI | 37–122 | Wire cut round shaft and head nails | 5.01 | 0.73 | 0.37 | 4 | 7.8 |
| 358 | V-VI | 37–122 | Rusted and corroded metal fragment | 11.74 | 0.35 | 0.75 | 1 | 13.2 |
| 359 | V-VI | 37–122 | Rusted/corroded flat head screwdriver shaft | 6.43 | 0.79 | 0.44 | 1 | 4.8 |
| 360 | V-VI | 37–122 | Very rusted/corroded metal fastener | 3.58 | 3.91 | 1.34 | 2 | 88.4 |
| 361 | V-VI | 37–122 | Rusted/corroded hinge/bolt | 1.76 | 0.9 | 0.9 | 1 | 2.4 |
| 362 | V-VI | 37–122 | Multiple various very corroded and rusted metal fragments | 1.26–7.44 | 0.88–4.18 | 0.13–1.06 | 38 | 85.8 |

# Appendix C Architectural Assessment of SIHP # 50-50-04-09167

Waiale Road Extension Project

Background
At the request of Kathleen Chu, P.E. at Bowers & Kubota, Maui County Planner and Architectural Historian Stanley Solamillo conducted a site visit on January 17, 2025 with staff from Cultural Surveys Hawai‘i (CSH), inspected features associated with an irrigation ditch complex (SIHP # 50-50-04-0967) and has provided the following analysis and recommendations for determinations of eligibility. In 2021 Mr. Solamillo conducted research and prepared HAER documentation for Wailuku Sugar Co. (WSCo) water-related infrastructure on the west side of Honoapi‘ilani Highway that included Reservoir No. 1 (HAER No. HI-161) and the Waihee Canal or Waihee Ditch (HAER No. HI-162) along with related appurtenances. They provide the threshold for NRHP-eligible properties that are WSCo water-related resources.

Irrigation Ditch Complex (SIHP # 50-50-04-09167)
The irrigation ditch complex that is located on the east side of Honoapi‘ilani Highway is WSCo infrastructure that is shown on the USGS Wailuku Hawaii Quadrangle, 1:24,000 (1955)—a color map which provides clear differentiation between WSCo irrigation ditches and roads (see Maps 1-2). The source for the ditch complex appears to have been ʻĪao Stream whose water was impounded at Hopoi Reservoir, located adjacent to a village of the same name, that was northwest and downslope of Wailuku Heights. The ditch then carried water from Hopoi Reservoir northwest-southeast and crossed Honoapi‘ilani Highway halfway between Hopoi Village and Waikapu Village where it connected with another reservoir. From that reservoir the ditch extended southeast and downslope of a Japanese cemetery and then veered southwest where it began to parallel Honoapi‘ilani Highway south of three WSCo reservoirs (Reservoirs 2-4) that were located on the west side of the arterial. A USGS oblique aerial (1950) of the Waikapu watershed clearly showed the irrigation ditch as it began to parallel the highway in proximity to the three reservoirs and continued passed Hyashi Village and on toward Mā‘alaea.

The ditch section that was oriented parallel to Honoapi‘ilani Hwy appears to have been built between 1937 and 1949 and its use was relatively short-lived. An earlier map of WSCo cane lands titled, “Title Map, Wailuku Sugar Company, Wailuku, Maui, T.H.” (1937), showed the ditch crossing Honoapi‘ilani Hwy and connecting with the lowest of three reservoirs (Reservoir 4) on the west side of the arterial and did not show it continuing beyond that point. Similarly, orthogonal aerial photographs (1965, 1976) suggest that use of the ditch (along with nearby reservoirs 2-4) was discontinued by the latter year in favor of another ditch that was located further east.

Irrigation Ditch
The irrigation ditch parallels Honoapi‘ilani Hwy. for a distance of 460.0 m, has a maximum width of 6.6 m, is 1.3 m in depth, and appears to have incurred at least three phases of construction. Phase 1 included Initial construction, excavation and installation of a board-formed or troweled concrete lining with construction of associated features; Phase 2 consisted of raising the height of the sides of the ditch with river rock (basalt cobbles and small boulders), faced with troweled concrete, troweled concrete with basalt aggregate, or troweled concrete covered Concrete Masonry Units (CMU); and Phase 3 included the 2009 installation of a polyvinyl chloride (PVC) pipe and complete abandonment of the ditch. Portions of the ditch have been damaged by recent clearing activities.

Irrigation Ditch Complex Features
The Irrigation Ditch Complex Features include: the ditch (Feature A), a culvert (Feature B), a stacked stone terrace (Feature C), three sluice gates (Features D, F, and H), and two pedestrian walkways (Features E and G). All features exhibit varying degrees of damage from recent

clearing activities (See Section 5, Historic Property Descriptions of the AIS for additional Feature details).

Ditch (Feature A)
WSCo began lining its irrigation ditches with concrete in 1920-21 and they are largely of uniform construction (troweled or board-form concrete) with nearly vertical walls (see Photo 4). Unlike the Waihee Ditch or Canal and other irrigation ditches on the west side of Honoapi‘ilani Hwy, the ditch that parallels the west side of arterial exhibits three stages of construction with subsequent changes in design, materials, and workmanship. Nearly vertical or sloped walls faced with troweled concrete and associated with initial construction are raised with the addition of smaller sloped walls of concrete with crushed basalt aggregate, river rock (basalt cobbles and small boulders), or concrete masonry units (CMU), and faced with troweled concrete, then further modified with the installation of PVC pipe (see Photos 5-7). Recommended Determination of Eligibility: Altered; changes to design, setting, materials, and workmanship; Not NRHP eligible.

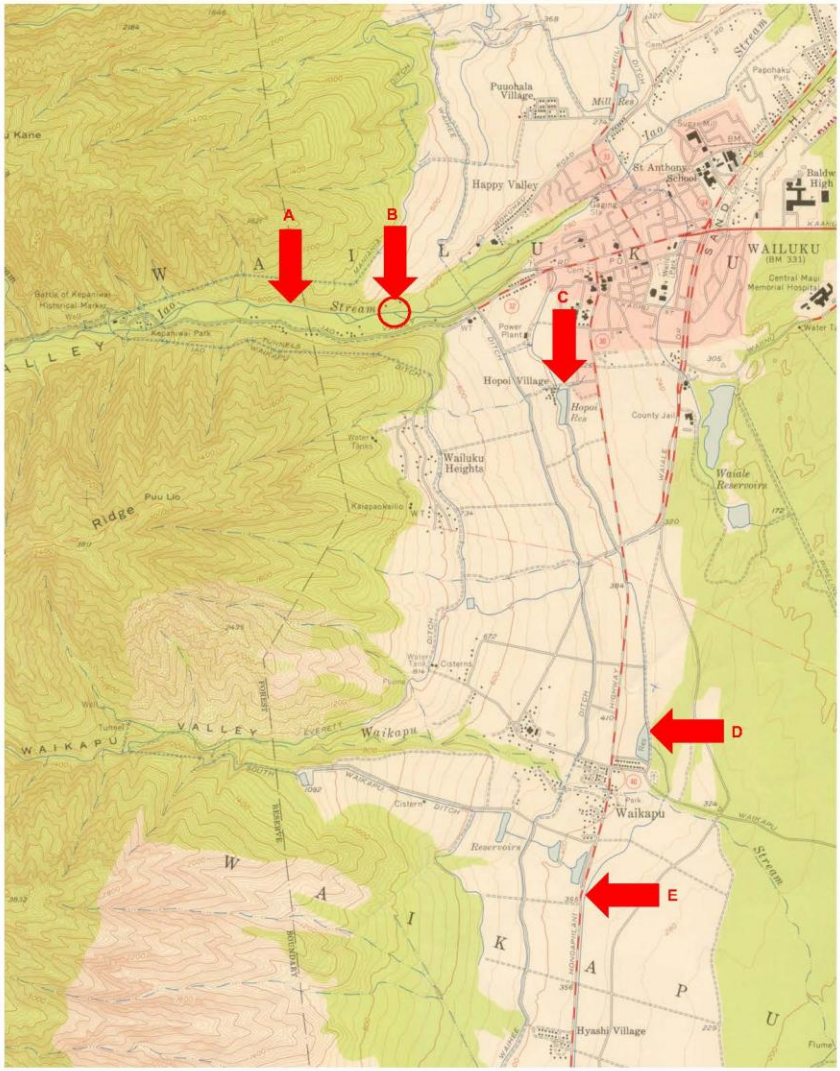
Culvert (Feature B)
Culverts on the west side of Honoapi‘ilani Hwy. have headwalls that are either of river rock (basalt cobble and small boulder) construction with troweled concrete with metal pipes (see Photo 8) or headwalls of river rock (basalt cobbles and small boulders) with troweled concrete and segmental arched openings of cut rock (basalt). The culvert in the ditch that parallels the west side of arterial has headwalls that are constructed of concrete masonry units (CMU), covered with troweled concrete and a metal pipe, then further modified with the installation of PVC pipe (See Photo 9). In addition, the standard concrete slab that spans the distance between the headwalls appears to be absent. Recommended Determination of Eligibility: Altered; changes to design, materials, and workmanship; Not NRHP eligible.

Stacked Stone Terrace (Feature C; SIHP # 50-50-04-06668)
Previously identified historic property (Perzinsky and Dega [2010]). Determination of Eligibility remains unchanged. The resource retains integrity of location, design, setting, materials, and workmanship; Eligible per HAR §13-275-6 Criterion “d.”

Sluice Gates (Features D, F, and H)
The sluice gates include walls that are concrete or CMU with gates that are wood (Feature D), metal (Feature F), or concrete (Feature H), and all exhibit varying degrees of damage. The mechanical apparatus used to raise or lower the gates (metal wheels or hand cranks with reducing gears, stems, and frames) have been removed so that they are inoperable. Although the dates of construction are unknown, one example with a wood gate (Feature D) has been inscribed with “1967,” indicating that it was added after the initial construction of the ditch. In contrast with the WSCo sluice gates on the west side of Honopi‘ilani Hwy that retain most if not all of their operating components (see Photos 10-11), the sluice gates on the ditch are not intact, are in poor condition, and damaged from deactivation efforts or recent clearing activities (see Photo 12). Recommended Determination of Eligibility: Altered; changes to design, materials, and workmanship; Not NRHP eligible.

Pedestrian Walkways (Features E and G)
The pedestrian walkways or crossings are concrete slabs that are similar to those that are located on the west side of Honoapi‘ilani Hwy. (see Photo 13) but they are unusually thin and have been damaged. One slab in the vicinity of a sluice gate (Feature D) is irregularly shaped and suggestive of reuse (see Photo 14). Recommended Determination of Eligibility: Altered; changes to design, materials, and workmanship; Not NRHP eligible.

Map 1. Enlargement of USGS map (1955) showing ʻĪao Stream (A), Diversion Ditch (B), Hopoi Reservoir at Hopoi Village (C), Reservoir at Waikapu Village (D), and Ditch parallel to Honoapiʻilani Hwy (E). *U.S. Geological Survey. Wailuku, Hawaii Quadrangle,* 1:24,000, 1955.



Map 2. Enlargement of USGS map (1955) showing Honoapi‘ilani Hwy (A), Ditch from Reservoir at Hopoi Village crossing Honopi‘ilani Hwy (B), Reservoir at Waikapu Village (C), and Ditch located parallel to Honoapi‘ilani Hwy. *U.S. Geological Survey. Wailuku, Hawaii Quadrangle,* 1:24,000, 1955.

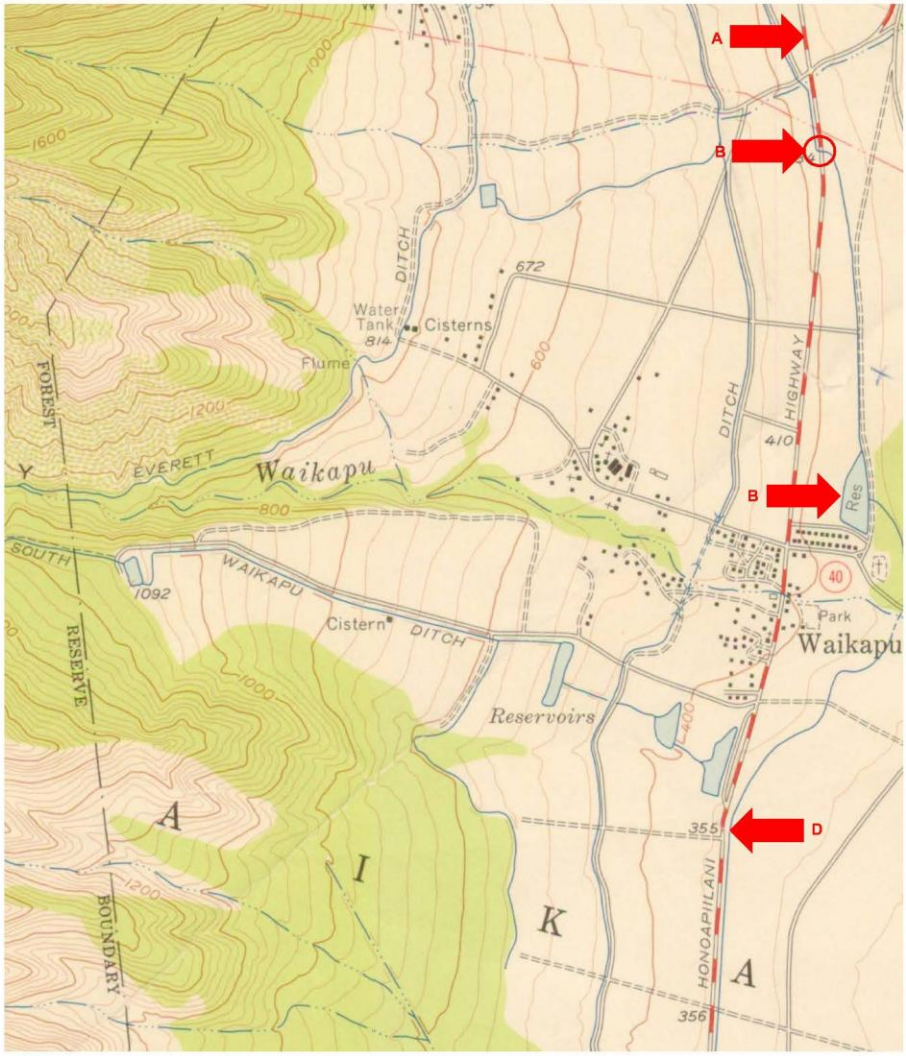


Photo 1. USGS aerial oblique of Waikapu watershed (1950), showing Honoapi‘ilani Hwy. (A), Ditch from Reservoir at Waikapu (B), and Ditch located parallel to Honoapi‘ilani Hwy (C). USGS Ref. No. 036-3942, 1950. *Courtesy Maps, Aerial Photographs and GIS (MAGIS), University of Hawai‘i at Mānoa Library.*



Photo 2. Enlargement of USGS aerial of Waikapu watershed (1965) showing the location of Honopi‘ilani Hwy. (A), Ditch from Reservoir at Waikapu (B), and Ditch located parallel to Honoapi‘ilani Hwy (C). USGS Ref. No. 051-4936, 1965. *Courtesy Maps, Aerial Photographs and GIS (MAGIS), University of Hawai‘i at Mānoa Library.*

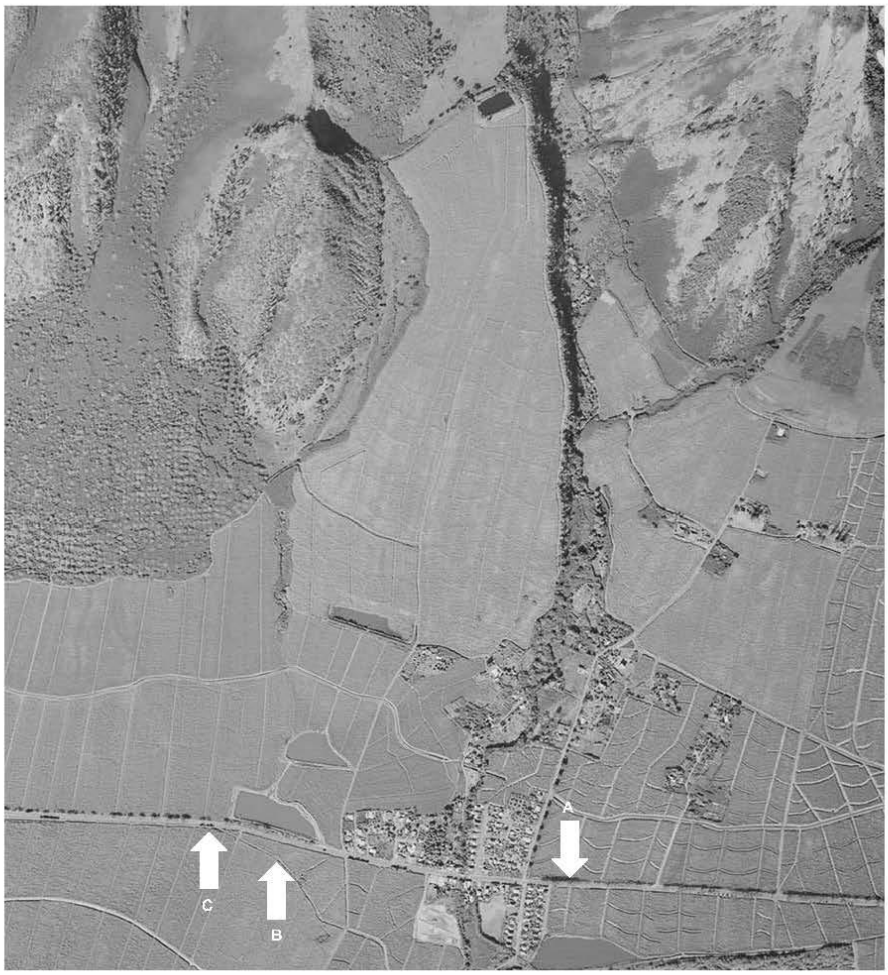


Photo 3. Enlargement of USGS aerial of Waikapu watershed (1976) showing the location of Honopi'ilani Hwy (A), abandoned Ditch from Reservoir at Waikapu (B), and abandoned Ditch located parallel to Honoapi'ilani Hwy (C). USGS Ref. No. 035-3365, 1976. *Courtesy Maps, Aerial Photographs, and GIS (MAGIS), University of Hawai'i at Mānoa Library.*

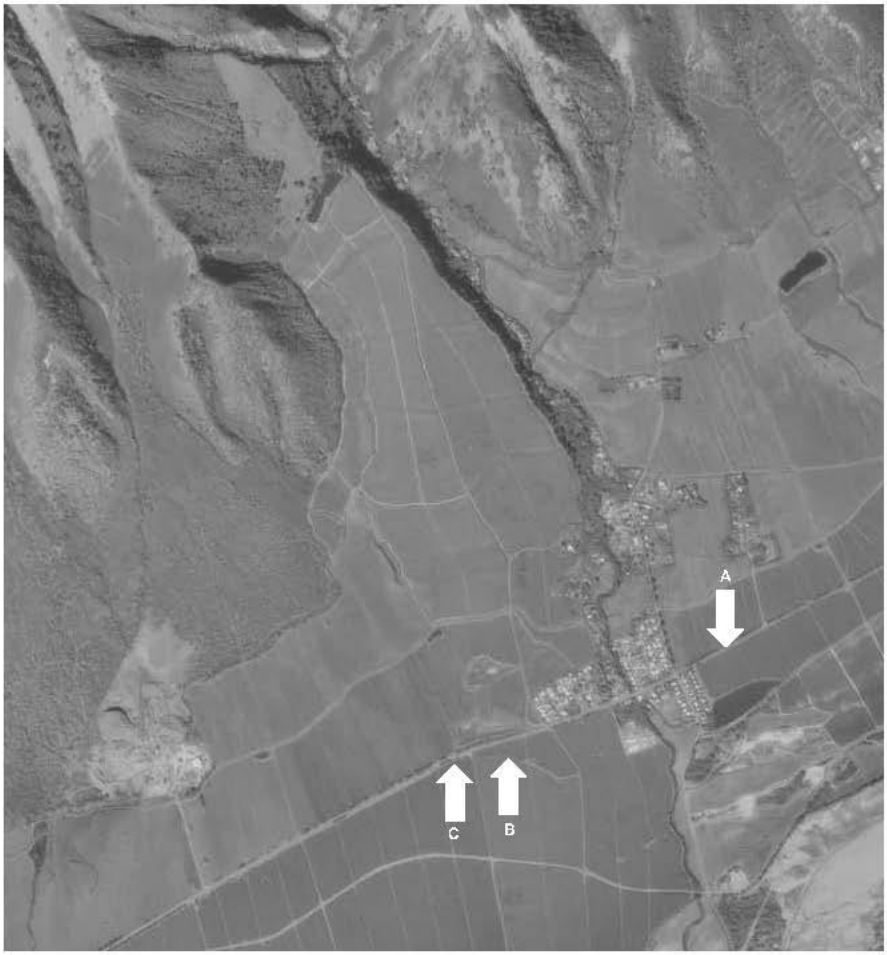


Photo 4. The Wailuku Sugar Co. (WSCo) Waihe‘e Canal (Waihe‘e Ditch) is a typical example of an intact concrete-lined ditch (HAER Photo No. HI-162-12). *Courtesy Tony Martie (2020).*



Photo 5. Section of ditch with nearly vertical walls faced with troweled concrete whose height has been increased with sloped walls of concrete with river rock (basalt cobbles and small boulders) faced with troweled concrete, then further modified with the installation of PVC pipe. Note that the depth of the original ditch has been reduced by more than fifty percent from silt accumulation.



Photo 6. Section of ditch with extensions made to earlier vertical walls, covered with troweled concrete, and further modified with the installation of PVC pipe.



Photo 7. Section of ditch with a sluice gate showing sloped walls, lined with troweled concrete, whose heights have been increased by the addition of short sloped walls of troweled concrete with basalt aggregate, and a later PVC pipe.



Photo 8. Waihee Canal (Waihee Ditch), typical cement covered river rock headwall of culvert with a metal pipe and a concrete vehicular span over ditch (HAER Photo No. HI-162-13). *Courtesy Tony Martie (2020).*




Photo 9. Headwall with metal pipe culvert constructed of CMU, covered with troweled concrete, with PVC pipe, but without concrete span for vehicular use.



Photo 10. Waihee Canal (Waihee Ditch), intact metal sluice gate at irrigation ditch with CMU wall and troweled concrete added to shut off flow to reservoir beyond (HAER Photo No. HI-162-08).



Photo 11. Waihee Canal (Waihee Ditch), intact metal sluice gate at irrigation ditch with CMU wall and troweled concrete added to shut off flow to reservoir beyond (HAER Photo No. HI-162-14). *Courtesy Tony Martie (2020).*



Photo 12. Sluice Gate with mechanical apparatus removed and damage from clearing activities.



Photo 13. Waihee Canal (Waihee Ditch), typical concrete slab used to provide vehicular and pedestrian travel across the appurtenance (HAER Photo No. HI-162-11). *Courtesy Tony Martie (2020).*



Photo 14. Irregular shaped, thin concrete slab at ditch provided for pedestrian travel across the appurtenance.



# Draft

# Archaeological Inventory Survey Report for the Central Maui Wastewater Reclamation Facility Project, Waikapū, Wailuku, and Pūlehunui Ahupua‘a, Pū‘ali Komohana District, Maui, TMKs: [2] 3-5-001:017 and 120 pors., [2] 3-5-002:014 por., [2] 3-5-020:036 por., [2] 3-6-002:003 and 004 pors., [2] 3-8-005:023 por., Wai‘ale Road Right-of-Way, Waiko Road Right-of-Way, and Waikapū Stream

## Volume II of II

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### 1.1.1 Test Excavation 1 (TE-1)

TE-1 was placed at the western end of the proposed connection corridor segment of the project area (Figure 1). The excavation was 6.00 m long by 1.0 m wide with a maximum depth of 1.77 mbs. The stratigraphy of TE-1 consisted of a dark brown, gravelly silty clay loam Ap horizon (Stratum I) overlying brown, previously disturbed natural silty clay loam (Stratum II) and dark brown, natural silty clay (Stratum III) (Figure 2 through Figure 4 and Table 1). No cultural materials were observed.



Figure 1. TE-1, overview of the general location, view to west

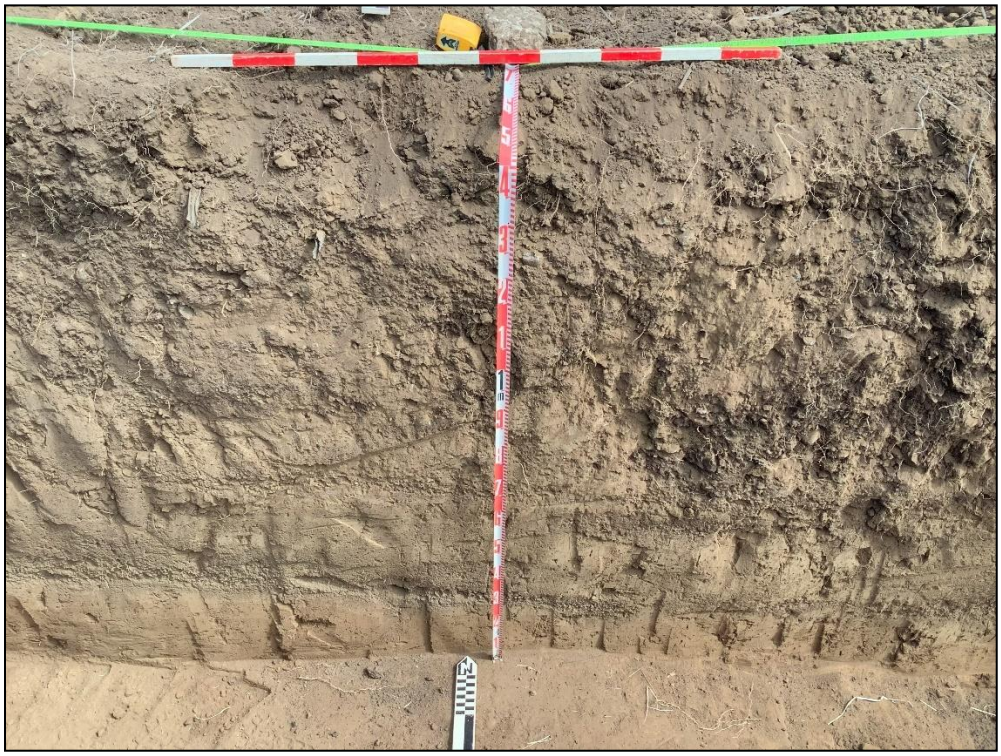


Figure 2. TE-1, close-up of the north wall, view to north



Figure 3. TE-1, oblique view of the north wall, view to northeast

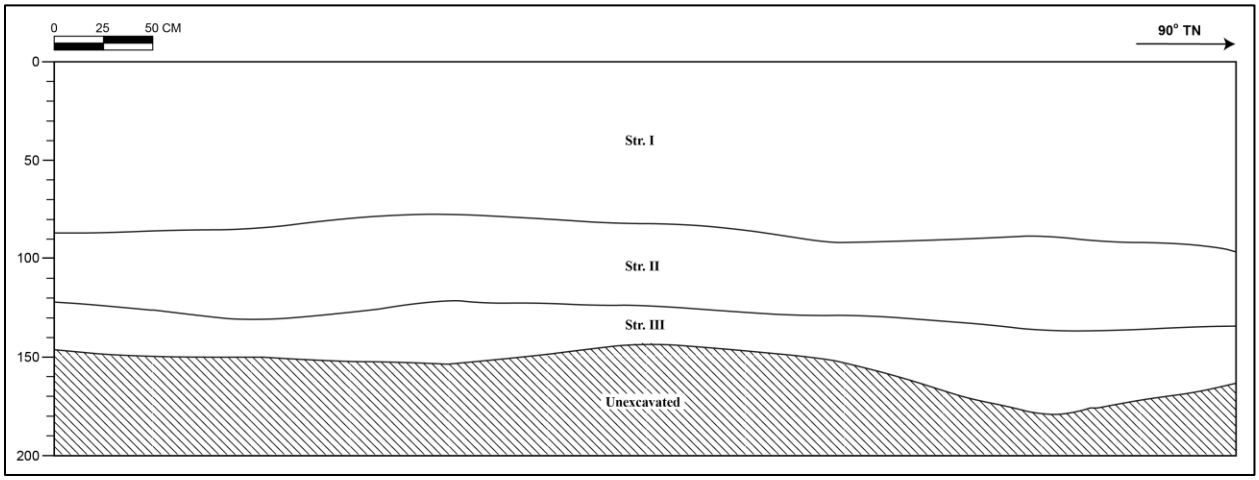



Figure 4. TE-1, stratigraphy of the north wall

Table 1. Strata observed at TE-1

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–95 | Ap horizon; 10YR 3/3, dark brown; gravelly silty clay loam; moderate, fine granular structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; many fine to medium roots; clear, wavy lower boundary |
| II | 76–135 | Previously disturbed natural; 10YR 4/3, brown; silty clay loam; strong, fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; fine roots common; abrupt, smooth lower boundary; contained a very coarse mottling of 10YR 4/2, dark grayish brown, gravelly sandy clay loam near upper interface |
| III | 121–177 | Natural; 10YR 3/3, dark brown; silty clay; moderate, very fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.2 Test Excavation 2 (TE-2)

TE-2 was placed near the western end of the proposed connection corridor segment of the project area (Figure 5). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.62 mbs. The stratigraphy of TE-2 consisted of a very dark grayish brown, gravelly silty clay loam Ap horizon (Stratum I) overlying a brown, previously disturbed, natural sandy clay loam (Stratum II); alluvial streambed gravel (Stratum III); brown, natural sandy clay loam (Stratum IV); and dark yellowish brown, natural silty clay (Stratum V) (Figure 6 through Figure 8 and Table 2). No cultural materials were encountered.



Figure 5. TE-2, overview of the general location, view to northeast



Figure 6. TE-2, close-up of the north wall, view to north



Figure 7. TE-2, oblique view of the north wall, view to northwest

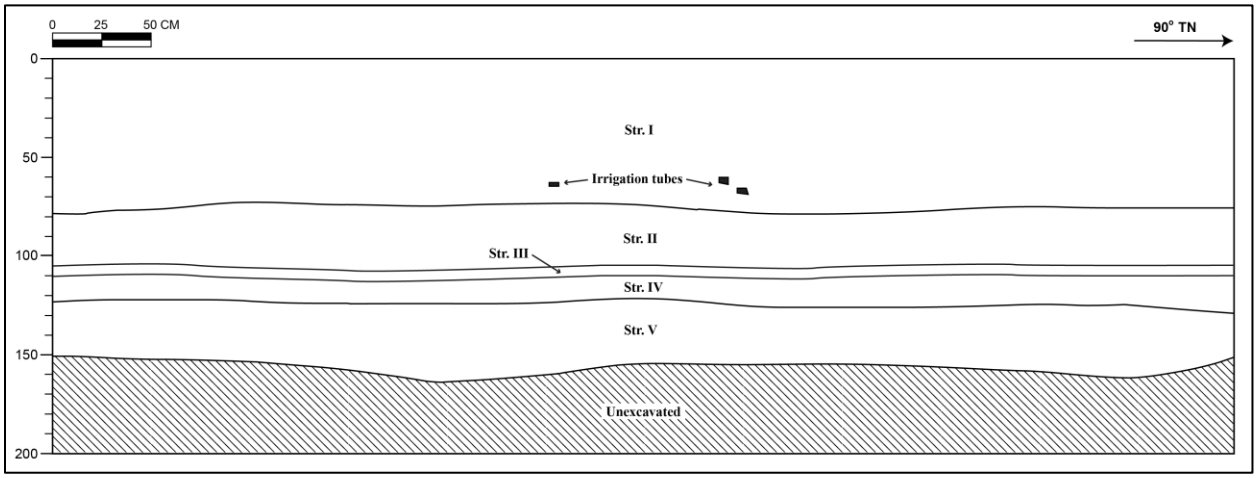



Figure 8. TE-2, stratigraphy of the north wall

Table 2. Strata observed at TE-2

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–78 | Ap horizon; 10YR 3/2, very dark grayish brown; gravelly silty clay loam; moderate, fine granular structure; dry, hard consistence; no cementation; plastic; terrigenous origin; many fine to medium roots; clear, smooth lower boundary |
| II | 72–108 | Previously disturbed natural; 10YR 4/3, brown; sandy clay loam; moist, friable consistence; no cementation; slightly plastic; mixed origin; fine roots common; abrupt, smooth lower boundary |
| III | 104–113 | Natural; 10YR 3/3, dark brown; extremely gravelly sandy loam; structureless (single grain); no cementation; non-plastic; mixed origin; few fine roots; abrupt, smooth lower boundary; alluvial streambed gravel |
| IV | 110–125 | Natural; 10YR 4/3, brown; sandy clay loam; moist, friable consistence; no cementation; slightly plastic; mixed origin; few fine roots; diffuse, smooth lower boundary |
| V | 120–162 | Natural; 10YR 3/4, dark yellowish brown; silty clay; strong, very fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.3 Test Excavation 3 (TE-3)

TE-3 was placed near the western end of the proposed connection corridor segment of the project area (Figure 9). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.54 mbs. The stratigraphy of TE-3 consisted of a dark brown, gravelly silty clay loam Ap horizon (Stratum I) overlying brown, previously disturbed, natural silty clay loam with a band of dark grayish brown, natural very gravelly sandy clay loam (Stratum II); dark brown, natural very gravelly sandy clay loam (Stratum III); and dark yellowish brown, natural silty clay (Stratum IV) (Figure 10 through Figure 12 and Table 3). Several pieces of concrete were observed near the surface of Stratum I.



Figure 9. TE-3, overview of the general location, view to southeast



Figure 10. TE-3, close-up of the south wall, view to south



Figure 11. TE-3, oblique view of the south wall, view to southwest

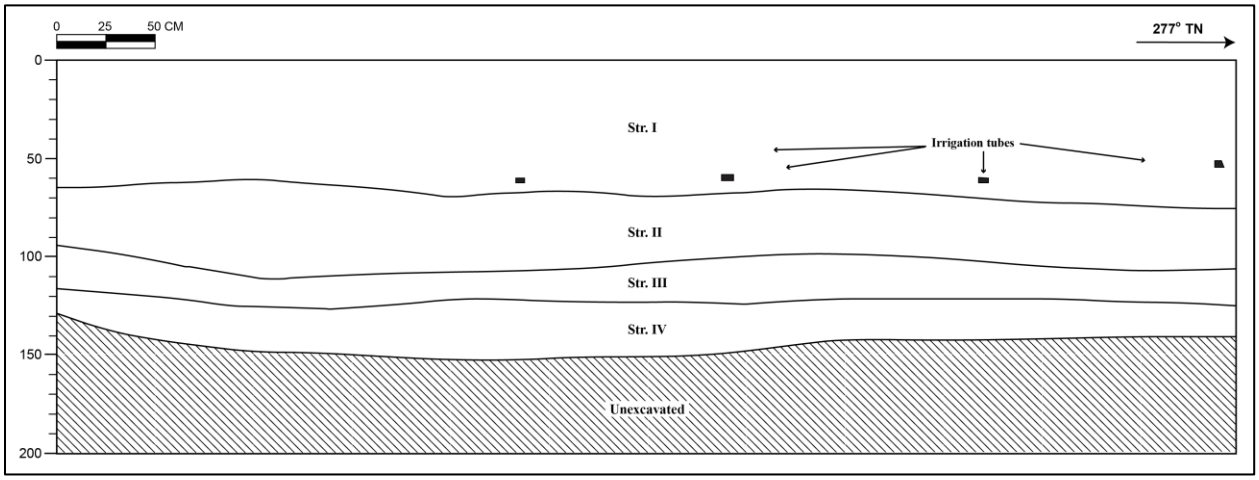



Figure 12. TE-3, stratigraphy of the south wall

Table 3. Strata observed at TE-3

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–83 | Ap horizon; 10YR 3/3, dark brown; gravelly silty clay loam; moderate, fine granular structure; dry, hard consistence; no cementation; plastic; mixed origin; many fine to medium roots; clear, smooth lower boundary; concrete pieces observed |
| II | 63–113 | Previously disturbed natural; 10YR 4/3, brown; silty clay loam; strong, very fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; fine roots common; abrupt, smooth lower boundary; contained bands of 10YR 4/2, dark grayish brown, very gravelly sandy clay loam alluvial gravel |
| III | 95–130 | Natural; 10YR 3/3, dark brown; very gravelly sandy clay loam; moderate, fine granular structure; moist, friable consistence; no cementation; plastic; mixed origin; no roots; abrupt, smooth lower boundary |
| IV | 117–154 | Natural; 10YR 3/4, dark yellowish brown; silty clay; strong, very fine granular structure; moist, friable consistence; no cementation; plastic; mixed origin; no roots; lower boundary not observed |

### 1.1.4 Test Excavation 4 (TE-4)

TE-4 was placed in the western half of the proposed connection corridor segment of the project area (Figure 13). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.70 mbs. The stratigraphy of TE-4 consisted of a very dark grayish brown, gravelly silty clay loam Ap horizon (Stratum I) overlying brown, previously disturbed, natural silty clay loam (Stratum II) and dark brown, natural silty clay (Stratum III) (Figure 14 through Figure 16 and Table 4). Two pieces of concrete were observed within Stratum I.



Figure 13. TE-4, overview of the general location, view to east



Figure 14. TE-4, close-up of the south wall, view to south



Figure 15. TE-4, oblique view of the south wall, view to southwest

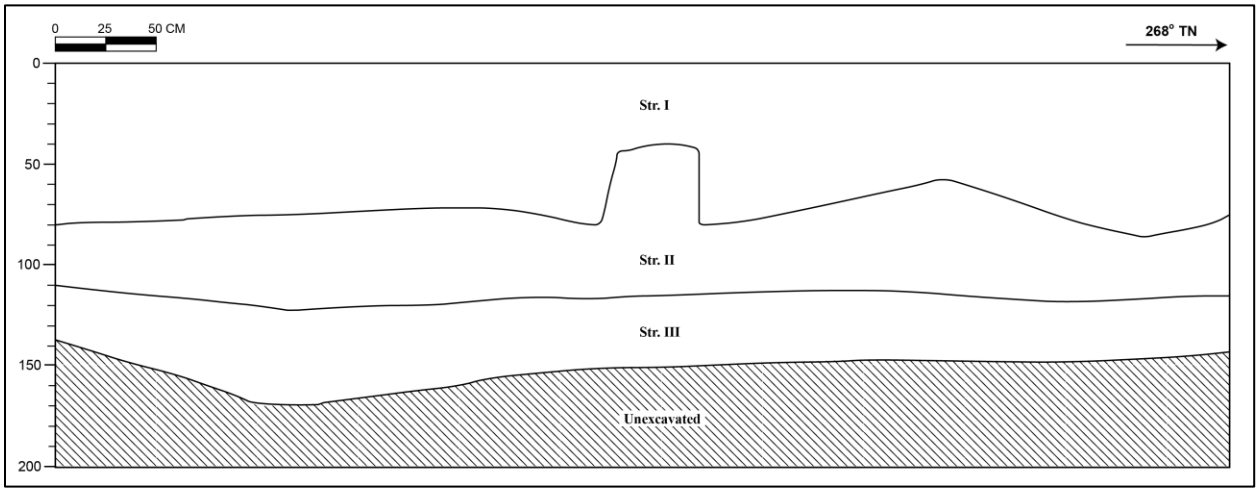



Figure 16. TE-4, stratigraphy of the south wall

Table 4. Strata observed at TE-4

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–90 | Ap horizon; 10YR 3/2, very dark grayish brown; gravelly silty clay loam; moderate, fine granular structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; many fine to medium roots; clear, irregular lower boundary; concrete pieces observed |
| II | 43–123 | Previously disturbed natural; 10YR 4/3, brown; gravelly silty clay loam; strong, very fine granular structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; few fine roots; clear, smooth lower boundary |
| III | 110–170 | Natural; 10YR 3/3, dark brown; silty clay; strong, very fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.5 Test Excavation 5 (TE-5)

TE-5 was placed in the western half of the proposed connection corridor segment of the project area (Figure 17). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.72 mbs. The stratigraphy of TE-5 consisted of a very dark grayish brown, gravelly silty clay loam Ap horizon (Stratum I) overlying dark grayish brown, previously disturbed, natural silty clay loam (Stratum II) and dark brown, natural silty clay (Stratum III) (Figure 18 through Figure 20 and Table 5). A piece of concrete was observed in Stratum I.



Figure 17. TE-5, overview of the general location, view to west



Figure 18. TE-5, close-up of the south wall, view to south



Figure 19. TE-5, oblique view of the south wall, view to southwest

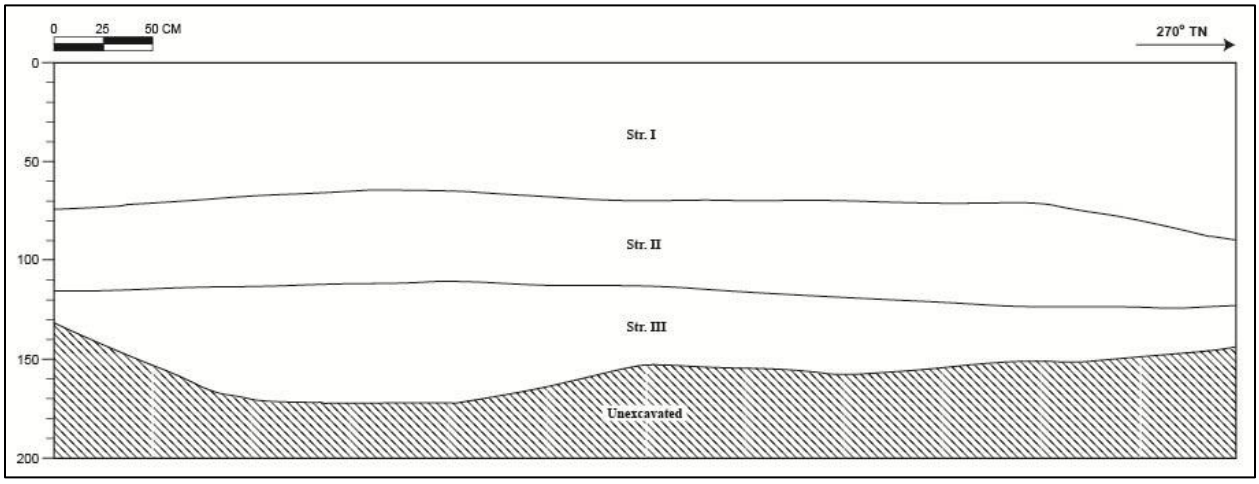



Figure 20. TE-5, stratigraphy of the south wall

Table 5. Strata observed at TE-5

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–88 | Ap horizon; 10YR 3/2, very dark grayish brown; gravelly silty clay loam; moderate, fine granular structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; many fine roots; clear, smooth lower boundary; concrete piece observed |
| II | 64–123 | Previously disturbed natural; 10YR 4/2, dark grayish brown; silty clay loam; moderate, very fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; few fine roots; abrupt, smooth lower boundary |
| III | 110–172 | Natural; 10YR 3/3, dark brown; silty clay; strong, very fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.6 Test Excavation 6 (TE-6)

TE-6 was placed in the western half of the proposed connection corridor segment of the project area (Figure 21). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.70 mbs. The stratigraphy of TE-6 consisted of a very dark grayish brown, gravelly silty clay loam Ap horizon (Stratum I) overlying brown, previously disturbed, natural silty clay loam (Stratum II) and dark brown, natural silty clay (Stratum III) (Figure 22 through Figure 24 and Table 6). Concrete fragments were observed in Stratum I.



Figure 21. TE-6, overview of the general location, view to west



Figure 22. TE-6, close-up of the south wall, view to south



Figure 23. TE-6, oblique view of the south wall, view to southwest

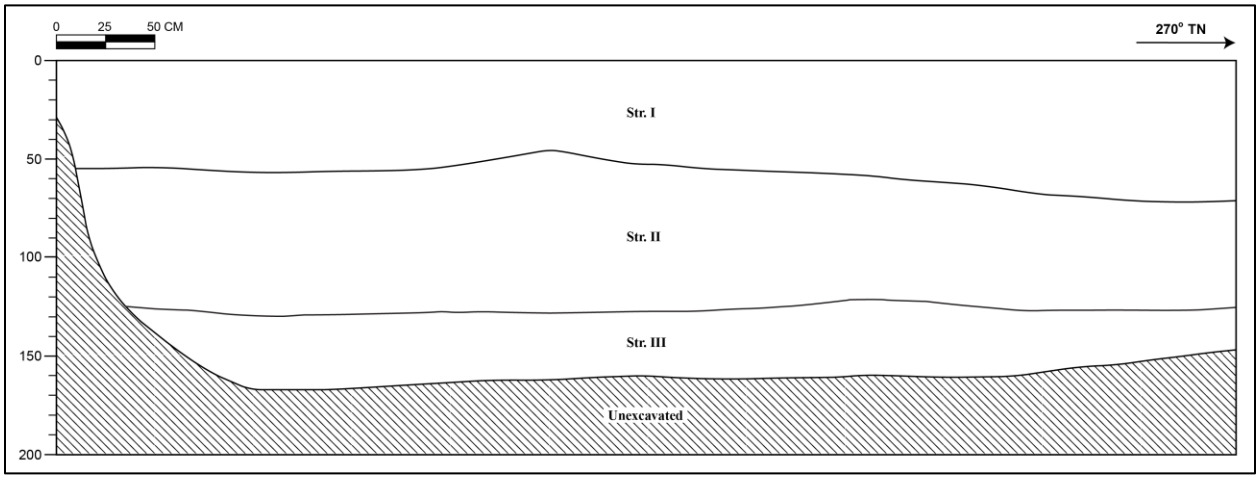



Figure 24. TE-6, stratigraphy of the south wall

Table 6. Strata observed at TE-6

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–70 | Ap horizon; 10YR 3/2, very dark grayish brown; gravelly silty clay loam; moderate, medium granular structure; dry, hard consistence; strong cementation; slightly plastic; terrigenous origin; many fine roots; clear, irregular lower boundary; concrete pieces observed |
| II | 35–130 | Natural; 10YR 4/3, brown; silty clay loam; strong, medium blocky structure; dry, hard consistence; no cementation; plastic; terrigenous origin; few fine roots; abrupt, smooth lower boundary |
| III | 120–167 | Natural; 10YR 3/3, dark brown; silty clay; strong, very fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.7 Test Excavation 7 (TE-7)

TE-7 was placed in the central portion of the proposed connection corridor segment of the project area (Figure 25). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.68 mbs. The stratigraphy of TE-7 consisted of a very dark grayish brown, gravelly silty clay loam Ap horizon with mottles of brown, silty clay loam (Stratum I) overlying a brown, previously disturbed, natural silty clay loam (Stratum II) and dark brown, natural silty clay (Stratum III) (Figure 26 through Figure 28 and Table 7). Pieces of concrete and a PVC pipe cap were observed in Stratum I.



Figure 25. TE-7, overview of the general location, view to east



Figure 26. TE-7, close-up of the south wall, view to south



Figure 27. TE-7, oblique view of the south wall, view to southwest

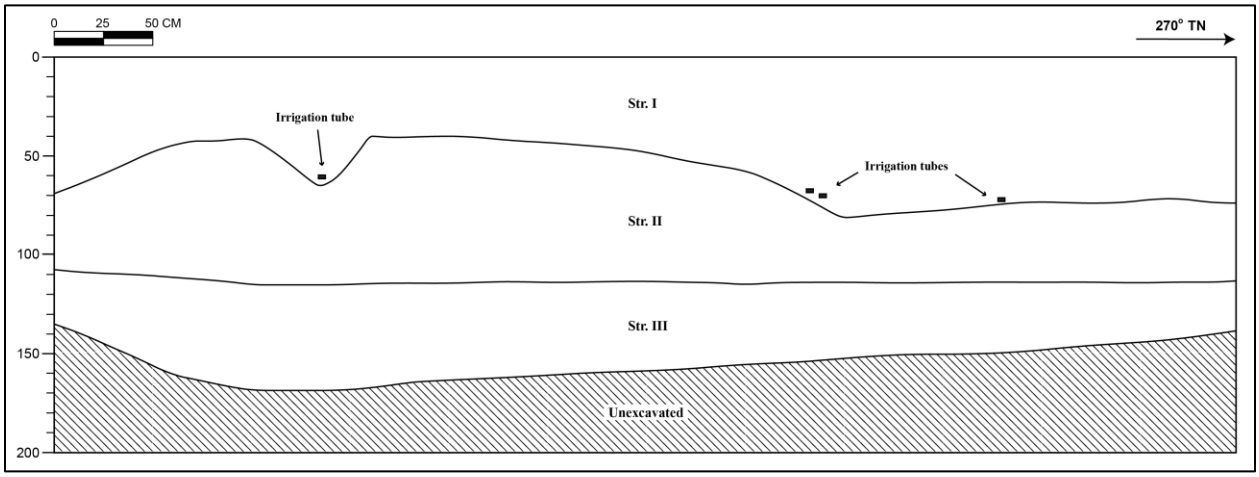



Figure 28. TE-7, stratigraphy of the south wall

Table 7. Strata observed at TE-7

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–80 | Ap horizon; 10YR 3/2, very dark grayish brown; gravelly silty clay loam; moderate, medium granular structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; many fine roots; clear, irregular lower boundary; contained mottles of 10YR 4/3, brown silty clay loam; pieces of concrete and a PVC pipe cap observed |
| II | 40–115 | Previously disturbed natural; 10YR 4/3, brown; silty clay loam; strong, medium blocky structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; fine roots common; clear, smooth lower boundary |
| III | 108–168 | Natural; 10YR 3/3, dark brown; silty clay; strong, very fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.8 Test Excavation 8 (TE-8)

TE-8 was placed in the central portion of the proposed connection corridor segment of the project area (Figure 29). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.82 mbs. The stratigraphy of TE-8 consisted of very dark grayish brown, gravelly silty clay loam Ap horizon (Stratum I) overlying a brown, previously disturbed, natural silty clay loam (Stratum II) and dark brown, natural silty clay (Stratum III) (Figure 30 through Figure 32 and Table 8). Several root moulds from Stratum II intrude into Stratum III. A piece of concrete was observed near the surface of Stratum I.



Figure 29. TE-8, overview of the general location, view to west



Figure 30. TE-8, close-up of the south wall, view to south



Figure 31. TE-8, oblique view of the south wall, view to southeast

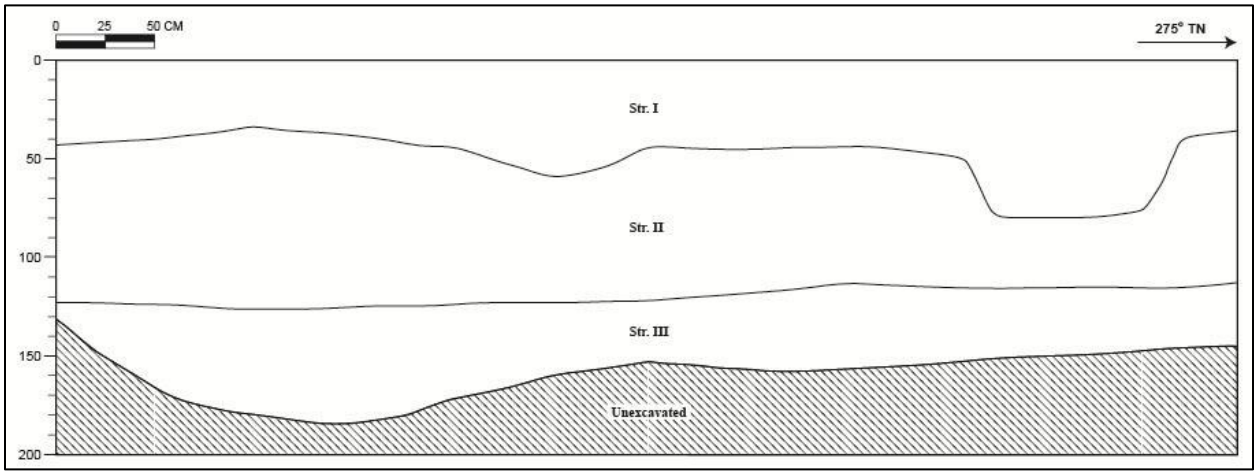



Figure 32. TE-8, stratigraphy of the south wall

Table 8. Strata observed at TE-8

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–58 | Ap horizon; 10YR 3/2, very dark grayish brown; gravelly silty clay loam; moderate, medium granular structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; many fine roots; clear, irregular lower boundary; contained very coarse mottles of 10YR 4/3, brown, silty clay loam; concrete piece observed |
| II | 33–125 | Previously disturbed natural; 10YR 4/3, brown; silty clay loam; strong, fine blocky structure; dry, hard consistence; no cementation; plastic; terrigenous origin; fine roots common; clear, smooth lower boundary |
| III | 110–182 | Natural; 10YR 3/3, dark brown; silty clay; strong, very fine granular structure; dry, hard consistence; no cementation; plastic; terrigenous origin; few fine roots; lower boundary not observed; contained root mould intrusions from Stratum II |

### 1.1.9 Test Excavation 9 (TE-9)

TE-9 was placed in the central portion of the proposed connection corridor segment of the project area (Figure 33). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.63 mbs. The stratigraphy of TE-9 consisted of a very dark grayish brown, gravelly silty clay loam Ap horizon (Stratum I) overlying brown, previously disturbed, natural silty clay loam (Stratum II); and dark brown, natural silty clay (Stratum III) (Figure 34 through Figure 36 and Table 9). Stratum II contained mottles of gravelly sandy clay loam composed of fine alluvial streambed gravels, and several root moulds from Stratum II intrude into Stratum III. Two concrete fragments were observed in Stratum I.



Figure 33. TE-9, overview of the general location, view to west



Figure 34. TE-9, close-up of the south wall, view to south



Figure 35. TE-9, oblique view of the south wall, view to southeast

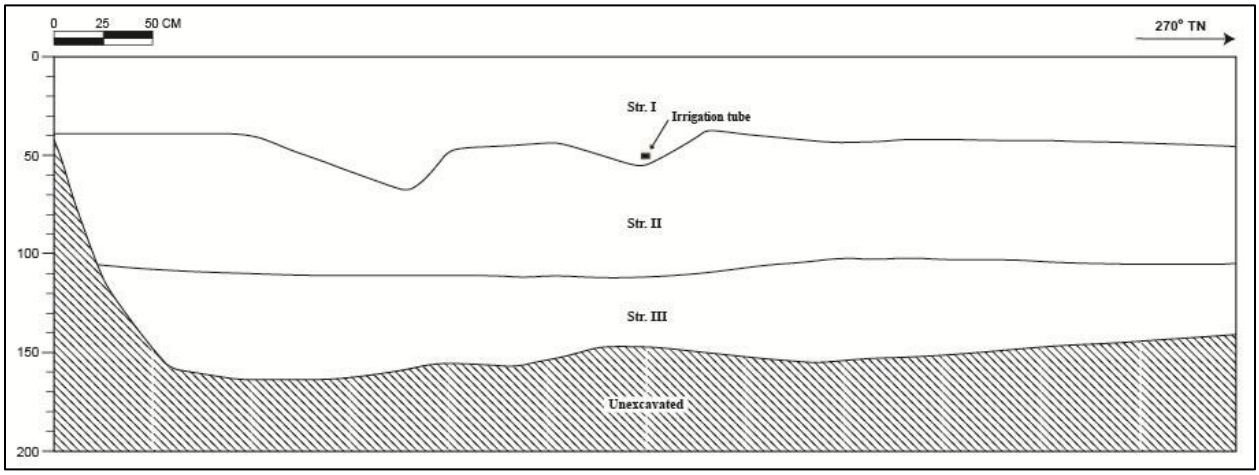



Figure 36. TE-9, stratigraphy of the south wall

Table 9. Strata observed at TE-9

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–67 | Ap horizon; 10YR 3/2, very dark grayish brown; gravelly silty clay loam; moderate, medium granular structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; many fine roots; clear, wavy lower boundary; concrete pieces observed |
| II | 36–110 | Previously disturbed natural; 10YR 4/3, brown; silty clay loam; strong, fine blocky structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; fine roots common; clear, smooth lower boundary; contained few very coarse mottles of 10YR 3/2, very dark grayish brown, gravelly sandy clay loam composed of fine alluvial streambed gravel |
| III | 100–163 | Natural; 10YR 3/3, dark brown; silty clay; strong, very fine granular structure; moist, firm consistence; no cementation; plastic; terrigenous origin; few fine roots; lower boundary not observed; contained root mould intrusions from Stratum II |

### 1.1.10 Test Excavation 10 (TE-10)

TE-10 was placed in the eastern half of the proposed connection corridor segment of the project area (Figure 37). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.60 mbs. The stratigraphy of TE-10 consisted of a very dark grayish brown, gravelly silty clay loam Ap horizon (Stratum I) and brown, previously disturbed, natural silty clay loam (Stratum II) overlying a brown, natural extremely gravelly sandy clay loam alluvial streambed deposit (Stratum III); brown, natural silty clay loam (Stratum IV); a very dark grayish brown, natural extremely gravelly sandy clay loam alluvial streambed deposit (Stratum V); brown, natural silty clay loam (Stratum VI); and dark brown, natural silty clay (Stratum VII) (Figure 38 through Figure 41 and Table 10). Stratum II contained an unconsolidated pit that intruded into Strata III and IV. Root moulds from Stratum VI intrude into Stratum VII. A piece of concrete was observed in Stratum I.



Figure 37. TE-10, overview of the general location, view to east



Figure 38. TE-10, close-up of the south wall, view to south



Figure 39. TE-10, oblique view of the south wall, view to southeast



Figure 40. TE-10, overview of the south wall, view to southwest

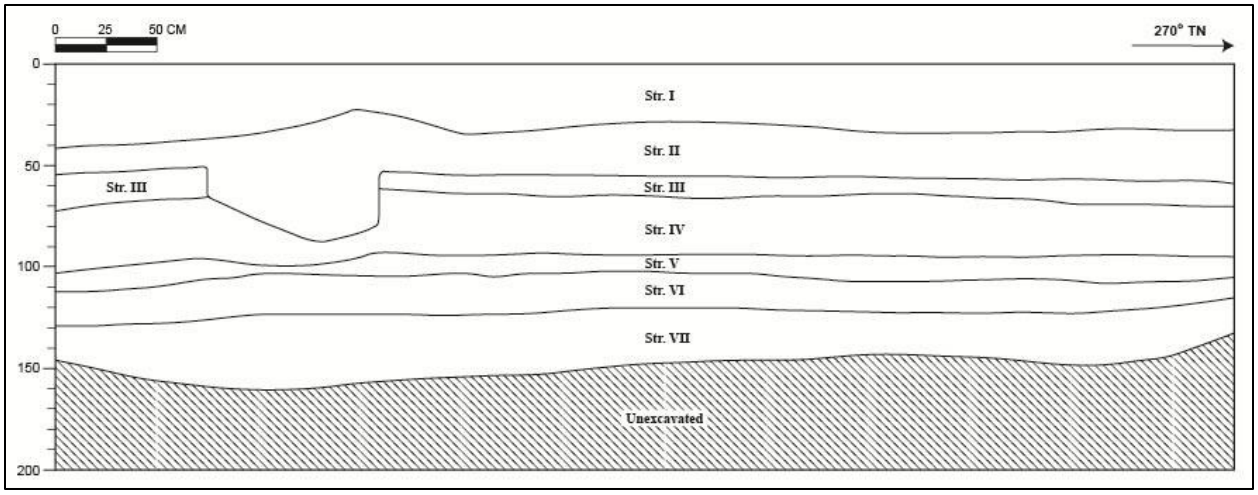



Figure 41. TE-10, stratigraphy of the south wall

Table 10. Strata observed at TE-10

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–43 | Ap horizon; 10YR 3/2, very dark grayish brown; gravelly silty clay loam; moderate coarse granular structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; many fine roots; clear, wavy lower boundary; concrete piece observed |
| II | 22–87 | Previously disturbed natural; 10YR 4/3, brown; silty clay loam; moderate, very coarse blocky structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; fine roots common; clear, irregular lower boundary |
| III | 50–72 | Natural; 10YR 4/3, brown; extremely gravelly sandy clay loam; weak, very fine granular structure; moist, loose consistence; no cementation; non-plastic; terrigenous origin; few fine roots; abrupt, broken lower boundary; contained approximately 90% alluvial gravels |
| IV | 60–103 | Natural; 10YR 4/3, brown; silty clay loam; weak, fine blocky structure; moist, friable consistence; no cementation; slightly plastic; terrigenous origin; few fine roots; diffuse, broken lower boundary |
| V | 92–112 | Natural; 10YR 3/2, very dark grayish brown; extremely gravelly sandy clay loam; weak, fine granular structure; dry, weakly coherent consistence; no cementation; slightly plastic; terrigenous origin; fine roots common; very abrupt, smooth lower boundary; contained approximately 90% alluvial gravels |
| VI | 100–130 | Natural; 10YR 4/3, brown; silty clay loam; weak, fine blocky structure; moist, firm consistence; no cementation; slightly plastic; terrigenous origin; few fine roots; clear, smooth lower boundary |
| VII | 113–160 | Natural; 10YR 3/3, dark brown; silty clay; weak, very fine granular structure; moist, firm consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed; contained a concentration of 10YR 4/3, brown; silty clay loam |

### 1.1.11 Test Excavation 11 (TE-11)

TE-11 was placed in the eastern half of the proposed connection corridor segment of the project area (Figure 42). The excavation was 5.5 m long by 1.0 m wide with a maximum depth of 1.63 mbs. The trench was shortened due to mechanical issues with the backhoe. The stratigraphy of TE-11 consisted of a very dark grayish brown, gravelly silty clay loam Ap horizon (Stratum I) overlying dark grayish brown, previously disturbed, natural silty clay loam (Stratum II); a very dark grayish brown, natural extremely gravelly sandy loam alluvial streambed deposit (Stratum III); brown, natural silty clay loam (Stratum IV); and dark brown, natural silty clay (Stratum V) (Figure 43 through Figure 45 and Table 11). Several concrete pieces were observed in Stratum I.



Figure 42. TE-11, overview of the general location, view to west



Figure 43. TE-11, close-up of the south wall, view to south



Figure 44. TE-11, oblique view of the south wall, view to southwest

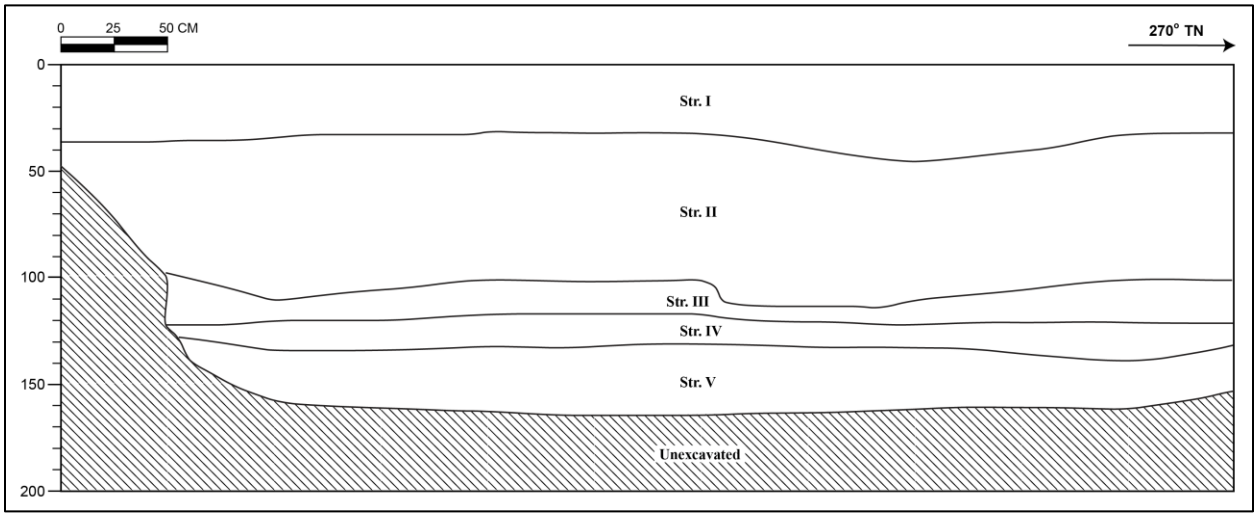



Figure 45. TE-11, stratigraphy of the south wall

Table 11. Strata observed at TE-11

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–45 | Ap horizon; 10YR 3/2, very dark grayish brown; gravelly silty clay loam; moderate, coarse granular structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; many fine roots; clear, wavy lower boundary |
| II | 32–116 | Previously disturbed natural; 10YR 4/2, dark grayish brown; silty clay loam; moderate, coarse blocky structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; fine roots common; abrupt, smooth lower boundary |
| III | 100–122 | Previously disturbed natural; 10YR 3/2, very dark grayish brown; extremely gravelly sandy loam; structureless (single grain); no cementation; non-plastic; mixed origin; few fine roots; abrupt, smooth lower boundary; contained approximately 90% alluvial gravel |
| IV | 116–137 | Natural; 10YR 4/3, brown; silty clay loam; weak, fine granular structure; moist, firm consistence; no cementation; plastic; terrigenous origin; no roots; clear, smooth lower boundary |
| V | 127–163 | Natural; 10YR 3/3, dark brown; silty clay; weak, fine granular structure; moist friable consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.12 Test Excavation 12 (TE-12)

TE-12 was placed in the eastern half of the proposed connection corridor segment of the project area (Figure 46). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.82 mbs. The stratigraphy of TE-12 consisted of a very dark grayish brown, gravelly silty clay loam Ap horizon (Stratum I) overlying dark grayish brown, previously disturbed, natural silty clay loam (Stratum II); a very dark grayish brown, natural, extremely gravelly loamy sand alluvial streambed deposit mottled with brown, silty clay loam (Stratum III); dark yellowish brown, natural silty clay (Stratum IV); a dark brown, extremely gravelly loamy sand alluvial streambed deposit (Stratum V); dark yellowish brown, natural gravelly silt loam (Stratum VI); and dark brown, natural silty clay (Stratum VII) (Figure 47 through Figure 49 and Table 12). Two concrete fragments were observed in Stratum I.



Figure 46. TE-12, overview of the general location, view to west



Figure 47. TE-12, close-up of the south wall, view to south



Figure 48. TE-12, oblique view of the south wall, view to southwest

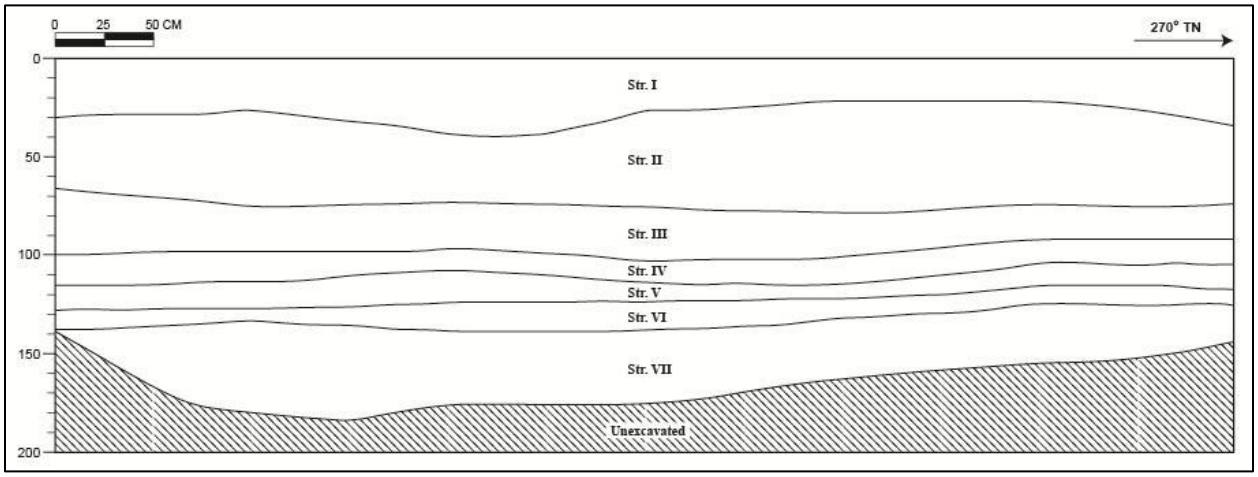



Figure 49. TE-12, stratigraphy of the south wall

Table 12. Strata observed at TE-12

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–38 | Ap horizon; 10YR 3/2, very dark grayish brown; gravelly silty clay loam; moderate, coarse granular structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; many fine roots; clear, wavy lower boundary; pieces of concrete observed |
| II | 20–78 | Previously disturbed natural; 10YR 4/2, dark grayish brown; gravelly silty clay loam; moderate, very coarse blocky structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; many fine roots; clear, smooth lower boundary |
| III | 65–102 | Natural; 10YR 4/2, dark grayish brown; extremely gravelly loamy sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; mixed origin; fine roots common; abrupt, smooth lower boundary; contained approximately 90% alluvial gravel; and common mottles of 10YR 4/3, brown silty clay loam |
| IV | 90–114 | Natural; 10YR 3/4, dark yellowish brown; silty clay; weak, very fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; common fine roots; abrupt, smooth lower boundary |
| V | 103–128 | Natural; 10YR 3/3, dark brown; extremely gravelly loamy sand; structureless (single grain); moist loose consistence; no cementation; non-plastic; terrigenous origin; fine roots common; abrupt, smooth lower boundary; contained approximately 90% alluvial gravel |
| VI | 113–138 | Natural; 10YR 4/4, dark yellowish brown; gravelly silt loam; weak, fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots, diffuse, smooth lower boundary |
| VII | 122–182 | Natural; 10YR 3/3, dark brown; silty clay; weak, medium granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots, lower boundary not observed |

### 1.1.13 Test Excavation 13 (TE-13)

TE-13 was placed in the eastern half of the proposed connection corridor segment of the project area (Figure 50). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.71 mbs. The stratigraphy of TE-13 consisted of a very dark grayish brown, gravelly silty clay loam Ap horizon (Stratum I) overlying brown, previously disturbed, natural silty clay loam (Stratum II); a brown, natural extremely gravelly sandy clay loam alluvial streambed deposit (Stratum III); dark yellowish brown, natural silt loam (Stratum IV); and dark brown, natural silty clay (Stratum V) (Figure 51 through Figure 53 and Table 13). A concrete fragment was observed in Stratum I.



Figure 50. TE-13, overview of the general location, view to west



Figure 51. TE-13, close-up of the south wall, view to south



Figure 52. TE-13, oblique view of the south wall, view to southwest

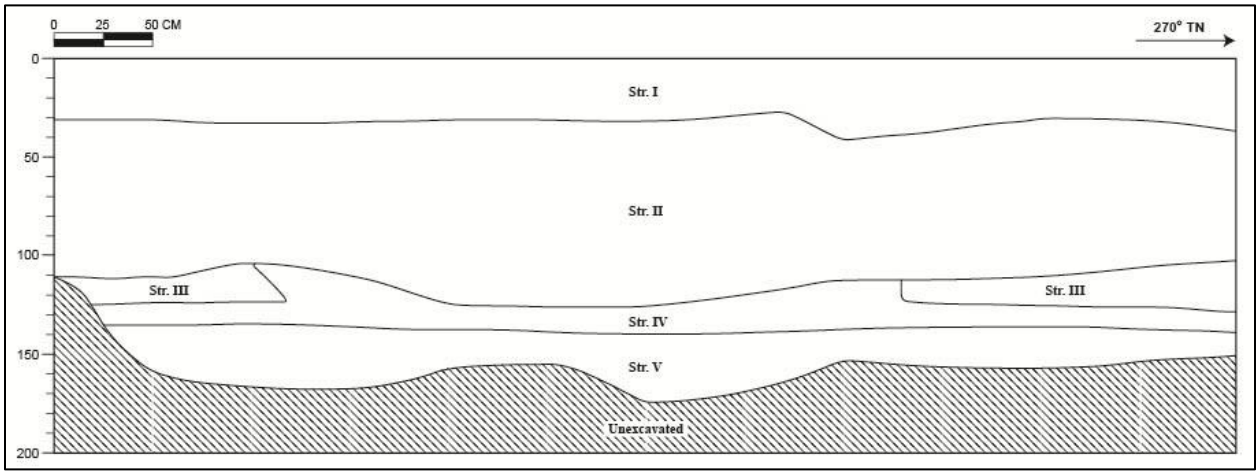



Figure 53. TE-13, stratigraphy of the south wall

Table 13. Strata observed at TE-13

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–40 | Ap horizon; 10YR 3/2, very dark grayish brown; gravelly silty clay loam; moderate, coarse granular structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; many fine roots; clear, wavy lower boundary |
| II | 25–124 | Previously disturbed natural; 10YR 4/3, brown; gravelly silty clay loam; moderate, very coarse blocky structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; many fine roots; wavy lower boundary that is abrupt over Stratum III and diffuse over Stratum IV |
| III | 92–125 | Natural; 10YR 4/3, brown; extremely gravelly sandy clay loam; weak, fine granular structure; moist, loose consistence; no cementation; slightly plastic; terrigenous origin; few fine roots; clear, broken lower boundary; alluvial streambed deposit |
| IV | 92–137 | Natural; 10YR 3/4, dark yellowish brown; silt loam; weak, fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; few fine roots; diffuse, smooth lower boundary |
| V | 133–171 | Natural; 10YR 3/3, dark brown; silty clay; moderate, fine granular structure; moist friable consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.14 Test Excavation 14 (TE-14)

TE-14 was placed in the eastern half of the proposed connection corridor segment of the project area (Figure 54). The excavation was 6.0 m long by 1.0 m wide with a base of excavation (BOE) of 1.66 mbs that was extended to 1.81 mbs across the center length of the trench. The stratigraphy of TE-14 consisted of very dark grayish brown, gravelly silty clay loam Ap horizon (Stratum I) overlying a brown, previously disturbed, natural silty clay loam mottled with alluvial streambed gravel (Stratum II); a brown, natural extremely gravelly loamy sand alluvial streambed deposit (Stratum III); brown, natural silty clay loam (Stratum IV); a brown, natural loamy sand buried A horizon (Stratum V); pale brown, natural sand (Stratum VI); and yellowish brown, natural sand with calcium carbonate ($CaCO_3$) mottling (Stratum VII) (Figure 54 through Figure 58 and Table 14). As the base layer consisted of natural sand, a 15-cm-deep, shovel-wide slit trench was hand excavated through the center of the BOE, and no features or a change in stratigraphy were observed (see Figure 57). Four concrete fragments were observed in Strata I and II. An approximate 3.0-gallon sediment sample from the buried A horizon (Stratum V) was screened in the field, and no cultural materials were encountered.



Figure 54. TE-14, overview of the general location, view to west



Figure 55. TE-14, close-up of the south wall, view to south



Figure 56. TE-14, oblique view of the south wall, view to southeast



Figure 57. TE-14, overview of the south was showing the screened sample location and slit trench

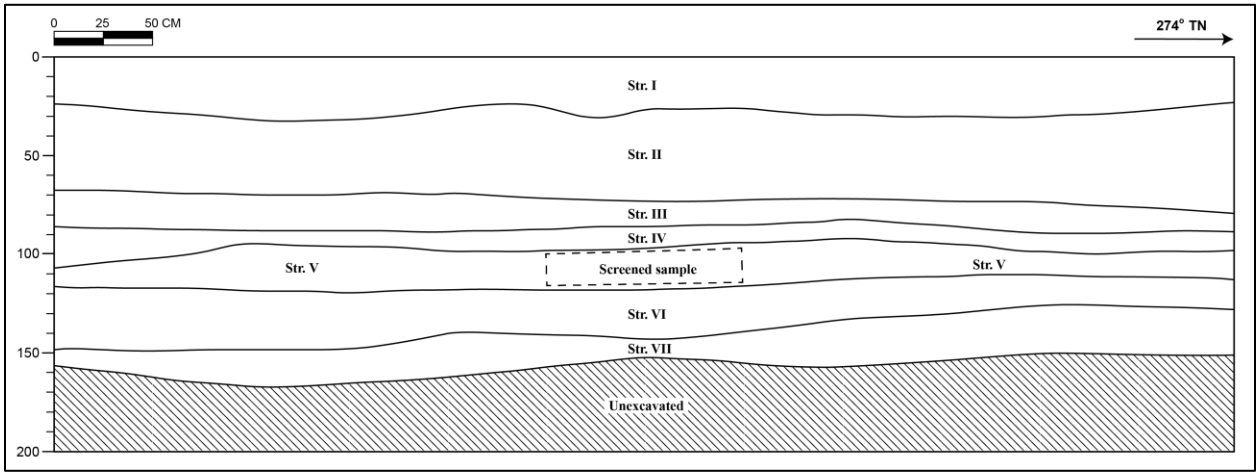



Figure 58. TE-14, stratigraphy of the south wall

Table 14. Strata observed at TE-14

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–32 | Ap horizon; 10YR 3/2, very dark grayish brown; gravelly silty clay loam; moderate, coarse granular structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; many fine roots; clear, wavy lower boundary; concrete pieces observed |
| II | 20–76 | Previously disturbed natural; 10YR 4/3, brown; silty clay loam; moderate, very coarse blocky structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; fine roots common; clear, smooth lower boundary; concrete pieces observed |
| III | 92–125 | Natural; 10YR 4/3, brown; extremely gravelly loamy sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; terrigenous origin; few fine roots; abrupt, smooth lower boundary; alluvial streambed deposit |
| IV | 80–108 | Natural; 10YR 4/3, brown; silty clay loam; weak, medium granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; clear, smooth lower boundary |
| V | 90–118 | Buried A horizon; 10YR 4/3, brown; loamy sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; mixed origin; no roots; diffuse, smooth lower boundary; non-cultural |
| VI | 110–148 | Natural; 10YR 6/3, pale brown; sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; marine origin; no roots; diffuse, smooth lower boundary |
| VII | 123–181 | Natural; 10YR 5/6, yellowish brown; sand; structureless (single grain); dry, loose consistence; weak cementation; non-plastic; marine origin; no roots; lower boundary not observed; contained mottles of 10YR 7/1; light gray $CaCO_3$ |

### 1.1.15 Test Excavation 15 (TE-15)

TE-15 was placed in the eastern half of the proposed connection corridor segment of the project area (Figure 59). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.79 mbs. The stratigraphy of TE-15 consisted of a very dark grayish brown, gravelly silty clay loam Ap horizon (Stratum I) overlying brown, previously disturbed, natural silty clay loam (Stratum II); dark brown, natural silty clay (Stratum III); dark yellowish brown, natural silt loam (Stratum IV); and dark brown, natural very gravelly silty clay loam (Stratum V) (Figure 60 through Figure 62 and Table 15). No cultural materials were encountered.



Figure 59. TE-15, overview of the general location, view to west



Figure 60. TE-15, close-up of the south wall, view to south



Figure 61. TE-15, oblique view of the south wall, view to southeast

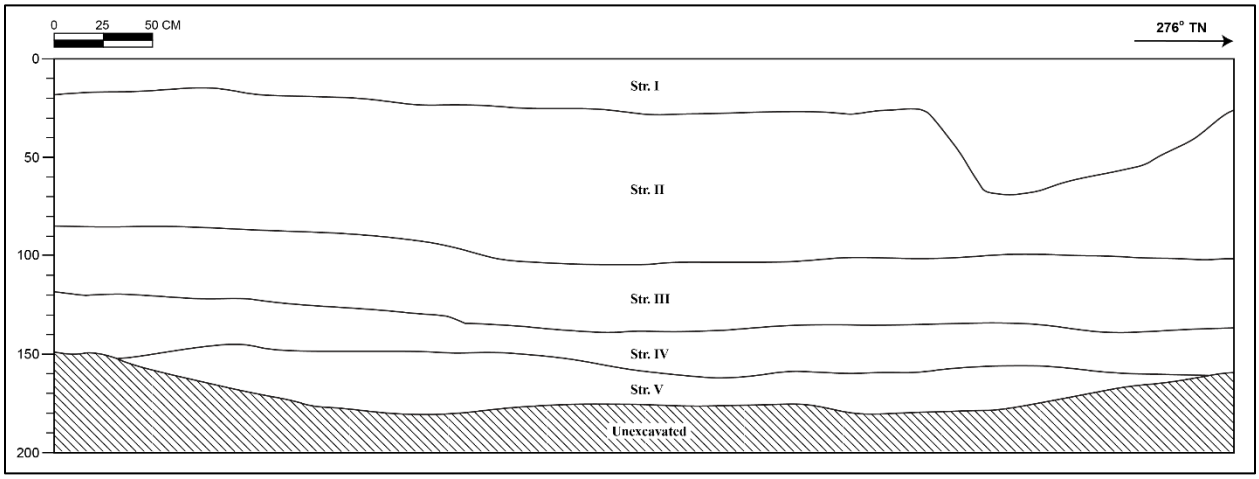



Figure 62. TE-15, stratigraphy of the south wall

Table 15. Strata observed at TE-15

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–65 | Ap horizon; 10YR 2/2, very dark brown; gravelly silty clay loam; moderate, very coarse granular structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; many fine roots; clear, wavy lower boundary |
| II | 16–103 | Previously disturbed natural; 10YR 4/3, brown; silty clay loam; moderate, coarse blocky structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; fine roots common; diffuse, smooth lower boundary |
| III | 85–136 | Natural; 10YR 3/3, dark brown; silty clay; weak, very fine granular structure; moist, firm consistence; no cementation; plastic; terrigenous origin; no roots; clear, smooth lower boundary |
| IV | 120–157 | Natural; 10YR 4/4, dark yellowish brown; silt loam; weak, fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; clear, irregular lower boundary |
| V | 157–179 | Natural; 10YR 3/3, dark brown; very gravelly silty clay loam; weak, fine granular structure; moist friable consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.16 Test Excavation 16 (TE-16)

TE-16 was placed at the eastern end of the proposed connection corridor segment of the project area (Figure 63). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.60 mbs. The stratigraphy of TE-16 consisted of a very dark grayish brown, gravelly silty clay loam Ap horizon (Stratum I) overlying brown, previously disturbed, natural silty clay loam (Stratum II); dark yellowish brown, natural silty clay (Stratum III); yellowish brown, natural silt loam (Stratum IV); alluvial streambed gravel (Stratum V); and yellowish brown, natural silt loam (Stratum VI) (Figure 64 through Figure 66 and Table 16). No cultural materials were encountered.



Figure 63. TE-16, overview of the general location, view to east



Figure 64. TE-16, close-up of the south wall, view to south



Figure 65. TE-16, oblique view of the south wall, view to southeast

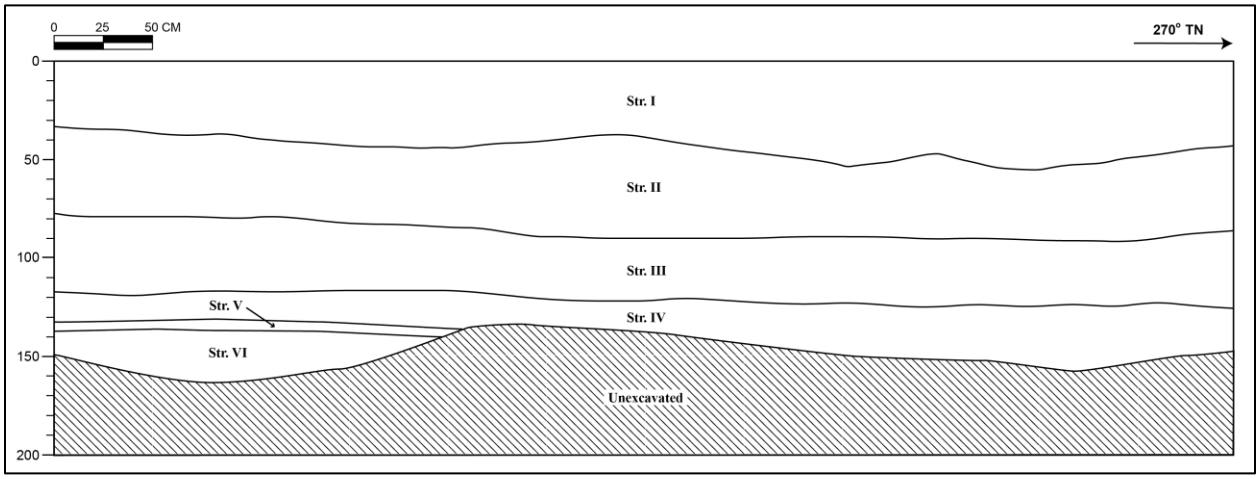



Figure 66. TE-16, stratigraphy of the south wall

Table 16. Strata observed at TE-16

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–53 | Ap horizon; 10YR 3/2, very dark grayish brown; gravelly silty clay loam; moderate, very coarse granular structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; many fine roots; clear, wavy lower boundary |
| II | 32–88 | Previously disturbed natural; 10YR 4/3, brown; silty clay loam; moderate, coarse blocky structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; fine roots common; diffuse, smooth lower boundary |
| III | 77–124 | Natural; 10YR 3/4, dark yellowish brown; silty clay; weak, fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; few fine roots; diffuse, smooth lower boundary |
| IV | 115–158 | Natural; 10YR 5/4, yellowish brown; silt loam; weak, very fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; abrupt, smooth lower boundary |
| V | 130–140 | 10YR 4/4, dark yellowish brown, extremely gravelly silty clay loam weak, very fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; abrupt, smooth lower boundary; alluvial streambed gravel |
| VI | 136–160 | Natural; 10YR 5/4, yellowish brown; silt loam; weak, very fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.17 Test Excavation 17 (TE-17)

TE-17 was placed in the northwestern corner of the Central Maui WWRF segment of the project area (Figure 67). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.50 mbs. The stratigraphy of TE-17 consisted of a very dark grayish brown, gravelly loam Ap horizon (Stratum I) overlying dark grayish brown, gravelly sandy clay loam fill (Stratum II); a dark yellowish brown, sandy loam buried A horizon (Stratum III); and brown, natural silty clay loam (Stratum IV) (Figure 68 through Figure 72 and Table 17). A piece of concrete was observed in Stratum I. The buried A horizon (Stratum III) contained burnt wood, charcoal, and light white ash from a burn event. A 3.0-gallon sediment sampled from Stratum III was screened in the field and was absent of cultural material.



Figure 67. TE-17, overview of the general location, view to east



Figure 68. TE-17, close-up of the west wall, view to west



Figure 69. TE-17, oblique view of the west wall, view to southwest



Figure 70. TE-17, close-up of the west wall showing the screened sample location, view to west



Figure 71. TE-17, overview of the west wall showing the screened sample location, view to northwest

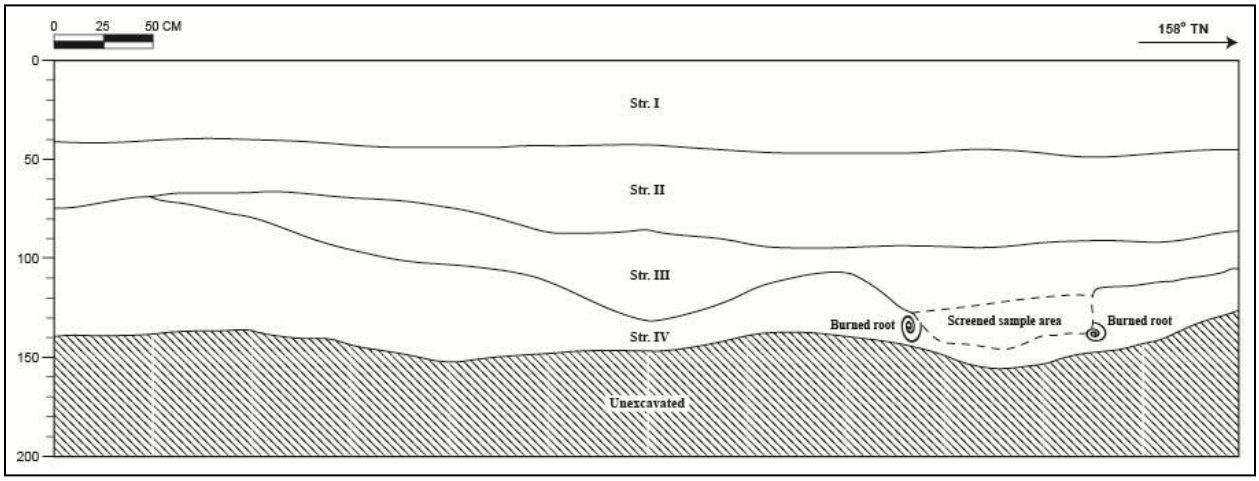



Figure 72. TE-17, stratigraphy of the west wall

Table 17. Strata observed at TE-17

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–46 | Ap horizon; 10YR 3/2, very dark grayish brown; gravelly loam; moderate, medium granular structure; dry, hard consistence; no cementation; slightly plastic; mixed origin; fine roots common; clear, smooth lower boundary |
| II | 40–90 | Fill; 10YR 4/2, dark grayish brown; gravelly sandy clay loam; weak, fine granular structure; dry, hard consistence; no cementation; plastic; terrigenous origin; few fine roots; clear, wavy lower boundary |
| III | 64–142 | Buried A horizon; 10YR 3/4, dark yellowish brown; sandy loam; weak, very fine granular structure; dry, weakly coherent consistence; no cementation; non-plastic; mixed origin; no roots; clear, wavy lower boundary; contained many mottles of 10YR 4/2, dark grayish brown sand and 10YR 7/1, light gray sand |
| IV | 68–150 | Natural; 10YR 4/3, brown; silty clay loam; weak, very fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.18 Test Excavation 18 (TE-18)

TE-18 was placed near the northern edge of the Central Maui WWRF segment of the project area (Figure 73). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.52 mbs. The stratigraphy of TE-18 consisted of a brown, gravelly loam Ap horizon (Stratum I) overlying brown, previously disturbed, natural gravelly sandy clay loam (Stratum II); brown, natural silty clay loam (Stratum III); brown, natural sandy clay loam (Stratum IV); and pale brown, natural sand (Stratum V) (Figure 74 through Figure 76 and Table 18). Pieces of plastic PVC were observed in Stratum I.



Figure 73. TE-18, overview of the general location, view to east



Figure 74. TE-18, close-up of the east wall, view to east



Figure 75. TE-18, oblique view of the east wall, view to northeast

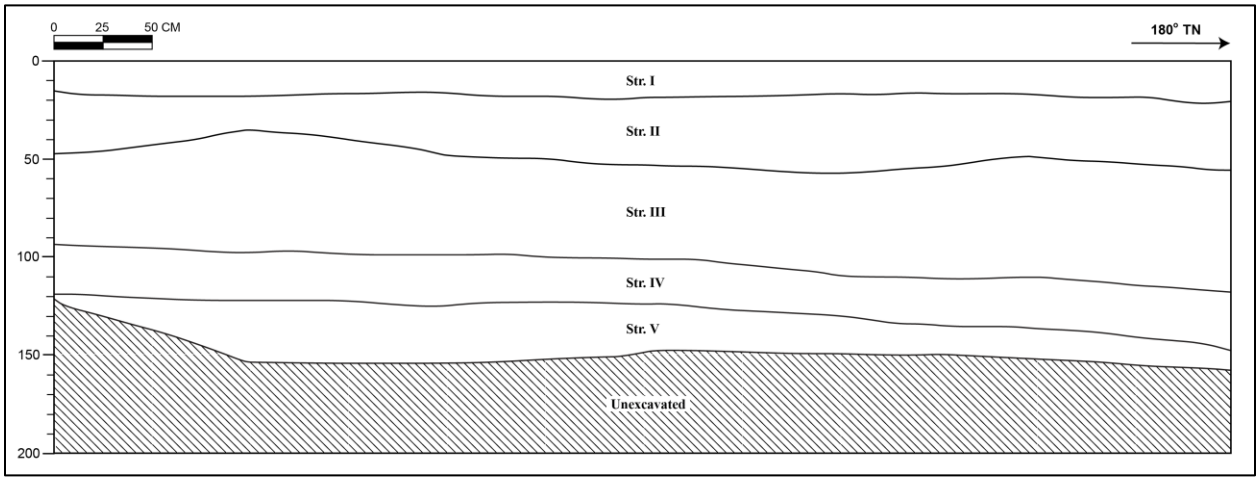



Figure 76. TE-18, stratigraphy of the east wall

Table 18. Strata observed at TE-18

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–19 | Ap horizon; 10YR 4/3, brown; gravelly loam; moderate, coarse granular structure; dry, hard consistence; no cementation; slightly plastic; mixed origin; many fine roots; clear, wavy lower boundary |
| II | 15–55 | Previously disturbed natural; 10YR 4/3, brown; gravelly sandy clay loam; weak, fine blocky structure; dry, hard consistence; no cementation; plastic; terrigenous origin; few fine roots; clear, smooth lower boundary |
| III | 34–115 | Natural; 10YR 4/3, brown; silty clay loam; weak, coarse blocky structure; moist, friable consistence; no cementation; plastic; terrigenous origin; few fine roots; diffuse, smooth lower boundary |
| IV | 93–143 | Natural; 10YR 4/3, brown; sandy clay loam; weak, fine granular structure; moist, friable consistence; no cementation; plastic; mixed origin; no roots; clear, smooth lower boundary |
| V | 118–152 | Natural; 10YR 6/3, pale brown; sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; marine origin; no roots; lower boundary not observed; contained common mottles of 10YR 5/6, yellowish brown sand |

### 1.1.19 Test Excavation 19 (TE-19)

TE-19 was placed near the northern edge of the Central Maui WWRF segment of the project area (Figure 77). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.49 mbs. The stratigraphy of TE-19 consisted of a brown, gravelly sandy loam Ap horizon (Stratum I) overlying brown, previously disturbed, natural sandy clay loam (Stratum II); brown, natural sand with $CaCO_3$ mottling (Stratum III); dark brown, natural gravelly silty clay loam (Stratum IV); and a natural alluvial streambed deposit (Stratum V) (Figure 78 through Figure 80 and Table 19). Stratum I contained two PVC pipes.



Figure 77. TE-19, overview of the general location, view to northwest



Figure 78. TE-19, close-up of the east wall, view to east



Figure 79. TE-19, oblique view of the east wall, view to north

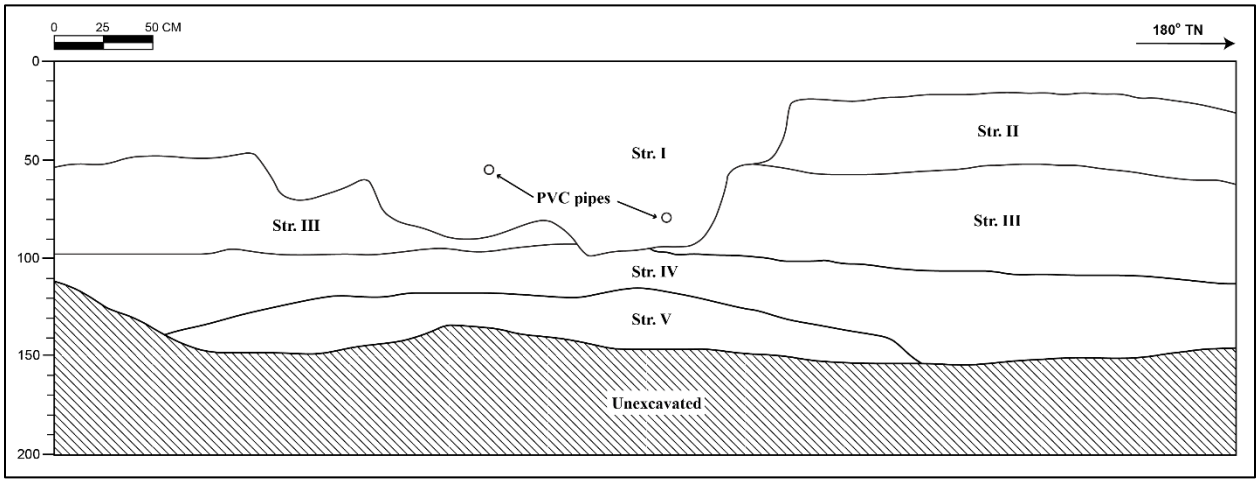



Figure 80. TE-19, stratigraphy of the east wall

Table 19. Strata observed at TE-19

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–96 | Ap horizon; 10YR 4/3, brown; gravelly sandy loam; moderate, medium granular structure; dry, hard consistence; no cementation; slightly plastic; mixed origin; many fine roots; clear, wavy lower boundary; contained two PVC pipes |
| II | 14–58 | Previously disturbed natural; 10YR 4/3, brown; sandy clay loam; moderate, very coarse blocky structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; few fine roots; diffuse, irregular lower boundary |
| III | 45–106 | Natural; 10YR 5/3, brown; sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; marine origin; no roots; abrupt, smooth lower boundary; contained many mottles of 10YR 6/4, light yellowish brown sand and 10YR 6/2, light gray $CaCO_3$ |
| IV | 92–145 | Natural; 10YR 3/3, dark brown; gravelly silty clay loam; weak, fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |
| V | 111–149 | Natural; 10YR 3/3, dark brown; gravels and cobbles (>90%) and silty clay loam (<10%); weak, very fine granular structure; moist loose consistence; no cementation; slightly plastic; terrigenous origin; no roots; lower boundary not observed; alluvial streambed deposit |

### 1.1.20 Test Excavation 20 (TE-20)

TE-20 was placed near the northeastern corner of the Central Maui WWRF segment of the project area (Figure 81). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.55 mbs. The stratigraphy of TE-20 consisted of a brown, gravelly loam Ap horizon (Stratum I) overlying dark yellowish brown, previously disturbed, natural silty clay loam (Stratum II); a natural alluvial streambed deposit (Stratum III); and dark brown, natural silty clay (Stratum IV) (Figure 82 through Figure 84 and Table 20). Stratum I contained two PVC pipes.



Figure 81. TE-20, overview of the general location, view to north



Figure 82. TE-20, close-up of the west wall, view to west



Figure 83. TE-20, oblique view of the west wall, view to northwest

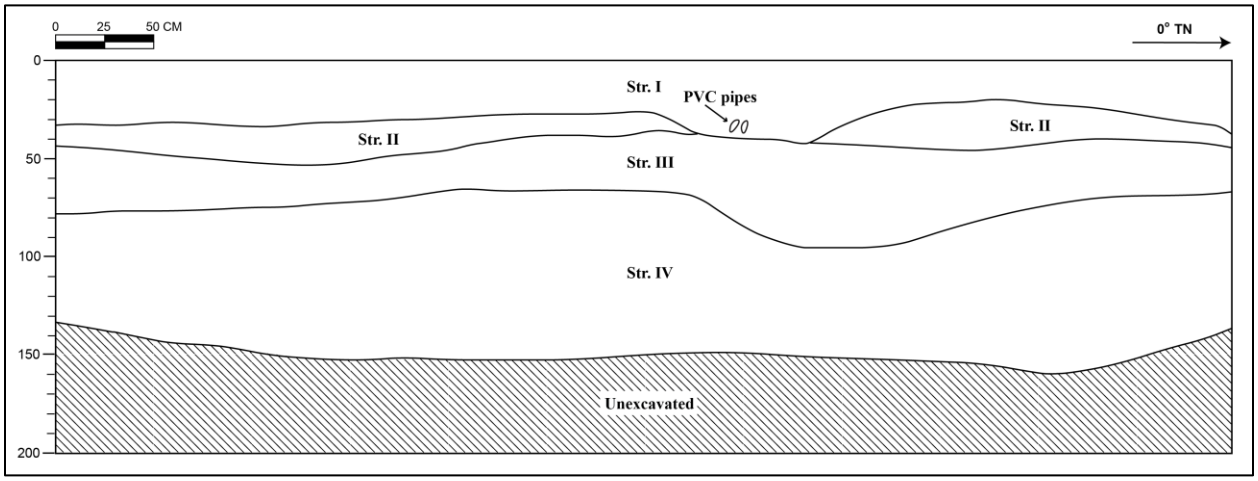



Figure 84. TE-20, stratigraphy of the west wall

Table 20. Strata observed at TE-20

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–39 | Ap horizon; 10YR 4/3, brown; gravelly loam; moderate, coarse granular structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; fine roots common; clear, wavy lower boundary; contained two PVC pipes |
| II | 23–50 | Previously disturbed natural; 10YR 4/4, dark yellowish brown; silty clay loam; weak, medium granular structure; dry, hard consistence; no cementation; plastic; terrigenous origin; few fine roots; clear, smooth lower boundary |
| III | 35–92 | Natural; 10YR 4/2, dark grayish brown; extremely gravelly sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; terrigenous origin; few fine roots; abrupt, wavy lower boundary; alluvial streambed deposit |
| IV | 62–155 | Natural; 10YR 3/3, dark brown; silty clay; weak, fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; few fine roots; lower boundary not observed |

### 1.1.21 Test Excavation 21 (TE-21)

TE-21 was placed in the northwestern portion of the Central Maui WWRF segment of the project area (Figure 85). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.63 mbs. The stratigraphy of TE-21 consisted of a very dark grayish brown, gravelly sandy clay loam Ap horizon (Stratum I) overlying very pale brown, previously disturbed, natural sand (Stratum II); light brownish gray, natural loamy sand (Stratum III); very pale brown, natural sand (Stratum IV); and dark brown, natural silty clay (Stratum V) (Figure 86 through Figure 88 and Table 21). No cultural materials were encountered.



Figure 85. TE-21, overview of the general location, view to north



Figure 86. TE-21, close-up of the east wall, view to east



Figure 87. TE-21, oblique view of the east wall, view to southeast

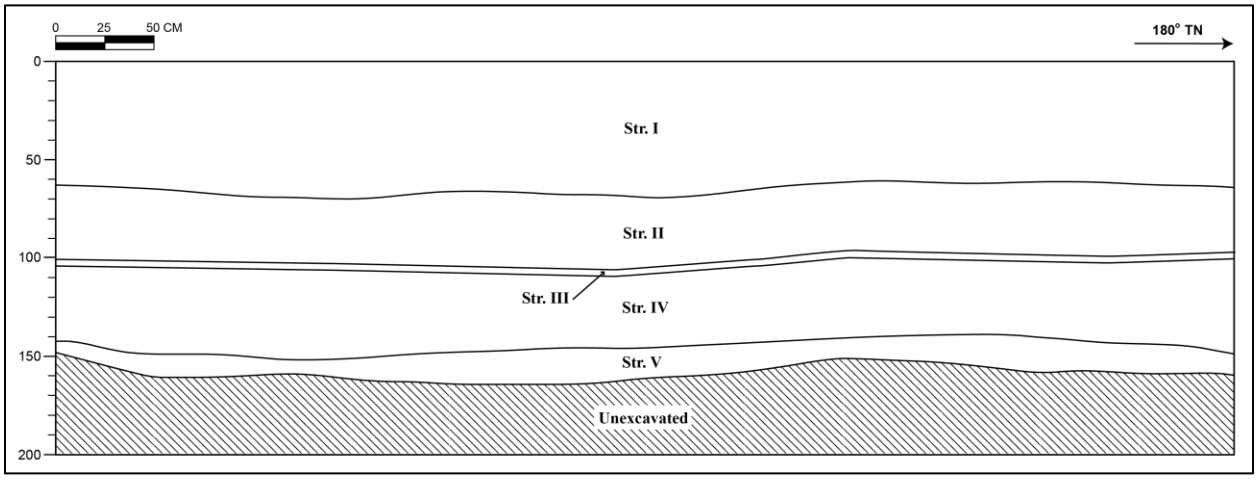



Figure 88. TE-21, stratigraphy of the east wall

Table 21. Strata observed at TE-21

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–66 | Ap horizon; 10YR 3/2, very dark grayish brown; gravelly sandy clay loam; moderate, coarse granular structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; fine roots common; abrupt, smooth lower boundary |
| II | 58–105 | Previously disturbed natural; 10YR 7/4, very pale brown; sand; structureless (single grain); dry, hard consistence; weak cementation; non-plastic; marine origin; no roots; abrupt, smooth lower boundary |
| III | 95–110 | Natural; 10YR 6/2, light brownish gray; loamy sand; structureless (single grain); moist, loose consistence; non-plastic; mixed origin; no roots; abrupt, smooth lower boundary |
| IV | 100–150 | Natural; 10YR 7/4, very pale brown; sand; structureless (single grain); dry, hard consistence; weak cementation; non-plastic; marine origin; no roots; abrupt, smooth lower boundary |
| V | 137–163 | Natural; 10YR 3/3, dark brown; silty clay; weak, fine granular structure; moist, firm consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.22 Test Excavation 22 (TE-22)

TE-22 was placed in the northern portion of the Central Maui WWRF segment of the project area (Figure 89). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.51 mbs. The stratigraphy of TE-22 consisted of a very dark grayish brown, gravelly sandy clay loam Ap horizon (Stratum I) overlying brown, previously disturbed natural sandy clay loam (Stratum II); a dark grayish brown, loamy sand buried A horizon (Stratum III); yellowish brown natural sand with $CaCO_3$ mottling (Stratum IV); and dark brown, natural silty clay (Stratum V) (Figure 90 through Figure 92 and Table 22).

Two sediment samples, each approximately 0.5 gallons, from the buried A horizon (Stratum III) were screened in the field. The sample near the northern end contained a land snail shell, which was not collected. The second sample contained sparse amounts of charcoal flecking that was not collected.



Figure 89. TE-22, overview of the general location, view to north



Figure 90. TE-22, close-up of the east wall, view to east



Figure 91. TE-22, oblique view of the east wall, view to northeast

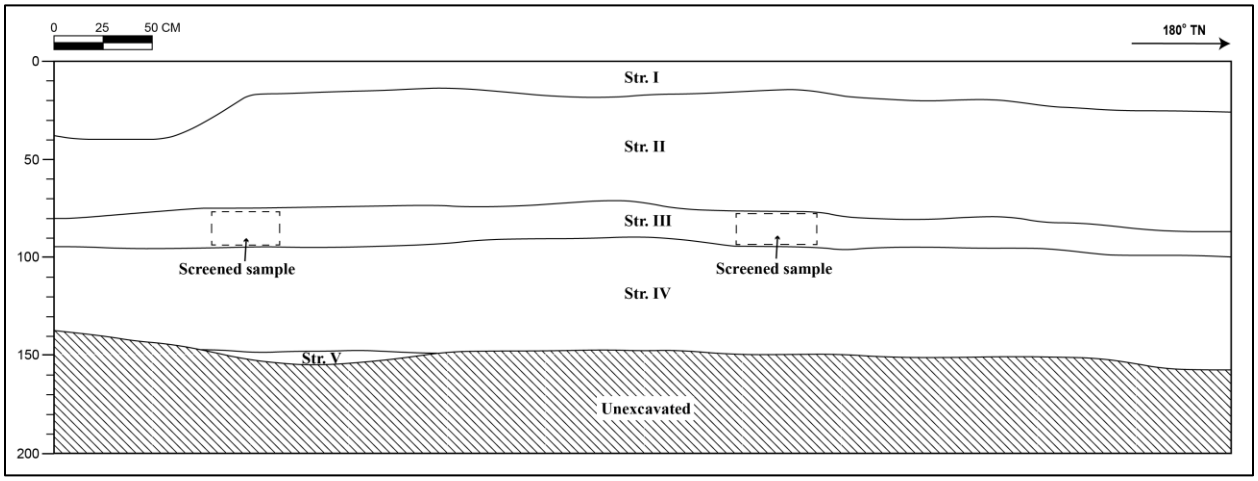



Figure 92. TE-22, stratigraphy of the east wall

Table 22. Strata observed at TE-22

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–40 | Ap horizon; 10YR 3/2, very dark grayish brown; gravelly sandy clay loam; moderate, very coarse granular structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; fine roots common; clear, smooth lower boundary |
| II | 13–83 | Previously disturbed natural; 10YR 4/3, brown; sandy clay loam; moderate, coarse granular structure; moist, friable consistence; no cementation; slightly plastic; terrigenous origin; few fine roots; diffuse, smooth lower boundary |
| III | 72–96 | Buried A horizon; 10YR 4/2, dark grayish brown; loamy sand; weak, fine granular structure; moist, friable consistence; no cementation; slightly plastic; mixed origin; few fine roots; diffuse, smooth lower boundary; screened samples contained a land snail shell and charcoal |
| IV | 86–152 | Natural; 10YR 5/6, yellowish brown; sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; marine origin; no roots; abrupt, irregular lower boundary; contained many mottles of 10YR 6/3, pale brown sand and 10YR 6/2, light gray CaCO3 |
| V | 144–151 | Natural; 10YR 3/3, dark brown; silty clay; weak, fine granular structure; moist, firm consistence; no cementation; slightly plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.23 Test Excavation 23 (TE-23)

TE-23 was placed in the northern portion of the Central Maui WWRF segment of the project area (Figure 93). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.46 mbs. The stratigraphy of TE-23 consisted of a very dark grayish brown, gravelly sandy clay loam Ap horizon (Stratum I) overlying brown, previously disturbed, natural sandy clay loam (Stratum II); pale brown, natural sand (Stratum III); and dark brown, natural gravelly silty clay (Stratum IV) (Figure 94 through Figure 96 and Table 23). No cultural materials were encountered.



Figure 93. TE-23, overview of the general location, view to northwest



Figure 94. TE-23, close-up of the east wall, view to east



Figure 95. TE-23, oblique view of the east wall, view to northeast

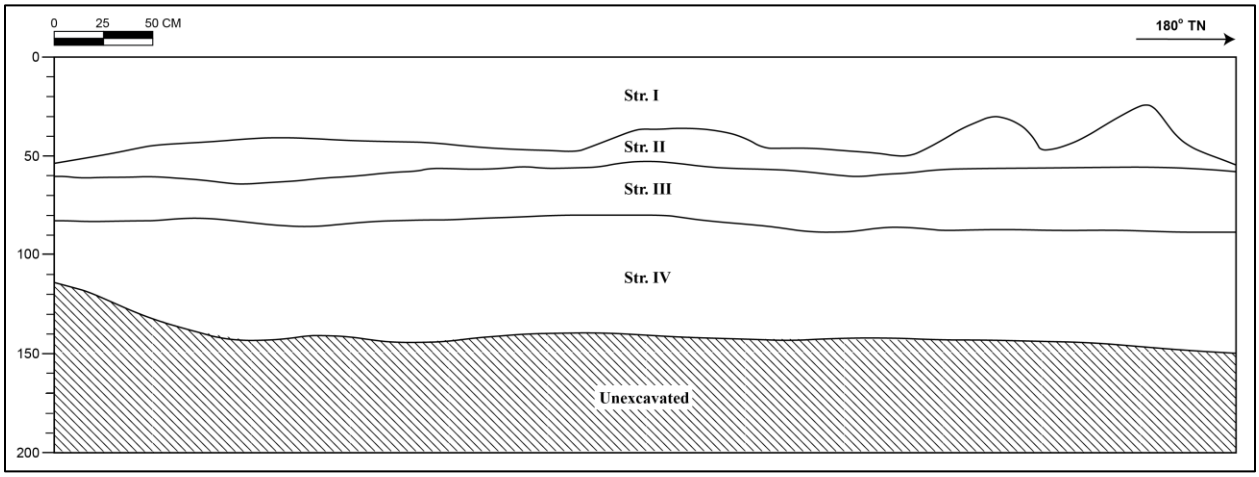



Figure 96. TE-23, stratigraphy of the east wall

Table 23. Strata observed at TE-23

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–54 | Ap horizon; 10YR 4/2, dark grayish brown; gravelly sandy clay loam; moderate, coarse granular structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; many fine roots; clear, wavy lower boundary |
| II | 22–58 | Previously disturbed natural; 10YR 4/3, brown; sandy clay loam; moderate, coarse blocky structure; moist, friable consistence; no cementation; plastic; terrigenous origin; few fine roots; diffuse, smooth lower boundary |
| III | 50–86 | Natural; 10YR 6/3, pale brown; sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; marine origin; few fine roots; abrupt, smooth lower boundary; contained many mottles of 10YR 6/6, brownish yellow sand |
| IV | 78–146 | Natural; 10YR 3/3, dark brown; gravelly silty clay; weak, fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; few fine roots; lower boundary not observed |

### 1.1.24 Test Excavation 24 (TE-24)

TE-24 was placed in the northeastern portion of the Central Maui WWRF segment of the project area (Figure 97). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.51 mbs. The stratigraphy of TE-24 consisted of a brown, gravelly sandy clay loam Ap horizon (Stratum I) overlying dark yellowish brown, previously disturbed, natural silty clay loam (Stratum II); dark brown, natural gravelly sandy clay loam with a concentration of alluvial streambed gravel in the northern end (Stratum III); and dark brown, natural silty clay (Stratum IV) (Figure 98 through Figure 101 and Table 24). No cultural materials were encountered.



Figure 97. TE-24, overview of the general location, view to northeast



Figure 98. TE-24, close-up of the east wall, view to east



Figure 99. TE-24, oblique view of the east wall, view to north



Figure 100. TE-24, overview of the east wall, view to southeast

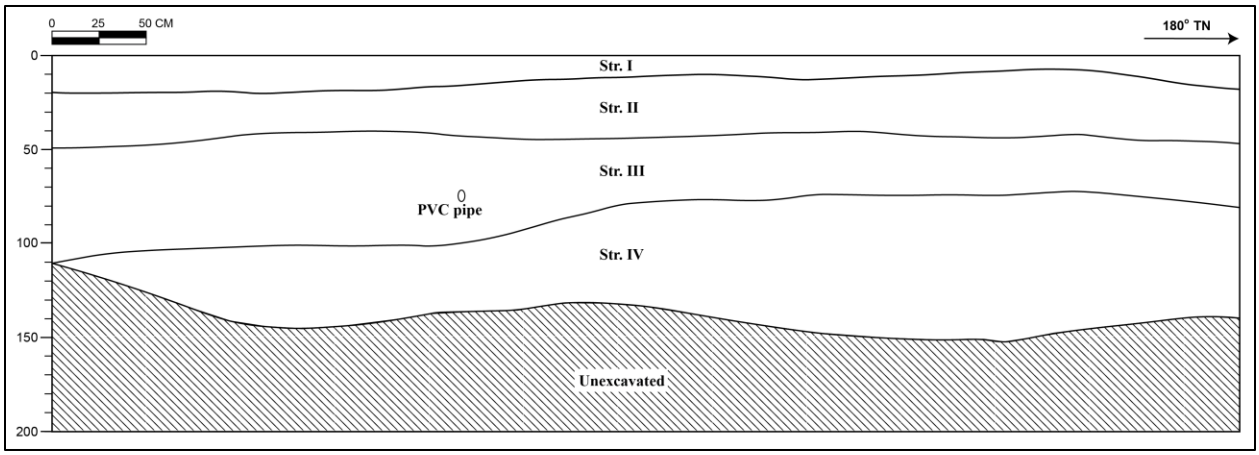



Figure 101. TE-24, stratigraphy of the east wall

Table 24. Strata observed at TE-24

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–20 | Ap horizon; 10YR 4/3, brown; gravelly sandy clay loam; weak, medium granular structure; dry, weaky coherent consistence; no cementation; slightly plastic; terrigenous origin; many fine roots; clear, smooth lower boundary |
| II | 10–50 | Previously disturbed natural; 10YR 4/4, dark yellowish brown; silty clay loam; weak, fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; few fine roots; gradual, smooth lower boundary |
| III | 41–110 | Natural; 10YR 3/3, dark brown; gravelly sandy clay loam; weak, fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; few fine roots; diffuse, wavy lower boundary; contained a concentration of alluvial streambed gravel and 10YR 4/2, dark grayish brown loamy sand |
| IV | 75–151 | Natural; 10YR 3/3, dark brown; silty clay; moderate, fine granular structure; moist, extremely firm consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.25 Test Excavation 25 (TE-25)

TE-25 was placed in the northwestern portion of the Central Maui WWRF segment of the project area (Figure 102). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.86 mbs. The stratigraphy of TE-25 consisted of brown, gravelly sandy clay loam Ap horizon (Stratum I) overlying brownish yellow, natural sand (Stratum II); a thin (approximately 2.0-cm-thick) layer of brown, natural loamy sand (Stratum III); brownish yellow, natural sand (Stratum IV); and dark brown, natural silty clay (Stratum V) (Figure 103 through Figure 105 and Table 25). No cultural materials were encountered.



Figure 102. TE-25, overview of the general location, view to northwest



Figure 103. TE-25, close-up of the west wall, view to west



Figure 104. TE-25, oblique view of the west wall, view to southwest

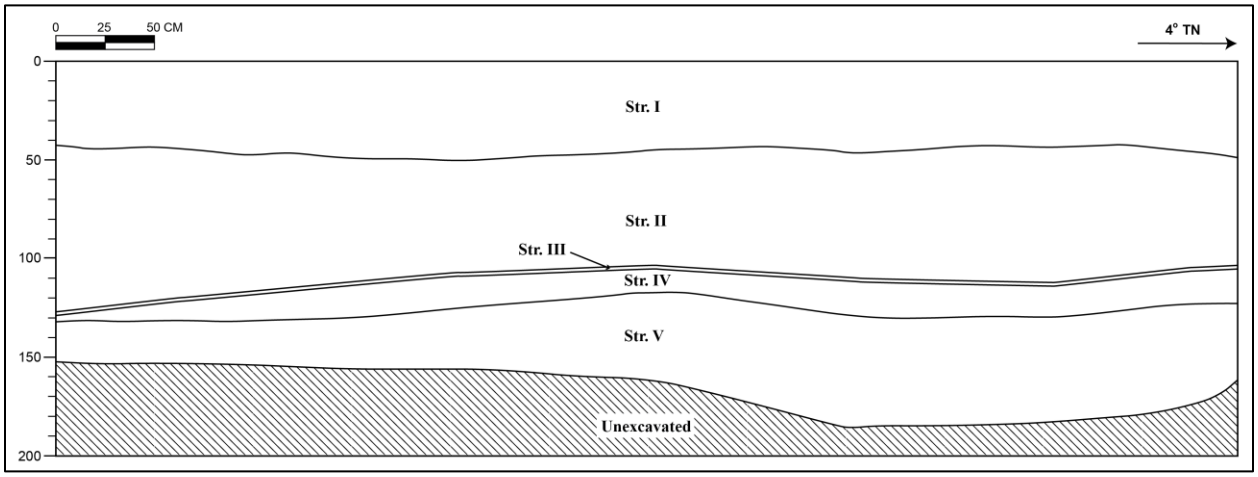



Figure 105. TE-25, stratigraphy of the west wall

Table 25. Strata observed at TE-25

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–49 | Ap horizon; 10YR 4/3, brown; gravelly sandy clay loam; moderate, coarse granular structure; dry, hard consistence; no cementation; slightly plastic; mixed origin; many fine roots; abrupt, smooth lower boundary; contained common mottling of 10YR 5/4, yellowish brown sand |
| II | 42–127 | Natural; 10YR 6/6, brownish yellow; sand; structureless (single grain); moist, friable consistence; moderate cementation; non-plastic; marine origin; no roots; abrupt, smooth lower boundary |
| III | 104–129 | Natural; 10YR 4/3, brown; loamy sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; mixed origin; no roots; abrupt, smooth lower boundary |
| IV | 105–132 | Natural; 10YR 6/6, brownish yellow; sand; structureless (single grain); moist, friable consistence; moderate cementation; non-plastic; marine origin; no roots; abrupt, smooth lower boundary |
| V | 115–186 | Natural; 10YR 3/3, dark brown; silty clay; weak, fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; few medium roots; lower boundary not observed |

### 1.1.26 Test Excavation 26 (TE-26)

TE-26 was placed in the northern portion of the Central Maui WWRF segment of the project area (Figure 106). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.79 mbs. The stratigraphy of TE-26 consisted of a very dark grayish brown, sandy clay loam Ap horizon (Stratum I) overlying brown, previously disturbed, natural sandy clay loam (Stratum II); a very dark grayish brown, loamy sand buried A horizon (Stratum III); brown, natural sandy clay loam (Stratum IV); yellowish brown, natural sand (Stratum V); and dark yellowish brown, natural gravelly silty clay loam (Stratum VI) (Figure 107 through Figure 109 and Table 26). Stratum III contained a lens of ash from a burn event and several long pieces of wire connected to fragments of metal sheets (Figure 110).



Figure 106. TE-26, overview of the general location, view to southeast



Figure 107. TE-26, close-up of the east wall, view to east



Figure 108. TE-26, oblique view of the east wall, view to southeast

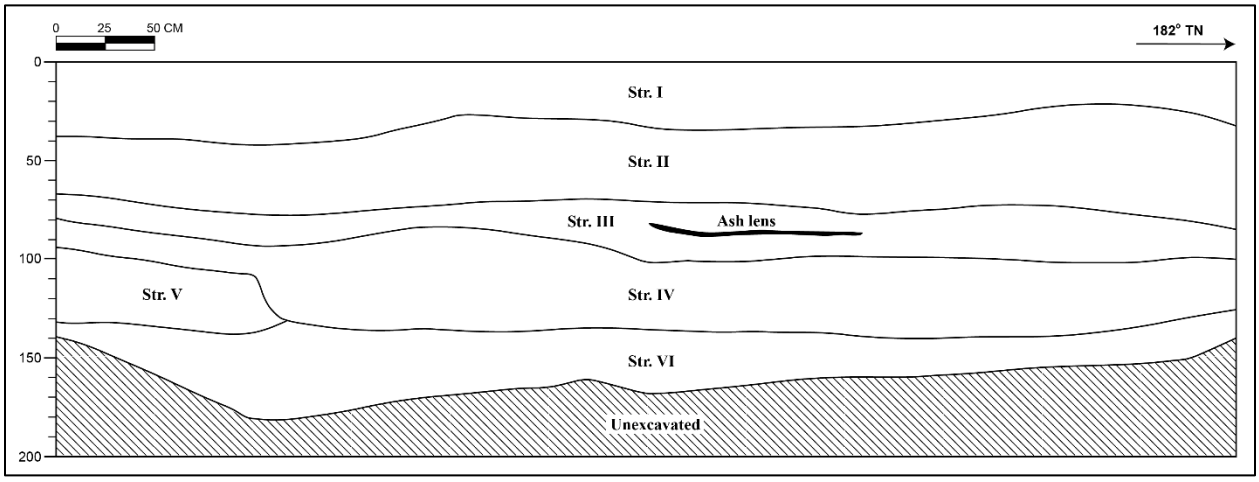



Figure 109. TE-26, stratigraphy of the east wall

Table 26. Strata observed at TE-26

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–42 | Ap horizon; 10YR 3/2, very dark grayish brown; sandy clay loam; weak, medium granular structure; moist, friable consistence; no cementation; slightly plastic; mixed origin; fine roots common; clear, wavy lower boundary |
| II | 22–85 | Previously disturbed natural; 10YR 4/3, brown; sandy clay loam; moderate, medium blocky structure; dry, hard consistence; no cementation; plastic; mixed origin; few fine roots; diffuse, wavy lower boundary |
| III | 66–101 | Buried A horizon; 10YR 3/2, very dark grayish brown; loamy sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; mixed origin; few fine roots; diffuse, wavy lower boundary; contained a lens of 10YR 3/3, dark brown sand and ash; observed wire and metal fragments |
| IV | 80–139 | Natural; 10YR 4/3, brown; sandy clay loam; weak, fine granular structure; moist, friable consistence; no cementation; plastic; mixed origin; few fine roots; diffuse, wavy lower boundary |
| V | 93–136 | Natural; 10YR 5/4, yellowish brown; sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; marine origin; abrupt, no roots; irregular lower boundary |
| VI | 123–179 | Natural; 10YR 3/4, dark yellowish brown; gravelly silty clay loam; weak, medium granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |



Figure 110. TE-26, wire with fragments of thin metal sheets attached that was encountered in Stratum III

### 1.1.27 Test Excavation 27 (TE-27)

TE-27 was placed in the northern portion of the Central Maui WWRF segment of the project area (Figure 111). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.67 mbs. The stratigraphy of TE-27 consisted of a brown, silty clay loam Ap horizon (Stratum I) overlying yellowish brown, natural sand with $CaCO_3$ mottling (Stratum II) and dark brown, natural silty clay (Stratum III) (Figure 112 through Figure 114 and Table 27). No cultural materials were encountered.



Figure 111. TE-27, overview of the general location, view to northeast



Figure 112. TE-27, close-up of the west wall, view to west



Figure 113. TE-27, oblique view of the west wall, view to northwest

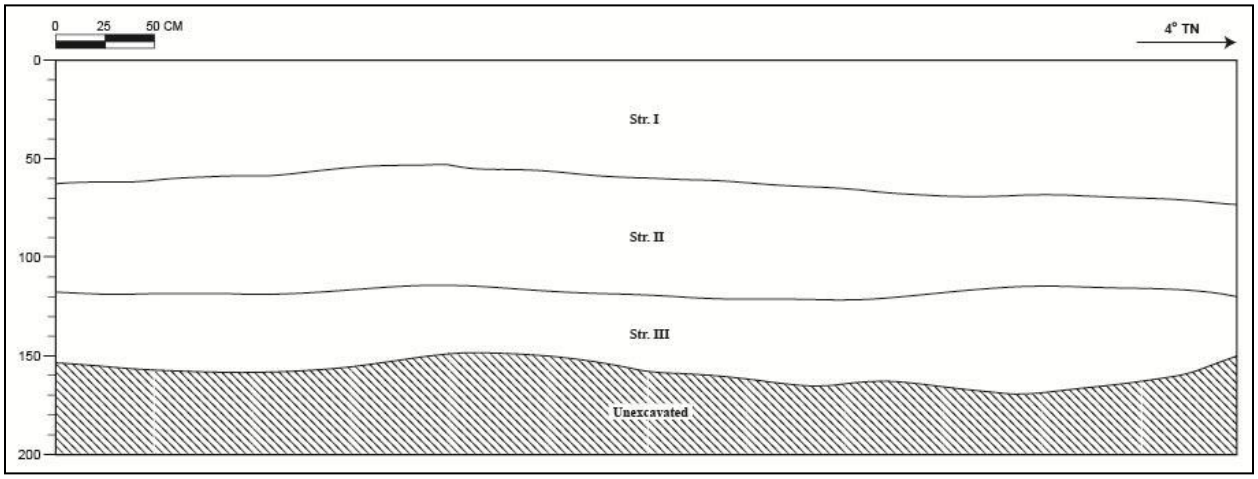



Figure 114. TE-27, stratigraphy of the west wall

Table 27. Strata observed at TE-27

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–72 | Ap horizon; 10YR 4/3, brown; silty clay loam; moderate, medium blocky structure; dry, hard consistence; no cementation; plastic; mixed origin; fine roots common; diffuse, smooth lower boundary |
| II | 51–120 | Natural; 10YR 5/6, yellowish brown; sand; structureless (single grain); moist, loose consistence; weak cementation; non-plastic; marine origin; no roots; very abrupt, smooth lower boundary; contained a common mottling of 10YR 6/4, light yellowish brown sand and 10YR 6/2, light gray $CaCO_3$ |
| III | 113–167 | Natural; 10YR 3/3, dark brown; silty clay; weak, fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.28 Test Excavation 28 (TE-28)

TE-28 was placed in the northeastern portion of the Central Maui WWRF segment of the project area (Figure 115). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.74 mbs. The stratigraphy of TE-28 consisted of a dark brown, gravelly sandy clay loam Ap horizon (Stratum I) overlying pale brown, natural sand (Stratum II) and yellowish brown, natural extremely gravelly loamy sand (Stratum III) (Figure 116 through Figure 118 and Table 28). No cultural materials were encountered.



Figure 115. TE-28, overview of the general location, view to east



Figure 116. TE-28, close-up of the east wall, view to east



Figure 117. TE-28, oblique view of the east wall, view to southeast

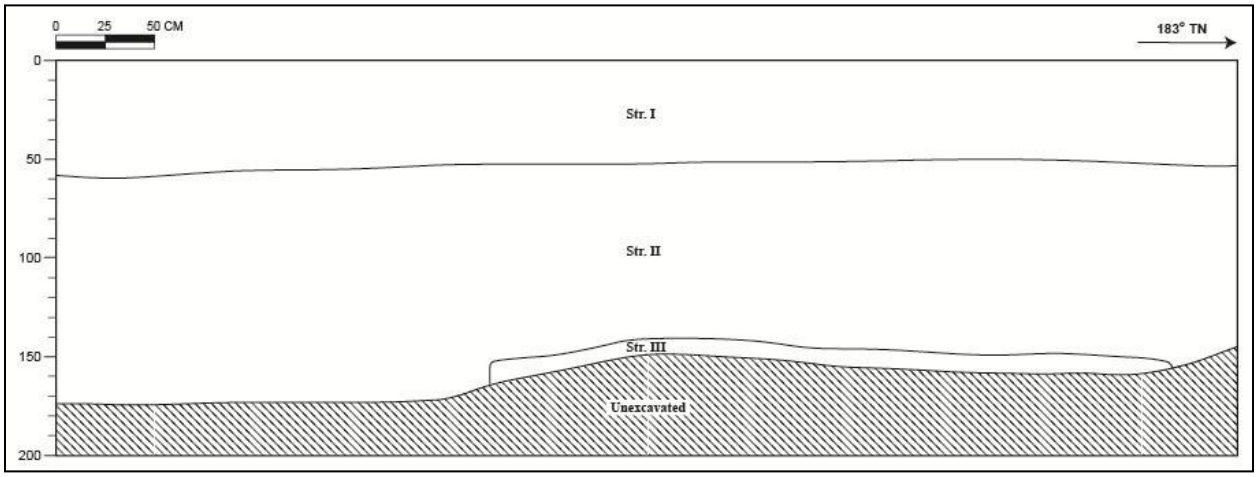



Figure 118. TE-28, stratigraphy of the east wall

Table 28. Strata observed at TE-28

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–60 | Ap horizon; 10YR 3/3, dark brown; gravelly sandy clay loam; weak, medium granular structure; dry, hard consistence; no cementation; slightly plastic; mixed origin; many fine roots; very abrupt, smooth lower boundary; contained common mottles of 10YR 4/4, dark yellowish brown loamy sand |
| II | 50–174 | Natural; 10YR 6/3, pale brown; sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; marine origin; few fine roots; abrupt, irregular lower boundary |
| III | 140–163 | Natural; 10YR 5/4, yellowish brown; extremely gravelly loamy sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; terrigenous origin; no roots; lower boundary not observed; alluvium |

### 1.1.29 Test Excavation 29 (TE-29)

TE-29 was placed in the northwestern portion of the Central Maui WWRF segment of the project area (Figure 119). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.64 mbs. The stratigraphy of TE-29 consisted of a brown, loamy sand Ap horizon (Stratum I) overlying yellowish brown, previously disturbed, natural sand with $CaCO_3$ mottling (Stratum II) and dark brown, natural gravelly silty clay loam (Stratum III) (Figure 120 through Figure 122 and Table 29). No cultural materials were encountered.



Figure 119. TE-29, overview of the general location, view to east



Figure 120. TE-29, close-up of the east wall, view to east



Figure 121. TE-29, oblique view of the east wall, view to southeast

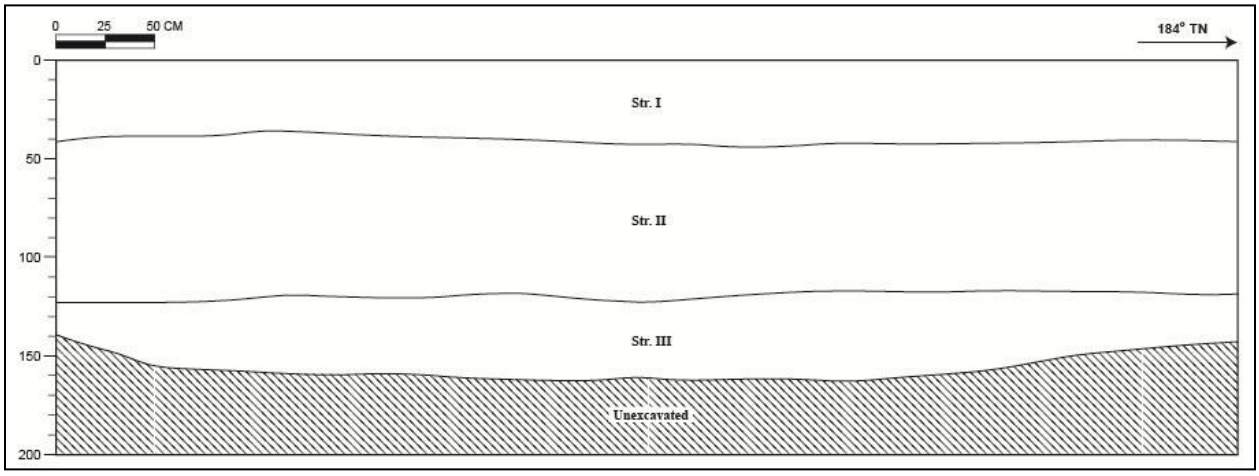



Figure 122. TE-29, stratigraphy of the east wall

Table 29. Strata observed at TE-29

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–43 | Ap horizon; 10YR 4/3, brown; loamy sand; weak, fine granular structure; dry, loose consistence; no cementation; slightly plastic; mixed origin; many fine to medium roots; clear, smooth lower boundary; contained common mottles of 10YR 6/4, light yellowish brown sand |
| II | 36–125 | Previously disturbed natural; 10YR 5/6, yellowish brown; sand; structureless (single grain); dry, weakly coherent consistence; weak cementation; non-plastic; marine origin; no roots; abrupt, smooth lower boundary; contained common mottles of 10YR 5/4, yellowish brown sand and 10YR 6/2, light gray $CaCO_3$ |
| III | 116–164 | Natural; 10YR 3/3, dark brown; gravelly silty clay loam; weak, fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; few, coarse roots; lower boundary not observed |

### 1.1.30 Test Excavation 30 (TE-30)

TE-30 was placed in the northern portion of the Central Maui WWRF segment of the project area (Figure 123). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.67 mbs. The stratigraphy of TE-30 consisted of a dark brown, sandy loam Ap horizon (Stratum I) overlying brown, previously disturbed, natural sand (Stratum II); dark yellowish brown, natural silty clay loam (Stratum III); a brown, natural sandy loam buried A horizon (Stratum IV); light brown, natural sand (Stratum V); and dark yellowish brown, natural gravelly silty clay loam (Stratum VI) (Figure 124 through Figure 128 and Table 30). The buried A horizon (Stratum IV) contained concentrations of dark grey sand and charcoal staining extending from the lower interface into Stratum V. An approximate 2.0-gallon sediment sample of the charcoal stain was screened in the field and contained a land snail shell. No discernable charcoal fragments were observed or collected.



Figure 123. TE-30, overview of the general location, view to northeast



Figure 124. TE-30, close-up of the west wall, view to west



Figure 125. TE-30, oblique view of the west wall, view to northwest



Figure 126. TE-30, oblique view of the west wall, view to southwest



Figure 127. TE-30, close-up of charcoal staining prior to sampling, view to west

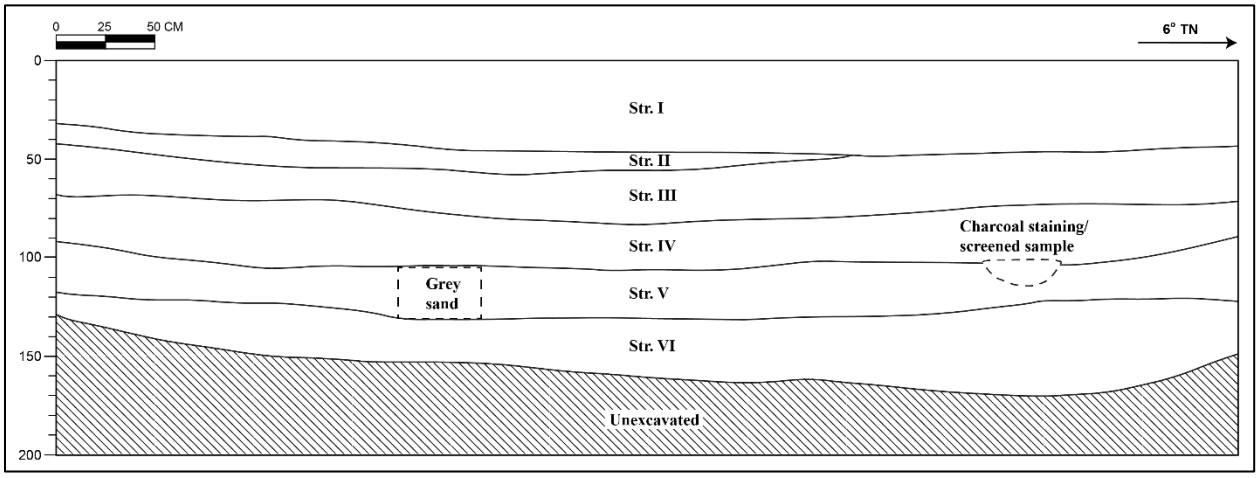



Figure 128. TE-30, stratigraphy of the west wall

Table 30. Strata observed at TE-30

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–45 | Ap horizon; 10YR 3/3, dark brown; sandy loam; weak, medium granular structure; dry, weakly coherent consistence; no cementation; slightly plastic; mixed origin; many fine roots; clear, smooth lower boundary |
| II | 32–55 | Previously disturbed natural; 10YR 5/3, brown; sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; marine origin; no roots; clear, irregular lower boundary |
| III | 40–80 | Previously disturbed natural; 10YR 3/4, dark yellowish brown; silty clay loam; moderate, coarse blocky structure; moist, friable consistence; no cementation; plastic; terrigenous origin; few fine roots; clear, smooth lower boundary |
| IV | 66–103 | Buried A horizon; 10YR 4/3, brown; sandy loam; weak, very fine granular structure; moist, loose consistence; no cementation; non-plastic; few fine roots; clear, smooth lower boundary; contained a charcoal stain at the lower boundary |
| V | 85–128 | Natural; 7.5YR 6/4, light brown; sand, structureless (single grain); moist, loose consistence; weak cementation; non-plastic; no roots; clear, smooth lower boundary; contained common mottles of 10YR 5/1, grey sand |
| VI | 126–167 | Natural; 10YR 3/6, dark yellowish brown; gravelly silty clay loam; weak, fine granular structure; moist, friable consistence; no cementation; plastic; no roots; lower boundary not observed; contained common mottles of 10YR 3/3, dark brown silty clay loam |

### 1.1.31 Test Excavation 31 (TE-31)

TE-31 was placed in the northern portion of the Central Maui WWRF segment of the project area (Figure 129). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.74 mbs. The stratigraphy of TE-31 consisted of a brown, sandy loam Ap horizon (Stratum I) overlying dark yellowish brown, previously disturbed, natural silty clay loam (Stratum II) (Figure 130 through Figure 133 and Table 31). Stratum II contained burned branches and logs



Figure 129. TE-31, overview of the general location, view to northeast



Figure 130. TE-31, close-up of the east wall, view to east



Figure 131. TE-31, oblique view of the east wall, view to southeast



Figure 132. TE-31, close-up of burned wood near the southern end of the trench, view to southeast

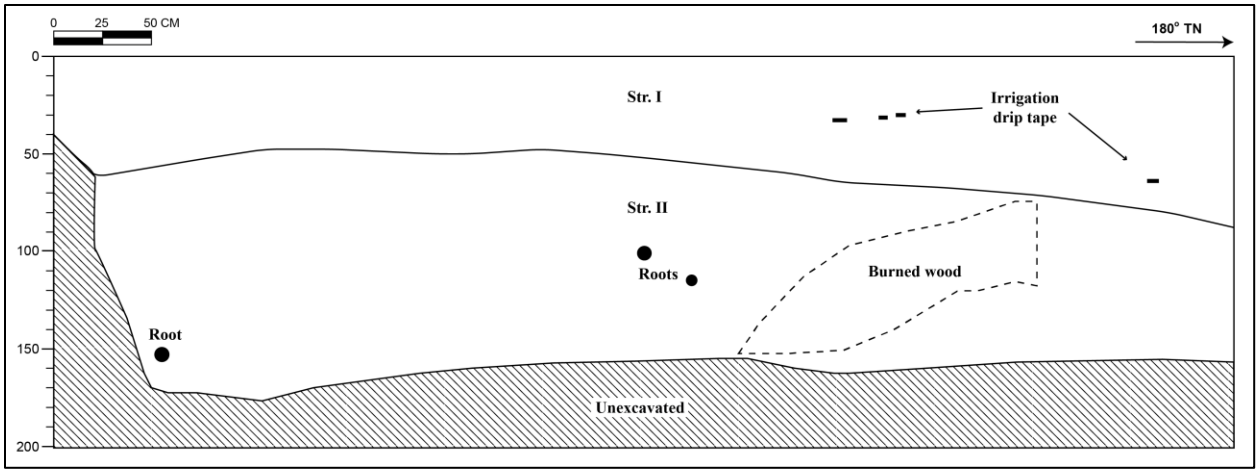



Figure 133. TE-31, stratigraphy of the east wall

Table 31. Strata observed at TE-31

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–83 | Ap horizon; 10YR 4/3, brown; sandy loam; moderate, medium blocky structure; dry, weakly coherent consistence; no cementation; plastic; terrigenous origin; many fine roots; clear, smooth lower boundary |
| II | 46–174 | Previously disturbed natural; 10YR 4/4, dark yellowish brown; silty clay loam; weak, fine granular structure; dry, weakly coherent consistence; no cementation; very plastic; terrigenous origin; no roots; lower boundary not observed; contained many inclusions of 10YR 4/3, brown loamy sand and burned wood |

### 1.1.32 Test Excavation 32 (TE-32)

TE-32 was placed in the northeastern portion of the Central Maui WWRF segment of the project area (Figure 134). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.76 mbs. The stratigraphy of TE-32 consisted of a brown, sandy loam Ap horizon (Stratum I) overlying light yellowish brown, previously disturbed, natural sand (Stratum II); a dark yellowish brown, gravelly sandy clay loam buried A horizon (Stratum III); and dark brown, natural clay loam (Stratum IV) (Figure 135 through Figure 138 and Table 32). Stratum III contained a burnt root and piece of wood.



Figure 134. TE-32, overview of the general location, view to north



Figure 135. TE-32, close-up of the west wall, view to west



Figure 136. TE-32, oblique view of the west wall, view to southwest



Figure 137. TE-32, overview of the west wall, view to northwest

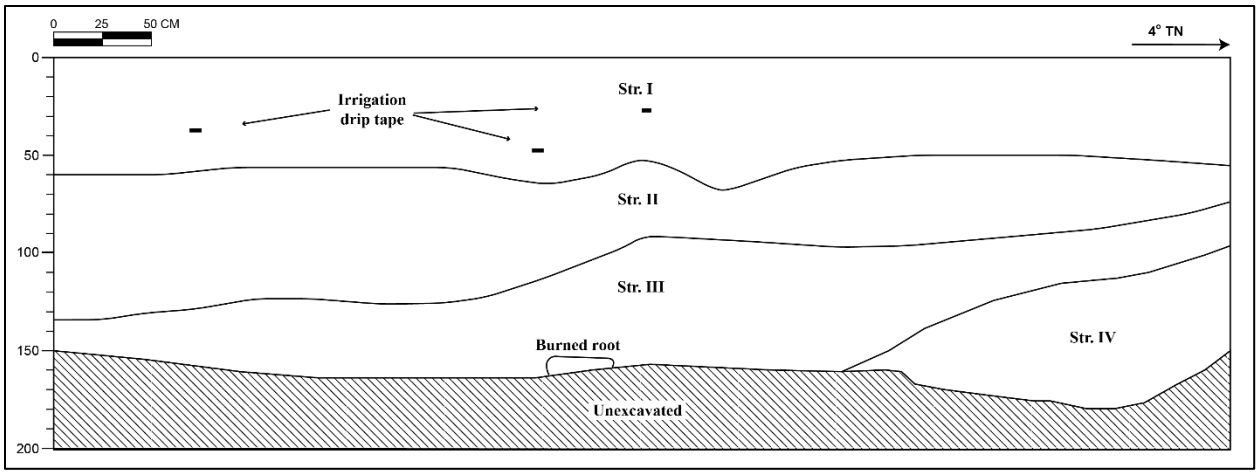



Figure 138. TE-32, stratigraphy of the west wall

Table 32. Strata observed at TE-32

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–66 | Ap horizon; 10YR 4/3, brown; gravelly sandy loam; weak, fine granular structure; dry, weakly coherent consistence; no cementation; slightly plastic; mixed origin; fine roots common; abrupt, wavy lower boundary; contained common mottles of 10YR 6/4, light yellowish brown sand |
| II | 50–132 | Previously disturbed natural; 10YR 6/4, light yellowish brown; sand; structureless (single grain); dry, weaky coherent consistence; weak cementation; non-plastic; marine origin; few fine roots; clear, wavy lower boundary |
| III | 72–163 | Buried A horizon; 10YR 4/4, dark yellowish brown; gravelly sandy clay loam; weak, fine granular structure; moist, friable consistence; no cementation; slightly plastic; mixed origin; few, coarse roots; diffuse, irregular lower boundary; contained many mottles of 10YR 2/2, very dark brown sandy clay loam, a burnt root and burned wood |
| IV | 95–176 | Natural; 10YR 3/3, dark brown; clay loam; structureless (massive); moist, extremely firm consistence; no cementation; very plastic; no roots; lower boundary not observed |

### 1.1.33 Test Excavation 33 (TE-33)

TE-33 was placed in the northwestern portion of the Central Maui WWRF segment of the project area (Figure 139). The trench was shifted 4.8 m east of the proposed testing location due to a *kiawe* tree. The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.65 mbs. The stratigraphy of TE-33 consisted of a dark grayish brown, gravelly sandy loam Ap horizon (Stratum I) overlying brownish yellow, previously disturbed, natural sand (Stratum II) and brown, natural gravelly silt loam (Stratum III) (Figure 140 through Figure 142 and Table 33). No cultural materials were encountered.



Figure 139. TE-33, overview of the general location, view to east



Figure 140. TE-33, close-up of the west wall, view to west



Figure 141. TE-33, oblique view of the west wall, view to southwest

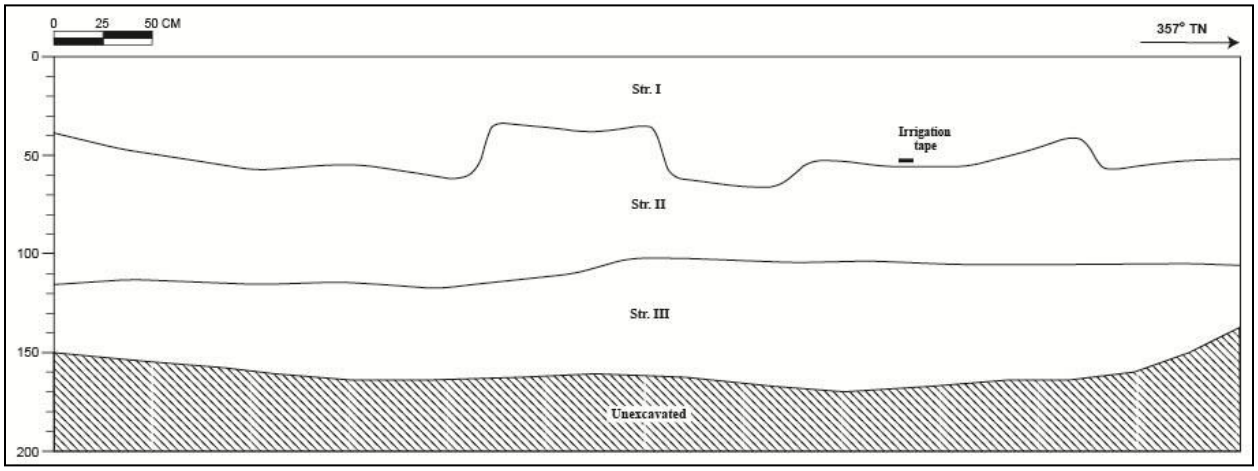



Figure 142. TE-33, stratigraphy of the west wall

Table 33. Strata observed at TE-33

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–64 | Ap horizon; 10YR 4/2, dark grayish brown; gravelly sandy loam; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; slightly plastic; mixed origin; fine roots common; clear, irregular lower boundary; contained common mottles of 10YR 6/4, light yellowish brown loamy sand |
| II | 32–114 | Previously disturbed natural; 10YR 6/6, brownish yellow; sand; structureless (single grain); dry, weakly coherent consistence; moderate cementation; non-plastic; marine origin; no fine roots; abrupt, smooth lower boundary; contained few inclusions of 10YR 7/3, very pale brown sand |
| III | 100–165 | Natural; 10YR 4/3, brown; gravelly silt loam; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed; contained few inclusions of 10YR 4/4, dark yellowish brown silty clay loam from root moulds |

### 1.1.34 Test Excavation 34 (TE-34)

TE-34 was placed in the northern portion of the Central Maui WWRF segment of the project area (Figure 143). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.78 mbs. The stratigraphy of TE-34 consisted of a brown, gravelly silt loam Ap horizon (Stratum I) overlying brown, previously disturbed, natural sandy loam (Stratum II); brown, natural silty clay loam (Stratum III); a dark brown, silty clay loam buried A horizon (Stratum IV); grayish brown, natural sandy clay (Stratum V); and dark yellowish brown, natural gravelly silt loam (Stratum VI) (Figure 144 through Figure 147 and Table 34). An approximate 3.0-gallon sediment sample from Stratum IV was screened in the field and contained three small land snail shells (see Figure 146).



Figure 143. TE-34, overview of the general location, view to southwest



Figure 144. TE-34, close-up of the east wall, view to east



Figure 145. TE-34, oblique view of the east wall, view to southeast



Figure 146. TE-34, close-up of the east wall showing the location of the screened sediment sample, view to east

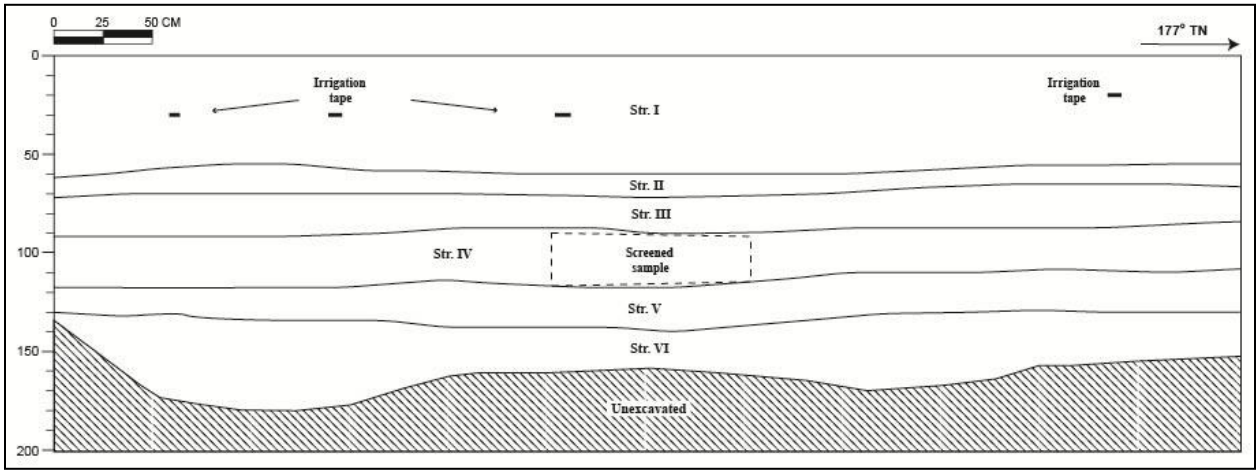



Figure 147. TE-34, stratigraphy of the east wall

Table 34. Strata observed at TE-34

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–60 | Ap horizon; 10YR 4/3, brown; gravelly silt loam; moderate, medium, granular structure; dry, hard consistence; weak cementation; slightly plastic; terrigenous origin; fine roots common; clear, smooth lower boundary; contained many mottles of 10YR 4/2, dark grayish brown silt loam |
| II | 5–70 | Previously disturbed natural; 10YR 5/3, brown; sandy loam; weak, fine granular structure; dry, weaky coherent consistence; no cementation; non-plastic; mixed origin; few fine roots; clear, smooth lower boundary |
| III | 62–92 | Natural; 10YR 4/3, brown; silty clay loam; moderate, very fine granular structure; dry, weakly coherent consistence; no cementation; plastic; terrigenous origin; no roots; clear, smooth lower boundary |
| IV | 80–116 | Buried A horizon; 10YR 3/3, dark brown; silty clay loam; weak, very fine granular structure; dry, weakly coherent consistence; no cementation; plastic; terrigenous origin; no roots; clear, smooth lower boundary; screened sample contained three land snail shells |
| V | 105–136 | Natural; 10YR 5/2, grayish brown; sandy clay; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; plastic; mixed origin; no roots; clear, smooth lower boundary; contained root moulds of 10YR 4/3, brown sandy clay |
| VI | 124–178 | Natural; 10YR 3/4, dark yellowish brown; gravelly silt loam; moderate, medium granular structure; moist, loose consistence; weak cementation; plastic; terrigenous origin; no roots; lower boundary not observed; contained root moulds of 10YR 4/3, brown sandy clay |

### 1.1.35 Test Excavation 35 (TE-35)

TE-35 was placed in the northern portion of the Central Maui WWRF segment of the project area (Figure 148). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.76 mbs. The stratigraphy of TE-35 consisted of a dark grayish brown, gravelly silt loam Ap horizon (Stratum I) overlying brown, previously disturbed, natural silty clay (Stratum II); dark yellowish brown, natural silty clay loam (Stratum III); dark yellowish brown, natural silty clay loam (Stratum IV); and dark brown, natural silt loam (Stratum V) (Figure 149 through Figure 151 and Table 35). No cultural materials were encountered.



Figure 148. TE-35, overview of the general location, view to east



Figure 149. TE-35, close-up of the east wall, view to east



Figure 150. TE-35, oblique view of the east wall, view to southeast

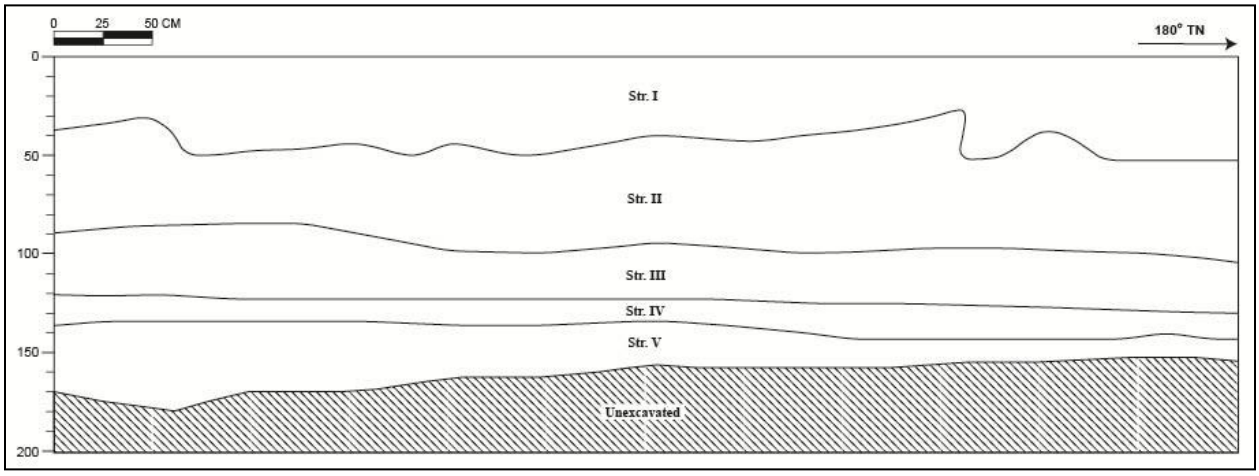



Figure 151. TE-35, stratigraphy of the east wall

Table 35. Strata observed at TE-35

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–48 | Ap horizon; 10YR 4/2, dark grayish brown; gravelly; silt loam; strong fine granular structure; dry, weakly coherent consistence; weak cementation; slightly plastic; terrigenous origin; fine to medium roots common; clear, wavy lower boundary; contained common mottles of 10YR 4/3, brown loamy sand |
| II | 24–100 | Previously disturbed natural; 10YR 4/3, brown; silty clay; moderate, fine blocky structure; dry, hard consistence; no cementation; very plastic; terrigenous origin; few fine roots; gradual, smooth lower boundary |
| III | 83–125 | Natural; 10YR 3/4, dark yellowish brown; silty clay loam; moderate, fine blocky structure; dry, weakly coherent consistence; weak cementation; very plastic; terrigenous origin; no roots; clear, smooth lower boundary |
| IV | 120–138 | Natural; 10YR 4/4, dark yellowish brown; silty clay loam; moderate, fine blocky structure; dry, weakly coherent consistence; no cementation; plastic; terrigenous origin; no roots; clear, smooth lower boundary |
| V | 130–176 | Natural; 10YR 3/3, dark brown; silt loam; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; very plastic; terrigenous origin; no roots; lower boundary not observed; contained common root moulds of 10YR 4/3, brown silty clay loam |

### 1.1.36 Test Excavation 36 (TE-36)

TE-36 was placed in the northeastern portion of the Central Maui WWRF segment of the project area (Figure 152). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.78 mbs. The stratigraphy of TE-36 consisted of a dark brown, gravelly sandy loam Ap horizon (Stratum I) overlying dark grayish brown, previously disturbed, extremely stony sand (Stratum II); yellowish brown, previously disturbed, natural sand (Stratum III); and dark brown, natural silt loam (Stratum IV) (Figure 153 through Figure 155 and Table 36). No cultural materials were encountered.



Figure 152. TE-36, overview of the general location, view to north



Figure 153. TE-36, close-up of the west wall, view to west



Figure 154. TE-36, oblique view of the west wall, view to northwest

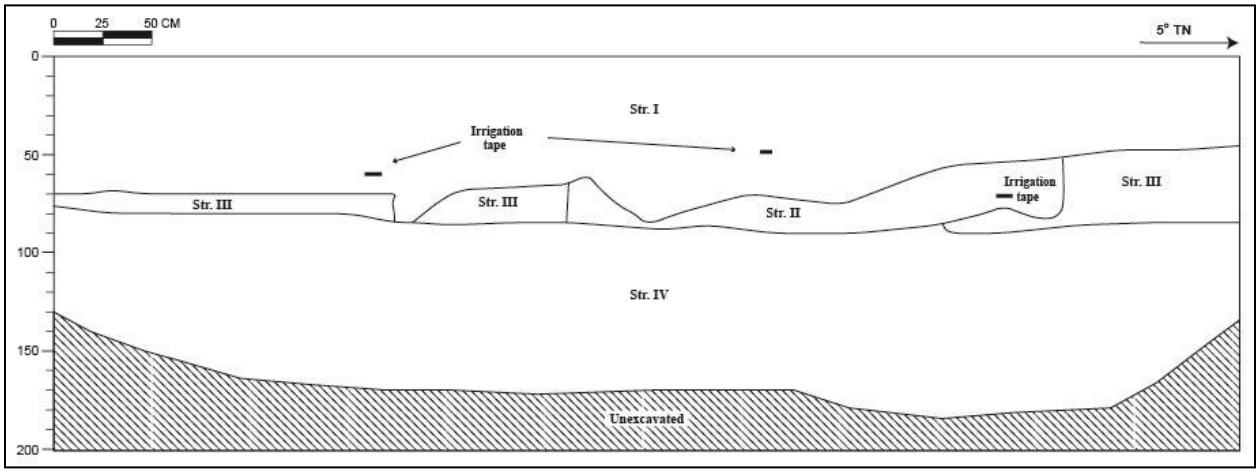



Figure 155. TE-36, stratigraphy of the west wall

Table 36. Strata observed at TE-36

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–80 | Ap horizon; 10YR 3/3, dark brown; gravelly sandy loam; strong medium granular structure; dry, weakly coherent consistence; no cementation; slightly plastic; mixed origin; fine roots common; clear, irregular lower boundary |
| II | 46–85 | Previously disturbed natural; 10YR 4/2, dark grayish brown; extremely stony sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; terrigenous origin; few fine roots; clear, broken lower boundary; alluvial streambed gravel; contained few mottles of 10YR 5/8, yellowish brown sand |
| III | 40–84 | Previously disturbed natural; 10YR 5/8, yellowish brown; sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; marine origin; few fine roots; clear, broken lower boundary; contained common mottles of 10YR 4/2, dark grayish brown sand |
| IV | 76–178 | Natural; 10YR 3/3, dark brown; silt loam; moderate, fine blocky structure; moist, friable consistence; no cementation; very plastic; terrigenous origin; no roots; lower boundary not observed; few root moulds of 10YR 4/3, brown silt loam |

### 1.1.37 Test Excavation 37 (TE-37)

TE-37 was placed in the northwestern portion of the Central Maui WWRF segment of the project area (Figure 156). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.76 mbs. The stratigraphy of TE-37 consisted of a dark grayish brown, gravelly sandy loam Ap horizon (Stratum I) overlying very pale brown, natural sand (Stratum II) and brown, natural silt loam (Stratum III) (Figure 157 through Figure 159 and Table 37). No cultural materials were encountered.



Figure 156. TE-37, overview of the general location, view to east



Figure 157. TE-37, close-up of the east wall, view to east



Figure 158. TE-37, oblique view of the east wall, view to southeast

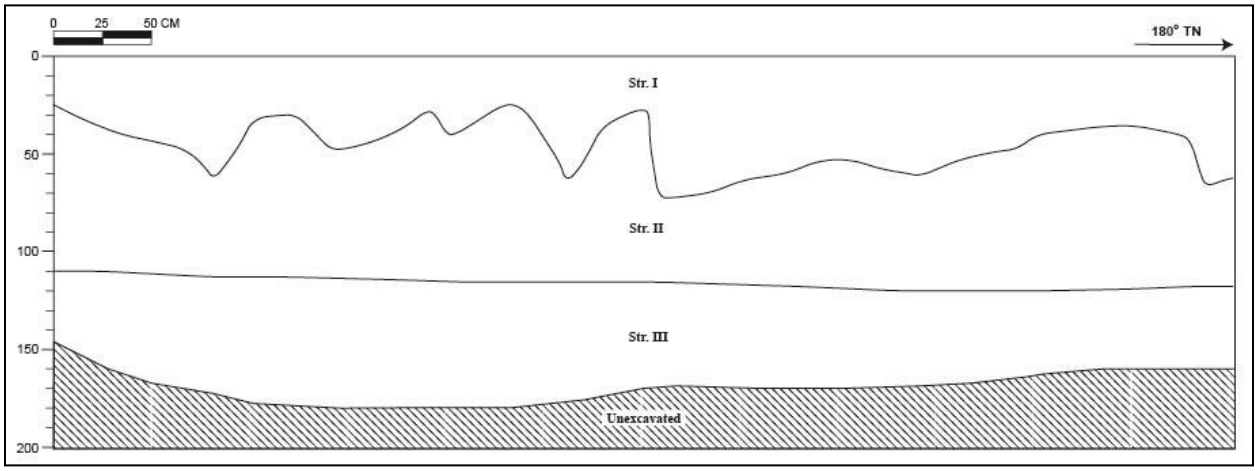



Figure 159. TE-37, stratigraphy of the east wall

Table 37. Strata observed at TE-37

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–70 | Ap horizon; 10YR 4/2, dark grayish brown; gravelly; sandy loam; weak, fine granular structure; dry, weakly coherent consistence; no cementation; slightly plastic; mixed origin; fine roots common; abrupt, irregular lower boundary; contained many mottles of 10YR 6/4, light yellowish brown sand |
| II | 23–116 | Natural; 10YR 7/4, very pale brown; sand; structureless (single grain); dry, loose consistence; weak cementation; non-plastic; marine origin; no roots; abrupt, smooth lower boundary |
| III | 108–176 | Natural; 10YR 4/3, brown; silt loam; moderate, fine blocky structure; dry, weakly coherent consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed; contained few root moulds of 10YR 4/3, brown silty clay |

### 1.1.38 Test Excavation 38 (TE-38)

TE-38 was placed in the northern half of the Central Maui WWRF segment of the project area (Figure 160). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.65 mbs. The stratigraphy of TE-38 consisted of a dark grayish brown, gravelly silt loam Ap horizon (Stratum I) overlying brown, natural sand (Stratum II); brown, natural silty clay loam (Stratum III); dark brown, natural sandy clay loam (Stratum IV); and dark yellowish brown, natural silty clay loam (Stratum V) (Figure 161 through Figure 163 and Table 38). No cultural materials were encountered.



Figure 160. TE-38, overview of the general location, view to northwest



Figure 161. TE-38, close-up of the east wall, view to east



Figure 162. TE-38, oblique view of the east wall, view to northeast

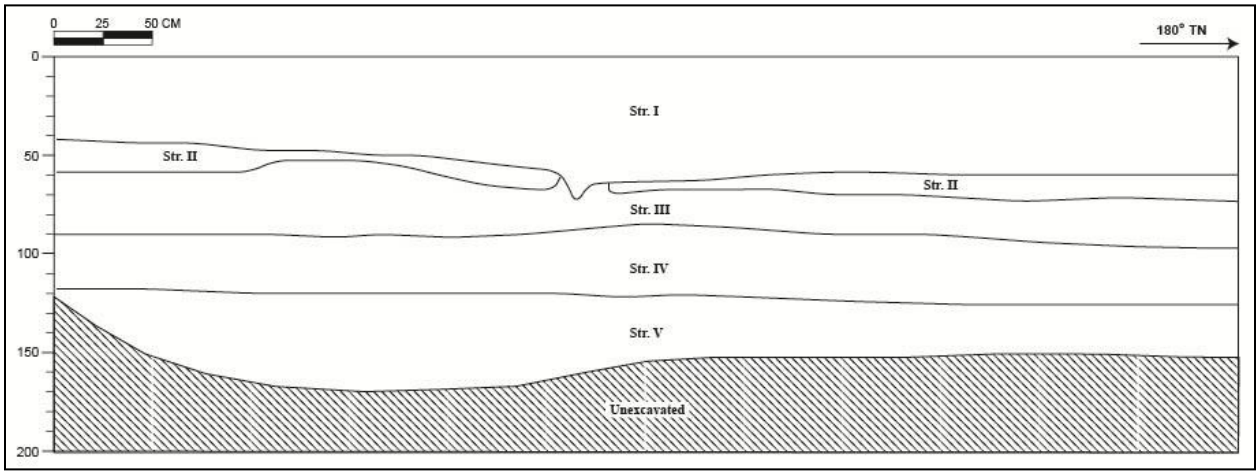



Figure 163. TE-38, stratigraphy of the east wall

Table 38. Strata observed at TE-38

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–72 | Ap horizon; 10YR 4/2, dark grayish brown; gravelly silt loam; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; slightly plastic; terrigenous origin; fine roots common; clear, irregular lower boundary; contained common mottles of 10YR 4/3, brown silt loam |
| II | 40–68 | Natural; 10YR 5/3, brown; sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; marine origin; no roots; clear, broken lower boundary |
| III | 55–94 | Natural; 10YR 4/3, brown; silty clay loam; moderate, fine blocky structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; clear, smooth lower boundary |
| IV | 82–120 | Natural; 10YR 3/3, dark brown; sandy clay loam; moderate, fine granular structure; moist, friable consistence; no cementation; very plastic; mixed origin; no roots; clear, smooth lower boundary |
| V | 116–165 | Natural; 10YR 3/4, dark yellowish brown; silty clay loam; moderate, fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed; contained few root moulds of 10YR 5/3, brown silty clay loam |

### 1.1.39 Test Excavation 39 (TE-39)

TE-39 was placed in the northern half of the Central Maui WWRF segment of the project area (Figure 164). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.70 mbs. The stratigraphy of TE-39 consisted of a dark grayish brown, gravelly silt loam Ap horizon (Stratum I) overlying brown, previously disturbed, natural sand (Stratum II); brown, natural silty clay loam (Stratum III); dark brown, natural sandy clay loam (Stratum IV); and dark yellowish brown, natural silty clay loam (Stratum V) (Figure 165 through Figure 168 and Table 39). No cultural materials were encountered.



Figure 164. TE-39, overview of the general location, view to northwest



Figure 165. TE-39, close-up of the west wall, view to west



Figure 166. TE-39, oblique view of the west wall, view to northwest



Figure 167. TE-39, oblique view of the west wall, view to southwest

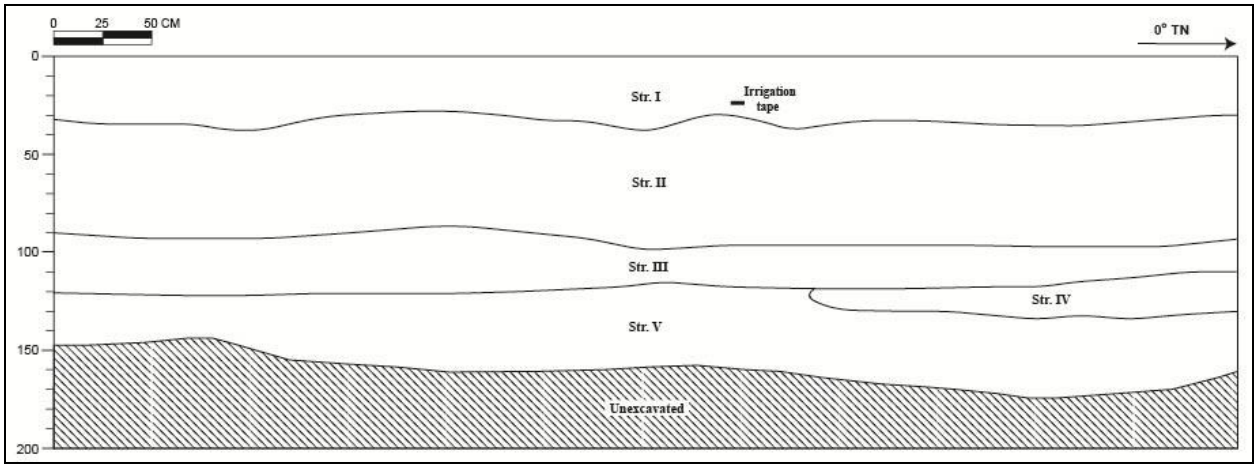



Figure 168. TE-39, stratigraphy of the west wall

Table 39. Strata observed at TE-39

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–38 | Ap horizon; 10YR 3/3, dark brown; gravelly sandy loam; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; non-plastic; mixed origin; fine roots common; clear, smooth lower boundary |
| II | 25–96 | Previously disturbed natural; 10YR 4/3, brown; silt loam; moderate, fine structure; dry, weakly coherent; no cementation; plastic; terrigenous origin; no roots; clear, smooth lower boundary |
| III | 87–121 | Natural; 10YR 5/3, brown; silty clay; moderate, fine blocky structure; dry, hard consistence; no cementation; very plastic; terrigenous origin; no roots; clear, smooth lower boundary |
| IV | 105–128 | Natural; 10YR 6/3, pale brown; sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; marine origin; no roots; clear, discontinuous lower boundary |
| V | 113–170 | Natural; 10YR 3/4, dark yellowish brown; sandy clay loam; moderate, fine granular structure; moist, loose consistence; no cementation; plastic; mixed origin; no roots; lower boundary not observed; contained few root moulds of 10YR 4/4, dark yellowish brown silty clay loam |

### 1.1.40 Test Excavation 40 (TE-40)

TE-40 was placed near the eastern boundary in the northern half of the Central Maui WWRF segment of the project area (Figure 5). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.63 mbs. The stratigraphy of TE-40 consisted of a dark grayish brown, sandy loam Ap horizon (Stratum I) overlying natural aeolian sand (Stratum II) and dark brown, natural silt loam (Stratum III) (Figure 169 through Figure 172 and Table 40). No cultural materials were encountered.



Figure 169. TE-40, overview of the general location, view to north



Figure 170. TE-40, close-up of the east wall, view to east



Figure 171. TE-40, oblique view of the east wall, view to southeast

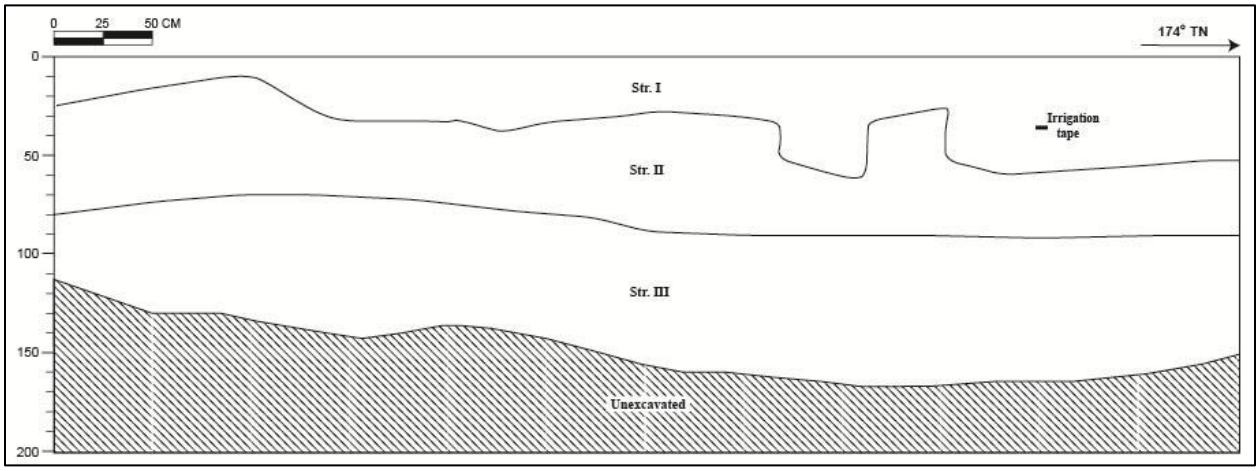



Figure 172. TE-40, stratigraphy of the east wall

Table 40. Strata observed at TE-40

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–57 | Ap horizon; 10YR 4/2, dark grayish brown; gravelly sandy loam; weak, fine granular structure; dry, weakly coherent consistence; no cementation; slightly plastic; mixed origin; fine roots common; clear, irregular lower boundary; contained mottles of 10YR 6/3, pale brown sand |
| II | 10–87 | Natural; 10YR 6/6, brownish yellow; sand; moderate, medium platy structure; dry, hard consistence; strong cementation; non-plastic; marine origin; no roots; very abrupt, smooth lower boundary |
| III | 69–163 | Natural; 10YR 3/3, dark brown; gravelly silt loam; moderate, very fine blocky structure; moist, friable consistence; no cementation; very plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.41 Test Excavation 41 (TE-41)

TE-41 was placed near the western boundary in the northern half of the Central Maui WWRF segment of the project area (Figure 173). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.68 mbs. The stratigraphy of TE-41 consisted of a dark brown, silt loam Ap horizon (Stratum I) and dark yellowish brown, previously disturbed, natural sandy loam mottled with alluvial streambed sand (Stratum II) overlying natural aeolian sand mottled with brown sandy loam (Stratum III); brown, natural sandy clay loam (Stratum IV); natural aeolian sand (Stratum V); dark yellowish brown, natural sandy clay loam (Stratum VI); natural aeolian sand mottled with very pale brown sandy clay (Stratum VII); grayish brown, natural clay loam (Stratum VIII); and dark brown, natural silty clay loam (Stratum IX) (Figure 173 through Figure 177 and Table 41). No cultural materials were encountered.



Figure 173. TE-41, overview of the general location, view to east



Figure 174. TE-41, close-up of the east wall, view to east



Figure 175. TE-41, oblique view of the east wall, view to northeast



Figure 176. TE-41, oblique view of the east wall, view to southeast

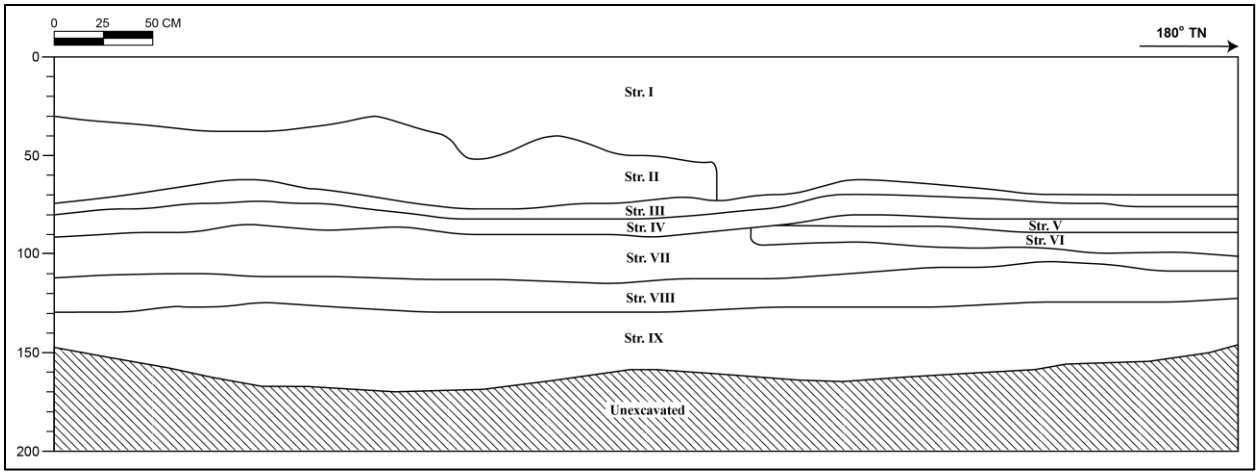



Figure 177. TE-41, stratigraphy of the east wall

Table 41. Strata observed at TE-41

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–73 | Ap horizon; 10YR 3/3, dark brown; gravelly silt loam; strong, medium granular structure; dry, hard consistence; strong cementation; plastic; terrigenous origin; few fine to medium roots; clear, wavy lower boundary |
| II | 30–77 | Previously disturbed natural; 10YR 4/4, dark yellowish brown; very cobbly sandy loam; structureless (single grain); dry, loose consistence; no cementation; non-plastic; terrigenous origin; no roots; clear, smooth lower boundary; contained mottles of 10YR 4/4, dark yellowish brown sandy loam |
| III | 63–80 | Natural; 10YR 4/6, dark yellowish brown; sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; marine origin; no roots; abrupt, smooth lower boundary; contained mottles of 10YR 4/3, brown sandy loam |
| IV | 68–93 | Natural; 10YR 4/3, brown; gravelly sandy clay loam; moderate, fine granular structure; moist, friable consistence; no cementation; slightly plastic; mixed origin; no roots; abrupt, smooth lower boundary |
| V | 80–89 | Natural; 10YR 5/6, yellowish brown; sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; marine origin; no roots; abrupt, discontinuous lower boundary |
| VI | 85–100 | Natural; 10YR 3/4, dark yellowish brown; sandy clay loam; moderate, fine platy structure; moist, friable consistence; no cementation; plastic; mixed origin; no roots; abrupt, discontinuous lower boundary |
| VII | 87–113 | Natural; 10YR 5/6, yellowish brown; sand; structureless (single grain); dry, loose consistence; weak cementation; non-plastic; marine origin; no roots; abrupt, smooth lower boundary; contained mottles of 10YR 7/3, very pale brown sandy clay |
| VIII | 103–129 | Natural; 10YR 5/2, grayish brown; clay loam; moderate, very fine blocky structure; moist, friable consistence; weak cementation; very plastic; terrigenous origin; no roots; clear, smooth lower boundary |
| IX | 122–168 | Natural; 10YR 3/3, dark brown; silty clay loam; moderate, fine blocky structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed; contained mottles of 10YR 4/3, brown silty clay loam |

### 1.1.42 Test Excavation 42 (TE-42)

TE-42 was placed in the northern half of the Central Maui WWRF segment of the project area (Figure 178). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.79 mbs. The stratigraphy of TE-42 consisted of a dark grayish brown, sandy loam Ap horizon (Stratum I) overlying dark grayish brown, previously disturbed, natural silt loam (Stratum II); a brown, silt loam buried A horizon (Stratum III); natural aeolian sand (Stratum IV); and brown, natural extremely cobbly silt loam with concentrations of alluvial streambed gravel (Figure 179 through Figure 183 and Table 42). An approximate 2.0-gallon sediment sample was collected from a charcoal stain within the buried A horizon (Stratum III) and screened in the field. No cultural materials were encountered.



Figure 178. TE-42, overview of the general location, view to northwest



Figure 179. TE-42, close-up of the west wall, view to west



Figure 180. TE-42, oblique view of the west wall, view to northwest



Figure 181. TE-42, close-up of a charcoal stain in the west wall, view to west



Figure 182. TE-42, close-up of the west wall showing the screened sediment sample location, view to west

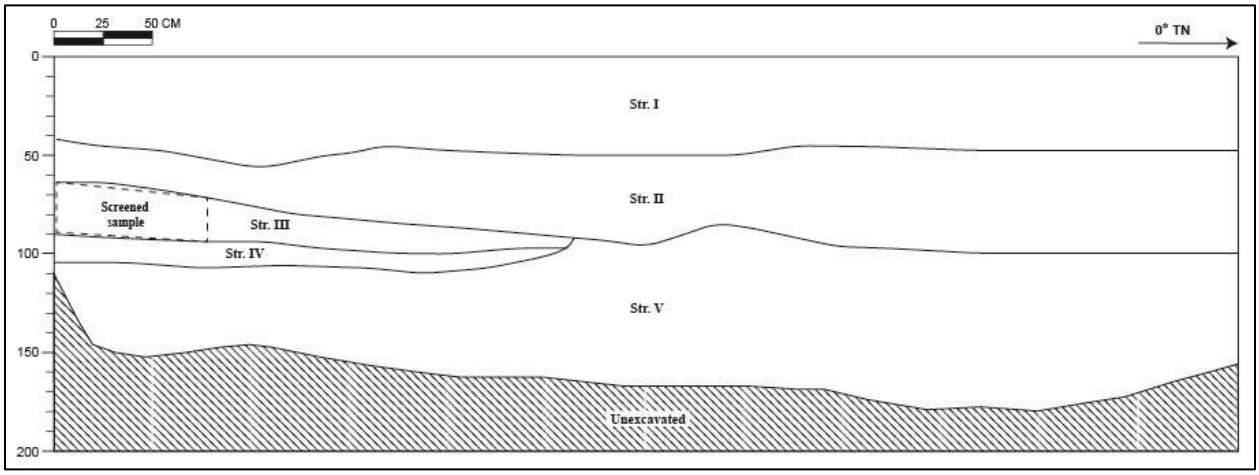



Figure 183. TE-42, stratigraphy of the west wall

Table 42. Strata observed at TE-42

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–55 | Ap horizon; 10YR 4/2, dark grayish brown; gravelly sandy loam; moderate, medium granular structure; dry, hard consistence; strong cementation; slightly plastic; terrigenous origin; few fine roots; gradual, smooth lower boundary; contained mottles of 10YR 4/3, brown sandy loam |
| II | 42–100 | Previously disturbed natural; 10YR 4/2, dark grayish brown; silt loam; moderate, fine blocky structure; dry, weakly coherent consistence; no cementation; plastic; terrigenous origin; no roots; clear, smooth lower boundary |
| III | 64–100 | Buried A horizon; 10YR 4/3, brown; silt loam; weak, fine granular structure; dry, weakly coherent consistence; no cementation; plastic; terrigenous origin; no roots; clear, discontinuous lower boundary; 2-gallon sediment sample screened and sterile |
| IV | 89–110 | Natural; 10YR 6/3, pale brown; sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; marine origin; no roots; clear, irregular lower boundary; aeolian sand |
| V | 85–179 | Natural; 10YR 4/3, brown; extremely cobbly silt loam; strong, medium granular structure; dry, hard consistence; strong cementation; very plastic; terrigenous origin; no roots; lower boundary not observed; contained concentrations of 10YR 4/3, brown silty clay alluvial streambed gravel and 10YR 5/1 gray sand and alluvial cobbles |

### 1.1.43 Test Excavation 43 (TE-43)

TE-43 was placed in the northern half of the Central Maui WWRF segment of the project area (Figure 184). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.87 mbs. The stratigraphy of TE-43 consisted of a brown, sandy loam Ap horizon (Stratum I) overlying a dark brown, previously disturbed, natural silt loam (Stratum II); brown, natural silt loam (Stratum III); dark yellowish brown, natural sandy loam (Stratum IV); alluvial streambed gravel (Stratum V); and dark yellowish brown, natural clay loam (Stratum VI) (Figure 185 through Figure 188 and Table 43). No cultural materials were encountered. Soil structure observed as mottled cracking was evident while shovel scraping the base of the trench within Stratum IV (see Figure 187).

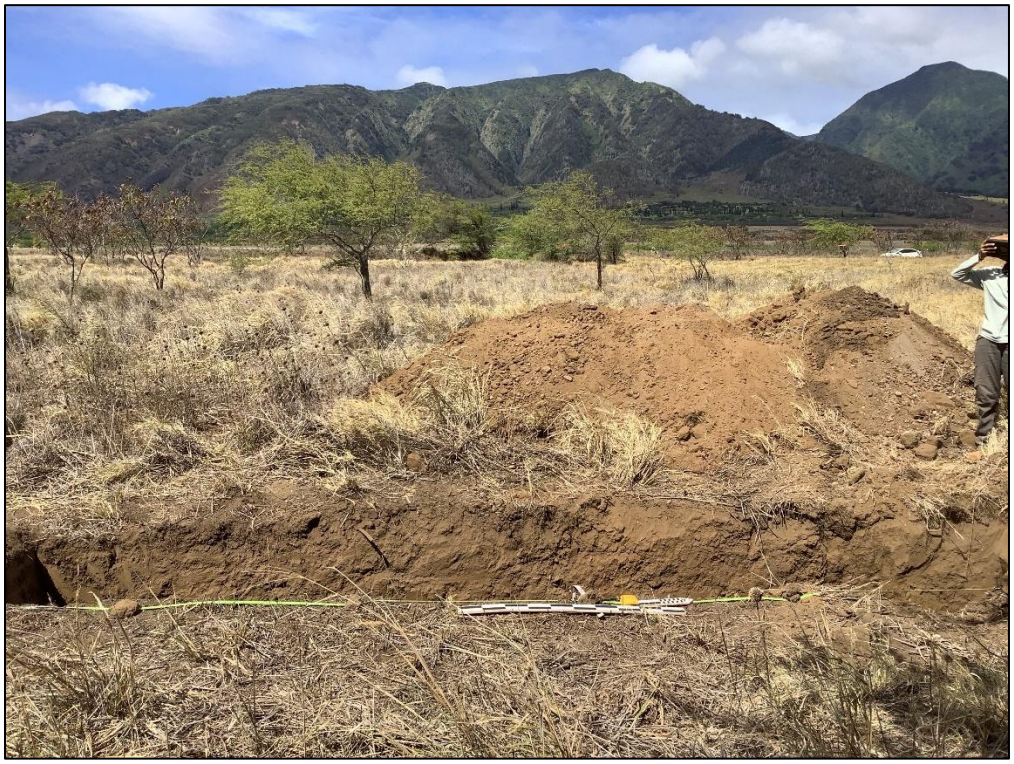


Figure 184. TE-43, overview of the general location, view to west



Figure 185. TE-43, close-up of the east wall, view to east



Figure 186. TE-43, oblique view of the east wall, view to northeast



Figure 187. TE-43, plan view at 123 cmbs showing the soil structure in profile view

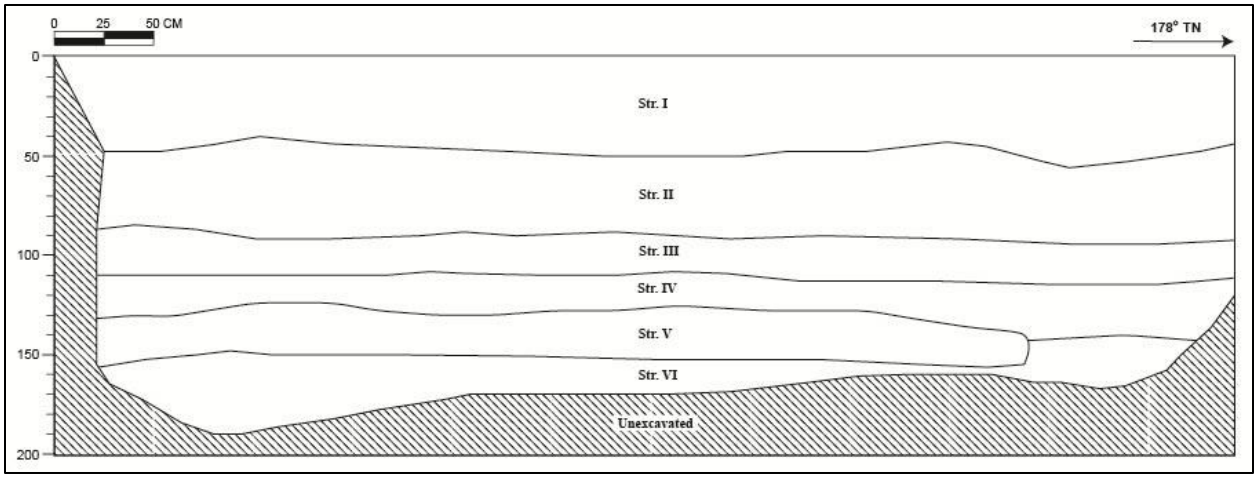



Figure 188. TE-43, stratigraphy of the east wall

Table 43. Strata observed at TE-43

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–52 | Ap horizon; 10YR 4/3, brown; gravelly sandy loam; moderate, medium granular structure; dry, hard consistence; no cementation; slightly plastic; mixed origin; few fine roots; clear, smooth lower boundary; contained mottles of 10YR 4/2, dark grayish brown sandy loam |
| II | 39–90 | Previously disturbed natural; 10YR 3/3, dark brown; silt loam; moderate, fine blocky structure; dry, weakly coherent consistence; no cementation; plastic; terrigenous origin; no roots; clear, smooth lower boundary |
| III | 86–113 | Natural; 10YR 5/3, brown; silt loam; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; slightly plastic; terrigenous origin; no roots; clear, smooth lower boundary |
| IV | 107–138 | Natural; 10YR 3/6, dark yellowish brown; sandy loam; moderate, fine granular structure; moist, loose consistence; weak cementation; slightly plastic; mixed origin; no roots; clear, smooth lower boundary; contained mottles of 10YR 4/3, brown sandy loam |
| V | 122–155 | Natural; 10YR 5/2, grayish brown; gravels and cobbles (>90%) and sandy clay loam (<10%); weak, very fine granular structure; dry, loose consistence; no cementation; slightly plastic; mixed origin; no roots; clear, discontinuous lower boundary; alluvial streambed deposit; contained mottles of 10YR 4/4, dark yellowish brown; silty clay |
| VI | 138–187 | Natural; 10YR 3/4, dark yellowish brown; clay loam; weak, very fine granular structure; moist, friable consistence; no cementation; very plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.44 Test Excavation 44 (TE-44)

TE-44 was placed near the eastern boundary in the northern half of the Central Maui WWRF segment of the project area (Figure 189). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.68 mbs. The stratigraphy of TE-44 consisted of a brown, sandy loam Ap horizon (Stratum I) overlying previously disturbed, natural aeolian sand (Stratum II); dark brown, natural silt loam (Stratum III); and dark brown, natural sandy clay (Stratum IV) (Figure 190 through Figure 192 and Table 44). No cultural materials were encountered.



Figure 189. TE-44, overview of the general location, view to east



Figure 190. TE-44, close-up of the east wall, view to east



Figure 191. TE-44, oblique view of the east wall, view to northeast

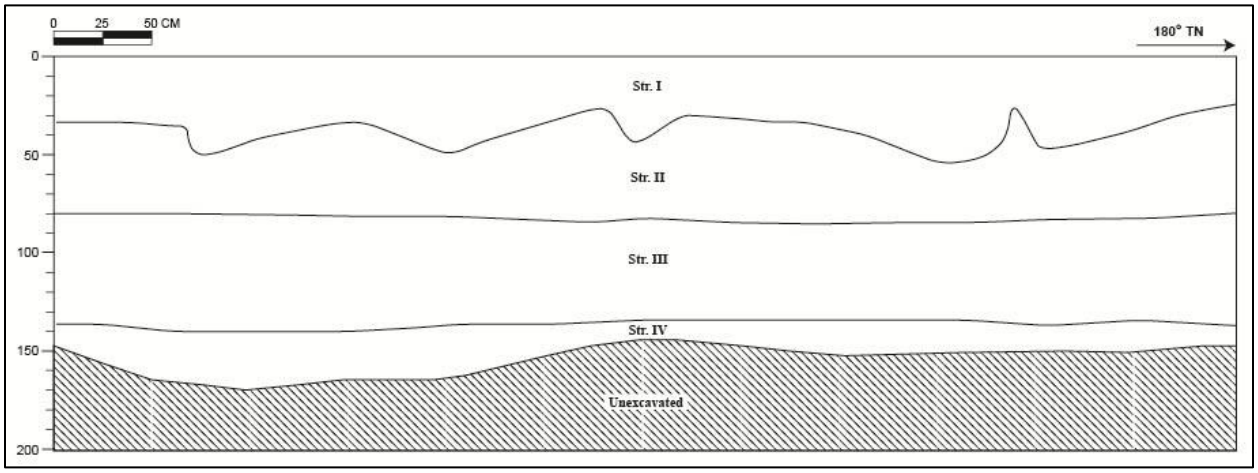



Figure 192. TE-44, stratigraphy of the east wall

Table 44. Strata observed at TE-44

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–50 | Ap horizon; 10YR 4/3, brown; gravelly sandy loam; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; slightly plastic; mixed origin; few fine roots; clear, wavy lower boundary; contained mottles of 10YR 6/4, light yellowish brown loamy sand |
| II | 23–83 | Previously disturbed natural; 10YR 6/6, brownish yellow; sand; structureless (single grain); dry, hard consistence; strong cementation; non-plastic; marine origin; no roots; very abrupt, smooth lower boundary; aeolian sand |
| III | 75–140 | Natural; 10YR 3/3, dark brown; gravelly silt loam; moderate, fine granular structure; moist, friable consistence; no cementation; very plastic; terrigenous origin; no roots; clear, smooth lower boundary; contained mottles of 10YR 4/3, brown silt loam |
| IV | 130–168 | Natural; 10YR 3/3, dark brown; gravelly sandy clay; moderate, fine granular structure; moist, friable consistence; no cementation; very plastic; mixed origin; no roots; lower boundary not observed |

### 1.1.45 Test Excavation 45 (TE-45)

TE-45 was placed in the western-central section of the Central Maui WWRF segment of the project area (Figure 193). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.72 mbs. The stratigraphy of TE-45 consisted of a dark grayish brown, gravelly silt loam Ap horizon (Stratum I) and previously disturbed, natural extremely cobbly loamy sand (Stratum II) overlying a natural alluvial streambed deposit (Stratum III); a thin deposit of natural aeolian sand (Stratum IV); a natural alluvial streambed deposit (Stratum V); dark brown, natural gravelly sandy loam including bands of silt loam and marine sand (Stratum VI); natural aeolian sand (Stratum VII); and dark brown, natural silt loam (Stratum VIII) (Figure 194 through Figure 197 and Table 45). Stratum V includes bands of very fine silt loam at both the upper and lower interfaces, which is interpreted as resulting from siltation and sorting following an alluvial event. No cultural materials were encountered.



Figure 193. TE-45, overview of the general location, view to east



Figure 194. TE-45, close-up of the east wall, view to east



Figure 195. TE-45, oblique view of the east wall, view to southeast



Figure 196. TE-45, oblique view of the east wall, view to northeast

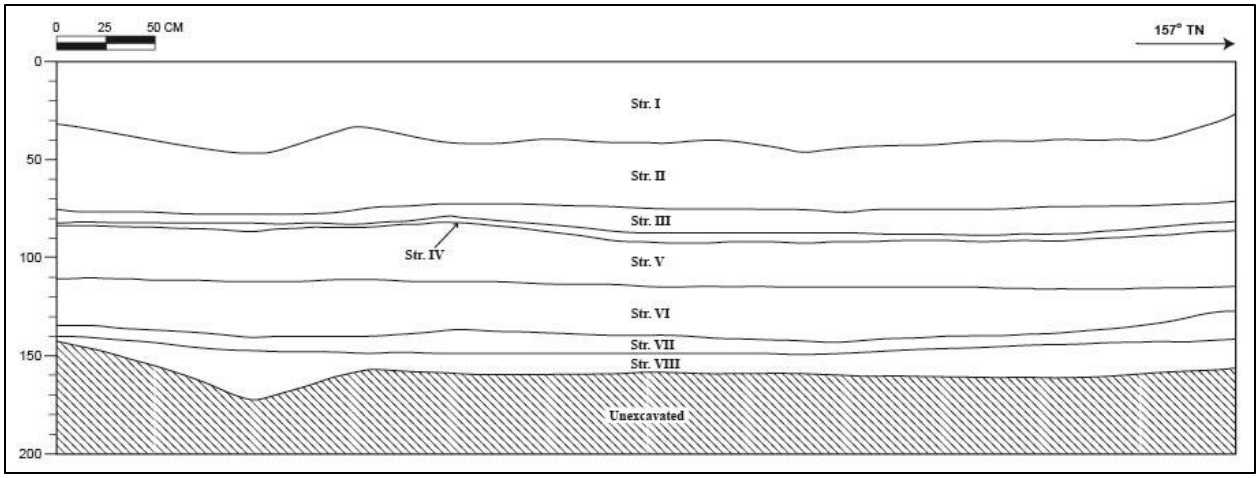



Figure 197. TE-45, stratigraphy of the east wall

Table 45. Strata observed at TE-45

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–48 | Ap horizon; 10YR 4/2, dark grayish brown; very gravelly silt loam; weak, fine granular structure; dry, weakly coherent consistence; no cementation; non-plastic; terrigenous origin; many fine roots; clear, smooth lower boundary |
| II | 23–78 | Previously disturbed natural; 10YR 3/2, very dark grayish brown; extremely cobbly loamy sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; terrigenous origin; few fine roots; clear, smooth lower boundary; contained a band of 10YR 3/4, dark yellowish brown, very fine silt loam |
| III | 67–86 | Natural; 10YR 3/2, very dark grayish brown; loamy sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; terrigenous origin; no roots; clear, smooth lower boundary; alluvial streambed deposit; contained banding of 10YR 4/2 dark grayish brown silt loam and 10YR 7/4 very pale brown sand |
| IV | 77–90 | Natural; 10YR 6/4, light yellowish brown; sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; marine origin; no roots; abrupt, smooth lower boundary; aeolian sand |
| V | 81–113 | Natural; 10YR 3/2, very dark grayish brown; extremely cobbly sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; terrigenous origin; no roots; clear, smooth lower boundary; alluvial streambed deposit with a band of 7.5YR 3/3, dark brown silt loam at the upper interface and 10YR 4/2, dark grayish brown silt loam at the lower interface |
| VI | 110–140 | Natural; 10YR 3/3, dark brown; gravelly sandy loam; moderate, fine granular structure; moist, loose consistence; no cementation; non-plastic; terrigenous origin; no roots; clear, smooth lower boundary; contained banding of 10YR 3/3, dark brown silt loam and 10YR 4/3, brown marine sand |
| VII | 123–148 | Natural; 10YR 6/3, pale brown; sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; marine origin; no roots; clear, smooth lower boundary; aeolian sand |
| VIII | 137–172 | Natural; 10YR 3/3, dark brown; silt loam; moderate, medium blocky structure; moist, firm consistence; weak cementation; non-plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.46 Test Excavation 46 (TE-46)

TE-46 was placed in the central section of the Central Maui WWRF segment of the project area (Figure 5). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.64 mbs. The stratigraphy of TE-46 consisted of a dark grayish brown, silt loam Ap horizon (Stratum I) overlying dark grayish brown, previously disturbed, natural silt loam (Stratum II); a brown, natural sandy loam buried A horizon (Stratum III); natural aeolian sand with $CaCO_3$ mottling (Stratum IV); and dark brown, natural silt loam (Stratum V) (Figure 198 through Figure 201 and Table 46). No cultural materials were encountered.



Figure 198. TE-46, overview of the general location, view to northwest



Figure 199. TE-46, close-up of the west wall, view to west



Figure 200. TE-46, oblique view of the west wall, view to southwest

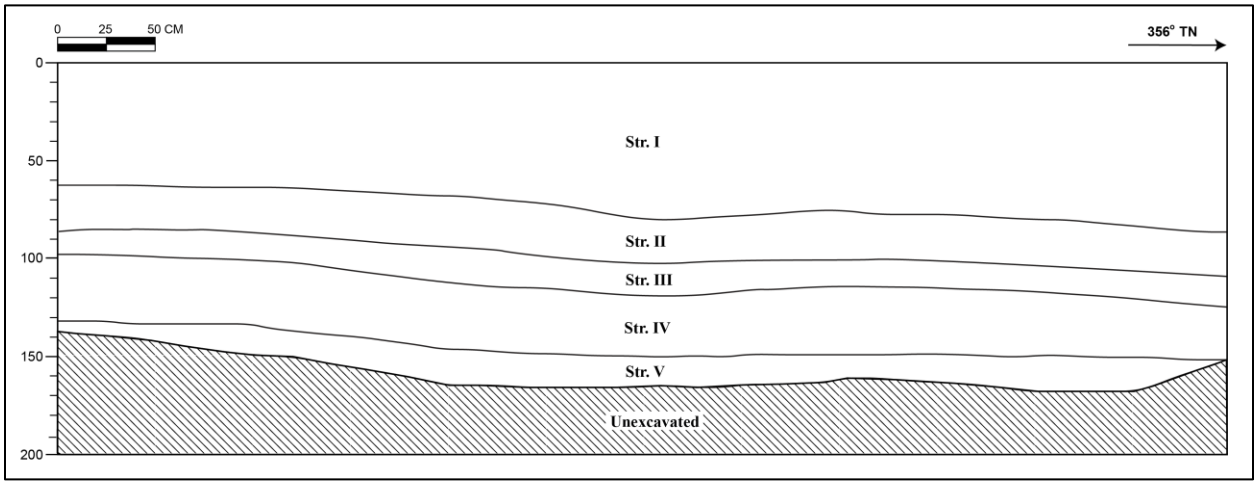



Figure 201. TE-46, stratigraphy of the west wall

Table 46. Strata observed at TE-46

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–82 | Ap horizon; 10YR 4/2, dark grayish brown; gravelly silt loam; moderate, fine granular structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; many fine roots; gradual, smooth lower boundary |
| II | 62–110 | Previously disturbed natural; 10YR 4/2, dark grayish brown; silt loam; moderate, fine granular structure; moist, friable consistence; no cementation; slightly plastic; terrigenous origin; few fine roots; gradual, smooth lower boundary |
| III | 85–120 | Buried A horizon; 10YR 4/3, brown; sandy loam; weak, very fine granular structure; moist, loose consistence; no cementation; non-plastic; few fine roots; clear, smooth lower boundary |
| IV | 99–150 | Natural; 7.5YR 6/6, reddish yellow; sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; marine origin; no roots; clear, smooth lower boundary; contained mottles of 7.5YR 7/2 pinkish gray CaCO3 |
| V | 132–164 | Natural; 7.5YR 3/2, dark brown; silt loam; moderate, fine blocky structure; moist, firm consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.47 Test Excavation 47 (TE-47)

TE-47 was placed in the central section of the Central Maui WWRF segment of the project area (Figure 202). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.68 mbs. The stratigraphy of TE-47 consisted of a dark yellowish brown, gravelly sandy clay loam Ap horizon (Stratum I) overlying brown, previously disturbed, natural silty clay loam (Stratum II); grayish brown, natural sandy loam with mottles of alluvial gravel (Stratum III); natural aeolian sand (Stratum IV); and dark brown, natural silt loam (Stratum V) (Figure 203 through Figure 205 and Table 47). No cultural materials were encountered.



Figure 202. TE-47, overview of the general location, view to northwest



Figure 203. TE-47, close-up of the east wall, view to east



Figure 204. TE-47, oblique view of the east wall, view to northeast

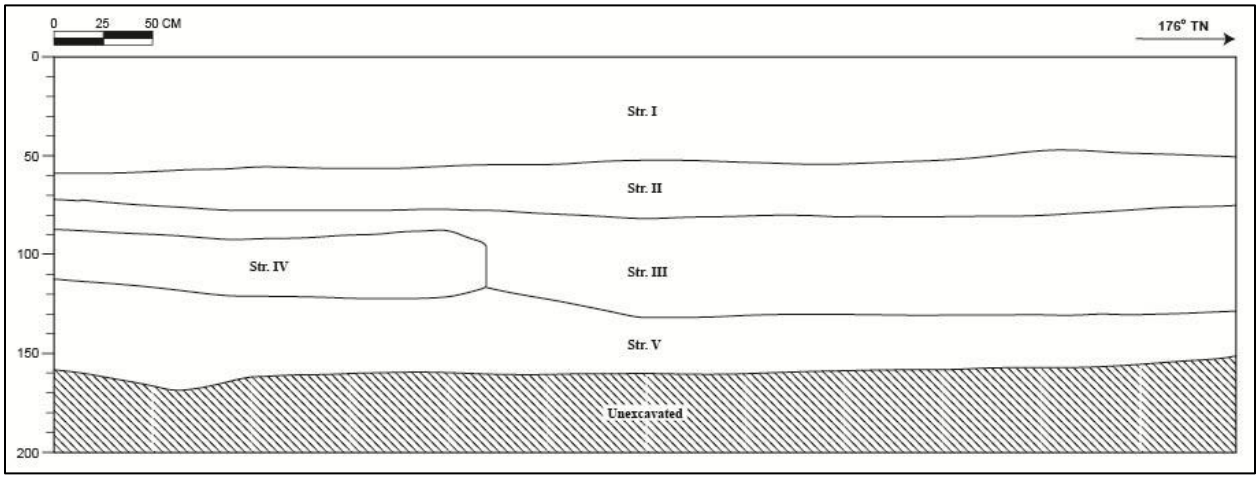



Figure 205. TE-47, stratigraphy of the east wall

Table 47. Strata observed at TE-47

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–60 | Ap horizon; 10YR 3/4, dark yellowish brown; gravelly sandy clay loam; moderate, fine granular structure; dry, hard consistence; no cementation; plastic; terrigenous origin; many fine to medium roots; clear, smooth lower boundary |
| II | 44–80 | Previously disturbed natural; 10YR 4/3, brown; silty clay loam; moderate, fine granular structure; moist, firm consistence; no cementation; very plastic; terrigenous origin; few fine roots; clear, smooth lower boundary |
| III | 72–130 | Natural; 10YR 5/2, grayish brown; sandy loam; weak, fine granular structure; moist, friable consistence; no cementation; slightly plastic; terrigenous origin; no roots; clear, smooth lower boundary; contained mottles of 10YR 6/1, gray loamy sand |
| IV | 86–120 | Natural; 7.5YR 6/6, reddish yellow; sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; marine origin; no roots; clear, smooth boundary |
| V | 113–168 | Natural; 10YR 3/3, dark brown; silt loam; moderate, fine granular structure; moist, friable consistence; no cementation; slightly plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.48 Test Excavation 48 (TE-48)

TE-48 was placed in the eastern-central section of the Central Maui WWRF segment of the project area (Figure 206). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.67 mbs. The stratigraphy of TE-48 consisted of a dark yellowish brown, sandy loam Ap horizon (Stratum I) overlying previously disturbed, natural aeolian sand (Stratum II) and dark brown, natural silty clay loam with inclusions of alluvial streambed gravel (Stratum III) (Figure 207 through Figure 209 and Table 48). No cultural materials were encountered.



Figure 206. TE-48, overview of the general location, view to northwest



Figure 207. TE-48, close-up of the east wall, view to east



Figure 208. TE-48, oblique view of the east wall, view to southeast

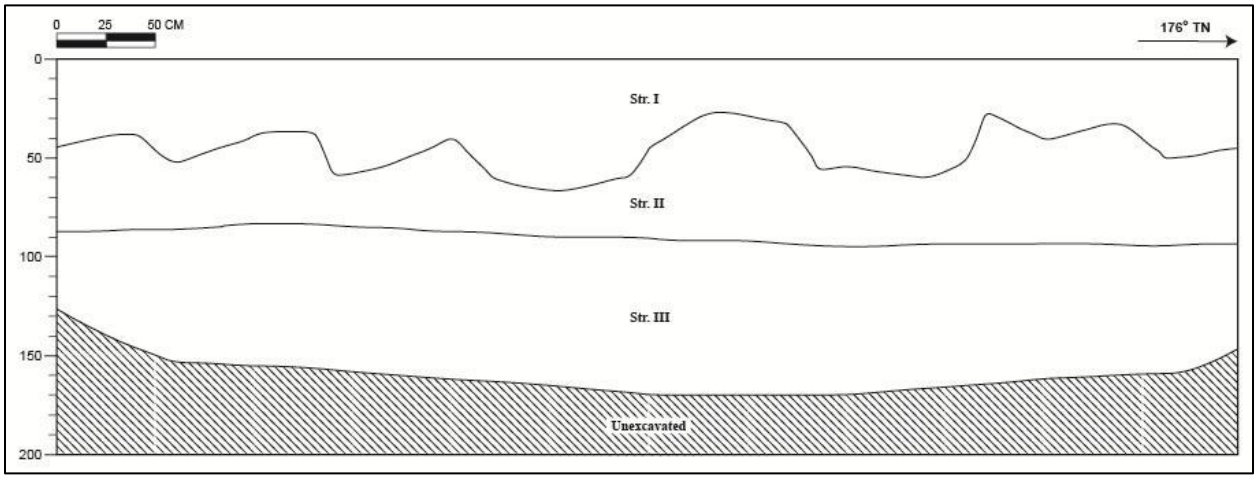



Figure 209. TE-48, stratigraphy of the east wall

Table 48. Strata observed at TE-48

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–65 | Ap horizon; 10YR 3/4, dark yellowish brown; gravelly sandy loam; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; slightly plastic; mixed origin; many fine to medium roots; clear, wavy lower boundary |
| II | 24–92 | Previously disturbed natural; 7.5YR 6/6, reddish yellow; sand; structureless (single grain); moist, firm consistence; weak cementation; non-plastic; marine origin; no roots; abrupt, smooth lower boundary; aeolian sand |
| III | 82–167 | Natural; 10YR 3/3, dark brown; silty clay loam; weak, fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed; contained inclusions of 10YR 4/3, brown cobbly loamy sand alluvial streambed gravel |

### 1.1.49 Test Excavation 49 (TE-49)

TE-49 was placed in the western-central section of the Central Maui WWRF segment of the project area (Figure 210). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.71 mbs. The stratigraphy of TE-49 consisted of a dark grayish brown, sandy loam Ap horizon (Stratum I) overlying aeolian sand with $CaCO_3$ mottling (Stratum II) and dark brown, natural silt clay loam (Stratum III) (Figure 211 through Figure 213 and Table 49). No cultural materials were encountered.



Figure 210. TE-49, overview of the general location, view to northwest



Figure 211. TE-49, close-up of the west wall, view to west



Figure 212. TE-49, oblique view of the west wall, view to northwest

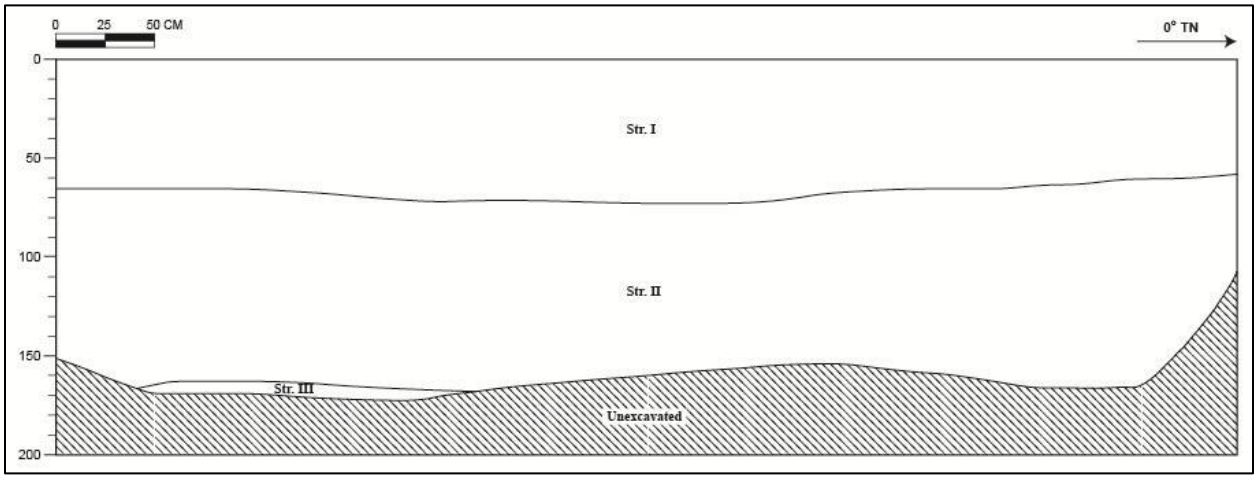



Figure 213. TE-49, stratigraphy of the west wall

Table 49. Strata observed at TE-49

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–71 | Ap horizon; 10YR 4/2, dark grayish brown; very gravelly sandy loam; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; slightly plastic; mixed origin; many fine roots; clear, smooth lower boundary; contained a band of 10YR 3/2, very dark grayish brown, loamy sand near the lower interface |
| II | 55–168 | Natural; 10YR 6/6, brownish yellow; sand; structureless (single grain); moist, loose consistence; weak cementation; non-plastic; marine origin; no roots; abrupt, smooth lower boundary; contained mottles of 10YR 7/2, light gray CaCO3 |
| III | 162–171 | Natural; 7.5YR 3/4, dark brown; silty clay loam; weak, fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.50 Test Excavation 50 (TE-50)

TE-50 was placed in the central section of the Central Maui WWRF segment of the project area (Figure 214). The excavation was 6.0 m long by 1.1 m wide with a maximum depth of 1.84 mbs. The stratigraphy of TE-50 consisted of a brown sandy loam Ap horizon (Stratum I) overlying a dark yellowish brown, previously disturbed, natural silt loam (Stratum II); dark yellowish brown, natural silt loam (Stratum III); a pale brown, sand buried A horizon (Stratum IV); natural aeolian sand with $CaCO_3$ mottling (Stratum V); and dark yellowish brown, natural sandy clay loam (Stratum VI) (Figure 215 through Figure 225 and Table 50).

A crab claw was collected from Stratum IV, at 105 cmbs, during shovel scraping inspection. The claw was brittle and disintegrated prior to laboratory analysis. An approximate 1.0-gallon sediment sample from Stratum IV was collected from the east wall and screened in the field (see Figure 217 and Figure 218). The sample contained organic remnants (dried roots). An approximate 1/4-gallon screened sediment sample was collected from an approximate 14-cm-diameter potential pit feature within the buried A horizon (Stratum IV). Rather than a pit feature, the change in soil from pale brown sand to brown sandy loam was a result of bioturbation activities (see Figure 219 and Figure 220). An approximate 1/2-gallon screened sediment sample was collected from a charcoal stain within Stratum IV in the southern end of the trench, and no significant contents were identified (see Figure 221 through Figure 223).



Figure 214. TE-50, overview of the general location, view to north



Figure 215. TE-50, close-up of the east wall, view to east



Figure 216. TE-50, overview of east wall, view to southeast



Figure 217. TE-50, close-up of the screened sediment sample location within Stratum IV in the east wall, view to east



Figure 218. TE-50, close-up of the sediment sample location from in the east wall, view to east



Figure 219. TE-50, close-up of bioturbation-related feature in the east wall, view to east



Figure 220. TE-50, close-up of the sampled area relating to bioturbation, view to east



Figure 221. TE-50, close-up of a charcoal stain in the southern end of Stratum IV, view to south



Figure 222. TE-50, close-up of sediment sample location in the southern end of the trench, view to south

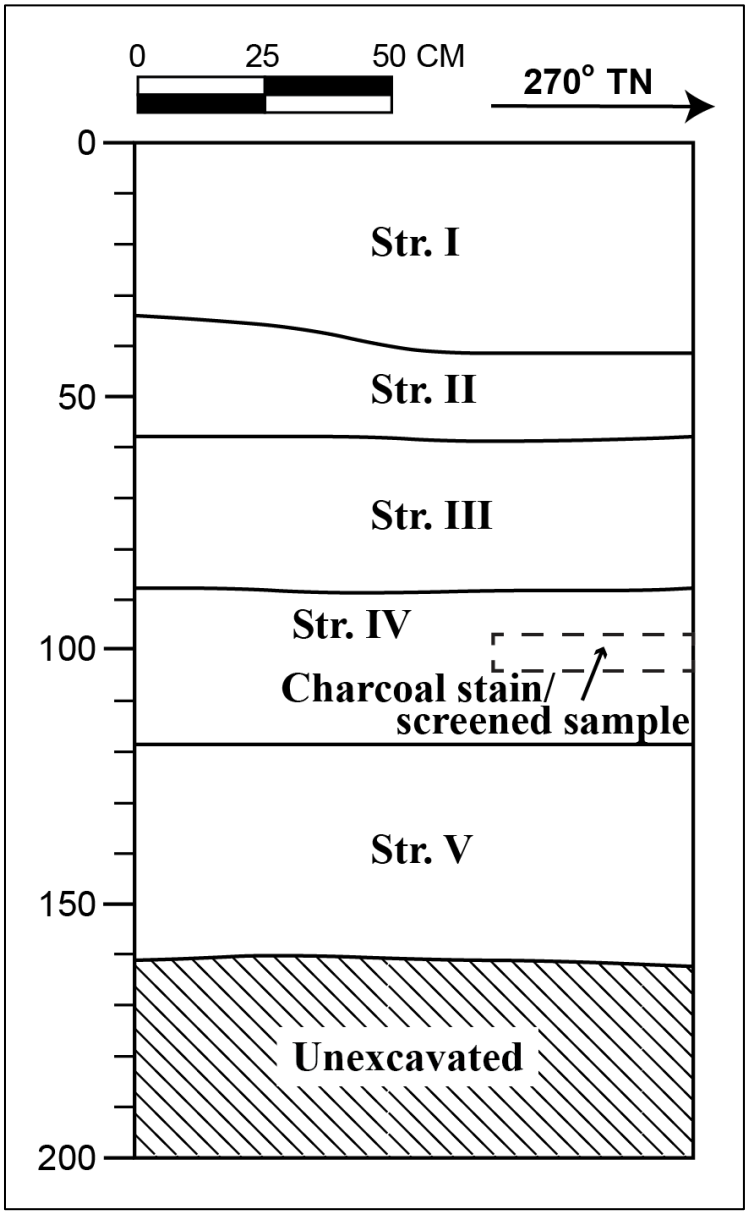



Figure 223. TE-50, stratigraphy of the south wall showing the screened sample from the charcoal staining



Figure 224. TE-50, oblique view of the east wall, view to southeast

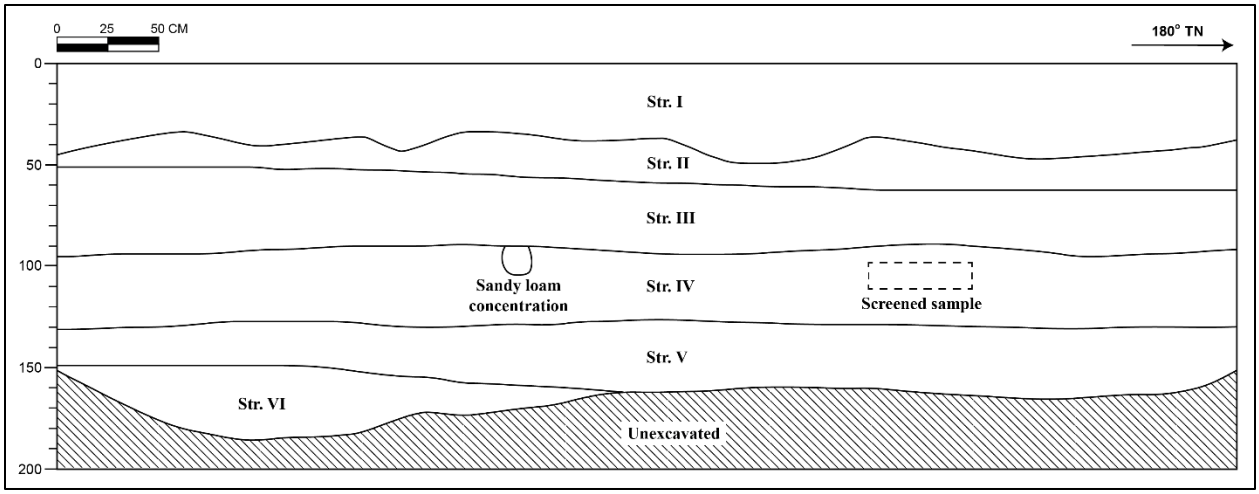



Figure 225. TE-50, stratigraphy of the east wall

Table 50. Strata observed at TE-50

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–47 | Ap horizon; 10YR 4/3, brown; gravelly sandy loam; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; slightly plastic; terrigenous origin; many fine roots; clear, smooth lower boundary |
| II | 32–60 | Previously disturbed natural; 10YR 4/4, dark yellowish brown; silt loam; moderate, fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; few fine roots; clear, smooth lower boundary |
| III | 50–95 | Natural; 10YR 3/4, dark yellowish brown; silt loam; weak, fine granular structure; moist, firm consistence; no cementation; slightly plastic; terrigenous origin; no roots; clear, smooth lower boundary |
| IV | 87–130 | Buried A horizon; 10YR 6/3, pale brown; sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; marine origin; no roots; clear, smooth lower boundary; contained charcoal stain of 10YR 5/3, brown sand with no charcoal pieces |
| V | 124–161 | Natural; 10YR 6/6, brownish yellow; sand; structureless (single grain); moist, loose consistence; weak cementation; non-plastic; marine origin; no roots, clear, smooth lower boundary; contained mottles of 7.5YR 6/1 gray $CaCO_3$ |
| VI | 147–184 | Natural; 10YR 3/4, dark yellowish brown; gravelly sandy clay loam; weak, fine granular structure; moist, firm consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.51 Test Excavation 51 (TE-51)

TE-51 was placed in the central section of the Central Maui WWRF segment of the project area (Figure 226). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.73 mbs. The stratigraphy of TE-51 consisted of a brown, gravelly sandy loam Ap horizon (Stratum I) overlying brownish yellow, previously disturbed, natural silt loam (Stratum II); a pale brown, sand buried A horizon (Stratum III); and dark brown, natural silty clay loam (Stratum IV) (Figure 227 through Figure 231 and Table 51).

An approximate 1/2-gallon screened sediment sample was collected from a charcoal stain within Stratum III of the west wall near the southern end of the trench (see Figure 229 and Figure 230). The lens contained dried rootlets, a small (< 1.0 g) piece of charcoal, and a small probable bird bone tubular shaft, which was brittle and disintegrated prior to laboratory analysis. The bone had been mostly white such as from heat alteration or sun bleaching.



Figure 226. TE-51, overview of the general location, view to northwest



Figure 227. TE-51, close-up of the west wall, view to west



Figure 228. TE-51, oblique of the west wall, view to northwest



Figure 229. TE-51, close-up of a charcoal stain (arrows) in the west wall, view to west



Figure 230. TE-51, close-up of the screened sample location in the west wall, view to west

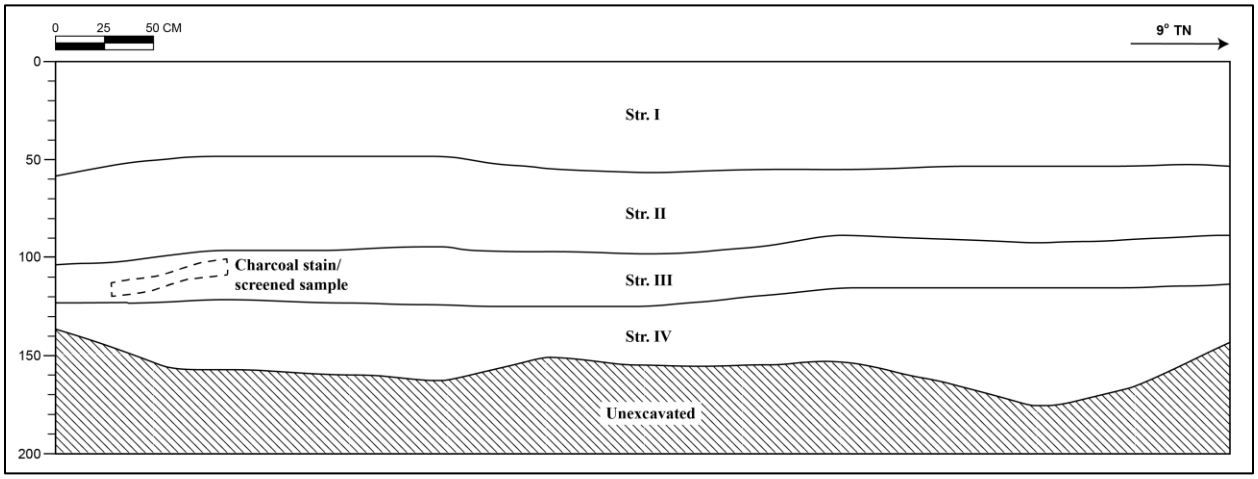



Figure 231. TE-51, stratigraphy of the west wall

Table 51. Strata observed at TE-51

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–57 | Ap horizon; 10YR 4/3, brown; gravelly sandy loam; moderate, medium granular structure; dry, hard consistence; no cementation; slightly plastic; mixed origin; many fine roots; clear, smooth lower boundary |
| II | 47–102 | Previously disturbed natural; 10YR 5/3, brown; silt loam; weak, fine blocky structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; clear, smooth lower boundary |
| III | 85–123 | Buried A horizon; 10YR 6/3, pale brown, sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; marine origin; no roots; clear, smooth lower boundary; contained charcoal stain of 10YR 5/3, brown sand and a probable bird bone shaft |
| IV | 110–173 | Natural; 10YR 3/3, dark brown; silty clay loam; moderate, fine blocky structure; moist, firm consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.52 Test Excavation 52 (TE-52)

TE-52 was placed in the eastern-central section of the Central Maui WWRF segment of the project area (Figure 232). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.65 mbs. The stratigraphy of TE-52 consisted of a dark grayish brown, sandy Ap horizon (Stratum I) overlying previously disturbed, natural aeolian sand (Stratum II); dark brown, very gravelly silt loam (Stratum III); natural alluvial streambed gravels and cobbles (Stratum IV); and dark yellowish brown, natural silt loam (Stratum V) (Figure 233 through Figure 235 and Table 52). No cultural materials were encountered.

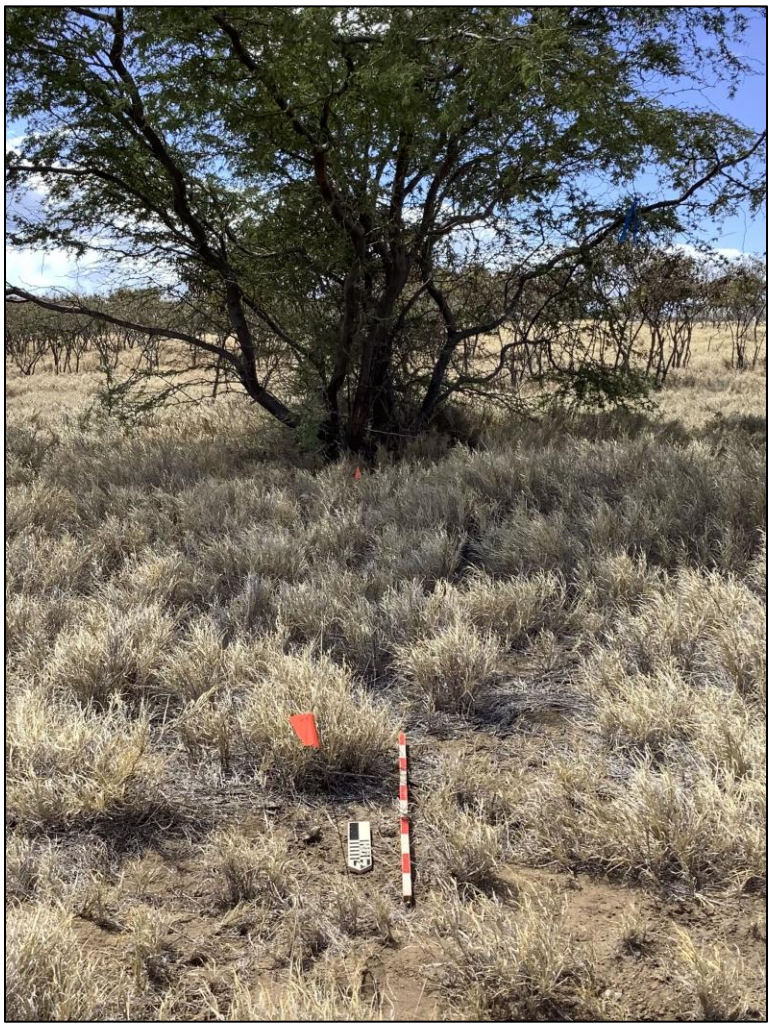


Figure 232. TE-52, overview of the general location prior to removal of the *kiawe* tree, view to south



Figure 233. TE-52, close-up of the west wall, view to west



Figure 234. TE-52, oblique view of the west wall, view to southwest

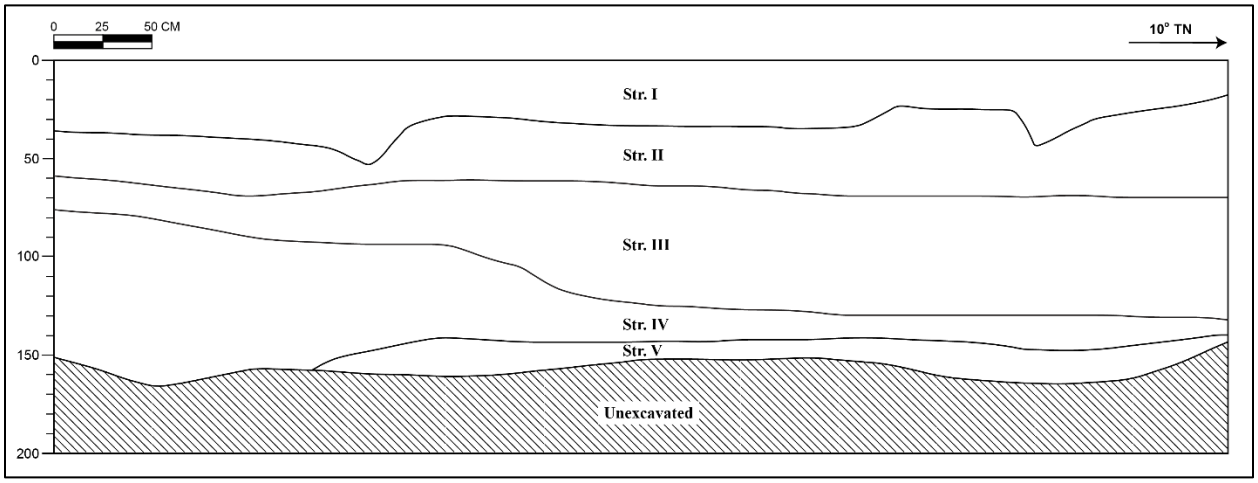



Figure 235. TE-52, stratigraphy of the west wall

Table 52. Strata observed at TE-52

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–63 | Ap horizon; 10YR 4/2, dark grayish brown; gravelly sandy loam; weak, fine granular structure; dry, weakly coherent consistence; no cementation; slightly plastic; mixed origin; many fine roots; clear, wavy lower boundary; contained mottles of 7.5YR 6/6, reddish yellow sand |
| II | 17–69 | Previously disturbed, natural; 10YR 7/4, very pale brown; sand; structureless (single grain); moist, friable consistence; weak cementation; non-plastic; marine origin; no roots; abrupt, smooth lower boundary |
| III | 60–130 | Natural; 7.5YR 3/3, dark brown; very gravelly silt loam; moderate, fine granular structure; moist, friable consistence; no cementation; slightly plastic; terrigenous origin; few fine to medium roots; clear, wavy lower boundary |
| IV | 76–165 | Natural; 10YR 3/3, dark brown; extremely cobbly loamy sand; weak, medium granular structure; moist, loose consistence; no cementation; non-plastic; terrigenous origin; no roots; clear, smooth lower boundary; alluvial streambed gravel and cobbles |
| V | 138–163 | Natural; 10YR 4/4, dark yellowish brown; silt loam; weak, fine blocky structure; moist, friable consistence; no cementation; slightly plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.53 Test Excavation 53 (TE-53)

TE-53 was placed in the western-central section of the Central Maui WWRF segment of the project area (Figure 236). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.68 mbs. The stratigraphy of TE-53 consisted of a dark brown, sandy loam developing A horizon (Stratum I) and a brown, sandy loam Ap horizon (Stratum II) overlying natural aeolian sand (Stratum III) (Figure 237 through Figure 239 and Table 53). Stratum II contained geotextile fabric and black plastic irrigation drip-tape.



Figure 236. TE-53, overview of the general location, view to north

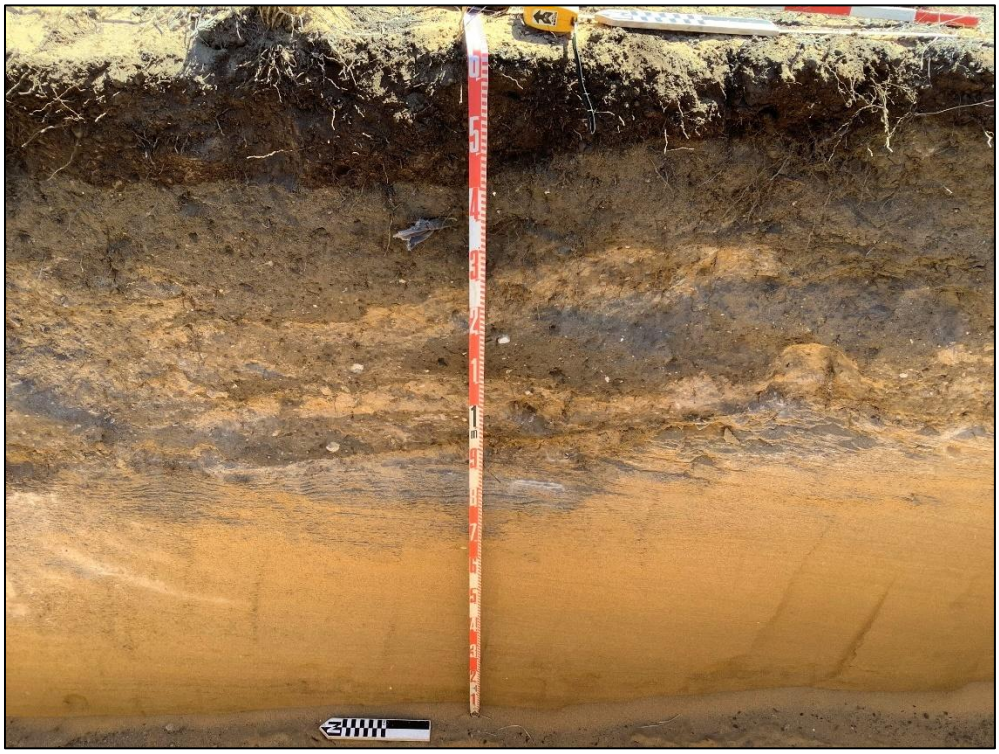


Figure 237. TE-53, close-up of the east wall, view to east



Figure 238. TE-53, oblique view of the east wall, view to northeast

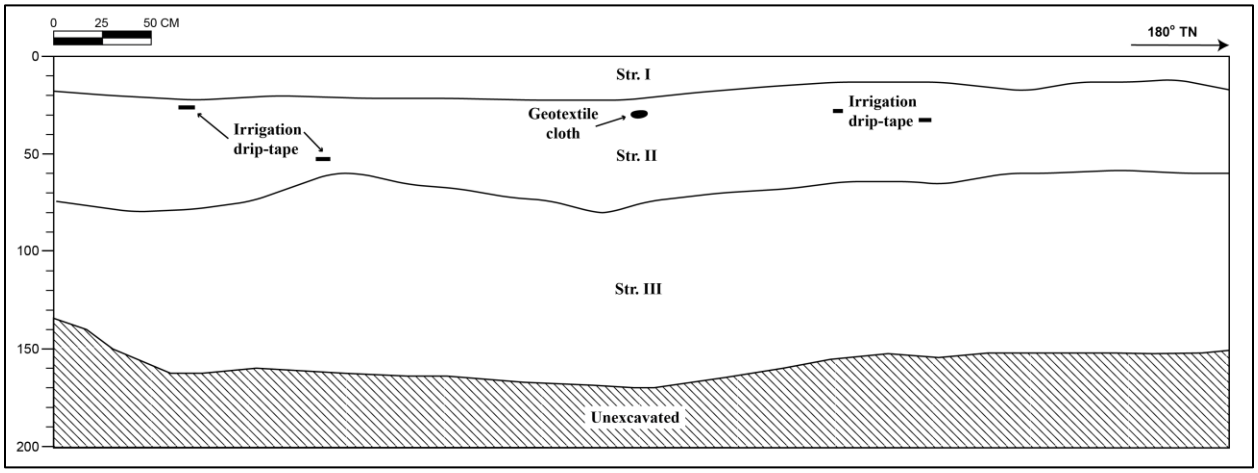



Figure 239. TE-53, stratigraphy of the east wall

Table 53. Strata observed at TE-53

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–20 | Developing A horizon; 10YR 3/3, dark brown; gravelly sandy loam; moderate, medium granular structure; dry, hard consistence; no cementation; non-plastic; terrigenous origin; many fine roots; clear, smooth lower boundary |
| II | 8–78 | Ap horizon; 10YR 4/3, brown; sandy loam; moderate, fine granular structure; moist, friable consistence; no cementation; non-plastic; mixed origin; few fine roots; clear, smooth lower boundary; contained mottles of 10YR 6/3, pale brown sand; irrigation drip-tape and geotextile fabric observed |
| III | 56–168 | Natural; 10YR 6/6, brownish yellow; sand; structureless (single grain); moist, loose consistence; weak cementation; non-plastic; marine origin; no roots; lower boundary not observed |

### 1.1.54 Test Excavation 54 (TE-54)

TE-54 was placed in the central section of the Central Maui WWRF segment of the project area (Figure 240). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 2.24 mbs at the northern end of the trench in order to investigate the depth of the natural aeolian sand (Stratum V). The stratigraphy of TE-54 consisted of a dark grayish brown, sandy loam Ap horizon (Stratum I) overlying natural alluvial streambed gravel (Stratum II); brown, natural silty clay loam (Stratum III); dark yellowish brown, natural alluvial streambed gravel (Stratum IV); natural aeolian sand with $CaCO_3$ mottling (Stratum V); and dark brown, natural silty clay loam (Stratum VI) (Figure 241 through Figure 243 and Table 54). No cultural materials were encountered.



Figure 240. TE-54, overview of the general location, view to north



Figure 241. TE-54, close-up of the northern portion of the east wall, view to east



Figure 242. TE-54, oblique view of the east wall, view to northeast

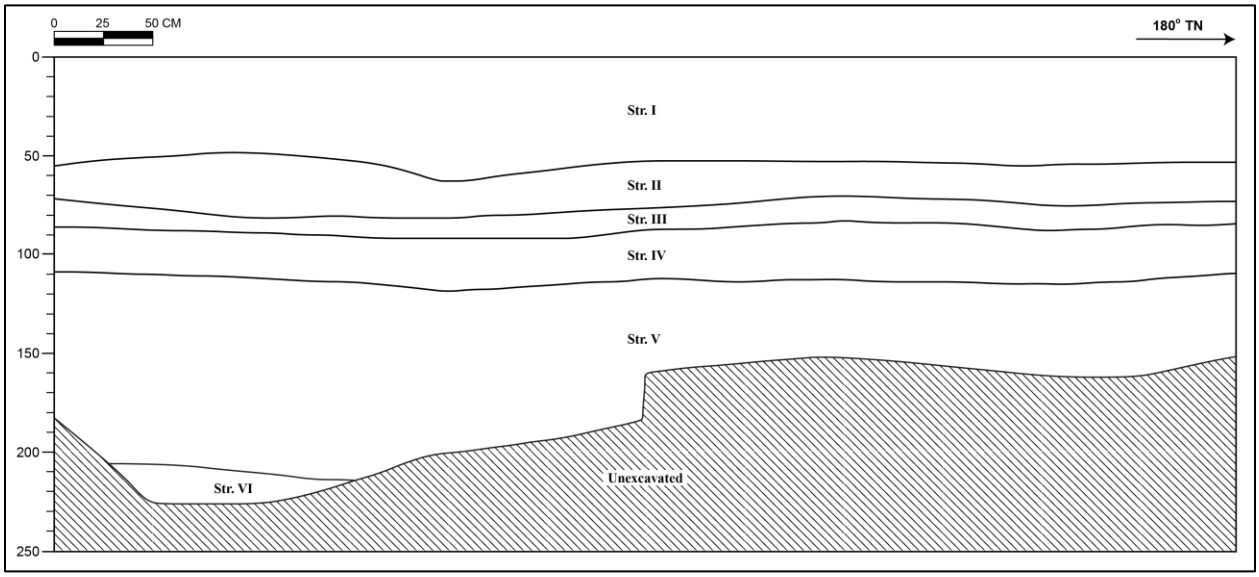



Figure 243. TE-54, stratigraphy of the east wall

Table 54. Strata observed at TE-54

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–62 | Ap horizon; 10YR 4/2, dark grayish brown; gravelly sandy loam; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; non-plastic; terrigenous origin; many fine roots; clear, smooth lower boundary |
| II | 47–80 | Natural; 10YR 3/2, very dark grayish brown; extremely gravelly loamy sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; terrigenous origin; no roots; clear, smooth lower boundary; alluvial streambed gravel |
| III | 67–90 | Natural; 10YR 4/3 brown; silty clay loam; moderate, very fine blocky structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; clear, smooth lower boundary |
| IV | 81–117 | Natural; 10YR 3/4, dark yellowish brown; extremely gravelly loamy sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; terrigenous origin; no roots; clear, smooth lower boundary; alluvial streambed gravel |
| V | 105–213 | Natural; 10YR 7/3, very pale brown; sand; structureless (single grain); moist, firm consistence; weak cementation; non-plastic; marine origin; clear, smooth lower boundary; contained mottling of 10YR 7/2, light gray CaCO3 |
| VI | 204–224 | Natural; 7.5YR 3/3, dark brown; silty clay loam; moderate, fine blocky structure; moist, firm consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.55 Test Excavation 55 (TE-55)

TE-55 was placed in the central section of the Central Maui WWRF segment of the project area (Figure 244). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.99 mbs at the northern end of the trench in order to investigate the depth of the natural aeolian sand (Stratum III). The stratigraphy of TE-55 consisted of a brown, sandy loam Ap horizon (Stratum I) overlying a pinkish gray, previously disturbed, natural sand buried A horizon (Stratum II); natural aeolian sand with $CaCO_3$ mottling (Stratum III); and dark brown, natural silty clay loam (Stratum IV) (Figure 245 through Figure 249 and Table 55). An approximate 1-gallon screened sediment sample was collected from a charcoal stain at the upper interface of Stratum II (see Figure 246 and Figure 247). The sample was sterile.



Figure 244. TE-55, overview of the general location, view to east



Figure 245. TE-55, close-up of the east wall, view to east



Figure 246. TE-55, close-up of charcoal staining at the upper interface of Stratum II in the east wall, view to east



Figure 247. TE-55, close-up of the east wall showing the location of a screened sediment sample, view to east



Figure 248. TE-55, overview of the east wall, view to southeast

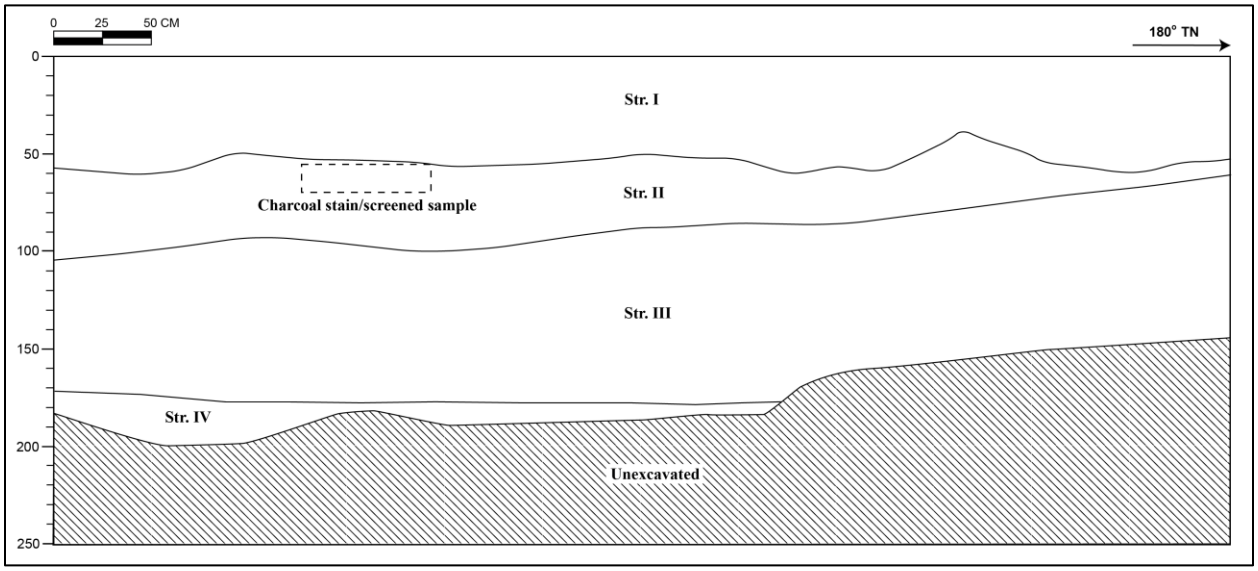



Figure 249. TE-55, stratigraphy of the east wall

Table 55. Strata observed at TE-55

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–60 | Ap horizon; 10YR 4/3, brown; sandy loam; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; non-plastic; mixed origin; many fine roots; clear, wavy lower boundary |
| II | 38–105 | Buried A horizon; 7.5YR 7/2, pinkish gray; sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; marine origin; no roots; clear, smooth lower boundary; previously disturbed; contained a lens of charcoal staining, a screened sediment sample was sterile |
| III | 60–178 | Natural; 10YR 6/6, brownish yellow; sand; structureless (single grain); dry, weakly coherent consistence; weak cementation; non-plastic; marine origin; no roots; clear, smooth lower boundary; contained mottles of 7.5YR 7/1 light gray $CaCO_3$ |
| IV | 171–199 | Natural; 7.5YR 3/3, dark brown; silty clay loam; moderate, fine blocky structure; moist, firm consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.56 Test Excavation 56 (TE-56)

TE-56 was placed in the eastern-central section of the Central Maui WWRF segment of the project area (Figure 250). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.70 mbs. The stratigraphy of TE-56 consisted of a brown sandy loam Ap horizon (Stratum I) overlying dark brown, previously disturbed, natural silt loam (Stratum II); brown, previously disturbed, natural extremely gravelly silt loam (Stratum III); and dark brown, natural silty clay loam (Stratum IV) (Figure 251 through Figure 253 and Table 56). Stratum I truncated portions of Strata II and III and was mixed with the underlying disturbed sediments. Charcoal fragments were observed in Stratum I, but not collected.



Figure 250. TE-56, overview of the general location, view to east



Figure 251. TE-56, close-up of the east wall, view to east



Figure 252. TE-56, oblique view of the east wall, view to southeast

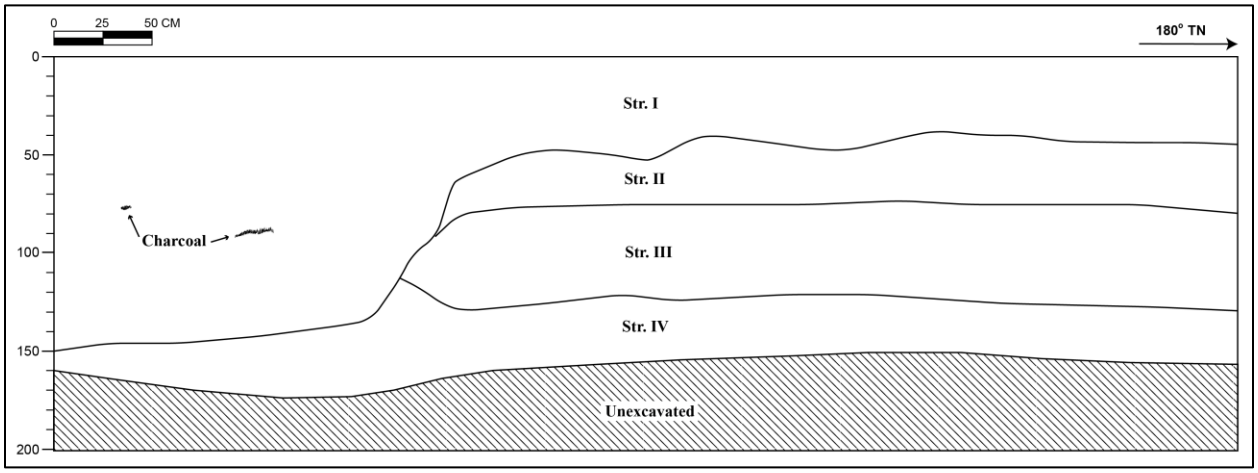



Figure 253. TE-56, stratigraphy of the east wall

Table 56. Strata observed at TE-56

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–147 | Ap horizon; 10YR 4/3, brown; sandy loam; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; non-plastic; mixed origin; medium to coarse roots common; clear, irregular lower boundary; contained charcoal and mottles of 10YR 7/3, very pale brown sand |
| II | 35–92 | Previously disturbed natural; 7.5YR 3/2, dark brown; extremely gravelly silt loam; weak, fine granular structure; moist, loose consistence; no cementation; slightly plastic; terrigenous origin; few medium roots; diffuse, broken lower boundary |
| III | 72–125 | Previously disturbed natural; 10YR 4/3, brown; gravelly silt loam; moderate, fine granular structure; moist, friable consistence; no cementation; slightly plastic; terrigenous origin; no roots, clear, smooth lower boundary |
| IV | 110–170 | Natural; 10YR 3/3, dark brown; silty clay loam; moderate, fine blocky structure; moist, friable consistence; no cementation, plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.57 Test Excavation 57 (TE-57)

TE-57 was placed in the western-central section of the Central Maui WWRF segment of the project area (Figure 254). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.50 mbs. The stratigraphy of TE-57 consisted of a very dark brown, silt loam developing A horizon (Stratum I) and a dark yellowish brown, loamy sand Ap horizon with mottles of yellowish brown loamy sand (Stratum II) overlying natural aeolian sand (Stratum III) (Figure 255 through Figure 257 and Table 57). No cultural materials were encountered.



Figure 254. TE-57, overview of the general location, view to east



Figure 255. TE-57, close-up of the west wall, view to west



Figure 256. TE-57, oblique view of the west wall, view to northwest

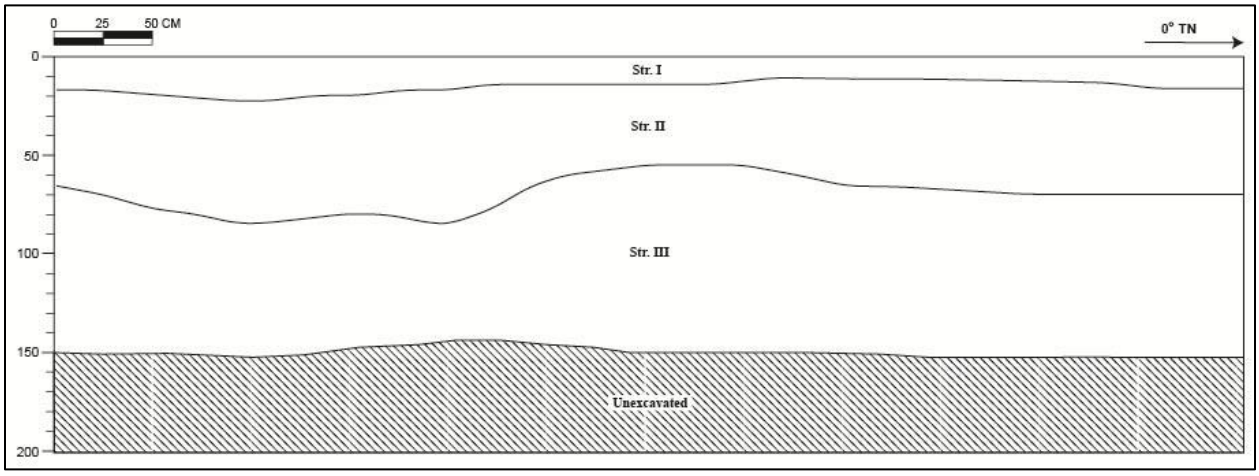



Figure 257. TE-57, stratigraphy of the west wall

Table 57. Strata observed at TE-57

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–20 | Developing A horizon; 7.5YR 2.5/3, very dark brown; gravelly silt loam; moderate, medium blocky structure; dry, weakly coherent consistence; no cementation; slightly plastic; terrigenous origin; fine roots common; abrupt, smooth lower boundary |
| II | 8–83 | Ap horizon; 10YR 4/4, dark yellowish brown; gravelly loamy sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; mixed origin; few fine roots; clear, smooth lower boundary; contained mottles of 10YR 5/6, yellowish brown loamy sand |
| III | 52–150 | Natural; 10YR 6/6, brownish yellow; sand; structureless (single grain); moist, loose consistence; weak cementation; non-plastic; marine origin; no roots, lower boundary not observed |

### 1.1.58 Test Excavation 58 (TE-58)

TE-58 was placed in the central section of the Central Maui WWRF segment of the project area (Figure 258). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.60 mbs. The stratigraphy of TE-58 consisted of a dark brown, gravelly silt loam developing A horizon (Stratum I) and a dark grayish brown, gravelly sandy loam Ap horizon (Stratum II) overlying a dark brown, natural very gravelly loamy sand alluvial deposit (Stratum III) and natural aeolian sand with $CaCO_3$ mottling (Stratum IV) (Figure 259 through Figure 261 and Table 58). Several small pieces of charcoal were observed within the plow zone (Stratum II).



Figure 258. TE-58, overview of the general location, view to north



Figure 259. TE-58, close-up of the east wall, view to east



Figure 260. TE-58, oblique view of the east wall, view to northeast

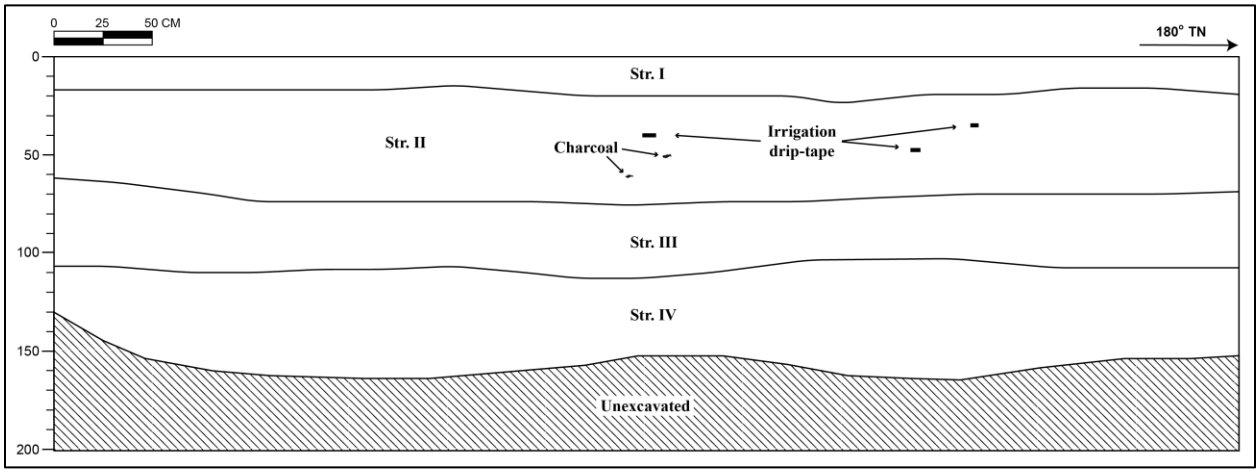



Figure 261. TE-58, stratigraphy of the east wall

Table 58. Strata observed at TE-58

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–19 | Developing A horizon; 7.5YR 3/3, dark brown; gravelly silt loam; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; non-plastic; terrigenous origin; many fine roots; abrupt, smooth lower boundary |
| II | 13–73 | Ap horizon; 10YR 4/2, dark grayish brown; gravelly sandy loam; moderate, fine granular structure; moist, loose consistence; no cementation; non-plastic; mixed origin; few fine roots; abrupt, smooth lower boundary |
| III | 64–109 | Natural; 7.5YR 3/2, dark brown; very gravelly loamy sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; terrigenous origin; no roots; abrupt, smooth lower boundary; alluvial deposit; contained mottles of 10YR 4/3 brown loamy sand |
| IV | 100–160 | Natural; 10YR 6/6, brownish yellow; sand; structureless (single grain); moist, loose consistence; weak cementation; non-plastic; marine origin; no roots; lower boundary not observed; aeolian sand |

### 1.1.59 Test Excavation 59 (TE-59)

TE-59 was placed in the central section of the Central Maui WWRF segment of the project area (Figure 262). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.72 mbs. The stratigraphy of TE-59 consisted of a brown, loamy sand Ap horizon (Stratum I) overlying natural aeolian sand with mottles of yellowish brown, loamy sand (Stratum II) (Figure 263 through Figure 265 and Table 59). No cultural materials were encountered.



Figure 262. TE-59, overview of the general location, view to northeast

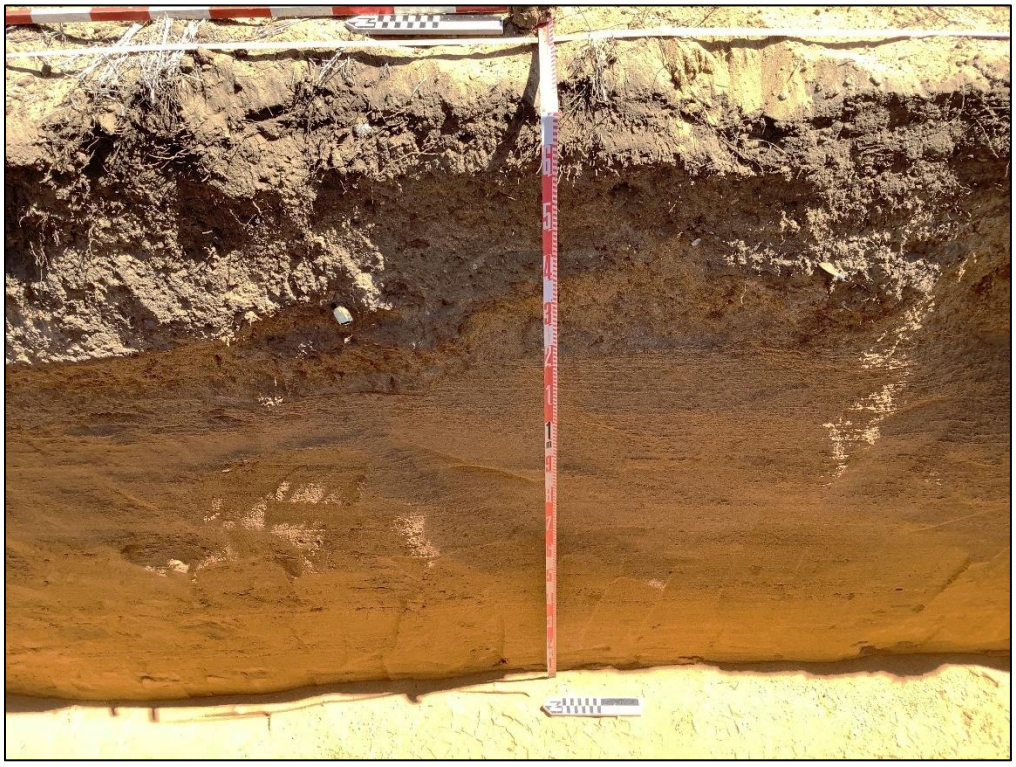


Figure 263. TE-59, close-up of the east wall, view to east



Figure 264. TE-59, oblique view of the east wall, view to southeast

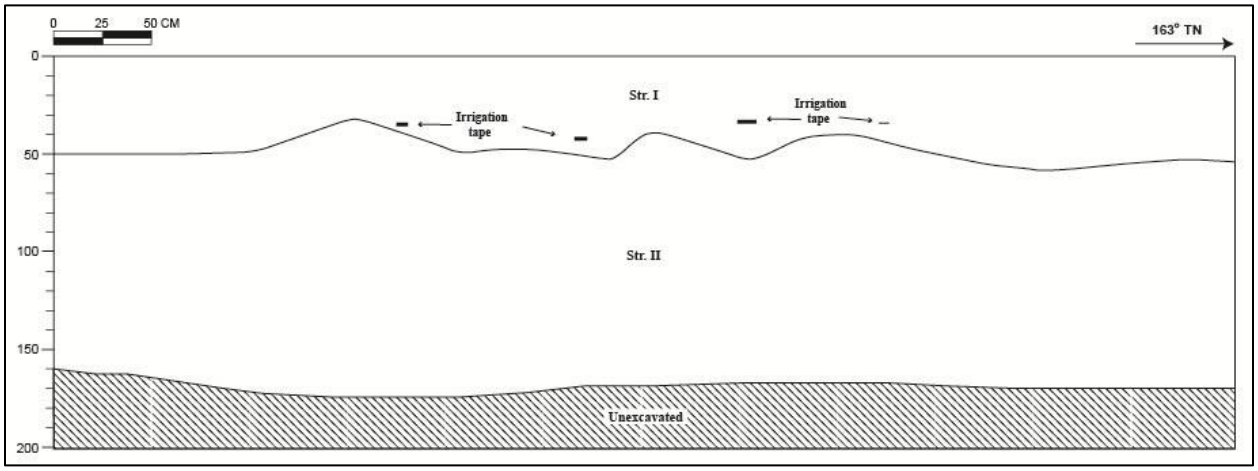



Figure 265. TE-59, stratigraphy of the east wall

Table 59. Strata observed at TE-59

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–55 | Ap horizon; 10YR 5/3, brown; loamy sand; structureless (single grain); dry, weakly coherent consistence; no cementation; non-plastic; mixed origin; fine roots common; clear, wavy lower boundary; contained mottles of 10YR 6/6, brownish yellow loamy sand |
| II | 30–172 | Natural; 10YR 6/6, brownish yellow; sand; structureless (single grain); moist, friable consistence; weak cementation; non-plastic; marine origin; no roots; lower boundary not observed; contained mottles of 10YR 5/6, yellowish brown sand |

### 1.1.60 Test Excavation 60 (TE-60)

TE-60 was placed in the eastern-central section of the Central Maui WWRF segment of the project area (Figure 266). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.63 mbs. The stratigraphy of TE-60 consisted of a yellowish brown, sandy loam Ap horizon (Stratum I) overlying natural aeolian sand (Stratum II) and dark brown, natural silt loam (Stratum III) (Figure 267 through Figure 269 and Table 60). No cultural materials were encountered.



Figure 266. TE-60, overview of the general location, view to north

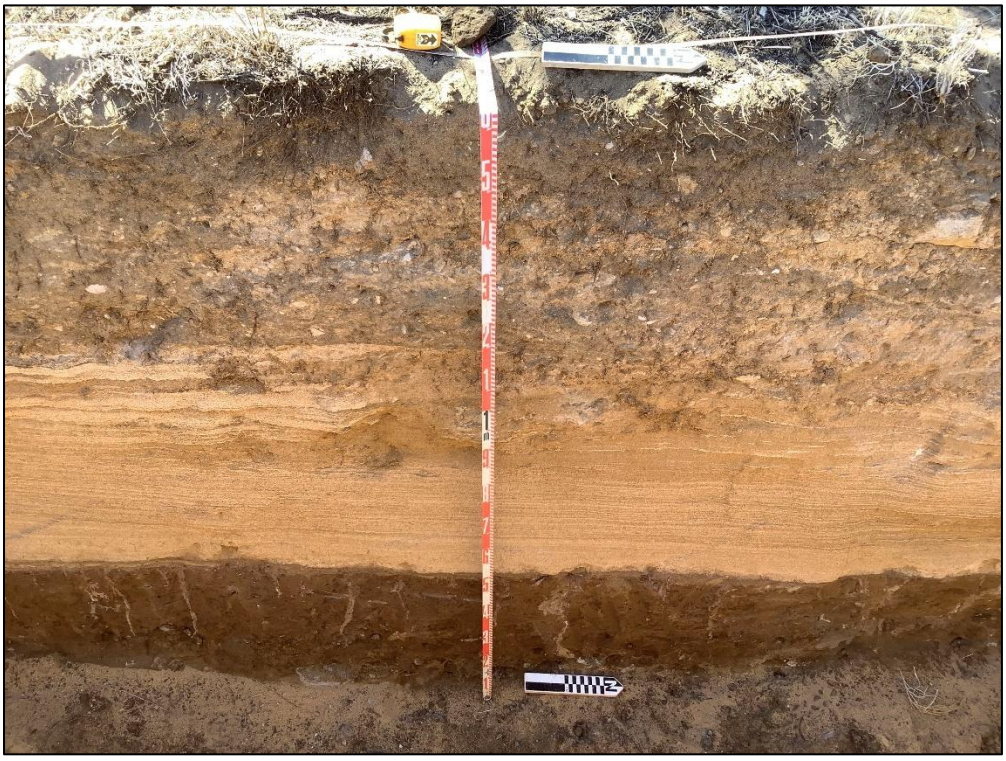


Figure 267. TE-60, close-up of the west wall, view to west



Figure 268. TE-60, oblique view of the west wall, view to southwest

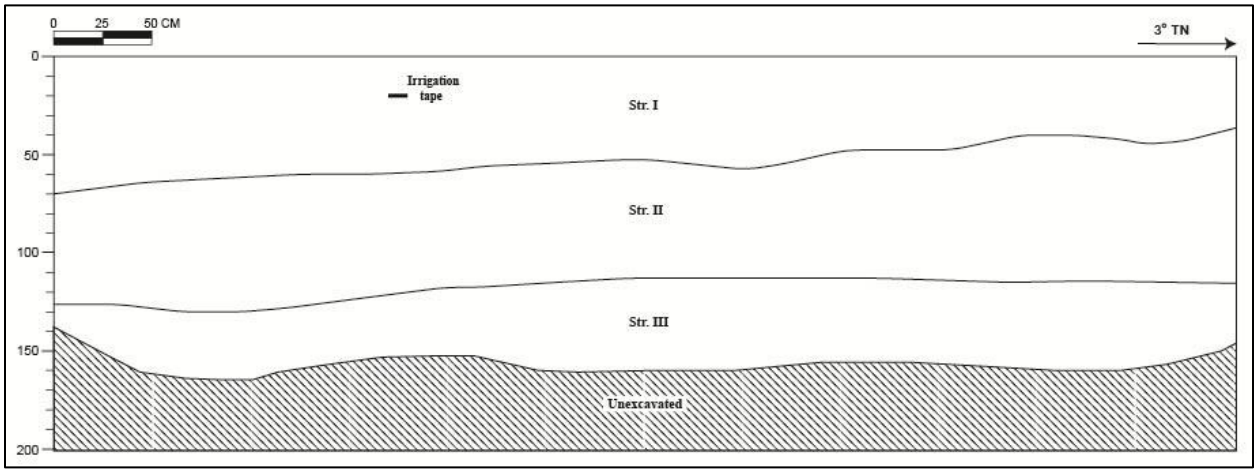



Figure 269. TE-60, stratigraphy of the west wall

Table 60. Strata observed at TE-60

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–68 | Ap horizon; 10YR 5/4, yellowish brown; loamy sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; mixed origin; fine roots common; clear, smooth lower boundary; contained mottles of 10YR 6/4, light yellowish brown, sand |
| II | 34–128 | Natural; 10YR 6/6, brownish yellow; sand; structureless (single grain); moist, loose consistence; weak cementation; non-plastic; marine origin; no roots; abrupt, smooth lower boundary; aeolian sand; contained mottles of 10YR 3/4, dark yellowish brown sand |
| III | 110–163 | Natural; 7.5YR 3/3, dark brown; silt loam; weak, fine blocky structure; moist, friable consistence; no cementation; slightly plastic; terrigenous origin; no roots; lower boundary not observed; contained mottles of 10YR 3/3, dark brown sandy loam |

### 1.1.61 Test Excavation 61 (TE-61)

TE-61 was placed in the western-central section of the Central Maui WWRF segment of the project area (Figure 5). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.83 mbs. The stratigraphy of TE-61 consisted of a dark brown, silt loam developing A horizon (Stratum I) and a brown, loamy sand Ap horizon (Stratum II) overlying natural aeolian sand (Stratum III) (Figure 270 through Figure 273 and Table 61). No cultural materials were encountered.



Figure 270. TE-61, overview of the general location, view to east



Figure 271. TE-61, close-up of the east wall, view to east



Figure 272. TE-61, oblique view of the east wall, view to northeast

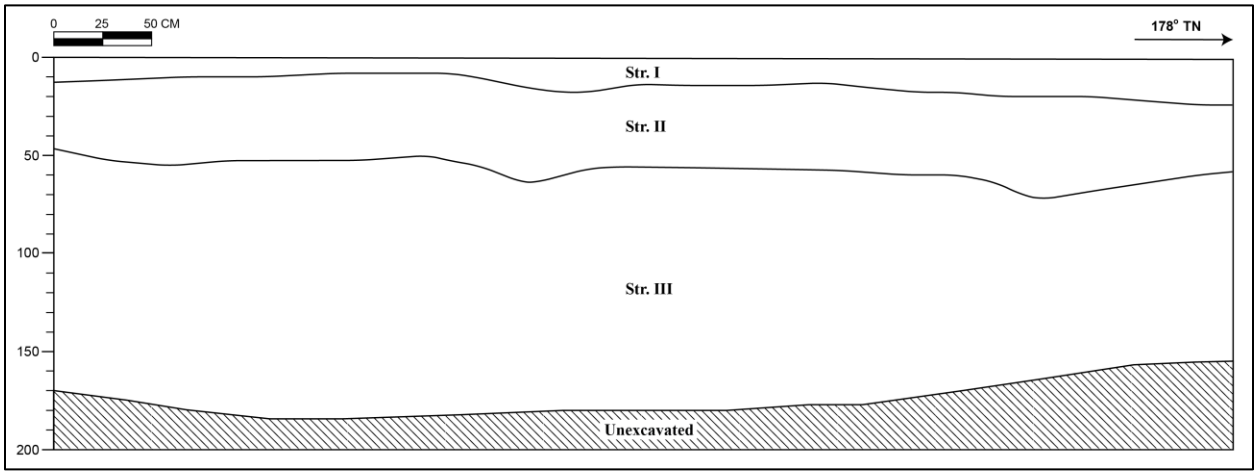



Figure 273. TE-61, stratigraphy of the east wall

Table 61. Strata observed at TE-61

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–23 | Developing A horizon; 7.5YR 3/3, dark brown; silt loam; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; slightly plastic; mixed origin; fine roots common; abrupt, smooth lower boundary |
| II | 8–70 | Ap horizon; 10YR 5/3, brown; loamy sand; weak, fine granular structure; dry, loose consistence; no cementation; non-plastic; mixed origin; few fine roots; clear, smooth lower boundary; contained mottles of 10YR 7/4, very pale brown sand |
| III | 44–183 | Natural; 10YR 6/6, brownish yellow; sand; structureless, moist, loose consistence; weak cementation; non-plastic; marine origin; no roots, lower boundary not observed; aeolian sand; contained mottles of 10YR 5/6, yellowish brown sand |

### 1.1.62 Test Excavation 62 (TE-62)

TE-62 was placed in the central section of the Central Maui WWRF segment of the project area (Figure 274). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.87 mbs. The stratigraphy of TE-62 consisted of a dark brown, gravelly silt loam developing A horizon (Stratum I) and a dark grayish brown, sandy loam Ap horizon (Stratum II) overlying dark grayish brown, natural sandy clay loam with mottles of dark grayish brown silty clay loam (Stratum III) and natural aeolian sand with $CaCO_3$ mottling (Stratum IV) (Figure 275 through Figure 277 and Table 62). No cultural materials were encountered.



Figure 274. TE-62, overview of the general location, view to east

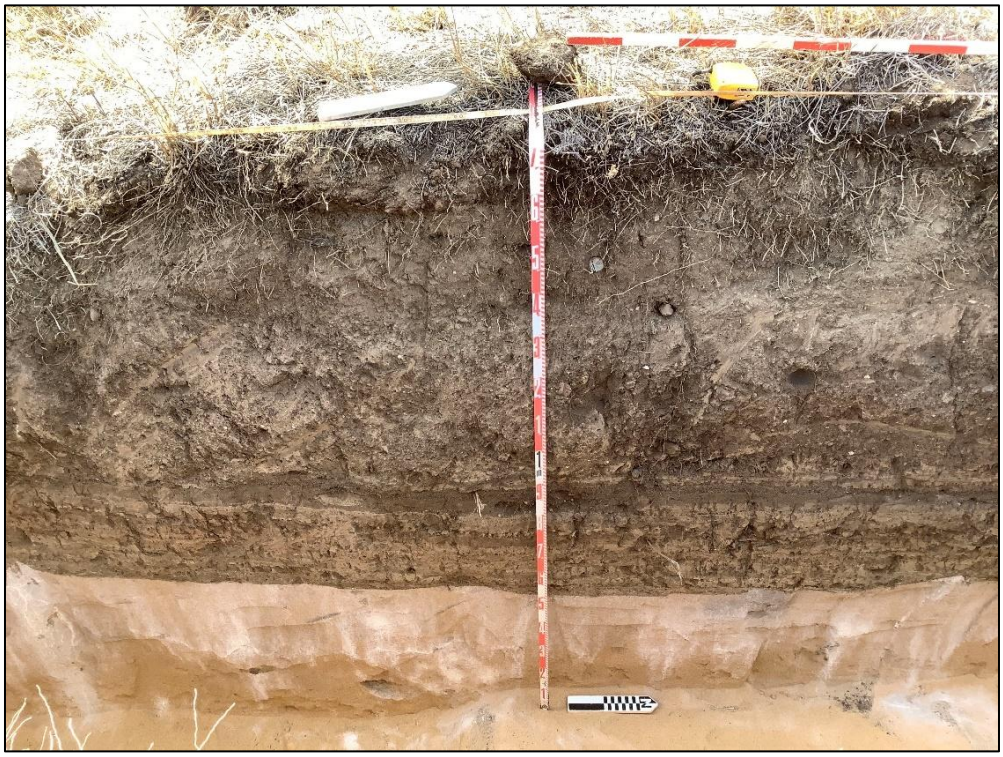


Figure 275. TE-62, close-up of the west wall, view to west



Figure 276. TE-62, oblique view of the west wall, view to northwest

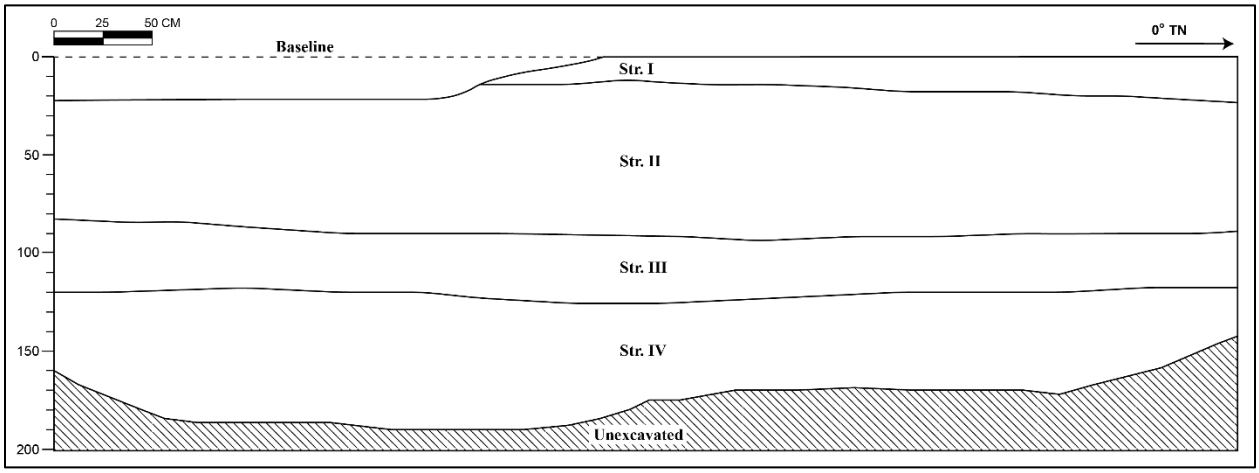



Figure 277. TE-62, stratigraphy of the west wall

Table 62. Strata observed at TE-62

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–20 | Developing A horizon; 7.5YR 3/2, dark brown; gravelly silt loam; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; slightly plastic; terrigenous origin; many fine roots; clear, discontinuous lower boundary |
| II | 12–90 | Ap horizon; 10YR 4/2, dark grayish brown; gravelly sandy loam; moderate, fine blocky structure; moist, loose consistence; no cementation; slightly plastic; mixed origin; few fine roots; clear, smooth lower boundary; contained mottles of 10YR 3/2, very dark grayish brown loamy sand |
| III | 81–123 | Natural; 10YR 4/2, dark grayish brown; sandy clay loam; moderate, very fine blocky structure; moist, friable consistence; no cementation; plastic; mixed origin; few fine to medium roots; abrupt, smooth lower boundary; contained mottles of 10YR 4/2, dark grayish brown silty clay loam |
| IV | 114–187 | Natural; 10YR 6/6, brownish yellow; sand; structureless (single grain); moist, loose consistence; weak cementation; non-plastic; marine origin; no roots; lower boundary not observed; aeolian sand; contained mottles of 10YR 7/2, light gray $CaCO_3$ |

### 1.1.63 Test Excavation 63 (TE-63)

TE-63 was placed in the central section of the Central Maui WWRF segment of the project area (Figure 278). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.98 mbs. The stratigraphy of TE-63 consisted of a brown, loamy sand Ap horizon (Stratum I) overlying natural aeolian sand (Stratum II) (Figure 279 through Figure 281 and Table 63). No cultural materials were encountered.



Figure 278. TE-63, overview of the general location, view to south



Figure 279. TE-63, close-up of the east wall, view to east



Figure 280. TE-63, oblique view of the east wall, view to southeast

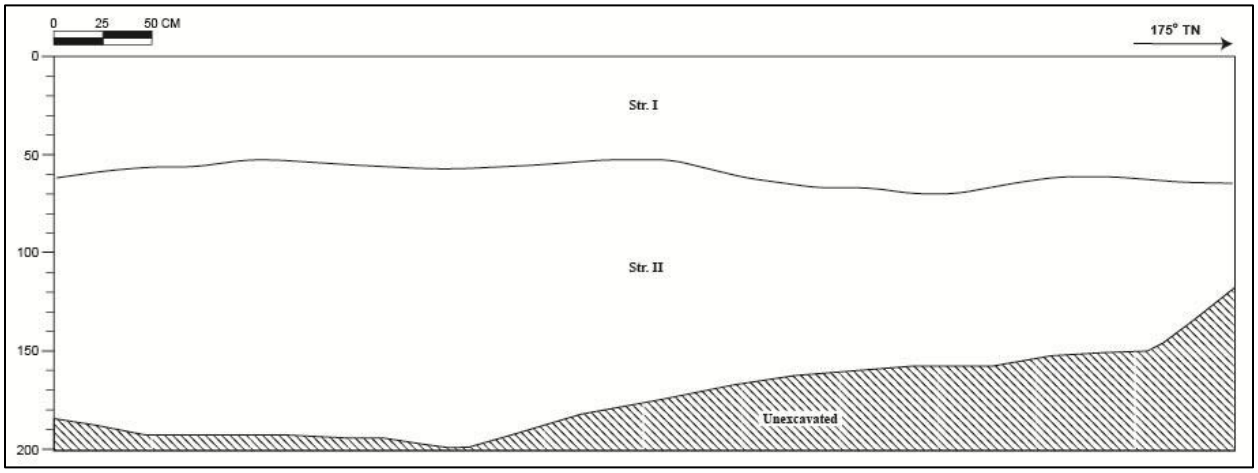



Figure 281. TE-63, stratigraphy of the east wall

Table 63. Strata observed at TE-63

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–67 | Ap horizon; 10YR 5/3, brown; loamy sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; mixed origin; many fine roots; clear, smooth lower boundary; contained mottles of 10YR 5/4, yellowish brown, loamy sand |
| II | 50–198 | Natural; 10YR 6/4, light yellowish brown; sand; strong, fine platy structure; dry, hard consistence; strong cementation; non-plastic; marine origin; no roots; lower boundary not observed; contained mottles of 10YR 6/6, brownish yellow sand |

### 1.1.64 Test Excavation 64 (TE-64)

TE-64 was placed in the eastern-central section of the Central Maui WWRF segment of the project area (Figure 282). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.78 mbs. The stratigraphy of TE-64 consisted of a brown, gravelly loamy sand Ap horizon (Stratum I) overlying natural aeolian sand (Stratum II) and dark yellowish brown, natural silt loam with inclusions of grayish brown sandy loam (Stratum III) (Figure 283 through Figure 285 and Table 64). No cultural materials were encountered.



Figure 282. TE-64, overview of the general location, view to east



Figure 283. TE-64, close-up of the east wall, view to east



Figure 284. TE-64, oblique view of the east wall, view to southeast

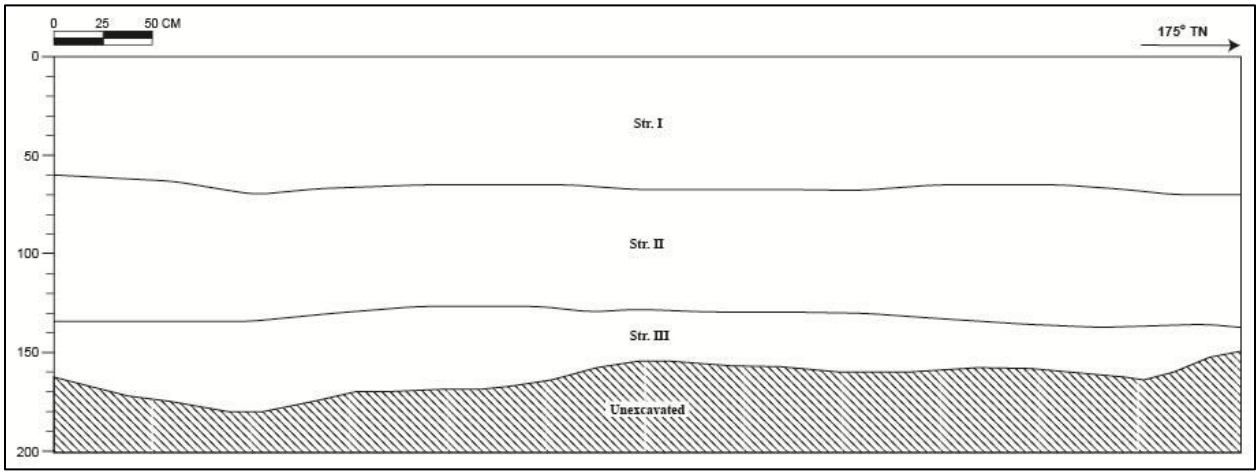



Figure 285. TE-64, stratigraphy of the east wall

Table 64. Strata observed at TE-64

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–68 | Ap horizon; 10YR 5/3, brown; gravelly loamy sand; structureless (single grain); dry, weakly coherent consistence; no cementation; non-plastic; mixed origin; fine to medium roots common; clear, smooth lower boundary; contained very coarse mottles of 10YR 6/4, light yellowish brown sand |
| II | 60–133 | Natural; 10YR 6/6, yellowish brown; sand; structureless (single grain); moist, loose consistence; weak cementation; non-plastic; marine origin; no roots; abrupt, smooth lower boundary; contained mottles of 10YR 5/4, yellowish brown sand |
| III | 124–178 | Natural; 10YR 4/3, dark yellowish brown; silt loam; moderate, fine blocky structure; moist, friable consistence; no cementation; slightly plastic; terrigenous origin; no roots; lower boundary not observed; contained mottles of 10YR 5/2 grayish brown sandy loam |

### 1.1.65 Test Excavation 65 (TE-65)

TE-65 was placed near the western boundary in the southern half of the Central Maui WWRF segment of the project area (Figure 5). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.88 mbs. The stratigraphy of TE-65 consisted of a dark brown, gravelly silty clay loam developing A horizon (Stratum I); a dark yellowish brown, gravelly sandy clay loam utility fill (Stratum II); and a dark yellowish brown, loamy sand Ap horizon (Stratum III) overlying natural aeolian sand (Stratum IV) (Figure 286 through Figure 289 and Table 65). The utility fill (Stratum II) contained two PVC pipes and corresponds to the location of an above ground portion of an irrigation line.



Figure 286. TE-65, overview of the general location next to the above ground portion of an irrigation line, view to east



Figure 287. TE-65, close-up of the west wall, view to west



Figure 288. TE-65, overview of the west wall, view to northwest

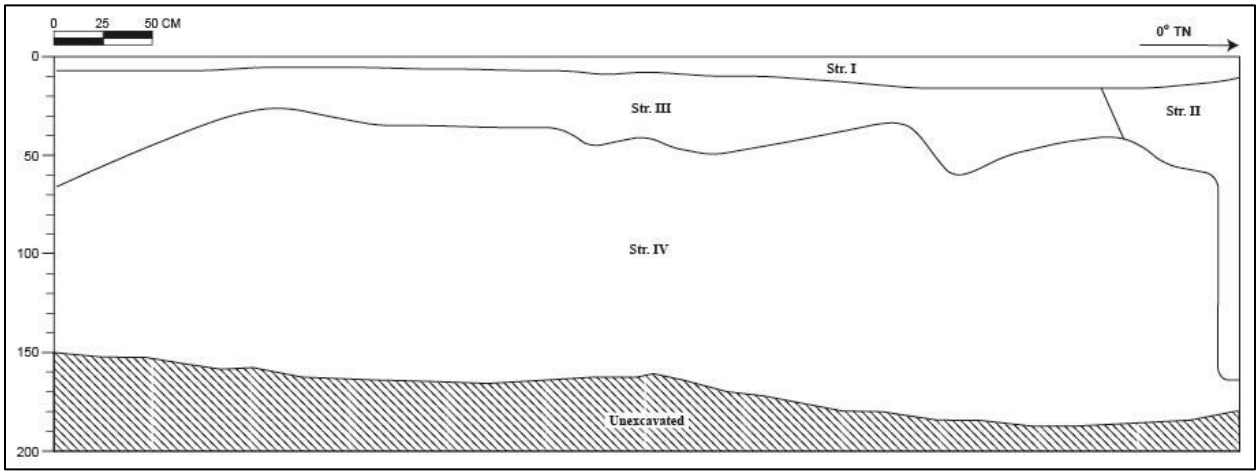



Figure 289. TE-65, stratigraphy of the west wall

Table 65. Strata observed at TE-65

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–16 | Developing A horizon; 7.5YR 3/2, dark brown; gravelly silty clay loam; strong, coarse blocky structure; dry, extremely hard consistence; weak cementation; plastic; terrigenous origin; fine roots common; clear, smooth lower boundary |
| II | 10–162 | Fill; 10YR 4/4, dark yellowish brown; gravelly sandy clay loam; weak, fine granular structure; dry, loose consistence; no cementation; non-plastic; mixed origin; few fine roots; clear, irregular lower boundary; contained two PVC pipes and mottles of 10YR 6/6, brownish yellow sand |
| III | 6–65 | Ap horizon; 10YR 4/4, dark yellowish brown; loamy sand; weak, fine granular structure; dry, weakly coherent consistence; no cementation; non-plastic; mixed origin; few fine roots; clear, smooth lower boundary; contained mottles of 10YR 6/3 pale brown sand |
| IV | 28–188 | Natural; 10YR 6/6, brownish yellow; sand; structureless (single grain); moist, loose consistence; weak cementation; non-plastic; marine origin; no roots; lower boundary not observed; contained mottles of 10YR 5/6, yellowish brown sand |

### 1.1.66 Test Excavation 66 (TE-66)

TE-66 was placed in the southern half of the Central Maui WWRF segment of the project area (Figure 290). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.66 mbs. The stratigraphy of TE-66 consisted of a dark yellowish brown, gravelly sandy loam Ap horizon (Stratum I) overlying dark yellowish brown, previously disturbed, natural silt loam (Stratum II); a brown, sandy loam buried A horizon (Statum III) and grayish brown loamy sand (Stratum IV) (Figure 291 through Figure 294 and Table 66). An approximate 3.0-gallon sediment sample from Stratum III was screened in the field and contained a small land snail shell.



Figure 290. TE-66, overview of the general location, view to northwest



Figure 291. TE-66, close-up of the west wall, view to west



Figure 292. TE-66, oblique view of the west wall, view to northwest



Figure 293. TE-66, close-up of the west wall showing the screened sediment sample location, view to west

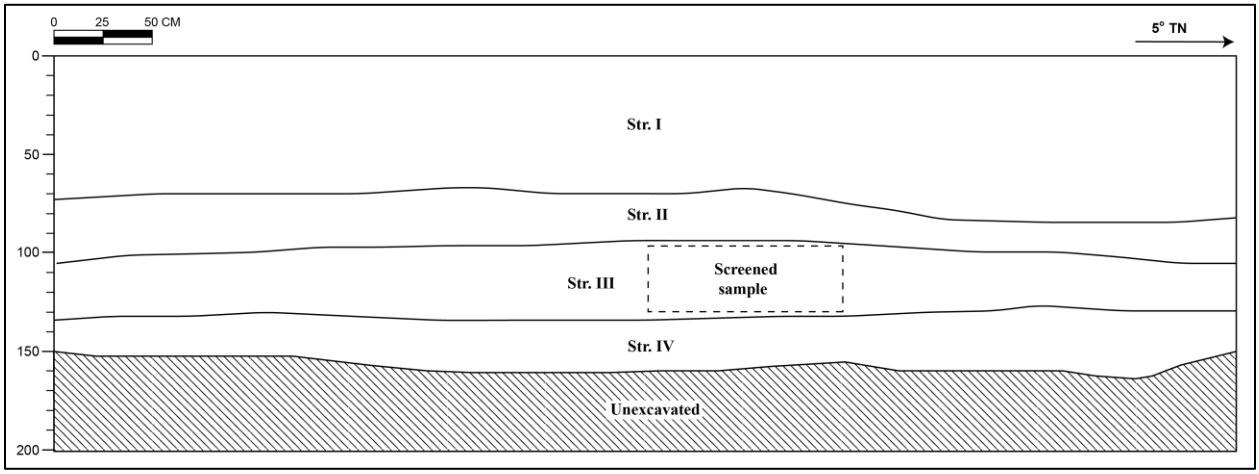



Figure 294. TE-66, stratigraphy of the west wall

Table 66. Strata observed at TE-66

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–82 | Ap horizon; 10YR 4/4, dark yellowish brown; gravelly sandy loam; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; non-plastic; mixed origin; fine roots common; clear, smooth lower boundary; contained mottles of 10YR 6/2, light brownish gray sand |
| II | 65–104 | Previously disturbed natural; 10YR 4/4, dark yellowish brown; silt loam; moderate, very fine blocky structure; moist, friable consistence; no cementation; plastic; terrigenous origin; few fine to medium roots; clear, smooth lower boundary |
| III | 93–134 | Natural; 10YR 4/3, brown; sandy loam; structureless (single grain); moist, loose consistence; no cementation; non-plastic; mixed origin; no roots; clear, smooth lower boundary; screened sample contained a land snail shell |
| IV | 130–162 | Natural; 10YR 5/2, grayish brown; loamy sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; mixed origin; no roots; lower boundary not observed |

### 1.1.67 Test Excavation 67 (TE-67)

TE-67 was placed in the southern half of the Central Maui WWRF segment of the project area (Figure 5). The placement of the trench was shifted 6.0 m to the south due to the presence of a berm in the proposed location. The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.58 mbs. The stratigraphy of TE-67 consisted of a brown, sandy loam Ap horizon (Stratum I) overlying previously disturbed, natural aeolian sand (Stratum II) and dark yellowish brown, natural silt loam (Stratum III) (Figure 295 through Figure 298 and Table 67). No cultural materials were encountered.



Figure 295. TE-67, overview of the general location, view to northwest



Figure 296. TE-67, close-up of the east wall, view to east



Figure 297. TE-67, oblique view of the east wall, view to southeast

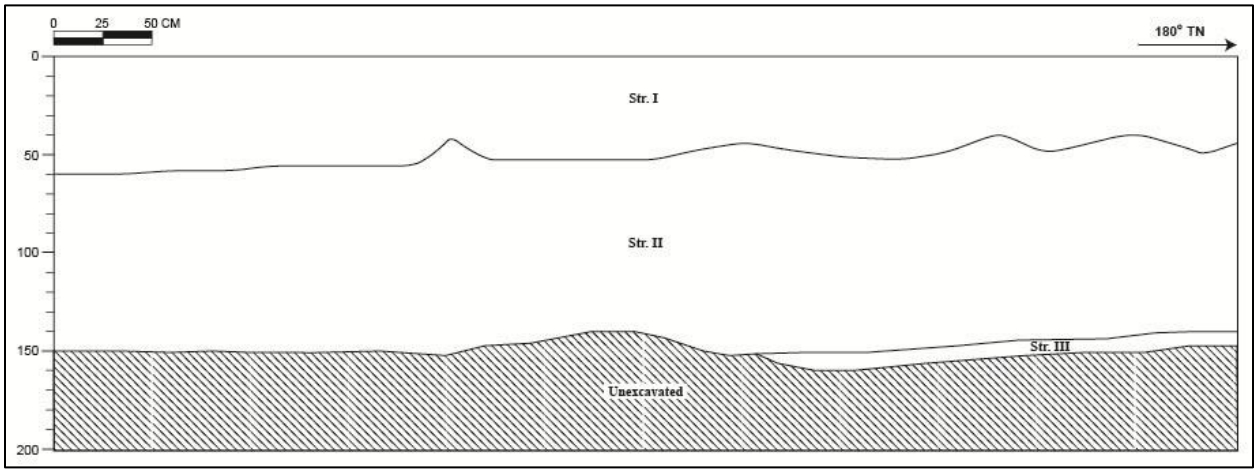



Figure 298. TE-67, stratigraphy of the east wall

Table 67. Strata observed at TE-67

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–60 | Ap horizon; 10YR 4/3, brown; sandy loam; weak, fine granular structure; dry, loose consistence; no cementation; non-plastic; mixed origin; many fine roots; clear, irregular lower boundary; contained mottles of 10YR 6/4, light yellowish brown, sand |
| II | 37–150 | Previously disturbed natural; 10YR 6/6, brownish yellow; sand; structureless (single grain); moist, loose consistence; weak cementation; non-plastic; marine origin; no roots; abrupt, smooth lower boundary; aeolian sand; contained mottles of 10YR 5/6, yellowish brown sand |
| III | 137–150 | Natural; 10YR 3/4, dark yellowish brown; silt loam; moderate, fine blocky structure; moist, firm consistence; no cementation; slightly plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.68 Test Excavation 68 (TE-68)

TE-68 was placed near the eastern boundary in the southern half of the Central Maui WWRF segment of the project area (Figure 299). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.70 mbs. The stratigraphy of TE-68 consisted of a brown, sandy loam Ap horizon (Stratum I) overlying previously disturbed, natural aeolian sand (Stratum II) and dark brown, natural gravelly silt loam (Stratum III) (Figure 300 through Figure 302 and Table 68). No cultural materials were encountered.



Figure 299. TE-68, overview of the general location, view to southeast



Figure 300. TE-68, close-up of the east wall, view to east



Figure 301. TE-68, oblique view of the east wall, view to southeast

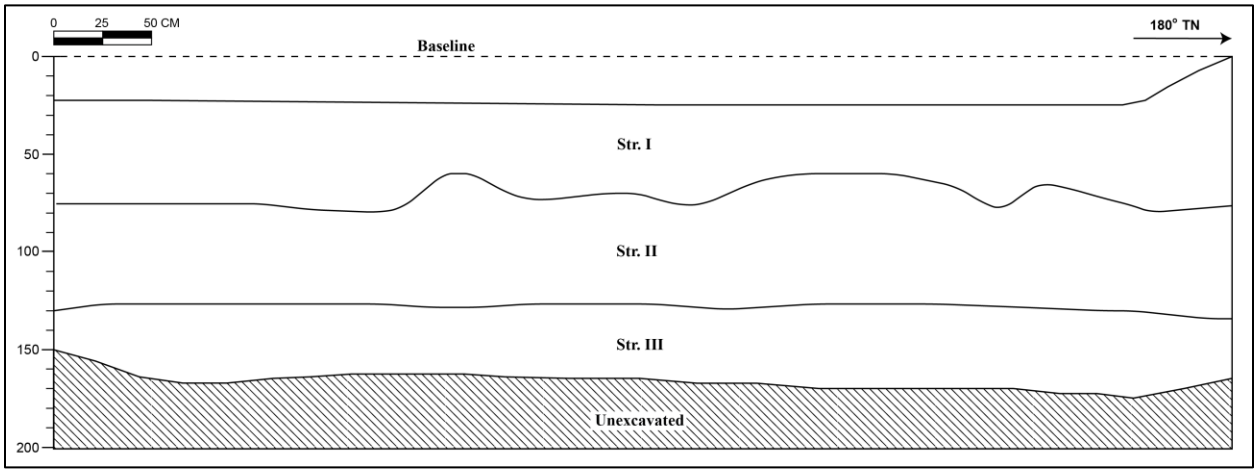



Figure 302. TE-68, stratigraphy of the east wall

Table 68. Strata observed at TE-68

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–77 | Ap horizon; 10YR 4/3, brown; sandy loam; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; non-plastic; mixed origin; few fine roots; clear, wavy lower boundary; contained mottles of 10YR 5/4, yellowish brown loamy sand |
| II | 58–130 | Previously disturbed natural; 10YR 5/6, yellowish brown; sand; structureless (single grain); dry, loose consistence; weak cementation; non-plastic; marine origin; no roots; abrupt, smooth lower boundary; contained mottles of 10YR 6/4, light yellowish brown lithified sand |
| III | 124–170 | Natural; 7.5YR 3/3, dark brown; gravelly silt loam; moderate, fine blocky structure; moist, firm consistence; no cementation; slightly plastic; terrigenous origin; no roots; lower boundary not observed; contained root moulds of 10YR 6/2 light brownish gray silty clay loam |

### 1.1.69 Test Excavation 69 (TE-69)

TE-69 was placed near the western boundary in the southern half of the Central Maui WWRF segment of the project area (Figure 303). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.59 mbs. The stratigraphy of TE-69 consisted of a dark brown, gravelly silt loam developing A horizon (Stratum I) overlying a dark brownish yellow, silt loam Ap horizon (Stratum II) and dark yellowish brown, natural silty clay (Stratum III) (Figure 304 through Figure 306 and Table 69). The Ap horizon (Stratum II) contained black plastic irrigation drip-tape, a concrete fragment and PVC pipe fragments.



Figure 303. TE-69, overview of the general location, view to northwest



Figure 304. TE-69, close-up of the east wall, view to east



Figure 305. TE-69, oblique view of the east wall, view to southeast

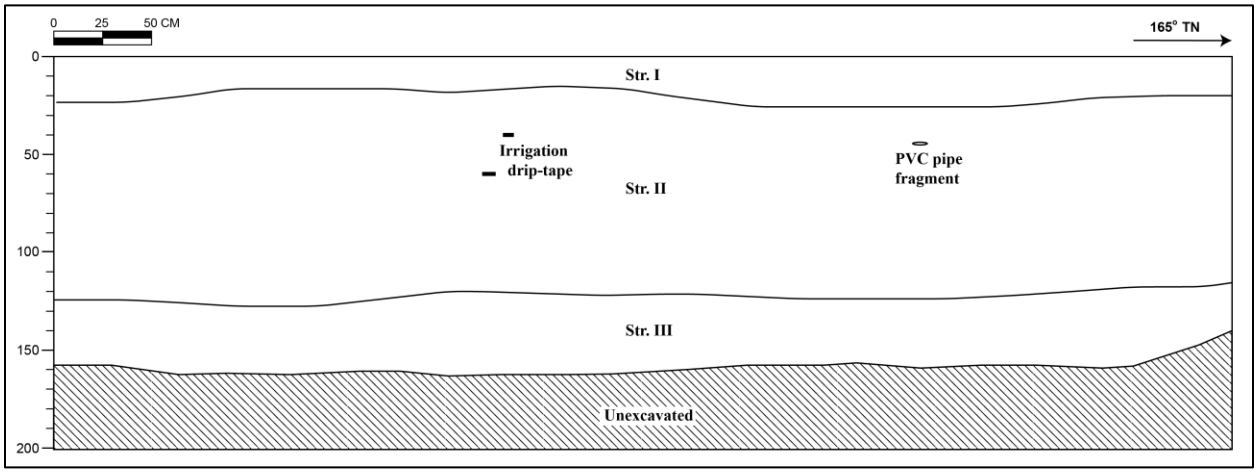



Figure 306. TE-69, stratigraphy of the east wall

Table 69. Strata observed at TE-69

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–23 | Developing A horizon; 10YR 3/3, dark brown; gravelly silt loam; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; slightly plastic; terrigenous origin; many fine roots; clear, smooth lower boundary |
| II | 13–126 | Ap horizon; 10YR 3/4, dark yellowish brown; silt loam; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; slightly plastic; terrigenous origin; few fine roots; clear, smooth lower boundary; contained mottles of 10YR 4/3, brown silty clay loam; PVC and concrete fragments observed |
| III | 110–159 | Natural; 10YR 4/4, dark yellowish brown; silty clay; moderate, very fine platy structure; moist, firm consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.70 Test Excavation 70 (TE-70)

TE-70 was placed near the western boundary in the southern half of the Central Maui WWRF segment of the project area (Figure 307). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.83 mbs. The stratigraphy of TE-70 consisted of a brown, gravelly sandy loam Ap horizon (Stratum I) overlying previously disturbed, natural aeolian sand (Stratum II) (Figure 308 through Figure 310 and Table 70). No cultural materials were encountered.



Figure 307. TE-70, overview of the general location, view to north



Figure 308. TE-70, close-up of the west wall, view to west



Figure 309. TE-70, oblique view of the west wall, view to northwest

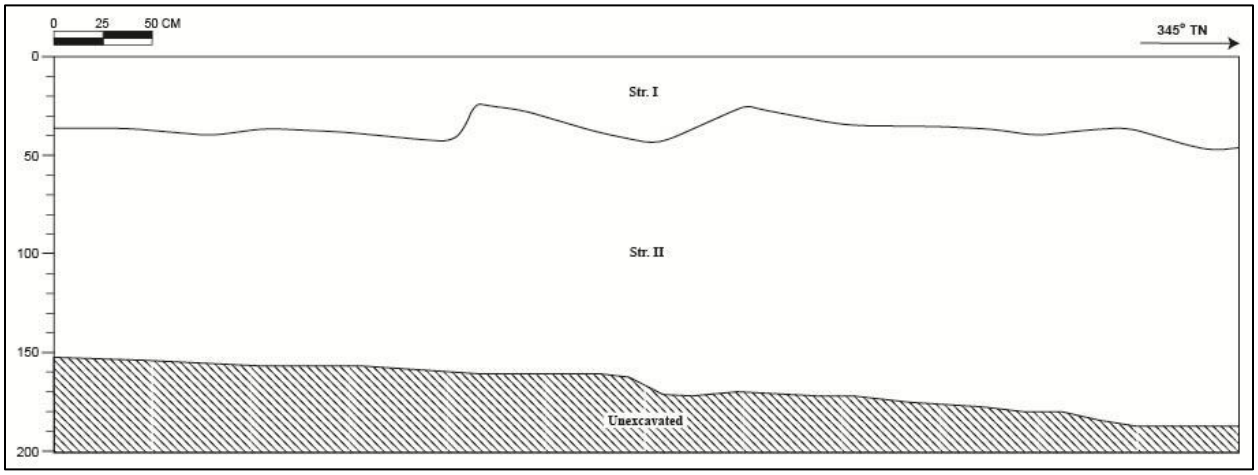



Figure 310. TE-70, stratigraphy of the west wall

Table 70. Strata observed at TE-70

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–43 | Ap horizon; 10YR 4/3, brown; gravelly sandy loam; weak, fine granular structure; dry, weakly coherent consistence; no cementation; non-plastic; mixed origin; many fine roots; clear, smooth lower boundary; contained mottles of 10YR 6/3, pale brown loamy sand |
| II | 22–182 | Previously disturbed natural; 10YR 6/6, brownish yellow; sand; structureless (single grain); dry, friable consistence; strong cementation; non-plastic; marine origin; no roots; lower boundary not observed; contained mottles of 10YR 5/6, yellowish brown sand |

### 1.1.71 Test Excavation 71 (TE-71)

TE-71 was placed in the southern half of the Central Maui WWRF segment of the project area (Figure 311). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.69 mbs. The stratigraphy of TE-71 consisted of a dark brown, gravelly sandy loam developing A horizon (Stratum I) overlying brown, gravelly silt loam utility fill (Stratum II); a brown, silt loam Ap horizon (Stratum III); dark brown, previously disturbed, natural silt loam buried A horizon (Stratum IV); pale brown, natural aeolian sand (Stratum V); and natural silty clay loam (Stratum VI) (Figure 312 through Figure 315 and Table 71). An approximate 2.0-gallon sediment sample from the buried A horizon (Stratum IV) was screened in the field, and no cultural materials were encountered.

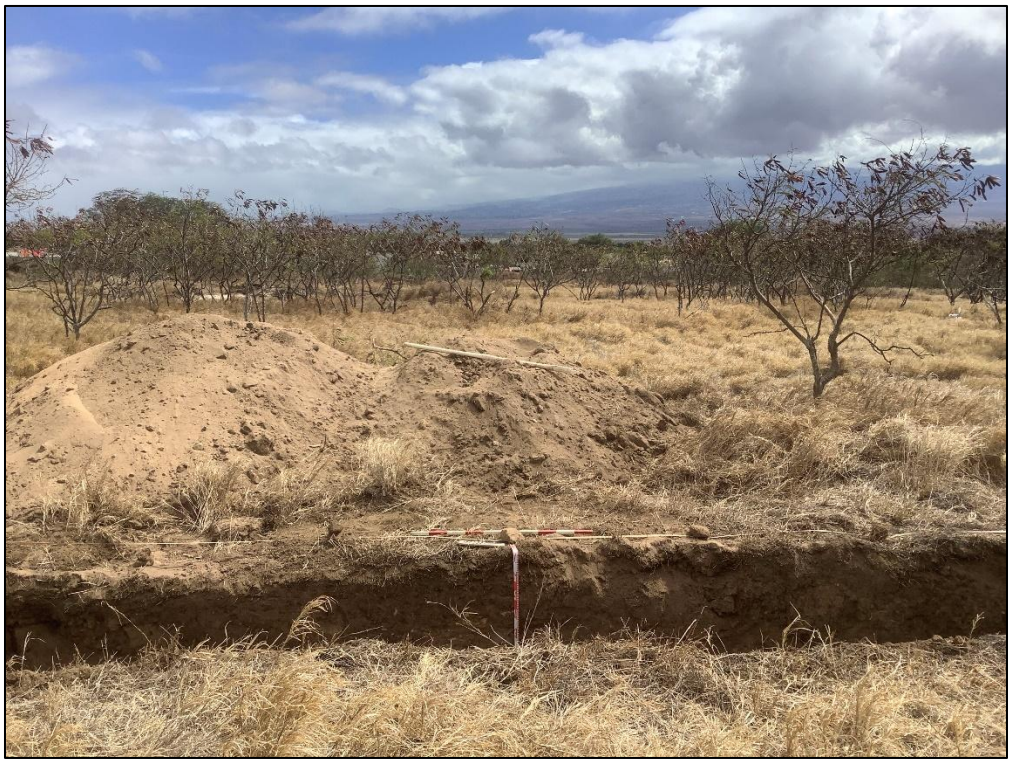


Figure 311. TE-71, overview of the general location, view to east



Figure 312. TE-71, close-up of the east wall, view to east



Figure 313. TE-71, oblique view of the east wall, view to northeast



Figure 314. TE-71, close-up of the east wall showing the screened sediment sample location, view to east

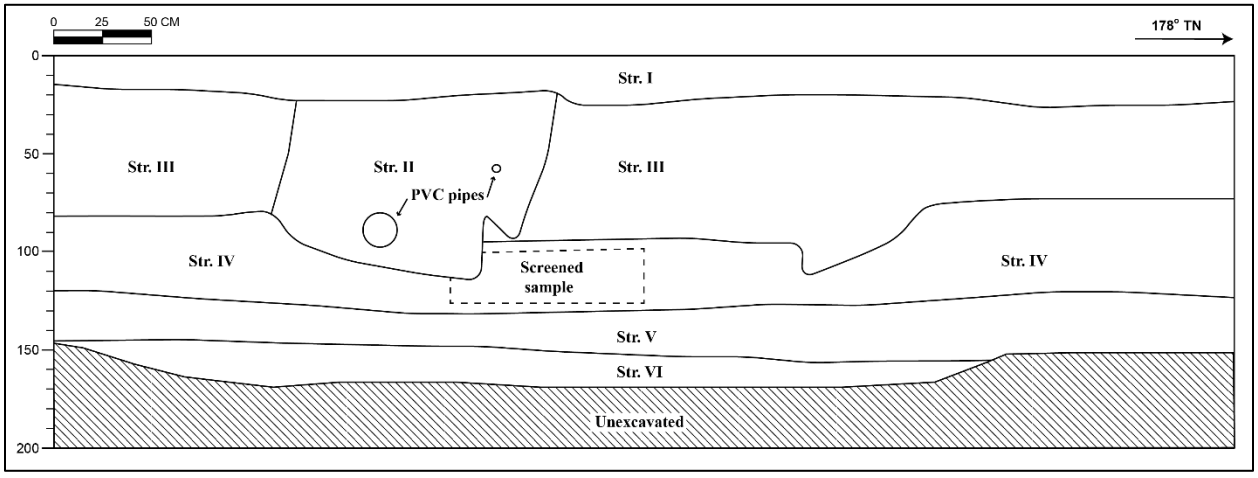



Figure 315. TE-71, stratigraphy of the east wall

Table 71. Strata observed at TE-71

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–25 | Developing A horizon; 10YR 3/3, dark brown; gravelly sandy loam; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; slightly plastic; mixed origin; many fine roots; clear, irregular lower boundary |
| II | 17–113 | Utility Fill; 10YR 4/3, brown; gravelly silt loam; moderate, fine granular structure; moist, friable consistence; no cementation; slightly plastic; terrigenous origin; no roots; abrupt, broken lower boundary; contained mottles of 10YR 4/4, dark yellowish brown sandy loam; contained two PVC pipes; backfilled utility trench |
| III | 17–110 | Ap horizon; 10YR 4/3, brown; silt loam; moderate, very fine blocky structure; moist, friable consistence; no cementation; plastic; terrigenous origin; few fine roots; clear, irregular lower boundary; contained mottles of 10YR 3/4, dark yellowish brown silt loam, 10YR 4/2, dark grayish brown sandy silt loam, and 10YR 6/2, light brownish gray silt loam |
| IV | 71–131 | Buried A horizon; 7.5YR 3/2, dark brown; silt loam; moderate, very fine blocky structure; moist, friable consistence; no cementation; slightly plastic; terrigenous origin; few fine roots; clear, smooth lower boundary; contained mottles of 10YR 6/2, light brownish gray silt loam; sterile screened sediment sample |
| V | 120–155 | Natural; 10YR 6/3, pale brown; sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; marine origin; no roots; clear, smooth lower boundary; aeolian sand; contained mottles of 10YR 6/2, light brownish gray silt loam |
| VI | 146–169 | Natural; 10YR 6/4, light yellowish brown; silty clay loam; moderate, very fine platy structure; moist, friable consistence; no cementation; slightly plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.72 Test Excavation 72 (TE-72)

TE-72 was placed in the southern half of the Central Maui WWRF segment of the project area (Figure 316). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.83 mbs. The stratigraphy of TE-72 consisted of a brown, gravelly sandy loam Ap horizon (Stratum I) overlying natural aeolian sand (Stratum II) and dark yellowish brown, natural silty clay loam (Stratum III) (Figure 317 through Figure 319 and Table 72). No cultural materials were encountered.



Figure 316. TE-72, overview of the general location, view to northwest



Figure 317. TE-72, close-up of the east wall, view to east



Figure 318. TE-72, oblique view of the east wall, view to northeast

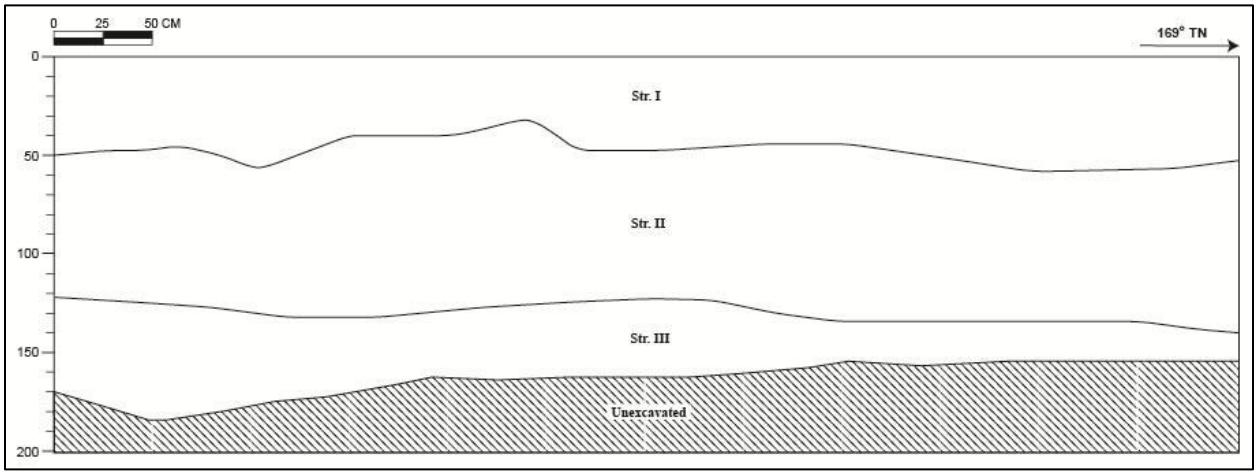



Figure 319. TE-72, stratigraphy of the east wall

Table 72. Strata observed at TE-72

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–54 | Ap horizon; 10YR 4/3, brown; gravelly sandy loam; weak, fine granular structure; dry, weakly coherent consistence; no cementation; non-plastic; mixed origin; fine roots common; clear, wavy lower boundary; contained mottles of 10YR 6/3, pale brown sand |
| II | 30–135 | Natural; 10YR 6/6, brownish yellow; sand; structureless (single grain); moist, loose consistence; weak cementation; non-plastic; marine origin; no roots; abrupt, smooth lower boundary; aeolian sand |
| III | 121–183 | Natural; 10YR 3/4, dark yellowish brown; silty clay loam; moderate, fine granular structure; moist, firm consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.73 Test Excavation 73 (TE-73)

TE-73 was placed near the eastern boundary in the southern half of the Central Maui WWRF segment of the project area (Figure 320). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.70 mbs. The stratigraphy of TE-73 consisted of a brown, gravelly sandy loam Ap horizon (Stratum I) overlying a pale brown, previously disturbed, natural sand with mottles of grayish brown, silt loam (Stratum II); natural aeolian sand (Stratum III); a cobbly alluvial streambed deposit (Stratum IV); and dark yellowish brown, natural silty clay loam with mottles of brown loamy sand (Figure 321 through Figure 323 and Table 73). No cultural materials were encountered.



Figure 320. TE-73, overview of the general location, view to southwest

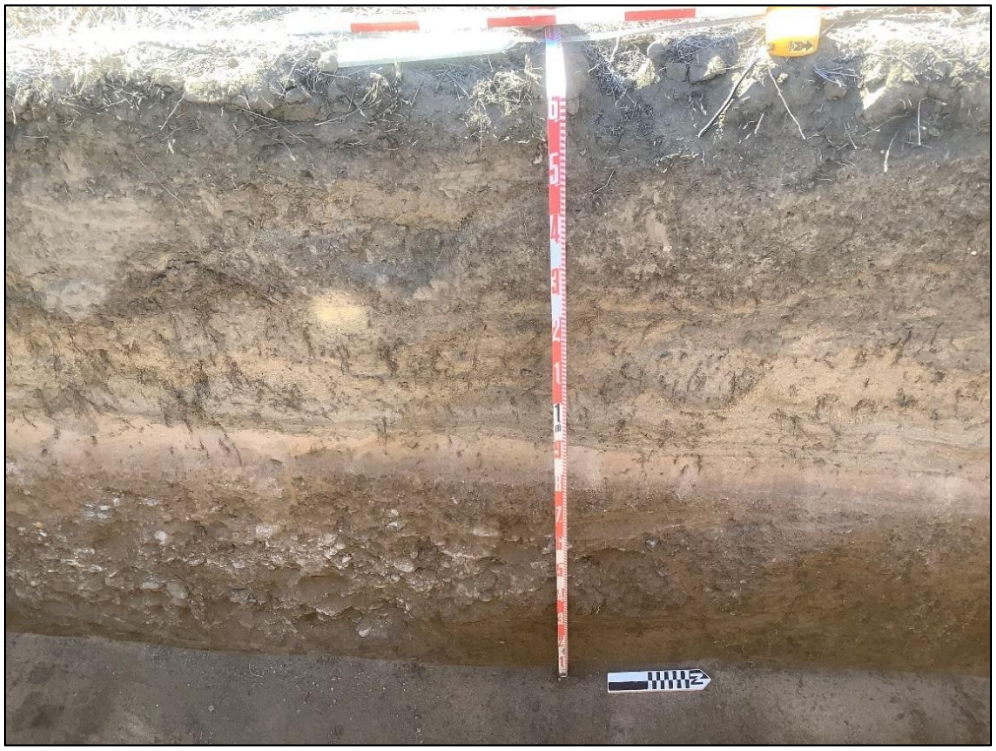


Figure 321. TE-73, close-up of the west wall, view to west



Figure 322. TE-73, oblique of the west wall, view to northwest

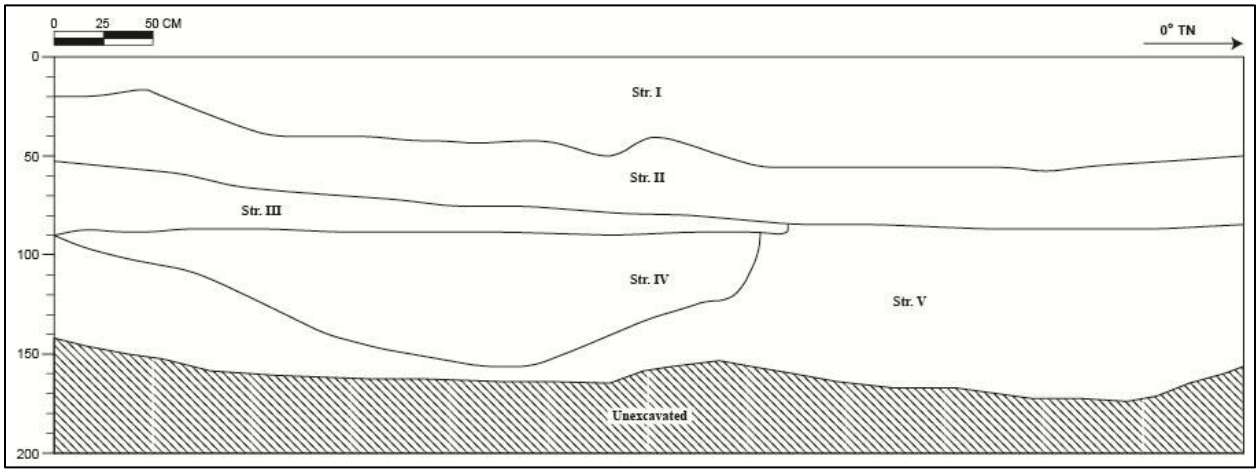



Figure 323. TE-73, stratigraphy of the west wall

Table 73. Strata observed at TE-73

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–54 | Ap horizon; 10YR 4/3, brown; gravelly sandy loam; moderate, fine granular structure; dry, hard consistence; weak cementation; slightly plastic; mixed origin; many fine roots; clear, smooth lower boundary; contained mottles of 10YR 5/3, brown loamy sand |
| II | 16–84 | Previously disturbed natural; 10YR 6/3, pale brown; sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; marine origin; few fine roots; gradual, smooth lower boundary; contained mottles of 10YR 5/2, grayish brown silt loam |
| III | 53–88 | Natural; 10YR 6/3, pale brown; sand (fine grain); structureless (single grain); moist, loose consistence; no cementation; non-plastic; marine origin; no roots; clear, discontinuous lower boundary |
| IV | 85–154 | Natural; 10YR 6/1, gray; cobbles (>90%) and sand (<10%); structureless (single grain); moist, loose consistence; no cementation; non-plastic; terrigenous origin; no roots; abrupt, irregular lower boundary; alluvial streambed deposit; contained mottles of 10YR 5/3, brown silt loam |
| V | 81–170 | Natural; 10YR 3/4, dark yellowish brown; gravelly silty clay loam; moderate, fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed; contained mottles of 10YR 5/3, brown loamy sand |

### 1.1.74 Test Excavation 74 (TE-74)

TE-74 was placed near the western boundary in the southern half of the Central Maui WWRF segment of the project area (Figure 324). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.72 mbs. The stratigraphy of TE-74 consisted of a dark brown, gravelly sandy loam developing A horizon (Stratum I) and a dark yellowish brown, loamy sand Ap horizon (Stratum II) overlying natural aeolian sand (Stratum III) (Figure 325 through Figure 327 and Table 74). A piece of decorative cloth was noted within the Ap horizon (Stratum II).



Figure 324. TE-74, overview of the general location, view to northwest

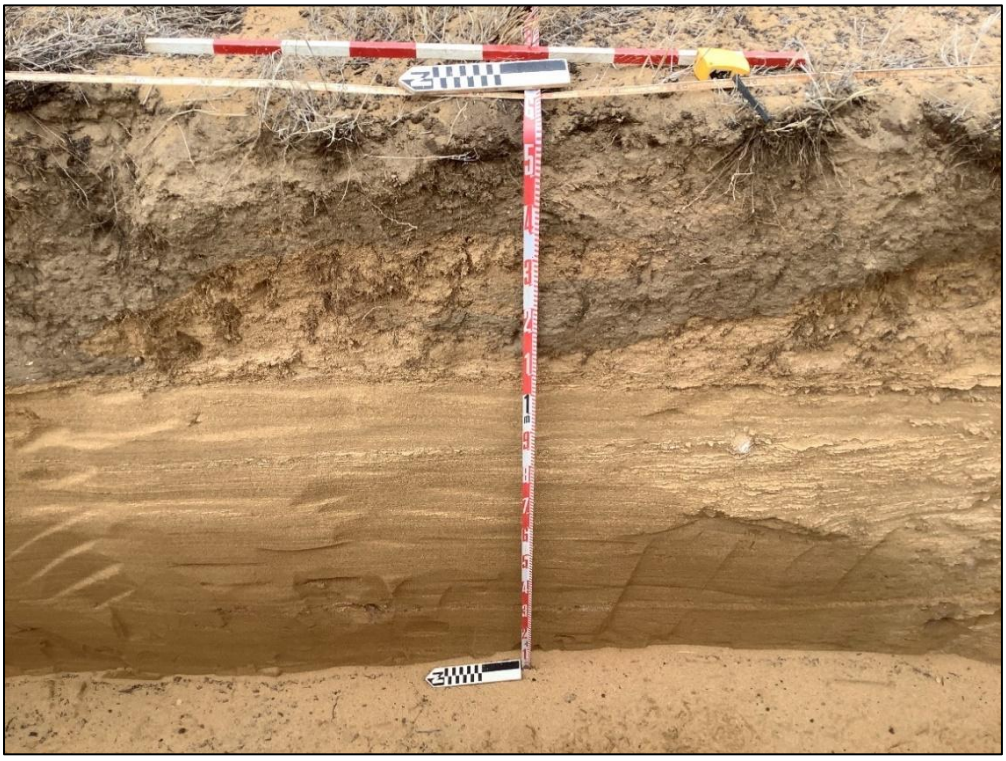


Figure 325. TE-74, close-up of the east wall, view to east



Figure 326. TE-74, overview of the east wall, view to northeast

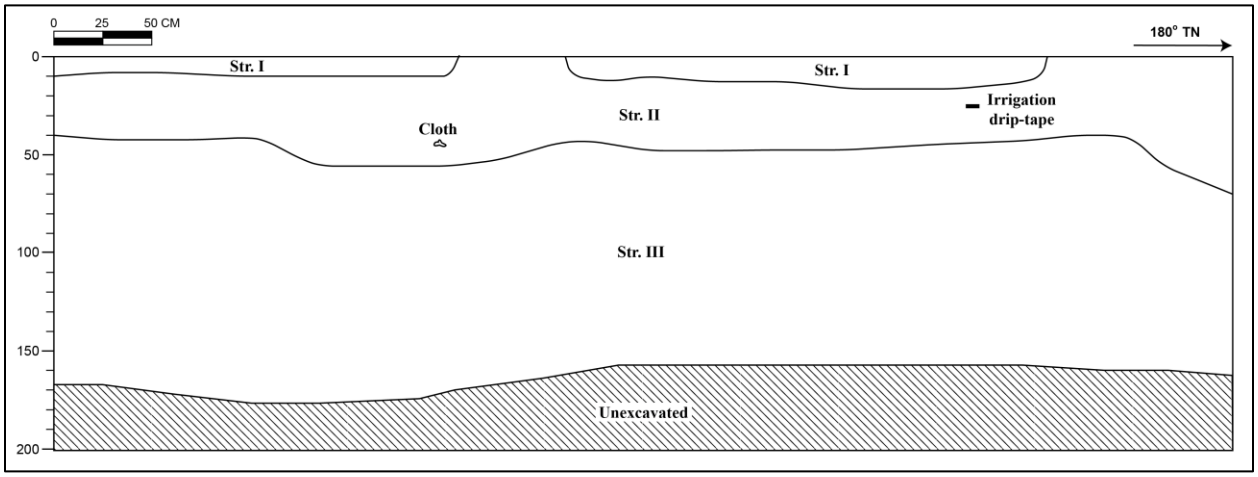



Figure 327. TE-74, stratigraphy of the east wall

Table 74. Strata observed at TE-74

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–13 | Developing A horizon; 7.5YR 3/3, dark brown; gravelly sandy loam; strong, fine blocky structure; dry, extremely hard consistence; no cementation; non-plastic; mixed origin; fine roots common; clear, broken lower boundary |
| II | 0–65 | Ap horizon; 10YR 4/4, dark yellowish brown; loamy sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; mixed origin; few fine roots; clear, smooth lower boundary; contained mottles of 10YR 5/4, yellowish brown sand; contained a piece of decorative cloth |
| III | 38–172 | Natural; 10YR 6/6, brownish yellow; sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; marine origin; no roots; lower boundary not observed; aeolian sand; contained mottles of 10YR 5/6, yellowish brown sand |

### 1.1.75 Test Excavation 75 (TE-75)

TE-75 was placed in the southern half of the Central Maui WWRF segment of the project area (Figure 328). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.64 mbs. The stratigraphy of TE-75 consisted of a dark brown, gravelly silt loam developing A horizon (Stratum I) and a dark yellowish brown, sandy loam Ap horizon (Stratum II) overlying natural aeolian sand with $CaCO_3$ mottling (Stratum IV) (Figure 329 through Figure 331 and Table 75). No cultural materials were encountered.



Figure 328. TE-75, overview of the general location, view to west

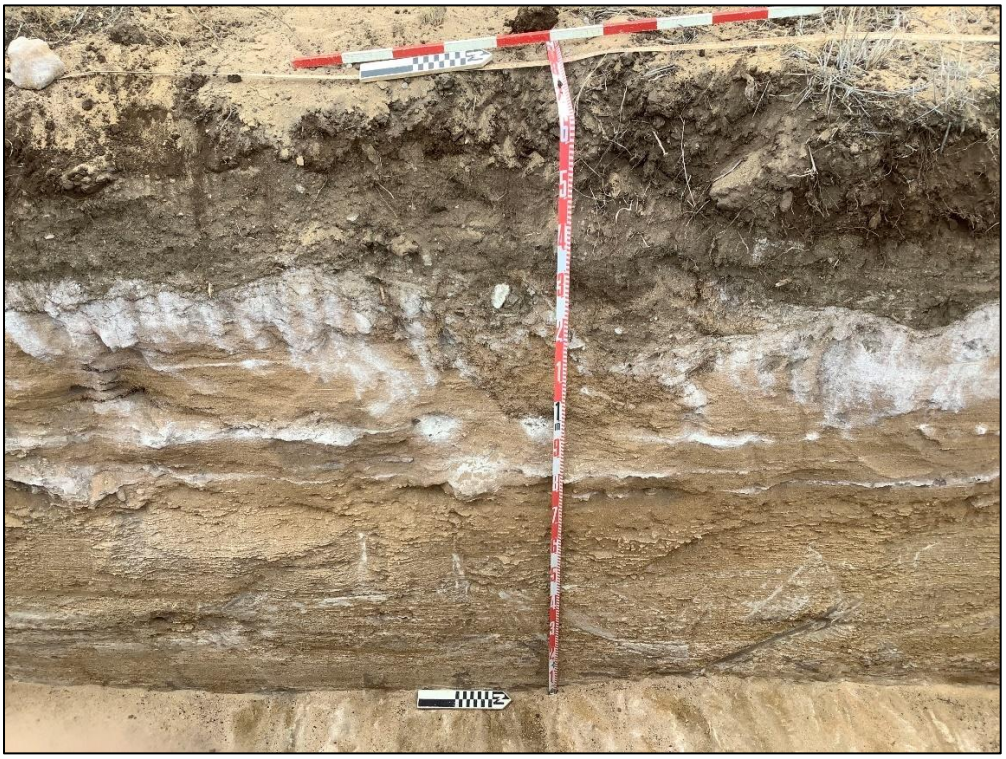


Figure 329. TE-75, close-up of the west wall, view to west



Figure 330. TE-75, overview of the excavation area, view to south

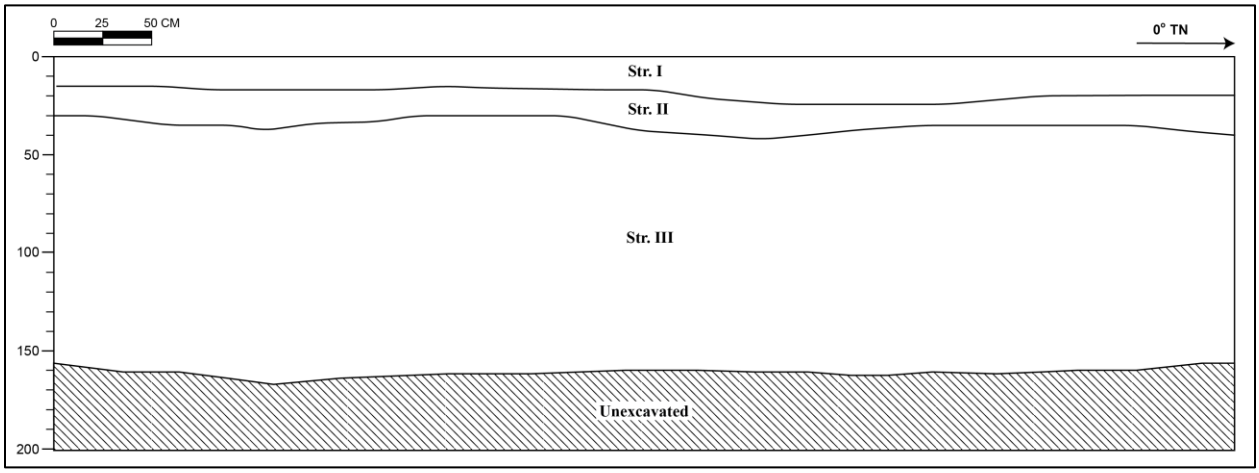



Figure 331. TE-75, stratigraphy of the west wall

Table 75. Strata observed at TE-75

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–23 | Developing A horizon; 7.5YR 3/4, dark brown; gravelly silt loam; moderate, fine granular structure; dry, hard consistence; no cementation; non-plastic; terrigenous origin; fine roots common; abrupt, smooth lower boundary |
| II | 14–40 | Ap horizon; 10YR 4/4, dark yellowish brown; sandy loam; weak, fine granular structure; dry, weakly coherent consistence; no cementation; non-plastic; mixed origin; few fine roots; clear, irregular lower boundary |
| IV | 23–164 | Natural; 10YR 5/6, yellowish brown; sand; structureless (single grain); moist, loose consistence; strong cementation; non-plastic; marine origin; no roots; lower boundary not observed; contained mottles of 10YR 7/1 light gray $CaCO_3$ |

### 1.1.76 Test Excavation 76 (TE-76)

TE-76 was placed in the southern half of the Central Maui WWRF segment of the project area (Figure 332). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.58 mbs. The stratigraphy of TE-76 consisted of a dark brown, gravelly silt loam developing A horizon (Stratum I) and a brown, sandy loam Ap horizon (Stratum II) overlying natural aeolian sand (Stratum III) and dark yellowish brown, silty clay loam (Stratum IV) (Figure 333 through Figure 335 and Table 76). No cultural materials were encountered.



Figure 332. TE-76, overview of the general location, view to northwest



Figure 333. TE-76, close-up of the west wall, view to west



Figure 334. TE-76, oblique view of the west wall, view to northwest

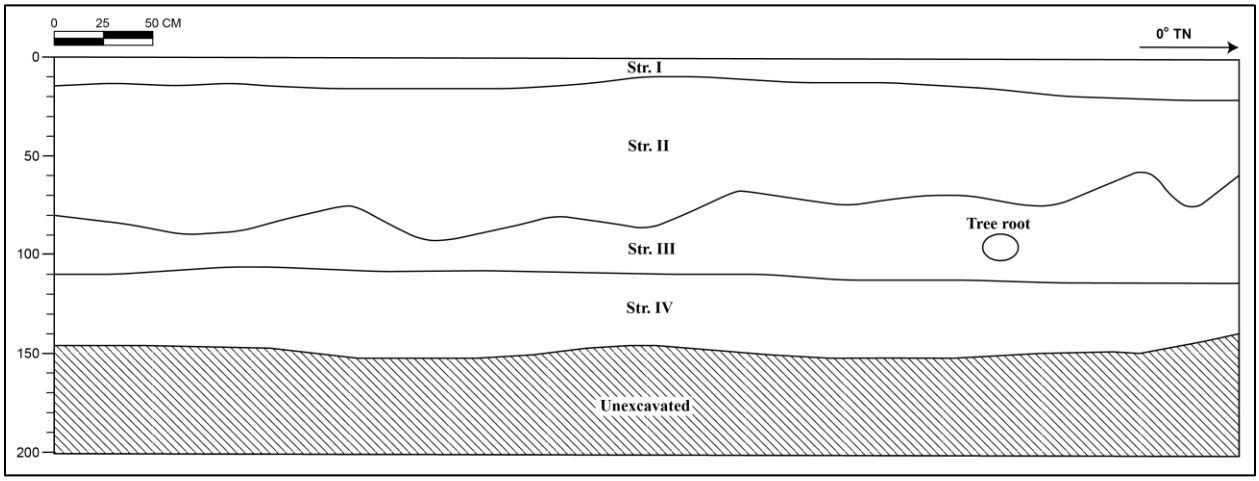



Figure 335. TE-76, stratigraphy of the west wall

Table 76. Strata observed at TE-76

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–20 | Developing A horizon; 7.5YR 3/4, dark brown; gravelly silt loam; moderate, fine granular structure; dry, hard consistence; weak cementation; slightly plastic; terrigenous origin; many fine roots; clear, smooth lower boundary |
| II | 10–93 | Ap horizon; 10YR 4/3, brown; sandy loam; weak, fine granular structure; moist, loose consistence; no cementation; non-plastic; mixed origin; few fine to medium roots; clear, wavy lower boundary; contained mottles of 10YR 5/6, yellowish brown loamy sand |
| III | 55–112 | Natural; 10YR 6/6, brownish yellow; sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; marine origin; no roots; clear, smooth lower boundary; aeolian sand; contained mottles of 10YR 6/3, pale brown sand |
| IV | 105–152 | Natural; 10YR 3/6, dark yellowish brown; silty clay loam; moderate, fine platy structure; moist, firm consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed; contained mottles of 10YR 6/2, light brownish gray silty clay |

### 1.1.77 Test Excavation 77 (TE-77)

TE-77 was placed near the eastern boundary in the southern half of the Central Maui WWRF segment of the project area (Figure 336). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.64 mbs. The stratigraphy of TE-77 consisted of a brown, silt loam Ap horizon (Stratum I) overlying dark yellowish brown, natural gravelly silt loam (Stratum II) and dark brown, natural silty clay loam (Stratum III) (Figure 337 through Figure 339 and Table 77). Stratum I contained black geotextile fabric.



Figure 336. TE-77, overview of the general location, view to northwest



Figure 337. TE-77, close-up of the east wall, view to east



Figure 338. TE-77, oblique view of the east wall, view to east

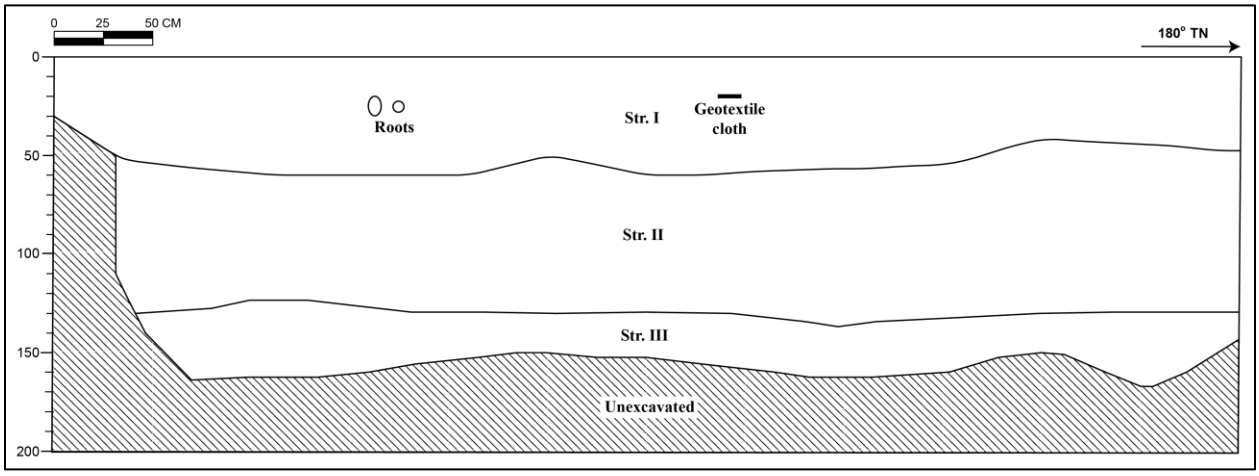



Figure 339. TE-77, stratigraphy of the east wall

Table 77. Strata observed at TE-77

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–60 | Ap horizon; 10YR 4/3, brown; silt loam; strong, fine blocky structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; fine roots common; clear, smooth lower boundary; contained geotextile fabric |
| II | 40–133 | Natural; 10YR 4/4, dark yellowish brown; gravelly silt loam; moderate, fine granular structure; moist, firm consistence; no cementation; plastic; terrigenous origin; few fine roots; clear, smooth lower boundary; contained mottles of 10YR 5/3, brown silty clay loam |
| III | 123–164 | Natural; 10YR 3/3, dark brown; silty clay loam; moderate, fine blocky structure; moist, firm consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed; contained mottles of 10YR 5/3, brown silty clay loam |

### 1.1.78 Test Excavation 78 (TE-78)

TE-78 was placed near the western boundary in the southern portion of the Central Maui WWRF segment of the project area (Figure 340). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.70 mbs. The stratigraphy of TE-78 consisted of a dark yellowish brown, loamy sand Ap horizon (Stratum I) overlying aeolian sand (Stratum II) (Figure 341 through Figure 343 and Table 78). No cultural materials were encountered.



Figure 340. TE-78, overview of the general location, view to southeast

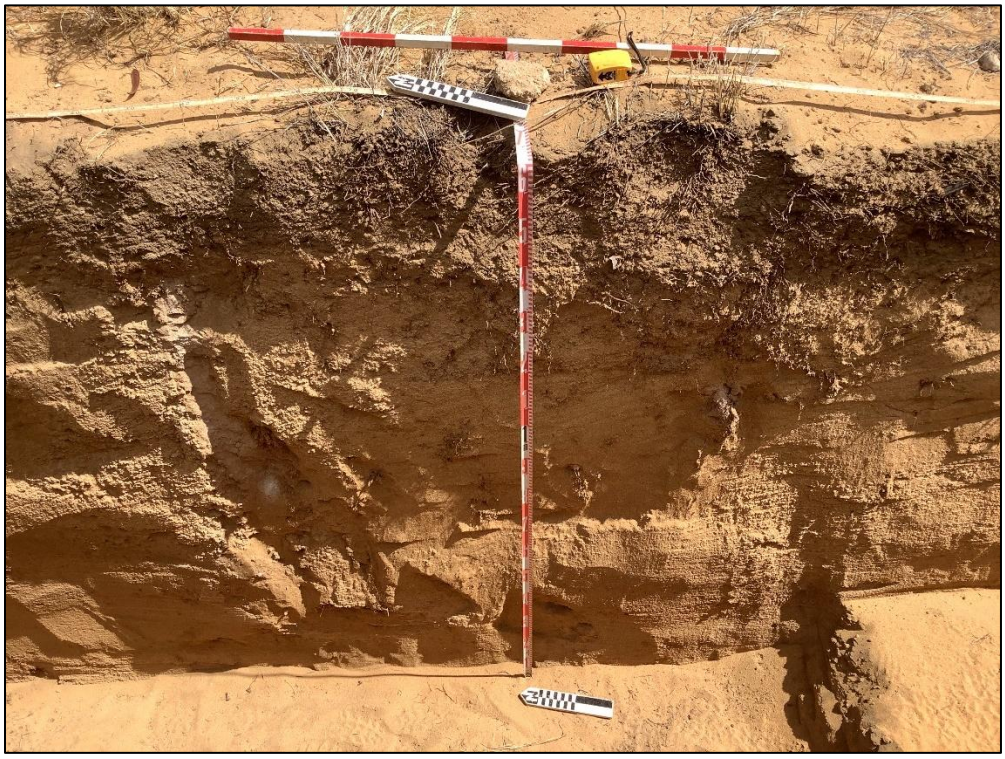


Figure 341. TE-78, close-up of the east wall, view to east



Figure 342. TE-78, oblique view of the east wall, view to southeast

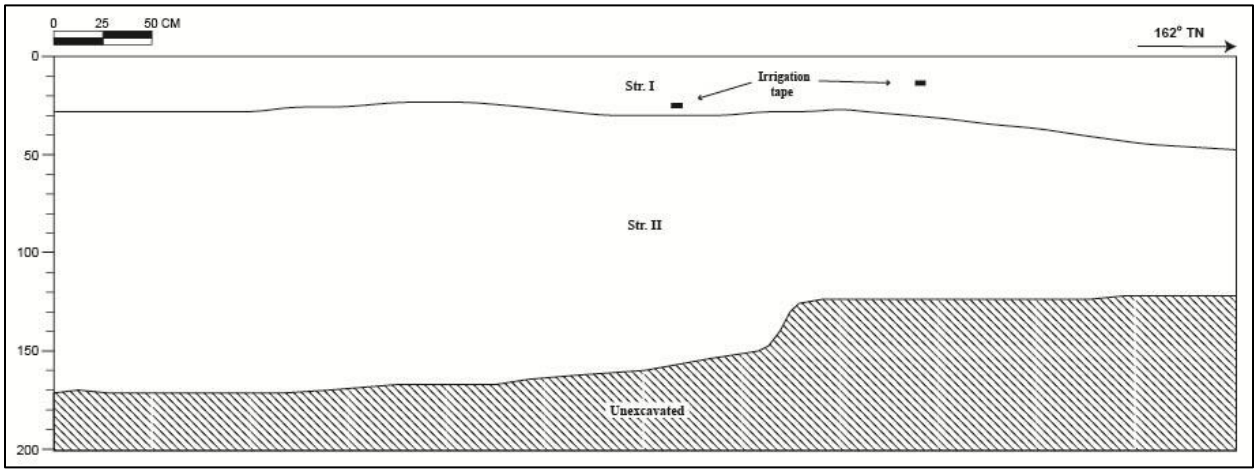



Figure 343. TE-78, stratigraphy of the east wall

Table 78. Strata observed at TE-78

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–45 | Ap horizon; 10YR 4/4, dark yellowish brown; loamy sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; mixed origin; fine roots common; clear, smooth lower boundary; contained mottles of 10YR 6/4, light yellowish brown; loamy sand |
| II | 23–170 | Natural; 10YR 6/3, pale brown; sand; structureless (single grain); moist, loose consistence; weak cementation; non-plastic; marine origin; no roots; lower boundary not observed; aeolian sand; contained mottles of 10YR 6/6, brownish yellow sand |

### 1.1.79 Test Excavation 79 (TE-79)

TE-79 was placed in the southern portion of the Central Maui WWRF segment of the project area (Figure 344). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.67 mbs. The stratigraphy of TE-79 consisted of a dark brown, silt loam developing A horizon (Stratum I) and a brown, loamy sand Ap horizon (Stratum II) overlying natural aeolian sand (Stratum III); a thin band of grayish brown, natural loamy sand (Stratum IV); and natural aeolian sand (Stratum V) (Figure 345 through Figure 347 and Table 79). No cultural materials were encountered.



Figure 344. TE-79, overview of the general location, view to northwest



Figure 345. TE-79, close-up of the east wall, view to east



Figure 346. TE-79, oblique view of the east wall, view to southeast

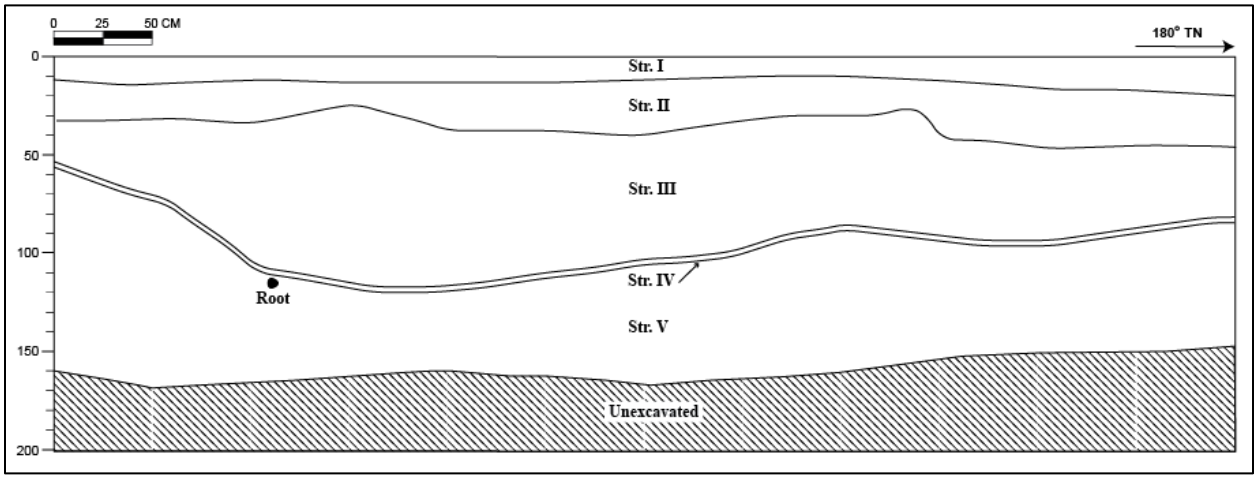



Figure 347. TE-79, stratigraphy of the east wall

Table 79. Strata observed at TE-79

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–18 | Developing A horizon; 7.5YR 3/4, dark brown; gravelly silt loam; strong, medium granular structure; dry, hard consistence; weak cementation; slightly plastic; terrigenous origin; fine roots common; abrupt, smooth lower boundary |
| II | 10–45 | Ap horizon; 10YR 5/3, brown; loamy sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; mixed origin; few fine roots; clear, smooth lower boundary; contained mottles of 10YR 6/4, light yellowish brown sand |
| III | 24–118 | Natural; 10YR 6/6, brownish yellow; sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; marine origin; no roots; lower boundary not observed; aeolian sand |
| IV | 55–120 | Natural; 10YR 5/2, grayish brown; loamy sand; weak, fine granular structure; dry, weakly coherent consistence; no cementation; non-plastic; mixed origin; fine to medium roots common; abrupt, smooth lower boundary |
| V | 58–167 | Natural; 10YR 6/4, light yellowish brown; sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; marine origin; no roots; lower boundary not observed; aeolian sand |

### 1.1.80 Test Excavation 80 (TE-80)

TE-80 was placed in the southern portion of the Central Maui WWRF segment of the project area (Figure 348). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.57 mbs. The stratigraphy of TE-80 consisted of a dark brown, gravelly silt loam developing A horizon (Stratum I); brown, loamy sand fill (Stratum II); and a brown, sandy loam Ap horizon (Stratum III) overlying dark brown, natural silty clay (Stratum IV) (Figure 349 through Figure 351 and Table 80). Strata II and III contained many pieces of black plastic irrigation drip-tape.



Figure 348. TE-80, overview of the general location, view to northwest



Figure 349. TE-80, close-up of the west wall, view to west



Figure 350. TE-80, oblique view of the west wall, view to southwest

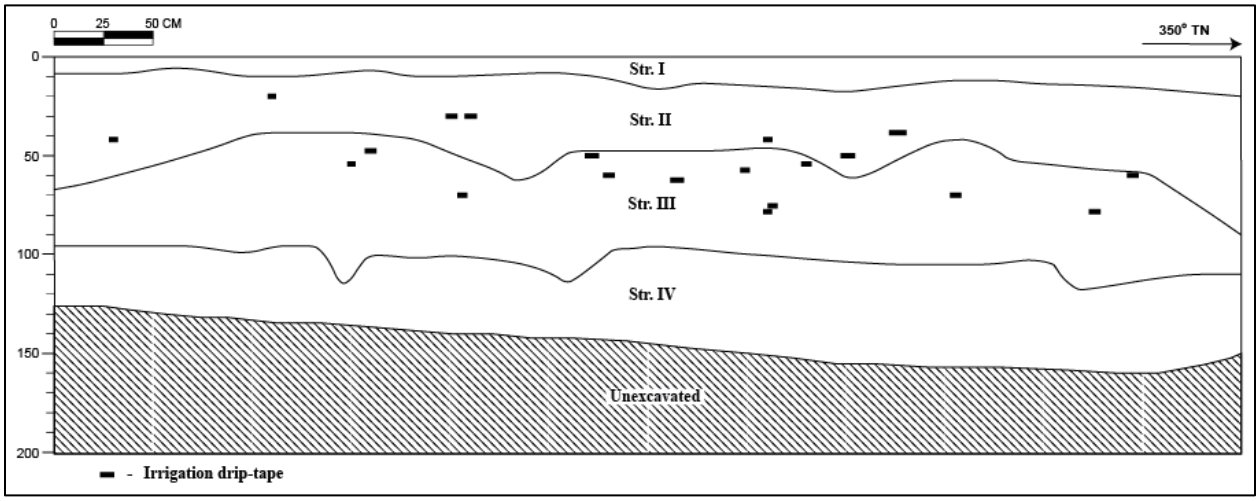



Figure 351. TE-80, stratigraphy of the west wall

Table 80. Strata observed at TE-80

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–16 | Developing A horizon; 7.5YR 3/4, dark brown; gravelly silt loam; moderate, fine granular structure; dry, hard consistence; no cementation; non-plastic; terrigenous origin; fine roots common; clear, smooth lower boundary |
| II | 7–88 | Fill; 7.5YR 5/3, brown; loamy sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; mixed origin; few fine to medium roots; clear, irregular lower boundary; contained mottles of 10YR 4/2, dark grayish brown loamy sand |
| III | 38–119 | Ap horizon; 10YR 4/3, brown; sandy loam; moderate, fine granular structure; moist, friable consistence; no cementation; slightly plastic; mixed origin; no roots; clear, smooth lower boundary |
| IV | 94–157 | Natural; 7.5YR 3/4, dark brown; silty clay; strong, medium blocky structure; moist, extremely firm consistence; no cementation; plastic; terrigenous origin; no roots; no lower boundary observed |

### 1.1.81 Test Excavation 81 (TE-81)

TE-81 was placed near the eastern boundary in the southern portion of the Central Maui WWRF segment of the project area (Figure 352). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.63 mbs. The stratigraphy of TE-81 consisted of a dark brown, silty clay loam Ap horizon (Stratum I) overlying dark brown, previously disturbed, natural silty clay loam with mottles of brown, silty clay (Stratum II) and alluvial streambed cobbles (Stratum III) (Figure 353 through Figure 355 and Table 81). No cultural materials were encountered.



Figure 352. TE-81, overview of the general location, view to east



Figure 353. TE-81, close-up of the east wall, view to east



Figure 354. TE-81, oblique view of the east wall, view to southeast

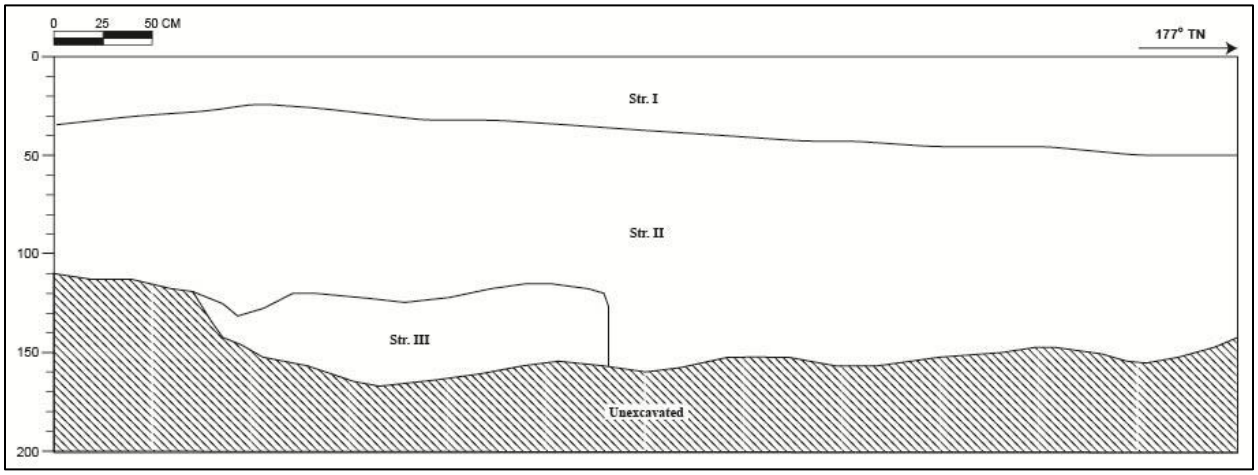



Figure 355. TE-81, stratigraphy of the east wall

Table 81. Strata observed at TE-81

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–48 | Ap horizon; 7.5YR 3/2, dark brown; gravelly silty clay loam; strong, medium granular structure; dry, extremely hard consistence; no cementation; slightly plastic; terrigenous origin; fine to coarse roots common; clear, smooth lower boundary |
| II | 23–156 | Previously disturbed natural; 7.5YR 3/4, dark brown; gravelly silty clay loam; weak, fine granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed; contained mottles of 7.5YR 4/2, brown silty clay |
| III | 113–163 | Natural; 10YR 4/1, dark gray; alluvial cobbles (>90%) and sand (<10%); structureless (single grain); moist, loose consistence; no cementation; non-plastic; terrigenous origin; no roots; no lower boundary observed |

### 1.1.82 Test Excavation 82 (TE-82)

TE-82 was placed near the western boundary in the southern portion of the Central Maui WWRF segment of the project area (Figure 356). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.97 mbs. The stratigraphy of TE-82 consisted of a yellowish brown, gravelly loamy sand Ap horizon (Stratum I) and dark yellowish brown, loamy sand fill (Stratum II) overlying natural aeolian sand (Stratum III); a thin band of grayish brown, natural loamy sand (Stratum IV); and natural aeolian sand (Stratum V) (Figure 357 through Figure 359 and Table 82). No cultural materials were encountered.



Figure 356. TE-82, overview of the general location, view to east



Figure 357. TE-82, close-up of the west wall, view to west



Figure 358. TE-82, oblique view of the west wall, view to northwest

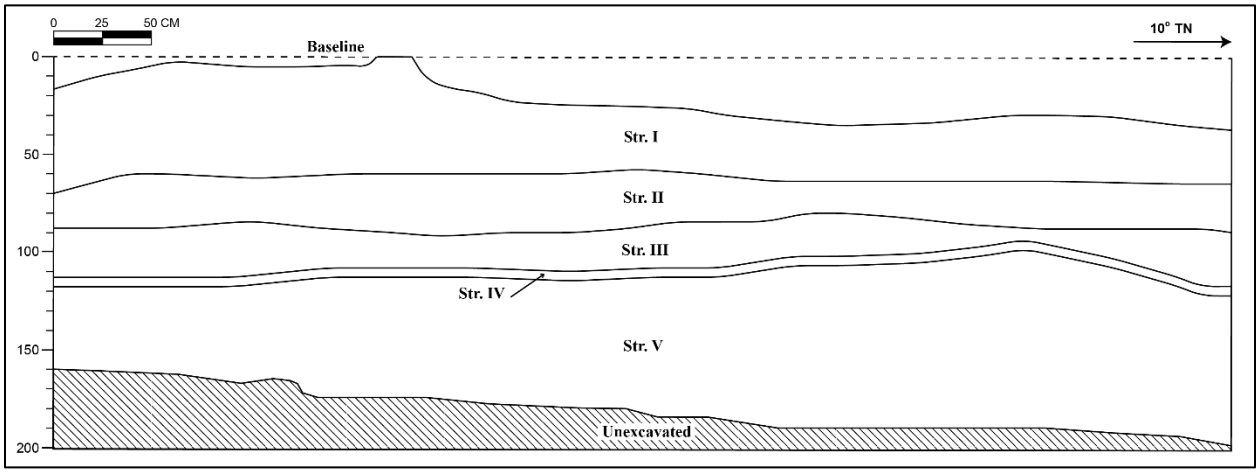



Figure 359. TE-82, stratigraphy of the west wall

Table 82. Strata observed at TE-82

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–70 | Ap horizon; 10YR 5/4, yellowish brown; gravelly loamy sand; structureless (single grain); dry, weakly coherent consistence; no cementation; non-plastic; mixed origin; many fine to medium roots; abrupt, smooth lower boundary; contained mottles of 10YR 4/6, dark yellowish brown loamy sand |
| II | 58–92 | Fill; 10YR 4/6, dark yellowish brown; loamy sand; structureless (single grain); dry, loose consistence; no cementation; non-plastic; mixed origin; fine roots common; abrupt, smooth lower boundary; contained mottles of 10YR 5/4, yellowish brown loamy sand |
| III | 80–130 | Natural; 10YR 7/2, light gray; sand; structureless (single grain); dry, extremely hard consistence; strong cementation; non-plastic; marine origin; no roots; gradual, irregular lower boundary; lithified aeolian sand |
| IV | 95–135 | Natural; 10YR 5/2, grayish brown; loamy sand; weak, fine granular structure; dry, weakly coherent consistence; no cementation; non-plastic; mixed origin; many fine to medium roots; abrupt, smooth lower boundary |
| V | 100–197 | Natural; 10YR 5/6, yellowish brown; sand; structureless (single grain); dry, weakly coherent consistence; weak cementation; non-plastic; marine origin; no roots; lower boundary not observed; aeolian sand |

### 1.1.83 Test Excavation 83 (TE-83)

TE-83 was placed in the southern portion of the Central Maui WWRF segment of the project area (Figure 360). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.76 mbs. The stratigraphy of TE-83 consisted of a very dark brown, gravelly silt loam developing A horizon (Stratum I); a pale brown, sand fill (Stratum II); and brown, loamy sand fill with a band of light yellowish brown sand (Stratum III); overlying natural alluvial streambed gravel (Stratum IV) and dark yellowish brown, natural silty clay loam (Stratum V) (Figure 361 through Figure 363 and Table 2). No cultural materials were encountered.



Figure 360. TE-83, overview of the general location, view to northwest



Figure 361. TE-83, close-up of the east wall, view to east



Figure 362. TE-83, overview of the east wall, view to northeast

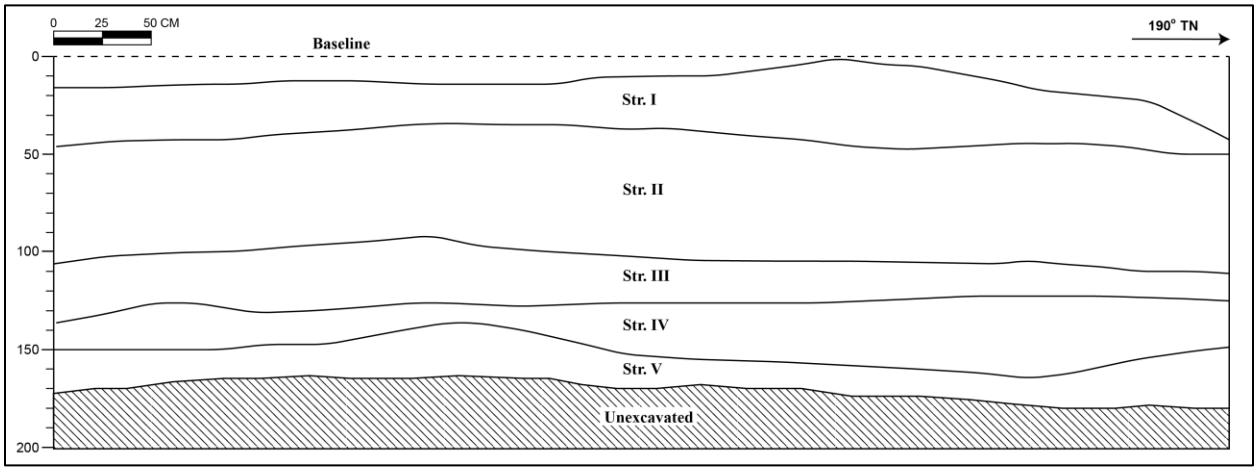



Figure 363. TE-83, stratigraphy of the east wall

Table 83. Strata observed at TE-83

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–50 | Ap horizon; 7.5YR 2.5/3, very dark brown; gravelly silt loam; moderate, fine granular structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; fine roots common; abrupt, smooth lower boundary |
| II | 32–108 | Fill; 10YR 6/3, pale brown; sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; marine origin; few fine to medium roots; clear, smooth lower boundary; contained mottles of 10YR 5/3 brown loamy sand |
| III | 93–135 | Fill; 10YR 5/3, brown; loamy sand; structureless (single grain); moist, loose consistence; no cementation; non-plastic; mixed origin; no roots; clear, smooth lower boundary; contained 10YR 6/4, light yellowish brown sand near the lower interface |
| IV | 120–162 | Natural; 10YR 5/1, gray; gravel (>90%) and sand (<10%); structureless (single grain); dry, loose consistence; no cementation; non-plastic; terrigenous origin; no roots; clear, smooth lower boundary; alluvial streambed gravel |
| V | 135–176 | Natural; 10YR 3/4, dark yellowish brown; silty clay loam; strong, fine blocky structure; moist, extremely firm consistence; no cementation; plastic; terrigenous origin; no roots; no lower boundary observed |

### 1.1.84 Test Excavation 84 (TE-84)

TE-84 was placed in the southern portion of the Central Maui WWRF segment of the project area (Figure 364). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.61 mbs. The stratigraphy of TE-84 consisted of a dark brown, gravelly silt loam developing A horizon (Stratum I) and a brown, gravelly sandy loam Ap horizon (Stratum II) overlying previously disturbed, natural aeolian sand (Stratum III); natural alluvial streambed gravel (Stratum IV); and dark brown, natural silty clay loam (Stratum V) (Figure 365 through Figure 367 and Table 84). No cultural materials were encountered.



Figure 364. TE-84, overview of the general location, view to northwest



Figure 365. TE-84, oblique view of the east wall, view to northeast



Figure 366. TE-84, overview of the east wall, view to northeast

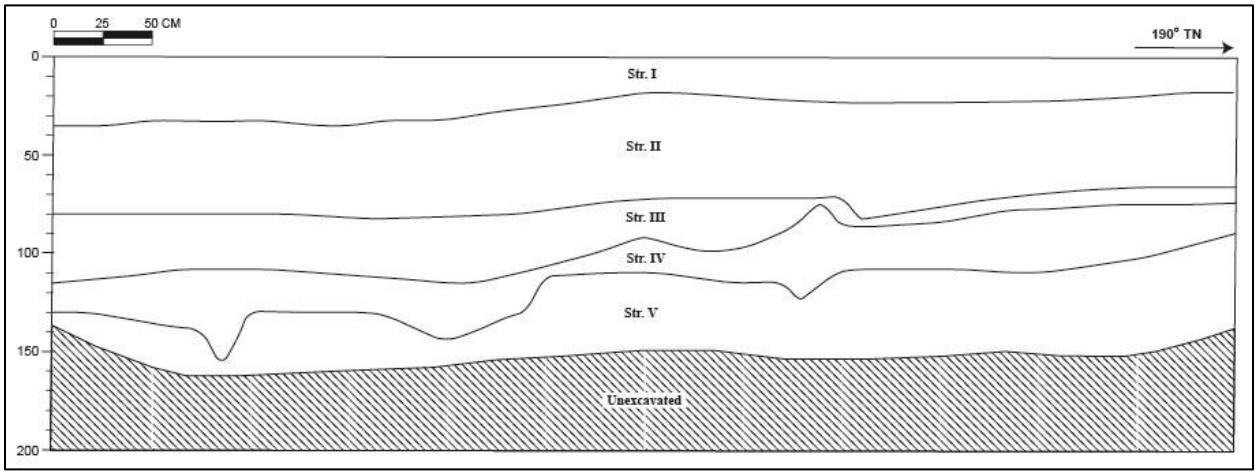



Figure 367. TE-84, stratigraphy of the east wall

Table 84. Strata observed at TE-84

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–35 | Developing A horizon; 7.5YR 3/3, dark brown; gravelly silt loam; moderate, fine granular structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; fine roots common; clear, smooth lower boundary |
| II | 15–80 | Ap horizon; 10YR 4/3, brown; gravelly sandy loam; weak, fine granular structure; moist, friable consistence; no cementation; slightly plastic; mixed origin; few fine roots; clear, smooth lower boundary, contained mottles of 10YR 5/3, brown sand |
| III | 62–115 | Previously disturbed natural; 10YR 6/4, light yellowish brown; sand; structureless (single grain); moist, loose consistence; weak cementation; non-plastic; marine origin; no roots; clear, smooth lower boundary |
| IV | 69–154 | Natural; 10YR 5/2, grayish brown; gravel (>90%) and sand (<10%); structureless (single grain); moist, loose consistence; no cementation; non-plastic; terrigenous origin; no roots; clear, smooth boundary; alluvial streambed gravel |
| V | 87–161 | Natural; 10YR 3/3, dark brown; silty clay loam; strong, medium blocky structure; moist, extremely firm consistence; no cementation; plastic; terrigenous origin; no roots; no lower boundary observed |

### 1.1.85 Test Excavation 85 (TE-85)

TE-85 was placed near the eastern boundary in the southern portion of the Central Maui WWRF segment of the project area (Figure 368). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.57 mbs. The stratigraphy of TE-85 consisted of a dark yellowish brown, sandy loam Ap horizon (Stratum I) overlying a dark yellowish brown, previously disturbed, natural gravelly silt loam with mottles of brown, loamy sand (Stratum II) and brown, gravelly sandy clay loam with mottles of brown loamy sand (Stratum III) (Figure 369 through Figure 371 and Table 85). No cultural materials were encountered.



Figure 368. TE-85, overview of the general location, view to east



Figure 369. TE-85, close-up of the west wall, view to west



Figure 370. TE-85, oblique view of the west wall, view to northwest

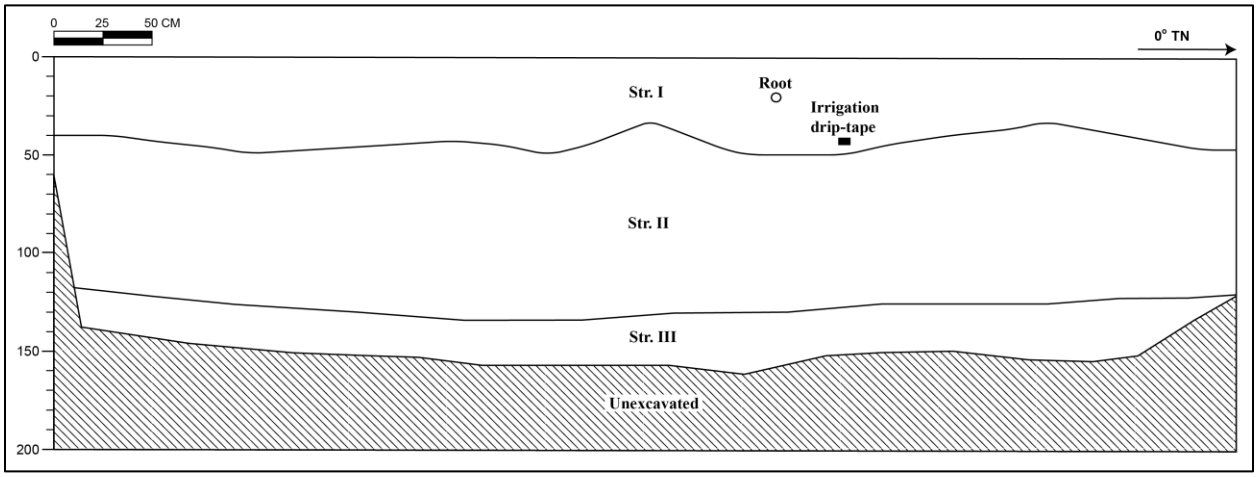



Figure 371. TE-85, stratigraphy of the west wall

Table 85. Strata observed at TE-85

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–48 | Ap horizon; 10YR 3/4, dark yellowish brown; gravelly sandy loam; moderate, fine blocky structure; dry, weakly coherent consistence; no cementation; slightly plastic; mixed origin; many fine to coarse roots; clear, smooth lower boundary |
| II | 31–131 | Previously disturbed natural; 10YR 3/4, dark yellowish brown; gravelly silt loam; moderate, fine blocky structure; moist, friable consistence; no cementation; plastic; terrigenous origin; few fine roots; clear, smooth lower boundary, contained mottles of 10YR 5/3 brown, loamy sand |
| III | 116–157 | Natural; 10YR 4/3 brown; gravelly sandy clay loam; weak, fine blocky structure; moist, firm consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed; contained mottles of 10YR 5/3 brown, loamy sand |

### 1.1.86 Test Excavation 86 (TE-86)

TE-86 was placed near the western boundary in the southern end of the Central Maui WWRF segment of the project area (Figure 372). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.70 mbs. The stratigraphy of TE-86 consisted of a brown, gravelly sandy loam Ap horizon (Stratum I) overlying utility pit fill (Stratum II) within dark brown, previously disturbed, natural gravelly silt loam with a concentration of alluvial streambed gravel in the southern end (Stratum III) and dark yellowish brown, natural silty clay loam (Stratum IV) (Figure 373 through Figure 376 and Table 86). No significant cultural materials were encountered.



Figure 372. TE-86, overview of the general location, view to northwest



Figure 373. TE-86, close-up of the west wall, view to west



Figure 374. TE-86, overview of the west wall, view to northwest



Figure 375. TE-86, overview of the west wall, view to southwest

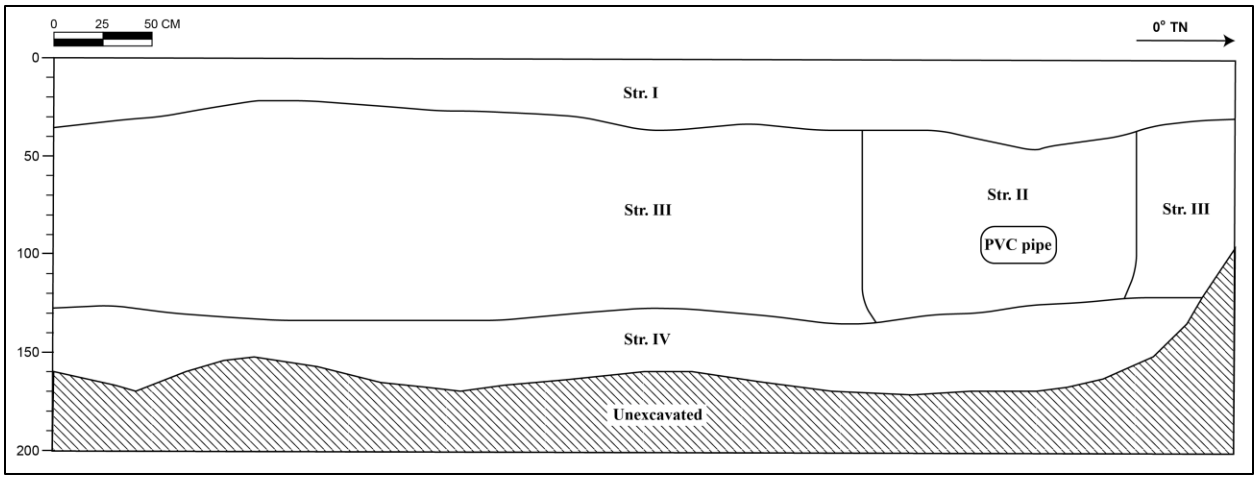



Figure 376. TE-86, stratigraphy of the west wall

Table 86. Strata observed at TE-86

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–45 | Ap horizon; 10YR 4/3, brown; gravelly sandy loam; weak, fine granular structure; dry, weakly coherent consistence; no cementation; slightly plastic; mixed origin; fine roots common; clear, irregular lower boundary |
| II | 37–134 | Fill; 10YR 3/3, dark brown; gravelly silt loam; moderate, medium granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; few fine roots; clear, discontinuous lower boundary; utility fill surrounding a 16” PVC pipe |
| III | 22–134 | Previously disturbed natural; 10YR 3/3, dark brown; gravelly silt loam; moderate, medium granular structure; moist, friable consistence; no cementation; plastic; terrigenous origin; few fine roots; clear, smooth lower boundary, with deposits of 10YR 4/2 dark grayish brown loamy sand |
| IV | 120–170 | Natural; 10YR 4/4, dark yellowish brown; silty clay loam; moderate, fine granular structure; moist, firm consistence; no cementation; plastic; terrigenous origin; no roots; no lower boundary observed |

### 1.1.87 Test Excavation 87 (TE-87)

TE-87 was placed near the southern end of the Central Maui WWRF segment of the project area (Figure 377). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.78 mbs. The stratigraphy of TE-87 consisted of a dark grayish brown, gravelly sandy loam Ap horizon (Stratum I) overlying dark brown, previously disturbed, natural gravelly silt loam (Stratum II) and brown, natural silty clay loam (Stratum III) (Figure 378 through Figure 380 and Table 2). No cultural materials were encountered.



Figure 377. TE-87, overview of the general location, view to east



Figure 378. TE-87, close-up of the east wall, view to east



Figure 379. TE-87, oblique view of the east wall, view to southeast

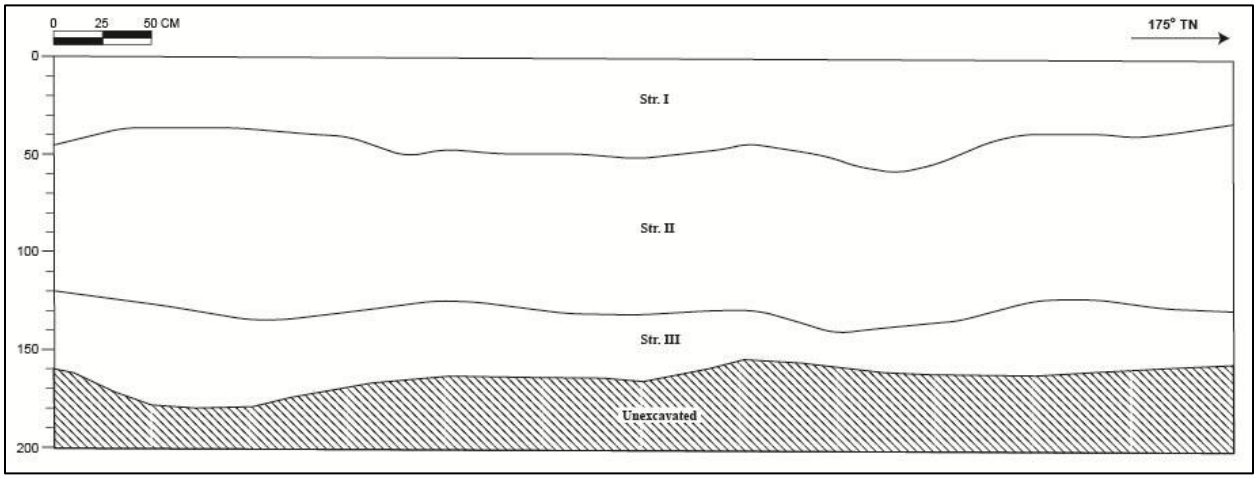



Figure 380. TE-87, stratigraphy of the east wall

Table 87. Strata observed at TE-87

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–57 | Ap horizon; 10YR 4/2, dark grayish brown; gravelly sandy loam; weak, fine granular structure; dry, weakly coherent consistence; no cementation; slightly plastic; mixed origin; many fine roots; clear, irregular lower boundary; contained mottles of 10YR 4/3, brown loam |
| II | 34–140 | Previously disturbed natural; 10YR 3/3, dark brown; gravelly silt loam; strong, fine granular structure; moist, firm consistence; weak cementation; non-plastic; terrigenous origin; no roots; clear, smooth lower boundary, with root moulds of 10YR 6/2, light brownish gray sand |
| III | 120–178 | Natural; 10YR 4/3, brown; silty clay loam; weak, very fine blocky structure; moist, firm consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.88 Test Excavation 88 (TE-88)

TE-88 was placed near the eastern boundary in the southern end of the Central Maui WWRF segment of the project area (Figure 381). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.72 mbs. The stratigraphy of TE-88 consisted of a dark grayish brown; gravelly sandy loam Ap horizon (Stratum I) overlying dark brown, previously disturbed, natural gravelly silt loam (Stratum II) and brown, natural silty clay loam with several alluvial streambed gravel lenses and an intrusion of dark grayish brown, sandy clay loam (Stratum III) (Figure 382 through Figure 384 and Table 88). Several intrusions of brown sandy loam within Stratum II appear to be from root moulds. No cultural materials were encountered.



Figure 381. TE-88, overview of the general location, view to northwest



Figure 382. TE-88, close-up of the east wall, view to east



Figure 383. TE-88, oblique view of the east wall, view to northeast

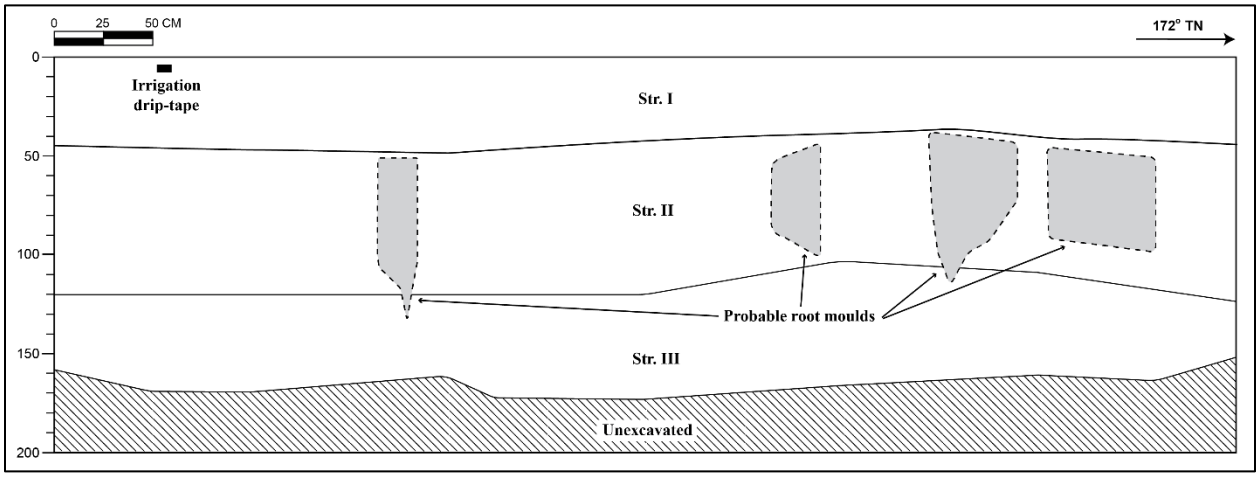



Figure 384. TE-88, stratigraphy of the east wall

Table 88. Strata observed at TE-88

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–49 | Ap horizon; 10YR 4/2, dark grayish brown; gravelly sandy loam; weak, fine granular structure; dry, weakly coherent consistence; no cementation; slightly plastic; mixed origin; many fine roots; clear, smooth lower boundary |
| II | 36–123 | Previously disturbed natural; 7.5YR 3/3, dark brown; gravelly silt loam; moderate, fine granular structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; fine roots common; clear, smooth lower boundary; contained concentrations of 10YR 4/3 brown, sandy loam probable root moulds |
| III | 102–172 | Previously disturbed natural; 10YR 4/3, brown; silty clay loam; moderate, fine blocky structure; moist, friable consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed; contained lenses of alluvial gravel and an intrusion of 10YR 4/2 dark grayish brown sandy loam |

### 1.1.89 Test Excavation 89 (TE-89)

TE-89 was placed in the southern end of the Central Maui WWRF segment of the project area (Figure 385 and Figure 386). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 2.34 mbs. The stratigraphy of TE-89 consisted of dark yellowish brown sandy loam fill (Stratum I); a brown, gravelly silt loam Ap horizon (Stratum II) overlying a very dark brown, previously disturbed, natural gravelly silty clay loam with a lens of alluvial streambed gravel and mottles of brown, loamy sand (Stratum III) and dark yellowish brown, natural silty clay (Stratum IV) (Figure 387 through Figure 389 and Table 89). Stratum I appeared to be a mounded push-pile of fill in the southern end of the trench. Notably, a datum baseline was established to include the top of the mound and used to measure the depths of the strata. Subsequently, the depths were recorded in centimeters below the datum (cmbd), which was 65 cm above the ground surface. No cultural materials were encountered.



Figure 385. TE-89, overview of the general location prior to excavation, view to northwest



Figure 386. TE-89, overview of the general location showing the push-pile, view to west



Figure 387. TE-89, close-up of the west wall, view to west



Figure 388. TE-89, oblique view of the west wall, view to northwest

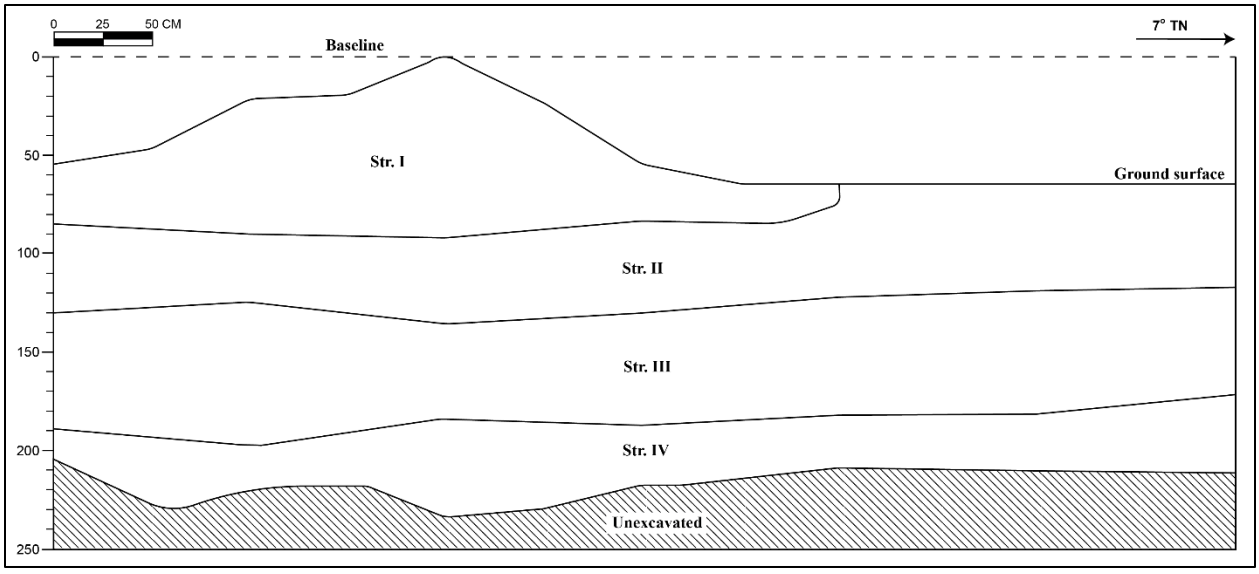



Figure 389. TE-89, stratigraphy of the west wall

Table 89. Strata observed at TE-89

| Stratum | Depth (cmbd) | Description |
|---|---|---|
| I | 0–93 | Fill; 10YR 4/4, dark yellowish brown; gravelly sandy loam; weak, fine granular structure; dry, weakly coherent consistence; no cementation; non-plastic; mixed origin; many fine roots; clear, discontinuous lower boundary; push-pile mound |
| II | 65–135 | Ap horizon; 10YR 4/3, brown; gravelly silt loam; moderate, fine granular structure; dry, hard consistence; no cementation; slightly plastic; terrigenous origin; fine to coarse roots common; clear, smooth lower boundary |
| III | 117–198 | Previously disturbed natural; 7.5YR 2.5/3, very dark brown; gravelly silty clay loam; strong, fine blocky structure; dry, extremely hard consistence; no cementation; slightly plastic; terrigenous origin; no roots; clear, smooth lower boundary; contained mottles of 10YR 5/3 brown loamy sand and a lens of alluvial streambed gravel |
| IV | 172–234 | Natural; 10YR 4/4, dark yellowish brown; silty clay; weak, very fine granular structure; moist, firm consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed |

### 1.1.90 Test Excavation 90 (TE-90)

TE-90 was placed in the southern end of the Central Maui WWRF segment of the project area (Figure 390). The excavation was 6.0 m long by 1.0 m wide with a maximum depth of 1.70 mbs. The stratigraphy of TE-90 consisted of a dark brown, gravelly sandy loam Ap horizon (Stratum I) overlying dark brown, previously disturbed, natural gravelly silt loam with mottles of dark yellowish brown, silt loam (Stratum II) and brown, natural silty clay with inclusions of grayish brown alluvial streambed deposits (Stratum III) (Figure 391 through Figure 393 and Table 90). No cultural materials were encountered.



Figure 390. TE-90, overview of the general location, view to northwest



Figure 391. TE-90, close-up of the east wall, view to east



Figure 392. TE-90, oblique view of the east wall, view to northeast

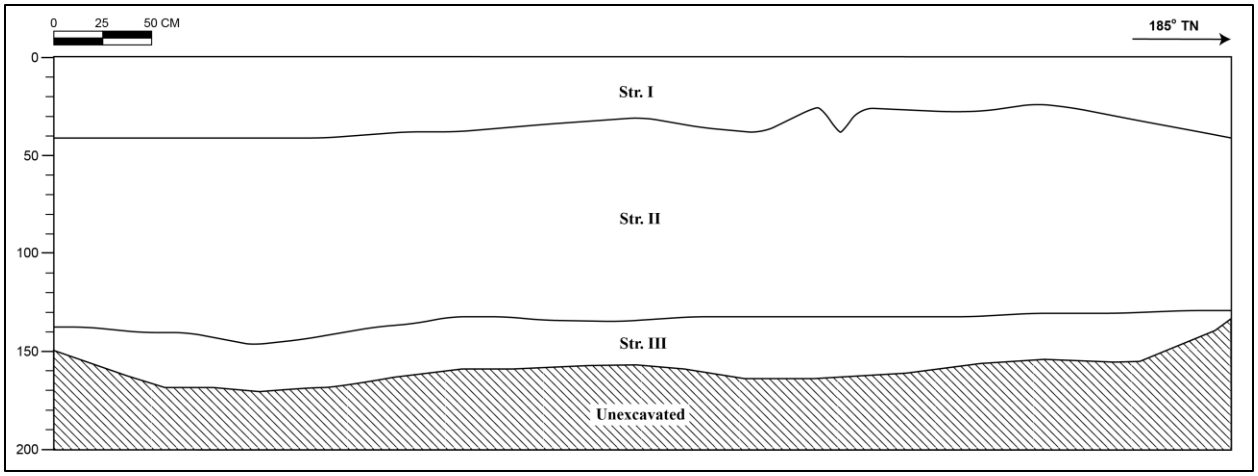



Figure 393. TE-90, stratigraphy of the east wall

Table 90. Strata observed at TE-90

| Stratum | Depth (cmbs) | Description |
|---|---|---|
| I | 0–42 | Ap horizon; 10YR 3/3, dark brown; gravelly sandy loam; moderate, fine granular structure; dry, weakly coherent consistence; no cementation; non-plastic; mixed origin; fine roots common; clear, smooth lower boundary; contained mottles of 10YR 5/3, brown loamy sand |
| II | 23–147 | Previously disturbed natural; 7.5YR 3/3, dark brown; gravelly silt loam; moderate, fine granular structure; moist, friable consistence; no cementation; slightly plastic; terrigenous origin; few fine roots; clear, smooth lower boundary; contained mottles of 10Y/R 3/4, dark yellowish brown silt loam |
| III | 128–170 | Natural; 10YR 4/3, brown; silty clay; moderate, very fine blocky structure; moist, firm consistence; no cementation; plastic; terrigenous origin; no roots; lower boundary not observed, contained inclusions of 10YR 5/2, grayish brown sand alluvial streambed deposits |

# CULTURAL IMPACT ASSESSMENT REPORT

## APPENDIX

# O

# Cultural Impact Assessment for the Central Maui Wastewater Reclamation Facility (WWRF) Project, Waikapū and Wailuku Ahupua‘a, Wailuku District, Maui TMKs: (2) 3-5-001:017 por. and 120 por.; 3-5-002:014 por.; 3-5-020:036 por.; 3-6-002:003 por. and 004 por.; and 3-8-005:023 por.; Wai‘ale Road Right-of-Way (ROW), Kuikahi Drive, Waiko Road ROW, and Waikapū Stream

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**August 2024**

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# Management Summary

| | |
|---|---|
| **Reference** | Cultural Impact Assessment for the Central Maui Wastewater Reclamation Facility Project, Waikapū and Wailuku Ahupua‘a, Wailuku District, Maui, TMKs: (2) 3-5-001:017 por. and 120 por.; 3-5-002:014 por.; 3-5-020:036 por.; 3-6-002:003 por. and 004 por.; 3-8-005:023 por.; Wai‘ale Road Right-of-Way (ROW), Kuikahi Drive, Waiko Road ROW, and Waikapū Stream (Baculpo et al. 2024) |
| **Date** | August 2024 |
| **Project Number(s)** | Cultural Surveys Hawai‘i, Inc. (CSH) Job Code: WAIKAPU 34 |
| **Agencies** | State Office of Planning and Sustainable Development (OPSD), Environmental Review Program (ERP) |
| **Land Jurisdiction** | Private; County of Maui; State of Hawai‘i |
| **Project Location** | The proposed project includes the construction of a new wastewater reclamation facility (WWRF), termed the Central Maui WWRF; a new wastewater pump station (WWPS), termed the Kehalani WWPS; new sewage pipeline; and a new recycled water (R-1) pipeline. The Central Maui WWRF will be located within former agricultural lands owned by the County of Maui along Kuihelani Highway. The Kehalani WWPS will be installed within the Wai‘ale Reservoir stormwater detention basin nearest the intersection of Wai‘ale Road and Olomea Street. The new sewage pipeline will connect the Central Maui WWRF and the Kehalani WWPS and will extend along a proposed access easement for the Central Maui WWRF as well as a portion of the future corridor of the Wai‘ale Road Extension to a connection to the proposed Waikapū Country Town project. The R-1 pipeline will extend west from the Central Maui WWRF along the future access easement to the future corridor of the Wai‘ale Road Extension and a connection to the proposed Waikapū Country Town project along Honoapi‘ilani Highway. The project area is depicted on portions of the 2017 Maalaea and 2017 Wailuku U.S. Geological Survey (USGS) 7.5-minute topographic quadrangles. |
| **Project Description** | The proposed project will provide wastewater treatment service to the Central Valley area of Maui. The construction of the new Kehalani WWPS and sewage pipeline will divert wastewater from the Wailuku-Kahului WWRF thereby reducing the volume of treated effluent disposal at the facility. The project will also provide recycled water irrigation for non-potable reuse for the proposed Waikapū Country Town project as well as agricultural fields, regional parks, and county facilities in the area. The increased use of recycled water will increase freshwater and raw water resources available for potable and other uses. |

| | |
|---|---|
| | A backup wastewater effluent disposal system is required for water reuse and will be accomplished through soil aquifer treatment (SAT) at the new Central Maui WWRF. The proposed facility plan contains four SAT basins, four secondary clarifiers, a headworks station, a dewatering and blower building, effluent pump station and RAS pump station, operations building, and facilities to process activated sludge, R-1 recycled water treatment, and aerobic digesters.<br><br>Project ground disturbance for the construction of the new Central Maui WWRF is expected to have a maximum excavation depth of 7.62 m (25 feet [ft]). The construction of the new Kehalani WWPS is expected to have a maximum excavation depth of 6.10 m (20 ft). The sewage pipeline trench along Wai‘ale Road and the future Wai‘ale Road Extension is expected to be 1.22 m (4 ft) wide with an estimated length of 5.18 linear km (17,000 linear ft) and a maximum excavation depth of 4.57 m (15 ft). The R-1 pipeline from the connection point to the Waikapu Country Town (WCT) is estimated to be 3.05 linear km (10,000 linear ft) with a maximum depth of 1.83 m (6 ft). An access and utility easement will be 548.64 m (1,800 ft) long and 30.48 m (100 ft) wide to connect the Central Maui WWRF to the Wai‘ale Road Extension. |
| **Project Acreage** | The project area is 16.83 acres (6.81 hectares). |
| **Document Purpose and Regulatory Context** | This cultural impact assessment (CIA) supports compliance for the Central Maui WWRF project with:<br><br>• The National Historic Preservation Act (NHPA), which requires consideration of a proposed project’s potential impacts to historic properties and resources;<br>• The mandate set forth by the Hawai‘i State Constitution (Articles IX and XII), courts, Hawai‘i Revised Statutes (HRS), and Hawai‘i Administrative Rules (HAR) and other Hawai‘i State laws requiring government agencies to promote and preserve cultural beliefs, practices, and resources of Native Hawaiians and other ethnic groups;<br>• The State of Hawai‘i’s environmental review process under HRS §343, which requires consideration of the proposed project’s potential effects on cultural practices and cultural features in order to “promote responsible decision making” (HRS §343); and<br>• The State of Hawai‘s historic preservation review process under HAR §13-275-6 and §13-284-6, which requires the identification and mitigation of adverse effects proposed by a potential project to “promote the use and conservation of |

| | |
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| | historic properties for the education of the citizens of Hawai‘i" (HAR §13-275-6).<br><br>This CIA contains information gathered from archival research and consultation, compiled to "analyze the impact of a proposed action on cultural practices and features associated with the project area" (Office of Environmental Quality 1997). Cultural practices and cultural features may include traditional cultural properties (TCPs), designated significant historic properties under State of Hawai‘i significance Criterion e, pursuant to HAR §13-275-6 and §13-284-6. Significance Criterion e refers to historic properties that "have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with 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" (HAR §13-275-6 and §13-284-6).<br><br>This project also includes a Ka Pa‘akai Analysis Study. In Ka Pa‘akai vs Land Use Commission, 94 Hawai‘i (2000) the Court held the following analysis must also be conducted:<br><br>1. The identity and scope of valued cultural, historical, or natural resources in the petition area, including the extent to which traditional and customary Native Hawaiian rights are exercised in the petition area;<br><br>2. The extent to which those resources—including traditional and customary Native Hawaiian rights—will be affected or impaired by the proposed action; and<br><br>3. The feasible action, if any, to be taken by the State to reasonably protect Native Hawaiian Rights if they are found to exist. |
| **Results of Background Research** | Background research for this study yielded the following results, presented in approximate chronological order:<br><br>1. The wind of Waikapū is Kololio and the wind of Wailuku is I‘a iki (Nakuina 1992:63). There were many recognized rains in the *moku* (district) of Wailuku, but the Kili‘o‘opu rain was specifically associated with Waikapū and the larger Wailuku district (Akana and Gonzalez 2015:84). Hō‘eha‘ili, ‘Ulalena, and Uhiwai are rains closely associated with Wailuku.<br>2. Waikapū Stream is one of four major deep-valley streams (Waikapū, Wailuku, Wai‘ehu, and Waihe‘e) which comprise the *‘okana* (sub-district) known as "Nā Wai ‘Ehā," or "The Four Waters" (Handy et al. 1991:469; Moffat and Fitzpatrick |

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| | 1995:23). Handy et al. (1991:496) describe Waikapū Stream as a land-bound stream whose water was “utilized for irrigating a great acreage of sugar cane” and “formerly was diverted into lo‘i [irrigated taro patch] and its overflow was dissipated on the dry plains of the broad isthmus between West and East Maui.”<br>3. In ancient times, Waikapū and Wailuku were agriculturally abundant lands known for their extensive *lo‘i* (Handy et al. 1991:497).<br>4. According to Pukui et al. (1974:223), “Waikapū” literally translates to “Water of the Conch.” This is due to a cave within Waikapū Valley that supposedly housed a supernatural conch shell (named Kīhapū, blessed with the breath of Lono) that resided there until it was stolen by a supernatural dog named Puapualenalena. This conch shell, when blown, was said to resound throughout all the Hawaiian Islands (Beckwith 1970:349; Pukui et al. 1974:223).<br>5. According to H.T. Cheever (in Sterling 1998:63), the waters of Nā Wai ‘Ehā were named after successive events during a famous, albeit unnamed, battle.<br>6. Ke Kula o Kama‘oma‘o, or the Plains of Kama‘oma‘o, is the name given to a region of sandy plains spanning portions of Wailuku and Waikapū Ahupua‘a (Emerson 1993). This area was known by Hawaiians in traditional times as a wandering place of the souls (Beckwith 1970), a place where dead spirits waited for a friendly escort, perhaps an *‘aumakua* (family god), to show them the way to eternity.<br>7. The Battle of Waikapū Common, or the Ahulau ka Pi‘ipi‘i i Kakanilua entailed the clash of invading Hawai‘i Island forces, headed by Kalani‘ōpu‘u, with the Maui forces under Kahekili in 1776. According to Fornander (1880:2:152–153), following the plunder of the leeward east Maui coastline, Kalani‘ōpu‘u landed his invading troops at Mā‘alaea. The Big Island army was ambushed at an area close to Waikapū and was destroyed by the army of Kahekili on the plains of Kama‘oma‘o (Hokulani Holt Padilla in Hill et al. 2006).<br>8. Geographically and culturally, Nā Wai ‘Ehā consisted of four deep valley streams (Waikapu, Wailuku, Waiehu, and Waihee) that watered four distinct areas of taro land that spread out fanwise to the shoreline (Handy et al. 1991:272) with the *ahupua‘a* (traditional land division) of both Wailuku and Waikapū extending across the isthmus of Maui to meet the traditional land boundaries of Hamakuapoko and Kula Moku. These two land divisions were of primary importance due to their location across “the whole of the central isthmus so as to |

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| | cut off half of the lands in the district of Kula from access to the sea" and were sometimes referred to as Na Poko (W.D. Alexander in Sterling 1998:63).<br>9. In 1819, the first whaling ships arrived in Hawaiian waters and Lāhainā Harbor became a primary port of call for provisioning ships in the Islands. Closely following the arrival of the first whaling ships, the first Protestant missionaries and their families arrived in Lāhainā in 1823 (Bingham 1824).<br>10. Foreign commercialism initially came to Waikapū in the form of sugar processing and coffee production (Wyllie 1854). A man by the name of Antone (Anthony) Catalena was running a cane syrup factory at Waikapū ca. 1823 and is credited with being the founder of the industry in Hawai‘i (Thrum 1874) while Antonio Silva set up a plantation and a mill in Waikapū ca. 1828 (Thurston 1906). At about the same time Antonio was also engaged in coffee agriculture with trees that reportedly produced above 20 pounds annually (Wyllie 1854).<br>11. Vestiges of extensive *lo‘i* cultivation, which spread to the north and south from the base of Waikapū to a considerable distance below the valley, remained through the 1930s. Although most of the *lo‘i* terraces in Waikapū had been plowed under by the expansion of commercial sugarcane cultivation, a few of the ancient terraces were preserved in plantation camps and under house sites as well as reused as garden sites, among which, and in addition to Hawaiian wet-taro, included Japanese dry-taro, truck gardens, and lotus for their seeds (Handy et al. 1991:497).<br>12. Ruth Ke‘elikolani, half-sister of Kamehameha V (Lot Kapuāiwa), inherited the *ahupua‘a* of Wailuku from Lot Kapuāiwa on his death in 1872. Ruth Ke‘elikolani then sold a portion of her Wailuku land holdings to the sugar-industrialist Claus Spreckels in 1882. Spreckels subsequently received Land Grant 3343 from King Kalākaua, which consisted of 24,000 acres of the southeastern portion of the Wailuku Ahupua‘a (Zambucka 1977:48). The current project area extends through Land Grant 3343 and Land Grant 3152 to Henry Cornwell. The lands purchased by Cornwell were added to the holdings of the Waikapū Sugar Plantation, originally started by Henry Cornwell and James Louzada on Grant 2951, before the plantation was sold in 1876 (*Pacific Commercial Advertiser* 1879:5).<br>13. In general, it appears the most agriculturally fertile lands of Waikapū Ahupua‘a did not extend beyond the alluvial sediments of the stream valley as the lower elevations leading into the central isthmus of Maui are dominated by windswept Pleistocene sand dune deposits (Foote et al. 1972:48, 115). |

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| | 14. In 1838, the Waikapū Congregational Church was established as a home-based Christian service. During World War II, Waikapū Congregational Church was turned over to the military and used as a surgical hospital. The Church building was used as a ward with an additional “nurses quarters” built off to the side of the main structure. As sugarcane cultivation began to dominate the region in the early to mid-twentieth century, residential dwellings dwindled, as did the attendees of the Waikapū Congregational Church. As full-time pastors became unnecessary, the church members voted to merge with the Kahului Church, and the Waikapū Congregational Church was abandoned to the sugarcane fields that surround it (Head 1960).<br>15. Henry Cornwell arrived on Maui from New York and started the Waikapu Sugar Company with James Louzada (his brother-in law) in 1864. The two partners constructed a steam-powered sugar mill situated on a 17-acre parcel that had been part of Land Grant 2951, land originally purchased by Henry Cornwell and J. Louzada in Waikapū (Wilcox 1996:61).<br>16. In 1876, Henry Cornwell retired, and the remaining plantation lands were sold to the new partners Colonel W.H. Cornwell and Colonel G.W. Macfarlane ( *Honolulu Advertiser* 1903:8). In 1878, Claus Spreckels bought an undivided interest in 12,000 acres of the Waikapū Commons from W.H. Cornwell and leased an additional 24,000 acres of adjacent Wailuku Commons crown lands from the government (Wilcox 1996:61). These lands would form a large portion of Hawaiian Commercial and Sugar Company (HC&S).<br>17. Most of the Waikapu Commons and across the isthmus was covered with sugarcane by the mid-nineteenth century. Waikapu Sugar Company operated from 1862 to 1894, when it was purchased and incorporated into the holdings of Wailuku Sugar Company (Kaukali and Subica 2010).<br>18. In 1862, the partners of the Wailuku Sugar Company grew to include James Robinson & Company, Thomas Cummins, and J. Fuller (Wilcox 1996:122). In 1863, Charles Brewer became a major partner in the operation of the Wailuku Sugar Company. By 1867, the Wailuku Sugar Company had 2,250 acres planted in cane. The Wailuku Sugar Company incorporated in 1875 and began to become profitable. In 1877, the Baileys were bought out (Nellist 1925:70).<br>19. Beginning in 1880, the Waikapū plantation lands began to be merged with those of the Wailuku and Waihe‘e plantations. In 1905, a new sugar mill was constructed in Wailuku to |

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| | accommodate the sugar brought in from the new outlying plantations, including Waikapū (Kaukali and Subica 2010:98).<br>20. Following World War II, buildings erected during reconstruction of Kahului in the 1910s and 1920s slowly gave way to post-war modernization. HC&S Company camp housing for the Kahului Store, including housing along Mill Street and Pu‘unēnē Avenue for stevedores and railroad workers, began to be dismantled. Areas once occupied by the military returned to cattle ranching, pineapple, and sugar cultivation.<br>21. Fifteen archaeological studies were previously conducted within or adjacent to the project area. Four burial sites (State Inventory of Historic Places [SIHP] #s 50-50-04-05966, -05965, -05680, and -08659), a sugarcane flume (-05967), a historic road bed (-5963), cultural material (-08017), and a historic terrace (-06668) were identified within or along the Wai‘ale Road portion of the project area.<br>22. Nine previous cultural studies were conducted within the project area vicinity. The following cultural practices were identified by previous consultants: freshwater and *lā‘au lapa‘au* (traditional Hawaiian herbal medicine) gathering practices, *kalo* (taro; *Colocasia esculenta*) and *‘ulu* (breadfruit; *Artocarpus* altilis) agricultural practices, and burial practices. |
| **Results of Community Consultation** | CSH attempted to contact Native Hawaiian organizations, agencies, and community members as well as cultural and lineal descendants. Community outreach letters were sent to 45 individuals or groups; nine responded, three met with CSH in person, one provided a written testimony, and one of these *kama‘āina* (resident) and/or *kūpuna* (elder) met with CSH for a more in-depth interview.<br><br>A meeting took place with Ms. Carol Lee Kamekona, a member and former President of ‘Ahahui Ka‘ahumanu Chapter IV, Wailuku, a member of Aha Moku o Wailuku, a Board Director and former Treasurer of Mālama Kakanilua, and *kama‘āina*, along with Clare Apana, Ui Hotta and another individual, on 19 January 2024. Per CSH’s standard approach to outreach during the CIA process as described in Section 2.2, this group was provided with a description of the project and maps depicting the location of the project area (see Appendix A) prior to and during the meeting. No comments related to ongoing cultural practices or cultural impacts were received based on the provided information and meeting.<br><br>The written testimony from Mr. Skippy Hau, *kama‘āina* and former Aquatic Biologist for the State of Hawai‘i, Division of Aquatic |

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| | Resources (DAR), has revealed no ongoing cultural practices within the proposed Central Maui WWRF project area. He fully supports the proposed project and his concerns are largely focused on the conditions of other wastewater facilities in the area, such as Kahului and Mā‘alaea.<br><br>The in-depth interview with Dr. Scott Fisher, the Director of ‘Āina Stewardship with the Hawai‘i Island Trust and the Chair of the Maui/Lāna‘i Island Burial Council, revealed there are no ongoing cultural practices within the proposed Central Maui WWRF project area. However, he is concerned with impacts to Waikapū Stream and indirect impacts to Keālia Pond, as well as the possibility of coming across burials. |
| **Identification of Cultural Practices** | Based on the results of community consultation and background research conducted as part of this CIA and Ka Pa‘akai Analysis, CSH has identified no ongoing customary cultural practices in the proposed Central Maui WWRF project area per se. The project area does include Waikapū Stream, a significant cultural, historical, and natural resource utilized, traditionally and presently, for *kalo* cultivation. However, there is no documentation or testimony of *kalo* cultivation being an ongoing traditional practice within the project area. There is archaeological evidence, a historical agricultural terrace (SIHP # -06668), found within the project area where the Wai‘ale Road extension and Waikapū Stream intersect. *Kalo* cultivation is a traditional practice within the project area, but not an ongoing practice.<br><br>Dr. Fisher has mentioned during consultation that there is a high possibility of coming across a burial even though there is currently no road built in the Wai‘ale Road extension portion of the project area and it being agricultural lands. The project area includes undeveloped and heavily vegetated former agricultural lands, utilized for sugarcane cultivation until the end of 2016, at which time the last commercial sugarcane operations on Maui closed. For over a century, the surface soil within most of the project area has been significantly disturbed by plowing and intermixed with imported material to increase the viability of agriculture in the region. Residential housing and retail businesses, with some peripheral developments consisting of light industrial yards, cemeteries, and paved roadways are located along the existing Wai‘ale Road. However, ongoing cultural practices within the project area vicinity include *kalo* and *‘ulu* cultivation along and near Waikapū Stream as well as *lā‘au lapa‘au* gathering practices in Waikapū Valley and along Waikapū Stream. |

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| **Identification of Impacts to Cultural Practices** | No impacts to ongoing cultural practices were identified within the project area during background research and community consultation for this CIA. However, an environmental concern brought up during consultation with Dr. Fisher is the impacts the proposed Central Maui WWRF project will have on Waikapū Stream and indirectly on Keālia Pond. Dr. Fisher has mentioned during consultation that Waikapū Stream and Keālia Pond are areas that could potentially be affected by the extension of Wai‘ale Road. What occurs upstream will affect downstream areas. Keālia Pond is home to many endangered and endemic species in the Hawaiian Islands. If water quality is affected by the construction of extending Wai‘ale Road, it will also negatively impact those species at Keālia Pond. |
| **Mitigation Possibilities Identified During Background Research and Consultation** | The results of community consultation, underscored by background research conducted for this CIA, inform the following mitigation possibilities promoting and preserving cultural beliefs, practices, and resources of Native Hawaiians and other ethnic groups:<br>1. A number of concerns expressed by the community during consultation do not relate specifically to ongoing cultural practices within the project area, but nonetheless should be considered during project planning and development. These concerns include the following:<br>a. Dr. Fisher has suggested a statistical analysis be conducted for the issue of possibly having to reroute the new sewage pipeline along the existing Wai‘ale Road if a burial were to be found. The corridors are very narrow and allow little to no room for changes.<br>2. Dr. Fisher encourages project developers to be very sensitive to burials and identify them beforehand rather than recording them as inadvertent discoveries. Dr. Fisher has recommended a very thorough archaeological inventory survey (AIS) and significant amounts of testing be conducted prior to construction.<br>3. Project construction workers and all other personnel involved in the construction and related activities of the project should be informed of the possibility of inadvertent cultural finds, including human remains. In the event that any potential historic properties are identified during construction activities, all activities will cease and the SHPD will be notified pursuant to HAR §13-280-3. In the event that *iwi kūpuna* (ancestral remains) are identified, all earth moving activities in the area will stop, the area will be cordoned off, and the SHPD and Police Department will be notified pursuant to HAR §13-300-40. In addition, in the event of an inadvertent discovery of human remains, the |

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| | completion of a burial treatment plan, in compliance with HAR §13-300 and HRS §6E-43, is recommended.<br>4. In the event that *iwi kūpuna* and/or cultural finds are encountered during construction, project proponents should consult with cultural and lineal descendants of the area to develop a reinterment plan and cultural preservation plan for proper cultural protocol, curation, and long-term maintenance. |
| **Ka Pa‘akai Analysis** | In Ka Pa‘akai vs Land Use Commission, 94 Hawai‘i (2000) the Court held the following analysis must also be conducted:<br>1. The identity and scope of valued cultural, historical, or natural resources in the petition area, including the extent to which traditional and customary Native Hawaiian rights are exercised in the petition area;<br>2. The extent to which those resources—including traditional and customary Native Hawaiian rights—will be affected or impaired by the proposed action; and<br>3. The feasible action, if any, to be taken by the State to reasonably protect Native Hawaiian Rights if they are found to exist.<br>Based on information gathered from the cultural and historical background, and community consultation for this project, Waikapū Stream and human remains were identified within the project area. Traditionally and presently, Waikapū Stream has been used to cultivate *kalo* and *‘ulu*. Today, many Hawaiian families are returning to Waikapū Ahupua‘a and restoring old *kuleana ‘auwai* (irrigation ditch) and *lo‘i kalo* to revitalize the traditional agricultural practice of *kalo* cultivation. One historic agricultural terrace (SIHP # -06669) was found along Waikapū Stream where the Wai‘ale Road extension portion of the project area and stream intersect. This portion of the project area is within fallow fields of sugarcane and overgrown field access roads. Surrounding this area are agricultural lands. Although no cultural practices were identified within the project area, Waikapū Stream itself is a significant cultural, historical, and natural resource that may possibly be impacted by the proposed project. If Waikapū Stream is impacted by the proposed project, then Keālia Pond will be affected as well. Four burials (SIHP #s -05966, -05965, -05680, and -08659) were also previously identified along the existing Wai‘ale Road portion of the project area. Two were reinterred (SIHP #s -05965 and -05966) and the other two remained in situ with a concrete slab poured over them (SIHP #s -05680 and -08659). Other historic properties within the project area and along Wai‘ale Road included a sugarcane flume (SIHP |

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| | # -05967), a historic roadbed (SIHP # -05963), and cultural material (SIHP # -08017). The focus of concerns is largely impacts on Waikapū Stream and burials. Community consultants have recommended a thorough AIS prior to construction to avoid inadvertently discovering burials within the project area, if there are any. |

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# Section 1 Introduction

## 1.1 Project Description

At the request of Munekiyo Hiraga, on behalf of the County of Maui, Department of Environmental Management (DEM), Cultural Surveys Hawai‘i, Inc. (CSH) is conducting a cultural impact assessment (CIA) and Ka Pa‘akai Analysis for the Central Maui Wastewater Reclamation Facility (WWRF) Project, Waikapū and Wailuku Ahupua‘a, Wailuku District, Maui, TMKs: (2) 3-5-001:017 por. and 120 por.; 3-5-002:014 por., 3-5-020:036 por.; 3-6-002:003 and 004; and 3-8-005:023 por., Wai‘ale Road Right-of-Way (ROW), Kuikahi Drive, Waiko Road ROW, and Waikapū Stream. The project area is depicted on a portion of the 2017 Maalaea and 2017 Wailuku U.S. Geological Survey (USGS) 7.5-minute topographic quadrangles (Figure 1), tax map plats (Figure 3 through Figure 6), and a 2020 aerial photograph (Figure 7).

The project area encompasses approximately 16.83 acres (6.81 hectares) of lands owned by the County of Maui and private landowners (Table 1). The proposed project includes the construction of a new wastewater reclamation facility, termed the Central Maui WWRF; a new wastewater pump station (WWPS), termed the Kehalani WWPS; new sewage pipeline; and a new recycled water (R-1) pipeline (Figure 8 through Figure 10). The Central Maui WWRF will be located within former agricultural lands owned by the County of Maui along Kuihelani Highway. The Kehalani WWPS will be installed within the Wai‘ale Reservoir stormwater detention basin nearest the intersection of Wai‘ale Road and Olomea Street. The new sewage pipeline will connect the Central Maui WWRF and the Kehalani WWPS and will extend along a proposed access easement for the Central Maui WWRF, as well as a portion of the future corridor of the Wai‘ale Road Extension to a connection to the proposed Waikapū Country Town project. The R-1 pipeline will extend west from the Central Maui WWRF along the future access easement to the future corridor of the Wai‘ale Road Extension and a connection to the proposed Waikapū Country Town project along Honoapi‘ilani Highway (Figure 8).

The proposed project will provide wastewater treatment service to the Central Valley area of Maui. The construction of the new Kehalani WWPS and sewage pipeline will divert wastewater from the Wailuku-Kahului WWRF thereby reducing the volume of treated effluent disposal at the facility. The project will also provide recycled water irrigation for non-potable reuse for the proposed Waikapū Country Town project as well as agricultural fields, regional parks, and county facilities in the area (Figure 9). The increased use of recycled water will increase freshwater and raw water resources available for potable and other uses.

A backup wastewater effluent disposal system is required for water reuse and will be accomplished through soil aquifer treatment (SAT) at the new Central Maui WWRF. The proposed facility plan contains four SAT basins, four secondary clarifiers, a headworks station, a dewatering and blower building, effluent pump station and RAS pump station, operations building, and facilities to process activated sludge, R-1 recycled water treatment, and aerobic digesters (Figure 10).

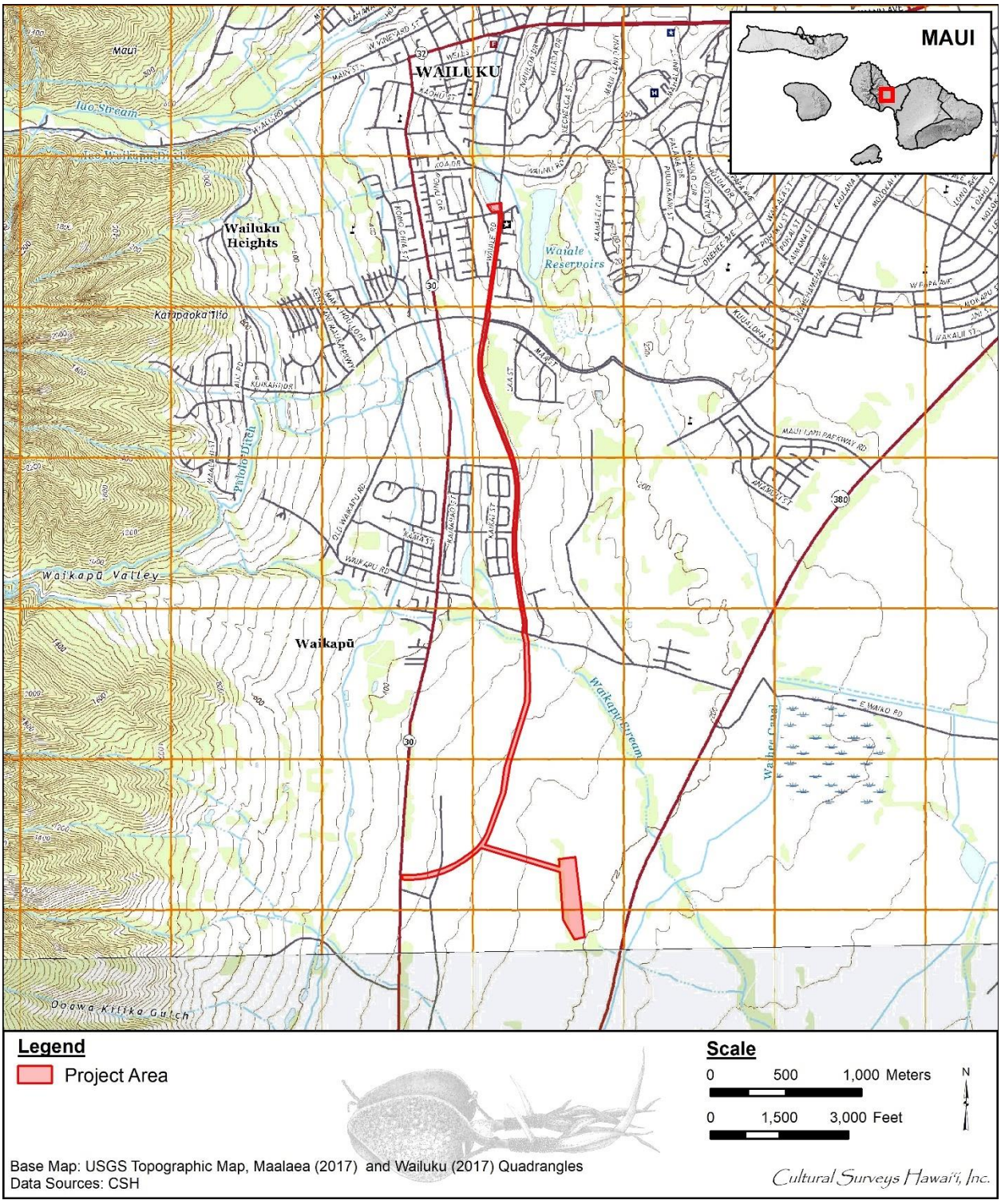



Figure 1. Portions of the 2017 Maalaea and Wailuku USGS 7.5-minute topographic quadrangles showing the location of the project area

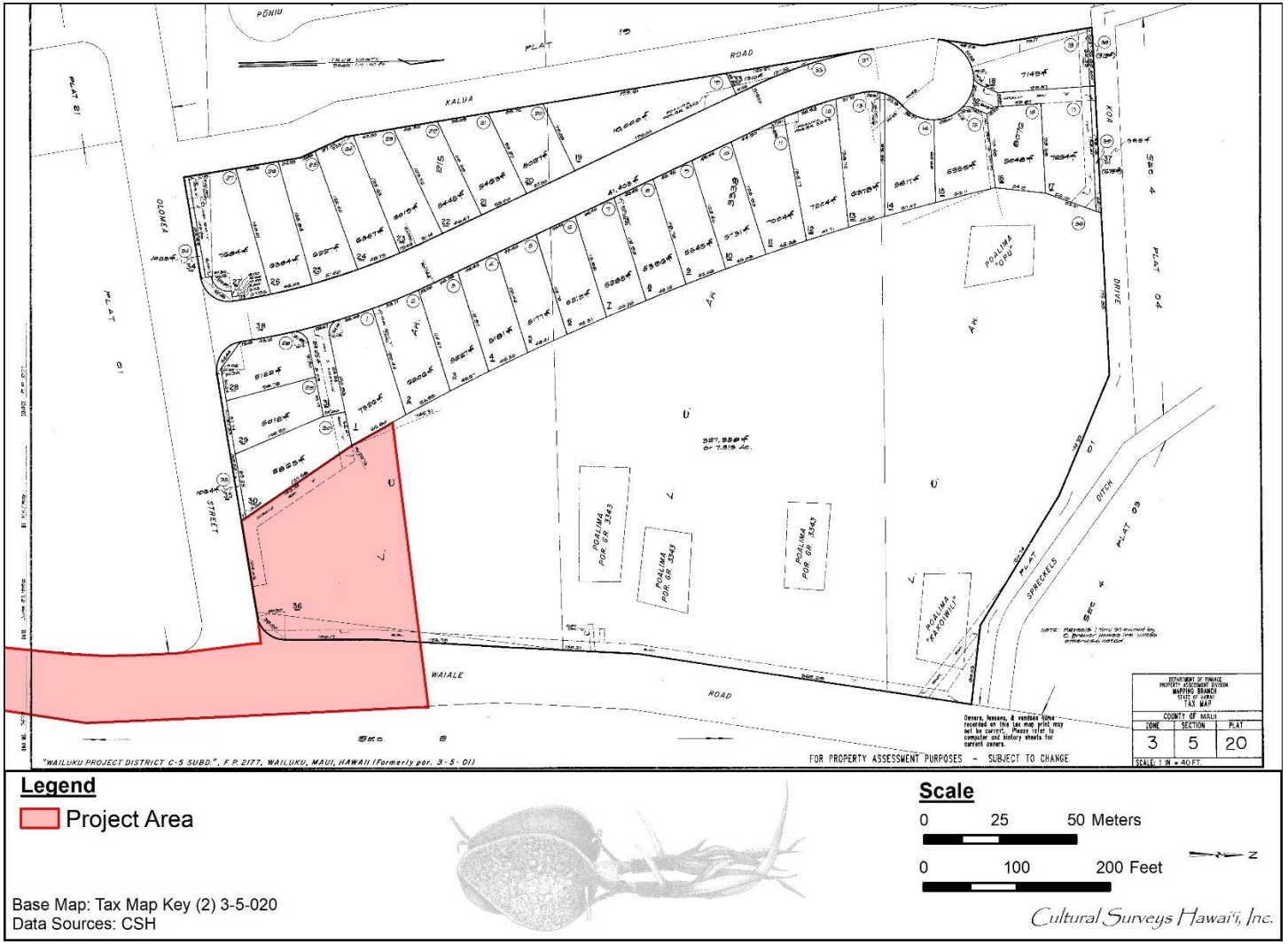



Figure 2. Tax Map Key (TMK) (2) 3-5-020 showing the project area (Hawai‘i TMK Service 2023)

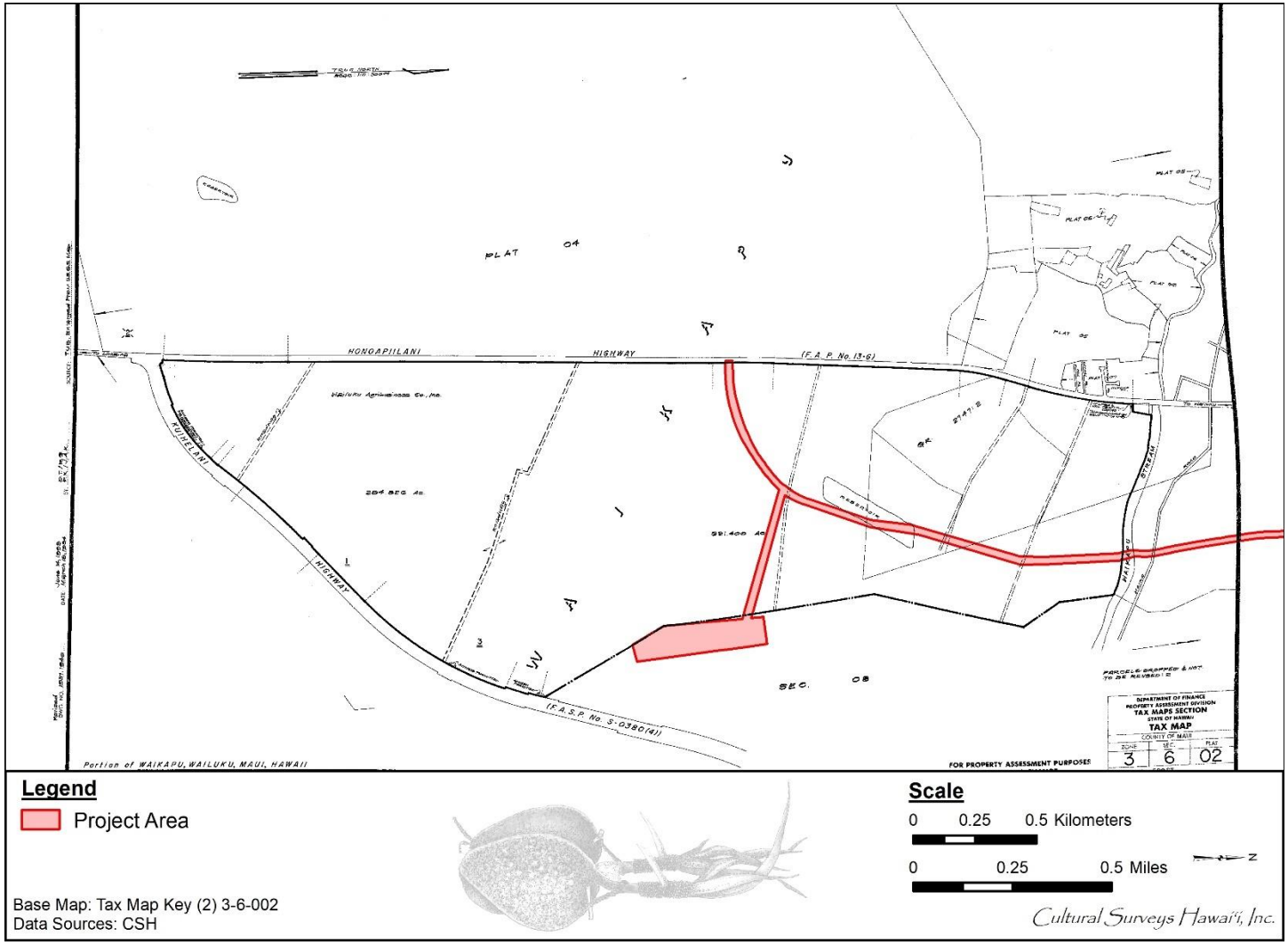



Figure 3. TMK (2) 3-6-002 showing the project area (Hawai‘i TMK Service 2023)

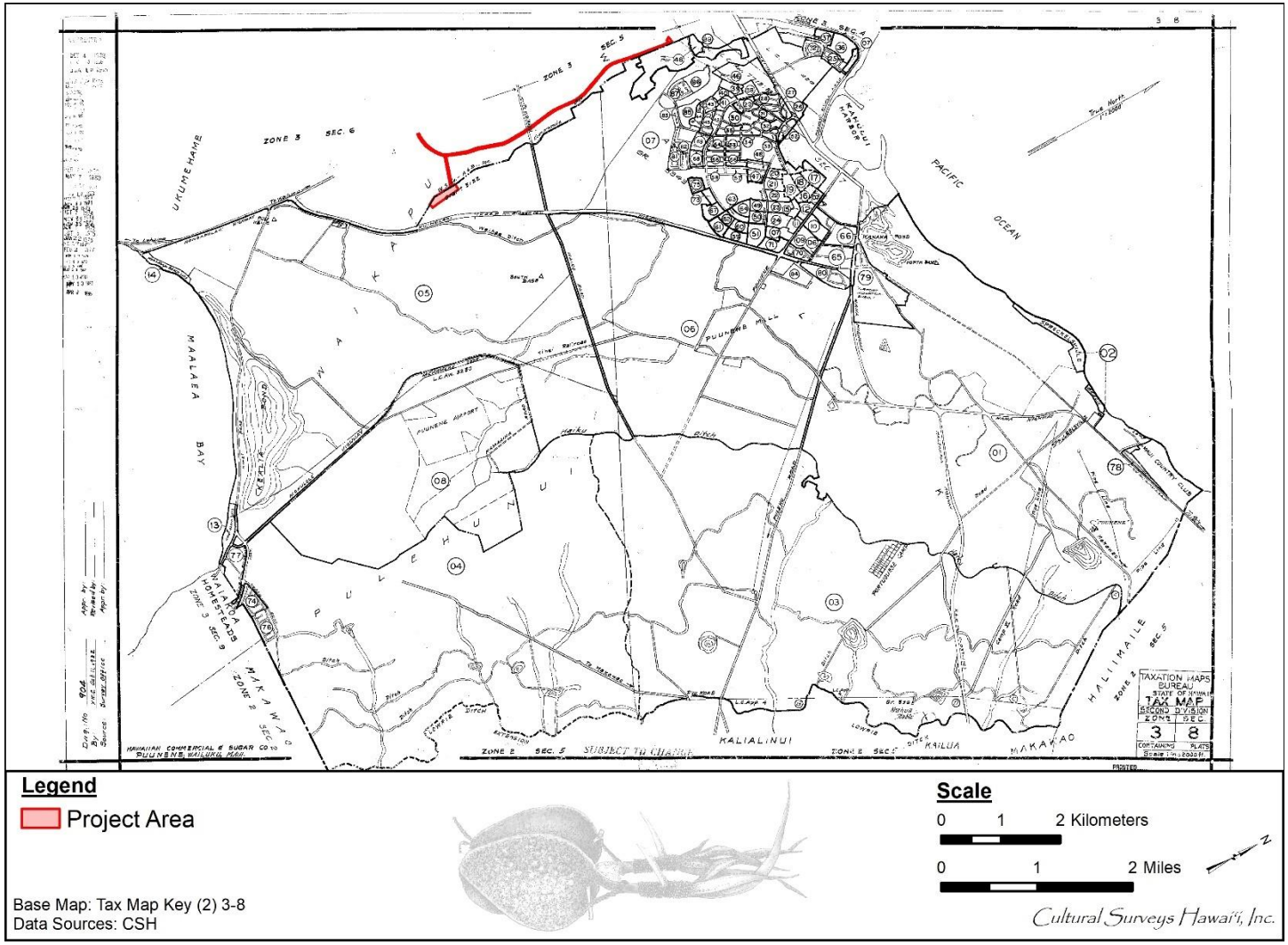



Figure 4. TMK: (2) 3-8 showing the project area (Hawai‘i TMK Service 2023)

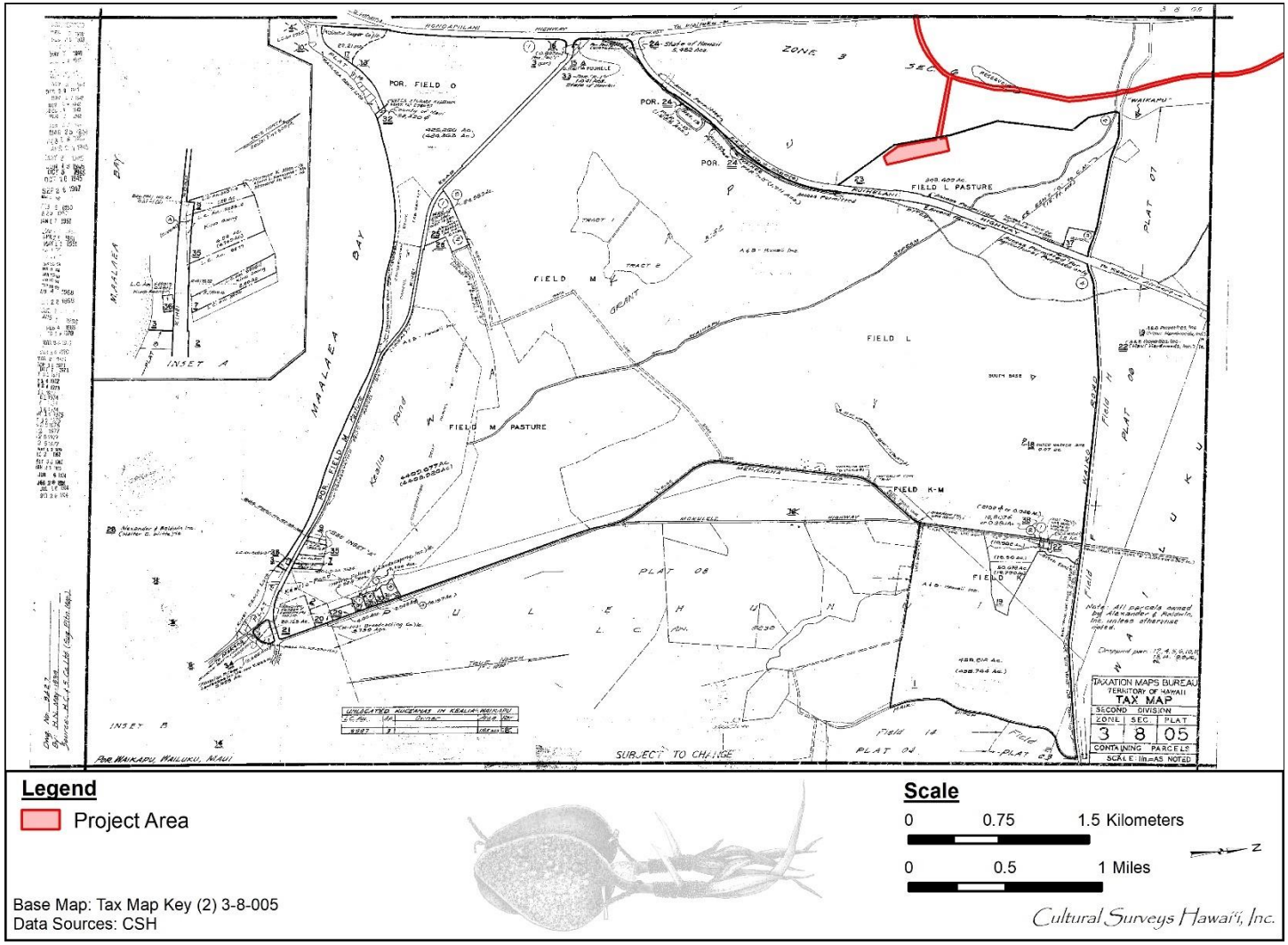



Figure 5. TMK: (2) 3-8-005 showing the project area (Hawai‘i TMK Service 2023)

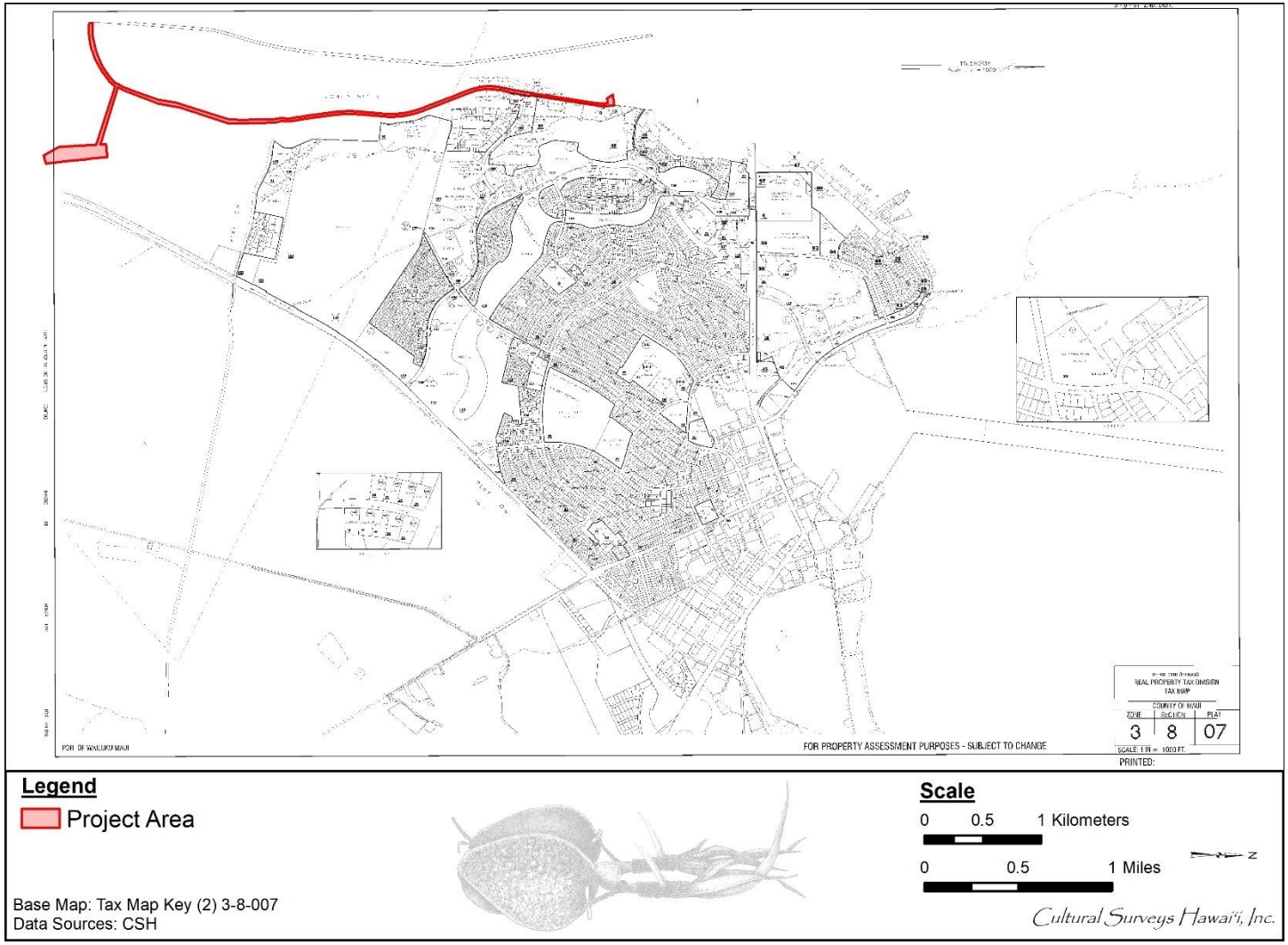



Figure 6. TMK: (2) 3-8-007 showing the project area (Hawai‘i TMK Service 2023)

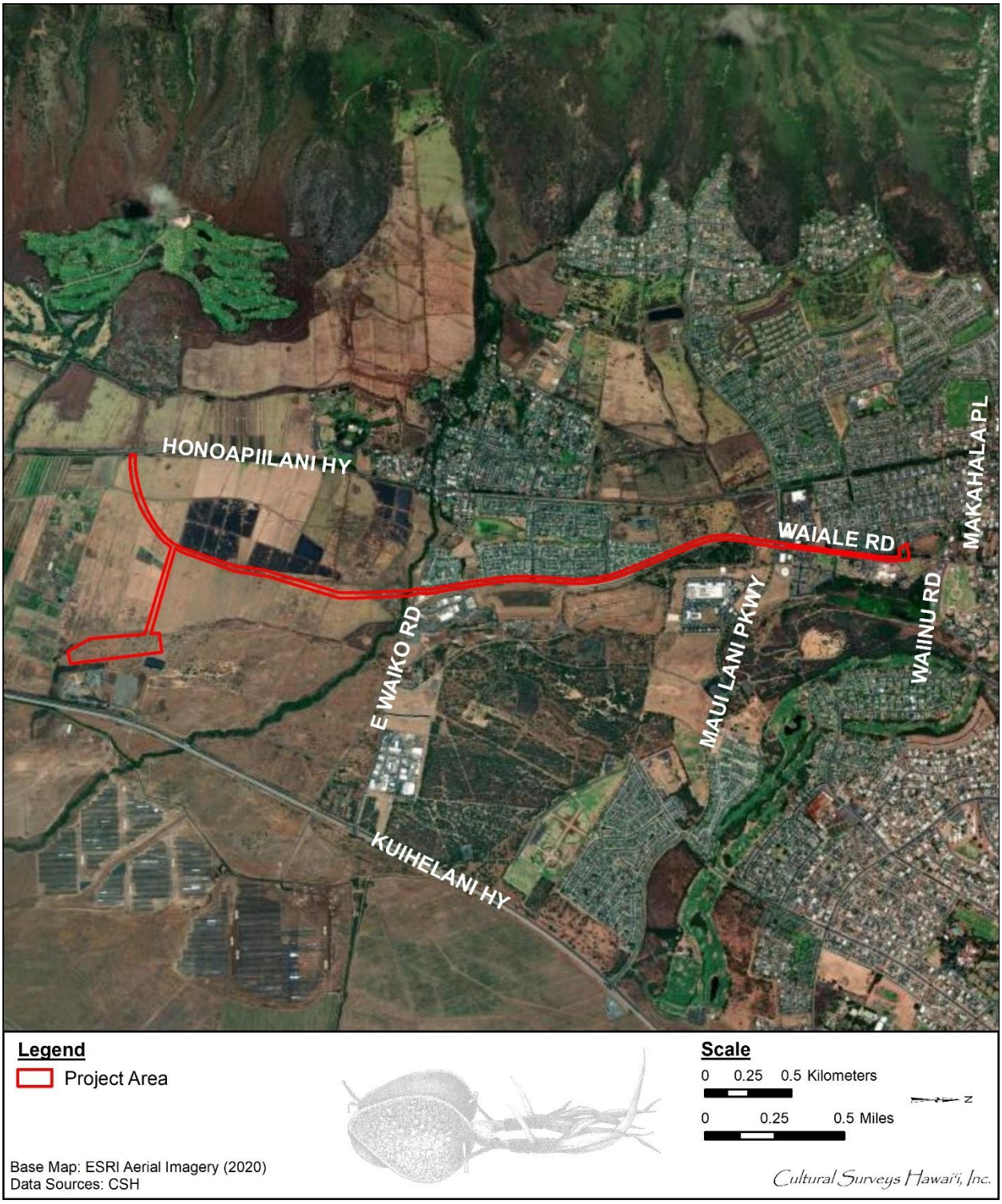



Figure 7. Esri (2020) aerial image showing the location of the project area

Table 1. Project land ownership

| Project Component | Location | Land Ownership | Existing Use |
|---|---|---|---|
| Central Maui WWRF | TMK: (2) 3-8-005:023 por. | County of Maui | Vacant |
| Kehalani WWPS | TMK: (2) 3-5-020:036 | County of Maui | Stormwater basin |
| Force main and R-1 Pipeline | Wai‘ale Rd ROW | County of Maui | Roadway |
| | TMK: (2) 3-5-002:014 | Waiko Baseyard LLC | Vacant |
| | Waikapū Stream; TMK: (2) 3-5-002:888 | Unknown | Stream |
| | Future Wai‘ale Rd extension; TMK: (2) 3-6-002:003 por. | Waiale 905 Partners, LLC | Vacant |
| | Future Wai‘ale Rd extension; TMK: (2) 3-6-002:004 por. | County of Maui | Vacant |
| | TMK: (2) 3-8-005:023 por. | County of Maui | Vacant |

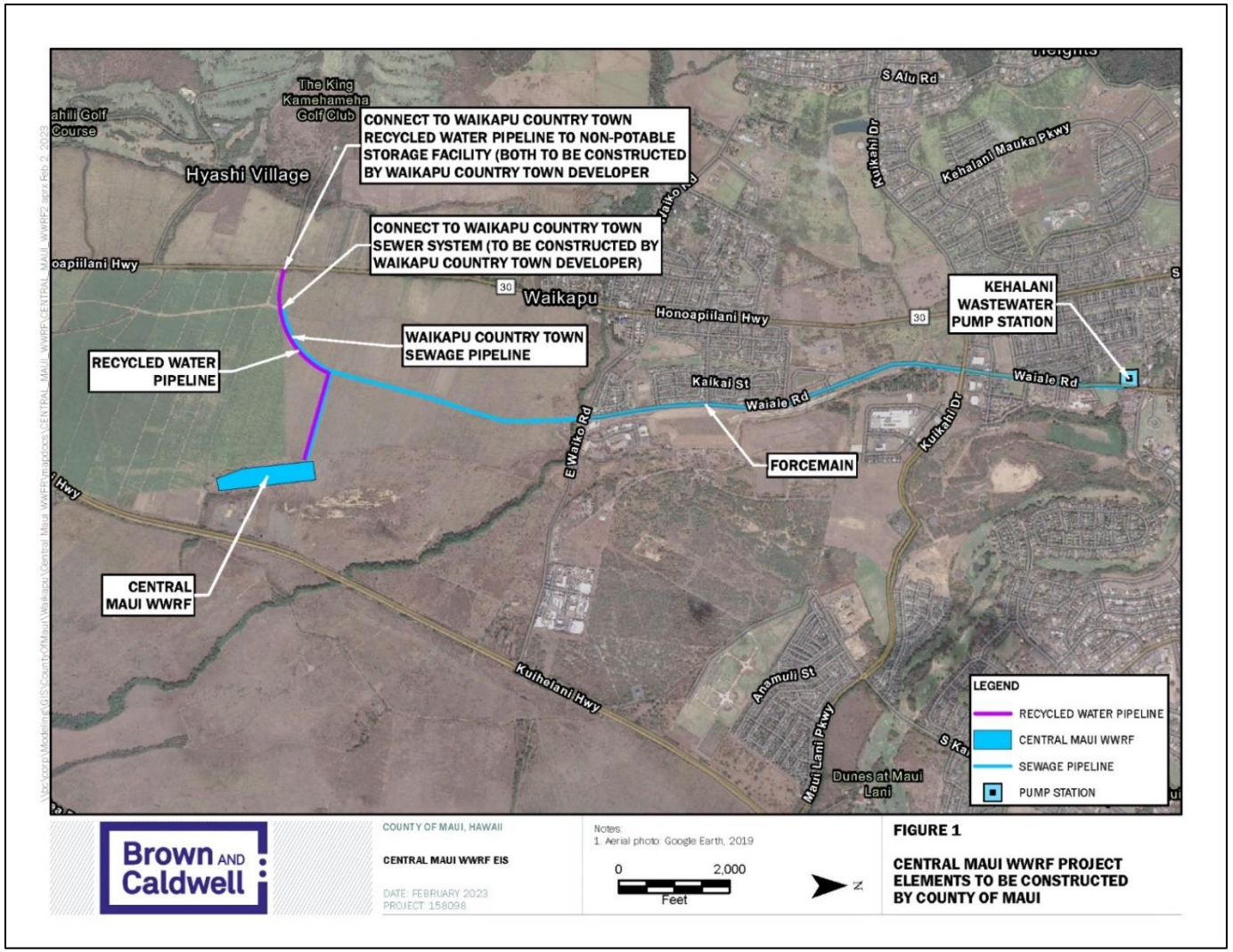



Figure 8. Schematic of the project area to illustrate the Central Maui WWRF elements (courtesy of client)

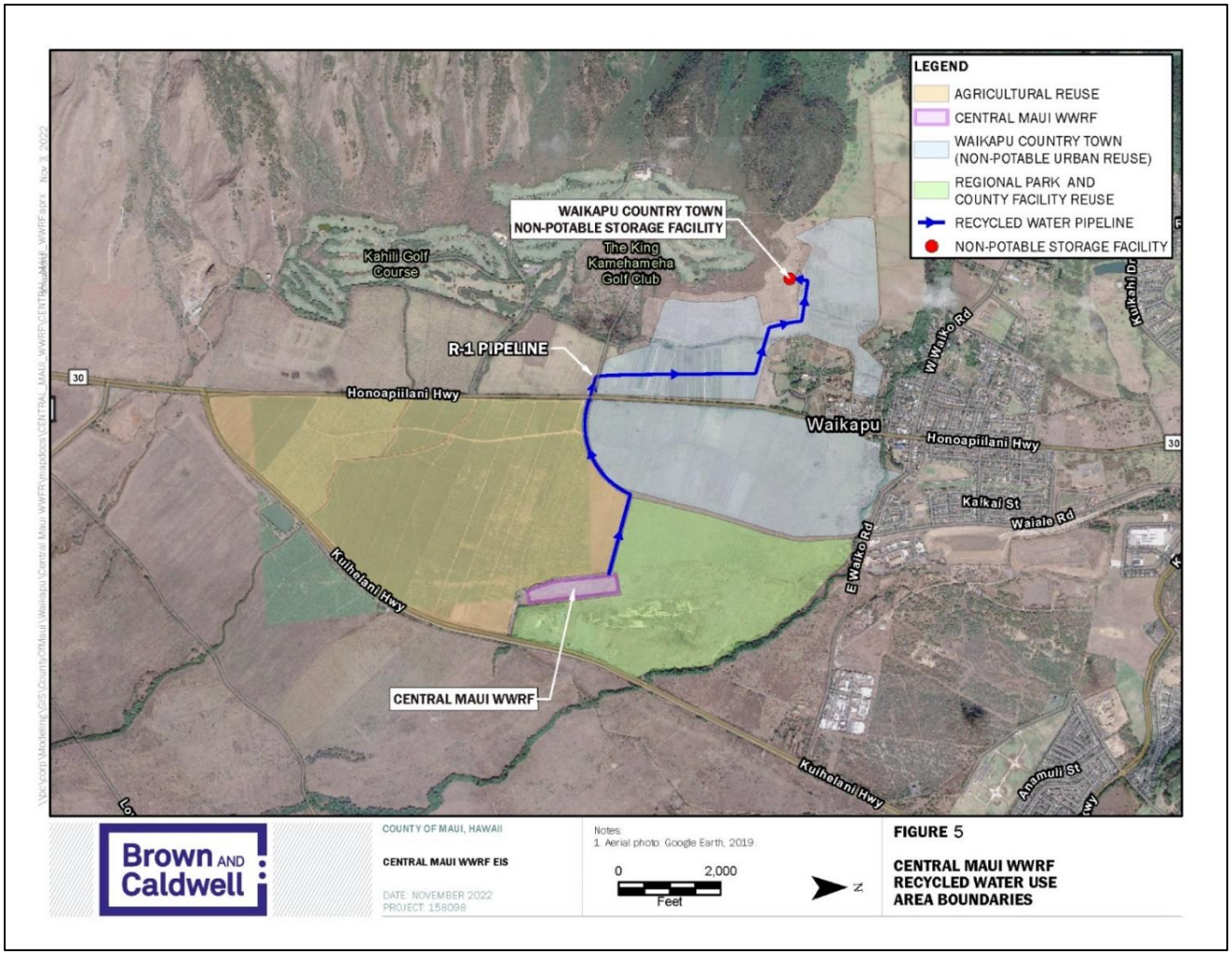



Figure 9. Plan of the Central Maui WWRF showing recycled water use area boundaries (courtesy of client)




Figure 10. Preliminary site plan of the proposed Central Maui WWRF (courtesy of client)

Project ground disturbance for the construction of the new Central Maui WWRF is expected to have a maximum excavation depth of 7.62 m (25 feet [ft]). The construction of the new Kehalani WWPS is expected to have a maximum excavation depth of 6.10 m (20 ft). The sewage pipeline trench along Wai‘ale Road and the future Wai‘ale Road Extension is expected to be 1.22 m (4 ft) wide with an estimated length of 5.18 linear km (17,000 linear ft) and a maximum excavation depth of 4.57 m (15 ft). The R-1 pipeline from the WWRF to the connection point to the Waikapū Country Town R-1 line is estimated to be 3.05 linear km (10,000 linear ft) with a maximum depth of 1.83 m (6 ft). An access and utility easement will be 548.64 m (1,800 ft) long and 30.48 m (100 ft) wide to connect the Central Maui WWRF to the Wai‘ale Road Extension.

## 1.2 Regulatory Context

This CIA supports compliance for the Central Maui WWRF project with:

- The National Historic Preservation Act (NHPA), which requires consideration of a proposed project’s potential impacts to historic properties and resources;
- The mandate set forth by the Hawai‘i State Constitution (Articles IX and XII), courts, Hawai‘i Revised Statutes (HRS), and Hawai‘i Administrative Rules (HAR) and other Hawai‘i State laws requiring government agencies to promote and preserve cultural beliefs, practices, and resources of Native Hawaiians and other ethnic groups;
- The State of Hawai‘i’s environmental review process under HRS §343, which requires consideration of the proposed project’s potential effects on cultural practices and cultural features in order to “promote responsible decision making” (HRS §343); and
- The State of Hawai‘i‘s historic preservation review process under HAR §13-275-6 and §13-284-6, which requires the identification and mitigation of adverse effects proposed by a potential project in order to “promote the use and conservation of historic properties for the education of the citizens of Hawai‘i” (HAR §13-275-6).

## 1.3 Document Purpose

This CIA contains information gathered from archival research and consultation, compiled to “analyze the impact of a proposed action on cultural practices and features associated with the project area” (Office of Environmental Quality 1997). Cultural practices and cultural features may include traditional cultural properties (TCPs), designated significant historic properties under State of Hawai‘i significance Criterion e, pursuant to HAR §13-275-6 and §13-284-6. Significance Criterion e refers to historic properties that “have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with 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” (HAR §13-275-6 and §13-284-6).

This project also includes a Ka Pa‘akai Analysis Study. In *Ka Pa‘akai O Ka ‘Aina v. Land Use Commission*, the Hawai‘i Supreme Court

> [...] articulated an analytical framework to assist state agencies in balancing the State‘s obligation to protect traditional and customary practices against private

property (as well as competing public) interests, by requiring specific findings and conclusions about:

1. the identity and scope of ‘valued cultural, historical, or natural resources’ in the relevant area, including the extent to which traditional and customary native Hawaiian rights are exercised in releveant area;
2. the extent to which those resources—including traditional and customary native Hawaiian rights—will be affected or impaired by the proposed action; and
3. the feasible action, if any, to be taken by the [agency] to reasonably protect native Hawaiian rights if they are found to exist. [Ka Pa‘akai O Ka ‘Aina v. Land Use Comm’n, 94 Hawai‘i 31, 35, 47 and 52–53, 7 P.3d 1068, 1072, 1084 and 1089–90 (2000)]

## 1.4 Scope of Work

The scope of work for this cultural impact assessment includes the following:

1. Examination of cultural and historical resources, including Land Commission documents, historic maps, and previous research reports, with the specific purpose of identifying traditional Hawaiian activities including gathering of plant, animal, and other resources or agricultural pursuits as may be indicated in the historic record.
2. Review of previous archaeological work at and near the subject parcel that may be relevant to reconstructions of traditional land use activities; and to the identification and description of cultural resources, practices, and beliefs associated with the parcel.
3. Consultation and interviews with knowledgeable parties regarding cultural and natural resources and practices at or near the parcel; present and past uses of the parcel; and/or other practices, uses, or traditions associated with the parcel and environs.
4. Preparation of a report that summarizes the results of these research activities and provides recommendations based on findings.

## 1.5 Natural Environment

The project area is located in the isthmus of Central Maui approximately 2.45 km (1.53 miles) from the north shore at Kahului Harbor and 4.21 km (2.62 miles) from the south shore at Mā‘alaea Harbor. The elevation of land within the project area ranges from approximately 60 to 112 m (approximately 197 to 367 ft) above mean sea level. The project area includes undeveloped and heavily vegetated former agricultural lands, utilized for sugarcane cultivation until the end of 2016, at which time the last commercial sugarcane operations on Maui closed.

Waikapū is located at the southern extent of an area known as Wailuku Sandhills, or also the Sand Hills, which is a geologic sand dune formed when the sea level was likely up to 12 m lower than it is today. Windblown sand from large beaches on the northern coast of Maui was deposited inland over most of the western portion of the central isthmus (Macdonald et al. 1983:388). These aeolian dunes partially cover the area’s largest alluvial fan created by Waikapū Stream (Stearns and Macdonald 1942:148). For over a century, the surface soils within most of the project area have been significantly disturbed by plowing and intermixed with imported material to increase the viability of agriculture in the region.

In 2014, the average monthly air temperature for the project area was between 21.5°C (67.2°F) in February and 25.5°C (74.4°F) in August with an average annual air temperature of 23.5°C (74.3°F) (Giambelluca et al. 2014). The vicinity of the project area received a mean annual rainfall of 394.8 mm (15.5 inches) between 1978 and 2007, according to the University of Hawai‘i 2011 *Rainfall Atlas of Hawaii* (Giambelluca et al. 2013). The mean monthly rainfall varied between 2.2 mm (0.08 inches) in June to 101.5 mm (4.00 inches) in January as measured from a Hawaiian Commercial and Sugar Company (HC&S) field station (Field 719) within the project area.

### 1.5.1 *Ka Lepo* (Soils)

According to the U.S. Department of Agriculture (USDA) Soil Survey Geographic (SSURGO) database (USDA 2001) and soil survey data gathered by Foote et al. (1972), soils within the project area are comprised of Jaucas sand, 0 to 15% slopes (JaC) and Puuone sand, 7 to 30% slopes (PZUE) in addition to areas of Ewa silty clay, 0 to 3% slopes (EsA), Ewa silty clay loam, 0 to 3% slopes (EaA), and Ewa cobbly silty clay loam, 3 to 7% slopes (EcA) (Figure 11). The soils along Wai‘ale Road and the extension road primarily consist of alluvial soil types as the topography inclines from the Central Isthmus toward the eastern slope of the West Maui Mountains, or Mauna Kahālāwai. These soils include Iao clay, 3 to 7% slopes (IcB); Iao silty clay, 0 to 3% slopes (IaA); Pulehu clay loam, 0 to 3% slopes (PsA); Pulehu cobbly clay loam, 0 to 3% slopes (PtA); Pulehu silt loam, 0 to 3% slopes (PpA); Pulehu silt loam, 3 to 7% slopes (PpB); and Pulehu cobbly silt loam, 3 to 7% slopes (PrB).

Jaucas sand, 0 to 15% slopes (JaC) is described as follows:

> This series consists of excessively drained, calcareous soils that occur as narrow strips on coastal plains, adjacent to the ocean. These soils occur on all islands of this survey area. They developed in wind- and water-deposited sand from coral and seashells. […] Jaucas soils are geographically associated with Pulehu, Mokuleia, Kaloko, and Lualualei soils.
>
> In many places the surface layer is dark brown as a result of accumulation of organic matter and alluvium. The soil is neutral to moderately alkaline throughout the profile.
>
> Permeability is rapid, and runoff is very slow to slow. The hazard of water erosion is slight, but wind erosion is a severe hazard where vegetation has been removed. The available water capacity is 0.5 to 1.0 inch per foot of soil. In places roots penetrate to a depth of 5 feet or more. Workability is slightly difficult because the soil is loose and lacks stability for use of equipment. [Foote et al. 1972:48]

Puuone sand, 7 to 30% slopes (PZUE) is described as follows:

> This series consists of somewhat excessively drained soils on low uplands on the island of Maui. These soils developed in material derived from coral and seashells.
>
> They are moderately sloping to moderately steep. […] Puuone soils are geographically associated with Iao and Jaucas soils.

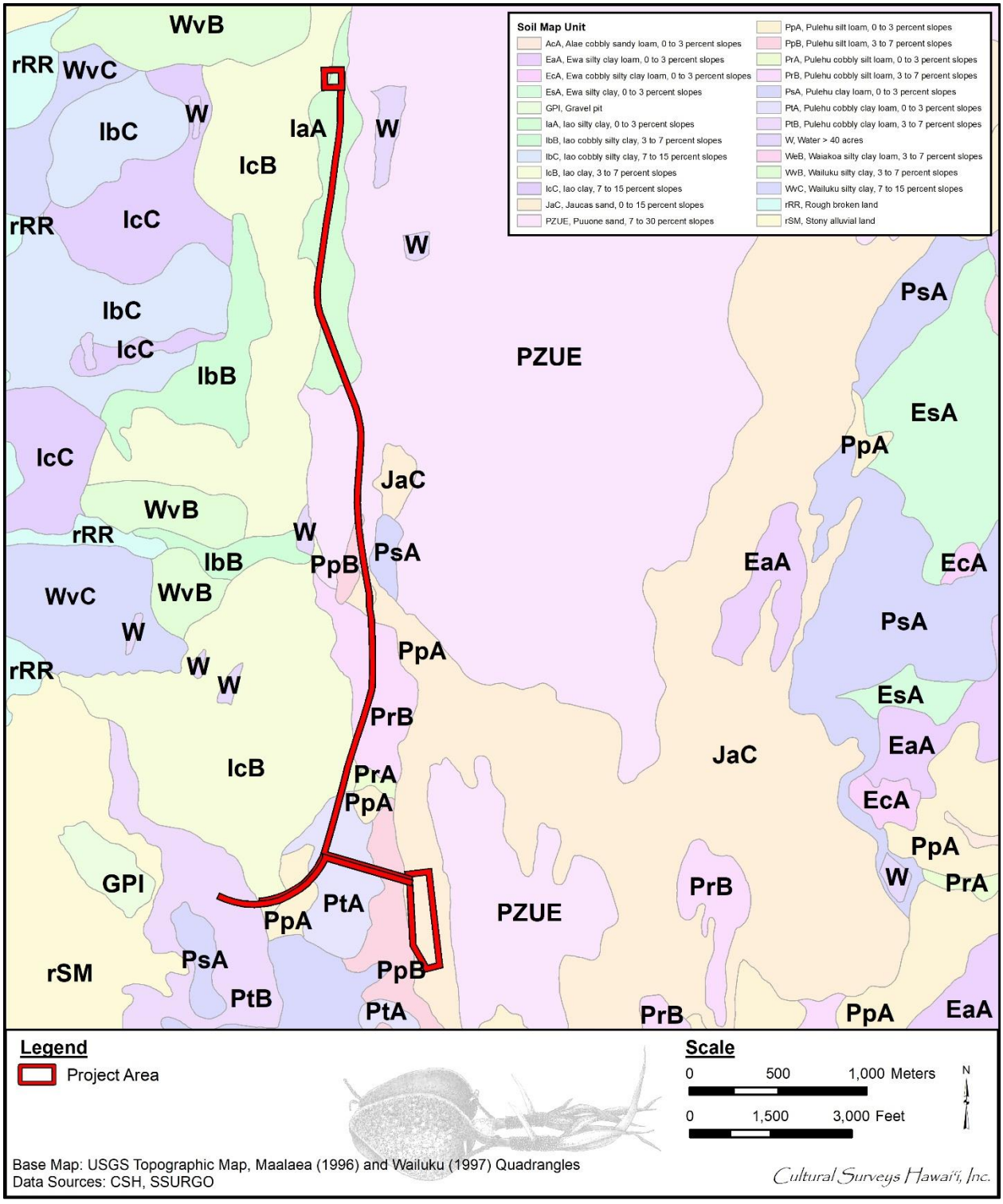



Figure 11. Overlay of *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii*. (Foote et al. 1972), indicating soil types within and surrounding the project area (USDA SSURGO 2001)

> […] This soil is on sandhills near the ocean. Included in mapping were small areas of Iao and Jaucas soils. Also included were small areas where the cemented layer is less than 20 inches below the surface.
>
> In a representative profile the surface layer is grayish-brown, calcareous sand about 20 inches thick. This is underlain by grayish-brown, cemented sand. The soil is moderately alkaline in the surface layer.
>
> Permeability is rapid above the cemented layer. Runoff is slow, and the hazard of wind erosion is moderate to severe. The available water capacity is about 0.7 inches per foot in the surface layer and subsoil. In places roots penetrate to the cemented layer. [Foote et al. 1972:117]

The Ewa Series soils are described as follows:

> This series consists of well-drained soils in basins and on alluvial fans on the islands of Maui and Oahu. These soils developed in alluvium derived from basic igneous rock. They are nearly level to moderately sloping. Elevations range from near sea level to 150 feet. The annual rainfall amounts to 10 to 30 inches. Most of it occurs between November and April. The mean annual soil temperature is 73° F. Ewa soils are geographically associated with Honouliuli, Mamala, Molokai, Pulehu, and Waiakoa soils.
>
> These soils are used for sugarcane, truck crops, and pasture. The natural vegetation consists of fingergrass, kiawe, koa haole, klu, and uhaloa. (Foote et al. 1972:29) […]
>
> **Ewa silty clay loam, 0 to 3 percent slopes** (EaA).—On this soil, runoff is very slow and the erosion hazard is no more than slight. In a few places small, gently sloping areas were included in mapping.
>
> This soil is used for sugarcane and homesites. (Capability classification I if irrigated IVc if nonirrigated; sugarcane group 1; pineapple group 1; pasture group 2) […]
>
> **Ewa cobbly silty clay loam, 0 to 3 percent slopes.** (EcA) — This soil has a profile like that of Ewa silty clay loam, 3 to 6 percent slopes, except that it is cobbly on the surface. Runoff is very slow, and the erosion hazard is no more than slight.
>
> Most of this soil is used for sugarcane. A small acreage is used for pasture. (Capability classification IIs if irrigated, IVs if nonirrigated; sugarcane group 1; pasture group 2) […]
>
> **Ewa silty clay, 0 to 3 percent slopes** (EsA)—This soil has a profile like that of Ewa silty clay loam, 3 to 6 percent slopes, except for the texture of the surface layer. Runoff is very slow, and the erosion hazard is no more than slight.
>
> This soil is used for sugarcane. (Capability classification I if irrigated, IVc if nonirrigated; sugarcane group 1 ; pineapple group 1; pasture group 2) [Foote et al. 1972:29–30]

The Iao Series soils are described as follows:

This series consists of well-drained soils on valley fill and alluvial fans. These soils developed in alluvium derived from basic igneous rock. They are nearly level to moderately sloping. Elevations range from 100 to 500 feet. The rainfall amounts to 25 to 40 inches. The mean annual soil temperature is 74° F. Iao soils are geographically associated with Paia, Pulehu, and Wailuku soils.

These soils are used for sugarcane. Small acreages are used for pastures and homesites. The natural vegetation consists of bermudagrass, feather fingergrass, koa haole, lantana, and Natal redtop.

**Iao clay, 3 to 7 percent slopes** (IcB) —This soil is on smooth alluvial fans and valley fill. Included in mapping were small areas of Paia and Wailuku soils. Also included were small, nearly level areas.

In a representative profile the surface layer is dark-brown clay about 15 inches thick. The subsoil, about 45 inches thick, is very dark brown, dark-brown, and very dark grayish-brown clay and silty clay. The substratum is clayey alluvium. The soil is neutral in the surface layer and subsoil.

Permeability is moderately slow. Runoff is medium, and the erosion hazard is slight to moderate. The available water capacity is about 1.7 inches per foot in the surface layer and subsoil. In places roots penetrate to a depth of 5 feet or more. [Foote et al. 1972:46]

[…]

**Iao silty clay, 0 to 3 percent slopes** (IaA)—On this soil, runoff is slow and the erosion hazard is no more than slight.

This soil is used for sugarcane. (Capability classification I if irrigated, IIIc if nonirrigated; sugarcane group 1; pasture group 3) [Foote et al. 1972:46–47]

The Pulehu series soils are described as follows:

This series consists of well-drained soils on alluvial fans and stream terraces and in basins. […] They developed in alluvium washed from basic igneous rock. The soils are nearly level to moderately sloping. Elevations range from nearly sea level to 300 feet. […]

The soils are used for sugarcane, truck crops, pasture, homesites, and wildlife habitat. The natural vegetation consists of bermudagrass, bristly foxtail, fingergrass, kiawe, klu, lantana, koa haole, and sandbur.

**Pulehu clay loam, 0 to 3 percent slopes** (PsA). —This soil is on alluvial fans and stream terraces and in basins. Included in mapping were small areas of Ewa, Mala, and Waialua soils. Also included were small areas of gravelly, stony, and gently sloping soils.

In a representative profile the surface layer is dark-brown clay loam about 21 inches thick. This is underlain by dark-brown, dark grayish-brown, and brown, massive and single grain, stratified loam, loamy sand, fine sandy loam, and silt loam about

> 39 inches thick. Below this is coarse, gravelly or sandy alluvium. The soil is neutral in the surface layer and neutral to mildly alkaline below the surface layer.
>
> Permeability is moderate. Runoff is slow, and the erosion hazard is no more than slight. The available water capacity is about 1.4 inches per foot in the surface layer and subsoil. In places roots penetrate to a depth of 5 feet or more. Low areas are subject to flooding. […]
>
> **Pulehu cobbly clay loam, 0 to 3 percent slopes** (PtA). —This soil is similar to Pulehu clay loam, 0 to 3 percent slopes, except that it is cobbly.
>
> This soil is used for sugarcane. Small acreages are used for pasture. (Capability classification IIs if irrigated, IVs if nonirrigated; sugarcane group 1; pasture group 2) […]
>
> **Pulehu silt loam, 0 to 3 percent slopes** (PpA)—This soil is similar to Pulehu clay loam, 0 to 3 percent slopes, except that the texture is silt loam. This soil is used for sugarcane. Small acreages are used for homesites. (Capability classification I if irrigated, IVc if nonirrigated; sugarcane group 1; pasture group 2)
>
> **Pulehu silt loam, 3 to 7 percent slopes** (PpB)—This soil is similar to Pulehu clay loam, 0 to 3 percent slopes, except that the texture is silt loam. Runoff is slow, and the erosion hazard is slight. Included in mapping were small areas underlain by coral sand at a depth of 20 to 36 inches.
>
> This soil is used for sugarcane. (Capability classification IIe if irrigated, IVc if nonirrrgated; sugarcane group 1; pasture group 2) […]
>
> **Pulehu cobbly silt loam, 3 to 7 percent slopes** (PrB).—This soil is similar to Pulehu clay loam, 0 to 3 percent slopes, except that the texture is silt loam, and the surface layer is cobbly. Runoff is slow, and the erosion hazard is slight. Included in mapping were small areas underlain by coral sand at a depth of 20 to 36 inches.
>
> This soil is used for sugarcane. Small areas are used for pasture. (Capability classification IIe if irrigated, IVs if nonirrrgated; sugarcane group 1; pasture group 2). [Foote et al. 1972:116]

### 1.5.2 *Nā Makani* (Winds)

For Native Hawaiians, *makani* (wind) were named for various reasons. Names of winds were assigned based on but not limited to their direction, strength, and geographic location. David Malo, a Native Hawaiian historian, explains some general terms related to wind:

> […] There was the *kona*, a wind from the south, of great violence and of wide extent. It affected all sides of an island, east, west, north, and south, and continued for many days […] The *kona* wind often brings rain, though sometimes it is rainless. […] The *hoolua*, a wind that blows from the north, sometimes brings rain and sometimes is rainless […] The *hau* is a wind from the mountains, and they are thought to be the cause of it, because this wind invariably blows from the mountains outwards towards the circumference of the island. [Malo 1951:14]

Malo has supplied a foundation of names for winds, however, there is an abundance of names in various stories and chants. In the traditional story *The Wind Gourd of La‘amaomao*, Pāka‘a and his son Kūapāka‘a are descendants of the wind goddess La‘amaomao whose traditional home was in a gourd that contained all of the winds of Hawai‘i. They could control the winds of Hawai‘i contained in the gourd by chanting their names. Pāka‘a’s chant traces the winds of Maui in the *moku* of Wailuku. The wind of Waikapū is Kololio and the wind of Wailuku is I‘a iki (Nakuina 1992:63). They are presented in Pāka‘a’s chant as follows:

| | |
|---|---|
| *Kololio mai o Waikapu,* | Kololio is of Waikapū, |
| *He i‘a iki ko Wailuku,* | I‘a iki is of Wailuku, |
| *He oopu ko Waihee,* | ‘O‘opu is of Waihe‘e, |
| *Pa ka makani Kauaula,* | The Kaua‘ula wind blows, |

[Nakuina 1992:63, 68]

Additionally, four winds of the Wailuku Moku are also recounted in Sterling (1998) by an informant who relates:

> Wailuku’s wind is the Makani-lawe-malie, the wind that takes it easy.
>
> Waiehu’s wind is the Makani-hoo‘eha-ili, the wind that hurts the skin.
>
> Waikapu’s wind is the Makani-ko-kololio, the gusty wind.
>
> Waihee’s wind is the Makani-kili-‘o‘opu.
>
> [Sterling 1998:62]

#### 1.5.2.1 Maui Vortex

Pāka‘a’s wind chant recognizes an upwardly circulating wind pattern in the following lines: “*He pelu ka makani no kai, He kupa he okea ka makani”* which translates to “The wind that doubles up is of the lowlands, Kupa and Okea are the winds” (Nakuina 1902:69; Nakuina 1992:63). In the iteration of the chant found in Sterling (1998:7), *okea* is written as *okee*, meaning, “To veer, as the wind, to change, as direction; to eddy” (Pukui and Elbert 1986:281).

The Maui Vortex is a diurnal weather pattern, dissipating in the evening when the slopes of Haleakalā cool. It was modelled in 1949 by Luna Leopold, Chief Meteorologist at the Pineapple Research Institute (Leopold 1949), and again in 1966 by the National Weather Service (Peterson 1966).

### 1.5.3 *Nā Ua* (Rains)

Precipitation is a major component of the water cycle and is responsible for depositing *wai* (fresh water) on local flora. Pre-Contact *kānaka* (Native Hawaiians) recognized two distinct annual seasons. The first, known as *kau* (period of time, especially summer) lasts typically from May to October and is a season marked by a high-sun period corresponding to warmer temperatures and steady trade winds. The second season, *ho‘oilo* (winter, rainy season) continues through the end of the year from November to April and is a much cooler period when trade winds are less frequent, and widespread storms and rainfall become more common (Giambelluca et al. 1986:17). Each

small geographic area on Maui had a Hawaiian name for its own rains. According to Akana and Gonzalez (2015):

> Rain names are a precious legacy from our kūpuna who were keen observers of the world around them and who had a nuanced understanding of the forces of nature. They knew that one place could have several types of rain, each distinct from the other. They knew when a particular rain would fall, its color, its duration, its intensity, its path, its sound, its scent, and its effect on the land and their lives […] Rain names are a treasure of cultural, historical, and environmental information. [Akana and Gonzalez 2015:n.p.]

There were many recognized rains in the *moku* of Wailuku, but the Kili‘o‘opu rain was specifically associated with Waikapū and the larger Wailuku district (Akana and Gonzalez 2015:84). Hō‘eha‘ili, ‘Ulalena, and Uhiwai are rains closely associated with Wailuku and are mentioned in the following excerpts.

#### 1.5.3.1 Hō‘eha‘ili Rain

The Hō‘eha‘ili rain is associated with Waiehu, Maui, the neighbor to Wailuku. It is mentioned below in a *kanikau* (lamentation) for Hawaiian scholar, Joseph Nāwahīokalani‘ōpu‘u.

*He aloha, he lihaliha, he kūmākena*

*He ‘ū iā ‘oe*

*E Hon. Iosepa Kaho‘oluhi Nāwahīokalani‘ōpu‘u*

*A ha‘o ē!*

*I uē ‘ia mai nei ‘oe e Nā Wai ‘Ehā*

*E ka makani Kili‘o‘opu o Waihe‘e*

*Ka ua Hō‘eha‘ili o Waiehu*

Translation:

Loving, heartsick, grief-stricken

Mourning for you

O Hon. Joseph Nāwahīokalani‘ōpu‘u

We shall truly miss you!

You have been mourned by the lands of the four waters

By the Kili‘o‘opu wind of Waihe‘e

And the Hō‘eha‘ili rain of Waiehu

[Akana and Gonzalez 2015:37]

#### 1.5.3.2 Kili‘o‘opu Rain

The Kili‘o‘opu rain is associated exclusively with Wailuku, Maui. The two *mele* (song) below, a *mele kanikau* and *mele ‘āina* or song of the land, both mention the Kili‘o‘opu rain.

*Ku‘u kāne mai ka ua Kili‘o‘opu o Waihe‘e*

*‘Au‘au ka ‘uhane i ka wai o Nī‘aukawa*

Translation:

My dear husband from the Kili‘o‘opu rain of Waihe‘e

The spirit bathes in the water of Nī‘aukawa

[Akana and Gonzalez 2015:83]

The *mele ‘āina* titled Nani Lahaina mentions the Kili‘o‘opu of Wailuku.

*He loa Pu‘ukoa‘e*

*He pāpā‘olelo na ka makani*

*Makani lū ‘ino i nā lehua o Kaukini*

*Polipoli Pūlehu i ka ua Kili‘o‘opu o Waihe‘e*

*Me ka ua nā māmala ‘ino a ka wai*

Translation:

Expansive is Pu‘ukoa‘e

A conversation held by the wind

Wind that violently scatters the lehua blossoms of Kaukini

Pūlehu is polished by the Kili‘o‘opu of Waihe‘e

With the rain come hard strokes of the water

[Akana and Gonzalez 2015:83]

#### 1.5.3.3 ‘Ulalena Rain

The ‘Ulalena rain was mentioned briefly in a *mele māka‘ika‘i* (travel chant) for Queen ‘Emalani Kaleleonālani. The song mentions Kama‘oma‘o, the great plain believed to be the place where spirits wander.

*Pau ‘ole ko‘u mahalo i ka laulā o Kama‘oma‘o*

*Ka hālana maika‘i a Keālia*

*Ka hemolele o ka ua ‘Ulalena*

*Lena ka pua o ka māmane pala luhiehu i ka lā*

Translation:

My admiration is endless for the expanse of Kama‘oma‘o

The fine rising of the waters of Keālia

The perfection of the ‘Ulalena rain

Yellow are the blossoms of the māmane, soft and lovely in the sun

[Akana and Gonzalez 2015:267]

#### 1.5.3.4 Uhiwai Mist

The Uhiwai is a heavy fog that means “water covering” (Akana and Gonzalez 2015:254) and is closely associated with ‘Īao. The following proverb mentions this mist of ‘Īao.

*Nae iki ‘Īao i ka uhiwai.*

Translation:

(Mount) ‘Īao is barely breathing in the heavy mist.

[Akana and Gonzalez 2015:255]

### 1.5.4 *Nā Kahawai* (Streams and Freshwater)

Waikapū Stream is one of four major deep-valley streams (Waikapū, Wailuku, Wai‘ehu, and Waihe‘e) which comprise the *‘okana* known as the “Nā Wai ‘Ehā” (Handy et al. 1991:469; Moffat and Fitzpatrick 1995:23). Handy et al. (1991:496) describe Waikapū Stream as a land-bound stream whose water was “utilized for irrigating a great acreage of sugar cane” and was “formerly was diverted into lo‘i and its overflow was dissipated on the dry plains of the broad isthmus between West and East Maui.”

The streams of Wailuku include the perennial ‘Īao Stream also known as Wailuku River. Handy and Handy (1972) describe Wailuku River saying, “Wailuku is partly landbound, but its stream flows into Kahului Bay, which has been eroded by the ocean out of what was formerly the stream mouth” (Handy and Handy 1972:496). Wailuku River drains from the heights of the western Maui uplands through the deep gorges of ‘Īao Valley Tributaries that flow into Wailuku River including Nākalaloa, Po‘onāhoahoa, Kinihāpai, and Ae streams.

### 1.5.5 *Ka Lihikai a me Ka Moana* (the Coast and Ocean)

The location of Maui in the chain of the Hawaiian Islands has it surrounded by four other islands. To the east is the island of Hawai‘i, south is Kaho‘olawe, southwest is Lana‘i, and O‘ahu is to the west. The short distance to the other islands allows ease of access to and from the island. The Pailolo (meaning lift and shift; Pukui et al. 1974:175) Channel separates Moloka‘i and Maui at a distance of 8 miles. The ‘Au‘au (meaning to bathe; Pukui et al. 1974:14) Channel is between Lana‘i and Maui at 8 miles apart; ‘Alalākeiki (meaning child’s wail; Pukui et al. 1974:9) separates Kaho‘olawe and Maui at 7 miles; and ‘Alenuihāhā (meaning great billows smashing; Pukui et al. 1974:10) separates Maui and Hawai‘i at 26 miles (Walker 1931:5).

## 1.6 Built Environment

The built environment of the project area includes areas of residential housing and retail businesses, with some peripheral developments consisting of light industrial yards, cemeteries, and paved roadways along the existing Wai‘ale Road. The Wai‘ale Road Extension and new WWRF are within fallow fields of sugarcane and overgrown field access roads. Any structures within those portions primarily relate to commercial agriculture and/or water control infrastructure.

# Section 2 Methods

## 2.1 Archival Research

Research centers on Hawaiian activities including *ka‘ao* (legends), *wahi pana* (storied places), *‘ōlelo no‘eau* (proverbs), *oli* (chants), *mele*, traditional *mo‘olelo* (stories), traditional subsistence and gathering methods, ritual and ceremonial practices, and more. Background research focuses on land transformation, development, and population changes beginning with the early post-Contact era to the present day.

Cultural documents, primary and secondary cultural and historical sources, historic maps, and photographs were reviewed for information pertaining to the study area. Research was primarily conducted at the CSH library. Other archives and libraries including the Hawai‘i State Archives, the Bishop Museum Archives, the University of Hawai‘i at Mānoa’s Hamilton Library, Ulukau, The Hawaiian Electronic Library (Ulukau 2014), the State Historic Preservation Division (SHPD) Library, the State of Hawai‘i Land Survey Division, the Hawaiian Historical Society, and the Hawaiian Mission Houses Historic Site and Archives are also repositories where CSH cultural researchers gather information. Information on Land Commission Awards (LCAs) were accessed via Waihona ‘Aina Corporation’s Māhele database (Waihona ‘Aina 2023), the Office of Hawaiian Affairs (OHA) Papakilo Database (Office of Hawaiian Affairs 2015), and the Ava Konohiki Ancestral Visions of ‘Āina website (Ava Konohiki 2015).

## 2.2 Consultation

Throughout the course of this assessment, an effort was made to contact and consult with Native Hawaiian Organizations (NHO), agencies, and community members including descendants of the area, in order to identify individuals with cultural expertise and/or knowledge of the *ahupua‘a* of Waikapū and Wailuku

### 2.2.1 Scoping for Participants

We begin our consultation efforts by utilizing our in-house contact list from previous outreach efforts to facilitate the interview process. This list often includes *kupuna* (elders), *kama‘āina* (native born), cultural practitioners, lineal and cultural descendants, Native Hawaiian Organizations (NHOs; includes Hawaiian Civic Clubs and those listed on the Department of Interior’s NHO list), and community groups. We also contact agencies such as SHPD, OHA, and the appropriate Island Burial Council where the proposed project is located for their response to the project and to identify lineal and cultural descendants, individuals and/or NHO with cultural expertise and/or knowledge of the study area. CSH is also open to referrals and new contacts.

### 2.2.2 Talk Story Sessions

Prior to the interview, CSH cultural researchers explain the role of a CIA, how the consent process works, the project purpose, the intent of the study, and how their *‘ike* (insight) and *mana‘o* (opinion) will be used in the report. The interviewee is given an Authorization and Release Form to read and sign.

“Talk Story” sessions range from the formal (e.g., sit down and *kūkākūkā* [consultation, discussion] in participant’s choice of place over set interview questions) to the informal (e.g., hiking to cultural sites near the study area and asking questions based on findings during the field outing). In some cases, interviews are recorded and transcribed later.

CSH also conducts group interviews, which range in size. Group interviews usually begin with set, formal questions. As the group interview progresses, questions are based on interviewee’s answers. Group interviews are always transcribed and notes are taken. Recorded interviews assist the cultural researcher in 1) conveying accurate information for interview summaries, 2) reducing misinterpretation, and 3) providing missing details for *mo‘olelo*.

CSH seeks *kōkua* (assistance) and guidance in identifying past and current traditional cultural practices of the study area. Those aspects include general history of the *ahupua‘a*; past and present land use of the study area; knowledge of cultural sites (for example, *wahi pana*, archaeological sites, and burials); knowledge of traditional gathering practices (past and present) within the study area; cultural associations (*ka‘ao* and *mo‘olelo*); referrals; and any other cultural concerns the community might have related to Hawaiian cultural practices within or in the vicinity of the study area.

### 2.2.3 Interview Completion

After an interview, CSH cultural researchers transcribe and create an interview summary based on information provided by the interviewee. Cultural researchers give a copy of the transcription and interview summary to the interviewee for review and ask them to make any necessary edits. Once the interviewee has made those edits, we incorporate their *‘ike* and *mana‘o* into the report. When the draft report is submitted to the client, cultural researchers then prepare a finalized packet of the participant’s transcription, interview summary, and any photos taken during the interview. We also include a thank you card and honoraria. This is for the interviewee’s records.

It is important for CSH cultural researchers to cultivate and maintain community relationships. The CIA report may be completed, but CSH researchers continuously keep in touch with the community and interviewees throughout the year—such as checking in to say hello via email or by phone, volunteering with past interviewees on community service projects, and sending holiday cards to them and their *‘ohana* (family). CSH researchers feel this is an important component to building relationships and being part of an *‘ohana* and community.

“*I ulu no ka lālā i ke kumu*—the branches grow because of the trunk,” an *‘ōlelo no‘eau* (#1261) shared by Mary Kawena Pukui with the simple explanation: “Without our ancestors we would not be here” (Pukui 1983:137). As cultural researchers, we often lose our *kūpuna* but we do not lose their wisdom and words. We routinely check obituaries and gather information from other informants if we have lost our *kūpuna*. CSH makes it a point to reach out to the *‘ohana* of our fallen *kūpuna* and pay our respects including sending all past transcriptions, interview summaries, and photos for families to have on file for genealogical and historical reference.

# Section 3 Traditional Background

## 3.1 Subsistence and Settlement Patterns

In ancient times, Waikapū and Wailuku were agriculturally abundant lands known for their extensive *lo‘i* (irrigated taro plots) (Handy et al. 1991:497). In an excerpt from C.T. Cheever (in Sterling 1998:75) the remnants of the pre-Contact cultivation of ‘Īao Valley in Wailuku is described,

> As you get into the valley and vega of Wailuku, you see numerous remains of old kihapais, or cultivated lots, and divisions of land now waste, showing how much more extensive formerly was the cultivation, and proportionately numerous the people, than now […]
>
> The whole valley of Wailuku, cultivated terrace after terrace, gleaming with running waters and standing pools, is a spectacle of uncommon beauty to one that has a position a little above it. [C.T. Cheevers in Sterling 1998:75]

Similar observations were made regarding the deep valley of Waikapū, lying immediately southwest of the paramount valley of the West Maui range in Wailuku. Writing his observations from long after the period of active *lo‘i* cultivation, E.S.C. Handy observed,

> Spreading north and south from the base of Waikapu to a considerable distance below the valley are the vestiges of extensive wet plantations, now almost obliterated by sugar cane cultivation; a few here and there are preserved in plantation camps and under house garden sites along the roads. […] Far on the north side, just above the main road and at least half a mile below the entrance to the canyon, an extensive truck garden on old terrace ground shows the large area and the distance below and away from the valley that was anciently developed in terraced taro culture. On the south side there are likewise several sizeable kuleana where terraces are now used for truck gardening. [E.S.C. Handy in Sterling 1998:94]

Though there has been some speculation on the establishment of small fishing settlements with cultivation of sweet potatoes in the sandy soil or red *lepo* (dirt) near the shore, E.S.C. Handy stated that:

> […] From Waihee to Waikapu there is much good land below and bounding the ancient terrace area on the *kula* and in the lower valleys which would be ideal for sweet potato culture, but it is said that little was grown in this section because there was so much taro. [Sterling 1998:63]

## 3.2 *Nā Ka‘ao a me Nā Mo‘olelo* (Legends and Stories)

Hawaiian storytellers of old were greatly honored; they were a major source of entertainment and their stories contained teachings while interweaving elements of Hawaiian lifestyles, genealogy, history, relationships, arts, and the natural environment (Pukui and Green 1995:IX).

According to Pukui and Green (1995), storytelling is better heard than read for much is lost in the transfer from the spoken to the written word and *ka‘ao* are often full of *kaona* or double meanings.

*Ka‘ao* are defined by Pukui and Elbert as a “legend, tale […], romance, [and/or], fiction” (Pukui and Elbert 1986:108). *Ka‘ao* may be thought of as oral literature or legends, often fictional or mythic in origin, and have been “consciously composed to tickle the fancy rather than to inform the mind as to supposed events” (Beckwith 1970:1). Conversely, Pukui and Elbert define *mo‘olelo* as a “story, tale, myth, history, [and/or] tradition” (Pukui and Elbert 1986:254). The *mo‘olelo* are generally traditional stories about the gods, historic figures or stories that cover historic events and locate the events with known places. *Mo‘olelo* are often intimately connected to a tangible place or space.

In differentiating *ka‘ao* and *mo‘olelo* it may be useful to think of *ka‘ao* as expressly delving into the *wao akua* (realm of the gods), discussing the exploits of *akua* (gods) in a primordial time. However, it is also necessary to note there are exceptions, and not all *ka‘ao* discuss gods of an ancient past. *Mo‘olelo* on the other hand, reference a host of characters from *ali‘i* (royalty), to *akua* and *kupua* (supernatural beings), to finally *maka‘āinana* (commoners), and discuss their varied and complex interactions within the *wao kānaka* (realm of man). Beckwith elaborates, “In reality, the distinction between ka‘ao as fiction and mo‘olelo as fact cannot be pressed too closely. It is rather in the intention than in the fact” (Beckwith 1970:1). Thus, a so-called *mo‘olelo*, which may be enlivened by fantastic adventures of *kupua*, “nevertheless corresponds with the Hawaiian view of the relation between nature and man” (Beckwith 1970:1).

Both *ka‘ao* and *mo‘olelo* provide important insight into a specific geographical area, adding to a rich fabric of traditional knowledge. The preservation and passing on of these stories through oration remain a highly valued tradition. Additionally, oral traditions associated with the study area communicate the intrinsic value and meaning of a place, specifically its meaning to both *kama‘āina* as well as others who also value that place.

The following section presents traditional accounts of ancient Hawaiians living in the vicinity of the Central Maui WWRF project area. Many relate an age of mythical characters whose epic adventures inadvertently lead to the Hawaiian race of *ali‘i* and *maka‘āinana.* The *ka‘ao* in and around the project area shared below are some of the oldest Hawaiian stories that have survived; they still speak to the characteristics and environment of the area and its people.

### 3.2.1 Hi‘iaka in Wailuku

An early legend surrounding the naming of Wailuku comes from the legend of Hi‘iaka, sister of the volcano goddess Pele, as she travelled through the Hawaiian Islands. When Hi‘iaka’s companion, Wahine‘ōma‘o complains of hunger during their travels along a *kaha* (hot dry shore) portion of northern Maui, Hi‘iaka offers a chant of supplication for nourishment from the local residents. Hi‘iaka and Wahine‘ōma‘o were met with little hospitality after their appeal for food was largely ignored by the area’s residents (Emerson 1993:74). Hi‘iaka then offered another chant making “known her wish, concluding her appeal with ominous threats against the life of the king, in case her demands were not met” (Emerson 1993:75). A portion of this chant reads:

| | |
|---|---|
| *Haki kepakepa na moku;* | What wailing and beating of breast! |
| *Pa‘iauma ka aina;* | Wild anguish of child and of ghost |

| | |
|---|---|
| *Uwē kamali‘i, uwē ka hanehane —* | O‘er the sandy plain of Kama‘o. |
| *Ke uwē la i ka pili,* | The districts are frenzied with grief |
| *I ke kula o Ka-ma‘o-ma‘o;* | Tearing of hair and breaking of teeth |
| *Ka‘a kumakena o Maui, e!* | One wail that lifts to heaven. |
| *la wai Maui?* | Who shall be heir to this Maui land? |
| | [Emerson 1993:75–76] |

### 3.2.2 Lepeamoa

In the legend of Lepeamoa, Wailuku was the name of a chiefess, the wife of Mauinui, chief of Maui, and sister of Kākuhihewa, chief of O‘ahu. In the *mo‘olelo*, Mauinui challenges Kākuhihewa to a cockfight where the winner receives all property and the life of the opponent. With the assistance of two demi-gods, Lepeamoa and Kauilani, Kākuhihewa is victorious. Following his victory, Kākuhihewa refuses to take Mauinui’s life and peace between the two kingdoms is established (Westervelt 1963:204–245).

### 3.2.3 Luahinepi‘i

‘Īao Valley is the subject of a number of *ka‘ao* and *mo‘olelo*. One legend tells of a woman named Luahinepi‘i who came to her end after jumping from Kūkaemoku, the 2,250-ft peak also known as the ‘Īao Needle. The story of Luahinepi‘i is recounted in Sterling (1998):

> At the base of this noble perpetual sentinel to Iao Canyons [Kukaemoku = ‘Iao Needle] lived, a few centuries ago, a most beautiful maiden. Her figure and form was so near perfection that a Raphael or a Michael Angelo might have selected her for a model representing a Hawaiian Venus. Her name was Luahinepii (climbing old woman), a name most unsuitable to a maiden so beautifully fair. She possessed, however, a voice so unpleasant and hideous that other maidens, jealous of her unsurpassed natural beauty, made fun of her.
>
> Luahinepii had a lover who lived at the beach near Paukukalo. Other maidens looked upon him as a possible suitor, but like all true lovers he turned a deaf ear to their entreaties.
>
> The rival belles met and agreed to circulate a report to this wise: ‘Ua lohe- ia ko leo kapu e ko ipo i Moealoha’ (Your sacred voice has been heard by your lover at Lover’s-dream). This soon reached the ear of Luahinepii. She felt deeply these to her, most humiliating words. In her frantic moments she sought to end her life and to free herself from the cares and woes of this deceptive world […] Luahinepii scaled to the top of Kukaemoku, called Nanahoa, and from its dizzy height dashed herself headlong to the valley beneath, and the waters of Iao were made incarnadine with her blood. [Sterling 1998:83]

### 3.2.4 Puapualenalena and Kiha-Pū

Puapualenalena was a famous dog *kupua*, or demi-god, who was noted as a great thief and runner who could take the shape of a yellow dog to provide for his master, one such thing being the famous *pū* (conch shell) called Kiha-pū (Beckwith 1970:349). While there are variations on the story that place the *pū* and Pupualenalena’s recovery of the object at Waipio Valley on Hawai‘i

Island (Beckwith 1970:350–351), an article published in *Ka Nupepa Kuokoa* during the latter part of the nineteenth century places the *pū* in a cave of Waikapū Valley, thus contributing to the origin of the place name Waikapū. The following is a portion of the tradition as printed in original Hawaiian language account, as well as the translation:

> *O Waikapu e oleloia nei, he wahi pana no ia i kapaia e kekahi poe o ka wa kahiko, a laha loa mai a hiki i keia wa, mamuli o keia inoa. O keia wahi no hoi o Waikapu, he wahi ana ia aia iloko lilo o ke kahawai, ua mile paha a oi aku ka loa mai ke kulanakauhale aku. Aia ma ka aoao hema o ua kahawai nei, he ana, a iloko o ua ana nei he pu, a e kani mau ana oia i na wa a pau me ka ike ole ia e ka lehulehu, a he makaula nae no Kauai ka mea nana i hoolohe mai i ke kani o ua pu nei, a ua imi mai oia me ka manao e loaa. Aia hoi ma ka aoao hikina akau o ua kahawai la, mai kahi aku o ka pu e kani nei, a aia hoi maluna ae o ka pali, he ilio, o Puapualenalena kona inoa, a no kona lohe no hoi i ke kani o ua pu nei, ua imi ikaika oia i kahi e loaa ai, aohe nae he loaa iki, oiai ua makaala loa na mea nana ua pu nei ma ke kiai ana, aka, ua hoomau no nae ua ilio nei ma ka hoomakaulii ana i wahi e loaa ai.*
>
> *A no ka manao paha o uamau mea nei nana ka mea kani, aohe kupua e lilo ai o ka laua milimili, nolaila, ua hoao laua ma ka hoohemahema liilii ana, aohe nae he lilo. Aka, iloko nae o ka la i lilo ai ia Pupualenalena, ua palaka loa laua ma ka hoomanao ana. A no ka lilo ana o ua pu nei ia Pupualenalena, mai laila mai ke kani ole ana a hiki i keia la. Ua lohe ia kona leo ma na wahi a pau o keia mau mokupuni, a ua lilo ia i mea hoouluhua i ka manao o kekahi poe. A no keia pu mai i kapaia ai ka inoa holookoa o Waikapu. Oia iho la ka moolelo no kahi i loaa mai ai keia inoa. He wahi makaikai nui ia no hoi keia e na malihini e makemake ana e ike.*
>
> *No Waikapu holookoa.—He maikai no ka noho ana o ka aina; eia nae, ua hapa ka ulu nui ana o na mea kanu, no ka uuku o ka wai, i ka ua mea he nui o ka wela o ka la i keia mau la. Ua maloo na loi kalo, nakakaka ka lepo. O ka mahiko o Waikapu nei, aohe no he maloo o ke ko, no ke kamau iki no o kahi wai, a ke maloo uuku mai nei nae ma ke kauwahi.*
>
> [...]
>
> *W.K. KAUALILILEHUA.*
>
> *Maui, Sept 13, 1872*
>
> Translation:
>
> Waikapū is the place being mentioned, it is a legendary place that was named by some people of ancient times, and is known as such until present day. This place is Waikapū, a place located near a stream, about a mile or more from town, south of the stream, there is a cave, and in the cave was a conch shell, and every time it’s blown, no ordinary person sees where the sound was coming from. A prophet from Kaua‘i is the one that heard this sound, and he searched for it thinking he was going to find it. On the northeast side of the stream, from the place where the pū is blown,

> on a cliff is a dog, Puapualenalena, and because he heard the sound of the pū, he searched effortlessly for it, however was not able to find it since the guardian of the pū guarded it carefully, but the dog continued, eagerly searching to find the place. Because of their (Kaua‘i prophet and Pupualenalena) ideas, the guardian (blower of the pū) believed that no demigod would be able to take it. Therefore the guardian of the pū began to neglect his responsibility, while the dog continued to search. As the day went on, it was taken by Pupualenalena. The guardian was very neglectful of his responsibility. And because it was taken by Pupualenalena, there has been no sound from this pū until today. Its sound was heard throughout all the islands, and became frustrating for some people. And from this pū, came the name in its entirety, Waikapū. That is the story of where this place got its name. This is a big touring place for people who want to see/know.
>
> For the entire place of Waikapū – it is a good place to live; however, only a portion can be used to farm because of limited amount of water and the heat of the sun these days. The taro patches became dry, and the dirt cracked. As for the Waikapū farmers, there is no sugarcane due to dryness, because of little continuance of water, the dryness continues slowly.
>
> [...]
>
> W.K. KAUALILILEHUA.
>
> Maui, Sept 13, 1872
>
> [translated by Cori-Ann Lorenzo; Kaualililehua 1872]

### 3.2.5 Pu‘uokamoa and ‘Īao

Pu‘uokamoa was a half-man, half-fish god, who fell in love with ‘Īao, the beautiful daughter of the demi-god Māui. Pu‘uokamoa lived in a pool near ‘Īao’s home. After becoming suspicious of ‘Iao’s frequent absences from home, Maui asked a *kahuna* (priest) to discover the truth. According to legend, when Māui learned his daughter was in love with Pu‘uokamoa, he became angry and captured Pu‘uokamoa and planned to burn him to death. The volcano goddess, Pele, a friend of Pu‘uokamoa, convinced Māui not to burn him but instead transformed him into a pillar of stone which is now known as the ‘Īao Needle (Denham et al. 1992:9).

### 3.2.6 The Owls of Kama‘oma‘o

Ke Kula o Kama‘oma‘o, or the Plains of Kama‘oma‘o, is cited as a home to owl deities, considered one of the oldest *‘aumakua* (personal family gods) in Hawaiian mythology. The endemic *pueo* (Hawaiian short-eared owl; *Asio flammeus sandwichensis*) was once worshiped by early Hawaiians as a god (Titcomb and Gagne 1976). Pueo-nui-akea was the name of an owl who traversed the Plains of Kama‘oma‘o and restored life to wandering souls (Beckwith 1970:124).

Fornander recalls the story of Pūmai‘a who was a heroic young man that fell to the hands of a spirit (Fornander 1918-1919:6:550–554). This spirit, Pu‘ukolea, had a dual body, capable of shape-shifting in ways the mere human, Pūmai‘a, could not. After falling to Pu‘ukolea, Pūmai‘a’s spirit returned home but continued to be chased by Pu‘ukolea. Pūmai‘a fled till he reached the plains of

Kama‘oma‘o. There an owl by the name of Pueonuiokona began battling Pu‘ukolea and ultimately killed him; his entrails were scattered about the plains.

### 3.2.7 The Wicked Chief, Hua

Wailuku is known as the death place of the Maui chief Hua. According to the *mo‘olelo*, Hua was a wicked chief who condemned his *kahuna* to death. In retaliation, the *kahuna* brought a severe drought to the islands. Fornander wrote,

> Hua, the chief, lived on, and because of the lack of water and food he sailed for Hawaii, the home of his elder brother; but because Hawaii also suffered from lack of water and food he came back and lived at Wailuku. Wailuku also did not have any water, and that caused the chief to be crazed, so he leaned against the edge of the precipice and died, and that was the origin of the saying ‘The bones of Hua rattle in the sun.’ [Fornander 1918-1919:5:516]

## 3.3 *Nā Wahi Pana* (Storied Places)

*Wahi pana* are legendary or storied places in a landscape. These legendary or storied places can be a variety of natural or human-constructed features. Oftentimes dating to the pre-Contact period, many but not all *wahi pana* are connected to particular *mo‘olelo*. Dr. Davianna McGregor outlines the types of natural and human-made structures that may constitute *wahi pana*:

> Natural places have mana or spiritual power, and are sacred because of the presence of the gods, the akua, and the ancestral guardian spirits, the ‘aumakua. Human-made structures for the Hawaiian religion and family religious practices are also sacred. These structures and places include temples, and shrines, or heiau, for war, peace, agriculture, fishing, healing, and the like; pu‘uhonua, places of refuge and sanctuaries for healing and rebirth; agricultural sites and sites of food production such as the lo‘i pond fields and terraces slopes, ‘auwai irrigation ditches, and the fishponds; and special function sites such as trails, salt pans, hōlua slides, quarries, petroglyphs, gaming sites, and canoe landings. [McGregor 1996:22]

As McGregor makes clear, *wahi pana* can refer to natural geographic locations such as streams, peaks, rock formations, ridges, offshore islands and reefs, or they can refer to Hawaiian land divisions such as *ahupua‘a* or *‘ili* (a land division within an *ahupua‘a*), and man-made structures such as fishponds. In this way, the *wahi pana* of Wailuku and Waikapū tangibly link the *kama‘āina* to their past. It is common for places and landscape features to have multiple names, some of which may only be known to certain *‘ohana* (family) or even certain individuals within an *‘ohana*, and many have been lost, forgotten, or kept secret through time. Place names also convey *kaona* and *huna* (secret) information that may even have political or subversive undertones. Before the introduction of writing to the Hawaiian Islands, cultural information was exclusively preserved and perpetuated orally. Hawaiians gave names to literally everything in their environment, including individual garden plots and *‘auwai* (water channel), house sites, intangible phenomena such as meteorological and atmospheric effects, *pōhaku* (stone), *pūnāwai* (freshwater spring), and many others. According to Landgraf (1994), Hawaiian *wahi pana* “physically and poetically describes an area while revealing its historical or legendary significance” (Landgraf 1994:v).

In the preface of *Place Names of Hawaii* (Pukui et al. 1974:x), Samuel Elbert states that

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

Inherent in the statements of Elbert is the knowledge that the oldest place names held meaning and told the story of an area prior to European Contact. Literal translations of place names for land areas and divisions near the project corridor are listed in Table 2 below and may provide some insight into what this area was like prior to Western Contact. Unless otherwise noted, translations are by Pukui et al. (1974) and the Ulukau electronic library (Ulukau 2014), Hawaiian place name database, and Soehren (2014), with references cited in text.

Table 2. Meanings of place names in the vicinity of Wailuku and Waikapū

| **Name** | **Translation** |
|---|---|
| Ahuakolea (*‘Ili*) | *Lit*., “plover’s hill” (Thrum 1922:625); note *‘ili* is a land division within an *ahupua‘a* |
| Aikanaha (*‘Ili*) | *Lit*., “possession by forties” (Thrum 1922:626); Kanahā is also a fishpond in Wailuku Ahupua‘a, name of which has been translated by Pukui et al. (1974) as “the shattered [thing]” |
| Hanaula (*‘Ili*) | *Lit*., “red bay” |
| Haleki‘i (*Heiau*) | *Lit*., “image house”; a *heiau* (pre-Christian place of worship) (Walker 1931; Site 44) located in Wailuku at the site of Pihana Heiau along the meander of ‘Īao Stream |
| ‘Īao (Stream, Valley) | *Lit*., “cloud supreme”; the ‘Īao Stream brings the water of the ‘Īao Valley to the ocean at Paukūkalo, a point just northwest of Kahului Harbor |
| Ka‘a (Point) | *Lit*., “rolling”; a shoreline promontory just east of Kahului Bay |
| Ka‘ahu (Surf) | Lit., “the garment.” An ancient surfing area in Wailuku (Soehren 2014) |
| Ka‘ahumanu (Avenue) | *Lit.*, “the bird [feather] cloak.” Avenue named in honor of Queen Ka‘ahumanu, favorite wife of Kamehameha I, who became *kuhina nui* (regent) to Kamehameha II and Kamehameha III and an ardent supporter of the Protestant mission in the Hawaiian Islands. She died in 1832, at Mānoa, on the island of O‘ahu (Kamakau 1992). |
| Ka‘ākaupōhaku | *Lit.*, “the north (or right-hand side) stone.” It was known as an ancient surfing area (Soehren 2014). |

| Name | Translation |
|---|---|
| Kaalaea (*‘Ili*) | *Lit*., “the ocherous earth” |
| Kahului | *Lit*., “the winning”; native name for the Kahului region is “Kaihuwa‘a” (Sterling 1998). According to Malo (1951:268), “the Kahului was a disposition or order of battle in which the main body of the soldiers were drawn up in the form of a crescent, with the horns pointing forwards.” This formation was “undoubtedly derived from the place of the same name,” a “flat and treeless” region (Malo 1951:268). |
| Kaiwaloa (Ridge) | *Lit*., “the long fern”; *‘iwa* is a native fern (*Asplenium horridum*) with narrow, feather-shaped fronds (Pukui and Elbert 1986:104), may also refer to the flight of the *‘iwa* bird (*Fregata minor palmerstoni*) |
| Kalapaoka‘īlio (Ridge) | *Lit.*, “the ridge of the dog.” The boundary between Wailuku and Waikapū runs up this ridge (Soehren 2014). |
| Kāluli (*Heiau*) | Lit., “to sway, bend.” Walker Site 42, repaired during the reign of Kahekili, its *kahu* (priest) was Kaleopu‘upu‘u. Totally destroyed (Soehren 2014). |
| Kanahā (Pond) | Star name (Pukui and Elbert 1986); salt was gathered at Kanahā: “When the sea rose the hollows in the rocks were filled” (Sterling 1998) |
| Ka‘ōpala | *Lit*., “the rubbish”; a dividing line between Pūlehu Nui Ahupua‘a and Waikapū Ahupua‘a |
| Kapalaalaea (*‘Ili*) | *Lit*., “daubed with reddish soil” (Thrum 1922:644) |
| Kapilau (Ridge) | *Lit*., “the stench” |
| Kapili iki (gulch) | “Pili” is a type of grass (*Heteropogon contortus*) used in the thatching of traditional *hale* (house) construction; “*iki*” translates to short, or small; possibly meaning “short pili [grass]” |
| Kapūhau (var. Pukau, Pūhau) (*‘Ili*) | Pūhau—*Lit*., “the ice spring”; *pū* is short for *puna* (spring) |
| Kapukaulua | *Lit*., “the fish hole”; located in the coastal region of Pā‘ia, at the most seaward portion of Spreckelsville; close to the reported location of Papanene Heiau (Walker Site 56); the reference to the fishing area concerns the *ulua* (crevalle, jack, pompano) fish |
| Kaulupala (*‘Ili/Heiau*) | *Lit.*, “the ripe breadfruit.” Mentioned in LCAw 3255 to Hoopuaina. Walker Site 52, consecrated by Liholiho in his tour of Maui in 1801 (Soehren 2014). |
| Kawelowelo (*Heiau*) | *Lit.*, “the flying streak.” Walker Site 51, consecrated by Liholiho (Soehren 2014). |
| Keahukū (*Heiau*) | *Lit.*, “the slaughter by stoning.” Walker Site 45, consecrated by Liholiho “[…] preceeding the peleleu fleet” (Soehren 2014). |

| Name | Translation |
|---|---|
| Keana (*‘Ili*) | *Lit*., “the cave” (Pukui et al. 1974:103) |
| Kuaiwa (*‘Ili*) | *Lit*., “nine times” (Thrum 1922:653) or nine generations |
| Lelemākō (*Heiau*) | Lit., “rough leaping.” Walker Site 50, consecrated by Liholiho (Soehren 2014). |
| Loaloa (var. Kaloaloa) (*‘Ili*) | “Elongated garden plot, as for sweet potatoes (so used in 1848 land claims)” (Pukui and Elbert 1986:209) |
| Luapua‘a (var. Kaluapuaa) (*‘Ili*) | *Lit*., “hog pit” |
| Mā‘alaea | Perhaps a contraction of Maka‘alaea (Ocherous earth beginning) |
| Malena (*Heiau*) | Consecrated by Liholiho “[...] preceeding the peleleu fleet” (Soehren 2014). |
| Malumaluakua (*Heiau*) | *Lit.*, “shelter of the gods.” Consecrated by Liholiho “[…] preceeding the peleleu fleet” (Soehren 2014). |
| Mauna Kahalawai | *Lit*., “the gathering of waters”; the West Maui Mountains (Pellegrino 2009) |
| Mau‘oni (Pond) | One of the two fishponds located at the shore of Kanahā |
| Noho‘ana (*‘Ili*) | *Lit*., “way of life” (Pukui and Elbert 1986:269) |
| ‘Ōhi‘a (*‘Ili*) | Two kinds of trees, *‘ōhi‘a‘ai* (*Eugenia malaccensis*/mountain apple) (Pukui and Elbert 1986:277) and *‘ōhi‘a lehua* (*Metrosideros macropus, M. collina polymorpha*) (Pukui and Elbert 1986:199); found in the forested regions, the fruit of the *‘ōhi‘a‘ai* was prepared by splitting and drying it in the sun (Pukui and Elbert 1986:277); the wood of the *‘ōhi‘a lehua* is hard and once used for images, spears, and mallets (Pukui and Elbert 1986:199) |
| Olokua (*Heiau*) | Walker Site 46, consecrated by Lihoho “[…] preceeding the peleleu fleet” (Soehren 2014). |
| Oloolokalani (*Heiau*) | Walker Site 54, consecrated by Liholiho (Soehren 2014). |
| Olopio (*Heiau*) | Walker Site 47, consecrated by Lihoho “[…] preceeding the peleleu fleet” (Soehren 2014). |
| Oukea (*‘Ili*) | Mentioned in LCAw 7907 to Kuke (Soehren 2014). |
| ‘Owā (*‘Ili*) | Cry of the *‘auku‘u*, heron, which suggests *‘owā*; to cry thus. A measurement equal to half the width of a finger, of fishing nets (Mākahi a ‘owā; the width of one and a half fingers). *‘Ili* where the Sand Hills, Baldwin High School, the Maui Arts & Cultural Center and the U.H. Maui College are situated. |
| Palamaihiki (*Heiau*) | Walker Site 53, consecrated by Liholiho (Soehren 2014). |

| Name | Translation |
|---|---|
| Paukūkalo | Lit., “taro piece.” ‘Īao Stream reaches the ocean at Paukūkalo, a region reported to have once been heavily planted in *kalo* (wetland taro). It has also been noted as an ancient surfing area (Soehren 2014). |
| Pihana (*Heiau*) | *Lit.,* “fullness.” Stories of this Paukūkalo *heiau* include it being built in a single night by the legendary race of Menehune, who brought the stones from Paukūkalo Beach. Pukui also states that the construction of this *heiau* has been attributed to the Maui chief, Kahekili. It is listed as Walker Site 43. The Pihana Heiau is a sacred place located within the *‘ili* of Paukūkalo. |
| Pohakuokahi | Lit., “stone of Kahi.” Walker Site 49, consecrated by Liholiho in his tour of Maui in 1801 (Soehren 2014). |
| Pu‘ali Komohana | Translated by Andrews (1865:73) as “western sun-setting isthmus.” Combined area of Wailuku, Waikapū, Waiehu, and Waihe‘e *ahupua‘a*. |
| Pūlehu Nui (*Ahupua‘a*) | Large *pūlehu* where *pūlehu* is literally translated as “broiled”; this *ahupua‘a* abuts Wailuku and Waikapū and constitutes much of the central isthmus |
| Pu‘u Lio (Hill) | *Pu‘u* is the word for hill and *li‘o* may be in reference to the bird named for the sound they make; place name possibly related to the *li‘o* bird, which is the same as the *‘a‘o* (*Puffinus auricularis newelli*) (Pukui and Elbert 1986:207) |
| Pu‘unēnē | *Lit*., “goose hill”; cinder cone once located inland of Papa‘ula, mined for its gravel during WWII to construct the runways at NAS Kahului |
| Wai‘ale (Reservoir) | *Lit*., “rippling water”; reservoir located in Wailuku, fed by waters of the Spreckels Ditch |
| Waikapū (*Ahupua‘a*) | *Lit*., “water of the conch”; reference to the conch shell formerly found in a cave at Waikapū, until it was stolen by a supernatural dog, named Puapualenalena; also, the scene of a great battle, fought between Kahekili, king of Maui, and Kalani‘opu‘u, king of Hawai‘i Island, at Waikapū Commons |
| Wailuku (*Ahupua‘a*) | *Lit*., “water of destruction”; possibly a reference to the battle which took place at ‘Īao between the forces of Kamehameha I and the Maui chiefs; Sterling (1998) states that Pukui et al. (1974) believes the name is older than the famous battle; Westervelt (1910) makes special reference to the waters of Wailuku in ‘Īao emptying into the Kahului Harbor |

### 3.3.1 Waikapū and Wailuku

According to (Pukui et al. 1974:223), “Waikapū” literally translates to “Water of the Conch.” This is due to a cave within Waikapū Valley that supposedly housed a supernatural conch shell (named Kīhapū, blessed with the breath on Lono) that resided there until it was stolen by a supernatural dog named Puapualenalena. This conch shell, when blown, was said to resound throughout all the Hawaiian Islands (Beckwith 1970:349; Pukui et al. 1974:223). According to W.K. Kaualililehua (in Sterling 1998:93):

> On the left side of the stream is a cave and in the cave was the conch. It sounded all the time, unseen by the public […]
>
> On the northeast side of the stream on the opposite side of the conch that sounded, on the cliff, was a dog named Puapualenalena. Because he heard it he sought diligently to find it but did not succeed. Those who guarded the conch were very watchful. […]
>
> The owners of the conch did not believe, perhaps, that a supernatural being would succeed in taking it away, so they tried to be a little careless. It was not taken, but on the day that Puapualenalena did get it away, they had been utterly careless. After he took it, it sounded no more to this day. [W.K. Kaualilileua in Sterling 1998:93]

Sterling (1998) provides several additional accounts of the naming of the waters of Nā Wai ‘Ehā, specifically Wailuku and Waikapū, that have a grounding in the affairs of the Hawaiian people. According to H.T. Cheever (in Sterling 1998:63), the waters of Nā Wai ‘Ehā were named after successive events during a famous, albeit unnamed, battle:

> Waikapu—The water where the conch was blown, and the engagement began.
> Waiehu— The water where the combatants smoked with dust and perspiration.
> Wailuku—The water of destruction, where the battle began to be fierce and fatal.
> Waihee— The water of total rout and defeat, where the army melted away. [H.T. Cheever in Sterling 1998:63]

Helen Wong Smith remarks that the Sterling notes (n.d.) in the Maui Historical Society mention that Waikapū Stream is not the nearest stream to Kalepolepo; however, it drains into Kealia Pond, which is fairly near, and may have been the nearest running stream. An intermediate version of the name occurs in Bates’ 1854 *Sandwich Island Notes* which associates the conch shell and Kamehameha I:

> The first village of any note on the way to Wailuku is Waikapū. It contains a population of about 500. Here the forces of Kamehameha the Great once assembled for battle at the sounding of the conch shell. Hence the name Wai-ka-pu (water of the conch or trumpet. [Bates 1854:309 in Wong Smith 1991:A2]

C.W. Stoddard expanded on this interpretation of the place names Waikapū and Wailuku in Nā Wai ‘Ehā by relating them to the landing of Kamehameha I at Kalepolepo in the late 1700s (Sterling 1998:63) by relating that

> Kamehameha landed at Kalepolepo and a kapu [taboo] was put upon the nearest stream. It became sacred to royalty, as was the custom and is known as Waikapu to this hour—that is, forbidden water.
>
> Presently the monarch began his march; and at the second stream a great battle raged, so those waters were called Luku—'to slaughter, to slay as in war, the destruction of many at once.' [C.W. Stoddard in Sterling 1998:63]

The names and legends of the region may have their origins in notable events that occurred prior to Western Contact. Though opinions vary, the central isthmus of Maui was nonetheless utilized by forces entering these battles.

### 3.3.2 The Battle of the Owls

One traditional account relates the naming of the *moku* of Wailuku and of a local hill named Pueokaia. In Pukui and Curtis's *The Water of Kāne* (1994), the naming of Wailuku is recounted in the *mo'olelo* of The Battle of the Owls. Mistaking owl eggs for duck eggs, a woman of Maui brings home eight owl eggs to her husband, Kapoi. Kapoi, in disgust, proclaims that the eggs are of an owl and no good to eat. At this moment the mother owl, to whom the eggs belonged, appears and appeals to the husband that the eggs be returned to her nest. The husband who was a cruel man smashed the eight owl eggs leaving the mother owl with only bits of shell (Pukui and Curtis 1994:188–189).

In *Sites of Maui,* Sterling (1998:89) cites W.H. Uaua (1871) who recounts the reaction of the mother owl:

> The owl gathered up the broken shells and the yokes that were dashed against the stone wall and took them all. She flew with them in tears, to the presence of Pueokaia on the western side of Wailuku. He was her husband and the seven eggs that were mercilessly smashed by Kapoi were theirs. [W.H. Uaua in Sterling 1998:89]

According to Pukui and Curtis (1994), this travesty toward their offspring would not be tolerated:

> Her mate was very angry. 'Cruel man!' he shouted.
>
> 'We shall punish him!'
>
> 'What can two owls do against a man?'
>
> 'Two owls? Four hundred owls! Four thousand owls! Fly to the west and tell all owls of this cruel deed. I shall fly to Hawai'i. Let us gather the owls of every island to our aid.'
>
> The owls of every island came. Those of Ni'ihau and Kaua'i met the owls of O'ahu. Flying together in a great flock they joined the owls of Moloka'i, Lāna'i, and Kaho'olawe. When they were united with the flocks from Hawai'i and from Maui their numbers filled the sky and shut out the sun's light. A fierce battle followed. [Pukui and Curtis 1994:188–189]

Following the unification of their flocks, Uaua (1871) recounts the ensuing Battle of the Owls:

> […] the battle began at Wailuku. […] How the owls and men fought! The men and chiefs were destroyed; many men of the Four-Waters. Kapoi and his wife were also killed. Because the owls caused such destruction the place was called Wai-luku (Water-of-destruction) to this day. [W.H. Uaua in Sterling 1998:74]

The home of the father owl, Pueokaia, was rumored to be on a small hill above a place named Awau in Wailuku, and the hill still bears the owl's name to this day (W.H. Uaua in Sterling 1998:89).

### 3.3.3 The Plains of Kama‘oma‘o

Ke Kula o Kama‘oma‘o, or the Plains of Kama‘oma‘o, is the name given to a region of sandy plains spanning portions of Wailuku and Waikapū Ahupua‘a (Emerson 1993). This area was known by Hawaiians in traditional times as a wandering place of the souls (Beckwith 1970), a place where dead spirits waited for a friendly escort, perhaps an *‘aumakua* (family god), to show them the way to eternity:

> The worst fate that can befall a soul is to be abandoned by its aumakua and left to stray, a wandering spirit (*kuewa*) in some barren and desolate place, feeding upon spiders and night moths. Such spirits are believed to be malicious and to take delight in leading travelers astray; hence the wild places which they haunt on each island are feared and avoided. Such are the plains of Kama‘oma‘o on the island of Maui. [Beckwith 1970:154]

According to author and historian, Helen P. Hoyt (1976), Kama‘oma‘o is also a region where the "Marchers of the Night," or *Ka huaka‘i o ka Po*, are sometimes heard and seen. When these spiritual "Night Marchers" appear, according to Beckwith (1932:199), "It is said that such a sight is fatal unless one has a relative among the dead to intercede for him."

> The marchers carried candlenut torches which burned brightly even on a rainy night. They might even be seen in broad daylight and were followed by whirlwinds such as come one after another in columns. They cried 'Kapu o moe!' as a warning to stragglers to get out of the way or to prostrate themselves with closed eyes until the marchers passed. [Beckwith 1932:199]

### 3.3.4 Warfare in the Sand Hills of Nā Wai ‘Ehā

As a political center for the chiefly class of Hawaiian society, several large battles took place in the general vicinity of Wailuku, many of which entailed the marching of foreign armies through the *ahupua‘a* of Waikapū after landing their canoes on the leeward shores of the central isthmus, near Kealia. One example was the Battle of Waikapū Common, or the Ahulau ka Pi‘ipi‘i i Kakanilua. This battle entailed the clash of invading Hawai‘i Island forces, headed by Kalani‘ōpu‘u, with the Maui forces under Kahekili in 1776. According to Fornander (1880:2:152–153), following the plunder of the leeward east Maui coastline, Kalani‘ōpu‘u landed his invading troops at Mā‘alaea. The following account describes the battle on the sand hills south of Wailuku:

> The landing being effected early in the day, it was resolved to push forward at once, and 'on to Wailuku!' where Kahekili was residing, became the war cry of the day. The detachment or regiment known as the Alapa, mustering with several hundred

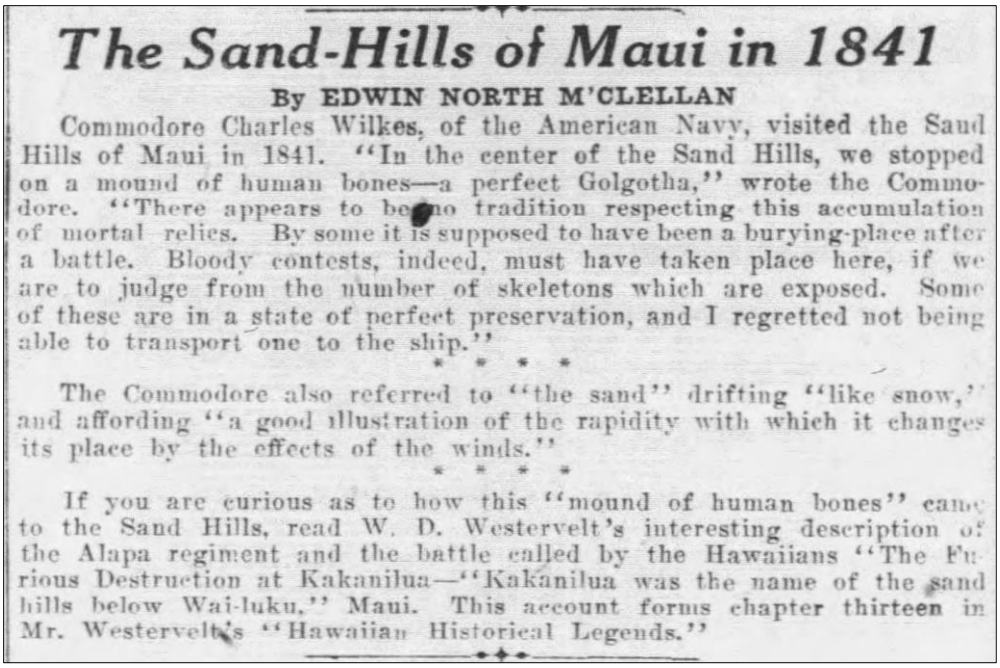
> men, was selected for this hazardous expedition, and with high courage they started across the isthmus of Kamaomao, known as the Waikapu common, determined, as the legend says, ‘to drink the waters of the Wailuku that day.’ This regiment was considered to be the bravest and best. […] They are said to have all been of equal stature and their spears of equal length; and the legend represents their appearance—with their feather cloaks reflecting the sunshine and the plumes of their helmets tossing in the wind—as a gorgeous and magnificent spectacle.
>
> Little did this gallant troop apprehend the terrible fate that awaited them. Little did Kalaniopuu know the wily warrior with whom he was contending. Offering no resistance to the enemy while crossing the common, Kahekili distributed his forces in various directions of the Wailuku side of the common and fell upon the [Alapa] as it was entering among the sandhills southeast of Kalua, near Wailuku. The gallant and devoted Alapa were literally annihilated; only two out of the eight hundred escaped alive. [Fornander 1880:2:152–153]

Following the humiliating defeat, Kalani‘ōpu‘u consulted his remaining fighters and his war leaders, including his favorite, the young Kamehameha. After this Kalani‘ōpu‘u and his forces proclaimed, “Tomorrow we will drink the waters of Wailuku and rest in the shade of Hekuawa” (Speakman 1978:13). In response to the invader’s renewed vigor for battle:

> Ka-hekili and his ally and nephew, the ruling chief of O‘ahu, prepared another fish net [ambush], and the fish [Hawai‘i Island warriors] swam into it. Ka-hekili’s men rose before dawn and took their stand in the sand hills, some toward the Waikapu turn. The invading force from Hawai‘i found a divided front from which the spears poured down on them ‘like a swift rainstorm.’ The terrified soldiers were surrounded and fled. [Speakman 1978:13–14]

The Hawai‘i Island army was ambushed at an area close to Waikapū and was destroyed by the army of Kahekili on the plains of Kama‘oma‘o (Hokulani Holt Padilla in Hill et al. 2006). This second day of fighting was known as the battle of Kamoku‘ilima (Kamakau 1992:132). Kalani‘ōpu‘u never succeeded in taking Wailuku, and died shortly after the Battle of Wailuku Common. Upon the death of Kalani‘ōpu‘u, and the death of his sons, the young Kamehameha became the ruling chief of Hawai‘i and the mortal enemy of the now aged Kahekili (Speakman 1978:12). Kamehameha would return to Wailuku and succeed where Kalani‘ōpu‘u had failed. By 1786, Kahekili controlled Maui, Moloka‘i, Lāna‘i, and O‘ahu. This undisputed political control lasted for only a short period of time. In 1790, the last great conflict on Maui—the Battle of Kepaniwai—was fought in ‘Īao Valley in Wailuku. The Battle of Kepaniwai marked the end of the reign of Kahekili and the beginning of the early historic period and a politically unified Hawai‘i (Pukui et al. 1974).

An 1841 account of Commodore Charles Wilkes of the American Navy published in the 7 January 1927 edition of the *Honolulu Advertiser* provides an early description of “a mound of human bones” thought to be the bodies of fallen warriors in the Sand Hills of Wailuku (Figure 12). The article refers to the accounts of past battles fought in Central Maui.



# The Sand-Hills of Maui in 1841

By EDWIN NORTH M'CLELLAN

Commodore Charles Wilkes, of the American Navy, visited the Sand Hills of Maui in 1841. "In the center of the Sand Hills, we stopped on a mound of human bones—a perfect Golgotha," wrote the Commodore. "There appears to be no tradition respecting this accumulation of mortal relics. By some it is supposed to have been a burying-place after a battle. Bloody contests, indeed, must have taken place here, if we are to judge from the number of skeletons which are exposed. Some of these are in a state of perfect preservation, and I regretted not being able to transport one to the ship."

* * * *

The Commodore also referred to "the sand" drifting "like snow," and affording "a good illustration of the rapidity with which it changes its place by the effects of the winds."

* * * *

If you are curious as to how this "mound of human bones" came to the Sand Hills, read W. D. Westervelt's interesting description of the Alapa regiment and the battle called by the Hawaiians "The Furious Destruction at Kakanilua—"Kakanilua was the name of the sand hills below Wai-luku," Maui. This account forms chapter thirteen in Mr. Westervelt's "Hawaiian Historical Legends."

Figure 12. Newspaper clipping from the 7 January 1927 edition of the *Honolulu Advertiser* describing an 1841 discovery of human remains in the Sand Hills of Ma

## 3.4 *Nā Oli* (Chants)

*Oli*, according to Mary Kawena Pukui (Pukui 1995:xvi–xvii) are often grouped according to content. Chants often were imbued with *mana* (spiritual power); such *mana* was made manifest through the use of themes and *kaona* (hidden meanings). According to Pukui, chants for the gods (prayers) came first, and chants for the *ali‘i*, “the descendants of the gods,” came second in significance. Chants “concerning the activities of the earth peopled by common humans,” were last in this hierarchy (Pukui 1995:xvi–xvii). Emerson conversely states,

> In its most familiar form the Hawaiians–many of whom [were lyrical masters]–used the oli not only for the songful expression of joy and affection, but as the vehicle of humorous or sarcastic narrative in the entertainment of their comrades. The dividing line, then, between the oli and those other weightier forms of the mele, the inoa, the kanikau (threnody), the pule, and that unnamed variety of mele in which the poet dealt with historic or mythologic subjects, is to be found almost wholly in the mood of the singer. [Emerson 1965:254]

While *oli* may vary thematically, subject to the perspective of the *ho‘opa‘a* (chanter), it was undoubtedly a valued art form used to preserve oral histories, genealogies, and traditions, to recall special places and events, and to offer prayers to *akua* (gods) and *‘aumākua* (family gods) alike. Perhaps most importantly, as Alameida (1993:26) writes, “chants […] created a mystic beauty […] confirming the special feeling for the environment among Hawaiians: their *one hānau* (birthplace), their *kula iwi* (land of their ancestors).”

### 3.4.1 Hi‘iaka and Wailuku

The goddess Hi‘iaka, sister of volcano goddess Pele, passes through Wailuku, Maui during her epic journey to Kaua‘i. When Hi‘iaka’s *aikāne* (close friend) Wahine‘ōma‘o complains of hunger during their travels along a *kaha* (hot dry shore) portion of northern Maui, Hi‘iaka offers the following chant:

| | |
|---|---|
| Ke kahulihuli a ka papa o Wailuku; | As trembles the plank at Wailuku (So trembles the fate of the king): |
| He ole ke kaha kuai ai, e: | There’s no market where to buy meat; |
| Ho-mai he ai; | Give the stranger, then, something to eat: |
| Ho-mai ana ua ai, e! | Give us, I pray, of your meat. |
| | [Emerson 1915:74] |

Hi‘iaka and Wahine‘ōma‘o were met with little hospitality after their appeal for food was largely ignored by the area’s residents. Hi‘iaka then offered the following chant making “known her wish, concluding her appeal with ominous threats against the life of the king, in case her demands were not met” (Emerson 1915:75):

| | |
|---|---|
| E Wai-hinano, wahine a ka po‘ipo‘i, e, | O Waihinano, thou soul-grabber, |
| Ua make ke alii, ka mea nona nei moku | Dead is the king of this island; |
| He pua‘a kau ka uku no Moloka‘i; | Moloka‘i shall offer a boar; |
| He ilio lohelohe Lana‘i; | Lana‘i’s a half-baked dog; |
| A pale ka A-a ka Kanaloa; | Kanaloa fends off the A-a; |
| He puo‘a kai Molokini: | Molokini buffets the waves. |
| Huli ka ele o na Hono; | The ship of state turns turtle: |
| Haki kepakepa na moku; | What wailing and beating of breast! |
| Pa‘iauma ka aina; | Wild anguish of child and of ghost |
| Uwē kamali‘i, uwē ka hanehane — | O’er the sandy plain of Kama‘o. |
| Ke uwē la i ka pili, | The districts are frenzied with grief |
| I ke kula o Ka-ma‘o-ma‘o; | Tearing of hair and breaking of teeth |
| Ka‘a kumakena o Maui, e! | One wail that lifts to heaven. |
| la wai Maui? | Who shall be heir to this Maui land? |
| | [Emerson 1915:75–76] |

### 3.4.2 The Mirage of Mana

Wailuku is mentioned in the *oli* “The Mirage of Mana” which appears in the Story of Lonoikamakahiki (Fornander 1916-1917:4:256–363). According to the *mo‘olelo*, Kākuhihewa challenges Lonoikamakahiki, ruling chief of Hawai‘i, to recite the *oli* “The Mirage of Mana.” Kākuhihewa believes the *oli* was written in honor of his name, however, Ohaikawiliula, a chiefess from Kaua‘i, had already imparted the *oli* to Lonoikamakahiki. Lonoikamahiki then recites the *oli* defeating Kākuhihewa.

| | |
|---|---|
| *O na Mahele i Wailuku.* | Of the division in Wailuku. |
| *Ka umi-* | The tenth. |
| *Kahi Koolau-e,* | One is Koolau, |

| | |
|---|---|
| *Kahi Wailuku-e* | One is Wailuku, |
| *Kahi Paie,* | One is Paie, |
| *Kahi Kahookuli ke haele:* | One is Kahookuli in going. |
| *Elua-* | Two- |
| *Elua ku mai,* | Two stand up. |
| *Elua-* | Two- |
| *Elua noho ae,* | Two sit down. |
| *Elua-* | Two- |
| *Elua Pili wale I Keaahala,* | Two are inclining against Keaahala. |
| *Elua-* | Two- |
| *Elua Nuailua,* | Two Nuailua. |
| *Ekolu-* | Three- |
| *Ekolu Makaiwa,* | Three Makaiwa. |
| *Ekolu-* | Three- |
| *Ekolu Papa,* | Three foundations. |
| *Eha-* | Four- |
| *Eha Waipio* | Four Waipio. |
| *Eha-* | Four- |
| *Eha ka uka i Halehaku* | There are four in the uplands of Halehaku. |
| *Elima-* | Five- |
| *Elima Pauwela,* | There are five Pauwela. |
| *Elima-* | Five- |
| *Elima Huleia.* | Five Huleia. |
| *Elima-* | Five- |
| *Elima na kanaka,* | There are five people. |
| *Alualu o ke kaha wale i Paie,* | Chasing each other on the lonely coast of Paie. |
| *He oi ahiku,* | The one in the lead is the seventh. |
| *Ehiku Pulehu,* | There are seven Pulehu |
| *Ehiku Mana,* | There are seven Mana, |

| | |
|---|---|
| *Ehiku ka ohia i Paukauwila:* | The Ohia of Paukauwila is the seventh. |

[Fornander 1916-1917:4:284–285]

The *oli* is also recited by Kaikilani, Lonoikamakahiki's wife, upon her arrival in Kailua, O‘ahu from Hawai‘i (Fornander 1916-1917:4:302–303).

Both *oli* contain variations of the following lines:

| | |
|---|---|
| *Kahua aolelo Wailuku-e* | Wailuku is the locality of flying clouds. |
| *He Aha Kula-loa?* | What is board Kula? |
| *Kaupaka Lanakila.* | It is open upland. |
| *Kaluianui o Kaluanui,* | Kaluanui of Kaluanui, |
| *Ke ku la i na puu mahoe;* | It stands by the twin hills, |
| *Na hale loulu a Kane,* | The palm houses of Kane, |
| *I ako no‘u Auwahi.* | Which were thatched for me at Auwahi |

[Fornander 1916-1917:4:284–285]

### 3.4.3 Ke‘elikōlani

In an *oli* to Ke‘elikōlani composed by Pipi (Fornander 1919-1920:6:486–487), Wailuku is mentioned in relation to "*malu kuawa*" which translates to "shelter of the valley" (Pukui and Elbert 1986:158). Also mentioned in the *oli* is the I‘a-iki wind.

| | |
|---|---|
| *Kapukoaku, kai kohola ka lani.* | The standing coral of the shallow sea, the chief. |
| *Kai luu o ke kai uli hohonu,* | Overturning waves of the dark deepsea, |
| *E kihe ai ka ihu, me he naia la.* | Diving its crest there as a porpoise |
| *E no ai I ke kapu o lakou,* | According to their kapu. |
| *5. Kanahae makawalu nono o ke ‘lii* | 5. Diminishing numerous noise of the chief. |
| *Kahiki wahie aloaloa,* | Kahiki scattering timber |
| *Loaloanui ia ka lani* | Exceedingly long is the chief |
| *Kaumakamano, he mano he naha na ‘lii* | Kaumakamano, a shark, a shark for chiefs. |
| *Hookahi lau konahala ke kapu;* | In one season the kapu passed; |

| | |
|---|---|
| *10. Kapu hoi paha Kekelaokalani;* | 10. May be Kekelaokalani was kapu also. |
| *Ka auhuhu hoi ia e lena ai ke kai,* | The poison plant it was, yellowing the seas. |
| *E onioni ai ka ia, make i ka hola;* | Stupifying the fish, deadened by the intoxicating plant; |
| *E kapalili ai i ka ili o ke kai,* | Fluttering on the surface of the sea, |
| *He kai hoonee; he kai oki apu,* | A moving sea; a cross, chasing sea. |
| *15. Kahiwalele kapu kalani, o Keelikolani la.* | 15. Kahiwalele kapued the chief Keelikolani; |
| *Ku Kauiki pa kohana i ka makani,* | Kauiki stands bare in the wind, |
| *Hoohalulu i ke kai o Kaihalulu* | Trembling by the sea of Kaihalulu |
| *Ke oi a lau i ka makani,* | Greatly increased by the wind, |
| *E kali ana i ka ua Paiolopawa,* | Waiting for the piolopawa rain |
| *20. I ka hili kua ia e ke Koholalele,* | 20. On the stricken back of the Koholalele. |
| *Lele ka hauli o Nalualele i kai* | The dark shadow of Nalualele leaps seaward. |
| *Ke komi komi‘a iho la e ka lau awa,* | Reducing gradually the lauawa [wind]. |
| *Wai kea hana na huli ka amau,* | Hana was water-whitened as the fern changed |
| *O na malo o Kama i Kualihau e!* | The malos of Kama in Kualihau. |
| *25. ae paha aohe wahahee, aho o koe aku e!* | 25. Perhaps so, without falsehood, be patient till more follows. |
| *Koe Auhi, pakele aku o Kahikihui,* | Excepting Auhi, Kahikinui escaped, |
| *Lilo aku la i na lima o ka naulu,* | Taken by the force of the naulu [wind]; |
| *Ulu ae la Kalupua e ka makani,* | Grown are the flowers scattered by the wind; |
| *Lomi‘a iho la na maka o ke aalii,* | Destroyed are the shoots of the aalii, |
| *30. Enaena wela I ka la.* | 30. Scorced by the sun. |
| *O Lualailua i ke kula la,* | Lualailua of the plain, |
| *Welo Waiahualele, lele ke ahi o kula maalo i ka maka;* | Waiahualele fluttering, the fire of kula attracts the eye, |

| | |
|---|---|
| *Weli oaka, a i uka o Koanaulu e!* | Suddenly brightened up above Koanaulu! |
| Ae paha, oahe wahahee e hookoe aku e! | Yes, perhaps, without falsehood to be set aside. |
| *35. Koe Wailuku i ka malu Kuawa,* | 35. Except Wailuku in the shade of Kuawa |
| *Ke hoopaio la me Kaiaiki, me ke Kaahaaha.* | In the contentions of Kaiaiki with Kaahaaha. |
| *Anu o Niua, hamo ke kilioopu ka o kai,* | Niua was cold; the grass waved towards the sea. |
| *Pohu ke kaha maloko o Hupukoa,* | Calm was the channel within Hupukoa, |
| *Hoopaaia i ka uwahi a ke kai,* | Withheld was the spray of the sea; |
| *40. He uwahi kai no Papale.* | 40. A sea-spray for Papale |
| *Kailiu ke hoale la, i ike kumu o ka maomao e!* | Stirred up by the salt sea seeking [the] roots of green verdure, |
| *Ae paha, aohe wahahee e hookoe aku e!* | Perhaps so, without falsehood to be set aside. |

[Fornander 1919-1920:6:486–487]

The phrase “*malu kuwawa*” also appears in Lahainaluna chants. A dirge was composed for L.L. Ua, a Lahainaluna teacher, by his students following his death in February 1854 (Fornander 1919-1920:6:525). The English translation defines “*malu kuwawa*” as “dark clouds.”

| | |
|---|---|
| *60. Malamalama kea lo pouli ke kua.* | 60. Before was the light and darkness at the rear. |
| *Papale na maka i ke aloha.* | Close thy eyes with love. |
| *Ke hoi nei ka uhane I ka malu niu o Lele;* | The soul is returning to the coconut grove of Lele; |
| *I ka malu kuwawa o Wailuku;* | To the dark clouds of Wailuku; |
| *I ka ua naulu noe anu o Kula;* | To the cold misty rain of Kula; |

[Fornander 1919-1920:6:525]

## 3.5 *Nā Mele* (Songs)

The following section draws from the Hawaiian art of *mele*, poetic song intended to create two styles of meaning.

> Words and word combinations were studied to see whether they were auspicious or not. There were always two things to consider the literal meaning and the *kaona*, or ‘inner meaning.’ The inner meaning was sometimes so veiled that only the people to whom the chant belonged understood it, and sometimes so obvious that anyone who knew the figurative speech of old Hawai‘i could see it very plainly. There are but two meanings: the literal and the *kaona,* or inner meaning. The literal is like the body and the inner meaning is like the spirit of the poem. [Pukui 1949:247]

> The Hawaiians were lovers of poetry and keen observers of nature. Every phase of nature was noted and expressions of this love and observation woven into poems of praise, of satire, of resentment, of love and of celebration for any occasion that might arise. The ancient poets carefully selected men worthy of carrying on their art. These young men were taught the old *meles* and the technique of fashioning new ones. [Pukui 1949:247]

### 3.5.1 “Nā Wai ‘Ehā O Maui”

This *mele* was composed by Alice Namakelua in 1940 for the Kamehameha Day Celebration in Honolulu. The four waters of Maui are mentioned in this *mele*.

| | |
|---|---|
| E Maui nui o Kama | Great Maui of Kama |
| ‘Āina ua kaulana | Famous land |
| O ka heke i‘o no ‘oe | You are truly superior |
| Ua lohe ‘ia ‘a puni ka honua | Heard around the earth |
| ‘Āina ‘oe ua wehi | You are the land adorned |
| Ua ‘ohu e ka roselani | Adorned by the rose |
| He pua ho‘i nāu e lei | A flower for you to wear as an adornment |
| A e ha‘aheo mau ai ‘oe | And continue to wear in pride |
| Kaulana nā wai ‘ehā | Famous are the four waters |
| He puana he inoa he ha‘ina | A refrain, a name, an answer |
| Waikapū, Wailuku, Waiehu | Waikapū, Wailuku, Waiehu |
| A‘o Waihe‘e iho ia wai | Water descends in Waihe‘e |
| He inoa nēia nou | This is a name chant for you |
| E Maui nui o Kama | Great Maui of Kama |

| | |
|---|---|
| Ha‘aheo ‘oe i ka roselani | You are cherished with pride because of the rose |
| E ō mai i kou inoa | Reply to your name |
| | [Huapala n.d.a] |

### 3.5.2 “No Na Wai ‘Ehā”

This twentieth century *mele* composed by Scott Hai mentions Waikapū and other locations on Hai’s beloved island home of Maui.

| | |
|---|---|
| I Waikapū ke aloha | My love is at Waikapū |
| Ka makani Kokololio | The gusty wind named Kokololio |
| Pili i ka poli nahenahe | Held close to the soft bosom |
| He ‘īnikiniki mālie | Gently pinching |
| I Wailuku iho ‘oe | You went down to Wailuku |
| I ka piko a‘o ‘Īao | To the summit of ‘Īao |
| Lihilihi o ka pua rose | Petals of the roses |
| He ‘īnikiniki mālie | Gently pinching |
| I Waiehu iho ‘oe | You went down to Waiehu |
| Ka makani Hō‘ehaili | Hō‘ehaili, the wind that pierces the skin |
| Me ka uhi wai a‘o uka | With the thick fog of the upland |
| He ‘īnikiniki mālie | Gently pinching |
| I Waihe‘e kāua | We were at Waihe‘e |
| Ka makani Kili‘o‘opu | The wind named Kili‘o‘opu |
| Me ka wai a‘o Eleile | And the water of Eleile |
| He ‘īnikiniki mālie | Gently pinching |
| I Lahaina iho ‘oe | You went down to Lahaina |
| Ka makani Kaua‘ula | Kaua‘ula, the strong mountain wind |
| Me ka malu ulu a‘o Lele | Amid the shade of the breadfruit trees of Lele |
| He ‘īnikiniki mālie | Gently pinching |
| Ha‘ina mai ka puana | Tell the refrain |

| | |
|---|---|
| No na wai ‘ehā | Of the four water |
| E ho‘i no e pili | Return and let us be together |
| He ‘īnikiniki mālie | Gently pinching |
| | [Huapala n.d.b] |

### 3.5.3 “Waikapū/‘Iniki Mālie”

This song describes the winds of the four water-lands in Maui: Waikapū, Wailuku, Waiehu, and Waihe‘e. The meaning of each name is described by Pukui et al. (1974): “Waikapū, water of the conch. A conch found in a cave in this area could be heard anywhere throughout the Hawaiian Islands. It was stolen by a supernatural dog named Puapualenalena whose name meant yellow tail feathers” (Pukui et al. 1974:223); Wailuku, water of destruction. Wailuku was the battle site where Kalani‘ōpu‘u’s army was nearly annihilated by Kahekili (Pukui et al. 1974:225); Waiehu, meaning water spray and Waihe‘e, meaning slipping water.

| | |
|---|---|
| *Waikapū makani Kokololio,* | Waikapū wind in gusts, |
| *He makani houhou ‘ili ‘inisinisi (‘inikiniki) mālie.* | Skin-stinging wind gently pinching. |
| *Wailuku makani Lawemālie,* | Wailuku wind becoming gentle, |
| *He makani houhou ‘ili ‘inisinisi (‘inikiniki) mālie.* | Skin-stinging wind gently pinching. |
| *Waiehu makani Hō‘eha‘ili* | Waiehu wind paining the skin, |
| *He makani houhou ‘ili ‘inisinisi (‘inikiniki) mālie.* | Skin-stinging wind gently pinching |
| *Waihe‘e makani Kili‘o‘opu* | Waihe‘e graceful wind, |
| *He makani houhou ‘ili ‘inisinisi (‘inikiniki) mālie.* | Skin-stinging wind gently pinching. |
| *Ha‘ina mai ana ka puana,* | Tell the refrain, |
| *He makani houhou ‘ili ‘inisinisi (‘inikiniki) mālie.* | Skin-stinging wind gently pinching. |
| [Huapala n.d.c] | |

## 3.6 *‘Ōlelo No‘eau* (Proverbs)

Hawaiian knowledge was shared by way of oral histories. Indeed, one’s *leo* (voice) is oftentimes presented as *ho‘okupu* (“tribute,” a gift given to convey appreciation, to strengthen bonds); the high valuation of the spoken word underscores the importance of the oral tradition (in this case, Hawaiian sayings or expressions), and its ability to impart traditional Hawaiian “aesthetic, historic, and educational values” (Pukui 1983:vii). Thus, in many ways these expressions may be understood as inspiring growth within the reader or between speaker and listener:

> They reveal with each new reading ever deeper layers of meaning, giving understanding not only of Hawai‘i and its people but of all humanity. Since the sayings carry the immediacy of the spoken word, considered to be the highest form of cultural expression in old Hawai‘i, they bring us closer to the everyday thoughts and lives of the Hawaiians who created them. Taken together, the sayings offer a
>
> basis for an understanding of the essence and origins of traditional Hawaiian values. The sayings may be categorized, in Western terms, as proverbs, aphorisms, didactic adages, jokes, riddles, epithets, lines from chants, etc., and they present a variety of literary techniques such as metaphor, analogy, allegory, personification, irony, pun, and repetition. It is worth noting, however, that the sayings were spoken, and that their meanings and purposes should not be assessed by the Western concepts of literary types and techniques. [Pukui 1983:vii]

Simply, *‘ōlelo no‘eau* may be understood as proverbs. The Webster dictionary notes it as “a phrase which is often repeated; especially, a sentence which briefly and forcibly expresses some practical truth, or the result of experience and observation.” It is a pithy or short form of folk wisdom. Pukui equates proverbs as a treasury of Hawaiian expressions (Pukui 1995:xii). Oftentimes within these Hawaiian expressions or proverbs are references to places. This section draws from the collection of author and historian Mary Kawena Pukui and her knowledge of Hawaiian proverbs describing *‘āina* (land), chiefs, plants, and places.

### 3.6.1 *‘Ōlelo No‘eau* #19

The following *‘ōlelo no‘eau* briefly describes the battle between Kahekili and Kalani‘ōpu‘u.

> Ahulau ka Pi‘ipi‘i i Kakanilua.
>
> *A slaughter of the Pi‘ipi‘i at Kakanilua.*
>
> In the battle between Kahekili of Maui and Kalani‘ōpu‘u of Hawai‘i, on the sand dunes of Wailuku, Maui, there was a great slaughter of Hawai‘i warriors who were called the Pi‘ipi‘i. Any great slaughter might be compared to the slaughter of the Pi‘ipi‘i. [Pukui 1983:5]

### 3.6.2 *‘Ōlelo No‘eau* #1465

The following *‘ōlelo no‘eau* describes the wind of Waikapū.

> Ka makani kokololio o Waikapū.
>
> *The swift, gusty wind of Waikapū.*

Waikapū is on Maui. [Pukui 1983:159]

### 3.6.3 *‘Ōlelo No‘eau* #1481

The subsequent *‘ōlelo no‘eau* all pertain to the Wailuku plains area known as Kama‘oma‘o. This place was famous for it’s connection to wandering spirits.

*Kama‘oma‘o, ka ‘āina huli hana.*

At Kama‘oma‘o, land of activities.

Ghosts who do not go to the pō of their ancestors often wander about in certain areas. Kama‘oma‘o, Maui is such a place. The activities of such ghosts usually annoy the living. [Pukui 1983:160]

### 3.6.4 *‘Ōlelo No‘eau* #1514

*Ka ‘ōlohe puka awakea o Kama‘oma‘o.*

The bare one of Kama‘oma‘o that appears at noonday.

The plain of Kama‘oma‘o, Maui, is said to be the haunt of ghosts (‘ōlohe) who appear at night or at noon. Also a play on ‘ōlohe (nude), applied to one who appears unclothed. [Pukui 1983:164]

### 3.6.5 *‘Ōlelo No‘eau* #1711

The following *‘ōlelo no‘eau* was said by Kalani‘ōpu‘u who believed his warriors were winning against Kahekili.

Ke inu aku la paha a‘u ‘Ālapa i ka wai o Wailuku.

*My ‘Ālapa warriors must now be drinking the water of Wailuku.*

Said when an unexpected success has turned into a failure. This was a remark made by Kalaniōpu‘u to his wife Kalola and son Kiwala‘ō, in the belief that his selected warriors, the ‘Ālapa, were winning in their battle against Kahekili. Instead they were being destroyed. [Pukui 1983:184]

### 3.6.6 *‘Ōlelo No‘eau* #1761

*Ke kula o Kama‘oma‘o ka ‘āina huli hana.*

The plain of Kama‘oma‘o – that is the place where plenty of work is to be found.

A taunt to one who talks of looking for work but does not do it. The plain of Kama‘oma‘o, Maui was said to be the haunt of ghosts whose activities were often terrifying. [Pukui 1983:189]

### 3.6.7 *‘Ōlelo No‘eau* #2300

The following *‘ōlelo no‘eau* describes the poetic term for four *ahupua‘a* on Maui.

> Na wai ‘ehā.
>
> *The four wai.*
>
> A poetic term for these places on Maui: Wailuku, Waiehu, Waihe‘e, Waikapū, each of which has a flowing water (*wai*). [Pukui 1983:251]

### 3.6.8 *‘Ōlelo No‘eau* #2578

The following *‘ōlelo no‘eau* describes two ponds in Kahului, Maui: Mau‘oni and Kanahā.

> *Pākāhi ka nehu a Kapi‘ioho.*
>
> The *nehu* of Kapi‘ioho are divided, one to a person.
>
> Kapi‘ioho, ruler of Moloka‘i, had two ponds, Mau‘oni and Kanahā, built on his land at Kahului, Maui. The men who were brought from Moloka‘i and O‘ahu to build the ponds were fed on food brought over from Moloka‘i. The drain on that island was often so great that the men were reduced to eating nehu fish, freshwater ‘ōpae and poi. The saying is used when poi is plentiful but fish is scarce and has to be carefully rationed. [Pukui 1983:284]

### 3.6.9 *‘Ōlelo No‘eau* #2647

The following *‘ōlelo no‘eau* play on the word *luku* (destruction).

> Pili ka hanu o Wailuku.
>
> *Wailuku holds its breath.*
>
> Said of one who is speechless or petrified with either fear or extreme cold. There is a play on *luku* (destruction). Refers to Wailuku, Maui. [Pukui 1983:290]

### 3.6.10 *‘Ōlelo No‘eau* #2911

The following *‘ōlelo no‘eau* also describes the wind of Waikapū.

> Waikapū i ka makani kokololio
>
> *Waikapū of the gusty wind.*
>
> Refers to Waikapū, Maui [Pukui 1983:319]

### 3.6.11 *‘Ōlelo No‘eau* #2912

The following *‘ōlelo no‘eau* gives a short description of Wailuku.

> Wailuku i ka malu he kuawa.
>
> *Wailuku in the shelter of the valleys.*
>
> Wailuku, Maui, reposes in the shelter of the clouds and the valley. [Pukui 1983:319]

### 3.6.12 Hawaiian Proverbs and Riddles #693

The following proverb from Judd's *Hawaiian Proverbs and Riddles* also speaks of Wailuku as a place of shelter.

> *Wailuku i aloha nui ia o ka malu hekuawa*.
>
> Wailuku of the westering shade, greatly loved.
>
> Wailuku is always shady in the afternoon. [Judd 1930:56]

# Section 4 Historical Background

### 4.1.1 Pre-Contact Period

The division of Maui's lands into political districts occurred during the rule of Kaka‘alaneo, under the direction of his *kahuna*, Kalaiha‘ōhi‘a (Beckwith 1970:383). This division resulted in 12 districts, or *moku*, during traditional times: Kula, Honua‘ula, Kahikinui, Kaupō, Kīpahulu, Hāna, Ko‘olau, Hāmākua Loa, Hāmākua Poko, Wailuku, Kā‘anapali, and Lāhainā. The current project area is located between Wailuku and Waikapū Ahupua‘a in the Wailuku Moku in the isthmus of Central Maui between the northwest slopes of Haleakalā and the southeast slopes of Mauna Kahālāwai (West Maui Mountains). Overall, Wailuku and Waikapū Ahupua‘a share an east-west boundary and collectively constitute the entirety of the central isthmus of Maui, which is bounded by ‘Īao Valley to the west, Kahului Harbor to the north, Pā‘ia and Hāli‘imaile to the east, and Mā‘alaea Harbor to the south. These combined lands encompass a total of approximately 43,779 acres.

Wailuku and Waikapū are two of four *ahupua‘a* that traditionally comprise the *‘okana* of Maui known as "Nā Wai ‘Ehā," so named for the four major deep-valley streams emanating from the West Maui Mountains (Handy et al. 1991:469; Moffat and Fitzpatrick 1995:23). Geographically and culturally, Nā Wai ‘Ehā consisted of four deep valley streams (Waikapu, Wailuku, Waiehu, and Waihee) that watered four distinct areas of taro land that spread out fanwise to the shoreline (Handy et al. 1991:272) with the *ahupua‘a* of both Wailuku and Waikapū extending across the isthmus of Maui to meet the traditional land boundaries of Hamakuapoko and Kula Moku. These two land divisions were of primary importance due to their location across "the whole of the central isthmus so as to cut off half of the lands in the district of Kula from access to the sea," and were sometimes referred to as Na Poko (W.D. Alexander in Sterling 1998:63).

### 4.1.2 Early Historic Period

The nineteenth century brought to Maui a multitude of commercial, demographic, social, and religious changes encouraged by the burgeoning foreign influx. In 1819, the first whaling ships arrived in Hawaiian waters and Lāhainā Harbor became a primary port of call for provisioning ships in the Islands. Closely following the arrival of the first whaling ships, the first Protestant missionaries and their families arrived in Lāhainā in 1823 (Bingham 1824). One of the first records regarding the number of residents living in the regions of Wailuku and Waikapū comes from population statistics compiled by the early missionaries who settled there. In 1829, Protestant missionaries recorded school attendance figures for the out-stations of Wailuku as consisting of 612 students, with an additional 329 students in Waikapū. Just a few years later, the mission census data of 1831-1832 records the population of Waikapū at 733 inhabitants (Schmitt 1973:18).

The use of the northern coastline landing at Kahului by early Europeans proved difficult, for far more records exist of early explorers and merchant ships at anchor off the southern, more protected coastline of Maui than along the exposed, northern coast. An account by the American missionary Rufus Anderson (1865) portrays the obstacle of landing in Wailuku District:

> We were bound to Wailuku, situated near the western side of the isthmus connecting West and east Maui. After crossing the channel the wind increased, and

> so rough was the sea that our landing seemed not quite safe. Mr. Alexander met us on the shore, but in such a stand-storm that we were obliged to veil our faces. We breasted the gale for a dozen miles, and near Wailuku were wet to the skin by a storm of rain. [Anderson 1865:176]

A landing on leeward coast of the central isthmus meant that the people and commerce that reached European ships came through the trails that transect the Plains of Kama‘oma‘o.

During the early and mid-1800s, the Hawaiian demography was affected by two dramatic factors: radical depopulation resulting from western disease and nucleation around the developing port towns. Traditional Hawaiian populations lived in a largely dispersed settlement pattern. Although there were royal centers and areas of more concentrated population, these areas never came close to rivaling the populations of the historic port towns that developed on Hawai‘i’s shorelines during the 1800s. Foreign commercialism initially came to Waikapū in the form of sugar processing and coffee production (Wyllie 1854). A man by the name of Antone (Anthony) Catalena was running a cane syrup factory at Waikapū ca. 1823 and is credited with being the founder of the industry in Hawai‘i (Thrum 1874) while Antonio Silva set up a plantation and a mill in Waikapū ca. 1828 (Thurston 1906). At about the same time Antonio was also engaged in coffee agriculture with trees that reportedly produced above 20 pounds annually (Wyllie 1854). The Reverend Hiram Bingham (1824) wrote the following description about an excursion he took with the Reverend William Richards, in a letter sent to the American Board of Commissioners of Foreign Missions (ABCFM) in Boston, dated 30 August 1823.

> The principal plantation in this district, called Waikapu (Wy-kah-poo) lies about midway between the two bays, watered by a small stream, descending in a south-eastern direction from the lofty mountains, that lie between Lahinah [sic] and that place. At this plantation which belongs to Cox [Kahekili Ke‘eaumoku] and Kaahoomanoo [Ka‘ahumanu], there are about 100 houses, six head of neat cattle, and eight horses. This is the most important, and almost the only inland settlement that I have seen in the islands. Its situation is very pleasant. You stand upon the bank of this little rivulet in the midst of the bananas, sugarcane, and taro; and the plains that lie upon the two bays spread upon your right and left, containing perhaps 100 or 150 square miles. Before you, at the distance of 15. [Bingham 1824:111]

These early commercial developments along with the establishment of the branch station of the ABCFM at Wailuku in November 1831 (Edwards 1832:403) would alter the traditional lifeways of Nā Wai ‘Ehā and Waikapū in a manner best described by Kuykendall (1938), noting that from 1830 to 1854:

> The commercial development during this period, by magnifying the importance of a few ports, gave momentum and direction to a townward drift of population; the population of the kingdom as a whole was steadily going down, but the population of Honolulu, Lahaina and Hilo was growing. [Kuykendall 1938:313]

Following this trend in the commercialization of agricultural pursuits across all islands, the remnants of indigenous agriculture either fell into disrepair or were absorbed by the developing plantations. Vestiges of extensive *lo‘i* cultivation, which spread to the north and south from the base of Waikapū to a considerable distance below the valley, remained through the 1930s.

Although most of the *lo‘i* terraces in Waikapū had been plowed under by the expansion of commercial sugarcane cultivation, a few of the ancient terraces were preserved in plantation camps and under house sites as well as reused as garden sites, among which, and in addition to Hawaiian wet-taro, included Japanese dry-taro, truck gardens, and lotus for their seeds (Handy et al. 1991:497) (Figure 13).

### 4.1.3 The Māhele and the Kuleana Act

The most significant change in land use patterns and land allocation came with the Māhele and the privatization of land in Hawai‘i. The establishment in 1839 by Kamehameha III (Kauikeaouli) of a Bill of Rights for the people of Hawai‘i, followed by a formal constitution in 1840, hastened the shift of the Hawaiian economy from that of a subsistence-based economy to that of a market-based economy. The Organic Acts of 1845 and 1846 initiated the process of the Māhele, the division of Hawaiian lands, which introduced private property into Hawaiian society. During the Māhele, all of the lands in the Kingdom of Hawai‘i were divided among the *mō‘ī* (king), *ali‘i* (royalty), *konohiki* (overseer of an *ahupua‘a*), and *maka‘āinana* (common people/tenants of the land) and passed into the western land tenure model of private ownership (Chinen 1958).

On 27 January 1848, the Crown and the *ali‘i* began to receive their land titles as *konohiki* awards. For *konohiki* lands, a claim first had to be approved by the Land Commissioners. Upon confirmation of the claim, a certificate was awarded to the claimant. This certificate was called a Land Commission Award (LCA), which confirmed the claim of an individual for a parcel. The awardee could then obtain a Royal Patent (RP) from the Minister of the Interior, which indicated the government’s interest in the land had been settled by the payment of a commutation fee. Commutation means “an exchange, or replacement.” The commutation fee was usually set at a maximum of one-third of the value of the unimproved land. The fee could be settled by the exchange of cash but was usually settled by the return of one-third of the lands (or cumulative value of the lands) originally awarded to the claimant (Chinen 1958:13).

On 8 March 1848, Kauikeaouli further divided his personal holdings into lands he would retain as private holdings and parcels he would give to the government. This act paved the way for government land sales to foreigners. In 1850, the legislature granted resident aliens the right to acquire fee simple land rights (Moffat and Fitzpatrick 1995).

On 19 October 1849, the Hawaiian Privy Council adopted resolutions to protect the rights of Native tenants, the *maka‘āinana*. The Kuleana Act of 1850 confirmed these rights. Under this act, the claimant was required to produce two witnesses who knew the claimant and the boundaries of the land, knew that the claimant had lived on the land for a minimum of two years, and knew that no one had challenged the claim. The land also had to be surveyed. Native tenants or naturalized foreigners who could prove occupancy on the parcels before 1845 could be awarded lands they occupied or that they cultivated as *kuleana* (land holding of a tenant or *hoa‘āina* residing in the *ahupua‘a*) awards.

No commutation fee was necessary to apply for a Royal Patent for a *kuleana* award, as the commutation fee had presumably already been paid by the *ali‘i*/*konohiki* who had been awarded the entire *ahupua‘a*, or an *‘ili* in which the native tenant claimed his own small parcels (Chinen 1958:29–30).

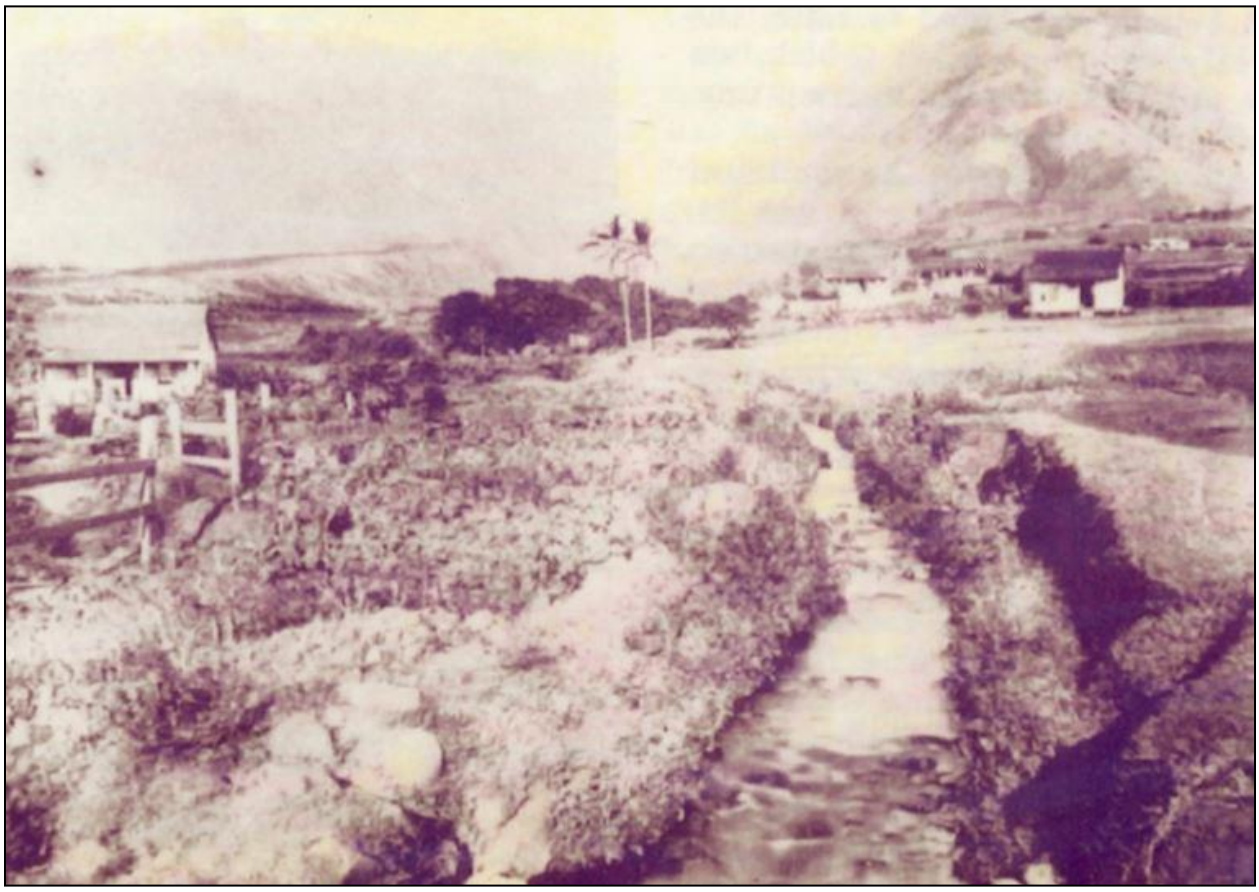


Figure 13. Early photograph of Waikapū Valley showing *lo‘i, ‘auwai*, and dispersed homes (Waikapu Community Association 2018)

Crown Lands were defined as: “[…] private lands of His Majesty Kamehameha III, to have and to hold for himself, his heirs and successors forever; and said lands shall be regulated and disposed of according to his royal will and pleasure subject only to the rights of tenants” (Kingdom of Hawaii 1848:25). Wailuku was declared as “Crown Land” to be used to support the Kingdom of Hawai‘i. Ruth Ke‘elikolani, half-sister of Kamehameha V (Lot Kapuāiwa), inherited the *ahupua‘a* of Wailuku from Lot Kapuāiwa on his death in 1872. Ruth Ke‘elikolani then sold a portion of her Wailuku land holdings to the sugar-industrialist Claus Spreckels in 1882. Spreckels subsequently received Land Grant 3343 from King Kalakaua, that consisted of 24,000 acres of the southeastern portion of the Wailuku Ahupua‘a (Zambucka 1977:48).

The current project area extends through Land Grant 3343 and Land Grant 3152 to Henry Cornwell (Figure 14). During the Māhele, the lands surrounding Waikapū Commons were sold by the Department of Education in ten parcels, each amounting to more than 1,317 acres, and had Royal Patents issued for the sales in 1854. Later, all ten of these Royal Patents were surrendered and cancelled, and the land was quit-claimed back to the Board of Education in August 1860. In 1875 the Board of Education sold at auction the “Land known as the ahupuaa of Waikapu, saving grants hitherto made within said ahupuaa, or sales by the board of education” to Mr. Henry Cornwell, lands extending out from Waikapū Valley to the northwestern boundary of Pulehunui Ahupua‘a (*Pacific Commercial Advertiser* 1879:5). Cornwell acquired the lands in fee-simple under Royal Patent No. 3152. The lands purchased by Cornwell were added to the holdings of the Waikapu Sugar Plantation, originally started by Henry Cornwell and James Louzada on Grant 2951, before the plantation was sold in 1876.

### 4.1.4 Mid- to Late 1800s

A common crop on nearly all major Hawaiian Islands was sugarcane. With the passage of Hawaiian lands into the western model of privatization, coupled with the decline of the indigenous population, the wet valleys on Nā Wai ‘Ehā began to shift away from subsistence farming toward plantation-style sugarcane cultivation. The fertility of the river valleys of Nā Wai ‘Ehā were readily observed by visitors of the period. While traveling from Mā‘alaea to Waikapū a late nineteenth century observer describes the following scenic views:

> It took us about an hour to drive from Maalea to Waikapu and we began to see some indications of the beauty which the inhabitants of Maui ascribe to their beloved isle. The mountain mass that seemed shapeless is rent by a series of deep gorges—each, we were told, a scene of bewildering beauty, both in rock-scenery and foliage. [Cummings 1881]

In general, it appears the most agriculturally fertile lands of Waikapū Ahupua‘a did not extend beyond the alluvial sediments of the stream valley as the lower elevations leading into the central isthmus of Maui are dominated by windswept Pleistocene sand dune deposits (Foote et al. 1972:48, 115) (Figure 15).

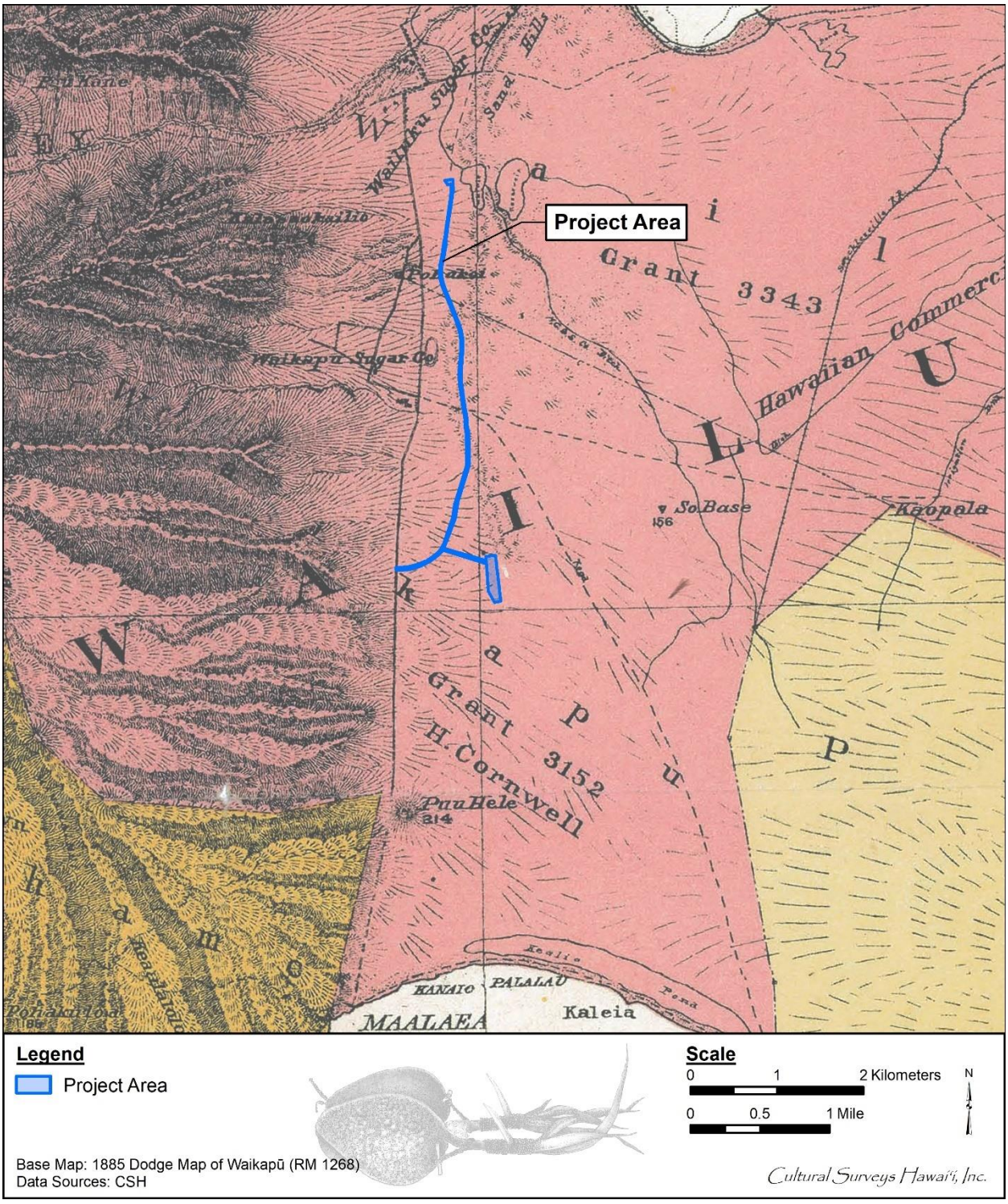



Figure 14. Portion of Dodge (1885) map showing the current project area within Grants 3152 and 3343

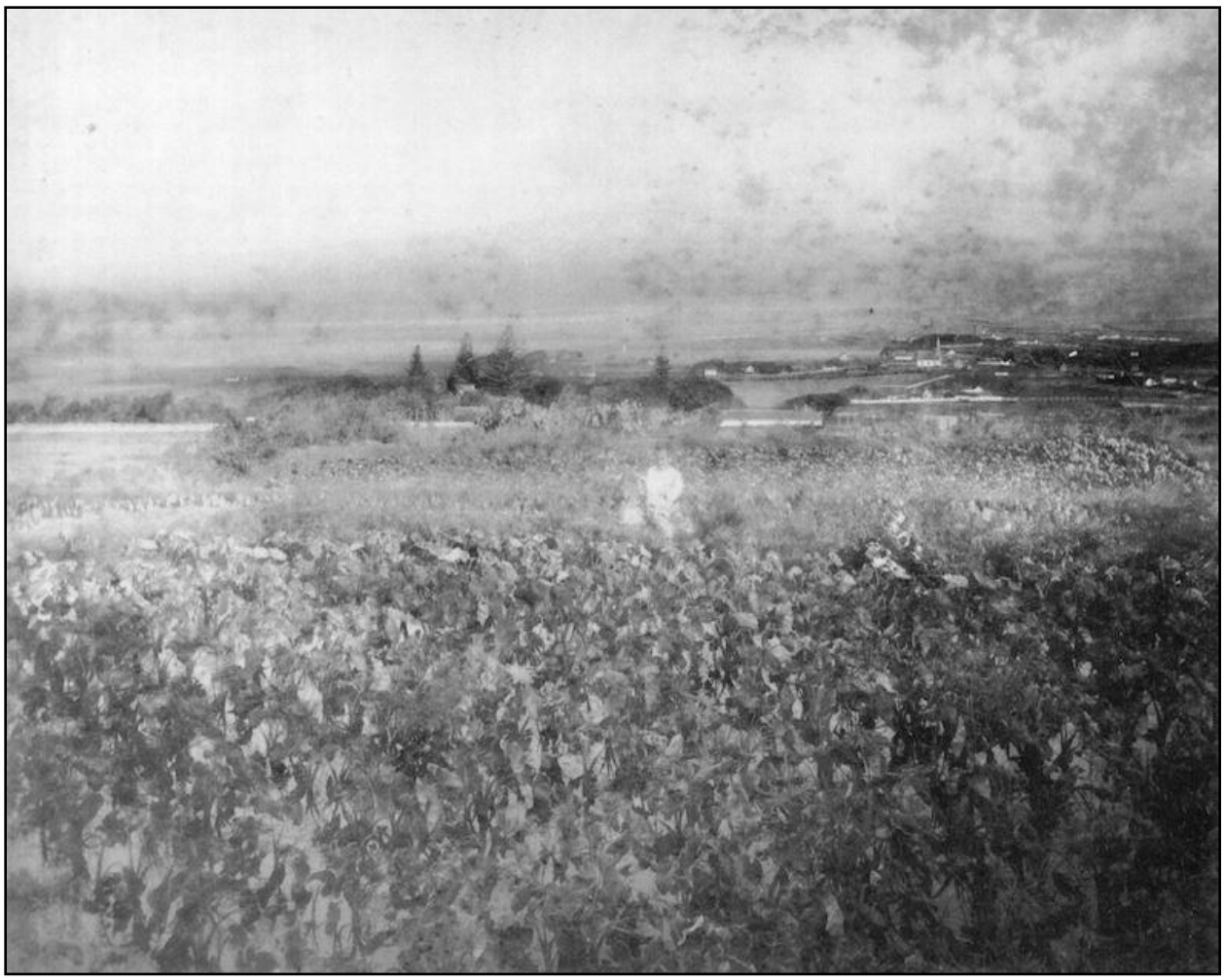


Figure 15. Historic photograph of the plains of Kama‘oma‘o (background) as viewed from the vegetated alluvial slopes of Waikapū Valley (Waikapu Community Association 2018)

#### 4.1.4.1 Waikapū Congregational Church

Prior to the surge in commercial sugarcane cultivation, Waikapū was inhabited by dominantly Hawaiian homes with nearby taro patches feeding from the waters of Waikapū Valley. The small community residing here established the Waikapū Congregational Church in 1838 as a home-based Christian service, sometimes utilizing the facilities of the distant Ka‘ahumanu Church in Wailuku. In 1868, the community was able to erect and dedicate a permanent structure (Figure 16). Residents moving to the region in 1908 recall that “we used to have ‘hoikes’, (rally days) there and folk from all Central Maui used to attend.” According to residents, both the Wednesday night prayer services and Sunday all-day services would fill the church building to capacity (Head 1960).

During World War II, Waikapū Congregational Church was turned over to the military and used as a surgical hospital. The Church building was used as a ward with an additional ‘nurses quarters’ built off to the side of the main structure. It was during this period that the church had its steeple removed for being too clear a target for potential marauding enemy submarine gunners (Figure 17). Although the steeple was re-erected after the war, it continuously leaked and was again removed from the building. As sugarcane cultivation began to dominate the region in the early to mid-twentieth century, residential dwellings dwindled, as did the attendees of the Waikapū Congregational Church. As full-time pastors became unnecessary, the church members voted to merge with the Kahului Church, and the Waikapū Congregational Church was abandoned to the sugarcane fields that surround it (Head 1960).

#### 4.1.4.2 Development of Commercial Sugar in Waikapū

Henry Cornwell arrived on Maui from New York and started the Waikapu Sugar Company with James Louzada (his brother-in law) in 1864. The two partners constructed a steam-powered sugar mill situated on a 17-acre parcel that had been part of Land Grant 2951, land originally purchased by Henry Cornwell and J. Louzada in Waikapū (Wilcox 1996:61) (Figure 18).

In 1878, Claus Spreckels bought an undivided interest in 12,000 acres of the Waikapū Commons from W.H. Cornwell and leased an additional 24,000 acres of adjacent Wailuku Commons crown lands from the government (Wilcox 1996:61). These lands would form a large portion of Hawaiian Commercial and Sugar Company (HC&S). The economic boom resulting from the passage of the Reciprocity Treaty in 1876 encouraged sugar baron Spreckels and other Hawaiian sugar planters to invest heavily in capital improvements such as irrigation systems, mills, and railroads. The reciprocity agreement with the U.S. brought down the heavy cost of high tariffs on sugar. In 1876, Henry Cornwell retired, and the remaining plantation lands were sold to the new partners Colonel W.H. Cornwell (Figure 19) and Colonel G.W. Macfarlane *(Honolulu Advertiser* 1903:8). Henry Cornwell, originally born on Long Island in 1815, died in Waikapū in 1886 and was buried at Nu‘uanu Valley Cemetery on O‘ahu (*Honolulu Advertiser* 1886:3)

During his time as the head of the Waikapū plantation, Col. William H. Cornwell nourished a healthy relationship with Hawaiian royalty. As a close friend of King Kalākaua and Queen Regent Lili‘uokalani, Col. Cornwell hosted events for the monarchs on his Maui properties, including celebrations for the Kalākaua’s birthday that entailed festivities and horse races (*Evening Bulletin* 1888:3) (Figure 20).

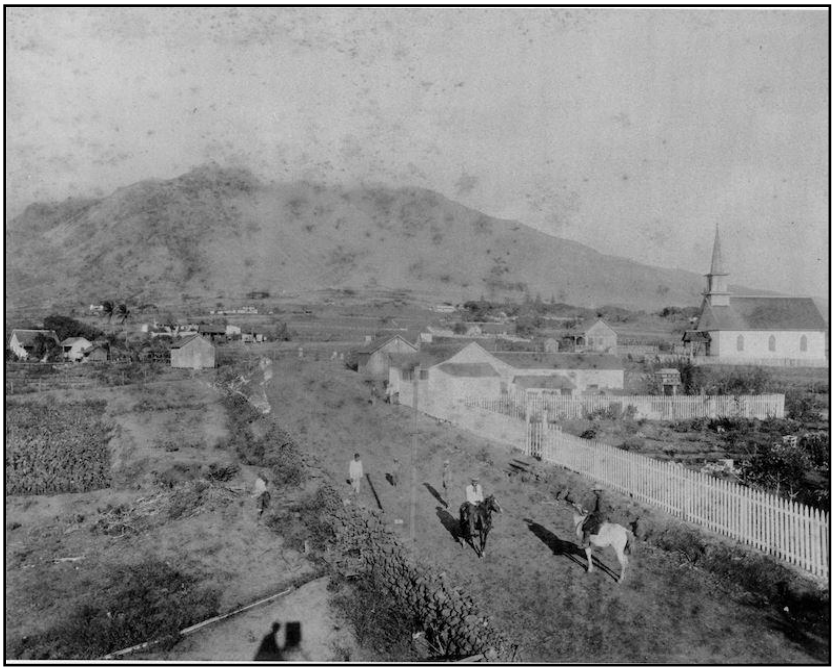


Figure 16. Historic photograph of Waikapū Congregational Church, Waiko Road, and the surrounding community (Waikapu Community Association 2018)

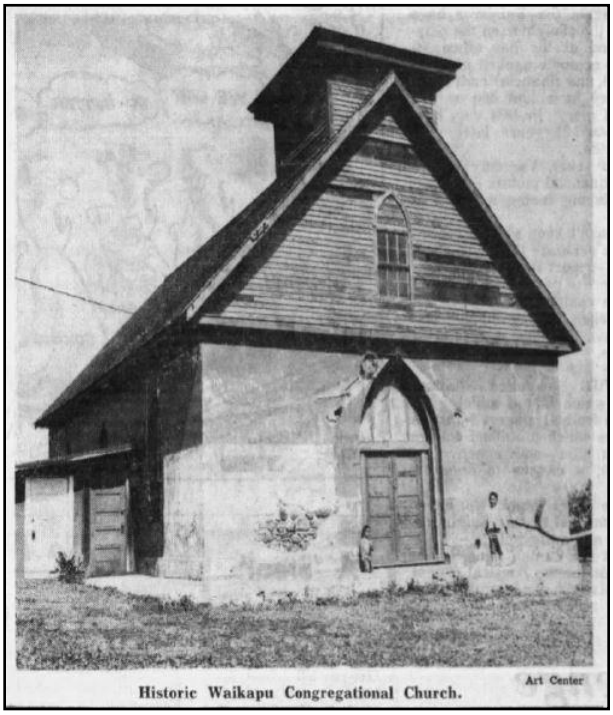


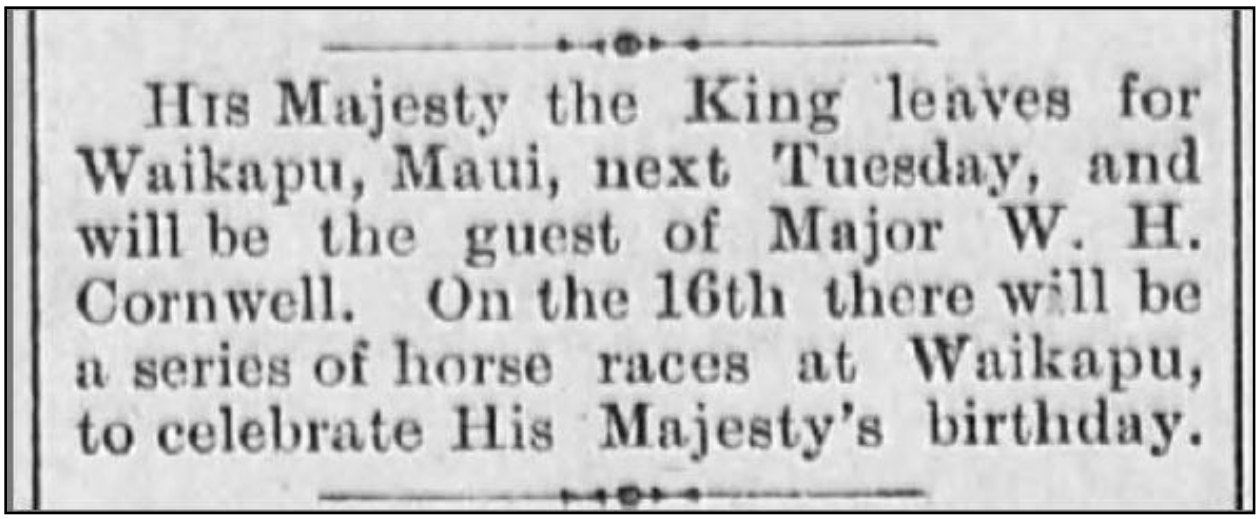

Figure 17. Waikapū Congregational Church after having its steeple removed during World War II (Waikapu Community Association 2018)




Figure 18. Waikapu Sugar Company mill, ca. 1890 (Waikapu Community Association 2018)



Figure 19. Colonel William H. Cornwell in the garb of the Hawaiian Royal Court (Unknown 1893)



His Majesty the King leaves for Waikapu, Maui, next Tuesday, and will be the guest of Major W. H. Cornwell. On the 16th there will be a series of horse races at Waikapu, to celebrate His Majesty's birthday.

Figure 20. Newspaper announcement for the arrival of Kalākaua visit to W.H. Cornwell on Maui for the King's birthday (*Evening Bulletin* 1888)

Kalākaua’s annual celebrations on November 16 would be remembered well into the early twentieth century for the excitement of the horse races and the occasional after-race polo match (*Honolulu Advertiser* 1916). Col. Cornwell also was appointed a member of the king’s staff in the Revolution of 1887, elected to a four-year term as a member in the House of Nobles in 1890, and served a very short stint as the Minister of Finance in the cabinet of Queen Regent Lili‘uokalani (*Honolulu Advertiser* 1903:8). Most of the Waikapū Commons and across the isthmus was covered with sugarcane by the mid-nineteenth century. Waikapu Sugar Company operated from 1862 to 1894, when it was purchased and incorporated into the holdings of Wailuku Sugar Company (Kaukali and Subica 2010).

#### 4.1.4.3 Organization of the Wailuku Sugar Company

A Chinese planter, Hungtai, is reputed to have operated the first sugar mill at Wailuku in 1823. As early as 1840, the first sugar venture organized by the Kingdom of Hawai‘i was begun by Kamehameha III (Kauikeaouli), at Wailuku (Moffat and Fitzpatrick 2004:54). The king’s Wailuku plantation and mill were described by the Protestant missionary, Richard Armstrong, in these terms:

> The King has given out small lots of land, from one to two acres, to individuals for the cultivation of cane. When the cane is ripe, the king finds all the apparatus for manufacturing and when manufactured takes the half. Of his half, one fifth is regarded as the tax due to the aupuni (Hawaii Department of Survey) & the remaining four fifths is his compensation for the manufacture. These cane cultivators are released from all other demands of every description on the part of the chiefs. [Wailuku Mission Station Report 1839 in MacLennan 1997:33]

The modern plantation framework for the Wailuku Sugar Company began in the 1850s by the Protestant missionary Edward Bailey and one of his sons. Their early water-run mill eventually merged with sugar cultivation performed by Bal and Adams. These pioneer sugar partners later began the Wailuku Sugar Company. In 1862, the partners of the Wailuku Sugar Company grew to include James Robinson & Company, Thomas Cummins, and J. Fuller (Wilcox 1996:122). In 1863, Charles Brewer became a major partner in the operation of the Wailuku Sugar Company. By 1867, the Wailuku Sugar Company had 2,250 acres planted in cane. The Wailuku Sugar Company incorporated in 1875 and began to become profitable. In 1877, the Baileys were bought out (Nellist 1925:70).

#### 4.1.4.4 The Waikapū Division of the Wailuku Sugar Company

The Waikapū sugar lands became a part of the Wailuku Sugar Company in 1894. Beginning in 1880, the Waikapū plantation lands began to be merged with those of the Wailuku and Waihee plantations. During the 1880s, F.L. Hoogs was named the head overseer of the Waikapu Division of the Wailuku Sugar Company. In 1887, American sugar growers revolted against the Hawaiian Monarchy and demanded a more liberal Constitution, which was granted, under duress, by Kalākaua. In 1905, a new sugar mill was constructed in Wailuku to accommodate the sugar brought in from the new outlying plantations, including Waikapū (Kaukali and Subica 2010:98).

The economic progress of the Wailuku Sugar Company required the importation of foreign labor. The increase in the labor population at the plantations required larger laborer camps. By the

1890s, a network of plantation housing camps had been established at the Waikapu Division of the Wailuku Sugar Company. These included Hopoi Camp, located at the Hopoi Reservoir, upland of the Wai‘ale Reservoir; Waikapu Camp, located downslope of the Palolo Ditch and the south side Waikapū Ditch, on the Waikapū Stream; Hyashi Camp, located just west of Waikapu Camp, toward the Pu‘u Hele cinder cone; Kimura Camp, located further west from Hyashi Camp; Pu‘u Hele Camp, located at the base of a cinder cone downslope of the Pohakea Gulch, where today the North Kīhei Road meets the Hono a Pi‘ilani Highway and the Pu‘u Hele Cemetery (Figure 21). In the 1880s, immigrants from South America began to settle in Waikapū. They worked the sugar fields and brought their love of horseracing to the plantation culture of Maui (Kaukali and Subica 2010:98).

The traditional *konohiki* system of water division was evident at the Waikapu Division of the Wailuku Sugar Company. In an 1896 lawsuit (Cornwell v. Wailuku Sugar Company), testimony was entered regarding the destruction of traditional *kuāuna* (embankments of taro patches). This testimony established that, along with the growing of cane in the region, the traditional farming of taro had continued based on the customary rights of landowners under the old Hawaiian tenure. The Wailuku Sugar Company brought the action to stop traditional landowners from diverting irrigation water for raising taro (Hawaii Supreme Court 1896).

#### 4.1.4.5 Hawaiian Commercial and Sugar in the Central Isthmus

The success of sugar grown in the region resulted in a second large plantation, in Waihe‘e, producing over 757 tons of sugar and 45,000 gallons of molasses in 1865. The Waihe‘e mill manager was Samuel T. Alexander, and the mill’s head foreman was Henry P. Baldwin, both of whom would resign in the late 1860s to establish a small sugar enterprise of their own in upper Pā‘ia (Gilmore 1936).

In 1869, on land located directly west of Pā‘ia, a small *kuleana* of 11.94 acres was purchased by S.T. Alexander and his business partner, H.P. Baldwin, both descended from Lāhainā missionary families, who were eager to apply their agricultural experience to their own plantation. This initial land purchase was the beginning of the development of the entire central isthmus for sugar cultivation. In rapid succession, Alexander & Baldwin expanded its operations by purchasing other small *kuleana*, setting up a mill, and attracting more investment capital (Dean 1950).

In 1876, the Reciprocity Treaty opened larger and more lucrative markets for Hawaiian sugar. Plans were immediately drawn up by Alexander & Baldwin to finance a ditch to bring water from the Hāna region of East Maui to the arid plains of Pā‘ia. The Kingdom of Hawai‘i issued a lease for the construction right-of-way, and in 1879, the successful venture delivered millions of gallons of water to the central isthmus via the Hamakua Ditch (Wilcox 1996).

Competition was supplied by Claus Spreckels who engineered a similar irrigation ditch from Honomanū in East Maui to lands located just inland of Kahului, where the Spreckelsville Mill and plantation camp were built. Spreckels invested three million dollars in the HC&S and competed for sugar lands, wharf and warehouse space, railway lines, and shipping schedules with Alexander & Baldwin (Dorrance and Morgan 2000).

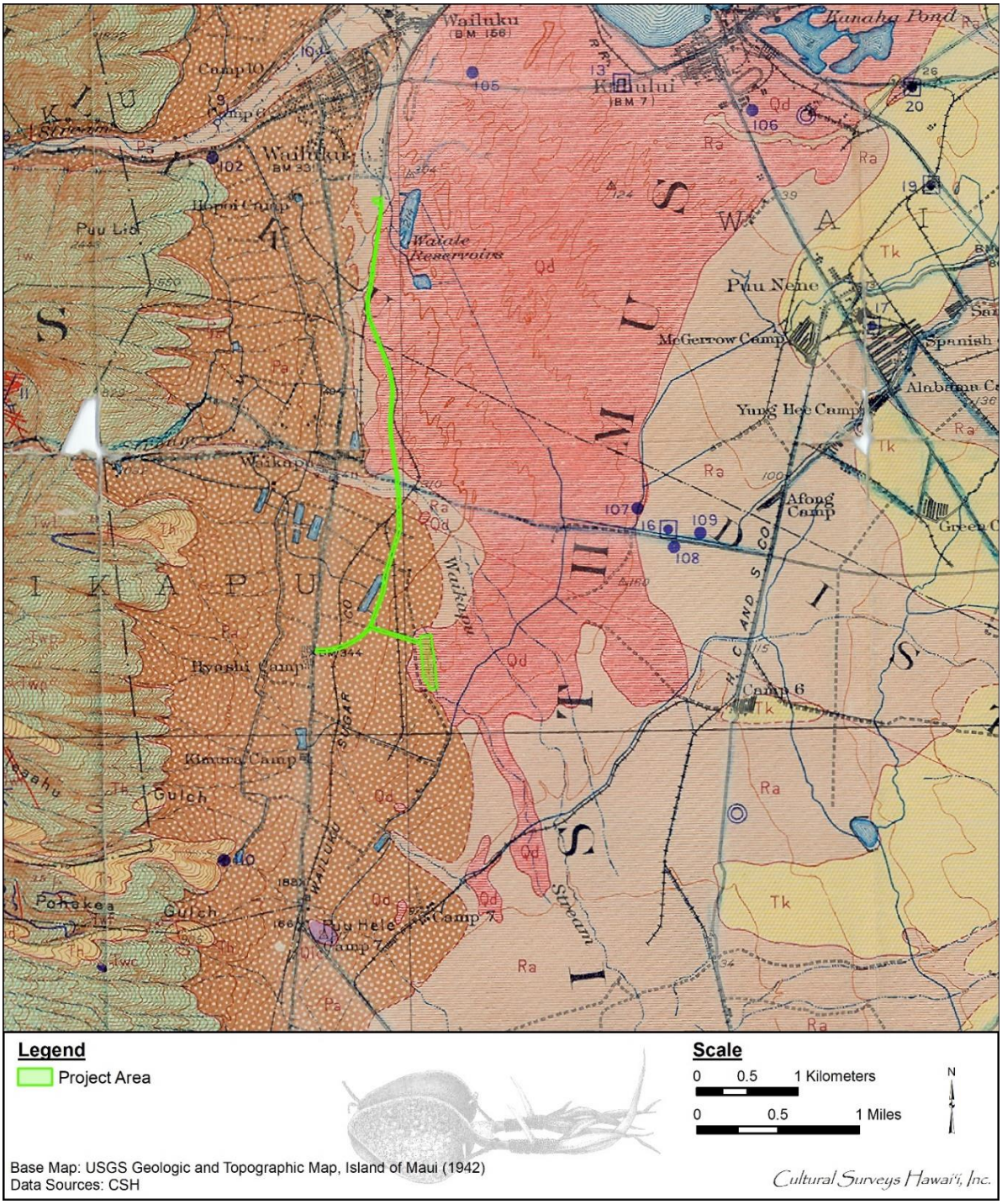



Figure 21. Portion of a 1942 Island of Maui USGS geologic and topographic map showing testing locations, calcareous sand dunes, unconsolidated deposits of younger alluvium, consolidated earthy deposits of older alluvium, and erosional unconformity of Kula volcanic series flows

In 1882, Spreckels, following his success in building the Honomanu Ditch linking East Maui water sources with his sugar fields in the central isthmus, further capitalized on that success to engineer the Waihe‘e Ditch (also named the Spreckels Ditch) in West Maui. The 15-mile-long ditch started at the 435 ft elevation of Waihe‘e Stream, and carried 60 million gallons of water (per 24-hour day) to the Wai‘ale Reservoir at the 214 ft elevation of Wailuku. Spreckels became the first plantation owner to irrigate his fields by water from both Haleakalā and the West Maui mountains (Wilcox 1996). By 1888, the Spreckels plantation covered 28,000 acres, making it the largest sugar plantation in the world. Financial pressures forced Spreckels to give up control of HC&S to Alexander & Baldwin in 1898 after a long and fierce battle (Dean 1950). An 1885 Dodge map of Maui shows early encroachment of HC&S cultivation lands into the Waikapū area (Grant 3343) (see Figure 14) and a 1940s USGS map shows the extent of HC&S sugar lands and the associated sugar plantation infrastructure, such as irrigation ditches and labor camps, in the vicinity of the project area (Figure 22).

In 1899, HC&S determined that cultivating the Pu‘unēnē plains required far more water than the original Hamakua Ditch could provide. The Lowrie Ditch project, completed in 1900, was undertaken to provide an additional source of water to the central Maui plains. The ditch began at the Pāpa‘a‘ea Reservoir, at 1,000 ft elevation, and maintained a 4-ft drop per mile following the ditch’s initial plunge from the Kailua reservoir. Steep mountain gulches were traversed using the force of the constant weight of water flowing in a series of siphons. The Halehaku Gulch, at 250 ft deep, and the Māliko Gulch, at over 350 ft deep, were both crossed by giant siphons fabricated of three-eighths-inch iron and set in place by Japanese laborers (Thrum 1900).

### 4.1.5 1900s

In 1912, HC&S began to modernize the existing plantation camps. Between a huge influx of immigrant workers in 1909, and the burning of village areas of Pā‘ia and Kahului to control smallpox in 1910, changes to the camp system were in full swing. The plantation workforce continued to expand until 1917, when the U.S. declared war on Germany, and the accompanying draft seriously depleted the labor pool. By 1919, postwar requirements for sugar had driven the price to an all-time high of $471.40 per ton (Burns 1991). The post-World War I years saw the sugar industry, and companies like HC&S, add electricity to some villages. HC&S completed the Waikapū well (Well 7) in 1926, one of the largest deep wells in the world. The additional capacity of 40 million gallons per day (mgd) provided by this well was instrumental in planning more sugar and industry within Maui’s central plains (Stearns and Macdonald 1942:216).

On 11 November 1929, Inter-Island Airways, Ltd. (later Hawaiian Airlines) began flying regularly scheduled flights between the Hawaiian Islands. Amphibious eight-passenger Sikorsky S-38 aircraft landed at Mā‘alaea Bay, taxied up a concrete ramp, and delivered passengers to waiting automobiles for the trip through Waikapū to Wailuku, and points beyond (Saito 2009).

By 1936, the airline had purchased three new 16-passenger Sikorsky S-43 aircraft to supplement their four S-38s (Kennedy 1937). With air travel between islands increasing, plans were underway to build a land-based air strip at Pu‘unēnē in Pūlehu Nui Ahupua‘a in lieu of the smaller airport located at Mā‘alaea Harbor.

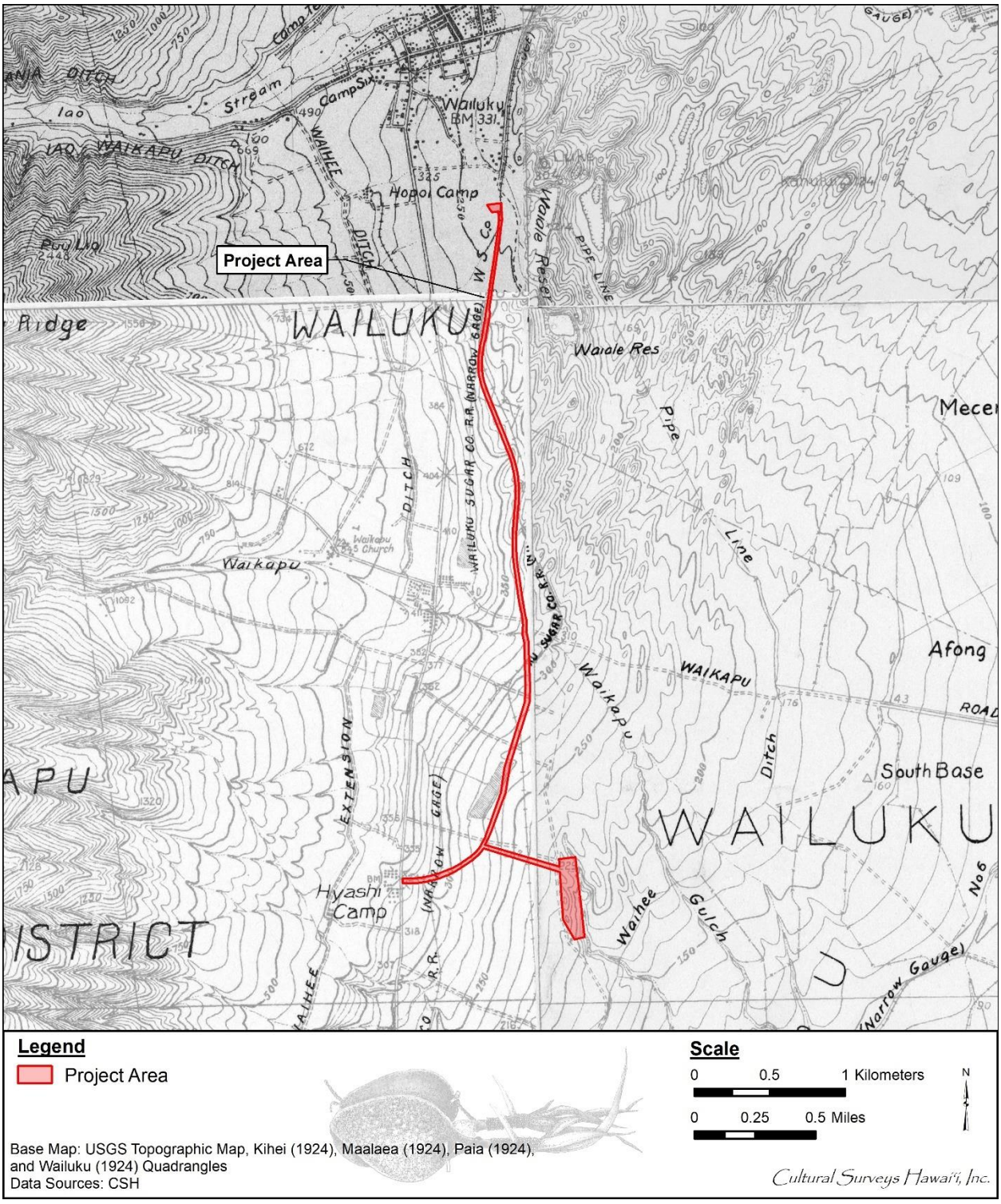



Figure 22. Portions 1924 Kihei, Maalaea, Paia, and Wailuku USGS topographic quadrangles showing plantation camps, railways, and unimproved cane roads around the project area

#### 4.1.5.1 Pre-World War II Aviation History

The Civil Aviation Authority (CAA) for the Territory had recommended an airport for Pu‘unēnē to accommodate the growth of commercial service in the early 1930s. The site was approved by the U.S. Army, Inter-Island Airways, the HC&S, the Kahului Railroad Company, and the CAA. Three intersecting runways were designed alongside the existing government roadway and railway lines connecting Kīhei Village to the HC&S mill and village at Pu‘unēnē.

By the mid-1930s, it was clear Japanese aggression against mainland China was jeopardizing the political stability of the Pacific region (Morison 1951). Pacific Naval Air Bases (PNAB) construction engineers were assigned to reinforce United States military outposts across the Pacific. In Hawai‘i, the construction of new civilian airports at Kane‘ohe (O‘ahu) and Pu‘unēnē (Maui) was undertaken by the U.S. Engineer Department (later U.S. Army Corps of Engineers [USACE]) contractors. Prior to 1940, 13 separate defense-related construction projects were begun in the Hawaiian Islands, primarily at Pearl Harbor (Woodbury 1947).

The Hepburn Board, a commission of six officers and engineers reporting to the U.S. Navy, authorized the immediate military-backed expansion of an existing design for a civilian airfield at Pu‘unēnē. Quarters for a permanent utility squadron, as well as for rotating Carrier Air Service Units (CASU) crews, were hastily approved (Woodbury 1947). The U.S. Engineer Department and PNAB construction crews began work on 17 June 1940, building quarters and messing facilities for 500 men. The Navy used barracks at the National Guard Camp in Paukūkalo while completing buildings at NAS Pu‘unene (Shettle 1997).

Two 50,000-gallon above-ground gasoline tanks were erected, and railroad spurs were laid to facilitate a direct supply line with the Kahului Harbor. As work progressed, a slew of change orders added bombproof revetments for aircraft storage, as well as bomb and ammunition magazines. By the time Pearl Harbor, on the island of O‘ahu, was attacked, NAS Puunene was an active training base (U.S. Department of the Navy 1947).

The location of Utility Squadron Three (VJ-3) at the Pu‘unēnē airfield was found to be ideal for operations involving the use of radio-controlled aircraft for anti-aircraft training. The development of radio-controlled full-scale aircraft was code-named “Project Dog,” and began as a military program located on the east coast of the United States in the mid-1930s (Farhney 1982). Project Dog was moved to San Diego in 1938, and finally to the Navy’s Maui Airport at Pu‘unēnē early in 1940, in order to prove the practicality of radio-controlled assault drones. These tests were the earliest experiments leading toward the development of the guided missile.

Full-scale fortification of the Hawaiian Islands began January 1940, immediately after President Franklin D. Roosevelt cancelled all trade agreements with Japan. On 7 May 1940, the U.S. Pacific Fleet was ordered out of the port of Los Angeles, to be based at Pearl Harbor, in the Territory of Hawaii. This action was designed as a deterrent against further aggression by Japan in the Pacific region (Morison 1951).

Lieutenant Robert F. Jones commanded VJ-3 at NAS Pu‘unene, and advanced the syllabus of testing radio-controlled aircraft to the point where a radio-controlled aerial torpedo was thought to be possible. By April 1941, the Navy’s efforts to develop a practical way to control drone aircraft from greater distances was in full swing (Foundation 2002). In the middle of this research program,

Navy Fighting Squadron VF-2 arrived at the Pu‘unēnē aerodrome for training purposes in April 1941.

Based aboard the aircraft carrier USS *Lexington*, the “Flying Chiefs” of VF-2 trained on Maui for approximately two months, returning to sea with the USS *Lexington* to take part in operations to ferry aircraft and supplies to Midway Island. The training regime of VF-2 included the use of “unrestricted air space for gunnery and tactics and many nearby bombing and strafing targets” (Lacouture 1989). The target range was located at lower ‘Ulupalakua, and the aircraft used practice bombs filled with lime powder and beach sand to mark their accuracy.

In May 1941, the First Battalion of the Army’s 299th Infantry Regiment was assigned to establish defensive positions along the exposed coastal areas of Maui. Tents housing the administrative section for the Army’s Twenty-fourth Infantry Division, and the Fourth Platoon Signal Company, Aircraft Warning Air Corps Detachment, were located within a 14-acre section at the Maui Airport at Pu‘unēnē (Allen 1950).

Plans were drawn up to expand the airfield to a size large enough to support both a U.S. Navy carrier air group and an U.S. Army Air Corps bombardment group. On average, pre-war U.S. Navy air groups consisted of 90 aircraft, made up of scout, dive-bomber, fighter, and torpedo divisions. A pre-World War II U.S. Army Air Corps bombardment group consisting of three squadrons of medium or heavy bombers would have numbered about 30 aircraft (Morison 1953).

#### 4.1.5.2 World War II

With the outbreak of war between Japan and the U.S., NAS Pu‘unene became the command headquarters for both Navy and Army units on the island of Maui. Plantation heavy equipment and plantation operators worked side by side with U.S. Engineering Department personnel to accelerate construction of defensive positions and immediately lengthen runways at the base. The call for an immediate extension of the runways to military specifications involved extensive engineering to reroute miles of irrigation culverts for the HC&S. The dispersion of facilities planned for NAS Pu‘unene would come to utilize over 2,500 acres of land, and involve housing for over 5,000 men (Command History 1945).

The 7 December 1941 attack on Pearl Harbor forced the Project Dog program at NAS Pu‘unene to assign its research to safer bases in the mainland United States. Wartime operations for VJ-3 would concentrate exclusively on providing radio-controlled aircraft as realistic targets for fleet anti-aircraft gunnery training exercises (Foundation 2002). Under wartime conditions, responsibilities for VJ-3 included maintaining an intense schedule of weather flights, rescue flights, and anti-submarine reconnaissance flights in the waters surrounding Maui.

Early in 1942, the first Carrier Air Service Unit, CASU-4, was commissioned at NAS Pu‘unene, and the utility squadron personnel of VJ-3 were reinforced by Naval Air Station Officers. In June 1942, U.S. Navy Fighting Squadron 72 (VF-72), the first of over 150 squadrons of U.S. Navy fighter, bomber, and scout aircraft, arrived for advanced training prior to moving into forward combat areas (Wilcox 2004). For four days in early June 1942, as the Battle of Midway raged 600 miles to the northwest, NAS Pu‘unene personnel were ordered into shelters and revetments, expecting bombing raids by Japanese aircraft sweeping across the Hawaiian archipelago (Paul Vint in Hill et al. 2007). With the success of American naval forces at Midway, the threat of a Japanese

invasion of the Hawaiian Islands was postponed, and U.S. efforts to outfit military bases in the Hawaiian Islands for wartime training were redoubled.

Anti-aircraft gun emplacements and protective aircraft revetments were given top construction priority by the U.S. Pacific Naval Air Bases supervisors. Heavy equipment and civilian operators from Wailuku Sugar Company and HC&S Company were employed at NAS Pu‘unene with their pay charged back to the U.S. government. Sugar milling at plantations across the Hawaiian Islands was confined to daylight hours until “blackout” procedures for night operations were approved (HC&S Archives).

U.S. Engineering Department construction contractors were reinforced at NAS Pu‘unene by additional PNAB personnel in July 1942. Domestic water pipelines were laid by HC&S to supply military camps being constructed at ten separate locations across the central Maui plains, including the Camp 6 location proximate to NAS Pu‘unene. The main government road and the railroad lines that served the wharf at North Kīhei were rerouted as NAS Pu‘unene expanded. The U.S. Army National Guard 108th Regiment, Twenty-Seventh Infantry Division, took up defensive duties along Maui’s coastlines beginning in March 1942, and occupied formal headquarters at NAS Pu‘unene (U.S. Army 1948).

On 16 November 1942, 400 men forming an advance echelon of the U.S. Navy Thirty-Ninth Construction Battalion (“SeaBee”) arrived at NAS Pu‘unene to begin construction of underground fuel bunkers, bombproof buildings, ammunition magazines, and an aviation ground school. By 20 September 1943, the first aircraft of Composite Squadron 23 (VC-23) landed with personnel and gear on hand for duty. Carrier Air Service Unit 32 assumed command of modifying and maintaining the aircraft of each visiting training squadron for combat duty in the Pacific Theater of Operations (Eggertsen 1947). The Thirty-Ninth SeaBees built 19 concrete ammunition storage magazines in Kanahā Pond, structures that remain today as storage bunkers for the County of Maui and the State of Hawai‘i. Construction of NAS Kahului continued in mid-June 1944 with the arrival of the 142nd SeaBees (U.S. Department of the Navy 1947).

In full operation, both NAS Puunene and NAS Kahului were virtual cities in themselves. Each employed several hundred civilian clerical and maintenance workers and provided housing to thousands of U.S. military personnel. At NAS Kahului, Construction Battalion Maintenance Unit (CBMU) personnel from CBMU 563 arrived 29 December 1943. The unit was responsible for the continued operation of refrigeration, water purification, and electrical components in kitchens, hospitals, churches, barracks, and offices. The open coastline at NAS Kahului allowed for live-fire training areas, where gunners practiced firing machine guns from turrets constructed to duplicate those on board scout-bombers and torpedo bombers (U.S. Department of the Navy 1945).

Immediately following the August 1945 surrender of Japan to the military forces of the U.S., additional facilities essential to the operation of NAS Kahului were removed from NAS Puunene. A bowling alley, bakery, and other specialized structures at NAS Puunene were relocated to NAS Kahului, only to be partially or entirely destroyed by a series of tidal waves that struck NAS Kahului facilities in 1946. On 1 April 1946, the Kahului Harbor and NAS Kahului suffered serious damage after a tsunami generated in the Aleutian Islands, Alaska, struck the north coast of Maui. Kahului Harbor was left empty when the water receded. The Coast Survey tide gage recorded five

waves with heights in excess of 9 ft during the first 90 minutes of the tsunami, two of the waves being greater than 11 ft (Green 1946).

At the end of World War II, the small harbor landing at Kā‘anapali closed. All pineapple shipments from the Baldwin Packers Cannery in Lāhainā were trucked to the port of Kahului for shipment. The systematic closing of all military installations on Maui saw the departure of over 15,000 men from "Maui's Own" Fourth Marine Division. During October and November 1945, Marines of the Twenty-Third, Twenty-Fourth, and Twenty-Fifth Regimental Combat Teams, plus their attached support groups, boarded aircraft carriers docked at the port of Kahului for deactivation in California (Proehl 1946). By 30 June 1947, the transfer of NAS Kahului to the CAA for the Territory of Hawaii was well underway, and virtually all military equipment of NAS Kahului had been shipped to military installations in Guam, Okinawa, or Midway Island (Eggertsen 1947). By the end of 1948, the site of the former NAS Kahului had been chosen to replace the Pu‘unēnē site for all future civilian flight operations.

By quitclaim deed dated 31 December 1948, the lands of the former air base were transferred from the United States back to the Territory of Hawaii. The remaining base facilities, most of which were wooden structures, had, by that time, been abandoned or demolished. In May 1951, the operations of Hawaiian Airlines and Trans-Pacific Airlines (subsequently Aloha Airlines) were moved to the new civilian airport at Kahului, which utilized the runways of the former Naval Air Station Kahului. Thereafter, the airfield at Pu‘unēnē was placed on "caretaker status" and sugar cultivation reclaimed much of the land area formerly dedicated to the aerodrome.

In addition to sugarcane cultivation, much of the lands of Waikapū in the mid-twentieth century were also tied-up in pastural endeavors (Figure 23). In 1952, over 7,000 acres of land along the base of the West Maui Mountains, spanning from Waikapū to Ukumehame, were sold at auction in two leases (15- to 21-year lease terms) for $16,582. These land tracts served as hog and cattle pasturage (*Honolulu Star-Bulletin* 1952:5).

### 4.1.6 Contemporary Land Use

Following World War II, buildings erected during reconstruction of Kahului in the 1910s and 1920s slowly gave way to post-war modernization. HC&S Company camp housing for the Kahului Store, including housing along Mill Street and Pu‘unēnē Avenue for stevedores and railroad workers, began to be dismantled. Areas once occupied by the military returned to cattle ranching, pineapple, and sugar cultivation. Maps and aerial images depict the changing development of the project area (Figure 24 through Figure 27).

The pace of social change began to accelerate. The political power base of the County of Maui began to include *Nisei*, second-generation Japanese Americans who had returned from service in Europe during World War II. Their involvement in county politics began to swing political power from the large agribusiness owners to the union leaders representing plantation workers eager for a change (Speakman 1978). Trucks and buses had replaced passenger transportation once provided by railroads. Cars that had been set up on blocks and stripped of their rubber tires as a wartime rationing measure were back on Maui's roads (Bartholomew and Bailey 1994).

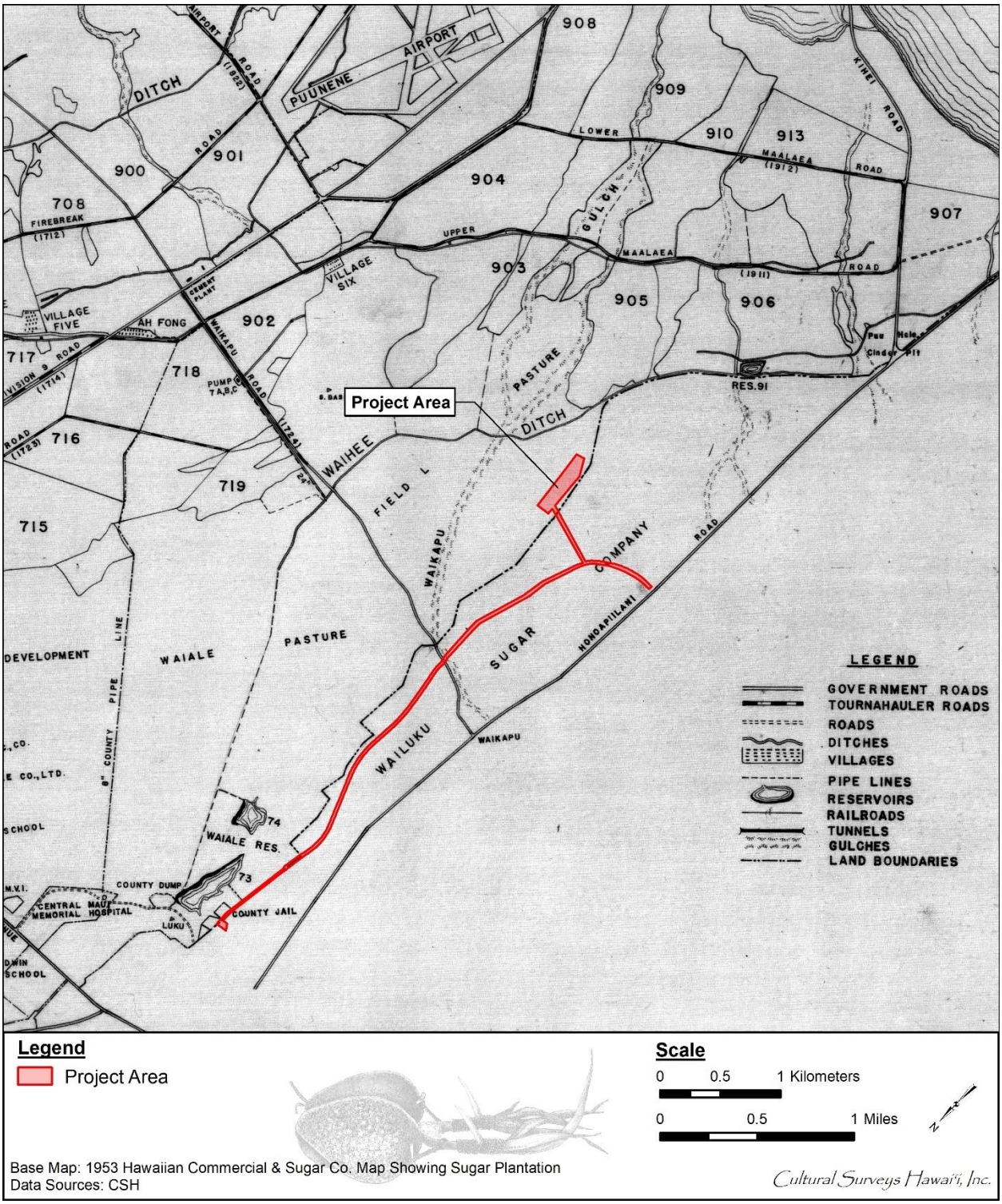



Figure 23. Hawaiian Commercial & Sugar Company (1953) map showing the sugar plantation fields, Waikapu Pasture, Waikapu Road, and Waihe‘e Ditch

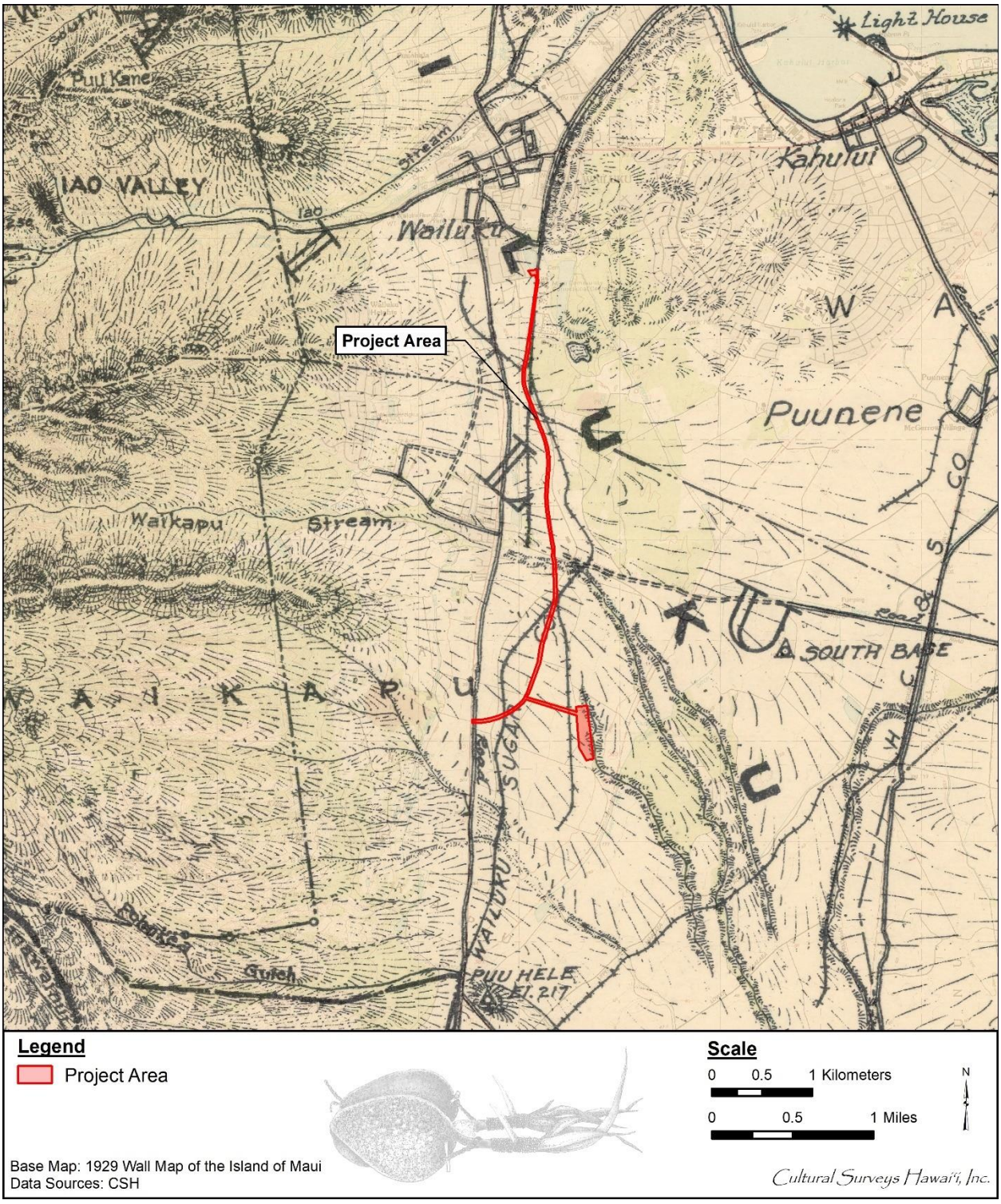



Figure 24. Portion of the Wall (1929) map of Maui showing the limited development surrounding the project area

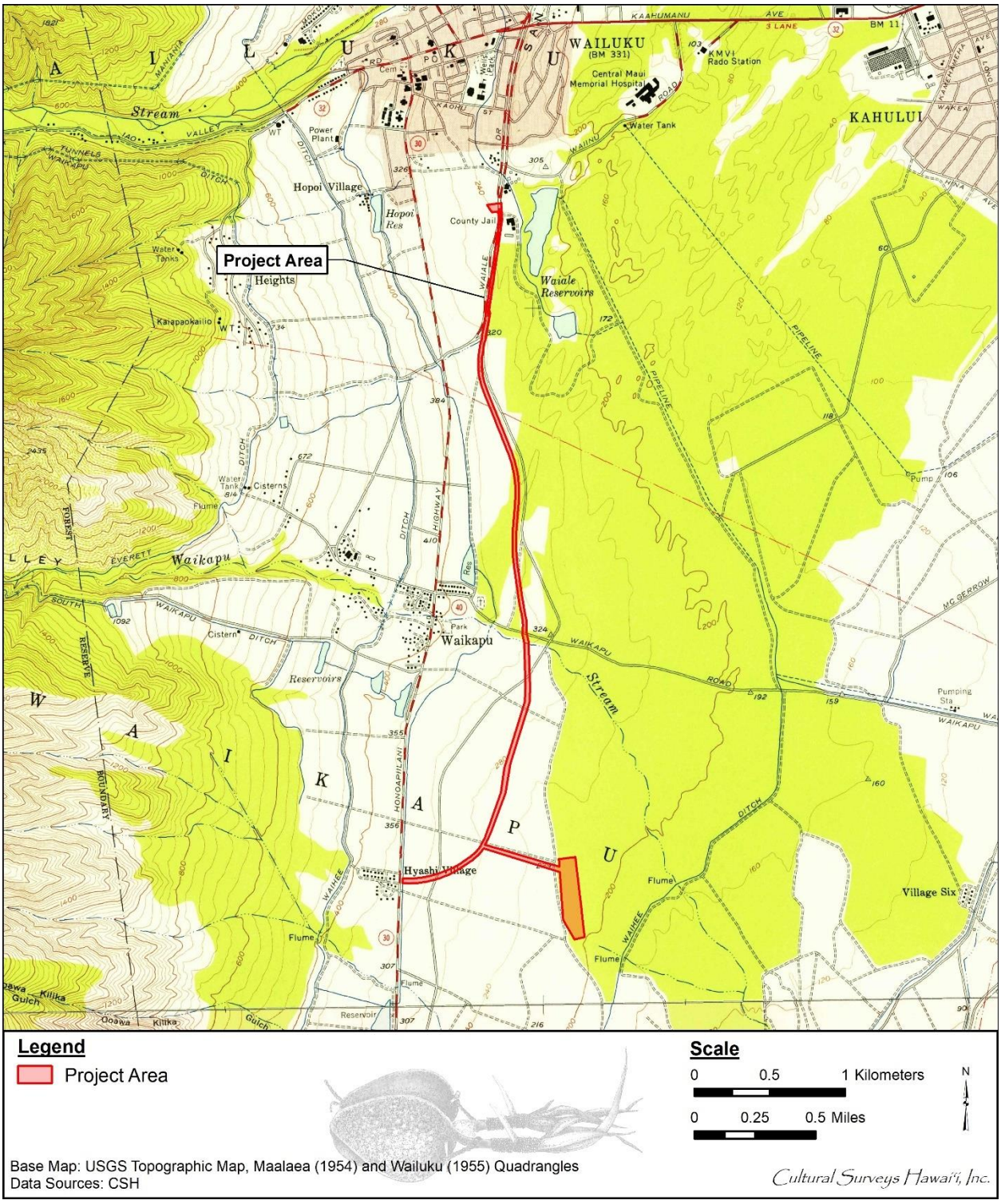



Figure 25. Portions of the 1954 Maalaea and 1955 Wailuku USGS 7.5-minute topographic quadrangles showing the project area and surrounding ditches, roads, and plantation camps

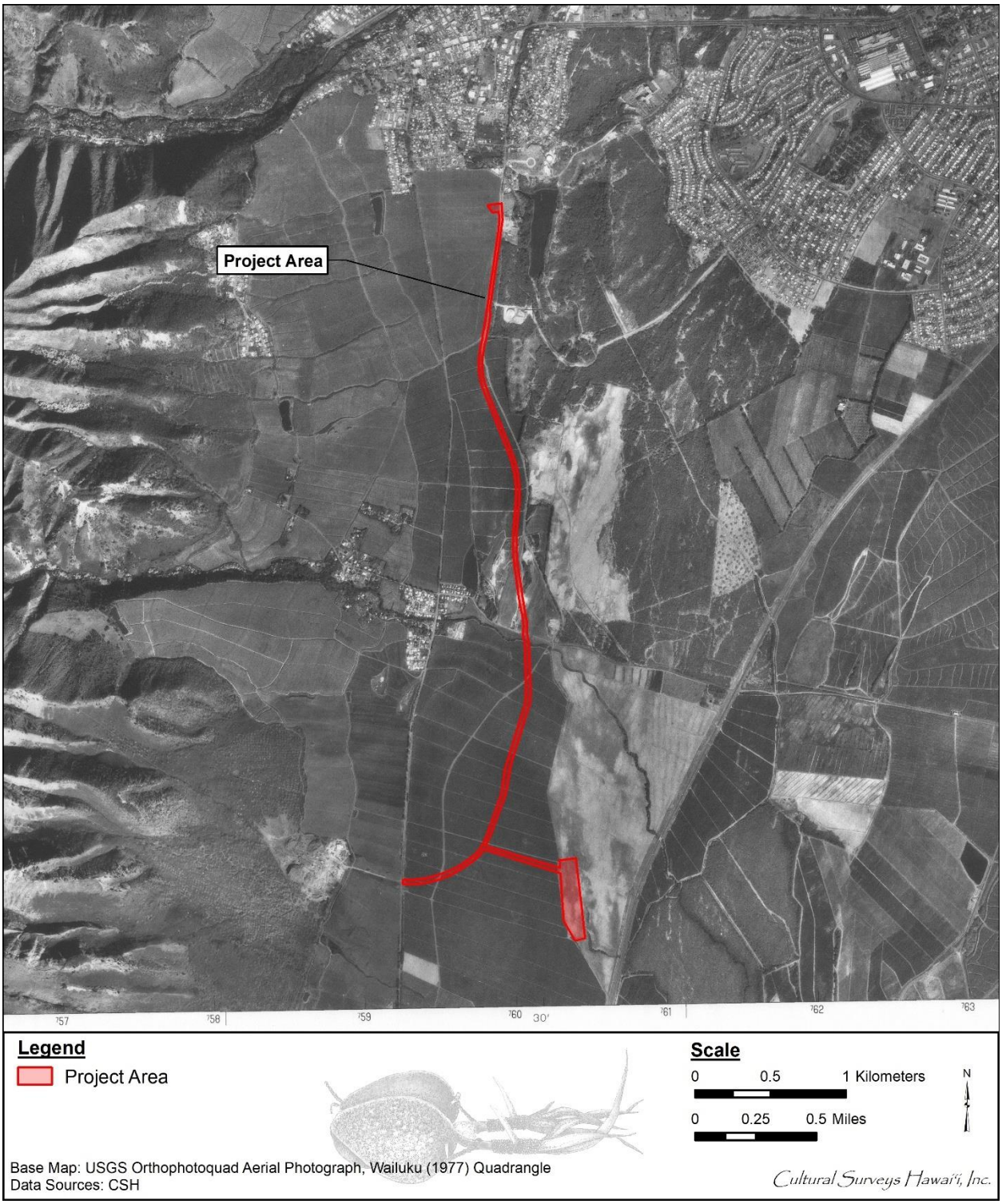



Figure 26. Portions of the 1977 Maalaea and 1977 Wailuku orthophotoquads showing the extent of sugar cultivation around the current project area; note black side is the edge of the orthophoto

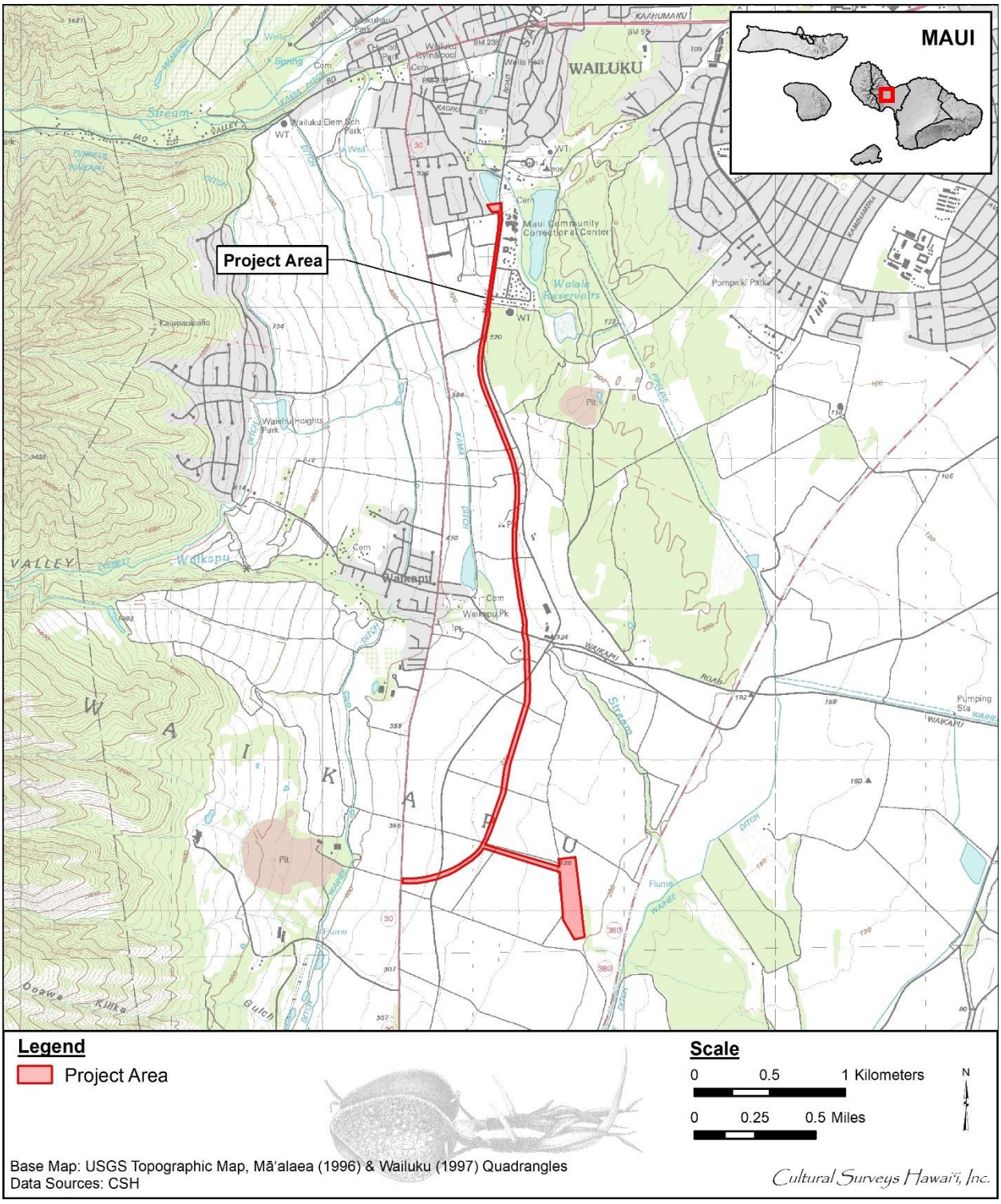



Figure 27. Portions of the 1996 Maalaea and 1997 Wailuku USGS 7.5-minute topographic quadrangles showing the current project area

Early post-war years (1946-1950) saw the construction of H.P. Baldwin High School and Maui Memorial Hospital in Wailuku. In 1947, plans began for wholesale development of Kahului as a master-planned community providing fee-simple ownership of single-family homes (*Honolulu Advertiser* 1956). The majority of homes, which were located between Baldwin High School and Pu‘unēnē Avenue, were purchased by plantation employees and servicemen returning from duty overseas. This trend continued throughout the 1950s, with plantation camp populations falling in the outlying communities, including Pu‘unēnē, and rising in the central town site of Kahului’s new “Dream City” (Dean 1950).

During the Korean War years (1950-1953), modernization of the workforce and stronger unions brought a host of changes to the central region of Maui. The railroads of the prewar age were replaced by trucks and mechanized sugar and pineapple harvesters. Modern facilities at Kahului Harbor meant that canned pineapple, bulk sugar, and molasses could be loaded onto ships faster.

On 12 March 1959, Hawai‘i became the 50th State of the Union. With labor costs for both sugar and pineapple steadily rising in the post-war years, driven primarily by labor union demands, both industries responded by adopting new technical innovations. Containerized shipping revolutionized the freight industry in the early 1960s, leading to the redesign of gantry systems and hardstand support areas to facilitate the moving and storage of the new containers at Kahului Harbor. Matson Navigation Company, a subsidiary of Alexander & Baldwin, became the leader in the development of an industry-wide standard for intermodal containers (Dean 1950). Kahului Railroad Company sold off its locomotives and rolling stock and became Kahului Trucking and Storage Company in 1966. Haleakala Storage & Transfer Company, a privately owned company, took over much of the specialized freight-forwarding operations once performed by the railroad (*Hawaii Business and Industry* 1966).

In the latter half of the 1900s, residential tracts were constructed along both the Kuihelani Highway and Honoapi‘ilani Highway corridors that traverse Waikapū. Alexander & Baldwin Inc., the largest landowner in Kahului, continued to expand residential housing in the “Dream City” incrementally between 1970 and 1990 (Hooser and Stewart 1995). Large-scale construction projects in Central Maui, such as the Maui Arts and Cultural Center (MACC) (constructed in 1993), Keopuolani Park (constructed in 1999), Maui Lani Dunes golf course (constructed in 1989) and the residential build-out of Maui Lani (1996-present) were precursors for light industrial development in Wailuku Town.

Following the closing of the Wailuku Sugar Company Mill in 1989, much of the former agricultural land along the eastern banks of the ‘Īao Stream was developed as the Iao Parkside Condominium while large-scale light industrial development utilized much of the remainder of the former sugar lands of Wailuku along the western bank of the ‘Īao Stream (Hooser and Stewart 1995). HC&S closed Pu‘unēnē Mill, its last operable mill and the last sugar plantation in Hawai‘i in 2016 (Cataluna 2016). The surrounding former sugarcane lands are primarily fallow with some new commercial development and plans for renewed agricultural production.

# Section 5 Previous Archaeological Research

## 5.1 Overview

A discussion of previously identified archaeological resources in the project area vicinity is included in this CIA to inform understandings of land and local communities from the initial Hawaiian discovery and settlement of the islands through the historic era, and to provide additional context for the historic documentation, traditional cultural practices, and oral histories associated with the project area and vicinity.

The earliest archaeological studies on the island of Maui were part of island-wide surveys conducted in the early 1900s (Stokes 1917; Walker 1931). These studies tended to focus on the generation of descriptive lists of large-scale architectural features or traditional ceremonial *heiau* sites. No *heiau* were documented in the immediate vicinity of the current project area.

Between 1931 and 1976, only sporadic archaeological studies were undertaken in the area. Following the passage of the National Historic Preservation Act in 1966 and HRS §6E, which established the historic preservation program in 1976, archaeological studies occurred as a condition of development on a more frequent basis. Previous archaeological studies in the vicinity have included reconnaissance surveys and literature review and field inspections (LRFI), ground penetrating radar (GPR) surveys, archaeological inventory survey (AIS) investigations (termed “archaeological surveys” pre-2002, before HAR §13-276-5), archaeological data recoveries, and archaeological monitoring programs (Figure 28 and Table 3). Historic properties identified during previous studies in the vicinity of the project area include large clusters of human burials within the Sand Hills region, a late pre-Contact to early post-Contact temporary habitation site (State Inventory of Historic Places [SIHP] # 50-50-04-04202), and various historic plantation and ranching features (Figure 29 and Table 4). Note, the SIHP designation refers to the state of Hawai‘i (50), the island code for Maui (50), the topographic quadrangle for Wailuku (04), and a unique five digit number.

## 5.2 Previous Archaeological Studies within or adjacent to the Project Area

### 5.2.1 Barrera (1976)

On 23 and 24 August 1976, Chiniago Enterprises conducted an archaeological walk-through survey of approximately 1,020 acres at Wai‘ale, formerly in agricultural orchard land (Barrera 1976). The survey was conducted along areas of known and observable ground disturbance, such as recent plantings and pipeline routes, in addition to overgrown areas of kiawe and lantana scrub. No historic properties were identified. The survey of the disturbed areas revealed no subsurface cultural remains except for two possible artifacts (a hammerstone and a possible basalt flake) on the surface of the parcel beneath dense vegetation. On-site monitoring was recommended due to known deposits of human skeletal remains in the nearby Sand Hills region of Wailuku.

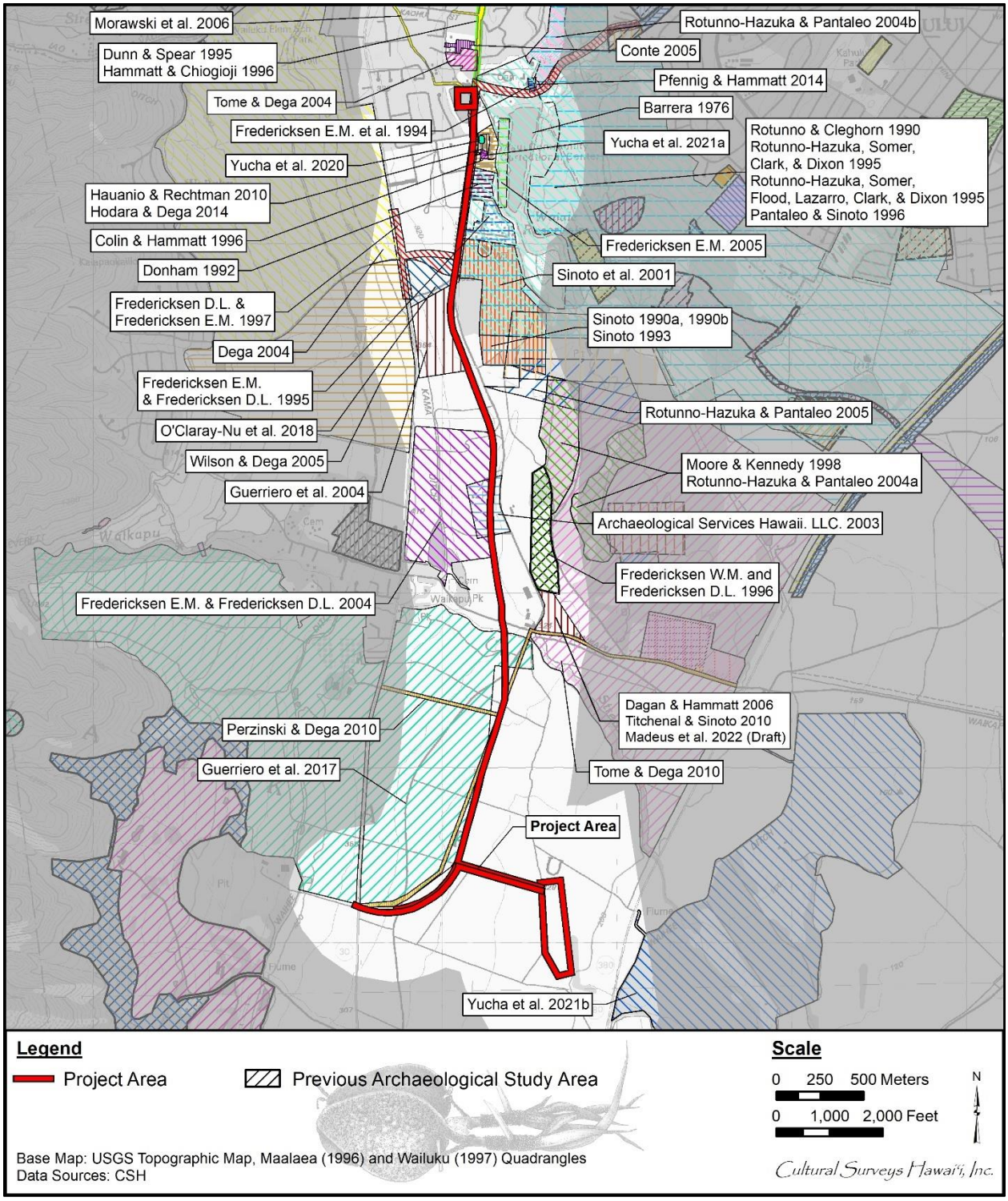



Figure 28. Portions of the 1996 Maalaea and 1997 Wailuku USGS 7.5-minute topographic quadrangles showing previous archaeological studies in the vicinity of the project area

Table 3. Previous archeological studies in the vicinity of the project area (studies within or adjacent to the project area are in **bold**)

| Reference | Type of Study | Location | Results (SIHP # 50-50-04) |
|---|---|---|---|
| **Barrera 1976** | **Archaeological walk-through survey** | **Upper Maui Lani area; multiple TMKs** | **No historic properties identified** |
| Rotunno and Cleghorn 1990 | Archaeological reconnaissance survey | Horita Homes; TMKs: (2) 3-8-007:002 and 110 | Identified two potential historic properties: a sandstone cobble-lined trail (Temp. Site No. 1) and a piled and compacted cobblestone mound (Temp. Site No. 3) |
| **Sinoto 1990a, 1990b** | **Archaeological surface survey, subsurface assessment, and archaeological monitoring** | **Maui Lani Sand Borrow Site; TMK: (2) 3-8-007:103** | **No historic properties identified** |
| **Donham 1992** | **Archaeological data recovery** | **Maui Homeless Shelter; TMK: (2) 3-8-046:021** | **Identified and recovered SIHP # -02916, two human burials; buried water channel also reported at construction site** |
| **Sinoto 1993** | **Archaeological monitoring** | **Maui Lani Sand Borrow Site; TMK: (2) 3-8-007:103** | **No historic properties identified** |
| Fredericksen et al. 1994 | Archaeological survey | Maui Memorial Park; TMK: (2) 3-8-046:030 | No historic properties identified |
| **Fredericksen and Fredericksen 1995** | **Archaeological survey** | **Parcel on eastern side of Wai‘ale Rd; TMK: (2) 3-8-046:021** | **No historic properties identified** |

| Reference | Type of Study | Location | Results (SIHP # 50-50-04) |
|---|---|---|---|
| **Dunn and Spear 1995** | **Archaeological monitoring** | **Wai‘ale Rd; TMKs: (2) 3-4-002:036, 3-4-003:019; 3-4-004:002** | **Identified three historic properties: SIHP # -04005, a human burial; SIHP # -04067, an isolated hearth; and SIHP # -04068, a cultural layer containing 13 burials and 21 habitation features; also identified scatter of previously disturbed human remains on eastern shoulder of Wai‘ale Rd (no SIHP #)** |
| Rotunno-Hazuka, Somer, Clark, and Dixon 1995 | Archaeological test excavations | Maui Lani Subdivision and Sand Borrow Site; TMKs: (2) 3-8-007:002 and 110 | Determined insignificance for two temporary sites (T-1 and T-3) previously recorded by Rotunno and Cleghorn (1990); identified and determined an additional temporary site (T-4) insignificant; documented at least three additional human burials associated with SIHP # -02797 |
| Rotunno-Hazuka, Somer, Flood, Lazarro, Clark, and Dixon 1995 | Archaeological research, test excavations, and burial investigations | Maui Lani Subdivision; TMKs: (2) 3-8-007:002 and 110 | Newly identified 10 burial features with an MNI of 12 associated with SIHP # -02797 |
| Colin and Hammatt 1996 | Archaeological monitoring | MCCC Work Furlough Center; TMK: (2) 3-8-046:006 | No historic properties identified |
| Fredericksen and Fredericksen 1996 | Archaeological data recovery | Waikapu Borrow Site; TMK: (2) 3-8-007:104 | Identified at least 22 individuals and associated artifacts disturbed from sand mine; reinterred in burial preserve, SIHP # -03525 |
| **Hammatt and Chiogioji 1996** | **Archaeological and historical assessment and field inspection** | **Wai‘ale Rd at Lower Maui St; TMK: (2) 3-4** | **No historic properties identified** |

| Reference | Type of Study | Location | Results (SIHP # 50-50-04) |
|---|---|---|---|
| Pantaleo and Sinoto 1996 | Archaeological subsurface sampling | Maui Lani Subdivision Phase 1 and 1A parcels; TMKs: (2) 3-8-007:002, 110 | Identified four additional burials of SIHP # -02797, burial complex; identified two additional human burials designated as SIHP #s -04146 and -04147 |
| **Fredericksen and Fredericksen 1997** | **Archaeological survey** | **Wai‘ale Dr and Mahalani St; TMKs: (2) 3-8-046:001, 002, 004, 004, 017, 018, 030 pors., and 3-8-007:121 por.** | **No historic properties identified** |
| Moore and Kennedy 1998 | Archaeological survey | Multiple locations; TMK: (2) 3-8-007:101 por. | Identified three historic properties: SIHP # -04200, four human burials; SIHP # -04201, human burial; and SIHP # -04202, temporary habitation site |
| **Sinoto et al. 2001** | **Supplemental archaeological sampling** | **Maui Lani Light Industrial Park; TMK: (2) 3-8-007:131 por.** | **No historic properties identified** |
| **Archaeological Services Hawaii 2003** | **Interim archaeological monitoring** | **Wailuku Agribusiness, Inc. sand mining operations; TMK: (2) 3-05-002:001** | **No historic properties identified** |
| Dega 2004 | AIS | 348.6-acre parcel; TMK: (2) 3-5-001:001 por. | Identified eight historic properties: SIHP #s -05473, Hopoi Reservoir; -05474, Kama Ditch; -05197, Waihe‘e Ditch; -05490, three small drainage ditches; -05491, historic artifact scatter; -05492, six field-clearing mounds; -05493, an unnamed irrigation ditch; and SIHP # -05498, a network of roadways |

| Reference | Type of Study | Location | Results (SIHP # 50-50-04) |
|---|---|---|---|
| **Fredericksen and Fredericksen 2004** | **AIS** | **Waikapu Affordable Housing Subdivision; TMKs: (2) 3-5-002:001 por. and 3-8-007:101** | **Documented a previously identified historic property, SIHP # -05474, Kama Ditch with associated Reservoir No. 6** |
| **Guerriero et al. 2004** | **AIS** | **50-acre parcel; TMK: (2) 3-5-002:001 por.** | **Documented SIHP # -05474, Kama Ditch** |
| Rotunno-Hazuka and Pantaleo 2004a | Interim archaeological monitoring | Hawaiian Cement Sand Mining Operations adjacent to Waiko Rd; TMK: (2) 3-8-007:101 por. | Identified two burial features within completed Phase B and 30 additional burial features within ongoing Phase A operations (features not assigned SIHP #s at time of report) |
| Rotunno-Hazuka and Pantaleo 2004b | AIS | New Sand Hills parcel; TMKs: (2) 3-8-007:121, 136, and 137 por. | No historic properties identified |
| Tome and Dega 2004 | AIS | 4.3-acre parcel in Wailuku; TMKs: (2) 3-4-003:005, 006, 011, 014, 026, and 033–042 | Documented a portion of SIHP # -01508, Spreckels Ditch and identified SIHP # -05569, historic bottle deposit |
| Conte 2005 | AIS | 391 Wai‘ale Rd; TMK: (2) 3-4-003:004 | No historic properties identified |
| Fredericksen 2005 | AIS | Wai‘ale Surface Water Treatment Facility; TMK: (2) 3-8-046:020 | No historic properties identified |
| Rotunno-Hazuka and Pantaleo 2005 | AIS | Maui Lani Elementary School; TMK: (2) 3-8-007:137 | No historic properties identified |

| Reference | Type of Study | Location | Results (SIHP # 50-50-04) |
|---|---|---|---|
| Wilson and Dega 2005 | AIS | 215.8-acre parcel in Wailuku and Waikapū; TMKs: (2) 3-5-002 and 3-5-003 | Documented components of SIHP #s -05179, Waihe‘e Ditch and -05493, Waikapū Ditch; identified five new historic properties: SIHP #s -05726, an earthen ditch; -05727, a large reservoir; -05728, 14 erosion control berms; -05729, a lesser stone and mortar ditch; and -05730, Old Waikapu Rd |
| Dagan and Hammatt 2006 | LRFI | Maui Scrap Yard; TMK: (2) 3-8-007:105 | No historic properties identified |
| **Morawski et al. 2006** | **Archaeological monitoring** | **Off-site construction near proposed Kehalani Mauka Subdivision in Wailuku and Waikapū; TMKs: (2) 3-5-002:001 por. and 3-5-001:017 por.** | **Identified five historic properties: SIHP #s -05680, human burial; -05965 and -05966, isolated and disturbed human remains; -05963, historic roadbed; -05964, sugarcane flume portion** |
| Hauanio and Rechtman 2010 | Archaeological monitoring | MCCC; TMK: (2) 3-8-046:005 | No historic properties identified |
| Tome and Dega 2010 | AIS | 607 acres of land spanning Wai‘ale, Wailuku, and Waikapū; TMKs: (2) 3-8-005:023 por. and 037; 3-8-007:071, 101, 102, and 104 | Confirmed previously identified locations of SIHP # -01508, portion of Spreckels/Waihe‘e Ditch and SIHP # -05504, three human burials; identified SIHP # -06578, a buried fire pit/*imu* (earth oven) |
| **Perzinski and Dega 2010** | **AIS** | **Proposed Wai‘ale Rd extension and section of Waiko Rd; TMKs: (2) 3-5-002:014, 018, 888; 3-5-027:021; 3-6-002:003; and 3-8-005:999** | **Documented SIHP # -06668, historic boulder terrace for either water diversion or former footbridge footing on southern bank of Waikapū Stream** |
| Titchenal and Sinoto 2010 | AIS | Maui Scrap Yard; | No historic properties identified |

| Reference | Type of Study | Location | Results (SIHP # 50-50-04) |
|---|---|---|---|
| | | TMK: (2) 3-8-007:105 | |
| Pfennig and Hammatt 2014 | Archaeological monitoring | Flores Family Residence; TMK: (2) 3-8-089:098 | No historic properties identified |
| Hodara and Dega 2014 | Archaeological monitoring | MCCC; TMK: (2) 3-8-046:005 | Identified SIHP # -08017, historic trash pit associated with cattle ranching activities in area |
| **Guerriero et al. 2017** | **AIS** | **Waikapū Country Town Project; TMKs: (2) 3-6-002:003; 3-6-004:003; and 3-6-005:007** | **Identified four historic properties: SIHP #s -07881, 18 commercial sugarcane irrigation features; -07882, remnant L-shaped retaining wall; -07883 WWII bunker; and -07884, three historic artifact scatters; also documented portion of previously identified historic property, SIHP # -05197, historic Waihe‘e Ditch** |
| **O’Claray-Nu et al. 2018** | **AIS** | **Parcel northwest of Wai‘ale Rd and Kuikahi Dr; TMK: (2) 3-5-001:064** | **No historic properties identified** |
| Yucha et al. 2020 | Archaeological monitoring | MCCC; TMK: (2) 3-8-046:005 por. | Identified SIHP # -08659, historic coffin burial, preserved in place |
| Yucha et al. 2021a | AIS and GPR survey | MCCC; TMK: (2) 3-8-046:005 por. | No historic properties identified |
| Yucha et al. 2021b | AIS and GPR survey | Former sugarcane fields east of Kuihelani Hwy; TMK: (2) 3-8-005:002 por. | Identified six new historic properties, SIHP #s -08800 through -08805, buildings, structures, and deposits associated with historic use of commercial sugarcane agriculture; and documented components a previously identified historic property, SIHP # -01508, Spreckels/Waihe‘e Ditch Complex |
| Madeus et al. 2022 | Archaeological monitoring | 109 E. Waiko Rd (former Maui Scrap Yard); TMK: (2) 3-8-007:105 | Identified SIHP # -08812, human burial complex consisting of two in situ burials (Feature A and |

| Reference | Type of Study | Location | Results (SIHP # 50-50-04) |
|---|---|---|---|
| | | | Feature C) and one isolated femur portion (Feature B) |

### 5.2.2 Sinoto (1990a, 1990b, 1993)

From 2 through 8 May 1990, the Bernice Pauahi Bishop Museum (BPBM) conducted a pedestrian survey of 70 acres for the Maui Lani Sand Borrowing project at TMK: (2) 3-007:103. No historic properties were observed, however, the "dense vegetation cover hindered observation" (Sinoto 1990a:1). Archaeological monitoring was recommended for future excavations in sand deposits.

On 12 July 1990, the BPBM conducted an archaeological subsurface assessment and continued archaeological monitoring of a portion of the Maui Lani Sand Borrow project at TMK: (2) 3-007:103 (Sinoto 1990b). The field assessment part of the study included a survey of approximately one third of the existing ground surface, which had been previously grubbed and graded without an archaeologist present and prior to issuance of a grading and grubbing permit. Following the surface survey, archaeologists were assigned to monitor further ground disturbances at the project area. At the time of the interim field report (30 September 1990), no historic properties had been identified.

In a letter report dated 24 September 1993, Aki Sinoto of Aki Sinoto Consulting, summarized the archaeological monitoring of sand borrowing activities conducted during the previous four years at the Maui Lani Sand Borrow Site (Sinoto 1993). The report included the results of the surface survey and field assessment conducted by Public Archaeology Section, Applied Research Group of the BPBM in May 1990 (Sinoto 1990a) and July 1990 (Sinoto 1990b), respectively. Results of subsequent archaeological monitoring were also reported.

Between July and November 1990, full-time archaeological monitoring was conducted by the BPBM. Following a year-long hiatus, archaeological monitoring resumed during March 1992, but was conducted by Aki Sinoto Consulting. Between May and November 1992, Aki Sinoto Consulting conducted periodic archaeological monitoring of the sand borrowing activities. No historic properties were identified during any archaeological monitoring. Cow bones were encountered, though were expected due to previous pasture uses associated with the project area. During the time of the report, sand borrowing had temporarily ceased; archaeological monitoring was expected to resume with future sand moving activities.

### 5.2.3 Donham (1992)

Between 6 May and 8 June 1992, the SHPD conducted an archaeological data recovery on two separate inadvertent discoveries of human skeletal remains found during construction activities at the Maui Homeless Shelter construction site (TMK: [2] 3-8-046:021) (Donham 1992). Burial 1 was discovered during grading activities in the location of Building 4, approximately 2 ft below the natural surface. Most of the remains were crushed by machinery, however, the remnant of the in situ burial was discovered nearby. No burial pit, soil discolorations, or portable artifacts were observed in association with Burial 1. Burial 1 was recorded, disinterred, and stored on site for re-interment following the completion of construction.

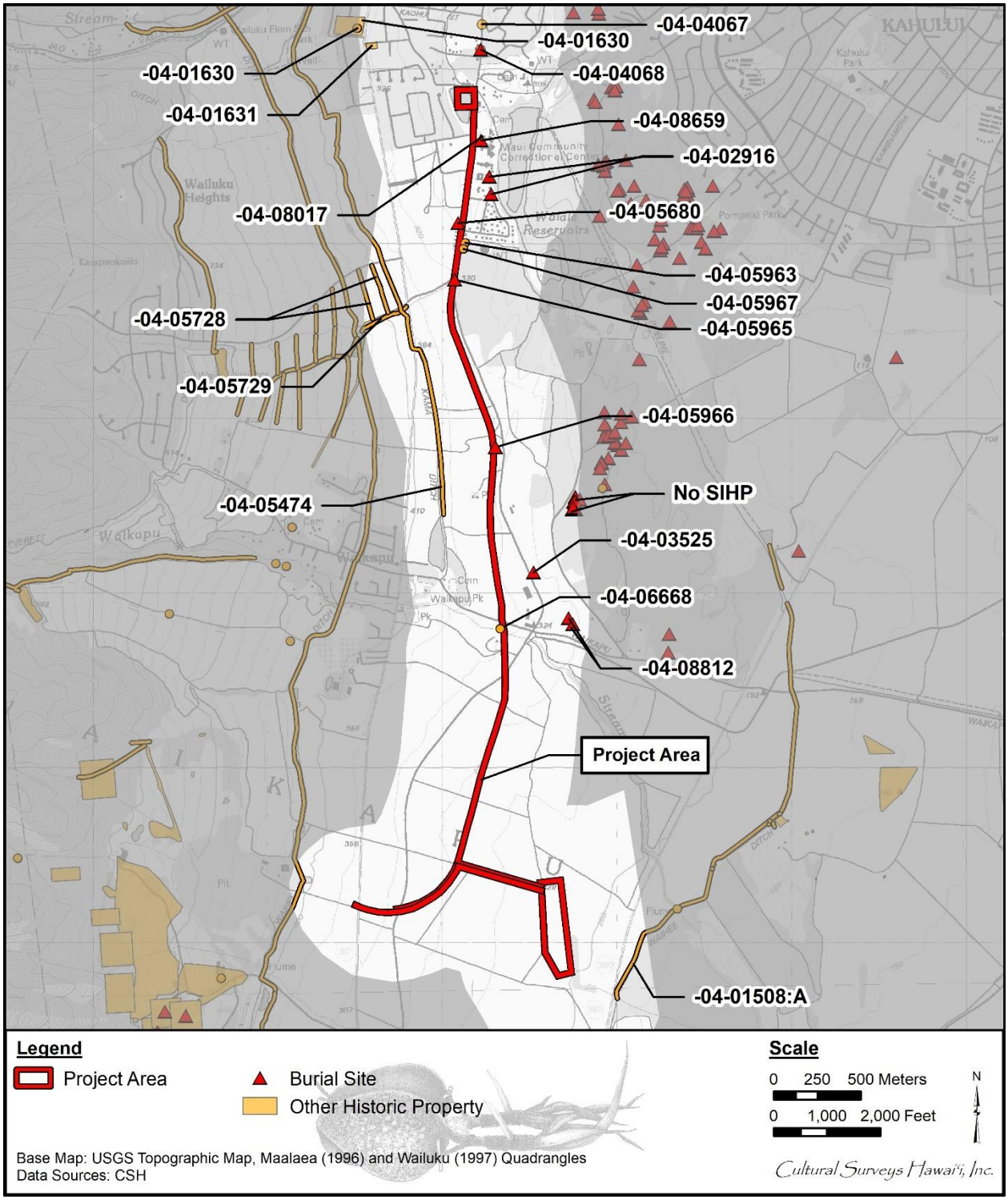



Figure 29. Portion of the 1996 Maalaea and 1997 Wailuku USGS 7.5-minute topographic quadrangles depicting the location of historic properties identified within and near the current project area

Table 4. Archaeological historic properties in the project area vicinity

| SIHP # 50-50-04- | Type | Comments | Reference |
|---|---|---|---|
| No SIHP | Human remains | Over 288 individual fragments of human remains within a reddish-brown historic fill layer with no evidence of a primary burial. Remains represent previously disturbed burials incorporated into fill materials used in either the construction of the Wai‘ale Road ROW or the historic Wailuku Sugar Co. Railroad ROW. | Dunn and Spear 1995 |
| 01508:A | Ditch | Portion of Spreckels Ditch | Tome and Dega 2004 |
| 01630 | Structure | Maui Public Schools-Henry Perrine Baldwin High School/Wailuku Elementary School<br>Historic structure | Listed on the National Register of Historic Places (NRHP) |
| 01631 | Inn | The Old Wailuku Inn at Ulupono | Listed on the Hawai‘i State Register of Historic Places (HRHP) |
| 02916 | Human remains | At the Maui Homeless Shelter | Donham 1992 |
| 03525 | Human remains | Minimum number of 22 individuals were dislocated by sand mining activity and reinterred at site. Site is fenced and preserved as a burial site. | Fredericksen and Fredericksen 1996 |
| 04067 | Hearth | Isolated and dated to AD 1430-1670 | Dunn and Spear 1995 |
| 04068 | Human remains | Cultural layer and 34 subsurface features included 13 human burials and 21 habitational features | Dunn and Spear 1995 |
| 05474 | Ditch | Portions of Kama Ditch within Lots 20 and 21 | Dega 2004 |
| 05680 | Human remains | Preserved in place with a concrete slab poured over it | Morawski et al. 2006 |
| 05728 | Soil berms | A series of 14 sugarcane-field erosion-control, soil berms | Wilson and Dega 2005 |
| 05729 | Ditch | Un-named, lesser ditch | Wilson and Dega 2005 |

| SIHP # 50-50-04- | Type | Comments | Reference |
|---|---|---|---|
| 05963 | Rock layer | Consisted of a layer of basalt cobbles that is likely a roadbed related to sugarcane cultivation | Morawski et al. 2006 |
| 05965 | Human remains | Reinterred | Morawski et al. 2006 |
| 05966 | Human remains | Reinterred | Morawski et al. 2006 |
| 05967 | Flume | Sugarcane flume | O’Clarey-Nu et al. 2018 |
| 06668 | Terrace | Historic terrace found along Waikapū Stream | Perzinksi and Dega 2010 |
| 08017 | Cultural material | Amorphous deposit of cultural debris buried beneath sandy deposits in the bottom of a utility trench. Refuse deposit consisted of iron nails, metal rods, glass shards, unidentifiable metal fragments, concrete fragments, coral fragments, lithified sandstone cobbles, basalt cobbles, and additional saw-cut faunal bone fragments. | Hodara and Dega 2014 |
| 08659 | Burial | Wooden coffin burial preserved in place beneath a concrete cap | Yucha et al. 2020 |
| 08812 | Human remains | Human burial complex consisting of three separate burial features, including two in situ burials and one isolated femur | Madeus et al. 2022 |

Burial 2 was discovered during the excavation of a desilting basin on the southeast corner of the property and consisted of an exposed partial cranium. Excavations around the cranium revealed additional subsurface skeletal remains scattered within a 26-sq m area, up to 75 cm below surface. No primary burial site for Burial 2 was identified during excavation. Researchers noted the matrix encasing Burial 2 appeared to be a disturbed layer that predated the current construction and was likely associated with the bulldozing of nearby access roads to the surrounding parcels. Researchers recommended monitoring of any further work in or around the location of Burial 2 involving heavy machinery (as work had not yet been completed).

### 5.2.4 Fredericksen and Fredericksen (1995)

In November 1994, Xamanek Researches conducted an archaeological survey on an approximate 15-acre parcel located along the eastern side of Wai‘ale Road for the construction of a 180 to 200-unit affordable rental housing project at TMK: (2) 3-8-046:021 (Fredericksen and Fredericksen 1995). A 100% pedestrian survey was conducted across the surface of the parcel at 5 m intervals, revealing a complete absence of surface sites. The second portion of the survey involved a subsurface testing regimen consisting of 43 backhoe trenches, 21 auger tests, and two manually excavated test units. Excavations generally revealed buried sterile sand layers up to 4.5 m deep, overlying a lithified layer of dune material. No in situ cultural remains were observed during subsurface testing. Due to the encroachment of Pu‘uone sand deposits onto the eastern portion of the project area, and the earlier discovery of human skeletal remains (SIHP # 50-50-04-02916) on an adjacent property by Donham (1992), researchers recommended archaeological monitoring for all ground disturbing activities within the project area.

### 5.2.5 Dunn and Spear (1995)

Between 18 February and 7 April 1995, Scientific Consultant Services, Inc. (SCS), conducted archaeological monitoring for sewer line trench excavations along the western shoulder of Wai‘ale Road (TMKs: [2] 3-4-002:036, 3-4-003:019, 3-4-010:002) (Dunn and Spear 1995). Monitoring of trenching activity, in addition to pothole testing for existing subsurface utilities, identified three historic properties and a scatter of human remains associated with a historic fill layer.

SIHP # -04005, human skeletal remains of one adult individual, were observed within the backfill of a trench excavated and filled prior to the 1995 sewer line project. No primary burial site was identified for SIHP # -04005, lending to the interpretation of having been previously disturbed. SIHP # -04067, an isolated hearth feature, was identified in the western sidewall of trench generally located at the intersection of Wai‘ale Road and Kaohu Street. SIHP # -04067 was approximately 1.2 m below surface and measured 70 cm across with subangular basalt cobbles on either side and showing evidence of having been cleaned out multiple times prior to its burial. Charcoal samples from SIHP # -04067 returned calibrated dates of AD 1434-1669 and AD 1772-1794. SIHP # -04068, consisting of a cultural layer containing 13 burials and 21 habitation features (postholes, hearths, and midden deposits), was identified near the intersection of Wai‘ale Road and Naniloa Drive. Six shovel probes were excavated into SIHP # -04067 revealing a widespread cultural deposit capping the observed burial features of the site, indicating the cultural deposit post-dates the skeletal remains. The cultural layer contained mostly pre-Contact artifacts and midden, occasionally producing isolated historic deposits, and returned a radiocarbon date of AD 1622 to 1807.

In addition to the three identified historic properties, researchers also observed human skeletal remains on the eastern shoulder of the Wai‘ale Road ROW. Three backhoe trenches were excavated into this area to test for subsurface historic properties. These excavations encountered over 288 individual fragments of human remains within a reddish-brown historic fill layer with no evidence of a primary burial. Researchers concluded these remains represent previously disturbed burials incorporated into fill materials used in either the construction of the Wai‘ale Road ROW or the historic Wailuku Sugar Company Railroad ROW. The burial deposits on the eastern shoulder were not assigned a site number during this study.

### 5.2.6 Hammatt and Chiogioji (1996)

On 13 October 1996, CSH conducted an archaeological field inspection, as a component study for an archaeological and historical assessment, of an approximate 500-ft-long corridor of the Wai‘ale Road/Lower Main Street ROW (TMK: [2] 3-4) (Hammatt and Chiogioji 1996). A surface survey conducted along the project area did not identify any new historic properties on the shoulder of the developed roadway comprising the project corridor. A berm was observed along the eastern extent of the project area, identified as a remnant berm servicing the now out-of-use Wailuku Sugar Company railroad line. The interpretation of the berm was confirmed by discarded rail segments lying along the base of the berm; however, the discarded rails were the only remainder of the historic era feature. Researchers recommended an archaeologist remain on site for all ground disturbing activities associated with this project due to known subsurface historic properties previously identified by Dunn and Spear (1995), for the potential to encounter human burials, and because the project was to be conducted near the historic Wai‘ale Road Bridge.

### 5.2.7 Fredericksen and Fredericksen (1997)

In February 1997, Xamanek Researches conducted an archaeological survey in advance of the ca. 990-m-long Mahalani Street and Wai‘ale Drive extension project (TMKs: [2] 3-8-046:001, 002, 003, 004, 017, 018, 030, and 032 pors. and 3-8-007:121 por.) (Fredericksen and Fredericksen 1997). A 100% pedestrian survey was conducted with no significant findings. The surface appeared to have been impacted by recent ground disturbance. Subsurface testing consisted of eight backhoe test trenches along the corridor. No historic properties were identified during subsurface testing. Buried sand dune deposits were noted in areas. Archaeological monitoring was recommended for any ground disturbance in areas containing dune sand.

### 5.2.8 Sinoto et al. (2001)

In 2001, Archaeological Services Hawaii (ASH) conducted supplementary archaeological subsurface sampling of an approximate 56-acre parcel within the Maui Lani subdivision for the construction of a light industrial park (TMK: [2] 3-8-007:131 por.) (Sinoto et al. 2001). A pedestrian survey was conducted with no historic properties observed. Subsurface testing consisted of 20 backhoe trenches, and no historic properties were identified. Archaeological monitoring was recommended for future construction based on the potential of human burials present in the area.

### 5.2.9 Archaeological Services Hawaii (2003)

In January 2003, ASH submitted an interim archaeological monitoring report to the SHPD for Wailuku Agribusiness, Inc. sand mining operations at TMK: (2) 3-05-002:001 (Archaeological Services Hawaii 2003). The report summarizes over 16 hours of archaeological monitoring that took place during 1999 through 2002. At the time of the report, no cultural materials or historic properties had been identified. Archaeological monitoring was recommended to continue for the remainder of the project, which was expected to end by 2005.

### 5.2.10 Fredericksen and Fredericksen (2004)

In August, September, and December 2003, Xamanek Researches conducted an AIS of approximately 100 acres for the Waikapu Affordable Housing Subdivision project (TMKs: [2] 3-5-002:001 por. and 3-8-007:101) (Fredericksen and Fredericksen 2004). Nearly half of the study area had been disturbed by former sand mining activities. A previously identified historic property, SIHP # -05474, Kama Ditch with associated Reservoir No. 6, was documented within the project area. The SHPD collected architectural data for SIHP # -05474, which was to be mostly demolished during the project. Archaeological monitoring was recommended for the project.

### 5.2.11 Guerriero et al. (2004)

ASH conducted an AIS of a 50-acre parcel for proposed development at the Emmanuel Lutheran Church (TMK: [2] 3-5-002:001 por.) (Guerriero et al. 2004). At this time, CSH has not been able to locate a copy of the report. The following was described by O’Claray-Nu et al. (2018:22):

> The AIS included a pedestrian survey with subsurface backhoe testing of a total of 25 backhoe trenches (TRl-25). Results of the pedestrian survey identified one historic property, a disturbed segment of State Site 50-50-04-5474, the Kama Ditch, situated within the southwestern portion of the project area. Also noted was a metal sluice gate, designated Feature 1 of Site 5474. The ditch, also known as *kamaauwai* was constructed around 1905 to 1907 and provided water to irrigate the sugar cane fields surrounding the project area. Site 5474 was assessed as significant under Criterion “a” because of its association with the plantation era and Criterion ‘d’ for its information content under the Federal and State historic preservation guidelines. [O’Claray-Nu et al. 2018:22]

### 5.2.12 Morawski et al. (2006)

Between December 2003 and July 2005, SCS and ASH conducted archaeological monitoring of off-site construction near the proposed Kehalani Mauka Subdivision project in Wailuku and Waikapū (TMKs: [2] 3-5-002:001 por. and 3-5-001:017 por.) (Morawski et al. 2006). Five historic properties were identified during the 20 months of monitoring. SIHP # -05680 is a complete, in situ human burial located along Wai‘ale Road. The burial was preserved in place and capped with a buried concrete slab. SIHP # -05965 consists of disturbed human remains (an adult humerus portion). SIHP # -05966 consists of an incomplete and previously disturbed subadult burial. The human remains of SIHP #s -05965 and -05966 were assessed at the Maui SHPD Office and

temporarily curated there pending long-term mitigation. SIHP # -05963 is a historic roadbed associated with early use of Wai‘ale Road. SIHP # -05964 is a portion of a historic sugarcane irrigation flume consisting of concrete and corrugated metal.

### 5.2.13 Perzinski and Dega (2010)

In August 2009, SCS conducted an AIS of an approximate 2.5-km long corridor for the proposed Wai‘ale Road extension and a 1.3-km long by 0.2-km wide corridor for the proposed Waiko Road improvement in Waikapū (TMKs: [2] 3-5-002:014, 018, 888; 3-5-027:021; 3-6-002:003; and 3-8-005:999) (Perzinski and Dega 2010). The investigation included a pedestrian survey and 64 backhoe trenches. No cultural materials were encountered within the backhoe trenches. One historic property was documented during the pedestrian survey. SIHP # -06668 is a historic boulder terrace on the southern bank of Waikapū Stream. The terrace was interpreted as functioning as either water diversion or as a former footbridge footing. No sediments were present within the boulder terrace. SIHP # -06668 was assessed as significant per Criterion d (have yielded, or have the potential to yield significant information to the history of the area), and no additional testing was recommended.

### 5.2.14 Guerriero et al. (2017)

From February through June 2013, ASH conducted an AIS for the Waikapū Country Town project (TMKs: [2] 3-6-002:003; 3-6-004:003; and 3-6-005:007) (Guerriero et al. 2017). The project area was divided into five parcels: Parcel 3 Mauka, Parcel 3 Waena, Parcel 3 Makai, Parcel 7, and Parcel 6. Fieldwork included a 100% coverage pedestrian survey followed by a subsurface testing program consisting of 150 mechanically excavated test excavations. The testing methods employed by the survey were systematic random sampling to obtain information about the subsurface conditions across the project area and to determine future or additional excavation strategies as needed. No historic properties were identified during subsurface test excavation.

During the AIS, four historic properties were identified during the surface survey: SIHP #s -07881 through -07884. SIHP # -07881 consists of 18 component features associated with historic commercial sugarcane irrigation (e.g., concrete-lined ditches and headwalls, dirt culverts, and sluice gates). SIHP # -07882 is a remnant L-shaped retaining wall. SIHP # -07883 was interpreted as a World War II bunker. SIHP # -07884 consists of three discrete scatters of historic materials including ceramic sherds and glass bottle fragments. Additionally, previously identified SIHP # -05197, the historic Waihe‘e Ditch, runs north/south through the northwest portion of the project area.

All 18 feature components of SIHP # -07881 were identified along the northwestern boundary of the project area, south of Waikapū Stream, in Parcel 3 Mauka. Irrigation features comprising SIHP # -07881, including the reservoir (Feature 3) at the project area’s western extent, were recorded historically on a USGS (1955) map. SIHP # -07882 is located near SIHP # -07881 Feature 2 (ditch) and the Parcel 3 Mauka and Parcel 6 boundary.

SIHP # -07883 was identified on the southern side of an access road transecting east/west Parcel 3 Mauka. The three distinct historic artifact scatters (Features 1–3) of SIHP # -07884 were documented near SIHP # -7881 Feature 2 (ditch) in the northeastern corner of Parcel 3 Mauka

(Feature 1), in the northern-central portion of Parcel 6 (Feature 2), and at the southeastern corner of Parcel 7 (Feature 3).

In addition to the SIHP #s identified, six other features were recorded and designated temporary site numbers. These temporary sites include a concrete slab of early to mid-1900s construction (TS4), and five rock piles (TS21, TS22, and TS23 through TS25). TS4 (slab) was identified with Parcel 3 Mauka approximately 81 m (265.75 ft) east of the reservoir at the western extent of the project area. TS21 and TS22 (rock piles) were recorded within Parcel 3 Mauka, while the other TS23 through TS25 (rock piles) were documented within Parcel 3 Waena. None of these features were determined to meet significance criteria. Other than archaeological monitoring during the project, additional archaeological work was not recommended for these temporary sites.

SIHP #s -07881 through -07884 were assessed as significant under Criterion D, since "they have yielded, or have the potential to yield significant information to the history of the area;" SIHP # -07883 (bunker) was additionally assessed with significance Criterion C for having "a distinct method or style of construction during a certain era" (Guerriero et al. 2017:2). Guerriero et al. (2017) recommended preservation in place for SIHP # -07883 (bunker); alternatively, a recommendation was presented for replacement of SIHP # -07883 with an interpretative commemorative plaque if preservation is not viable. Archaeological monitoring was recommended for the project.

#### 5.2.15 O'Claray-Nu et al. (2018)

From 17 to 22 March 2017, ASH conducted an AIS for a proposed Wailuku Apartment Rental Housing project in the lot on the northwestern side of the Wai‘ale Road and Kuikahi Drive intersection (TMK: [2] 3-5-001:064) (O'Claray-Nu et al. 2018). The AIS consisted of a 100% pedestrian survey and the excavation of 11 test trenches. No historic properties were discovered during the investigation. ASH suggested the lack of observed cultural resources may have resulted from extensive ground disturbance that has occurred in the project area during previous sugarcane cultivation, sand mining, and recent construction.

## 5.3 Discussion and Overview of Archaeological Historic Properties in the Project Area Vicinity

21 historic properties were identified within the vicinity of the project area consisting of burials, pre-contact agricultural sites, and historic sugarcane plantation related structures and sites. Eight of these sites are located within or adjacent to the project area. Four burial sites (SIHP #s -05966, -05965, -05680, and -08659), a sugarcane flume (SIHP # -05967), a historic road bed (SIHP # -05963), cultural material (SIHP # -08017), and a historic terrace (SIHP # -06668) were identified within or along the existing Wai‘ale Road portion of the project area. Of the four previously identified burial sites, two were reinterred (SIHP #s -05965 and -05966) and the other two remained in situ with a concrete slab poured over them (SIHP #s -05680 and -08659).

# Section 6 Previous Cultural Research

## 6.1 Overview

A review of previous cultural impact assessments has been conducted for the study area. An effort was made to locate community members with ties to Waikapū and Wailuku *ahupua‘a* who live or had lived in the region or who, in the past, used the area for traditional and cultural purposes. Nine previous cultural studies were conducted within the project area vicinity. The following cultural practices were identified by previous consultants: freshwater and *lā‘au lapa‘au* (herbal medicine) gathering practices, agricultural practices, and burial practices. Previous CIA projects (Dagher 2018, Dagher 2020, Fredericksen 2006, McGerty and Spear 2011, Pellegrino 2014, Santos et al. 2018, Spencer and Hammatt 2021, and Tanaka et al. 2023, Taua et al. 2010) in close proximity to the project area are shown in Figure 30 and presented below in Table 5.

Table 5. Previous cultural studies within the vicinity of the project area

| Reference | Location | Community Participants | Traditional Cultural Practices Identified |
|---|---|---|---|
| Fredericksen 2006 | Wai‘ale Surface Treatment Plant; TMK (2) 3-8-046:020 | Leslie Kulolio | Past burial practices |
| Taua et al. 2010 | Lot 1-A, Kopa‘a Subdivision No.2: TMK: (2) 3-8-007:105 | Sandy Bell, Marian Ching, Zelie Harders | Agricultural practices (taro); Gathering practices (*lā‘au lapa‘au);* Freshwater Resources |
| McGerty and Spear 2011 | Wai‘ale Road Extensions and East Waiko Road; TMK: (2) 3-5-002:014, 018, 888; 3-5-027:021; 3-6-002:003; 3-8-005:999 | Thelma Shimaoka, Hinano Rodrigues, Patty Nishiyama, and Kamila Kepa‘a (2009); Charles Maxwell, Ke‘eaumoku Kapu, Leslie Kuloloio, Lahaina Hawaiian Civic Club | None |
| Pellegrino 2014 | Waikapū County Town; TMK(s): (2) 3-6-005:007 (por.), 006, and 003 (por.) | Faith Epp, Dawn Mahi, Wally Rogers, Muriel Prager, Dalani Tanahy, Florence Nakama, Ace Miller, Wallette Pellegrino, and Keahi Bustamente | Agricultural practices; Gathering practices (*lā‘au lapa‘au*; Native seed gathering) |

| Reference | Location | Community Participants | Traditional Cultural Practices Identified |
|---|---|---|---|
| Dagher 2018 | Wailuku Affordable Housing TMK: (2) 3-5-001:064 | Clayton Suzuki, Roger Yamaoka, and Wally Rogers | None |
| Santos et al. 2018 | Maui Community Correctional Center TMK: (2) 3-8-046:005 and 006 | Johanna Kamaunu, Kaniloa Kamaunu, Scott Fisher, and Hōkūao Pellegrino | None |
| Dagher 2020 | Pu‘unani Homestead TMK: (2) 3-5-002:002 | Hōkūao Pellegrino and Foster Ampong | Agricultural practices; Historical and cultural properties |
| Spencer and Hammatt 2021 | TMK: (2) 3-8-005:002 por. | Foster Ampong | Burial practices |
| Tanaka et al. 2023 | Waiko Road Subdivision; TMKs: (2) 3-5-004:028, 031, and 063; 3-5-010:001, 033, 034, 036-038; 3-5-011:001-041, 043-046 & 048; 3-5-012:001-023, 025, 035-040, and 043-047 | Scott Fisher, Kaniloa Kamaunu, and Robert Hobdy | Freshwater gathering and uses; Burials practices; *Iwi kūpuna* (ancestral remains) |

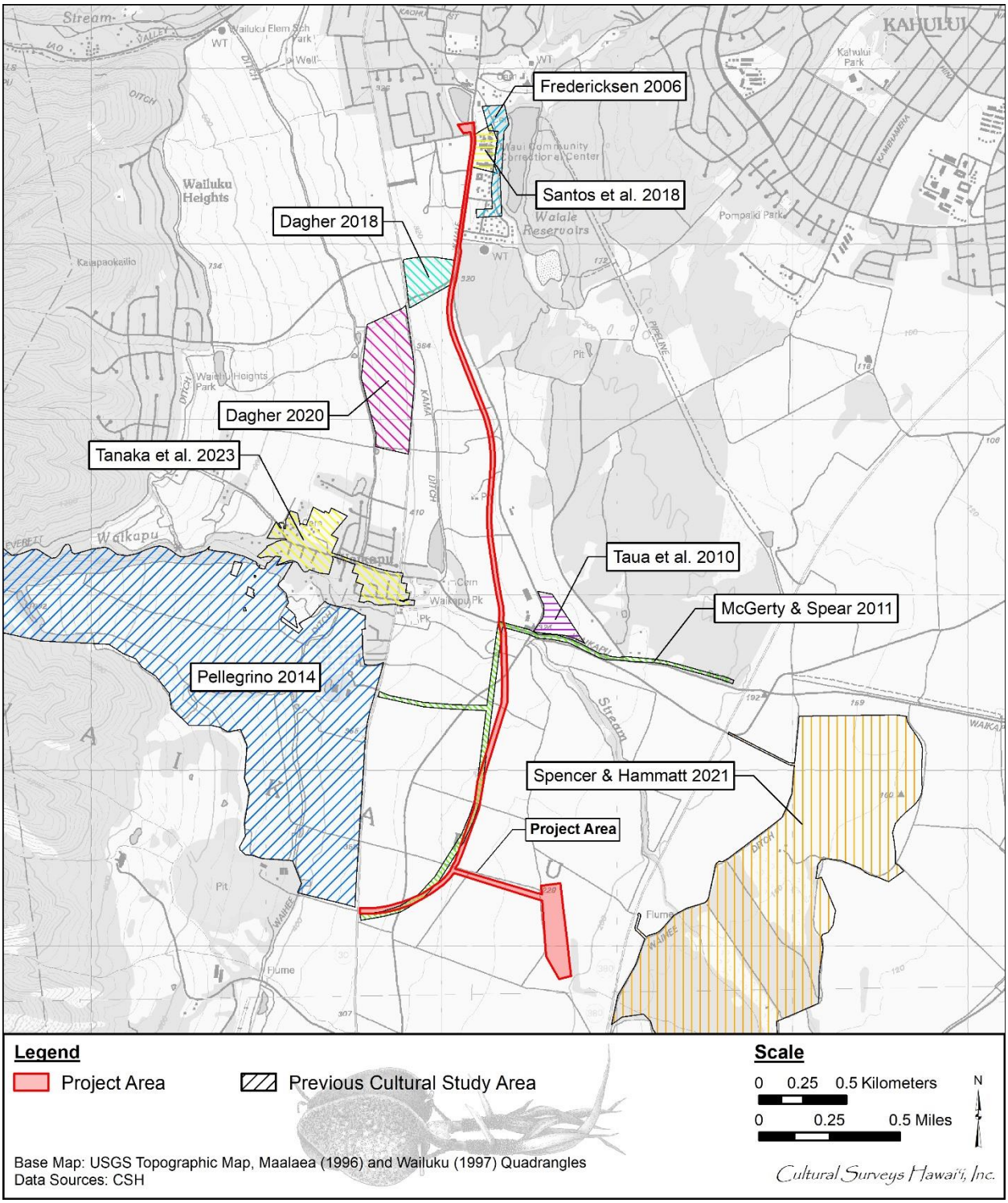



Figure 30. Previous cultural studies within the vicinity of the project area

## 6.2 Freshwater Practices and Resources

Waikapū Stream is part of the *‘okana* known as “Nā Wai ‘Ehā.” According to Scott Fisher, in traditional times, the Nā Wai ‘Ehā was the “most culturally productive land on Maui” (Tanaka et al. 2023:68). Informants (Ace Miller Jr. and Scott Fisher) stated that the *muliwai* (end or river mouth) of Waikapū Stream is Keālia Pond (Pellegrino 2014:87). Scott Fisher also recalled waterworn rocks while working on his farm which indicates the alignment of Waikapū Stream changed over time (Tanaka et al. 2023:68).

Informants (Keahi Bustamente and Wallettee Pellegrino) mentioned swimming and playing in the stream and *‘auwai* when they were younger. Keahi Bustamente stated, “As a child I would wade in both the Waikapū Stream and ‘auwai along Waikō Road. There was never enough water to swim in the stream for my friends and I to actually swim in but we did enjoy what was there at that time” (Pellegrino 2014:98).

Regarding Waikapū Stream resources, informants (Keahi Bustamente, Eassie “Ace” Miller Jr., Florence Nakama, Wallette Pellegrino, and Muriel Prager) mentioned catching *‘o‘opu* (goby; *Awaous guamensisi*), *‘opae* (shrimp; *Halocaridina rubra*), *hīhīwai* (snail; *Neritina granosa*), snails, and guppies. Keahi Bustamente mentioned that *‘o‘opu* used to be found in the stream prior to it being drained (Pellegrino 2014:96). According to Florence Nakama, the *‘o‘opu* were too small to eat, around 3-4 inches (Pellegrino 2014:81). Ace Miller Jr. mentioned the stream used to have more holding ponds that were 4 ft deep or more for the *‘opae* to survive (Pellegrino 2014:87). Scott Fisher also mentioned flora and fauna found along Waikapū Stream, which included *‘auku‘u* (black-crowned night heron; *Nycticorax nycticoras*), deer, wild birds, *olopua* (Hawai‘i olive; *Nestegis sandwicensis*), *‘ōhi‘a* (*Metrosideros polymorpha*), ferns, and grasses (Tanaka et al. 2023:68).

Keahi Bustamente mentioned the diversions of Waikapū Stream in the following:

> […] I clearly remember the stream diversions and how the stream was always stagnant and had a foul stench below which I believe was from the lack of flow and buildup of organic material from surrounding trees [Pellegrino 2014:96]
>
> […]
>
> I remember all of the diversion in Waikapū, they used to suck the entire stream dry. Never did I see the water flowing mauka to makai. I remember 3 specific diversions, one in the upper regions which I believe is a cement dam which diverts water into Reservoir #1. I know of the Waihe‘e Ditch which is adjacent to the development project [not included within project area, but runs parallel to Honoapi‘ilani Highway] I think and lastly the one by the bridge near the Honoapi‘ilani Highway. Waikapū is a dead stream from my perspective. [Pellegrino 2014:97]

Florence Nakama also mentioned the diversions of Waikapū Stream:

> […] The stream had a side stream on the other side of the park. I don’t know where it was diverted, it used to flow into #5. The main stream used to go to Ma‘alaea,

> but not the side stream. Especially if it rained, the river would be full. The river always had water. [Pellegrino 2014:81]

Nicholas Harders mentioned the North Waikapū ‘Auwai:

> […] now known as the North Waikapu ‘Auwai, to deliver water to our kuleana lands. The ‘auwai splits in two directions as it meets W Waiko Rd, one flow runs alongside W Waiko with the other going under W Waiko in an aged culvert then to our property where we irrigate yards, gardens, fruit trees and most importantly our kalo. [Dagher 2020:44]

These “diversions” mentioned by informants refer to the *‘auwai* systems from Waikapū Stream that led to the *lo‘i kalo*. Alfred Santiago “described the ancient auwai systems as being umbilical cords for the communities to the streams” (Taua et al. 2010:16). Regarding the management of water flow, Alfred Santiago shared the following:

> Alfred compared the current system to his understanding of how the Hawaiian kupuna would have managed the water system. His thoughts were that the kupuna would have tightly, manually and visually monitored the water flow. They didn’t have the luxury of a large reservoir, so they had to quickly regulate any excess water so it would do any damage. They would have had to be constantly hands-on and be able to anticipate changes in water flow. [Taua et al. 2010:15–16]

Nicholas Hardens also mentions the maintenance of the North Waikapū ‘Auwai by stating that his family and neighborhood performed maintenance on the roadside sections of the *‘auwai* (Dagher 2020:44). Wallettee Pellegrino is one of many who are currently farming *lo‘i kalo* and utilizing the north *kuleana ‘auwai* to feed them (Pellegrino 2014:89). Wally Rogers also mentioned, “Their family continue to farm their lands traditionally with lo‘i kalo and other food crops that utilize water directly from the Waikapū Stream via a kuleana ‘auwai (irrigation ditch)” (Pellegrino 2014:58).

Keahi Bustamente also mentioned the north *kuleana ‘auwai* as well as the south *kuleana ‘auwai* in the following:

> I clearly remember the north and south kuleana ‘auwai. I remember an old ‘auwai back in the valley on the north side but I don’t know if it has a name. The only reason I believe it is an ancient ‘auwai are because of extensive archaeological sites found around the ditch. [Pellegrino 2014:98]

Ace Miller Jr. also mentioned the South Waikapū Kuleana Ditch which his family utilized on their *kuleana* lands to feed their *lo‘i kalo* (Pellegrino 2014:84). Presently, many Hawaiian families are in the process of returning to Waikapū Ahupua‘a and restoring traditional *lo‘i kalo* and utilizing the *kuleana ‘auwai*.

## 6.3 Agricultural Practices

A variety of crops were cultivated within Waikapū Ahupua‘a, traditionally and historically. According to Scott Fisher, “historically farming in Waikapū consisted of crops such as *‘ulu, kalo,* and sugarcane” (Tanaka et al. 2023:68). Hōkūao Pellegrino also mentioned pineapple being grown in the area and Ace Miller Jr. mentioned that it began in the 1980s. He shared that “prior to that,

these lands were rich in traditional agricultural terraces" and further stated, "Predominantly, these lands were traditionally used for cultural ag practices, specifically tied to wetland cultivation" (Dagher 2020:48). Sandy Bell also mentioned Waikapū was known for these agricultural terraces (Tauae et al. 2010:12).

Tanaka et al. (2023) mentioned Robert Hobdy described the Nā Wai ‘Ehā agricultural system in the following:

> Mr. Hobdy also stated that, ‘This area was once part of the of the great Na Wai Eha agricultural system. It was in the southern area centering around Waikapu Stream.’ He pointed out that there were ‘[a]t least 18 ‘ili (‘ili kalo or ‘ili mo‘o) clustered around the stream here and above this project area.’ Mr. Hobdy clarified that, ‘The term ‘ili kalo describes or connotes wetland grown kalo in contrast with dryland kalo or other crops. The term ‘ili mo‘o is descriptive of how the water flows from lo‘i (irrigated taro patch) to lo‘i like the thread connecting a string of pearls.’ He also noted that, ‘Each ‘ili was composed of several kuleana that were all fed by a single ‘auwai fed by Waikapu Stream. Each ‘ili had a name and each was usually managed by an extended family.’ [Tanaka et al. 2023:68]

Regarding *kalo* cultivation, many informants (Sandy Bell, Keahi Bustamente, Scott Fisher, Nicholas Harders, Ace Miller Jr., Florence Nakama, Hōkūao Pellegrino, Wallettee Pellegrino, Muriel Prager, Wally Rogers, and Dalani Tanahy) have either mentioned that *kalo* cultivation was or continues to be practiced within Waikapū Ahupua‘a. Scott Fisher shared that Waikapū was a very productive area and is "covered by an alluvial fan with rich soil that was good for *kalo* production" (Tanaka et al. 2023:68). Keahi Bustamente also mentioned that wetland *kalo* farming occurred in the lower reaches of the valley (Pellegrino 2014:100).

Hōkūao Pellegrino further described *kalo* cultivation in the following:

> […] prior to the land being in sugar cane there were lo‘i kalo and ‘auwai systems that spanned Waikapū in its entirety […] [Dagher 2020:47]

> […] prior to western contact, it was a thriving kalo growing landscape which was part of the greater Nā Wai ‘Ehā region. There were over 1,400 lo‘i kalo documented on 900 acres of land as being in cultivation at the time of the Māhele in Waikapū alone. [Dagher 2020:52]

Wallette Pellegrino mentioned some of the locations of taro patches in the following:

> Playing with the Enos children (Wilford Brother Enos Jr; Ku‘ulei Enos). Spending time at the liquor store with my father. Going to the Protestant church for services and lū‘au. Pig pens. The terraced taro patches next to the stream. In fact, when we moved to Waikapū in the 60’s, I could not figure out where the taro patches had gone, only to find out that after the Enos families left Waikapū, everything was overgrown and only an old wooden house remained. When we were privileged to purchase the two acres from the Keanini Partners in the early 2000s who are family to me, we began to restore the old taro patches and found the rock walls which delineated them as well as other markings which confirmed what I remembered from my childhood. [Pellegrino 2014:91]

Informants have mentioned *‘ulu* being cultivated and found within Waikapū Ahupua‘a. Hōkūao Pellegrino stated, “There are all these ‘ulu trees and traditional pre-Western stone walls located along the ‘auwai […]” (Dagher 2020:50). Scott Fisher also shared that he had an *‘ulu* farm in Waikapū (Tanaka et al. 2023:68).

## 6.4 Gathering Practices

Informants (Hōkūao Pellegrino, Keahi Bustamente, and Marian Ching) have discussed gathering *lā‘au lapa‘au* within Waikapū ahupua‘a. Hōkūao Pellegrino spoke of gathering *lā‘au lapa‘au* on specific ridges like Kahoi, Lapaleihua, and Kalapaooka‘īlio that house some very rare native plant species (Dagher 2020:51). Keahi Bustamente also mentioned gathering native *koai‘a* for traditional uses as well as other native plants for *lā‘au lapa‘au* on the slopes (Pellegrino 2014:97). She further states the following regarding gathering native plants for *lā‘au lapa‘au* along Waikapū Stream and Valley:

> I don’t remember my family gathering anything specifically from the stream but for many years now, I have gathered native plants for lā‘au lapa‘au or Hawaiian medicine such as ko‘oko‘olau and māmaki both of which are native plants that grow adjacent to the Waikapū Stream and used for making teas. I also gather seeds from this area and propagate them for outplaning in the same location. We in the conservation field have a very strict policy about seed gathering and outplanting, both of which I follow pretty religiously. The seeds have also been used for storage and propagation, especially that of the rare and endemic Hawaiian noni which supposedly cannot be found anywhere else in Hawai‘i, but Waikapū. I have only seen a handful of these plant growing in the upper reaches of the Waikapū valley and watershed. [Pellegrino 2014:98]

Keahi Bustamente also stated that many lineal descendants of families in the area, such as Hōkūao Pellegrino, Luke McLean, and the Rogers-Harders family continue to gather native plants for medicinal purposes (Pellegrino 2014:100–101). Marian Ching mentioned her family uses Hawaiian *lā‘au lapa‘au* practices such as guava shoots for diarrhea and eucalyptus stem for clearing sinuses (Taua et al. 2010:13). Alfred Santiago mentioned “As a child he remembers going up into Waikapu valley and collecting opai and guava and banana” (Taua et al. 2010:16). Informants (Florence Nakama and Wallette Pellegrino) also mentioned gathering tī leaves and plums. Florence Nakama stated, “We would just stay on this side. They had a lot of plum trees. We used to climb and pick the plumbs and put them into jars with sugar and shake them up” (Pellegrino 2014:80).

Regarding flora found in Waikapū ahupua‘a, Keahi Bustamente shared the following:

> The dominant dryland forest trees such as koai‘a, wiliwili and alahe‘e of Waikapū have basically all but disappeared except for the area in which we are protecting as a hui.
>
> […]
>
> Much of the Waikapū watershed is dominated by invasive species which form monotypic stands that inhibit the growth of other species. In steep areas, like the

> ones inhabited by *Macaranga tanarius*, this leads to erosion, runoff and potentially little groundwater recharge. *Casuarina*, which makes up a large percentage of the alien forest in Waikapū, is known for its inability to allow recharge and for the runoff it creates. Stands of *Casuarina* are also known to have low infiltration and low transpiration rates. We are losing our native forest at an alarming rate, and little of the true endangerment of our watershed is known by those outside the conservation world. In my opinion, we may see a 20-30% loss of remaining native forest in Waikapū to invasive species within my lifetime. As species like *Macaranga, Casuarina,* and others invade and become the forest, groundwater recharge will decline and runoff will increase. I would like to see land cover data and other models be improved and watershed health should be a factor in the calculation of available water for future use. The native forest go hand in hand in regards to the output of our invaluable cultural resource, wai. The name Waikapū alone along with the other three streams in Nā Wai ‘Ehā are clear evidence of the abundance of water the once existed in these ahupua‘a. [Pellegrino 2014:100]

## 6.5 Carving Practices

Regarding carving practices, Dagher (2020) mentioned that Hōkūao Pellegrino is a traditional wood and stone carver. He makes traditional-type stone tools such as adzes and poi pounders (Dagher 2020:50).

## 6.6 Burial Practices

Many informants have mentioned the *pu‘u one* sand dune system located within Waikapū and Wailuku ahupua‘a as well as other cemeteries and burials. Hōkūao Pellegrino stated, “This area was part of the Nā Wai ‘Ehā sand dune system that came across part of the upper central plains of Maui. There are ancient burials of his kupuna and the kupuna of others that are buried there” (Dagher 2020:47). Tanaka et al. (2023) shared Scott Fisher’s explanation of the sand dunes in the following:

> He mentioned that Waikapū was a popular place for burials […] While working on his farm, Dr. Fisher discovered that beneath a 9-to-12-inch layer of alluvial dirt is sand. He explained that during the late Pleistocene period, about 20,000 years ago, water levels dropped and sand blew in forming sand dunes. He added that around 12,000 years ago, during the Holocene period, the sand dunes were covered by sediments brought in by floods. [Tanaka et al. 2023:69]

Spencer and Hammatt (2021) shared Foster Ampong’s *‘ike* on the *pu‘u one* sand dune complex:

> Mr. Foster Ampong shared that it is widely known by numerous descendants of Maui that the *pu‘u one* complex has been, for centuries, the chosen burial grounds of Maui’s Native Hawaiian communities. There had been debate whereupon several members of the community insist these burials are that of the fallen warriors of Kalaniopu‘u. Mr. Ampong strongly believes these burials throughout the sand dunes are ancestors of Maui Island. [Spencer and Hammattt 2021:87]

Informants (Scott Fisher and Hōkūao Pellegrino) have also mentioned a Japanese cemetery located on East Waikō Road. Hōkūao Pellegrino stated the following:

> This particular parcel which is located where the Japanese cemetery and remaining sand dune system is, was described at the time of the Māhele by Edward Bailey who was a surveyor for the Kingdom of Hawai‘i, as having ancient Hawaiian burials. While the Nā Wai ‘Ehā sand dune system was historically and is currently known as having hundreds if not thousands of iwi kūpuna interred in them, it was one of the only Māhele awards to make this notation, especially in the Waikapū ahupua‘a. [Dagher 2020:47]

Other informants have mentioned families in the area tending to graves at cemeteries in the area, like the Cornwell cemetery or on the north side of Waikapū Stream. Some burial sites were identified during projects, such as the one located along East Waikō Road, which was mentioned by Kaniloa Kamauna (Tanaka et al. 2023:69). Keahi Bustamente also mentioned the Rogers-Harders families scattering ashes of their *‘ohana* in Waikapū Valley (Pellegrino 2014:100–101).

## 6.7 Historical and Cultural Properties

Hōkūao Pellegrino mentioned Pōhāki‘o, a grinding stone and boundary marker, located near the Old Government Road. However, its exact location is unknown as well as whether it remained in situ or was relocated. According to Hōkūao Pellegrino, “Pōhāki‘o was first and foremost a hoana, or grinding stone used to file and finish ko‘i (adzes-stone tool used for cutting and carving wood). Secondly, it was a commonly known palena ‘āina (boundary marker) for the northern end of the Waikapū ahupua‘a” (Dagher 2020:48–49). Pōhāki‘o is shown on approximately 60 historic maps of Waikapū and is referenced as an *‘ili* as well. Evidence of Pōhāki‘o being referenced as an *‘ili* is “Land Grant 2952, to David Crowningburg, and Land Commission Award 433, to William Crowningburg, both specified the ahupua‘a boundary, as well as the ‘ili, as Pōhāki‘o” (Dagher 2020:49). Not only is Pōhāki‘o an important cultural site as a grinding stone and boundary marker, but also for being a place name.

Hōkūao Pellegrino mentioned a historic bridge that crossed Kahoi Gulch and Lapaleihua Gulch, both gulches come from the West Maui Mountains. He further stated this bridge existed during the mid-1800s and was shown on historic maps dated as late as 1939 (Dagher 2020:49). Scott Fisher also mentioned finding old “railroad pins” on his farm.

Keahi Bustamente mentioned many cultural sites she came across as a result of exploring and her line of work, which consisted of *lo‘i kalo*, Keālia wetlands, and Mā‘alaea fishing grounds. She also mentioned the remnants of a Protestant Church located above their house (Pellegrino 2014:96–97). Other informants (Keahi Bustamente, Scott Fisher, and Wallettee Pellegrino) have mentioned remnants of stone wall terraces found along the embankment of Waikapū Stream, along Waikō Road, and the whole area in the valley.

## 6.8 *Wahi pana* and *Mo‘olelo*

Informants (Keahi Bustamente, Scott Fisher, Robert Hobdy, and Wallettee Pellegrino) have mentioned some *wahi pana* within Waikapū such as Keālia Pond, Mā‘alaea, Pu‘uhele, Loaloa, Wahineomā‘ili, Pilipili, Nohoana, and Kuaiwa. Keahi Bustamente shared that Loaloa is an *‘ili* that

was claimed by Charles Copp and Kupali‘i (Pellegrino 2014:97). Wahineomā‘ili, Pilipili, Nohoana, and Kuaiwa are *‘ili* as well and were mentioned by Robert Hobdy (Tanaka et al. 2023:69).

Scott Fisher shared two *mo‘olelo*, one in relation to how Waikapū received its name and the other in relation to the battle between Hawai‘i Island chief, Kalani‘ōpu‘u and Maui Island chief, Kahekili. Scott Fisher stated that “the name of Waikapū comes from the sound the wind makes when it blows through Waikapū Valley, which resembles the sound of a *pū* being blown” (Tanaka et al. 2023:68–69). The story of the battle between Kalani‘ōpu‘u and Kahekili occurred on the plains of Kama‘oma‘o. Tanaka et al. (2023) summarizes this battle mentioned by Scott Fisher in the following:

> The second *mo‘olelo* is associated with the battle between Kalani‘ōpu‘u, and his armies and chief of Maui, Kahekili, and his armies on the plains of Kama‘oma‘o. He stated that chief of Hawai‘i, Kalani‘ōpu‘u and his armies including the ‘Ālapa and Pi‘ipi‘i landed at Kīheipūko‘a, which is located on the ‘Kīhei side of Keālia Pond.’ As the ‘Ālapa and Pi‘ipi‘i crossed through Waikapū on their way to Wailuku, they were surrounded and slaughtered by the forces of Maui and O‘ahu. Dr. Fisher stated that the Maui army blew the conch shell to signal their attack on the Hawai‘i army. He noted there were only two survivors from the ‘Ālapa and Pi‘ipi‘i after the battle. He also noted that cultural descendants of slain warriors from Hawai‘i who were among the ‘Ālapa and Pi‘ipi‘i have been recognized by the MLIBC. [Tanaka et al. 2023:69]

# Section 7 Community Consultation

## 7.1 Overview

Throughout the course of this assessment, an effort was made to contact and consult with NHO, agencies, and community members including descendants of the area, in order to identify individuals with cultural expertise and/or knowledge of the *ahupua‘a* of Waikapū and Wailuku. CSH initiated its outreach effort in April 2023 through letters, emails, and/or telephone calls. CSH completed the community consultation in January 2024. CSH reached out to 45 individuals and organizations; nine responded, three met with CSH, one provided a written testimony, and one participated in an in-depth interview.

## 7.2 Community Contact Letter

Letters along with a map, an aerial photograph, and profile drawing were sent via email and USPS with the following text:

> With this letter, Cultural Surveys Hawai‘i (CSH) humbly requests your mana‘o and ‘ike (experience, insights, and perspectives) regarding past and ongoing cultural practices, beliefs, and resources within Waikapū and Wailuku Ahupua‘a.
>
> Consultation with traditional cultural practitioners, kūpuna, kama‘āina, and Hawai‘i’s diverse ethnic communities is an important and deeply valued part of our work and the environmental review process for proposed projects in Hawai‘i. Your contributions will revitalize and keep alive knowledge of cultural practices, storied places, and life experiences that will remind Hawai‘i’s children of their history for generations to come.
>
> Project Description
>
> At the request of Munekiyo Hiraga, on behalf of the County of Maui, Department of Environmental Management (DEM), CSH is conducting a cultural impact assessment (CIA) and Ka Pa‘akai Analysis for the Central Maui Wastewater Reclamation Facility (WWRF) Project, Waikapū and Wailuku Ahupua‘a, Wailuku District, Maui TMKs: (2) 3-5-001:017, 3-5-001:120, 3-5-002:014 and 888, 3-5-020:036 (por.), 3-6-002:003 and 004, and 3-8-005:023 (por.). The Central Maui WWRF will be completed in central Maui between Honoapi‘ilani and Kuihelani highways in Waikapū. The project also includes offsite infrastructure improvements which consist of a wastewater pump station (WWPS) near the existing master-planned Kehalani community, a wastewater force main from the Kehalani WWPS to the WWRF, portions of wastewater force main and R-1 recycled water transmission line that connect the WWRF and the future Waikapū Country Town development, and a WWRF access road. The project area is depicted on a portion of the 2017 Mā‘alaea and 2017 Wailuku U.S. Geological Survey (USGS) 7.5-minute topographic quadrangles and a 2020 aerial photograph.
>
> Introduction

The County of Maui Department of Environmental Management (County) proposes to construct a new wastewater reclamation facility (WWRF) in the Central Valley of Maui Island. The new Central Maui WWRF will provide a number of benefits to the community:

Provide wastewater treatment service to growth areas in the Central Valley area, as established in the Maui Island Plan. Wastewater treatment service is required to construct affordable and market rate housing in the area.

Divert a portion of the wastewater flow that is currently treated at the Wailuku-Kahului WWRF, reducing the volume of treated effluent that is currently disposed via injection wells at the facility.

Provide recycled water to irrigation users located near the Central Maui WWRF.

[Figure; see Appendix A] provides an overview of the Central Maui WWRF elements to be implemented by the County.

Wastewater Service Areas

[Figure; see Appendix A] presents the wastewater service areas that are expected to contribute wastewater to the Central Maui WWRF. Wastewater will be conveyed to the Central Maui WWRF by gravity sewers, pump stations, and pressurized pipelines.

The Central Maui WWRF will produce effluent that complies with State of Hawai‘i Department of Health (DOH) R-1 recycled water requirements. R-1 water will be available for potential users nearby, including the Waikapu Country Town development, nearby agricultural areas, and County properties.

Preliminary Flow Projections

[Table 6] provides a summary of the projected average dry weather flow (ADWF) contributions from the wastewater service areas. As shown in the table, approximately half the flow is expected to originate from areas that currently contribute flow to the Wailuku-Kahului WWRF. Diversion of the flow from the Wailuku-Kahului WWRF to the Central Maui WWRF will reduce disposal volumes at the current facility. The remaining half of the flow is projected to originate from new and future growth areas within the wastewater service areas. The future potential development shown in the table is not defined at this time but could potentially include the existing Mā‘alaea community if a decision is made to connect it to the Central Maui WWRF.

Table 6. Anticipated Buildout Wastewater Flow from Developments in Service Area

| Wastewater Flow Source | Average Dry Weather Flow (mgd) | Percent of Total Buildout Capacity of 4 mgd |
|---|---|---|

| | | |
|---|---|---|
| Existing Development (Diverted Flow from Wailuku-Kahului WWRF) | 1.78 | 45% |
| New Anticipated Development Growth | 1.93 | 48% |
| Future Potential Development | 0.29 | 7% |
| Total | 4.00 | 100% |

Note: mgd = million gallons per day

The Central Maui WWRF will have an average dry weather flow capacity of 4 million gallons per day (mgd). Construction of the WWRF may be phased.

Summary of County of Maui Project Elements

The project elements to be implemented by the County of Maui are described in this section.

New Kehalani Wastewater Pump Station and Forcemain

A new Kehalani WWPS located near Wai‘ale Road, will be designed to divert all of the flow from the existing 18-inch sewer in Wai‘ale Road away from the Wailuku-Kahului WWRF and instead pump it to the new Central Maui WWRF. A new wastewater forcemain will be designed to deliver flow from the new WWPS to the new Central Maui WWRF. [Figure; see Appendix A] shows the route of the forcemain.

The Kehalani WWPS will be constructed on parcel tax map key (TMK) number (2) 3-5-020:036. The parcel is a stormwater detention basin that serves the Kehalani development. The new WWPS will be constructed on the edge of the detention basin, and modifications will be made to the detention basin to retain its full function as originally designed. Additional information will be presented in the Draft Environmental Impact Statement.

Central Maui Wastewater Reclamation Facility

The Central Maui Wastewater Reclamation Facility will provide wastewater treatment and effluent management for the service area.

Site

The Central Maui WWRF will be located on a portion of parcel TMK (2) 3-8-005:023, owned by the County of Maui. The 209.04-acre parcel will be subdivided to provide a separate 14.9-acre parcel for the WWRF. [Figure; see Appendix A] shows the proposed WWRF location within the larger parcel. The WWRF location within the larger parcel was chosen to take advantage of the soil conditions present there for effluent disposal purposes, as described below.

The WWRF will be accessed from an extension of Wai‘ale Road to be constructed by the County of Maui. A 100-foot-wide access and utility easement will be developed across parcel TMK (2) 3-6-002:004 for the new WWRF.

Liquid Treatment Processes

The Central Maui WWRF will include the following:

**Preliminary treatment**: screening and grit removal to remove coarse debris prior to further treatment.

**Secondary treatment with biological nutrient removal**: activated sludge process with anoxic zones, intermediate mixed liquor recycling, and clarification: to remove carbon and nitrogen.

**Tertiary treatment**: filtration to remove suspended solids and turbidity.

**UV disinfection**: to inactivate bacteria and viruses from the effluent.

[Figure; see Appendix A] includes a conceptual plan for the facility.

Effluent Quality

The anticipated recycled water uses include irrigation of agricultural fields, parks, school yards, and streetscapes. The effluent from the Central Maui WWRF will comply with DOH requirements for R-1 recycled water. In addition, the effluent total nitrogen concentration will be 10 mg/L or less to ensure the amount of total nitrogen applied to land with the recycled water does not exceed the needs of the crops irrigated with the R-1 water and to minimize the potential impact of the effluent disposal system.

Water Recycling Program

A recycled water program is planned to be a major part of the effluent management system at the Central Maui WWRF. The water recycling program will extend Maui’s freshwater resources by putting treated effluent to beneficial non-potable use, freeing up valuable potable and raw water resources for other uses. These uses include facilitating growth within the community and enhancing the environment.

[Figure; see Appendix A] shows the pipeline that will be used to deliver recycled water to a recycled water storage facility to be constructed by Waikapū Country Town. The portion of the pipeline located within the Waikapū Country Town Development will be constructed by the developer and was included in the Waikapū Country Town Final EIS. The portion of the pipeline located on the Wai‘ale Road Extension will be constructed by the County of Maui.

Recycled water will be used for non-potable purposes at approved sites in accordance with DOH regulations and guidelines. Recycled water will also be used for agricultural irrigation purposes in the area shown in [Figure; see Appendix A].

Effluent Disposal

A wastewater effluent disposal system is necessary for the proposed WWRF. Hawai‘i Administrative Rules (HAR) §11-62 and the DOH’s Recycled Water Guidelines require a backup effluent disposal system for all water reuse applications. This backup system ensures effluent can be safely disposed when recycled water supply exceeds the demand or if the recycled water fails to meet the required treatment specifications. The backup disposal system must be designed to allow for disposal of 100% of the WWRF flow.

Soil aquifer treatment (SAT) appears to be a viable effluent disposal approach for the Central Maui WWRF. SAT consists of the intermittent application of effluent at high hydraulic loading rates to basins constructed in highly permeable soils, such as sand or gravel. Treatment in the SAT process is accomplished via biological, chemical, and physical interactions that occur as the water percolates through the soil matrix to groundwater. Treatment benefits can include nitrogen and phosphorus removal, heavy metal and trace organic removal, and removal of endocrine disrupting chemicals.

Vegetation may or may not be present and doesn’t play a significant role in the treatment provided due to the high hydraulic loading rate. Vegetation can also be used as a visual mitigation method. The draft EIS will include a hydrogeological study of the proposed SAT system.

Solids Management

The proposed liquid treatment processes will create residual solids that will require management:

**Grit and Screenings:** Grit and screenings will be washed and dewatered prior to disposal at the Central Maui Landfill.

**Secondary and Tertiary Solids**: Secondary and tertiary solids will be stabilized using aerobic digestion with decant thickening. The digested solids will be dewatered using screw press technology. The dewatered solids will be managed in accordance with wastewater solids generated by the County’s other WWRFs. Currently dewatered solids are composted with green waste at the Central Maui Landfill.

Ancillary Systems

Ancillary systems needed for the WWRF include electrical service, potable water, non-potable water, fire protection, stormwater management, and odor control.

**Electrical Systems**: It is anticipated that a new electrical service from Hawaiian Electric Company (HECO) will need to be brought to the site via underground or aboveground electrical lines from the intersection of Wai‘ale Road and Waiko Road following along the proposed Wai‘ale Road extension or from Honoapiilani Highway. An emergency power system will be provided to ensure uninterrupted wastewater treatment in the event of power failure.

**Potable Water**: Potable water needs will be met by connection to the County water system.

**Non-Potable Water**: Non-potable utility water needs like hose bibbs, water cannons, and foam sprays will be met with R-1 effluent. A pump system will be needed to provide adequate flow and pressure.

**Fire Protection**: Fire protection systems will be needed for certain WWRF elements in accordance with applicable codes.

**Stormwater Management**: A stormwater system compliant with applicable codes will be required. A stormwater pump station may be required.

**Odor Control**: Wastewater treatment plants can be a source of nuisance odors to the surrounding community if not properly designed and/or operated. Not all processes with a wastewater treatment plant generate odors; nuisance odors are most commonly associated with anaerobic (without oxygen) conditions and with residual solids processing. Foul air collection and treatment will be provided for treatment processes that can generate nuisance odors.

Purpose of this Study

The purpose of a CIA is to gather information on Hawai‘i’s cultural resources, practices, or beliefs that have occurred or still occur within the proposed project area and Waikapū and Wailuku Ahupua‘a. The purpose of a Ka Pa‘akai Analysis outreach is to 1) identify and scope valued cultural, historical, or natural resources in the project area, including the extent to which traditional and customary Native Hawaiian rights are exercised in the project area; 2) identify the extent to which those resources, including traditional and customary Native Hawaiian rights, will be affected or impaired by the proposed action; and 3) identify any feasible action, if any, to be taken to reasonably protect traditional and customary Native Hawaiian rights, if they are found to exist, either currently or possibly in the past. This is accomplished through consultation and background research using previously written documents, studies, and interviews. This information is used to assess potential impacts by the proposed project to the specific identified resources, practices, and beliefs in the project area and throughout Waikapū and Wailuku Ahupua‘a. As a traditional cultural practitioner and holder of long-term knowledge, your insight, input, and perspective provide a valuable contribution to the assessment of potential effects of this project and an understanding of how to protect these resources and practices.

Insights focused on the following topics in the project area (shown on the attached [Figure; see Appendix A] are especially helpful and appreciated:

1. Your knowledge of traditional cultural practices of the past within the proposed project area and Waikapū and Wailuku Ahupua‘a
2. Your specific traditional cultural practice and its connection to the proposed project area and Waikapū and Wailuku Ahupua‘a

3. The different natural resources associated with your specific traditional cultural practice
4. Legends, stories, or chants associated with your specific traditional cultural practices and their relationships to the proposed project area and Waikapū and Wailuku Ahupua‘a
5. Referrals to other kūpuna, kama‘āīna, and traditional cultural practitioners knowledgeable about the proposed project area and Waikapū and Wailuku Ahupua‘a
6. Your comments or thoughts on the potential impacts the proposed project may have on your ongoing traditional cultural practices and natural resources within the proposed project area and Waikapū and Wailuku Ahupua‘a
7. Your knowledge of cultural sites and wahi pana (storied places) within the proposed project area and Waikapū and Wailuku Ahupua‘a
8. Your comments or thoughts on the potential impacts the proposed project may have on cultural sites and wahi pana within the proposed project area and Waikapū and Wailuku Ahupua‘a

Consultation Information

Consultation is an important and deeply valued part of the CIA and the environmental review process. Your contributions will revitalize and keep alive our combined knowledge of past and ongoing cultural practices, historic places, and experiences, reminding our children of their history generation after generation.

With your agreement to participate in this study, your contributions will become part of the comprehensive understanding of traditions of the area and will be part of the public record. The study will be included as an appendix of the Environmental Impact Statement (EIS), which is being prepared for the proposed project; the EIS and CIA will be available for future access through the State Office of Planning and Sustainable Development (OPSD) Environmental Review Program (ERP) (https://planning.hawaii.gov/erp) and at the State Historic Preservation Division Library (https://dlnr.hawaii.gov/shpd/about/research-resources-library).

As a part of this process, your knowledge may be used to inform future CIAs and other heritage studies of cultural practices and resources that need protection from impacts of proposed future projects. If you engage in consultation, and the mana‘o and ‘ike you provide appears in the study, we would like to recognize your contribution by including your name. If you prefer not to allow your name to be included, your information can be attributed to an anonymous source.

The consultation interview structure and format are flexible. We will accommodate your preference on how to get together: talk story, over the phone, by email correspondence, remotely via Zoom, MS Teams, Google Chat, or other remote meeting platform.

Your knowledge of the resources and potential effect of the project on traditional practices in the project area and Waikapū and Wailuku Ahupua‘a focusing on the topics in the bullet points above can also be submitted in a written statement. CSH will provide return postage for your written statement on request. CSH is happy to provide a list of topics for discussion, a more structured questionnaire of interview questions, or any other assistance that might be helpful.

## 7.3 Community Consultation Table

In most cases, two or three attempts were made to contact individuals, organizations, and agencies. Community outreach letters were sent to 45 individuals or groups; nine responded, one provided a written testimony, and one of these *kama‘āina* and/or *kūpuna* met with CSH for a more in-depth interview. The results of the community consultation process are presented in Table 6.

Table 6. Summary of community consultation efforts

| Name | Affiliation | Notes |
|---|---|---|
| Adams, Mark | Wai‘ehu Kou Phase II | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |
| Ahia, Jennifer Noelani | Malama Kakanilua | Letter and figures sent via email on 7 April 2023<br>Letter and figures sent via email on 21 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |
| Ampong, Foster | Aha Moku Council Wailuku Representative; Aha Moku Council Burial Committee | Letter and figures sent via email on 7 April 2023<br>Letter and figures sent via email on 21 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |
| Apana, Clare | Cultural Practitioner; Malama Kakanilua; Aha Moku Council Burial Committee | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |
| Apo, Allanette | Paukukalo Hawaiian Homes Community Association | Letter and figures sent via USPS on 10 April 2023<br>Mail returned to sender on 24 April 2023<br>Letter and figures sent via email on 4 May 2023<br>Second round letter and figures sent via email on 19 May 2023 |
| Biga, Marie | Hawaiian Cultural Practitioner/Leader, Maui Waena Hawaiian Clun | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |

| Name | Affiliation | Notes |
|---|---|---|
| Buland, Holly | Assistant Director, Alexander & Baldwin Sugar Museum | Ms. Buland responded on behalf of Jill Pridemore, Director of Alexander & Baldwin Sugar Museum<br>Ms. Buland responded on 22 May 2023 and provided photos and historical background resources of the project area<br>CSH responded on 25 May 2023<br>Ms. Buland responded on 29 May 2023 and recommended Wallette Pellegrino. Ms. Buland also added the following along with two pdfs of information regarding the history of Waikapū:<br>*You can also try "Blast To Maui's Past" or "We Grew Up On Maui" Facebook pages. A lot of people go there and talk story about old times. You could put the question out there, and use one of our photos. I think you would get a good response. Here are a few more ideas.*<br><br>*https://archives.starbulletin.com/2003/07/19/news/story5.html*<br>*https://www.waikapu.com/history*<br>CSH responded on 30 May 2023 |
| Cameron, Don | *Kama‘āina* | Letter and figures sent via USPS on 10 April 2023<br>Second round letter and figures sent via USPS on 19 May 2023 |
| Eaton, Antoinette “Toni” | Maui District Supervisor, Department of Hawaiian Home Lands | Letter and figures sent via USPS on 10 April 2023<br>Second round letter and figures sent via USPS on 19 May 2023 |
| Farden, Hailama | President, Association of Hawaiian Civic Clubs (AHCC) | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |
| Feiteira, Blossom | President, Association for Hawaiians on Homestead Lands | Letter and figures sent via USPS on 10 April 2023<br>Mail returned to sender on 24 April 2023<br>Letter and figures sent via email on 4 May 2023<br>Second round letter and figures sent via email on 19 May 2023 |
| Fisher, Scott | Chief Conservation Officer, Hawaiian Islands Land Trust (HILT) | Letter and figures sent via email on 7 April 2023<br>Mr. Fisher responded same day:<br>*I’m happy to meet with you when it’s convenient. I don’t live in Waikapu, but I farm there, and I have some* |

| Name | Affiliation | Notes |
|---|---|---|
| | | *understanding of the burial practices in the general area based on my experience on the burial council.*<br>*Me ka ha‘aha‘a*<br>*Scott*<br>CSH responded on 10 April 2023 requesting dates and times available for an interview<br>Mr. Fisher responded same day and suggested Wednesday, April 19th at 1pm<br>CSH responded on 12 April 2023 and agreed to the date and time suggested. We also inquired what method would work best to do an interview.<br>Mr. Fisher responded same day and stated Zoom would be best.<br>CSH sent a zoom invite on 17 April 2023<br>Interview via Zoom on 19 April 2023<br>CSH sent a follow-up email on 21 April 2023 regarding more information on Dr. Fisher’s background to include in the interview summary.<br>Mr. Fisher responded same day:<br>*Thanks for your message. Currently I am the Director of ‘Āina Stewardship with the Hawai‘i Island Trust. For better context on some of my responses, however, you might also want to include that I am the chair of the Maui/Lāna‘i Island Burial Council. No problem on timing; I know these things take time.*<br>*Mahalo*<br>*Scott*<br>CSH sent the interview summary via email on 19 May 2023<br>CSH sent an email addressing pipeline depth of project area mentioned during interview on 22 May 2023:<br>*Aloha Scott,*<br>*I wanted to inform you that I heard back from the client about the depth of the underground pipelines that will be installed. The majority of the underground pipes will be between 5 ft. – 10 ft. deep, while some spots will reach 15 ft. We were speaking more about the project area along Waiko Road and the maximum excavation depth for the Kehalani sewage pipeline to the Central Maui WWRF will be 15 ft.*<br>*I attached a map of the project area, which is part of the consultation letter I previously sent to you, to this email* |

| Name | Affiliation | Notes |
|---|---|---|
| | | *for reference. The blue line labeled as "Forcemain" is what I'm referring to along Waiko Road.*<br>*If you would like more info, in terms of pipeline depth, for the rest of the project area or have any other questions, please let me know.*<br>*Mahalo*<br>Mr. Fisher responded same day:<br>*Mahalo for the information Tehani! I appreciate you sending it.*<br>CSH sent a follow-up email for the interview summary review on 27 June 2023<br>Mr. Fisher responded same day and approved the interview summary<br>CSH responded same day with the authorization form<br>Mr. Fisher responded same day with authorization form signed<br>CSH responded same day thanking him for his participation and time |
| Hall, Dana | Hui Alanui o Makena | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |
| Hanada, Paul | Soil Expert; Owner, Aloha Shell | Letter and figures sent via USPS on 10 April 2023<br>Second round letter and figures sent via USPS on 19 May 2023 |
| Hau, Skippy | *Kama'āina*; Former Aquatic Biologist, DLNR Division of Aquatic Resources | Letter and figures sent via email on 7 April 2023<br>Mr. Hau responded same day:<br>*I fully support the proposed project. I've retired over a year ago and will not be commenting further for this project.*<br><br>*I support the concept to go away from a centralized system otherwise I foresee problems in the future with increasing demands from a growing population. I do not want to see another Sand Island wastewater system with an outfall pipe into the ocean. This also means that the existing Lahaina, Kihei, will continue with existing injection wells for disposal. Kahului wastewater should be recycled as much as possible. Have you seen the Google Earth photo of the discolored water at the Treatment Plant next to Kanaha Pond?? Kahului Wastewater Plant will need to be upgraded and protected from a possible tsunami.* |

| Name | Affiliation | Notes |
|---|---|---|
| | | *I am concerned that there could be more drugs which could impact or taint wastewater or the resulting sediment. The increase use of Oxycodone or Fentanyl may spike in future testing if done at all.*<br><br>*I am also concerned about Maalaea wastewater treatment which existing leaching fields could be discontinued. They will need to address sea level rising, shoreline erosion, and reducing drainage runoff from possible kona storms, similar to Kihei.*<br><br>*Aloha,*<br>*Skippy*<br>CSH responded on 12 April 2023 requesting Mr. Hau's approval to include his written testimony in this report.<br>Mr. Hau responded on 15 April 2023:<br>CSH responded on 18 April 2023:<br>Mr. Hau responded same day<br>CSH responded same day<br>CSH received authorization form via USPS on 19 April 2023 |
| Hobdy, Robert | Retired Naturalist and Forester | Letter and figures sent via USPS on 10 April 2023<br>Second round letter and figures sent via USPS on 19 May 2023 |
| Hokoana, Lui | President, Central Maui Hawaiian Civic Club/Chancellor, CEO of UH Maui College | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |
| Holt-Padilla, Hokulani | Kumu Hula, Pā‘ū o Hi‘iaka/Cultural Specialist | Letter and figures sent via USPS on 10 April 2023<br>Second letter and figures sent via USPS on 19 May 2023 |
| Kahalehau, Clyde | Aha Moku, Wailuku | Letter and figures sent via email on 7 April 2023<br>Second letter and figures sent via email on 19 May 2023 |
| Kalanikau, Vernon | *Kama‘āina* | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023<br>Mr. Kalanikau responded on 23 May 2023 and stated he would like to participate. |

| Name | Affiliation | Notes |
|---|---|---|
| | | CSH responded same day and inquired what dates and times would work best for Mr. Kalanikau to do an interview<br>CSH sent a follow-up email on 27 June 2023<br>CSH sent another follow-up email on 2 August 2023<br>Mr. Kalanikau responded same day and suggested to meet on 3 August 2023 after 12 noon or 4 August 2023 morning up until 1pm.<br>CSH responded same day and inquired what method to do the interview would work best for Mr. Kalanikau. |
| Kamaunu, Johanna | MLIBC, Wailuku Representative | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |
| Kamaunu, Kaniloa | Aha Moku Council Wailuku Representative; Aha Moku Council Burial Committee | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |
| Kamekona, Carol Lee | Ahahui Kaahumanu - Wailuku | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023<br>Aunty Carol responded same day that she would like to participate. She also forwarded the letter and figures to others who might be interested in participating.<br>CSH responded same day and inquired what dates and times she would be available to do an interview as well as what method would work best for her.<br>Aunty Carol responded same day<br>CSH responded on 22 May 2023<br>Aunty Carol responded on 23 May 2023<br>CSH responded same day<br>CSH sent a follow-up email on 27 June 2023<br>Aunty Carol responded same day what dates and times would work best for us<br>CSH responded same day with available dates for Aunty Carol<br>Aunty Carol responded same day and suggested 6 July 2023 at 10am<br>CSH responded on 28 June 2023 and agreed to the date and time suggested. We also asked what method would be best to do an interview. |

| Name | Affiliation | Notes |
|---|---|---|
| | | Aunty Carol responded on 28 June 2023 that she would prefer face-to-face.<br>Aunty Carol responded same day and requested to delay the meeting time to 4pm on 6 July 2023<br>CSH responded on 6 July 2023<br>Aunty Carol responded same day<br>CSH responded same day<br>Aunty Carol responded same day<br>CSH arranged to meet with Aunty Carol on 19 January 2024 |
| Kapahulehua Leonard Kimokeo | Founder, Kimokeo Foundation | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |
| Kapu, Ke‘eaumoku | Chair, Aha Moku o Maui/Koani Foundation (501C3) | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023<br>Mr. Kapu responded same day and forwarded the letter and figures to the Wailuku *moku* representatives Mr. Clyde Kahalehau and Kaniloa Kamaunu.<br>CSH responded same day |
| Kekahuna, Janice | Paukukalo Hawaiian Homestead Community Association | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |
| Kapu, Uilani | Treasurer, Na Aikane o Maui | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |
| Kuloloio, Manuel | Makuakāne, Kuloloi‘a Lineage I ke Kai ‘o Kuloloi‘a | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |
| Lake-Farm, Sissy | Executive Director, Maui Museum/ Kumu Hula, Nā Hanona Kūlike ‘o Pi‘ilani | Letter and figures sent via USPS on 10 April 2023<br>Second round letter and figures sent via USPS on 19 May 2023 |
| Lu‘uwai, Kalei | *Kama‘āina* | Letter and figures sent via USPS on 10 April 2023<br>Second round letter and figures sent via USPS on 19 May 2023 |
| Manuel, Kaleo M. | Deputy Director, Commission on | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |

| Name | Affiliation | Notes |
|---|---|---|
| | Water Resource Management | |
| Molitau, Kaponoai | Owner, Native Intelligence | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |
| Nakahashi, Ikaika | Cultural Historian, SHPD | Letter and figures sent via email on 7 April 2023<br>Mr. Nakahashi responded on 10 April 2023:<br>*Mahalo for contacting me regarding the Cultural Impact Assessment for the proposed Central Maui Wastewater Reclamation Facility, Waikapū and Wailuku Ahupua‘a, Maui.*<br>*I recommend CSH to utilize the media (e.x. OHA’s Ka Wai Ola, etc.) to solicit additional information for this CIA.*<br>*I recommend CSH consult with:*<br>*Ke‘eaumoku Kapu – ‘Aha Moku o Maui Inc., kapukapuakea@gmail.com*<br>*Hōkūao Pellegrino - Hui o Na Wai ‘Eha, huionawai4@gmail.com*<br><br>*I recommend CSH minimally to meet with any native tenants and people that currently live or previously lived in the ahupua‘a listed above on Maui for information about the cultural resources and cultural practices for this CIA.*<br>*Koe nae ke kuleana o na kanaka ma loko = reserving the rights of native tenants.*<br>*Please let me know if I can assist with anything else.*<br>*A hui hou,*<br>CSH responded on 12 April 2023 |
| OHA Compliance Unit | | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |
| Oliveira, Roy Kalani | President, Waiehu Kou Phase 3 Association | Letter and figures sent via USPS on 10 April 2023<br>Second round letter and figures sent via USPS on 19 May 2023 |
| Ornellas, Daniel L. | Vice President, Waiehu Kou Phase 3 Association | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |
| Pellegrino, Hōkūao | Noho‘ana Farm Owner/Manager and Land Education | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |

| Name | Affiliation | Notes |
|---|---|---|
| | Specialist for Kamehameha Schools Maui President, Hui Nā Wai ‘Ehā | Mr. Pellegrino responded on 23 May 2023 and stated he would like to comment on this project.<br>Mr. Pellegrono responded again on 24 May 2023 that he would be gone until June 6th and would schedule after returning.<br>CSH responded same day<br>CSH sent a follow-up email on 27 June 2023<br>CSH sent another follow-up email on 2 August 2023 |
| Polido, Travis | Waikapu Community Association President | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |
| Pridemore, Jill | Director, Alexander & Baldwin Sugar Museum | Letter and figures sent via USPS on 10 April 2023<br>Second round letter and figures sent via USPS on 19 May 2023<br>Ms. Holly Buland responded on 22 May 2023 (Please see Holly Bulland’s correspondence section of this table) |
| Raymond, Ki‘ope | Hawaiian Studies Teacher, UH Maui | Letter and figures sent via email on 7 April 2023<br>Mr. Raymond responded same day and stated he had no comment at this time.<br>CSH responded on 10 April 2023 |
| Schattenburg-Raymond, Lisa | Horticulturalist/Former Executive Director, Maui Nui Botanical Gardens | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |
| Sherill, Tamara | Executive Director, Maui Nui Botanical Gardens | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |
| Six, Janet | Principal Investigator, County of Maui | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |
| Smythe, Crystal | Lineal/Cultural Descendant | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |
| Watanabe, Evalina “Noelani” | Maui, Vice-Chair, OHA‘s Native Hawaiian Historic Preservation Council (NHHPC) | Letter and figures sent via email on 7 April 2023<br>Second round letter and figures sent via email on 19 May 2023 |

## 7.4 Summaries of Responses

The authors and researchers of this report extend our deep appreciation to everyone who took the time to speak and share their *mana‘o* and *‘ike* with CSH, whether in interviews or brief consultations. We request that if these interviews are used in future documents, the words of contributors be reproduced accurately and in no way altered, and that if large excerpts from interviews are used, report preparers obtain the express written consent of the interviewee/s.

### 7.4.1 Ms. Carol Lee Kamekona (“Aunty Carol”)

CSH arranged to meet with Carol Lee Kamekona on 19 January 2024 to discuss the proposed project. Aunty Carol invited Clare Apana, Ui Hotta, and another individual to the meeting. Per CSH’s standard approach to outreach during the CIA process as described in Section 2.2, this group was provided with a description of the project and maps depicting the location of the project area (see Appendix A) prior to and during the meeting. No comments related to ongoing cultural practices or cultural impacts were received based on the provided information and meeting.

### 7.4.2 Mr. Skippy Hau

On 7 April 2023, Mr. Skippy Hau, *kama‘āina* and former Aquatic Biologist for the State of Hawai‘i, Division of Aquatic Resources (DAR), provided written testimony regarding the CIA and Ka Pa‘akai Analysis for the Central Maui WWRF project. Mr. Hau’s statement is included below in its entirety.

> I fully support the proposed project. I’ve retired over a year ago and will not be commenting further for this project.
>
> I support the concept to go away from a centralized system otherwise I foresee problems in the future with increasing demands from a growing population. I do not want to see another Sand Island wastewater system with an outfall pipe into the ocean. This also means that the existing Lahaina, Kihei, will continue with existing injection wells for disposal. Kahului wastewater should be recycled as much as possible. Have you seen the Google Earth photo of the discolored water at the Treatment Plant next to Kanaha Pond ?? Kahului Wastewater Plant will need to be upgraded and protected from a possible tsunami.
>
> I am concerned that there could be more drugs which could impact or taint wastewater or the resulting sediment. The increase use of Oxycodone or Fentanyl may spike in future testing if done at all.
>
> I am also concerned about Maalaea wastewater treatment which existing leaching fields could be discontinued. They will need to address sea level rising, shoreline erosion, and reducing drainage runoff from possible kona storms, similar to Kihei.
>
> Aloha,
>
> Skippy

### 7.4.3 Dr. Scott Fisher

On 19 April 2023, CSH conducted an interview remotely via Zoom with Scott Fisher regarding the Central Maui WWRF project. Dr. Fisher is the Director of ‘Āina Stewardship with the Hawai‘i Island Trust as well as the Chair of the Maui/Lāna‘i Island Burial Council. Dr. Fisher owns an *‘ulu* farm in Waikapū Ahupua‘a, south of the most southern portion of the current project area where the Central Maui WWRF will be built, which consists of 4 acres.

“Nā Wai ‘Ehā” refers to four streams on Maui: Waikapū, Wailuku, Wai‘ehu, and Waihe‘e. Waikapū Stream intercepts the current project area near the intersection of East Waiko Road and Wai‘ale Road. The area surrounding Waikapū Stream was an important area for *kalo* cultivation and Dr. Fisher stated that “all along this corridor, there would’ve been significant amounts of taro grown.” He further stated that *kalo* would be grown all the way to the river mouth, which is where Kealia Pond is located. Both Waikapū Stream and Keālia Pond are areas that could potentially be impacted by the proposed project. Waikapū was also known to have a lot of *‘ulu* which is one of the reasons why Dr. Fisher has an *‘ulu* farm in Waikapū.

Regarding how Waikapū received its name, Dr. Fisher stated it was “because they blew the conch shell and that’s how it became Waikapū, ‘water of the conch.’” However, Dr. Fisher believes there is a more plausible explanation and stated, “Waikapū gets very narrow in the back and what it does is it kind of makes this whistling sound like a conch shell.”

Regarding the natural environment, Dr. Fisher mentioned the wind of Waikapū, “*ka makani kololio*,” *kololio* meaning “rumbling wildness.” He further stated that *kololio* describes the “intense, venturi effect that happens when the wind is channeled through the mountains.”

Sugarcane plays a significant role in the history of both Waikapū and Wailuku Ahupua‘a. According to Dr. Fisher, the earliest sugarcane plantation on Maui was in Waikapū, known as Waikapu Sugar. Then it became Wailuku Sugar and later Hawaiian Commercial & Sugar Company (HC&S) took over. Dr. Fisher also mentioned his father previously worked for HC&S and he oversaw the transition in the early 1980s.

Dr. Fisher spoke of coming across a lot of railroad ties, dating back to the nineteenth and early twentieth century. He stated the train was in use when they would collect materials for the train tracks as opposed to the tourna haulers, which replaced plantation railroads in 1950. In terms of cultural sites, Dr. Fisher stated the possibility of coming across pre-Contact sites is very low.

Regarding historical events, Dr. Fisher mentioned the current project area is “reaching” to the general area where the Battle of Kama‘oma‘o occurred in 1776. Kalani‘ōpu‘u invaded Maui with his warriors from Hawai‘i Island and crossed the central plains where the project area is located. Kalani‘ōpu‘u’s army consisted of two elite warrior units, ‘Ālapa and Pi‘ipi‘i. These two units were slaughtered in this battle by the Maui army, led by Kahekili, which was hiding on top of the sand dunes. Dr. Fisher also mentioned there were a lot more sand dunes where Kalani‘ōpu‘u and his army were traversing.

Regarding soil, Dr. Fisher stated “it’s colluvial, but just under the surface it’s sand.” He further commented, “When we were digging to plant our trees, we kept punching through the colluvium, that sediment that washed down over the last 20,000 years and hitting pre-Contact sand. You know that’s going to be enticing for people to bury there.” It is well known that sand dunes were popular

burial sites. Stephen Desha in *Kamehameha and His Warrior Kekūhaupi‘o*, stated that after the two elite warrior units of Kalani‘ōpu‘u were slaughtered, two messengers reported, “[…] Those persons who had been slain and whose bones were laid in the sand dunes of Wailuku and Waikapū were of the chiefly blood of Hawai‘i” (Desha 2000:43). Within the Native Hawaiian community, there are ongoing debates on whether human remains found in the sand dunes are those from Maui or Hawai‘i Island.

Dr. Fisher emphasized the density of burials in the vicinity of the current project area. He is concerned with the possibility of burials being found within the project area and suggests a very thorough archaeological inventory survey and significant testing be conducted prior to construction. He would like to encourage project developers to be very sensitive to burials and identify them beforehand rather than recording them as inadvertent discoveries. Previous projects have been shut down because developers and archaeologists have not done significant amounts of testing, especially in an area well-known to have burials, which resulted in public outcry.

Dr. Fisher has pointed out multiple areas within the vicinity of the project area that have known burials. A burial site was found off Maui Lani Parkway, past Wai‘ale Road, up *mauka*; he stated it’s in the vicinity of Foodland. He also stated that a historic Japanese cemetery was located near the intersection of Wai‘ale Road and East Waiko Road. East of the project area, where Maui Lani Phase VI occurred, around 180 burials were inadvertent discoveries. Maui Lani Phase VI, Increment 4 was identified by the Maui/Lāna‘i Island Burial Council as a known burial area, a *pā ‘ilina* (cemetery) (*Maui News* 2019). Regarding the southern portion of the project area that consists of the WWRF and extension of Waiko Road to Honoapi‘ilani Highway, Dr. Fisher stated there is a high possibility of coming across a burial even though there is currently no road built in that area and it is agricultural lands.

Dr. Fisher is also concerned with wastewater because of previous wastewater projects in the area, such as Maui Land Phase VI, where there were a multitude of problems. He further commented that “if the pipe breaks, you’ll have all this wastewater going around.” There is also the issue of rerouting the pipes if burials are found. He pointed out that the “corridors are narrow, maybe four to five feet at the widest. It’s not like a highway where it’s thirty to forty feet wide and there’s room to make changes.” This comment was regarding the portion of the project area along Wai‘ale Road. Dr. Fisher suggests doing a statistical analysis of this.

# Section 8 Traditional Cultural Practices

## 8.1 Overview

Timothy R. Pauketat succinctly describes the importance of traditions, especially regarding the active manifestation of one's culture or aspects thereof. According to Pauketat,

> People have always had traditions, practiced traditions, resisted traditions, or created traditions […] Power, plurality, and human agency are all a part of how traditions come about. Traditions do not simply exist without people and their struggles involved every step of the way. [Pauketat 2001:1]

It is understood that traditional practices are developed within the group, in this case, within the Hawaiian culture. These traditions are meant to mark or represent aspects of Hawaiian culture that have been practiced since ancient times. As with most human constructs, traditions are evolving and prone to change resulting from multiple influences, including modernization as well as other cultures. It is well known that within Hawai‘i, a "broader 'local' multicultural perspective exists" (Kawelu 2015:3). While this "local" multicultural culture is deservedly celebrated, it must be noted that it has often come into contact with "traditional Hawaiian culture." This contact between cultures and traditions has undoubtedly resulted in numerous cultural entanglements. These cultural entanglements have prompted questions regarding the legitimacy of newly evolved traditional practices. The influences of "local" culture are well noted throughout this section and understood to represent survivance or "the active sense of presence, the continuance of native stories, not a mere reaction, or a survivable name. Native survivance stories are renunciations of dominance, tragedy and victimry" (Vizenor 1999:vii). Acknowledgement of these "local" influences helps inform nuanced understandings of entanglement and of a "living [Hawaiian] contemporary culture" (Kawelu 2015:3). This section strives to articulate traditional Hawaiian cultural practices within the *ahupua‘a* in ancient times, and the aspects of these traditional practices that continue to be practiced today; however, this section also challenges "tropes of authenticity" (Cipolla 2013) and acknowledges the multicultural influences and entanglements that may "change" or "create" a tradition.

This section integrates information from Sections 3–7 in examining cultural resources and practices identified within or in proximity of the project area in the broader context of the encompassing Waikapū and Wailuku landscape. Excerpts from interviews are incorporated throughout this section where applicable.

## 8.2 Gathering Practices and Plant Resources

Many previous informants have mentioned gathering plants for *lā‘au lapa‘au* in the uplands of Waikapū Valley and along Waikapū Stream. Three ridges were identified by informants as locations to gather plants for *lā‘au lapa‘au*, Kahoi Ridge, Lapaleihua Ridge, and Kalapaook‘īlio Ridge. Some plant resources identified in the uplands of Waikapū Valley include *koai‘a, noni, wiliwili, alahe‘e,* guava, and banana. Plant resources that would be found along Waikapū Stream include *ko‘oko‘olau, māmaki, olopua*, *‘ōhi‘a*, ferns, and grasses. Ms. Bustamente mentioned using *ko‘oko‘olau* and *māmaki* for tea, which are grown along Waikapū Stream (Pellegrino 2014:98).

## 8.3 Agricultural Practices

Traditionally, Waikapū and Wailuku were known for taro and *‘ulu* cultivation as a result of the Nā Wai ‘Ehā. Regarding *‘ulu* cultivation, Mr. Pellegrino mentioned they were located along the *‘auwai* and Dr. Fisher shared that he had an *‘ulu* farm in Waikapū, south of the most southern portion of the current project area where the Central Maui WWRF will be built, which consists of 4 acres (Tanaka et al. 2023:68). Many informants mentioned that *kalo* cultivation was or continues to be practiced within Waikapū Ahupua‘a. These lands were traditionally rich with agricultural terraces used for wetland cultivation (Dagher 2020:48; Taua et al. 2010:12).

For the current project, Dr. Fisher has stated that *kalo* would be grown all the way to the river mouth, which is where Kealia Pond is located. Ms. Bustamente also mentioned wetland *kalo* farming occurred in the lower reaches of the valley (Pellegrino 2014:100). According to Mr. Pellegrino, “There were over 1,400 lo‘i kalo documented on 900 acres of land as being in cultivation at the time of the Māhele in Waikapū alone” (Dagher 2020:52). Mr. Hobdy described how there were clusters of *‘ili kalo* and *‘ili mo‘o* around the stream, which indicates settlements in Waikapū were focused around Waikapū Stream. *‘Ili kalo* is wetland taro and *‘ili mo‘o* is “how the water flows from lo‘i (irrigated taro patch) to lo‘i like a thread connecting a string of pearls” (Tanaka et al. 2023:68).

## 8.4 Freshwater Resources

Waikapū Stream and Wailuku River (‘Īao Stream) are a part of what is known as the “Nā Wai ‘Ehā” (Handy et al. 1991:469; Moffat and Fitzpatrick 1995:23). According to Dr. Fisher, in traditional times, the Nā Wai ‘Ehā was the “most culturally productive land on Maui” (Tanaka et al. 2023:68).

Waikapū Stream intercepts the current project area near the intersection of East Waiko Road and Wai‘ale Road. As mentioned before, Waikapū Stream is a land-bound stream traditionally diverted into *lo‘i kalo* and “its overflow was dissipated on the dry plains of the broad isthmus between West and East Maui” (Handy et al. 1991:496).

Many previous informants discussed the multiple stream diversions that were developed over the years for sugarcane cultivation and development, which has negatively impacted the flow of Waikapū Stream. Some informants have even mentioned that they have never seen the water flowing *mauka* to *makai*. However, presently many Hawaiian families are in the process of returning to Waikapū Ahupua‘a and restoring traditional *lo‘i kalo* and utilizing the *kuleana ‘auwai*.

Taua et al. (2010) mentioned Mr. Santiago described the following regarding traditional water flow management:

> Alfred compared the current system to his understanding of how the Hawaiian kupuna would have managed the water system. His thoughts were that the kupuna would have tightly, manually and visually monitored the water flow. They didn’t have the luxury of a large reservoir, so they had to quickly regulate any excess water so it wouldn’t do any damage. They would have had to be constantly hands-on and be able to anticipate changes in water flow. [Taua et al. 2010:15–16]

## 8.5 *Nā Wahi Pana*

The most known story associated with how Waikapū received its name is due to the sound of a supernatural conch shell located in a cave within Waikapū Valley that was stolen by a supernatural dog named Puapualenalena. However, Dr. Fisher shared a different perspective on how Waikapū received its name and stated “the name of Waikapū comes from the sound the wind makes when it blows through Waikapū Valley, which resembles the sound of a *pū* being blown” (Tanaka et al. 2023:68–69).

Informants (Keahi Bustamente, Scott Fisher, Robert Hobdy, and Wallettee Pellegrino) have mentioned some *wahi pana* within Waikapū such as Keālia Pond, Māʻalaea, Puʻuhele, Loaloa, Wahineomāʻili, Pilipili, Nohoana, and Kuaiwa. Keahi Bustamente shared that Loaloa is an *ʻili* that was claimed by Charles Copp and Kupaliʻi (Pellegrino 2014:97). Wahineomāʻili, Pilipili, Nohoana, and Kuaiwa are *ʻili* as well and were mentioned by Robert Hobdy (Tanaka et al. 2023:69). Regarding the natural environment, Dr. Fisher mentioned the wind of Waikapū, “*ka makani kololio*,” *kololio* meaning “rumbling wildness.” He further stated that *kololio* describes the “intense, venturi effect that happens when the wind is channeled through the mountains.”

The story of the battle between Kalaniʻōpuʻu and Kahekili occurred on the plains of Kamaʻomaʻo. Tanaka et al. (2023) summarizes this battle mentioned by Scott Fisher in the following:

> The second *moʻolelo* is associated with the battle between Kalaniʻōpuʻu, and his armies and chief of Maui, Kahekili, and his armies on the plains of Kamaʻomaʻo. He stated that chief of Hawaiʻi, Kalaniʻōpuʻu and his armies including the ʻĀlapa and Piʻipiʻi landed at Kīheipūkoʻa, which is located on the “Kīhei side of Keālia Pond.” As the ʻĀlapa and Piʻipiʻi crossed through Waikapū on their way to Wailuku, they were surrounded and slaughtered by the forces of Maui and Oʻahu. Dr. Fisher stated that the Maui army blew the conch shell to signal their attack on the Hawaiʻi army. He noted there were only two survivors from the ʻĀlapa and Piʻipiʻi after the battle. He also noted that cultural descendants of slain warriors from Hawaiʻi who were among the ʻĀlapa and Piʻipiʻi have been recognized by the MLIBC. [Tanaka et al. 2023:69]

## 8.6 Burials

Waikapū is located at the southern extent of an area known as Wailuku Sandhills, or also the Sand Hills. The *puʻu one* sand dune system located within Waikapū and Wailuku ahupuaʻa was a popular burial ground for Hawaiians. Hōkūao Pellegrino stated, “This area was part of the Nā Wai ʻEhā sand dune system that came across part of the upper central plains of Maui. There are ancient burials of his kupuna and the kupuna of others that are buried there” (Dagher 2020:47).

During the Wailuku Commons battle, the Big Island army was ambushed at an area close to Waikapū and was destroyed by the army of Kahekili on the plains of Kamaʻomaʻo (Hokulani Holt Padilla in Hill et al. 2006). Ke Kula o Kamaʻomaʻo, or the Plains of Kamaʻomaʻo, is the name given to a region of sandy plains spanning portions of Wailuku and Waikapū Ahupuaʻa (Emerson 1993). There is an ongoing debate in the Hawaiian community on whether or not *iwi* found in Waikapū were those of the Hawaiʻi Island or Maui warriors. Mr. Ampong believes those buried

throughout the sand dunes of Maui are likely ancestors of Maui Island since the Hawai‘i island warriors were “invaders”; their bones were left to rot in the sun (Spencer and Hammatt 2021:87).

Dr. Fisher has pointed out multiple areas within the vicinity of the project area that have known burials. A burial site was found off Maui Lani Parkway, past Wai‘ale Road, up *mauka;* he stated it’s in the vicinity of where Foodland is currently located. East of the project area, around 180 burials were inadvertently discovered. Maui Lani Phase VI, Increment 4 was identified by the Maui/Lāna‘i Island Burial Council as a known burial area, a *pā ‘ilina* (*Maui News* 2019). Regarding the southern portion of the project area that consists of the WWRF and extension of Waiko Road to Honoapi‘ilani Highway, Dr. Fisher stated there is a high possibility of coming across a burial even though there is currently no road built in that area and it is agricultural lands.

Other informants have mentioned families in the area tending to graves at cemeteries in the area, like the Cornwell cemetery or on the north side of Waikapū Stream. Some burial sites were identified during projects, such as the one located along East Waikō Road, which was mentioned by Kaniloa Kamauna (Tanaka et al. 2023:69). Keahi Bustamente also mentioned the Rogers-Harders families scattering ashes of their *‘ohana* in Waikapū Valley (Pellegrino 2014:100–101).

## 8.7 Cultural Properties

Hōkūao Pellegrino mentioned Pōhāki‘o, a grinding stone and boundary marker, located near the Old Government Road. However, its exact location is unknown as well as whether it remained in situ or was relocated. According to Hōkūao Pellegrino, “Pōhāki‘o was first and foremost a hoana, or grinding stone used to file and finish ko‘i (adzes-stone tool used for cutting and carving wood). Secondly, it was a commonly known palena ‘āina (boundary marker) for the northern end of the Waikapū ahupua‘a” (Dagher 2020:48–49). Not only is Pōhāki‘o an important cultural site as a grinding stone and boundary marker, but also for being a place name.

Keahi Bustamente mentioned many cultural sites she came across as a result of exploring and her line of work, which consisted of *lo‘i kalo*, Keālia wetlands, and Mā‘alaea fishing grounds. Other informants (Keahi Bustamente, Scott Fisher, and Wallettee Pellegrino) have mentioned remnants of stone wall terraces found along the embankment of Waikapū Stream, along Waikō Road, and the whole area in the valley.

# Section 9 Ka Pa‘akai Analysis

## 9.1 Overview

In Ka Pa‘akai vs Land Use Commission, 94 Hawai‘i (2000) the Court held the following analysis must also be conducted:

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

Based on information gathered from the cultural and historical background, and community consultation for this project, Waikapū Stream and human remains were identified within the project area. Traditionally and presently, Waikapū Stream has been used to cultivate *kalo* and *‘ulu*. Today, many Hawaiian families are returning to Waikapū Ahupua‘a and restoring old *kuleana ‘auwai* and *lo‘i kalo* to revitalize the traditional agricultural practices of *kalo* cultivation. One historic agricultural terrace (SIHP # -06669) was found along Waikapū Stream where the Wai‘ale Road extension portion of the project area and stream intersect. This portion of the project area is within fallow fields of sugarcane and overgrown field access roads. Surrounding this area are agricultural lands. Although no cultural practices were identified within the project area, Waikapū Stream itself is a significant cultural, historical, and natural resource that may possibly be impacted by the proposed project. If Waikapū Stream is impacted by the proposed project, then Keālia Pond will be affected as well. Four burials (SIHP #s -05966, -05965, -05680, and -08659) were also previously identified along the existing Wai‘ale Road portion of the project area. Two were reinterred (SIHP #s -05965 and -05966) and the other two remained in situ with a concrete slab poured over them (SIHP #s -05680 and -08659). Other historic properties within the project area and along Wai‘ale Road included a sugarcane flume (SIHP # -05967), a historic roadbed (SIHP # -05963), and cultural material (SIHP # -08017). The focus of concerns is largely impacts on Waikapū Stream and burials. Community consultants have recommended a thorough AIS prior to construction to avoid inadvertently discovering burials within the project area.

## 9.2 Archaeological Resources

Fifteen archaeological studies were previously conducted within or adjacent to the project area. The earliest study was an archaeological walk-through survey of approximately 1,020 acres on the eastern side of the northern portion of Wai‘ale Road conducted by Barrera in 1976. The most recent study was an AIS for a proposed Wailuku Apartment Rental Housing project in the lot on the northwestern side of the Wai‘ale Road and Kuikahi Drive intersection (TMK: [2] 3-5-001:064) (O’Claray-Nu et al. 2018). As a result of these 15 studies, four burial sites (SIHP #s -05966, -05965, -05680, and -08659), a sugarcane flume (SIHP # -05967), a historic road bed (SIHP #

-5963), cultural material (SIHP # -08017), and a historic terrace (SIHP # -06668) were identified within or along the Wai‘ale Road portion of the project area.

Historical records, maps and photographs, and archaeological fieldwork support that taro cultivation, sugar cultivation, ranching, and residential development was the dominant land use within the project area and surrounding lands. The majority of historic properties within the project area vicinity are located along the northern portion of Wai‘ale Road. Sugarcane-related historic properties, such as irrigation ditches, are located upland and to the west of the current project area. Traditional agricultural-related sites are located along Waikapū Stream and the majority of burials or human remains are located along and to the east of Wai‘ale Road.

Based on previous consultation, Hōkūao Pellegrino has revealed Pōhāki‘o, a grinding stone and boundary marker, located near the Old Government Road. Keahi Bustamente mentioned many cultural sites she came across as a result of exploring and her line of work, which consisted of *lo‘i kalo*, Keālia wetlands, and Mā‘alaea fishing grounds. Other informants (Keahi Bustamente, Scott Fisher, and Wallettee Pellegrino) have mentioned remnants of stone wall terraces found along the embankment of Waikapū Stream, along Waikō Road, and in Waikapū Valley.

## 9.3 Burials

Four burial sites (SIHP #s -05966, -05965, -05680, and -08659) were previously identified within or adjacent to the Wai‘ale Road portion of the project area. Two were reinterred (SIHP #s -05965 and -05966) and the other two remained in situ with a concrete slab poured over them (SIHP #s -05680 and -08659). Morawski et al. (2006:18) recommended this area be subjected to full-time archaeological monitoring. Yucha et al. (2020) recommended consultation with SHPD prior to any projects within the Maui Community Correctional Center.

Based on previous consultation and background research, there are multiple burial sites located within the project area vicinity. Previous archaeological studies have revealed burials were identified along and east of Wai‘ale Road. The project area is located within proximity to the *pu‘u one* sand dune system, a popular burial ground for Hawaiians. Previous consultations conducted within the vicinity of the project area have mentioned cemeteries or family graves located on the north side of Waikapū Stream. Other burial sites include one located along East Waikō Road or the Rogers-Harders *‘ohana* scattering ashes in Waikapū Valley.

As a result of consultation for this project, Dr. Fisher has pointed out multiple areas within the vicinity of the project area that have known burials. A burial site was found off Maui Lani Parkway, past Wai‘ale Road, up *mauka*; he stated it’s in the vicinity of where Foodland is currently located. East of the project area, around 180 burials were inadvertently discovered. Maui Lani Phase VI, Increment 4 was identified by the Maui/Lāna‘i Island Burial Council as a known burial area, a *pā ‘ilina* (*Maui News* 2019). Regarding the southern portion of the project area that consists of the WWRF and extension of Waiko Road to Honoapi‘ilani Highway, Dr. Fisher stated there is a high possibility of coming across a burial even though there is currently no road built in that area and it being agricultural lands.

## 9.4 Faunal Resources

No faunal resources were documented within the project area.

## 9.5 Earth Resources

No traditional use of the stones (or soft sediments) within the project area has been documented. However, Dr. Fisher stated the project area's soil is "colluvial, but just under the surface it's sand." He further commented, "When we were digging to plant our trees, we kept punching through the colluvium, that sediment that washed down over the last 20,000 years and hitting pre-Contact sand. You know that's going to be enticing for people to bury there."

## 9.6 Plant Resources

Traditionally, Waikapū and Wailuku were known for taro and *‘ulu* cultivation as a result of the Nā Wai ‘Ehā. Waikapū Stream intercepts the current project area near the intersection of East Waiko Road and Wai‘ale Road. As mentioned before, Waikapū Stream is a land-bound stream traditionally diverted into *lo‘i kalo* and "its overflow was dissipated on the dry plains of the broad isthmus between West and East Maui" (Handy et al. 1991:496). Previous archaeological studies revealed agricultural terraces and irrigation ditches located along Waikapū Stream. According to Mr. Pellegrino, "There were over 1,400 lo‘i kalo documented on 900 acres of land as being in cultivation at the time of the Māhele in Waikapū alone" (Dagher 2020:52). Presently, many Hawaiian families are in the process of returning to Waikapū Ahupua‘a and restoring traditional *lo‘i kalo* and utilizing the *kuleana ‘auwai*.

Based on previous consultation, traditional gathering practices include gathering plants for *lā‘au lapa‘au* in the uplands of Waikapū Valley and along Waikapū Stream. Three ridges were identified by informants as locations to gather plants for *lā‘au lapa‘au*: Kahoi Ridge, Lapaleihua Ridge, and Kalapaook‘īlio Ridge. Some plant resources identified in the uplands of Waikapū Valley include *koai‘a, noni, wiliwili, alahe‘e,* guava, and banana. Plant resources that would be found along Waikapū Stream include *ko‘oko‘olau, māmaki, olopua, ‘ōhi‘a*, ferns, and grasses. Ms. Bustamente mentioned using *ko‘oko‘olau* and *māmaki* for tea, which are grown along Waikapū Stream (Pellegrino 2014:98).

## 9.7 Trails

No traditional trails within the project area have been documented.

## 9.8 *Nā Wahi Pana*

The project area is located at Waikapū and Wailuku Ahupua‘a in Wailuku Moku on the island of Maui. According to Pukui et al. (1974), Waikapū translates to the "water of the conch" and Wailuku translates to the "water of destruction." The most known story associated with how Waikapū received its name is due to the sound of a supernatural conch shell located in a cave within Waikapū Valley that was stolen by a supernatural dog named Puapualenalena. However, Dr. Fisher shared a different perspective on how Waikapū received its name and stated, "the name of Waikapū comes from the sound the wind makes when it blows through Waikapū Valley, which resembles the sound of a *pū* being blown" (Tanaka et al. 2023:68–69).

Another *wahi pana* mentioned by previous and current consultants within the project area vicinity included the plains of Kama‘oma‘o where the battle between Kalani‘ōpu‘u and Kahekili occurred. Other *wahi pana* included Keālia Pond, Mā‘alaea, Pu‘uhele, Loaloa, Wahineomā‘ili,

Pilipili, Nohoana, and Kuaiwa. Keālia Pond is the *muliwai* of Waikapū Stream and a national wildlife refuge where native and endemic species of the Hawaiian Islands reside. Keahi Bustamente shared that Loaloa is an *‘ili* that was claimed by Charles Copp and Kupali‘i (Pellegrino 2014:97). Wahineomā‘ili, Pilipili, Nohoana, and Kuaiwa are *‘ili* as well and were mentioned by Robert Hobdy (Tanaka et al. 2023:69).

## 9.9 Valued Cultural, Historical, or Natural Resources in the Project Area

The southern portion of the project area where Wai‘ale Road will be extended and connect to Honoapi‘ilani Highway includes Waikapū Stream. Waikapū Stream is a valued cultural, historical, and natural resource. Traditionally and historically, the stream was diverted by *kuleana ‘auwai* into *lo‘i kalo*. Previously identified historic properties included historic agricultural terraces and irrigation ditches along Waikapū Stream. Presently, these *kuleana ‘auwai* and *lo‘i kalo* are being restored by Native Hawaiian families who are returning to Waikapū Ahupua‘a and reviving the traditional cultural practice of *kalo* cultivation..

Based on previous archaeological studies, there are four burials (SIHP #s -05966, -05965, -05680, and -08659) located within or adjacent to the Wai‘ale Road portion of the project area. Two were reinterred (SIHP #s -05965 and -05966) and the other two remained in situ with a concrete slab poured over them (SIHP #s -05680 and -08659). Full-time archaeological monitoring was recommended for the areas where these burials are located. Other historic properties within the project area and along Wai‘ale Road included a sugarcane flume (SIHP # -05967), a historic roadbed (SIHP # -5963), cultural material (SIHP # -08017), and a historic terrace (SIHP # -06668).

## 9.10 The Extent to which Traditional and Customary Native Hawaiian Resources will be Affected by the Proposed Action

As a result of the prior land use of intensive sugarcane cultivation and modern development, it is concluded that traditional and customary Native Hawaiian resources that may be directly affected by the proposed action are the possible presence of human burials in the project area and Waikapū Stream and its *muliwai,* Keālia Pond. Dr. Fisher has mentioned during consultation that Waikapū Stream and Keālia Pond are areas that could potentially be affected by the extension of Wai‘ale Road. What occurs upstream will affect downstream. Keālia Pond is home to many endangered and endemic species to the Hawaiian Islands. If water quality is affected by the construction extending Wai‘ale Road, it will also negatively impact those species at Keālia Pond.

Regarding the possible presence of human burials in the project area, previous archaeological studies have identified four burials (SIHP #s -05966, -05965, -05680, and -08659) located within or adjacent to the Wai‘ale Road portion of the project area. Two were reinterred (SIHP #s -05965 and -05966) and the other two remained in situ with a concrete slab poured over them (SIHP #s -05680 and -08659). Dr. Fisher has also mentioned during consultation that there is a high possibility of coming across a burial even though there is currently no road built in the Wai‘ale Road extension portion of the project area and it being agricultural lands. The project area includes undeveloped and heavily vegetated former agricultural lands, utilized for sugarcane cultivation until the end of 2016, at which time the last commercial sugarcane operations on Maui closed. For

over a century, the surface soils within most of the project area have been significantly disturbed by plowing and intermixed with imported material to increase the viability of agriculture in the region. Residential housing and retail businesses, with some peripheral developments consisting of light industrial yards, cemeteries, and paved roadways are located along the existing Wai‘ale Road.

The new force main will connect the Central Maui WWRF and the Kehalani WWPS, and it will extend along a portion of the existing corridor of Wai‘ale Road and the future corridor of the Wai‘ale Road Extension to a connection to the proposed Waikapū Country Town project. The force main trench along Wai‘ale Road and the future Wai‘ale Road Extension is expected to be 1.22 m (4 ft) wide with an estimated length of 5.18 linear km (17,000 linear ft) and a maximum excavation depth of 4.57 m (15 ft). Dr. Fisher has expressed concerns about rerouting the pipes if burials are found. He pointed out that the “corridors are narrow, maybe four to five feet at the widest. It’s not like a highway where it’s thirty to forty feet wide and there’s room to make changes.”

## 9.11 Feasible Action, if any, to be Taken to Reasonably Protect Native Hawaiian Rights

If indeed the anticipated population growth in Waikapū and Wailuku Ahupua‘a is to continue, then the question is how best to manage it and how to mitigate adverse impact on traditional Hawaiian resources and customary practices, or of course ideally, to improve traditional Hawaiian resources.

For starters, mitigation would seem to ensure that any development projects do not make matters worse, minimally by ensuring best management practices.

Dr. Fisher has recommended a very thorough AIS and significant amounts of testing be conducted prior to construction. Many burials have been previously identified within the project area along Wai‘ale Road, especially with two of the four burials remaining in situ. There is also a possibility of burials being found within the southern portion of the project area where the extension of Wai‘ale Road to Honoapi‘ilani Highway will occur. Dr. Fisher encourages project developers to be very sensitive to burials and identify them beforehand rather than recording them as inadvertent discoveries. Regarding the issue of rerouting pipes if a burial is found, Dr. Fisher has suggested a statistical analysis. As the corridors are very narrow along Wai‘ale Road, it will be very difficult to reroute the pipes if a burial is inadvertently discovered.

# Section 10 Summary and Recommendations

## 10.1 Results of Background Research

Background research for this study yielded the following results, presented in approximate chronological order:

1. The wind of Waikapū is Kololio and the wind of Wailuku is I‘a iki (Nakuina 1992:63). There were many recognized rains in the *moku* of Wailuku, but the Kili‘o‘opu rain was specifically associated with Waikapū and the larger Wailuku district (Akana and Gonzalez 2015:84). Hō‘eha‘ili, ‘Ulalena, and Uhiwai are rains closely associated with Wailuku.
2. Waikapū Stream is one of four major deep-valley streams (Waikapū, Wailuku, Wai‘ehu, and Waihe‘e) which comprise the *‘okana* known as “Nā Wai ‘Ehā” (Handy et al. 1991:469; Moffat and Fitzpatrick 1995:23). Handy et al. (1991:496) describe Waikapū Stream as a land bound stream whose water was “utilized for irrigating a great acreage of sugar cane” and “formerly was diverted into lo‘i and its overflow was dissipated on the dry plains of the broad isthmus between West and East Maui.”
3. In ancient times, Waikapū and Wailuku were agriculturally abundant lands known for their extensive *lo‘i* (Handy et al. 1991:497).
4. According to (Pukui et al. 1974:223), “Waikapū” literally translates to “Water of the Conch.” This is due to a cave within Waikapū Valley that supposedly housed a supernatural conch shell (named Kīhapū, blessed with the breath on Lono) that resided there until it was stolen by a supernatural dog named Puapualenalena. This conch shell, when blown, was said to resound throughout all the Hawaiian Islands (Beckwith 1970:349; Pukui et al. 1974:223).
5. According to H.T. Cheever (in Sterling 1998:63), the waters of Nā Wai ‘Ehā were named after successive events during a famous, albeit unnamed, battle.
6. Ke Kula o Kama‘oma‘o, or the Plains of Kama‘oma‘o, is the name given to a region of sandy plains spanning portions of Wailuku and Waikapū Ahupua‘a (Emerson 1993). This area was known by Hawaiians in traditional times as a wandering place of the souls (Beckwith 1970), a place where dead spirits waited for a friendly escort, perhaps an *‘aumakua*, to show them the way to eternity.
7. The Battle of Waikapū Common, or the Ahulau ka Pi‘ipi‘i i Kakanilua entailed the clash of invading Hawai‘i Island forces, headed by Kalani‘ōpu‘u, with the Maui forces under Kahekili in 1776. According to Fornander (1880:2:152–153), following the plunder of the leeward east Maui coastline, Kalani‘ōpu‘u landed his invading troops at Mā‘alaea. The Big Island army was ambushed at an area close to Waikapū and was destroyed by the army of Kahekili on the plains of Kama‘oma‘o (Hokulani Holt Padilla in Hill et al. 2006).

8. Geographically and culturally, Nā Wai ‘Ehā consisted of four deep valley streams (Waikapu, Wailuku, Waiehu, and Waihee) that watered four distinct areas of taro land that spread out fanwise to the shoreline (Handy et al. 1991:272) with the *ahupua‘a* of both Wailuku and Waikapū extending across the isthmus of Maui to meet the traditional land boundaries of Hamakuapoko and Kula Moku. These two land divisions were of primary importance due to their location across “the whole of the central isthmus so as to cut off half of the lands in the district of Kula from access to the sea,” and were sometimes referred to as Na Poko (W.D. Alexander in Sterling 1998:63).
9. In 1819, the first whaling ships arrived in Hawaiian waters and Lāhainā Harbor became a primary port of call for provisioning ships in the Islands. Closely following the arrival of the first whaling ships, the first Protestant missionaries and their families arrived in Lāhainā in 1823 (Bingham 1824).
10. Foreign commercialism initially came to Waikapū in the form of sugar processing and coffee production (Wyllie 1854). A man by the name of Antone (Anthony) Catalena was running a cane syrup factory at Waikapū ca. 1823 and is credited with being the founder of the industry in Hawai‘i (Thrum 1874) while Antonio Silva set up a plantation and a mill in Waikapū ca. 1828 (Thurston 1906). At about the same time Antonio was also engaged in coffee agriculture with trees that reportedly produced above 20 pounds annually (Wyllie 1854).
11. Vestiges of extensive *lo‘i* cultivation, which spread to the north and south from the base of Waikapū to a considerable distance below the valley, remained through the 1930s. Although most of the *lo‘i* terraces in Waikapū had been plowed under by the expansion of commercial sugarcane cultivation, a few of the ancient terraces were preserved in plantation camps and under house sites as well as reused as garden sites, among which, and in addition to Hawaiian wet-taro, included Japanese dry-taro, truck gardens, and lotus for their seeds (Handy et al. 1991:497).
12. Ruth Ke‘elikolani, half-sister of Kamehameha V (Lot Kapuāiwa), inherited the *ahupua‘a* of Wailuku from Lot Kapuāiwa on his death in 1872. Ruth Ke‘elikolani then sold a portion of her Wailuku land holdings to the sugar-industrialist Claus Spreckels in 1882. Spreckels subsequently received Land Grant 3343 from King Kalākaua, that consisted of 24,000 acres of the southeastern portion of the Wailuku Ahupua‘a (Zambucka 1977:48). The current project area extends through Land Grant 3343 and Land Grant 3152 to Henry Cornwell (Figure 14). The lands purchased by Cornwell were added to the holdings of the Waikapu Sugar Plantation, originally started by Henry Cornwell and James Louzada on Grant 2951, before the plantation was sold in 1876 (*Pacific Commercial Advertiser* 1879:5).
13. In general, it appears the most agriculturally fertile lands of Waikapū Ahupua‘a did not extend beyond the alluvial sediments of the stream valley as the lower elevations leading into the central isthmus of Maui are dominated by windswept Pleistocene sand dune deposits (Foote et al. 1972:48, 115).
14. In 1838, the Waikapū Congregational Church was established as a home-based Christian service. During World War II, Waikapū Congregational Church was turned over to the

military and used as a surgical hospital. The Church building was used as a ward with an additional “nurses quarters” built off to the side of the main structure. As sugarcane cultivation began to dominate the region in the early to mid-twentieth century, residential dwellings dwindled, as did the attendees of the Waikapū Congregational Church. As full-time pastors became unnecessary, the church members voted to merge with the Kahului Church, and the Waikapū Congregational Church was abandoned to the sugarcane fields that surrounded it (Head 1960).

15. Henry Cornwell arrived on Maui from New York and started the Waikapu Sugar Company with James Louzada (his brother-in law) in 1864. The two partners constructed a steam-powered sugar mill situated on a 17-acre parcel that had been part of Land Grant 2951; land originally purchased by Henry Cornwell and J. Louzada in Waikapū (Wilcox 1996:61).
16. In 1876, Henry Cornwell retired, and the remaining plantation lands were sold to the new partners Colonel W.H. Cornwell and Colonel G.W. Macfarlane (*Honolulu Advertiser* 1903:8). In 1878, Claus Spreckels bought an undivided interest in 12,000 acres of the Waikapū Commons from W.H. Cornwell and leased an additional 24,000 acres of adjacent Wailuku Commons crown lands from the government (Wilcox 1996:61). These lands would form a large portion of Hawaiian Commercial and Sugar Company (HC&S).
17. Most of the Waikapu Commons and across the isthmus was covered with sugarcane by the mid-nineteenth century. Waikapu Sugar Company operated from 1862 to 1894, when it was purchased and incorporated into the holdings of Wailuku Sugar Company (Kaukali and Subica 2010).
18. In 1862, the partners of the Wailuku Sugar Company grew to include James Robinson & Company, Thomas Cummins, and J. Fuller (Wilcox 1996:122). In 1863, Charles Brewer became a major partner in the operation of the Wailuku Sugar Company. By 1867, the Wailuku Sugar Company had 2,250 acres planted in cane. The Wailuku Sugar Company incorporated in 1875 and began to become profitable. In 1877, the Baileys were bought out (Nellist 1925:70).
19. Beginning in 1880, the Waikapū plantation lands began to be merged with those of the Wailuku and Waihe‘e plantations. In 1905, a new sugar mill was constructed in Wailuku to accommodate the sugar brought in from the new outlying plantations, including Waikapū (Kaukali and Subica 2010:98).
20. Following World War II, buildings erected during reconstruction of Kahului in the 1910s and 1920s slowly gave way to post-war modernization. HC&S Company camp housing for the Kahului Store, including housing along Mill Street and Pu‘unēnē Avenue for stevedores and railroad workers, began to be dismantled. Areas once occupied by the military returned to cattle ranching, pineapple, and sugar cultivation.
21. Fifteen archaeological studies were previously conducted within or adjacent to the project area. Four burial sites (SIHP #s -05966, -05965, -05680, and -08659), a sugarcane flume (SIHP # -05967), a historic road bed (SIHP # -5963), cultural material (SIHP # -08017), and a historic terrace (SIHP # -06668) were identified within or along the Wai‘ale Road portion of the project area.

22. Nine previous cultural studies were conducted within the project area vicinity. The following cultural practices were identified by previous consultants: freshwater and *lā‘au lapa‘au* gathering practices, *kalo* and *‘ulu* agricultural practices, and burial practices.

## 10.2 Results of Community Consultation

CSH attempted to contact Native Hawaiian organizations, agencies, and community members as well as cultural and lineal descendants. Community outreach letters were sent to 45 individuals or groups; nine responded, three met with CSH in person, one provided a written testimony, and one of these *kama‘āina* and/or *kūpuna* met with CSH for a more in-depth interview.

A meeting took place with Ms. Carol Lee Kamekona, a member and former President of ‘Ahahui Ka‘ahumanu Chapter IV, Wailuku, a member of Aha Moku o Wailuku, a Board Director and former Treasurer of Mālama Kakanilua, and *kama‘āina*, along with Clare Apana, Ui Hotta and another individual, on 19 January 2024. Per CSH’s standard approach to outreach during the CIA process as described in Section 2.2, this group was provided with a description of the project and maps depicting the location of the project area (see Appendix A ) prior to and during the meeting. No comments related to ongoing cultural practices or cultural impacts were received based on the provided information and meeting.

The written testimony from Mr. Skippy Hau, *kama‘āina* and former Aquatic Biologist for the State of Hawai‘i, Division of Aquatic Resources (DAR), has revealed no ongoing cultural practices within the proposed Central Maui WWRF project area. He fully supports the proposed project and his concerns are largely focused on the conditions of other wastewater facilities in the area, such as Kahului and Mā‘alaea.

The in-depth interview with Dr. Scott Fisher, the Director of ‘Āina Stewardship with the Hawai‘i Island Trust and the Chair of the Maui/Lāna‘i Island Burial Council, revealed there are no ongoing cultural practices within the proposed Central Maui WWRF project area. However, he is concerned with impacts to Waikapū Stream and indirect impacts to Keālia Pond, as well as the possibility of coming across burials.

## 10.3 Impacts and Recommendations

Based on information gathered from the community consultation, participants voiced and framed their concerns in a cultural context. Scott Fisher’s main concern is the possibility of coming across burials within the project area. Previous archaeological studies have revealed four burials located along the existing Wai‘ale Road portion of the project area, two of which remain in situ. There is also a possibility of burials being found within the southern portion of the project area where the extension of Wai‘ale Road to Honoapi‘ilani Highway will occur. Dr. Fisher encourages project developers to be very sensitive to burials and identify them beforehand rather than recording them as inadvertent discoveries. Dr. Fisher has recommended a very thorough AIS and significant amounts of testing be conducted prior to construction.

An environmental concern brought up during consultation by Dr. Fisher is the impacts the proposed Central Maui WWRF project may have on Waikapū Stream and indirectly on Keālia Pond. Dr. Fisher has mentioned during consultation that Waikapū Stream and Keālia Pond are areas that could potentially be affected by the extension of Wai‘ale Road. What occurs upstream

will affect downstream. Keālia Pond is home to many endangered and endemic species to the Hawaiian Islands. If water quality is affected by the construction of extending Wai‘ale Road, it will also negatively impact those species at Keālia Pond.

## 10.4 Ka Pa‘akai Analysis

In Ka Pa‘akai vs Land Use Commission, 94 Hawai‘i (2000) the Court held the following analysis must also be conducted:

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

Based on information gathered from the cultural and historical background, and community consultation for this project, Waikapū Stream and human remains were identified within the project area. Traditionally and presently, Waikapū Stream has been used to cultivate *kalo* and *‘ulu*. Today, many Hawaiian families are returning to Waikapū Ahupua‘a and restoring old *kuleana ‘auwai* and *lo‘i kalo* to revitalize the traditional agricultural practices of *kalo* cultivation. One historic agricultural terrace (SIHP # -06669) was found along Waikapū Stream where the Wai‘ale Road extension portion of the project area and stream intersect. This portion of the project area is within fallow fields of sugarcane and overgrown field access roads. Surrounding this area are agricultural lands. Dr. Fisher owns a 4-acre *‘ulu* farm south of the project area. Although no cultural practices were identified within the project area, Waikapū Stream itself is a significant cultural, historical, and natural resource that may possibly be impacted by the proposed project. If Waikapū Stream is impacted by the proposed project, then Keālia Pond will be affected as well. Four burials (SIHP #s -05966, -05965, -05680, and -08659) were also previously identified along the existing Wai‘ale Road portion of the project area. Two were reinterred (SIHP #s -05965 and -05966) and the other two remained in situ with a concrete slab poured over them (SIHP #s -05680 and -08659). Other historic properties within the project area and along Wai‘ale Road included a sugarcane flume (SIHP # -05967), a historic roadbed (SIHP # -05963), and cultural material (SIHP # -08017). The focus of concern is largely impacts on Waikapū Stream and burials. Community consultants have recommended a thorough AIS prior to construction to avoid inadvertently discovering burials within the project area, if there are any.

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# Appendix A Community Outreach Letter

CULTURAL SURVEYS HAWAI'I
ARCHAEOLOGICAL, CULTURAL, AND HISTORICAL DOCUMENTATION SERVICES - SINCE 1982

P.O. Box 1114 Kailua, Hawai‘i 96734 Ph: (808) 262-9972 Fax: (808) 262-4950

*Aloha mai kāua,*

With this letter, Cultural Surveys Hawai‘i (CSH) humbly requests your *mana‘o* and *‘ike* (experience, insights, and perspectives) regarding past and ongoing cultural practices, beliefs, and resources within Waikapū and Wailuku Ahupua‘a.

Consultation with traditional cultural practitioners, *kūpuna*, *kama‘āina*, and Hawai‘i’s diverse ethnic communities is an important and deeply valued part of our work and the environmental review process for proposed projects in Hawai‘i. Your contributions will revitalize and keep alive knowledge of cultural practices, storied places, and life experiences that will remind Hawai‘i’s children of their history for generations to come.

Project Description

At the request of Munekiyo Hiraga, on behalf of the County of Maui, Department of Environmental Management (DEM), CSH is conducting a cultural impact assessment (CIA) and Ka Pa‘akai Analysis for the Central Maui Wastewater Reclamation Facility (WWRF) Project, Waikapū and Wailuku Ahupua‘a, Wailuku District, Maui TMKS: (2) 3-5-001:017 por. and 120 por., 3-5-002:014 por., 3-5-020:036 por., 3-6-002:003 and 004, and 3-8-005:023 por., Wai‘ale Road ROW, Waiko Road ROW, and Waikapū Stream. The Central Maui WWRF will be completed in central Maui between Honoapi‘ilani and Kuihelani highways in Waikapū. The project also includes offsite infrastructure improvements which consist of a wastewater pump station (WWPS) near the existing master-planned Kehalani community, a wastewater force main from the Kehalani WWPS to the WWRF, portions of wastewater force main and R-1 recycled water transmission line that connect the WWRF and the future Waikapū Country Town development, and a WWRF access road. The project area is depicted on a portion of the 2017 Mā‘alaea and 2017 Wailuku U.S. Geological Survey (USGS) 7.5-minute topographic quadrangles (Figure 1) and a 2020 aerial photograph (Figure 2).

Introduction

The County of Maui Department of Environmental Management (County) proposes to construct a new wastewater recycling facility (WWRF) in the Central Valley of Maui Island. The new Central Maui WWRF will provide a number of benefits to the community:

1. Provide wastewater treatment service to growth areas in the Central Valley area, as established in the Maui Island Plan. Wastewater treatment service is required to construct affordable and market rate housing in the area.
2. Divert a portion of the wastewater flow that is currently treated at the Wailuku-Kahului WWRF, reducing the volume of treated effluent that is currently disposed via injection wells at the facility.
3. Provide recycled water to irrigation users located near the Central Maui WWRF.

Figure 31. Community outreach letter page one

**CIA for the Central Maui Wastewater Reclamation Facility (WWRF) Project**

**Page 2**

Figure 3 provides an overview of the Central Maui WWRF elements to be implemented by the County.

Wastewater Service Areas

Figure 4 presents the wastewater service areas that are expected to contribute wastewater to the Central Maui WWRF. Wastewater will be conveyed to the Central Maui WWRF by gravity sewers, pump stations, and pressurized pipelines.

The Central Maui WWRF will produce effluent that complies with State of Hawai‘i Department of Health (DOH) R-1 recycled water requirements. R-1 water will be available for potential users nearby, including the Waikapu Country Town development, nearby agricultural areas, and County properties.

Preliminary Flow Projections

Table 1 provides a summary of the projected average dry weather flow (ADWF) contributions from the wastewater service areas. As shown in the table, approximately half the flow is expected to originate from areas that currently contribute flow to the Wailuku-Kahului WWRF. Diversion of the flow from the Wailuku-Kahului WWRF to the Central Maui WWRF will reduce disposal volumes at the current facility. The remaining half of the flow is projected to originate from new and future growth areas within the wastewater service areas. The future potential development shown in the table is not defined at this time but could potentially include the existing Mā‘alaea community if a decision is made to connect it to the Central Maui WWRF.

Table 1. Anticipated Buildout Wastewater Flow from Developments in Service Area

| Wastewater Flow Source | Average Dry Weather Flow (mgd) | Percent of Total Buildout Capacity of 4 mgd |
|---|---|---|
| Existing Development (Diverted Flow from Wailuku-Kahului WWRF) | 1.78 | 45% |
| New Anticipated Development Growth | 1.93 | 48% |
| Future Potential Development | 0.29 | 7% |
| Total | 4.00 | 100% |

Note: mgd = million gallons per day

The Central Maui WWRF will have an average dry weather flow capacity of 4 million gallons per day (mgd). Construction of the WWRF may be phased.

Summary of County of Maui Project Elements

The project elements to be implemented by the County of Maui are described in this section.

New Kehalani Wastewater Pump Station and Forcemain

Figure 32. Community outreach letter page two

**CIA for the Central Maui Wastewater Reclamation Facility (WWRF) Project**

**Page 3**

A new Kehalani WWPS located near Waiale Road, will be designed to divert all of the flow from the existing 18-inch sewer in Waiale Road away from the Wailuku-Kahului WWRF and instead pump it to the new Central Maui WWRF. A new wastewater forcemain will be designed to deliver flow from the new WWPS to the new Central Maui WWRF. Figure 3 shows the route of the forcemain.

The Kehalani WWPS will be constructed on parcel tax map key (TMK) number (2) 3-5-020:036. The parcel is a stormwater detention basin that serves the Kehalani development. The new WWPS will be constructed on the edge of the detention basin, and modifications will be made to the detention basin to retain its full function as originally designed. Additional information will be presented in the Draft Environmental Impact Statement.

Central Maui Wastewater Reclamation Facility

The Central Maui Wastewater Reclamation Facility will provide wastewater treatment and effluent management for the service area.

*Site*

The Central Maui WWRF will be located on a portion of parcel TMK (2) 3-8-005:023, owned by the County of Maui. The 209.04-acre parcel will be subdivided to provide a separate 14.9-acre parcel for the WWRF. Figure 5 shows the proposed WWRF location within the larger parcel. The WWRF location within the larger parcel was chosen to take advantage of the soil conditions present there for effluent disposal purposes, as described below.

The WWRF will be accessed from an extension of Waiale Road to be constructed by the County of Maui. A 100-foot-wide access and utility easement will be developed across parcel TMK (2) 3-6-002:004 for the new WWRF.

*Liquid Treatment Processes*

The Central Maui WWRF will include the following:

- **Preliminary treatment**: screening and grit removal to remove coarse debris prior to further treatment.
- **Secondary treatment with biological nutrient removal**: activated sludge process with anoxic zones, intermediate mixed liquor recycling, and clarification: to remove carbon and nitrogen.
- **Tertiary treatment**: filtration to remove suspended solids and turbidity.
- **UV disinfection**: to inactivate bacteria and viruses from the effluent.

Figure 6 includes a conceptual plan for the facility.

*Effluent Quality*

The anticipated recycled water uses include irrigation of agricultural fields, parks, school yards, and streetscapes. The effluent from the Central Maui WWRF will comply with DOH

Figure 33. Community outreach letter page three

requirements for R-1 recycled water. In addition, the effluent total nitrogen concentration will be 10 mg/L or less to ensure the amount of total nitrogen applied to land with the recycled water does not exceed the needs of the crops irrigated with the R-1 water and to minimize the potential impact of the effluent disposal system.

*Water Recycling Program*

A recycled water program is planned to be a major part of the effluent management system at the Central Maui WWRF. The water recycling program will extend Maui's freshwater resources by putting treated effluent to beneficial non-potable use, freeing up valuable potable and raw water resources for other uses. These uses include facilitating growth within the community and enhancing the environment.

Figure 7 shows the pipeline that will be used to deliver recycled water to a recycled water storage facility to be constructed by Waikapū Country Town. The portion of the pipeline located within the Waikapū Country Town Development will be constructed by the developer and was included in the Waikapū Country Town Final EIS. The portion of the pipeline located on the Waiale Road Extension will be constructed by the County of Maui.

Recycled water will be used for non-potable purposes at approved sites in accordance with DOH regulations and guidelines. Recycled water will also be used for agricultural irrigation purposes in the area shown in Figure 7.

*Effluent Disposal*

A wastewater effluent disposal system is necessary for the proposed WWRF. Hawai‘i Administrative Rules (HAR) §11-62 and the DOH's Recycled Water Guidelines require a backup effluent disposal system for all water reuse applications. This backup system ensures effluent can be safely disposed when recycled water supply exceeds the demand or if the recycled water fails to meet the required treatment specifications. The backup disposal system must be designed to allow for disposal of 100% of the WWRF flow.

Soil aquifer treatment (SAT) appears to be a viable effluent disposal approach for the Central Maui WWRF. SAT consists of the intermittent application of effluent at high hydraulic loading rates to basins constructed in highly permeable soils, such as sand or gravel. Treatment in the SAT process is accomplished via biological, chemical, and physical interactions that occur as the water percolates through the soil matrix to groundwater. Treatment benefits can include nitrogen and phosphorus removal, heavy metal and trace organic removal, and removal of endocrine disrupting chemicals.

Vegetation may or may not be present and doesn't play a significant role in the treatment provided due to the high hydraulic loading rate. Vegetation can also be used as a visual mitigation method. The draft EIS will include a hydrogeological study of the proposed SAT system.

*Solids Management*

Figure 34. Community outreach letter page four

**CIA for the Central Maui Wastewater Reclamation Facility (WWRF) Project**

**Page 5**

The proposed liquid treatment processes will create residual solids that will require management:

- **Grit and Screenings:** Grit and screenings will be washed and dewatered prior to disposal at the Central Maui Landfill.
- **Secondary and Tertiary Solids**: Secondary and tertiary solids will be stabilized using aerobic digestion with decant thickening. The digested solids will be dewatered using screw press technology. The dewatered solids will be managed in accordance with wastewater solids generated by the County's other WWRFs. Currently dewatered solids are composted with green waste at the Central Maui Landfill.

*Ancillary Systems*

Ancillary systems needed for the WWRF include electrical service, potable water, non-potable water, fire protection, stormwater management, and odor control.

**Electrical Systems**: It is anticipated that a new electrical service from Hawaiian Electric Company (HECO) will need to be brought to the site via underground or aboveground electrical lines from the intersection of Waiale Road and Waiko Road following along the proposed Waiale Road extension or from Honoapiilani Highway. An emergency power system will be provided to ensure uninterrupted wastewater treatment in the event of power failure.

**Potable Water**: Potable water needs will be met by connection to the County water system.

**Non-Potable Water**: Non-potable utility water needs like hose bibbs, water cannons, and foam sprays will be met with R-1 effluent. A pump system will be needed to provide adequate flow and pressure.

**Fire Protection**: Fire protection systems will be needed for certain WWRF elements in accordance with applicable codes.

**Stormwater Management**: A stormwater system compliant with applicable codes will be required. A stormwater pump station may be required.

**Odor Control**: Wastewater treatment plants can be a source of nuisance odors to the surrounding community if not properly designed and/or operated. Not all processes with a wastewater treatment plant generate odors; nuisance odors are most commonly associated with anaerobic (without oxygen) conditions and with residual solids processing. Foul air collection and treatment will be provided for treatment processes that can generate nuisance odors.

Purpose of this Study

The purpose of a CIA is to gather information on Hawai‘i's cultural resources, practices, or beliefs that have occurred or still occur within the proposed project area and Waikapū and Wailuku Ahupua‘a. The purpose of a Ka Pa‘akai Analysis outreach is to 1) identify and scope valued cultural, historical, or natural resources in the project area, including the extent to which

Figure 35. Community outreach letter page five

traditional and customary Native Hawaiian rights are exercised in the project area; 2) identify the extent to which those resources, including traditional and customary Native Hawaiian rights, will be affected or impaired by the proposed action; and 3) identify any feasible action, if any, to be taken to reasonably protect traditional and customary Native Hawaiian rights, if they are found to exist, either currently or possibly in the past. This is accomplished through consultation and background research using previously written documents, studies, and interviews. This information is used to assess potential impacts by the proposed project to the specific identified resources, practices, and beliefs in the project area and throughout Waikapū and Wailuku Ahupua‘a. As a traditional cultural practitioner and holder of long-term knowledge, your insight, input, and perspective provide a valuable contribution to the assessment of potential effects of this project and an understanding of how to protect these resources and practices.

Insights focused on the following topics in the project area (shown on the attached Figure 1 and Figure 2) are especially helpful and appreciated:

- Your knowledge of traditional cultural practices of the past within the proposed project area and Waikapū and Wailuku Ahupua‘a
- Your specific traditional cultural practice and its connection to the proposed project area and Waikapū and Wailuku Ahupua‘a
- The different natural resources associated with your specific traditional cultural practice
- Legends, stories, or chants associated with your specific traditional cultural practices and their relationships to the proposed project area and Waikapū and Wailuku Ahupua‘a
- Referrals to other *kūpuna*, *kama‘āīna*, and traditional cultural practitioners knowledgeable about the proposed project area and Waikapū and Wailuku Ahupua‘a
- Your comments or thoughts on the potential impacts the proposed project may have on your ongoing traditional cultural practices and natural resources within the proposed project area and Waikapū and Wailuku Ahupua‘a
- Your knowledge of cultural sites and *wahi pana* (storied places) within the proposed project area and Waikapū and Wailuku Ahupua‘a
- Your comments or thoughts on the potential impacts the proposed project may have on cultural sites and *wahi pana* within the proposed project area and Waikapū and Wailuku Ahupua‘a

Consultation Information

Consultation is an important and deeply valued part of the CIA and the environmental review process. Your contributions will revitalize and keep alive our combined knowledge of past and ongoing cultural practices, historic places, and experiences, reminding our children of their history generation after generation.

With your agreement to participate in this study, your contributions will become part of the comprehensive understanding of traditions of the area and will be part of the public record.

Figure 36. Community outreach letter page six

**CIA for the Central Maui Wastewater Reclamation Facility (WWRF) Project**

**Page 7**

The study will be included as an appendix of the Environmental Impact Statement (EIS), which is being prepared for the proposed project; the EIS and CIA will be available for future access through the State Office of Planning and Sustainable Development (OPSD) Environmental Review Program (ERP) (https://planning.hawaii.gov/erp) and at the State Historic Preservation Division Library (https://dlnr.hawaii.gov/shpd/about/research-resources-library).

As a part of this process, your knowledge may be used to inform future CIAs and other heritage studies of cultural practices and resources that need protection from impacts of proposed future projects. If you engage in consultation, and the *mana‘o* and *‘ike* you provide appears in the study, we would like to recognize your contribution by including your name. If you prefer not to allow your name to be included, your information can be attributed to an anonymous source.

The consultation interview structure and format are flexible. We will accommodate your preference on how to get together: talk story, over the phone, by email correspondence, remotely via Zoom, MS Teams, Google Chat, or other remote meeting platform.

Your knowledge of the resources and potential effect of the project on traditional practices in the project area and Waikapū and Wailuku Ahupua‘a focusing on the topics in the bullet points above can also be submitted in a written statement. CSH will provide return postage for your written statement on request.

CSH is happy to provide a list of topics for discussion, a more structured questionnaire of interview questions, or any other assistance that might be helpful.

If you have questions regarding consultation, or are interested in participating in this study, please contact Tehani Baculpo by email at tbaculpo@culturalsurveys.com and Chantellee Spencer at cspencer@culturalsurveys.com. We are both available by phone at (808) 965-6478.

*Mahalo nui loa* for your time and attention to this request for consultation,

Tehani Baculpo
*CSH Cultural Researcher*

Figure 37. Community outreach letter page seven

**CIA for the Central Maui Wastewater Reclamation Facility (WWRF) Project**

**Page 8**

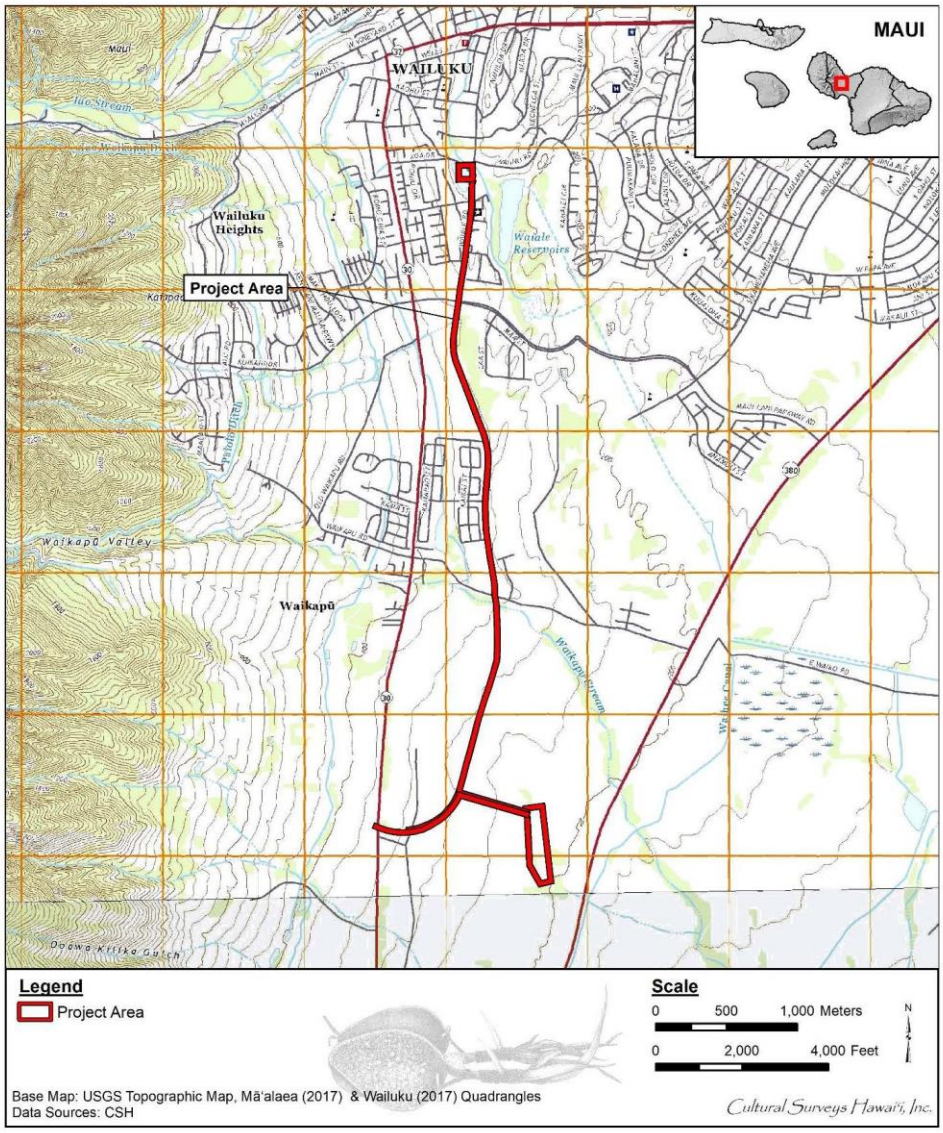



Figure 1. Portion of the 2017 Mā‘alaea and 2017 Wailuku USGS 7.5-minute topographic quadrangle showing the project area

Figure 38. Community outreach letter page eight

**CIA for the Central Maui Wastewater Reclamation Facility (WWRF) Project**

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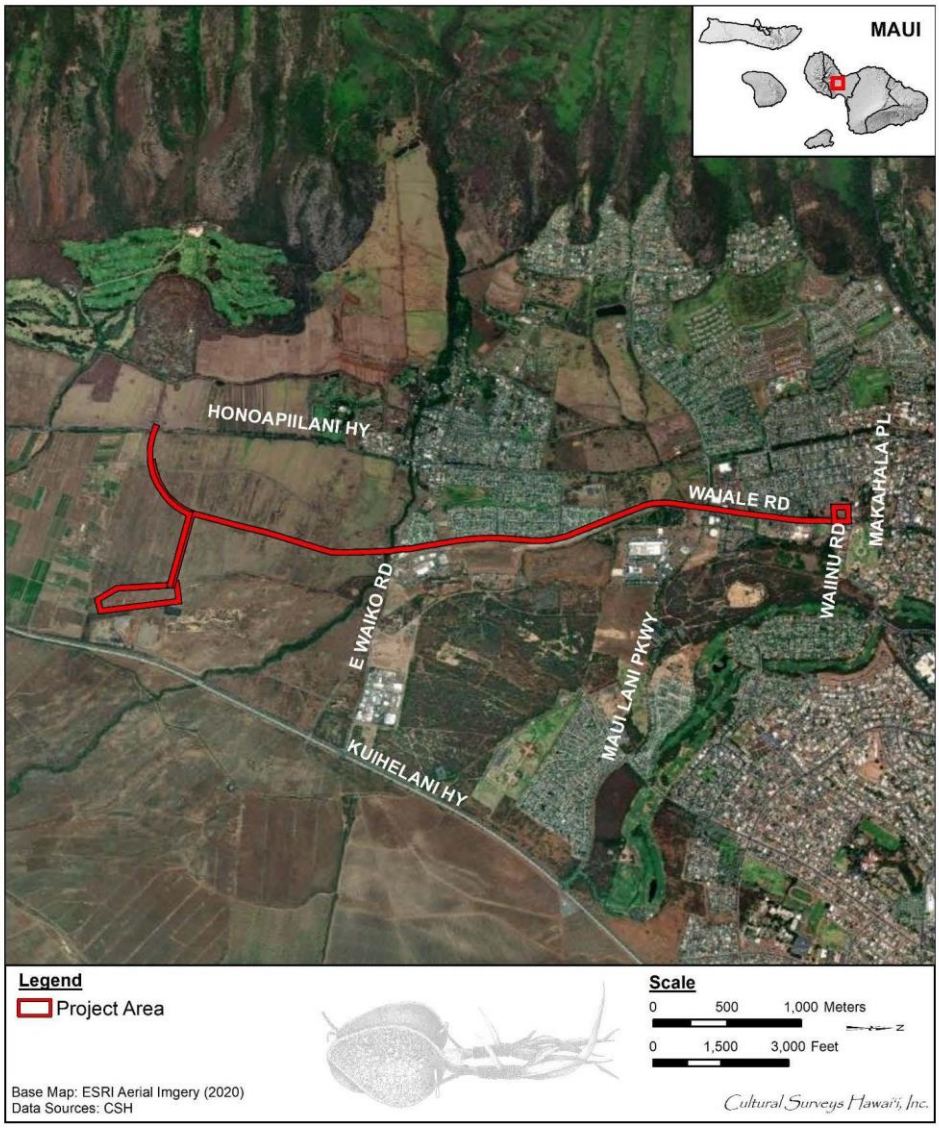



Figure 2. Aerial photograph showing the project area (ESRI 2020)

Figure 39. Community outreach letter page nine

CIA for the Central Maui Wastewater Reclamation Facility (WWRF) Project

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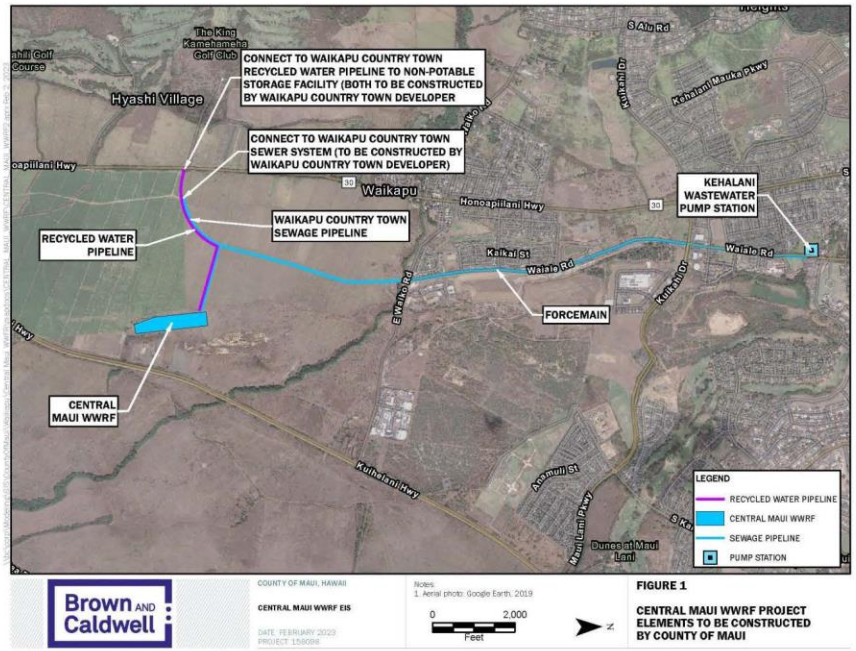



Figure 3. Overview of the Central Maui WWRF elements to be implemented by the County (courtesy of client)

Figure 40. Community outreach letter page 10

**CIA for the Central Maui Wastewater Reclamation Facility (WWRF) Project**

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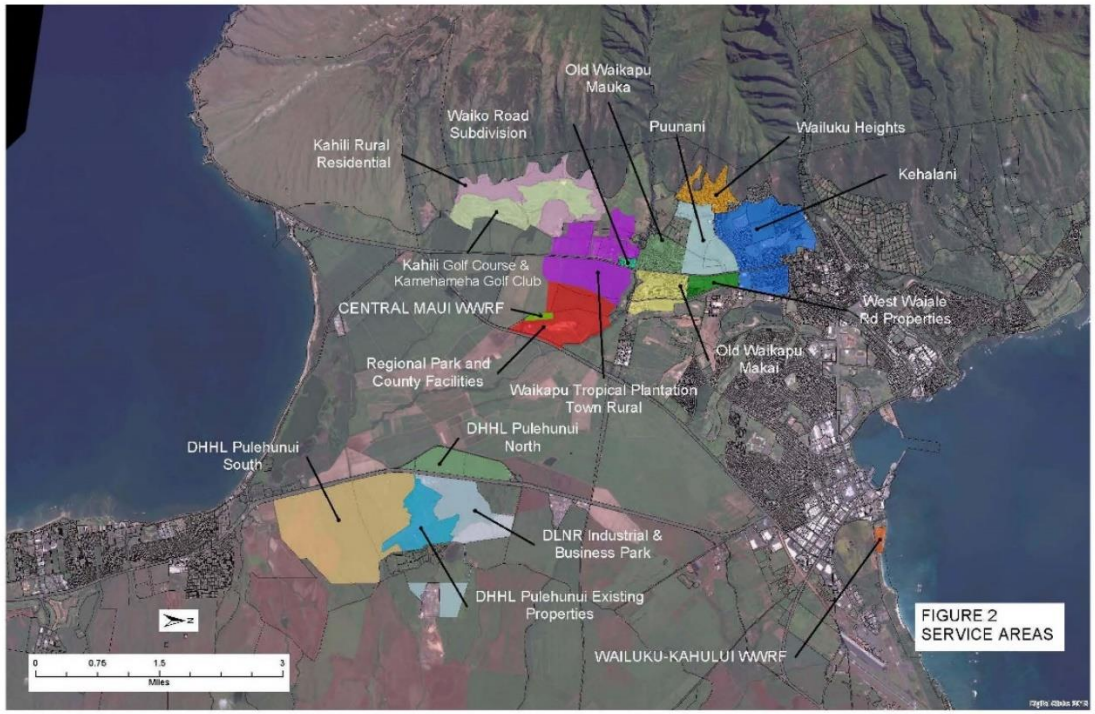



Figure 4. Wastewater service areas that are expected to contribute wastewater to the Central Maui WWRF (courtesy of client)

Figure 41. Community outreach letter page 11

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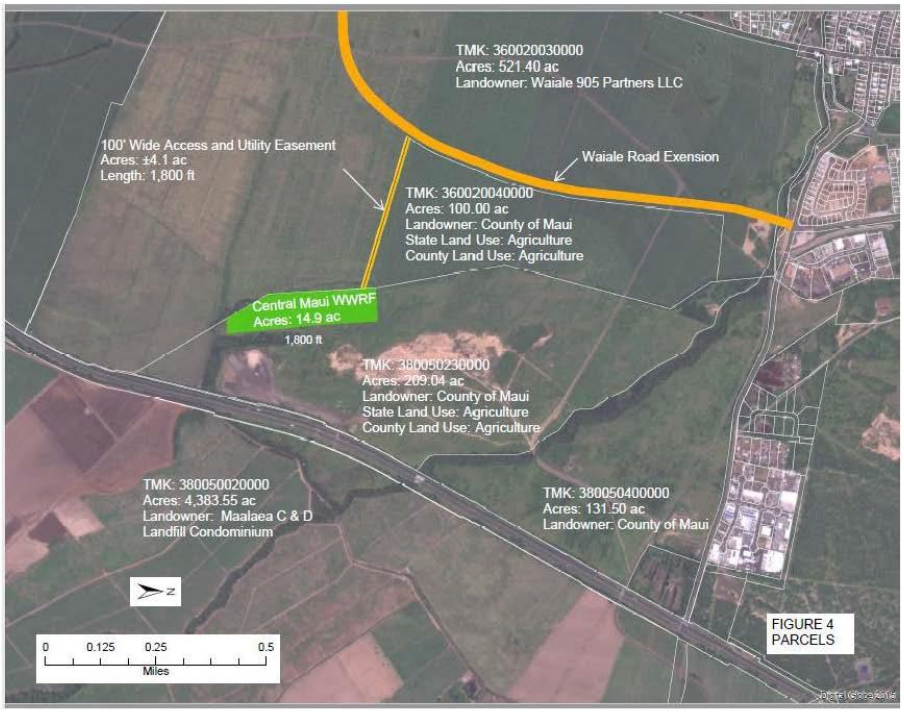



Figure 5. Proposed WWRF location within the larger parcel (courtesy of client)

Figure 42. Community outreach letter page 12

CIA for the Central Maui Wastewater Reclamation Facility (WWRF) Project

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Figure 6. Conceptual site plan for the facility (courtesy of client)

Figure 43. Community outreach letter page 13

CIA for the Central Maui Wastewater Reclamation Facility (WWRF) Project

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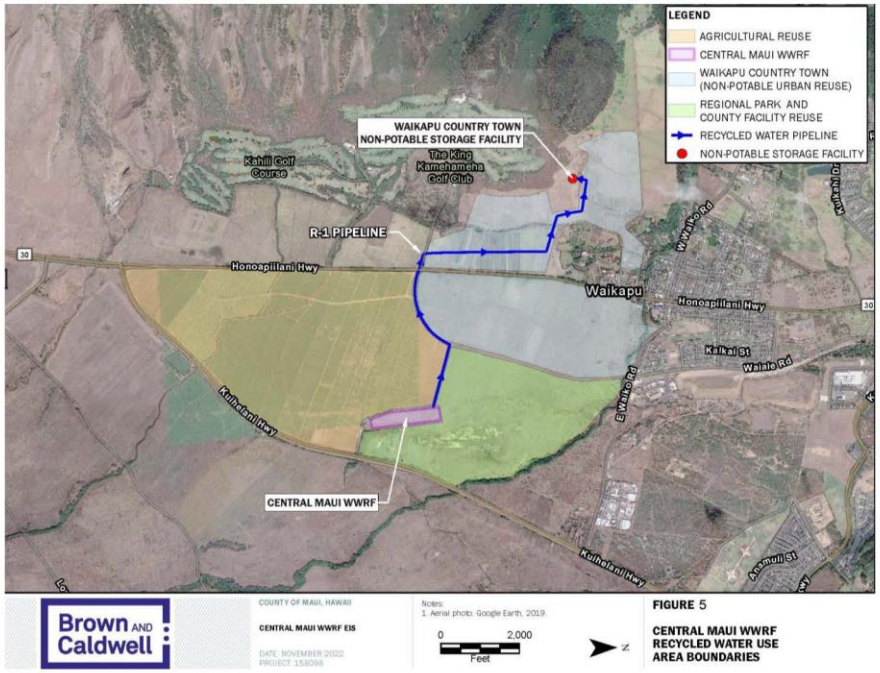



Figure 7. The pipeline that will be used to deliver recycled water to a recycled water storage facility to be constructed by Waikapu Country Town (courtesy of client)

Figure 44. Community outreach letter page 14

# ECONOMIC AND FISCAL IMPACT ANALYSIS

## APPENDIX P-1

# Final

# Economic and Fiscal Impact Study

## PROPOSED CENTRAL MAUI WASTEWATER RECLAMATION FACILITY

**Prepared for:**

**County of Maui,**
**Department of Environmental Management**

**May 2025**

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**by Munekiyo Hiraga**

MUNEKIYO HIRAGA

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# INTRODUCTION



# I. INTRODUCTION

This Economic and Fiscal Impact Study (Study) has been prepared for the proposed Central Maui Wastewater Reclamation Facility (WWRF) project on Maui, Hawai'i. The Study presents an analysis of the short-term construction related economic impacts to the local economy, as well as short-term construction related fiscal impacts to the State of Hawai'i (State) and County of Maui (County). The Study also assesses economic impacts to the local economy and fiscal impacts to the State and County related to the long-term operation of the Central Maui WWRF.

## A. PROJECT OVERVIEW

The County of Maui, Department of Environmental Management (DEM) proposes to develop a new Central Maui WWRF and onsite Soil Aquifer Treatment (SAT) basins on approximately 14.9 acres of former agricultural lands between Honoapi'ilani Highway and Kuihelani Highway in the vicinity of Waikapū, as well as related offsite infrastructure improvements. Offsite improvements consist of a wastewater pump station (WWPS) near the existing master-planned Kehalani community ("Kehalani WWPS"), a sewage pipeline from the Kehalani WWPS to the WWRF ("Kehalani Sewage Pipeline"), portions of sewage pipeline and R-1 recycled water pipeline that connect the WWRF and the future Waikapū Country Town development ("Waikapū Country Town Sewage Pipeline" and "Waikapū Country Town R-1 Recycled Water Pipeline"), and a WWRF access road. The WWRF access road will be provided from the future Waiale Road extension proposed by the County of Maui, Department of Public Works. The total project area (onsite and offsite improvements) is approximately 21.5 acres. See **Figure 1**.

The proposed WWRF will service existing and planned developments throughout the Waikapū/Wailuku area, as well as the State of Hawai'i projects in Pūlehunui. Implementation of this new WWRF will serve to reduce wastewater flows currently being handled by the Wailuku-Kahului WWRF, the main wastewater treatment facility servicing the Central Maui region.

The majority of the project components are located within undeveloped lands and rights-of-way (ROW) owned by the County of Maui, except for the Kehalani WWPS proposed to be located on the periphery of an existing stormwater basin parcel owned by the County of Maui and portions of pipeline alignments which will be located on lands currently owned by private landowners. The assumed development period is two (2) years from about 2027 to 2029. The project components, affected areas, and duration of construction are summarized in **Table 1** below.

**Table 1**. Proposed Development

| Item | Source or Multiplier | Amount | Units |
|---|---|---|---|
| **1.1. PROJECT AREA** | | | |
| Central Maui Wastewater Reclamation Facility (WWRF) and Onsite Soil Aquifer Treatment (SAT) | Brown and Caldwell | 14.9 | acres |
| Kehalani Wastewater Pump Station (WWPS) | Brown and Caldwell | 0.25 | acres |
| Kehalani Wastewater Sewage Pipeline | Brown and Caldwell | 17,000 | linear ft. |
| Waikapū Country Town Sewage Pipeline | Brown and Caldwell | 4,000 | linear ft. |
| Waikapū Country Town R-1 Recycled Water Pipeline | Brown and Caldwell | 10,000 | linear ft. |
| **1.2. DEVELOPMENT PERIOD** | | | |
| Duration of Construction | Brown and Caldwell | 2 | years |

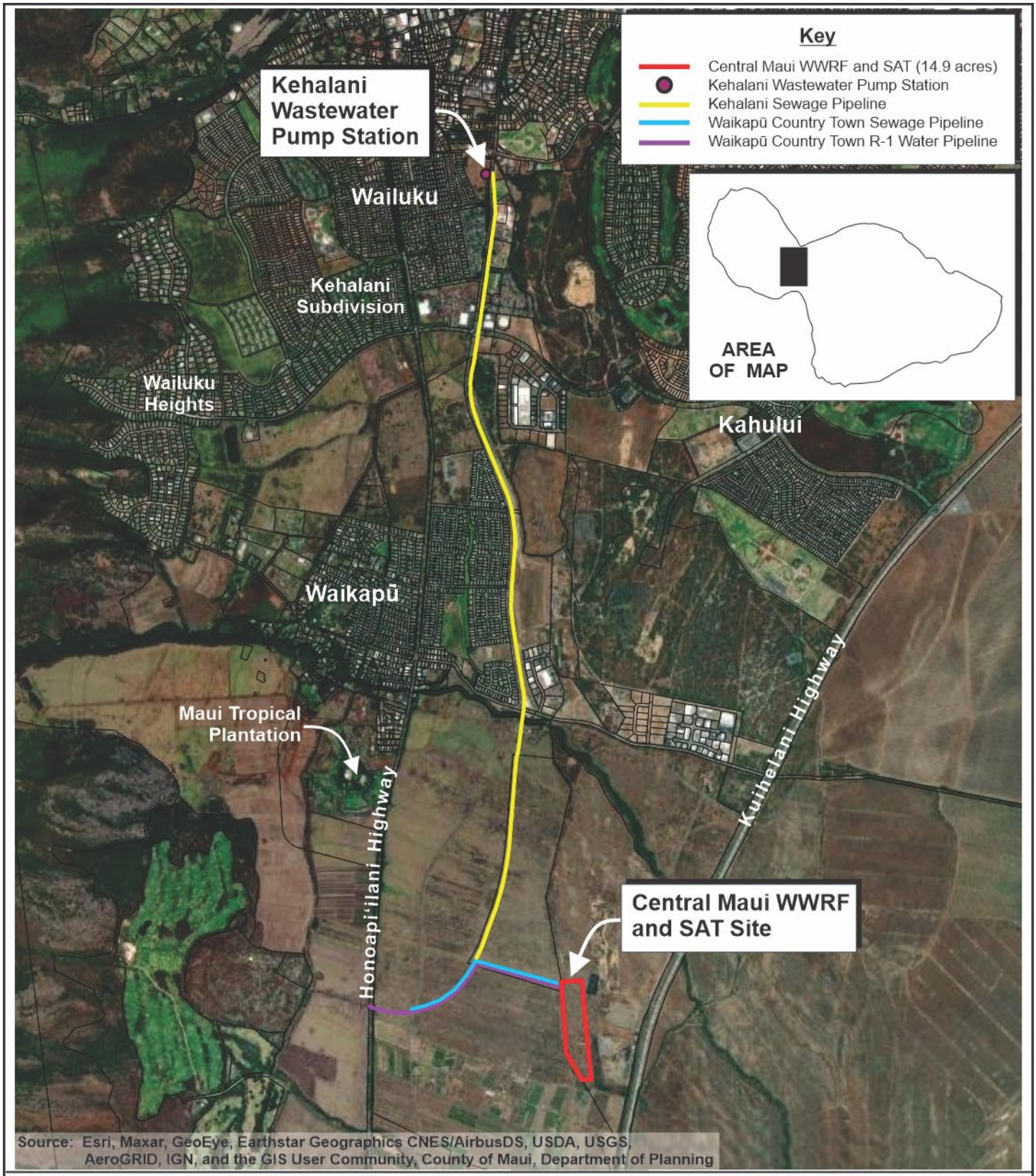



Figure 1 Proposed Central Maui Wastewater Reclamation Facility
Project Location Map

0 1250 Feet
625 2500

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO HIRAGA

COM/DEM Cmaui WW Infrastructure/Applications/Figures/ProjLoca

## B. METHODOLOGY

This report was prepared utilizing data from a number of public data sources, including the U.S. Census Bureau, State of Hawai'i, Department of Business, Economic Development and Tourism, and County of Maui.

### 1. Economic Impact Assessment

The development and operational economic impacts of the proposed Central Maui WWRF project were analyzed using the Hawai'i State Input-Output Study: 2017 Benchmark Report, which was prepared by the State Department of Business, Economic Development, and Tourism (DBEDT) in March 2022. The Input-Output (I-O) analysis provides information on the relationships between industries, final users, and factors of production within an economy to determine the role and relative importance of each sector. Specifically, the I-O analysis provides multipliers for direct, indirect, and induced effects for output, earnings, and employment resulting from an exogenous change in an industry's final demand. In this case, the changes in the economy that are analyzed are construction spending for development. The multipliers measure the economic activity resulting from an industry or household spending an additional dollar.

The State Input-Output Study reports direct, indirect, and induced output (dollars), employment, and labor income. Direct, indirect, and induced effects are described below:

- ***Direct effects*** *- Direct effects refer to immediate effects associated with a change in the economy. For example, direct effects could be the dollar value of a construction budget or the number of jobs associated with that construction budget.*
- ***Indirect effects*** *- Indirect effects relate to inter-industry spending or the secondary impacts of a change. These impacts occur when industries buy goods and services from other local industries. In the construction sector, for example, indirect effects would include contractor expenditures on construction materials such as wood or steel.*
- ***Induced effects*** *- Induced effects capture household spending impacts generated when people who benefit from direct or indirect impacts spend their income on local goods and services. For example, a construction industry employee may spend his or her income on groceries or eating out.*

For the purposes of this analysis, indirect effects and induced effects are combined and referred to collectively as "indirect effects".

### 2. Fiscal Impact Assessment

Fiscal impacts were analyzed for both the construction period and at full build-out of the project. This analysis identifies the key revenues, namely taxes, that the State and County would collect from the proposed project. For each major source,

a dollar estimate of revenues is provided based on project characteristics and market conditions. It is noted that this study is not intended to provide a comprehensive analysis of all revenue sources that would be impacted, but rather focuses on the largest revenue sources, in terms of dollars collected. The analysis of fiscal impacts to the State and County are based on fiscal year 2025 budget and tax rates. The analysis assumes that the structure of tax revenues and government expenditures presented in the 2025 budgets remains the same. If taxation or spending policies are substantially changed in the future, the projected fiscal impacts of the proposed project would differ.

The fiscal impact analysis was conducted for the general funds of the State of Hawai‘i and the County of Maui. With respect to the County of Maui, the development of the proposed Central Maui WWRF is anticipated be funded by various sources, which may include municipal bonds backed by the County's Sewer Fund, federal funds, and County's General Exercise Tax (GET) surcharge revenues. The breakdown of the funding sources is undetermined at the time of this Study. The operation and maintenance (O&M) cost of the proposed Central Maui WWRF is anticipated to be funded by County's Sewer Fund. As such, significant impacts to the County of Maui general fund are not expected. It is noted that as of January 1, 2024, the County of Maui started implementation of 0.5 percent surcharge on GET which goes to the County general fund. As such, the fiscal impact analysis for the County of Maui captures the County's GET surcharge for the construction period and at full build-out. Analysis of other State or County special funds is not included in this Study.

# ECONOMIC AND FISCAL IMPACTS FOR DEVELOPMENT PERIOD

# II

# II. ECONOMIC AND FISCAL IMPACTS FOR DEVELOPMENT PERIOD

## A. ECONOMIC IMPACT ASSESSMENT

The proposed project involves construction of a new Central Maui Wastewater Reclamation Facility (WWRF) and onsite Soil Aquifer Treatment (SAT) basins on approximately 14.9 acres of former agricultural lands, as well as related offsite infrastructure improvements. Offsite improvements consist of a wastewater pump station (WWPS) near the existing master-planned Kehalani community ("Kehalani WWPS"), a sewage pipeline from the Kehalani WWPS to the WWRF ("Kehalani Sewage Pipeline"), portions of sewage pipeline and R-1 recycled water transmission line that connect the WWRF and the future Waikapū Country Town development ("Waikapū Country Town Sewage Pipeline" and "Waikapū Country Town R-1 Recycled Water Pipeline"), and a WWRF access road. From a development perspective, the proposed project will generate short-term economic impacts associated with construction spending and employment. The development cost of the proposed project is anticipated to total approximately $130.6 million. This includes approximately $90.0 million for the Central Maui WWRF and onsite SAT, and approximately $40.6 million for the offsite improvements. The total construction cost of infrastructure and buildings translates into average construction expenditures of about $65.3 million per year. In practice, construction expenditures will vary from year to year. See **Table 2**.

The development of the proposed project will generate indirect sales associated with the purchase of goods and services by construction companies and their employees. This spending will generate additional jobs in the economy. The annual indirect sales are anticipated to be $50.2 million on Maui and $27.0 million on Oʻahu. The total of the construction expenditures and indirect sales related to construction are expected to average about $142.6 million per year.

During the project's 2-year development period, construction activities related to the project are anticipated to directly generate 120 full-time equivalent (FTE) jobs per year. These jobs will include supervisors, heavy-equipment operators (grading, roads, sewer lines, etc.), as well as architects, civil engineers, draftsmen, and government inspectors. While recognizing that construction employment will fluctuate over the different phases of development, for the purpose of this study's analysis, it is assumed that the construction jobs would be distributed evenly across the 2-year development period. Refer to **Table 2**.

As with indirect sales, development activities will generate indirect jobs associated with supplying goods and services to construction companies and to the families of construction workers. In turn, the companies supplying goods and services, and the families of their employees, will purchase goods and services from other companies, and so on. Indirect jobs will include those at companies supplying building materials; rent construction equipment; repair equipment; provide warehousing services; provide shipping and trucking services; etc. Other indirect jobs will include those involved with supplying goods and services to employees and their families. The jobs will range over a variety of skill levels, including entry-level, semi-skilled, skilled, and management

positions. Based on State employment multipliers, indirect employment related to Project development is expected to average about 180 FTE jobs per year.

Direct labor income associated with development-related employment would total $12.7 million per year in the construction industry alone over the 2-year construction period. When considering direct and indirect impacts together, earnings resulting from the $130-million construction project would total approximately $24.0 million per year for two (2) years or $47.9 million cumulatively.

**Table 2.** Economic Impacts of Development Activities
(Values in 2025 dollars)

| Item | Source or Multiplier | Amount | Units |
|---|---|---|---|
| **2.1. CONSTRUCTION EXPENDITURES AND RELATED SALES** | | | |
| **Construction Costs** | | | |
| Central Maui WWRF and onsite SAT | Brown and Caldwell | $ 89,974,900 | |
| Kehalani WWPS | Brown and Caldwell | $ 8,339,100 | |
| Kehalani Sewage Pipeline | $ 1,090.00 per linear ft. | $ 18,530,000 | |
| Waikapū Country Town Sewage Pipeline | $ 720.00 per linear ft. | $ 2,880,000 | |
| Waikapū Country Town R-1 Recycled Water Pipeline | $ 1,090.00 per linear ft. | $ 10,900,000 | |
| **Total Construction Costs** | | **$ 130,624,000** | |
| **Annual Construction Costs** | | **$ 65,312,000** | |
| **Construction Expenditures, Annual Average** | | **$ 65,312,000** | **per year** |
| Hawaii | 55% | $ 35,769,500 | per year |
| Imports | 45% | $ 29,542,500 | per year |
| **Indirect Sales, Annual Average** | 1.18 of Hawaii exp. | **$ 77,247,000** | **per year** |
| Maui | 65% | $ 50,210,600 | per year |
| Oahu | 35% | $ 27,036,400 | per year |
| **Total Direct and Indirect Sales, Annual Average** | | **$ 142,559,000** | **per year** |
| **Final Sales (taxed at 4%)** | | | |
| Construction Expenditures | | $ 65,312,000 | per year |
| Consumption | 55% of payroll | $ 7,002,600 | per year |
| **Total Sales at 4%** | | **$ 72,314,600** | **per year** |
| **Intermediate Sales (taxed at 0.5%)** | | | |
| Indirect Sales Related to Construction | | $ 77,247,000 | per year |
| Less Consumption | | $ (7,002,600) | |
| **Total Sales at 0.5%** | | **$ 70,244,400** | **per year** |
| **2.2. PROFITS** | | | |
| Profits on Total Expenditures & Sales | 10.0% | $ 14,255,900 | per year |
| **Total Profit from Construction & Related Activity** | | **$ 14,255,900** | **per year** |
| **2.3. EMPLOYMENT (on-site & off-site)** | | | |
| Construction Jobs | 3.49 x sales/$1 mil | 120 | jobs/year |
| Indirect Jobs Generated by Construction | 1.50 x direct jobs | 180 | jobs/year |
| **Total Employment** | | **300** | **jobs/year** |
| **2.4. PAYROLL** | | | |
| Construction Payroll | $ 106,100 per job | $ 12,732,000 | per year |
| Payroll for Indirect Employment | $ 62,500 per job | $ 11,223,000 | per year |
| **Total Payroll** | | **$ 23,955,000** | **per year** |

## B. FISCAL IMPACT ASSESSMENT

### 1. State of Hawai'i

The construction of the proposed project would generate tax revenue for the State of Hawai'i. These taxes would primarily be comprised of General Excise Tax (GET), corporate income tax, and personal income tax. GET, corporate income tax, and personal income tax revenues are estimated in **Table 3** and are based on the economic impacts presented in the preceding section.

**Table 3.** Fiscal Impacts of Development Activities
(Values in 2025 dollars)

| Item | Source or Multiplier | Amount | Units |
|---|---|---|---|
| **3.1. IMPACTS TO STATE OF HAWAI'I** | | | |
| **Revenues, Average Annual** | | | |
| General Excise Tax (GET) | | $ 3,243,800 | per year |
| *Final Sales* | *4.0% of sales* | *$ 2,892,600* | *per year* |
| *Intermediate Sales* | *0.5% of sales* | *$ 351,200* | *per year* |
| Corporate Income Taxes | 4.4% of profits | $ 627,300 | per year |
| Personal Income Taxes | 6.8% of income | $ 1,619,400 | per year |
| Total Revenues | | **$ 5,490,500** | **per year** |
| **Revenues, Cumulative** | | **$ 10,981,000** | |
| **3.2. IMPACTS TO COUNTY OF MAUI** | | | |
| **Revenues, Average Annual** | | | |
| GET Surchage | | | |
| Final Sales | 0.5% of sales | $ 361,600 | per year |
| **Revenues, Cumulative** | | **$ 723,200** | |

The State collects GET based on two (2) rates, 4 percent for final sales, including construction expenditures and consumption by construction workers and their families, and 0.5 percent for indirect sales, such as wholesale construction materials. The total GET revenue associated with the $130-million development budget would be approximately $3.2 million per year or $6.5 million over the 2-year development period. Actual construction spending and associated tax revenue will vary year to year depending on the development and market conditions.

In addition, the State would collect corporate and personal income taxes on the corporate profits and labor income resulting from the direct and indirect jobs generated by construction of the proposed project. Assuming that companies which receive revenues from the proposed project, directly and indirectly, make profits of 10 percent, the estimated corporate tax over the 2-year development period is anticipated to be approximately $627,300 per year or $1.3 million over the 2-year development period on an estimated corporate tax rate of 4.4 percent. As previously discussed in the economic impact analysis, labor income would total approximately $47.9 million. This would translate into an estimated $3.2 million in personal income tax revenue over the 2-year development period, or $1.6 million per year as a result of direct and indirect jobs created by the project's development activities.

## 2. County of Maui

The development cost of the proposed Central Maui WWRF Project will be funded by a combination of funding sources, which may include municipal bonds backed by the County's Sewer Fund, federal funds, and County's GET surcharge revenues. The breakdown of the funding sources is undetermined at the time of this Study. The County's Sewer Fund is a type of special fund, and all revenues, including, but not limited to, service charges, surcharges, pumping of cesspools, septic tanks and pumps, fees for reclaimed water service and installation of reclaimed water meters, waste discharge permits, hauler permits and fines, are deposited into the Sewer Fund. It is noted that because a portion of the construction cost is anticipated to be paid by municipal bonds backed by the Sewer Fund, the construction of the project is anticipated to have some degree of impacts on the sewer rates for residents and businesses Countywide. As noted previously, this Study is limited to fiscal impact analysis related to the County's general fund. A separate rate impact analysis for the project was prepared by Brown and Caldwell in April 2025 and will be included and discussed in the project's Environmental Impact Statement (EIS).

It is noted that the State Legislature authorized the counties to adopt a surcharge on the GET and use tax by ordinance at a rate of no greater than 0.5 percent. As of January 1, 2024, the County of Maui initiated to impose a GET surcharge at the rate of 0.5 percent for final sales. The GET surcharge is not imposed on indirect sales. The total GET surcharge revenue associated with the $130-million development budget would be approximately $361,600 per year or $723,200 over the 2-year development period for the County of Maui. Refer to **Table 3**.

# ECONOMIC AND FISCAL IMPACTS AT FULL BUILD-OUT

III

# III. ECONOMIC AND FISCAL IMPACTS AT FULL BUILD-OUT

## A. ECONOMIC IMPACT ASSESSMENT

This analysis presented herein, and **Table 4** assesses the economic impacts of the project at full build-out. The operation of the proposed Central Maui WWRF is anticipated to generate 16 FTE jobs per year. The anticipated average payroll for these jobs is $ 62,500 per job, and the total payroll is estimated to be $1.0 million per year. Assuming that 55 percent of the payroll will be spent in the local economy, such as for use of services, grocery shopping, and restaurants, the total consumption associated with the operation of the Central Maui WWRF is estimated to be $550,000.00 per year.

**Table 4.** Economic Impacts of Operations at Full Build-Out
(Values in 2025 dollars)

| Item | Source or Multiplier | Amount | Units |
|---|---|---|---|
| **4. ECONOMIC IMPACTS RELATED TO OPERATION** | | | |
| Employment | | | |
| Direct Jobs | COM, DEM | 16 | jobs |
| Payroll | | | |
| County Operational Jobs | $ 62,500 per job | $ 1,000,000.00 | per year |
| Consumption in local economy | 55% of payroll | $ 550,000.00 | per year |

## B. FISCAL IMPACT ASSESSMENT

### 1. State of Hawai‘i

The State would receive revenues from personal income tax from the new jobs created by the operation of the Central Maui WWRF and GET generated by the consumption of the local economy by the new workers and their families. See **Table 5**. The total personal income tax is estimated to be approximately $67,600 annually and the total GET generated by the operation jobs is estimated to be approximately $22,000 per year.

**Table 5.** Fiscal Impacts of Operations at Full Build-Out
(Values in 2025 dollars)

| Item | Source or Multiplier | Amount | Units |
|---|---|---|---|
| **5.1. IMPACTS TO STATE OF HAWAI‘I** | | | |
| **Revenues, Net New, Annual** | | | |
| Personal Income Tax | 6.8% of income | $ 67,600 | per year |
| GET | 4.0% of local consumption | $ 22,000 | per year |
| Total Tax Revenue, Net New, Annual | | $ 89,600 | per year |
| **5.2. IMPACTS TO COUNTY OF MAUI** | | | |
| **Revenues, Average Annual** | | | |
| GET Surchage | | | |
| Final Sales | 0.5% of local consumption | $ 2,800 | per year |
| Total Tax Revenue, Net New, Annual | | $ 2,800 | per year |

## 2. County of Maui

The operating cost of the Central Maui WWRF as well as the Kehalani WWPS is estimated to be approximately $7.1 million per year, which includes operating personnel, repair and maintenance costs, and other related expenses. The operating cost will be funded by the Sewer Fund where the service charges by the ratepayers will be deposited to, and as such, the operation of the Central Maui WWRF will not negatively impact the County's general fund. As noted previously, a separate rate impact analysis was prepared by Brown and Caldwell and includes an analysis of the potential long-term rate impacts due to the O&M cost for the Central Maui WWRF and Kehalani WWPS. The rate impact analysis will be included and discussed in the project's EIS.

The GET surcharge at a rate of 0.5 percent is generated by the consumption at local economy by the new workers and their families and is estimated to be approximately $2,800 per year. It is noted that public properties are exempt from real property tax pursuant to Section 3.48.530, Maui County Code (MCC), and as such, no fiscal impact related to real property tax is anticipated.

The Central Maui WWRF will provide additional sewer capacity to the Central Maui region to support the future population growth anticipated for the region as well as diverting the existing sewer treatment capacity at the Wailuku-Kahului WWRF which is located near the shoreline and currently utilizes injection wells as a method of disposing treated wastewater.

# SUMMARY IV

# IV. SUMMARY

The proposed Central Maui Wastewater Reclamation Facility (WWRF) project will generate positive economic and fiscal impacts during the 2-year construction period and at full development. Total construction expenditure is estimated at $130.6 million. Construction is anticipated to generate approximately 120 full-time equivalent (FTE) jobs on average per year with annual payroll of approximately $12.7 million. In addition to direct construction spending and employment, the project will generate indirect spending and employment related to supplying goods and services to construction companies and to the families of construction workers. Indirect sales are expected to average $77.2 million per year and 180 FTE indirect jobs will be generated per year. Earnings resulting from indirect sales during the construction would total approximately $11.2 million per year.

During the construction period, the State will collect an estimated $11.0 million in general excise tax (GET) and corporate and personal income taxes cumulatively. With respect to the County of Maui, the development of the proposed Central Maui WWRF is anticipated be funded by various sources, which may include municipal bonds backed by the County's Sewer Fund, federal funds, and County's GET surcharge revenues. The breakdown of the funding sources is undetermined at the time of this Study. During the two-year construction period, the County of Maui will collect the GET surcharge of 0.5 percent, which is estimated to be $723,200.00 million cumulatively.

At full build-out, the operation of the proposed Central Maui WWRF is anticipated to generate 16 FTE jobs per year, and the total payroll is estimated to be $1.0 million per year. Assuming that 55 percent of the payroll will be spent in the local economy, the total consumption associated with the operation of the Central Maui WWRF is estimated to be approximately $550,000. In terms of fiscal impacts, the State would receive revenues from personal income tax, estimated to be approximately $67,600 annually, from the new jobs created by the operation of the Central Maui WWRF, and GET of approximately $22,000 per year generated by the consumption at local economy by the new workers and their families. On the other hand, the County of Maui would receive revenues from the GET surcharge of approximately $2,800 per year, generated by the consumption of at the local economy by the new workers and their families.

# REFERENCES | V

# V. REFERENCES

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MUNEKIYO HIRAGA

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APPENDIX

# RATE IMPACT ANALYSIS

# P-2

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T: 808.244.7005

April 3, 2025

Mr. Juan Rivera, P.E.
County of Maui Wastewater Reclamation Division
2200 Main Street, Suite 610
Wailuku, HI 96793

158098.305

Subject: Central Maui WWRF – Rate Impact Analysis

Dear Mr. Rivera,

The County of Maui Department of Environmental Management (County) Wastewater Reclamation Division (WWRD) is proposing to develop a new wastewater reclamation facility (WWRF) in Central Maui to meet the needs of new growth and development within the service area. The new WWRF will also divert some wastewater flow from the existing Wailuku-Kahului (W-K) WWRF to reduce the amount of effluent disposed of via injection wells. This report evaluates the impact the new Central Maui WWRF may have on long-term sewer rates for the county. This report is not intended to be a rate study and does not represent or propose future sewer rates for the county.

## Rate Model Overview

A simple rate model was developed to approximate the average monthly sewer rate per connection. The model projects the average monthly sewer rate over 25 years to demonstrate the project's impact on sewer rates as the Central Maui WWRF service area develops. Construction and bond payments for the project begin in year 1, with operational costs starting in year 3. The rate model uses the connection schedule from the Central Maui WWRF facility plan to account for the timing of new connections to the service area.

The average monthly sewer rate per connection is calculated for each year for the baseline scenario and the Central Maui WWRF project scenario to assess the impact of the Central Maui WWRF on sewer rates.

The baseline average monthly sewer rate for the no-project scenario was calculated using the following equation:

$$Baseline\ Avg\ Monthly\ Sewer\ Rate = \frac{(Total\ Wastewater\ Reclamation\ Division\ Budget)}{(12\ months) * Existing\ Connections}$$

For the scenario with the Central Maui WWRF project, the average monthly sewer rate was modified to reflect the increased capital and operational costs associated with the new Central Maui WWRF and the increased development in the Central Maui WWRF service area. The anticipated annual debt service and O&M costs were combined with the existing Wastewater Reclamation Division (WWRD) budget items to represent the increase in expenses associated with the new Central Maui WWRF. Based on the projected flows timeline in the Central Maui WWRF facility plan, future connections were

added in the anticipated connection year to account for the increase in ratepayers for the service area.

$$Avg\ Monthly\ Sewer\ Rate = \frac{(Total\ WWRD\ Budget)+(Central\ Maui\ WWRF\ O\&M)+(Central\ Maui\ WWRF\ Debt\ Service)}{(12\ months)*(Existing\ Connections+Future\ Connections)}$$

# Rate Model Inputs

The rate model inputs to develop the average monthly sewer rate are documented in this section.

## County Sewer Budget

The County budget for the WWRD describes the annual costs for operating and maintaining the utility. The total WWRD budget adopted for 2025 is $59,003,992. The section of the budget for transfers out of the wastewater budget represents the portion of the budget allocated to debt service for ongoing capital improvement projects (CIP). The total of transfers out for the wastewater program and the rate model input for 2025 debt service is $13,669,602. For the simple rate model, the 2025 adopted budget for CIP is assumed to remain consistent and increase with inflation, allowing the county to continue the same level of investment in its wastewater infrastructure. The existing O&M budget was defined as the remaining portion of the budget that is not used for CIP projects and debt service, $45,334,390. In the rate model, the Total WWRD budget was adjusted for inflation for each year, with an inflation rate of 2.2%.

## Central Maui WWRF Capital Cost and O&M Costs

The Central Maui WWRF Facility Plan developed a planning-level capital construction cost for the new Central Maui WWRF, expressed in 2022 dollars is $82 million. Additional capital costs for the project include the Kehalani wastewater pumping station (WWPS), Kehalani sewage pipeline, and the R-1 transmission pipeline. Table 1 summarizes the costs associated with the Central Maui WWRF project. As noted in the table below, some of the projects related to the Central Maui WWRF project will be paid for by others and will not impact sewer rates. The total capital cost that will be borne by sewer ratepayers is $99.5 million.

| Table 1. Central Maui WWRF Capital Costs | |
|---|---|
| Description | Capital Cost |
| Central Maui WWRF | $82 million |
| Kehalani WWPS | $7.6 million |
| Kehalani sewage pipeline (WWPS to Waiko Rd) | $9.9 million |
| Kehalani sewage pipeline (Waiko Rd to WWRF easement) | By others |
| Kehalani sewage pipeline (WWRF easement) | Included in Central Maui WWRF capital cost above |
| R-1 transmission pipeline (WWRF easement) | Included in Central Maui WWRF capital cost above |
| R-1 transmission pipeline (WWRF easement to storage facility) | By others |
| Total Capital Cost | $99.5 million |

To determine the annual debt service, it was assumed that the facility would be funded with a 20-year term, tax-free municipal bond. 2024 bond rates for this type of municipal bond have a nominal interest rate of 4.2%. The annual debt payments for the total cost of the Central Maui WWRF program were determined using the formula for calculating an annual debt payment from a present capital cost:

$$Annual\ Debt\ Service\ = (CAPEX) * \frac{i(1+i)^n}{(1+i)^n - 1}$$

$$where\ CAPEX\ is\ capital\ expenditure,$$

$$n\ is\ the\ number\ of\ years,$$

$$i\ is\ the\ effective\ interest\ rate:$$

$$i = (e^r - 1)$$

$$r\ is\ the\ nominal\ interest\ rate$$

Using this formula, the annual debt service payments would be $7,510,258 per year.

The annual O&M costs used in the rate model were developed using the O&M cost for the Central Maui WWRF from the facility plan and calculating the operating cost for the Kehalani WWPS. The annual cost for operating the Kehalani WWPS was determined by estimating the energy consumption of the pump station and using an electricity cost of $0.40/kWh. The planning level O&M costs for the facility and the pump station are anticipated to be $7.1 million annually. In the rate model, the Central Maui WWRF O&M costs were adjusted for inflation for each year, with an inflation rate of 2.2%. These O&M costs include labor, electricity, chemicals, maintenance materials, and solids disposal.

## Maui County WWRD Total Budget Comparison

Figure 1 shows the Total Budget for the Maui County WWRD used in the simple rate model for the baseline scenario and the Central Maui WWRF project scenario. In the baseline scenario, the total budget increases annually with inflation, starting at approximately $59 million and reaching $99 million by the end of the 25-year period. The Total Budget for the scenario with the Central Maui WWRF project starts at the existing County Sewer Budget and increases in year 1 to account for the new bond payments associated with the project. The County Budget with the Central Maui WWRF project increases again in year 3 when the facility begins operation. In year 21, the bond associated with the Central Maui project will be paid off, reducing the budget impact from the project. The WWRD budget in the project scenario ultimately reaches $111 million, ending higher than the baseline WWRD budget scenario due to the increased O&M costs associated with the Central Maui WWRF.

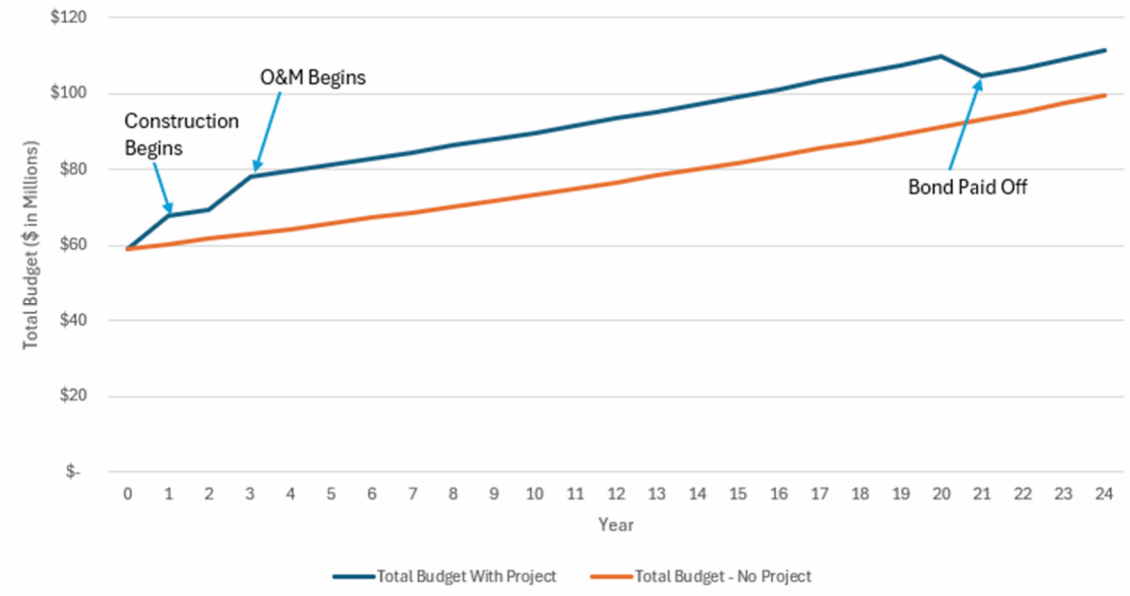



**Figure 1. Maui WWRD Total Budget**

## Existing and Future Connections

The utility billing data was used to establish the number of active wastewater service accounts. The County currently has 23,591 active accounts, representing the number of existing connections.

Projections for the future wastewater flows were developed in the facility plan based on available land use information for new developments. Since the Central Maui WWRF will serve both existing and future connections, flows that will be diverted from the existing developments were not included in the future connections calculations. The flows from future developments were transformed into connections using the equivalent dwelling unit method (EDU). Based on the data utilized in the facility plan, one EDU equals 353 gallons per day of wastewater flow. The timeline for the projected flows in the facility plan was used to determine the modeled connection year for each development in the rate model. Table 2 summarizes the anticipated Central Maui WWRF flows and associated future connections.

**Table 2. Central Maui WWRF Future Connections**

| Future Developments | Modeled Connection Year | Average Dry Weather Flow (mgd) | Connections |
|---|---|---|---|
| Waikapu Tropical Plantation Town | 2 | 0.65 | 1,838 |
| Kahili Residential | 6 | 0.04 | 113 |
| Puunani, Regional Parks and County Facilities | 8 | 0.54 | 1,527 |
| Pulehunui | 11 | 0.45 | 1,272 |
| DLNR Industrial & Business Park | 14 | 0.25 | 707 |
| Total | | 1.93 | 5,457 |

Figure 2 shows the number of connections over time in the rate model in the baseline scenario and the scenario with the project. In the baseline "no-project" scenario, the number of connections is anticipated to remain unchanged from existing conditions since there is no available wastewater treatment capacity in the service area to support new growth. For the scenario with the Central Maui WWRF project, the number of connections starts at the existing County Sewer connections and increases as new developments are connected. As described in Table 2, the Central Maui WWRF project will add 5,457 new connections to the County, bringing the ultimate number of existing and future connections to 29,048.

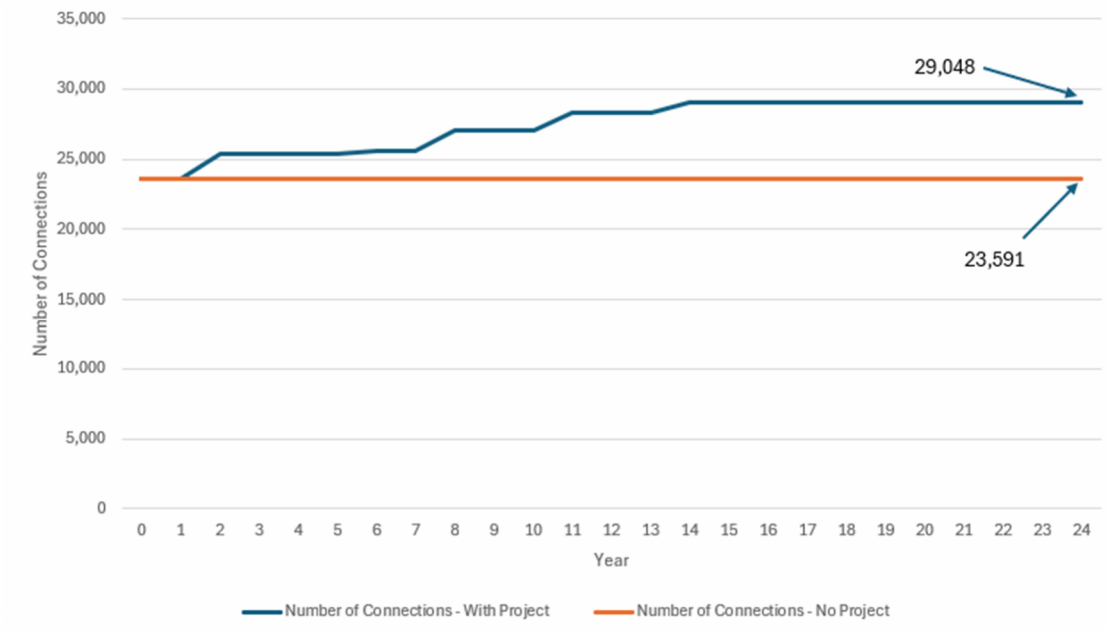



**Figure 2. Number of Sewer Connections**

## Modeled Rate Impacts

Using the projections for the Total WWRD Budget and the Maui sewer connections, the average monthly sewer rate was modeled for the baseline scenario and the Central Maui WWRF project scenario over 25 years. The average monthly sewer rate represents the average across all user types, including single family, multi-family and commercial connections. Figure 3 illustrates the modeled average monthly sewer rate for both the baseline scenario and the Central Maui WWRF project scenario, assuming that 100% of the project's capital cost is funded through bonds. The rate impact was determined by calculating the percent difference in sewer rates between the scenarios. The model demonstrates that the impact on rates from the project is most significant during the first 10 years because the future connections that the Central Maui WWRF will serve have not yet been fully constructed.

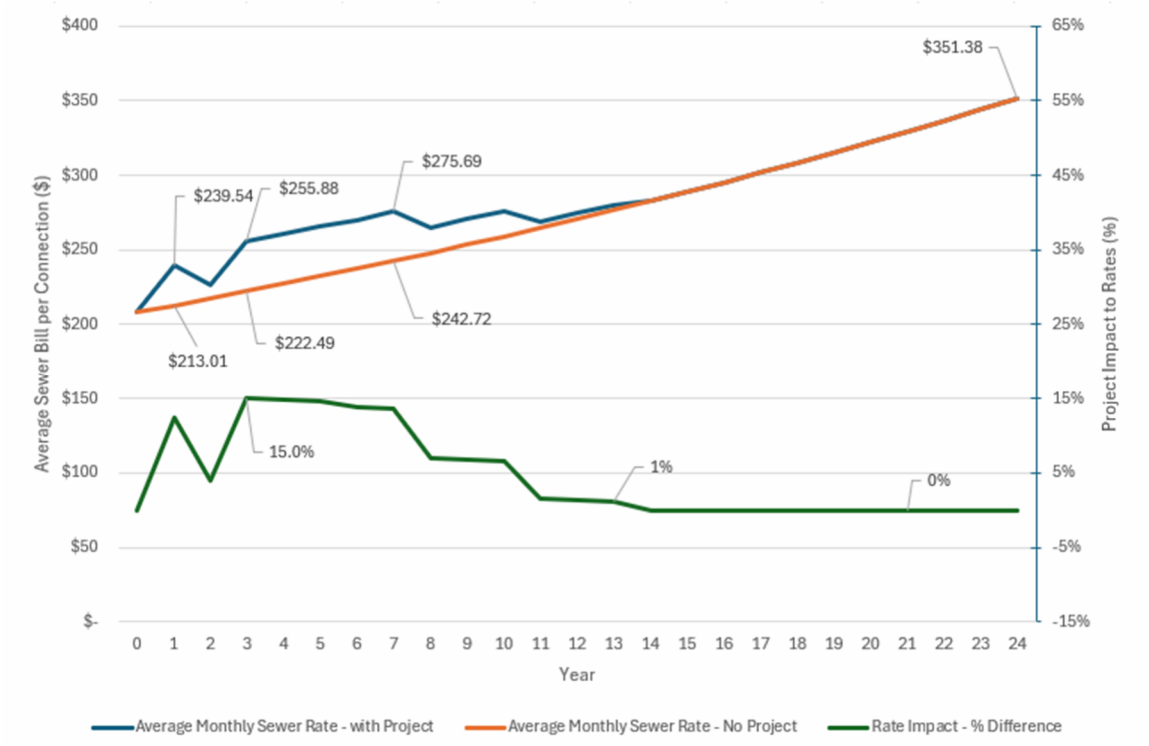



**Figure 3. Central Maui WWRF Rate Impacts**

Table 3 summarizes the rate impact of the Central Maui WWRF project across different bond funding scenarios, showing the percentage difference in average monthly sewer rates. The table highlights the rate impact in year 3 of the project, when the Central Maui WWRF begins operation. This represents the year of the highest rate impact to existing customers. The rate impact was determined for different bond funding scenarios, adjusting the Central Maui WWRF Debt Service model input parameter to reflect the proportion of the funding from bonds. The impact was assessed for different funding scenarios, including:

- 100 percent bond funded
- 75 percent bond funded
- 50 percent bond funded
- 25 percent bond funded
- 0 percent bond funded

**Table 3. Central Maui WWRF Rate Impacts**

| Description | Baseline | Capital Funding Scenario – Bond Funding Percentage | | | | |
|---|---|---|---|---|---|---|
| | | 100% | 75% | 50% | 25% | 0% |
| Average monthly sewer rate when Central Maui WWRF begins operation | $222.49 | $255.88 | $249.73 | $243.58 | $237.43 | $231.27 |
| % Change | - | +15% | +12% | +9.5% | +6.7% | +3.9% |

If the Central Maui WWRF is funded entirely through bonds, sewer rates will need to increase by approximately 15 percent more than in the baseline scenario to cover the expenses and debt service for the new WWRF. However, if alternate capital funding sources that do not incur debt service (e.g., grants, connection fees) are available, the impact on sewer rates is expected to be reduced.

Very truly yours,

**Brown and Caldwell**



Craig Lekven, P.E., Project Director

# TRAFFIC IMPACT ANALYSIS REPORT

## APPENDIX

# Q-1

# TRAFFIC IMPACT ANALYSIS REPORT
# CENTRAL MAUI WASTEWATER RECLAMATION FACILITY
WAIKAPU, MAUI, HAWAII

## FINAL

September 23, 2025

Prepared for:

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# TRAFFIC IMPACT ANALYSIS REPORT
# CENTRAL MAUI WASTEWATER RECLAMATION FACILITY

Waikapu, Maui Hawaii

## FINAL

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September 23, 2025

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

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# TRAFFIC IMPACT ANALYSIS REPORT

## Central Maui Wastewater Reclamation Facility

## Waikapu, Maui, Hawaii

# 1. INTRODUCTION

This report documents the findings of a traffic study conducted by Austin, Tsutsumi, and Associates, Inc. (ATA) to evaluate the traffic impacts resulting from the proposed Central Maui Wastewater Reclamation Facility (hereinafter referred to as the "Project") located in Waikapu, Maui, Hawaii.

## 1.1 Project Location

The Project is located in Waikapu on the island of Maui on agricultural lands between Honoapiilani Highway and Kuihelani Highway. See Figure 1.1 for Project location.

## 1.2 Project Description

The Project will consist of the following:

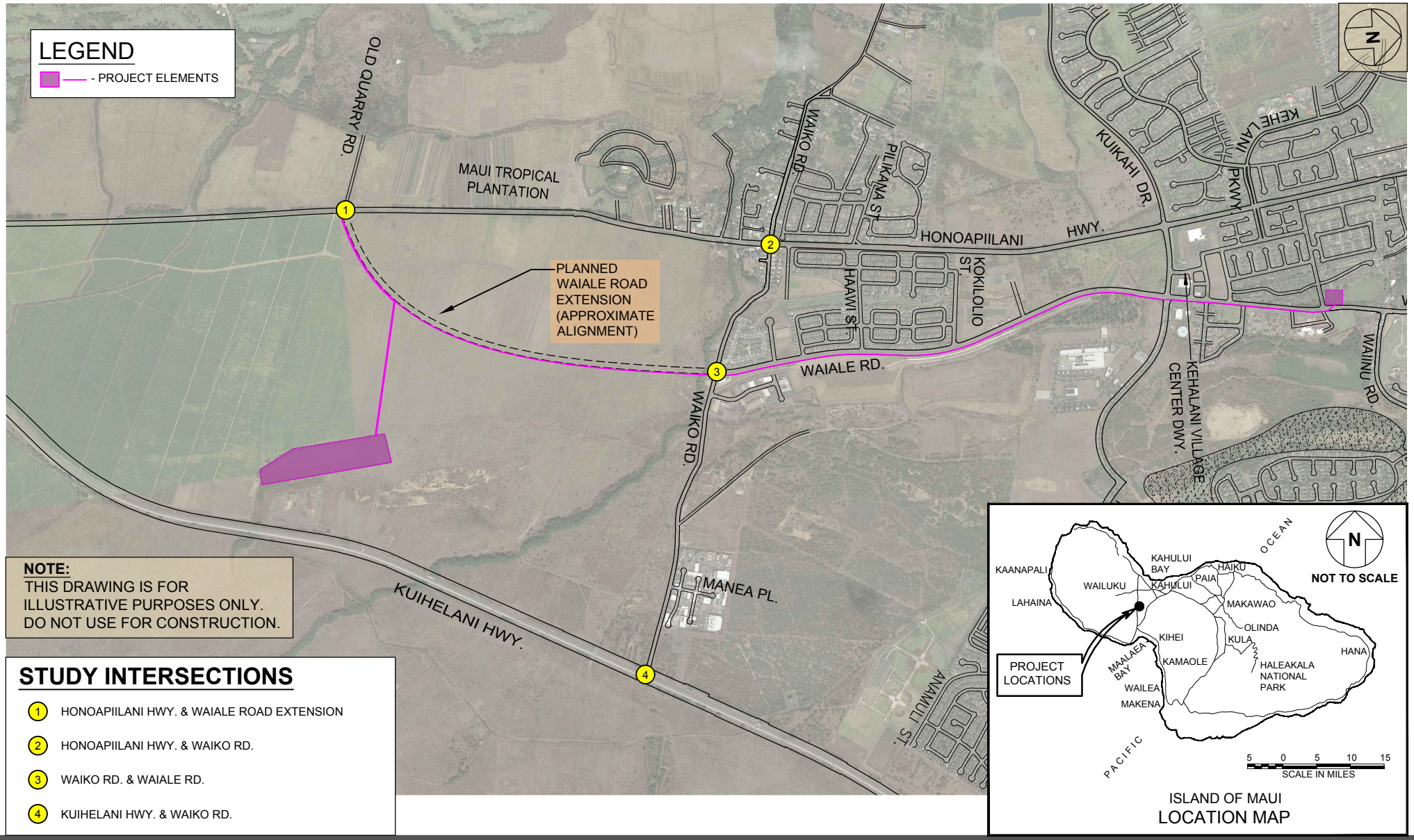
- A new Kehalani Wastewater Pump Station (WWPS) at an existing stormwater detention basin near the Waiale Road/Olomea Street intersection.
- A new Central Maui Wastewater Reclamation Facility (WWRF) located on a vacant County-owned parcel TMK (2) 3-8-005:023.
- A new sewage pipeline that will deliver flows from the WWPS to the WWRF. This new pipeline will run along Waiale Road and the future Waiale Road Extension.
- A new 100' wide access and utility easement approximately 1,800 ft long, to provide access from the future Waiale Road Extension to the WWRF. This access runs through a vacant County-owned parcel TMK (2) 3-6-002:004.
- A new sewage pipeline and a new recycled water pipeline that connect the WWRF and the Waikapu Country Town (WCT) mauka development. Only a segment of these pipelines will be constructed by the County as part of this Project, up to the future Honoapiilani Highway/Waiale Road Extension intersection. The remaining segment of these pipelines will be constructed by WCT.

During construction, it is anticipated that daily traffic to the site will consist of an average of 161 workers and four (4) delivery trucks. For full operation (post-construction), it is anticipated that trip generation to the site will be lower than it was during construction and will consist of only worker's vehicles.

See Figure 1.2 for the Project site plan.

# CENTRAL MAUI WASTEWATER RECLAMATION FACILITY TIAR

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# FIGURE 1.1

LOCATION MAP

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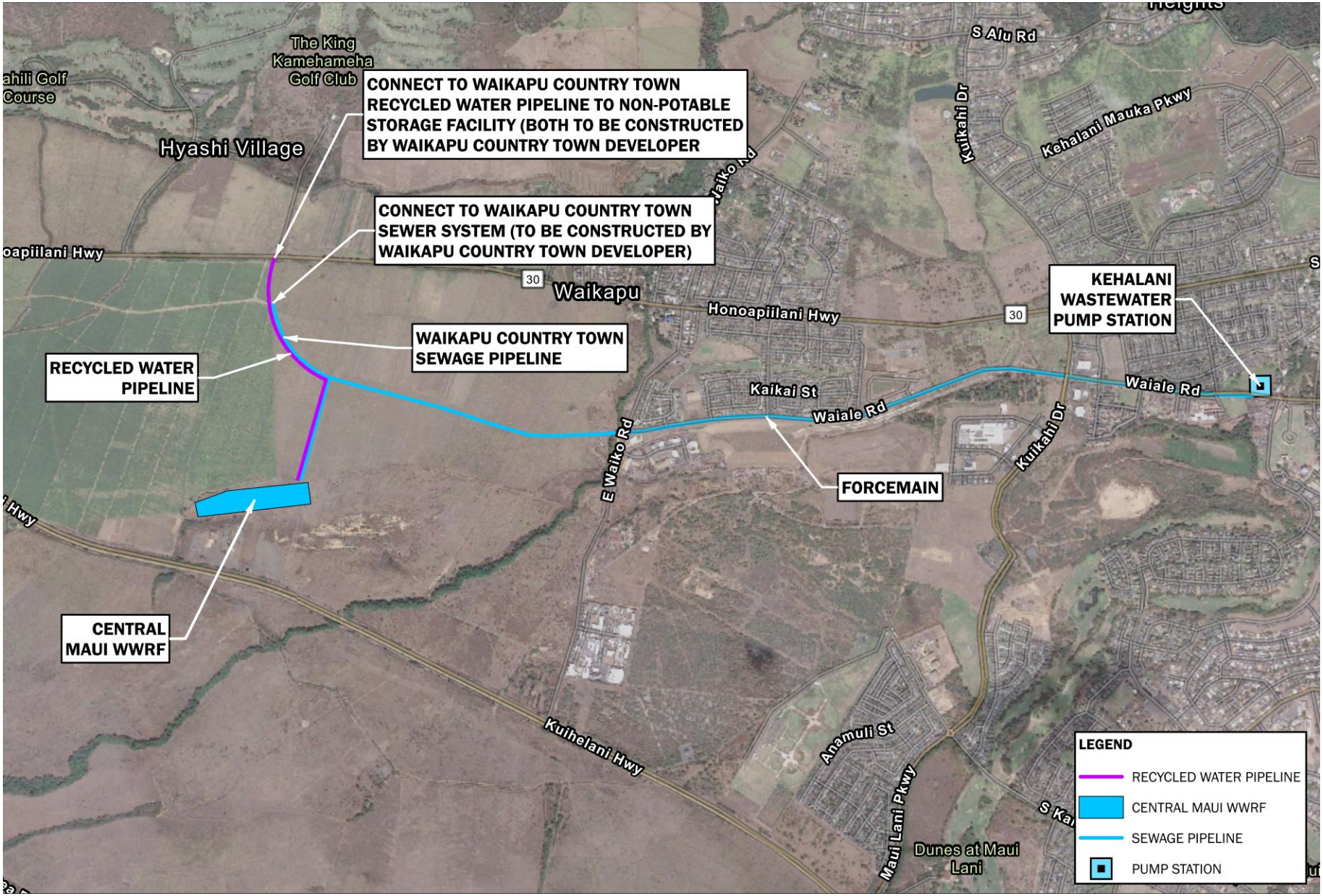



FIGURE 1.2

CONCEPTUAL SITE PLAN

# 2. METHODOLOGY

## 2.1 Study Methodology

This study will address the following:

- Assess existing traffic operating conditions at key intersections during the weekday morning (AM) and afternoon (PM) peak hours of traffic within the study area.
- Traffic projections for Base Year 2029 (without the Project) including traffic generated by other known developments in the vicinity of the Project in addition to an ambient growth rate. These other known developments are projects that are currently under construction or known new/future developments that are anticipated to affect traffic demand and operations within the study area.
- Trip generation and traffic assignment characteristics for the proposed Project for two (2) scenarios: one (1) during construction and one (1) during full operations.
- Traffic projections for Future Year 2029 (with the Project), which includes Base Year traffic volumes in addition to traffic volumes generated by the Project. Traffic projections for Future Year 2029 will be completed for the two (2) scenarios described above.
- Recommendations for Base Year and Future Year roadway improvements or other mitigative measures, as appropriate, to reduce or eliminate the adverse impacts resulting from traffic generated by known developments in the region or the Project.

## 2.2 Intersection Analysis

Level of Service (LOS) is a qualitative measure used to describe the conditions of traffic flow at intersections, with values ranging from free-flow conditions at LOS A to congested conditions at LOS F. The Highway Capacity Manual (HCM), 6th Edition, includes methods for calculating volume to capacity ratios, delays, and corresponding Levels of Service that were utilized in this study. LOS definitions for signalized and unsignalized intersections are provided in Appendix A.

Analyses for the study intersections were performed using the traffic analysis software Synchro, which is able to prepare reports based on the methodologies described in the HCM. Roundabout analysis was performed using SIDRA Intersection, which is also able to prepare reports based on SIDRA methodologies. These reports contain control delay results based on intersection lane geometry, signal timing, and hourly traffic volumes. Based on the vehicular delay at each intersection, a LOS is assigned to each approach and intersection movement as a qualitative measure of performance. These results, as confirmed or refined by field observations, constitute the technical analysis that will form the basis of the recommendations outlined in this report.

## 2.3 Study Area Intersection Analysis

Intersection analysis within the Project's study area was performed on the following intersections due to their proximity to the Project:

- Honoapiilani Highway/Waiale Road Extension (Unsignalized)
- Honoapiilani Highway/Waiko Road (Signalized)
- East Waiko Road/Waiale Road (Unsignalized)
- Kuihelani Highway/East Waiko Road (Signalized)

# 3. EXISTING TRAFFIC CONDITIONS

## 3.1 Existing Pedestrian, Bicycle, and Transit Facilities

No sidewalks are provided along Honoapiilani Highway, East Waiko Road, Waiale Road or Kuihelani Highway in the vicinity of the study area except for an approximately 200-foot segment of Honoapiilani Highway between East Waiko Road and Waiolu Place.

HDOT's Bike Plan Hawaii Master Plan currently identifies Waiale Road as a signed shared roadway between Waiko Road and Maui Community Correctional Center (MCCC). A marked bike lane is also striped along the Kehalani Village Center frontage along Waiale Road between Kaupo Street and Kuikahi Drive.

In the vicinity of the Project site, Honoapiilani Highway is not currently identified as a signed shared roadway. However, marked bike lanes are provided along Honoapiilani Highway at major intersections at Waiko Road, Pilikana Street, Kuikahi Drive, and Kehalani Mauka Parkway with continuous paved shoulders throughout most of the stretch in the Project site area.

The Maui Bus system offers several routes that connect the major areas in Maui. As of May 2023, a one-way general fare costs $2.00 and a monthly pass costs $45.00. There are two (2) bus stops in the vicinity of the study area located along both directions of Honoapiilani Highway just south of East Waiko Road at the Wilikona Place intersection. The bus stops are serviced by the Lahaina Islander Route 20, which provides service between the Queen Kaahumanu Shopping Center transit hub in Kahului and the Wharf Cinema Center transit hub in Lahaina.

## 3.2 Existing Roadway System

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

Honoapiilani Highway is generally a north-south, two-way, two-lane, undivided arterial highway with posted speed limits ranging between 30 miles per hour (mph) and 45 mph. Honoapiilani Highway begins to the north at its intersection with Keanu Street and High Street in Wailuku, and runs southward and then westward, generally following the coast, until it transitions into Kahekili Highway at its intersection with Honokohau Valley Road near the Honokohau Bay.

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

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

Kuihelani Highway is a north-south, two-way, four-lane, divided arterial highway with posted speed limits ranging from 30 mph to 55 mph. Kuihelani Highway begins as the continuation of Mayor Elmer F. Cravalho Way at the Puunene Avenue/Maui Veterans Highway intersection and continues southward through Waikapu where it terminates at its intersection with Honoapiilani

Highway. The speed limit along the highway is 45 mph in the vicinity of East Waiko Road and increases to 55 mph near the Project site.

## 3.3 Existing Traffic Volumes

The hourly traffic volume data utilized in this report was collected on Thursday, September 22, 2022. See the traffic count data provided in Appendix B for the existing intersections studied and their corresponding traffic count data. Based on the traffic count data, the weekday AM and PM peak hours of traffic were determined to occur between 7:00 AM – 8:00 AM and between 3:45 PM – 4:45 PM, respectively.

## 3.4 Existing Observations and Intersection Analysis

Traffic was observed to proceed smoothly through all study intersections, with no significant or persistent congestion. Analysis shows that all movements at all study intersections operate at LOS C or better across both peak hours.

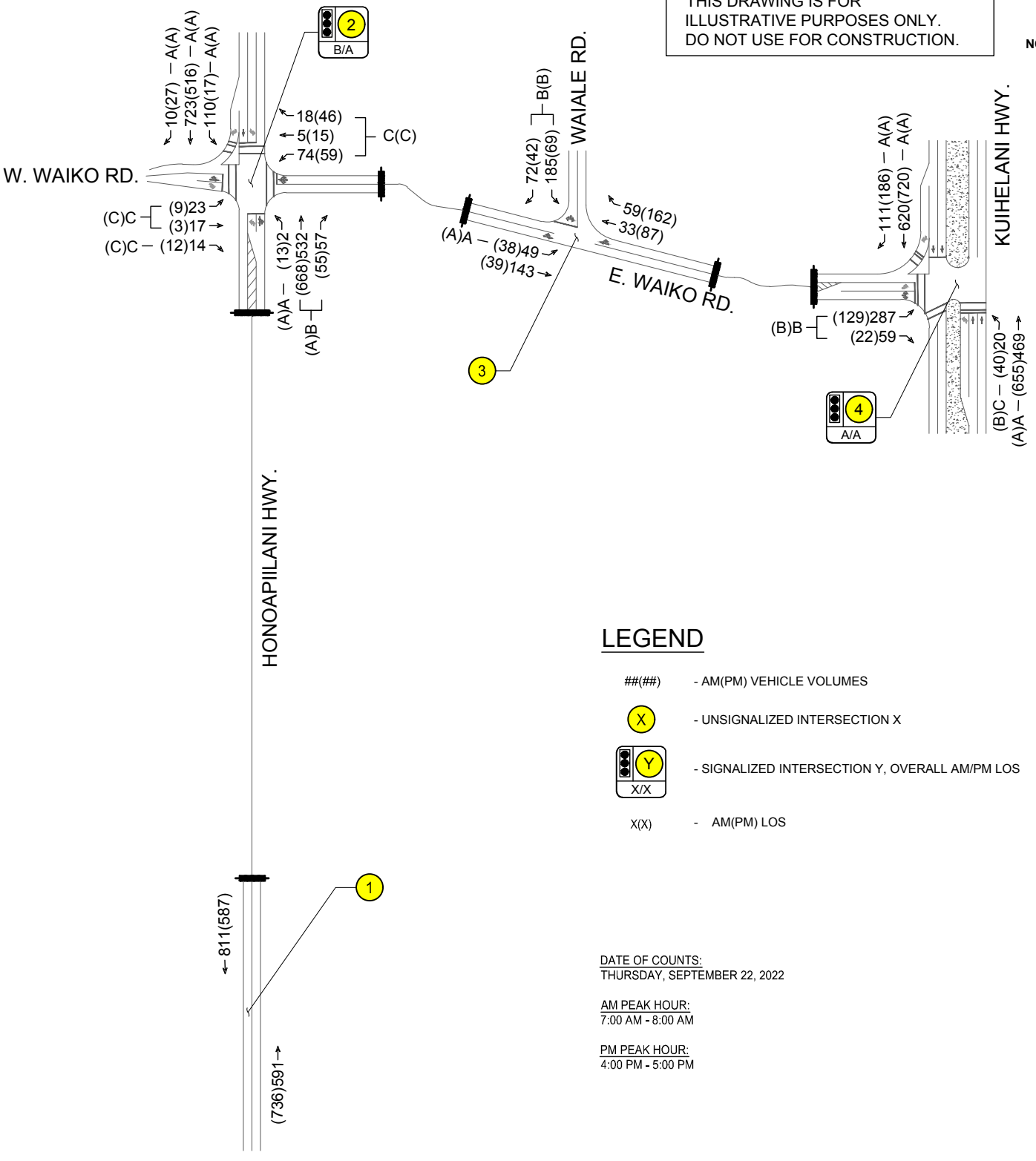
Figure 3.1 illustrates the existing lane configuration, traffic volumes, and LOS for each study intersection. Table 3.1 summarizes the existing LOS at the study intersections. LOS worksheets are provided in Appendix C.

# CENTRAL MAUI WASTEWATER RECLAMATION FACILITY TIAR

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**NOTE:**
THIS DRAWING IS FOR ILLUSTRATIVE PURPOSES ONLY.
DO NOT USE FOR CONSTRUCTION.

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NOT TO SCALE




## LEGEND

| | |
|---|---|
| ##(##) | - AM(PM) VEHICLE VOLUMES |
| X | - UNSIGNALIZED INTERSECTION X |
| Y / X/X | - SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS |
| X(X) | - AM(PM) LOS |

DATE OF COUNTS:
THURSDAY, SEPTEMBER 22, 2022

AM PEAK HOUR:
7:00 AM - 8:00 AM

PM PEAK HOUR:
4:00 PM - 5:00 PM

# FIGURE 3.1

EXISTING CONDITIONS LANE CONFIGURATION, VOLUMES AND MOVEMENT LOS

## TABLE 3.1: LOS SUMMARY TABLE
## EXISTING CONDITIONS

| Intersection | Existing 2022 Conditions | | | | | |
|---|---|---|---|---|---|---|
| | AM | | | PM | | |
| | HCM Delay | v/c Ratio | LOS | HCM Delay | v/c Ratio | LOS |
| **1: Honoapiilani Highway & Future Waiale Road** | There are currently no traffic control devices at this location. | | | | | |
| **2: Honoapiilani Hwy & W Waiko Rd/E Waiko Rd** | | | | | | |
| NB LT | 7.2 | 0.01 | A | 4.9 | 0.03 | A |
| NB TH/RT | 10.8 | 0.65 | B | 9.6 | 0.71 | A |
| EB LT/TH | 22.9 | 0.15 | C | 23.5 | 0.05 | C |
| EB RT | 22.3 | 0.01 | C | 23.3 | 0.01 | C |
| WB LT/TH/RT | 24.0 | 0.36 | C | 25.5 | 0.44 | C |
| SB LT | 6.5 | 0.24 | A | 6.6 | 0.05 | A |
| SB TH | 9.0 | 0.69 | A | 7.0 | 0.49 | A |
| SB RT | 4.3 | 0.01 | A | 4.5 | 0.02 | A |
| OVERALL | 10.7 | - | B | 9.8 | - | A |
| **3: E Waiko Road/Waiale Road** | | | | | | |
| EB LT | 7.5 | 0.04 | A | 7.9 | 0.03 | A |
| SB LT/RT | 13.3 | 0.39 | B | 10.9 | 0.17 | B |
| OVERALL | 7.0 | - | - | 3.5 | - | - |
| **4: Kuihelani Hwy & E Waiko Rd** | | | | | | |
| NB LT | 21.8 | 0.45 | C | 19.3 | 0.49 | B |
| NB TH | 4.1 | 0.27 | A | 3.2 | 0.33 | A |
| EB LT/RT | 12.7 | 0.54 | B | 14.0 | 0.37 | B |
| SB TH | 8.2 | 0.51 | A | 7.2 | 0.52 | A |
| SB RT | 6.6 | 0.07 | A | 5.8 | 0.14 | A |
| OVERALL | 8.1 | - | A | 6.4 | - | A |

# 4. BASE YEAR 2029 TRAFFIC CONDITIONS

The Year 2029 was selected to reflect the Project completion year. The Base Year 2029 scenario represents the traffic conditions within the study area without the Project. Traffic projections were formulated by applying a defacto growth rate to the existing 2022 traffic count volumes as well as trips generated by known future developments in the vicinity of the Project.

## 4.1 Defacto Growth Rate

Projections for Base Year 2029 traffic were based upon the Maui Regional Travel Demand Model (MRTDM) growth for forecast years between 2019 and 2045, and nearby developments in the immediate vicinity of the Project. The overall annual growth rates applied along Honoapiilani Highway, Kuihelani Highway, Waiko Road and Waiale Road was approximately 0.5% to 0.9% percent per year.

## 4.2 Traffic Forecasts for Known Developments

By Year 2029, the following developments shown in Figure 4.1 and Table 4.1 may be constructed.

- Waiale Business Park – Formerly known as "Waiko Light Industrial Subdivision", this industrial park along Waiko Road will include approximately 102,414 SF of commercial space and 215,195 SF of light industrial uses. Forecast traffic growth was based on the latest land use breakdown and was added to the roadway network.
- Waikapu Light Industrial Project – Proposed 8.5-acre industrial development along Waiko Road. Forecast traffic growth generated by this development was obtained from the Project's TIAR dated April 2013 and was added to the network.
- Emmanuel Lutheran Church Maui – Proposed relocation of Emmanuel Lutheran Church Maui church and school facilities to a currently unoccupied lot bound by the proposed Wailuku Apartments to the north, proposed Waikapu Ventures Affordable Housing to the south, Waiale Road to the east, and Honoapiilani Highway to the west. At full build-out, this development envisions a new preschool, K-8 school and buildings for church/office related functions, dependent on funding. In December 2018, State Land Use Commission (LUC) approved a 10-year time extension for developers with a condition to obtain funding and build a multi-purpose building for the preschool/church activities within six (6) years. This TIAR assumes that the first two phases of the project will be completed by 2029.
- Maui Lani Village Center – Expansion of the existing retail center in the Maui Lani subdivision, currently occupied by Walgreens and a mix of various commercial, office, residential and warehouse uses. Based on the historic growth of this site, approximately 112,000 SF of commercial, 73,000 SF of office and 275,000 SF of warehouse/self-storage space may be completed by year 2029. The forecast AM and PM peak hour trips were generated based on the cumulative ITE Trip generation and added to the roadway network.
- Kehalani Village Center – Infill development of the existing retail center in the Kehalani subdivision, currently occupied by Longs Drugs, Foodland, Foodland Gas, American Savings Bank, Coffee Bean Tea & Leaf, McDonalds, Maui County Federal Credit Union, and Fabmac Homes. It is anticipated that the Kehalani Village Center will be expanded with infill commercial space and 56 multi-family dwelling units. The forecast AM and PM peak hour trips were generated based on the ITE trip generation for the remaining build-out.

- Kehalani Mauka – Expansion of the existing residential subdivision located north of Kuikahi Drive, west of Honoapiilani Highway and east of Wailuku Heights. Kehalani Mauka is partially developed with residential homes and the Puu Kukui Elementary School. Based on the latest projections, the remaining 345 single-family units are anticipated to be completed by Year 2029.
- Waikapu Country Town – This future development is currently satisfying required conditions to obtain building permits for construction. When fully built-out, this development is planned to consist of 1,579 residential units, 169,600 SF of commercial space and a 750-student elementary school. To be conservative, it was assumed that Phase 1 of the development, which is anticipated to consist of 169,600 SF of commercial space, 731 residential units, elementary school, and 27 acres of park and open space, will be built-out by 2029. Phase 1 is anticipated to have access from a new roadway named Main Street. The intersection of Waiale Road Extension/Main Street was included in Base Year conditions and discussed further in Section 4.3.
- Waikapu Ventures Affordable Housing – Proposed residential subdivision with 68 single-family units and 12 multi-family units on land bound by Emmanuel Lutheran Church Maui to the north, Waiale Elua to the south, Waiale Road to the east, and Honoapiilani Highway to the west. The forecast AM and PM peak hour trips were obtained from the Project's TIAR dated 2018 and added to the roadway network.
- Kaulana Mahina (formerly Wailuku Apartments) – Proposed 324 multi-family dwelling units upon 14.4 acres of undeveloped land bound by Kuikahi Drive to the north, the proposed Emmanuel Lutheran Church to the south, Waiale Road to the east and Honoapiilani Highway to the west. Vehicular access is anticipated to be provided by two (2) new project accesses; one (1) along Kuikahi Drive directly across the Kehalani Village Center driveway and one (1) along Waiale Road.
- Maui Lani Parkways Phase 3 – Proposed additional 74 single-family units to the existing Maui Lani Parkways Phase 1 and 2 residential subdivision bound by Maui Lani Parkway to the south and The Dunes at Maui Lani Golf Course to the north.
- Ag Subdivision Lots – Proposed five (5) Ag lots, adjacent and to the west of the Puunani Homesteads development. Build-out and occupancy is unknown, but for purposes of this TIAR, was assumed to be occupied by Year 2029. Ohana units will be permitted, and access to the site will occur temporarily by the existing dirt road easement just north of the Waiolani Subdivision. Permanent access will occur via the future Puunani Homesteads South Access.
- Gentry (Maui Lani Ph 8B & 8C) – Proposed 291 single-family dwelling units. As of the writing of this report, site work for this project has not yet begun; however, it was conservatively assumed that occupancy would occur at a rate of 1 home per week thereafter until all homes are completed. Therefore, by Year 2029, it was assumed that all units in the development would be completed and occupied.
- Puunani Homesteads – Proposed 137 turn-key homes and 24 vacant residential lots, for a total of 161 single-family dwelling units, bounded by Honoapiilani Highway to the east and the Waiolani residential subdivision to the south. Access to the site will occur via two (2) new driveways off of Honoapiilani Highway. The forecast AM and PM peak hour trips were obtained from the Project's TIAR dated August 31, 2020 and were added to the roadway network.

- Kuikahi Residential – Proposed 204 residential units, including 120 multi-family residential units, 34 duplex units, 16 live work units, 28 studio units and six (6) single family lots. Access to the site will occur via tow (2) new driveways off of Kuikahi Drive, with primary access from a new leg at the Kuikahi Drive/Kehalani Mauka Parkway intersection. The forecast AM and PM peak hour trips were obtained from the Project's TIAR dated May 25, 2021 and were added to the roadway network.

## 4.3 Planned Roadway Projects

The following roadway projects were assumed to be completed and were included in analysis for the Base Year 2029 scenario:

- Waiale Road Extension – This new roadway is anticipated to begin to the south at a T-intersection with Honoapiilani Highway and extend eastward and northward until it connects to the existing Waiko Road/Waiale Road intersection, converting the existing T-intersection into a four-way intersection. The Waiale Road Extension Final Environmental Assessment (EA), published in August 2025, stated that roundabouts are preferred at the Waiale Road Extension intersections with the future Main Street and future Makai Parkway which tie into the Waikapu Country Town developments to the west. The EA also stated that both signals and roundabouts are being considered for installation at the Waiale Road/Honoapiilani Highway and Waiale Road/East Waiko Road intersections.

  For the purpose of this report, traffic signals were analyzed at the Waiale Road intersections with Waiko Road and Honoapiilani Highway, in addition to single-lane roundabouts. Only a roundabout was analyzed at the Waiale Road Extension/Main Street intersection.

  For the signal scenario, the following laneage was assumed, based upon the Waikapu Country Town TIAR completed by Fehr and Peers in December 2016:

  - Waiale Road/Waiko Road: Signalization and widening of the intersection to provide the following laneage:
    - Northbound approach: Dedicated left-turn, through, and right-turn lanes
    - Eastbound approach: Dedicated left-turn lane and shared through/right-turn lane
    - Westbound approach: Dedicated left-turn, through, and right-turn lanes
    - Southbound approach: Dedicated left-turn lane, and shared through/right-turn lane
  - Honoapiilani Highway/Waiale Road Extension: Signalization and widening of the intersection to provide the following laneage:
    - Northbound approach: Dedicated through lane and right-turn lane
    - Westbound approach: Dedicated left-turn lane and right-turn lane
    - Southbound approach: Southbound through lane and left-turn lane

Table 4.1: Total Trips Generated by Known Developments in Project Vicinity [1]

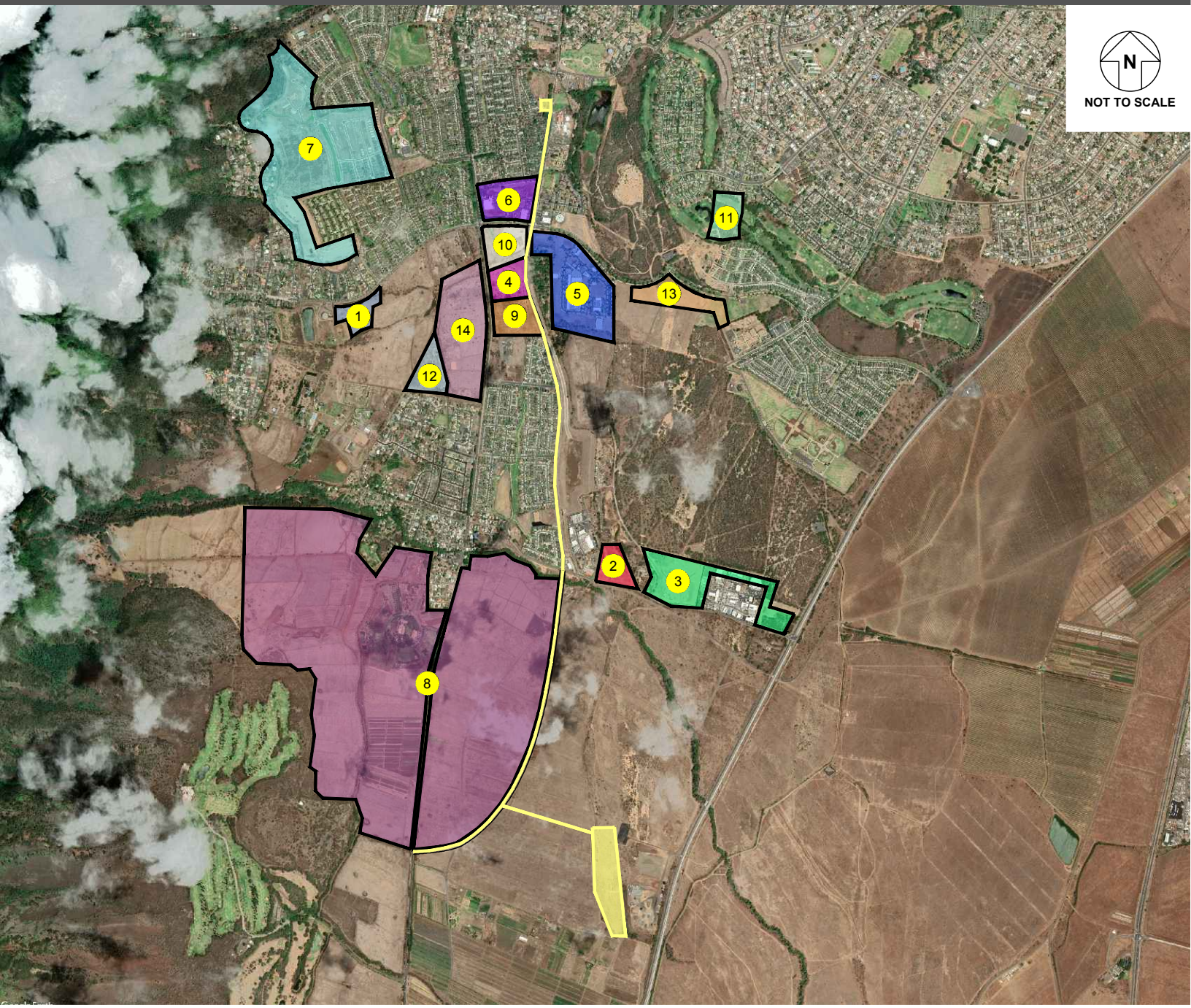
| Known Development | Land Use | Units | AM Peak Hour | | | PM Peak Hour | | |
|---|---|---|---|---|---|---|---|---|
| | | | Enter | Exit | Total | Enter | Exit | Total |
| Waikapu Light Industrial Project | Industrial Park | 8.5 Acres | 74 | 15 | 89 | 21 | 79 | 100 |
| Waiale Business Park | Retail/Light Industrial | 102,414 SF retail<br>215,195 SF light ind. | 187 | 79 | 266 | 183 | 253 | 436 |
| Emmanuel Lutheran Church | Daycare, Private School | 36 Students<br>127 Students | 73 | 60 | 133 | 31 | 34 | 65 |
| Maui Lani Village Center (formerly VMX) [1] | Commercial, Office, Warehouse | 112,000 SF commercial,<br>73,000 SF office,<br>275,000 SF warehouse | 110 | 33 | 143 | 229 | 302 | 532 |
| Kehalani Village Center [2] | Commercial, Residential | 100,000 SF<br>56 MF units | 37 | 41 | 78 | 133 | 138 | 271 |
| Kehalani Mauka [3] | Single-Family, Multi-Family Residential | 345 SF units | 72 | 223 | 295 | 208 | 123 | 331 |
| Waikapu Country Town [4] | Mixed-Use | 170,000 SF commercial<br>1,579 SF and MF units<br>Elementary School<br>33 acres parks/open space | 306 | 427 | 733 | 552 | 460 | 1012 |
| Waikapu Ventures Affordable Housing | Single-Family, Multi-Family Residential | 68 SF units<br>12 MF units | 17 | 51 | 68 | 54 | 32 | 86 |
| Kaulana Mahina | Multi-Family Residential | 324 MF units | 36 | 103 | 139 | 90 | 51 | 141 |
| Maui Lani Parkways Phase 3 | Single-Family Residential | 74 SF units | 14 | 43 | 57 | 48 | 28 | 76 |
| Ag Subdivision Lots | Single-Family Residential | 10 SF units | 3 | 9 | 12 | 8 | 4 | 12 |
| Gentry (Maui Lani Ph 8B & 8C) | Single-Family Residential | 291 SF units | 53 | 158 | 211 | 178 | 105 | 283 |
| Puunani Homesteads | Single-Family Residential | 161 SF units | 30 | 89 | 119 | 101 | 60 | 161 |
| Kuikahi Residential | Single-Family, Multi-Family Residential | 6 SF units<br>198 MF units | 24 | 78 | 102 | 73 | 43 | 116 |

Note:

1. Maui Lani Village Center projections are based on historic growth rate. Majority of expansion attributed to lower trip generating office and warehouse land uses.
2. Kehalani Village Center is already partially completed with Longs Drugs, Foodland, Foodland Gas and McDonalds. Trips shown account for the additional 100,000 SF of commercial space and multi-family low-rise units anticipated to be completed by Year 2029. ITE recommended 34% pass-by reduction applied to new retail.
3. Kehalani Mauka projections based on latest assumptions for growth.
4. It was assumed that only a portion of the Waikapu Country Town project would be built out by 2029. Phase 1 only was conservatively assumed to be complete by Year 2029.

# CENTRAL MAUI WASTEWATER RECLAMATION FACILITY TIAR

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## LEGEND

- PROJECT AREA
- 1 KUIKAHI RESIDENTIAL
- 2 WAIKAPU LIGHT INDUSTRIAL
- 3 WAIALE BUSINESS PARK
- 4 EMMANUEL LUTHERAN SCHOOL
- 5 MAUI LANI VILLAGE CENTER
- 6 KEHALANI VILLAGE CENTER
- 7 KEHALANI MAUKA
- 8 WAIKAPU COUNTRY TOWN
- 9 WAIKAPU VENTURES AFFORDABLE HOUSING
- 10 KAULANA MAHINA
- 11 MAUI LANI PARKWAYS PH. 3
- 12 AG SUBDIVISION LOTS
- 13 GENTRY (MAUI LANI PH 8B & 8C)
- 14 PUUNANI HOMESTEADS

# FIGURE 4.1

## BACKGROUND DEVELOPMENTS IN PROJECT VICINITY

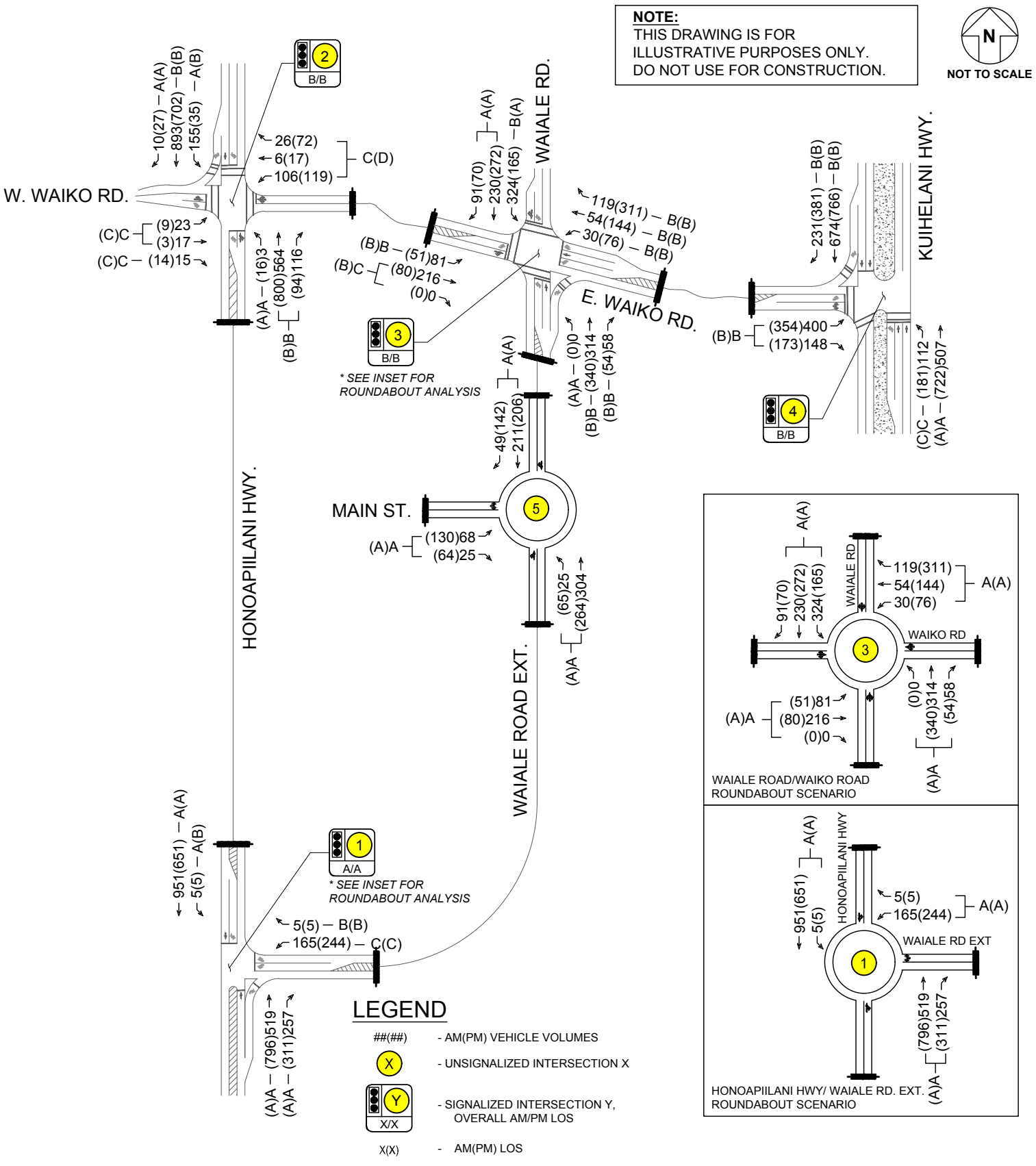
## 4.4 Base Year 2029 Analysis

With Base Year 2029 conditions, all movements at all study intersections are anticipated to operate adequately at LOS D or better across both peak hours.

Figure 4.2 illustrates the lane configuration, forecast traffic volumes and movement LOS for Base Year 2029 Table 4.2 summarizes the Base Year 2029 LOS at the study intersections. LOS worksheets are provided in Appendix C.

# CENTRAL MAUI WASTEWATER RECLAMATION FACILITY TIAR

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# FIGURE 4.2

## BASE YEAR 2029 LANE CONFIGURATION, VOLUMES AND MOVEMENT LOS

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## TABLE 4.2: LOS SUMMARY TABLE
## EXISTING AND BASE YEAR LOS SUMMARY

| Intersection | Existing 2022 Conditions | | | | | | Base Year | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AM | | | PM | | | AM | | | PM | | |
| | HCM Delay | v/c Ratio | LOS | HCM Delay | v/c Ratio | LOS | HCM Delay | v/c Ratio | LOS | HCM Delay | v/c Ratio | LOS |
| **1: Honoapiilani Highway & Waiale Road Extension** | | | | | | | *With Traffic Signal; See Table 4.3 for Traffic Signal vs. Roundabout Conditions* | | | | | |
| NB TH | - | - | - | - | - | - | 4.3 | 0.46 | A | 8.7 | 0.80 | A |
| NB RT | - | - | - | - | - | - | 3.3 | 0.18 | A | 4.6 | 0.21 | A |
| WB LT | - | - | - | - | - | - | 24.6 | 0.74 | C | 20.4 | 0.76 | C |
| WB RT | - | - | - | - | - | - | 18.2 | 0.02 | B | 14.5 | 0.02 | B |
| SB LT | - | - | - | - | - | - | 5.8 | 0.01 | A | 13.7 | 0.02 | B |
| SB TH | - | - | - | - | - | - | 7.9 | 0.84 | A | 7.0 | 0.65 | A |
| OVERALL | - | - | - | - | - | - | 8.0 | - | A | 9.3 | - | A |
| **2: Honoapiilani Hwy & W Waiko Rd/E Waiko Rd** | | | | | | | | | | | | |
| NB LT | 7.2 | 0.01 | A | 4.9 | 0.03 | A | 9.5 | 0.01 | A | 8.3 | 0.04 | A |
| NB TH/RT | 10.8 | 0.65 | B | 9.6 | 0.71 | A | 11.7 | 0.67 | B | 18.5 | 0.84 | B |
| EB LT/TH | 22.9 | 0.15 | C | 23.5 | 0.05 | C | 29.8 | 0.15 | C | 32.1 | 0.04 | C |
| EB RT | 22.3 | 0.01 | C | 23.3 | 0.01 | C | 29.1 | 0.01 | C | 31.9 | 0.01 | C |
| WB LT/TH/RT | 24.0 | 0.36 | C | 25.5 | 0.44 | C | 32.5 | 0.52 | C | 37.9 | 0.68 | D |
| SB LT | 6.5 | 0.24 | A | 6.6 | 0.05 | A | 8.5 | 0.37 | A | 13.9 | 0.15 | B |
| SB TH | 9.0 | 0.69 | A | 7.0 | 0.49 | A | 11.8 | 0.79 | B | 11.1 | 0.64 | B |
| SB RT | 4.3 | 0.01 | A | 4.5 | 0.02 | A | 4.4 | 0.01 | A | 5.9 | 0.02 | A |
| OVERALL | 10.7 | - | B | 9.8 | - | A | 13.3 | - | B | 17.5 | - | B |
| **3: E Waiko Road/Waiale Road** | | | | | | | *With Traffic Signal; See Table 4.3 for Traffic Signal vs. Roundabout Conditions* | | | | | |
| NB LT | - | - | - | - | - | - | 0.0 | 0.00 | A | 0.0 | 0.00 | A |
| NB TH | - | - | - | - | - | - | 19.8 | 0.73 | B | 15.4 | 0.70 | B |
| NB RT | - | - | - | - | - | - | 14.6 | 0.04 | B | 11.1 | 0.03 | B |
| EB LT | 7.5 | 0.04 | A | 7.9 | 0.03 | A | 17.1 | 0.22 | B | 15.1 | 0.17 | B |
| EB TH/RT | - | - | - | - | - | - | 22.2 | 0.69 | C | 17.6 | 0.34 | B |
| WB LT | - | - | - | - | - | - | 17.9 | 0.12 | B | 14.9 | 0.21 | B |
| WB TH | - | - | - | - | - | - | 19.3 | 0.21 | B | 18.7 | 0.56 | B |
| WB RT | - | - | - | - | - | - | 18.8 | 0.08 | B | 16.5 | 0.23 | B |
| SB LT | - | - | - | - | - | - | 11.5 | 0.63 | B | 9.5 | 0.39 | A |
| SB TH/RT | - | - | - | - | - | - | 7.6 | 0.36 | A | 7.6 | 0.42 | A |
| SB LT/RT | 13.3 | 0.39 | B | 10.9 | 0.17 | B | - | - | - | - | - | - |
| OVERALL | 7.0 | - | - | 3.5 | - | - | 15.2 | - | B | 13.0 | - | B |
| **4: Kuihelani Hwy & E Waiko Rd** | | | | | | | | | | | | |
| NB LT | 21.8 | 0.45 | C | 19.3 | 0.49 | B | 25.8 | 0.75 | C | 25.2 | 0.76 | C |
| NB TH | 4.1 | 0.27 | A | 3.2 | 0.33 | A | 5.6 | 0.29 | A | 5.3 | 0.37 | A |
| EB LT/RT | 12.7 | 0.54 | B | 14.0 | 0.37 | B | 15.5 | 0.61 | B | 19.2 | 0.62 | B |
| SB TH | 8.2 | 0.51 | A | 7.2 | 0.52 | A | 12.4 | 0.61 | B | 13.9 | 0.65 | B |
| SB RT | 6.6 | 0.07 | A | 5.8 | 0.14 | A | 10.1 | 0.14 | B | 11.7 | 0.28 | B |
| OVERALL | 8.1 | - | A | 6.4 | - | A | 12.4 | - | B | 13.2 | - | B |

## TABLE 4.3: LOS SUMMARY TABLE
## BASE YEAR CONDITIONS WITH TRAFFIC SIGNALS VS. ROUNDABOUTS

| Intersection | Base Year (With Traffic Signals) | | | | | | Base Year (With Roundabouts) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AM | | | PM | | | AM | | | PM | | |
| | HCM Delay | v/c Ratio | LOS | HCM Delay | v/c Ratio | LOS | HCM Delay | v/c Ratio | LOS | HCM Delay | v/c Ratio | LOS |
| **1: Honoapiilani Highway & Waiale Road Extension** | | | | | | | | | | | | |
| NB TH | 4.3 | 0.46 | A | 8.7 | 0.80 | A | - | - | - | - | - | - |
| NB TH/RT | - | - | - | - | - | - | 0.1 | 0.60 | A | 0.1 | 0.85 | A |
| NB RT | 3.3 | 0.18 | A | 4.6 | 0.21 | A | - | - | - | - | - | - |
| WB LT | 24.6 | 0.74 | C | 20.4 | 0.76 | C | - | - | - | - | - | - |
| WB LT/RT | - | - | - | - | - | - | 5.9 | 0.19 | A | 9.2 | 0.38 | A |
| WB RT | 18.2 | 0.02 | B | 14.5 | 0.02 | B | - | - | - | - | - | - |
| SB LT | 5.8 | 0.01 | A | 13.7 | 0.02 | B | - | - | - | - | - | - |
| SB TH | 7.9 | 0.84 | A | 7.0 | 0.65 | A | - | - | - | - | - | - |
| SB LT/TH | - | - | - | - | - | - | 5.0 | 0.86 | A | 2.8 | 0.64 | A |
| OVERALL | 8.0 | - | A | 9.3 | - | A | 3.1 | 0.86 | A | 2.1 | 0.85 | A |
| **3: E Waiko Road/Waiale Road** | | | | | | | | | | | | |
| NB LT | 0.0 | 0.00 | A | 0.0 | 0.00 | A | - | - | - | - | - | - |
| NB TH | 19.8 | 0.73 | B | 15.4 | 0.70 | B | - | - | - | - | - | - |
| NB LT/TH/RT | - | - | - | - | - | - | 5.7 | 0.49 | A | 2.0 | 0.39 | A |
| NB RT | 14.6 | 0.04 | B | 11.1 | 0.03 | B | - | - | - | - | - | - |
| EB LT | 17.1 | 0.22 | B | 15.1 | 0.17 | B | - | - | - | - | - | - |
| EB TH/RT | 22.2 | 0.69 | C | 17.6 | 0.34 | B | - | - | - | - | - | - |
| EB LT/TH/RT | - | - | - | - | - | - | 4.8 | 0.38 | A | 4.0 | 0.16 | A |
| WB LT | 17.9 | 0.12 | B | 14.9 | 0.21 | B | - | - | - | - | - | - |
| WB TH | 19.3 | 0.21 | B | 18.7 | 0.56 | B | - | - | - | - | - | - |
| WB LT/TH/RT | - | - | - | - | - | - | 2.6 | 0.23 | A | 4.4 | 0.58 | A |
| WB RT | 18.8 | 0.08 | B | 16.5 | 0.23 | B | - | - | - | - | - | - |
| SB LT | 11.5 | 0.63 | B | 9.5 | 0.39 | A | - | - | - | - | - | - |
| SB TH/RT | 7.6 | 0.36 | A | 7.6 | 0.42 | A | - | - | - | - | - | - |
| SB LT/TH/RT | - | - | - | - | - | - | 2.2 | 0.54 | A | 2.6 | 0.49 | A |
| OVERALL | 15.2 | - | B | 13.0 | - | B | 3.6 | 0.54 | A | 3.2 | 0.58 | A |

# 5. FUTURE YEAR 2029 TRAFFIC CONDITIONS

## 5.1 Background

The Project will consist of a new Kehalani Wastewater Pump Station (WWPS) and sewage pipelines and R-1 water transmission line and Central Maui Wastewater Reclamation Facility (WWRF). The Kehalani WWPS is planned to be constructed on an existing stormwater detention basin that serves the Kehalani development, and the sewage pipeline is planned to be constructed along Waiale Road. The Central Maui WWRF is planned to be constructed on a portion of parcel TMK (2) 3-8-005:023, which will be subdivided to provide a 14.9-acre parcel for the WWRF located between Honoapiilani Highway and Kuihelani Highway in Waikapu. The Project is anticipated to be completed in late 2029.

During construction, it is anticipated that daily traffic to the site will consist of an average of 161 workers and four (4) delivery trucks. For full operation (post-construction), it is anticipated that trip generation to the site will be lower than it was during construction and will consist of only worker's vehicles.

## 5.2 Future Year 2029 During Construction Traffic Conditions

### 5.2.1 Trip Generation – During Construction

Information provided by the Client indicates that during construction, a conservatively assumed daily average of 161 workers and four (4) delivery trucks are anticipated to access the site. It was therefore assumed that a maximum of four (4) delivery trucks will arrive, unload, and depart the project site during both the AM and PM peak hours of traffic. In addition, it was assumed that 161 workers would arrive during the AM peak hour and leave the site during the PM peak hour. This is assumed to be a relatively conservative estimate since carpooling will likely occur, with some workers traveling outside of the studied peak hours of traffic. It was assumed that deliveries and worker parking will initially be routed to the larger WWRF site and will be transported to and from the smaller Kehalani WWPS and sewage pipeline construction sites outside of the peak hours.

Trips generated for the peak of construction activity are shown in Table 5.1.

Table 5.1: Project-Generated Trips During Construction

| Independent Variables | Weekday AM Peak Hour | | | Weekday PM Peak Hour | | |
|---|---|---|---|---|---|---|
| | Enter (vph) | Exit (vph) | Total (vph) | Enter (vph) | Exit (vph) | Total (vph) |
| Construction Worker Trips | 161 | 0 | 161 | 0 | 161 | 161 |
| Construction Vehicle Trips | 4 | 4 | 8 | 4 | 4 | 8 |
| **Total** | **165** | **4** | **169** | **4** | **165** | **169** |

### 5.2.2 Trip Distribution & Assignment – During Construction

Trips generated by the construction workers were assigned throughout the study area generally based upon population data indicating where workers reside. All delivery trucks were assumed to

originate from Kahului Harbor and upon exiting the site, return to Kahului Harbor. The traffic generated by the Project during construction was added to the forecast Base Year 2029 traffic volumes within the vicinity of the Project to constitute the traffic volumes for the Future Year 2029 traffic conditions during construction. Figure 5.1 illustrates the Project-generated trip distribution during Project construction.

### 5.2.3 Future Year 2029 Analysis – During Construction

During construction, the Project is anticipated to generate 169(169) trips during the AM(PM) peak hours of traffic. With construction traffic, it is anticipated that all movements will operate adequately at LOS D or better across both peak hours.

At the Waiale Road Extension/Project Access intersection, adequate sight distance should be maintained. No additional improvements are recommended as a result of construction traffic.

A Construction Traffic Management Plan (CTMP) describing anticipated construction logistics will be submitted separately from this TIAR. The construction of the Project should be coordinated with the State of Hawaii Department of Transportation (HDOT) to minimize possible conflicts with HDOT's scheduled highway and maintenance projects in the area.

Figure 5.2 illustrates the lane configuration, forecast traffic volumes and movement LOS for Base Year 2029 Table 5.4 summarizes the Future Year 2029 during construction LOS at the study intersections. LOS worksheets are provided in Appendix C.

## 5.3 Future Year 2029 After Construction Traffic Conditions

"After Construction" conditions refers to the scenario after construction has completed and the Project assumes normal operations.

### 5.3.1 Trip Generation – After Construction

Based on information provided by the Client, there will be a small number of staff on-site to operate the WWRF once it is built out and fully operational and 10 septage haulers which will enter and exit the site during business hours. The septage haulers were assumed to be evenly distributed over the course of the 8-hour business day, from 7:00 – 3:00 PM, and as a result, two (2) septage haulers are expected to enter and exit the site during the AM peak hours only, as the business day ends before the start of the PM peak hour. In addition, there will be one large truck to haul away solids from the WWRF site, with up to three (3) truckloads per day anticipated; however these hauls are anticipated to occur outside of the AM and PM peak hours.

During normal operations of the site, staff and contractors may occasionally travel between the WWRF site and the Kehalani WWPS located near the Waiale Road/Olomea Street intersection; however it is anticipated that these trips will be infrequent and will therefore have a negligible impact to volumes and operations overall. As a result, only trips that are anticipated to be regularly generated by the WWRF were included in the After Construction trip generation, shown in Table 5.2.

Table 5.2: Project-Generated Trips After Construction

| Land Use Type | Weekday AM Peak Hour | | | Weekday PM Peak Hour | | |
|---|---|---|---|---|---|---|
| | Enter (vph) | Exit (vph) | Total (vph) | Enter (vph) | Exit (vph) | Total (vph) |
| Central Maui Wastewater Reclamation Facility - Employees | 16 | 0 | 16 | 0 | 16 | 16 |
| Central Maui Wastewater Reclamation Facility - Septage haulers | 2 | 2 | 4 | - | - | - |
| **Total** | **18** | **2** | **20** | **0** | **16** | **16** |

### 5.3.2 Trip Distribution & Assignment – After Construction

Trips generated by the Project were assigned throughout the study area generally based upon existing travel patterns in the study area. The traffic generated by the Project was added to the forecast Base Year 2029 traffic volumes within the vicinity of the Project to constitute the traffic volumes for the Future Year 2029 traffic conditions after construction. Figure 5.3 illustrates the Project-generated trip distribution.

### 5.3.3 Future Year 2029 Analysis – After Construction

During normal operations, the Project is anticipated to generate 20(16) trips during the AM(PM) peak hours of traffic. All movements are anticipated to continue to operate acceptably at LOS D or better across both peak hours.

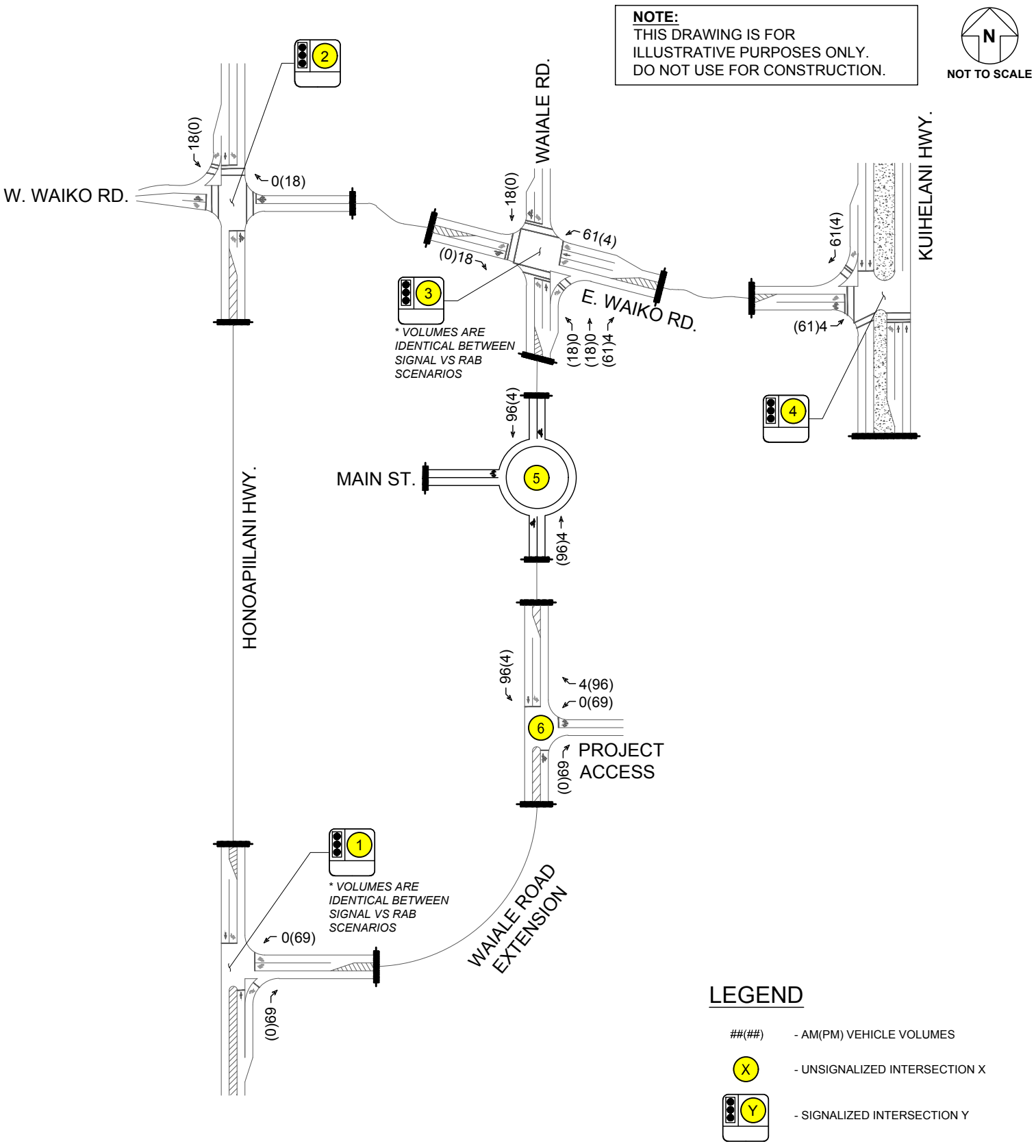
Although the trips generated by the large truck are not anticipated to have a significant impact on operations, it is recommended that the hauling trips be coordinated to occur outside of the AM and PM peak hours to avoid interruption to traffic on adjacent streets.

At the Waiale Road Extension/Project Access intersection, adequate sight distance should be maintained. No additional improvements are recommended as a result of project traffic.

Figure 5.4 illustrates the lane configuration, forecast traffic volumes and movement LOS for Future Year 2029 After Construction. Table 5.4 summarizes the Future Year 2029 After Construction LOS at the study intersections. LOS worksheets are provided in Appendix C.

# CENTRAL MAUI WASTEWATER RECLAMATION FACILITY TIAR

AustinTsutsumi & ASSOCIATES, INC.
Engineers & Surveyors

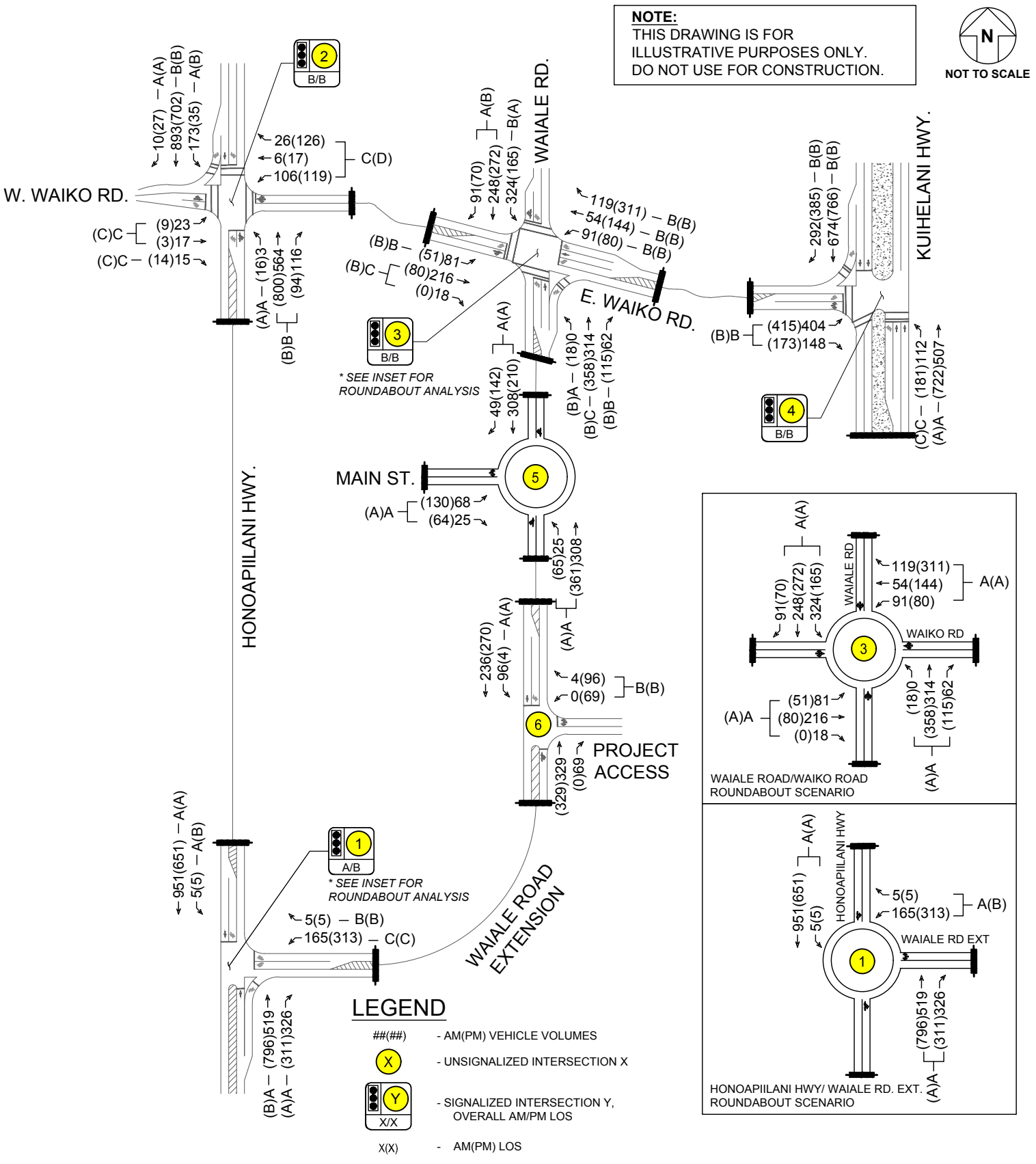



# FIGURE 5.1

DURING CONSTRUCTION
PROJECT-GENERATED TRIPS

# CENTRAL MAUI WASTEWATER RECLAMATION FACILITY TIAR

AustinTsutsumi & ASSOCIATES, INC.
Engineers & Surveyors



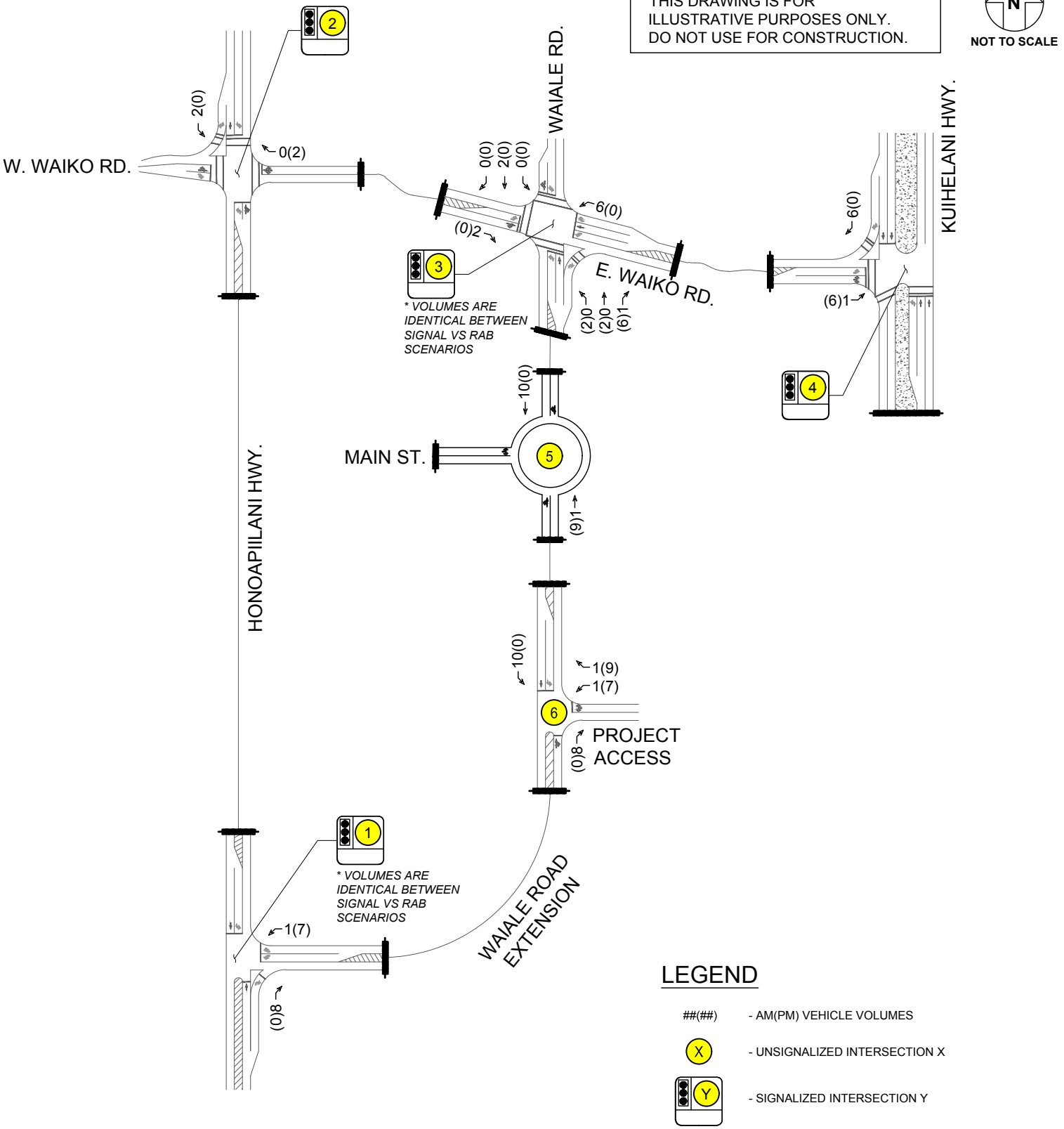

# FIGURE 5.2

## FUTURE YEAR 2029 DURING CONSTRUCTION LANE CONFIGURATION, VOLUMES AND MOVEMENT LOS

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**NOTE:**
THIS DRAWING IS FOR ILLUSTRATIVE PURPOSES ONLY.
DO NOT USE FOR CONSTRUCTION.

N
NOT TO SCALE

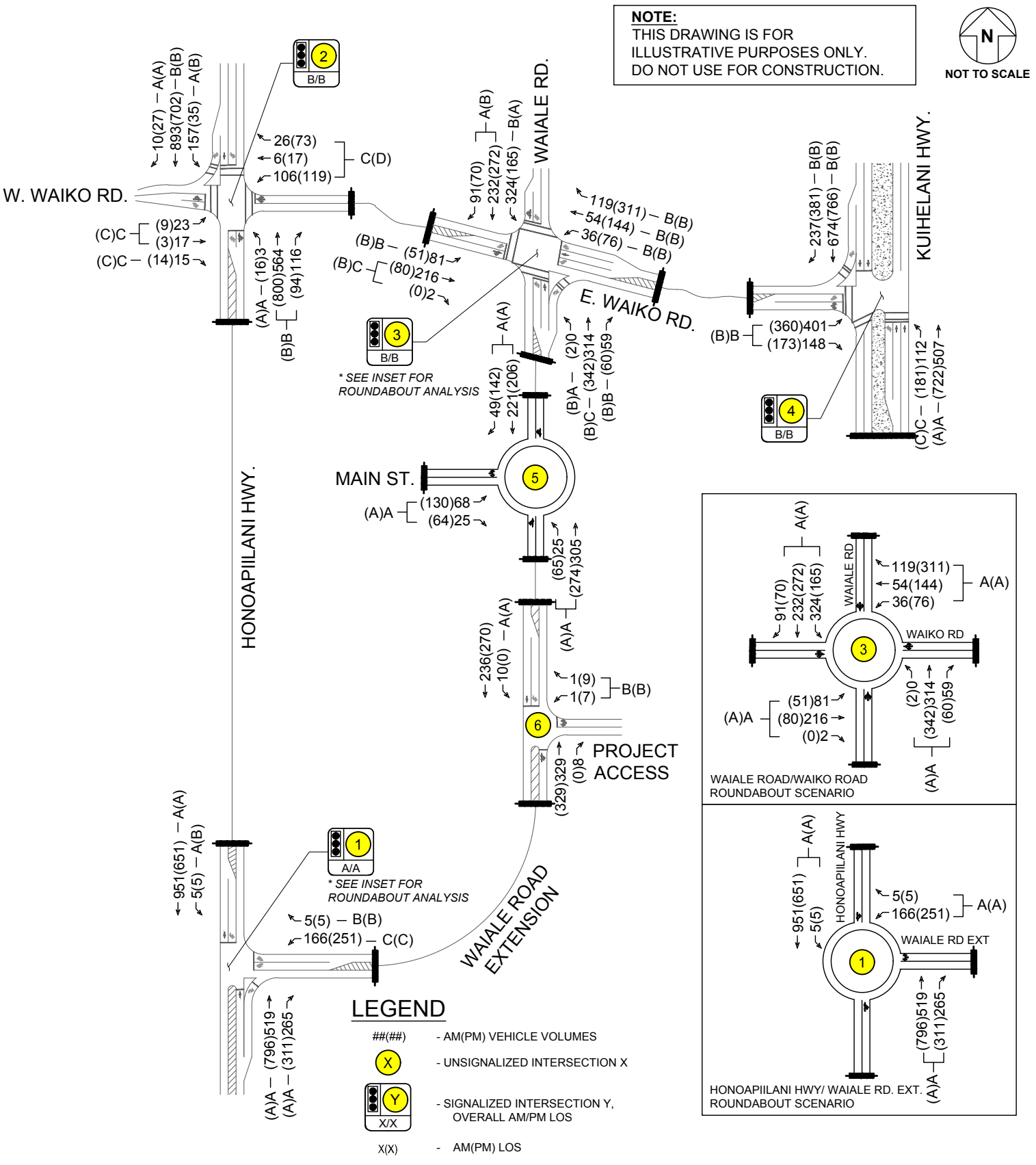



## LEGEND

| | |
|---|---|
| ##(##) | - AM(PM) VEHICLE VOLUMES |
| X | - UNSIGNALIZED INTERSECTION X |
| Y | - SIGNALIZED INTERSECTION Y |

# FIGURE 5.3

POST-CONSTRUCTION
PROJECT-GENERATED TRIPS




# FIGURE 5.4

FUTURE YEAR 2029 POST-CONSTRUCTION LANE CONFIGURATION, VOLUMES AND MOVEMENT LOS

## TABLE 5.3: LOS SUMMARY TABLE
## EXISTING, BASE YEAR, AND FUTURE YEAR LOS SUMMARY

| Intersection | Existing 2022 Conditions | | | | | | Base Year | | | | | | Future Year During Construction | | | | | | Future Year After Construction | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AM | | | PM | | | AM | | | PM | | | AM | | | PM | | | AM | | | PM | | |
| | HCM Delay | v/c Ratio | LOS | HCM Delay | v/c Ratio | LOS | HCM Delay | v/c Ratio | LOS | HCM Delay | v/c Ratio | LOS | HCM Delay | v/c Ratio | LOS | HCM Delay | v/c Ratio | LOS | HCM Delay | v/c Ratio | LOS | HCM Delay | v/c Ratio | LOS |
| **1: Honoapiilani Highway & Waiale Road Extension** | | | | | | | *With Traffic Signal; See Table 5.4 for Traffic Signal vs. Roundabout Conditions* | | | | | | | | | | | | | | | | | |
| NB TH | - | - | - | - | - | - | 4.3 | 0.46 | A | 8.7 | 0.80 | A | 4.3 | 0.46 | A | 10.5 | 0.82 | B | 4.3 | 0.46 | A | 8.9 | 0.80 | A |
| NB RT | - | - | - | - | - | - | 3.3 | 0.18 | A | 4.6 | 0.21 | A | 3.5 | 0.23 | A | 5.5 | 0.21 | A | 3.3 | 0.18 | A | 4.6 | 0.20 | A |
| WB LT | - | - | - | - | - | - | 24.6 | 0.74 | C | 20.4 | 0.76 | C | 24.6 | 0.74 | C | 21.8 | 0.81 | C | 24.7 | 0.75 | C | 20.5 | 0.77 | C |
| WB RT | - | - | - | - | - | - | 18.2 | 0.02 | B | 14.5 | 0.02 | B | 18.2 | 0.02 | B | 14.8 | 0.01 | B | 18.1 | 0.00 | B | 14.5 | 0.02 | B |
| SB LT | - | - | - | - | - | - | 5.8 | 0.01 | A | 13.7 | 0.02 | B | 5.8 | 0.01 | A | 16.7 | 0.02 | B | 5.8 | 0.01 | A | 14.0 | 0.02 | B |
| SB TH | - | - | - | - | - | - | 7.9 | 0.84 | A | 7.0 | 0.65 | A | 7.9 | 0.84 | A | 8.4 | 0.67 | A | 7.9 | 0.84 | A | 7.1 | 0.65 | A |
| OVERALL | - | - | - | - | - | - | 8.0 | - | A | 9.3 | - | A | 7.9 | - | A | 11.2 | - | B | 8.0 | - | A | 9.5 | - | A |
| **2: Honoapiilani Hwy & W Waiko Rd/E Waiko Rd** | | | | | | | | | | | | | | | | | | | | | | | | |
| NB LT | 7.2 | 0.01 | A | 4.9 | 0.03 | A | 9.5 | 0.01 | A | 8.3 | 0.04 | A | 9.5 | 0.01 | A | 8.6 | 0.04 | A | 9.5 | 0.01 | A | 8.2 | 0.04 | A |
| NB TH/RT | 10.8 | 0.65 | B | 9.6 | 0.71 | A | 11.7 | 0.67 | B | 18.5 | 0.84 | B | 11.7 | 0.67 | B | 19.3 | 0.85 | B | 11.7 | 0.67 | B | 18.3 | 0.84 | B |
| EB LT/TH | 22.9 | 0.15 | C | 23.5 | 0.05 | C | 29.8 | 0.15 | C | 32.1 | 0.04 | C | 29.8 | 0.15 | C | 32.1 | 0.04 | C | 29.8 | 0.15 | C | 32.1 | 0.04 | C |
| EB RT | 22.3 | 0.01 | C | 23.3 | 0.01 | C | 29.1 | 0.01 | C | 31.9 | 0.01 | C | 29.1 | 0.01 | C | 31.9 | 0.01 | C | 29.1 | 0.01 | C | 31.9 | 0.01 | C |
| WB LT/TH/RT | 24.0 | 0.36 | C | 25.5 | 0.44 | C | 32.5 | 0.52 | C | 37.9 | 0.68 | D | 32.5 | 0.52 | C | 38.3 | 0.69 | D | 32.5 | 0.52 | C | 37.8 | 0.67 | D |
| SB LT | 6.5 | 0.24 | A | 6.6 | 0.05 | A | 8.5 | 0.37 | A | 13.9 | 0.15 | B | 8.8 | 0.42 | A | 14.4 | 0.15 | B | 8.5 | 0.38 | A | 13.7 | 0.14 | B |
| SB TH | 9.0 | 0.69 | A | 7.0 | 0.49 | A | 11.8 | 0.79 | B | 11.1 | 0.64 | B | 11.8 | 0.79 | B | 11.6 | 0.64 | B | 11.8 | 0.79 | B | 11.0 | 0.63 | B |
| SB RT | 4.3 | 0.01 | A | 4.5 | 0.02 | A | 4.4 | 0.01 | A | 5.9 | 0.02 | A | 4.4 | 0.01 | A | 6.1 | 0.02 | A | 4.4 | 0.01 | A | 5.8 | 0.02 | A |
| OVERALL | 10.7 | - | B | 9.8 | - | A | 13.3 | - | B | 17.5 | - | B | 13.3 | - | B | 18.2 | - | B | 13.3 | - | B | 17.4 | - | B |
| **3: E Waiko Road/Waiale Road** | | | | | | | *With Traffic Signal; See Table 5.4 for Traffic Signal vs. Roundabout Conditions* | | | | | | | | | | | | | | | | | |
| NB LT | - | - | - | - | - | - | 0.0 | 0.00 | A | 0.0 | 0.00 | A | 0.0 | 0.00 | A | 10.6 | 0.05 | B | 0.0 | 0.00 | A | 11.0 | 0.00 | B |
| NB TH | - | - | - | - | - | - | 19.8 | 0.73 | B | 15.4 | 0.70 | B | 22.2 | 0.75 | C | 15.4 | 0.71 | B | 20.0 | 0.73 | C | 15.4 | 0.70 | B |
| NB RT | - | - | - | - | - | - | 14.6 | 0.04 | B | 11.1 | 0.03 | B | 16.3 | 0.04 | B | 11.4 | 0.12 | B | 14.8 | 0.04 | B | 11.1 | 0.04 | B |
| EB LT | 7.5 | 0.04 | A | 7.9 | 0.03 | A | 17.1 | 0.22 | B | 15.1 | 0.17 | B | 17.2 | 0.20 | B | 15.6 | 0.17 | B | 17.1 | 0.21 | B | 15.2 | 0.17 | B |
| EB TH/RT | - | - | - | - | - | - | 22.2 | 0.69 | C | 17.6 | 0.34 | B | 24.4 | 0.73 | C | 18.1 | 0.35 | B | 22.4 | 0.70 | C | 17.6 | 0.34 | B |
| WB LT | - | - | - | - | - | - | 17.9 | 0.12 | B | 14.9 | 0.21 | B | 17.9 | 0.32 | B | 15.3 | 0.22 | B | 17.8 | 0.14 | B | 14.9 | 0.21 | B |
| WB TH | - | - | - | - | - | - | 19.3 | 0.21 | B | 18.7 | 0.56 | B | 19.1 | 0.16 | B | 19.2 | 0.57 | B | 19.3 | 0.20 | B | 18.7 | 0.57 | B |
| WB RT | - | - | - | - | - | - | 18.8 | 0.08 | B | 16.5 | 0.23 | B | 18.6 | 0.07 | B | 16.9 | 0.22 | B | 18.7 | 0.08 | B | 16.5 | 0.22 | B |
| SB LT | - | - | - | - | - | - | 11.5 | 0.63 | B | 9.5 | 0.39 | A | 13.2 | 0.66 | B | 9.7 | 0.40 | A | 11.7 | 0.63 | B | 9.5 | 0.39 | A |
| SB TH/RT | - | - | - | - | - | - | 7.6 | 0.36 | A | 7.6 | 0.42 | A | 9.1 | 0.40 | A | 11.3 | 0.53 | B | 7.8 | 0.37 | A | 10.8 | 0.52 | B |
| SB LT/RT | 13.3 | 0.39 | B | 10.9 | 0.17 | B | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| OVERALL | 7.0 | - | - | 3.5 | - | - | 15.2 | - | B | 13.0 | - | B | 16.8 | - | B | 14.1 | - | B | 15.3 | - | B | 13.9 | - | B |
| **4: Kuihelani Hwy & E Waiko Rd** | | | | | | | | | | | | | | | | | | | | | | | | |
| NB LT | 21.8 | 0.45 | C | 19.3 | 0.49 | B | 25.8 | 0.75 | C | 25.2 | 0.76 | C | 25.9 | 0.75 | C | 26.9 | 0.77 | C | 25.8 | 0.75 | C | 25.5 | 0.76 | C |
| NB TH | 4.1 | 0.27 | A | 3.2 | 0.33 | A | 5.6 | 0.29 | A | 5.3 | 0.37 | A | 5.7 | 0.29 | A | 6.2 | 0.38 | A | 5.7 | 0.29 | A | 5.5 | 0.37 | A |
| EB LT/RT | 12.7 | 0.54 | B | 14.0 | 0.37 | B | 15.5 | 0.61 | B | 19.2 | 0.62 | B | 15.6 | 0.61 | B | 19.5 | 0.65 | B | 15.5 | 0.61 | B | 19.2 | 0.63 | B |
| SB TH | 8.2 | 0.51 | A | 7.2 | 0.52 | A | 12.4 | 0.61 | B | 13.9 | 0.65 | B | 12.5 | 0.61 | B | 15.4 | 0.67 | B | 12.4 | 0.61 | B | 14.3 | 0.65 | B |
| SB RT | 6.6 | 0.07 | A | 5.8 | 0.14 | A | 10.1 | 0.14 | B | 11.7 | 0.28 | B | 10.3 | 0.19 | B | 12.5 | 0.24 | B | 10.1 | 0.15 | B | 11.6 | 0.22 | B |
| OVERALL | 8.1 | - | A | 6.4 | - | A | 12.4 | - | B | 13.2 | - | B | 12.4 | - | B | 14.5 | - | B | 12.4 | - | B | 13.5 | - | B |
| **5: Waiale Rd Extension & Main St** | | | | | | | | | | | | | | | | | | | | | | | | |
| NB LT/TH/RT | - | - | - | - | - | - | 0.6 | 0.27 | A | 1.3 | 0.28 | A | 0.6 | 0.27 | A | 1.3 | 0.37 | A | 0.6 | 0.27 | A | 1.3 | 0.37 | A |
| EB LT/TH/RT | - | - | - | - | - | - | 3.1 | 0.09 | A | 3.0 | 0.18 | A | 3.6 | 0.09 | A | 3.1 | 0.18 | A | 3.6 | 0.09 | A | 3.1 | 0.18 | A |
| SB LT/TH/RT | - | - | - | - | - | - | 0.1 | 0.20 | A | 0.4 | 0.28 | A | 0.2 | 0.28 | A | 1.3 | 0.37 | A | 0.2 | 0.28 | A | 0.4 | 0.29 | A |
| OVERALL | - | - | - | - | - | - | 0.8 | 0.27 | A | 1.3 | 0.28 | A | 0.8 | 0.28 | A | 1.3 | 0.37 | A | 0.8 | 0.28 | A | 1.3 | 0.37 | A |
| **6: Waiale Rd Extension & Project Access** | | | | | | | | | | | | | | | | | | | | | | | | |
| WB LT/RT | - | - | - | - | - | - | - | - | - | - | - | - | 10.6 | 0.01 | B | 14.8 | 0.33 | B | 11.8 | 0.00 | B | 11.8 | 0.03 | B |
| SB LT | - | - | - | - | - | - | - | - | - | - | - | - | 8.5 | 0.09 | A | 8.0 | 0.00 | A | 8.0 | 0.01 | A | 0.0 | - | A |
| OVERALL | - | - | - | - | - | - | - | - | - | - | - | - | 1.2 | - | - | 3.2 | - | - | 0.2 | - | - | 0.3 | - | - |

## TABLE 5.4: LOS SUMMARY TABLE
## FUTURE YEAR CONDITIONS WITH TRAFFIC SIGNALS VS. ROUNDABOUTS

| Intersection | Future Year During Construction (With Traffic Signals) | | | | | | Future Year During Construction (With Roundabout) | | | | | | Future Year After Construction (With Traffic Signals) | | | | | | Future Year After Construction (With Roundabout) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AM | | | PM | | | AM | | | PM | | | AM | | | PM | | | AM | | | PM | | |
| | HCM Delay | v/c Ratio | LOS | HCM Delay | v/c Ratio | LOS | HCM Delay | v/c Ratio | LOS | HCM Delay | v/c Ratio | LOS | HCM Delay | v/c Ratio | LOS | HCM Delay | v/c Ratio | LOS | HCM Delay | v/c Ratio | LOS | HCM Delay | v/c Ratio | LOS |
| **1: Honoapiilani Highway & Waiale Road Extension** | | | | | | | | | | | | | | | | | | | | | | | | |
| NB TH | 4.3 | 0.46 | A | 10.5 | 0.82 | B | - | - | - | - | - | - | 4.3 | 0.46 | A | 8.9 | 0.80 | A | - | - | - | - | - | - |
| NB TH/RT | - | - | - | - | - | - | 0.1 | 0.65 | A | 0.1 | 0.85 | A | - | - | - | - | - | - | 0.1 | 0.60 | A | 0.1 | 0.85 | A |
| NB RT | 3.5 | 0.23 | A | 5.5 | 0.21 | A | - | - | - | - | - | - | 3.3 | 0.18 | A | 4.6 | 0.20 | A | - | - | - | - | - | - |
| WB LT | 24.6 | 0.74 | C | 21.8 | 0.81 | C | - | - | - | - | - | - | 24.7 | 0.75 | C | 20.5 | 0.77 | C | - | - | - | - | - | - |
| WB LT/RT | - | - | - | - | - | - | 5.9 | 0.20 | A | 11.2 | 0.48 | B | - | - | - | - | - | - | 5.9 | 0.20 | A | 9.4 | 0.39 | A |
| WB RT | 18.2 | 0.02 | B | 14.8 | 0.01 | B | - | - | - | - | - | - | 18.1 | 0.00 | B | 14.5 | 0.02 | B | - | - | - | - | - | - |
| SB LT | 5.8 | 0.01 | A | 16.7 | 0.02 | B | - | - | - | - | - | - | 5.8 | 0.01 | A | 14.0 | 0.02 | B | - | - | - | - | - | - |
| SB TH | 7.9 | 0.84 | A | 8.4 | 0.67 | A | - | - | - | - | - | - | 7.9 | 0.84 | A | 7.1 | 0.65 | A | - | - | - | - | - | - |
| SB LT/TH | - | - | - | - | - | - | 5.0 | 0.86 | A | 4.5 | 0.69 | A | - | - | - | - | - | - | 5.1 | 0.86 | A | 2.9 | 0.65 | A |
| OVERALL | 7.9 | - | A | 11.2 | - | B | 3.0 | 0.86 | A | 3.2 | 0.85 | A | 8.0 | - | A | 9.5 | - | A | 3.1 | 0.86 | A | 2.2 | 0.85 | A |
| **3: E Waiko Road/Waiale Road** | | | | | | | | | | | | | | | | | | | | | | | | |
| NB LT | 0.0 | 0.00 | A | 10.6 | 0.05 | B | - | - | - | - | - | - | 0.0 | 0.00 | A | 11.0 | 0.00 | B | - | - | - | - | - | - |
| NB TH | 22.2 | 0.75 | C | 15.4 | 0.71 | B | - | - | - | - | - | - | 20.0 | 0.73 | C | 15.4 | 0.70 | B | - | - | - | - | - | - |
| NB LT/TH/RT | - | - | - | - | - | - | 5.8 | 0.50 | A | 2.3 | 0.49 | A | - | - | - | - | - | - | 5.7 | 0.49 | A | 2.0 | 0.40 | A |
| NB RT | 16.3 | 0.04 | B | 11.4 | 0.12 | B | - | - | - | - | - | - | 14.8 | 0.04 | B | 11.1 | 0.04 | B | - | - | - | - | - | - |
| EB LT | 17.2 | 0.20 | B | 15.6 | 0.17 | B | - | - | - | - | - | - | 17.1 | 0.21 | B | 15.2 | 0.17 | B | - | - | - | - | - | - |
| EB TH/RT | 24.4 | 0.73 | C | 18.1 | 0.35 | B | - | - | - | - | - | - | 22.4 | 0.70 | C | 17.6 | 0.34 | B | - | - | - | - | - | - |
| EB LT/TH/RT | - | - | - | - | - | - | 6.2 | 0.44 | A | 4.0 | 0.16 | A | - | - | - | - | - | - | 4.9 | 0.39 | A | 4.0 | 0.16 | A |
| WB LT | 17.9 | 0.32 | B | 15.3 | 0.22 | B | - | - | - | - | - | - | 17.8 | 0.14 | B | 14.9 | 0.21 | B | - | - | - | - | - | - |
| WB TH | 19.1 | 0.16 | B | 19.2 | 0.57 | B | - | - | - | - | - | - | 19.3 | 0.20 | B | 18.7 | 0.57 | B | - | - | - | - | - | - |
| WB LT/TH/RT | - | - | - | - | - | - | 3.4 | 0.29 | A | 5.2 | 0.60 | A | - | - | - | - | - | - | 2.7 | 0.23 | A | 4.5 | 0.58 | A |
| WB RT | 18.6 | 0.07 | B | 16.9 | 0.22 | B | - | - | - | - | - | - | 18.7 | 0.08 | B | 16.5 | 0.22 | B | - | - | - | - | - | - |
| SB LT | 13.2 | 0.66 | B | 9.7 | 0.40 | A | - | - | - | - | - | - | 11.7 | 0.63 | B | 9.5 | 0.39 | A | - | - | - | - | - | - |
| SB TH/RT | 9.1 | 0.40 | A | 11.3 | 0.53 | B | - | - | - | - | - | - | 7.8 | 0.37 | A | 10.8 | 0.52 | B | - | - | - | - | - | - |
| SB LT/TH/RT | - | - | - | - | - | - | 2.8 | 0.59 | A | 2.7 | 0.49 | A | - | - | - | - | - | - | 2.3 | 0.54 | A | 2.6 | 0.49 | A |
| OVERALL | 16.8 | - | B | 14.1 | - | B | 4.2 | 0.59 | A | 3.5 | 0.60 | A | 15.3 | - | B | 13.9 | - | B | 3.7 | 0.54 | A | 3.2 | 0.58 | A |

# 6. CONCLUSIONS

The Project will consist of a new Kehalani Wastewater Pump Station (WWPS), sewage pipeline, R-1 water transmission line, and Central Maui Wastewater Reclamation Facility (WWRF). The Kehalani WWPS is planned to be constructed on the periphery of an existing stormwater detention basin that serves the Kehalani development, and the sewage pipeline is planned to be constructed along Waiale Road. The Central Maui WWRF is planned to be constructed on a portion of parcel TMK (2) 3-8-005:023, which will be subdivided to provide a 14.9-acre parcel for the WWRF located between Honoapiilani Highway and Kuihelani Highway in Waikapu. The Project is anticipated to be completed in late 2029.

Access to the site is anticipated to be from a single driveway from the planned Waiale Road Extension and cane haul roadways. No access to the project is planned from Kehalani Highway.

## 6.1 Existing Conditions

Traffic was observed to proceed smoothly through all study intersections, with no significant or persistent congestion. Analysis shows that all movements at all study intersections operate at LOS C or better across both peak hours.

## 6.2 Base Year 2029

With Base Year 2029 conditions, a number of developments were assumed to be fully or partially complete, and the corresponding trips were added throughout the study network. In addition, a defacto growth rate of 0.5%-0.9% per year was added along Honoapiilani Highway, Kuihelani Highway, Waiko Road and Waiale Road based on projections within the Maui Regional Travel Demand Model (MRTDM).

It is assumed that the Waiale Road Extension, which is anticipated to begin to the south at a T-intersection with Honoapiilani Highway south Waiko Road, to the existing Waiko Road/Waiale Road intersection, will be complete by the Year 2029. For the purpose of this report, traffic signals were analyzed at the Waiale Road intersections with Waiko Road and Honoapiilani Highway, in addition to single-lane roundabouts. Only a roundabout was analyzed at the Waiale Road Extension/Main Street intersection.

With Base Year 2029 conditions, all movements at all study intersections are anticipated to operate adequately at LOS D or better across both peak hours.

## 6.3 Future Year 2029

### 6.3.1 Future Year 2029 During Construction

Based on information provided by the Client, it was assumed that a maximum of four (4) delivery trucks will arrive, unload, and depart the project site during both the AM and PM peak hours of traffic. In addition, it was assumed that 161 workers would arrive during the AM peak hour and leave the site during the PM peak hour. It was assumed that deliveries and worker parking will initially be routed to the larger WWRF site and will be transported to and from the smaller Kehalani WWPS and sewage pipeline construction sites outside of the peak hours.

Trips generated by the construction workers were assigned throughout the study area generally based upon population data indicating where workers reside. All delivery trucks were assumed to originate from Kahului Harbor, and upon exiting the site, return to Kahului Harbor.

During peak construction activities, the Project is anticipated to generate 169(169) trips during the AM(PM) peak hours of traffic. With construction traffic, it is anticipated that all movements will operate adequately at LOS D or better across both peak hours.

A Construction Traffic Management Plan (CTMP) describing anticipated construction logistics will be submitted separately from this TIAR. The construction of the Project should be coordinated with the State of Hawaii Department of Transportation (HDOT) to minimize possible conflicts with HDOT's scheduled highway and maintenance projects in the area.

### 6.3.2 Future Year 2029 After Construction

"After Construction" conditions refers to the scenario after construction has completed and the Project assumes normal operations.

During normal operation, the Project is anticipated to generate 20(16) trips during the AM(PM) peak hours of traffic, which is inclusive of trips generated by on-site staff, septage haulers, and the large truck to haul away solids from the site, with up to three (3) truckloads per day anticipated. Trips generated by the construction workers were assigned throughout the study area generally based upon population data indicating where workers reside.

All movements are anticipated to continue to operate acceptably at LOS D or better across both peak hours. Although the trips generated by the large truck are not anticipated to have a significant impact on operations, it is recommended that the hauling trips be coordinated to occur outside of the AM and PM peak hours to avoid interruption to traffic on adjacent streets.

During normal operations of the site, staff and contractors may occasionally go to the Kehalani WWPS located near the Waiale Road/Olomea Street intersection; however it is not anticipated that these trips will occur frequently and will have a negligible impact to volumes and operations overall.

At the Waiale Road Extension/Project Access intersection, adequate sight distance should be maintained at all times. No additional improvements are recommended as a result of project traffic, during or after construction (normal operations).

# 7. REFERENCES


1. American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highway and Streets, 2018.
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3. Austin, Tsutsumi & Associates, Puunani Homesteads TIAR, 2020.
4. Austin, Tsutsumi & Associates, Waiale Affordable Housing TIAR, 2016.
5. Austin, Tsutsumi & Associates, Waikapu Light Industrial Project TIAR, 2013.
6. Federal Highway Administration, Manual on Uniform Traffic Control Devices, 2009.
7. Fehr & Peers, Waiale Road Extension TIAR, October 2023.
8. Fehr & Peers, Waikapu Country Town TIAR, December 2016.
9. Institute of Transportation Engineers, Trip Generation, 11th Edition, 2021.
10. Munekiyo Hiraga, Final Environmental Assessment for the Waiale Road Extension Project, August 2025.
11. Phillip Rowell & Associates, Waiko Road Light Industrial Park TIAR, 2014.
12. Transportation Research Board, Highway Capacity Manual, 6th Edition.

# APPENDICES

# APPENDIX A

LOS CRITERIA

## LEVEL OF SERVICE (LOS) CRITERIA

### VEHICULAR LEVEL OF SERVICE FOR SIGNALIZED INTERSECTIONS (HCM 6th Edition)

Level of service for vehicles at signalized intersections is directly related to delay values and is assigned on that basis. Level of Service is a measure of the acceptability of delay values to motorists at a given intersection. The criteria are given in the table below.

Level-of Service Criteria for Signalized Intersections

| Level of Service | Control Delay per Vehicle (sec./veh.) |
|---|---|
| A | < 10.0 |
| B | >10.0 and ≤ 20.0 |
| C | >20.0 and ≤ 35.0 |
| D | >35.0 and ≤ 55.0 |
| E | >55.0 and ≤ 80.0 |
| F | > 80.0 |

Delay is a complex measure, and is dependent on a number of variables, including the quality of progression, the cycle length, the green ratio, and the v/c ratio for the lane group or approach in question.

### VEHICULAR LEVEL OF SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS (HCM 6th Edition)

The level of service criteria for vehicles at unsignalized intersections is defined as the average control delay, in seconds per vehicle.

LOS delay threshold values are lower for two-way stop-controlled (TWSC) and all-way stop-controlled (AWSC) intersections than those of signalized intersections. This is because more vehicles pass through signalized intersections, and therefore, drivers expect and tolerate greater delays. While the criteria for level of service for TWSC and AWSC intersections are the same, procedures to calculate the average total delay may differ.

Level of Service Criteria for Two-Way Stop-Controlled Intersections

| Level of Service | Average Control Delay (sec/veh) |
|---|---|
| A | ≤ 10 |
| B | >10 and ≤15 |
| C | >15 and ≤25 |
| D | >25 and ≤35 |
| E | >35 and ≤50 |
| F | > 50 |

# APPENDIX B

TRAFFIC COUNT DATA

# Austin Tsutsumi & Associates

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*Phone: (808)533-3646 Fax: (808)526-1267*


File Name : Honoapiilani Hwy - South of Maui Plantation Dwy
Site Code : 22-511 CMWRF TIAR & TMP
Start Date : 9/22/2022
Page No : 1

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

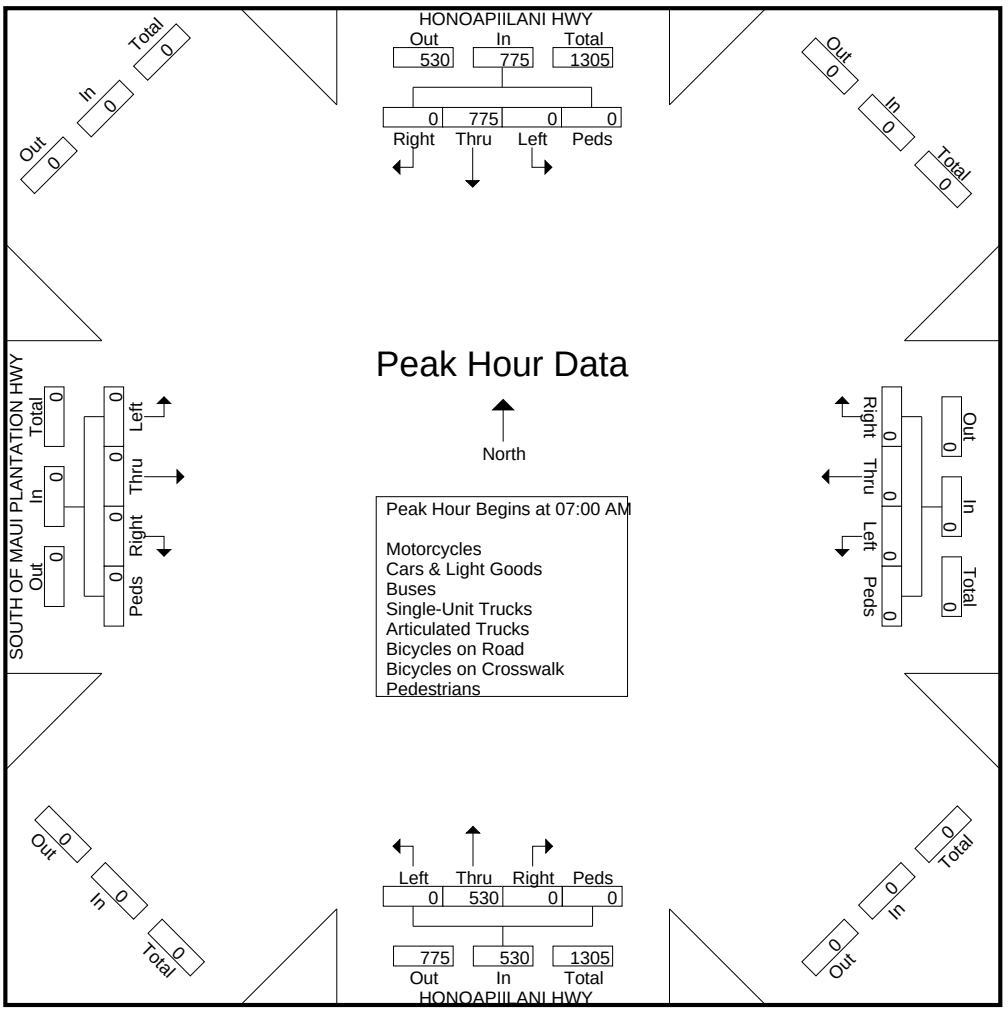
| | HONOAPIILANI HWY Southbound | | | | Westbound | | | | HONOAPIILANI HWY Northbound | | | | SOUTH OF MAUI PLANTATION HWY Eastbound | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Int. Total |
| 06:30 AM | 0 | 177 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 80 | 0 | 0 | 0 | 0 | 0 | 0 | 257 |
| 06:45 AM | 0 | 179 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 93 | 0 | 0 | 0 | 0 | 0 | 0 | 272 |
| Total | 0 | 356 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 173 | 0 | 0 | 0 | 0 | 0 | 0 | 529 |
| 07:00 AM | 0 | 194 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 121 | 0 | 0 | 0 | 0 | 0 | 0 | 315 |
| 07:15 AM | 0 | 218 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 146 | 0 | 0 | 0 | 0 | 0 | 0 | 364 |
| 07:30 AM | 0 | 175 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 148 | 0 | 0 | 0 | 0 | 0 | 0 | 323 |
| 07:45 AM | 0 | 188 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 115 | 0 | 0 | 0 | 0 | 0 | 0 | 303 |
| Total | 0 | 775 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 530 | 0 | 0 | 0 | 0 | 0 | 0 | 1305 |
| 08:00 AM | 0 | 143 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 116 | 0 | 0 | 0 | 0 | 0 | 0 | 259 |
| 08:15 AM | 0 | 149 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 108 | 0 | 0 | 0 | 0 | 0 | 0 | 257 |
| Grand Total | 0 | 1423 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 927 | 0 | 0 | 0 | 0 | 0 | 0 | 2350 |
| Apprch % | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Total % | 0 | 60.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 39.4 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Motorcycles | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| % Motorcycles | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 |
| Cars & Light Goods | 0 | 1381 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 898 | 0 | 0 | 0 | 0 | 0 | 0 | 2279 |
| % Cars & Light Goods | 0 | 97 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 96.9 | 0 | 0 | 0 | 0 | 0 | 0 | 97 |
| Buses | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 16 |
| % Buses | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.7 |
| Single-Unit Trucks | 0 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 31 |
| % Single-Unit Trucks | 0 | 1.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1.3 |
| Articulated Trucks | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| % Articulated Trucks | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 |
| Bicycles on Road | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| % Bicycles on Road | 0 | 0.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0.4 |
| Bicycles on Crosswalk | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| % Bicycles on Crosswalk | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pedestrians | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| % Pedestrians | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

# Austin Tsutsumi & Associates

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*Phone: (808)533-3646 Fax: (808)526-1267*


File Name : Honoapiilani Hwy - South of Maui Plantation Dwy
Site Code : 22-511 CMWRF TIAR & TMP
Start Date : 9/22/2022
Page No : 2

| | HONOAPIILANI HWY Southbound | | | | | Westbound | | | | | HONOAPIILANI HWY Northbound | | | | | SOUTH OF MAUI PLANTATION HWY Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 06:30 AM to 08:15 AM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Peak Hour for Entire Intersection Begins at 07:00 AM | | | | | | | | | | | | | | | | | | | | | |
| 07:00 AM | 0 | 194 | 0 | 0 | 194 | 0 | 0 | 0 | 0 | 0 | 0 | 121 | 0 | 0 | 121 | 0 | 0 | 0 | 0 | 0 | 315 |
| 07:15 AM | 0 | **218** | 0 | 0 | **218** | 0 | 0 | 0 | 0 | 0 | 0 | 146 | 0 | 0 | 146 | 0 | 0 | 0 | 0 | 0 | **364** |
| 07:30 AM | 0 | 175 | 0 | 0 | 175 | 0 | 0 | 0 | 0 | 0 | 0 | **148** | 0 | 0 | **148** | 0 | 0 | 0 | 0 | 0 | 323 |
| 07:45 AM | 0 | 188 | 0 | 0 | 188 | 0 | 0 | 0 | 0 | 0 | 0 | 115 | 0 | 0 | 115 | 0 | 0 | 0 | 0 | 0 | 303 |
| Total Volume | 0 | 775 | 0 | 0 | 775 | 0 | 0 | 0 | 0 | 0 | 0 | 530 | 0 | 0 | 530 | 0 | 0 | 0 | 0 | 0 | 1305 |
| % App. Total | 0 | 100 | 0 | 0 | | 0 | 0 | 0 | 0 | | 0 | 100 | 0 | 0 | | 0 | 0 | 0 | 0 | | |
| PHF | .000 | .889 | .000 | .000 | .889 | .000 | .000 | .000 | .000 | .000 | .000 | .895 | .000 | .000 | .895 | .000 | .000 | .000 | .000 | .000 | .896 |



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File Name : Honoapiilani Hwy - South of Maui Plantation Dwy
Site Code : 22-511 CMWRF TIAR & TMP
Start Date : 9/22/2022


Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

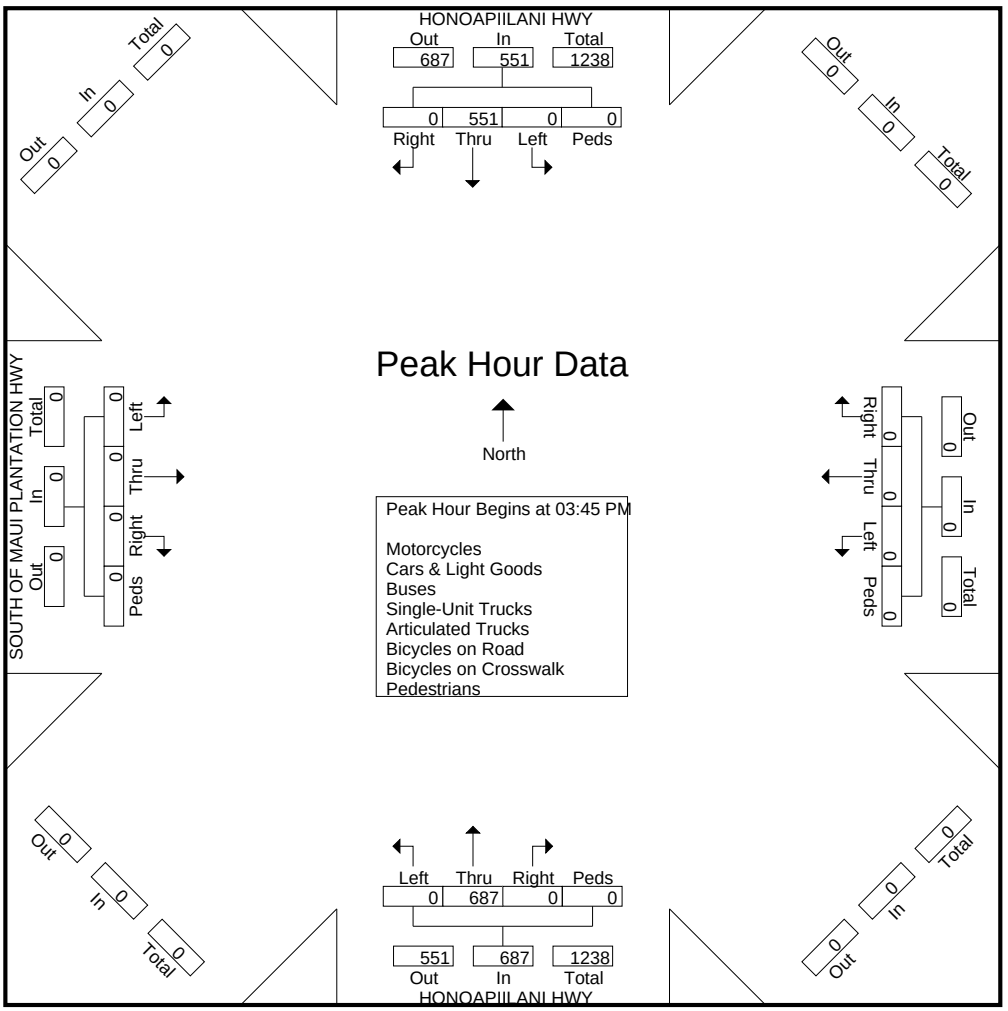
| | HONOAPIILANI HWY Southbound | | | | Westbound | | | | HONOAPIILANI HWY Northbound | | | | SOUTH OF MAUI PLANTATION HWY Eastbound | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Int. Total |
| 03:30 PM | 0 | 130 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 162 | 0 | 0 | 0 | 0 | 3 | 0 | 295 |
| 03:45 PM | 0 | 144 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 170 | 0 | 0 | 0 | 0 | 0 | 0 | 314 |
| Total | 0 | 274 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 332 | 0 | 0 | 0 | 0 | 3 | 0 | 609 |
| 04:00 PM | 0 | 134 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 155 | 0 | 0 | 0 | 0 | 0 | 0 | 289 |
| 04:15 PM | 0 | 145 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 176 | 0 | 0 | 0 | 0 | 0 | 0 | 321 |
| 04:30 PM | 0 | 128 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 186 | 0 | 0 | 0 | 0 | 0 | 0 | 314 |
| 04:45 PM | 0 | 133 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 179 | 0 | 0 | 0 | 0 | 0 | 0 | 312 |
| Total | 0 | 540 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 696 | 0 | 0 | 0 | 0 | 0 | 0 | 1236 |
| 05:00 PM | 0 | 138 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 168 | 0 | 0 | 0 | 0 | 0 | 0 | 306 |
| 05:15 PM | 0 | 116 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 196 | 0 | 0 | 0 | 0 | 0 | 0 | 312 |
| Grand Total | 0 | 1068 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1392 | 0 | 0 | 0 | 0 | 3 | 0 | 2463 |
| Apprch % | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 | 100 | 0 | |
| Total % | 0 | 43.4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 56.5 | 0 | 0 | 0 | 0 | 0.1 | 0 | |
| Motorcycles | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |
| % Motorcycles | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 |
| Cars & Light Goods | 0 | 1050 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1357 | 0 | 0 | 0 | 0 | 3 | 0 | 2410 |
| % Cars & Light Goods | 0 | 98.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 97.5 | 0 | 0 | 0 | 0 | 100 | 0 | 97.8 |
| Buses | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| % Buses | 0 | 0.7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.4 | 0 | 0 | 0 | 0 | 0 | 0 | 0.6 |
| Single-Unit Trucks | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 21 |
| % Single-Unit Trucks | 0 | 0.4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0.9 |
| Articulated Trucks | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| % Articulated Trucks | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 |
| Bicycles on Road | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| % Bicycles on Road | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 |
| Bicycles on Crosswalk | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| % Bicycles on Crosswalk | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pedestrians | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| % Pedestrians | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

# Austin Tsutsumi & Associates

501 Sumner St, Suite 521
Honolulu, Hawaii 96817
*Phone: (808)533-3646 Fax: (808)526-1267*


File Name : Honoapiilani Hwy - South of Maui Plantation Dwy
Site Code : 22-511 CMWRF TIAR & TMP
Start Date : 9/22/2022
Page No : 2

| | HONOAPIILANI HWY Southbound | | | | | Westbound | | | | | HONOAPIILANI HWY Northbound | | | | | SOUTH OF MAUI PLANTATION HWY Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 03:45 PM to 04:30 PM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Peak Hour for Entire Intersection Begins at 03:45 PM | | | | | | | | | | | | | | | | | | | | | |
| 03:45 PM | 0 | 144 | 0 | 0 | 144 | 0 | 0 | 0 | 0 | 0 | 0 | 170 | 0 | 0 | 170 | 0 | 0 | 0 | 0 | 0 | 314 |
| 04:00 PM | 0 | 134 | 0 | 0 | 134 | 0 | 0 | 0 | 0 | 0 | 0 | 155 | 0 | 0 | 155 | 0 | 0 | 0 | 0 | 0 | 289 |
| 04:15 PM | 0 | **145** | 0 | 0 | **145** | 0 | 0 | 0 | 0 | 0 | 0 | 176 | 0 | 0 | 176 | 0 | 0 | 0 | 0 | 0 | **321** |
| 04:30 PM | 0 | 128 | 0 | 0 | 128 | 0 | 0 | 0 | 0 | 0 | 0 | **186** | 0 | 0 | **186** | 0 | 0 | 0 | 0 | 0 | 314 |
| Total Volume | 0 | 551 | 0 | 0 | 551 | 0 | 0 | 0 | 0 | 0 | 0 | 687 | 0 | 0 | 687 | 0 | 0 | 0 | 0 | 0 | 1238 |
| % App. Total | 0 | 100 | 0 | 0 | | 0 | 0 | 0 | 0 | | 0 | 100 | 0 | 0 | | 0 | 0 | 0 | 0 | | |
| PHF | .000 | .950 | .000 | .000 | .950 | .000 | .000 | .000 | .000 | .000 | .000 | .923 | .000 | .000 | .923 | .000 | .000 | .000 | .000 | .000 | .964 |



# Austin Tsutsumi & Associates

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File Name : Honoapiilani Hwy - Waiko Rd
Site Code : 22-511 CMWRF TIAR & TMP
Start Date : 9/22/2022


Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

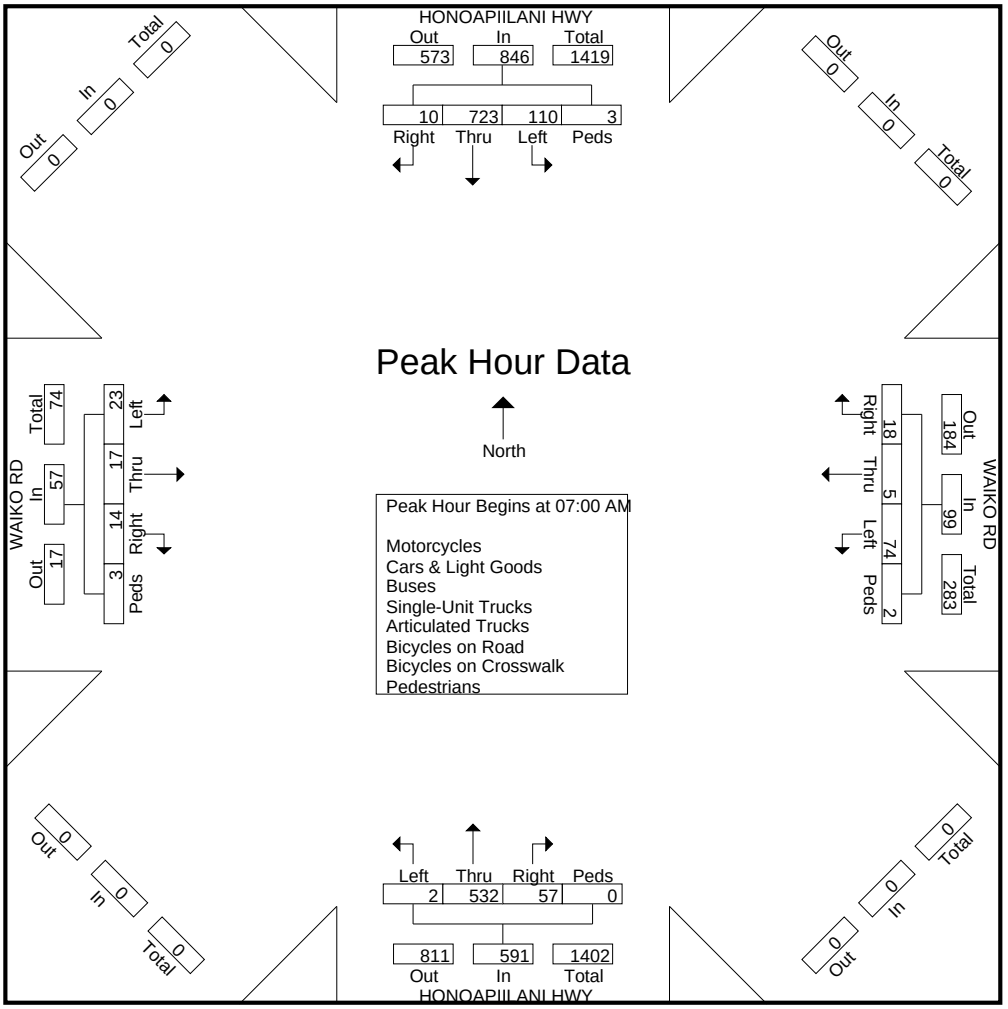
| | HONOAPIILANI HWY Southbound | | | | WAIKO RD Westbound | | | | HONOAPIILANI HWY Northbound | | | | WAIKO RD Eastbound | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Int. Total |
| 06:30 AM | 15 | 167 | 2 | 0 | 12 | 2 | 1 | 0 | 4 | 72 | 6 | 0 | 7 | 4 | 3 | 1 | 296 |
| 06:45 AM | 13 | 161 | 3 | 1 | 18 | 1 | 6 | 0 | 1 | 100 | 6 | 0 | 4 | 6 | 1 | 0 | 321 |
| Total | 28 | 328 | 5 | 1 | 30 | 3 | 7 | 0 | 5 | 172 | 12 | 0 | 11 | 10 | 4 | 1 | 617 |
| | | | | | | | | | | | | | | | | | |
| 07:00 AM | 18 | 182 | 4 | 1 | 17 | 2 | 3 | 0 | 1 | 122 | 15 | 0 | 6 | 3 | 5 | 0 | 379 |
| 07:15 AM | 29 | 216 | 1 | 1 | 25 | 1 | 7 | 0 | 0 | 146 | 20 | 0 | 7 | 5 | 1 | 0 | 459 |
| 07:30 AM | 43 | 155 | 2 | 0 | 19 | 2 | 3 | 2 | 1 | 141 | 14 | 0 | 7 | 4 | 5 | 2 | 400 |
| 07:45 AM | 20 | 170 | 3 | 1 | 13 | 0 | 5 | 0 | 0 | 123 | 8 | 0 | 3 | 5 | 3 | 1 | 355 |
| Total | 110 | 723 | 10 | 3 | 74 | 5 | 18 | 2 | 2 | 532 | 57 | 0 | 23 | 17 | 14 | 3 | 1593 |
| | | | | | | | | | | | | | | | | | |
| 08:00 AM | 9 | 132 | 1 | 0 | 14 | 0 | 7 | 0 | 0 | 114 | 7 | 0 | 2 | 3 | 2 | 0 | 291 |
| 08:15 AM | 5 | 142 | 2 | 0 | 12 | 2 | 9 | 0 | 0 | 101 | 13 | 0 | 5 | 3 | 1 | 0 | 295 |
| Grand Total | 152 | 1325 | 18 | 4 | 130 | 10 | 41 | 2 | 7 | 919 | 89 | 0 | 41 | 33 | 21 | 4 | 2796 |
| Apprch % | 10.1 | 88.4 | 1.2 | 0.3 | 71 | 5.5 | 22.4 | 1.1 | 0.7 | 90.5 | 8.8 | 0 | 41.4 | 33.3 | 21.2 | 4 | |
| Total % | 5.4 | 47.4 | 0.6 | 0.1 | 4.6 | 0.4 | 1.5 | 0.1 | 0.3 | 32.9 | 3.2 | 0 | 1.5 | 1.2 | 0.8 | 0.1 | |
| Motorcycles | 1 | 5 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 5 | 1 | 0 | 0 | 0 | 0 | 0 | 14 |
| % Motorcycles | 0.7 | 0.4 | 0 | 0 | 0.8 | 0 | 2.4 | 0 | 0 | 0.5 | 1.1 | 0 | 0 | 0 | 0 | 0 | 0.5 |
| Cars & Light Goods | 149 | 1284 | 18 | 0 | 123 | 10 | 39 | 0 | 6 | 888 | 83 | 0 | 41 | 31 | 20 | 0 | 2692 |
| % Cars & Light Goods | 98 | 96.9 | 100 | 0 | 94.6 | 100 | 95.1 | 0 | 85.7 | 96.6 | 93.3 | 0 | 100 | 93.9 | 95.2 | 0 | 96.3 |
| Buses | 1 | 9 | 0 | 0 | 3 | 0 | 0 | 0 | 1 | 10 | 4 | 0 | 0 | 2 | 1 | 0 | 31 |
| % Buses | 0.7 | 0.7 | 0 | 0 | 2.3 | 0 | 0 | 0 | 14.3 | 1.1 | 4.5 | 0 | 0 | 6.1 | 4.8 | 0 | 1.1 |
| Single-Unit Trucks | 1 | 23 | 0 | 0 | 3 | 0 | 1 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 41 |
| % Single-Unit Trucks | 0.7 | 1.7 | 0 | 0 | 2.3 | 0 | 2.4 | 0 | 0 | 1.4 | 0 | 0 | 0 | 0 | 0 | 0 | 1.5 |
| Articulated Trucks | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 |
| % Articulated Trucks | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.1 | 0 | 0 | 0 | 0 | 0 | 0.1 |
| Bicycles on Road | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| % Bicycles on Road | 0 | 0.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 |
| Bicycles on Crosswalk | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| % Bicycles on Crosswalk | 0 | 0 | 0 | 50 | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 |
| Pedestrians | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 6 |
| % Pedestrians | 0 | 0 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0.2 |

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File Name : Honoapiilani Hwy - Waiko Rd
Site Code : 22-511 CMWRF TIAR & TMP
Start Date : 9/22/2022
Page No : 2

| | HONOAPIILANI HWY Southbound | | | | | WAIKO RD Westbound | | | | | HONOAPIILANI HWY Northbound | | | | | WAIKO RD Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 06:30 AM to 08:15 AM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Peak Hour for Entire Intersection Begins at 07:00 AM | | | | | | | | | | | | | | | | | | | | | |
| 07:00 AM | 18 | 182 | **4** | **1** | 205 | 17 | **2** | 3 | 0 | 22 | **1** | 122 | 15 | 0 | 138 | 6 | 3 | **5** | 0 | 14 | 379 |
| 07:15 AM | 29 | **216** | 1 | 1 | **247** | **25** | 1 | **7** | 0 | **33** | 0 | **146** | **20** | 0 | **166** | **7** | **5** | 1 | 0 | 13 | **459** |
| 07:30 AM | **43** | 155 | 2 | 0 | 200 | 19 | 2 | 3 | **2** | 26 | 1 | 141 | 14 | 0 | 156 | 7 | 4 | 5 | **2** | **18** | 400 |
| 07:45 AM | 20 | 170 | 3 | 1 | 194 | 13 | 0 | 5 | 0 | 18 | 0 | 123 | 8 | 0 | 131 | 3 | 5 | 3 | 1 | 12 | 355 |
| Total Volume | 110 | 723 | 10 | 3 | 846 | 74 | 5 | 18 | 2 | 99 | 2 | 532 | 57 | 0 | 591 | 23 | 17 | 14 | 3 | 57 | 1593 |
| % App. Total | 13 | 85.5 | 1.2 | 0.4 | | 74.7 | 5.1 | 18.2 | 2 | | 0.3 | 90 | 9.6 | 0 | | 40.4 | 29.8 | 24.6 | 5.3 | | |
| PHF | .640 | .837 | .625 | .750 | .856 | .740 | .625 | .643 | .250 | .750 | .500 | .911 | .713 | .000 | .890 | .821 | .850 | .700 | .375 | .792 | .868 |



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Site Code : 22-511 CMWRF TIAR & TMP
Start Date : 9/22/2022
Page No : 1

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

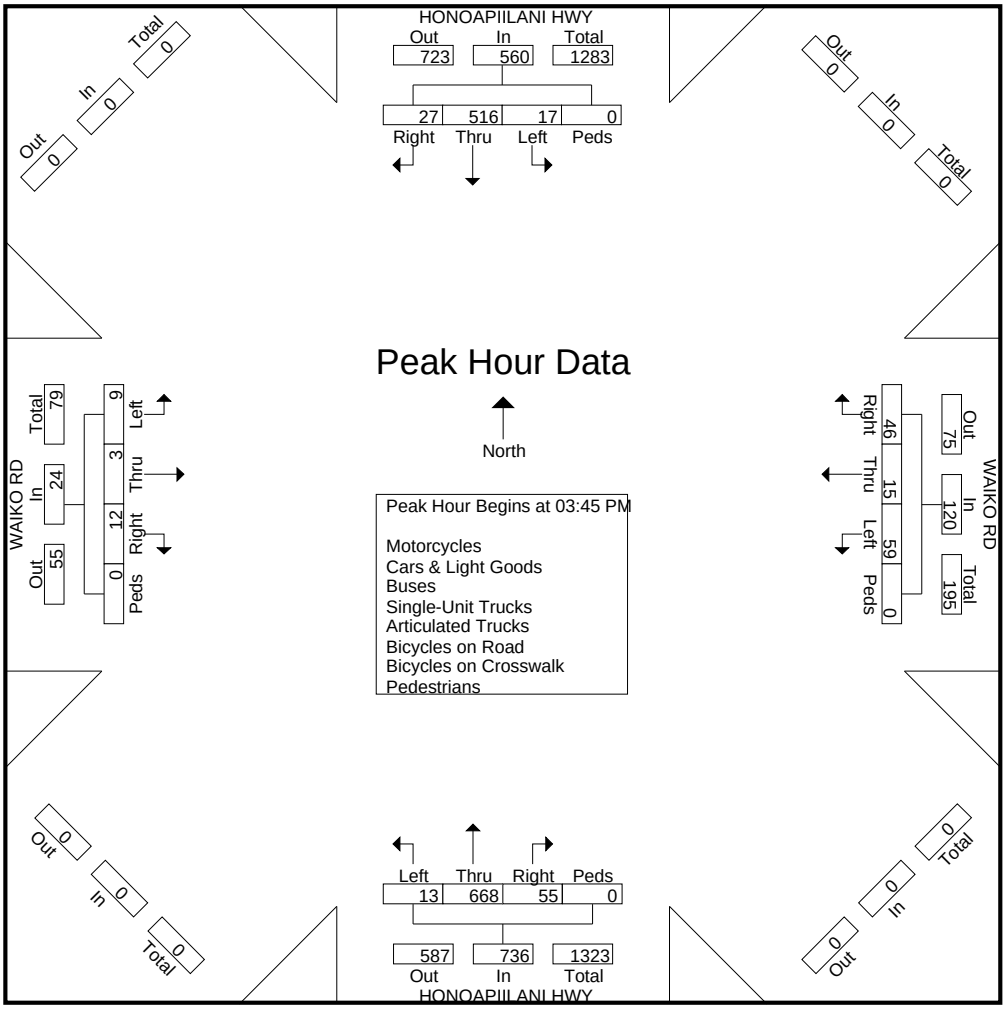
| | HONOAPIILANI HWY Southbound | | | | WAIKO RD Westbound | | | | HONOAPIILANI HWY Northbound | | | | WAIKO RD Eastbound | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Int. Total |
| 03:30 PM | 3 | 129 | 5 | 0 | 16 | 3 | 14 | 1 | 2 | 137 | 10 | 0 | 3 | 2 | 0 | 0 | 325 |
| 03:45 PM | 4 | 140 | 7 | 0 | 16 | 5 | 10 | 0 | 3 | 179 | 16 | 0 | 3 | 1 | 2 | 0 | 386 |
| Total | 7 | 269 | 12 | 0 | 32 | 8 | 24 | 1 | 5 | 316 | 26 | 0 | 6 | 3 | 2 | 0 | 711 |
| 04:00 PM | 4 | 129 | 7 | 0 | 9 | 8 | 11 | 0 | 5 | 152 | 16 | 0 | 2 | 0 | 3 | 0 | 346 |
| 04:15 PM | 3 | 128 | 4 | 0 | 17 | 1 | 12 | 0 | 2 | 171 | 14 | 0 | 3 | 0 | 3 | 0 | 358 |
| 04:30 PM | 6 | 119 | 9 | 0 | 17 | 1 | 13 | 0 | 3 | 166 | 9 | 0 | 1 | 2 | 4 | 0 | 350 |
| 04:45 PM | 6 | 113 | 4 | 0 | 17 | 5 | 12 | 0 | 2 | 153 | 19 | 0 | 4 | 1 | 2 | 0 | 338 |
| Total | 19 | 489 | 24 | 0 | 60 | 15 | 48 | 0 | 12 | 642 | 58 | 0 | 10 | 3 | 12 | 0 | 1392 |
| 05:00 PM | 5 | 130 | 5 | 0 | 14 | 3 | 11 | 0 | 1 | 164 | 20 | 0 | 2 | 1 | 1 | 0 | 357 |
| 05:15 PM | 9 | 106 | 4 | 0 | 16 | 4 | 12 | 0 | 4 | 185 | 15 | 0 | 1 | 3 | 0 | 0 | 359 |
| Grand Total | 40 | 994 | 45 | 0 | 122 | 30 | 95 | 1 | 22 | 1307 | 119 | 0 | 19 | 10 | 15 | 0 | 2819 |
| Apprch % | 3.7 | 92.1 | 4.2 | 0 | 49.2 | 12.1 | 38.3 | 0.4 | 1.5 | 90.3 | 8.2 | 0 | 43.2 | 22.7 | 34.1 | 0 | |
| Total % | 1.4 | 35.3 | 1.6 | 0 | 4.3 | 1.1 | 3.4 | 0 | 0.8 | 46.4 | 4.2 | 0 | 0.7 | 0.4 | 0.5 | 0 | |
| Motorcycles | 1 | 6 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 17 |
| % Motorcycles | 2.5 | 0.6 | 0 | 0 | 1.6 | 0 | 0 | 0 | 0 | 0.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0.6 |
| Cars & Light Goods | 39 | 975 | 45 | 0 | 120 | 29 | 94 | 0 | 22 | 1278 | 118 | 0 | 19 | 10 | 15 | 0 | 2764 |
| % Cars & Light Goods | 97.5 | 98.1 | 100 | 0 | 98.4 | 96.7 | 98.9 | 0 | 100 | 97.8 | 99.2 | 0 | 100 | 100 | 100 | 0 | 98 |
| Buses | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| % Buses | 0 | 0.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 |
| Single-Unit Trucks | 0 | 3 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 19 |
| % Single-Unit Trucks | 0 | 0.3 | 0 | 0 | 0 | 3.3 | 1.1 | 0 | 0 | 1.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.7 |
| Articulated Trucks | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| % Articulated Trucks | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bicycles on Road | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 3 |
| % Bicycles on Road | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | 0.8 | 0 | 0 | 0 | 0 | 0 | 0.1 |
| Bicycles on Crosswalk | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| % Bicycles on Crosswalk | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pedestrians | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| % Pedestrians | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

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File Name : Honoapiilani Hwy - Waiko Rd
Site Code : 22-511 CMWRF TIAR & TMP
Start Date : 9/22/2022
Page No : 2

| | HONOAPIILANI HWY Southbound | | | | | WAIKO RD Westbound | | | | | HONOAPIILANI HWY Northbound | | | | | WAIKO RD Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 03:30 PM to 05:15 PM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Peak Hour for Entire Intersection Begins at 03:45 PM | | | | | | | | | | | | | | | | | | | | | |
| 03:45 PM | 4 | **140** | 7 | 0 | **151** | 16 | 5 | 10 | 0 | **31** | 3 | **179** | **16** | 0 | **198** | **3** | 1 | 2 | 0 | 6 | **386** |
| 04:00 PM | 4 | 129 | 7 | 0 | 140 | 9 | **8** | 11 | 0 | 28 | **5** | 152 | 16 | 0 | 173 | 2 | 0 | 3 | 0 | 5 | 346 |
| 04:15 PM | 3 | 128 | 4 | 0 | 135 | **17** | 1 | 12 | 0 | 30 | 2 | 171 | 14 | 0 | 187 | 3 | 0 | 3 | 0 | 6 | 358 |
| 04:30 PM | **6** | 119 | **9** | 0 | 134 | 17 | 1 | **13** | 0 | 31 | 3 | 166 | 9 | 0 | 178 | 1 | **2** | **4** | 0 | **7** | 350 |
| Total Volume | 17 | 516 | 27 | 0 | 560 | 59 | 15 | 46 | 0 | 120 | 13 | 668 | 55 | 0 | 736 | 9 | 3 | 12 | 0 | 24 | 1440 |
| % App. Total | 3 | 92.1 | 4.8 | 0 | | 49.2 | 12.5 | 38.3 | 0 | | 1.8 | 90.8 | 7.5 | 0 | | 37.5 | 12.5 | 50 | 0 | | |
| PHF | .708 | .921 | .750 | .000 | .927 | .868 | .469 | .885 | .000 | .968 | .650 | .933 | .859 | .000 | .929 | .750 | .375 | .750 | .000 | .857 | .933 |



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File Name : Kuihelani Hwy - Waiko Rd
Site Code : 21-511 CMWRF TIAR & TMP
Start Date : 9/22/2022
Page No : 1

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

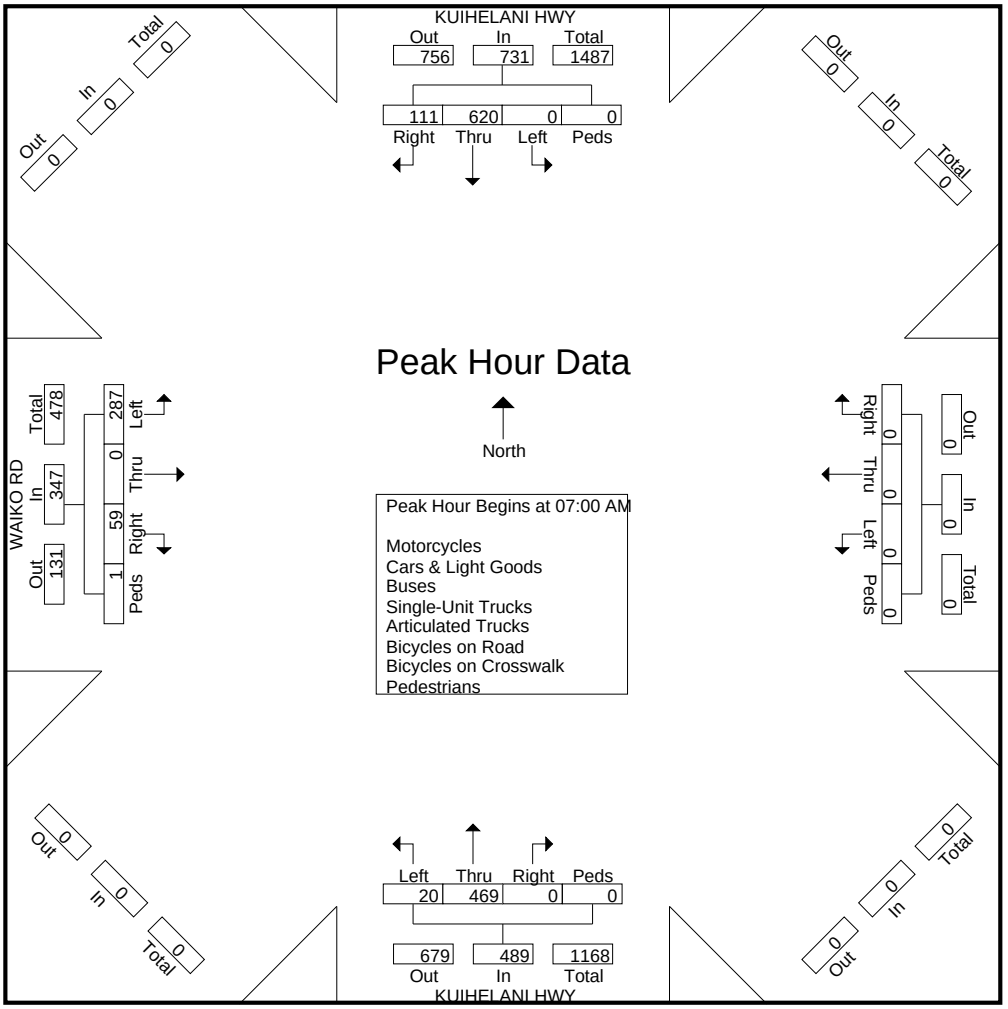
| | KUIHELANI HWY Southbound | | | | Westbound | | | | KUIHELANI HWY Northbound | | | | WAIKO RD Eastbound | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Int. Total |
| 06:30 AM | 0 | 148 | 24 | 0 | 0 | 0 | 0 | 0 | 9 | 98 | 0 | 0 | 38 | 0 | 11 | 0 | 328 |
| 06:45 AM | 0 | 169 | 43 | 0 | 0 | 0 | 0 | 0 | 7 | 106 | 0 | 0 | 55 | 0 | 13 | 0 | 393 |
| Total | 0 | 317 | 67 | 0 | 0 | 0 | 0 | 0 | 16 | 204 | 0 | 0 | 93 | 0 | 24 | 0 | 721 |
| 07:00 AM | 0 | 190 | 27 | 0 | 0 | 0 | 0 | 0 | 3 | 112 | 0 | 0 | 64 | 0 | 14 | 1 | 411 |
| 07:15 AM | 0 | 169 | 26 | 0 | 0 | 0 | 0 | 0 | 7 | 110 | 0 | 0 | 84 | 0 | 14 | 0 | 410 |
| 07:30 AM | 0 | 121 | 35 | 0 | 0 | 0 | 0 | 0 | 4 | 123 | 0 | 0 | 83 | 0 | 11 | 0 | 377 |
| 07:45 AM | 0 | 140 | 23 | 0 | 0 | 0 | 0 | 0 | 6 | 124 | 0 | 0 | 56 | 0 | 20 | 0 | 369 |
| Total | 0 | 620 | 111 | 0 | 0 | 0 | 0 | 0 | 20 | 469 | 0 | 0 | 287 | 0 | 59 | 1 | 1567 |
| 08:00 AM | 0 | 134 | 28 | 0 | 0 | 0 | 0 | 0 | 4 | 172 | 0 | 0 | 23 | 0 | 9 | 0 | 370 |
| 08:15 AM | 0 | 148 | 28 | 0 | 0 | 0 | 0 | 0 | 3 | 121 | 0 | 0 | 22 | 0 | 12 | 0 | 334 |
| Grand Total | 0 | 1219 | 234 | 0 | 0 | 0 | 0 | 0 | 43 | 966 | 0 | 0 | 425 | 0 | 104 | 1 | 2992 |
| Apprch % | 0 | 83.9 | 16.1 | 0 | 0 | 0 | 0 | 0 | 4.3 | 95.7 | 0 | 0 | 80.2 | 0 | 19.6 | 0.2 | |
| Total % | 0 | 40.7 | 7.8 | 0 | 0 | 0 | 0 | 0 | 1.4 | 32.3 | 0 | 0 | 14.2 | 0 | 3.5 | 0 | |
| Motorcycles | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 3 | 0 | 0 | 0 | 6 |
| % Motorcycles | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 | 0 | 0 | 0.7 | 0 | 0 | 0 | 0.2 |
| Cars & Light Goods | 0 | 1152 | 219 | 0 | 0 | 0 | 0 | 0 | 41 | 941 | 0 | 0 | 375 | 0 | 83 | 0 | 2811 |
| % Cars & Light Goods | 0 | 94.5 | 93.6 | 0 | 0 | 0 | 0 | 0 | 95.3 | 97.4 | 0 | 0 | 88.2 | 0 | 79.8 | 0 | 94 |
| Buses | 0 | 7 | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 21 |
| % Buses | 0 | 0.6 | 1.3 | 0 | 0 | 0 | 0 | 0 | 2.3 | 0.5 | 0 | 0 | 1.2 | 0 | 0 | 0 | 0.7 |
| Single-Unit Trucks | 0 | 52 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 22 | 0 | 16 | 0 | 109 |
| % Single-Unit Trucks | 0 | 4.3 | 3.8 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 5.2 | 0 | 15.4 | 0 | 3.6 |
| Articulated Trucks | 0 | 7 | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 8 | 0 | 0 | 19 | 0 | 5 | 0 | 43 |
| % Articulated Trucks | 0 | 0.6 | 1.3 | 0 | 0 | 0 | 0 | 0 | 2.3 | 0.8 | 0 | 0 | 4.5 | 0 | 4.8 | 0 | 1.4 |
| Bicycles on Road | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| % Bicycles on Road | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 | 0 | 0 | 0 | 0 |
| Bicycles on Crosswalk | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| % Bicycles on Crosswalk | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pedestrians | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| % Pedestrians | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

# Austin Tsutsumi & Associates

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Honolulu, Hawaii 96817
*Phone: (808)533-3646 Fax: (808)526-1267*


File Name : Kuihelani Hwy - Waiko Rd
Site Code : 21-511 CMWRF TIAR & TMP
Start Date : 9/22/2022
Page No : 2

| | KUIHELANI HWY Southbound | | | | | Westbound | | | | | KUIHELANI HWY Northbound | | | | | WAIKO RD Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 07:00 AM to 07:45 AM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Peak Hour for Entire Intersection Begins at 07:00 AM | | | | | | | | | | | | | | | | | | | | | |
| 07:00 AM | 0 | **190** | 27 | 0 | **217** | 0 | 0 | 0 | 0 | 0 | 3 | 112 | 0 | 0 | 115 | 64 | 0 | 14 | **1** | 79 | **411** |
| 07:15 AM | 0 | 169 | 26 | 0 | 195 | 0 | 0 | 0 | 0 | 0 | **7** | 110 | 0 | 0 | 117 | **84** | 0 | 14 | 0 | **98** | 410 |
| 07:30 AM | 0 | 121 | **35** | 0 | 156 | 0 | 0 | 0 | 0 | 0 | 4 | 123 | 0 | 0 | 127 | 83 | 0 | 11 | 0 | 94 | 377 |
| 07:45 AM | 0 | 140 | 23 | 0 | 163 | 0 | 0 | 0 | 0 | 0 | 6 | **124** | 0 | 0 | **130** | 56 | 0 | **20** | 0 | 76 | 369 |
| Total Volume | 0 | 620 | 111 | 0 | 731 | 0 | 0 | 0 | 0 | 0 | 20 | 469 | 0 | 0 | 489 | 287 | 0 | 59 | 1 | 347 | 1567 |
| % App. Total | 0 | 84.8 | 15.2 | 0 | | 0 | 0 | 0 | 0 | | 4.1 | 95.9 | 0 | 0 | | 82.7 | 0 | 17 | 0.3 | | |
| PHF | .000 | .816 | .793 | .000 | .842 | .000 | .000 | .000 | .000 | .000 | .714 | .946 | .000 | .000 | .940 | .854 | .000 | .738 | .250 | .885 | .953 |



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Start Date : 9/22/2022
Page No : 1

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

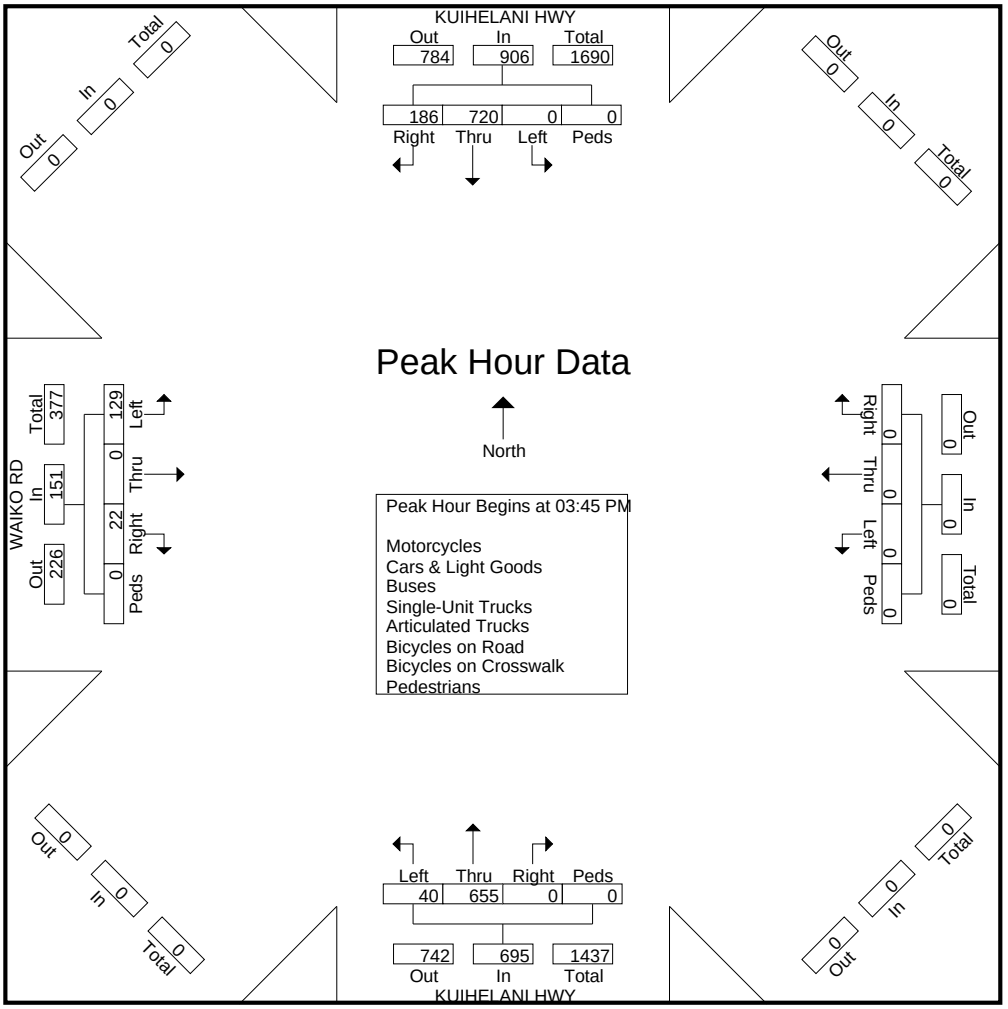
| | KUIHELANI HWY Southbound | | | | Westbound | | | | KUIHELANI HWY Northbound | | | | WAIKO RD Eastbound | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Int. Total |
| 03:30 PM | 0 | 187 | 49 | 0 | 0 | 0 | 0 | 0 | 12 | 178 | 0 | 0 | 34 | 0 | 8 | 0 | 468 |
| 03:45 PM | 0 | 170 | 50 | 0 | 0 | 0 | 0 | 0 | 14 | 166 | 0 | 0 | 33 | 0 | 3 | 0 | 436 |
| Total | 0 | 357 | 99 | 0 | 0 | 0 | 0 | 0 | 26 | 344 | 0 | 0 | 67 | 0 | 11 | 0 | 904 |
| 04:00 PM | 0 | 196 | 52 | 0 | 0 | 0 | 0 | 0 | 15 | 169 | 0 | 0 | 36 | 0 | 6 | 0 | 474 |
| 04:15 PM | 0 | 182 | 40 | 0 | 0 | 0 | 0 | 0 | 4 | 154 | 0 | 0 | 26 | 0 | 5 | 0 | 411 |
| 04:30 PM | 0 | 172 | 44 | 0 | 0 | 0 | 0 | 0 | 7 | 166 | 0 | 0 | 34 | 0 | 8 | 0 | 431 |
| 04:45 PM | 0 | 157 | 36 | 0 | 0 | 0 | 0 | 0 | 6 | 196 | 0 | 0 | 29 | 0 | 5 | 0 | 429 |
| Total | 0 | 707 | 172 | 0 | 0 | 0 | 0 | 0 | 32 | 685 | 0 | 0 | 125 | 0 | 24 | 0 | 1745 |
| 05:00 PM | 0 | 148 | 37 | 0 | 0 | 0 | 0 | 0 | 5 | 169 | 0 | 0 | 28 | 0 | 8 | 0 | 395 |
| 05:15 PM | 0 | 160 | 40 | 0 | 0 | 0 | 0 | 0 | 9 | 168 | 0 | 0 | 26 | 0 | 5 | 0 | 408 |
| Grand Total | 0 | 1372 | 348 | 0 | 0 | 0 | 0 | 0 | 72 | 1366 | 0 | 0 | 246 | 0 | 48 | 0 | 3452 |
| Apprch % | 0 | 79.8 | 20.2 | 0 | 0 | 0 | 0 | 0 | 5 | 95 | 0 | 0 | 83.7 | 0 | 16.3 | 0 | |
| Total % | 0 | 39.7 | 10.1 | 0 | 0 | 0 | 0 | 0 | 2.1 | 39.6 | 0 | 0 | 7.1 | 0 | 1.4 | 0 | |
| Motorcycles | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 6 |
| % Motorcycles | 0 | 0.1 | 0.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 2.1 | 0 | 0.2 |
| Cars & Light Goods | 0 | 1356 | 327 | 0 | 0 | 0 | 0 | 0 | 53 | 1334 | 0 | 0 | 241 | 0 | 42 | 0 | 3353 |
| % Cars & Light Goods | 0 | 98.8 | 94 | 0 | 0 | 0 | 0 | 0 | 73.6 | 97.7 | 0 | 0 | 98 | 0 | 87.5 | 0 | 97.1 |
| Buses | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 0 | 0 | 1 | 0 | 1 | 0 | 17 |
| % Buses | 0 | 0.4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.7 | 0 | 0 | 0.4 | 0 | 2.1 | 0 | 0.5 |
| Single-Unit Trucks | 0 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 11 | 15 | 0 | 0 | 4 | 0 | 1 | 0 | 41 |
| % Single-Unit Trucks | 0 | 0.4 | 1.4 | 0 | 0 | 0 | 0 | 0 | 15.3 | 1.1 | 0 | 0 | 1.6 | 0 | 2.1 | 0 | 1.2 |
| Articulated Trucks | 0 | 4 | 14 | 0 | 0 | 0 | 0 | 0 | 8 | 5 | 0 | 0 | 0 | 0 | 1 | 0 | 32 |
| % Articulated Trucks | 0 | 0.3 | 4 | 0 | 0 | 0 | 0 | 0 | 11.1 | 0.4 | 0 | 0 | 0 | 0 | 2.1 | 0 | 0.9 |
| Bicycles on Road | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 3 |
| % Bicycles on Road | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 4.2 | 0 | 0.1 |
| Bicycles on Crosswalk | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| % Bicycles on Crosswalk | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pedestrians | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| % Pedestrians | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

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File Name : Kuihelani Hwy - Waiko Rd
Site Code : 21-511 CMWRF TIAR & TMP
Start Date : 9/22/2022
Page No : 2

| | KUIHELANI HWY Southbound | | | | | Westbound | | | | | KUIHELANI HWY Northbound | | | | | WAIKO RD Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 03:45 PM to 04:30 PM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Peak Hour for Entire Intersection Begins at 03:45 PM | | | | | | | | | | | | | | | | | | | | | |
| 03:45 PM | 0 | 170 | 50 | 0 | 220 | 0 | 0 | 0 | 0 | 0 | 14 | 166 | 0 | 0 | 180 | 33 | 0 | 3 | 0 | 36 | 436 |
| 04:00 PM | 0 | **196** | **52** | 0 | **248** | 0 | 0 | 0 | 0 | 0 | **15** | **169** | 0 | 0 | **184** | **36** | 0 | 6 | 0 | **42** | **474** |
| 04:15 PM | 0 | 182 | 40 | 0 | 222 | 0 | 0 | 0 | 0 | 0 | 4 | 154 | 0 | 0 | 158 | 26 | 0 | 5 | 0 | 31 | 411 |
| 04:30 PM | 0 | 172 | 44 | 0 | 216 | 0 | 0 | 0 | 0 | 0 | 7 | 166 | 0 | 0 | 173 | 34 | 0 | **8** | 0 | 42 | 431 |
| Total Volume | 0 | 720 | 186 | 0 | 906 | 0 | 0 | 0 | 0 | 0 | 40 | 655 | 0 | 0 | 695 | 129 | 0 | 22 | 0 | 151 | 1752 |
| % App. Total | 0 | 79.5 | 20.5 | 0 | | 0 | 0 | 0 | 0 | | 5.8 | 94.2 | 0 | 0 | | 85.4 | 0 | 14.6 | 0 | | |
| PHF | .000 | .918 | .894 | .000 | .913 | .000 | .000 | .000 | .000 | .000 | .667 | .969 | .000 | .000 | .944 | .896 | .000 | .688 | .000 | .899 | .924 |



# Austin Tsutsumi & Associates

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Site Code : 22-511 CMWRF TIAR & TMP
Start Date : 9/22/2022
Page No : 1

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

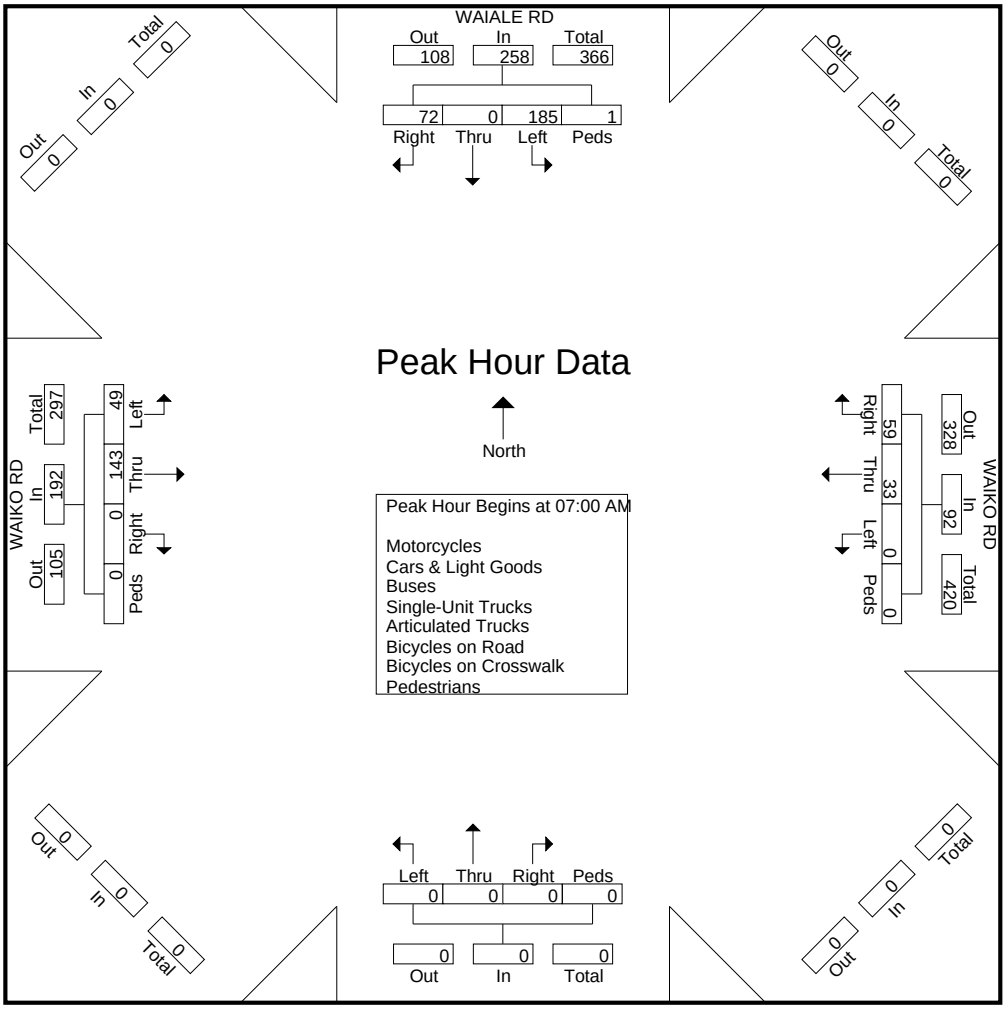
| | WAIALE RD Southbound | | | | WAIKO RD Westbound | | | | Northbound | | | | WAIKO RD Eastbound | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Int. Total |
| 06:30 AM | 40 | 0 | 13 | 0 | 0 | 3 | 6 | 0 | 0 | 0 | 0 | 0 | 7 | 18 | 0 | 0 | 87 |
| 06:45 AM | 40 | 0 | 13 | 0 | 0 | 8 | 15 | 0 | 0 | 0 | 0 | 0 | 4 | 23 | 0 | 0 | 103 |
| Total | 80 | 0 | 26 | 0 | 0 | 11 | 21 | 0 | 0 | 0 | 0 | 0 | 11 | 41 | 0 | 0 | 190 |
| 07:00 AM | 41 | 0 | 22 | 0 | 0 | 5 | 13 | 0 | 0 | 0 | 0 | 0 | 9 | 31 | 0 | 0 | 121 |
| 07:15 AM | 57 | 0 | 22 | 0 | 0 | 12 | 16 | 0 | 0 | 0 | 0 | 0 | 13 | 36 | 0 | 0 | 156 |
| 07:30 AM | 54 | 0 | 15 | 0 | 0 | 8 | 15 | 0 | 0 | 0 | 0 | 0 | 15 | 52 | 0 | 0 | 159 |
| 07:45 AM | 33 | 0 | 13 | 1 | 0 | 8 | 15 | 0 | 0 | 0 | 0 | 0 | 12 | 24 | 0 | 0 | 106 |
| Total | 185 | 0 | 72 | 1 | 0 | 33 | 59 | 0 | 0 | 0 | 0 | 0 | 49 | 143 | 0 | 0 | 542 |
| 08:00 AM | 21 | 0 | 13 | 0 | 0 | 9 | 19 | 0 | 0 | 0 | 0 | 0 | 5 | 15 | 0 | 0 | 82 |
| 08:15 AM | 16 | 0 | 7 | 0 | 0 | 13 | 14 | 0 | 0 | 0 | 0 | 0 | 5 | 16 | 0 | 0 | 71 |
| Grand Total | 302 | 0 | 118 | 1 | 0 | 66 | 113 | 0 | 0 | 0 | 0 | 0 | 70 | 215 | 0 | 0 | 885 |
| Apprch % | 71.7 | 0 | 28 | 0.2 | 0 | 36.9 | 63.1 | 0 | 0 | 0 | 0 | 0 | 24.6 | 75.4 | 0 | 0 | |
| Total % | 34.1 | 0 | 13.3 | 0.1 | 0 | 7.5 | 12.8 | 0 | 0 | 0 | 0 | 0 | 7.9 | 24.3 | 0 | 0 | |
| Motorcycles | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 4 |
| % Motorcycles | 0.7 | 0 | 0.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 0 | 0 | 0.5 |
| Cars & Light Goods | 286 | 0 | 116 | 0 | 0 | 61 | 104 | 0 | 0 | 0 | 0 | 0 | 66 | 208 | 0 | 0 | 841 |
| % Cars & Light Goods | 94.7 | 0 | 98.3 | 0 | 0 | 92.4 | 92 | 0 | 0 | 0 | 0 | 0 | 94.3 | 96.7 | 0 | 0 | 95 |
| Buses | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 4 | 3 | 0 | 0 | 14 |
| % Buses | 1 | 0 | 0 | 0 | 0 | 4.5 | 0.9 | 0 | 0 | 0 | 0 | 0 | 5.7 | 1.4 | 0 | 0 | 1.6 |
| Single-Unit Trucks | 9 | 0 | 1 | 0 | 0 | 2 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 20 |
| % Single-Unit Trucks | 3 | 0 | 0.8 | 0 | 0 | 3 | 5.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0.9 | 0 | 0 | 2.3 |
| Articulated Trucks | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 4 |
| % Articulated Trucks | 0.3 | 0 | 0 | 0 | 0 | 0 | 1.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 0 | 0 | 0.5 |
| Bicycles on Road | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| % Bicycles on Road | 0.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 |
| Bicycles on Crosswalk | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| % Bicycles on Crosswalk | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pedestrians | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| % Pedestrians | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 |

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Start Date : 9/22/2022
Page No : 2

| | WAIALE RD Southbound | | | | | WAIKO RD Westbound | | | | | Northbound | | | | | WAIKO RD Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 06:30 AM to 08:15 AM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Peak Hour for Entire Intersection Begins at 07:00 AM | | | | | | | | | | | | | | | | | | | | | |
| 07:00 AM | 41 | 0 | **22** | 0 | 63 | 0 | 5 | 13 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 9 | 31 | 0 | 0 | 40 | 121 |
| 07:15 AM | **57** | 0 | 22 | 0 | **79** | 0 | **12** | **16** | 0 | **28** | 0 | 0 | 0 | 0 | 0 | 13 | 36 | 0 | 0 | 49 | 156 |
| 07:30 AM | 54 | 0 | 15 | 0 | 69 | 0 | 8 | 15 | 0 | 23 | 0 | 0 | 0 | 0 | 0 | **15** | **52** | 0 | 0 | **67** | **159** |
| 07:45 AM | 33 | 0 | 13 | **1** | 47 | 0 | 8 | 15 | 0 | 23 | 0 | 0 | 0 | 0 | 0 | 12 | 24 | 0 | 0 | 36 | 106 |
| Total Volume | 185 | 0 | 72 | 1 | 258 | 0 | 33 | 59 | 0 | 92 | 0 | 0 | 0 | 0 | 0 | 49 | 143 | 0 | 0 | 192 | 542 |
| % App. Total | 71.7 | 0 | 27.9 | 0.4 | | 0 | 35.9 | 64.1 | 0 | | 0 | 0 | 0 | 0 | | 25.5 | 74.5 | 0 | 0 | | |
| PHF | .811 | .000 | .818 | .250 | .816 | .000 | .688 | .922 | .000 | .821 | .000 | .000 | .000 | .000 | .000 | .817 | .688 | .000 | .000 | .716 | .852 |



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Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

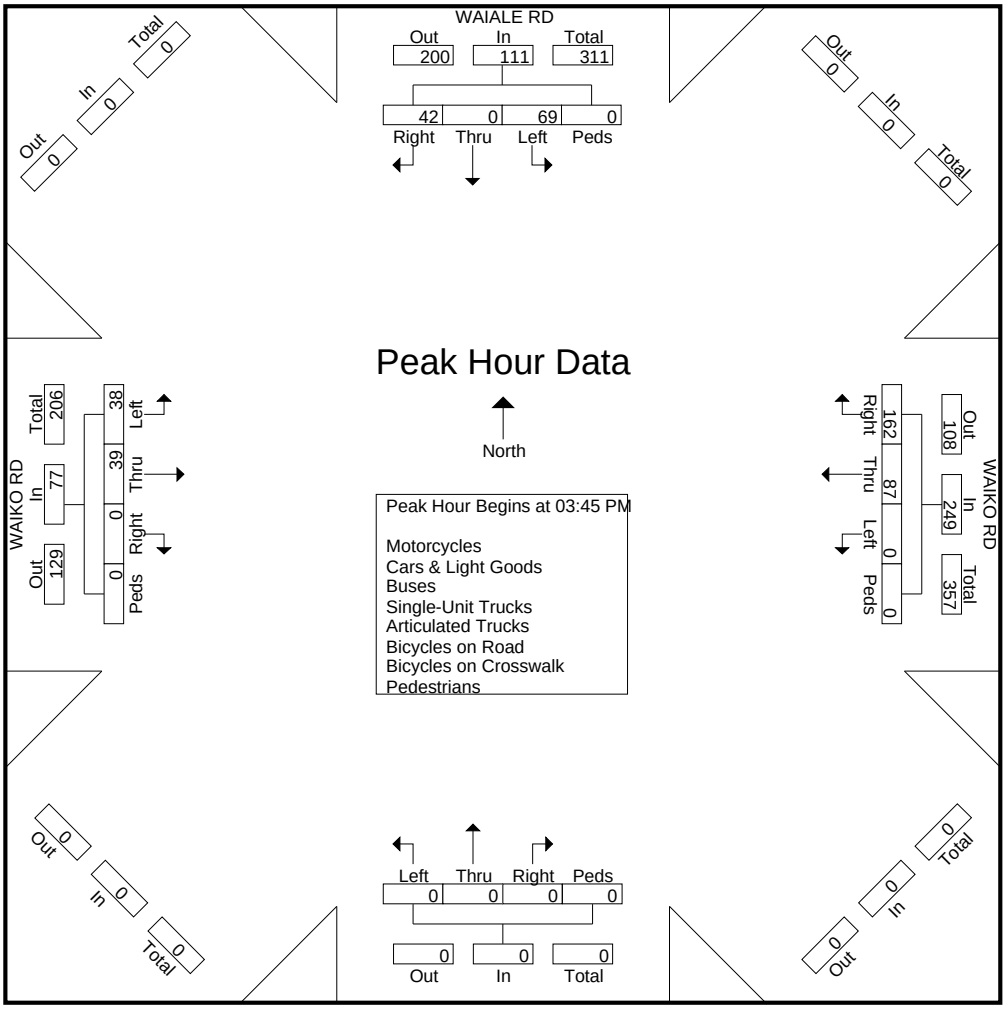
| | WAIALE RD Southbound | | | | WAIKO RD Westbound | | | | Northbound | | | | WAIKO RD Eastbound | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Int. Total |
| 03:30 PM | 13 | 0 | 10 | 0 | 0 | 23 | 33 | 0 | 0 | 0 | 0 | 0 | 10 | 4 | 0 | 0 | 93 |
| 03:45 PM | 17 | 0 | 8 | 0 | 0 | 25 | 37 | 0 | 0 | 0 | 0 | 0 | 9 | 12 | 0 | 0 | 108 |
| Total | 30 | 0 | 18 | 0 | 0 | 48 | 70 | 0 | 0 | 0 | 0 | 0 | 19 | 16 | 0 | 0 | 201 |
| | | | | | | | | | | | | | | | | | |
| 04:00 PM | 14 | 0 | 7 | 0 | 0 | 19 | 52 | 0 | 0 | 0 | 0 | 0 | 12 | 11 | 0 | 0 | 115 |
| 04:15 PM | 18 | 0 | 15 | 0 | 0 | 18 | 31 | 0 | 0 | 0 | 0 | 0 | 7 | 8 | 0 | 0 | 97 |
| 04:30 PM | 20 | 0 | 12 | 0 | 0 | 25 | 42 | 0 | 0 | 0 | 0 | 0 | 10 | 8 | 0 | 0 | 117 |
| 04:45 PM | 22 | 0 | 16 | 0 | 0 | 22 | 30 | 0 | 0 | 0 | 0 | 0 | 14 | 10 | 0 | 0 | 114 |
| Total | 74 | 0 | 50 | 0 | 0 | 84 | 155 | 0 | 0 | 0 | 0 | 0 | 43 | 37 | 0 | 0 | 443 |
| | | | | | | | | | | | | | | | | | |
| 05:00 PM | 13 | 0 | 8 | 0 | 0 | 16 | 31 | 0 | 0 | 0 | 0 | 0 | 18 | 12 | 0 | 0 | 98 |
| 05:15 PM | 12 | 0 | 12 | 0 | 0 | 17 | 27 | 0 | 0 | 0 | 0 | 0 | 13 | 15 | 0 | 0 | 96 |
| Grand Total | 129 | 0 | 88 | 0 | 0 | 165 | 283 | 0 | 0 | 0 | 0 | 0 | 93 | 80 | 0 | 0 | 838 |
| Apprch % | 59.4 | 0 | 40.6 | 0 | 0 | 36.8 | 63.2 | 0 | 0 | 0 | 0 | 0 | 53.8 | 46.2 | 0 | 0 | |
| Total % | 15.4 | 0 | 10.5 | 0 | 0 | 19.7 | 33.8 | 0 | 0 | 0 | 0 | 0 | 11.1 | 9.5 | 0 | 0 | |
| Motorcycles | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 3 |
| % Motorcycles | 0 | 0 | 0 | 0 | 0 | 1.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.2 | 0 | 0 | 0.4 |
| Cars & Light Goods | 119 | 0 | 86 | 0 | 0 | 162 | 275 | 0 | 0 | 0 | 0 | 0 | 92 | 77 | 0 | 0 | 811 |
| % Cars & Light Goods | 92.2 | 0 | 97.7 | 0 | 0 | 98.2 | 97.2 | 0 | 0 | 0 | 0 | 0 | 98.9 | 96.2 | 0 | 0 | 96.8 |
| Buses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| % Buses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Single-Unit Trucks | 6 | 0 | 1 | 0 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 13 |
| % Single-Unit Trucks | 4.7 | 0 | 1.1 | 0 | 0 | 0.6 | 1.1 | 0 | 0 | 0 | 0 | 0 | 1.1 | 1.2 | 0 | 0 | 1.6 |
| Articulated Trucks | 4 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| % Articulated Trucks | 3.1 | 0 | 0 | 0 | 0 | 0 | 1.4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Bicycles on Road | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 3 |
| % Bicycles on Road | 0 | 0 | 1.1 | 0 | 0 | 0 | 0.4 | 0 | 0 | 0 | 0 | 0 | 0 | 1.2 | 0 | 0 | 0.4 |
| Bicycles on Crosswalk | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| % Bicycles on Crosswalk | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pedestrians | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| % Pedestrians | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

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| | WAIALE RD Southbound | | | | | WAIKO RD Westbound | | | | | Northbound | | | | | WAIKO RD Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 03:45 PM to 04:30 PM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Peak Hour for Entire Intersection Begins at 03:45 PM | | | | | | | | | | | | | | | | | | | | | |
| 03:45 PM | 17 | 0 | 8 | 0 | 25 | 0 | **25** | 37 | 0 | 62 | 0 | 0 | 0 | 0 | 0 | 9 | **12** | 0 | 0 | 21 | 108 |
| 04:00 PM | 14 | 0 | 7 | 0 | 21 | 0 | 19 | **52** | 0 | **71** | 0 | 0 | 0 | 0 | 0 | **12** | 11 | 0 | 0 | **23** | 115 |
| 04:15 PM | 18 | 0 | **15** | 0 | **33** | 0 | 18 | 31 | 0 | 49 | 0 | 0 | 0 | 0 | 0 | 7 | 8 | 0 | 0 | 15 | 97 |
| 04:30 PM | **20** | 0 | 12 | 0 | 32 | 0 | 25 | 42 | 0 | 67 | 0 | 0 | 0 | 0 | 0 | 10 | 8 | 0 | 0 | 18 | **117** |
| Total Volume | 69 | 0 | 42 | 0 | 111 | 0 | 87 | 162 | 0 | 249 | 0 | 0 | 0 | 0 | 0 | 38 | 39 | 0 | 0 | 77 | 437 |
| % App. Total | 62.2 | 0 | 37.8 | 0 | | 0 | 34.9 | 65.1 | 0 | | 0 | 0 | 0 | 0 | | 49.4 | 50.6 | 0 | 0 | | |
| PHF | .863 | .000 | .700 | .000 | .841 | .000 | .870 | .779 | .000 | .877 | .000 | .000 | .000 | .000 | .000 | .792 | .813 | .000 | .000 | .837 | .934 |



# APPENDIX C

LOS WORKSHEETS

# APPENDIX C

LOS WORKSHEETS

Existing Conditions

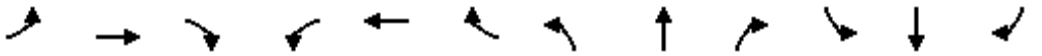
| Intersection | |
|---|---|
| Int Delay, s/veh | 0 |

| Movement | EBL | EBR | NBL | NBT | SBT | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 0 | 0 | 0 | 591 | 811 | 0 |
| Future Vol, veh/h | 0 | 0 | 0 | 591 | 811 | 0 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Free | Free | Free | Free |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 0 | - | - | - | - | - |
| Veh in Median Storage, # | 0 | - | - | 0 | 0 | - |
| Grade, % | 0 | - | - | 0 | 0 | - |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 0 | 0 | 642 | 882 | 0 |

| Major/Minor | Minor2 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 1524 | 882 | 882 | 0 | - | 0 |
| Stage 1 | 882 | - | - | - | - | - |
| Stage 2 | 642 | - | - | - | - | - |
| Critical Hdwy | 6.42 | 6.22 | 4.12 | - | - | - |
| Critical Hdwy Stg 1 | 5.42 | - | - | - | - | - |
| Critical Hdwy Stg 2 | 5.42 | - | - | - | - | - |
| Follow-up Hdwy | 3.518 | 3.318 | 2.218 | - | - | - |
| Pot Cap-1 Maneuver | 130 | 345 | 767 | - | - | - |
| Stage 1 | 405 | - | - | - | - | - |
| Stage 2 | 524 | - | - | - | - | - |
| Platoon blocked, % | | | | - | - | - |
| Mov Cap-1 Maneuver | 130 | 345 | 767 | - | - | - |
| Mov Cap-2 Maneuver | 130 | - | - | - | - | - |
| Stage 1 | 405 | - | - | - | - | - |
| Stage 2 | 524 | - | - | - | - | - |

| Approach | EB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s | 0 | 0 | 0 |
| HCM LOS | A | | |

| Minor Lane/Major Mvmt | NBL | NBT | EBLn1 | SBT | SBR |
|---|---|---|---|---|---|
| Capacity (veh/h) | 767 | - | - | - | - |
| HCM Lane V/C Ratio | - | - | - | - | - |
| HCM Control Delay (s) | 0 | - | 0 | - | - |
| HCM Lane LOS | A | - | A | - | - |
| HCM 95th %tile Q(veh) | 0 | - | - | - | - |



| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 23 | 17 | 14 | 74 | 5 | 18 | 2 | 532 | 57 | 110 | 723 | 10 |
| Future Volume (veh/h) | 23 | 17 | 14 | 74 | 5 | 18 | 2 | 532 | 57 | 110 | 723 | 10 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | | No | | | No | | | No | | | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 25 | 18 | 1 | 80 | 5 | 12 | 2 | 578 | 59 | 120 | 786 | 8 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 179 | 99 | 160 | 242 | 11 | 19 | 356 | 889 | 91 | 491 | 1133 | 960 |
| Arrive On Green | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.00 | 0.53 | 0.53 | 0.08 | 0.61 | 0.61 |
| Sat Flow, veh/h | 746 | 976 | 1578 | 1212 | 106 | 186 | 1781 | 1669 | 170 | 1781 | 1870 | 1585 |
| Grp Volume(v), veh/h | 43 | 0 | 1 | 97 | 0 | 0 | 2 | 0 | 637 | 120 | 786 | 8 |
| Grp Sat Flow(s),veh/h/ln | 1722 | 0 | 1578 | 1505 | 0 | 0 | 1781 | 0 | 1840 | 1781 | 1870 | 1585 |
| Q Serve(g_s), s | 0.0 | 0.0 | 0.0 | 2.1 | 0.0 | 0.0 | 0.0 | 0.0 | 13.7 | 1.5 | 15.8 | 0.1 |
| Cycle Q Clear(g_c), s | 1.2 | 0.0 | 0.0 | 3.3 | 0.0 | 0.0 | 0.0 | 0.0 | 13.7 | 1.5 | 15.8 | 0.1 |
| Prop In Lane | 0.58 | | 1.00 | 0.82 | | 0.12 | 1.00 | | 0.09 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 278 | 0 | 160 | 272 | 0 | 0 | 356 | 0 | 979 | 491 | 1133 | 960 |
| V/C Ratio(X) | 0.15 | 0.00 | 0.01 | 0.36 | 0.00 | 0.00 | 0.01 | 0.00 | 0.65 | 0.24 | 0.69 | 0.01 |
| Avail Cap(c_a), veh/h | 826 | 0 | 715 | 774 | 0 | 0 | 803 | 0 | 2334 | 808 | 2373 | 2011 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 1.00 | 1.00 | 0.00 | 0.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 22.8 | 0.0 | 22.3 | 23.7 | 0.0 | 0.0 | 7.2 | 0.0 | 9.2 | 6.4 | 7.4 | 4.3 |
| Incr Delay (d2), s/veh | 0.1 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 1.6 | 0.1 | 1.6 | 0.0 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.5 | 0.0 | 0.0 | 1.2 | 0.0 | 0.0 | 0.0 | 0.0 | 4.6 | 0.4 | 4.8 | 0.0 |
| Unsig. Movement Delay, s/veh | | | | | | | | | | | | |
| LnGrp Delay(d),s/veh | 22.9 | 0.0 | 22.3 | 24.0 | 0.0 | 0.0 | 7.2 | 0.0 | 10.8 | 6.5 | 9.0 | 4.3 |
| LnGrp LOS | C | A | C | C | A | A | A | A | B | A | A | A |
| Approach Vol, veh/h | | 44 | | | 97 | | | 639 | | | 914 | |
| Approach Delay, s/veh | | 22.9 | | | 24.0 | | | 10.8 | | | 8.7 | |
| Approach LOS | | C | | | C | | | B | | | A | |

| Timer - Assigned Phs | 1 | 2 | | 4 | 5 | 6 | | 8 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | 9.2 | 35.4 | | 10.6 | 5.2 | 39.4 | | 10.6 | | | | |
| Change Period (Y+Rc), s | 5.0 | 6.0 | | 5.0 | 5.0 | 6.0 | | 5.0 | | | | |
| Max Green Setting (Gmax), s | 14.0 | 70.0 | | 25.0 | 14.0 | 70.0 | | 25.0 | | | | |
| Max Q Clear Time (g_c+I1), s | 3.5 | 15.7 | | 3.2 | 2.0 | 17.8 | | 5.3 | | | | |
| Green Ext Time (p_c), s | 0.1 | 11.2 | | 0.1 | 0.0 | 15.7 | | 0.3 | | | | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM 6th Ctrl Delay | | 10.7 | |
| HCM 6th LOS | | B | |

**Notes**

User approved pedestrian interval to be less than phase max green.

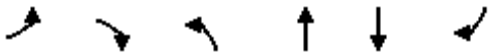
| Intersection | |
|---|---|
| Int Delay, s/veh | 7 |

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 49 | 143 | 33 | 59 | 185 | 72 |
| Future Vol, veh/h | 49 | 143 | 33 | 59 | 185 | 72 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Free | Free | Free | Free | Stop | Stop |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | - | - | - | - | 0 | - |
| Veh in Median Storage, # | - | 0 | 0 | - | 0 | - |
| Grade, % | - | 0 | 0 | - | 0 | - |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 53 | 155 | 36 | 64 | 201 | 78 |

| Major/Minor | Major1 | | Major2 | | Minor2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 100 | 0 | - | 0 | 329 | 68 |
| Stage 1 | - | - | - | - | 68 | - |
| Stage 2 | - | - | - | - | 261 | - |
| Critical Hdwy | 4.12 | - | - | - | 6.42 | 6.22 |
| Critical Hdwy Stg 1 | - | - | - | - | 5.42 | - |
| Critical Hdwy Stg 2 | - | - | - | - | 5.42 | - |
| Follow-up Hdwy | 2.218 | - | - | - | 3.518 | 3.318 |
| Pot Cap-1 Maneuver | 1493 | - | - | - | 665 | 995 |
| Stage 1 | - | - | - | - | 955 | - |
| Stage 2 | - | - | - | - | 783 | - |
| Platoon blocked, % | | - | - | - | | |
| Mov Cap-1 Maneuver | 1493 | - | - | - | 639 | 995 |
| Mov Cap-2 Maneuver | - | - | - | - | 639 | - |
| Stage 1 | - | - | - | - | 918 | - |
| Stage 2 | - | - | - | - | 783 | - |

| Approach | EB | WB | SB |
|---|---|---|---|
| HCM Control Delay, s | 1.9 | 0 | 13.3 |
| HCM LOS | | | B |

| Minor Lane/Major Mvmt | EBL | EBT | WBT | WBR | SBLn1 |
|---|---|---|---|---|---|
| Capacity (veh/h) | 1493 | - | - | - | 710 |
| HCM Lane V/C Ratio | 0.036 | - | - | - | 0.393 |
| HCM Control Delay (s) | 7.5 | 0 | - | - | 13.3 |
| HCM Lane LOS | A | A | - | - | B |
| HCM 95th %tile Q(veh) | 0.1 | - | - | - | 1.9 |



| Movement | EBL | EBR | NBL | NBT | SBT | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 287 | 59 | 20 | 469 | 620 | 111 |
| Future Volume (veh/h) | 287 | 59 | 20 | 469 | 620 | 111 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | 1.00 | 1.00 | | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | No | | | No | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 356 | 0 | 22 | 510 | 674 | 41 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 660 | 293 | 49 | 1916 | 1327 | 592 |
| Arrive On Green | 0.19 | 0.00 | 0.03 | 0.54 | 0.37 | 0.37 |
| Sat Flow, veh/h | 3563 | 1585 | 1781 | 3647 | 3647 | 1585 |
| Grp Volume(v), veh/h | 356 | 0 | 22 | 510 | 674 | 41 |
| Grp Sat Flow(s),veh/h/ln | 1781 | 1585 | 1781 | 1777 | 1777 | 1585 |
| Q Serve(g_s), s | 3.0 | 0.0 | 0.4 | 2.5 | 4.8 | 0.5 |
| Cycle Q Clear(g_c), s | 3.0 | 0.0 | 0.4 | 2.5 | 4.8 | 0.5 |
| Prop In Lane | 1.00 | 1.00 | 1.00 | | | 1.00 |
| Lane Grp Cap(c), veh/h | 660 | 293 | 49 | 1916 | 1327 | 592 |
| V/C Ratio(X) | 0.54 | 0.00 | 0.45 | 0.27 | 0.51 | 0.07 |
| Avail Cap(c_a), veh/h | 4366 | 1943 | 1474 | 7731 | 4301 | 1918 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 12.0 | 0.0 | 15.6 | 4.0 | 7.9 | 6.6 |
| Incr Delay (d2), s/veh | 0.7 | 0.0 | 6.2 | 0.1 | 0.3 | 0.0 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 1.0 | 0.0 | 0.2 | 0.4 | 1.2 | 0.1 |
| Unsig. Movement Delay, s/veh | | | | | | |
| LnGrp Delay(d),s/veh | 12.7 | 0.0 | 21.8 | 4.1 | 8.2 | 6.6 |
| LnGrp LOS | B | A | C | A | A | A |
| Approach Vol, veh/h | 356 | | | 532 | 715 | |
| Approach Delay, s/veh | 12.7 | | | 4.9 | 8.1 | |
| Approach LOS | B | | | A | A | |

| Timer - Assigned Phs | | 2 | | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | | 22.1 | | 10.5 | 5.4 | 16.7 |
| Change Period (Y+Rc), s | | 4.5 | | 4.5 | 4.5 | 4.5 |
| Max Green Setting (Gmax), s | | 71.0 | | 40.0 | 27.0 | 39.5 |
| Max Q Clear Time (g_c+I1), s | | 4.5 | | 5.0 | 2.4 | 6.8 |
| Green Ext Time (p_c), s | | 4.0 | | 1.3 | 0.0 | 5.4 |

| Intersection Summary | |
|---|---|
| HCM 6th Ctrl Delay | 8.1 |
| HCM 6th LOS | A |

**Notes**

User approved volume balancing among the lanes for turning movement.

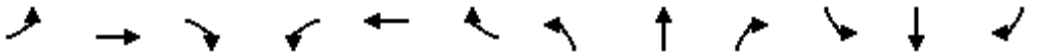
| Intersection | |
|---|---|
| Int Delay, s/veh | 0 |

| Movement | EBL | EBR | NBL | NBT | SBT | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 0 | 0 | 0 | 736 | 587 | 0 |
| Future Vol, veh/h | 0 | 0 | 0 | 736 | 587 | 0 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Free | Free | Free | Free |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 0 | - | - | - | - | - |
| Veh in Median Storage, # | 0 | - | - | 0 | 0 | - |
| Grade, % | 0 | - | - | 0 | 0 | - |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 0 | 0 | 800 | 638 | 0 |

| Major/Minor | Minor2 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 1438 | 638 | 638 | 0 | - | 0 |
| Stage 1 | 638 | - | - | - | - | - |
| Stage 2 | 800 | - | - | - | - | - |
| Critical Hdwy | 6.42 | 6.22 | 4.12 | - | - | - |
| Critical Hdwy Stg 1 | 5.42 | - | - | - | - | - |
| Critical Hdwy Stg 2 | 5.42 | - | - | - | - | - |
| Follow-up Hdwy | 3.518 | 3.318 | 2.218 | - | - | - |
| Pot Cap-1 Maneuver | 147 | 477 | 946 | - | - | - |
| Stage 1 | 526 | - | - | - | - | - |
| Stage 2 | 442 | - | - | - | - | - |
| Platoon blocked, % | | | | - | - | - |
| Mov Cap-1 Maneuver | 147 | 477 | 946 | - | - | - |
| Mov Cap-2 Maneuver | 147 | - | - | - | - | - |
| Stage 1 | 526 | - | - | - | - | - |
| Stage 2 | 442 | - | - | - | - | - |

| Approach | EB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s | 0 | 0 | 0 |
| HCM LOS | A | | |

| Minor Lane/Major Mvmt | NBL | NBT | EBLn1 | SBT | SBR |
|---|---|---|---|---|---|
| Capacity (veh/h) | 946 | - | - | - | - |
| HCM Lane V/C Ratio | - | - | - | - | - |
| HCM Control Delay (s) | 0 | - | 0 | - | - |
| HCM Lane LOS | A | - | A | - | - |
| HCM 95th %tile Q(veh) | 0 | - | - | - | - |



| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 9 | 3 | 12 | 59 | 15 | 46 | 13 | 668 | 55 | 17 | 516 | 27 |
| Future Volume (veh/h) | 9 | 3 | 12 | 59 | 15 | 46 | 13 | 668 | 55 | 17 | 516 | 27 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | | No | | | No | | | No | | | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 10 | 3 | 1 | 64 | 16 | 29 | 14 | 726 | 58 | 18 | 561 | 20 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 222 | 52 | 150 | 181 | 26 | 38 | 530 | 1029 | 82 | 378 | 1134 | 961 |
| Arrive On Green | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.02 | 0.60 | 0.60 | 0.02 | 0.61 | 0.61 |
| Sat Flow, veh/h | 1162 | 554 | 1585 | 848 | 275 | 407 | 1781 | 1709 | 137 | 1781 | 1870 | 1584 |
| Grp Volume(v), veh/h | 13 | 0 | 1 | 109 | 0 | 0 | 14 | 0 | 784 | 18 | 561 | 20 |
| Grp Sat Flow(s),veh/h/ln | 1715 | 0 | 1585 | 1530 | 0 | 0 | 1781 | 0 | 1846 | 1781 | 1870 | 1584 |
| Q Serve(g_s), s | 0.0 | 0.0 | 0.0 | 3.6 | 0.0 | 0.0 | 0.2 | 0.0 | 16.7 | 0.2 | 9.6 | 0.3 |
| Cycle Q Clear(g_c), s | 0.4 | 0.0 | 0.0 | 3.9 | 0.0 | 0.0 | 0.2 | 0.0 | 16.7 | 0.2 | 9.6 | 0.3 |
| Prop In Lane | 0.77 | | 1.00 | 0.59 | | 0.27 | 1.00 | | 0.07 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 274 | 0 | 150 | 245 | 0 | 0 | 530 | 0 | 1112 | 378 | 1134 | 961 |
| V/C Ratio(X) | 0.05 | 0.00 | 0.01 | 0.44 | 0.00 | 0.00 | 0.03 | 0.00 | 0.71 | 0.05 | 0.49 | 0.02 |
| Avail Cap(c_a), veh/h | 776 | 0 | 697 | 767 | 0 | 0 | 937 | 0 | 2274 | 778 | 2304 | 1951 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 1.00 | 1.00 | 0.00 | 0.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 23.5 | 0.0 | 23.3 | 25.0 | 0.0 | 0.0 | 4.9 | 0.0 | 7.8 | 6.6 | 6.3 | 4.5 |
| Incr Delay (d2), s/veh | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 1.8 | 0.0 | 0.7 | 0.0 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.2 | 0.0 | 0.0 | 1.4 | 0.0 | 0.0 | 0.0 | 0.0 | 5.2 | 0.1 | 2.9 | 0.1 |
| Unsig. Movement Delay, s/veh | | | | | | | | | | | | |
| LnGrp Delay(d),s/veh | 23.5 | 0.0 | 23.3 | 25.5 | 0.0 | 0.0 | 4.9 | 0.0 | 9.6 | 6.6 | 7.0 | 4.5 |
| LnGrp LOS | C | A | C | C | A | A | A | A | A | A | A | A |
| Approach Vol, veh/h | | 14 | | | 109 | | | 798 | | | 599 | |
| Approach Delay, s/veh | | 23.5 | | | 25.5 | | | 9.5 | | | 6.9 | |
| Approach LOS | | C | | | C | | | A | | | A | |

| Timer - Assigned Phs | 1 | 2 | | 4 | 5 | 6 | | 8 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | 6.2 | 40.2 | | 10.4 | 6.0 | 40.5 | | 10.4 | | | | |
| Change Period (Y+Rc), s | 5.0 | 6.0 | | 5.0 | 5.0 | 6.0 | | 5.0 | | | | |
| Max Green Setting (Gmax), s | 14.0 | 70.0 | | 25.0 | 14.0 | 70.0 | | 25.0 | | | | |
| Max Q Clear Time (g_c+I1), s | 2.2 | 18.7 | | 2.4 | 2.2 | 11.6 | | 5.9 | | | | |
| Green Ext Time (p_c), s | 0.0 | 15.5 | | 0.0 | 0.0 | 9.5 | | 0.3 | | | | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM 6th Ctrl Delay | | 9.8 | |
| HCM 6th LOS | | A | |

**Notes**

User approved pedestrian interval to be less than phase max green.

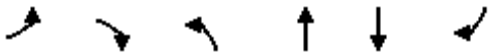
| Intersection | |
|---|---|
| Int Delay, s/veh | 3.5 |

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 38 | 39 | 87 | 162 | 69 | 42 |
| Future Vol, veh/h | 38 | 39 | 87 | 162 | 69 | 42 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Free | Free | Free | Free | Stop | Stop |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | - | - | - | - | 0 | - |
| Veh in Median Storage, # | - | 0 | 0 | - | 0 | - |
| Grade, % | - | 0 | 0 | - | 0 | - |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 41 | 42 | 95 | 176 | 75 | 46 |

| Major/Minor | Major1 | | Major2 | | Minor2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 271 | 0 | - | 0 | 307 | 183 |
| Stage 1 | - | - | - | - | 183 | - |
| Stage 2 | - | - | - | - | 124 | - |
| Critical Hdwy | 4.12 | - | - | - | 6.42 | 6.22 |
| Critical Hdwy Stg 1 | - | - | - | - | 5.42 | - |
| Critical Hdwy Stg 2 | - | - | - | - | 5.42 | - |
| Follow-up Hdwy | 2.218 | - | - | - | 3.518 | 3.318 |
| Pot Cap-1 Maneuver | 1292 | - | - | - | 685 | 859 |
| Stage 1 | - | - | - | - | 848 | - |
| Stage 2 | - | - | - | - | 902 | - |
| Platoon blocked, % | | - | - | - | | |
| Mov Cap-1 Maneuver | 1292 | - | - | - | 663 | 859 |
| Mov Cap-2 Maneuver | - | - | - | - | 663 | - |
| Stage 1 | - | - | - | - | 821 | - |
| Stage 2 | - | - | - | - | 902 | - |

| Approach | EB | WB | SB |
|---|---|---|---|
| HCM Control Delay, s | 3.9 | 0 | 10.9 |
| HCM LOS | | | B |

| Minor Lane/Major Mvmt | EBL | EBT | WBT | WBR | SBLn1 |
|---|---|---|---|---|---|
| Capacity (veh/h) | 1292 | - | - | - | 726 |
| HCM Lane V/C Ratio | 0.032 | - | - | - | 0.166 |
| HCM Control Delay (s) | 7.9 | 0 | - | - | 10.9 |
| HCM Lane LOS | A | A | - | - | B |
| HCM 95th %tile Q(veh) | 0.1 | - | - | - | 0.6 |



| Movement | EBL | EBR | NBL | NBT | SBT | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 129 | 22 | 40 | 655 | 720 | 186 |
| Future Volume (veh/h) | 129 | 22 | 40 | 655 | 720 | 186 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | 1.00 | 1.00 | | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | No | | | No | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 147 | 0 | 43 | 712 | 783 | 92 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 401 | 178 | 88 | 2179 | 1516 | 676 |
| Arrive On Green | 0.11 | 0.00 | 0.05 | 0.61 | 0.43 | 0.43 |
| Sat Flow, veh/h | 3563 | 1585 | 1781 | 3647 | 3647 | 1585 |
| Grp Volume(v), veh/h | 147 | 0 | 43 | 712 | 783 | 92 |
| Grp Sat Flow(s),veh/h/ln | 1781 | 1585 | 1781 | 1777 | 1777 | 1585 |
| Q Serve(g_s), s | 1.3 | 0.0 | 0.8 | 3.2 | 5.3 | 1.2 |
| Cycle Q Clear(g_c), s | 1.3 | 0.0 | 0.8 | 3.2 | 5.3 | 1.2 |
| Prop In Lane | 1.00 | 1.00 | 1.00 | | | 1.00 |
| Lane Grp Cap(c), veh/h | 401 | 178 | 88 | 2179 | 1516 | 676 |
| V/C Ratio(X) | 0.37 | 0.00 | 0.49 | 0.33 | 0.52 | 0.14 |
| Avail Cap(c_a), veh/h | 4344 | 1933 | 1466 | 7692 | 4279 | 1909 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 13.5 | 0.0 | 15.2 | 3.1 | 6.9 | 5.7 |
| Incr Delay (d2), s/veh | 0.6 | 0.0 | 4.1 | 0.1 | 0.3 | 0.1 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.4 | 0.0 | 0.4 | 0.3 | 1.2 | 0.2 |
| Unsig. Movement Delay, s/veh | | | | | | |
| LnGrp Delay(d),s/veh | 14.0 | 0.0 | 19.3 | 3.2 | 7.2 | 5.8 |
| LnGrp LOS | B | A | B | A | A | A |
| Approach Vol, veh/h | 147 | | | 755 | 875 | |
| Approach Delay, s/veh | 14.0 | | | 4.1 | 7.0 | |
| Approach LOS | B | | | A | A | |

| Timer - Assigned Phs | | 2 | | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | | 24.6 | | 8.2 | 6.1 | 18.5 |
| Change Period (Y+Rc), s | | 4.5 | | 4.5 | 4.5 | 4.5 |
| Max Green Setting (Gmax), s | | 71.0 | | 40.0 | 27.0 | 39.5 |
| Max Q Clear Time (g_c+I1), s | | 5.2 | | 3.3 | 2.8 | 7.3 |
| Green Ext Time (p_c), s | | 6.0 | | 0.5 | 0.1 | 6.7 |

| Intersection Summary | |
|---|---|
| HCM 6th Ctrl Delay | 6.4 |
| HCM 6th LOS | A |

**Notes**

User approved volume balancing among the lanes for turning movement.

# APPENDIX C

LOS WORKSHEETS

Base Year Conditions



| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 165 | 5 | 519 | 257 | 5 | 951 |
| Future Volume (veh/h) | 165 | 5 | 519 | 257 | 5 | 951 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | 1.00 | | 1.00 | 1.00 | |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | No | | No | | | No |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 179 | 5 | 564 | 184 | 5 | 1034 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 241 | 215 | 1231 | 1044 | 513 | 1231 |
| Arrive On Green | 0.14 | 0.14 | 0.66 | 0.66 | 0.66 | 0.66 |
| Sat Flow, veh/h | 1781 | 1585 | 1870 | 1585 | 713 | 1870 |
| Grp Volume(v), veh/h | 179 | 5 | 564 | 184 | 5 | 1034 |
| Grp Sat Flow(s),veh/h/ln | 1781 | 1585 | 1870 | 1585 | 713 | 1870 |
| Q Serve(g_s), s | 4.7 | 0.1 | 7.1 | 2.2 | 0.2 | 20.5 |
| Cycle Q Clear(g_c), s | 4.7 | 0.1 | 7.1 | 2.2 | 7.3 | 20.5 |
| Prop In Lane | 1.00 | 1.00 | | 1.00 | 1.00 | |
| Lane Grp Cap(c), veh/h | 241 | 215 | 1231 | 1044 | 513 | 1231 |
| V/C Ratio(X) | 0.74 | 0.02 | 0.46 | 0.18 | 0.01 | 0.84 |
| Avail Cap(c_a), veh/h | 955 | 850 | 2084 | 1766 | 838 | 2084 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 20.1 | 18.2 | 4.0 | 3.2 | 5.8 | 6.3 |
| Incr Delay (d2), s/veh | 4.5 | 0.0 | 0.3 | 0.1 | 0.0 | 1.6 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 2.1 | 0.0 | 0.9 | 0.2 | 0.0 | 3.0 |
| Unsig. Movement Delay, s/veh | | | | | | |
| LnGrp Delay(d),s/veh | 24.6 | 18.2 | 4.3 | 3.3 | 5.8 | 7.9 |
| LnGrp LOS | C | B | A | A | A | A |
| Approach Vol, veh/h | 184 | | 748 | | | 1039 |
| Approach Delay, s/veh | 24.5 | | 4.1 | | | 7.9 |
| Approach LOS | C | | A | | | A |

| Timer - Assigned Phs | | 2 | | | 6 | 8 |
|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | | 37.9 | | | 37.9 | 10.6 |
| Change Period (Y+Rc), s | | 6.0 | | | 6.0 | 4.0 |
| Max Green Setting (Gmax), s | | 54.0 | | | 54.0 | 26.0 |
| Max Q Clear Time (g_c+I1), s | | 9.1 | | | 22.5 | 6.7 |
| Green Ext Time (p_c), s | | 4.3 | | | 9.4 | 0.5 |

| Intersection Summary | |
|---|---|
| HCM 6th Ctrl Delay | 8.0 |
| HCM 6th LOS | A |



| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 23 | 17 | 15 | 106 | 6 | 26 | 3 | 564 | 116 | 155 | 893 | 10 |
| Future Volume (veh/h) | 23 | 17 | 15 | 106 | 6 | 26 | 3 | 564 | 116 | 155 | 893 | 10 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | | No | | | No | | | No | | | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 25 | 18 | 2 | 115 | 7 | 20 | 3 | 613 | 119 | 168 | 971 | 7 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 178 | 109 | 197 | 234 | 11 | 26 | 272 | 914 | 177 | 449 | 1235 | 1047 |
| Arrive On Green | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.00 | 0.60 | 0.60 | 0.06 | 0.66 | 0.66 |
| Sat Flow, veh/h | 827 | 876 | 1579 | 1192 | 90 | 210 | 1781 | 1522 | 295 | 1781 | 1870 | 1585 |
| Grp Volume(v), veh/h | 43 | 0 | 2 | 142 | 0 | 0 | 3 | 0 | 732 | 168 | 971 | 7 |
| Grp Sat Flow(s),veh/h/ln | 1703 | 0 | 1579 | 1492 | 0 | 0 | 1781 | 0 | 1817 | 1781 | 1870 | 1585 |
| Q Serve(g_s), s | 0.0 | 0.0 | 0.1 | 5.3 | 0.0 | 0.0 | 0.1 | 0.0 | 20.4 | 2.5 | 27.8 | 0.1 |
| Cycle Q Clear(g_c), s | 1.6 | 0.0 | 0.1 | 6.9 | 0.0 | 0.0 | 0.1 | 0.0 | 20.4 | 2.5 | 27.8 | 0.1 |
| Prop In Lane | 0.58 | | 1.00 | 0.81 | | 0.14 | 1.00 | | 0.16 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 287 | 0 | 197 | 272 | 0 | 0 | 272 | 0 | 1091 | 449 | 1235 | 1047 |
| V/C Ratio(X) | 0.15 | 0.00 | 0.01 | 0.52 | 0.00 | 0.00 | 0.01 | 0.00 | 0.67 | 0.37 | 0.79 | 0.01 |
| Avail Cap(c_a), veh/h | 606 | 0 | 521 | 566 | 0 | 0 | 594 | 0 | 1678 | 664 | 1728 | 1464 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 1.00 | 1.00 | 0.00 | 0.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 29.7 | 0.0 | 29.1 | 31.9 | 0.0 | 0.0 | 9.5 | 0.0 | 10.1 | 8.3 | 9.1 | 4.4 |
| Incr Delay (d2), s/veh | 0.1 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 1.5 | 0.2 | 2.8 | 0.0 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.7 | 0.0 | 0.0 | 2.5 | 0.0 | 0.0 | 0.0 | 0.0 | 7.2 | 0.7 | 9.6 | 0.0 |
| Unsig. Movement Delay, s/veh | | | | | | | | | | | | |
| LnGrp Delay(d),s/veh | 29.8 | 0.0 | 29.1 | 32.5 | 0.0 | 0.0 | 9.5 | 0.0 | 11.7 | 8.5 | 11.8 | 4.4 |
| LnGrp LOS | C | A | C | C | A | A | A | A | B | A | B | A |
| Approach Vol, veh/h | | 45 | | | 142 | | | 735 | | | 1146 | |
| Approach Delay, s/veh | | 29.8 | | | 32.5 | | | 11.7 | | | 11.3 | |
| Approach LOS | | C | | | C | | | B | | | B | |

| Timer - Assigned Phs | 1 | 2 | | 4 | 5 | 6 | | 8 |
|---|---|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | 9.9 | 51.5 | | 14.4 | 5.3 | 56.0 | | 14.4 |
| Change Period (Y+Rc), s | 5.0 | 6.0 | | 5.0 | 5.0 | 6.0 | | 5.0 |
| Max Green Setting (Gmax), s | 4.9 | 70.0 | | 25.0 | 14.0 | 70.0 | | 25.0 |
| Max Q Clear Time (g_c+I1), s | 4.5 | 22.4 | | 3.6 | 2.1 | 29.8 | | 8.9 |
| Green Ext Time (p_c), s | 0.2 | 13.7 | | 0.1 | 0.0 | 20.3 | | 0.4 |

| Intersection Summary | |
|---|---|
| HCM 6th Ctrl Delay | 13.3 |
| HCM 6th LOS | B |

**Notes**

User approved pedestrian interval to be less than phase max green.



| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 81 | 216 | 0 | 30 | 54 | 119 | 0 | 314 | 58 | 324 | 230 | 91 |
| Future Volume (veh/h) | 81 | 216 | 0 | 30 | 54 | 119 | 0 | 314 | 58 | 324 | 230 | 91 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | | No | | | No | | | No | | | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 88 | 235 | 0 | 33 | 59 | 20 | 0 | 341 | 14 | 352 | 250 | 86 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 409 | 340 | 0 | 266 | 287 | 244 | 406 | 469 | 397 | 560 | 687 | 236 |
| Arrive On Green | 0.06 | 0.18 | 0.00 | 0.03 | 0.15 | 0.15 | 0.00 | 0.25 | 0.25 | 0.19 | 0.52 | 0.52 |
| Sat Flow, veh/h | 1781 | 1870 | 0 | 1781 | 1870 | 1585 | 1781 | 1870 | 1585 | 1781 | 1330 | 458 |
| Grp Volume(v), veh/h | 88 | 235 | 0 | 33 | 59 | 20 | 0 | 341 | 14 | 352 | 0 | 336 |
| Grp Sat Flow(s),veh/h/ln | 1781 | 1870 | 0 | 1781 | 1870 | 1585 | 1781 | 1870 | 1585 | 1781 | 0 | 1788 |
| Q Serve(g_s), s | 2.1 | 6.0 | 0.0 | 0.8 | 1.4 | 0.6 | 0.0 | 8.6 | 0.3 | 6.6 | 0.0 | 5.7 |
| Cycle Q Clear(g_c), s | 2.1 | 6.0 | 0.0 | 0.8 | 1.4 | 0.6 | 0.0 | 8.6 | 0.3 | 6.6 | 0.0 | 5.7 |
| Prop In Lane | 1.00 | | 0.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 0.26 |
| Lane Grp Cap(c), veh/h | 409 | 340 | 0 | 266 | 287 | 244 | 406 | 469 | 397 | 560 | 0 | 923 |
| V/C Ratio(X) | 0.22 | 0.69 | 0.00 | 0.12 | 0.21 | 0.08 | 0.00 | 0.73 | 0.04 | 0.63 | 0.00 | 0.36 |
| Avail Cap(c_a), veh/h | 446 | 1021 | 0 | 422 | 1094 | 927 | 541 | 1349 | 1143 | 1302 | 0 | 2230 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 |
| Uniform Delay (d), s/veh | 16.8 | 19.7 | 0.0 | 17.7 | 19.0 | 18.6 | 0.0 | 17.6 | 14.5 | 10.4 | 0.0 | 7.4 |
| Incr Delay (d2), s/veh | 0.3 | 2.5 | 0.0 | 0.2 | 0.3 | 0.1 | 0.0 | 2.2 | 0.0 | 1.2 | 0.0 | 0.2 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.8 | 2.7 | 0.0 | 0.3 | 0.6 | 0.2 | 0.0 | 3.6 | 0.1 | 2.3 | 0.0 | 1.8 |
| Unsig. Movement Delay, s/veh | | | | | | | | | | | | |
| LnGrp Delay(d),s/veh | 17.1 | 22.2 | 0.0 | 17.9 | 19.3 | 18.8 | 0.0 | 19.8 | 14.6 | 11.5 | 0.0 | 7.6 |
| LnGrp LOS | B | C | A | B | B | B | A | B | B | B | A | A |
| Approach Vol, veh/h | | 323 | | | 112 | | | 355 | | | 688 | |
| Approach Delay, s/veh | | 20.8 | | | 18.8 | | | 19.6 | | | 9.6 | |
| Approach LOS | | C | | | B | | | B | | | A | |

| Timer - Assigned Phs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | 13.6 | 17.9 | 5.5 | 14.3 | 0.0 | 31.5 | 6.9 | 12.9 |
| Change Period (Y+Rc), s | 4.0 | 5.0 | 4.0 | 5.0 | 4.0 | 5.0 | 4.0 | 5.0 |
| Max Green Setting (Gmax), s | 31.6 | 37.0 | 6.0 | 28.0 | 4.0 | 64.0 | 4.0 | 30.0 |
| Max Q Clear Time (g_c+I1), s | 8.6 | 10.6 | 2.8 | 8.0 | 0.0 | 7.7 | 4.1 | 3.4 |
| Green Ext Time (p_c), s | 1.1 | 2.3 | 0.0 | 1.3 | 0.0 | 2.5 | 0.0 | 0.3 |

| Intersection Summary | |
|---|---|
| HCM 6th Ctrl Delay | 15.2 |
| HCM 6th LOS | B |



| Movement | EBL | EBR | NBL | NBT | SBT | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 400 | 148 | 112 | 507 | 674 | 231 |
| Future Volume (veh/h) | 400 | 148 | 112 | 507 | 674 | 231 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | 1.00 | 1.00 | | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | No | | | No | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 278 | 290 | 122 | 551 | 733 | 76 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 459 | 408 | 164 | 1901 | 1206 | 538 |
| Arrive On Green | 0.26 | 0.26 | 0.09 | 0.53 | 0.34 | 0.34 |
| Sat Flow, veh/h | 1781 | 1585 | 1781 | 3647 | 3647 | 1585 |
| Grp Volume(v), veh/h | 278 | 290 | 122 | 551 | 733 | 76 |
| Grp Sat Flow(s),veh/h/ln | 1781 | 1585 | 1781 | 1777 | 1777 | 1585 |
| Q Serve(g_s), s | 6.0 | 7.2 | 2.9 | 3.7 | 7.4 | 1.4 |
| Cycle Q Clear(g_c), s | 6.0 | 7.2 | 2.9 | 3.7 | 7.4 | 1.4 |
| Prop In Lane | 1.00 | 1.00 | 1.00 | | | 1.00 |
| Lane Grp Cap(c), veh/h | 459 | 408 | 164 | 1901 | 1206 | 538 |
| V/C Ratio(X) | 0.61 | 0.71 | 0.75 | 0.29 | 0.61 | 0.14 |
| Avail Cap(c_a), veh/h | 1642 | 1461 | 1109 | 5816 | 3236 | 1443 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 14.2 | 14.6 | 19.2 | 5.6 | 11.9 | 9.9 |
| Incr Delay (d2), s/veh | 1.3 | 2.3 | 6.6 | 0.1 | 0.5 | 0.1 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 2.2 | 6.3 | 1.3 | 0.7 | 2.1 | 0.4 |
| Unsig. Movement Delay, s/veh | | | | | | |
| LnGrp Delay(d),s/veh | 15.5 | 16.9 | 25.8 | 5.6 | 12.4 | 10.1 |
| LnGrp LOS | B | B | C | A | B | B |
| Approach Vol, veh/h | 568 | | | 673 | 809 | |
| Approach Delay, s/veh | 16.2 | | | 9.3 | 12.2 | |
| Approach LOS | B | | | A | B | |

| Timer - Assigned Phs | 2 | | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | 27.7 | | 15.7 | 8.5 | 19.2 |
| Change Period (Y+Rc), s | 4.5 | | 4.5 | 4.5 | 4.5 |
| Max Green Setting (Gmax), s | 71.0 | | 40.0 | 27.0 | 39.5 |
| Max Q Clear Time (g_c+I1), s | 5.7 | | 9.2 | 4.9 | 9.4 |
| Green Ext Time (p_c), s | 3.7 | | 2.0 | 0.3 | 5.3 |

| Intersection Summary | |
|---|---|
| HCM 6th Ctrl Delay | 12.4 |
| HCM 6th LOS | B |

**Notes**

User approved volume balancing among the lanes for turning movement.

# MOVEMENT SUMMARY

## Site: 101 [Honoapiilani Hwy/Waiale Rd Ext. (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

**Vehicle Movement Performance**

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] % | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] ft | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed mph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: NB Honoapiilani Hwy | | | | | | | | | | | | | | |
| 7 | T1 | 519 | 2.0 | 546 | 2.0 | 0.597 | 0.1 | LOS A | 7.4 | 187.0 | 0.11 | 0.01 | 0.11 | 19.9 |
| 25 | R2 | 257 | 2.0 | 271 | 2.0 | 0.597 | 0.1 | LOS A | 7.4 | 187.0 | 0.11 | 0.01 | 0.11 | 19.9 |
| Approach | | 776 | 2.0 | 817 | 2.0 | 0.597 | 0.1 | LOS A | 7.4 | 187.0 | 0.11 | 0.01 | 0.11 | 19.9 |
| East: WB Waiale Rd Ext. | | | | | | | | | | | | | | |
| 19 | L2 | 165 | 2.0 | 174 | 2.0 | 0.194 | 6.0 | LOS A | 1.1 | 27.0 | 0.60 | 0.64 | 0.60 | 20.3 |
| 24 | R2 | 5 | 2.0 | 5 | 2.0 | 0.194 | 3.0 | LOS A | 1.1 | 27.0 | 0.60 | 0.64 | 0.60 | 19.0 |
| Approach | | 170 | 2.0 | 179 | 2.0 | 0.194 | 5.9 | LOS A | 1.1 | 27.0 | 0.60 | 0.64 | 0.60 | 20.3 |
| North: SB Honoapiilani Hwy | | | | | | | | | | | | | | |
| 15 | L2 | 5 | 2.0 | 5 | 2.0 | 0.857 | 8.0 | LOS A | 16.2 | 411.8 | 0.97 | 0.78 | 1.08 | 20.4 |
| 2 | T1 | 951 | 2.0 | 1001 | 2.0 | 0.857 | 5.0 | LOS A | 16.2 | 411.8 | 0.97 | 0.78 | 1.08 | 19.1 |
| Approach | | 956 | 2.0 | 1006 | 2.0 | 0.857 | 5.0 | LOS A | 16.2 | 411.8 | 0.97 | 0.78 | 1.08 | 19.1 |
| All Vehicles | | 1902 | 2.0 | 2002 | 2.0 | 0.857 | 3.1 | LOS A | 16.2 | 411.8 | 0.58 | 0.46 | 0.64 | 19.5 |

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# MOVEMENT SUMMARY

## Site: 101 [Waiale Rd - Waiko Rd (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

**Vehicle Movement Performance**

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] % | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] ft | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed mph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: NB Waiale Road | | | | | | | | | | | | | | |
| 102 | L2 | 1 | 2.0 | 1 | 2.0 | 0.489 | 8.6 | LOS A | 3.8 | 97.2 | 0.81 | 0.84 | 0.92 | 20.3 |
| 7 | T1 | 314 | 2.0 | 331 | 2.0 | 0.489 | 5.6 | LOS A | 3.8 | 97.2 | 0.81 | 0.84 | 0.92 | 19.0 |
| 25 | R2 | 58 | 2.0 | 61 | 2.0 | 0.489 | 5.6 | LOS A | 3.8 | 97.2 | 0.81 | 0.84 | 0.92 | 19.0 |
| Approach | | 373 | 2.0 | 393 | 2.0 | 0.489 | 5.7 | LOS A | 3.8 | 97.2 | 0.81 | 0.84 | 0.92 | 19.1 |
| East: WB Waiko Road | | | | | | | | | | | | | | |
| 19 | L2 | 30 | 2.0 | 32 | 2.0 | 0.225 | 5.2 | LOS A | 1.4 | 34.7 | 0.60 | 0.47 | 0.60 | 20.8 |
| 336 | T1 | 54 | 2.0 | 57 | 2.0 | 0.225 | 2.2 | LOS A | 1.4 | 34.7 | 0.60 | 0.47 | 0.60 | 19.4 |
| 24 | R2 | 119 | 2.0 | 125 | 2.0 | 0.225 | 2.2 | LOS A | 1.4 | 34.7 | 0.60 | 0.47 | 0.60 | 19.4 |
| Approach | | 203 | 2.0 | 214 | 2.0 | 0.225 | 2.6 | LOS A | 1.4 | 34.7 | 0.60 | 0.47 | 0.60 | 19.6 |
| North: SB Waiale Road | | | | | | | | | | | | | | |
| 15 | L2 | 324 | 2.0 | 341 | 2.0 | 0.539 | 3.7 | LOS A | 4.8 | 121.3 | 0.42 | 0.30 | 0.42 | 20.7 |
| 2 | T1 | 230 | 2.0 | 242 | 2.0 | 0.539 | 0.7 | LOS A | 4.8 | 121.3 | 0.42 | 0.30 | 0.42 | 19.4 |
| 40 | R2 | 91 | 2.0 | 96 | 2.0 | 0.539 | 0.7 | LOS A | 4.8 | 121.3 | 0.42 | 0.30 | 0.42 | 19.4 |
| Approach | | 645 | 2.0 | 679 | 2.0 | 0.539 | 2.2 | LOS A | 4.8 | 121.3 | 0.42 | 0.30 | 0.42 | 20.1 |
| West: EB Waiko Road | | | | | | | | | | | | | | |
| 30 | L2 | 81 | 2.0 | 85 | 2.0 | 0.380 | 7.0 | LOS A | 2.5 | 63.7 | 0.75 | 0.71 | 0.75 | 20.4 |
| 464 | T1 | 216 | 2.0 | 227 | 2.0 | 0.380 | 4.0 | LOS A | 2.5 | 63.7 | 0.75 | 0.71 | 0.75 | 19.1 |
| 78 | R2 | 1 | 2.0 | 1 | 2.0 | 0.380 | 4.0 | LOS A | 2.5 | 63.7 | 0.75 | 0.71 | 0.75 | 19.1 |
| Approach | | 298 | 2.0 | 314 | 2.0 | 0.380 | 4.8 | LOS A | 2.5 | 63.7 | 0.75 | 0.71 | 0.75 | 19.5 |
| All Vehicles | | 1519 | 2.0 | 1599 | 2.0 | 0.539 | 3.6 | LOS A | 4.8 | 121.3 | 0.61 | 0.54 | 0.63 | 19.6 |

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# MOVEMENT SUMMARY

## Site: 101 [Waiale Rd Ext - Main St BY 2029 (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

**Vehicle Movement Performance**

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] % | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] ft | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed mph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: NB Waiale Road Ext | | | | | | | | | | | | | | |
| 102 | L2 | 25 | 2.0 | 26 | 2.0 | 0.268 | 3.4 | LOS A | 1.6 | 40.5 | 0.25 | 0.10 | 0.25 | 21.1 |
| 7 | T1 | 304 | 2.0 | 320 | 2.0 | 0.268 | 0.4 | LOS A | 1.6 | 40.5 | 0.25 | 0.10 | 0.25 | 19.7 |
| Approach | | 329 | 2.0 | 346 | 2.0 | 0.268 | 0.6 | LOS A | 1.6 | 40.5 | 0.25 | 0.10 | 0.25 | 19.8 |
| North: SB Waiale Road Ext | | | | | | | | | | | | | | |
| 2 | T1 | 211 | 2.0 | 222 | 2.0 | 0.204 | 0.1 | LOS A | 1.1 | 27.9 | 0.13 | 0.02 | 0.13 | 19.9 |
| 40 | R2 | 49 | 2.0 | 52 | 2.0 | 0.204 | 0.1 | LOS A | 1.1 | 27.9 | 0.13 | 0.02 | 0.13 | 19.9 |
| Approach | | 260 | 2.0 | 274 | 2.0 | 0.204 | 0.1 | LOS A | 1.1 | 27.9 | 0.13 | 0.02 | 0.13 | 19.9 |
| West: EB Main Street | | | | | | | | | | | | | | |
| 30 | L2 | 68 | 2.0 | 72 | 2.0 | 0.085 | 3.9 | LOS A | 0.4 | 10.2 | 0.36 | 0.40 | 0.36 | 20.7 |
| 78 | R2 | 25 | 2.0 | 26 | 2.0 | 0.085 | 1.0 | LOS A | 0.4 | 10.2 | 0.36 | 0.40 | 0.36 | 19.4 |
| Approach | | 93 | 2.0 | 98 | 2.0 | 0.085 | 3.1 | LOS A | 0.4 | 10.2 | 0.36 | 0.40 | 0.36 | 20.3 |
| All Vehicles | | 682 | 2.0 | 718 | 2.0 | 0.268 | 0.8 | LOS A | 1.6 | 40.5 | 0.22 | 0.11 | 0.22 | 19.9 |

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.



| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 244 | 5 | 796 | 311 | 5 | 651 |
| Future Volume (veh/h) | 244 | 5 | 796 | 311 | 5 | 651 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | 1.00 | | 1.00 | 1.00 | |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | No | | No | | | No |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 265 | 5 | 865 | 191 | 5 | 708 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 348 | 309 | 1085 | 920 | 302 | 1085 |
| Arrive On Green | 0.20 | 0.20 | 0.58 | 0.58 | 0.58 | 0.58 |
| Sat Flow, veh/h | 1781 | 1585 | 1870 | 1585 | 640 | 1870 |
| Grp Volume(v), veh/h | 265 | 5 | 865 | 191 | 5 | 708 |
| Grp Sat Flow(s),veh/h/ln | 1781 | 1585 | 1870 | 1585 | 640 | 1870 |
| Q Serve(g_s), s | 6.3 | 0.1 | 16.1 | 2.6 | 0.3 | 11.4 |
| Cycle Q Clear(g_c), s | 6.3 | 0.1 | 16.1 | 2.6 | 16.4 | 11.4 |
| Prop In Lane | 1.00 | 1.00 | | 1.00 | 1.00 | |
| Lane Grp Cap(c), veh/h | 348 | 309 | 1085 | 920 | 302 | 1085 |
| V/C Ratio(X) | 0.76 | 0.02 | 0.80 | 0.21 | 0.02 | 0.65 |
| Avail Cap(c_a), veh/h | 1040 | 926 | 2268 | 1922 | 706 | 2268 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 16.9 | 14.5 | 7.3 | 4.5 | 13.7 | 6.3 |
| Incr Delay (d2), s/veh | 3.5 | 0.0 | 1.4 | 0.1 | 0.0 | 0.7 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 2.6 | 0.0 | 3.0 | 0.4 | 0.0 | 2.0 |
| Unsig. Movement Delay, s/veh | | | | | | |
| LnGrp Delay(d),s/veh | 20.4 | 14.5 | 8.7 | 4.6 | 13.7 | 7.0 |
| LnGrp LOS | C | B | A | A | B | A |
| Approach Vol, veh/h | 270 | | 1056 | | | 713 |
| Approach Delay, s/veh | 20.3 | | 7.9 | | | 7.0 |
| Approach LOS | C | | A | | | A |

| Timer - Assigned Phs | | 2 | | | 6 | 8 |
|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | | 31.8 | | | 31.8 | 12.7 |
| Change Period (Y+Rc), s | | 6.0 | | | 6.0 | 4.0 |
| Max Green Setting (Gmax), s | | 54.0 | | | 54.0 | 26.0 |
| Max Q Clear Time (g_c+I1), s | | 18.1 | | | 18.4 | 8.3 |
| Green Ext Time (p_c), s | | 7.8 | | | 5.1 | 0.7 |

| Intersection Summary | |
|---|---|
| HCM 6th Ctrl Delay | 9.3 |
| HCM 6th LOS | A |



| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 9 | 3 | 14 | 119 | 17 | 72 | 16 | 800 | 94 | 35 | 702 | 27 |
| Future Volume (veh/h) | 9 | 3 | 14 | 119 | 17 | 72 | 16 | 800 | 94 | 35 | 702 | 27 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | | No | | | No | | | No | | | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 10 | 3 | 2 | 129 | 18 | 62 | 17 | 870 | 99 | 38 | 763 | 17 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 230 | 60 | 258 | 210 | 26 | 73 | 392 | 1034 | 118 | 262 | 1201 | 1017 |
| Arrive On Green | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.02 | 0.63 | 0.63 | 0.03 | 0.64 | 0.64 |
| Sat Flow, veh/h | 984 | 371 | 1585 | 896 | 161 | 446 | 1781 | 1649 | 188 | 1781 | 1870 | 1584 |
| Grp Volume(v), veh/h | 13 | 0 | 2 | 209 | 0 | 0 | 17 | 0 | 969 | 38 | 763 | 17 |
| Grp Sat Flow(s),veh/h/ln | 1355 | 0 | 1585 | 1503 | 0 | 0 | 1781 | 0 | 1836 | 1781 | 1870 | 1584 |
| Q Serve(g_s), s | 0.0 | 0.0 | 0.1 | 11.7 | 0.0 | 0.0 | 0.3 | 0.0 | 37.9 | 0.7 | 22.4 | 0.4 |
| Cycle Q Clear(g_c), s | 0.5 | 0.0 | 0.1 | 12.3 | 0.0 | 0.0 | 0.3 | 0.0 | 37.9 | 0.7 | 22.4 | 0.4 |
| Prop In Lane | 0.77 | | 1.00 | 0.62 | | 0.30 | 1.00 | | 0.10 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 291 | 0 | 258 | 309 | 0 | 0 | 392 | 0 | 1152 | 262 | 1201 | 1017 |
| V/C Ratio(X) | 0.04 | 0.00 | 0.01 | 0.68 | 0.00 | 0.00 | 0.04 | 0.00 | 0.84 | 0.15 | 0.64 | 0.02 |
| Avail Cap(c_a), veh/h | 450 | 0 | 436 | 476 | 0 | 0 | 632 | 0 | 1414 | 476 | 1440 | 1220 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 1.00 | 1.00 | 0.00 | 0.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 32.1 | 0.0 | 31.9 | 36.9 | 0.0 | 0.0 | 8.2 | 0.0 | 13.4 | 13.8 | 9.8 | 5.9 |
| Incr Delay (d2), s/veh | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.1 | 0.1 | 1.3 | 0.0 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.2 | 0.0 | 0.0 | 4.6 | 0.0 | 0.0 | 0.1 | 0.0 | 15.0 | 0.3 | 8.4 | 0.1 |
| Unsig. Movement Delay, s/veh | | | | | | | | | | | | |
| LnGrp Delay(d),s/veh | 32.1 | 0.0 | 31.9 | 37.9 | 0.0 | 0.0 | 8.3 | 0.0 | 18.5 | 13.9 | 11.1 | 5.9 |
| LnGrp LOS | C | A | C | D | A | A | A | A | B | B | B | A |
| Approach Vol, veh/h | | 15 | | | 209 | | | 986 | | | 818 | |
| Approach Delay, s/veh | | 32.1 | | | 37.9 | | | 18.3 | | | 11.1 | |
| Approach LOS | | C | | | D | | | B | | | B | |

| Timer - Assigned Phs | 1 | 2 | | 4 | 5 | 6 | | 8 |
|---|---|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | 8.1 | 63.0 | | 19.8 | 6.7 | 64.4 | | 19.8 |
| Change Period (Y+Rc), s | 5.0 | 6.0 | | 5.0 | 5.0 | 6.0 | | 5.0 |
| Max Green Setting (Gmax), s | 14.6 | 70.0 | | 25.0 | 14.0 | 70.0 | | 25.0 |
| Max Q Clear Time (g_c+I1), s | 2.5 | 39.9 | | 2.5 | 2.3 | 24.4 | | 14.3 |
| Green Ext Time (p_c), s | 0.0 | 17.2 | | 0.0 | 0.0 | 14.4 | | 0.6 |

| Intersection Summary | |
|---|---|
| HCM 6th Ctrl Delay | 17.5 |
| HCM 6th LOS | B |

**Notes**

User approved pedestrian interval to be less than phase max green.



| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 51 | 80 | 0 | 76 | 144 | 311 | 0 | 340 | 54 | 165 | 272 | 70 |
| Future Volume (veh/h) | 51 | 80 | 0 | 76 | 144 | 311 | 0 | 340 | 54 | 165 | 272 | 70 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | | No | | | No | | | No | | | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 55 | 87 | 0 | 83 | 157 | 54 | 0 | 370 | 14 | 179 | 296 | 67 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 331 | 252 | 0 | 395 | 278 | 236 | 460 | 527 | 447 | 457 | 706 | 160 |
| Arrive On Green | 0.04 | 0.13 | 0.00 | 0.06 | 0.15 | 0.15 | 0.00 | 0.28 | 0.28 | 0.10 | 0.48 | 0.48 |
| Sat Flow, veh/h | 1781 | 1870 | 0 | 1781 | 1870 | 1585 | 1781 | 1870 | 1585 | 1781 | 1476 | 334 |
| Grp Volume(v), veh/h | 55 | 87 | 0 | 83 | 157 | 54 | 0 | 370 | 14 | 179 | 0 | 363 |
| Grp Sat Flow(s),veh/h/ln | 1781 | 1870 | 0 | 1781 | 1870 | 1585 | 1781 | 1870 | 1585 | 1781 | 0 | 1810 |
| Q Serve(g_s), s | 1.1 | 1.8 | 0.0 | 1.7 | 3.3 | 1.3 | 0.0 | 7.6 | 0.3 | 2.7 | 0.0 | 5.6 |
| Cycle Q Clear(g_c), s | 1.1 | 1.8 | 0.0 | 1.7 | 3.3 | 1.3 | 0.0 | 7.6 | 0.3 | 2.7 | 0.0 | 5.6 |
| Prop In Lane | 1.00 | | 0.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 0.18 |
| Lane Grp Cap(c), veh/h | 331 | 252 | 0 | 395 | 278 | 236 | 460 | 527 | 447 | 457 | 0 | 866 |
| V/C Ratio(X) | 0.17 | 0.34 | 0.00 | 0.21 | 0.56 | 0.23 | 0.00 | 0.70 | 0.03 | 0.39 | 0.00 | 0.42 |
| Avail Cap(c_a), veh/h | 418 | 920 | 0 | 916 | 1402 | 1188 | 623 | 1489 | 1262 | 774 | 0 | 1781 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 |
| Uniform Delay (d), s/veh | 14.9 | 16.8 | 0.0 | 14.6 | 16.9 | 16.0 | 0.0 | 13.7 | 11.1 | 9.0 | 0.0 | 7.3 |
| Incr Delay (d2), s/veh | 0.2 | 0.8 | 0.0 | 0.3 | 1.8 | 0.5 | 0.0 | 1.7 | 0.0 | 0.5 | 0.0 | 0.3 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.4 | 0.8 | 0.0 | 0.6 | 1.4 | 0.4 | 0.0 | 3.0 | 0.1 | 0.9 | 0.0 | 1.7 |
| Unsig. Movement Delay, s/veh | | | | | | | | | | | | |
| LnGrp Delay(d),s/veh | 15.1 | 17.6 | 0.0 | 14.9 | 18.7 | 16.5 | 0.0 | 15.4 | 11.1 | 9.5 | 0.0 | 7.6 |
| LnGrp LOS | B | B | A | B | B | B | A | B | B | A | A | A |
| Approach Vol, veh/h | | 142 | | | 294 | | | 384 | | | 542 | |
| Approach Delay, s/veh | | 16.6 | | | 17.2 | | | 15.3 | | | 8.2 | |
| Approach LOS | | B | | | B | | | B | | | A | |

| Timer - Assigned Phs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | 8.4 | 17.0 | 6.5 | 10.8 | 0.0 | 25.4 | 5.9 | 11.4 |
| Change Period (Y+Rc), s | 4.0 | 5.0 | 4.0 | 5.0 | 4.0 | 5.0 | 4.0 | 5.0 |
| Max Green Setting (Gmax), s | 12.0 | 34.0 | 15.0 | 21.0 | 4.0 | 42.0 | 4.0 | 32.0 |
| Max Q Clear Time (g_c+I1), s | 4.3 | 9.6 | 3.7 | 3.8 | 0.0 | 7.6 | 3.1 | 5.3 |
| Green Ext Time (p_c), s | 0.3 | 2.5 | 0.1 | 0.3 | 0.0 | 2.6 | 0.0 | 1.1 |

| Intersection Summary | |
|---|---|
| HCM 6th Ctrl Delay | 13.0 |
| HCM 6th LOS | B |



| Movement | EBL | EBR | NBL | NBT | SBT | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 354 | 173 | 181 | 722 | 766 | 381 |
| Future Volume (veh/h) | 354 | 173 | 181 | 722 | 766 | 381 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | 1.00 | 1.00 | | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | No | | | No | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 246 | 256 | 197 | 785 | 833 | 163 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 398 | 354 | 259 | 2124 | 1288 | 575 |
| Arrive On Green | 0.22 | 0.22 | 0.15 | 0.60 | 0.36 | 0.36 |
| Sat Flow, veh/h | 1781 | 1585 | 1781 | 3647 | 3647 | 1585 |
| Grp Volume(v), veh/h | 246 | 256 | 197 | 785 | 833 | 163 |
| Grp Sat Flow(s),veh/h/ln | 1781 | 1585 | 1781 | 1777 | 1777 | 1585 |
| Q Serve(g_s), s | 6.3 | 7.5 | 5.3 | 5.7 | 9.8 | 3.7 |
| Cycle Q Clear(g_c), s | 6.3 | 7.5 | 5.3 | 5.7 | 9.8 | 3.7 |
| Prop In Lane | 1.00 | 1.00 | 1.00 | | | 1.00 |
| Lane Grp Cap(c), veh/h | 398 | 354 | 259 | 2124 | 1288 | 575 |
| V/C Ratio(X) | 0.62 | 0.72 | 0.76 | 0.37 | 0.65 | 0.28 |
| Avail Cap(c_a), veh/h | 1418 | 1262 | 957 | 5021 | 2793 | 1246 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 17.6 | 18.1 | 20.6 | 5.2 | 13.3 | 11.4 |
| Incr Delay (d2), s/veh | 1.6 | 2.8 | 4.5 | 0.1 | 0.6 | 0.3 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 2.5 | 6.6 | 2.2 | 1.1 | 3.0 | 1.0 |
| Unsig. Movement Delay, s/veh | | | | | | |
| LnGrp Delay(d),s/veh | 19.2 | 20.9 | 25.2 | 5.3 | 13.9 | 11.7 |
| LnGrp LOS | B | C | C | A | B | B |
| Approach Vol, veh/h | 502 | | | 982 | 996 | |
| Approach Delay, s/veh | 20.0 | | | 9.3 | 13.5 | |
| Approach LOS | C | | | A | B | |

| Timer - Assigned Phs | | 2 | | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | | 34.5 | | 15.7 | 11.8 | 22.7 |
| Change Period (Y+Rc), s | | 4.5 | | 4.5 | 4.5 | 4.5 |
| Max Green Setting (Gmax), s | | 71.0 | | 40.0 | 27.0 | 39.5 |
| Max Q Clear Time (g_c+I1), s | | 7.7 | | 9.5 | 7.3 | 11.8 |
| Green Ext Time (p_c), s | | 5.8 | | 1.7 | 0.5 | 6.4 |

| Intersection Summary | | |
|---|---|---|
| HCM 6th Ctrl Delay | | 13.2 |
| HCM 6th LOS | | B |

**Notes**

User approved volume balancing among the lanes for turning movement.

# MOVEMENT SUMMARY

## Site: 101 [Honoapiilani Hwy/Waiale Rd Ext. (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

**Vehicle Movement Performance**

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] % | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] ft | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed mph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: NB Honoapiilani Hwy | | | | | | | | | | | | | | |
| 7 | T1 | 796 | 2.0 | 838 | 2.0 | 0.852 | 0.1 | LOS A | 24.1 | 611.5 | 0.25 | 0.03 | 0.25 | 19.8 |
| 25 | R2 | 311 | 2.0 | 327 | 2.0 | 0.852 | 0.1 | LOS A | 24.1 | 611.5 | 0.25 | 0.03 | 0.25 | 19.8 |
| Approach | | 1107 | 2.0 | 1165 | 2.0 | 0.852 | 0.1 | LOS A | 24.1 | 611.5 | 0.25 | 0.03 | 0.25 | 19.8 |
| East: WB Waiale Rd Ext. | | | | | | | | | | | | | | |
| 19 | L2 | 244 | 2.0 | 257 | 2.0 | 0.376 | 9.3 | LOS A | 2.5 | 64.0 | 0.83 | 0.86 | 0.83 | 19.7 |
| 24 | R2 | 5 | 2.0 | 5 | 2.0 | 0.376 | 6.4 | LOS A | 2.5 | 64.0 | 0.83 | 0.86 | 0.83 | 18.5 |
| Approach | | 249 | 2.0 | 262 | 2.0 | 0.376 | 9.2 | LOS A | 2.5 | 64.0 | 0.83 | 0.86 | 0.83 | 19.7 |
| North: SB Honoapiilani Hwy | | | | | | | | | | | | | | |
| 15 | L2 | 5 | 2.0 | 5 | 2.0 | 0.643 | 5.7 | LOS A | 6.5 | 165.9 | 0.75 | 0.51 | 0.79 | 20.6 |
| 2 | T1 | 651 | 2.0 | 685 | 2.0 | 0.643 | 2.7 | LOS A | 6.5 | 165.9 | 0.75 | 0.51 | 0.79 | 19.3 |
| Approach | | 656 | 2.0 | 691 | 2.0 | 0.643 | 2.8 | LOS A | 6.5 | 165.9 | 0.75 | 0.51 | 0.79 | 19.3 |
| All Vehicles | | 2012 | 2.0 | 2118 | 2.0 | 0.852 | 2.1 | LOS A | 24.1 | 611.5 | 0.48 | 0.29 | 0.50 | 19.6 |

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# MOVEMENT SUMMARY

## Site: 101 [Waiale Rd - Waiko Rd (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

**Vehicle Movement Performance**

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] % | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] ft | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed mph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: NB Waiale Road | | | | | | | | | | | | | | |
| 102 | L2 | 1 | 2.0 | 1 | 2.0 | 0.391 | 4.9 | LOS A | 2.5 | 63.7 | 0.57 | 0.35 | 0.57 | 20.8 |
| 7 | T1 | 340 | 2.0 | 358 | 2.0 | 0.391 | 1.9 | LOS A | 2.5 | 63.7 | 0.57 | 0.35 | 0.57 | 19.5 |
| 25 | R2 | 54 | 2.0 | 57 | 2.0 | 0.391 | 1.9 | LOS A | 2.5 | 63.7 | 0.57 | 0.35 | 0.57 | 19.5 |
| Approach | | 395 | 2.0 | 416 | 2.0 | 0.391 | 2.0 | LOS A | 2.5 | 63.7 | 0.57 | 0.35 | 0.57 | 19.5 |
| East: WB Waiko Road | | | | | | | | | | | | | | |
| 19 | L2 | 76 | 2.0 | 80 | 2.0 | 0.578 | 6.9 | LOS A | 5.1 | 129.4 | 0.76 | 0.74 | 0.85 | 20.6 |
| 336 | T1 | 144 | 2.0 | 152 | 2.0 | 0.578 | 4.0 | LOS A | 5.1 | 129.4 | 0.76 | 0.74 | 0.85 | 19.2 |
| 24 | R2 | 311 | 2.0 | 327 | 2.0 | 0.578 | 4.0 | LOS A | 5.1 | 129.4 | 0.76 | 0.74 | 0.85 | 19.2 |
| Approach | | 531 | 2.0 | 559 | 2.0 | 0.578 | 4.4 | LOS A | 5.1 | 129.4 | 0.76 | 0.74 | 0.85 | 19.4 |
| North: SB Waiale Road | | | | | | | | | | | | | | |
| 15 | L2 | 165 | 2.0 | 174 | 2.0 | 0.485 | 4.6 | LOS A | 3.8 | 95.5 | 0.60 | 0.40 | 0.60 | 20.7 |
| 2 | T1 | 272 | 2.0 | 286 | 2.0 | 0.485 | 1.6 | LOS A | 3.8 | 95.5 | 0.60 | 0.40 | 0.60 | 19.3 |
| 40 | R2 | 70 | 2.0 | 74 | 2.0 | 0.485 | 1.6 | LOS A | 3.8 | 95.5 | 0.60 | 0.40 | 0.60 | 19.3 |
| Approach | | 507 | 2.0 | 534 | 2.0 | 0.485 | 2.6 | LOS A | 3.8 | 95.5 | 0.60 | 0.40 | 0.60 | 19.7 |
| West: EB Waiko Road | | | | | | | | | | | | | | |
| 30 | L2 | 51 | 2.0 | 54 | 2.0 | 0.160 | 5.8 | LOS A | 0.9 | 23.8 | 0.64 | 0.56 | 0.64 | 20.5 |
| 464 | T1 | 80 | 2.0 | 84 | 2.0 | 0.160 | 2.9 | LOS A | 0.9 | 23.8 | 0.64 | 0.56 | 0.64 | 19.2 |
| 78 | R2 | 1 | 2.0 | 1 | 2.0 | 0.160 | 2.9 | LOS A | 0.9 | 23.8 | 0.64 | 0.56 | 0.64 | 19.2 |
| Approach | | 132 | 2.0 | 139 | 2.0 | 0.160 | 4.0 | LOS A | 0.9 | 23.8 | 0.64 | 0.56 | 0.64 | 19.7 |
| All Vehicles | | 1565 | 2.0 | 1647 | 2.0 | 0.578 | 3.2 | LOS A | 5.1 | 129.4 | 0.65 | 0.51 | 0.68 | 19.6 |

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# MOVEMENT SUMMARY

## Site: 101 [Waiale Rd Ext - Main St BY 2029 (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

**Vehicle Movement Performance**

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] % | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] ft | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed mph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: NB Waiale Road Ext | | | | | | | | | | | | | | |
| 102 | L2 | 65 | 2.0 | 68 | 2.0 | 0.283 | 3.7 | LOS A | 1.7 | 43.1 | 0.36 | 0.20 | 0.36 | 20.9 |
| 7 | T1 | 264 | 2.0 | 278 | 2.0 | 0.283 | 0.8 | LOS A | 1.7 | 43.1 | 0.36 | 0.20 | 0.36 | 19.6 |
| Approach | | 329 | 2.0 | 346 | 2.0 | 0.283 | 1.3 | LOS A | 1.7 | 43.1 | 0.36 | 0.20 | 0.36 | 19.8 |
| North: SB Waiale Road Ext | | | | | | | | | | | | | | |
| 2 | T1 | 206 | 2.0 | 217 | 2.0 | 0.283 | 0.4 | LOS A | 1.7 | 43.1 | 0.25 | 0.08 | 0.25 | 19.8 |
| 40 | R2 | 142 | 2.0 | 149 | 2.0 | 0.283 | 0.4 | LOS A | 1.7 | 43.1 | 0.25 | 0.08 | 0.25 | 19.8 |
| Approach | | 348 | 2.0 | 366 | 2.0 | 0.283 | 0.4 | LOS A | 1.7 | 43.1 | 0.25 | 0.08 | 0.25 | 19.8 |
| West: EB Main Street | | | | | | | | | | | | | | |
| 30 | L2 | 130 | 2.0 | 137 | 2.0 | 0.177 | 4.0 | LOS A | 0.9 | 23.4 | 0.39 | 0.41 | 0.39 | 20.7 |
| 78 | R2 | 64 | 2.0 | 67 | 2.0 | 0.177 | 1.1 | LOS A | 0.9 | 23.4 | 0.39 | 0.41 | 0.39 | 19.4 |
| Approach | | 194 | 2.0 | 204 | 2.0 | 0.177 | 3.0 | LOS A | 0.9 | 23.4 | 0.39 | 0.41 | 0.39 | 20.3 |
| All Vehicles | | 871 | 2.0 | 917 | 2.0 | 0.283 | 1.3 | LOS A | 1.7 | 43.1 | 0.32 | 0.20 | 0.32 | 19.9 |

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# APPENDIX C

LOS WORKSHEETS

Future Year Conditions
During Construction



| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 165 | 5 | 519 | 326 | 5 | 951 |
| Future Volume (veh/h) | 165 | 5 | 519 | 326 | 5 | 951 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | 1.00 | | 1.00 | 1.00 | |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | No | | No | | | No |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 179 | 5 | 564 | 242 | 5 | 1034 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 241 | 215 | 1231 | 1044 | 494 | 1231 |
| Arrive On Green | 0.14 | 0.14 | 0.66 | 0.66 | 0.66 | 0.66 |
| Sat Flow, veh/h | 1781 | 1585 | 1870 | 1585 | 676 | 1870 |
| Grp Volume(v), veh/h | 179 | 5 | 564 | 242 | 5 | 1034 |
| Grp Sat Flow(s),veh/h/ln | 1781 | 1585 | 1870 | 1585 | 676 | 1870 |
| Q Serve(g_s), s | 4.7 | 0.1 | 7.1 | 3.0 | 0.2 | 20.5 |
| Cycle Q Clear(g_c), s | 4.7 | 0.1 | 7.1 | 3.0 | 7.3 | 20.5 |
| Prop In Lane | 1.00 | 1.00 | | 1.00 | 1.00 | |
| Lane Grp Cap(c), veh/h | 241 | 215 | 1231 | 1044 | 494 | 1231 |
| V/C Ratio(X) | 0.74 | 0.02 | 0.46 | 0.23 | 0.01 | 0.84 |
| Avail Cap(c_a), veh/h | 955 | 850 | 2083 | 1766 | 802 | 2083 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 20.1 | 18.2 | 4.0 | 3.3 | 5.8 | 6.3 |
| Incr Delay (d2), s/veh | 4.5 | 0.0 | 0.3 | 0.1 | 0.0 | 1.6 |
| Initial Q Delay(d3), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 2.1 | 0.0 | 0.9 | 0.3 | 0.0 | 3.0 |
| Unsig. Movement Delay, s/veh | | | | | | |
| LnGrp Delay(d), s/veh | 24.6 | 18.2 | 4.3 | 3.5 | 5.8 | 7.9 |
| LnGrp LOS | C | B | A | A | A | A |
| Approach Vol, veh/h | 184 | | 806 | | | 1039 |
| Approach Delay, s/veh | 24.5 | | 4.1 | | | 7.9 |
| Approach LOS | C | | A | | | A |

| Timer - Assigned Phs | | 2 | | | 6 | 8 |
|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | | 37.9 | | | 37.9 | 10.6 |
| Change Period (Y+Rc), s | | 6.0 | | | 6.0 | 4.0 |
| Max Green Setting (Gmax), s | | 54.0 | | | 54.0 | 26.0 |
| Max Q Clear Time (g_c+I1), s | | 9.1 | | | 22.5 | 6.7 |
| Green Ext Time (p_c), s | | 4.6 | | | 9.4 | 0.5 |

| Intersection Summary | |
|---|---|
| HCM 6th Ctrl Delay, s/veh | 7.9 |
| HCM 6th LOS | A |



| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 23 | 17 | 15 | 106 | 6 | 26 | 3 | 564 | 116 | 173 | 893 | 10 |
| Future Volume (veh/h) | 23 | 17 | 15 | 106 | 6 | 26 | 3 | 564 | 116 | 173 | 893 | 10 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | | No | | | No | | | No | | | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 25 | 18 | 2 | 115 | 7 | 20 | 3 | 613 | 119 | 188 | 971 | 7 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 178 | 109 | 197 | 234 | 11 | 26 | 272 | 913 | 177 | 449 | 1235 | 1047 |
| Arrive On Green | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.00 | 0.60 | 0.60 | 0.06 | 0.66 | 0.66 |
| Sat Flow, veh/h | 827 | 876 | 1579 | 1192 | 90 | 210 | 1781 | 1522 | 295 | 1781 | 1870 | 1585 |
| Grp Volume(v), veh/h | 43 | 0 | 2 | 142 | 0 | 0 | 3 | 0 | 732 | 188 | 971 | 7 |
| Grp Sat Flow(s),veh/h/ln | 1703 | 0 | 1579 | 1492 | 0 | 0 | 1781 | 0 | 1817 | 1781 | 1870 | 1585 |
| Q Serve(g_s), s | 0.0 | 0.0 | 0.1 | 5.3 | 0.0 | 0.0 | 0.1 | 0.0 | 20.5 | 2.8 | 27.8 | 0.1 |
| Cycle Q Clear(g_c), s | 1.6 | 0.0 | 0.1 | 6.9 | 0.0 | 0.0 | 0.1 | 0.0 | 20.5 | 2.8 | 27.8 | 0.1 |
| Prop In Lane | 0.58 | | 1.00 | 0.81 | | 0.14 | 1.00 | | 0.16 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 287 | 0 | 197 | 272 | 0 | 0 | 272 | 0 | 1090 | 449 | 1235 | 1047 |
| V/C Ratio(X) | 0.15 | 0.00 | 0.01 | 0.52 | 0.00 | 0.00 | 0.01 | 0.00 | 0.67 | 0.42 | 0.79 | 0.01 |
| Avail Cap(c_a), veh/h | 606 | 0 | 521 | 566 | 0 | 0 | 594 | 0 | 1678 | 663 | 1728 | 1464 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 1.00 | 1.00 | 0.00 | 0.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 29.7 | 0.0 | 29.1 | 31.9 | 0.0 | 0.0 | 9.5 | 0.0 | 10.2 | 8.5 | 9.1 | 4.4 |
| Incr Delay (d2), s/veh | 0.1 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 1.5 | 0.2 | 2.8 | 0.0 |
| Initial Q Delay(d3), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.7 | 0.0 | 0.0 | 2.5 | 0.0 | 0.0 | 0.0 | 0.0 | 7.3 | 0.9 | 9.6 | 0.0 |
| Unsig. Movement Delay, s/veh | | | | | | | | | | | | |
| LnGrp Delay(d), s/veh | 29.8 | 0.0 | 29.1 | 32.5 | 0.0 | 0.0 | 9.5 | 0.0 | 11.7 | 8.8 | 11.8 | 4.4 |
| LnGrp LOS | C | | C | C | | | A | | B | A | B | A |
| Approach Vol, veh/h | | 45 | | | 142 | | | 735 | | | 1166 | |
| Approach Delay, s/veh | | 29.8 | | | 32.5 | | | 11.7 | | | 11.3 | |
| Approach LOS | | C | | | C | | | B | | | B | |

| Timer - Assigned Phs | 1 | 2 | | 4 | 5 | 6 | | 8 |
|---|---|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | 9.9 | 51.4 | | 14.4 | 5.3 | 56.0 | | 14.4 |
| Change Period (Y+Rc), s | 5.0 | 6.0 | | 5.0 | 5.0 | 6.0 | | 5.0 |
| Max Green Setting (Gmax), s | 4.9 | 70.0 | | 25.0 | 14.0 | 70.0 | | 25.0 |
| Max Q Clear Time (g_c+I1), s | 4.8 | 22.5 | | 3.6 | 2.1 | 29.8 | | 8.9 |
| Green Ext Time (p_c), s | 0.2 | 13.7 | | 0.1 | 0.0 | 20.3 | | 0.4 |

| Intersection Summary | |
|---|---|
| HCM 6th Ctrl Delay, s/veh | 13.3 |
| HCM 6th LOS | B |

**Notes**

User approved pedestrian interval to be less than phase max green.



| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 81 | 216 | 18 | 91 | 54 | 119 | 0 | 314 | 62 | 324 | 248 | 91 |
| Future Volume (veh/h) | 81 | 216 | 18 | 91 | 54 | 119 | 0 | 314 | 62 | 324 | 248 | 91 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | | No | | | No | | | No | | | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 88 | 235 | 18 | 99 | 59 | 22 | 0 | 341 | 15 | 352 | 270 | 86 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 451 | 324 | 25 | 307 | 367 | 311 | 381 | 457 | 387 | 535 | 680 | 217 |
| Arrive On Green | 0.06 | 0.19 | 0.19 | 0.06 | 0.20 | 0.20 | 0.00 | 0.24 | 0.24 | 0.19 | 0.50 | 0.50 |
| Sat Flow, veh/h | 1781 | 1715 | 131 | 1781 | 1870 | 1585 | 1781 | 1870 | 1585 | 1781 | 1359 | 433 |
| Grp Volume(v), veh/h | 88 | 0 | 253 | 99 | 59 | 22 | 0 | 341 | 15 | 352 | 0 | 356 |
| Grp Sat Flow(s),veh/h/ln | 1781 | 0 | 1847 | 1781 | 1870 | 1585 | 1781 | 1870 | 1585 | 1781 | 0 | 1792 |
| Q Serve(g_s), s | 2.2 | 0.0 | 7.3 | 2.5 | 1.5 | 0.6 | 0.0 | 9.5 | 0.4 | 7.4 | 0.0 | 7.0 |
| Cycle Q Clear(g_c), s | 2.2 | 0.0 | 7.3 | 2.5 | 1.5 | 0.6 | 0.0 | 9.5 | 0.4 | 7.4 | 0.0 | 7.0 |
| Prop In Lane | 1.00 | | 0.07 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 0.24 |
| Lane Grp Cap(c), veh/h | 451 | 0 | 349 | 307 | 367 | 311 | 381 | 457 | 387 | 535 | 0 | 897 |
| V/C Ratio(X) | 0.20 | 0.00 | 0.73 | 0.32 | 0.16 | 0.07 | 0.00 | 0.75 | 0.04 | 0.66 | 0.00 | 0.40 |
| Avail Cap(c_a), veh/h | 477 | 0 | 915 | 384 | 993 | 841 | 504 | 1224 | 1037 | 1182 | 0 | 2029 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 |
| Uniform Delay (d), s/veh | 17.0 | 0.0 | 21.5 | 17.3 | 18.9 | 18.5 | 0.0 | 19.7 | 16.3 | 11.8 | 0.0 | 8.8 |
| Incr Delay (d2), s/veh | 0.2 | 0.0 | 2.9 | 0.6 | 0.2 | 0.1 | 0.0 | 2.5 | 0.0 | 1.4 | 0.0 | 0.3 |
| Initial Q Delay(d3), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.9 | 0.0 | 3.2 | 1.0 | 0.6 | 0.2 | 0.0 | 4.2 | 0.1 | 2.7 | 0.0 | 2.4 |
| Unsig. Movement Delay, s/veh | | | | | | | | | | | | |
| LnGrp Delay(d), s/veh | 17.2 | 0.0 | 24.4 | 17.9 | 19.1 | 18.6 | 0.0 | 22.2 | 16.3 | 13.2 | 0.0 | 9.1 |
| LnGrp LOS | B | | C | B | B | B | | C | B | B | | A |
| Approach Vol, veh/h | | 341 | | | 180 | | | 356 | | | 708 | |
| Approach Delay, s/veh | | 22.6 | | | 18.3 | | | 22.0 | | | 11.1 | |
| Approach LOS | | C | | | B | | | C | | | B | |

| Timer - Assigned Phs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | 14.5 | 18.8 | 7.6 | 15.7 | 0.0 | 33.3 | 7.2 | 16.1 |
| Change Period (Y+Rc), s | 4.0 | 5.0 | 4.0 | 5.0 | 4.0 | 5.0 | 4.0 | 5.0 |
| Max Green Setting (Gmax), s | 21.0 | 37.0 | 6.0 | 28.0 | 4.0 | 64.0 | 4.0 | 30.0 |
| Max Q Clear Time (g_c+I1), s | 9.4 | 11.5 | 4.5 | 9.3 | 0.0 | 9.0 | 4.2 | 3.5 |
| Green Ext Time (p_c), s | 1.1 | 2.3 | 0.0 | 1.4 | 0.0 | 2.7 | 0.0 | 0.3 |

| Intersection Summary | |
|---|---|
| HCM 6th Ctrl Delay, s/veh | 16.8 |
| HCM 6th LOS | B |



| Movement | EBL | EBR | NBL | NBT | SBT | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 404 | 148 | 112 | 507 | 674 | 292 |
| Future Volume (veh/h) | 404 | 148 | 112 | 507 | 674 | 292 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | 1.00 | 1.00 | | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | No | | | No | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 281 | 292 | 122 | 551 | 733 | 105 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 461 | 410 | 164 | 1903 | 1210 | 540 |
| Arrive On Green | 0.26 | 0.26 | 0.09 | 0.54 | 0.34 | 0.34 |
| Sat Flow, veh/h | 1781 | 1585 | 1781 | 3647 | 3647 | 1585 |
| Grp Volume(v), veh/h | 281 | 292 | 122 | 551 | 733 | 105 |
| Grp Sat Flow(s),veh/h/ln | 1781 | 1585 | 1781 | 1777 | 1777 | 1585 |
| Q Serve(g_s), s | 6.1 | 7.3 | 2.9 | 3.7 | 7.5 | 2.0 |
| Cycle Q Clear(g_c), s | 6.1 | 7.3 | 2.9 | 3.7 | 7.5 | 2.0 |
| Prop In Lane | 1.00 | 1.00 | 1.00 | | | 1.00 |
| Lane Grp Cap(c), veh/h | 461 | 410 | 164 | 1903 | 1210 | 540 |
| V/C Ratio(X) | 0.61 | 0.71 | 0.75 | 0.29 | 0.61 | 0.19 |
| Avail Cap(c_a), veh/h | 1631 | 1452 | 1101 | 5776 | 3214 | 1433 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 14.3 | 14.7 | 19.3 | 5.6 | 12.0 | 10.2 |
| Incr Delay (d2), s/veh | 1.3 | 2.3 | 6.6 | 0.1 | 0.5 | 0.2 |
| Initial Q Delay(d3), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 2.3 | 6.4 | 1.3 | 0.7 | 2.1 | 0.5 |
| Unsig. Movement Delay, s/veh | | | | | | |
| LnGrp Delay(d), s/veh | 15.6 | 17.0 | 25.9 | 5.7 | 12.5 | 10.3 |
| LnGrp LOS | B | B | C | A | B | B |
| Approach Vol, veh/h | 573 | | | 673 | 838 | |
| Approach Delay, s/veh | 16.3 | | | 9.3 | 12.2 | |
| Approach LOS | B | | | A | B | |

| Timer - Assigned Phs | 2 | | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | 27.9 | | 15.8 | 8.5 | 19.4 |
| Change Period (Y+Rc), s | 4.5 | | 4.5 | 4.5 | 4.5 |
| Max Green Setting (Gmax), s | 71.0 | | 40.0 | 27.0 | 39.5 |
| Max Q Clear Time (g_c+I1), s | 5.7 | | 9.3 | 4.9 | 9.5 |
| Green Ext Time (p_c), s | 3.7 | | 2.0 | 0.3 | 5.4 |

| Intersection Summary | |
|---|---|
| HCM 6th Ctrl Delay, s/veh | 12.4 |
| HCM 6th LOS | B |

**Notes**

User approved volume balancing among the lanes for turning movement.

| Intersection | |
|---|---|
| Int Delay, s/veh | 1.2 |

| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 0 | 4 | 329 | 69 | 96 | 236 |
| Future Vol, veh/h | 0 | 4 | 329 | 69 | 96 | 236 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Free | Free | Free | Free |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 0 | - | - | - | - | - |
| Veh in Median Storage, # | 0 | - | 0 | - | - | 0 |
| Grade, % | 0 | - | 0 | - | - | 0 |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 4 | 358 | 75 | 104 | 257 |

| Major/Minor | Minor1 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 861 | 396 | 0 | 0 | 433 | 0 |
| Stage 1 | 396 | - | - | - | - | - |
| Stage 2 | 465 | - | - | - | - | - |
| Critical Hdwy | 6.42 | 6.22 | - | - | 4.12 | - |
| Critical Hdwy Stg 1 | 5.42 | - | - | - | - | - |
| Critical Hdwy Stg 2 | 5.42 | - | - | - | - | - |
| Follow-up Hdwy | 3.518 | 3.318 | - | - | 2.218 | - |
| Pot Cap-1 Maneuver | 326 | 653 | - | - | 1127 | - |
| Stage 1 | 680 | - | - | - | - | - |
| Stage 2 | 632 | - | - | - | - | - |
| Platoon blocked, % | | | - | - | | - |
| Mov Cap-1 Maneuver | 291 | 653 | - | - | 1127 | - |
| Mov Cap-2 Maneuver | 291 | - | - | - | - | - |
| Stage 1 | 680 | - | - | - | - | - |
| Stage 2 | 564 | - | - | - | - | - |

| Approach | WB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s/v | 10.6 | 0 | 2.5 |
| HCM LOS | B | | |

| Minor Lane/Major Mvmt | NBT | NBR | WBLn1 | SBL | SBT |
|---|---|---|---|---|---|
| Capacity (veh/h) | - | - | 653 | 1127 | - |
| HCM Lane V/C Ratio | - | - | 0.007 | 0.093 | - |
| HCM Control Delay (s/veh) | - | - | 10.6 | 8.5 | 0 |
| HCM Lane LOS | - | - | B | A | A |
| HCM 95th %tile Q (veh) | - | - | 0 | 0.3 | - |

| Intersection | |
|---|---|
| Int Delay, s/veh | 0 |

| Movement | EBL | EBR | NBL | NBT | SBT | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 0 | 0 | 0 | 619 | 822 | 0 |
| Future Vol, veh/h | 0 | 0 | 0 | 619 | 822 | 0 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Free | Free | Free | Free |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 0 | - | 100 | - | - | 100 |
| Veh in Median Storage, # | 0 | - | - | 0 | 0 | - |
| Grade, % | 0 | - | - | 0 | 0 | - |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 0 | 0 | 673 | 893 | 0 |

| Major/Minor | Minor2 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 1230 | 447 | 893 | 0 | - | 0 |
| Stage 1 | 893 | - | - | - | - | - |
| Stage 2 | 337 | - | - | - | - | - |
| Critical Hdwy | 6.84 | 6.94 | 4.14 | - | - | - |
| Critical Hdwy Stg 1 | 5.84 | - | - | - | - | - |
| Critical Hdwy Stg 2 | 5.84 | - | - | - | - | - |
| Follow-up Hdwy | 3.52 | 3.32 | 2.22 | - | - | - |
| Pot Cap-1 Maneuver | 170 | 559 | 755 | - | - | - |
| Stage 1 | 360 | - | - | - | - | - |
| Stage 2 | 695 | - | - | - | - | - |
| Platoon blocked, % | | | | - | - | - |
| Mov Cap-1 Maneuver | 170 | 559 | 755 | - | - | - |
| Mov Cap-2 Maneuver | 170 | - | - | - | - | - |
| Stage 1 | 360 | - | - | - | - | - |
| Stage 2 | 695 | - | - | - | - | - |

| Approach | EB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s/v | 0 | 0 | 0 |
| HCM LOS | A | | |

| Minor Lane/Major Mvmt | NBL | NBT | EBLn1 | SBT | SBR |
|---|---|---|---|---|---|
| Capacity (veh/h) | 755 | - | - | - | - |
| HCM Lane V/C Ratio | - | - | - | - | - |
| HCM Control Delay (s/veh) | 0 | - | 0 | - | - |
| HCM Lane LOS | A | - | A | - | - |
| HCM 95th %tile Q (veh) | 0 | - | - | - | - |

# MOVEMENT SUMMARY

## Site: 101 [Honoapiilani Hwy/Waiale Rd Ext. (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

**Vehicle Movement Performance**

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] % | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] ft | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed mph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: NB Honoapiilani Hwy | | | | | | | | | | | | | | |
| 7 | T1 | 519 | 2.0 | 546 | 2.0 | 0.650 | 0.1 | LOS A | 9.1 | 230.4 | 0.13 | 0.01 | 0.13 | 19.9 |
| 25 | R2 | 326 | 2.0 | 343 | 2.0 | 0.650 | 0.1 | LOS A | 9.1 | 230.4 | 0.13 | 0.01 | 0.13 | 19.9 |
| Approach | | 845 | 2.0 | 889 | 2.0 | 0.650 | 0.1 | LOS A | 9.1 | 230.4 | 0.13 | 0.01 | 0.13 | 19.9 |
| East: WB Waiale Rd Ext. | | | | | | | | | | | | | | |
| 19 | L2 | 165 | 2.0 | 174 | 2.0 | 0.195 | 6.0 | LOS A | 1.1 | 27.1 | 0.60 | 0.64 | 0.60 | 20.3 |
| 24 | R2 | 5 | 2.0 | 5 | 2.0 | 0.195 | 3.0 | LOS A | 1.1 | 27.1 | 0.60 | 0.64 | 0.60 | 19.0 |
| Approach | | 170 | 2.0 | 179 | 2.0 | 0.195 | 5.9 | LOS A | 1.1 | 27.1 | 0.60 | 0.64 | 0.60 | 20.3 |
| North: SB Honoapiilani Hwy | | | | | | | | | | | | | | |
| 15 | L2 | 5 | 2.0 | 5 | 2.0 | 0.857 | 8.0 | LOS A | 16.2 | 412.0 | 0.97 | 0.78 | 1.08 | 20.4 |
| 2 | T1 | 951 | 2.0 | 1001 | 2.0 | 0.857 | 5.0 | LOS A | 16.2 | 412.0 | 0.97 | 0.78 | 1.08 | 19.1 |
| Approach | | 956 | 2.0 | 1006 | 2.0 | 0.857 | 5.0 | LOS A | 16.2 | 412.0 | 0.97 | 0.78 | 1.08 | 19.1 |
| All Vehicles | | 1971 | 2.0 | 2075 | 2.0 | 0.857 | 3.0 | LOS A | 16.2 | 412.0 | 0.57 | 0.44 | 0.63 | 19.5 |

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# MOVEMENT SUMMARY

## Site: 101 [Waiale Rd - Waiko Rd (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

**Vehicle Movement Performance**

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] % | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] ft | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed mph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: NB Waiale Road | | | | | | | | | | | | | | |
| 102 | L2 | 1 | 2.0 | 1 | 2.0 | 0.498 | 8.7 | LOS A | 4.0 | 101.3 | 0.82 | 0.85 | 0.94 | 20.3 |
| 7 | T1 | 314 | 2.0 | 331 | 2.0 | 0.498 | 5.8 | LOS A | 4.0 | 101.3 | 0.82 | 0.85 | 0.94 | 19.0 |
| 25 | R2 | 62 | 2.0 | 65 | 2.0 | 0.498 | 5.8 | LOS A | 4.0 | 101.3 | 0.82 | 0.85 | 0.94 | 19.0 |
| Approach | | 377 | 2.0 | 397 | 2.0 | 0.498 | 5.8 | LOS A | 4.0 | 101.3 | 0.82 | 0.85 | 0.94 | 19.0 |
| East: WB Waiko Road | | | | | | | | | | | | | | |
| 19 | L2 | 91 | 2.0 | 96 | 2.0 | 0.293 | 5.3 | LOS A | 1.9 | 47.4 | 0.63 | 0.54 | 0.63 | 20.7 |
| 336 | T1 | 54 | 2.0 | 57 | 2.0 | 0.293 | 2.4 | LOS A | 1.9 | 47.4 | 0.63 | 0.54 | 0.63 | 19.3 |
| 24 | R2 | 119 | 2.0 | 125 | 2.0 | 0.293 | 2.4 | LOS A | 1.9 | 47.4 | 0.63 | 0.54 | 0.63 | 19.3 |
| Approach | | 264 | 2.0 | 278 | 2.0 | 0.293 | 3.4 | LOS A | 1.9 | 47.4 | 0.63 | 0.54 | 0.63 | 19.8 |
| North: SB Waiale Road | | | | | | | | | | | | | | |
| 15 | L2 | 324 | 2.0 | 341 | 2.0 | 0.588 | 4.3 | LOS A | 5.3 | 134.9 | 0.57 | 0.39 | 0.57 | 20.6 |
| 2 | T1 | 248 | 2.0 | 261 | 2.0 | 0.588 | 1.3 | LOS A | 5.3 | 134.9 | 0.57 | 0.39 | 0.57 | 19.3 |
| 40 | R2 | 91 | 2.0 | 96 | 2.0 | 0.588 | 1.3 | LOS A | 5.3 | 134.9 | 0.57 | 0.39 | 0.57 | 19.3 |
| Approach | | 663 | 2.0 | 698 | 2.0 | 0.588 | 2.8 | LOS A | 5.3 | 134.9 | 0.57 | 0.39 | 0.57 | 19.9 |
| West: EB Waiko Road | | | | | | | | | | | | | | |
| 30 | L2 | 81 | 2.0 | 85 | 2.0 | 0.443 | 8.4 | LOS A | 3.3 | 84.4 | 0.83 | 0.85 | 0.89 | 20.2 |
| 464 | T1 | 216 | 2.0 | 227 | 2.0 | 0.443 | 5.5 | LOS A | 3.3 | 84.4 | 0.83 | 0.85 | 0.89 | 19.0 |
| 78 | R2 | 18 | 2.0 | 19 | 2.0 | 0.443 | 5.5 | LOS A | 3.3 | 84.4 | 0.83 | 0.85 | 0.89 | 19.0 |
| Approach | | 315 | 2.0 | 332 | 2.0 | 0.443 | 6.2 | LOS A | 3.3 | 84.4 | 0.83 | 0.85 | 0.89 | 19.3 |
| All Vehicles | | 1619 | 2.0 | 1704 | 2.0 | 0.588 | 4.2 | LOS A | 5.3 | 134.9 | 0.69 | 0.61 | 0.73 | 19.6 |

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# MOVEMENT SUMMARY

## Site: 101 [Waiale Rd Ext - Main St BY 2029 (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

**Vehicle Movement Performance**

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] % | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] ft | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed mph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: NB Waiale Road Ext | | | | | | | | | | | | | | |
| 102 | L2 | 25 | 2.0 | 26 | 2.0 | 0.272 | 3.4 | LOS A | 1.7 | 42.1 | 0.26 | 0.10 | 0.26 | 21.1 |
| 7 | T1 | 308 | 2.0 | 324 | 2.0 | 0.272 | 0.4 | LOS A | 1.7 | 42.1 | 0.26 | 0.10 | 0.26 | 19.7 |
| Approach | | 333 | 2.0 | 351 | 2.0 | 0.272 | 0.6 | LOS A | 1.7 | 42.1 | 0.26 | 0.10 | 0.26 | 19.8 |
| North: SB Waiale Road Ext | | | | | | | | | | | | | | |
| 2 | T1 | 308 | 2.0 | 324 | 2.0 | 0.279 | 0.2 | LOS A | 1.6 | 41.7 | 0.14 | 0.03 | 0.14 | 19.9 |
| 40 | R2 | 49 | 2.0 | 52 | 2.0 | 0.279 | 0.2 | LOS A | 1.6 | 41.7 | 0.14 | 0.03 | 0.14 | 19.9 |
| Approach | | 357 | 2.0 | 376 | 2.0 | 0.279 | 0.2 | LOS A | 1.6 | 41.7 | 0.14 | 0.03 | 0.14 | 19.9 |
| West: EB Main Street | | | | | | | | | | | | | | |
| 30 | L2 | 68 | 2.0 | 72 | 2.0 | 0.091 | 4.4 | LOS A | 0.4 | 11.2 | 0.44 | 0.46 | 0.44 | 20.6 |
| 78 | R2 | 25 | 2.0 | 26 | 2.0 | 0.091 | 1.5 | LOS A | 0.4 | 11.2 | 0.44 | 0.46 | 0.44 | 19.3 |
| Approach | | 93 | 2.0 | 98 | 2.0 | 0.091 | 3.6 | LOS A | 0.4 | 11.2 | 0.44 | 0.46 | 0.44 | 20.3 |
| All Vehicles | | 783 | 2.0 | 824 | 2.0 | 0.279 | 0.8 | LOS A | 1.7 | 42.1 | 0.23 | 0.11 | 0.23 | 19.9 |

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 313 | 5 | 796 | 311 | 5 | 651 |
| Future Volume (veh/h) | 313 | 5 | 796 | 311 | 5 | 651 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | 1.00 | | 1.00 | 1.00 | |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | No | | No | | | No |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 340 | 5 | 865 | 186 | 5 | 708 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 422 | 375 | 1057 | 896 | 265 | 1057 |
| Arrive On Green | 0.24 | 0.24 | 0.57 | 0.57 | 0.57 | 0.57 |
| Sat Flow, veh/h | 1781 | 1585 | 1870 | 1585 | 640 | 1870 |
| Grp Volume(v), veh/h | 340 | 5 | 865 | 186 | 5 | 708 |
| Grp Sat Flow(s),veh/h/ln | 1781 | 1585 | 1870 | 1585 | 640 | 1870 |
| Q Serve(g_s), s | 9.1 | 0.1 | 18.9 | 2.9 | 0.3 | 13.4 |
| Cycle Q Clear(g_c), s | 9.1 | 0.1 | 18.9 | 2.9 | 19.2 | 13.4 |
| Prop In Lane | 1.00 | 1.00 | | 1.00 | 1.00 | |
| Lane Grp Cap(c), veh/h | 422 | 375 | 1057 | 896 | 265 | 1057 |
| V/C Ratio(X) | 0.81 | 0.01 | 0.82 | 0.21 | 0.02 | 0.67 |
| Avail Cap(c_a), veh/h | 918 | 817 | 2003 | 1697 | 588 | 2003 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 18.2 | 14.7 | 8.9 | 5.4 | 16.6 | 7.7 |
| Incr Delay (d2), s/veh | 3.7 | 0.0 | 1.6 | 0.1 | 0.0 | 0.7 |
| Initial Q Delay(d3), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 3.8 | 0.0 | 4.6 | 0.6 | 0.0 | 3.1 |
| Unsig. Movement Delay, s/veh | | | | | | |
| LnGrp Delay(d), s/veh | 21.8 | 14.8 | 10.5 | 5.5 | 16.7 | 8.4 |
| LnGrp LOS | C | B | B | A | B | A |
| Approach Vol, veh/h | 345 | | 1051 | | | 713 |
| Approach Delay, s/veh | 21.7 | | 9.6 | | | 8.5 |
| Approach LOS | C | | A | | | A |

| Timer - Assigned Phs | | 2 | | | 6 | 8 |
|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | | 34.5 | | | 34.5 | 15.9 |
| Change Period (Y+Rc), s | | 6.0 | | | 6.0 | 4.0 |
| Max Green Setting (Gmax), s | | 54.0 | | | 54.0 | 26.0 |
| Max Q Clear Time (g_c+I1), s | | 20.9 | | | 21.2 | 11.1 |
| Green Ext Time (p_c), s | | 7.6 | | | 5.0 | 0.9 |

| Intersection Summary | |
|---|---|
| HCM 6th Ctrl Delay, s/veh | 11.2 |
| HCM 6th LOS | B |



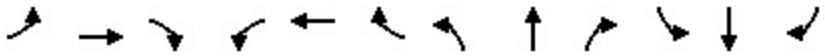
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 9 | 3 | 14 | 119 | 17 | 90 | 16 | 800 | 94 | 35 | 702 | 27 |
| Future Volume (veh/h) | 9 | 3 | 14 | 119 | 17 | 90 | 16 | 800 | 94 | 35 | 702 | 27 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | | No | | | No | | | No | | | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 10 | 3 | 2 | 129 | 18 | 73 | 17 | 870 | 99 | 38 | 763 | 17 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 230 | 61 | 269 | 206 | 27 | 85 | 386 | 1028 | 117 | 256 | 1194 | 1011 |
| Arrive On Green | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.02 | 0.62 | 0.62 | 0.03 | 0.64 | 0.64 |
| Sat Flow, veh/h | 952 | 357 | 1585 | 849 | 158 | 500 | 1781 | 1649 | 188 | 1781 | 1870 | 1584 |
| Grp Volume(v), veh/h | 13 | 0 | 2 | 220 | 0 | 0 | 17 | 0 | 969 | 38 | 763 | 17 |
| Grp Sat Flow(s),veh/h/ln | 1309 | 0 | 1585 | 1507 | 0 | 0 | 1781 | 0 | 1836 | 1781 | 1870 | 1584 |
| Q Serve(g_s), s | 0.0 | 0.0 | 0.1 | 12.6 | 0.0 | 0.0 | 0.3 | 0.0 | 38.9 | 0.7 | 23.0 | 0.4 |
| Cycle Q Clear(g_c), s | 0.5 | 0.0 | 0.1 | 13.1 | 0.0 | 0.0 | 0.3 | 0.0 | 38.9 | 0.7 | 23.0 | 0.4 |
| Prop In Lane | 0.77 | | 1.00 | 0.59 | | 0.33 | 1.00 | | 0.10 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 291 | 0 | 269 | 317 | 0 | 0 | 386 | 0 | 1145 | 256 | 1194 | 1011 |
| V/C Ratio(X) | 0.04 | 0.00 | 0.01 | 0.69 | 0.00 | 0.00 | 0.04 | 0.00 | 0.85 | 0.15 | 0.64 | 0.02 |
| Avail Cap(c_a), veh/h | 432 | 0 | 429 | 468 | 0 | 0 | 621 | 0 | 1391 | 466 | 1416 | 1199 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 1.00 | 1.00 | 0.00 | 0.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 32.1 | 0.0 | 31.9 | 37.3 | 0.0 | 0.0 | 8.6 | 0.0 | 13.9 | 14.3 | 10.2 | 6.1 |
| Incr Delay (d2), s/veh | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.4 | 0.1 | 1.3 | 0.0 |
| Initial Q Delay(d3), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.2 | 0.0 | 0.0 | 4.9 | 0.0 | 0.0 | 0.1 | 0.0 | 15.6 | 0.3 | 8.7 | 0.1 |
| Unsig. Movement Delay, s/veh | | | | | | | | | | | | |
| LnGrp Delay(d), s/veh | 32.1 | 0.0 | 31.9 | 38.3 | 0.0 | 0.0 | 8.6 | 0.0 | 19.3 | 14.4 | 11.6 | 6.1 |
| LnGrp LOS | C | | C | D | | | A | | B | B | B | A |
| Approach Vol, veh/h | | 15 | | | 220 | | | 986 | | | 818 | |
| Approach Delay, s/veh | | 32.1 | | | 38.3 | | | 19.1 | | | 11.6 | |
| Approach LOS | | C | | | D | | | B | | | B | |

| Timer - Assigned Phs | 1 | 2 | | 4 | 5 | 6 | | 8 |
|---|---|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | 8.1 | 63.7 | | 20.7 | 6.8 | 65.0 | | 20.7 |
| Change Period (Y+Rc), s | 5.0 | 6.0 | | 5.0 | 5.0 | 6.0 | | 5.0 |
| Max Green Setting (Gmax), s | 14.0 | 70.0 | | 25.0 | 14.0 | 70.0 | | 25.0 |
| Max Q Clear Time (g_c+I1), s | 2.5 | 40.9 | | 2.5 | 2.3 | 25.0 | | 15.1 |
| Green Ext Time (p_c), s | 0.0 | 16.8 | | 0.0 | 0.0 | 14.4 | | 0.6 |

| Intersection Summary | |
|---|---|
| HCM 6th Ctrl Delay, s/veh | 18.2 |
| HCM 6th LOS | B |

**Notes**

User approved pedestrian interval to be less than phase max green.



| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 51 | 80 | 0 | 80 | 144 | 311 | 18 | 358 | 115 | 165 | 272 | 70 |
| Future Volume (veh/h) | 51 | 80 | 0 | 80 | 144 | 311 | 18 | 358 | 115 | 165 | 272 | 70 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | | No | | | No | | | No | | | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 55 | 87 | 0 | 87 | 157 | 51 | 20 | 389 | 58 | 179 | 296 | 66 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 325 | 247 | 0 | 389 | 275 | 233 | 425 | 551 | 467 | 450 | 558 | 124 |
| Arrive On Green | 0.04 | 0.13 | 0.00 | 0.06 | 0.15 | 0.15 | 0.02 | 0.29 | 0.29 | 0.10 | 0.38 | 0.38 |
| Sat Flow, veh/h | 1781 | 1870 | 0 | 1781 | 1870 | 1585 | 1781 | 1870 | 1585 | 1781 | 1481 | 330 |
| Grp Volume(v), veh/h | 55 | 87 | 0 | 87 | 157 | 51 | 20 | 389 | 58 | 179 | 0 | 362 |
| Grp Sat Flow(s),veh/h/ln | 1781 | 1870 | 0 | 1781 | 1870 | 1585 | 1781 | 1870 | 1585 | 1781 | 0 | 1811 |
| Q Serve(g_s), s | 1.1 | 1.9 | 0.0 | 1.8 | 3.4 | 1.2 | 0.3 | 8.1 | 1.2 | 2.8 | 0.0 | 6.8 |
| Cycle Q Clear(g_c), s | 1.1 | 1.9 | 0.0 | 1.8 | 3.4 | 1.2 | 0.3 | 8.1 | 1.2 | 2.8 | 0.0 | 6.8 |
| Prop In Lane | 1.00 | | 0.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 0.18 |
| Lane Grp Cap(c), veh/h | 325 | 247 | 0 | 389 | 275 | 233 | 425 | 551 | 467 | 450 | 0 | 682 |
| V/C Ratio(X) | 0.17 | 0.35 | 0.00 | 0.22 | 0.57 | 0.22 | 0.05 | 0.71 | 0.12 | 0.40 | 0.00 | 0.53 |
| Avail Cap(c_a), veh/h | 409 | 898 | 0 | 893 | 1369 | 1160 | 553 | 1454 | 1233 | 757 | 0 | 1740 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 |
| Uniform Delay (d), s/veh | 15.4 | 17.3 | 0.0 | 15.1 | 17.4 | 16.4 | 10.5 | 13.7 | 11.3 | 9.1 | 0.0 | 10.6 |
| Incr Delay (d2), s/veh | 0.2 | 0.9 | 0.0 | 0.3 | 1.9 | 0.5 | 0.0 | 1.7 | 0.1 | 0.6 | 0.0 | 0.6 |
| Initial Q Delay(d3), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.4 | 0.8 | 0.0 | 0.7 | 1.5 | 0.4 | 0.1 | 3.2 | 0.4 | 0.9 | 0.0 | 2.3 |
| Unsig. Movement Delay, s/veh | | | | | | | | | | | | |
| LnGrp Delay(d), s/veh | 15.6 | 18.1 | 0.0 | 15.3 | 19.2 | 16.9 | 10.6 | 15.4 | 11.4 | 9.7 | 0.0 | 11.3 |
| LnGrp LOS | B | B | | B | B | B | B | B | B | A | | B |
| Approach Vol, veh/h | | 142 | | | 295 | | | 467 | | | 541 | |
| Approach Delay, s/veh | | 17.2 | | | 17.7 | | | 14.7 | | | 10.7 | |
| Approach LOS | | B | | | B | | | B | | | B | |

| Timer - Assigned Phs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | 8.5 | 17.9 | 6.6 | 10.8 | 4.9 | 21.5 | 5.9 | 11.4 |
| Change Period (Y+Rc), s | 4.0 | 5.0 | 4.0 | 5.0 | 4.0 | 5.0 | 4.0 | 5.0 |
| Max Green Setting (Gmax), s | 12.0 | 34.0 | 15.0 | 21.0 | 4.0 | 42.0 | 4.0 | 32.0 |
| Max Q Clear Time (g_c+I1), s | 4.8 | 10.1 | 3.8 | 3.9 | 2.3 | 8.8 | 3.1 | 5.4 |
| Green Ext Time (p_c), s | 0.3 | 2.8 | 0.1 | 0.3 | 0.0 | 2.6 | 0.0 | 1.1 |

| Intersection Summary | |
|---|---|
| HCM 6th Ctrl Delay, s/veh | 14.1 |
| HCM 6th LOS | B |



| Movement | EBL | EBR | NBL | NBT | SBT | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 415 | 173 | 181 | 722 | 766 | 385 |
| Future Volume (veh/h) | 415 | 173 | 181 | 722 | 766 | 385 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | 1.00 | 1.00 | | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | No | | | No | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 292 | 304 | 197 | 785 | 833 | 131 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 451 | 401 | 257 | 2060 | 1249 | 557 |
| Arrive On Green | 0.25 | 0.25 | 0.14 | 0.58 | 0.35 | 0.35 |
| Sat Flow, veh/h | 1781 | 1585 | 1781 | 3647 | 3647 | 1585 |
| Grp Volume(v), veh/h | 292 | 304 | 197 | 785 | 833 | 131 |
| Grp Sat Flow(s),veh/h/ln | 1781 | 1585 | 1781 | 1777 | 1777 | 1585 |
| Q Serve(g_s), s | 7.9 | 9.5 | 5.7 | 6.4 | 10.7 | 3.1 |
| Cycle Q Clear(g_c), s | 7.9 | 9.5 | 5.7 | 6.4 | 10.7 | 3.1 |
| Prop In Lane | 1.00 | 1.00 | 1.00 | | | 1.00 |
| Lane Grp Cap(c), veh/h | 451 | 401 | 257 | 2060 | 1249 | 557 |
| V/C Ratio(X) | 0.65 | 0.76 | 0.77 | 0.38 | 0.67 | 0.24 |
| Avail Cap(c_a), veh/h | 1325 | 1179 | 895 | 4693 | 2611 | 1164 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 17.9 | 18.6 | 22.1 | 6.1 | 14.8 | 12.3 |
| Incr Delay (d2), s/veh | 1.6 | 3.0 | 4.7 | 0.1 | 0.6 | 0.2 |
| Initial Q Delay(d3), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 8.2 | 8.3 | 2.4 | 1.4 | 3.4 | 0.9 |
| Unsig. Movement Delay, s/veh | | | | | | |
| LnGrp Delay(d), s/veh | 19.5 | 21.5 | 26.9 | 6.2 | 15.4 | 12.5 |
| LnGrp LOS | B | C | C | A | B | B |
| Approach Vol, veh/h | 596 | | | 982 | 964 | |
| Approach Delay, s/veh | 20.5 | | | 10.4 | 15.0 | |
| Approach LOS | C | | | B | B | |

| Timer - Assigned Phs | 2 | | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | 35.7 | | 18.1 | 12.3 | 23.4 |
| Change Period (Y+Rc), s | 4.5 | | 4.5 | 4.5 | 4.5 |
| Max Green Setting (Gmax), s | 71.0 | | 40.0 | 27.0 | 39.5 |
| Max Q Clear Time (g_c+I1), s | 8.4 | | 11.5 | 7.7 | 12.7 |
| Green Ext Time (p_c), s | 5.8 | | 2.1 | 0.5 | 6.2 |

| Intersection Summary | | |
|---|---|---|
| HCM 6th Ctrl Delay, s/veh | | 14.5 |
| HCM 6th LOS | | B |

**Notes**

User approved volume balancing among the lanes for turning movement.

| Intersection | |
|---|---|
| Int Delay, s/veh | 3.2 |

| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 69 | 96 | 329 | 0 | 4 | 270 |
| Future Vol, veh/h | 69 | 96 | 329 | 0 | 4 | 270 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Free | Free | Free | Free |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 0 | - | - | - | - | - |
| Veh in Median Storage, # | 0 | - | 0 | - | - | 0 |
| Grade, % | 0 | - | 0 | - | - | 0 |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 75 | 104 | 358 | 0 | 4 | 293 |

| Major/Minor | Minor1 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 659 | 358 | 0 | 0 | 358 | 0 |
| Stage 1 | 358 | - | - | - | - | - |
| Stage 2 | 301 | - | - | - | - | - |
| Critical Hdwy | 6.42 | 6.22 | - | - | 4.12 | - |
| Critical Hdwy Stg 1 | 5.42 | - | - | - | - | - |
| Critical Hdwy Stg 2 | 5.42 | - | - | - | - | - |
| Follow-up Hdwy | 3.518 | 3.318 | - | - | 2.218 | - |
| Pot Cap-1 Maneuver | 429 | 686 | - | - | 1201 | - |
| Stage 1 | 707 | - | - | - | - | - |
| Stage 2 | 751 | - | - | - | - | - |
| Platoon blocked, % | | | - | - | | - |
| Mov Cap-1 Maneuver | 427 | 686 | - | - | 1201 | - |
| Mov Cap-2 Maneuver | 427 | - | - | - | - | - |
| Stage 1 | 707 | - | - | - | - | - |
| Stage 2 | 748 | - | - | - | - | - |

| Approach | WB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s/v | 14.8 | 0 | 0.1 |
| HCM LOS | B | | |

| Minor Lane/Major Mvmt | NBT | NBR | WBLn1 | SBL | SBT |
|---|---|---|---|---|---|
| Capacity (veh/h) | - | - | 547 | 1201 | - |
| HCM Lane V/C Ratio | - | - | 0.328 | 0.004 | - |
| HCM Control Delay (s/veh) | - | - | 14.8 | 8 | 0 |
| HCM Lane LOS | - | - | B | A | A |
| HCM 95th %tile Q (veh) | - | - | 1.4 | 0 | - |

| Intersection | |
|---|---|
| Int Delay, s/veh | 0 |

| Movement | EBL | EBR | NBL | NBT | SBT | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 0 | 0 | 0 | 903 | 939 | 0 |
| Future Vol, veh/h | 0 | 0 | 0 | 903 | 939 | 0 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Free | Free | Free | Free |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 0 | - | 100 | - | - | 100 |
| Veh in Median Storage, # | 0 | - | - | 0 | 0 | - |
| Grade, % | 0 | - | - | 0 | 0 | - |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 0 | 0 | 982 | 1021 | 0 |

| Major/Minor | Minor2 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 1512 | 511 | 1021 | 0 | - | 0 |
| Stage 1 | 1021 | - | - | - | - | - |
| Stage 2 | 491 | - | - | - | - | - |
| Critical Hdwy | 6.84 | 6.94 | 4.14 | - | - | - |
| Critical Hdwy Stg 1 | 5.84 | - | - | - | - | - |
| Critical Hdwy Stg 2 | 5.84 | - | - | - | - | - |
| Follow-up Hdwy | 3.52 | 3.32 | 2.22 | - | - | - |
| Pot Cap-1 Maneuver | 111 | 508 | 675 | - | - | - |
| Stage 1 | 309 | - | - | - | - | - |
| Stage 2 | 581 | - | - | - | - | - |
| Platoon blocked, % | | | | - | - | - |
| Mov Cap-1 Maneuver | 111 | 508 | 675 | - | - | - |
| Mov Cap-2 Maneuver | 111 | - | - | - | - | - |
| Stage 1 | 309 | - | - | - | - | - |
| Stage 2 | 581 | - | - | - | - | - |

| Approach | EB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s/v | 0 | 0 | 0 |
| HCM LOS | A | | |

| Minor Lane/Major Mvmt | NBL | NBT | EBLn1 | SBT | SBR |
|---|---|---|---|---|---|
| Capacity (veh/h) | 675 | - | - | - | - |
| HCM Lane V/C Ratio | - | - | - | - | - |
| HCM Control Delay (s/veh) | 0 | - | 0 | - | - |
| HCM Lane LOS | A | - | A | - | - |
| HCM 95th %tile Q (veh) | 0 | - | - | - | - |

# MOVEMENT SUMMARY

## Site: 101 [Honoapiilani Hwy/Waiale Rd Ext. (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

**Vehicle Movement Performance**

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] % | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] ft | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed mph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: NB Honoapiilani Hwy | | | | | | | | | | | | | | |
| 7 | T1 | 796 | 2.0 | 838 | 2.0 | 0.852 | 0.1 | LOS A | 24.8 | 629.3 | 0.25 | 0.03 | 0.25 | 19.8 |
| 25 | R2 | 311 | 2.0 | 327 | 2.0 | 0.852 | 0.1 | LOS A | 24.8 | 629.3 | 0.25 | 0.03 | 0.25 | 19.8 |
| Approach | | 1107 | 2.0 | 1165 | 2.0 | 0.852 | 0.1 | LOS A | 24.8 | 629.3 | 0.25 | 0.03 | 0.25 | 19.8 |
| East: WB Waiale Rd Ext. | | | | | | | | | | | | | | |
| 19 | L2 | 313 | 2.0 | 329 | 2.0 | 0.482 | 11.3 | LOS B | 3.9 | 98.4 | 0.87 | 1.01 | 1.04 | 19.4 |
| 24 | R2 | 5 | 2.0 | 5 | 2.0 | 0.482 | 8.3 | LOS A | 3.9 | 98.4 | 0.87 | 1.01 | 1.04 | 18.2 |
| Approach | | 318 | 2.0 | 335 | 2.0 | 0.482 | 11.2 | LOS B | 3.9 | 98.4 | 0.87 | 1.01 | 1.04 | 19.4 |
| North: SB Honoapiilani Hwy | | | | | | | | | | | | | | |
| 15 | L2 | 5 | 2.0 | 5 | 2.0 | 0.688 | 7.4 | LOS A | 7.9 | 201.9 | 0.85 | 0.80 | 0.97 | 20.5 |
| 2 | T1 | 651 | 2.0 | 685 | 2.0 | 0.688 | 4.4 | LOS A | 7.9 | 201.9 | 0.85 | 0.80 | 0.97 | 19.2 |
| Approach | | 656 | 2.0 | 691 | 2.0 | 0.688 | 4.5 | LOS A | 7.9 | 201.9 | 0.85 | 0.80 | 0.97 | 19.2 |
| All Vehicles | | 2081 | 2.0 | 2191 | 2.0 | 0.852 | 3.2 | LOS A | 24.8 | 629.3 | 0.54 | 0.42 | 0.60 | 19.5 |

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# MOVEMENT SUMMARY

## Site: 101 [Waiale Rd - Waiko Rd (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

**Vehicle Movement Performance**

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] % | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] ft | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed mph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: NB Waiale Road | | | | | | | | | | | | | | |
| 102 | L2 | 18 | 2.0 | 19 | 2.0 | 0.487 | 5.1 | LOS A | 3.4 | 87.0 | 0.62 | 0.41 | 0.62 | 20.8 |
| 7 | T1 | 358 | 2.0 | 377 | 2.0 | 0.487 | 2.2 | LOS A | 3.4 | 87.0 | 0.62 | 0.41 | 0.62 | 19.4 |
| 25 | R2 | 115 | 2.0 | 121 | 2.0 | 0.487 | 2.2 | LOS A | 3.4 | 87.0 | 0.62 | 0.41 | 0.62 | 19.4 |
| Approach | | 491 | 2.0 | 517 | 2.0 | 0.487 | 2.3 | LOS A | 3.4 | 87.0 | 0.62 | 0.41 | 0.62 | 19.5 |
| East: WB Waiko Road | | | | | | | | | | | | | | |
| 19 | L2 | 80 | 2.0 | 84 | 2.0 | 0.604 | 7.7 | LOS A | 5.7 | 144.9 | 0.81 | 0.82 | 0.93 | 20.4 |
| 336 | T1 | 144 | 2.0 | 152 | 2.0 | 0.604 | 4.8 | LOS A | 5.7 | 144.9 | 0.81 | 0.82 | 0.93 | 19.1 |
| 24 | R2 | 311 | 2.0 | 327 | 2.0 | 0.604 | 4.8 | LOS A | 5.7 | 144.9 | 0.81 | 0.82 | 0.93 | 19.1 |
| Approach | | 535 | 2.0 | 563 | 2.0 | 0.604 | 5.2 | LOS A | 5.7 | 144.9 | 0.81 | 0.82 | 0.93 | 19.3 |
| North: SB Waiale Road | | | | | | | | | | | | | | |
| 15 | L2 | 165 | 2.0 | 174 | 2.0 | 0.493 | 4.7 | LOS A | 3.8 | 97.2 | 0.62 | 0.42 | 0.62 | 20.6 |
| 2 | T1 | 272 | 2.0 | 286 | 2.0 | 0.493 | 1.8 | LOS A | 3.8 | 97.2 | 0.62 | 0.42 | 0.62 | 19.3 |
| 40 | R2 | 70 | 2.0 | 74 | 2.0 | 0.493 | 1.8 | LOS A | 3.8 | 97.2 | 0.62 | 0.42 | 0.62 | 19.3 |
| Approach | | 507 | 2.0 | 534 | 2.0 | 0.493 | 2.7 | LOS A | 3.8 | 97.2 | 0.62 | 0.42 | 0.62 | 19.7 |
| West: EB Waiko Road | | | | | | | | | | | | | | |
| 30 | L2 | 51 | 2.0 | 54 | 2.0 | 0.161 | 5.8 | LOS A | 1.0 | 24.1 | 0.65 | 0.56 | 0.65 | 20.5 |
| 464 | T1 | 80 | 2.0 | 84 | 2.0 | 0.161 | 2.9 | LOS A | 1.0 | 24.1 | 0.65 | 0.56 | 0.65 | 19.2 |
| 78 | R2 | 1 | 2.0 | 1 | 2.0 | 0.161 | 2.9 | LOS A | 1.0 | 24.1 | 0.65 | 0.56 | 0.65 | 19.2 |
| Approach | | 132 | 2.0 | 139 | 2.0 | 0.161 | 4.0 | LOS A | 1.0 | 24.1 | 0.65 | 0.56 | 0.65 | 19.7 |
| All Vehicles | | 1665 | 2.0 | 1753 | 2.0 | 0.604 | 3.5 | LOS A | 5.7 | 144.9 | 0.68 | 0.56 | 0.72 | 19.5 |

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# MOVEMENT SUMMARY

## Site: 101 [Waiale Rd Ext - Main St BY 2029 (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

**Vehicle Movement Performance**

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] % | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] ft | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed mph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: NB Waiale Road Ext | | | | | | | | | | | | | | |
| 102 | L2 | 65 | 2.0 | 68 | 2.0 | 0.366 | 3.8 | LOS A | 2.4 | 61.1 | 0.39 | 0.20 | 0.39 | 20.9 |
| 7 | T1 | 361 | 2.0 | 380 | 2.0 | 0.366 | 0.9 | LOS A | 2.4 | 61.1 | 0.39 | 0.20 | 0.39 | 19.6 |
| Approach | | 426 | 2.0 | 448 | 2.0 | 0.366 | 1.3 | LOS A | 2.4 | 61.1 | 0.39 | 0.20 | 0.39 | 19.8 |
| North: SB Waiale Road Ext | | | | | | | | | | | | | | |
| 2 | T1 | 210 | 2.0 | 221 | 2.0 | 0.286 | 0.4 | LOS A | 1.7 | 44.2 | 0.25 | 0.08 | 0.25 | 19.8 |
| 40 | R2 | 142 | 2.0 | 149 | 2.0 | 0.286 | 0.4 | LOS A | 1.7 | 44.2 | 0.25 | 0.08 | 0.25 | 19.8 |
| Approach | | 352 | 2.0 | 371 | 2.0 | 0.286 | 0.4 | LOS A | 1.7 | 44.2 | 0.25 | 0.08 | 0.25 | 19.8 |
| West: EB Main Street | | | | | | | | | | | | | | |
| 30 | L2 | 130 | 2.0 | 137 | 2.0 | 0.177 | 4.0 | LOS A | 0.9 | 23.5 | 0.40 | 0.42 | 0.40 | 20.7 |
| 78 | R2 | 64 | 2.0 | 67 | 2.0 | 0.177 | 1.1 | LOS A | 0.9 | 23.5 | 0.40 | 0.42 | 0.40 | 19.4 |
| Approach | | 194 | 2.0 | 204 | 2.0 | 0.177 | 3.1 | LOS A | 0.9 | 23.5 | 0.40 | 0.42 | 0.40 | 20.2 |
| All Vehicles | | 972 | 2.0 | 1023 | 2.0 | 0.366 | 1.3 | LOS A | 2.4 | 61.1 | 0.34 | 0.20 | 0.34 | 19.9 |

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# APPENDIX C

LOS WORKSHEETS

Future Year Conditions
After Construction



| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 166 | 5 | 519 | 265 | 5 | 951 |
| Future Volume (veh/h) | 166 | 5 | 519 | 265 | 5 | 951 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | 1.00 | | 1.00 | 1.00 | |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | No | | No | | | No |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 180 | 1 | 564 | 190 | 5 | 1034 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 241 | 214 | 1231 | 1044 | 511 | 1231 |
| Arrive On Green | 0.14 | 0.14 | 0.66 | 0.66 | 0.66 | 0.66 |
| Sat Flow, veh/h | 1781 | 1585 | 1870 | 1585 | 710 | 1870 |
| Grp Volume(v), veh/h | 180 | 1 | 564 | 190 | 5 | 1034 |
| Grp Sat Flow(s),veh/h/ln | 1781 | 1585 | 1870 | 1585 | 710 | 1870 |
| Q Serve(g_s), s | 4.7 | 0.0 | 7.1 | 2.3 | 0.2 | 20.5 |
| Cycle Q Clear(g_c), s | 4.7 | 0.0 | 7.1 | 2.3 | 7.3 | 20.5 |
| Prop In Lane | 1.00 | 1.00 | | 1.00 | 1.00 | |
| Lane Grp Cap(c), veh/h | 241 | 214 | 1231 | 1044 | 511 | 1231 |
| V/C Ratio(X) | 0.75 | 0.00 | 0.46 | 0.18 | 0.01 | 0.84 |
| Avail Cap(c_a), veh/h | 956 | 851 | 2084 | 1767 | 835 | 2084 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 20.2 | 18.1 | 4.0 | 3.2 | 5.8 | 6.3 |
| Incr Delay (d2), s/veh | 4.6 | 0.0 | 0.3 | 0.1 | 0.0 | 1.6 |
| Initial Q Delay(d3), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 2.1 | 0.0 | 0.9 | 0.2 | 0.0 | 2.9 |
| Unsig. Movement Delay, s/veh | | | | | | |
| LnGrp Delay(d), s/veh | 24.7 | 18.1 | 4.3 | 3.3 | 5.8 | 7.9 |
| LnGrp LOS | C | B | A | A | A | A |
| Approach Vol, veh/h | 181 | | 754 | | | 1039 |
| Approach Delay, s/veh | 24.7 | | 4.1 | | | 7.9 |
| Approach LOS | C | | A | | | A |

| Timer - Assigned Phs | | 2 | | | 6 | 8 |
|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | | 37.9 | | | 37.9 | 10.6 |
| Change Period (Y+Rc), s | | 6.0 | | | 6.0 | 4.0 |
| Max Green Setting (Gmax), s | | 54.0 | | | 54.0 | 26.0 |
| Max Q Clear Time (g_c+I1), s | | 9.1 | | | 22.5 | 6.7 |
| Green Ext Time (p_c), s | | 4.4 | | | 9.4 | 0.5 |

| Intersection Summary | |
|---|---|
| HCM 6th Ctrl Delay, s/veh | 8.0 |
| HCM 6th LOS | A |



| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 23 | 17 | 15 | 106 | 6 | 26 | 3 | 564 | 116 | 157 | 893 | 10 |
| Future Volume (veh/h) | 23 | 17 | 15 | 106 | 6 | 26 | 3 | 564 | 116 | 157 | 893 | 10 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | | No | | | No | | | No | | | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 25 | 18 | 2 | 115 | 7 | 20 | 3 | 613 | 119 | 171 | 971 | 7 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 178 | 109 | 197 | 234 | 11 | 26 | 272 | 913 | 177 | 449 | 1235 | 1047 |
| Arrive On Green | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.00 | 0.60 | 0.60 | 0.06 | 0.66 | 0.66 |
| Sat Flow, veh/h | 827 | 876 | 1579 | 1192 | 90 | 210 | 1781 | 1522 | 295 | 1781 | 1870 | 1585 |
| Grp Volume(v), veh/h | 43 | 0 | 2 | 142 | 0 | 0 | 3 | 0 | 732 | 171 | 971 | 7 |
| Grp Sat Flow(s),veh/h/ln | 1703 | 0 | 1579 | 1492 | 0 | 0 | 1781 | 0 | 1817 | 1781 | 1870 | 1585 |
| Q Serve(g_s), s | 0.0 | 0.0 | 0.1 | 5.3 | 0.0 | 0.0 | 0.1 | 0.0 | 20.4 | 2.5 | 27.8 | 0.1 |
| Cycle Q Clear(g_c), s | 1.6 | 0.0 | 0.1 | 6.9 | 0.0 | 0.0 | 0.1 | 0.0 | 20.4 | 2.5 | 27.8 | 0.1 |
| Prop In Lane | 0.58 | | 1.00 | 0.81 | | 0.14 | 1.00 | | 0.16 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 287 | 0 | 197 | 272 | 0 | 0 | 272 | 0 | 1091 | 449 | 1235 | 1047 |
| V/C Ratio(X) | 0.15 | 0.00 | 0.01 | 0.52 | 0.00 | 0.00 | 0.01 | 0.00 | 0.67 | 0.38 | 0.79 | 0.01 |
| Avail Cap(c_a), veh/h | 606 | 0 | 521 | 566 | 0 | 0 | 594 | 0 | 1678 | 663 | 1728 | 1464 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 1.00 | 1.00 | 0.00 | 0.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 29.7 | 0.0 | 29.1 | 31.9 | 0.0 | 0.0 | 9.5 | 0.0 | 10.1 | 8.3 | 9.1 | 4.4 |
| Incr Delay (d2), s/veh | 0.1 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 1.5 | 0.2 | 2.8 | 0.0 |
| Initial Q Delay(d3), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.7 | 0.0 | 0.0 | 2.5 | 0.0 | 0.0 | 0.0 | 0.0 | 7.2 | 0.7 | 9.6 | 0.0 |
| Unsig. Movement Delay, s/veh | | | | | | | | | | | | |
| LnGrp Delay(d), s/veh | 29.8 | 0.0 | 29.1 | 32.5 | 0.0 | 0.0 | 9.5 | 0.0 | 11.7 | 8.5 | 11.8 | 4.4 |
| LnGrp LOS | C | | C | C | | | A | | B | A | B | A |
| Approach Vol, veh/h | | 45 | | | 142 | | | 735 | | | 1149 | |
| Approach Delay, s/veh | | 29.8 | | | 32.5 | | | 11.7 | | | 11.3 | |
| Approach LOS | | C | | | C | | | B | | | B | |

| Timer - Assigned Phs | 1 | 2 | | 4 | 5 | 6 | | 8 |
|---|---|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | 9.9 | 51.5 | | 14.4 | 5.3 | 56.0 | | 14.4 |
| Change Period (Y+Rc), s | 5.0 | 6.0 | | 5.0 | 5.0 | 6.0 | | 5.0 |
| Max Green Setting (Gmax), s | 14.9 | 70.0 | | 25.0 | 14.0 | 70.0 | | 25.0 |
| Max Q Clear Time (g_c+I1), s | 4.5 | 22.4 | | 3.6 | 2.1 | 29.8 | | 8.9 |
| Green Ext Time (p_c), s | 0.2 | 13.7 | | 0.1 | 0.0 | 20.3 | | 0.4 |

| Intersection Summary | | |
|---|---|---|
| HCM 6th Ctrl Delay, s/veh | | 13.3 |
| HCM 6th LOS | | B |



| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 81 | 216 | 2 | 36 | 54 | 119 | 0 | 314 | 59 | 324 | 232 | 91 |
| Future Volume (veh/h) | 81 | 216 | 2 | 36 | 54 | 119 | 0 | 314 | 59 | 324 | 232 | 91 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | | No | | | No | | | No | | | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 88 | 235 | 2 | 39 | 59 | 20 | 0 | 341 | 14 | 352 | 252 | 86 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 414 | 338 | 3 | 271 | 297 | 251 | 403 | 468 | 396 | 557 | 686 | 234 |
| Arrive On Green | 0.06 | 0.18 | 0.18 | 0.03 | 0.16 | 0.16 | 0.00 | 0.25 | 0.25 | 0.19 | 0.51 | 0.51 |
| Sat Flow, veh/h | 1781 | 1852 | 16 | 1781 | 1870 | 1585 | 1781 | 1870 | 1585 | 1781 | 1333 | 455 |
| Grp Volume(v), veh/h | 88 | 0 | 237 | 39 | 59 | 20 | 0 | 341 | 14 | 352 | 0 | 338 |
| Grp Sat Flow(s),veh/h/ln | 1781 | 0 | 1868 | 1781 | 1870 | 1585 | 1781 | 1870 | 1585 | 1781 | 0 | 1788 |
| Q Serve(g_s), s | 2.1 | 0.0 | 6.2 | 0.9 | 1.4 | 0.6 | 0.0 | 8.7 | 0.3 | 6.7 | 0.0 | 5.9 |
| Cycle Q Clear(g_c), s | 2.1 | 0.0 | 6.2 | 0.9 | 1.4 | 0.6 | 0.0 | 8.7 | 0.3 | 6.7 | 0.0 | 5.9 |
| Prop In Lane | 1.00 | | 0.01 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 0.25 |
| Lane Grp Cap(c), veh/h | 414 | 0 | 341 | 271 | 297 | 251 | 403 | 468 | 396 | 557 | 0 | 920 |
| V/C Ratio(X) | 0.21 | 0.00 | 0.70 | 0.14 | 0.20 | 0.08 | 0.00 | 0.73 | 0.04 | 0.63 | 0.00 | 0.37 |
| Avail Cap(c_a), veh/h | 449 | 0 | 1008 | 418 | 1082 | 917 | 537 | 1334 | 1131 | 1289 | 0 | 2207 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 |
| Uniform Delay (d), s/veh | 16.8 | 0.0 | 19.9 | 17.6 | 19.0 | 18.6 | 0.0 | 17.8 | 14.7 | 10.5 | 0.0 | 7.5 |
| Incr Delay (d2), s/veh | 0.3 | 0.0 | 2.6 | 0.2 | 0.3 | 0.1 | 0.0 | 2.2 | 0.0 | 1.2 | 0.0 | 0.2 |
| Initial Q Delay(d3), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.8 | 0.0 | 2.7 | 0.4 | 0.6 | 0.2 | 0.0 | 3.7 | 0.1 | 2.3 | 0.0 | 1.9 |
| Unsig. Movement Delay, s/veh | | | | | | | | | | | | |
| LnGrp Delay(d), s/veh | 17.1 | 0.0 | 22.4 | 17.8 | 19.3 | 18.7 | 0.0 | 20.0 | 14.8 | 11.7 | 0.0 | 7.8 |
| LnGrp LOS | B | | C | B | B | B | | C | B | B | | A |
| Approach Vol, veh/h | | 325 | | | 118 | | | 355 | | | 690 | |
| Approach Delay, s/veh | | 21.0 | | | 18.7 | | | 19.8 | | | 9.8 | |
| Approach LOS | | C | | | B | | | B | | | A | |

| Timer - Assigned Phs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | 13.7 | 18.0 | 5.7 | 14.5 | 0.0 | 31.7 | 7.0 | 13.2 |
| Change Period (Y+Rc), s | 4.0 | 5.0 | 4.0 | 5.0 | 4.0 | 5.0 | 4.0 | 5.0 |
| Max Green Setting (Gmax), s | 21.0 | 37.0 | 6.0 | 28.0 | 4.0 | 64.0 | 4.0 | 30.0 |
| Max Q Clear Time (g_c+I1), s | 8.7 | 10.7 | 2.9 | 8.2 | 0.0 | 7.9 | 4.1 | 3.4 |
| Green Ext Time (p_c), s | 1.1 | 2.3 | 0.0 | 1.3 | 0.0 | 2.5 | 0.0 | 0.3 |

| Intersection Summary | |
|---|---|
| HCM 6th Ctrl Delay, s/veh | 15.3 |
| HCM 6th LOS | B |



| Movement | EBL | EBR | NBL | NBT | SBT | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 401 | 148 | 112 | 507 | 674 | 237 |
| Future Volume (veh/h) | 401 | 148 | 112 | 507 | 674 | 237 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | 1.00 | 1.00 | | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | No | | | No | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 279 | 291 | 122 | 551 | 733 | 78 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 460 | 409 | 164 | 1900 | 1206 | 538 |
| Arrive On Green | 0.26 | 0.26 | 0.09 | 0.53 | 0.34 | 0.34 |
| Sat Flow, veh/h | 1781 | 1585 | 1781 | 3647 | 3647 | 1585 |
| Grp Volume(v), veh/h | 279 | 291 | 122 | 551 | 733 | 78 |
| Grp Sat Flow(s),veh/h/ln | 1781 | 1585 | 1781 | 1777 | 1777 | 1585 |
| Q Serve(g_s), s | 6.0 | 7.2 | 2.9 | 3.7 | 7.5 | 1.5 |
| Cycle Q Clear(g_c), s | 6.0 | 7.2 | 2.9 | 3.7 | 7.5 | 1.5 |
| Prop In Lane | 1.00 | 1.00 | 1.00 | | | 1.00 |
| Lane Grp Cap(c), veh/h | 460 | 409 | 164 | 1900 | 1206 | 538 |
| V/C Ratio(X) | 0.61 | 0.71 | 0.75 | 0.29 | 0.61 | 0.15 |
| Avail Cap(c_a), veh/h | 1640 | 1459 | 1107 | 5806 | 3230 | 1441 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 14.2 | 14.6 | 19.2 | 5.6 | 11.9 | 10.0 |
| Incr Delay (d2), s/veh | 1.3 | 2.3 | 6.6 | 0.1 | 0.5 | 0.1 |
| Initial Q Delay(d3), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 2.3 | 6.4 | 1.3 | 0.7 | 2.1 | 0.4 |
| Unsig. Movement Delay, s/veh | | | | | | |
| LnGrp Delay(d), s/veh | 15.5 | 16.9 | 25.8 | 5.7 | 12.4 | 10.1 |
| LnGrp LOS | B | B | C | A | B | B |
| Approach Vol, veh/h | 570 | | | 673 | 811 | |
| Approach Delay, s/veh | 16.2 | | | 9.3 | 12.2 | |
| Approach LOS | B | | | A | B | |

| Timer - Assigned Phs | 2 | | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | 27.7 | | 15.7 | 8.5 | 19.2 |
| Change Period (Y+Rc), s | 4.5 | | 4.5 | 4.5 | 4.5 |
| Max Green Setting (Gmax), s | 71.0 | | 40.0 | 27.0 | 39.5 |
| Max Q Clear Time (g_c+I1), s | 5.7 | | 9.2 | 4.9 | 9.5 |
| Green Ext Time (p_c), s | 3.7 | | 2.0 | 0.3 | 5.3 |

| Intersection Summary | | |
|---|---|---|
| HCM 6th Ctrl Delay, s/veh | 12.4 | |
| HCM 6th LOS | B | |

**Notes**

User approved volume balancing among the lanes for turning movement.

| Intersection | |
|---|---|
| Int Delay, s/veh | 0.2 |

| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 1 | 1 | 329 | 8 | 10 | 236 |
| Future Vol, veh/h | 1 | 1 | 329 | 8 | 10 | 236 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Free | Free | Free | Free |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 0 | - | - | - | - | - |
| Veh in Median Storage, # | 0 | - | 0 | - | - | 0 |
| Grade, % | 0 | - | 0 | - | - | 0 |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 1 | 1 | 358 | 9 | 11 | 257 |

| Major/Minor | Minor1 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 642 | 363 | 0 | 0 | 367 | 0 |
| Stage 1 | 363 | - | - | - | - | - |
| Stage 2 | 279 | - | - | - | - | - |
| Critical Hdwy | 6.42 | 6.22 | - | - | 4.12 | - |
| Critical Hdwy Stg 1 | 5.42 | - | - | - | - | - |
| Critical Hdwy Stg 2 | 5.42 | - | - | - | - | - |
| Follow-up Hdwy | 3.518 | 3.318 | - | - | 2.218 | - |
| Pot Cap-1 Maneuver | 438 | 682 | - | - | 1192 | - |
| Stage 1 | 704 | - | - | - | - | - |
| Stage 2 | 768 | - | - | - | - | - |
| Platoon blocked, % | | | - | - | | - |
| Mov Cap-1 Maneuver | 433 | 682 | - | - | 1192 | - |
| Mov Cap-2 Maneuver | 433 | - | - | - | - | - |
| Stage 1 | 704 | - | - | - | - | - |
| Stage 2 | 760 | - | - | - | - | - |

| Approach | WB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s/v | 11.8 | 0 | 0.3 |
| HCM LOS | B | | |

| Minor Lane/Major Mvmt | NBT | NBR | WBLn1 | SBL | SBT |
|---|---|---|---|---|---|
| Capacity (veh/h) | - | - | 530 | 1192 | - |
| HCM Lane V/C Ratio | - | - | 0.004 | 0.009 | - |
| HCM Control Delay (s/veh) | - | - | 11.8 | 8 | 0 |
| HCM Lane LOS | - | - | B | A | A |
| HCM 95th %tile Q (veh) | - | - | 0 | 0 | - |

| Intersection | |
|---|---|
| Int Delay, s/veh | 0 |

| Movement | EBL | EBR | NBL | NBT | SBT | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 0 | 0 | 0 | 619 | 822 | 0 |
| Future Vol, veh/h | 0 | 0 | 0 | 619 | 822 | 0 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Free | Free | Free | Free |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 0 | - | 100 | - | - | 100 |
| Veh in Median Storage, # | 0 | - | - | 0 | 0 | - |
| Grade, % | 0 | - | - | 0 | 0 | - |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 0 | 0 | 673 | 893 | 0 |

| Major/Minor | Minor2 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 1230 | 447 | 893 | 0 | - | 0 |
| Stage 1 | 893 | - | - | - | - | - |
| Stage 2 | 337 | - | - | - | - | - |
| Critical Hdwy | 6.84 | 6.94 | 4.14 | - | - | - |
| Critical Hdwy Stg 1 | 5.84 | - | - | - | - | - |
| Critical Hdwy Stg 2 | 5.84 | - | - | - | - | - |
| Follow-up Hdwy | 3.52 | 3.32 | 2.22 | - | - | - |
| Pot Cap-1 Maneuver | 170 | 559 | 755 | - | - | - |
| Stage 1 | 360 | - | - | - | - | - |
| Stage 2 | 695 | - | - | - | - | - |
| Platoon blocked, % | | | | - | - | - |
| Mov Cap-1 Maneuver | 170 | 559 | 755 | - | - | - |
| Mov Cap-2 Maneuver | 170 | - | - | - | - | - |
| Stage 1 | 360 | - | - | - | - | - |
| Stage 2 | 695 | - | - | - | - | - |

| Approach | EB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s/v | 0 | 0 | 0 |
| HCM LOS | A | | |

| Minor Lane/Major Mvmt | NBL | NBT | EBLn1 | SBT | SBR |
|---|---|---|---|---|---|
| Capacity (veh/h) | 755 | - | - | - | - |
| HCM Lane V/C Ratio | - | - | - | - | - |
| HCM Control Delay (s/veh) | 0 | - | 0 | - | - |
| HCM Lane LOS | A | - | A | - | - |
| HCM 95th %tile Q (veh) | 0 | - | - | - | - |

# MOVEMENT SUMMARY

## Site: 101 [Honoapiilani Hwy/Waiale Rd Ext. (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

**Vehicle Movement Performance**

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] % | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] ft | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed mph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: NB Honoapiilani Hwy | | | | | | | | | | | | | | |
| 7 | T1 | 519 | 2.0 | 546 | 2.0 | 0.603 | 0.1 | LOS A | 7.5 | 191.7 | 0.11 | 0.01 | 0.11 | 19.9 |
| 25 | R2 | 265 | 2.0 | 279 | 2.0 | 0.603 | 0.1 | LOS A | 7.5 | 191.7 | 0.11 | 0.01 | 0.11 | 19.9 |
| Approach | | 784 | 2.0 | 825 | 2.0 | 0.603 | 0.1 | LOS A | 7.5 | 191.7 | 0.11 | 0.01 | 0.11 | 19.9 |
| East: WB Waiale Rd Ext. | | | | | | | | | | | | | | |
| 19 | L2 | 166 | 2.0 | 175 | 2.0 | 0.196 | 6.0 | LOS A | 1.1 | 27.2 | 0.60 | 0.64 | 0.60 | 20.3 |
| 24 | R2 | 5 | 2.0 | 5 | 2.0 | 0.196 | 3.0 | LOS A | 1.1 | 27.2 | 0.60 | 0.64 | 0.60 | 19.0 |
| Approach | | 171 | 2.0 | 180 | 2.0 | 0.196 | 5.9 | LOS A | 1.1 | 27.2 | 0.60 | 0.64 | 0.60 | 20.3 |
| North: SB Honoapiilani Hwy | | | | | | | | | | | | | | |
| 15 | L2 | 5 | 2.0 | 5 | 2.0 | 0.857 | 8.0 | LOS A | 16.3 | 413.8 | 0.97 | 0.79 | 1.09 | 20.4 |
| 2 | T1 | 951 | 2.0 | 1001 | 2.0 | 0.857 | 5.1 | LOS A | 16.3 | 413.8 | 0.97 | 0.79 | 1.09 | 19.1 |
| Approach | | 956 | 2.0 | 1006 | 2.0 | 0.857 | 5.1 | LOS A | 16.3 | 413.8 | 0.97 | 0.79 | 1.09 | 19.1 |
| All Vehicles | | 1911 | 2.0 | 2012 | 2.0 | 0.857 | 3.1 | LOS A | 16.3 | 413.8 | 0.58 | 0.46 | 0.64 | 19.5 |

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# MOVEMENT SUMMARY

## Site: 101 [Waiale Rd - Waiko Rd (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

**Vehicle Movement Performance**

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] % | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] ft | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed mph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: NB Waiale Road | | | | | | | | | | | | | | |
| 102 | L2 | 1 | 2.0 | 1 | 2.0 | 0.490 | 8.6 | LOS A | 3.9 | 97.9 | 0.81 | 0.84 | 0.92 | 20.3 |
| 7 | T1 | 314 | 2.0 | 331 | 2.0 | 0.490 | 5.7 | LOS A | 3.9 | 97.9 | 0.81 | 0.84 | 0.92 | 19.0 |
| 25 | R2 | 59 | 2.0 | 62 | 2.0 | 0.490 | 5.7 | LOS A | 3.9 | 97.9 | 0.81 | 0.84 | 0.92 | 19.0 |
| Approach | | 374 | 2.0 | 394 | 2.0 | 0.490 | 5.7 | LOS A | 3.9 | 97.9 | 0.81 | 0.84 | 0.92 | 19.0 |
| East: WB Waiko Road | | | | | | | | | | | | | | |
| 19 | L2 | 36 | 2.0 | 38 | 2.0 | 0.232 | 5.2 | LOS A | 1.4 | 35.9 | 0.61 | 0.48 | 0.61 | 20.8 |
| 336 | T1 | 54 | 2.0 | 57 | 2.0 | 0.232 | 2.2 | LOS A | 1.4 | 35.9 | 0.61 | 0.48 | 0.61 | 19.4 |
| 24 | R2 | 119 | 2.0 | 125 | 2.0 | 0.232 | 2.2 | LOS A | 1.4 | 35.9 | 0.61 | 0.48 | 0.61 | 19.4 |
| Approach | | 209 | 2.0 | 220 | 2.0 | 0.232 | 2.7 | LOS A | 1.4 | 35.9 | 0.61 | 0.48 | 0.61 | 19.6 |
| North: SB Waiale Road | | | | | | | | | | | | | | |
| 15 | L2 | 324 | 2.0 | 341 | 2.0 | 0.544 | 3.8 | LOS A | 4.8 | 122.7 | 0.44 | 0.31 | 0.44 | 20.7 |
| 2 | T1 | 232 | 2.0 | 244 | 2.0 | 0.544 | 0.8 | LOS A | 4.8 | 122.7 | 0.44 | 0.31 | 0.44 | 19.4 |
| 40 | R2 | 91 | 2.0 | 96 | 2.0 | 0.544 | 0.8 | LOS A | 4.8 | 122.7 | 0.44 | 0.31 | 0.44 | 19.4 |
| Approach | | 647 | 2.0 | 681 | 2.0 | 0.544 | 2.3 | LOS A | 4.8 | 122.7 | 0.44 | 0.31 | 0.44 | 20.0 |
| West: EB Waiko Road | | | | | | | | | | | | | | |
| 30 | L2 | 81 | 2.0 | 85 | 2.0 | 0.385 | 7.1 | LOS A | 2.6 | 65.0 | 0.76 | 0.72 | 0.76 | 20.4 |
| 464 | T1 | 216 | 2.0 | 227 | 2.0 | 0.385 | 4.1 | LOS A | 2.6 | 65.0 | 0.76 | 0.72 | 0.76 | 19.1 |
| 78 | R2 | 2 | 2.0 | 2 | 2.0 | 0.385 | 4.1 | LOS A | 2.6 | 65.0 | 0.76 | 0.72 | 0.76 | 19.1 |
| Approach | | 299 | 2.0 | 315 | 2.0 | 0.385 | 4.9 | LOS A | 2.6 | 65.0 | 0.76 | 0.72 | 0.76 | 19.5 |
| All Vehicles | | 1529 | 2.0 | 1609 | 2.0 | 0.544 | 3.7 | LOS A | 4.8 | 122.7 | 0.61 | 0.54 | 0.64 | 19.6 |

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# MOVEMENT SUMMARY

## Site: 101 [Waiale Rd Ext - Main St BY 2029 (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

**Vehicle Movement Performance**

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] % | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] ft | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed mph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: NB Waiale Road Ext | | | | | | | | | | | | | | |
| 102 | L2 | 25 | 2.0 | 26 | 2.0 | 0.272 | 3.4 | LOS A | 1.7 | 42.1 | 0.26 | 0.10 | 0.26 | 21.1 |
| 7 | T1 | 308 | 2.0 | 324 | 2.0 | 0.272 | 0.4 | LOS A | 1.7 | 42.1 | 0.26 | 0.10 | 0.26 | 19.7 |
| Approach | | 333 | 2.0 | 351 | 2.0 | 0.272 | 0.6 | LOS A | 1.7 | 42.1 | 0.26 | 0.10 | 0.26 | 19.8 |
| North: SB Waiale Road Ext | | | | | | | | | | | | | | |
| 2 | T1 | 308 | 2.0 | 324 | 2.0 | 0.279 | 0.2 | LOS A | 1.6 | 41.7 | 0.14 | 0.03 | 0.14 | 19.9 |
| 40 | R2 | 49 | 2.0 | 52 | 2.0 | 0.279 | 0.2 | LOS A | 1.6 | 41.7 | 0.14 | 0.03 | 0.14 | 19.9 |
| Approach | | 357 | 2.0 | 376 | 2.0 | 0.279 | 0.2 | LOS A | 1.6 | 41.7 | 0.14 | 0.03 | 0.14 | 19.9 |
| West: EB Main Street | | | | | | | | | | | | | | |
| 30 | L2 | 68 | 2.0 | 72 | 2.0 | 0.091 | 4.4 | LOS A | 0.4 | 11.2 | 0.44 | 0.46 | 0.44 | 20.6 |
| 78 | R2 | 25 | 2.0 | 26 | 2.0 | 0.091 | 1.5 | LOS A | 0.4 | 11.2 | 0.44 | 0.46 | 0.44 | 19.3 |
| Approach | | 93 | 2.0 | 98 | 2.0 | 0.091 | 3.6 | LOS A | 0.4 | 11.2 | 0.44 | 0.46 | 0.44 | 20.3 |
| All Vehicles | | 783 | 2.0 | 824 | 2.0 | 0.279 | 0.8 | LOS A | 1.7 | 42.1 | 0.23 | 0.11 | 0.23 | 19.9 |

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 251 | 5 | 796 | 311 | 5 | 651 |
| Future Volume (veh/h) | 251 | 5 | 796 | 311 | 5 | 651 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | 1.00 | | 1.00 | 1.00 | |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | No | | No | | | No |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 273 | 5 | 865 | 186 | 5 | 708 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 356 | 317 | 1082 | 917 | 298 | 1082 |
| Arrive On Green | 0.20 | 0.20 | 0.58 | 0.58 | 0.58 | 0.58 |
| Sat Flow, veh/h | 1781 | 1585 | 1870 | 1585 | 640 | 1870 |
| Grp Volume(v), veh/h | 273 | 5 | 865 | 186 | 5 | 708 |
| Grp Sat Flow(s),veh/h/ln | 1781 | 1585 | 1870 | 1585 | 640 | 1870 |
| Q Serve(g_s), s | 6.5 | 0.1 | 16.4 | 2.5 | 0.3 | 11.6 |
| Cycle Q Clear(g_c), s | 6.5 | 0.1 | 16.4 | 2.5 | 16.6 | 11.6 |
| Prop In Lane | 1.00 | 1.00 | | 1.00 | 1.00 | |
| Lane Grp Cap(c), veh/h | 356 | 317 | 1082 | 917 | 298 | 1082 |
| V/C Ratio(X) | 0.77 | 0.02 | 0.80 | 0.20 | 0.02 | 0.65 |
| Avail Cap(c_a), veh/h | 1027 | 914 | 2240 | 1898 | 694 | 2240 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 17.0 | 14.5 | 7.5 | 4.5 | 14.0 | 6.4 |
| Incr Delay (d2), s/veh | 3.5 | 0.0 | 1.4 | 0.1 | 0.0 | 0.7 |
| Initial Q Delay(d3), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 2.7 | 0.0 | 3.2 | 0.4 | 0.0 | 2.2 |
| Unsig. Movement Delay, s/veh | | | | | | |
| LnGrp Delay(d), s/veh | 20.5 | 14.5 | 8.9 | 4.6 | 14.0 | 7.1 |
| LnGrp LOS | C | B | A | A | B | A |
| Approach Vol, veh/h | 278 | | 1051 | | | 713 |
| Approach Delay, s/veh | 20.4 | | 8.1 | | | 7.2 |
| Approach LOS | C | | A | | | A |

| Timer - Assigned Phs | | 2 | | | 6 | 8 |
|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | | 32.1 | | | 32.1 | 13.0 |
| Change Period (Y+Rc), s | | 6.0 | | | 6.0 | 4.0 |
| Max Green Setting (Gmax), s | | 54.0 | | | 54.0 | 26.0 |
| Max Q Clear Time (g_c+I1), s | | 18.4 | | | 18.6 | 8.5 |
| Green Ext Time (p_c), s | | 7.7 | | | 5.1 | 0.8 |

| Intersection Summary | |
|---|---|
| HCM 6th Ctrl Delay, s/veh | 9.5 |
| HCM 6th LOS | A |



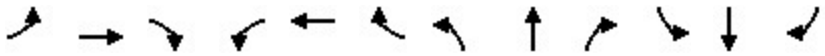
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 9 | 3 | 14 | 119 | 17 | 73 | 16 | 800 | 94 | 35 | 702 | 27 |
| Future Volume (veh/h) | 9 | 3 | 14 | 119 | 17 | 73 | 16 | 800 | 94 | 35 | 702 | 27 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | | No | | | No | | | No | | | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 10 | 3 | 2 | 129 | 18 | 59 | 17 | 870 | 99 | 38 | 763 | 17 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 230 | 60 | 255 | 211 | 26 | 69 | 393 | 1036 | 118 | 264 | 1203 | 1018 |
| Arrive On Green | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.02 | 0.63 | 0.63 | 0.03 | 0.64 | 0.64 |
| Sat Flow, veh/h | 993 | 375 | 1585 | 910 | 162 | 430 | 1781 | 1649 | 188 | 1781 | 1870 | 1584 |
| Grp Volume(v), veh/h | 13 | 0 | 2 | 206 | 0 | 0 | 17 | 0 | 969 | 38 | 763 | 17 |
| Grp Sat Flow(s),veh/h/ln | 1368 | 0 | 1585 | 1502 | 0 | 0 | 1781 | 0 | 1836 | 1781 | 1870 | 1584 |
| Q Serve(g_s), s | 0.0 | 0.0 | 0.1 | 11.5 | 0.0 | 0.0 | 0.3 | 0.0 | 37.6 | 0.7 | 22.3 | 0.4 |
| Cycle Q Clear(g_c), s | 0.5 | 0.0 | 0.1 | 12.0 | 0.0 | 0.0 | 0.3 | 0.0 | 37.6 | 0.7 | 22.3 | 0.4 |
| Prop In Lane | 0.77 | | 1.00 | 0.63 | | 0.29 | 1.00 | | 0.10 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 291 | 0 | 255 | 307 | 0 | 0 | 393 | 0 | 1154 | 264 | 1203 | 1018 |
| V/C Ratio(X) | 0.04 | 0.00 | 0.01 | 0.67 | 0.00 | 0.00 | 0.04 | 0.00 | 0.84 | 0.14 | 0.63 | 0.02 |
| Avail Cap(c_a), veh/h | 454 | 0 | 438 | 479 | 0 | 0 | 635 | 0 | 1421 | 479 | 1447 | 1225 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 1.00 | 1.00 | 0.00 | 0.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 32.1 | 0.0 | 31.9 | 36.8 | 0.0 | 0.0 | 8.2 | 0.0 | 13.2 | 13.6 | 9.7 | 5.8 |
| Incr Delay (d2), s/veh | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.0 | 0.1 | 1.3 | 0.0 |
| Initial Q Delay(d3), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.2 | 0.0 | 0.0 | 4.5 | 0.0 | 0.0 | 0.1 | 0.0 | 14.9 | 0.3 | 8.3 | 0.1 |
| Unsig. Movement Delay, s/veh | | | | | | | | | | | | |
| LnGrp Delay(d), s/veh | 32.1 | 0.0 | 31.9 | 37.8 | 0.0 | 0.0 | 8.2 | 0.0 | 18.3 | 13.7 | 11.0 | 5.8 |
| LnGrp LOS | C | | C | D | | | A | | B | B | B | A |
| Approach Vol, veh/h | | 15 | | | 206 | | | 986 | | | 818 | |
| Approach Delay, s/veh | | 32.1 | | | 37.8 | | | 18.1 | | | 11.0 | |
| Approach LOS | | C | | | D | | | B | | | B | |

| Timer - Assigned Phs | 1 | 2 | | 4 | 5 | 6 | | 8 |
|---|---|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | 8.1 | 62.8 | | 19.6 | 6.7 | 64.2 | | 19.6 |
| Change Period (Y+Rc), s | 5.0 | 6.0 | | 5.0 | 5.0 | 6.0 | | 5.0 |
| Max Green Setting (Gmax), s | 14.0 | 70.0 | | 25.0 | 14.0 | 70.0 | | 25.0 |
| Max Q Clear Time (g_c+I1), s | 2.5 | 39.6 | | 2.5 | 2.3 | 24.3 | | 14.0 |
| Green Ext Time (p_c), s | 0.0 | 17.3 | | 0.0 | 0.0 | 14.4 | | 0.6 |

| Intersection Summary | |
|---|---|
| HCM 6th Ctrl Delay, s/veh | 17.4 |
| HCM 6th LOS | B |

**Notes**

User approved pedestrian interval to be less than phase max green.



| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 51 | 80 | 0 | 76 | 144 | 311 | 2 | 342 | 60 | 165 | 272 | 70 |
| Future Volume (veh/h) | 51 | 80 | 0 | 76 | 144 | 311 | 2 | 342 | 60 | 165 | 272 | 70 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | | No | | | No | | | No | | | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 55 | 87 | -2 | 83 | 157 | 51 | 2 | 372 | 17 | 179 | 296 | 66 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 331 | 252 | 0 | 395 | 277 | 235 | 407 | 530 | 449 | 456 | 568 | 127 |
| Arrive On Green | 0.04 | 0.13 | 0.00 | 0.06 | 0.15 | 0.15 | 0.00 | 0.28 | 0.28 | 0.10 | 0.38 | 0.38 |
| Sat Flow, veh/h | 1781 | 1870 | 0 | 1781 | 1870 | 1585 | 1781 | 1870 | 1585 | 1781 | 1481 | 330 |
| Grp Volume(v), veh/h | 55 | 85 | 0 | 83 | 157 | 51 | 2 | 372 | 17 | 179 | 0 | 362 |
| Grp Sat Flow(s),veh/h/ln | 1781 | 1870 | 0 | 1781 | 1870 | 1585 | 1781 | 1870 | 1585 | 1781 | 0 | 1811 |
| Q Serve(g_s), s | 1.1 | 1.8 | 0.0 | 1.7 | 3.3 | 1.2 | 0.0 | 7.6 | 0.3 | 2.7 | 0.0 | 6.6 |
| Cycle Q Clear(g_c), s | 1.1 | 1.8 | 0.0 | 1.7 | 3.3 | 1.2 | 0.0 | 7.6 | 0.3 | 2.7 | 0.0 | 6.6 |
| Prop In Lane | 1.00 | | 0.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 0.18 |
| Lane Grp Cap(c), veh/h | 331 | 252 | 0 | 395 | 277 | 235 | 407 | 530 | 449 | 456 | 0 | 695 |
| V/C Ratio(X) | 0.17 | 0.34 | 0.00 | 0.21 | 0.57 | 0.22 | 0.00 | 0.70 | 0.04 | 0.39 | 0.00 | 0.52 |
| Avail Cap(c_a), veh/h | 417 | 918 | 0 | 916 | 1399 | 1186 | 569 | 1487 | 1260 | 773 | 0 | 1778 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 |
| Uniform Delay (d), s/veh | 14.9 | 16.8 | 0.0 | 14.6 | 16.9 | 16.0 | 11.0 | 13.7 | 11.1 | 9.0 | 0.0 | 10.2 |
| Incr Delay (d2), s/veh | 0.2 | 0.8 | 0.0 | 0.3 | 1.8 | 0.5 | 0.0 | 1.7 | 0.0 | 0.6 | 0.0 | 0.6 |
| Initial Q Delay(d3), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.4 | 0.7 | 0.0 | 0.6 | 1.4 | 0.4 | 0.0 | 3.0 | 0.1 | 0.9 | 0.0 | 2.2 |
| Unsig. Movement Delay, s/veh | | | | | | | | | | | | |
| LnGrp Delay(d), s/veh | 15.2 | 17.6 | 0.0 | 14.9 | 18.7 | 16.5 | 11.0 | 15.4 | 11.1 | 9.5 | 0.0 | 10.8 |
| LnGrp LOS | B | B | | B | B | B | B | B | B | A | | B |
| Approach Vol, veh/h | | 140 | | | 291 | | | 391 | | | 541 | |
| Approach Delay, s/veh | | 16.6 | | | 17.2 | | | 15.2 | | | 10.3 | |
| Approach LOS | | B | | | B | | | B | | | B | |

| Timer - Assigned Phs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | 8.4 | 17.1 | 6.5 | 10.8 | 4.1 | 21.4 | 5.9 | 11.3 |
| Change Period (Y+Rc), s | 4.0 | 5.0 | 4.0 | 5.0 | 4.0 | 5.0 | 4.0 | 5.0 |
| Max Green Setting (Gmax), s | 12.0 | 34.0 | 15.0 | 21.0 | 4.0 | 42.0 | 4.0 | 32.0 |
| Max Q Clear Time (g_c+I1), s | 4.7 | 9.6 | 3.7 | 3.8 | 2.0 | 8.6 | 3.1 | 5.3 |
| Green Ext Time (p_c), s | 0.3 | 2.5 | 0.1 | 0.3 | 0.0 | 2.6 | 0.0 | 1.1 |

| Intersection Summary | |
|---|---|
| HCM 6th Ctrl Delay, s/veh | 13.9 |
| HCM 6th LOS | B |



| Movement | EBL | EBR | NBL | NBT | SBT | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 360 | 173 | 181 | 722 | 766 | 381 |
| Future Volume (veh/h) | 360 | 173 | 181 | 722 | 766 | 381 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | 1.00 | 1.00 | | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | No | | | No | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 259 | 268 | 197 | 785 | 833 | 125 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 412 | 366 | 259 | 2104 | 1273 | 568 |
| Arrive On Green | 0.23 | 0.23 | 0.15 | 0.59 | 0.36 | 0.36 |
| Sat Flow, veh/h | 1781 | 1585 | 1781 | 3647 | 3647 | 1585 |
| Grp Volume(v), veh/h | 259 | 268 | 197 | 785 | 833 | 125 |
| Grp Sat Flow(s),veh/h/ln | 1781 | 1585 | 1781 | 1777 | 1777 | 1585 |
| Q Serve(g_s), s | 6.7 | 8.0 | 5.4 | 5.9 | 10.0 | 2.8 |
| Cycle Q Clear(g_c), s | 6.7 | 8.0 | 5.4 | 5.9 | 10.0 | 2.8 |
| Prop In Lane | 1.00 | 1.00 | 1.00 | | | 1.00 |
| Lane Grp Cap(c), veh/h | 412 | 366 | 259 | 2104 | 1273 | 568 |
| V/C Ratio(X) | 0.63 | 0.73 | 0.76 | 0.37 | 0.65 | 0.22 |
| Avail Cap(c_a), veh/h | 1400 | 1246 | 945 | 4957 | 2758 | 1230 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 17.6 | 18.1 | 20.9 | 5.4 | 13.7 | 11.4 |
| Incr Delay (d2), s/veh | 1.6 | 2.8 | 4.6 | 0.1 | 0.6 | 0.2 |
| Initial Q Delay(d3), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 2.7 | 0.3 | 2.2 | 1.1 | 3.1 | 0.8 |
| Unsig. Movement Delay, s/veh | | | | | | |
| LnGrp Delay(d), s/veh | 19.2 | 20.9 | 25.5 | 5.5 | 14.3 | 11.6 |
| LnGrp LOS | B | C | C | A | B | B |
| Approach Vol, veh/h | 527 | | | 982 | 958 | |
| Approach Delay, s/veh | 20.1 | | | 9.5 | 13.9 | |
| Approach LOS | C | | | A | B | |

| Timer - Assigned Phs | 2 | | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | 34.6 | | 16.3 | 11.9 | 22.7 |
| Change Period (Y+Rc), s | 4.5 | | 4.5 | 4.5 | 4.5 |
| Max Green Setting (Gmax), s | 71.0 | | 40.0 | 27.0 | 39.5 |
| Max Q Clear Time (g_c+I1), s | 7.9 | | 10.0 | 7.4 | 12.0 |
| Green Ext Time (p_c), s | 5.8 | | 1.8 | 0.5 | 6.2 |

| Intersection Summary | |
|---|---|
| HCM 6th Ctrl Delay, s/veh | 13.5 |
| HCM 6th LOS | B |

**Notes**

User approved volume balancing among the lanes for turning movement.

| Intersection | |
|---|---|
| Int Delay, s/veh | 0.3 |

| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 7 | 9 | 329 | 0 | 0 | 270 |
| Future Vol, veh/h | 7 | 9 | 329 | 0 | 0 | 270 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Free | Free | Free | Free |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 0 | - | - | - | - | - |
| Veh in Median Storage, # | 0 | - | 0 | - | - | 0 |
| Grade, % | 0 | - | 0 | - | - | 0 |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 8 | 10 | 358 | 0 | 0 | 293 |

| Major/Minor | Minor1 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 651 | 358 | 0 | 0 | 358 | 0 |
| Stage 1 | 358 | - | - | - | - | - |
| Stage 2 | 293 | - | - | - | - | - |
| Critical Hdwy | 6.42 | 6.22 | - | - | 4.12 | - |
| Critical Hdwy Stg 1 | 5.42 | - | - | - | - | - |
| Critical Hdwy Stg 2 | 5.42 | - | - | - | - | - |
| Follow-up Hdwy | 3.518 | 3.318 | - | - | 2.218 | - |
| Pot Cap-1 Maneuver | 433 | 686 | - | - | 1201 | - |
| Stage 1 | 707 | - | - | - | - | - |
| Stage 2 | 757 | - | - | - | - | - |
| Platoon blocked, % | | | - | - | | - |
| Mov Cap-1 Maneuver | 433 | 686 | - | - | 1201 | - |
| Mov Cap-2 Maneuver | 433 | - | - | - | - | - |
| Stage 1 | 707 | - | - | - | - | - |
| Stage 2 | 757 | - | - | - | - | - |

| Approach | WB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s/v | 11.8 | 0 | 0 |
| HCM LOS | B | | |

| Minor Lane/Major Mvmt | NBT | NBR | WBLn1 | SBL | SBT |
|---|---|---|---|---|---|
| Capacity (veh/h) | - | - | 546 | 1201 | - |
| HCM Lane V/C Ratio | - | - | 0.032 | - | - |
| HCM Control Delay (s/veh) | - | - | 11.8 | 0 | - |
| HCM Lane LOS | - | - | B | A | - |
| HCM 95th %tile Q (veh) | - | - | 0.1 | 0 | - |

| Intersection | |
|---|---|
| Int Delay, s/veh | 0 |

| Movement | EBL | EBR | NBL | NBT | SBT | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 0 | 0 | 0 | 903 | 939 | 0 |
| Future Vol, veh/h | 0 | 0 | 0 | 903 | 939 | 0 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Free | Free | Free | Free |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 0 | - | 100 | - | - | 100 |
| Veh in Median Storage, # | 0 | - | - | 0 | 0 | - |
| Grade, % | 0 | - | - | 0 | 0 | - |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 0 | 0 | 982 | 1021 | 0 |

| Major/Minor | Minor2 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 1512 | 511 | 1021 | 0 | - | 0 |
| Stage 1 | 1021 | - | - | - | - | - |
| Stage 2 | 491 | - | - | - | - | - |
| Critical Hdwy | 6.84 | 6.94 | 4.14 | - | - | - |
| Critical Hdwy Stg 1 | 5.84 | - | - | - | - | - |
| Critical Hdwy Stg 2 | 5.84 | - | - | - | - | - |
| Follow-up Hdwy | 3.52 | 3.32 | 2.22 | - | - | - |
| Pot Cap-1 Maneuver | 111 | 508 | 675 | - | - | - |
| Stage 1 | 309 | - | - | - | - | - |
| Stage 2 | 581 | - | - | - | - | - |
| Platoon blocked, % | | | | - | - | - |
| Mov Cap-1 Maneuver | 111 | 508 | 675 | - | - | - |
| Mov Cap-2 Maneuver | 111 | - | - | - | - | - |
| Stage 1 | 309 | - | - | - | - | - |
| Stage 2 | 581 | - | - | - | - | - |

| Approach | EB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s/v | 0 | 0 | 0 |
| HCM LOS | A | | |

| Minor Lane/Major Mvmt | NBL | NBT | EBLn1 | SBT | SBR |
|---|---|---|---|---|---|
| Capacity (veh/h) | 675 | - | - | - | - |
| HCM Lane V/C Ratio | - | - | - | - | - |
| HCM Control Delay (s/veh) | 0 | - | 0 | - | - |
| HCM Lane LOS | A | - | A | - | - |
| HCM 95th %tile Q (veh) | 0 | - | - | - | - |

# MOVEMENT SUMMARY

## Site: 101 [Honoapiilani Hwy/Waiale Rd Ext. (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

**Vehicle Movement Performance**

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] % | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] ft | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed mph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: NB Honoapiilani Hwy | | | | | | | | | | | | | | |
| 7 | T1 | 796 | 2.0 | 838 | 2.0 | 0.852 | 0.1 | LOS A | 24.2 | 613.4 | 0.25 | 0.03 | 0.25 | 19.8 |
| 25 | R2 | 311 | 2.0 | 327 | 2.0 | 0.852 | 0.1 | LOS A | 24.2 | 613.4 | 0.25 | 0.03 | 0.25 | 19.8 |
| Approach | | 1107 | 2.0 | 1165 | 2.0 | 0.852 | 0.1 | LOS A | 24.2 | 613.4 | 0.25 | 0.03 | 0.25 | 19.8 |
| East: WB Waiale Rd Ext. | | | | | | | | | | | | | | |
| 19 | L2 | 251 | 2.0 | 264 | 2.0 | 0.387 | 9.5 | LOS A | 2.6 | 67.1 | 0.83 | 0.88 | 0.85 | 19.7 |
| 24 | R2 | 5 | 2.0 | 5 | 2.0 | 0.387 | 6.5 | LOS A | 2.6 | 67.1 | 0.83 | 0.88 | 0.85 | 18.5 |
| Approach | | 256 | 2.0 | 269 | 2.0 | 0.387 | 9.4 | LOS A | 2.6 | 67.1 | 0.83 | 0.88 | 0.85 | 19.7 |
| North: SB Honoapiilani Hwy | | | | | | | | | | | | | | |
| 15 | L2 | 5 | 2.0 | 5 | 2.0 | 0.648 | 5.8 | LOS A | 6.7 | 169.4 | 0.76 | 0.54 | 0.80 | 20.6 |
| 2 | T1 | 651 | 2.0 | 685 | 2.0 | 0.648 | 2.9 | LOS A | 6.7 | 169.4 | 0.76 | 0.54 | 0.80 | 19.3 |
| Approach | | 656 | 2.0 | 691 | 2.0 | 0.648 | 2.9 | LOS A | 6.7 | 169.4 | 0.76 | 0.54 | 0.80 | 19.3 |
| All Vehicles | | 2019 | 2.0 | 2125 | 2.0 | 0.852 | 2.2 | LOS A | 24.2 | 613.4 | 0.49 | 0.30 | 0.51 | 19.6 |

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# MOVEMENT SUMMARY

## Site: 101 [Waiale Rd - Waiko Rd (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

**Vehicle Movement Performance**

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] % | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] ft | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed mph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: NB Waiale Road | | | | | | | | | | | | | | |
| 102 | L2 | 2 | 2.0 | 2 | 2.0 | 0.400 | 4.9 | LOS A | 2.6 | 65.7 | 0.57 | 0.36 | 0.57 | 20.8 |
| 7 | T1 | 342 | 2.0 | 360 | 2.0 | 0.400 | 2.0 | LOS A | 2.6 | 65.7 | 0.57 | 0.36 | 0.57 | 19.5 |
| 25 | R2 | 60 | 2.0 | 63 | 2.0 | 0.400 | 2.0 | LOS A | 2.6 | 65.7 | 0.57 | 0.36 | 0.57 | 19.5 |
| Approach | | 404 | 2.0 | 425 | 2.0 | 0.400 | 2.0 | LOS A | 2.6 | 65.7 | 0.57 | 0.36 | 0.57 | 19.5 |
| East: WB Waiko Road | | | | | | | | | | | | | | |
| 19 | L2 | 76 | 2.0 | 80 | 2.0 | 0.579 | 7.0 | LOS A | 5.1 | 130.5 | 0.76 | 0.74 | 0.85 | 20.5 |
| 336 | T1 | 144 | 2.0 | 152 | 2.0 | 0.579 | 4.0 | LOS A | 5.1 | 130.5 | 0.76 | 0.74 | 0.85 | 19.2 |
| 24 | R2 | 311 | 2.0 | 327 | 2.0 | 0.579 | 4.0 | LOS A | 5.1 | 130.5 | 0.76 | 0.74 | 0.85 | 19.2 |
| Approach | | 531 | 2.0 | 559 | 2.0 | 0.579 | 4.5 | LOS A | 5.1 | 130.5 | 0.76 | 0.74 | 0.85 | 19.4 |
| North: SB Waiale Road | | | | | | | | | | | | | | |
| 15 | L2 | 165 | 2.0 | 174 | 2.0 | 0.485 | 4.6 | LOS A | 3.8 | 95.6 | 0.60 | 0.40 | 0.60 | 20.7 |
| 2 | T1 | 272 | 2.0 | 286 | 2.0 | 0.485 | 1.6 | LOS A | 3.8 | 95.6 | 0.60 | 0.40 | 0.60 | 19.3 |
| 40 | R2 | 70 | 2.0 | 74 | 2.0 | 0.485 | 1.6 | LOS A | 3.8 | 95.6 | 0.60 | 0.40 | 0.60 | 19.3 |
| Approach | | 507 | 2.0 | 534 | 2.0 | 0.485 | 2.6 | LOS A | 3.8 | 95.6 | 0.60 | 0.40 | 0.60 | 19.7 |
| West: EB Waiko Road | | | | | | | | | | | | | | |
| 30 | L2 | 51 | 2.0 | 54 | 2.0 | 0.160 | 5.8 | LOS A | 0.9 | 23.9 | 0.64 | 0.56 | 0.64 | 20.5 |
| 464 | T1 | 80 | 2.0 | 84 | 2.0 | 0.160 | 2.9 | LOS A | 0.9 | 23.9 | 0.64 | 0.56 | 0.64 | 19.2 |
| 78 | R2 | 1 | 2.0 | 1 | 2.0 | 0.160 | 2.9 | LOS A | 0.9 | 23.9 | 0.64 | 0.56 | 0.64 | 19.2 |
| Approach | | 132 | 2.0 | 139 | 2.0 | 0.160 | 4.0 | LOS A | 0.9 | 23.9 | 0.64 | 0.56 | 0.64 | 19.7 |
| All Vehicles | | 1574 | 2.0 | 1657 | 2.0 | 0.579 | 3.2 | LOS A | 5.1 | 130.5 | 0.65 | 0.52 | 0.68 | 19.6 |

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# MOVEMENT SUMMARY

## Site: 101 [Waiale Rd Ext - Main St BY 2029 (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

**Vehicle Movement Performance**

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] % | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] ft | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed mph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: NB Waiale Road Ext | | | | | | | | | | | | | | |
| 102 | L2 | 65 | 2.0 | 68 | 2.0 | 0.366 | 3.8 | LOS A | 2.4 | 61.1 | 0.39 | 0.20 | 0.39 | 20.9 |
| 7 | T1 | 361 | 2.0 | 380 | 2.0 | 0.366 | 0.9 | LOS A | 2.4 | 61.1 | 0.39 | 0.20 | 0.39 | 19.6 |
| Approach | | 426 | 2.0 | 448 | 2.0 | 0.366 | 1.3 | LOS A | 2.4 | 61.1 | 0.39 | 0.20 | 0.39 | 19.8 |
| North: SB Waiale Road Ext | | | | | | | | | | | | | | |
| 2 | T1 | 210 | 2.0 | 221 | 2.0 | 0.286 | 0.4 | LOS A | 1.7 | 44.2 | 0.25 | 0.08 | 0.25 | 19.8 |
| 40 | R2 | 142 | 2.0 | 149 | 2.0 | 0.286 | 0.4 | LOS A | 1.7 | 44.2 | 0.25 | 0.08 | 0.25 | 19.8 |
| Approach | | 352 | 2.0 | 371 | 2.0 | 0.286 | 0.4 | LOS A | 1.7 | 44.2 | 0.25 | 0.08 | 0.25 | 19.8 |
| West: EB Main Street | | | | | | | | | | | | | | |
| 30 | L2 | 130 | 2.0 | 137 | 2.0 | 0.177 | 4.0 | LOS A | 0.9 | 23.5 | 0.40 | 0.42 | 0.40 | 20.7 |
| 78 | R2 | 64 | 2.0 | 67 | 2.0 | 0.177 | 1.1 | LOS A | 0.9 | 23.5 | 0.40 | 0.42 | 0.40 | 19.4 |
| Approach | | 194 | 2.0 | 204 | 2.0 | 0.177 | 3.1 | LOS A | 0.9 | 23.5 | 0.40 | 0.42 | 0.40 | 20.2 |
| All Vehicles | | 972 | 2.0 | 1023 | 2.0 | 0.366 | 1.3 | LOS A | 2.4 | 61.1 | 0.34 | 0.20 | 0.34 | 19.9 |

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# CONSTRUCTION TRAFFIC MANAGEMENT PLAN

## APPENDIX

# Q-2

# CONSTRUCTION TRAFFIC MANAGEMENT PLAN CENTRAL MAUI WASTEWATER RECLAMATION FACILITY

WAIKAPU, MAUI, HAWAII

## DRAFT FINAL

June 19, 2024

Prepared for:

Munekiyo Hiraga
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Wailuku, HI 96793

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# CONSTRUCTION TRAFFIC MANAGEMENT PLAN
# CENTRAL MAUI WASTEWATER RECLAMATION FACILITY

Waikapu, Maui Hawaii

## DRAFT FINAL

Prepared for

**Munekiyo Hiraga**
**305 High Street, Suite 104**
**Wailuku, Hawaii 96793**

Prepared by
**Austin, Tsutsumi & Associates, Inc.**
Civil Engineers • Surveyors
Honolulu • Wailuku, Hawaii

June 19, 2024

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AUSTIN, TSUTSUMI & ASSOCIATES, INC. CIVIL ENGINEERS • SURVEYORS
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# DRAFT

# CONSTRUCTION TRAFFIC MANAGEMENT PLAN

# Central Maui Wastewater Reclamation Facility

# Waikapu, Maui, Hawaii

## 1. INTRODUCTION

This Transportation Management Plan (TMP) provides recommendations to describe and mitigate potential traffic impacts resulting from construction activities for the proposed Central Maui Wastewater Reclamation Facility (hereinafter referred to as the "Project") located in Waikapu, Maui, Hawaii.

At this time, the project is in early stages of planning, and construction logistics, including staging, loading/unloading, parking areas, etc. have not yet been determined, and will be clarified once design has been completed. Once construction logistics become available, the "Level" of TMP required will be determined utilizing the Hawaii Department of Transportation, Highways Division (HDOT) "Determination of a Significant Highway Project" flow chart, and this TMP will be updated to include those details.

### 1.1 Roles and Responsibilities

| | |
|---|---|
| TMP Manager: | Contractor, To be determined |
| Author: | Austin, Tsutsumi & Associates, Inc. (ATA) |
| TMP Monitor: | Contractor, To be determined |
| Emergency Contacts: | Project Managers, To be determined |

REPLY TO:
501 SUMNER STREET, SUITE 521 • HONOLULU, HAWAII 96817-5031
PHONE (808) 533-3646 • FAX (808) 526-1267
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OFFICES IN:
HONOLULU, HAWAII
WAILUKU, MAUI, HAWAII

# 2. PROJECT DESCRIPTION

## 2.1 Project Type

The Project consists of a new Kehalani Wastewater Pump Station (WWPS), a new Central Maui Wastewater Reclamation Facility (WWRF), onsite Soil Aquifer Treatment (SAT) system, and several new pipelines to provide connection between the new facilities and surrounding developments. The Kehalani WWPS is planned to be constructed on parcel tax map key (TMK) number (2) 3-5-020:036, which is currently a stormwater detention basin that serves the Kehalani development. The Central Maui WWRF is planned to be constructed on a portion of parcel TMK (2) 3-8-005:023. The 14.9-acre portion of the parcel for the WWRF is located between Honoapiilani Highway and Kuihelani Highway in Waikapu. The new pipelines will run along the existing Waiale Road and the future Waiale Road Extension. The Project is anticipated to be completed by 2029.

Figure 2.1 shows the Project location and Figure 2.2 shows the Project site plan.

## 2.2 Project Area/Corridor

The proposed WWRF is located in Waikapu on the island of Maui on agricultural lands between Honoapiilani Highway and Kuihelani Highway. The site will be accessed via a single driveway from the planned Waiale Road Extension. No access to the site is planned from Kuihelani Highway.

The proposed WWPS is located near the Waiale Road/Olomea Street. This site will be accessed via Waiale Road.

The proposed pipelines will be constructed along Waiale Road from Waiinu Road to Waiko Road. A portion of the pipelines will also be constructed as part of the Waiale Road Extension, which will travel from the Waiale Road/Waiko Road intersection to the Honopiilani Highway/Old Quarry Road intersection.

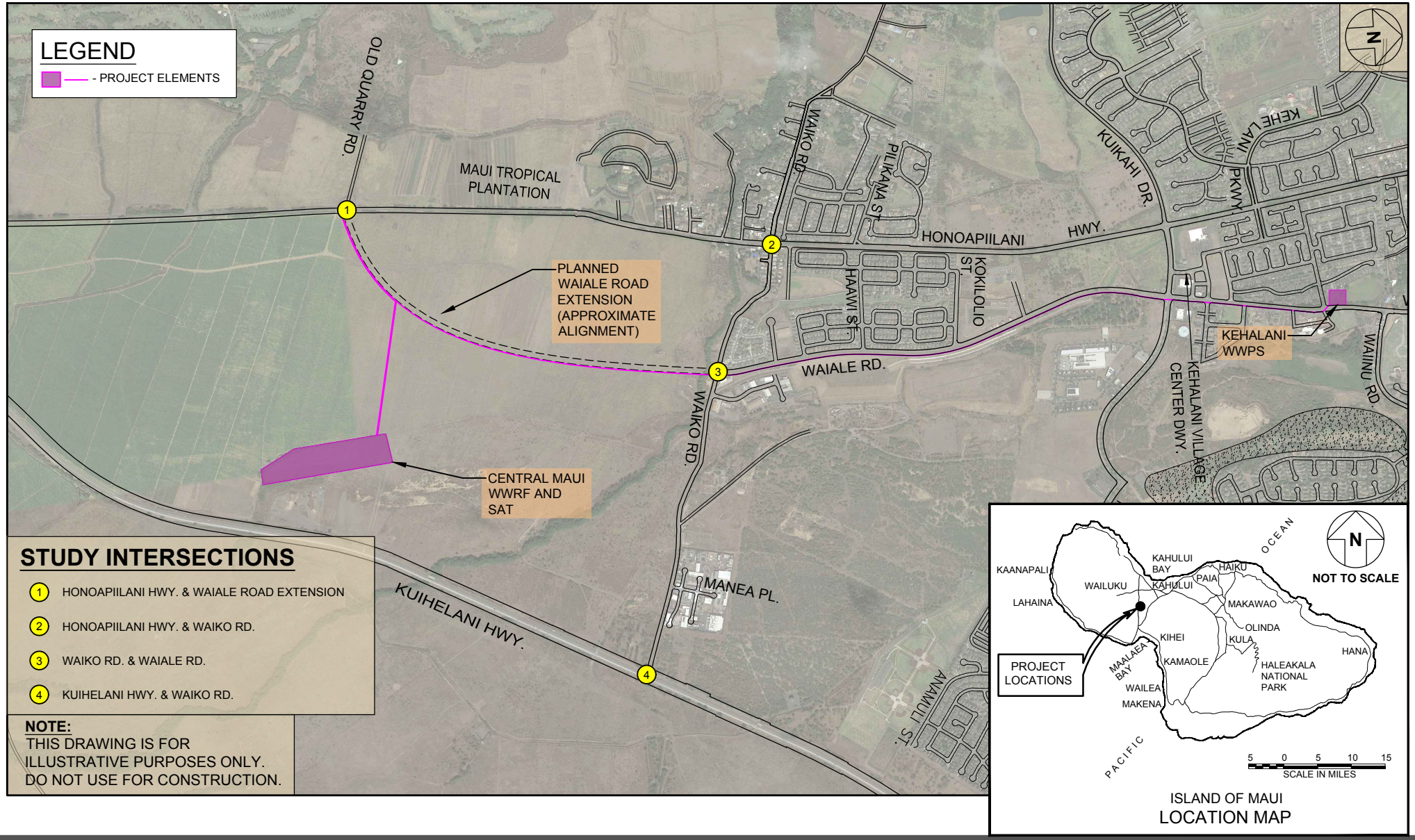
## 2.3 General Schedule and Timeline

Construction of the Project will begin upon approval, and construction is anticipated to be complete by the Year 2029.

The TMP will be updated to include normal construction hours and weekend work required, if any, once construction logistics become available.

# CENTRAL MAUI WASTEWATER RECLAMATION FACILITY TMP

AustinTsutsumi & ASSOCIATES, INC.
Engineers & Surveyors




# FIGURE 2.1

LOCATION MAP

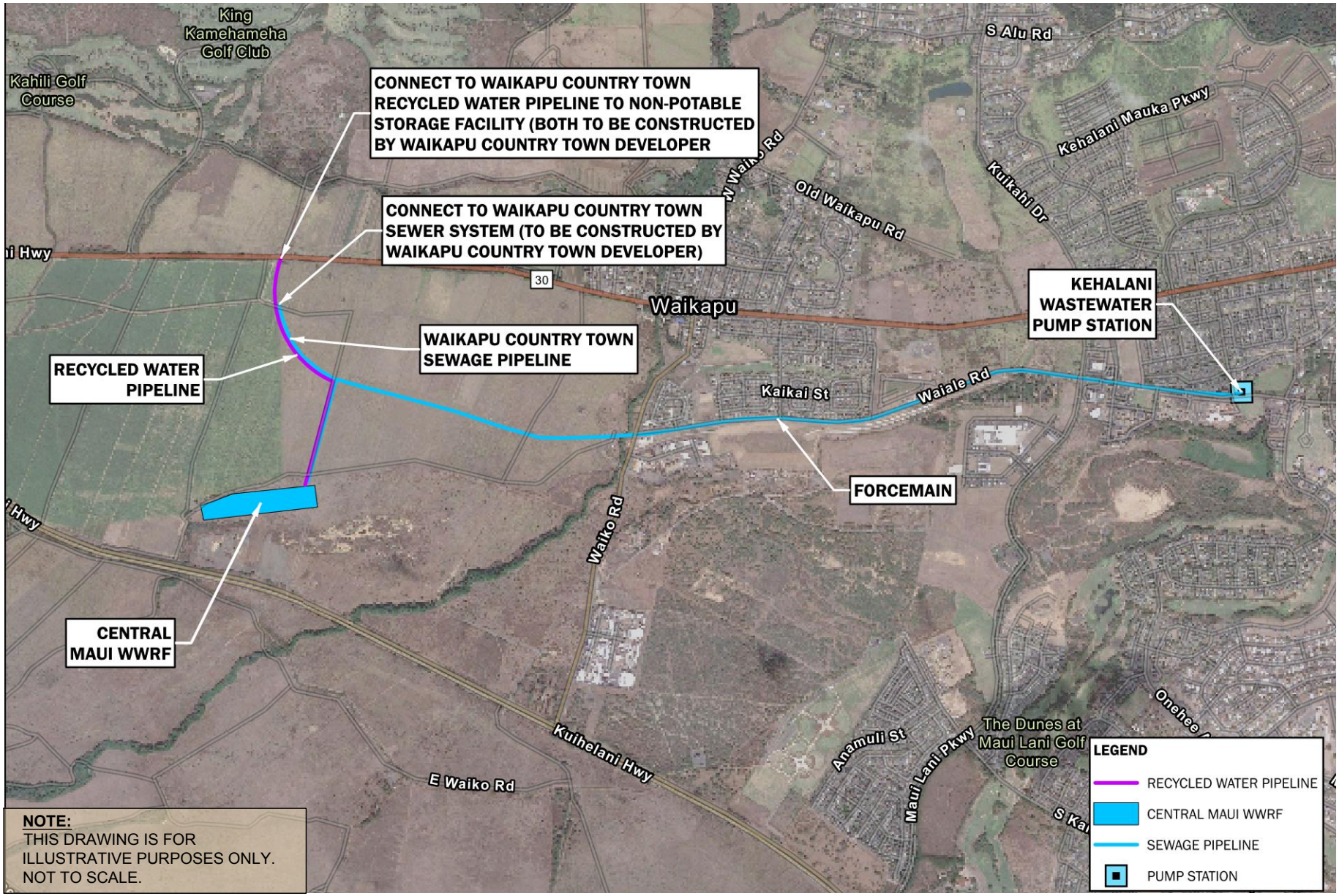



FIGURE 2.2

CONCEPTUAL SITE PLAN

# 3. EXISTING CONDITIONS

## 3.1 Roadway Characteristics

Below are descriptions of the existing roadways in the vicinity of the Project. These roadway conditions reflect the existing conditions at the time of this report.

Honoapiilani Highway is generally a north-south, two-way, two-lane, undivided arterial highway with posted speed limits ranging between 30 miles per hour (mph) and 45 mph. Honoapiilani Highway begins to the north at its intersection with Keanu Street and High Street in Wailuku, and runs southward and then westward, generally following the coast, until it transitions into Kahekili Highway at its intersection with Honokohau Valley Road near the Honokohau Bay.

Waiale Road is a north-south, two-way, two-lane, undivided collector roadway. Waiale Road has a posted speed limit of 20 mph between its intersection with Lower Main Street and Waiinu Road, where it transitions to 25 mph between Waiinu Road and Maui Lani Parkway/Kuikahi Drive and increases again to 30 mph from Maui Lani Parkway/Kuikahi Drive to its southern terminus at East Waiko Road.

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

Kuihelani Highway is a north-south, two-way, four-lane, divided arterial highway with posted speed limits ranging from 30 mph to 55 mph. Kuihelani Highway begins as the continuation of Mayor Elmer F. Cravalho Way at the Puunene Avenue/Maui Veterans Highway intersection and continues southward through Waikapu where it terminates at its intersection with Honoapiilani Highway. The speed limit along the highway is 45 mph in the vicinity of East Waiko Road and increases to 55 mph near the Project site.

## 3.2 Existing Traffic Data

A Traffic Impact Analysis Report (TIAR) for the Central Maui Wastewater Reclamation Facility was completed by ATA in March 2024. The TIAR studied assess traffic conditions at key intersections listed below:

- Honoapiilani Highway/Waiale Road Extension (Future Intersection)
- Honoapiilani Highway/Waiko Road
- East Waiko Road/Waiale Road
- Kuihelani Highway/East Waiko Road

The hourly traffic volume data utilized in the TIAR was collected on Thursday, September 22, 2022 and based on the traffic count data, the weekday AM and PM peak hours of traffic were determined to occur between 7:00 AM – 8:00 AM and 3:45 PM – 4:45 PM, respectively.

Traffic was observed to proceed smoothly through all study intersections, with no significant or persistent congestion. Analysis shows that all movements at all study intersections operate at LOS C or better across both peak hours.

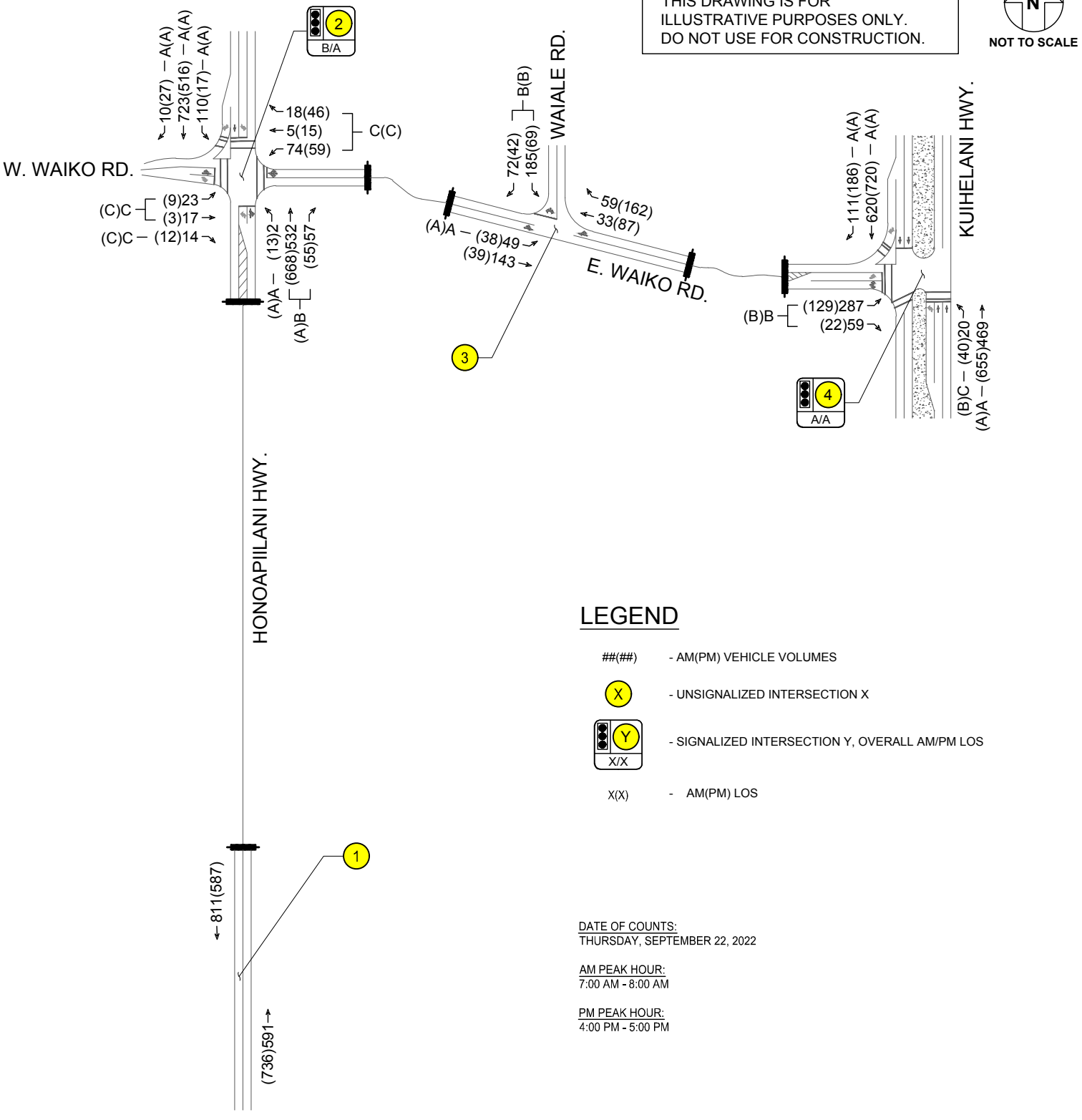
See Figure 3.1 for existing lane configuration, traffic volumes, and LOS for the study intersections from the Central Maui Wastewater Reclamation Facility Traffic Impact Analysis Report (TIAR) completed by ATA in January 2023.

# CENTRAL MAUI WASTEWATER RECLAMATION FACILITY TMP

AustinTsutsumi & ASSOCIATES, INC.
Engineers & Surveyors

**NOTE:**
THIS DRAWING IS FOR ILLUSTRATIVE PURPOSES ONLY.
DO NOT USE FOR CONSTRUCTION.

N
NOT TO SCALE




## LEGEND

| | |
|---|---|
| ##(##) | - AM(PM) VEHICLE VOLUMES |
| X | - UNSIGNALIZED INTERSECTION X |
| Y / X/X | - SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS |
| X(X) | - AM(PM) LOS |

DATE OF COUNTS:
THURSDAY, SEPTEMBER 22, 2022

AM PEAK HOUR:
7:00 AM - 8:00 AM

PM PEAK HOUR:
4:00 PM - 5:00 PM

# FIGURE 3.1

EXISTING CONDITIONS LANE CONFIGURATION, VOLUMES AND MOVEMENT LOS

# 4. CONSTRUCTION WORK ZONE IMPACTS ASSESSMENT

## 4.1 Qualitative Summary of Anticipated Work Zone Impacts

### 4.1.1 Anticipated Work Zone Impacts, Detour Routes, and Temporary Traffic Control (TTC)

Construction logistics have not yet been finalized; however, this section outlines preliminary anticipated impacts based on the current understanding.

- The WWRF, pipeline, and WWPS will be bid as separate construction projects, and will have separate contractor laydown and storage areas, but construction-related deliveries and other traffic will be specified to occur outside of peak hours in construction documents for all three (3) projects.
- Construction for the pipelines/force main along Waiale Road will be open trench construction. It is likely that a lane will be closed with traffic control around the active construction segment. This construction and temporary traffic control measures will occur outside of peak hours.

The TMP will be updated to include additional anticipated work zone impacts, detour routes, and temporary traffic control once construction logistics become available.

# 5. SELECTED WORK ZONE IMPACTS MANAGEMENT STRATEGIES

## 5.1 Project Coordination

To further minimize or mitigate any unanticipated adverse impacts of the Project's construction on surrounding roadways, additional measures to facilitate smooth traffic operations should be considered.

Delivery of some construction materials and equipment may arrive to the site as an oversized and/or overweight load. Delivery of items that require special permitting to utilize County and/or State facilities should occur outside of peak traffic hours. To the point where it is still feasible and practical, typical tractor trailer deliveries should also be timed to occur outside of peak traffic hours to further minimize any potential impacts of deliveries to surrounding roadways.

In addition, if any other projects in the vicinity are actively in construction or planning future construction activities, the schedule and timing of freight deliveries should be coordinated between parties in order to minimize any traffic related impacts.

## 5.2 Temporary Traffic Control Devices

The TMP will be updated to include temporary traffic control devices once construction logistics become available.

## 5.3 Best Management Practice (BMP) Controls

In adherence to County of Maui (COM) BMP controls, the following should be practiced to reduce the tracking of mud and dirt onto public roadways:

- Provide a pad of aggregate underlain with filter cloth at the site exit.
- Provide a tire wash area to remove sediment from tires and under vehicles at the site exit.
- Provide a sediment trap to collect wash water runoff at the tire area.
- Sweep and vacuum adjacent public streets regularly.

If construction vehicle traffic results in damage to the surrounding roadways, the affected roads should be repaired immediately and restored back to pre-construction conditions.

## 5.4 Public Information

Community members should be kept apprised of the Projects construction status. Area representatives, neighborhood board, residents, businesses, first responders and public transportation should be provided prior notice of any construction related traffic impacts to roadways.

# 6. TMP MONITORING DURING CONSTRUCTION

The TMP Manager shall monitor all phases of the construction work and shall document any problems, issues, or recommendations for use by future projects.

# 7. RECOMMENDATIONS

- To the extent practicable, accommodate all equipment storage/staging, loading/unloading, and worker parking occurring on-site to eliminate impacts to traffic on adjacent streets.
- To the extent practicable, limit construction-related deliveries during the weekdays to off-peak traffic hours to minimize any possible disruption to traffic on the local streets.
- Delivery of construction materials and equipment using oversized trucks which require permits to use County and/or State facilities should occur during off-peak traffic hours.
- Repair/restore any and all damages to COM right-of-way as a result of construction activities to the current County standards and Americans with Disabilities Act requirements.
- As necessary, establish detours and temporary traffic control (TTC) zones to facilitate traffic during lane closures.
- In adherence to BMP controls, the following should be practiced to reduce the tracking of mud and dirt onto public roadways:
    - Provide a pad of aggregate underlain with filter cloth at the site exit.
    - Provide a tire wash area to remove sediment from tires and under vehicles at the site exit.
    - Provide a sediment trap to collect wash water runoff at the tire area.
    - Sweep and vacuum adjacent public streets regularly.
- Keep members of the community appraised of the status of the project and the impacts, if any, that may affect them.

# 8. REFERENCES

1. Austin, Tsutsumi, and Associates, Central Maui Wastewater Reclamation Facility Traffic Impact Analysis Report, January 2023.
2. Maui, Hawaii, Code of Ordinances § 20.08.035.

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# PROPOSED CENTRAL MAUI WWRF POTABLE WATER DEMAND TECHNICAL MEMORANDUM

# APPENDIX

# R

Brown AND Caldwell

2261 Aupuni Street, Suite 201
Wailuku, HI 96793

T: 808.244.7005

# Technical Memorandum

Prepared for: County of Maui Wastewater Reclamation Division

Project Title: Central Maui Wastewater Reclamation Facility

Project No.: 158098.161

**Technical Memorandum**

Subject: Proposed Central Maui Wastewater Reclamation Facility – Potable Water Demands

Date: April 21, 2025

To: Juan Rivera, P.E.

From: Irina L. Constantinescu, P.E., Project Manager

Copy to: Yukino Uchiyama, AICP, Munekiyo Hiraga

Prepared by: Craig C. Lekven, P.E., Project Director, HI License No. 13003, Expires 4/30/26

This technical memorandum (TM) has been prepared in response to the County of Maui Department of Water Supply (DWS) letter dated August 9, 2023, with the subject, "ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE, Proposed Central Maui Wastewater Reclamation Facility, TMK: (2) 3-5-001:017 (por.) and 120 (por.), 3-5-002:014 (por.), 3-5-020:036 (por.), 3-6-002:003 (por.) and 004 (por.), 3-8-005:023 (por.), portions of Waikapu Stream, and portions of the existing Waiale Road, Kuikahi Drive, and Waiko Road".

# Section 1: Project Overview

As described in the Environmental Impact Statement Preparation Notice (EISPN), the subject project is being constructed to provide wastewater service to existing and future customers within a defined service area. The two project facilities that will require potable water service are:

- A new Kehalani (Wailuku Waikapu Diversion) Wastewater Pump Station (WWPS), to be located on a portion of parcel TMK 3-5-020:036.
- A new Central Maui Wastewater Reclamation Facility (WWRF) to be located on a portion of parcel TMK 3-8-005:023.

Both facilities will be owned and operated by the County of Maui Department of Environmental Management (DEM) and will provide a governmental service for public benefit (wastewater collection, treatment, and disposal) as defined in §19.04.040 of the Maui County Code. As such, §16-201-03 (g) (3) establishes that the projects shall not be considered projects using large quantities of water, provided that the water system has adequate capacity to meet the project's water needs.

# Section 2: Potable Water Needs

Potable water needs for the two facilities are summarized below.

## 2.1 Kehalani WWPS

The Kehalani WWPS will require potable water for hose bibbs (clean up), odor control system makeup water, and worker sanitation. Potable water demands will be similar to other County WWPS facilities. Water bills for the Hawaiian Homes WWPS, located on parcel TMK 3-3-005:003 for the period of January 2021 through June 2024 were evaluated to establish likely water demand at the Kehalani WWPS. The Hawaiian Homes WWPS is similar in size to the proposed Kehalani WWPS and is equipped with a similar odor control system. Table 1 summarizes the projected potable water demand at the Kehalani WWPS.

**Table 1. Potable Water Demand Projections for Kehalani WWPS**

| Demand Description | Peaking Factor | Demand |
|---|---|---|
| Average day | 1.0 | 4,000 gpd (2.8 gpm) |
| Peak day | 1.5 | 6,000 gpd (4.2 gpm) |
| Peak hour | 3.0 | 8.3 gpm |

DWS noted in its letter that there are two existing meters located along Olomea Street. The WWPS design team will work with DWS during the design process to identify the preferred method for supplying potable water to the new facility. The potable water improvements will be designed in accordance with the Water System Standards and will be submitted for DWS review and approval prior to construction.

## 2.2 Central Maui WWRF

The Central Maui WWRF will be designed so that the effluent will meet State of Hawaii Department of Health (DOH) R-1 recycled water requirements, and the recycled water will be used extensively within the facility. Table 2 summarizes the anticipated water demands within the facility, and what sources will be used to meet the demands.

**Table 2. Central Maui WWRF Water Demands and Sources**

| Demand | R-1 Recycled Water | Potable Water |
|---|---|---|
| Irrigation | ● | |
| Process water | ● | |
| Hose bibbs | ● | |
| Chemical dilution | ● | |
| Chemical carrier | ● | |
| Pump seal water | ● | |
| Restrooms | | ● |
| Showers | | ● |
| Sinks | | ● |
| Drinking fountains | | ● |
| Emergency eyewash | | ● |
| Emergency showers | | ● |
| Laboratories | | ● |

Potable water demands at the Central Maui WWRF are anticipated to be similar to the existing Kihei WWRF. Kihei WWRF potable water use records from July 2021 through July 2022 were evaluated to establish estimates for the Central Maui WWRF. Table 3 summarizes the potable water use projections for the Central Maui WWRF.

| Table 3. Potable Water Demand Projections for Central Maui WWRF | | |
|---|---|---|
| **Demand Description** | **Peaking Factor** | **Demand** |
| Average day | 1.0 | 4,500 gpd (3.1 gpm) |
| Peak day | 1.5 | 6,800 gpd (4.7 gpm) |
| Peak hour | 3.0 | 9.4 gpm |

Fire flows are estimated to be 2,500 gpd for 2 hours, for a total volume of 300,000 gallons per the Water Systems Standards. A separate fire line is proposed to be installed from the Waiale Road extension to the Central Maui WWRF hydrants.

The potable water improvements will be designed in accordance with the Water System Standards and will be submitted for DWS review and approval prior to construction.

# ANALYSIS OF PROJECT APPLICABILITY TO HAWAIʻI STATE PLAN

APPENDIX

# S-1

# APPENDIX S-1

## Analysis of Project Applicability to Hawai‘i State Plan

Chapter 226, HRS, also known as the Hawai‘i State Plan, is a long-range comprehensive plan which serves as a guide for the future long-term development of the State by identifying goals, objectives, policies, and priorities, as well as implementation mechanisms. The Plan consists of three (3) parts. Part I includes the Overall Theme, Goals, Objectives, and Policies; Part II includes Planning, Coordination, and Implementation; and Part III establishes Priority Guidelines. Inasmuch as Part II of the State Plan covers its administrative structure and implementation process, discussion of the proposed project's applicability to Part II is not appropriate. Below is an analysis of the project's applicability to Part I and Part III of the Hawai‘i State Plan.

The methodology for the analysis involves examining the project's applicability to the Hawai‘i State Plan's goals, objectives, and policies. "Applicability" refers to a project's need, purpose, and effects, and how these advance or promote a particular set of goals, objectives, and priority guidelines. In assessing the relationship between a proposed action and the Hawai‘i State Plan, an action may be categorized in one of the following groups:

1. **Directly applicable**: the action and its potential effects directly advance or promote the objective, policy, or priority guideline.

   **Example:** A county project to develop a new water source and related transmission facilities would be directly applicable to the objectives and policies for Facility Systems-Water (HRS 226-16) which states: *(5) Support water supply services to areas experiencing critical water problems.*

2. **Indirectly applicable**: the action and its potential effects indirectly support or advance the objective, policy, or priority guideline.

   **Example:** The county water source project cited above supports other related objectives and policies for the economy (HRS 226-6, General), which, for example, states: *(9) Strive to achieve a level of construction activity responsive to, and consistent with, state growth objectives.* In this case, the principle purpose of the project was not to create new construction activities, but nonetheless, supports this policy by creating temporary construction activity during the implementation of the project. In this instance, the proposed action may be deemed to be indirectly applicable to the objective and policy of the Hawai‘i State Plan.

3. **Not applicable**: the action and its potential effects have no direct or indirect relationship to the objectives and policies of the Hawai‘i State Plan.

**Example:** That same county water source improvement project referenced above, may not have direct or indirect linkage to objectives and policies for the economy-Federal Expenditures (HRS 226-9) which states: *(1) Encourage the sustained flow of federal expenditures in Hawaii that generates long-term government civilian employment*. From the standpoint of the agency proposing the water system improvement, and assuming no Federal Funding for the project, there is an unlikely intent that the proposed water source project would be connected to or reliant upon the foregoing policy. Hence, from the standpoint of judiciously applied policy analysis, the proposed action would be considered not applicable to the policy.

In general, a proposed action's applicability to the objectives, policies and priority guidelines of the Hawai'i State Plan is judged on the basis of the action's direct or indirect relationship to the respective objectives, policies, and priority directions. It is recognized that the categorization of "applicability" is subject to interpretation and should be appropriately considered in the context of local and regional conditions.

| **Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives, and Policies**<br>**Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable** | **DA** | **IA** | **NA** |
|---|---|---|---|
| **HRS 226-1: Findings and Purpose** | | | |
| **HRS 226-2: Definitions** | | | |
| **HRS 226-3: Overall Theme** | | | |
| **HRS 226-4: State Goals**. In order to ensure, for the present and future generations, those elements of choice and mobility that ensure that individuals and groups may approach their desired levels of self-reliance and self determination, it shall be the goal of the State to achieve:<br>(1) A strong, viable economy, characterized by stability, diversity, and growth, that enables the fulfillment of the needs and expectations of Hawaii's present and future generations.<br>(2) A desired physical environment, characterized by beauty, cleanliness, quiet, stable natural systems, and uniqueness, that enhances the mental and physical well-being of the people.<br>(3) Physical, social, and economic well-being, for individuals and families in Hawaii, that nourishes a sense of community responsibility, of caring, and of participation in community life. | | | |
| ***Analysis:*** **The Central Maui Wastewater Reclamation Facility (WWRF) Project supports the State goals stated above as it will provide wastewater infrastructure necessary to support the projected population and economic growth in the Central Maui region.** | | | |
| **Chapter 226-5 Objective and Policies for Population** | | | |
| **Objective:** | | | |
| (a) It shall be the objective in planning for the State's population to guide population growth to be consistent with the achievement of physical, economic and social objectives contained in this chapter. | ✓ | | |
| **Policies:** | | | |
| (b) To achieve the population objective, it shall be the policy of this State to: | | | |
| (1) Manage population growth statewide in a manner that provides increased opportunities for Hawaii's people to pursue their physical, social, and economic aspirations while recognizing the unique needs of each county. | ✓ | | |

| Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
|---|---|---|---|
| (2) Encourage an increase in economic activities and employment opportunities on the neighbor islands consistent with community needs and desires. | | ✓ | |
| (3) Promote increased opportunities for Hawaii's people to pursue their socio-economic aspirations throughout the islands. | | ✓ | |
| (4) Encourage research activities and public awareness programs to foster an understanding of Hawaii's limited capacity to accommodate population needs and to address concerns resulting from an increase in Hawaii's population. | | | ✓ |
| (5) Encourage federal actions and coordination among major governmental agencies to promote a more balanced distribution of immigrants among the states, provided that such actions do not prevent the reunion of immediate family members. | | | ✓ |
| (6) Pursue an increase in federal assistance for states with a greater proportion of foreign immigrants relative to their state's population. | | | ✓ |
| (7) Plan the development and availability of land and water resources in a coordinated manner so as to provide for the desired levels of growth in each geographic area. | | | ✓ |
| ***Analysis:*** **The proposed project involves capacity improvements to the Central Maui wastewater system and is directly and indirectly applicable to the objective and relevant policies of planning for the State's population. The proposed project will increase the wastewater treatment capacity in Central Maui, which will allow for the future development of housing and other business related land uses that will help the community meet its future housing and employment needs.** | | | |
| **Chapter 226-6 Objectives and policies for the economy – – in general** | | | |
| **<u>Objectives</u>:** | | | |
| (a) Planning for the State's economy in general shall be directed toward achievement of the following objectives: | | | |
| (1) Increased and diversified employment opportunities to achieve full employment, increased income and job choice, and improved living standards for Hawaii's people, while at the same time stimulating the development and expansion of economic activities capitalizing on defense, dual-use, and science and technology assets, particularly on the neighbor islands where employment opportunities may be limited. | | ✓ | |
| (2) A steadily growing and diversified economic base that is not overly dependent on a few industries, and includes the development and expansion of industries on the neighbor islands. | | ✓ | |
| **<u>Policies</u>:** | | | |
| (b) To achieve general economic objectives, it shall be the policy of this State to: | | | |
| (1) Promote and encourage entrepreneurship within Hawaii by residents and nonresidents of the State. | | | ✓ |
| (2) Expand Hawaii's national and international marketing, communication, and organizational ties, to increase the State's capacity to adjust to and capitalize upon economic changes and opportunities occurring outside the State. | | | ✓ |

| Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
|---|---|---|---|
| (3) Promote Hawaii as an attractive market for environmentally and socially sound investment activities that benefit Hawaii's people. | | | ✓ |
| (4) Transform and maintain Hawaii as a place that welcomes and facilitates innovative activity that may lead to commercial opportunities. | | | ✓ |
| (5) Promote innovative activity that may pose initial risks, but ultimately contribute to the economy of Hawaii. | | | ✓ |
| (6) Seek broader outlets for new or expanded Hawaii business investments. | | | ✓ |
| (7) Expand existing markets and penetrate new markets for Hawaii's products and services. | | | ✓ |
| (8) Assure that the basic economic needs of Hawaii's people are maintained in the event of disruptions in overseas transportation. | | | ✓ |
| (9) Strive to achieve a level of construction activity responsive to, and consistent with, state growth objectives. | | ✓ | |
| (10) Encourage the formation of cooperatives and other favorable marketing arrangements at the local or regional level to assist Hawaii's small scale producers, manufacturers, and distributors. | | | ✓ |
| (11) Encourage labor-intensive activities that are economically satisfying and which offer opportunities for upward mobility. | | | ✓ |
| (12) Encourage innovative activities that may not be labor-intensive, but may otherwise contribute to the economy of Hawaii. | | | ✓ |
| (13) Foster greater cooperation and coordination between the government and private sectors in developing Hawaii's employment and economic growth opportunities. | | ✓ | |
| (14) Stimulate the development and expansion of economic activities which will benefit areas with substantial or expected employment problems. | | | ✓ |
| (15) Maintain acceptable working conditions and standards for Hawaii's workers. | | | ✓ |
| (16) Provide equal employment opportunities for all segments of Hawaii's population through affirmative action and nondiscrimination measures. | | | ✓ |
| (17) Stimulate the development and expansion of economic activities capitalizing on defense, dual-use, and science and technology assets, particularly on the neighbor islands where employment opportunities may be limited. | | | ✓ |
| (18) Encourage businesses that have favorable financial multiplier effects within Hawaii's economy, particularly with respect to emerging industries in science and technology. | | | ✓ |
| (19) Promote and protect intangible resources in Hawaii, such as scenic beauty and the aloha spirit, which are vital to a healthy economy. | | | ✓ |
| (20) Increase effective communication between the educational community and the private sector to develop relevant curricula and training programs to meet future employment needs in general, and requirements of new or innovative potential growth industries in particular. | | | ✓ |

| Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
|---|---|---|---|
| (21) Foster a business climate in Hawaii--including attitudes, tax and regulatory policies, and financial and technical assistance programs-- that is conducive to the expansion of existing enterprises and the creation and attraction of new business and industry. | | | ✓ |
| ***Analysis:*** **The proposed project indirectly supports the objectives and relevant policies for the economy in general. In the short term, the proposed project will create construction jobs and stimulate the local economy. In the long term, the proposed project will increase the capacity of wastewater treatment infrastructure in Central Maui, which will support future economic development. In addition, the County of Maui has established a public-private partnership with the private developer of Waikapū Country Town to allow for the development to connect to the proposed Central Maui WWRF in exchange for additional affordable housing.** | | | |
| **Chapter 226-7 Objectives and policies for the economy – – agriculture.** | | | |
| **Objectives:** | | | |
| (a) Planning for the State's economy with regard to agriculture shall be directed towards achievement of the following objectives: | | | |
| (1) Viability of Hawaii's sugar and pineapple industries. | | | ✓ |
| (2) Growth and development of diversified agriculture throughout the State. | | ✓ | |
| (3) An agriculture industry that continues to constitute a dynamic and essential component of Hawaii's strategic, economic, and social well-being. | | ✓ | |
| **Policies:** | | | |
| (b) To achieve the agriculture objectives, it shall be the policy of this State to: | | | |
| (1) Establish a clear direction for Hawaii's agriculture through stakeholder commitment and advocacy. | | | ✓ |
| (2) Encourage agriculture by making the best use of natural resources. | | | ✓ |
| (3) Provide the governor and the legislature with information and options needed for prudent decision-making for the development of agriculture. | | | ✓ |
| (4) Establish strong relationships between the agricultural and visitor industries for mutual marketing benefits. | | | ✓ |
| (5) Foster increased public awareness and understanding of the contributions and benefits of agriculture as a major sector of Hawaii's economy. | | | ✓ |
| (6) Seek the enactment and retention of federal and state legislation that benefits Hawaii's agricultural industries. | | | ✓ |
| (7) Strengthen diversified agriculture by developing an effective promotion, marketing, and distribution system between Hawaii's food producers and consumers in the State, nation, and world. | | | ✓ |
| (8) Support research and development activities that strengthen economic productivity in agriculture, stimulate greater efficiency, and enhance the development of new products and agricultural by-products. | | | ✓ |
| (9) Enhance agricultural growth by providing public incentives and encouraging private initiatives. | | | ✓ |
| (10) Assure the availability of agriculturally suitable lands with adequate water to accommodate present and future needs. | | ✓ | |

| Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
|---|---|---|---|
| (11) Increase the attractiveness and opportunities for an agricultural education and livelihood. | | | ✓ |
| (12) In addition to the State's priority on food, expand Hawaii's agricultural base by promoting growth and development of flowers, tropical fruits and plants, livestock, feed grains, forestry, food crops, aquaculture, and other potential enterprises. | | | ✓ |
| (13) Promote economically competitive activities that increase Hawaii's agricultural self-sufficiency, including the increased purchase and use of Hawaii-grown food and food products by residents, businesses, and governmental bodies as defined under section 103D-104. | | | ✓ |
| (14) Promote and assist in the establishment of sound financial programs for diversified agriculture. | | | ✓ |
| (15) Institute and support programs and activities to assist the entry of displaced agricultural workers into alternative agricultural or other employment. | | | ✓ |
| (16) Facilitate the transition of agricultural lands in economically nonfeasible agricultural production to economically viable agricultural uses. | | | ✓ |
| (17) Perpetuate, promote, and increase use of traditional Hawaiian farming systems, such as the use of loko i'a, māla, and irrigated lo'i, and growth of traditional Hawaiian crops, such as kalo, 'uala, and 'ulu. | | | ✓ |
| (18) Increase and develop small-scale farms. | | | ✓ |
| ***Analysis:*** **Agricultural activity through the generation of R-1 recycled water which will be used as a water source for nearby agricultural fields, including Waikapū Country Town's Agricultural Preserve, and park lands, etc. An Agricultural Impact Assessment has been prepared for the project and concluded that the use of the WWRF site, and sites for related improvements for non-agricultural uses, are not anticipated to result in significant adverse impacts on the growth of agricultural activities in the Central Maui region.** | | | |
| **Chapter 226-8 Objective and policies for the economy – – visitor industry.** | | | |
| **Objective:** | | | |
| (a) Planning for the State's economy with regard to the visitor industry shall be directed towards the achievement of the objective of a visitor industry that constitutes a major component of steady growth for Hawaii's economy. | | | ✓ |
| **Policies:** | | | |
| (b) To achieve the visitor industry objective, it shall be the policy of this State to: | | | |
| (1) Support and assist in the promotion of Hawaii's visitor attractions and facilities. | | | ✓ |
| (2) Ensure that visitor industry activities are in keeping with the social, economic, and physical needs and aspirations of Hawaii's people. | | | ✓ |
| (3) Improve the quality of existing visitor destination areas by utilizing Hawaii's strengths in science and technology. | | | ✓ |
| (4) Encourage cooperation and coordination between the government and private sectors in developing and maintaining well-designed, adequately serviced visitor industry and related developments which are sensitive to neighboring communities and activities. | | | ✓ |

| Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
|---|---|---|---|
| (5) Develop the industry in a manner that will continue to provide new job opportunities and steady employment for Hawaii's people. | | | ✓ |
| (6) Provide opportunities for Hawaii's people to obtain job training and education that will allow for upward mobility within the visitor industry. | | | ✓ |
| (7) Foster a recognition of the contribution of the visitor industry to Hawaii's economy and the need to perpetuate the aloha spirit. | | | ✓ |
| (8) Foster an understanding by visitors of the aloha spirit and of the unique and sensitive character of Hawaii's cultures and values. | | | ✓ |
| ***Analysis:*** **The proposed facility is not directly or indirectly applicable to objectives and policies for the visitor industry or activities.** | | | |
| **Chapter 226-9 Objective and policies for the economy – – federal expenditures.** | | | |
| **Objective:** | | | |
| (a) Planning for the State's economy with regard to federal expenditures shall be directed towards achievement of the objective of a stable federal investment base as an integral component of Hawaii's economy. | | ✓ | |
| **Policies:** | | | |
| (b) To achieve the federal expenditures objective, it shall be the policy of this State to: | | | |
| (1) Encourage the sustained flow of federal expenditures in Hawaii that generates long-term government civilian employment; | | | ✓ |
| (2) Promote Hawaii's supportive role in national defense, in a manner consistent with Hawaii's social, environmental, and cultural goals by building upon dual-use and defense applications to develop thriving ocean engineering, aerospace research and development, and related dual-use technology sectors in Hawaii's economy; | | | ✓ |
| (3) Promote the development of federally supported activities in Hawaii that respect statewide economic concerns, are sensitive to community needs, and minimize adverse impacts on Hawaii's environment; | | ✓ | |
| (4) Increase opportunities for entry and advancement of Hawaii's people into federal government service; | | | ✓ |
| (5) Promote federal use of local commodities, services, and facilities available in Hawaii; | | | ✓ |
| (6) Strengthen federal-state-county communication and coordination in all federal activities that affect Hawaii; and | | | ✓ |
| (7) Pursue the return of federally controlled lands in Hawaii that are not required for either the defense of the nation or for other purposes of national importance, and promote the mutually beneficial exchanges of land between federal agencies, the State, and the counties. | | | ✓ |

| Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
|---|---|---|---|
| ***Analysis:*** **The proposed facility is indirectly applicable to the objective and relevant policies for the federal expenditures. A portion of the development cost of the proposed WWRF may be funded by federal fund. The proposed WWRF will support projected urban growth in the region and much needed housing developments, while utilizing a more sustainable method, namely, the Soil Aquifer Treatment (SAT) process, than conventional WWRFs for disposing treated effluent.** | | | |
| **Chapter 226-10 Objective and policies for the economy – – potential growth and innovative activities.** | | | |
| **Objective:** | | | |
| (a) Planning for the State's economy with regard to potential growth and innovative activities shall be directed towards achievement of the objective of development and expansion of potential growth and innovative activities that serve to increase and diversify Hawaii's economic base. | | ✓ | |
| **Policies:** | | | |
| (b) To achieve the potential growth and innovative activity objective, it shall be the policy of this State to: | | | |
| (1) Facilitate investment and employment growth in economic activities that have the potential to expand and diversify Hawaii's economy, including but not limited to diversified agriculture, aquaculture, renewable energy development, creative media, health care, and science and technology-based sectors; | | ✓ | |
| (2) Facilitate investment in innovative activity that may pose risks or be less labor-intensive than other traditional business activity, but if successful, will generate revenue in Hawaii through the export of services or products or substitution of imported services or products; | | | ✓ |
| (3) Encourage entrepreneurship in innovative activity by academic researchers and instructors who may not have the background, skill, or initial inclination to commercially exploit their discoveries or achievements; | | | ✓ |
| (4) Recognize that innovative activity is not exclusively dependent upon individuals with advanced formal education, but that many self-taught, motivated individuals are able, willing, sufficiently knowledgeable, and equipped with the attitude necessary to undertake innovative activity; | | | ✓ |
| (5) Increase the opportunities for investors in innovative activity and talent engaged in innovative activity to personally meet and interact at cultural, art, entertainment, culinary, athletic, or visitor-oriented events without a business focus; | | | ✓ |
| (6) Expand Hawaii's capacity to attract and service international programs and activities that generate employment for Hawaii's people; | | | ✓ |
| (7) Enhance and promote Hawaii's role as a center for international relations, trade, finance, services, technology, education, culture, and the arts; | | | ✓ |
| (8) Accelerate research and development of new energy-related industries based on wind, solar, ocean, underground resources, and solid waste; | | | ✓ |
| (9) Promote Hawaii's geographic, environmental, social, and technological advantages to attract new or innovative economic activities into the State; | | | ✓ |

| Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
|---|---|---|---|
| (10) Provide public incentives and encourage private initiative to attract new or innovative industries that best support Hawaii's social, economic, physical, and environmental objectives; | | | ✓ |
| (11) Increase research and the development of ocean-related economic activities such as mining, food production, and scientific research; | | | ✓ |
| (12) Develop, promote, and support research and educational and training programs that will enhance Hawaii's ability to attract and develop economic activities of benefit to Hawaii; | | | ✓ |
| (13) Foster a broader public recognition and understanding of the potential benefits of new or innovative growth-oriented industry in Hawaii; | | | ✓ |
| (14) Encourage the development and implementation of joint federal and state initiatives to attract federal programs and projects that will support Hawaii's social, economic, physical, and environmental objectives; | | | ✓ |
| (15) Increase research and development of businesses and services in the telecommunications and information industries; | | | ✓ |
| (16) Foster the research and development of nonfossil fuel and energy efficient modes of transportation; and | | | ✓ |
| (17) Recognize and promote health care and health care information technology as growth industries. | | | ✓ |
| ***Analysis:*** **Indirectly, the proposed project advances the objective and relevant policies for potential growth and innovative activities. The SAT basins presents an alternative disposal method for treated wastewater, which is the first of its kind in the State. This project may indirectly encourage the addition of new technology for wastewater treatment and disposal throughout the State. The proposed project will also service the DLNR Industrial & Business Park, providing necessary infrastructure for future industry and business.** | | | |
| **Chapter 226-10.5 Objectives and policies for the economy – – information industry.** | | | |
| **Objective:** | | | |
| (a) Planning for the State's economy with regard to telecommunications and information technology shall be directed toward recognizing that broadband and wireless communication capability and infrastructure are foundations for an innovative economy and positioning Hawaii as a leader in broadband and wireless communications and applications in the Pacific Region. | | | ✓ |
| **Policies:** | | | |
| (b) To achieve the information industry objective, it shall be the policy of this State to: | | | |
| (1) Promote efforts to attain the highest speeds of electronic and wireless communication within Hawaii and between Hawaii and the world, and make high speed communication available to all residents and businesses in Hawaii; | | | ✓ |
| (2) Encourage the continued development and expansion of the telecommunications infrastructure serving Hawaii to accommodate future growth and innovation in Hawaii's economy; | | | ✓ |
| (3) Facilitate the development of new or innovative business and service ventures in the information industry which will provide employment opportunities for the people of Hawaii; | | | ✓ |

| Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
|---|---|---|---|
| (4) Encourage mainland- and foreign-based companies of all sizes, whether information technology-focused or not, to allow their principals, employees, or contractors to live in and work from Hawaii, using technology to communicate with their headquarters, offices, or customers located out-of-state; | | | ✓ |
| (5) Encourage greater cooperation between the public and private sectors in developing and maintaining a well-designed information industry; | | | ✓ |
| (6) Ensure that the development of new businesses and services in the industry are in keeping with the social, economic, and physical needs and aspirations of Hawaii's people; | | | ✓ |
| (7) Provide opportunities for Hawaii's people to obtain job training and education that will allow for upward mobility within the information industry; | | | ✓ |
| (8) Foster a recognition of the contribution of the information industry to Hawaii's economy; and | | | ✓ |
| (9) Assist in the promotion of Hawaii as a broker, creator, and processor of information in the Pacific. | | | ✓ |
| ***Analysis:*** **The proposed project is a wastewater infrastructure project and is not directly or indirectly applicable to the objectives and policies for the telecommunications and information industry.** | | | |
| **Chapter 226-11 Objectives and policies for the physical environment – – land based, shoreline, and marine resources.** | | | |
| **Objectives:** | | | |
| (a) Planning for the State's physical environment with regard to land-based, shoreline, and marine resources shall be directed towards achievement of the following objectives: | | | |
| (1) Prudent use of Hawaii's land-based, shoreline, and marine resources. | ✓ | | |
| (2) Effective protection of Hawaii's unique and fragile environmental resources. | | ✓ | |
| **Policies:** | | | |
| (b) To achieve the land-based, shoreline, and marine resources objectives, it shall be the policy of this State to: | | | |
| (1) Exercise an overall conservation ethic in the use of Hawaii's natural resources. | | ✓ | |
| (2) Ensure compatibility between land-based and water-based activities and natural resources and ecological systems. | | ✓ | |
| (3) Take into account the physical attributes of areas when planning and designing activities and facilities. | | | ✓ |
| (4) Manage natural resources and environs to encourage their beneficial and multiple use without generating costly or irreparable environmental damage. | | | ✓ |

| Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
|---|---|---|---|
| (5) Consider multiple uses in watershed areas, provided such uses do not detrimentally affect water quality and recharge functions. | | | ✓ |
| (6) Encourage the protection of rare or endangered plant and animal species and habitats native to Hawaii. | | | ✓ |
| (7) Provide public incentives that encourage private actions to protect significant natural resources from degradation or unnecessary depletion. | | | ✓ |
| (8) Pursue compatible relationships among activities, facilities, and natural resources. | ✓ | | |
| (9) Promote increased accessibility and prudent use of inland and shoreline areas for public recreational, educational, and scientific purposes. | | | ✓ |
| ***Analysis:*** **The proposed project involves wastewater treatment capacity improvements in Central Maui and is both directly and indirectly applicable to the objectives and relevant policies for land based, shoreline, and marine resources. The WWRF and SAT system for treating and disposing wastewater effluent is sustainable and compatible with the surrounding ecological systems. The proposed system does not involve disposal into injection wells, which may be harmful to the environment. In addition, the production and use of R-1 recycled water represents a prudent use of natural resources.** | | | |
| **Chapter 226-12 Objective and policies for the physical environment – – scenic, natural beauty, and historic resources.** | | | |
| **Objective:** | | | |
| (a) Planning for the State's physical environment shall be directed towards achievement of the objective of enhancement of Hawaii's scenic assets, natural beauty, and multi-cultural/historical resources. | | ✓ | |
| **Policies:** | | | |
| (b) To achieve the scenic, natural beauty, and historic resources objective, it shall be the policy of this State to: | | | |
| (1) Promote the preservation and restoration of significant natural and historic resources. | | | ✓ |
| (2) Provide incentives to maintain and enhance historic, cultural, and scenic amenities. | | | ✓ |
| (3) Promote the preservation of views and vistas to enhance the visual and aesthetic enjoyment of mountains, ocean, scenic landscapes, and other natural features. | | ✓ | |
| (4) Protect those special areas, structures, and elements that are an integral and functional part of Hawaii's ethnic and cultural heritage. | | | ✓ |
| (5) Encourage the design of developments and activities that complement the natural beauty of the islands. | | | ✓ |

| Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
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| ***Analysis:*** **The proposed project is indirectly applicable to the objective and relevant policies for scenic, natural beauty, and historic resources. A Visual Impact Analysis has been prepared to identify potential impacts of the project to scenic views and potential mitigation measures. The potential view impacts of the proposed WWRF and WWPS are assessed to be minor to moderate at most, and recommended mitigation measures, such as earth-tone finishes, low-profile design, and use of screening will be implemented to minimize the potential view impacts.** | | | |
| **Chapter 226-13 Objectives and policies for the physical environment – – land, air, and water quality.** | | | |
| **Objectives:** | | | |
| (a) Planning for the State's physical environment with regard to land, air, and water quality shall be directed towards achievement of the following objectives. | | | |
| (1) Maintenance and pursuit of improved quality in Hawaii's land, air, and water resources. | ✓ | | |
| (2) Greater public awareness and appreciation of Hawaii's environmental resources. | | | ✓ |
| **Policies:** | | | |
| (b) To achieve the land, air, and water quality objectives, it shall be the policy of this State to: | | | |
| (1) Foster educational activities that promote a better understanding of Hawaii's limited environmental resources. | | | ✓ |
| (2) Promote the proper management of Hawaii's land and water resources. | ✓ | | |
| (3) Promote effective measures to achieve desired quality in Hawaii's surface, ground, and coastal waters. | | | ✓ |
| (4) Encourage actions to maintain or improve aural and air quality levels to enhance the health and well-being of Hawaii's people. | | ✓ | |
| (5) Reduce the threat to life and property from erosion, flooding, tsunamis, hurricanes, earthquakes, volcanic eruptions, and other natural or man-induced hazards and disasters. | | ✓ | |
| (6) Encourage design and construction practices that enhance the physical qualities of Hawaii's communities. | | | ✓ |
| (7) Encourage urban developments in close proximity to existing services and facilities. | | | ✓ |
| (8) Foster recognition of the importance and value of the land, air, and water resources to Hawaii's people, their cultures and visitors. | | ✓ | |

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| ***Analysis:*** **The proposed project is directly and indirectly applicable to relevant objectives and policies for land, air, and water quality. The proposed WWRF and SAT disposal system is a managed aquifer recharge system in which the quality of the treated wastewater is further improved during soil passage in order to protect the quality of groundwater resources. The proposed project values precious water resources by recycling treated water to R-1 grade water for reuse. In addition, drainage improvements will be carried out throughout the project area and pipeline corridor, which will help, protect, and restore nearshore reef environments and water quality. This improved stewardship of the land and water recognizes the importance Hawaii's people place on natural resources, and will hopefully foster others to do the same.** | | | |
| **Chapter 226-14 Objective and policies for facility systems – – in general.** | | | |
| **Objective:** | | | |
| (a) Planning for the State's facility systems in general shall be directed towards achievement of the objective of water, transportation, sustainable development, climate change adaptation, sea level rise adaptation, waste disposal, and energy and telecommunication systems that support statewide social, economic, and physical objectives. | ✓ | | |
| **Policies:** | | | |
| (b) To achieve the general facility systems objective, it shall be the policy of this State to: | | | |
| (1) Accommodate the needs of Hawaii's people through coordination of facility systems and capital improvement priorities in consonance with state and county plans. | ✓ | | |
| (2) Encourage flexibility in the design and development of facility systems to promote prudent use of resources and accommodate changing public demands and priorities. | | | ✓ |
| (3) Ensure that required facility systems can be supported within resource capacities and at reasonable cost to the user. | | | ✓ |
| (4) Pursue alternative methods of financing programs and projects and cost-saving techniques in the planning, construction, and maintenance of facility systems. | | | ✓ |
| (5) Identify existing and planned state facilities that are vulnerable to sea level rise, flooding impacts, and natural hazards. | ✓ | | |
| (6) Assess a range of options to mitigate the impacts of sea level rise to existing and planned state facilities. | ✓ | | |
| ***Analysis:*** **The proposed project is directly applicable to the objective and relevant policies for facility systems in general. The proposed project involves the development of a wastewater treatment and R-1 recycled water facility, which is a capital improvement priority that will help to accommodate the needs of existing and planned residential developments in Central Maui. Furthermore, the location of the proposed new facility is outside of the area vulnerable to natural hazards, such as the 3.2-foot sea level rise exposure area and tsunami evacuation zone. Because the Wailuku-Kahului WWRF has been identified to be vulnerable to sea level rise, flooding impacts, and natural hazards, alternate facilities like the proposed project are advisable over expanding the Wailuku-Kahului WWRF. The proposed project will reduce burden to the Wailuku-Kahului WWRF by redirecting a portion of the wastewater flow, and provide additional treatment capacity in an area not vulnerable to sea level rise, flooding, and natural hazards.** | | | |

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| **Chapter 226-15 Objectives and policies for facility systems – – solid and liquid waste.** | | | |
| **Objectives:** | | | |
| (a) Planning for the State's facility systems with regard to solid and liquid wastes shall be directed towards the achievement of the following objectives: | | | |
| (1) Maintenance of basic public health and sanitation standards relating to treatment and disposal of solid and liquid wastes. | ✓ | | |
| (2) Provision of adequate sewerage facilities for physical and economic activities that alleviate problems in housing, employment, mobility, and other areas. | ✓ | | |
| **Policies:** | | | |
| (b) To achieve solid and liquid waste objectives, it shall be the policy of this State to: | | | |
| (1) Encourage the adequate development of sewerage facilities that complement planned growth. | ✓ | | |
| (2) Promote reuse and recycling to reduce solid and liquid wastes and employ a conservation ethic. | ✓ | | |
| (3) Promote research to develop more efficient and economical treatment and disposal of solid and liquid wastes. | ✓ | | |
| ***Analysis:*** **The proposed project involves a new WWRF, which will allow for the provision of adequate sewerage treatment capacity in the Central Maui region. The proposed project will meet regulations for wastewater systems to ensure basic public health and sanitation standards are met. The proposed project will provide wastewater treatment capacity in a timely manner to support planned growth in Central Maui. The primary method of effluent disposal is R-1 recycled water for irrigation and as a backup system, the SAT system is proposed, which is a sustainable technology for disposing treated wastewater and will allow the use of R-1 recycled water for irrigation. The proposed project will not use injection wells to dispose of the effluent.** | | | |
| **Chapter 226-16 Objective and policies for facility systems – – water.** | | | |
| **Objective:** | | | |
| (a) Planning for the State's facility systems with regard to water shall be directed towards achievement of the objective of the provision of water to adequately accommodate domestic, agricultural, commercial, industrial, recreational, and other needs within resource capacities. | ✓ | | |
| **Policies:** | | | |
| (b) To achieve the facility systems water objective, it shall be the policy of this State to: | | | |
| (1) Coordinate development of land use activities with existing and potential water supply. | ✓ | | |
| (2) Support research and development of alternative methods to meet future water requirements well in advance of anticipated needs. | ✓ | | |
| (3) Reclaim and encourage the productive use of runoff water and wastewater discharges. | ✓ | | |
| (4) Assist in improving the quality, efficiency, service, and storage capabilities of water systems for domestic and agricultural use. | | | ✓ |

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| (5) Support water supply services to areas experiencing critical water problems. | | | ✓ |
| (6) Promote water conservation programs and practices in government, private industry, and the general public to help ensure adequate water to meet long-term needs. | | | ✓ |
| ***Analysis:*** **Through the reclamation of treated wastewater and production of R-1 recycled water for agricultural uses, the proposed project directly advances the State's objective and policies for water facility systems.** | | | |
| **Chapter 226-17 Objectives and policies for facility systems – – transportation.** | | | |
| **Objectives:** | | | |
| (a) Planning for the State's facility systems with regard to transportation shall be directed towards the achievement of the following objectives: | | | |
| (1) An integrated multi-modal transportation system that services statewide needs and promotes the efficient, economical, safe, and convenient movement of people and goods. | | | ✓ |
| (2) A statewide transportation system that is consistent with and will accommodate planned growth objectives throughout the State. | | | ✓ |
| **Policies:** | | | |
| (b) To achieve the transportation objectives, it shall be the policy of this State to: | | | |
| (1) Design, program, and develop a multi-modal system in conformance with desired growth and physical development as stated in this chapter; | | | ✓ |
| (2) Coordinate state, county, federal, and private transportation activities and programs toward the achievement of statewide objectives; | | | ✓ |
| (3) Encourage a reasonable distribution of financial responsibilities for transportation among participating governmental and private parties; | | | ✓ |
| (4) Provide for improved accessibility to shipping, docking, and storage facilities; | | | ✓ |
| (5) Promote a reasonable level and variety of mass transportation services that adequately meet statewide and community needs; | | | ✓ |
| (6) Encourage transportation systems that serve to accommodate present and future development needs of communities; | | | ✓ |
| (7) Encourage a variety of carriers to offer increased opportunities and advantages to interisland movement of people and goods; | | | ✓ |
| (8) Increase the capacities of airport and harbor systems and support facilities to effectively accommodate transshipment and storage needs; | | | ✓ |
| (9) Encourage the development of transportation systems and programs which would assist statewide economic growth and diversification; | | | ✓ |

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| (10) Encourage the design and development of transportation systems sensitive to the needs of affected communities and the quality of Hawaii's natural environment; | | | ✓ |
| (11) Encourage safe and convenient use of low-cost, energy-efficient, non-polluting means of transportation; | | | ✓ |
| (12) Coordinate intergovernmental land use and transportation planning activities to ensure the timely delivery of supporting transportation infrastructure in order to accommodate planned growth objectives; and | | | ✓ |
| (13) Encourage diversification of transportation modes and infrastructure to promote alternate fuels and energy efficiency. | | | ✓ |
| ***Analysis:*** **The proposed Central Maui WWRF is neither directly nor indirectly applicable to the objectives and policies for transportation facility systems. However, it is noted that a Traffic Impact Analysis Report (TIAR) and construction traffic management plan have been prepared for the project's EIS.** | | | |
| **Chapter 226-18 Objectives and policies for facility systems – – energy.** | | | |
| **Objectives:** | | | |
| (a) Planning for the State's facility systems with regard to energy shall be directed toward the achievement of the following objectives, giving due consideration to all: | | | |
| (1) Dependable, efficient, and economical statewide energy systems capable of supporting the needs of the people; | | | ✓ |
| (2) Increased energy security and self-sufficiency through the reduction and ultimate elimination of Hawaii's dependence on imported fuels for electrical generation and ground transportation. | | | ✓ |
| (3) Greater diversification of energy generation in the face of threats to Hawaii's energy supplies and systems; | | ✓ | |
| (4) Reduction, avoidance, or sequestration of greenhouse gas emissions from energy supply and use; and | | | ✓ |
| (5) Utility models that make the social and financial interests of Hawaii's utility customers a priority. | | | ✓ |
| **Policies:** | | | |
| (b) To achieve the energy objectives, it shall be the policy of this State to ensure the short- and long-term provision of adequate, reasonably prices, and dependable energy services to accommodate demand. | | | ✓ |
| (c) To further achieve the energy objectives, it shall be the policy of this State to: | | | |
| (1) Support research and development as well as promote the use of renewable energy sources; | | ✓ | |
| (2) Ensure that the combination of energy supplies and energy-saving systems is sufficient to support the demands of growth; | | | ✓ |

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| (3) Base decisions of least-cost supply-side and demand-side energy resource options on a comparison of their total costs and benefits when a least-cost is determined by a reasonably comprehensive, quantitative, and qualitative accounting of their long-term, direct and indirect economic, environmental, social, cultural, and public health costs and benefits; | | | ✓ |
| (4) Promote all cost-effective conservation of power and fuel supplies through measures, including: | | | |
| (A) Development of cost-effective demand-side management programs; | | | ✓ |
| (B) Education; | | | ✓ |
| (C) Adoption of energy-efficient practices and technologies; and | | | ✓ |
| (D) Increasing energy efficiency and decreasing energy use in public infrastructure | | | ✓ |
| (5) Ensure, to the extent that new supply-side resources are needed, that the development or expansion of energy systems uses the least-cost energy supply option and maximizes efficient technologies; and | | | ✓ |
| (6) Support research, development, demonstration, and use of energy efficiency, load management, and other demand-side management programs, practices, and technologies; | | | ✓ |
| (7) Promote alternate fuels and transportation energy efficiency; | | | ✓ |
| (8) Support actions that reduce, avoid, or sequester greenhouse gases in utility, transportation, and industrial sector applications; | | | ✓ |
| (9) Support actions that reduce, avoid, or sequester Hawaii's greenhouse gas emissions through agriculture and forestry initiatives; | | | ✓ |
| (10) Provide priority handling and processing for all state and county permits required for renewable energy projects; | | | ✓ |
| (11) Ensure that liquefied natural gas is used only as a cost-effective transitional, limited-term replacement of petroleum for electricity generation and does not impede the development and use of other cost-effective renewable energy sources; and | | | ✓ |
| (12) Promote the development of indigenous geothermal energy resources that are located on public trust land as an affordable and reliable source of firm power for Hawaii. | | | ✓ |
| ***Analysis:*** **The proposed project involves the use of renewable energy sources in the form of solar photovoltaic (PV) panels at the WWRF and is indirectly applicable to relevant objectives and policies related to energy facility systems.** | | | |
| **Chapter 226-18.5 Objectives and policies for facility systems – – telecommunications.** | | | |
| **Objectives:** | | | |
| (a) Planning for the State's telecommunications facility systems shall be directed towards the achievement of dependable, efficient, and economical statewide telecommunications systems capable of supporting the needs of the people. | | | ✓ |

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| **Policies:** | | | |
| (b) To achieve the telecommunications objective, it shall be the policy of this State to ensure the provision of adequate, reasonably priced, and dependable telecommunications services to accommodate demand. | | | ✓ |
| (c) To further achieve the telecommunications objective, it shall be the policy of this State to: | | | |
| (1) Facilitate research and development of telecommunications systems and resources; | | | ✓ |
| (2) Encourage public and private sector efforts to develop means for adequate, ongoing telecommunications planning; | | | ✓ |
| (3) Promote efficient management and use of existing telecommunications systems and services; and | | | ✓ |
| (4) Facilitate the development of education and training of telecommunications personnel. | | | ✓ |
| ***Analysis:*** **The proposed project involves wastewater treatment capacity improvements in Central Maui and is not applicable to the objective and policies related to telecommunications facility systems.** | | | |
| **Chapter 226-19 Objectives and policies for socio-cultural advancement – – housing.** | | | |
| **Objectives:** | | | |
| (a) Planning for the State's socio-cultural advancement with regard to housing shall be directed toward the achievement of the following objectives: | | | |
| (1) Greater opportunities for Hawaii's people to secure reasonably priced, safe, sanitary, and livable homes, located in suitable environments that satisfactorily accommodate the needs and desires of families and individuals, through collaboration and cooperation between government and nonprofit and for-profit developers to ensure that more rental and for sale affordable housing is made available to very low-, very low-,lower-, moderate-, and above moderate-income segments of Hawaii's population. | | ✓ | |
| (2) The orderly development of residential areas sensitive to community needs and other land uses. | | ✓ | |
| (3) The development and provision of affordable rental housing by the State to meet the housing needs of Hawaii's people. | | ✓ | |
| **Policies:** | | | |
| (b) To achieve the housing objectives, it shall be the policy of this State to: | | | |
| (1) Effectively accommodate the housing needs of Hawaii's people. | | ✓ | |
| (2) Stimulate and promote feasible approaches that increase affordable rental and for sale housing choices for extremely low-, very low-, lower-, moderate-, and above moderate-income households. | | | ✓ |
| (3) Increase homeownership and rental opportunities and choices in terms of quality, location, cost, densities, style, and size of housing. | | ✓ | |
| (4) Promote appropriate improvement, rehabilitation, and maintenance of existing rental and for sale housing units and residential areas. | | | ✓ |

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| (5) Promote design and location of housing developments taking into account the physical setting, accessibility to public facilities and services, and other concerns of existing communities and surrounding areas. | | | ✓ |
| (6) Facilitate the use of available vacant, developable, and underutilized urban lands for housing. | | | ✓ |
| (7) Foster a variety of lifestyles traditional to Hawaii through the design and maintenance of neighborhoods that reflect the culture and values of the community. | | | ✓ |
| (8) Promote research and development of methods to reduce the cost of housing construction in Hawaii. | | | ✓ |
| ***Analysis:*** **The proposed Central Maui WWRF Project indirectly advances the objectives and relevant policies for socio-cultural advancement of housing through the provision of wastewater treatment infrastructure necessary for the construction of housing, including affordable housing.** | | | |
| **Chapter 226-20 Objectives and policies for socio-cultural advancement – – health.** | | | |
| **Objectives:** | | | |
| (a) Planning for the State's socio-cultural advancement with regard to health shall be directed towards achievement of the following objectives: | | | |
| (1) Fulfillment of basic individual health needs of the general public. | | | ✓ |
| (2) Maintenance of sanitary and environmentally healthful conditions in Hawaii's communities. | | ✓ | |
| (3) Elimination of health disparities by identifying and addressing social determinants of health. | | | ✓ |
| **Policies:** | | | |
| (b) To achieve the health objectives, it shall be the policy of this State to: | | | |
| (1) Provide adequate and accessible services and facilities for prevention and treatment of physical and mental health problems, including substance abuse. | | | ✓ |
| (2) Encourage improved cooperation among public and private sectors in the provision of health care to accommodate the total health needs of individuals throughout the State. | | | ✓ |
| (3) Encourage public and private efforts to develop and promote statewide and local strategies to reduce health care and related insurance costs. | | | ✓ |
| (4) Foster an awareness of the need for personal health maintenance and preventive health care through education and other measures. | | | ✓ |
| (5) Provide programs, services, and activities that ensure environmentally healthful and sanitary conditions. | | ✓ | |
| (6) Improve the State's capabilities in preventing contamination by pesticides and other potentially hazardous substances through increased coordination, education, monitoring, and enforcement. | | | ✓ |

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| (7) Prioritize programs, services, interventions, and activities that address identified social determinants of health to improve native Hawaiian health and well-being consistent with the United States Congress' declaration of policy as codified in title 42 United States Code section 11702, and to reduce health disparities of disproportionately affected demographics, including native Hawaiians, other Pacific Islanders, and Filipinos. The prioritization of affected demographic groups other than native Hawaiians may be reviewed every ten years and revised based on the best available epidemiological and public health data. | | | ✓ |
| ***Analysis:*** **Indirectly, the proposed project supports relevant objective and policy for the maintenance of sanitary and environmentally healthful conditions in the community through the expansion of proper wastewater treatment in the Central Maui region.** | | | |
| **Chapter 226-21 Objectives and policies for socio-cultural advancement – – education.** | | | |
| **Objective:** | | | |
| (a) Planning for the State's socio-cultural advancement with regard to education shall be directed towards achievement of the objective of the provision of a variety of educational opportunities to enable individuals to fulfill their needs, responsibilities, and aspirations. | | | ✓ |
| **Policies:** | | | |
| (b) To achieve the education objective, it shall be the policy of this State to: | | | |
| (1) Support educational programs and activities that enhance personal development, physical fitness, recreation, and cultural pursuits of all groups. | | | ✓ |
| (2) Ensure the provision of adequate and accessible educational services and facilities that are designed to meet individual and community needs. | | | ✓ |
| (3) Provide appropriate educational opportunities for groups with special needs. | | | ✓ |
| (4) Promote educational programs which enhance understanding of Hawaii's cultural heritage. | | | ✓ |
| (5) Provide higher educational opportunities that enable Hawaii's people to adapt to changing employment demands. | | | ✓ |
| (6) Assist individuals, especially those experiencing critical employment problems or barriers, or undergoing employment transitions, by providing appropriate employment training programs and other related educational opportunities. | | | ✓ |
| (7) Promote programs and activities that facilitate the acquisition of basic skills, such as reading, writing, computing, listening, speaking, and reasoning. | | | ✓ |
| (8) Emphasize quality educational programs in Hawaii's institutions to promote academic excellence. | | | ✓ |
| (9) Support research programs and activities that enhance the education programs of the State. | | | ✓ |
| ***Analysis:*** **The proposed project involves the development of a WWRF and increase of wastewater service capacity in Central Maui to support future development and is not applicable to the objective and policies for educational opportunities.** | | | |

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| **Chapter 226-22 Objective and policies for socio-cultural advancement – – social services.** | | | |
| **Objective:** | | | |
| (a) Planning for the State's socio-cultural advancement with regard to social services shall be directed towards the achievement of the objective of improved public and private social services and activities that enable individuals, families, and groups to become more self-reliant and confident to improve their well-being. | | | ✓ |
| **Policies:** | | | |
| (a) To achieve the social service objective, it shall be the policy of the State to: | | | |
| (1) Assist individuals, especially those in need of attaining a minimally adequate standard of living and those confronted by social and economic hardship conditions, through social services and activities within the State's fiscal capacities. | | | ✓ |
| (2) Promote coordination and integrative approaches among public and private agencies and programs to jointly address social problems that will enable individuals, families, and groups to deal effectively with social problems and to enhance their participation in society. | | | ✓ |
| (3) Facilitate the adjustment of new residents, especially recently arrived immigrants, into Hawaii's communities. | | | ✓ |
| (4) Promote alternatives to institutional care in the provision of long-term care for elder and disabled populations. | | | ✓ |
| (5) Support public and private efforts to prevent domestic abuse and child molestation, and assist victims of abuse and neglect. | | | ✓ |
| (6) Promote programs which assist people in need of family planning services to enable them to meet their needs. | | | ✓ |
| ***Analysis:*** **The proposed wastewater infrastructure project is not directly or indirectly applicable to the objective and policies for social services.** | | | |
| **Chapter 226-23 Objective and policies for socio-cultural advancement – – leisure.** | | | |
| **Objective:** | | | |
| (a) Planning for the State's socio-cultural advancement with regard to leisure shall be directed towards the achievement of the objective of the adequate provision of resources to accommodate diverse cultural, artistic, and recreational needs for present and future generations. | | | ✓ |
| **Policies:** | | | |
| (b) To achieve the leisure objective, it shall be the policy of this State to: | | | |
| (1) Foster and preserve Hawaii's multi-cultural heritage through supportive cultural, artistic, recreational, and humanities-oriented programs and activities. | | | ✓ |
| (2) Provide a wide range of activities and facilities to fulfill the cultural, artistic, and recreational needs of all diverse and special groups effectively and efficiently. | | | ✓ |

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| (3) Enhance the enjoyment of recreational experiences through safety and security measures, educational opportunities, and improved facility design and maintenance. | | | ✓ |
| (4) Promote the recreational and educational potential of natural resources having scenic, open space, cultural, historical, geological, or biological values while ensuring that their inherent values are preserved. | | | ✓ |
| (5) Ensure opportunities for everyone to use and enjoy Hawaii's recreational resources. | | | ✓ |
| (6) Assure the availability of sufficient resources to provide for future cultural, artistic, and recreational needs. | | | ✓ |
| (7) Provide adequate and accessible physical fitness programs to promote the physical and mental well-being of Hawaii's people. | | | ✓ |
| (8) Increase opportunities for appreciation and participation in the creative arts, including the literary, theatrical, visual, musical, folk, and traditional art forms. | | | ✓ |
| (9) Encourage the development of creative expression in the artistic disciplines to enable all segments of Hawaii's population to participate in the creative arts. | | | ✓ |
| (10) Assure adequate access to significant natural and cultural resources in public ownership. | | | ✓ |
| ***Analysis:*** **The proposed project involves the development of wastewater treatment capacity and extension of wastewater service areas and is neither directly nor indirectly applicable to the objective and policies for the socio-cultural advancement of leisure.** | | | |
| **Chapter 226-24 Objective and policies for socio-cultural advancement – – individual rights and personal well-being.** | | | |
| **Objective:** | | | |
| (a) Planning for the State's socio-cultural advancement with regard to individual rights and personal well-being shall be directed towards achievement of the objective of increased opportunities and protection of individual rights to enable individuals to fulfill their socio-economic needs and aspirations. | | | ✓ |
| **Policies:** | | | |
| (b) To achieve the individual rights and personal well-being objective, it shall be the policy of this State to: | | | |
| (1) Provide effective services and activities that protect individuals from criminal acts and unfair practices and that alleviate the consequences of criminal acts in order to foster a safe and secure environment. | | | ✓ |
| (2) Uphold and protect the national and state constitutional rights of every individual. | | | ✓ |
| (3) Assure access to, and availability of, legal assistance, consumer protection, and other public services which strive to attain social justice. | | | ✓ |
| (4) Ensure equal opportunities for individual participation in society. | | | ✓ |

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| ***Analysis:*** **The proposed project involves the development of wastewater treatment capacity and extension of wastewater service capacity and is neither directly nor indirectly applicable to the objective and policies for individual rights and personal well-being.** | | | |
| **Chapter 226-25 Objective and policies for socio-cultural advancement – – culture.** | | | |
| **Objective:** | | | |
| (a) Planning for the State's socio-cultural advancement with regard to culture shall be directed toward the achievement of the objective of enhancement of cultural identities, traditions, values, customs, and arts of Hawaii's people. | | ✓ | |
| **Policies:** | | | |
| (b) To achieve the culture objective, it shall be the policy of this State to: | | | |
| (1) Foster increased knowledge and understanding of Hawaii's ethnic and cultural heritages and the history of Hawaii. | | ✓ | |
| (2) Support activities and conditions that promote cultural values, customs, and arts that enrich the lifestyles of Hawaii's people and which are sensitive and responsive to family and community needs. | | | ✓ |
| (3) Encourage increased awareness of the effects of proposed public and private actions on the integrity and quality of cultural and community lifestyles in Hawaii. | | | ✓ |
| (4) Encourage the essence of the aloha spirit in people's daily activities to promote harmonious relationships among Hawaii's people and visitors. | | | ✓ |
| ***Analysis:*** **The proposed project is indirectly applicable to the objective and relevant policy for the socio-cultural advancement of culture. A Cultural Impact Assessment (CIA) and an Archaeological Inventory Survey (AIS) have been conducted, which helps to foster increased knowledge and understanding of Hawai'i's ethnic and cultural heritages and history.** | | | |
| **Chapter 226-26 Objectives and policies for socio-cultural advancement – – public safety.** | | | |
| **Objectives:** | | | |
| (a) Planning for the State's socio-cultural advancement with regard to public safety shall be directed towards the achievement of the following objectives: | | | |
| (1) Assurance of public safety and adequate protection of life and property for all people. | | | ✓ |
| (2) Optimum organizational readiness and capability in all phases of emergency management to maintain the strength, resources, and social and economic well-being of the community in the event of civil disruptions, wars, natural disasters, and other major disturbances. | | | ✓ |
| (3) Promotion of a sense of community responsibility for the welfare and safety of Hawaii's people. | | | ✓ |
| **Policies (Public Safety):** | | | |
| (b) To achieve the public safety objectives, it shall be the policy of this State to: | | | |
| (1) Ensure that public safety programs are effective and responsive to community needs. | | | ✓ |
| (2) Encourage increased community awareness and participation in public safety programs. | | | ✓ |

| Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
|---|---|---|---|
| **Policies (Public Safety-Criminal Justice):** | | | |
| (c) To further achieve public safety objectives related to criminal justice, it shall be the policy of this State to: | | | |
| (1) Support criminal justice programs aimed at preventing and curtailing criminal activities. | | | ✓ |
| (2) Develop a coordinated, systematic approach to criminal justice administration among all criminal justice agencies. | | | ✓ |
| (3) Provide a range of correctional resources which may include facilities and alternatives to traditional incarceration in order to address the varied security needs of the community and successfully reintegrate offenders into the community. | | | ✓ |
| **Policies (Public Safety – Emergency Management):** | | | |
| (d) To further achieve public safety objectives related to emergency management, it shall be the policy of this State to: | | | |
| (1) Ensure that responsible organizations are in a proper state of readiness to respond to major war-related, natural, or technological disasters and civil disturbances at all times. | | | ✓ |
| (2) Enhance the coordination between emergency management programs throughout the State. | | | ✓ |
| ***Analysis:*** **The proposed project involves development of a new wastewater treatment system in Central Maui and is not applicable to the objectives and policies related to public safety.** | | | |
| **Chapter 226-27 Objectives and policies for socio-cultural advancement – – government.** | | | |
| **Objectives:** | | | |
| (a) Planning the State's socio-cultural advancement with regard to government shall be directed towards the achievement of the following objectives: | | | |
| (1) Efficient, effective, and responsive government services at all levels in the State. | | ✓ | |
| (2) Fiscal integrity, responsibility, and efficiency in the state government and county governments. | | | ✓ |
| **Policies:** | | | |
| (b) To achieve the government objectives, it shall be the policy of this State to: | | | |
| (1) Provide for necessary public goods and services not assumed by the private sector. | | ✓ | |
| (2) Pursue an openness and responsiveness in government that permits the flow of public information, interaction, and response. | | ✓ | |
| (3) Minimize the size of government to that necessary to be effective. | | | ✓ |
| (4) Stimulate the responsibility in citizens to productively participate in government for a better Hawaii. | | | ✓ |
| (5) Assure that government attitudes, actions, and services are sensitive to community needs and concerns. | | | ✓ |
| (6) Provide for a balanced fiscal budget. | | | ✓ |

| Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
|---|---|---|---|
| (7) Improve the fiscal budgeting and management system of the State. | | | ✓ |
| (8) Promote the consolidation of state and county governmental functions to increase the effective and efficient delivery of government programs and services and to eliminate duplicative services wherever feasible. | | | ✓ |
| ***Analysis:*** **The proposed project is indirectly applicable to relevant objective and policies for planning for efficient, effective, and responsive government services through the provision of a wastewater treatment facility and services not assumed by the private sector. Through the preparation of an EIS, the County of Maui, Department of Environmental Management (DEM) has conducted a public scoping meeting and outreach efforts to the community and government agencies, allowing for the flow of public information, interaction, and response.** | | | |

| Hawai'i State Plan, Chapter 226, HRS Part III. Priority Guidelines<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | N/A |
|---|---|---|---|
| **Chapter 226-101: Purpose.** The purpose of this part is to establish overall priority guidelines to address areas of statewide concern. | | | |
| **Chapter 226-102: Overall direction.** The State shall strive to improve the quality of life for Hawaii's present and future population through the pursuit of desirable courses of action in seven major areas of statewide concern which merit priority attention: economic development, population growth and land resource management, affordable housing, crime and criminal justice, quality education, principles of sustainability, and climate change adaptation. | | | |
| **Chapter 226-103: Economic priority guidelines.** | | | |
| **(a) Priority guidelines to stimulate economic growth and encourage business expansion and development to provide needed jobs for Hawaii's people and achieve a stable and diversified economy:** | | ✓ | |
| (1) Seek a variety of means to increase the availability of investment capital for new and expanding enterprises. | | ✓ | |
| (A) Encourage investments which: | | ✓ | |
| (i) Reflect long term commitments to the State; | | ✓ | |
| (ii) Rely on economic linkages within the local economy; | | | ✓ |
| (iii) Diversify the economy; | | | ✓ |
| (iv) Reinvest in the local economy; | | ✓ | |
| (v) Are sensitive to community needs and priorities; and | | | ✓ |
| (vi) Demonstrate a commitment to provide management opportunities to Hawaii residents; and | | | ✓ |
| (B) Encourage investments in innovative activities that have a nexus to the State, such as: | | | ✓ |
| (i) Present or former residents acting as entrepreneurs or principals; | | | ✓ |
| (ii) Academic support from an institution of higher education in Hawaii; | | | ✓ |
| (iii) Investment interest from Hawaii residents; | | | ✓ |
| (iv) Resources unique to Hawaii that are required for innovative activity; and | | | ✓ |
| (v) Complementary or supportive industries or government programs or projects. | | | ✓ |
| (2) Encourage the expansion of technological research to assist industry development and support the development and commercialization of technological advancements. | | | ✓ |
| (3) Improve the quality, accessibility, and range of services provided by government to business, including data and reference services and assistance in complying with governmental regulations. | | | ✓ |
| (4) Seek to ensure that state business tax and labor laws and administrative policies are equitable, rational, and predictable. | | | ✓ |
| (5) Streamline the processes for building and development permit and review, and telecommunication infrastructure installation approval and eliminate or consolidate other burdensome or duplicative governmental requirements imposed on business, where scientific evidence indicates that public health, safety and welfare would not be adversely affected. | | | ✓ |
| (6) Encourage the formation of cooperatives and other favorable marketing or distribution arrangements at the regional or local level to assist Hawaii's small-scale producers, manufacturers, and distributors. | | | ✓ |
| (7) Continue to seek legislation to protect Hawaii from transportation interruptions between Hawaii and the continental United States. | | | ✓ |

| Hawai'i State Plan, Chapter 226, HRS Part III. Priority Guidelines<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | N/A |
|---|---|---|---|
| (8) Provide public incentives and encourage private initiative to develop and attract industries which promise long-term growth potentials and which have the following characteristics: | | | ✓ |
| (A) An industry that can take advantage of Hawaii's unique location and available physical and human resources. | | | ✓ |
| (B) A clean industry that would have minimal adverse effects on Hawaii's environment. | | | ✓ |
| (C) An industry that is willing to hire and train Hawaii's people to meet the industry's labor needs at all levels of employment. | | | ✓ |
| (D) An industry that would provide reasonable income and steady employment. | | | ✓ |
| (9) Support and encourage, through educational and technical assistance programs and other means, expanded opportunities for employee ownership and participation in Hawaii business. | | | ✓ |
| (10) Enhance the quality of Hawaii's labor force and develop and maintain career opportunities for Hawaii's people through the following actions: | | | ✓ |
| (A) Expand vocational training in diversified agriculture, aquaculture, information industry, and other areas where growth is desired and feasible. | | | ✓ |
| (B) Encourage more effective career counseling and guidance in high schools and post-secondary institutions to inform students of present and future career opportunities. | | | ✓ |
| (C) Allocate educational resources to career areas where high employment is expected and where growth of new industries is desired. | | | ✓ |
| (D) Promote career opportunities in all industries for Hawaii's people by encouraging firms doing business in the State to hire residents. | | | ✓ |
| (E) Promote greater public and private sector cooperation in determining industrial training needs and in developing relevant curricula and on-the-job training opportunities. | | | ✓ |
| (F) Provide retraining programs and other support services to assist entry of displaced workers into alternative employment. | | | ✓ |
| **(b) Priority guidelines to promote the economic health and quality of the visitor industry:** | | | ✓ |
| (1) Promote visitor satisfaction by fostering an environment which enhances the aloha spirit and minimizes inconveniences to Hawaii's residents and visitors. | | | ✓ |
| (2) Encourage the development and maintenance of well-designed, adequately serviced hotels and resort destination areas which are sensitive to neighboring communities and activities and which provide for adequate shoreline setbacks and beach access. | | | ✓ |
| (3) Support appropriate capital improvements to enhance the quality of existing resort destination areas and provide incentives to encourage investment in upgrading, repair, and maintenance of visitor facilities. | | | ✓ |
| (4) Encourage visitor industry practices and activities which respect, preserve, and enhance Hawaii's significant natural, scenic, historic, and cultural resources. | | | ✓ |
| (5) Develop and maintain career opportunities in the visitor industry for Hawaii's people, with emphasis on managerial positions. | | | ✓ |
| (6) Support and coordinate tourism promotion abroad to enhance Hawaii's share of existing and potential visitor markets. | | | ✓ |
| (7) Maintain and encourage a more favorable resort investment climate consistent with the objectives of this chapter. | | | ✓ |

| Hawai'i State Plan, Chapter 226, HRS Part III. Priority Guidelines<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | N/A |
|---|---|---|---|
| (8) Support law enforcement activities that provide a safer environment for both visitors and residents alike. | | | ✓ |
| (9) Coordinate visitor industry activities and promotions to business visitors through the state network of advanced data communication techniques. | | | ✓ |
| **(c) Priority guidelines to promote the continued viability of the sugar and pineapple industries:** | | | ✓ |
| (1) Provide adequate agricultural lands to support the economic viability of the sugar and pineapple industries. | | | ✓ |
| (2) Continue efforts to maintain federal support to provide stable sugar prices high enough to allow profitable operations in Hawaii. | | | ✓ |
| (3) Support research and development, as appropriate, to improve the quality and production of sugar and pineapple crops. | | | ✓ |
| **(d) Priority guidelines to promote the growth and development of diversified agriculture and aquaculture:** | ✓ | | |
| (1) Identify, conserve, and protect agricultural and aquacultural lands of importance and initiate affirmative and comprehensive programs to promote economically productive agricultural and aquacultural uses of such lands. | | | ✓ |
| (2) Assist in providing adequate, reasonably priced water for agricultural activities. | ✓ | | |
| (3) Encourage public and private investment to increase water supply and to improve transmission, storage, and irrigation facilities in support of diversified agriculture and aquaculture. | | | ✓ |
| (4) Assist in the formation and operation of production and marketing associations and cooperatives to reduce production and marketing costs. | | | ✓ |
| (5) Encourage and assist with the development of a waterborne and airborne freight and cargo system capable of meeting the needs of Hawaii's agricultural community. | | | ✓ |
| (6) Seek favorable freight rates for Hawaii's agricultural products from interisland and overseas transportation operators. | | | ✓ |
| (7) Encourage the development and expansion of agricultural and aquacultural activities which offer long-term economic growth potential and employment opportunities. | | | ✓ |
| (8) Continue the development of agricultural parks and other programs to assist small independent farmers in securing agricultural lands and loans. | | | ✓ |
| (9) Require agricultural uses in agricultural subdivisions and closely monitor the uses in these subdivisions. | | | ✓ |
| (10) Support the continuation of land currently in use for diversified agriculture. | | | ✓ |
| (11) Encourage residents and visitors to support Hawaii's farmers by purchasing locally grown food and food products. | | | ✓ |
| **(e) Priority guidelines for water use and development:** | ✓ | | |
| (1) Maintain and improve water conservation programs to reduce the overall water consumption rate. | | | ✓ |
| (2) Encourage the improvement of irrigation technology and promote the use of nonpotable water for agricultural and landscaping purposes. | ✓ | | |
| (3) Increase the support for research and development of economically feasible alternative water sources. | | | ✓ |
| (4) Explore alternative funding sources and approaches to support future water development programs and water system improvements. | | | ✓ |

| Hawai'i State Plan, Chapter 226, HRS Part III. Priority Guidelines<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | N/A |
|---|---|---|---|
| **(f) Priority guidelines for energy use and development:** | | | ✓ |
| (1) Encourage the development, demonstration, and commercialization of renewable energy sources. | | | ✓ |
| (2) Initiate, maintain, and improve energy conservation programs aimed at reducing energy waste and increasing public awareness of the need to conserve energy. | | | ✓ |
| (3) Provide incentives to encourage the use of energy conserving technology in residential, industrial, and other buildings. | | | ✓ |
| (4) Encourage the development and use of energy conserving and cost-efficient transportation systems. | | | ✓ |
| **(g) Priority guidelines to promote the development of the information industry:** | | | ✓ |
| (1) Establish an information network, with an emphasis on broadband and wireless infrastructure and capability that will serve as the foundation of and catalyst for overall economic growth and diversification in Hawaii. | | | ✓ |
| (2) Encourage the development of services such as financial data processing, a products and services exchange, foreign language translations, telemarketing, teleconferencing, a twenty-four-hour international stock exchange, international banking, and a Pacific Rim management center. | | | ✓ |
| (3) Encourage the development of small businesses in the information field such as software development; the development of new information systems, peripherals, and applications; data conversion and data entry services; and home or cottage services such as computer programming, secretarial, and accounting services. | | | ✓ |
| (4) Encourage the development or expansion of educational and training opportunities for residents in the information and telecommunications fields. | | | ✓ |
| (5) Encourage research activities, including legal research in the information and telecommunications fields. | | | ✓ |
| (6) Support promotional activities to market Hawaii's information industry services. | | | ✓ |
| (7) Encourage the location or co-location of telecommunication or wireless information relay facilities in the community, including public areas, where scientific evidence indicates that the public health, safety, and welfare would not be adversely affected. | | | ✓ |
| ***Analysis:*** **The proposed Central Maui WWRF Project is directly and indirectly applicable to relevant economic priority guidelines. As a capital improvement project, the proposed WWRF and SAT reflects long-term commitments of the State to provide wastewater treatment services, which allow for connections to existing properties while planning for future growth. The WWRF will provide R-1 recycled water available for agricultural and irrigation uses and promotes the priority guidelines for water use and development with nonpotable water for agricultural purposes.** | | | |
| **Chapter 226-104: Population growth and land resources priority guidelines.** | | | |
| **(a) Priority guidelines to effect desired statewide growth and distribution:** | ✓ | | |
| (1) Encourage planning and resource management to insure that population growth rates throughout the State are consistent with available and planned resource capacities and reflect the needs and desires of Hawaii's people. | ✓ | | |
| (2) Manage a growth rate for Hawaii's economy that will parallel future employment needs for Hawaii's people. | | | ✓ |
| (3) Ensure that adequate support services and facilities are provided to accommodate the desired distribution of future growth throughout the State. | ✓ | | |

| Hawai'i State Plan, Chapter 226, HRS Part III. Priority Guidelines<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | N/A |
|---|---|---|---|
| (4) Encourage major state and federal investments and services to promote economic development and private investment to the neighbor islands, as appropriate. | | | ✓ |
| (5) Explore the possibility of making available urban land, low-interest loans, and housing subsidies to encourage the provision of housing to support selective economic and population growth on the neighbor islands. | | | ✓ |
| (6) Seek federal funds and other funding sources outside the State for research, program development, and training to provide future employment opportunities on the neighbor islands. | | | ✓ |
| (7) Support the development of high technology parks on the neighbor islands. | | | ✓ |
| **(b) Priority guidelines for regional growth distribution and land resource utilization:** | | ✓ | |
| (1) Encourage urban growth primarily to existing urban areas where adequate public facilities are already available or can be provided with reasonable public expenditures, and away from areas where other important benefits are present, such as protection of important agricultural land or preservation of lifestyles. | | | ✓ |
| (2) Make available marginal or nonessential agricultural lands for appropriate urban uses while maintaining agricultural lands of importance in the agricultural district. | | | ✓ |
| (3) Restrict development when drafting of water would result in exceeding the sustainable yield or in significantly diminishing the recharge capacity of any groundwater area. | | | ✓ |
| (4) Encourage restriction of new urban development in areas where water is insufficient from any source for both agricultural and domestic use. | | | ✓ |
| (5) In order to preserve green belts, give priority to state capital-improvement funds which encourage location of urban development within existing urban areas except where compelling public interest dictates development of a noncontiguous new urban core. | | | ✓ |
| (6) Seek participation from the private sector for the cost of building infrastructure and utilities, and maintaining open spaces. | | | ✓ |
| (7) Pursue rehabilitation of appropriate urban areas. | | | ✓ |
| (8) Support the redevelopment of Kakaako into a viable residential, industrial, and commercial community. | | | ✓ |
| (9) Direct future urban development away from critical environmental areas or impose mitigating measures so that negative impacts on the environment would be minimized. | | | ✓ |
| (10) Identify critical environmental areas in Hawaii to include but not be limited to the following: watershed and recharge areas; wildlife habitats (on land and in the ocean); areas with endangered species of plants and wildlife; natural streams and water bodies; scenic and recreational shoreline resources; open space and natural areas; historic and cultural sites; areas particularly sensitive to reduction in water and air quality; and scenic resources. | | | ✓ |
| (11) Identify all areas where priority should be given to preserving rural character and lifestyle. | | | ✓ |
| (12) Utilize Hawaii's limited land resources wisely, providing adequate land to accommodate projected population and economic growth needs while ensuring the protection of the environment and the availability of the shoreline, conservation lands, and other limited resources for future generations. | | ✓ | |

| Hawai'i State Plan, Chapter 226, HRS Part III. Priority Guidelines<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | N/A |
|---|---|---|---|
| (13) Protect and enhance Hawaii's shoreline, open spaces, and scenic resources. | | ✓ | |
| ***Analysis:*** **The proposed Central Maui WWRF Project is directly and indirectly applicable to relevant priority guidelines for population growth and land resource utilization. The project will provide needed wastewater treatment capacity to accommodate desired growth in Central Maui. Wastewater treatment and the use of SAT basins help to prevent potential environmental contamination from untreated wastewater and represent a prudent use of natural resources. In addition, a view analysis has been conducted to ensure scenic resources are protected through implementation of the proposed project and recommended mitigation measures will be implemented.** | | | |
| **Chapter 226-105: Crime and criminal justice.** | | | |
| **Priority guidelines in the area of crime and criminal justice**: | | | ✓ |
| (1) Support law enforcement activities and other criminal justice efforts that are directed to provide a safer environment. | | | ✓ |
| (2) Target state and local resources on efforts to reduce the incidence of violent crime and on programs relating to the apprehension and prosecution of repeat offenders. | | | ✓ |
| (3) Support community and neighborhood program initiatives that enable residents to assist law enforcement agencies in preventing criminal activities. | | | ✓ |
| (4) Reduce overcrowding or substandard conditions in correctional facilities through a comprehensive approach among all criminal justice agencies which may include sentencing law revisions and use of alternative sanctions other than incarceration for persons who pose no danger to their community. | | | ✓ |
| (5) Provide a range of appropriate sanctions for juvenile offenders, including community-based programs and other alternative sanctions. | | | ✓ |
| (6) Increase public and private efforts to assist witnesses and victims of crimes and to minimize the costs of victimization. | | | ✓ |
| ***Analysis:*** **The Proposed wastewater infrastructure project is neither directly or indirectly applicable to the priority guidelines for crime and criminal justice.** | | | |
| **Chapter 226-106: Affordable housing.** | | | |
| **Priority guidelines for the provision of affordable housing:** | | ✓ | |
| (1) Seek to use marginal or nonessential agricultural land and public land to meet housing needs of extremely low-, very low-, lower-, moderate-, and above and moderate-income households. | | ✓ | |
| (2) Encourage the use of alternative construction and development methods as a means of reducing production costs. | | | ✓ |
| (3) Improve information and analysis relative to land availability and suitability for housing. | | | ✓ |
| (4) Create incentives for development which would increase home ownership and rental opportunities for Hawaii's low-, very low-, lower-, and moderate-income households and residents with special needs. | | | ✓ |
| (5) Encourage continued support for government or private housing programs that provide low interest mortgages to Hawaii's people for the purchase of initial owner-occupied housing. | | | ✓ |
| (6) Encourage public and private sector cooperation in the development of rental housing alternatives. | | | ✓ |
| (7) Encourage improved coordination between various agencies and levels of government to deal with housing policies and regulations. | | | ✓ |

| Hawai'i State Plan, Chapter 226, HRS Part III. Priority Guidelines<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | N/A |
|---|---|---|---|
| (8) Give higher priority to the provision of quality housing that is affordable for Hawaii's residents and less priority to development of housing intended primarily for individuals outside of Hawaii. | | | ✓ |
| ***Analysis:*** **The proposed project indirectly advances relevant priority guidelines for affordable housing through the provision of marginal agricultural lands for critical wastewater infrastructure to support future affordable housing development in the Central Maui region. The Central Maui WWRF is proposed to be located on vacant agricultural lands near existing and planned residential developments.** | | | |
| **Chapter 226-107: Quality education.** | | | |
| **Priority guidelines to promote quality education:** | | | ✓ |
| (1) Pursue effective programs which reflect the varied district, school, and student needs to strengthen basic skills achievement; | | | ✓ |
| (2) Continue emphasis on general education "core" requirements to provide common background to students and essential support to other university programs; | | | ✓ |
| (3) Initiate efforts to improve the quality of education by improving the capabilities of the education work force; | | | ✓ |
| (4) Promote increased opportunities for greater autonomy and flexibility of educational institutions in their decision making responsibilities; | | | ✓ |
| (5) Increase and improve the use of information technology in education by the availability of telecommunications equipment for: | | | ✓ |
| (A) The electronic exchange of information; | | | ✓ |
| (B) Statewide electronic mail; and | | | ✓ |
| (C) Access to the Internet. | | | ✓ |
| (6) Encourage programs that increase the public's awareness and understanding of the impact of information technologies on our lives; | | | ✓ |
| (7) Pursue the establishment of Hawaii's public and private universities and colleges as research and training centers of the Pacific; | | | ✓ |
| (8) Develop resources and programs for early childhood education; | | | ✓ |
| (9) Explore alternatives for funding and delivery of educational services to improve the overall quality of education; and | | | ✓ |
| (10) Strengthen and expand educational programs and services for students with special needs. | | | ✓ |
| ***Analysis:*** **he proposed Central Maui WWRF is an infrastructure improvement project that is not applicable to the priority guidelines for quality education.** | | | |
| **CHAPTER 226-108: Sustainability** | | | |
| **Priority guidelines and principles to promote sustainability shall include:** | | ✓ | |
| (1) Encouraging balanced economic, social, community, and environmental priorities; | | ✓ | |
| (2) Encouraging planning that respects and promotes living within the natural resources and limits of the State; | | ✓ | |
| (3) Promoting a diversified and dynamic economy; | | | ✓ |
| (4) Encouraging respect for the host culture; | | | ✓ |
| (5) Promoting decisions based on meeting the needs of the present without compromising the needs of future generations; | | ✓ | |
| (6) Considering the principles of the ahupuaa system; and | | | ✓ |

| Hawai'i State Plan, Chapter 226, HRS Part III. Priority Guidelines<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | N/A |
|---|---|---|---|
| (7) Emphasizing that everyone, including individuals, families, communities, businesses, and government, has the responsibility for achieving a sustainable Hawaii. | | | ✓ |
| ***Analysis:*** **The proposed project is indirectly applicable to relevant priority guidelines for sustainability through planning for the sewerage capacity for existing and future development in the Central Maui region. Additionally, the use of R-1 recycled water promotes conservation of natural resources.** | | | |
| **CHAPTER 226-109: Climate change adaptation priority guidelines** | | | |
| **Priority guidelines to prepare the State to address the impacts of climate change, including impacts to the areas of agriculture; conservation lands; coastal and nearshore marine areas; natural and cultural resources; education; energy; higher education; health; historic preservation; water resources; the built environment, such as housing, recreation, transportation; and the economy shall:** | ✓ | | |
| (1) Ensure that Hawaii's people are educated, informed, and aware of the impacts climate change may have on their communities; | | | ✓ |
| (2) Encourage community stewardship groups and local stakeholders to participate in planning and implementation of climate change policies; | | | ✓ |
| (3) Invest in continued monitoring and research of Hawaii's climate and the impacts of climate change on the State; | | | ✓ |
| (4) Consider native Hawaiian traditional knowledge and practices in planning for the impacts of climate change; | | | ✓ |
| (5) Encourage the preservation and restoration of natural landscape features, such as coral reefs, beaches and dunes, forests, streams, floodplains, and wetlands, that have the inherent capacity to avoid, minimize, or mitigate the impacts of climate change; | | | ✓ |
| (6) Explore adaptation strategies that moderate harm or exploit beneficial opportunities in response to actual or expected climate change impacts to the natural and built environments; | | ✓ | |
| (7) Promote sector resilience in areas such as water, roads, airports, and public health, by encouraging the identification of climate change threats, assessment of potential consequences, and evaluation of adaptation options; | ✓ | | |
| (8) Foster cross-jurisdictional collaboration between county, state, and federal agencies and partnerships between government and private entities and other nongovernmental entities, including nonprofit entities; | | | ✓ |
| (9) Use management and implementation approaches that encourage the continual collection, evaluation, and integration of new information and strategies into new and existing practices, policies, and plans; and | | | ✓ |
| (10) Encourage planning and management of the natural and built environments that effectively integrate climate change policy. | | | ✓ |
| **Analysis: The proposed project is directly applicable to relevant priority guidelines for climate change adaptation. The location of the proposed Central Maui WWRF was selected to be outside of the 3.2-foot Sea Level Rise Exposure Area, tsunami evaluation zone, and Special Management Area, representing efforts to plan for the impacts of climate change and sea level rise, in particular. The potential consequences of expanding the existing Wailuku-Kahului WWRF to accommodate the planned growth in central Maui would include continued use of a facility located within an area identified to be threatened by climate change. Adapting to climate change by diversifying the infrastructure systems, like adding the proposed WWRF Project, will alleviate pressures on the existing Wailuku-Kahului WWRF.** | | | |

# ANALYSIS OF PROJECT APPLICABILITY TO COUNTYWIDE POLICY PLAN

## APPENDIX

# S-2

# APPENDIX S-2

## Analysis of Project Applicability to Countywide Policy Plan

The Countywide Policy Plan was adopted in March 2010 and is a comprehensive policy document for the islands of Maui County to the year 2030. The plan replaces the *General Plan of the County of Maui 1990 Update* and provides the policy framework for the development of the forthcoming Maui Island Plan as well as for updating the nine detailed Community Plans.

The Countywide Policy Plan provides broad goals, objectives, policies and implementing actions that portray the desired direction of the County's future. Goals are intended to describe a desirable condition of the County by the year 2030 and are intentionally general. Objectives tend to be more specific and may be regarded as milestones to achieve the larger goals. Policies are not intended as regulations, but instead provide a general guideline for County decision makers, departments, and collaborating organizations toward the attainment of goals and objectives. Implementing actions are specific tasks, procedures, programs, or techniques that carry out policy.

Discussion of the proposed project conforms to the relevant goals, objectives, policies, and implementing actions of the Countywide Policy Plan is provided below. The methodology for assessing a project's relationship to the Countywide Policy Plan involves examining the project's applicability to the Plan's goals, objectives, and policies. "Applicability" refers to a project's need, purpose and effects, and how they advance or promote a particular set of goals, objectives and policies. In assessing the relationship between a proposed action and the Countywide Policy Plan, an action may be categorized in one of the following groups:

1. **Directly applicable:** the action and its potential effects directly advances, promotes or affects the relevant goal, objective, or policy.

   **Example:** A County project to develop a new water source and related transmission facilities would be directly applicable to improving physical infrastructure. The relevant objective states: *"Improve water systems to assure access to sustainable, clean, reliable, and affordable sources of water*" (Objective I.1). A policy within this objective category states: *Ensure that adequate supplies of water are available prior to approval of subdivision or construction documents* (Policy I.1.a).

   In this instance, the proposed action is considered to be directly applicable to the cited objective and policy.

2. **Indirectly applicable:** the action and its potential effects indirectly supports, advances or affects the objective, policy or priority guideline.

**Example:** The county water source project cited above supports the objective to: *"Improve land use management and implement a directed-growth strategy"* (Objective J.1). A related policy encompassed by this objective states: *"Direct new development in and around communities with existing infrastructure and service capacity, and protect natural, scenic, shoreline, and cultural resources"* (Policy J.1.h). In this case, the principle purpose of the project is not to create source specifically intended to improve land use management. Nonetheless, the proposed action indirectly supports the Countywide Policy Plan's directives relating to appropriate locations for new development.

3. **Not applicable:** the action and its potential effects have no direct or indirect relationship to the objectives and policies of the Countywide Policy Plan.

**Example:** The county water source improvement project referenced above, may not have direct or indirect linkage to Objective D.1, which states: *"In cooperation with the Federal and State governments and nonprofit agencies, broaden access to social and healthcare services and expand options to improve the overall wellness of the people of Maui County"*. Hence, from a policy analysis and linkage standpoint, the proposed action would be considered not applicable to this set of objectives and policies.

It is recognized that policy analysis is subject to interpretation and is best considered in the context of the proposed action's local and regional conditions.

| COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable) | DA | IA | NA |
|---|---|---|---|
| **A. PROTECT THE NATURAL ENVIRONMENT** | | | |
| **Goal:** Maui County's natural environment and distinctive open spaces will be preserved, managed, and cared for in perpetuity. | | ✓ | |
| **Objective:** | | | |
| (1) Improve the opportunity to experience the natural beauty and native biodiversity of the islands for present and future generations. | | ✓ | |
| **Policies:** | | | |
| (a) Perpetuate native Hawaiian biodiversity by preventing the introduction of invasive species, containing or eliminating existing noxious pests, and protecting critical habitat areas. | | | ✓ |
| (b) Preserve and reestablish indigenous and endemic species' habitats and their connectivity. | | | ✓ |
| (c) Restore and protect forests, wetlands, watersheds, and stream flows, and guard against wildfires, flooding, and erosion. | | ✓ | |
| (d) Protect baseline stream flows for perennial streams, and support policies that ensure adequate stream flow to support Native Hawaiian aquatic species, traditional kalo cultivation, and self-sustaining ahupua'a. | | | ✓ |
| (e) Protect undeveloped beaches, dunes, and coastal ecosystems, and restore natural shoreline processes. | | | ✓ |

| COUNTYWIDE POLICY PLAN<br>(Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable) | DA | IA | NA |
|---|---|---|---|
| (f) Protect the natural state and integrity of unique terrain, valued natural environments, and geological features. | | ✓ | |
| (g) Preserve and provide ongoing care for important scenic vistas, view planes, landscapes, and open-space resources. | | ✓ | |
| (h) Expand coordination with the State and nonprofit agencies and their volunteers to reduce invasive species, replant indigenous species, and identify critical habitat. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Develop island-wide networks of greenways, watercourses, and habitat corridors. | | | ✓ |
| ***Analysis:*** **The proposed action is indirectly applicable to the goal, objective, and relevant policies to preserve Maui County's natural environment, and indigenous and endemic species' habitats. An Environmental Impact Statement (EIS) inclusive of a Biological Resources Survey has been carried out to identify and minimize impacts to the environment as a result of the project. The Survey did not identify endangered or threatened species or their habitats. Furthermore, the proposed wastewater reclamation facility (WWRF) will provide a new disposal method for treated wastewater utilizing Soil Aquifer Treatment (SAT) basins which offers an alternative to injection wells which may be harmful to the environment.** | | | |
| **Objective:** | | | |
| (2) Improve the quality of environmentally sensitive, locally valued natural resources and native ecology of each island. | | ✓ | |
| **Policies:** | | | |
| (a) Protect and restore nearshore reef environments and water quality. | | ✓ | |
| (b) Protect marine resources and valued wildlife. | | ✓ | |
| (c) Improve the connection between urban environments and the natural landscape, and incorporate natural features of the land into urban design. | | | ✓ |
| (d) Utilize land-conservation tools to ensure the permanence of valued open spaces. | | | ✓ |
| (e) Mitigate the negative effects of upland uses on coastal wetlands, marine life, and coral reefs. | | ✓ | |
| (f) Strengthen coastal-zone management, re-naturalization of shorelines, where possible, and filtration or treatment of urban and agricultural runoff. | | ✓ | |
| (g) Regulate the use and maintenance of stormwater-treatment systems that incorporate the use of native vegetation and mimic natural systems. | | ✓ | |
| (h) Advocate for stronger regulation of fishing, boating, cruise ship, and ecotourism activities. | | | ✓ |
| (i) Restore watersheds and aquifer-recharge areas to healthy and productive status, and increase public knowledge about the importance of watershed stewardship, water conservation, and groundwater protection. | | ✓ | |
| **Implementing Actions:** | | | |
| (a) Develop regulations to minimize runoff of pollutants into nearshore waters and reduce nonpoint and point source pollution. | | | ✓ |

| COUNTYWIDE POLICY PLAN<br>(Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable) | DA | IA | NA |
|---|---|---|---|
| ***Analysis:*** **The proposed project is indirectly applicable to the objective and relevant policies for improving the quality of environmentally sensitive, locally valued natural resources of each island. The proposed SAT disposal system is a managed aquifer recharge system in which the quality of the treated wastewater is further improved during soil passage in order to protect the quality of groundwater resources. In addition, drainage improvements will be carried out throughout the project area and pipeline corridor which will help protect and help restore nearshore reef environments and water quality.** | | | |
| **Objective:** | | | |
| (3) Improve the stewardship of the natural environment. | | ✓ | |
| **Policies:** | | | |
| (a) Preserve and protect natural resources with significant scenic, economic, cultural, environmental, or recreational value. | | ✓ | |
| (b) Improve communication, coordination, and collaboration among government agencies, nonprofit organizations, communities, individuals, and land owners that work for the protection of the natural environment. | | | ✓ |
| (c) Evaluate development to assess potential short-term and long-term impacts on land, air, aquatic, and marine environments. | | ✓ | |
| (d) Improve efforts to mitigate and plan for the impact of natural disasters, human influenced emergencies, and global warming. | | ✓ | |
| (e) Regulate access to sensitive ecological sites and landscapes. | | | ✓ |
| (f) Reduce air, noise, light, land, and water pollution, and reduce Maui County's contribution to global climate change. | | ✓ | |
| (g) Plan and prepare for and educate visitors and residents about the possible effects of global warming. | | | ✓ |
| (h) Provide public access to beaches and shorelines for recreational and cultural purposes where appropriate. | | | ✓ |
| (i) Educate the construction and landscape industries and property owners about the use of best management practices to prevent erosion and nonpoint source pollution. | | ✓ | |
| (j) Support the acquisition of resources with scenic, environmental, and recreational value, and encumber their use. | | | ✓ |
| (k) Improve enforcement activities relating to the natural environment. | | | ✓ |
| (l) For each shoreline community, identify and prioritize beach-conservation objectives, and develop action plans for their implementation. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Document, record, and monitor existing conditions, populations, and locations of flora and fauna communities. | | ✓ | |
| (b) Implement Federal and State policies that require a reduction of greenhouse-gas emissions. | | | ✓ |
| (c) Establish a baseline inventory of available natural resources and their respective carrying capacities. | | | ✓ |

| COUNTYWIDE POLICY PLAN<br>(Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable) | DA | IA | NA |
|---|---|---|---|
| ***Analysis:*** **The proposed project is indirectly applicable to the objective and relevant policies and implementing actions related to improved stewardship of the natural environment. An EIS has been carried out for the proposed project to assess the potential impacts on environmental features such as impacts on land, air, aquatic, and marine environments, and to ensure adverse impacts to these resources are avoided or mitigated to the extent practical. A Biological Resources Survey was also carried out in the project area to inventory flora and fauna species and their habitats. The proposed project is also indirectly applicable to the policy to improve efforts to mitigate and plan for the impact of natural disasters and global warming as the proposed WWRF and SAT facilities are located inland, away from the anticipated 3.2 ft. sea level rise exposure area (SLR-XA) and outside of the tsunami evacuation zone. In addition, a Construction Best Management Practices Plan will be prepared for the proposed project to inform the construction and landscape contractors about BMP practices to prevent erosion and stormwater runoff impacts to downstream properties.** | | | |
| **Objective:** | | | |
| (4) Educate residents and visitors about responsible stewardship practices and the interconnectedness of the natural environment and people. | | | ✓ |
| **Policies:** | | | |
| (a) Expand education about native flora, fauna, and ecosystems. | | | ✓ |
| (b) Align priorities to recognize that the health of the natural environment and the health of people are inextricably linked. | | | ✓ |
| (c) Promote programs and incentives that decrease greenhouse-gas emissions and improve environmental stewardship. | | | ✓ |
| ***Analysis:*** **The proposed project involves wastewater infrastructure improvements in Central Maui and is not applicable to the objective and policies related to educating residents and visitors about responsible stewardship practices.** | | | |
| **B. PRESERVE LOCAL CULTURES AND TRADITIONS** | | | |
| **Goal:** Maui County will foster a spirit of pono and protect, perpetuate, and reinvigorate its residents multi-cultural values and traditions to ensure that current and future generations will enjoy the benefits of their rich island heritage. | | ✓ | |
| **Objective:** | | | |
| (1) Perpetuate the Hawaiian culture as a vital force in the lives of residents. | | | ✓ |
| **Policies:** | | | |
| (a) Protect and preserve access to mountain, ocean, and island resources for traditional Hawaiian cultural practices. | | ✓ | |
| (b) Prohibit inappropriate development of cultural lands and sites that are important for traditional Hawaiian cultural practices, and establish mandates for the special protection of these lands in perpetuity. | | ✓ | |
| (c) Promote the use of ahupua‘a and moku management practices. | | | ✓ |
| (d) Encourage the use of traditional Hawaiian architecture and craftsmanship. | | | ✓ |

| COUNTYWIDE POLICY PLAN<br>(Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable) | DA | IA | NA |
|---|---|---|---|
| (e) Promote the use of the Hawaiian language. | | | ✓ |
| (f) Recognize and preserve the unique natural and cultural characteristics of each ahupua'a or district. | | ✓ | |
| (g) Encourage schools to promote broader incorporation of Hawaiian and other local cultures' history and values lessons into curriculum. | | | ✓ |
| (h) Ensure the protection of Native Hawaiian rights. | | ✓ | |
| (i) Promote, encourage, and require the correct use of traditional place names, particularly in government documents, signage, and the tourism industry. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Establish alternative land use and overlay zoning designations that recognize and preserve the unique natural and cultural characteristics of each ahupua'a or district. | | | ✓ |
| (b) Develop requirements for all County applicants to perpetuate and use proper traditional place names in all applications submitted. | | | ✓ |
| ***Analysis:*** **The proposed project is indirectly applicable to the goal and relevant policies to protect multi-cultural values and traditions. An Archaeological Inventory Survey (AIS) and a Cultural Impact Assessment (CIA) have been conducted for the project and consultation with the State Historic Preservation Division (SHPD) has been initiated to assess historic and cultural resources and identify mitigation measures for their protection and preservation.** | | | |
| **Objective:** | | | |
| (2) Emphasize respect for our island lifestyle and our unique local cultures, family, and natural environment. | | ✓ | |
| **Policies:** | | | |
| (a) Acknowledge the Hawaiian culture as the host culture, and foster respect and humility among residents and visitors toward the Hawaiian people and their practices. | | ✓ | |
| (b) Perpetuate a respect for diversity, and recognize the historic blending of cultures and ethnicities. | | | ✓ |
| (c) Encourage the perpetuation of each culture's unique cuisine, attire, dance, music, and folklore, and other unique island traditions and recreational activities. | | | ✓ |
| (d) Recognize the interconnectedness between the natural environment and the cultural heritage of the islands. | | ✓ | |
| (e) Protect and prioritize funding for recreational activities that support local cultural practices, such as surfing, fishing, and outrigger-canoe paddling. | | | ✓ |
| ***Analysis:*** **The proposed project is indirectly applicable to the objective of emphasizing respect for our unique local cultures and natural environment and relevant policies. An EIS has been carried out to assess the project's impact on the environment and to identify measures to avoid or mitigate adverse impacts to the environment where possible. As noted previously, consultation with SHPD is ongoing and a CIA has been carried out on the project in recognition of the interconnectedness between the natural environment and the cultural heritage of the project area.** | | | |

| COUNTYWIDE POLICY PLAN<br>(Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable) | DA | IA | NA |
|---|---|---|---|
| **Objective:** | | | |
| (3) Preserve for present and future generations the opportunity to know and experience the arts, culture, and history of Maui County. | | | ✓ |
| **Policies:** | | | |
| (a) Foster teaching opportunities for cultural practitioners to share their knowledge and skills. | | | ✓ |
| (b) Support the development of cultural centers. | | | ✓ |
| (c) Broaden opportunities for public art and the display of local artwork. | | | ✓ |
| (d) Foster the Aloha Spirit by celebrating the Hawaiian host culture and other Maui County cultures through support of cultural-education programs, festivals, celebrations, and ceremonies. | | | ✓ |
| (e) Support the perpetuation of Hawaiian arts and culture. | | | ✓ |
| (f) Support programs and activities that record the oral and pictorial history of residents. | | | ✓ |
| (g) Support the development of repositories for culture, history, genealogy, oral history, film, and interactive learning. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Establish incentives for the display of public art. | | | ✓ |
| (b) Establish centers and programs of excellence for the perpetuation of Hawaiian arts and culture. | | | ✓ |
| ***Analysis:*** **The proposed project involves wastewater infrastructure improvements to the Central Maui wastewater system and is not applicable to the objective of preserving the arts, culture, and history of Maui County.** | | | |
| **Objective:** | | | |
| (4) Preserve and restore significant historic architecture, structures, cultural sites, cultural districts, and cultural landscapes. | | ✓ | |
| **Policies:** | | | |
| (a) Support the development of island-wide historic, archaeological, and cultural resources inventories. | | ✓ | |
| (b) Promote the rehabilitation and adaptive reuse of historic sites, buildings, and structures to perpetuate a traditional sense of place. | | | ✓ |
| (c) Identify a sustainable rate of use and set forth specific policies to protect cultural resources. | | | ✓ |
| (d) Protect and preserve lands that are culturally or historically significant. | | ✓ | |
| (e) Support programs that protect, record, restore, maintain, provide education about, and interpret cultural districts, landscapes, sites, and artifacts in both natural and museum settings. | | | ✓ |
| (f) Perpetuate the authentic character and historic integrity of rural communities and small towns. | | | ✓ |

| COUNTYWIDE POLICY PLAN<br>(Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable) | DA | IA | NA |
|---|---|---|---|
| (g) Seek solutions that honor the traditions and practices of the host culture while recognizing the needs of the community. | | | ✓ |
| (h) Support the development of an Archaeological District Ordinance. | | | ✓ |
| (i) Protect summits, slopes, and ridgelines from inappropriate development. | | | ✓ |
| (j) Support the registering of important historic sites on the State and Federal historic registers. | | | ✓ |
| (k) Provide opportunities for public involvement with restoration and enhancement of all types of cultural resources. | | | ✓ |
| (l) Foster partnerships to identify and preserve or revitalize historic and cultural sites. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Identify, develop, map, and maintain an inventory of locally significant natural. cultural, and historical resources for protection. | | ✓ | |
| (b) Prepare, continually update, and implement a cultural-management plan for cultural sites, districts, and landscapes, where appropriate. | | | ✓ |
| (c) Enact an Archaeological District Ordinance. | | | ✓ |
| (d) Nominate important historic sites to the State and Federal historic registers. | | | ✓ |
| ***Analysis:*** **The proposed project is indirectly supportive of the objective and relevant policies and implementing actions to protect significant cultural and historic resources. This EIS is being carried out on the proposed action to identify potential impacts and propose mitigative measures. An AIS and a CIA have been prepared for the proposed project to ensure cultural activities, historic resources, and historic lands are not adversely impacted by the proposed action.** | | | |
| **C. IMPROVE EDUCATION** | | | |
| **Goal:** Residents will have access to lifelong formal and informal educational options enabling them to realize their ambitions. | | | ✓ |
| **Objective:** | | | |
| (1) Encourage the State to attract and retain school administrators and educators of the highest quality. | | | ✓ |
| **Policies:** | | | |
| (a) Encourage the State to provide teachers with nationally competitive pay and benefit packages. | | | ✓ |
| (b) Encourage the State to ensure teachers will have the teaching tools and support staff needed to provide students with an excellent education. | | | ✓ |
| (c) Explore Maui County district- and school-based decision making in public education. | | | ✓ |
| ***Analysis:*** **The proposed action is neither directly or indirectly applicable to the goal, objective, and policies for educational opportunities and the retention of high-quality educators and administrators.** | | | |

| COUNTYWIDE POLICY PLAN<br>(Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable) | DA | IA | NA |
|---|---|---|---|
| **Objective:** | | | |
| (2) Provide nurturing learning environments that build skills for the 21st century. | | | ✓ |
| **Policies:** | | | |
| (a) Expand professional-development opportunities in disciplines that support the economic-development goals of Maui County. | | | ✓ |
| (b) Plan for demographic, social, and technological changes in a timely manner. | | | ✓ |
| (c) Encourage collaborative partnerships to improve conditions of learning environments. | | | ✓ |
| (d) Promote development of neighborhood schools and educational centers. | | | ✓ |
| (e) Integrate schools, community parks, and playgrounds, and expand each community's use of these facilities. | | | ✓ |
| (f) Support coordination between land use and school-facility planning agencies. | | | ✓ |
| (g) Encourage the upgrade and ongoing maintenance of public-school facilities. | | | ✓ |
| (h) Encourage the State Department of Education to seek reliable, innovative, and alternative methods to support a level of per-pupil funding that places Hawai'i among the top tier of states nationally for its financial support of public schools. | | | ✓ |
| (i) Encourage the State to promote healthier, more productive learning environments, including by providing healthy meals, more physical activity, natural lighting, and passive cooling. | | | ✓ |
| (j) Encourage the State to support the development of benchmarks to measure the success of Hawai'i's public-education system and clarify lines of accountability. | | | ✓ |
| (k) Design school and park facilities in proximity to residential areas. | | | ✓ |
| (l) Support technology- and natural-environment-based learning. | | | ✓ |
| (m) Encourage the State to support lower student-teacher ratios in public schools. | | | ✓ |
| (n) Encourage alternative learning and educational opportunities. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Develop safe walking and bicycling programs for school children..38 | | | ✓ |
| ***Analysis:*** **The proposed project involves wastewater infrastructure improvements in the Central Maui region and is not applicable to the objective of improving education.** | | | |
| **Objective:** | | | |
| (3) Provide all residents with educational opportunities that can help them better understand themselves and their surroundings and allow them to realize their ambitions. | | | ✓ |

| COUNTYWIDE POLICY PLAN<br>(Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable) | DA | IA | NA |
|---|---|---|---|
| **Policies:** | | | |
| (a) Encourage the State to improve Maui Community College as a comprehensive community college that will serve each community. | | | ✓ |
| (b) Broaden the use of technology and telecommunications to improve educational opportunities throughout the County. | | | ✓ |
| (c) Attract graduate-level research programs and institutions. | | | ✓ |
| (d) Promote the teaching of traditional practices, including aquaculture; subsistence agriculture; Pacific Island, Asian, and other forms of alternative health practices; and indigenous Hawaiian architecture. | | | ✓ |
| (e) Integrate cultural and environmental values in education, including self-sufficiency and sustainability. | | | ✓ |
| (f) Foster a partnership and ongoing dialogue between business organizations, formal educational institutions, and vocational training centers to tailor learning and mentoring programs to County needs. | | | ✓ |
| (g) Ensure teaching of the arts to all ages. | | | ✓ |
| (h) Expand and develop vocational learning opportunities by establishing trade schools. | | | ✓ |
| (i) Encourage the State to integrate financial and economic literacy in elementary, secondary, and higher-education levels. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Encourage the State to establish a four-year university, and support the development of other higher-education institutions to enable residents to obtain bachelor degrees and postgraduate degrees in Maui County. | | | ✓ |
| ***Analysis:*** **The proposed project involves wastewater infrastructure improvements in the Central Maui region and is not applicable to the objective and policies of providing all residents with educational opportunities. In addition, the proposed project is not subject to school impact fees.** | | | |
| **Objective:** | | | |
| (4) Maximize community-based educational opportunities. | | | ✓ |
| **Policies:** | | | |
| (a) Encourage the State and others to expand pre-school, after-school, and homebased (parent-child) learning. | | | ✓ |
| (b) Support public-private partnerships to develop youth-internship, -apprenticeship, and -mentoring programs. | | | ✓ |
| (c) Support the development of a wide range of informal educational and cultural programs for all residents. | | | ✓ |
| (d) Improve partnerships that utilize the skills and talents at Hawai‘i’s colleges and universities to benefit the County. | | | ✓ |
| (e) Support career-development and job-recruitment programs and centers. | | | ✓ |
| (f) Attract learning institutions and specialty schools to diversify and enhance educational opportunities. | | | ✓ |
| (g) Expand education of important life skills for the general public. | | | ✓ |

| COUNTYWIDE POLICY PLAN<br>(Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable) | DA | IA | NA |
|---|---|---|---|
| (h) Support community facilities such as museums, libraries, nature centers, and open spaces that provide interactive-learning opportunities for all ages. | | | ✓ |
| ***Analysis:*** **The proposed project involves wastewater infrastructure improvements in the Central Maui region and is not applicable to the objective and policies to maximize community-based educational opportunities.** | | | |
| **D. STRENGTHEN SOCIAL AND HEALTHCARE SERVICES** | | | |
| **Goal:** Health and social services in Maui County will fully and comprehensively serve all segments of the population. | | | ✓ |
| **Objective:** | | | |
| (1) In cooperation with the Federal and State governments and nonprofit agencies, broaden access to social and healthcare services and expand options to improve the overall wellness of the people of Maui County. | | | ✓ |
| **Policies:** | | | |
| (a) Work with other levels of government and the nonprofit sector to expand services to address hunger, homelessness, and poverty. | | | ✓ |
| (b) Support the improvement of opportunities for disadvantaged youth, encourage the tradition of hanai relatives, and support expanded opportunities for foster care. | | | ✓ |
| (c) Support expanded long-term-care options, both in institutions and at home, for patients requiring ongoing assistance and medical attention. | | | ✓ |
| (d) Encourage the expansion and improvement of local hospitals, facilitate the establishment of new healthcare facilities, and facilitate prompt and high-quality emergency- and urgent-care services for all. | | | ✓ |
| (e) Support broadened access to affordable health insurance and health care, and recognize the unique economic challenges posed to families when healthcare services are provided off-island. | | | ✓ |
| (f) Encourage equal access to social and healthcare services through both technological and traditional means. | | | ✓ |
| ***Analysis:*** **The proposed action is not applicable to the objectives and policies for the provision of social and healthcare services and will not impact access to these services or facilities.** | | | |
| **Objective:** | | | |
| (2) Encourage the Federal and State governments and the private sector to improve the quality and delivery of social and healthcare services. | | | ✓ |
| **Policies:** | | | |
| (a) Strengthen partnerships with government, nonprofit, and private organizations to provide funding and to improve counseling and other assistance to address substance abuse, domestic violence, and other pressing social challenges. | | | ✓ |
| (b) Encourage the State to improve the quality of medical personnel, facilities, services, and equipment. | | | ✓ |

| COUNTYWIDE POLICY PLAN<br>(Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable) | DA | IA | NA |
|---|---|---|---|
| (c) Encourage investment to improve the recruitment of medical professionals and the quality of medical facilities and equipment throughout Maui County. | | | ✓ |
| (d) Promote the development of continuum-of-care facilities that provide assisted living, hospice, home-care, and skilled-nursing options allowing the individual to be cared for in a manner congruent with his or her needs and desires. | | | ✓ |
| (e) Support improved social, healthcare, and governmental services for special needs populations. | | | ✓ |
| (f) Plan for the needs of an aging population and the resulting impacts on social services, housing, and healthcare delivery. | | | ✓ |
| (g) Improve coordination among the police, the courts, and the public in the administration of social and healthcare services. | | | ✓ |
| (h) Support programs that address needs of veterans. | | | ✓ |
| (i) Support programs that address the needs of immigrants. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Invest in programs designed to improve the general welfare and quality of life of Native Hawaiians. | | | ✓ |
| (b) Assist and facilitate the State Department of Public Safety and others in efforts to strengthen programs and facilities that will improve the mental and social health of incarcerated people and assist in prison inmates' successful transition back into Maui County communities. | | | ✓ |
| (c) Develop and maintain a comprehensive index that will measure the health and wellness needs of families. | | | ✓ |
| (d) Provide heliports countywide for emergency health and safety purposes. | | | ✓ |
| ***Analysis:*** **The proposed project involves wastewater infrastructure improvements in the Central Maui region. The proposed project is not applicable to the objectives and policies related to strengthening partnerships with Federal and State agencies and the private sector to improve the quality and delivery of social and healthcare services.** | | | |
| **Objective:** | | | |
| (3) Strengthen public-awareness programs related to healthy lifestyles and social and medical services. | | | ✓ |
| **Policies:** | | | |
| (a) Expand public awareness about personal safety and crime prevention. | | | ✓ |
| (b) Encourage residents to pursue education and training for careers in the healthcare, social services, and community-development fields. | | | ✓ |
| (c) Expand public awareness and promote programs to achieve healthy eating habits and drug-free lifestyles. | | | ✓ |
| ***Analysis:*** **The proposed project involves development of a wastewater treatment and disposal system and related improvements and is not applicable to the objectives and policies related to strengthening public awareness programs related to healthy lifestyles and social and medical services.** | | | |

| COUNTYWIDE POLICY PLAN<br>(Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable) | DA | IA | NA |
|---|---|---|---|
| **E. EXPAND HOUSING OPPORTUNITIES FOR RESIDENTS** | | | |
| **Goal:** Quality, island-appropriate housing will be available to all residents. | | ✓ | |
| **Objective:** | | | |
| (1) Reduce the affordable housing deficit for residents. | | ✓ | |
| **Policies:** | | | |
| (a) Ensure that an adequate and permanent supply of affordable housing, both new and existing units, is made available for purchase or rental to our resident and/or workforce population, with special emphasis on providing housing for low- to moderate-income families, and ensure that all affordable housing remains affordable in perpetuity. | | ✓ | |
| (b) Seek innovative ways to lower housing costs without compromising the quality of our island lifestyle. | | | ✓ |
| (c) Seek innovative methods to secure land for the development of low- and moderate- income housing. | | | ✓ |
| (d) Provide the homeless population with emergency and transitional shelter and other supportive programs. | | | ✓ |
| (e) Provide for a range of senior-citizen and special needs housing choices on each island that affordably facilitates a continuum of care and services. | | | ✓ |
| (f) Support the Department of Hawaiian Home Lands' development of homestead lands. | | ✓ | |
| (g) Manage property-tax burdens to protect affordable resident homeownership. | | | ✓ |
| (h) Explore taxation mechanisms to increase and maintain access to affordable housing. | | | ✓ |
| (i) Improve awareness regarding available affordable homeowner's insurance. | | | ✓ |
| (j) Redevelop commercial areas with a mixture of affordable residential and business uses, where appropriate. | | | ✓ |
| (k) Ensure residents are given priority to obtain affordable housing units developed in their communities, consistent with all applicable regulations. | | | ✓ |
| (l) Establish pricing for affordable housing that is more reflective of Maui County's workforce than the United States Housing and Urban Development's median-income estimates for Maui County. | | | ✓ |
| (m) Develop neighborhoods with a mixture of accessible and integrated community facilities and services. | | | ✓ |
| (n) Provide alternative regulatory frameworks to facilitate the use of Kuleana lands by the descendants of Native Hawaiians who received those lands pursuant to the Kuleana Act of 1850. | | | ✓ |
| (o) Work with lending institutions to expand housing options and safeguard the financial security of homeowners. | | | ✓ |
| (p) Promote the use of the community land trust model and other land-lease and land- financing options. | | | ✓ |

| COUNTYWIDE POLICY PLAN<br>(Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable) | DA | IA | NA |
|---|---|---|---|
| (q) Support the opportunity to age in place by providing accessible and appropriately designed residential units. | | | ✓ |
| ***Analysis:*** **The proposed project involves the capacity expansion of wastewater services in Central Maui which will indirectly support affordable housing development through provision of wastewater services to Waikapū Country Town which includes affordable housing, and other future affordable housing developments in the Central Maui region. The proposed project will also service the Department of Hawaiian Homelands (DHHL) lands at Pūlehunui, which indirectly supports the DHHL beneficiaries.** | | | |
| **Objective:** | | | |
| (2) Increase the mix of housing types in towns and neighborhoods to promote sustainable land use planning, expand consumer choice, and protect the County's rural and small town character. | | ✓ | |
| **Policies:** | | | |
| (a) Seek innovative ways to develop 'ohana cottages and accessory-dwelling units as affordable housing. | | | ✓ |
| (b) Design neighborhoods to foster interaction among neighbors. | | | ✓ |
| (c) Encourage a mix of social, economic, and age groups within neighborhoods. | | | ✓ |
| (d) Promote infill housing in urban areas at scales that capitalize on existing infrastructure, lower development costs, and are consistent with existing or desired patterns of development. | | ✓ | |
| (e) Encourage the building industry to use environmentally sustainable materials, technologies, and site planning. | | | ✓ |
| (f) Develop workforce housing in proximity to job centers and transit facilities. | | ✓ | |
| (g) Provide incentives to developers and owners who incorporate green building practices and energy-efficient technologies into their housing developments. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Revise laws to support neighborhood designs that incorporate a mix of housing types that are appropriate for island living. | | | ✓ |
| ***Analysis:*** **The proposed project involves development of a new wastewater treatment facility and SAT basins to increase available wastewater treatment capacity and an extension of wastewater services in Central Maui which will indirectly support the objective and relevant policies related to the development of increasing the mix of housing types to promote sustainable land use planning and consumer choice as well as infill housing in Central Maui. The proposed project is located in Central Maui which indirectly supports workforce housing development in proximity to job centers and transit facilities.** | | | |
| **Objective:** | | | |
| (3) Increase and maintain the affordable housing inventory. | | ✓ | |
| **Policies:** | | | |
| (a) Recognize housing as a basic human need, and work to fulfill that need. | | | ✓ |
| (b) Prioritize available infrastructure capacity for affordable housing. | | ✓ | |

| COUNTYWIDE POLICY PLAN<br>(Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable) | DA | IA | NA |
|---|---|---|---|
| (c) Improve communication, collaboration, and coordination among housing providers and social-service organizations. | | | ✓ |
| (d) Study future projected housing needs, monitor economic cycles, and prepare for future conditions on each island. | | | ✓ |
| (e) Develop public-private and nonprofit partnerships that facilitate the construction of quality affordable housing. | | | ✓ |
| (f) Streamline the review process for high-quality, affordable housing developments that implement the goals, objectives, and policies of the General Plan. | | | ✓ |
| (g) Minimize the intrusion of housing on prime, productive, and potentially productive agricultural lands and regionally valuable agricultural lands. | | | ✓ |
| (h) Encourage long-term residential use of existing and future housing to meet residential needs. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Develop policies to even out the peaks and valleys in Maui County's construction-demand cycles. | | | ✓ |
| ***Analysis:*** **The proposed project is indirectly applicable to the objective and policies to increase and maintain the affordable housing inventory. The proposed project will expand and increase the wastewater treatment services and capacity in the Central Maui wastewater system to support future development. It is anticipated future development will include affordable housing projects which will increase the affordable housing inventory.** | | | |
| **Objective:** | | | |
| (4) Expand access to education related to housing options, homeownership, financing, and residential construction. | | | ✓ |
| **Policies:** | | | |
| (a) Broaden access to information about County, State, and Federal programs that provide financial assistance to renters and home buyers. | | | ✓ |
| (b) Expand access to information about opportunities for homeownership and self-help housing. | | | ✓ |
| (c) Educate residents about making housing choices that support their individual needs, the needs of their communities, and the health of the islands' natural systems. | | | ✓ |
| (d) Improve home buyers' education on all aspects of homeownership. | | | ✓ |
| ***Analysis:*** **The proposed project involves wastewater improvements to the Central Maui wastewater system and is not applicable to the objectives to expand education related to housing.** | | | |
| **F. STRENGTHEN THE LOCAL ECONOMY** | | | |
| **Goal:** Maui County's economy will be diverse, sustainable, and supportive of community values. | | ✓ | |
| **Objective:** | | | |
| (1) Promote an economic climate that will encourage diversification of the County's economic base and a sustainable rate of economic growth. | | ✓ | |
| **Policies:** | | | |
| (a) Support economic decisions that create long-term benefits. | | | ✓ |

| COUNTYWIDE POLICY PLAN<br>(Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable) | DA | IA | NA |
|---|---|---|---|
| (b) Promote lifelong education, career development, and technical training for existing and emerging industries. | | | ✓ |
| (c) Invest in infrastructure, facilities, and programs that foster economic diversification. | | ✓ | |
| (d) Support and promote locally produced products and locally owned operations and businesses that benefit local communities and meet local demand. | | | ✓ |
| (e) Support programs that assist industries to retain and attract more local labor and facilitate the creation of jobs that offer a living wage. | | | ✓ |
| (f) Encourage work environments that are safe, rewarding, and fulfilling to employees. | | | ✓ |
| (g) Support home-based businesses that are appropriate for and in character with the community. | | | ✓ |
| (h) Encourage businesses that promote the health and well-being of the residents, produce value-added products, and support community values. | | | ✓ |
| (i) Foster an understanding of the role of all industries in our economy. | | ✓ | |
| (j) Support efforts to improve conditions that foster economic vitality in our historic small towns. | | | ✓ |
| (k) Support and encourage traditional host-culture businesses and indigenous agricultural practices. | | | ✓ |
| (l) Support public and private entities that assist entrepreneurs in establishing locally operated businesses. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Develop regulations and programs that support opportunities for local merchants, farmers, and small businesses to sell their goods and services directly to the public. | | | ✓ |
| (b) Monitor the carrying capacity of the islands' social, ecological, and infrastructure systems with respect to the economy. | | | ✓ |
| ***Analysis:*** **The proposed project is indirectly applicable to the goal, objective, and relevant policies of strengthening the local economy. The proposed project will increase the capacity of wastewater treatment infrastructure in Central Maui which will support future economic development. The proposed project represents an investment in infrastructure which will indirectly foster economic development and diversification.** | | | |
| **Objective:** | | | |
| (2) Diversify and expand sustainable forms of agriculture and aquaculture. | | ✓ | |
| **Policies:** | | | |
| (a) Support programs that position Maui County's agricultural products as premium export products. | | | ✓ |
| (b) Prioritize the use of agricultural land to feed the local population, and promote the use of agricultural lands for sustainable and diversified agricultural activities. | | ✓ | |
| (c) Capitalize on Hawai'i's economic opportunities in the ecologically sensitive aquaculture industries. | | | ✓ |

| COUNTYWIDE POLICY PLAN<br>(Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable) | DA | IA | NA |
|---|---|---|---|
| (d) Assist farmers to help make Maui County more self-sufficient in food production. | | | ✓ |
| (e) Support ordinances, programs, and policies that keep agricultural land and water available and affordable to farmers. | | | ✓ |
| (f) Support a tax structure that is conducive to the growth of the agricultural economy. | | | ✓ |
| (g) Enhance County efforts to monitor and regulate important agricultural issues. | | | ✓ |
| (h) Support education, research, and facilities that strengthen the agricultural industry. | | | ✓ |
| (i) Maintain the genetic integrity of existing food crops. | | | ✓ |
| (j) Encourage healthy and organic farm practices that contribute to land health and regeneration. | | ✓ | |
| (k) Support cooperatives and other types of nontraditional communal farming and efforts. | | | ✓ |
| (l) Encourage methods of monitoring and controlling genetically modified crops to prevent adverse effects. | | | ✓ |
| (m) Work with the State to ease the permitting process for the revitalization of traditional fish ponds. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Redirect efforts in the Office of Economic Development to further facilitate the development of the agricultural section and to monitor agricultural legislation and issues. | | | ✓ |
| (b) Publicly identify, with signage and other means, the field locations of all genetically modified crops. | | | ✓ |
| (c) Create agricultural parks in areas distant from genetically modified crops. | | | ✓ |
| ***Analysis:*** **An Agricultural Impact Assessment has been prepared to ensure that the proposed project will not significantly impact agricultural activities in Central Maui. The proposed project includes the generation of R-1 recycled water which will be used to irrigate Waikapū Country Town's Agricultural Preserve and other lands in the vicinity. Indirectly, the project supports sustainable forms of agriculture through the use of recycled water for agricultural purposes.** | | | |
| **Objective:** | | | |
| (3) Support a visitor industry that respects the resident culture and the environment. | | | ✓ |
| **Policies:** | | | |
| (a) Promote traditional Hawaiian practices in visitor-related facilities and activities. | | | ✓ |
| (b) Encourage and educate the visitor industry to be sensitive to island lifestyles and cultural values. | | | ✓ |
| (c) Encourage a spirit of welcome for residents at visitor facilities, such as by offering kama'aina incentives and discount programs. | | | ✓ |
| (d) Support the renovation and enhancement of existing visitor facilities. | | | ✓ |
| (e) Support policies, programs, and a tax structure that redirect the benefits of the visitor industry back into the local community. | | | ✓ |

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|---|---|---|---|
| (f) Encourage resident ownership of visitor-related businesses and facilities. | | | ✓ |
| (g) Develop partnerships to provide educational and training facilities to residents employed in the visitor industry. | | | ✓ |
| (h) Foster an understanding of local cultures, customs, and etiquette, and emphasize the importance of the Aloha Spirit as a common good for all. | | | ✓ |
| (i) Support the diversification, development, evolution, and integration of the visitor industry in a way that is compatible with the traditional, social, economic, spiritual, and environmental values of island residents | | | ✓ |
| (j) Improve collaboration between the visitor industry and the other sectors of Maui County's economy. | | | ✓ |
| (k) Perpetuate an authentic image of the Hawaiian culture and history and an appropriate recognition of the host culture. | | | ✓ |
| (l) Support the programs and initiatives outlined in the Maui County Tourism Strategic Plan 2006-2015. | | | ✓ |
| (m) Promote water conservation, beach conservation, and open-space conservation in areas providing services for visitors. | | | ✓ |
| (n) Recognize the important contributions that the visitor industry makes to the County's economy, and support a healthy and vibrant visitor industry. | | | ✓ |
| ***Analysis:*** **The proposed project involves wastewater infrastructure improvements and does not have a direct or indirect impact on the visitor industry. The proposed project has no implications that prevent the visitor industry from respecting the resident culture and the environment.** | | | |
| **Objective:** | | | |
| (4) Expand economic sectors that increase living-wage job choices and are compatible with community values. | | ✓ | |
| **Policies:** | | | |
| (a) Support emerging industries, including the following:<br>• Health and wellness industry;<br>• Sports and recreation industry;<br>• Film and entertainment industry;<br>• Arts and culture industry;<br>• Renewable-energy industry;<br>• Research and development industry;<br>• High-technology and knowledge-based industries;<br>• Education and training industry;<br>• Ecotourism industry; and<br>• Agritourism industry. | | ✓ | |
| ***Analysis:*** **The proposed project is indirectly applicable to the objective and policies to expand economic sectors and support emerging industries. The proposed project will increase wastewater treatment and system capacity in Central Maui which will support future economic development in the area.** | | | |
| **G. IMPROVE PARKS AND PUBLIC FACILITIES** | | | |
| **Goal:** A full range of island-appropriate public facilities and recreational opportunities will be provided to improve the quality of life for residents and visitors. | | ✓ | |

| COUNTYWIDE POLICY PLAN<br>(Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable) | DA | IA | NA |
|---|---|---|---|
| **Objective:** | | | |
| (1) Expand access to recreational opportunities and community facilities to meet the present and future needs of residents of all ages and physical abilities. | | | ✓ |
| **Policies:** | | | |
| (a) Protect, enhance, and expand access to public shoreline and mountain resources. | | | ✓ |
| (b) Expand and enhance the network of parks, multi-use paths, and bikeways. | | | ✓ |
| (c) Assist communities in developing recreational facilities that promote physical fitness. | | | ✓ |
| (d) Expand venue options for recreation and performances that enrich the lifestyles of Maui County's people. | | | ✓ |
| (e) Expand affordable recreational and after-school programs for youth. | | | ✓ |
| (f) Encourage and invest in recreational, social, and leisure activities that bring people together and build community pride. | | | ✓ |
| (g) Promote the development and enhancement of community centers, civic spaces, and gathering places throughout our communities. | | | ✓ |
| (h) Expand affordable access to recreational opportunities that support the local lifestyle. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Identify and reserve lands for cemeteries, and preserve existing cemeteries on all islands, appropriately accommodating varying cultural and, faith-based traditions. | | | ✓ |
| ***Analysis:*** **The proposed project is not directly or indirectly applicable to the goal, objective, policies, or implementing actions for expanding or improving access to recreational and public facilities. However, there are parks and recreational facilities in Central Maui which will be serviced by the proposed WWRF.** | | | |
| **Objective:** | | | |
| (2) Improve the quality and adequacy of community facilities. | | | ✓ |
| **Policies:** | | | |
| (a) Provide an adequate supply of dedicated shelters and facilities for disaster relief. | | | ✓ |
| (b) Provide and maintain community facilities that are appropriately designed to reflect the traditions and customs of local cultures. | | | ✓ |
| (c) Ensure that parks and public facilities are safe and adequately equipped for the needs of all ages and physical abilities to the extent reasonable. | | | ✓ |
| (d) Maintain, enhance, expand, and provide new active and passive recreational facilities in ways that preserve the natural beauty of their locations. | | | ✓ |
| (e) Redesign or retrofit public facilities to adapt to major shifts in environmental or urban conditions to the extent reasonable. | | | ✓ |

| COUNTYWIDE POLICY PLAN<br>(Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable) | DA | IA | NA |
|---|---|---|---|
| ***Analysis:*** **The proposed action does not directly or indirectly support the objective or policies for the improvement or provision of adequate community facilities.** | | | |
| **Objective:** | | | |
| (3) Enhance the funding, management, and planning of public facilities and park lands. | | ✓ | |
| **Policies:** | | | |
| (a) Identify and encourage the establishment of regulated and environmentally sound campgrounds. | | | ✓ |
| (b) Manage park use and control access to natural resources in order to rest sensitive places and utilize the resources in a sustainable manner. | | | ✓ |
| (c) Provide public-recreational facilities that are clean and well-maintained. | | | ✓ |
| (d) Develop partnerships to ensure proper stewardship of the islands' trails, public lands, and access systems. | | | ✓ |
| (e) Ensure that there is an adequate supply of public restrooms in convenient locations. | | ✓ | ✓ |
| **Implementing Actions:** | | | |
| (a) Encourage the State to allow for overnight fishing along the shoreline in accordance with management plans and regulations. | | | ✓ |
| (b) Develop and regularly update functional plans, including those relating to public facilities, parks, and campgrounds. | | | ✓ |
| (c) Develop and adopt local level-of service standards for public facilities and parks. | | | ✓ |
| (d) Identify, acquire, and develop lands for parks, civic spaces, and public uses. | | | ✓ |
| ***Analysis:*** **The proposed action is indirectly applicable to the objective and relevant policy related to the enhancement of funding, management, or planning of public facilities and recreational park lands. The project involves development of a new WWRF to support adequate supply of public restrooms in convenient locations in the Central Maui.** | | | |
| **H. DIVERSIFY TRANSPORTATION OPTIONS** | | | |
| **Goal:** Maui County will have an efficient, economical, and environmentally sensitive means of moving people and goods. | | | ✓ |
| **Objective:** | | | |
| (1) Provide an effective, affordable, and convenient ground-transportation system that is environmentally sustainable. | | | ✓ |
| **Policies:** | | | |
| (a) Execute planning strategies to reduce traffic congestion. | | | ✓ |
| (b) Plan for the efficient relocation of roadways for the public benefit. | | | ✓ |
| (c) Support the use of alternative roadway designs, such as traffic-calming techniques and modern roundabouts. | | | ✓ |
| (d) Increase route and mode options in the ground-transportation network. | | | ✓ |

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|---|---|---|---|
| (e) Ensure that roadway systems are safe, efficient, and maintained in good condition. | | | ✓ |
| (f) Preserve roadway corridors that have historic, scenic, or unique physical attributes that enhance the character and scenic resources of communities. | | | ✓ |
| (g) Design new roads and roadway improvements to retain and enhance the existing character and scenic resources of the communities through which they pass. | | | ✓ |
| (h) Promote a variety of affordable and convenient transportation services that meet countywide and community needs and expand ridership of transit systems. | | | ✓ |
| (i) Collaborate with transit agencies, government agencies, employers, and operators to provide planning strategies that reduce peak-hour traffic. | | | ✓ |
| (j) Develop and expand an attractive, island-appropriate, and efficient public transportation system. | | | ✓ |
| (k) Provide and encourage the development of specialized transportation options for the young, the elderly, and persons with disabilities. | | | ✓ |
| (l) Evaluate all alternatives to preserve quality of life before widening roads. | | | ✓ |
| (m) Encourage businesses in the promotion of alternative transportation options for resident and visitor use. | | | ✓ |
| (n) Support the development of carbon-emission standards and an incentive program aimed at achieving County carbon-emission goals. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Create incentives and implement strategies to reduce visitor dependence on rental cars. | | | ✓ |
| (b) Establish efficient public-transit routes between employment centers and primary workforce residential areas. | | | ✓ |
| (c) Create attractive, island-appropriate, conveniently located park-and-ride and ride- share facilities. | | | ✓ |
| ***Analysis:*** **The proposed project involves wastewater infrastructure improvements and is not applicable to the goal, objective, policies, and implementing actions related to diversifying transportation options.** | | | |
| **Objective:** | | | |
| (2) Reduce the reliance on the automobile and fossil fuels by encouraging walking, bicycling, and other energy-efficient and safe alternative modes of transportation. | | | ✓ |
| **Policies:** | | | |
| (a) Make walking and bicycling transportation safe and easy between and within communities. | | | ✓ |
| (b) Require development to be designed with the pedestrian in mind. | | | ✓ |
| (c) Design new and retrofit existing rights-of-way with adequate sidewalks, bicycle lanes, or separated multi-use transit corridors. | | | ✓ |

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|---|---|---|---|
| (d) Support the development of a countywide network of bikeways, equestrian trails, and pedestrian paths. | | | ✓ |
| (e) Support the reestablishment of traditional trails between communities, to the ocean, and through the mountains for public use. | | | ✓ |
| (f) Encourage educational programs to increase safety for pedestrians and bicyclists. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Design, build, and modify existing bikeways to improve safety and separation from automobiles. | | | ✓ |
| (b) Increase enforcement to reduce abuse of bicycle and pedestrian lanes by motorized vehicles. | | | ✓ |
| (c) Identify non-motorized transportation options as a priority for new sources of funding. | | | ✓ |
| ***Analysis:*** **The proposed project involves wastewater infrastructure improvements and is not applicable to the objective, policies, and implementing actions related to reducing the reliance on the automobile and fossil fuels by encouraging walking, bicycling, and other energy-efficient modes of transportation.** | | | |
| **Objective:** | | | |
| (3) Improve opportunities for affordable, efficient, safe, and reliable air transportation. | | | ✓ |
| **Policies:** | | | |
| (a) Discourage private helicopter and fixed-wing landing sites to mitigate environmental and social impacts. | | | ✓ |
| (b) Encourage the use of quieter aircraft and noise-abatement procedures for arrivals and departures. | | | ✓ |
| (c) Encourage the modernization and maintenance of air-transportation facilities for general-aviation activities. | | | ✓ |
| (d) Encourage a viable and competitive atmosphere for air carriers to expand service and ensure sufficient intra-County flights and affordable fares for consumers. | | | ✓ |
| (e) Continue to support secondary airports, and encourage the State to provide them with adequate funding. | | | ✓ |
| (f) During Community Plan updates, explore the use of the smaller airports. | | | ✓ |
| (g) Encourage the State to provide efficient, adequate, and affordable parking and transit connections within and around airports. | | | ✓ |
| ***Analysis:*** **The proposed project involves wastewater infrastructure improvements and is not applicable to the objective and policies related to improving opportunities for air transportation.** | | | |
| **Objective:** | | | |
| (4) Improve opportunities for affordable, efficient, safe, and reliable ocean transportation. | | | ✓ |
| **Policies:** | | | |
| (a) Support programs and regulations that reduce the disposal of maritime waste and prevent spills into the ocean. | | | ✓ |
| (b) Encourage the upgrading of harbors to resist damage from natural hazards and disasters. | | | ✓ |

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|---|---|---|---|
| (c) Encourage the State to study the use of existing harbors and set priorities for future use. | | | ✓ |
| (d) Explore all options to protect the traditional recreational uses of harbors, and mitigate harbor-upgrade impacts to recreational uses where feasible. | | | ✓ |
| (e) Encourage the upgrading of harbors and the separation of cargo and bulk materials from passenger and recreational uses. | | | ✓ |
| (f) Encourage the State to provide for improved capacity at shipping, docking, and storage facilities. | | | ✓ |
| (g) Encourage the State to provide adequate parking facilities and transit connections within and around harbor areas. | | | ✓ |
| (h) Encourage the redevelopment and revitalization of harbors while preserving historic and cultural assets in harbor districts. | | | ✓ |
| (i) Encourage the State to provide adequate facilities for small-boat operations, including small-boat launch ramps, according to community needs. | | | ✓ |
| (j) Support the maintenance and cleanliness of harbor facilities. | | | ✓ |
| (k) Support the redevelopment of harbors as pedestrian-oriented gathering places. | | | ✓ |
| ***Analysis:*** **The proposed project involves wastewater infrastructure improvements and is not applicable to the objective and policies related to improving opportunities for affordable, safe, and reliable ocean transportation.** | | | |
| **Objective:** | | | |
| (5) Improve and expand the planning and management of transportation systems. | | | ✓ |
| **Policies:** | | | |
| (a) Encourage progressive community design and development that will reduce transportation trips. | | | ✓ |
| (b) Require new developments to contribute their pro rata share of local and regional infrastructure costs. | | | ✓ |
| (c) Establish appropriate user fees for private enterprises that utilize public transportation facilities for recreational purposes. | | | ✓ |
| (d) Support the revision of roadway-design criteria and standards so that roads are compatible with surrounding neighborhoods and the character of rural areas. | | | ✓ |
| (e) Plan for multi-modal transportation and utility corridors on each island. | | | ✓ |
| (f) Support designing all transportation facilities, including airport, harbor, and mass- transit stations, to reflect Hawaiian architecture. | | | ✓ |
| (g) Utilize transportation-demand management as an integral part of transportation planning. | | | ✓ |
| (h) Accommodate the planting of street trees and other appropriate landscaping in all public rights-of-way. | | | ✓ |

| COUNTYWIDE POLICY PLAN<br>(Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable) | DA | IA | NA |
|---|---|---|---|
| ***Analysis:*** **The proposed project involves wastewater infrastructure improvements and is not applicable to the objective and policies related to improving and expanding the planning and management of transportation systems.** | | | |
| **I. IMPROVE PHYSICAL INFRASTRUCTURE** | | | |
| **Goal:** Maui County's physical infrastructure will be maintained in optimum condition and will provide for and effectively serve the needs of the County through clean and sustainable technologies. | ✓ | | |
| **Objective:** | | | |
| (1) Improve water systems to assure access to sustainable, clean, reliable, and affordable sources of water. | | | ✓ |
| **Policies:** | | | |
| (a) Ensure that adequate supplies of water are available prior to approval of subdivision or construction documents. | | | ✓ |
| (b) Develop and fund improved water-delivery systems. | | | ✓ |
| (c) Ensure a reliable and affordable supply of water for productive agricultural uses. | ✓ | | |
| (d) Promote the reclamation of gray water, and enable the use of reclaimed, gray, and brackish water for activities that do not require potable water. | ✓ | | |
| (e) Retain and expand public control and ownership of water resources and delivery systems. | | | ✓ |
| (f) Improve the management of water systems so that surface-water and groundwater resources are not degraded by overuse or pollution. | | | ✓ |
| (g) Explore and promote alternative water-source-development methods. | | | ✓ |
| (h) Seek reliable long-term sources of water to serve developments that achieve consistency with the appropriate Community Plans. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Develop a process to review all applications for desalination. | | | ✓ |
| ***Analysis:*** **The proposed project involves wastewater infrastructure improvements and is directly applicable to the goal and relevant policies to maintain Maui County's physical infrastructure in optimum condition and provide for and effectively serve the needs of the County through clean and sustainable technologies. The new WWRF will produce R-1 recycled water available for agricultural and irrigation uses. The SAT system is a clean and sustainable water effluent treatment technology that is novel to the state of Hawai'i.** | | | |
| **Objective:** | | | |
| (2) Improve waste-disposal practices and systems to be efficient, safe, and as environmentally sound as possible. | ✓ | | |
| **Policies:** | | | |
| (a) Provide sustainable waste-disposal systems and comprehensive, convenient recycling programs to reduce the flow of waste into landfills. | | | ✓ |

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|---|---|---|---|
| (b) Support innovative and alternative practices in recycling solid waste and wastewater and disposing of hazardous waste. | ✓ | | |
| (c) Encourage vendors and owners of automobile, appliance, and white goods to participate in the safe disposal and recycling of such goods, and ensure greater accountability for large waste producers. | | | ✓ |
| (d) Develop strategies to promote public awareness to reduce pollution and litter, and encourage residents to reduce, reuse, recycle, and compost waste materials. | | | ✓ |
| (e) Pursue improvements and upgrades to existing wastewater and solid-waste systems consistent with current and future plans and the County's Capital Improvement Program. | ✓ | | |
| **Implementing Actions:** | | | |
| (a) Establish recycling, trash-separation, and materials recovery programs and facilities to reduce the flow of waste into landfills. | | | ✓ |
| (b) Study the feasibility of developing environmentally safe waste-to-energy facilities. | | | ✓ |
| (c) Utilize taxes and fees as means to encourage conservation and recycling. | | | ✓ |
| (d) Implement and regularly update the Integrated Solid Waste Management Plan. | | | ✓ |
| (e) Phase out the use of injection wells. | ✓ | | |
| ***Analysis:*** **The proposed project involves the development of a new WWRF and extension of wastewater services in Central Maui to support future development and is directly applicable to the objective and related policies and implementing actions related to waste disposal systems. The WWRF will produce R-1 recycled water available for agricultural and irrigation uses. As a back-up treated water disposal system, the SAT system will be in place which is more efficient, safe, and environmentally sound than most existing systems in Maui County.** | | | |
| **Objective:** | | | |
| (3) Significantly increase the use of renewable and green technologies to promote energy efficiency and energy self-sufficiency. | | ✓ | |
| **Policies:** | | | |
| (a) Promote the use of locally renewable energy sources, and reward energy efficiency. | | | ✓ |
| (b) Consider tax incentives and credits for the development of sustainable- and renewable-energy sources. | | | ✓ |
| (c) Expand education about energy conservation and self-sufficiency. | | | ✓ |
| (d) Encourage small-scale energy generation that utilizes wind, sun, water, biowaste, and other renewable sources of energy. | | | ✓ |
| (e) Expand renewable-energy production. | | | ✓ |
| (f) Develop public-private partnerships to ensure the use of renewable energy and increase energy efficiency. | | | ✓ |

| COUNTYWIDE POLICY PLAN<br>(Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable) | DA | IA | NA |
|---|---|---|---|
| (g) Require the incorporation of locally appropriate energy-saving and green building design concepts in all new developments by providing energy efficient urban design guidelines and amendments to the Building Code. | | | ✓ |
| (h) Encourage the use of sustainable energy to power vehicles. | | | ✓ |
| (i) Promote the retrofitting of existing buildings and new development to incorporate energy-saving design concepts and devices. | | | ✓ |
| (j) Encourage green footprint practices. | | | ✓ |
| (k) Reduce Maui County's dependence on fossil fuels and energy imports. | | ✓ | |
| (l) Support green building practices such as the construction of buildings that aim to minimize carbon dioxide production, produce renewable energy, and recycle water. | | | ✓ |
| (m) Promote and support environmentally friendly practices in all energy sectors. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Adopt an energy-efficiency policy for Maui County government as a model for other jurisdictions. | | | ✓ |
| (b) Adopt a Green Building Code, and support green building practices. | | | ✓ |
| ***Analysis:*** **The proposed action is indirectly applicable to the objective and relevant policies for renewable and sustainable energy systems. A solar PV system will be incorporated at the proposed WWRF to generate renewable energy to support energy consumption though the wastewater treatment process.** | | | |
| **Objective:** | | | |
| (4) Direct growth in a way that makes efficient use of existing infrastructure and to areas where there is available infrastructure capacity. | ✓ | | |
| **Policies:** | | | |
| (a) Capitalize on existing infrastructure capacity as a priority over infrastructure expansion. | | | ✓ |
| (b) Planning for new towns should only be considered if a region's growth is too large to be directed into infill and adjacent growth areas. | | | ✓ |
| (c) Utilize appropriate infrastructure technologies in the appropriate locations. | ✓ | | |
| (d) Promote land use patterns that can be provided with infrastructure and public facilities in a cost-effective manner. | ✓ | | |
| (e) Support catchment systems and on-site wastewater treatment in rural areas and aggregated water and wastewater systems in urban areas if they are appropriately located. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Develop a streamlining system for urban infill projects. | | | ✓ |
| (b) Identify appropriate areas for urban expansion of existing towns where infrastructure and public facilities can be provided in a cost-effective manner. | | ✓ | |

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|---|---|---|---|
| ***Analysis:*** **The proposed project involves wastewater infrastructure improvements in Central Maui and is directly and indirectly applicable to the objective and related policies and implementing actions to direct growth in a way that makes efficient use of existing infrastructure and to areas where there is available infrastructure capacity. The primary disposal method for treated wastewater is the provision of R-1 recycled water for agricultural uses. The proposed SAT technology will be used as a backup system, which is an appropriate wastewater disposal technology in the appropriate location. The service areas of the proposed Central Maui WWRF is consistent with the Maui Island Plan, which identifies areas for future growth; the project will support urban expansion in appropriate areas planned for future growth in a cost-effective manner.** | | | |
| **Objective:** | | | |
| (5) Improve the planning and management of infrastructure systems. | ✓ | | |
| **Policies:** | | | |
| (a) Provide a reliable and sufficient level of funding to enhance and maintain infrastructure systems. | ✓ | | |
| (b) Require new developments to contribute their pro rata share of local and regional infrastructure costs. | | | ✓ |
| (c) Improve coordination among infrastructure providers and planning agencies to minimize construction impacts. | | | ✓ |
| (d) Maintain inventories of infrastructure capacity, and project future infrastructure needs. | | | ✓ |
| (e) Require social-justice and -equity issues to be considered during the infrastructure-planning process. | | | ✓ |
| (f) Discourage the development of critical infrastructure systems within hazard zones and the tsunami-inundation zone to the extent practical. | ✓ | | |
| (g) Ensure that infrastructure is built concurrent with or prior to development. | ✓ | | |
| (h) Ensure that basic infrastructure needs can be met during a disaster. | | | ✓ |
| (i) Locate public facilities and emergency services in appropriate locations that support the health, safety, and welfare of each community and that minimize delivery inefficiencies. | ✓ | | |
| (j) Promote the undergrounding of utility and other distribution lines for health safety, and aesthetic reasons. | ✓ | | |
| **Implementing Actions:** | | | |
| (a) Develop and regularly update functional plans for infrastructure systems. | | | ✓ |
| (b) Develop, adopt, and regularly update local or community-sensitive level-of service standards for infrastructure systems. | | | ✓ |
| ***Analysis:*** **The proposed project is directly applicable to the objective and relevant policies to improve planning and management of infrastructure systems. Upon assessing both the existing wastewater infrastructure's capacity and vicinity to natural hazards, and the projection of future wastewater infrastructure needs in Central Maui, the need for the proposed project is apparent. The proposed project is strategically located outside of the tsunami-inundation zones, flood hazard zones, and the projected** | | | |

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|---|---|---|---|
| **3.2-ft. SLR-XA and is considered an appropriate location to the service area. The proposed sewage transmission pipelines and R-1 recycled water pipeline will be installed underground.** | | | |
| **J. PROMOTE SUSTAINABLE LAND USE AND GROWTH MANAGEMENT** | | | |
| **Goal:** Community character, lifestyles, economies, and natural assets will be preserved by managing growth and using land in a sustainable manner. | ✓ | | |
| **Objective:** | | | |
| (1) Improve land use management and implement a directed-growth strategy. | ✓ | | |
| **Policies:** | | | |
| (a) Establish, map, and enforce urban- and rural-growth limits. | | ✓ | |
| (b) Direct urban and rural growth to designated areas. | | ✓ | |
| (c) Limit the number of visitor-accommodation units and facilities in Community Plan Areas. | | | ✓ |
| (d) Maintain a sustainable balance between the resident, part-time resident, and visitor populations. | | | ✓ |
| (e) Encourage redevelopment and infill in existing communities on lands intended for urban use to protect productive farm land and open-space resources. | | | ✓ |
| (f) Discourage new entitlements for residential, resort, or commercial development along the shoreline. | | | ✓ |
| (g) Restrict development in areas that are prone to natural hazards, disasters, or sea-level rise. | ✓ | | |
| (h) Direct new development in and around communities with existing infrastructure and service capacity, and protect natural, scenic, shoreline, and cultural resources. | ✓ | | |
| (i) Establish and maintain permanent open space between communities to protect each community's identity. | | | ✓ |
| (j) Support the dedication of land for public uses. | | | ✓ |
| (k) Preserve the public's rights of access to and continuous lateral access along all shorelines. | | | ✓ |
| (l) Enable existing and future communities to be self-sufficient through sustainable land use planning and management practices. | | | ✓ |
| (m) Protect summits, slopes, and ridgelines from inappropriate development. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Regularly update urban- and rural-growth boundaries and their maps. | | | ✓ |
| (b) Establish transfer and purchase of development rights programs. | | | ✓ |
| (c) Develop and adopt a green infrastructure plan. | | | ✓ |

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|---|---|---|---|
| (d) Develop studies to help determine a sustainable social, environmental, and economic carrying capacity for each island. | | | ✓ |
| (e) Identify and define resort-destination areas. | | | ✓ |
| ***Analysis:*** **The proposed project is directly applicable to the goal and relevant objective and policies managing growth. Increasing wastewater capacity in Central Maui will facilitate future development in designated growth areas, as identified in the Maui Island Plan. The existing Wailuku-Kahului WWRF is located in natural hazard areas. Expanding the existing facility would then encourage growth near the facility. However, the proposed project encourages development in areas that are not prone to natural hazards or sea-level rise.** | | | |
| **Objective:** | | | |
| (2) Improve planning for and management of agricultural lands and rural areas. | | ✓ | |
| **Policies:** | | | |
| (a) Protect prime, productive, and potentially productive agricultural lands to maintain the islands' agricultural and rural identities and economies. | | ✓ | |
| (b) Provide opportunities and incentives for self-sufficient and subsistence homesteads and farms. | | | ✓ |
| (c) Discourage developing or subdividing agriculturally designated lands when non- agricultural activities would be primary uses. | | | ✓ |
| (d) Conduct agricultural-development planning to facilitate robust and sustainable agricultural activities. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Inventory and protect prime, productive, and potentially productive agricultural lands from competing non-agricultural land uses. | | | ✓ |
| ***Analysis:*** **The proposed project involves wastewater infrastructure in Central Maui and will involve use of R-1 recycled water for agricultural and park lands, including the Waikapū agricultural preserve. An Agricultural Impact Assessment has been prepared for the project to identify and mitigate any potential impacts to agricultural lands. A large amount of unused agricultural land is available for diversified agriculture on Maui. A small portion of prime agricultural land must be used for the wastewater and R-1 water transmission lines. However, this will not negatively affect the adjacent prime agricultural land. Conversely, it will benefit the prime agricultural land by providing the R-1 water for agricultural use. Because of this, and because the majority of the project site is not identified as prime agricultural lands, the project will indirectly protect prime, productive, and potentially productive agricultural lands.** | | | |
| **Objective:** | | | |
| (3) Design all developments to be in harmony with the environment and to protect each community's sense of place. | | | ✓ |
| **Policies:** | | | |
| (a) Support and provide incentives for green building practices. | | | ✓ |
| (b) Encourage the incorporation of green building practices and technologies into all government facilities to the extent practicable. | | | ✓ |
| (c) Protect and enhance the unique architectural and landscape characteristics of each Community Plan Area, small town, and neighborhood. | | | ✓ |

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|---|---|---|---|
| (d) Ensure that adequate recreational areas, open spaces, and public-gathering places are provided and maintained in all urban centers and neighborhoods. | | | ✓ |
| (e) Ensure business districts are distinctive, attractive, and pedestrian-friendly destinations. | | | ✓ |
| (f) Use trees and other forms of landscaping along rights-of-way and within parking lots to provide shade, beauty, urban-heat reduction, and separation of pedestrians from automobile traffic in accordance with community desires. | | | ✓ |
| (g) Where appropriate, integrate public-transit, equestrian, pedestrian, and bicycle facilities, and public rights-of-way as design elements in new and existing communities. | | | ✓ |
| (h) Ensure better connectivity and linkages between land uses. | | | ✓ |
| (i) Adequately buffer and mitigate noise and air pollution in mixed-use areas to maintain residential quality of life. | | | ✓ |
| (j) Protect rural communities and traditional small towns by regulating the footprint, locations, site planning, and design of structures. | | | ✓ |
| (k) Support small-town revitalization and preservation. | | | ✓ |
| (l) Facilitate safe pedestrian access, and create linkages between destinations and within parking areas. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Establish design guidelines and standards to enhance urban and rural environments. | | | ✓ |
| (b) Provide funding for civic-center and civic-space developments. | | | ✓ |
| (c) Establish and enhance urban forests in neighborhoods and business districts. | | | ✓ |
| ***Analysis:*** **The proposed project is not directly or indirectly applicable to the objective of designing all developments to be in harmony with the environment.** | | | |
| **Objective:** | | | |
| (4) Improve and increase efficiency in land use planning and management. | ✓ | | |
| **Policies:** | | | |
| (a) Assess the cumulative impact of developments on natural ecosystems, natural resources, wildlife habitat, and surrounding uses. | ✓ | | |
| (b) Ensure that new development projects requiring discretionary permits demonstrate a community need, show consistency with the General Plan, and provide an analysis of impacts. | ✓ | | |
| (c) Encourage public and private partnerships to preserve lands of importance, develop housing, and meet the needs of residents. | | | ✓ |
| (d) Promote creative subdivision designs that implement best practices in land development, sustainable management of natural and physical resources, increased pedestrian and bicycle functionality and safety, and the principles of livable communities. | | | ✓ |

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|---|---|---|---|
| (e) Coordinate with Federal, State, and County officials in order to ensure that land use decisions are consistent with County plans and the vision local populations have for their communities. | ✓ | | |
| (f) Enable greater public participation in the review of subdivisions. | | | ✓ |
| (g) Improve land use decision making through the use of land- and geographic information systems. | ✓ | | |
| **Implementing Actions:** | | | |
| (a) Institute a time limit and sunsetting stipulations on development entitlements and their implementation. | | | ✓ |
| ***Analysis:*** **The proposed project is directly applicable to the objective and relevant policies to improve efficiency in land use planning and management. This EIS has been prepared for the proposed project to assess direct, indirect, and cumulative impacts and identify measures to avoid or mitigate adverse impacts. During the preparation for the EIS, various Federal, State, and County agencies have been consulted to ensure land use decisions related to this proposed project are consistent with County plans and the vision local populations have for their communities. The EIS identifies the community's need for the project, its consistency with various County plans (including the General Plan), and an analysis of project impacts. The proposed project is consistent with relevant goals, objectives, and policies of the Wailuku-Kahului Community Plan, Countywide Policy Plan, and Urban Growth Boundaries established by the Maui Island Plan, as set out in Chapter III of this EIS.** | | | |
| **K. STRIVE FOR GOOD GOVERNANCE** | | | |
| **Objective:** | | | |
| (1) Strengthen governmental planning, coordination, consensus building, and decision making. | | ✓ | |
| **Policies:** | | | |
| (a) Plan and prepare for the effects of social, demographic, economic, and environmental shifts. | | ✓ | |
| (b) Plan for and address the possible implications of Hawaiian sovereignty. | | | ✓ |
| (c) Encourage collaboration among government agencies to reduce duplication of efforts and promote information availability and exchange. | | | ✓ |
| (d) Expand opportunities for the County to be involved in and affect State and Federal decision making. | | | ✓ |
| (e) Plan and prepare for large-scale emergencies and contingencies. | | ✓ | |
| (f) Improve public awareness about preparing for natural hazards, disasters, and evacuation plans. | | | ✓ |
| (g) Improve coordination among Federal, State, and County agencies. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Develop policies, regulations, and programs to protect and enhance the unique character and needs of the County's various communities. | | | ✓ |

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|---|---|---|---|
| (b) Evaluate and if necessary, recommend modifications to the County Charter that could result in a possible change to the form of governance for Maui County. | | | ✓ |
| (c) Study and evaluate the feasibility and implications of voting in Maui County Council elections. | | | ✓ |
| (d) Study and evaluate the feasibility of authorizing town governments in Maui County. | | | ✓ |
| ***Analysis:*** **The proposed project is indirectly applicable to the objective and relevant policies of striving for good governance. The proposed project has been planned in preparation for environmental shifts and large-scale emergencies, such as sea level rise, flooding, and tsunami. In addition, as part of the EIS process, the County of Maui Department of Environmental Management has conducted a public scoping meeting and has consulted with various government agencies. Furthermore, the County of Maui has a public-private partnership with the Waikapū Country Town developer in which Waikapū Country Town will include 213 affordable housing units in exchange for connection to the County wastewater system.** | | | |
| **Objective:** | | | |
| (2) Promote civic engagement. | | ✓ | |
| **Policies:** | | | |
| (a) Foster consensus building through in-depth, innovative, and accessible public participatory processes. | | ✓ | |
| (b) Promote and ensure public participation and equal access to government among all citizens. | | | ✓ |
| (c) Encourage a broad cross-section of residents to volunteer on boards and commissions. | | | ✓ |
| (d) Encourage the State to improve its community-involvement processes. | | | ✓ |
| (e) Support community-based decision making. | | | ✓ |
| (f) Expand advisory functions at the community level. | | | ✓ |
| (g) Expand opportunities for all members of the public to participate in public meetings and forums. | | ✓ | |
| (h) Facilitate the community's ability to obtain relevant documentation. | | ✓ | |
| (i) Increase voter registration and turnout. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Implement two-way communication using audio-visual technology that allows residents to participate in the County's planning processes. | | | ✓ |
| (b) Ensure and expand the use of online notification of County business and public meetings, and ensure the posting of all County board and commission meeting minutes. | | | ✓ |
| (c) Explore funding mechanisms to improve participation by volunteers on boards and commissions. | | | ✓ |

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|---|---|---|---|
| (d) Develop a project-review process that mandates early and ongoing consultation in and with communities affected by planning and land use activities. | | | ✓ |
| ***Analysis:*** **The proposed project is indirectly applicable to the objective and relevant policies to promote civic engagement. The proposed project is undergoing an EIS process, pursuant to Hawai'i Revised Statutes, 343, and Hawai'i Administrative Rules, Title 11 Section 200.1 Environmental Impact Statement Rules. In addition, land use permit applications, including a District Boundary Amendment (DBA), Maui Island Plan Amendment, Change of Zoning (COZ), and a Community Plan Amendment (CPA), will be submitted to the Planning Department, which will require multiple public hearings, which are accessible public participatory meetings where all members of the public can participate and obtain documentation relevant to the proposed project.** | | | |
| **Objective:** | | | |
| (3) Improve the efficiency, reliability, and transparency of County government's internal processes and decision making. | | ✓ | |
| **Policies:** | | | |
| (a) Use advanced technology to improve efficiency. | | | ✓ |
| (b) Simplify and clarify the permitting process to provide uniformity, reliability, efficiency, and transparency. | | | ✓ |
| (c) Improve communication with Lana'i and Moloka'i through the expanded use of information technologies, expanded staffing, and the creation and expansion of government-service centers. | | | ✓ |
| (d) Ensure that laws, policies, and regulations are internally consistent and effectuate the intent of the General Plan. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Update the County Code to be consistent with the General Plan. | | | ✓ |
| (b) Identify and update County regulations and procedures to increase the productivity and efficiency of County government. | | | ✓ |
| (c) Develop local level-of-service standards for infrastructure, public facilities, and services. | | | ✓ |
| (d) Implement plans through programs, regulations, and capital improvements in a timely manner. | | ✓ | |
| (e) Expand government online services. | | | ✓ |
| ***Analysis:*** **The proposed project is indirectly applicable to the objective and relevant implementing action related to the implementation of capital improvements in a timely manner. The proposed project will provide increased wastewater treatment capacity in Central Maui in accordance with the projected urban growth in the Maui Island Plan. Implementation of the proposed project will ensure that wastewater infrastructure will be available in a timely manner to support future projected urban growth. The proposed project will undergo public review during the EIS process and the DBA, Maui Island Plan Amendment, COZ, and CPA application processes.** | | | |
| **Objective:** | | | |
| (4) Adequately fund in order to effectively administer, implement, and enforce the General Plan. | | ✓ | |

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|---|---|---|---|
| **Policies:** | | | |
| (a) Adequately fund, staff, and support the timely update and implementation of planning policy, programs, functional plans, and enforcement activities. | | | ✓ |
| (b) Ensure that the County's General Plan process provides for efficient planning at the County, island, town, and neighborhood level. | | | ✓ |
| (c) Encourage ongoing professional development, education, and training of County employees. | | | ✓ |
| (d) Encourage competitive compensation packages for County employees to attract and retain County personnel. | | | ✓ |
| (e) Enable the County government to be more responsive in implementing our General Plan and Community Plans. | | ✓ | |
| (f) Review discretionary permits for compliance with the Countywide Policy Plan. | | ✓ | |
| (g) Strengthen the enforcement of County, State, and Federal land use laws. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Establish penalties to ensure compliance with County, State, and Federal land use laws. | | | ✓ |
| ***Analysis:*** **The proposed project is indirectly applicable to objective and related policies related to the implementation of the General Plan and Community Plans and review of discretionary permits for compliance with the Countywide Policy Plan. The proposed project provides necessary capacity in the wastewater system for Central Maui to support projected growth and development as set out in the General Plan and Maui Island Plan. The proposed project is compatible with the General Plan, Wailuku-Kahului Community Plan, and Countywide Policy Plan as discussed, in Chapter III of the EIS.** | | | |
| **Objective:** | | | |
| (5) Strive for County government to be a role model for implementing cultural and environmental policies and practices. | ✓ | | |
| **Policies:** | | | |
| (a) Educate residents on the benefits of sustainable practices. | | | ✓ |
| (b) Encourage the retention and hiring of qualified professionals who can improve cultural and environmental practices. | ✓ | | |
| (c) Incorporate environmentally sound and culturally appropriate practices in government operations and services. | ✓ | | |
| (d) Encourage all vendors with County contracts to incorporate environmentally sound and culturally appropriate practices. | | | ✓ |
| ***Analysis:*** **The proposed project is directly applicable to the objective and relevant policies for the County government to be a role model for implementing cultural and environmental policies and practices. The County DEM has retained qualified professionals to assess the proposed project in preparation of the EIS, such as professional planners, engineers, biologist, archaeologists, and cultural specialists. An AIS and CIA have been carried out on the proposed action to ensure the proposed project will not adversely impact cultural and historic resources. In the EIS document,** | | | |

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|---|---|---|---|
| **appropriate construction and permanent Best Management Practices (BMPs), including archaeological and cultural procedures, have been established to encourage contractors to incorporate environmentally sound and culturally appropriate practices.** | | | |
| **L. MITIGATE CLIMATE CHANGE AND WORK TOWARD RESILIENCE** | | | |
| **Goal:** Minimize the causes and negative effects of climate change. | ✓ | | |
| **Objective:** | | | |
| (1) Lower carbon emissions levels to mitigate climate change impacts and limit the rate of global warming. | | ✓ | |
| **Policies:** | | | |
| (a) Increase reforestation efforts by encouraging residents and visitors to plant non-invasive gardens and trees. | | | ✓ |
| (b) Improve communication, coordination, and collaboration among those that work to mitigate climate change impacts. | | | ✓ |
| (c) Promote the teaching and use of regenerative agriculture. | | | ✓ |
| (d) Invest in infrastructure that is not dependent on fossil fuels and utilizes renewable energy. | | | ✓ |
| (e) Improve efforts to mitigate and plan for the impact of natural disasters and global warming. | | ✓ | |
| (f) Encourage the building industry to use environmentally sustainable materials, technology, and site planning. | | | ✓ |
| (g) Reduce air, noise, light, land, and water pollution, and reduce Maui County's contribution to global climate change. | | ✓ | |
| (h) Plan and prepare for and educate visitors and residents about the possible effects of global warming. | | | ✓ |
| (i) Promote programs and incentives that decrease greenhouse-gas emissions and improve environmental stewardship. | | | ✓ |
| (j) Support the development of carbon-emission standards and an incentive program aimed at achieving County carbon-emission goals. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Implement Federal and State policies that require a reduction of greenhouse-gas emissions. | | | ✓ |
| (b) Establish a Countywide Climate Action Plan | | | ✓ |
| (c) Develop programs that assist residents and businesses with obtaining access to renewable energy sources. | | | ✓ |
| (d) Revise laws to support neighborhood designs that incorporate the use of renewable energy sources that are appropriate for island living. | | | ✓ |
| (e) Incorporate planting of native and indigenous trees as a major component of Urban Design to both cool neighborhoods and reduce carbon dioxide. | | | ✓ |

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|---|---|---|---|
| (f) Coordinate with State, County, and private landowners in the development of forestry and prioritizing of native and indigenous trees to reduce carbon dioxide. | | | ✓ |
| (g) Strongly support efforts to restore and improve Maui County's watersheds for the purpose of improving the water supply, controlling carbon dioxide levels, decreasing soil runoff, and reducing coastal flooding. | | | ✓ |
| ***Analysis:*** **The proposed project is directly and indirectly applicable to the goal, objective, and relevant policies to mitigate climate change and work towards resiliency. The proposed project is strategically located outside the tsunami evacuation zone, flood zones, and anticipated 3.2-foot SLR-XA and will be resilient to the impact of natural disasters and global warming. The proposed SAT basins are an alternative to the existing injection wells used at other Maui Island WWRFs. They will reduce water pollution by providing a more sustainable disposal method for treated wastewater.** | | | |
| **Objective:** | | | |
| (2) Reduce the impacts of sea-level rise by acknowledging climate change, adapting, mitigating, and planning accordingly. | ✓ | | |
| **Policies:** | | | |
| (a) Evaluate development to assess potential short-term and long-term sea-level rise impacts on nearshore environments. | | ✓ | |
| (b) Improve efforts to mitigate and plan for the impact of sea-level rise. | | ✓ | |
| (c) Protect undeveloped beaches, dunes, and ecosystems, and restore natural shoreline processes. | | | ✓ |
| (d) Develop an inventory of private wastewater systems (septic systems, cesspools) that may be affected by sea-level rise. | | | ✓ |
| (e) Strengthen coastal-zone management, re-naturalization of shorelines, where possible, and filtration or treatment of urban and agricultural runoff. | | | ✓ |
| (f) Educate the construction and landscape industries and property owners about the use of best management practices to prevent erosion and nonpoint source pollution. | | ✓ | |
| (g) Discourage beach hardening processes such as building sea walls and revetments that block movement of the shoreline and can accelerate erosion. | | | ✓ |
| (h) Discourage new entitlements for residential, resort, or commercial development along the shoreline. | | | ✓ |
| (i) Restrict development in areas that are prone to sea-level rise. | | ✓ | |
| (j) Move or rebuild public facilities away from nearshore environments to account for sea-level rise to the extent reasonable. | ✓ | | |
| (k) Move or rebuild roads that are in sea-level rise inundation zones to the extent reasonable. | | | ✓ |
| (l) Ensure that public or affordable housing projects include siting and design standards that promote equity and resilience for vulnerable populations. | | | ✓ |

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|---|---|---|---|
| (m) Identify, research, and evaluate innovative and sustainable financing to support mitigation and adaptation to sea level rise. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Develop programs to help transition shoreline property owners out of their nearshore locations and develop a long-term plan to stay out of the way of natural beach migration. | | | ✓ |
| (b) Identify buildings, roads, and other infrastructure that are in sea-level rise inundation zones and assist in adaptive efforts, including nature-based solutions, elevation, or moving them away from such zones. | | | ✓ |
| (c) Identify disaster redevelopment alternatives that support resilience-focused adaptation to sea level rise in the event of a catastrophic coastal event. | | | ✓ |
| ***Analysis:*** **One significant reason for building a new WWRF instead of expanding the existing Wailuku-Kahului WWRF is to locate the necessary infrastructure at an inland site that is resilient to sea level rise. The existing Wailuku-Kahului WWRF is located close to the shoreline, within the 3.2-foot SLR-XA, in the tsunami zone, and a flood hazard area. Additionally, the proposed project will alleviate pressure on the existing facility. A BMP Plan will be prepared to inform the construction and landscape contractors of erosion potential, stormwater runoff impacts, and nonpoint sources of pollution, and will include measures to avoid or mitigate adverse impacts.** | | | |
| **Objective:** | | | |
| (3) Significantly increase the use of renewable and green technologies to promote energy efficiency and energy self-sufficiency. | ✓ | | |
| **Policies:** | | | |
| (a) Promote the use of locally renewable energy sources, and reward energy efficiency. | | | ✓ |
| (b) Consider tax incentives and credits for the development of sustainable- and renewable-energy sources. | | | ✓ |
| (c) Expand education about energy conservation and self-sufficiency. | | | ✓ |
| (d) Encourage small-scale energy generation that utilizes wind, sun, water, biowaste, and other renewable sources of energy. | | | ✓ |
| (e) Expand renewable-energy production. | | | ✓ |
| (f) Develop public-private partnerships to ensure the use of renewable energy and increase energy efficiency. | | | ✓ |
| (g) Require the incorporation of locally appropriate energy-saving and green building design concepts in all new developments by providing energy-efficient urban design guidelines and amendments to the Building Code. | | | ✓ |
| (h) Encourage the use of sustainable energy to power vehicles. | | | ✓ |
| (i) Promote the retrofitting of existing buildings and new development to incorporate energy-saving design concepts and devices. | | | ✓ |
| (j) Encourage green footprint practices. | | | ✓ |

| COUNTYWIDE POLICY PLAN<br>(Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable) | DA | IA | NA |
|---|---|---|---|
| (k) Reduce Maui County's dependence on fossil fuels and energy imports. | | | ✓ |
| (l) Support green building practices such as the construction of buildings that aim to minimize carbon dioxide production, produce renewable energy, and recycle water. | ✓ | | |
| (m) Promote and support environmentally friendly practices in all energy sectors. | | | ✓ |
| **Implementing Actions:** | | | |
| (a) Adopt an energy-efficiency policy for Maui County government as a model for other jurisdictions. | | | ✓ |
| (b) Adopt a Green Building Code and support green building practices. | | | ✓ |
| ***Analysis:*** **The proposed Central Maui WWRF will generate R-1 recycled water available for non-potable purposes, including agricultural and landscaping irrigation. In this regard, the proposed WWRF directly supports green building practices.** | | | |

# ANALYSIS OF PROJECT APPLICABILITY TO MAUI ISLAND PLAN

APPENDIX

# S-3

# APPENDIX S-3

## Analysis of Project Applicability to Maui Island Plan

The Maui Island Plan (MIP) is applicable to the island of Maui only, providing more specific policy-based strategies for population, land use, transportation, public and community facilities, water and wastewater systems, visitor destinations, urban design, and other matters related to future growth.

As provided by Chapter 2.80B, the MIP shall include the following components:

1. *An island-wide land use strategy, including a managed and directed growth plan*

2. *A water element assessing supply, demand and quality parameters*

3. *A nearshore ecosystem element assessing nearshore waters and requirements for preservation and restoration*

4. *An implementation program which addresses the County's 20-year capital improvement requirements, financial program for implementation, and action implementation schedule*

5. *Milestone indicators designed to measure implementation progress of the MIP*

It is noted that Ordinance No. 4004 does not address the component relating to the implementation program. Chapter 2.80B of the Maui County Code, relating to the General Plan, was amended via Ordinance No. 3979, October 5, 2012, to provide that the implementation program component be adopted no later than one (1) year following the effective date of Ordinance No. 4004. In December 2013 and March 2014, the Maui County Council approved time extensions for approval and adoption of the implementation chapter of the MIP. The implementation program component of the MIP was adopted as Ordinance No. 4126 on May 29, 2014.

The MIP addresses a number of planning categories with detailed policy analysis and recommendations which are framed in terms of goals, objectives, policies, and implementing actions. These planning categories address the following areas:

1. *Population*
2. *Heritage Resources*
3. *Natural Hazards*
4. *Economic Development*
5. *Housing*
6. *Infrastructure and Public Facilities*
7. *Land Use*

The proposed project has been reviewed with respect to pertinent goals, objectives, policies, and implementing actions of the MIP. The analysis is presented in the table below.

The methodology used for assessing a project's relationship to the MIP involves examining the project's applicability to the Plan's goals, objectives, and policies. "Applicability" refers to a project's need, purpose and effects, and how these advance or promote a particular set of goals, objectives and priority guidelines. In assessing the relationship between a proposed action and the MIP, an action may be categorized in one of the following groups:

1. **Directly applicable:** the action and its potential effects directly advances or promotes the objective, policy, or priority guideline.

   **Example:** Using a county project to develop a new water source and related transmission facilities as an example, a project of this nature would be directly applicable to the MIP's Objective 6.3.2, which states: *"Increase the efficiency and capacity of the water systems in striving to meet the needs and balance the island's water needs".* As well, this action would directly advance the MIP's Policy 6.3.2.f, which states: *Acquire and develop additional sources of potable water.* The need, purpose and effects of the proposed new water source project is directly applicable to the foregoing objective and policy.

2. **Indirectly applicable:** the action's potential effects indirectly support or advance the objective, policy, or priority guideline.

   **Example:** The county water source project cited above supports the Objective 7.3.2 which states: *"Facilitate more self-sufficient and sustainable communities".* Additionally, this kind of action is indirectly applicable to the related MIP Policy 7.3.2.f, which states: *"Facilitate the development of housing by focusing projects in locations where land and infrastructure costs facilitate the development of affordably-priced housing".* In this case, the principle purpose of the project was not to specifically facilitate the development of affordably-priced housing. However, the project's contribution to adequate infrastructure systems is supportive of the policy. In this instance, the proposed action may be deemed to be indirectly applicable to the objective and policy of the MIP.

3. **Not applicable:** The action and its potential effects have no direct or indirect relationship to the objectives and policies of the Maui Island Plan.

   **Example:** That same county water source improvement project referenced above, may not have direct or indirect linkage to the MIP's Objective 4.2.1, which states: *"Increase the economic contribution of the visitor industry to the island's environmental well-being for the island's residents' quality of life"*. In this case, there is no reasonably deduced direct or indirect relationship between the proposed action and Objective 4.2.1. Hence, the proposed action would be considered not applicable to the objective.

In general, a proposed action's applicability to the MIP is assessed on the basis of the action's direct or indirect relationship to the respective objectives, policies, and implementing actions. It is recognized that the categorization of "applicability" is subject to interpretation and should be appropriately considered in the context of local and regional conditions.

| Maui Island Plan Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
|---|---|---|---|
| **CHAPTER 1 – POPULATION** | | | |
| **Goal:** | | | |
| 1.1 Maui's people, values, and lifestyles thrive through strong, healthy, and vibrant island communities. | | ✓ | |
| **Objective:** | | | |
| 1.1.1 Greater retention and return of island residents by providing viable work, education, and lifestyle options. | | ✓ | |
| **Policies:** | | | |
| 1.1.1.a Expand programs that enable the community to meet the education, employment, housing, and social goals of youth and young adults. | | ✓ | |
| 1.1.1.b Expand housing, transportation, employment, and social opportunities to ensure residents are able to comfortably age within their communities. | | ✓ | |
| 1.1.1.c Measure and track resident satisfaction through surveys and community indicators. | | | ✓ |
| 1.1.1.d Support funding for transportation, housing, health care, recreation, and social service programs that help those with special needs (including the elderly and disabled). | | | ✓ |
| ***Analysis:*** **The proposed project involves development of a new wastewater reclamation facility (WWRF) and related improvements and is indirectly applicable to the goal and relevant objective and policies of healthy and vibrant island communities. The proposed project will increase the wastewater treatment capacity in Central Maui that will support the future development of housing and other business related land uses that will help the community meet its future housing and employment needs.** | | | |
| **CHAPTER 2 – HERITAGE RESOURCES** | | | |
| **CULTURAL, HISTORICAL, AND ARCHAEOLOGICAL RESOURCES ISSUES** | | | |
| **Goal:** | | | |
| 2.1 Our community respects and protects archaeological and cultural resources while perpetuating diverse cultural identities and traditions. | | ✓ | |
| **Objective:** | | | |
| 2.1.1 An island culture and lifestyle that is healthy and vibrant as measured by the ability of residents to live on Maui, access and enjoy the natural environment, and practice Hawaiian customs and traditions in accordance with Article XII, Section 7, Hawai'i State Constitution, and Section 7-1, Hawai`i Revised Statutes (HRS). | | ✓ | |
| **Policies:** | | | |
| 2.1.1.a Perpetuate the spirit of aloha and celebrate the host Hawaiian culture and other ethnic cultures. | | ✓ | |
| 2.1.1.b Perpetuate a respect for diversity and recognize the broad blending of cultures and ethnicities as vital to the quality of life on Maui. | | ✓ | |

| Maui Island Plan Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
|---|---|---|---|
| 2.1.1.c Ensure traditional public access routes, including native Hawaiian trails, are maintained for public use. | | | ✓ |
| 2.1.1.d Support the education of visitors and new residents about the customs and etiquette of the Hawaiian culture, as well as other cultures. | | | ✓ |
| **Objective:** | | | |
| 2.2 A more effective and efficient planning and review process that incorporates the best available cultural resources inventory, protection techniques, and preservation strategies. | ✓ | | |
| **Policies:** | | | |
| 2.1.2.a Ensure that the island has a comprehensive and up-to-date inventory of historic and archaeological resources, and their cultural significance. | ✓ | | |
| 2.1.2.b Require the update of existing planning and regulatory mechanisms to protect the natural, cultural, scenic, and historic resources within designated Heritage Areas (see Cultural Resources Overlay/Scenic Corridor Protection Technical Reference Map). | | | ✓ |
| 2.1.2.c Ensure that cultural, historic, and archaeological resources are protected for the benefit of present and future generations. | ✓ | | |
| **Objective:** | | | |
| 2.3 Enhance the island's historic, archaeological, and cultural resources. | ✓ | | |
| **Policies:** | | | |
| 2.1.3.a Identify and pursue a listing of the properties and sites on the State and National Register of Historic Places. | | | ✓ |
| 2.1.3.b Support the use of easements, dedications, and other mechanisms to acquire, maintain, and protect lands with cultural, archaeological, and historic significance. | | | ✓ |
| 2.1.3.c Support regulations to require developers, when appropriate, to prepare an Archaeological Inventory Survey, Cultural Impact Assessment, and Ethnographic Inventories that are reviewed and commented upon by the Office of Hawaiian Affairs, Native Hawaiian advisory bodies, the State Historic Preservation Division (SHPD), and the Office of Environmental Quality Control, and systematically comply with the steps listed in SHPD's administrative rules, including consultation and monitoring during construction phases of projects. | ✓ | | |
| 2.1.3.d Promote the rehabilitation and adaptive reuse of historic sites, buildings, and structures. | | | ✓ |
| 2.1.3.e Encourage property owners to register historic and archaeological sites on the State and National Register. | | | ✓ |
| 2.1.3.f Support opportunities for public involvement with the intent to facilitate the protection and restoration of historic and archeological sites, including consultation with stakeholders. | ✓ | | |
| 2.1.3.g Encourage the resolution of land title questions relating to Land Commission Awards and Royal patents. | | | ✓ |
| 2.1.3.h Ensure compliance with historic preservation laws, and discourage demolition of properties that are determined to be eligible for listing on the National or State Register of Historic Places. | ✓ | | |

| Maui Island Plan Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
|---|---|---|---|
| ***Analysis:*** **The proposed project involves development of a new WWRF and related improvements in Central Maui and is directly and indirectly applicable to the relevant objectives policies related to more effective and efficient planning and review process that incorporates the best available cultural resources inventory, protection techniques, and preservation strategies. This Environmental Impact Statement (EIS) is being carried out to assess the potential impacts of the proposed project. Technical studies conducted for the EIS included an AIS and a CIA in efforts to identify and protect important historic and cultural resources. Impact assessment of the project involved coordination with the State Historic Preservation Division (SHPD), as well as interviews with cultural informants knowledgeable about the Central Maui region. The Department of Environmental Management (DEM) also held a public scoping meeting to provide opportunities for public involvement during the EIS Preparation Notice public review period.** | | | |
| **SHORELINE, REEFS, AND NEARSHORE WATERS** | | | |
| **Goal:** | | | |
| 2.2 An intact, ecologically functional system of reef, shoreline, and nearshore waters that are protected in perpetuity. | ✓ | | |
| **Objective:** | | | |
| 2.2.1 A more comprehensive and community-based ICZM program. | | | ✓ |
| **Policies:** | | | |
| 2.2.1.a Encourage a management system that protects and temporarily rests the reef ecosystems from overuse. | | | ✓ |
| 2.2.1.b Support the establishment of additional MMAs and reef replenishment areas. | | | ✓ |
| 2.2.1.c Work with appropriate agencies and community members to protect any special managed conservation areas from overuse and ensure that surrounding land uses do not contribute to the degradation of the natural resources, such as ʻAhihi-Kinaʻu Natural Area Reserve, Honolua-Mokulēʻia Bay Marine Life Conservation District, and Mākena State Park. | | | ✓ |
| 2.2.1.d Incorporate the following into the MIP, where consistent with the MIP: | | | ✓ |
| (1) Beach Management Plan for Maui; | | | ✓ |
| (2) Coastal Nonpoint Pollution Control Program Management Plan; | | | ✓ |
| (3) Implementation Plan for Polluted Runoff Control; and | | | ✓ |
| (4) Ocean Resource Management Plan. | | | ✓ |
| 2.2.1.e Support greater coordination among governmental agencies involved with the protection of the island's marine resources. | | | ✓ |
| **Objective:** | | | |
| 2.2.2 Improved reef health, coastal water quality, and marine life. | | ✓ | |
| **Policies:** | | | |
| 2.2.2.a Create additional mechanisms where needed to contain and control runoff and pollution. | | ✓ | |

| Maui Island Plan Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
|---|---|---|---|
| 2.2.2.b Allow extraction of high quality, Class A, low silt sands only when they will be used to protect or restore Maui's shorelines and beaches. | | | ✓ |
| 2.2.2.c Carefully manage beach nourishment activities to protect the coastal and marine ecosystem. | | | ✓ |
| 2.2.2.d Require, where appropriate, a buffer between landscaped areas and the shoreline, gulches, and streams to reduce the runoff of fertilizers, pesticides, herbicides, and other pollutants into coastal waters. | | | ✓ |
| 2.2.2.e Strictly regulate shoreline armoring in accordance with adopted Shoreline Rules, with an intent to protect the coastal and marine ecosystem. | | | ✓ |
| 2.2.2.f Support greater protection of Keālia Pond National Wildlife Refuge through the following: | | | ✓ |
| (1) Enhancement of marine ecosystems; | | | ✓ |
| (2) Beach and sand dune restoration; and | | | ✓ |
| (3) Expansion of habitat for Maui's threatened or endangered sea turtles, birds, and other species. | | | ✓ |
| 2.2.2.g Support the development of regulations to prevent the excessive depletion of fish stocks due to non-sustainable practices and gear such as SCUBA spear-fishing and lay nets, within the context of nearshore ecosystems. | | | ✓ |
| 2.2.2.h Encourage the State to conduct a regular census of fish populations and monitor coral health. | | | ✓ |
| 2.2.2.i Encourage the State to significantly increase the number of park rangers, enforcement officers, and marine biologists to protect coastal resources. | | | ✓ |
| 2.2.2.j Encourage the State to prohibit the collection and exportation of fish, coral, algae, and other marine species for the ornamental and aquarium trade. | | | ✓ |
| **Objective:** | | | |
| 2.2.3 Water quality that meets or exceeds State Clean Water Act standards. | ✓ | | |
| **Policies:** | | | |
| 2.2.3.a Reduce the amount of impervious surface and devise site plan standards that aim to minimize storm runoff and NPS pollution. | | ✓ | |
| 2.2.3.b Support the revision of existing regulations to require an Erosion and Sedimentation Control Plan (ESCP) for development activities that may pose a threat to water quality. | | | ✓ |
| 2.2.3.c Require an on-site monitoring program, where applicable, when grading may pose a threat to water quality or when recommended in the ESCP. | | | ✓ |
| 2.2.3.d Avoid development actions that impair Maui's reef systems and remove identified stressors. | | | ✓ |
| 2.2.3.e Phase out cesspools and restrict the use of septic systems in ecologically sensitive coastal areas by converting to environmentally-friendly alternative sewage treatment systems, and connecting to central sewerage systems when and where feasible. | | ✓ | |

| Maui Island Plan Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
|---|---|---|---|
| 2.2.3.f Prohibit the development of new wastewater injection wells, except when unavoidable for public health and safety purposes. | ✓ | | |
| 2.2.3.g Ensure that the County upholds its affirmative duty under the Clean Water Act by monitoring and reducing point and NPS pollution to help safeguard coastal waters. | | ✓ | |
| **Objective:** | | | |
| 2.2.4 Acquire additional shoreline lands and shoreline access rights. | | | ✓ |
| **Policies:** | | | |
| 2.2.4.a Promote the use of conservation easements, land trusts, transfer and purchase of development rights, and mitigation banking. | | | ✓ |
| 2.2.4.b Require the dedication of public beach and rocky shoreline access ways to and along the shoreline where it serves a practical public interest as a condition of development or subdivision approval; future subdivisions and developments shall be consistent with and effectuate, to the extent practicable, the *Shoreline Access Inventory Update - Final Report* (March 2005), and its updates. | | | ✓ |
| 2.2.4.c Incorporate the *Shoreline Access Inventory Update - Final Report* (March 2005), and its regular updates, into this plan. | | | ✓ |
| 2.2.4.d Identify access points while further acquiring key shoreline parcels and easement rights to enhance and protect beach access and shoreline recreation. | | | ✓ |
| ***Analysis:*** **The proposed project involves development of a new WWRF and related improvements in Central Maui and is both directly and indirectly applicable to the goal and relevant objectives and policies to protect reefs, shorelines, and nearshore water quality. At the new Central Maui WWRF, wastewater will be treated to the R-1 recycled water standard and will be used for irrigation purposes. As a back-up system, the Soil Aquifer Treatment (SAT) system will be employed for disposal of treated wastewater effluent which is more sustainable and environmentally friendly than the use of injection wells. Implementation of the proposed project will involve Best Management Practices (BMPs) during construction such as temporary drainage swales and detention basins which will prevent increased stormwater runoff from impacting adjacent and downstream properties. In the long term, permanent drainage improvements will be implemented to prevent increasing stormwater runoff from entering adjacent and downstream properties. In addition, drainage system improvements will include catch basins with filtration to filter harmful chemicals and sediment in the stormwater runoff, which will help restore water quality in the nearshore marine environment.** | | | |
| **WATERSHEDS, STREAMS, AND WETLANDS ISSUES** | | | |
| **Goal:** | | | |
| 2.3 Healthy watersheds, streams, and riparian environments. | | ✓ | |
| **Objective:** | | | |
| 2.3.1 Greater protection and enhancement of watersheds, streams, and riparian environments. | | ✓ | |
| **Policies:** | | | |
| 2.3.1.a All present and future watershed management plans shall incorporate concepts of ahupuaʻa management based on the interconnectedness of upland and coastal ecosystems/species. | | | ✓ |
| 2.3.1.b Continue to support and be an active member of watershed partnerships. | | | ✓ |

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|---|---|---|---|
| 2.3.1.c Support the establishment of regional water trusts, composed of public and private members, to manage water resources. | | | ✓ |
| 2.3.1.d Support regulations to require developments to utilize ahupua‘a management practices. | | | ✓ |
| 2.3.1.e Work with private and non-profit entities to educate the public about the connection between upland activities within the watershed and the impacts on nearshore ecosystems and coral reefs. | | | ✓ |
| 2.3.1.f Provide adequate funding and staff to develop and implement watershed protection plans and policies, including acquisition and management of watershed resources and land. | | | ✓ |
| 2.3.1.g Encourage the State to mandate instream assessment to provide adequate water for native species. | | | ✓ |
| 2.3.1.h Maui will protect all watersheds and streams in a manner that guarantees a healthy, sustainable riparian environment. | | ✓ | |
| **Objective:** | | | |
| 2.3.2 Decreased NPS and point source pollution. | | ✓ | |
| **Policies:** | | | |
| 2.3.2.a Enforce water pollution related standards and codes. | | ✓ | |
| 2.3.2.b Support the use of LID Techniques such as those described in the State of Hawai‘i LID Practitioner’s Guide (June 2006), as amended. | | | ✓ |
| 2.3.2.c Encourage farmers and ranchers to use agricultural BMPs to address NPS pollution. | | | ✓ |
| **Objective:** | | | |
| 2.3.3 Preserve existing wetlands and improve and restore degraded wetlands. | | ✓ | |
| **Policies:** | | | |
| 2.3.3.a Prohibit the destruction and degradation of existing upland, mid-elevation, and coastal wetlands. | | ✓ | |
| 2.3.3.b Support and fund wetland protection and improvement, and restoration of degraded wetlands. | | | ✓ |
| 2.3.3.c Where applicable, require developers to provide a wetland protection buffer and/or other protective measures around and between development and wetland resources. | | | ✓ |
| **Objective:** | | | |
| 2.3.4 Greater preservation of native flora and fauna biodiversity to protect native species. | | | ✓ |
| **Policies:** | | | |
| 2.3.4.a Work with appropriate agencies to eliminate feral ungulate populations and invasive species. | | | ✓ |

| Maui Island Plan Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
|---|---|---|---|
| 2.3.4.b Encourage the State to provide adequate funding to preserve biodiversity, protect native species, and contain or eliminate invasive species. | | | ✓ |
| 2.3.4.c Support the work of conservation groups and organizations that protect, reestablish, manage, and nurture sensitive ecological areas and threatened indigenous ecosystems. | | | ✓ |
| **Objective:** | | | |
| 2.3.5 Limited development in critical watershed areas. | | | ✓ |
| **Policies:** | | | |
| 2.3.5.a Discourage development and subdivision of land within critical watersheds and in areas susceptible to high erosion and sediment loss. | | | ✓ |
| 2.3.5.b Designate critical watershed areas as conservation lands. | | | ✓ |
| 2.3.5.c Strongly encourage new subdivisions and developments that are proximate to environmentally sensitive watershed resources to prepare and implement CSD plans. | | | ✓ |
| **Objective:** | | | |
| 2.3.6 Enhance the vitality and functioning of streams, while balancing the multiple needs of the community. | | | ✓ |
| **Policies** | | | |
| 2.3.6.a Protect and enhance natural streambeds and discourage stream alteration. | | | ✓ |
| 2.3.6.b Work with appropriate agencies to establish minimum stream flow levels and ensure adequate stream flow to sustain riparian ecosystems, traditional kalo cultivation, and self-sustaining ahupua‘a. | | | ✓ |
| 2.3.6.c Respect and participate in the resolution of native Hawaiian residual land and water rights issues (kuleana lands, ceded lands, and historic agricultural and gathering rights). | | | ✓ |
| 2.3.6.d Ensure that stream flows implement laws and policies found in the State Constitution and Water Code. | | | ✓ |
| 2.3.6.e Work with appropriate agencies and stakeholders to establish minimum stream flow levels, promote actions to support riparian habitat and the use of available lo‘i, and maintain adequate flows for the production of healthy kalo crops. | | | ✓ |
| ***Analysis:*** **The proposed project involves development of a new WWRF and related improvements in Central Maui and is indirectly applicable to the goal, objectives, and relevant policies related to healthy watersheds, streams, and riparian environments. An EIS has been prepared for the proposed project to ensure adverse impacts to these resources are avoided or mitigated. A Hydrogeological Study was prepared and concluded that the proposed SAT system is not anticipated to adversary impact groundwater resources, nearby streams and wetlands, as well as nearshore waters.** | | | |
| **WILDLIFE AND NATURAL AREAS** | | | |
| **Goal:** | | | |

| Maui Island Plan Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
|---|---|---|---|
| 2.4 Maui's natural areas and indigenous flora and fauna will be protected. | ✓ | | |
| **Objective:** | | | |
| 2.4.1 A comprehensive management strategy that includes further identification, protection, and restoration of indigenous wildlife habitats. | | | ✓ |
| **Policies:** | | | |
| 2.4.1.a Identify and inventory the following: | | | |
| (1) Natural, recreational, and open space resources; | | | ✓ |
| (2) Flora and fauna with medium, high, and very high concentrations of threatened or endangered species; and | | ✓ | |
| (3) Location and extent of invasive species. | | ✓ | |
| 2.4.1.b Require flora and fauna assessment and protection plans for development in areas with concentrations of indigenous flora and fauna; development shall comply with the assessment and protection plan and shall use the avoidance, minimization, and mitigation approach respectively, with an emphasis on avoidance. | ✓ | | |
| 2.4.1.c Support the implementation of Hawai`i's Comprehensive Wildlife Conservation Strategy (October 2005). | | | ✓ |
| **Objective:** | | | |
| 2.4.2 A decrease in invasive species through programs and partnerships that eradicate undesirable species and protect native habitat. | | | ✓ |
| **Policies:** | | | |
| 2.4.2.a Prevent the introduction of invasive species at all of Maui's airports and harbors. | | | ✓ |
| 2.4.2.b Encourage the State to increase funding in support of invasive species interception, control, and eradication. | | | ✓ |
| 2.4.2.c Encourage the State to develop programs that allow students to participate in invasive species eradication projects. | | | ✓ |
| **Objective:** | | | |
| 2.4.3 Greater protection of sensitive lands, indigenous habitat, and native flora and fauna. | | ✓ | |
| **Policies:** | | | |
| 2.4.3.a Secure an interconnected network of sensitive lands, greenways, watercourses, and habitats. | | | ✓ |
| 2.4.3.b Protect Maui's sensitive lands (see Sensitive Lands on Protected Areas Diagrams). | | | ✓ |
| 2.4.3.c Promote innovative environmental-planning methods and site-planning standards that preserve and re-establish indigenous flora and fauna habitat, to preserve and restore connected habitat corridors and open space. | | | ✓ |

| Maui Island Plan Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
|---|---|---|---|
| 2.4.3.d Utilize protection tools such as conservation easements, land trusts, land banks, Purchase of Developments Rights (PDRs), Transfer of Development Rights (TDRs), and other stewardship tools to acquire natural areas | | | ✓ |
| 2.4.3.e Encourage discussions with communities to designate heritage areas that protect recreational and cultural lifestyles and resources. | | | ✓ |
| 2.4.3.f Support the expansion of Haleakalā National Park, and the creation of new national parks, where appropriate and supported by local communities. | | | ✓ |
| 2.4.3.g Encourage reforestation efforts that increase native species' habitat. | | | ✓ |
| 2.4.3.h Utilize the Natural Area Partnership Program (NAPP) and other programs to protect natural lands. | | | ✓ |
| 2.4.3.i Support increased dedicated funding for the acquisition, protection, restoration, or preservation of important natural areas or open space through the following: grants from the Land and Water Conservation Fund; dedicated funding from real property taxes or other appropriate revenues; bond issues; real estate transfer tax; revenues from the Transient Accommodations Tax; development mitigation fees; and other appropriate funding sources. | | | ✓ |
| ***Analysis:*** **The proposed project involves development of a new WWRF and related improvements in Central Maui and is directly and indirectly applicable to the goal and relevant objectives and policies related to protecting Maui's natural areas and indigenous flora and fauna. The EIS includes a Biological Resources Survey to document rare, endangered, indigenous flora and fauna and their habitats. Mitigation and avoidance measures will also be implemented for the protection of rare, endangered, or threatened species. The proposed Central Maui WWRF will be located on lands currently designated as "Park" on the Maui Island Plan Planned Protected Areas Diagram but avoids the use of Sensitive Lands.** | | | |
| **SCENIC RESOURCES** | | | |
| **Goal:** | | | |
| 2.5 Maui will continue to be a beautiful island steeped in coastal, mountain, open space, and historically significant views that are preserved to enrich the residents' quality of life, attract visitors, provide a connection to the past, and promote a sense of place. | | ✓ | |
| **Objective:** | | | |
| 2.5.1 A greater level of protection for scenic resources. | | ✓ | |
| **Policies:** | | | |
| 2.5.1.a Protect views to include, but not be limited to, Haleakalā, ʻĪao Valley, the Mauna Kahalawai (West Maui Mountains), Puʻu Ōʻlaʻi, Kahoʻolawe, Molokini, Molokaʻi, and Lānaʻi, Mauna Kea, Mauna Loa, sea stacks, the Pacific Ocean, and significant water features, ridgelines, and landforms. | | ✓ | |
| 2.5.1.b Identify, preserve, and provide ongoing management of important scenic vistas and open space resources, including mauka-to-makai and makai-to-mauka view planes. | | | ✓ |
| 2.5.1.c Protect "night sky" resources by encouraging the implementation of ambient light ordinances and encouraging conversion of all sources that create excessive light pollution, affecting our ability to view the stars. | | ✓ | |

| Maui Island Plan Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
|---|---|---|---|
| 2.5.1.d Protect ridgelines from development where practicable to facilitate the protection of public views. | | ✓ | |
| 2.5.1.e Protect scenic resources along Maui's scenic roadway corridors. | | ✓ | |
| **Objective:** | | | |
| 2.5.2. Reduce impacts of development projects and public-utility improvements on scenic resources. | | ✓ | |
| **Policies:** | | | |
| 2.5.2.a Enforce the policies and guidelines of the SMA regarding the protection of views. | | | ✓ |
| 2.5.2.b Require any new subdivision of land, development, or redevelopment adjacent to a "high" or "exceptional" scenic corridor to submit an impact assessment of the project's scenic impacts; this assessment shall use the avoidance, minimization, and mitigation steps respectively, with an emphasis on avoidance. | | | ✓ |
| 2.5.2.c Require appropriate building setbacks and limits on wall heights to protect views along scenic corridors. | | | ✓ |
| 2.5.2.d Encourage the State of Hawai`i Board of Land and Natural Resources to deny any development within the State Conservation District that interferes with a scenic landscape or disrupts important open space resources. | | | ✓ |
| 2.5.2.e Require Urban Design and Review Board (UDRB) review and approval of utility poles, facilities, and other visible infrastructure improvements along scenic corridors. | | | ✓ |
| 2.5.2.f Ensure little or no effect on scenic resources from utility improvements, primarily power poles. | | | ✓ |
| 2.5.2.g Protect scenic vistas from intrusion by power poles. | | | ✓ |
| **Objective:** | | | |
| 2.5.3 Greater protection of and access to scenic vistas, access points, and scenic lookout points. | | | ✓ |
| **Policy:** | | | |
| 2.5.3.a Protect, enhance, and acquire access to Maui's scenic vistas and resources. | | | ✓ |
| ***Analysis:*** **The proposed project involves development of a new WWRF and related improvements in Central Maui and is indirectly applicable to the goal, objectives, and relevant policies related to protecting scenic resources. A Visual Impact Analysis has been prepared to identify potential impacts of the project to scenic views. The proposed action will be set back from public roadways and will be low profile to mitigate impacts to visual resources. The proposed project does not involve development of ridgelines. All project lighting will be downcast and in compliance with regulations protecting Maui's night sky scenic resources. A View Analysis prepared for the WWRF and WWPS concluded that the project would have overall minimal to moderate visual impacts to the surrounding area.** | | | |
| **CHAPTER 3 – NATURAL HAZARDS** | | | |

| Maui Island Plan Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
|---|---|---|---|
| **Goal:** | | | |
| 3.1 Maui will be disaster resilient. | ✓ | | |
| **Objective:** | | | |
| 3.1.1 Increased inter-agency coordination. | | | ✓ |
| **Policy:** | | | |
| 3.1.1.a Reinforce the island's preparedness capacity by: | | | ✓ |
| (1) Applying the latest data-gathering techniques/technology; | | | ✓ |
| (2) Pursuing funding opportunities; | | | ✓ |
| (3) Improving monitoring and advance warning systems; | | | ✓ |
| (4) Fostering public awareness; and | | | ✓ |
| (5) Working with external agencies to coordinate disaster mitigation and response. | | | ✓ |
| **Objective:** | | | |
| 3.1.2 Greater protection of life and property. | ✓ | | |
| **Policies:** | | | |
| 3.1.2.a Identify critical infrastructure, lifelines, roads, and populations that are vulnerable to coastal hazards, and encourage strategic retreat and relocation to safer areas. | ✓ | | |
| 3.1.2.b Consider the location of dams, reservoirs, holding ponds, and other water-containing entities that are upstream of inhabited areas to anticipate, avoid, and mitigate inundation risks, and discourage new development in areas where possible inundation hazards may exist. | ✓ | | |
| 3.1.2.c Strengthen current development standards to minimize destruction of land and property. | | | ✓ |
| 3.1.2.d Encourage the use of construction techniques that reduce the potential for damage from natural hazards. | | | ✓ |
| 3.1.2.e Increase the County's resilience to drought. | | | ✓ |
| 3.1.2.f Increase food and energy security through local production and storage. | | | ✓ |
| **Objective:** | | | |
| 3.1.3 A more coordinated emergency response system that includes clearly defined and mapped evacuation routes. | | | ✓ |
| **Policy:** | | | |
| 3.1.3.a Identify and expand shelter facilities and evacuation routes away from areas susceptible to natural hazards. | | | ✓ |

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|---|---|---|---|
| **Objective:** | | | |
| 3.1.4 A more educated and involved public that is aware of and prepared for natural hazards. | | | ✓ |
| **Policies:** | | | |
| 3.1.4.a Promote public education and involvement related to natural hazards awareness and preparedness. | | | ✓ |
| 3.1.4.b Coordinate a multi-agency effort to establish and promote a comprehensive public education program that will focus on practical approaches to preparedness, damage prevention, and hazard mitigation. | | | ✓ |
| ***Analysis:*** **The proposed project involves development of a new WWRF and related improvements in Central Maui and is directly and indirectly applicable to the goals and relevant objectives and policies related to natural hazards. One of the purposes of the project is to reduce pressure on the existing Wailuku-Kahului WWRF that is located in the coastal area and the proposed WWRF is proposed to be located in an inland area of minimal flooding, tsunami hazards, and erosion hazards. As such, the proposed project will support the effort to make Maui more disaster resilient.** | | | |
| **CHAPTER 4 – ECONOMIC DEVELOPMENT** | | | |
| **ECONOMIC DIVERSIFICATION** | | | |
| **Goal:** | | | |
| 4.1 Maui will have a balanced economy composed of a variety of industries that offer employment opportunities and well-paying jobs and a business environment that is sensitive to resident needs and the island's unique natural and cultural resources. | | ✓ | |
| **Objective:** | | | |
| 4.1.1 A more diversified economy. | | ✓ | |
| **Policies:** | | | |
| 4.1.1.a Encourage an economy that is driven by innovation, research and development, and human resource development, including but not limited to, increasing technology- and knowledge-based sectors to be a major component in Maui County's economic base. | | | ✓ |
| 4.1.1.b Support the creation of new jobs and industries that provide a living wage. | | ✓ | |
| 4.1.1.c Facilitate and expedite permits and approvals. | | | ✓ |
| 4.1.1.d Develop linkages and partnerships among international research and development activities and Maui businesses. | | | ✓ |
| **Objective:** | | | |
| 4.1.2 Increase activities that support principles of sustainability. | | ✓ | |
| **Policies:** | | | |
| 4.1.2.a Support industries that are sustainable, and culturally and environmentally sensitive. | | ✓ | |

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|---|---|---|---|
| 4.1.2.b Encourage and support local businesses. | | | ✓ |
| 4.1.2.c Substitute imports with locally-produced services and products where practicable. | | | ✓ |
| 4.1.2.d Support the development of economic development clusters in targeted industry sectors. | | | ✓ |
| 4.1.2.e Encourage all businesses to save energy, water, and other resources. | | | ✓ |
| **Objective:** | | | |
| 4.1.3 Improve the island's business climate. | | ✓ | |
| **Policies:** | | | |
| 4.1.3.a Upgrade, maintain the quality of, and improve access to telecommunications infrastructure. | | | ✓ |
| 4.1.3.b Ensure an adequate supply of affordable workforce housing. | | ✓ | |
| 4.1.3.c Develop neighborhoods and communities that are attractive to the workforce of a diversified economy. | | ✓ | |
| 4.1.3.d Encourage, nurture, and reward entrepreneurship and innovation. | | | ✓ |
| 4.1.3.e Encourage employers to establish incentive programs. Support flexibility in workforce policies compatible with business and quality of life goals. | | | ✓ |
| 4.1.3.f Assist community development organizations with revitalization and development of neighborhoods and communities that are attractive to the workforce of a diversified economy. | | | ✓ |
| ***Analysis:*** **The proposed project involves development of a new WWRF and related improvements in Central Maui and is indirectly applicable to the goal and relevant objectives and policies related to economic diversification. The project will facilitate future economic growth and diversification through provisions of additional wastewater treatment services to support expansion of business, industrial, and residential land use, including market and affordable housing developments in Central Maui. Being sensitive to the islands unique resources and the harm associated with injection wells, the proposed project utilizes sustainable wastewater reclamation technologies novel to Hawaii, the SAT system.** | | | |
| **TOURISM** | | | |
| **Goal:** | | | |
| 4.2 A healthy visitor industry that provides economic well-being with stable and diverse employment opportunities. | | | ✓ |
| **Objective:** | | | |
| 4.2.1 Increase the economic contribution of the visitor industry to the island's environmental well-being for the island's residents' quality of life. | | | ✓ |
| **Policies:** | | | |
| 4.2.1.a Engage the visitor industry in the growth of emerging sectors where practicable. | | | ✓ |

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|---|---|---|---|
| 4.2.1.b Support the implementation of the Maui County TSP, when consistent with the MIP. | | | ✓ |
| 4.2.1.c Focus economic growth in the visitor industry through enhanced visitor experiences and an emphasis on attracting higher-spending. | | | ✓ |
| 4.2.1.d Provide a rich visitor experience, while protecting the island's natural beauty, culture, lifestyles, and aloha spirit. | | | ✓ |
| 4.2.1.e Diversify the tourism industry by supporting appropriate niche activities such as ecotourism, cultural tourism, voluntourism, ag-tourism, health and wellness tourism, educational tourism, medical tourism, and other viable tourism-related businesses in appropriate locations. | | | ✓ |
| 4.2.1.f Recognize the important economic contributions that the visitor industry makes and support a healthy and vibrant visitor industry. | | | ✓ |
| 4.2.1.g Support the increased availability of kama'āina discount programs. | | | ✓ |
| **Objective:** | | | |
| 4.2.2 Comprehensively manage future visitor-unit expansion. | | | ✓ |
| **Policies:** | | | |
| 4.2.2.a Mitigate the impact of tourism on the host culture, natural environment, and resident lifestyles. | | | ✓ |
| 4.2.2.b Allow, where permitted by the community plan, the development of business hotels and small, sensitively-designed inns. | | | ✓ |
| 4.2.2.c Manage impacts from transient vacation rentals, hotels, bed and breakfast units, timeshares, and resort condominiums on residential communities, public infrastructure, and community facilities. | | | ✓ |
| 4.2.2.d Discourage supplanting of existing island housing to visitor accommodations that may have a negative impact on long-term rental housing, price of housing, and price of land. | | | ✓ |
| 4.2.2.e Allow the designation of retreat/mini-conference centers in appropriate locations through the community plan process. | | | ✓ |
| 4.2.2.f Community plans should consider establishing standards such as limits on building size, room count, and the number of inns, if any, that will be allowed in small towns. | | | ✓ |
| **Objective:** | | | |
| 4.2.3 Maximize residents' benefits from the visitor industry. | | | ✓ |
| **Policies:** | | | |
| 4.2.3.a Promote a desirable island population by striving to not exceed an island-wide visitor population of roughly 33 percent of the resident population. | | | ✓ |
| 4.2.3.b Use the required General Plan Annual Status Report to monitor trends related to residents and visitors. | | | ✓ |

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|---|---|---|---|
| ***Analysis:*** **The proposed project is not applicable to the goal, objective, and policies related to a healthy visitor industry.** | | | |
| **AGRICULTURE** | | | |
| **Goal:** | | | |
| 4.3 Maui will have a diversified agricultural industry contributing to greater economic, food, and energy security and prosperity. | | | ✓ |
| **Objective:** | | | |
| 4.3.1 Strive for at least 85 percent of locally-consumed fruits and vegetables and 30 percent of all other locally-consumed foods to be grown in-State. | | | ✓ |
| **Policies:** | | | |
| 4.3.1.a Strive to substitute food/agricultural product imports with a reliable supply of locally produced food and agricultural products. | | | ✓ |
| 4.3.1.b Facilitate and support the direct marketing/sale of the island's agricultural products to local consumers, through farmers markets and similar venues. | | | ✓ |
| 4.3.1.c Encourage growing a diverse variety of crops and livestock to ensure the stewardship of our land while safeguarding consumer safety. | | | ✓ |
| 4.3.1.d Work with the State to regulate and monitor genetically-modified-organism (GMO) crops to ensure the safety of all crops and label all GMO products. | | | ✓ |
| **Objective:** | | | |
| 4.3.2 Maintain or increase agriculture's share of the total island economy. | | | ✓ |
| **Policies:** | | | |
| 4.3.2.a Encourage the export of the island's agricultural products to offshore markets. | | | ✓ |
| 4.3.2.b Support infrastructure investments at harbors, such as ferry service, airports, and other facilities for the rapid and cost-effective export of island-grown products. | | | ✓ |
| 4.3.2.c Encourage the continued viability of sugar cane production, or other agricultural crops, in central Maui and all of Maui Island. | | | ✓ |
| 4.3.2.d Work with the State to reduce excise taxes for commercial agricultural products produced within the State. | | | ✓ |
| 4.3.2.e Coordinate with appropriate State and Federal Departments and agencies, private shipping companies, and farmers associations to assist in the rapid and cost-effective export of Maui's agricultural products to off-island markets. | | | ✓ |
| **Objective:** | | | |
| 4.3.3 Expand diversified agriculture production at an average annual rate of 4 percent. | | | ✓ |
| **Policies:** | | | |

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|---|---|---|---|
| 4.3.3.a Promote the development of locally-grown and ecologically-sound biofuels, aquaculture, and forest products. | | | ✓ |
| 4.3.3.b Support the development of farming associations/cooperatives. | | | ✓ |
| 4.3.3.c Work with educational institutions and appropriate agencies to provide education and training for farm owners and entrepreneurs. | | | ✓ |
| ***Analysis:*****The proposed project is not applicable to the goal, objective, and policies for a diversified agricultural industry. However, the proposed project will generate R-1 recycled water which will be used for irrigation purposes at the Waikapū Country Town Agricultral Preserve and surrounding areas.** | | | |
| **EMERGING SECTORS** | | | |
| **Goal:** | | | |
| 4.4 A diverse array of emerging economic sectors. | | ✓ | |
| **Objective:** | | | |
| 4.4.1 Support increased investment and expanded activity in emerging industries. | | ✓ | |
| **Policies:** | | | |
| 4.4.1.a Support the development of and access to state-of-the-art voice, video, and data telecommunications systems and high-speed Internet. | | | ✓ |
| 4.4.1.b Attract and assist industries to compete in high technology activities such as those related to renewable energy, green technologies, diversified agriculture, ocean sciences, health sciences, space technologies, and other knowledge-based industries. | | ✓ | |
| 4.4.1.c Support new industries that are environmentally and culturally sensitive such as health and wellness, sports and outdoor activities, cultural activities, the arts, film-making, entertainment, and digital media. | | | ✓ |
| 4.4.1.d Support a sustainable, culturally sensitive, astronomy industry. | | | ✓ |
| 4.4.1.e Support the continued development of the Maui Research and Technology Park in Kihei, as a center for research and development, education, and diversified economic development, as provided by the Maui County Code. | | | ✓ |
| 4.4.1.f Work with appropriate organizations to support the development of high technology clusters around renewable energy, diversified agriculture, ocean sciences, health sciences, and other knowledge-based industries. | | | ✓ |
| **Objective:** | | | |
| 4.4.2 Increase the development of renewable energy technologies that are supported by the local community. | | | ✓ |
| **Policies:** | | | |
| 4.4.2.a Support the expansion of the renewable energy sector and the use of solar, wind, wave, and biofuel technologies. | | | ✓ |

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|---|---|---|---|
| 4.4.2.b Provide incentives to encourage renewable energy development, the use of green energy technologies, and energy conservation. | | | ✓ |
| 4.4.2.c Ensure an adequate supply of land and facilitate permitting to meet the needs for renewable energy technologies such as solar, wind, wave, biofuel, and other technologies, provided that environmental, view plane, and cultural impacts are addressed. | | | ✓ |
| 4.4.2.d Support the Maui County Energy Alliance Plan where consistent with the MIP. | | | ✓ |
| ***Analysis:*** **The proposed project involves the use of SAT technology for disposal of treated wastewater, which is more sustainable and environmentally friendly compared to injection wells that are traditionally used on the Island of Maui. As such, the project is indirectly applicable to the goal and relevant objective and policies related to emerging economic sectors.** | | | |
| **SMALL BUSINESS DEVELOPMENT** | | | |
| **Goal:** | | | |
| 4.5 Small businesses will play a key role in Maui's economy. | | | ✓ |
| **Objective:** | | | |
| 4.5.1 Increase the number of and revenue generated by small businesses and decrease the percentage of small business failures. | | | ✓ |
| **Policies:** | | | |
| 4.5.1.a Provide incentives and support for small businesses and entrepreneurs that incorporate sustainable technologies and practices into their operations, utilize local materials, or produce and sell locally-made goods or services. | | | ✓ |
| 4.5.1.b Assist traditional "mom and pop" business establishments. | | | ✓ |
| 4.5.1.c Reduce barriers to small business development. | | | ✓ |
| 4.5.1.d Require, where feasible, the government procurement of goods and services from locally-owned, small businesses. | | | ✓ |
| 4.5.1.e Support community markets and venues that sell locally-made produce, goods, and services. | | | ✓ |
| ***Analysis:*** **The proposed project involves development of a new WWRF and related improvements in Central Maui and is not applicable to the goal, objective, and policies related to small business development.** | | | |
| **HEALTH CARE SECTOR** | | | |
| **Goal:** | | | |
| 4.6 Maui will have a health care industry and options that broaden career opportunities that are reliable, efficient, and provide social well-being. | | | ✓ |
| **Objective:** | | | |
| 4.6.1 Expand the economic benefits of the health care sector. | | | ✓ |

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|---|---|---|---|
| **Policies:** | | | |
| 4.6.1.a Encourage expanded services at MMMC and at other medical facilities. | | | ✓ |
| 4.6.1.b Support expansion of federally qualified health centers with the direct involvement of the residents of the communities served. | | | ✓ |
| 4.6.1.c Support the use of multimedia as a means to provide healthcare information. | | | ✓ |
| 4.6.1.d Encourage digitalization of all diagnostic equipment at all facilities on Maui to enable sharing of data and more efficient use of limited provider workforce, consistent with data protection and patient privacy. | | | ✓ |
| 4.6.1.e Support the expansion of telemedicine. | | | ✓ |
| 4.6.1.f Encourage expansion and improved access to emergency care in all communities. | | | ✓ |
| **Objective:** | | | |
| 4.6.2 Be more efficient in the delivery of health care services and in minimizing health care costs. | | | ✓ |
| **Policies:** | | | |
| 4.6.2.a Support expansion of health care providers and facilities to improve access to quality care throughout the island. | | | ✓ |
| 4.6.2.b Encourage the expansion of veteran health care services. | | | ✓ |
| 4.6.2.c Allow home-based out-patient medical care that does not interfere with surrounding neighborhoods. | | | ✓ |
| **Objective:** | | | |
| 4.6.3. Expand Maui's alternative health care services, including spiritual practices. | | | ✓ |
| **Policies:** | | | |
| 4.6.3.a Support efforts to promote alternative medicine. | | | ✓ |
| 4.6.3.b Allow small-scale home-alternative medicine businesses such as massage, chiropractic care, traditional Hawaiian healing, and acupuncture that do not interfere with surrounding neighborhoods. | | | ✓ |
| ***Analysis:*** **The proposed project is not applicable to the goal, objective, and policies related to the health industry and services.** | | | |
| **EDUCATION AND WORKFORCE DEVELOPMENT** | | | |
| **Goal:** | | | |
| 4.7 Maui will have effective education and workforce development programs and initiatives that are aligned with economic development goals. | | | ✓ |
| **Objective:** | | | |

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|---|---|---|---|
| 4.7.1 Improve preschool and K-12 education to allow our youth to develop the skills needed to successfully navigate the 21st century. | | | ✓ |
| **Objective:** | | | |
| 4.7.1.a Encourage the State to implement programs such as: | | | ✓ |
| (1) Universally available preschool for children between the ages of one and five; | | | ✓ |
| (2) Mandatory kindergarten; | | | ✓ |
| (3) Mandatory K-5th grade classroom size limits of 1 teacher to 20 students; | | | ✓ |
| (4) Mandatory nutrition programs; and | | | ✓ |
| (5) Mandatory Native Hawaiian programs at all grade levels. | | | ✓ |
| 4.7.1.b Encourage the DOE to extend the school day by at least an hour. | | | ✓ |
| 4.7.1.c Encourage the State to increase funding for public education so that Hawai‘i is among the top 10 states nationally as measured by investment per pupil. | | | ✓ |
| 4.7.1.d Encourage the State to ensure teacher certifications relate to effective delivery and improved student performances, and develop an industry experience/equivalency certification to assure our DOE students have access to career technical education and training. | | | ✓ |
| 4.7.1.e Encourage the UHMC to provide dormitory space for high school students. | | | ✓ |
| 4.7.1.f Encourage the development and implementation of curriculum on native Hawaiian history, culture, and practices, in consultation with native Hawaiian groups and associations. | | | ✓ |
| **Objective:** | | | |
| 4.7.2 Encourage an increase in the number of certificate recipients and associate, bachelors, and graduate degrees conferred. | | | ✓ |
| **Policies:** | | | |
| 4.7.2.a Encourage the State to increase the number of articulation agreements between the UHMC and four-year universities, particularly the University of Hawai‘i at Manoa. | | | ✓ |
| 4.7.2.b Encourage the State to expand accredited 2-year, 4-year, and graduate programs through the UHMC. | | | ✓ |
| 4.7.2.c Encourage the education and training of our residents to meet the needs of a diversified economy. | | | ✓ |
| 4.7.2.d Support education and training programs such as student internships, vocational training, and career development opportunities to ensure a highly skilled workforce | | | ✓ |
| 4.7.2.e Work with educational institutions to improve and expand access to education and training through multiple modes, including distance learning. | | | ✓ |
| **Objective:** | | | |

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|---|---|---|---|
| 4.7.3 Strive to ensure that more of Maui's jobs are developed in STEM-related sectors by 2030. | | | ✓ |
| **Policies:** | | | |
| 4.7.3.a Support the development of STEM-related certificates and degrees at the two- and four year levels. | | | ✓ |
| 4.7.3.b Support the education initiatives of the Maui Agricultural Development Plan. | | | ✓ |
| 4.7.3.c Expand and seek funding for internships, mentoring, job shadowing, etc. to foster interest in health and green workforce careers. | | | ✓ |
| 4.7.3.d Work with MEDB, UHMC, and other similar organizations to expand internship/education programs to support STEM careers. | | | ✓ |
| 4.7.3.e Continue to partner with the MEDB and other similar organizations to recruit, assist, and retain emerging industries, research and development activities, and educational/workforce opportunities. | | | ✓ |
| ***Analysis:*** **The proposed is not applicable to the goal, objective, and policies related to the education and workforce development.** | | | |
| **CHAPTER 5 – HOUSING** | | | |
| **Goal:** | | | |
| 5.1 Maui will have safe, decent, appropriate, and affordable housing for all residents developed in a way that contributes to strong neighborhoods and a thriving island community. | ✓ | | |
| **Objective:** | | | |
| 5.1.1 More livable communities that provide for a mix of housing types, land uses, income levels, and age. | | ✓ | |
| **Policies:** | | | |
| 5.1.1.a Promote livable communities (compact/walkable/bikeable, access to transit) that provide for a mix of housing types and land uses, including parks, open space, and recreational areas. | | ✓ | |
| 5.1.1.b Promote planning approaches that provide a mix of multifamily and single-family housing units to expand housing choices. | | | ✓ |
| 5.1.1.c Discourage gated communities. | | | ✓ |
| 5.1.1.d Provide incentives for the rehabilitation or adaptive reuse of historic structures to facilitate more housing choices. | | | ✓ |
| 5.1.1.e Use planning and regulatory approaches to provide higher housing densities. | | | ✓ |
| **Objective:** | | | |
| 5.1.2 Better monitoring, evaluation, and refinement of affordable housing policy in conjunction with the economic cycle. | | | ✓ |
| **Policies:** | | | |

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|---|---|---|---|
| 5.1.2.a Improve data on resident and nonresident housing. | | | ✓ |
| 5.1.2.b Utilize the following approaches to promote resident housing and to minimize offshore market impacts: | | | ✓ |
| (1) Ensure that the future housing stock is composed of a mix of housing types (multifamily, small lots, ohana units, co-housing, cottage houses, etc.); | | | ✓ |
| (2) Encourage new housing in proximity to jobs and services, in places that are conducive/affordable to island residents; and | | | ✓ |
| (3) Explore taxation alternatives and building fee structures. | | | ✓ |
| **Objective:** | | | |
| 5.1.3 Provide affordable housing, rental or in fee, to the broad spectrum of our island community. | | | ✓ |
| **Policies:** | | | |
| 5.1.3.a Consider regulations that can help keep affordable housing available at affordable rents. | | | ✓ |
| 5.1.3.b Seek to have ownership of affordable for-sale and rental housing vested in a non-profit community land trust, or other qualified housing provider, committed to keeping such housing affordable in perpetuity. | | | ✓ |
| 5.1.3.c Facilitate the use of public lands in urban areas that are suitable for affordable housing. | | | ✓ |
| 5.1.3.d Develop or support partnerships and initiatives that provide housing-related education/outreach. | | | ✓ |
| 5.1.3.e Support the continuing efforts of the County and its community partners to: | | | ✓ |
| (1) Disseminate information on different housing/financial assistance programs (loans, grants, etc.) including information on housing rehabilitation/restoration/adaptive reuse; | | | ✓ |
| (2) Provide housing-related counseling including budget, credit, and financial planning assistance; and | | | ✓ |
| (3) Create and maintain a comprehensive/master list of available affordable housing to help residents secure a unit that satisfies their need. | | | ✓ |
| **Objective:** | | | |
| 5.1.4 Provide infrastructure in a more timely manner to support the development of affordable housing. | ✓ | | |
| **Policies:** | | | |
| 5.1.4.a Prioritize the development of infrastructure that supports the development of affordable housing. | ✓ | | |
| 5.1.4.b Utilize appropriate financing approaches and assistance tools to encourage the development of infrastructure and public facilities. | ✓ | | |

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|---|---|---|---|
| 5.1.4.c Tailor infrastructure requirements to correspond with appropriate level-of-service standards to help control housing costs and to maintain safety. | | | ✓ |
| **Objective:** | | | |
| 5.1.5 A wider range of affordable housing options and programs for those with special needs. | | | ✓ |
| **Policies:** | | | |
| 5.1.5.a Ensure that residents with special needs have access to appropriate housing. | | | ✓ |
| 5.1.5.b Encourage housing to be built or rehabilitated to allow the elderly and those with special needs to live in their homes. | | | ✓ |
| 5.1.5.c Ensure and facilitate programs to assist those with special needs from becoming homeless. | | | ✓ |
| 5.1.5.d Promote programs that stimulate the production of sustainable homeless shelters and alternative housing technologies. | | | ✓ |
| 5.1.5.e Support programs that offer home modification counseling on low-interest retrofit loans and grants to those with special needs. | | | ✓ |
| **Objective:** | | | |
| 5.1.6 Reduce the cost to developers of providing housing that is affordable to families with household incomes 160 percent and below of annual median income. | | | ✓ |
| **Policies:** | | | |
| 5.1.6.a Support fast-track processing procedures for the following housing-related entitlements: affordable housing projects/units; indigenous Hawaiian housing/units; and special-needs housing units (seniors, disabled, homeless, etc.). | | | ✓ |
| 5.1.6.b Require the construction of affordable for-sale and rental housing units as part of the construction of new housing developments. | | | ✓ |
| 5.1.6.c Offer extra incentives in boom periods and withdraw incentives during slack periods. | | | ✓ |
| **Objective:** | | | |
| 5.1.7 Increased preservation and promotion of indigenous Hawaiian housing and architecture. | | | ✓ |
| **Policies:** | | | |
| 5.1.7.a Preserve, promote, and give priority to Hawaiian housing/architecture forms to preserve Hawaiian culture. | | | ✓ |
| 5.1.7.b Provide for indigenous architecture as an allowable structure for native Hawaiian uses to include hula and lāʻau lapaʻau. | | | ✓ |

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|---|---|---|---|
| ***Analysis:*** **The proposed project involves development of a new WWRF and related improvements in Central Maui and is directly and indirectly applicable to the goal and relevant objectives and policies related to housing and affordable housing. The proposed project will provide additional wastewater treatment capacity to support future development in Central Maui including affordable housing developments. The proposed project is being planned and implemented to ensure wastewater infrastructure is developed in a timely manner in order to support the projected future growth in Central Maui. The service areas for the Central Maui WWRF correspond with the projected future growth identified in the Maui Island Plan.** | | | |
| **CHAPTER 6 – INFRASTRUCTURE AND PUBLIC FACILITES** | | | |
| **SOLID WASTE** | | | |
| **Goal:** | | | |
| 6.1 Maui will have implemented the ISWMP thereby diverting waste from its landfills, extending their capacities. | | | ✓ |
| **Objective:** | | | |
| 6.1.1 Meet our future solid waste needs with a more comprehensive planning and management strategy. | | | ✓ |
| **Policies:** | | | |
| 6.1.1.a Update and publicize the ISWMP every ten years. | | | ✓ |
| 6.1.1.b Strengthen inter-agency coordination including Planning and Environmental Management departments. | | | ✓ |
| 6.1.1.c Divert waste from the landfills and educate the public about the recommendations of the ISWMP. | | | ✓ |
| 6.1.1.d Minimize future active, unlined landfill cells to the extent feasible. | | | ✓ |
| **Objective:** | | | |
| 6.1.2 Divert at least 60 percent of solid waste from the island's landfills. | | | ✓ |
| **Policies:** | | | |
| 6.1.2.a Require residents and commercial enterprises that generate waste to pay a fair proportion of disposal costs. | | | ✓ |
| 6.1.2.b Encourage environmentally safe waste-to-energy solutions. | | | ✓ |
| 6.1.2.c Facilitate the reduction of solid waste generated by packaging, food service products, construction waste, etc. | | | ✓ |
| 6.1.2.d Educate residents and visitors about the impacts of and methods to reduce, reuse, and recycle. | | | ✓ |
| 6.1.2.e Discourage the disposal of landfill leachate by diversion to wastewater treatment plants, where practicable. | | | ✓ |
| ***Analysis:*** **The proposed project is not applicable to the goal, objective, and policies related to infrastructure and solid waste facilities.** | | | |

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|---|---|---|---|
| **WASTEWATER** | | | |
| **Goal:** | | | |
| 6.2 Maui will have wastewater systems that comply with or exceed State and Federal regulations; meet levels-of-service needs; provide adequate capacity to accommodate projected demand; ensure efficient, effective, and environmentally sensitive operation; and maximize wastewater reuse where feasible. | ✓ | | |
| **Objective:** | | | |
| 6.2.1 A wastewater planning program capable of efficiently providing timely and adequate capacity to service projected demand where economically feasible and practicable. | ✓ | | |
| **Policies:** | | | |
| 6.2.1.a Encourage the use of renewable energy in support of wastewater treatment facilities. | | | ✓ |
| 6.2.1.b Focus the expansion of wastewater systems to accommodate planned growth consistent with the MIP Directed Growth Strategy. | ✓ | | |
| 6.2.1.c Establish new wastewater treatment plant(s) outside the tsunami zone. | ✓ | | |
| **Objective:** | | | |
| 6.2.2 Adequate levels of wastewater service with minimal environmental impacts. | ✓ | | |
| **Policies:** | | | |
| 6.2.2.a Meet or exceed all State and Federal standards regulating wastewater disposal or reuse. | ✓ | | |
| 6.2.2.b Encourage tertiary treatment for all municipal wastewater that is disposed through deep injection wells. Phase out all municipal and private injection wells in coordination with water reuse programs, where feasible, by 2020. | ✓ | | |
| 6.2.2.c Improve and upgrade the County's existing wastewater collection, treatment, and reuse facilities consistent with current and future plans and the County's CIP. | ✓ | | |
| 6.2.2.d Maintain an ongoing sewer inspection program for public and private multi-user systems to identify potential problems and forecast each system's residual life. | | | ✓ |
| 6.2.2.e Require all new developments to fund system improvements in proportion to the development impact and in accordance with the County's wastewater functional plan. | | | ✓ |
| 6.2.2.f Require appropriate funding mechanisms, such as a sinking fund, to adequately maintain or replace aging water-system components. | | | ✓ |
| 6.2.2.g Strongly encourage the phase out of cesspools. | ✓ | | |
| **Objective:** | | | |
| 6.2.3 Increase the reuse of wastewater. | ✓ | | |

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|---|---|---|---|
| **Policies:** | | | |
| 6.2.3.a Strengthen coordination between the Department of Water Supply (DWS) and the WWRD to promote reuse/recycling of wastewater. | | | ✓ |
| 6.2.3.b Expand the reuse of wastewater from the Central Maui, Kīhei, Lahaina, and other wastewater systems. | ✓ | | |
| ***Analysis:*** **The proposed project involves development of a new WWRF and related improvements in Central Maui and is directly applicable to the goal and relevant objectives and policies related to infrastructure wastewater facilities. The proposed project will meet Federal and State regulations and standards for wastewater systems. The proposed project will provide wastewater treatment capacity in a timely manner to support the projected growth identified in the MIP and will help with the phasing out of cesspools. The proposed Central Maui WWRF will produce R-1 recycled water that will be available for irrigation purposes. The SAT system for disposing treated wastewater will be placed onsite as a backup system for any excess R-1 recycled water not used for irrigation or when the treated water does not meet the R-1 water standard. The SAT system is a sustainable alternative to injection wells to dispose of the treated effluent.** | | | |
| **WATER** | | | |
| **Goal:** | | | |
| 6.3 Maui will have an environmentally sustainable, reliable, safe, and efficient water system. | | ✓ | |
| **Objective:** | | | |
| 6.3.1 More comprehensive approach to water resources planning to effectively protect, recharge, and manage water resources including watersheds, groundwater, streams, and aquifers. | | ✓ | |
| **Policies:** | | | |
| 6.3.1.a Ensure that DWS actions reflect its public trust responsibilities toward water. | | | ✓ |
| 6.3.1.b Ensure the WUDP implements the State Water Code and MIP's goals, objectives, and policies. | | | ✓ |
| 6.3.1.c Regularly update the WUDP, to maintain compliance with the General Plan. | | | ✓ |
| 6.3.1.d Ensure that the County's CIP for water-source development is consistent with the WUDP and the MIP. | | | ✓ |
| 6.3.1.e Where desirable, retain and expand public ownership and management of watersheds and fresh-water systems. | | | ✓ |
| 6.3.1.f Encourage and improve data exchange and coordination among Federal, State, County, and private land use planning and water resource management agencies. | | | ✓ |
| **Objective:** | | | |
| 6.3.2 Increase the efficiency and capacity of the water systems in striving to meet the needs and balance the island's water needs. | | ✓ | |
| **Policies:** | | | |

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|---|---|---|---|
| 6.3.2.a Ensure the efficiency of all water system elements including well and stream intakes, water catchment, transmission lines, reservoirs, and all other system infrastructure. | | | ✓ |
| 6.3.2.b Encourage increased education about and use of private catchment systems where practicable for nonpotable uses. | | | ✓ |
| 6.3.2.c Maximize the efficient use of reclaimed wastewater to serve nonpotable needs. | | ✓ | |
| 6.3.2.d Work with appropriate State and County agencies to achieve a balance in resolving the needs of water users in keeping with the water allocation priorities of the MIP. | | | ✓ |
| 6.3.2.e Ensure water conservation through education, incentives, and regulations. | | | ✓ |
| 6.3.2.f Acquire and develop additional sources of potable water. | | | ✓ |
| **Objective:** | | | |
| 6.3 Improve water quality and the monitoring of public and private water systems. | | | ✓ |
| **Policy:** | | | |
| 6.3.3.a Protect and maintain water delivery systems. | | | ✓ |
| ***Analysis:*** **The proposed project is indirectly applicable to the goal and relevant objectives and policies related to infrastructure for water. The project's primary function is wastewater treatment; however, R-1 recycled water will be generated from the treated wastewater, which will be used for the Waikapū Country Town agricultural preserve and surrounding lands for irrigation. Indirectly, the proposed project supports the maximization and efficient use of reclaimed wastewater for nonpotable needs.** | | | |
| **TRANSPORTATION** | | | |
| **Goal:** | | | |
| 6.4 An interconnected, efficient, and well-maintained, multimodal transportation system. | | | ✓ |
| **Objective:** | | | |
| 6.4.1 Provide for a more integrated island-wide transportation and land use planning program that reduces congestion and promotes more efficient (transit-friendly) land use patterns. | | | ✓ |
| **Policies:** | | | |
| 6.4.1.a Plan for an integrated multi-modal transportation system comprised of public transit, bicycle, pedestrian, automobile, and other transportation modes. | | | ✓ |
| 6.4.1.b Refocus transportation investment from the construction of additional roadways only for the automobile to the expansion of a multimodal transportation system. | | | ✓ |
| 6.4.1.c Encourage the use of "complete streets" design methods. | | | ✓ |
| 6.4.1.d Encourage employers to implement TDM strategies. | | | ✓ |
| **Objective:** | | | |

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|---|---|---|---|
| 6.4.2 Safe, interconnected transit, roadway, bicycle, equestrian, and pedestrian network. | | | ✓ |
| **Policies:** | | | |
| 6.4.2.a Ensure transit-, roadway-, and pedestrian-facilities design and level-of-service standards respect the unique character of our communities. | | | ✓ |
| 6.4.2.b Prioritize transportation improvements list to cost-effectively meet existing and future needs consistent with the MIP. | | | ✓ |
| 6.4.2.c Require new development, where appropriate, to integrate sidewalks, pathways, bikeways, and transit infrastructure into new commercial and residential projects while enhancing community character. | | | ✓ |
| 6.4.2.d Identify and improve hazardous and substandard sections of roadways, drainage infrastructure, and bridges, provided that the historical integrity of the roads and bridges are protected. | | | ✓ |
| 6.4.2.e Consider identification, acquisition where appropriate, and utilization of abandoned right of-ways for bikeways, pedestrian pathways, and open-space networks. | | | ✓ |
| 6.4.2.f Support the implementation of the *Central Maui Pedestrian & Bicycle Master Plan* (March 2012), when consistent with the MIP. | | | ✓ |
| **Objective:** | | | |
| 6.4.3 An island-wide, multimodal transportation system that respects and enhances the natural environment, scenic views, and each community's character. | | | ✓ |
| **Policies:** | | | |
| 6.4.3.a Ensure that the roadway and transit alignments respect the natural environment and scenic views. | | | ✓ |
| 6.4.3.b Ensure that roadways and transit systems in rural areas and small towns enhance community character. | | | ✓ |
| 6.4.3.c Design all transit systems to respect visual corridors and Maui's character. | | | ✓ |
| ***Analysis:*** **The proposed project is not applicable to the goal, objective, and policies related to infrastructure related to transportation.** | | | |
| **TRANSIT** | | | |
| **Goal:** | | | |
| 6.5 An island-wide transit system that addresses the needs of residents and visitors and contributes to healthy and livable communities. | | | ✓ |
| **Objective:** | | | |
| 6.5.1 An integrated transit system that better serves all mobility needs of Maui's residents and visitors. | | | ✓ |
| **Policies:** | | | |
| 6.5.1.a Maximize access to public transit in town centers, commercial districts, and employment centers. | | | ✓ |
| 6.5.1.b Expand regional and inter-regional transit services, where appropriate, in heavily traveled corridors and within communities | | | ✓ |

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|---|---|---|---|
| 6.5.1.c Increase the frequency of current service, add additional bus routes as demand requires, and transition to nonpolluting transit vehicles, as funding permits. | | | ✓ |
| 6.5.1.d Provide adequate transit infrastructure (e.g., bus pullouts, waiting benches and shelters, signs) along existing and future transit right-of-ways. | | | ✓ |
| 6.5.1.e Require new development where appropriate, to provide right-of-ways (ROWs) to accommodate transit circulation and support facilities. | | | ✓ |
| 6.5.1.f Identify, protect, and preserve, or acquire corridors for future inter-community transit use, including but not limited to, rail and also multimodal use corridors. | | | ✓ |
| 6.5.1.g Establish transit corridors by planning for and securing right-of-way when appropriate for alternative modes of transportation (such as rail and water ferry service). | | | ✓ |
| 6.5.1.h Pursue improvements and upgrades to the existing transit system consistent with updated MDOT planning studies/transit plans (within the framework of comprehensive island-wide multimodal transportation plans). | | | ✓ |
| 6.5.1.i Increase inter-agency coordination between the Department of Planning, State Department of Transportation, County Department of Public Works, and other applicable agencies. | | | ✓ |
| **Objective:** | | | |
| 6.5.2 Plan for a more diversified and stable funding base to support transportation goals. | | | ✓ |
| **Policies:** | | | |
| 6.5.2.a Support alternative methods and sources of funding transportation improvements (including impact fees, higher taxes, fare adjustments, dedicated sources of funding, and assessments). | | | ✓ |
| 6.5.2.b Collaborate with public-private entities or nonprofit organizations to reduce public transit operational expenses. | | | ✓ |
| 6.5.2.c Coordinate with appropriate Federal, State, and County agencies to fund transportation projects in areas where growth is anticipated. | | | ✓ |
| ***Analysis:*** **The proposed project involves development of a new WWRF and related improvements in Central Maui and is not applicable to the goal, objective, and policies related to infrastructure related to transit. It is noted that a Traffic Impact Analysis Report (TIAR) has been prepared as part of the EIS process to assess potential traffic impacts during construction and the operational period. A Construction Traffic Management Plan (CTMP) has also been prepared and will be implemented to reduce potential traffic impacts during construction of the proposed project.** | | | |
| **PARKS** | | | |
| **Goal:** | | | |
| 6.6 Maui will have a diverse range of active and passive recreational parks, wilderness areas, and other natural-resource areas linked, where feasible, by a network of greenways, bikeways, pathways, and roads that are accessible to all. | | | ✓ |
| **Objective:** | | | |

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|---|---|---|---|
| 6.6.1 More effective, long-range planning of parks and recreation programs able to meet community needs. | | | ✓ |
| **Policies:** | | | |
| 6.6.1.a Support, consistent with the MIP, the implementation of open-space and recreational plans, such as the *Pali to Puamana Parkway* Master Plan and the *Upcountry Greenways Master Plan*. | | | ✓ |
| 6.6.1.b Utilize the ahupua‘a approach by integrating mauka-to-makai natural landscapes into an island-wide parks and recreation functional plan. | | | ✓ |
| 6.6.1.c Provide a balanced mix of passive and active parks, including neighborhood, community, and regional parks, in each community plan area. | | | ✓ |
| 6.6.1.d Support the expansion of Haleakala National Park, where supported by affected communities. | | | ✓ |
| 6.6.1.e Support lo‘i and dryland taro restoration in County, State, and Federal parks. | | | ✓ |
| 6.6.1.f Encourage private landowners to dedicate land to Federal, State, or County governments, or nonprofit land trusts, for parks and open-space protection consistent with the MIP. | | | ✓ |
| 6.6.1.g Strengthen inter-agency coordination including State and County departments, such as resolving joint use of facilities and properties. | | | ✓ |
| 6.6.1.h Work with the State to prepare and implement a master management plan for ‘Āhihi-Kīna‘u and La Perouse-Keone‘ō‘io Bay to Kanaloa Point region. | | | ✓ |
| **Objective:** | | | |
| 6.6.2 Achieve parks and recreation opportunities to meet the diverse needs of our community. | | | ✓ |
| **Policies:** | | | |
| 6.6.2.a Establish appropriate level-of-service standards at the neighborhood, community, and regional levels. | | | ✓ |
| 6.6.2.b Identify and acquire parks and recreational facilities that address existing park inadequacies and complement and enhance neighborhoods, communities, and natural land features. | | | ✓ |
| 6.6.2.c Design park facilities to preserve and enhance natural site characteristics, maximize views, protect environmental and cultural sites, and minimize water demands. | | | ✓ |
| 6.6.2.d Acquire lands along the shoreline, between coastal roadways and the ocean. | | | ✓ |
| 6.6.2.e Encourage the development of regional parks, district parks, and greenways in a manner that helps to contain sprawl, provide separation between distinct communities, or offer open space within urban communities. | | | ✓ |
| 6.6.2.f Require large master-planned communities that incorporate a mixture of park facilities pursuant to parks standards and functional plans. | | | ✓ |
| 6.6.2.g Support appropriate areas for cultural parks (e.g., Kepaniwai) in each community plan area. | | | ✓ |

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|---|---|---|---|
| 6.6.2.h Incorporate community input to determine the appropriate location, design, and long-term stewardship of parks and recreation facilities. | | | ✓ |
| 6.6.2.i Manage commercial activities at public parks to minimize impacts to residents. | | | ✓ |
| 6.6.2.j Support public-private partnerships to implement the acquisition and development of parks when consistent with the General Plan. | | | ✓ |
| 6.6.2.k Support a coordinated program to improve, operate, and maintain joint-use facilities and grounds. | | | ✓ |
| **Objective:** | | | |
| 6.6.3 An expanded network of greenways, trails, pathways, and bikeways. | | | ✓ |
| **Policies:** | | | |
| 6.6.3.a Link existing and future park sites, natural areas, the shoreline, and residential areas with a network of bikeways, pedestrian paths, trails, and greenways. | | | ✓ |
| 6.6.3.b Support the implementation of plans and programs that facilitate pedestrian mobility and access to active and passive recreation areas and sites. | | | ✓ |
| 6.6.3.c Collaborate with the State and private land owners to ensure perpetual access and proper stewardship of traditional trails and access systems. | | | ✓ |
| 6.6.3.d Facilitate the development of well-managed noncommercial campgrounds throughout the island. | | | ✓ |
| 6.6.3.e Consider requiring commercial bike rental businesses to provide funding that supports a mauka-to-makai Haleakalā bikeway improvement program. | | | ✓ |
| 6.6.3.f Ensure ADA compliance and seek opportunities to make all parks and recreational facilities accessible to people with disabilities. | | | ✓ |
| ***Analysis:*** **The proposed project involves development of a new WWRF and related improvements in Central Maui and is not applicable to the goal, objective, and policies related to parks. It is noted that the proposed WWRF is currently located within "Park" designation identified by the MIP's Planned Growth Areas Map and "Park Protected Area" designation identified by the MIP's Planned Protected Areas Map. Both maps indicate that the project site is for "Regional Park and County Facilities". However, the proposed project does not preclude the use of the surrounding lands for open space and recreational uses. Appropriate landscaping and odor controls will be implemented to minimize any potential nuisance issues from the WWRF. It is noted that a MIP amendment application will be initiated by the Planning Director to modify the above mentioned MIP maps and related narratives to make MIP fully compatible with the project.** | | | |
| **PUBLIC FACILITIES** | | | |
| **Goal:** | | | |
| 6.7 Maui will have adequate public facilities that meet the diverse needs of residents. | | | ✓ |
| **Objective:** | | | |
| 6.7.1 More effective planning for public facilities to meet community needs. | | | ✓ |
| **Policies:** | | | |
| 6.7.1.a Ensure the development and update of island-wide public facilities functional plans that incorporate prioritized facilities, programs, and a financial component. | | | ✓ |

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|---|---|---|---|
| 6.7.1.b Establish appropriate level-of-service standards for public facilities provided by the County. | | | ✓ |
| 6.7.1.c Pursue improvements and upgrades of County public facilities consistent with the public facilities functional plan. | | | ✓ |
| 6.7.1.d Recognize Wailuku Town as Maui's Civic Center and support the revitalization of the Civic Center District by consolidating government office spaces, enhancing landscape beautification, and providing adequate public parking. | | | ✓ |
| 6.7.1.e Support, with community input, the relocation of the Maui Community Correctional Center from Wailuku to an appropriate location in Puʻunēnē. | | | ✓ |
| 6.7.1.f Adequately plan and fund public safety facilities (fire, police, ambulance, civil defense) to meet community needs. | | | ✓ |
| 6.7.1.g Increase joint facilities utilization and program coordination between State and County agencies such as baseyards, communication centers, recreational facilities, etc., where feasible. | | | ✓ |
| 6.7.1.h Focus future expenditures for additional government office space, parking, and related facilities in Wailuku's Civic Center District. | | | ✓ |
| 6.7.1.i Encourage continuous and safe walkways for children within one mile of each school. | | | ✓ |
| 6.7.1.j Encourage public-private partnerships to identify and resolve public facility plan shortcomings when consistent with the General Plan. | | | ✓ |
| 6.7.1.k Incorporate community/area residents' input to determine the appropriate location and design of public facilities. | | | ✓ |
| ***Analysis:*** **The proposed project involves development of a new WWRF and related improvements in Central Maui which will serve the public. However, the project is not applicable to the goal, objective, and policies related to public facilities as described in the MIP.** | | | |
| **SCHOOLS AND LIBRARIES** | | | |
| **Goal:** | | | |
| 6.8 Maui will have school and library facilities that meet residents' needs and goals. | | | ✓ |
| **Objective:** | | | |
| 6.8.1 Assist in providing appropriate school and library facilities in a timely manner and in strategic locations. | | | ✓ |
| **Policies:** | | | |
| 6.8.1.a Work in partnership with all educational institutions to meet current and future needs including appropriate location, timing, and design of future facilities. | | | ✓ |
| 6.8.1.b Allow for the expansion and intensification of uses at the UHMC including satellite campuses operating in remote areas. | | | ✓ |
| 6.8.1.c Encourage the DOE to build and maintain smaller, community-oriented schools. | | | ✓ |

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|---|---|---|---|
| 6.8.1.d Encourage better cooperation by the State and County for use of State and County facilities. | | | ✓ |
| 6.8.1.e Encourage the State to upgrade, modernize, and expand school facilities, including those in remote communities. | | | ✓ |
| 6.8.1.f Work with the State to develop a master plan for the expansion of UHMC in accordance with the MIP. | | | ✓ |
| 6.8.1.g Support partnerships (public/private/nonprofit) to build and staff new schools and improve existing facilities. | | | ✓ |
| 6.8.1.h Work with the BOE HSPLS to provide centralized library services (including telecommunications) to all areas of Maui. | | | ✓ |
| 6.8.1.i Work with the State to expedite planning and construction of Kīhei High School, including the integration of the high school with the Maui Research and Technology Park. | | | ✓ |
| 6.8.1.j Work with the State to identify intermediate school sites in Central Maui and other areas where needed. | | | ✓ |
| **Objective:** | | | |
| 6.8.2 Provide a more expansive network of safe and convenient pedestrian-friendly streets, trails, pathways, and bikeways between neighborhoods and schools where appropriate. | | | ✓ |
| **Policies:** | | | |
| 6.8.2.a Encourage the State to build new school facilities in appropriate locations that minimize time and distance for students to travel to and from school. | | | ✓ |
| 6.8.2.b Encourage the State to implement the Safe Routes to School initiative with funding commitments to help the County plan and fund projects that ensure safe access routes to school. | | | ✓ |
| ***Analysis:*** **The proposed project involves development of a new WWRF and related improvements in Central Maui, which may service future school facilities. However, the project is not directly or indirectly applicable to the goal, objective, and policies related to schools and libraries.** | | | |
| **HEALTH CARE** | | | |
| **Goal:** | | | |
| 6.9 All of Maui residents will have the best possible health care to include healthy living, disease prevention, as well as acute and long-term care. | | | ✓ |
| **Objective:** | | | |
| 6.9.1 Greater autonomy to the Maui region in their efforts to improve medical care on the island. | | | ✓ |
| **Policies:** | | | |
| 6.9.1.a Encourage the State to give greater autonomy to the Maui region in their efforts to improve medical care on the island. | | | ✓ |

| Maui Island Plan Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
|---|---|---|---|
| 6.9.1.b Support innovative financial solutions, such as capital partnerships, joint ventures, and consolidations for MMMC and other health institutions. | | | ✓ |
| 6.9.1.c Support MMMC as a major core medical center that provides a greater range of services. | | | ✓ |
| 6.9.1.d Support the immediate development of a critical access hospital in West Maui. | | | ✓ |
| 6.9.1.e Support the expansion of regional critical-access facilities, where allowed by Federal regulations. | | | ✓ |
| 6.9.1.f Improve medical service to remote and outlying regions. | | | ✓ |
| 6.9.1.g Support transportation services for dialysis patients and community dialysis programs. | | | ✓ |
| 6.9.1.h Work with the State to determine the feasibility of appropriate medical facilities in South Maui and Hāna, including the possible reestablishment of a small community hospital in Hāna, the establishment of a hospital in South Maui, and assist the State in securing funding to meet Maui's health care needs. | | | ✓ |
| **Objective:** | | | |
| 6.9.2 An expansion of long-term care facilities and long-term care alternatives to meet the needs of our aging population. | | | ✓ |
| **Policies:** | | | |
| 6.9.2.a Support efforts to increase Maui's long-term care bed capacity to cover current and future needs, close to large population centers. | | | ✓ |
| 6.9.2.b Recognize that facilities for low-income elders who need long-term care are a needed form of affordable and subsidized housing. | | | ✓ |
| 6.9.2.c Evaluate the needs of the long-term disabled and provide planning support for their care, if there is a need for long-term care facilities. | | | ✓ |
| 6.9.2.d Consider long-term care facilities as a major potential employment base and encourage the recruitment and training of potential employees. | | | ✓ |
| **Objective:** | | | |
| 6.9.3 More support to home-care and community-based programs so they become alternatives to traditional nursing homes. | | | ✓ |
| **Policies:** | | | |
| 6.9.3.a Support the establishment of a program to assist the elderly and people with disabilities to remain in their homes or in a home-like setting. | | | ✓ |
| 6.9.3.b Support the establishment of senior and adult-day-care centers and senior housing. | | | ✓ |
| 6.9.3.c Continue to support existing senior centers (e.g. Kaunoa), and establish new senior centers that will provide day-care sites and programs for the disabled and elderly. | | | ✓ |

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|---|---|---|---|
| 6.9.3.d Support funding alternatives for community-based services that assist home-care efforts. | | | ✓ |
| 6.9.3.e Encourage the State to adopt the recommendations contained within the Legislative Reference Bureau's report entitled "Gimme a Break: Respite Care Services in Other States," (December 2007) where appropriate, feasible, and consistent with the MIP. | | | ✓ |
| **Objective:** | | | |
| 6.9.4 Improved preventative medicine and primary health care. | | | ✓ |
| **Policies:** | | | |
| 6.9.4.a Develop and utilize health-status benchmarks to measure prevention and primary health care service delivery. | | | ✓ |
| 6.9.4.b Support programs that provide family planning assistance. | | | ✓ |
| ***Analysis:*** **The proposed project involves development of a new WWRF and related improvements in Central Maui, which may service future health care facilities. However, the project is neither directly or indirectly applicable to the goal, objective, and policies related to health care.** | | | |
| **ENERGY** | | | |
| **Goal:** | | | |
| 6.10 Maui will meet its energy needs through local sources of clean, renewable energy, and through conservation. | | ✓ | |
| **Objective:** | | | |
| 6.10.1 Reduce fossil fuel consumption. Using the 2005 electricity consumption as a baseline, reduce by 15 percent in 2015; 20 percent by 2020; and 30 percent by 2030. | | | ✓ |
| **Policies:** | | | |
| 6.10.1.a Support energy efficient systems, processes, and methods in public and private operations, buildings, and facilities. | | | ✓ |
| 6.10.1.b Support the Maui Solar Rooftop initiative. | | | ✓ |
| 6.10.1.c Support Hawai`i Energy and other Public Utility Commission (PUC) approved energy efficiency programs. | | | ✓ |
| **Objective:** | | | |
| 6.10.2 Increase the minimum percentage of electricity obtained from clean, renewable energy sources. By 2015, more than 15 percent of Maui's electricity will be produced from locally-produced, clean, renewable energy sources, 25 percent by 2020, and 40 percent by 2030. | | ✓ | |
| **Policies:** | | | |
| 6.10.2.a Evaluate available renewable energy resource sites and applicable technologies. | | | ✓ |

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|---|---|---|---|
| 6.10.2.b Encourage the installation of renewable energy systems, where appropriate. | | ✓ | |
| 6.10.2.c Support the establishment of new renewable energy facilities at appropriate locations provided that environmental, view plane, and cultural impacts are addressed. | | | ✓ |
| 6.10.2.d Encourage all new County facilities completed after January 1, 2015, to produce at least 15 percent of their projected electricity needs with onsite renewable energy. | | | ✓ |
| **Objective:** | | | |
| 6.10.3 Increased use of clean, renewable energy. | | | ✓ |
| **Policies:** | | | |
| 6.10.3.a Support efforts in the PUC to upgrade Maui's power grid to integrate renewable energy from multiple sources and wheeling of electricity. | | | ✓ |
| 6.10.3.b Encourage the PUC to work with the County to implement and expedite community supported renewable energy projects. | | | ✓ |
| 6.10.3.c Encourage efforts to produce more renewable energy using distributed generation. | | | ✓ |
| 6.10.3.d Encourage import substitution by MECO and the broader community to become more self-sufficient in energy production. | | | ✓ |
| 6.10.3.e Educate the public on the economic and environmental benefits from the increased use of renewable energy. | | | ✓ |
| 6.10.3.f Encourage support from the Federal government, State, and the private sector for Maui's renewable energy objectives. | | | ✓ |
| 6.10.3.g Encourage incentives to support the development and use of renewable energy. | | | ✓ |
| **Objective:** | | | |
| 6.10.4 More efficient distribution of power throughout the island while preserving island beauty. | | | ✓ |
| ***Analysis:*** **The proposed project involves development of a new WWRF and related improvements in Central Maui and is indirectly applicable to the goal and relevant objectives and for clean or renewable energy. as the proposed WWRF will be designed to incorporate solar PV systems to offset the electrical demand of the facility.** | | | |
| **HARBORS AND AIRPORT** | | | |
| **Goal:** | | | |
| 6.11 Maui will have harbors and airports that will efficiently, dependably, and safely facilitate the movement of passengers and cargo. | | | ✓ |
| **Objective:** | | | |
| 6.11.1 Upgraded harbor facilities to handle larger volumes of freight and passengers and additional small boat harbors. | | | ✓ |

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|---|---|---|---|
| **Policies:** | | | |
| 6.11.1.a Support the expansion and upgrade of Kahului Harbor through the following, provided that any expansion is respectful of cultural practices and existing recreational uses and supports improved water quality: | | | ✓ |
| (1) Accommodate increasing volumes of cargo; | | | ✓ |
| (2) Provide deeper pier depths and greater fuel-receiving and storing capacities; and | | | ✓ |
| (3) Ensure safe and efficient work areas, including separating passenger operations from fuel and cargo operations. | | | ✓ |
| 6.11.1.b Work with public and private entities to provide adequate pier slips, utilities, repair facilities, and waste-disposal capabilities. | | | ✓ |
| 6.11.1.c Encourage the State to safely separate passenger (cruise and ferry) operations from hazardous bulk fuels and heavy cargo transporting operations, while not decreasing harbor's capacity to safely support various recreational uses. | | | ✓ |
| 6.11.1.d Encourage the State to develop cargo inspecting sites and facilities for efficient cargo and container processing and transportation and to prevent alien species entry. | | | ✓ |
| 6.11.1.e Support a State and County task force to study the feasibility of a second commercial harbor on Maui. | | | ✓ |
| **Objective:** | | | |
| 6.11.2 Establish more economically thriving and environmentally sensitive small boat harbors accommodating resident and business activity, including fishing, recreation, and tour boats. | | | ✓ |
| **Policy:** | | | |
| 6.11.2.a Provide for needed shore-side facilities and capabilities to support small boat harbor users (e.g. repair facilities, parking, cold storage, and mass-transit connections). | | | ✓ |
| **Objective:** | | | |
| 6.11.3 Upgraded airport facilities and navigation aids to serve the needs of passengers, freight movements, and general aviation. | | | ✓ |
| **Policies:** | | | |
| 6.11.3.a Protect the island's airports from encroaching urbanization that may negatively impact the airport operations. | | | ✓ |
| 6.11.3.b Support State efforts to improve Kahului Airport operations to better serve passenger and cargo needs. | | | ✓ |
| 6.11.3.c Support State efforts to identify sites and plan to relocate and accommodate small and rotary wing aircraft. | | | ✓ |
| 6.11.3.d Encourage the State to improve airport safety including lighting, fuel transmission, fuel safety, etc. | | | ✓ |

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|---|---|---|---|
| 6.11.3.e Consider expansion of rental car facilities in West and South Maui. | | | ✓ |
| 6.11.3.f Consider expansion of mass transit (bus, fixed-rail, shuttle, and taxis, bicycle, and pedestrian facilities) to and from Kahului Airport and not limited to passenger movements (allowing for luggage and cargo). | | | ✓ |
| 6.11.3.g Encourage the State to maintain airport capacity and to encourage more responsive air services to Hāna and Kapalua. | | | ✓ |
| ***Analysis:*** **The proposed project is neither directly or indirectly applicable to the goal, objective, and policies related to harbors and airports.** | | | |
| **CHAPTER 7 – LAND USE** | | | |
| **AGRICULTURAL LANDS** | | | |
| **Goal:** | | | |
| 7.1 Maui will have a prosperous agricultural industry and will protect agricultural lands. | | ✓ | |
| **Objective:** | | | |
| 7.1.1 Significantly reduce the loss of productive agricultural lands. | | | ✓ |
| **Policies:** | | | |
| 7.1.1.a Allow, where appropriate, the clustering of development on agricultural lands when approved as a CSD plan or similar approval mechanism. | | | ✓ |
| 7.1.1.b Require, where appropriate, the review and approval of CSD plans prior to the subdivision of agricultural land. | | | ✓ |
| 7.1.1.c Discourage developing or subdividing productive agricultural lands for residential uses in which the residence would be the primary use and any agricultural activities would be secondary uses. | | | ✓ |
| 7.1.1.d Consider requirements for public notification and review of the subdivision of agricultural land into four or more lots. | | | ✓ |
| 7.1.1.e Focus urban growth, to the extent practicable, away from productive and important agricultural lands. | | | ✓ |
| 7.1.1.f Strongly discourage the conversion of productive and important agricultural lands (such as sugar, pineapple, and other produce lands) to rural or urban use, unless justified during the General Plan update, or when other overriding factors are present. | | | ✓ |
| 7.1.1.g Further develop the requirements for agricultural assessments found under Section 19.510, MCC. | | | ✓ |
| 7.1.1.h Provide incentives for landowners to preserve and protect agricultural lands from development through the use of TDR/PDR, tax credits, easement programs, or similar means. | | | ✓ |
| 7.1.1.i Promote the use of U.S.D.A. Farm and Ranch Lands Protection Program grants to fund the acquisition of conservation easements on eligible agricultural lands. | | | ✓ |

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|---|---|---|---|
| 7.1.1.j Require all major developments adjacent to agricultural lands to provide an appropriate and site-specific agricultural protection buffer as part of a required site plan. | | | ✓ |
| 7.1.1.k Support and promote the viability of Maui's agricultural businesses through property tax incentives and other programs and subsidies. | | | ✓ |
| 7.1.1.l Encourage future community plan efforts to identify lands within the County Agricultural zoning district that are primarily being used for large-lot residential or rural use and consider such lands for reclassification to an appropriate County Rural zone. | | | ✓ |
| **Objective:** | | | |
| 7.1.2 Reduction of the island's dependence on off-island agricultural products and expansion of export capacity. | | ✓ | |
| **Policies:** | | | |
| 7.1.2.a Coordinate with the agricultural community, associations/community groups, agricultural landowners, and the State to designate IALs. | | | ✓ |
| 7.1.2.b Support an incentive package for productive Agricultural Lands which aims to ensure agricultural viability for small- and commercial-scale agricultural producers. | | | ✓ |
| 7.1.2.c Actively look to acquire land and provide infrastructure to expand the agricultural park and establish new agricultural parks. | | | ✓ |
| 7.1.2.d Support the designation of a research and development area within agricultural parks to help farmers stay attuned to new technology and research. | | | ✓ |
| 7.1.2.e Support local cooperative extension services to facilitate timely technology transfer opportunities. | | | ✓ |
| 7.1.2.f Support plans and programs to develop additional sources of water for irrigation purposes. | | ✓ | |
| 7.1.2.g Consider appropriate subdivision requirements (gravel roads, above-ground utilities, etc.) in those subdivisions creating Agricultural Parks where lots are limited to agricultural production with no dwellings. | | | ✓ |
| 7.1.2.h Support the recommendations, policies, and actions contained within the Maui Agricultural Development Plan, July 2009, when consistent with the MIP. | | | ✓ |
| 7.1.2.i Allow water and tax discounts for legitimate farming operations on rural and agricultural land. | | | ✓ |
| 7.1.2.j Give priority in delivery and use of agricultural water and agricultural land within County agricultural parks to cultivation of food crops for local consumption. | | | ✓ |
| 7.1.2.k Support programs that control pests and diseases that affect agriculture. | | | ✓ |
| 7.1.2.l Support the development of training and apprenticeship programs to encourage an adequate supply of agricultural workers. | | | ✓ |
| **Objective:** | | | |

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|---|---|---|---|
| 7.1.3 Support and facilitate connectivity between communities. | | | ✓ |
| **Policies:** | | | |
| 7.1.3.a Evaluate the impact of gated communities on interconnectivity. | | | ✓ |
| 7.1.3.b Discourage land use and urban design that impedes interconnectivity between adjacent communities. | | | ✓ |
| ***Analysis:*** **The proposed project involves the development of a new WWRF and related improvements in Central Maui and is indirectly applicable to the goal and relevant objectives and policies related to agricultural land use. The proposed Central Maui WWRF will provide R-1 recycled water for agricultural uses and will support agricultural land use on Maui. As part of the EIS, an Agricultural Impact Assessment has been prepared to assess the project's potential impacts on agricultural lands. A portion of the proposed sewage and R-1 recycled water pipelines appear to be within the Agricultural Preserve of the MIP Planned Growth Areas map. However, these pipelines are permitted uses within areas designated for agriculture.** | | | |
| **RURAL AREAS** | | | |
| **Goal:** | | | |
| 7.2 Maui will have a rural landscape and lifestyle where natural systems, cultural resources and farm lands are protected and development enhances and compliments the viability and character of rural communities. | | | ✓ |
| **Objective:** | | | |
| 7.2.1 Reduce the proliferation and impact of residential development outside of urban, small town, and rural growth boundaries. | | | ✓ |
| **Policies:** | | | |
| 7.2.1.a Focus development to areas inside urban, small town, and rural growth boundaries to preserve natural, cultural, and agricultural resources. | | | ✓ |
| 7.2.1.b Encourage cluster development with a mandatory buffer requirement/clear edge at the interface of country towns, agricultural uses, and surrounding rural landscapes. | | | ✓ |
| 7.2.1.c Encourage or require, where appropriate, CSDs and the use of green spaces/natural separations to protect the character of rural landscapes. | | | ✓ |
| 7.2.1.d Encourage basic goods/services in business country towns. | | | ✓ |
| 7.2.1.e Allow for mixed uses, including residential uses, within Business Country Town Districts. | | | ✓ |
| 7.2.1.f Encourage the use of alternative stormwater management techniques that minimize land disturbance and preserve natural drainage features. | | | ✓ |
| 7.2.1.g Encourage green belts, open space buffers, and riparian zones to minimize conflicts between agriculture and residential uses. | | | ✓ |
| 7.2.1.h Evaluate the impact of gated communities on inter-connectivity. | | | ✓ |
| **Objective:** | | | |

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|---|---|---|---|
| 7.2.2 More appropriate service/infrastructure standards to enhance and protect the island's rural character and natural systems. | | | ✓ |
| **Policies:** | | | |
| 7.2.2.a Minimize impermeable surfaces within rural areas. | | | ✓ |
| 7.2.2.b Protect and support the character, economic viability, and historic integrity of Maui's small towns. | | | ✓ |
| 7.2.2.c Use infrastructure, public service, and design standards that are appropriate to rural areas. | | | ✓ |
| 7.2.2.d Discourage land use and urban design that impede interconnectivity between adjacent communities. | | | ✓ |
| ***Analysis:*** **The proposed project involves the development of a new WWRF and related improvements in Central Maui and does not involve any rural designated lands. As such, the proposed project is not applicable to the goals and objectives related to protecting rural lands.** | | | |
| **URBAN AREAS** | | | |
| **Goal:** | | | |
| 7.3 Maui will have livable human-scale urban communities, an efficient and sustainable land use pattern, and sufficient housing and services for Maui residents. | | ✓ | |
| **Objective:** | | | |
| 7.3.1 Facilitate and support a more compact, efficient, human-scale urban development pattern. | | ✓ | |
| **Policies:** | | | |
| 7. 3.1.a Ensure higher-density compact urban communities, infill, and redevelopment of underutilized urban lots within Urban Growth Boundaries. | | ✓ | |
| 7.3.1.b Maintain a distinct separation between communities, such as but not limited to, Wailuku and Waikapū; Wailuku and Waiheʻe; Pukalani and Makawao; Pukalani and Kula; Makawao and Hāliʻimaile; Lahaina and Kāʻanapali; Kīhei and Māʻalaea; and Māʻalaea and Waikapū, to protect the character and identity of Maui's communities. | | | ✓ |
| 7.3.1.c Strengthen evaluation requirements for new urban expansion, new towns, and major urban infill projects within urban growth areas. Tailor submittal requirements to reflect the impact or scale of different projects. | | | ✓ |
| 7.3.1.d Ensure future amendments to urban growth boundaries achieve the following: (1) provide a beneficial extension of the existing community; (2) are in areas where it is cost-effective to provide and operate infrastructure/public service facilities; and (3) do not promote automobile-oriented land use patterns. | | | ✓ |
| 7.3.1.e Evaluate the impact of gated communities on inter-connectivity. | | | ✓ |

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|---|---|---|---|
| 7.3.1.f Encourage the development and implementation of neighborhood design standards that are environmentally friendly, such as LEED for Neighborhood Development (LEED – ND) standards. | | | ✓ |
| 7.3.1.g Discourage future pyramid zoning within the industrial zoning districts, while allowing accessory commercial uses and grandfathering existing uses. | | | ✓ |
| 7.3.1.h Promote agriculture by encouraging community gardening, community-supported agricultural programs, and farmers markets within and adjacent to urban areas. | | | ✓ |
| 7.3.1.i Discourage land use and urban design that impedes inter-connectivity between adjacent communities. | | | ✓ |
| **Objective:** | | | |
| 7.3.2 Facilitate more self-sufficient and sustainable communities. | | ✓ | |
| **Policies:** | | | |
| 7.3.2.a When developing new communities, provide sufficient lands for commercial, appropriate industrial, educational, spiritual, and non-profit uses to serve the daily needs of community residents. | | ✓ | |
| 7.3.2.b Site community facilities such as schools, parks, libraries, and community centers within walking and biking distance of residences. | | | ✓ |
| 7.3.2.c Facilitate self-sufficient communities and shorten commutes by: | | | ✓ |
| (1) Directing residential development to job-rich areas; | | | ✓ |
| (2) Allowing for appropriate commercial development and community services to shorten commutes; and | | | ✓ |
| (3) Allowing home occupations or home-based businesses that are compatible with surrounding neighborhoods and lifestyles. | | | ✓ |
| 7.3.2.d Ensure, where appropriate, that affordable employee housing and multi-modal transportation opportunities are located near major employment centers. | | ✓ | |
| 7.3.2.e Discourage the establishment of bedroom communities where long commutes are required to employment centers. | | | ✓ |
| 7.3.2.f Facilitate the development of housing by focusing projects in locations where land and infrastructure costs facilitate the development of affordably-priced housing. | | ✓ | |
| 7.3.2.g Provide incentives to facilitate the development of multifamily housing. | | | ✓ |
| 7.3.2.h Encourage the placement of rental housing projects in the same areas as for-sale housing to facilitate mixed-income communities. | | | ✓ |
| 7.3.2.i Develop communities that provide sufficient parks, schools, libraries, and other essential public facilities and services to serve resident needs. | | ✓ | |

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|---|---|---|---|
| 7.3.2.j Promote agriculture by encouraging community gardening, edible landscaping, community-supported agricultural programs, and farmers markets within and adjacent to urban areas. | | | ✓ |
| **Objective:** | | | |
| 7.3.3 Strengthen the island's sense of place. | | | ✓ |
| **Policies:** | | | |
| 7.3.3.a Protect and enhance the unique architectural and landscape characteristics of each community. | | | ✓ |
| 7.3.3.b Encourage Hawaiian architecture and tropical building designs. | | | ✓ |
| 7.3.3.c Support the continued revitalization of historic country towns, Wailuku Town, and Kahului's commercial core and harbor-front without displacing traditional, cultural, recreational and customary uses. | | | ✓ |
| 7.3.3.d Strongly encourage the preservation of buildings, structures, and sites of historic significance. | | | ✓ |
| 7.3.3.e Require community input through Design Workshops for major new urban expansion, new towns, and major urban infill projects. | | | ✓ |
| 7.3.3.f Require design enhancement, landscaping, and integration of park and rides, bicycle parking areas, and mass-transit infrastructure to mitigate the effect of parking lots and structured parking on the urban landscape. | | | ✓ |
| 7.3.3.g Ensure that safe and attractive public spaces (e.g., plazas, parks, town/village squares) are provided throughout the island's urban areas. | | | ✓ |
| **Objective:** | | | |
| 7.3.4 Strengthen planning and management for the visitor industry to protect resident quality of life and enhance the visitor experience. | | | ✓ |
| **Policies:** | | | |
| 7.3.4.a Discourage the conversion of hotel units to timeshares and fractional ownership. | | | ✓ |
| 7.3.4.b Monitor and manage the amount of, and impacts from, timeshares and fractional ownership. | | | ✓ |
| 7.3.4.c Manage short-term rentals and bed-and-breakfast homes through a permitting and regulatory process in accordance with adopted ordinances and community plan policies. | | | ✓ |
| 7.3.4.d Limit large-scale resort development to the four existing resort destination areas of Wailea, Mākena, Kapalua and Kā'anapali. "Large Scale Resort" is defined as complexes that include multiple accommodation facilities, activity businesses, retail complexes, and other amenities. | | | ✓ |
| **Objective:** | | | |

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|---|---|---|---|---|
| 7.3.5 | Ensure that Maui's planning and development review process becomes more transparent, efficient, and innovative. | | | ✓ |
| **Policies:** | | | | |
| 7.3.5.a | Encourage greater community involvement in land use planning and decision making. | | ✓ | |
| 7.3.5.b | Establish a predictable and timely development review process that facilitates the approval of projects that meet planning and regulatory requirements. | | | ✓ |
| 7.3.5.c | Increase inter-agency coordination between the Department of Planning and all State and County agencies responsible for infrastructure and public facilities provision, particularly as it relates to the mitigation of long-term cumulative impacts resulting from development projects. | | | ✓ |
| 7.3.5.d | Provide greater certainty and transparency in the development review process. | | ✓ | |
| 7.3.5.e | Expand and maintain land use and geographic information system databases for improved decisions, and make data and products available to the public. | | | ✓ |
| ***Analysis:*** **The proposed project is indirectly applicable to the goal and relevant objectives and policies related to land use in urban areas. The proposed project will support the future development of higher-density compact urban communities, infill, and redevelopment of underutilized urban lots within the Central Maui Urban Growth Boundary (UGB) through the provision of future wastewater treatment capacity in Central Maui. This will facilitate future growth and development close to a major employment center and will facilitate the development of the Waikapu Country Town, a portion of which will include affordable housing.** | | | | |
| **CHAPTER 8 – DIRECTED GROWTH PLAN** | | | | |
| **URBAN AND SMALL TOWN GROWTH AREA** | | | | |
| **Goal:** | | | | |
| 8.1 | Maui will have well-serviced, complete, and vibrant urban communities and traditional small towns through sound planning and clearly defined development expectations. | ✓ | | |
| **Policies:** | | | | |
| 8.1.a | The County, with public input, will be responsible for designating new growth areas where infrastructure and public facilities will be provided, consistent with the policies of the MIP and in accordance with State and County infrastructure plans. | ✓ | | |
| 8.1.b | Amendments to a UGB or STB shall be reviewed as a MIP amendment. A UGB or STB shall only be expanded if the island-wide inventory (maintained by the Department of Planning) of existing land uses (residential, commercial, industrial) indicates that additional urban density land is necessary to provide for the needs of the projected population growth within ten years of that inventory; or, during the decennial update of the MIP. | | | ✓ |
| 8.1.c | Community plans shall provide for urban density land use designations only within UGBs and Small Towns. The County may only support and approve State Urban Land Use Designations for areas within UGBs, STBs, and Rural Villages. | ✓ | | |

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|---|---|---|---|---|
| 8.1.d | The unique character and function of existing small towns shall be protected to retain and preserve their sense of place. | | | ✓ |
| 8.1.e | New development shall be consistent with the UGBs, STBs, and all other applicable policies of the MIP. New urban-density development shall not be allowed outside of a UGB or STB. | ✓ | | |
| 8.1.f | The County, as a condition of development approval, shall require developers of privately owned infrastructure systems to provide financial insurance (bonding, etc.) for the operation and maintenance of these systems. | | | ✓ |
| 8.1.g | The County shall implement a zoning program to comprehensively redistrict and rezone lands within UGBs according to updated community plan policies and map designations. | | | ✓ |
| 8.1.h | The County will seek to focus capital improvements (schools, libraries, roads, and other infrastructure and public facilities) within the UGBs and STBs in accordance with the MIP. | ✓ | | |
| 8.1.i | The County will promote (through incentives, financial participation, expedited project review, infrastructure/public facilities support, etc.) appropriate urban infill, redevelopment and the efficient use of buildable land within UGBs to avoid the need to expand the UGBs. | ✓ | | |
| 8.1.j | The MIP's UGBs and STBs shall not be construed or implemented to prohibit the construction of a single-family dwelling on any existing parcel where otherwise permitted by law. | | | ✓ |
| ***Analysis:*** **The proposed project is directly applicable to the goal and relevant policies related to the Directed Growth Plan. The proposed project is primarily located within the UGB with a portion of the pipeline located in the Small Town Boundaries (STB). The proposed project provides future wastewater treatment capacity to service future developments in accordance with the MIP.** | | | | |
| **RURAL GROWTH AREA** | | | | |
| **Goal:** | | | | |
| 8.2 | Maui will maintain opportunities for agriculture and rural communities through sound planning and clearly defined development expectations. | | | ✓ |
| **Policies:** | | | | |
| 8.2.a | Amendments to a RGB shall be reviewed as an MIP amendment. A RGB shall only be expanded if an island-wide inventory of existing land uses (residential, commercial, industrial) indicates that additional lands are necessary to provide for the needs of the projected population growth within ten years of that inventory; or, during the decennial update of the MIP. | | | ✓ |
| 8.2.b | New development shall be consistent with RGB and all other applicable policies and requirements of the MIP. Public, quasi-public, civic, and limited commercial or industrial uses may be allowed in the RGB when the proposed uses demonstrate a public need and are consistent with the Community Plan and zoning. | | | ✓ |
| 8.2.c | Environmental protection and compatibility will be a top priority in rural growth areas. | | | ✓ |

| Maui Island Plan Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | | DA | IA | NA |
|---|---|---|---|---|
| 8.2.d | All development within rural growth areas should avoid encroachment upon prime agricultural land. | | | ✓ |
| 8.2.e | Rural growth areas include Rural Residential Areas and Rural Villages. Rural residential areas may be designated when they are located in association with or on the border of urban growth areas or Small Towns; and/or when they provide for complete, self-sufficient rural communities with a range of uses to be developed at densities that do not require urban infrastructure. | | | ✓ |
| 8.2.f | Community plans shall provide for rural density land use designations only within RGBs; provided that limited community plan urban designations may be allowed within Rural Villages. New rural growth areas shall not be located where urban expansion may ultimately become necessary or desirable. New rural-density development shall not be allowed outside of a RGB. | | | ✓ |
| 8.2.g | New rural growth areas intended to be complete, self-sufficient rural communities must be located a significant distance from existing urban areas, distinctly separated by agricultural or open lands. | | | ✓ |
| 8.2.h | Urban-scale infrastructure and public facilities shall not be provided in rural areas except as described in the defined Level-of-Service (LOS) standards. There should be no expectations of urban services in rural areas. | | | ✓ |
| 8.2.i | Urban development standards shall not be required within RGBs except in fulfillment of Federal law. | | | ✓ |
| 8.2.j | The unique character and function of existing small towns and rural communities shall be protected to retain and preserve their sense of place. | | | ✓ |
| 8.2.k | Preserve rural landscapes in which natural systems, cultural resources, and agricultural lands are protected and development compliments rural character and contributes to the viability of communities and small towns. | | | ✓ |
| 8.2.l | The MIP's RGBs shall not be construed or implemented to prohibit the construction of a single family dwelling on any existing parcel where otherwise permitted by law. | | | ✓ |
| 8.2.m | The County shall implement a zoning program to comprehensively redistrict and rezone lands within RGBs, and to implement community plan policies and map designations. | | | ✓ |
| 8.2.n | At the time of zoning from agricultural to rural, Council will consider prohibiting restrictions on agricultural activity. | | | ✓ |
| ***Analysis:*** **The proposed project involves development of a new WWRF and related improvements outside of the RGB and is not applicable to goals and policies for the RGB. However, Rural Growth Boundaries (RGB) R-1 recycled water from the proposed WWRF will be used for the Waikapū Country Town's agricultural preserve, part of which is located within the RGB.** | | | | |
| **PROTECTED AREA POLICY** | | | | |
| 8.3.a | The Protected Areas in Diagrams E-1, NW-1, N-1, NE-1, S-1, SE-1, and WC-1 should be concurrently reviewed with Table 8-2 and with any proposed land uses that may result in an adverse impact on a Protected Area. The County Council and the Administration should be notified if a Protected Area may be compromised by a development proposal. | ✓ | | |

| Maui Island Plan Goals, Objectives, and Policies<br>Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable | DA | IA | NA |
|---|---|---|---|
| **The proposed Central Maui WWRF is located within the "Park" protected area and portions of the proposed sewage pipeline are proposed within the "Preservation" and "Park" protected areas. It is noted that a MIP Amendment application will be initiated by the Planning Director to remove the "Park" protected area designation for the 14.9-acre WWRF and SAT site in order to make the MIP fully compatible with the proposed County WWRF.** | | | |

# PUBLIC SCOPING MEETING MEMORANDUM AND COPY OF PRESENTATION/ HANDOUT

## APPENDIX

# T

MUNEKIYO HIRAGA
Planning. Project Management. Sustainable Solutions.

Karlynn K. Fukuda
PRESIDENT
Mark Alexander Roy AICP, LEED AP
VICE PRESIDENT
Tessa Munekiyo Ng AICP
VICE PRESIDENT

Michael T. Munekiyo AICP
FOUNDER

September 25, 2025

# CENTRAL MAUI WASTEWATER RECLAMATION FACILITY PROJECT

# PUBLIC SCOPING MEETING SUMMARY

**From:** Yukino Uchiyama, AICP, Manager, Munekiyo Hiraga (MH)

**To:** Juan Rivera, County of Maui, Department of Environmental Management (DEM)

## MEETING INFORMATION

**Date of Meeting:** Wednesday, August 16, 2023

**Time:** 6:00 p.m.

**Place:** Waikapū Community Center (22 East Waiko Road, Waikapū, Maui, Hawai'i 96793)

**Purpose:** To solicit the public's input on the range of actions, alternatives, impacts, and proposed mitigation measures to be considered in the project's Draft Environmental Impact Statement (EIS) and the significant issues to be analyzed in depth in the Draft EIS, pursuant to Hawai'i Administrative Rules (HAR) §11-200.1-2.

**Participants:**

- Brad Harger, Chair, Waikapū Community Association
- Glenn Adolpho, Waikapū Community Association
- Eassie Miller, Community Member
- Jacky Takakura, Community Member
- Project Team Members:
  - Juan Rivera, County of Maui, DEM
  - Craig Lekven, Brown and Caldwell (B&C)
  - Irina Constantinescu, B&C
  - Derek Ono, Warren S. Unemori Engineering (WSUE)
  - Mark Roy, MH
  - Yukino Uchiyama, MH

**EXHIBITS:**

**Exhibit A.** Sign-in Sheet

**Exhibit B.** Sample Comment Card

**Exhibit C.** Project Fact Sheet Handout

## MEETING SUMMARY

### I. Introduction

J. Rivera of DEM opened up the meeting at 6:00 p.m. by expressing appreciation for participants' attendance and recognizing the gravity of the recent wildfires that devastated Lāhainā. J. Rivera (DEM) also provided a high-level overview of the project and the need of the project for the Central Maui communities.

### II. Project Presentation

Y. Uchiyama (MH) and C. Lekven (B&C) provided a presentation for the Central Maui Wastewater Reclamation Facility (WWRF) Project. The outline of the presentation is provided below:

1. Purpose of Public Scoping Meeting
2. Project Need
3. Project Overview
4. EIS Process
5. Next Steps
6. Public Comments

### III. Comments Received During Public Scoping Meeting and Responses

As the purpose of the meeting was to solicit public comments related to the proposed project (range of actions), alternatives, potential impacts, and mitigation measures to be considered in the Draft Environmental Impact Statement (EIS), formal responses were not provided at the meeting. **Table 1** below summarizes the verbal comments received at the meeting as well as formal responses from DEM that were prepared following the public scoping meeting. These comments and responses are being addressed in the Draft EIS document, as may be appropriate. It is noted that no written comments were received during the meeting.

**Table 1.** Summary of Public Scoping Meeting Comments and Responses

| ATTENDEE/COMPANY | | COMMENT | RESPONSE |
|---|---|---|---|
| HARGER, Brad, President, Waikapū Community Association | 1 | Will funding be set aside to put pipes or some kind of irrigation system in place to use the wastewater to irrigate the valley here, to keep it green instead of a foul, dry place that it is now? | The subject project includes a R-1 recycled water transmission pipeline to the boundary of the Waikapū Country Town development along Honoapi‘ilani Highway. From there, the Waikapū Country Town developer will construct a pipeline and recycled water storage facility on Waikapū Country Town property. The R-1 recycled water will be distributed from the storage facility and used for common area irrigation within the Waikapū Country Town development, within the agricultural preserve located south of the Central Maui WWRF, and within the two (2) parcels owned by the County of Maui. It is estimated that over 90 percent of the treated effluent from the Central Maui WWRF will be used for irrigation purposes on land that is currently fallow. |
| | 2 | Has there been any thought given to having a large water tower become part of this operation to provide emergency backup water for fire emergencies? | The Waikapū Country Town developer will construct a recycled water storage facility within their property at approximately 550 feet above sea level. The storage facility will provide sufficient pressure and volume for fire hydrants if they are connected to the recycled water system. The County will rely on the Water System Standards to determine fire suppression flow, duration, and minimum pressure requirements. |

| ATTENDEE/COMPANY | | COMMENT | RESPONSE |
|---|---|---|---|
| | | | A large water tower was not considered for the Central Maui WWRF project because the existing topography facilitates construction of at-grade water storage systems in a more cost-effective manner. |
| | 3 | Are there any concerns about dangers of this polluting the local stream that runs very close by? The stream diverges in rainy times and goes real close to your plant. | The Central Maui WWRF will not discharge effluent to local streams. The majority of the effluent from the facility will be recycled for irrigation purposes. Effluent that cannot be recycled or beyond the irrigation demand will be disposed in onsite soil aquifer treatment (SAT) basins for percolation disposal. A hydrogeological study is being prepared for the project and will be included in the Draft EIS to document the hydraulic pathway and additional treatment benefits provided by the SAT system. Water that is discharged to the SAT will not emerge in the local stream that runs close by. The Draft EIS also includes a preliminary drainage report that evaluates stormwater flow onto the WWRF site, and management of precipitation that falls on the WWRF site. |
| | 4 | The Old Waikapu neighborhood is mainly on septic systems or cesspools. Is the county going to be putting in lines to connect them? | The County is currently preparing a study assessing the potential sewer connection for residences located on Waiko Road and Upper Waiko Road. While there is no current plan for a sewer connection south of Waiko Road, the proposed Central Maui |

| ATTENDEE/COMPANY | | COMMENT | RESPONSE |
|---|---|---|---|
| | | | WWRF will have capacity to service the Old Waikapū neighborhood. |
| | 5 | You mentioned the water treatment process and using ultraviolet light to purify the water. Other areas use also hydrogen peroxide in that process. Will we be doing that at all? Or are we just sticking with ultraviolet light? | The WWRF will use ultraviolet light disinfection to create R-1 recycled water that is suitable for non-potable uses.<br><br>Hydrogen peroxide is used in conjunction with ultraviolet light to create purified water for potable reuse (i.e., reintroduce the highly treated wastewater back into the potable water supply), however, potable reuse is **not** part of the proposed project. |
| | 6 | We want to make sure that Old Waikapu gets on the sewer line, and it's available to us. Not just Waiko Road, but all of Old Waikapu. From Waiko to the Tropical Plantation, mauka and makai. So these houses just right here on the other side of this park are still on cesspools. | The Central Maui WWRF facility plan anticipates connecting Waikapū residential communities that are located north of Waiko Road and currently on septic or cesspools. The County is currently conducting a study on how to provide sewer service to the existing Waikapū communities north of Waiko Road. |
| MILLER, Eassie | 1 | The project is needed. But more importantly, I believe the county is at a crossroads relative to wastewater treatment in Central Maui, which runs all of Central Maui and through Mā'alaea. If I'm not mistaken, the county will be investing close to $100 million-plus for all of this work, so that's a major investment. I just encourage or hope that when you go through this work and this study, that you look at all the potential facilities or systems that needs to be addressed. | Thank you for the comment. The County agrees that this project is much needed and will cost greater than $100 million to implement – a major investment in the Central Maui wastewater infrastructure.<br><br>The County is currently reviewing wastewater facilities and systems in the Central Maui region to ensure that all potential issues are addressed as part of the Central Maui WWRF project as much as practical. |

| ATTENDEE/COMPANY | | COMMENT | RESPONSE |
|---|---|---|---|
| | 2 | There's historically been discussions of phasing out Wailuku-Kahului facility. This is a start with diverting flow. If that's down the horizon, that should be considered now relative to land requirements. You talk about Mā'alaea, but it's like an if and maybe kind of thing. There's been issues we all recognize in the last year or so that Mā'alaea needs to be sorted. It's all on private packaged plants right on the shoreline. I would encourage you to look at that, too, and be holistic in all of Central Maui and looking at your land requirements. Don't be shortsighted and let's do it right for the long haul. | The County has initiated a study evaluating wastewater treatment options and opportunities for sewer connection from Mā'alaea to the Central Maui WWRF. The Central Maui WWRF will be designed to have additional capacity to accommodate a possible connection from Mā'alaea should it be determined to be feasible in the future. The County agrees that good planning is needed to look at the Central Maui holistically so that the project can adequately service the region. |
| | 3 | The presentation mentioned that there will be no development around where the new facility is plan to be constructed. I would just say you need to make sure that there will be no development surrounding that facility. I know there is going to be a park and things of this sort, but you just need to ensure that that's addressed.<br><br>We've seen it happen on Oahu, where out in Kailua, they built a treatment plant, and years later, they built townhouses across the highway. There's been ongoing issues for the last 30, 40 years about odors in that area. We don't want to create the same scenario. | The proposed Central Maui WWRF is located on a portion of a large parcel that is owned by the County of Maui, which will serve as a buffer between the Central Maui WWRF and land uses to the west, east, and north. The land to the south is a permanent agricultural reserve that will not be developed for residential purposes.<br><br>The DEM WWRD is also coordinating with Department of Parks and Recreation (DPR) on the facility's compatibility with potential future surrounding land uses. Visual and odor mitigation strategies will be evaluated for implementation. Potential visual and odor mitigation strategies include buffer land or walls/berms around |

| ATTENDEE/COMPANY | | COMMENT | RESPONSE |
|---|---|---|---|
| | | | the WWRF, landscaping, a biotrickling filter and/or granular activated carbon scrubbers at odor sources and maintenance of aerobic conditions in the treatment processes. |
| | 4 | On the SAT land requirements, I know you show four basins. Are those basins intended to deal with Wailuku-Kahului's effluent also? Because I know there's projects that are planned for Wailuku-Kahului to divert the effluent in there. Is that going to be addressed as part of this project, or is that going to be another SAT? | The SAT basins are designed to accommodate flow from the Central Maui WWRF only (including flow diverted from the Wailuku-Kahului WWRF via the Kehalani Wastewater Pump Station and associated sewage pipeline). The County is planning another SAT project that will accommodate the remaining effluent from the Wailuku-Kahului WWRF, which is separate and unrelated to the Central Maui WWRF project. |
| | 5 | The other issue is staffing requirements. It's so hard to find people if we're going to build another SAT for the Wailuku-Kahului facility. If Mā'alaea builds their own, that's another. To find people to operate is a challenge in the county's experience and challenges now. I think that needs to be considered as a part of the criteria in looking at where you put the facility and what you hope to treat at this facility. | The County agrees that recruiting and retaining qualified wastewater treatment operators is a challenge and will continue to be so in the future. The County chose the intended Central Maui WWRF treatment processes to be consistent with other County WWRFs located on Maui island to lessen operational and maintenance burdens. |
| | 6 | I would encourage you guys to look at another site. What I would recommend is to go look at a site by the sugar mill. A&B has 800 acres of industrial lands. You'd have to negotiate with A&B, but it could be available and that's more appropriate for | While the sugar mill site has not been directly evaluated, another site near the sugar mill was evaluated. Both the evaluated site and the sugar mill site do not have soils that are conducive to soil aquifer treatment and would require |

| ATTENDEE/COMPANY | | COMMENT | RESPONSE |
|---|---|---|---|
| | | this facility. So just urge you to consider that. | substantially more land area for secondary effluent disposal purposes. |
| | 7 | Somewhere it was mentioned about a facility's plan. Is that available for the general public to look at or the final? | The facility plan document will be discussed and included in the Draft EIS, which will be available for review by the public. |
| | 8 | Another key concern from a ratepayer's perspective is, how is this going to be paid for? I know there's mention of state moneys or government moneys and things of the sort, but it still needs to be paid back. It's an SRF loan. So who's going to pay for all of this? Is it going to be the ratepayers, the current ratepayers? Or is it going to come out of the General Fund? I would encourage you to look at that and make sure you address that in the EIS. | A combination of funding sources will likely be used to construct the proposed project. The funding sources may include, but not limited to State funds, grants, loans, and bonds. Additional discussion on the project funding will be included in the Draft EIS. |
| | 9 | Craig mentioned that you're going to be building a new pump station in that Kehalani drainage basin. Just ask that you address that you're taking away 10,000 square feet of drainage basin. What's the impact relative to dealing with drainage for the all of those subdivisions? | The Kehalani drainage basin was built with excess capacity. After the new Kehalani Wastewater Pump Station is constructed, its capacity will still be more than what is required. Additional information on this will be provided in the Draft EIS. |
| | 10 | I was of the understanding that this proposed facility would be treating septage from all of the County of Maui. Right now, all the septage waste goes to the Wailuku-Kahului facility. We were led to believe that it's all going to be diverted to this new facility. And if that's the case, that should be addressed. | The Central Maui WWRF facility plan includes a septage receiving facility so that the organic and nutrient loads from septage will be diverted from the Wailuku-Kahului WWRF. |

| ATTENDEE/COMPANY | | COMMENT | RESPONSE |
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| | 11 | 4 million gallons per day of effluent treated recycled water will go to the Waikapū Country Town and the other agricultural areas. I guess there is a demand for 4 million gallons in those areas identified. Who's going to own the tank and the recycled water system? Is the Waikapū County Town going to be responsible for distributing the recycled water and dealing with issues that come up with it? | Waikapū Country Town will develop a recycled water storage facility and a portion of the R-1 Recycled Water Transmission Pipeline that is located on their property. Waikapū Country Town will own and operate the storage facility and will be responsible for distributing the recycled water within the Waikapū Country Town community. |
| | 12 | I'm just wanting to be ensured that the SAT treatment's going to be evaluated. This gentleman asked about impacting the stream and you said the project's not going to impact it. How do you know it's not going to impact it? Is it going to be modeled and evaluated as part of the EIS? | The Draft EIS will include and discuss a Hydrogeological Study of the SAT system that will include an evaluation of the project's potential impacts to surrounding streams. |
| | 13 | Craig mentioned the soil type is mostly sand. Is that a positive thing? For drainage it's great. But to achieve all of the treatment that was laid out, is sand the best to deal with that? | Sandy soil, which underlies the proposed SAT basin is preferred for SAT systems because it allows high hydraulic loading rates, resulting in a relatively small footprint. The Hydrogeological Study that will be included in the Draft EIS will discuss the treatment benefits from the SAT system. |

| ATTENDEE/COMPANY | | COMMENT | RESPONSE |
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| | 14 | The EISPN says the county's going to be constructing a gravity sewer line through the Waikapū Country Town. I'm just wondering why the county is paying for it and not the developer? That's over a million dollars of capital improvement. That's only going to serve that development, so shouldn't it be the developer that pays for it? | The developer will pay for and construct the sewage pipeline within Waikapū Country Town. |
| | 15 | Who will make that decision on Mā'alaea connection or not connecting? Maybe you can address that in the EIS. | The County has initiated a separate study project to evaluate the possibility of connecting Mā'alaea to the Central Maui WWRF. The proposed Central Maui WWRF will have capacity to accommodate wastewater flow from Mā'alaea, however, a connection to Mā'alaea is not part of the proposed improvements of this project. |
| | 16 | When you're looking at the alternatives, I would ask that, relative to the secondary treatment process, that you look at the granular activity sludge system, because that's proven to be viable, and it's taken hold throughout the country and the world as a viable alternative. What you get out of that is those four circles on the site plan. You don't need those four secondary clarifiers, which gives you more land to do whatever you need to be doing at the facility, relative to expansion or things of the sort. | The WWRF facility plan considered the Nereda granular activated sludge process, however the Biological Nutrient Removal (BNR) via Modified Ludzack-Ettinger (MLE) or Membrane Bioreactor (MBR) was deemed more appropriate and desirable for this particular application. It was determined that due to the lack of long-term operational experience in the United States, the Nereda granular activated sludge process is considered not appropriate for the Central Maui WWRF. In addition, the Nereda system is operated by a computer control system and cannot be operated in manual mode, and may |

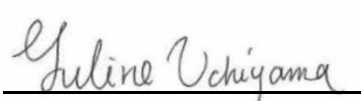
| ATTENDEE/COMPANY | | COMMENT | RESPONSE |
|---|---|---|---|
| | | The other thing is, it's more energy-efficient than conventional activated sludge. I know in the draft plan that we were able to looked at, they talked about MBRs. But MBRs you have very energy-intensive to operate. But the AGS or GAS is pretty viable. I would ask that it be looked at closely in terms of its acceptability or appropriateness for this project. | require influent and/or effluent equalization (and thus increasing the footprint requirements). |
| | 17 | I would strongly urge you to do another community outreach-type meeting when the draft EIS is done, because what's presented in the supporting report or study is just bones. The details will show up in the Draft EIS. That'd be a great time to communicate with the community about what's going to be happening, financial impact to the community, and things of the sort. So I would urge you to do another community meeting, even if it's not required by law. | DEM will consider holding an additional community meeting following the publication of the Draft EIS. |
| ADOLPHO, Glenn, Waikapū Community Association | 23 | The Waikapū Country Town's developer, Mike Atherton, got funding from the State to contribute to the facility in exchange for schools being built in the area and the extension of Waiale Road. Because it's building in our backyard, we want to make sure our people have the service, too. There was talk about Mā'alaea coming in too. But please consider the people whose community you're building in first. Because these people have to get off, from what I | The WWRF Facility Plan anticipates connecting Waikapū residential communities that are located north of Waiko Road and currently using septic systems or cesspools for wastewater treatment and/or disposal. The County is currently conducting a study to evaluate sewer service connections to the existing Waikapū communities north of Waiko Road. |

| ATTENDEE/COMPANY | | COMMENT | RESPONSE |
|---|---|---|---|
| | | understand, the septic tanks and cesspools by a certain year, it would only be fair that you consider the people impacted by the project first. | |
| TAKAKURA, Jackie | 25 | If you could please consider landscaping so that when we drive by, we don't have to look at a treatment plant that might be unsightly from the main roads. | The Draft EIS will include and discuss a visual impact assessment. Potential visual mitigation strategies include buffer land or walls/berms around the WWRF and landscaping, and appropriate visual mitigation measures will be further evaluated in the Draft EIS based on the findings of the visual impact assessment. |
| | 26 | I also encourage the use of photovoltaic because I know this is going to be a lot of power used. | A rooftop solar PV system will be installed at the WWRF property to help supplement the facility's energy needs. In addition, the County of Maui may consider larger scale photovoltaic when master planning the surrounding County-owned lands. |
| HARGER, Brad, Waikapū Community Association | 27 | We want to make sure that Old Waikapū gets on the sewer line, and it's available to us. Not just Waiko Road, but all of Old Waikapū. From Waiko to the Tropical Plantation, mauka and makai. So these houses just right here on the other side of this park are still on cesspools. | The Central Maui WWRF facility plan anticipates connecting Waikapū residential communities that are located north of Waiko Road and currently on septic or cesspools. The County is currently conducting a study on how to provide sewer service to the existing Waikapū communities north of Waiko Road. |
| ADOLPHO, Glenn, Waikapū Community Association | 28 | There'll be more presentations and opportunities for people to come out on this? | DEM will consider holding an additional community meeting following the publication of the Draft EIS. |

| ATTENDEE/COMPANY | | COMMENT | RESPONSE |
|---|---|---|---|
| | 29 | We had our board meeting tonight. It was supposed to be by Zoom, but we cancelled it so that we could be here tonight. If we could share the PowerPoint you have, we can share with our community as well. Or even do something, not this extensive, but just real brief so that our people can know as well what's going on. There is a lot of development coming up that the Waikapū Country Town will be about 1500-plus units, plus two schools. There's going to be a middle school and an elementary school there as well. And lots of businesses and commercial areas. We're looking at big developments happening here and as well as down the street from us, so we're trying to keep on top of what's happening so that we can have a say and know what's going on in our community. | We appreciate you adjusting the Waikapū Community Association (WCA) board meeting to attend the scoping meeting. The project team presented the proposed project at the WCA meeting on September 18, 2023. A meeting memorandum will be included in the Draft EIS and comments from the meeting will be addressed in the Draft EIS, as appropriate. |

## IV. Closure of Meeting

Y. Uchiyama (MH) expressed appreciation for the participants' time and input and closed the meeting at approximately 7:15 p.m.



Yukino Uchiyama, AICP
Manager

YU:ab
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# Exhibit A.
# Sign-In Sheet

**COUNTY OF MAUI, DEPARTMENT OF ENVIRONMENTAL MANAGEMENT, WASTEWATER RECLAMATION DIVISION**
**CENTRAL MAUI WASTEWATER RECLAMATION FACILITY PROJECT**
***EIS Public Scoping Meeting – Sign In Sheet***
**Wednesday, August 16, 2023 at 6:00 p.m., Waikapu Community Center, Maui**

**This meeting will be audio recorded as required by Chapter 11-200.1-23(d), Hawaii Administrative Rules**

| | Name | Address | Phone | Email | Check if you would like to provide an oral comment at this meeting |
|---|---|---|---|---|---|
| 1 | BRAD HARGER | [redacted] | [redacted] | [redacted] | ✓ |
| 2 | Eassie Miller | [redacted] | [redacted] | [redacted] | ✓ |
| 3 | GLENN ADOLPHO | [redacted] | [redacted] | [redacted] | ✓ |
| 4 | Jacky Takakura | [redacted] | [redacted] | [redacted] | |
| 5 | WAIKAPU COMMUNITY ASSOCIATION BRAD HARGER | [redacted] | [redacted] | [redacted] | |
| 6 | JUAN A RIVERA | [redacted] | [redacted] | [redacted] | |
| 7 | IRINA CONSTANTINESCU | | [redacted] | [redacted] | |
| 8 | CRAIG LEKVEN | | [redacted] | [redacted] | |
| 9 | Derek Ono | | [redacted] | [redacted] | |
| | Scott Rollins | | [redacted] | [redacted] | |

**COUNTY OF MAUI, DEPARTMENT OF ENVIRONMENTAL MANAGEMENT, WASTEWATER RECLAMATION DIVISION**
**CENTRAL MAUI WASTEWATER RECLAMATION FACILITY PROJECT**
***EIS Public Scoping Meeting – Sign In Sheet***
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## This meeting will be audio recorded as required by Chapter 11-200.1-23(d), Hawaii Administrative Rules

| | Name | Address | Phone | Email | Check if you would like to provide an oral comment at this meeting |
|---|---|---|---|---|---|
| 1 | Brad Harger | [redacted] | [redacted] | [redacted] | X |
| 2 | Eassie Miller | [redacted] | [redacted] | [redacted] | X |
| 3 | Glenn Adolpho | [redacted] | [redacted] | [redacted] | X |
| 4 | Jacky Takakura | [redacted] | [redacted] | [redacted] | |
| 5 | Waikapu Community Association | Brad Harger | [redacted] | [redacted] | |
| 6 | Juan A. Rivera | [redacted] | [redacted] | [redacted] | |
| 7 | Irina Constantinescu | | [redacted] | [redacted] | |
| 8 | Craig Lekven | | [redacted] | [redacted] | |
| 9 | Derek Ono | | [redacted] | [redacted] | |
| 10 | Scott Rollins | | [redacted] | [redacted] | |

# Exhibit B.
# Sample Comment Card

# COMMENT FORM

## County of Maui, Department of Environmental Management
## Wastewater Reclamation Division
## CENTRAL MAUI WASTEWATER RECLAMATION FACILITY PROJECT

***EIS PUBLIC SCOPING MEETING***
**Wednesday, August 16, 2023 at 6:00 p.m.**

Name:_____ Phone No._____

Address: _____

Email Address: _____

Please write any comments you wish to share on the proposed project below.

_____

_____

_____

_____

_____

_____

Please submit your comments by **August 22, 2023** via mail to:

Yukino Uchiyama, AICP, Manager
Munekiyo Hiraga
305 High Street, Suite 104
Wailuku, Hawaii 96793
or via email to CentralMauiWWRF@munekiyohiraga.com

A copy of the EISPN can be accessed by scanning the QR code or going to the link provided below:

**Scan QR code for EISPN or go to link provided below**
**https://tinyurl.com/CMauiWWRF**

Should you have any questions, please feel free to contact Yukino Uchiyama, Munekiyo Hiraga, at CentralMauiWWRF@munekiyohiraga.com or call (808) 983-1233.

# Exhibit C.
# Project Fact Sheet Handout

# County of Maui Department of Environmental Management
# Wastewater Reclamation Division
# CENTRAL MAUI WASTEWATER RECLAMATION FACILITY
# EISPN PUBLIC SCOPING MEETING

The project's Environmental Impact Statement Preparation Notice (EISPN) has been published in the Environmental Review Program's Environmental Notice for public review.

A copy of the EISPN can be accessed by scanning the QR code or going to the link provided below:

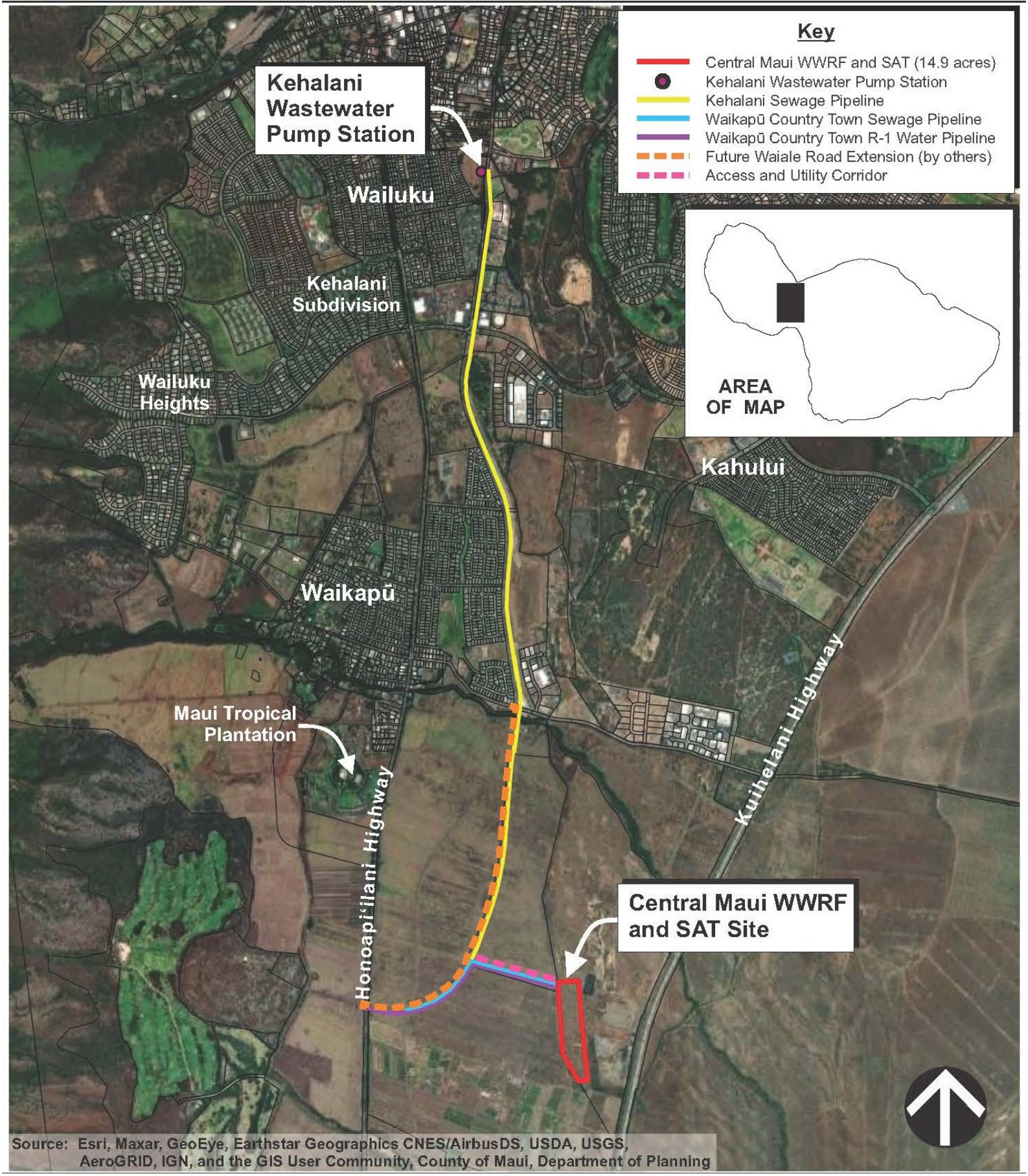
**Scan QR code for EISPN or go to link provided below**

**https://tinyurl.com/CMauiWWRF**

**Comments on the EISPN can be submitted via mail or email (see contact information below). The deadline for comments is August 22, 2023.**

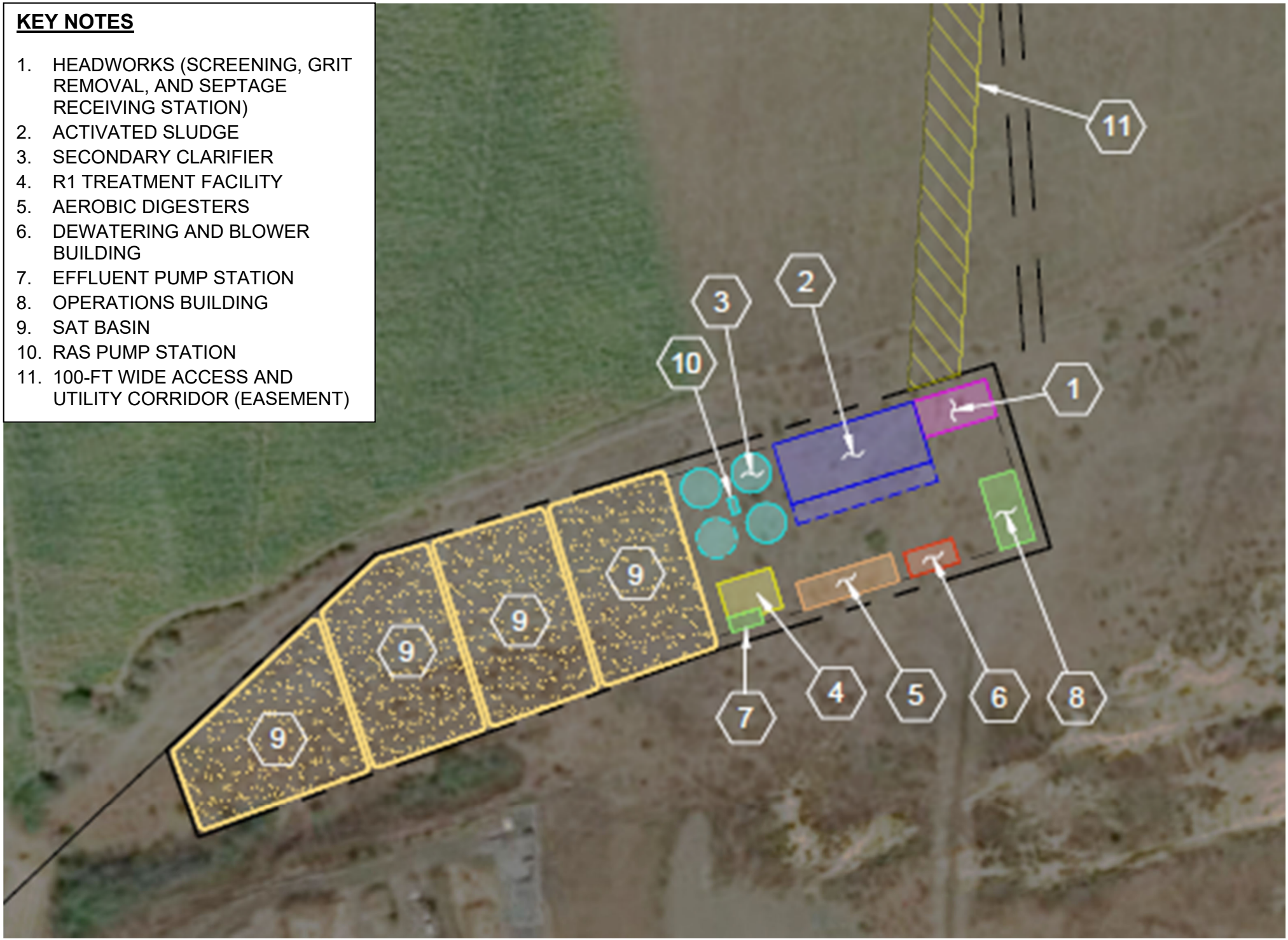

Yukino Uchiyama, AICP, Manager
Munekiyo Hiraga
305 High Street, Suite 104
Wailuku, Hawaii 96793
Email: CentralMauiWWRF@munekiyohiraga.com


If you have any questions, please contact Yukino Uchiyama, Munekiyo Hiraga, at CentralMauiWWRF@munekiyohiraga.com or call (808) 983-1233.


Key
Central Maui WWRF and SAT (14.9 acres)
Kehalani Wastewater Pump Station
Kehalani Sewage Pipeline
Waikapū Country Town Sewage Pipeline
Waikapū Country Town R-1 Water Pipeline
Future Waiale Road Extension (by others)
Access and Utility Corridor
Kehalani Wastewater Pump Station
Wailuku
Kehalani Subdivision
Wailuku Heights
AREA OF MAP
Kahului
Waikapū
Maui Tropical Plantation
Honoapiʻilani Highway
Kuihelani Highway
Central Maui WWRF and SAT Site
Source: Esri, Maxar, GeoEye, Earthstar Geographics CNES/AirbusDS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, County of Maui, Department of Planning

**KEY NOTES**

1. HEADWORKS (SCREENING, GRIT REMOVAL, AND SEPTAGE RECEIVING STATION)
2. ACTIVATED SLUDGE
3. SECONDARY CLARIFIER
4. R1 TREATMENT FACILITY
5. AEROBIC DIGESTERS
6. DEWATERING AND BLOWER BUILDING
7. EFFLUENT PUMP STATION
8. OPERATIONS BUILDING
9. SAT BASIN
10. RAS PUMP STATION
11. 100-FT WIDE ACCESS AND UTILITY CORRIDOR (EASEMENT)



# Exhibit D.
# Meeting Presentation

# CENTRAL MAUI WASTEWATER RECLAMATION FACILITY PROJECT

## ENVIRONMENTAL IMPACT STATEMENT (EIS)

## PUBLIC SCOPING MEETING

**August 16, 2023**

# AGENDA

1. Purpose of Today's Meeting
2. Project Need
3. Project Overview
4. EIS Process
5. Next Steps
6. Public Comments

# PURPOSE OF EIS
# PUBLIC SCOPING MEETING

# PURPOSE OF EIS PUBLIC SCOPING MEETING

- Project Team to provide high-level overview of the proposed project.
- Public to provide comment on significant issues to be analyzed in depth in the Draft EIS.
- Public to provide feedback on the proposed project (range of actions), alternatives, impacts, and mitigation measures to be considered in the Draft EIS.

# PURPOSE OF EIS PUBLIC SCOPING MEETING

- The purpose of this meeting is to receive comments to help inform preparation of the Draft EIS.
- As such, this is not intended to be a Q & A session as technical studies for the EIS have yet to be prepared.

# PROJECT NEED

# PROJECT NEED

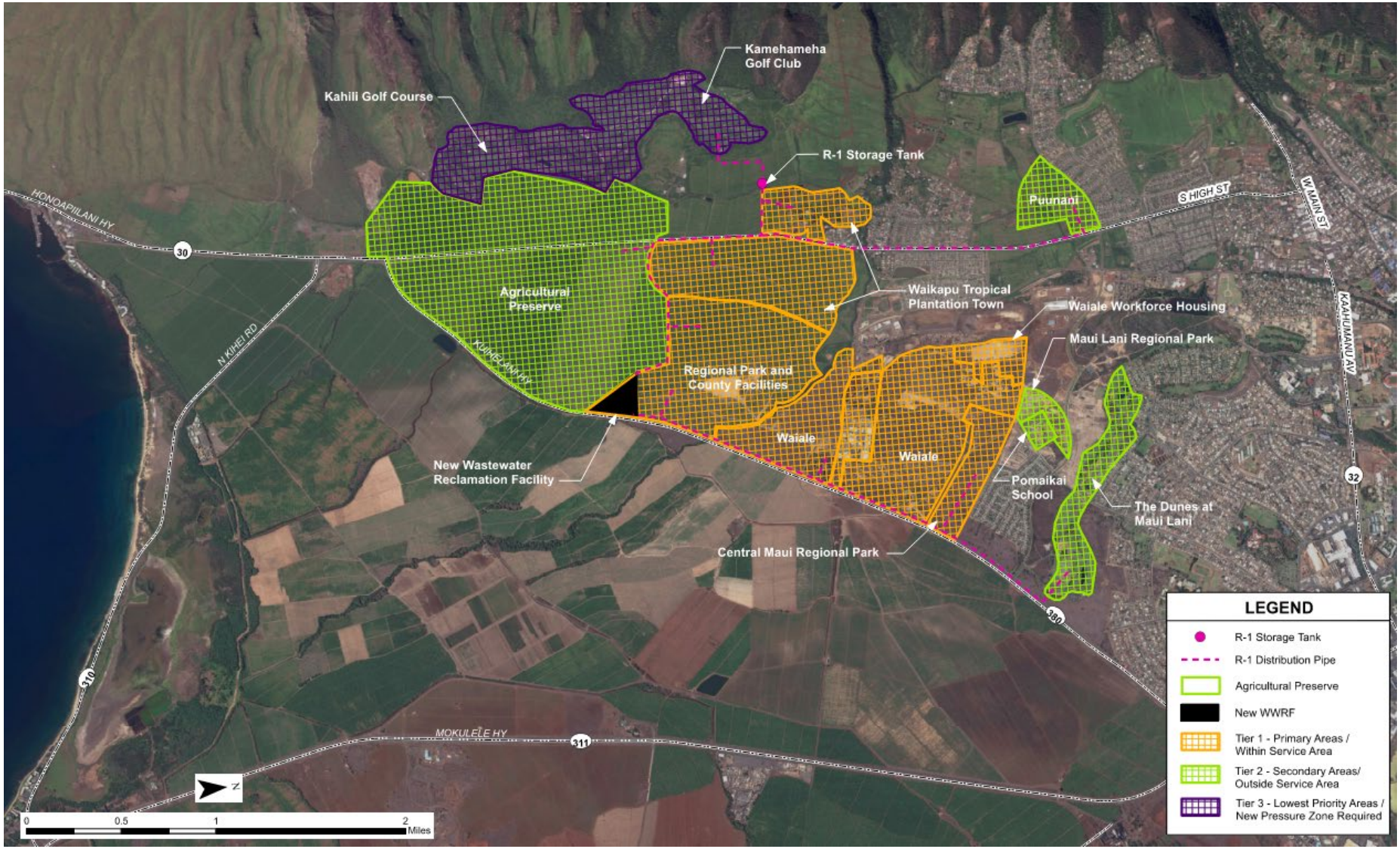


- Resolution No. 06-23 (Feb 2006) accepted a study that assessed wastewater infrastructure needs for Central Maui region.
- Concerns for future of Wailuku-Kahului WWRF included:
  - Remaining Capacity
  - Shoreline Erosion
  - Potential Tsunami Impacts
- Recommendations include "*Implement the long-term plan of action to service the Central Maui Service Area*".

# PROJECT NEED

- Central Maui Recycled Water Study was completed by Brown and Caldwell in 2015.
- The study considered how the County could provide wastewater service to designated growth areas in Central Maui.
- Goal was to recycle as much effluent from a new WWRF as possible.

# PROJECT NEED



# PROJECT NEED

The Central Maui WWRF Project is considered necessary for the following reasons:

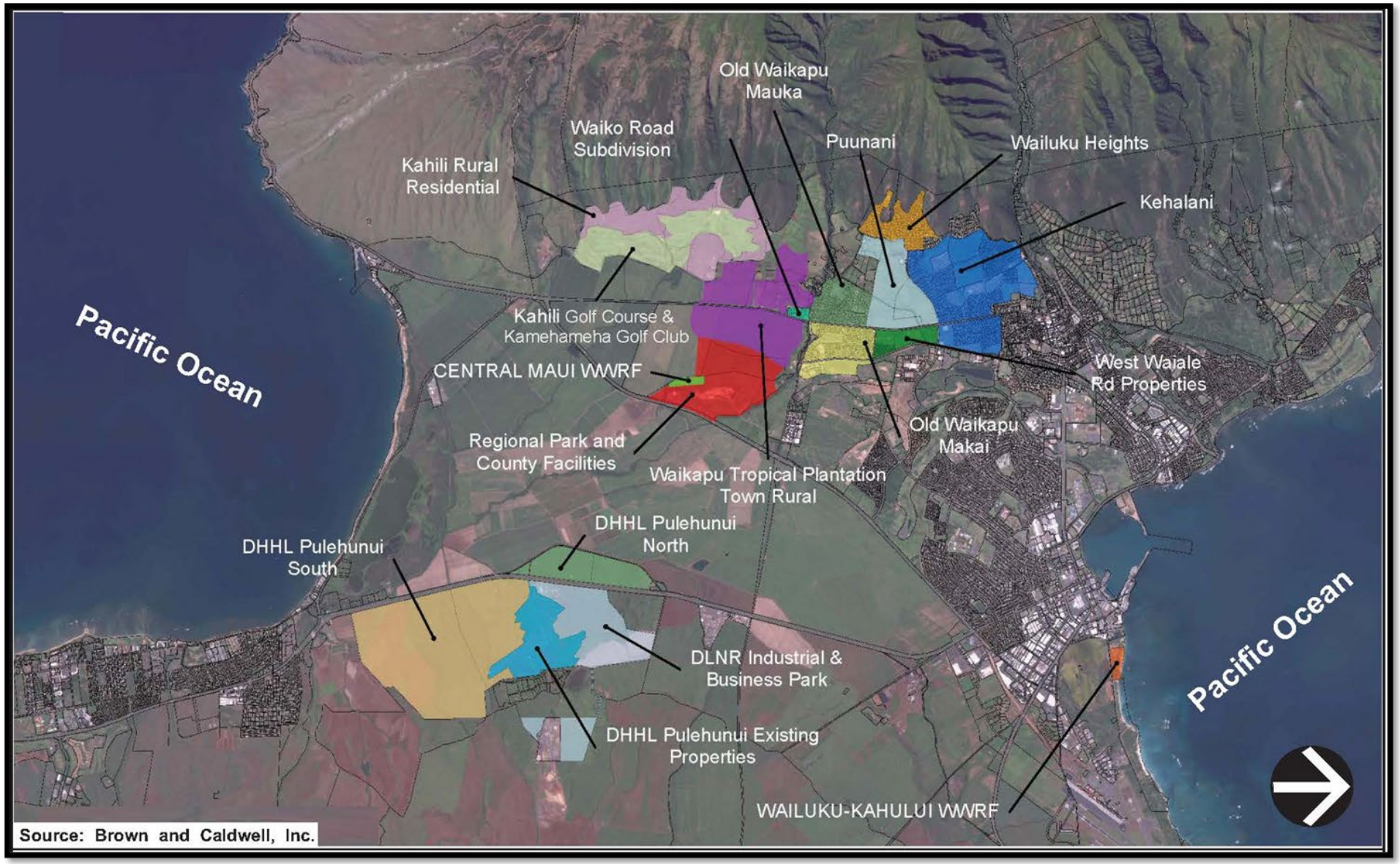
- Provides additional wastewater capacity to support existing and additional housing on Maui, including affordable housing.
- Alleviates pressure on existing Wailuku-Kahului WWRF.
- County selected an inland site that is resilient from tsunami hazard/shoreline erosion sea level rise and outside of SMA.
- Provides for over 90% reuse of R-1 water for agricultural/irrigation use.
- Helps to reduce use of injection wells at County facilities by selecting nature-based, Soil Aquifer Treatment (SAT) system as a backup system.

# PROJECT OVERVIEW

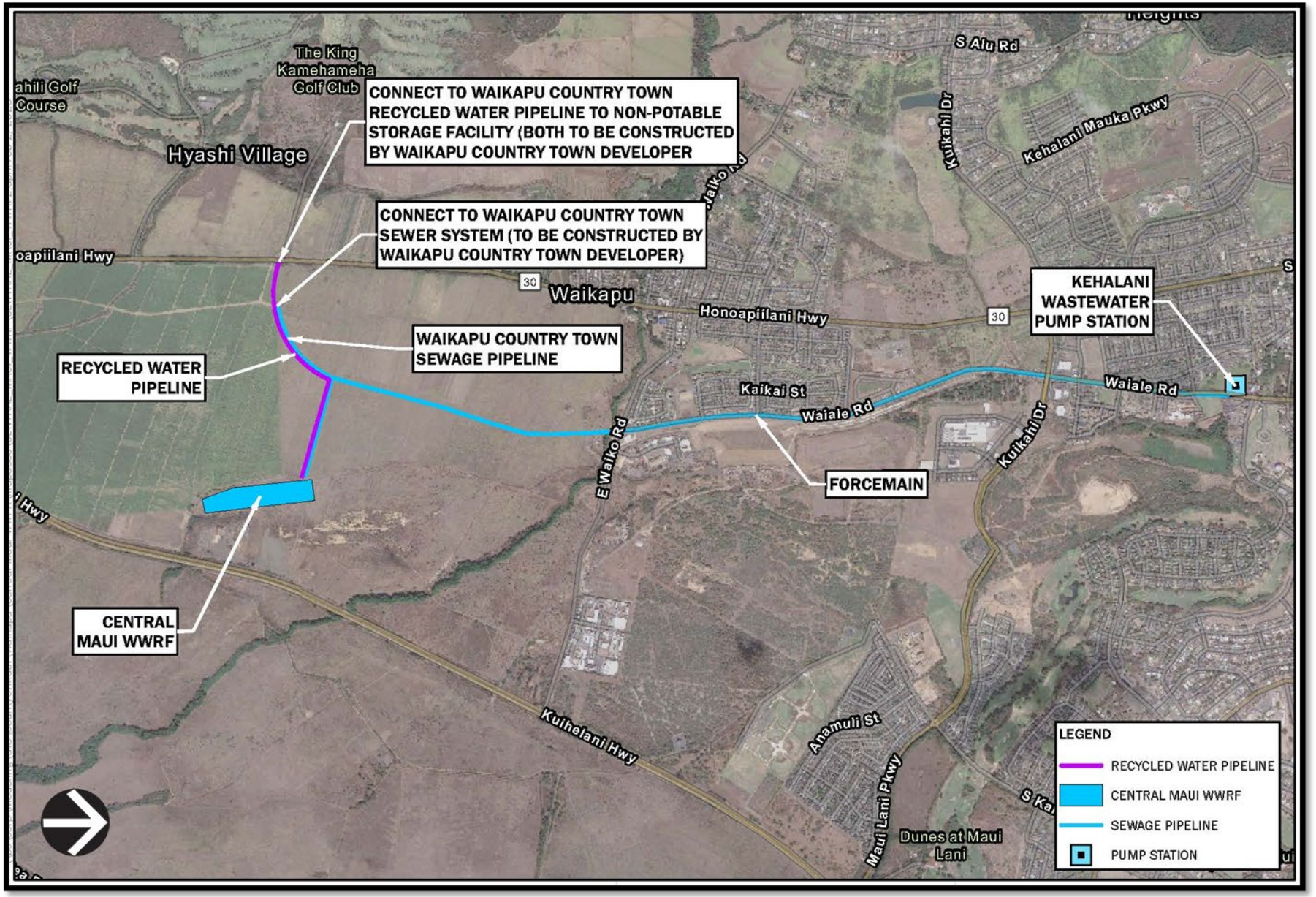
# PROJECT OVERVIEW

- Service area
- Wastewater transmission
- Wastewater treatment
- Water recycling of treated effluent
- Disposal of treated effluent that can’t be reused

# SERVICE AREA



# WASTEWATER TRANSMISSION



# PROJECT LOCATION

| Project Component | Tax Map Key (TMK) and/or Location | Land Ownership | Existing Use |
|---|---|---|---|
| **Central Maui WWRF and Onsite SAT System** | TMK (2)3-8-005:023 (por.) | County of Maui | Vacant |
| **Kehalani Sewage Pipeline** | Existing Waiʻale Road (ROW) | County of Maui | Roadway |
| | Existing Waiko Road (ROW) | County of Maui | Roadway |
| | Existing Kuikahi Drive (ROW) | County of Maui | Roadway |
| | TMK (2)3-5-001:017 (por.) | Kehalani Holdings Company Inc. | Roadway |
| | TMK (2)3-5-001:120 (por.) | Kehalani Holdings Company Inc. | Roadway |
| | TMK (2)3-5-002:014 (por.) | Waiko Baseyard LLC | Vacant |
| | TMK (2)3-5-002:888 (Waikapū Stream) | Unknown | Stream |
| | Future Waiʻale Road extension (by others) (TMK (2)3-6-002:003(por.)) | Waiale 905 Partners, LLC | Vacant |
| | Future Waiʻale Road extension (by others) and access and utility corridor (TMK (2)3-6-002:004(por.)) | County of Maui | Vacant |
| | TMK (2)3-8-005:023(por.) | County of Maui | Vacant |
| **Kehalani WWPS** | TMK (2)3-5-020:036 (por.) | County of Maui | Stormwater Basin |
| **Waikapū Country Town Sewage Pipeline and R-1 Recycled Water Pipeline** | Future Waiʻale Road extension (by others) (TMK (2)3-6-002:003 (por.)) | Waiale 905 Partners, LLC | Vacant |
| | Future Waiʻale Road extension (by others) and access and utility corridor (TMK (2)3-6-002:004(por.)) | County of Maui | Vacant |
| | TMK (2)3-8-005:023(por.) | County of Maui | Vacant |

# CENTRAL MAUI WASTEWATER RECLAMATION FACILITY

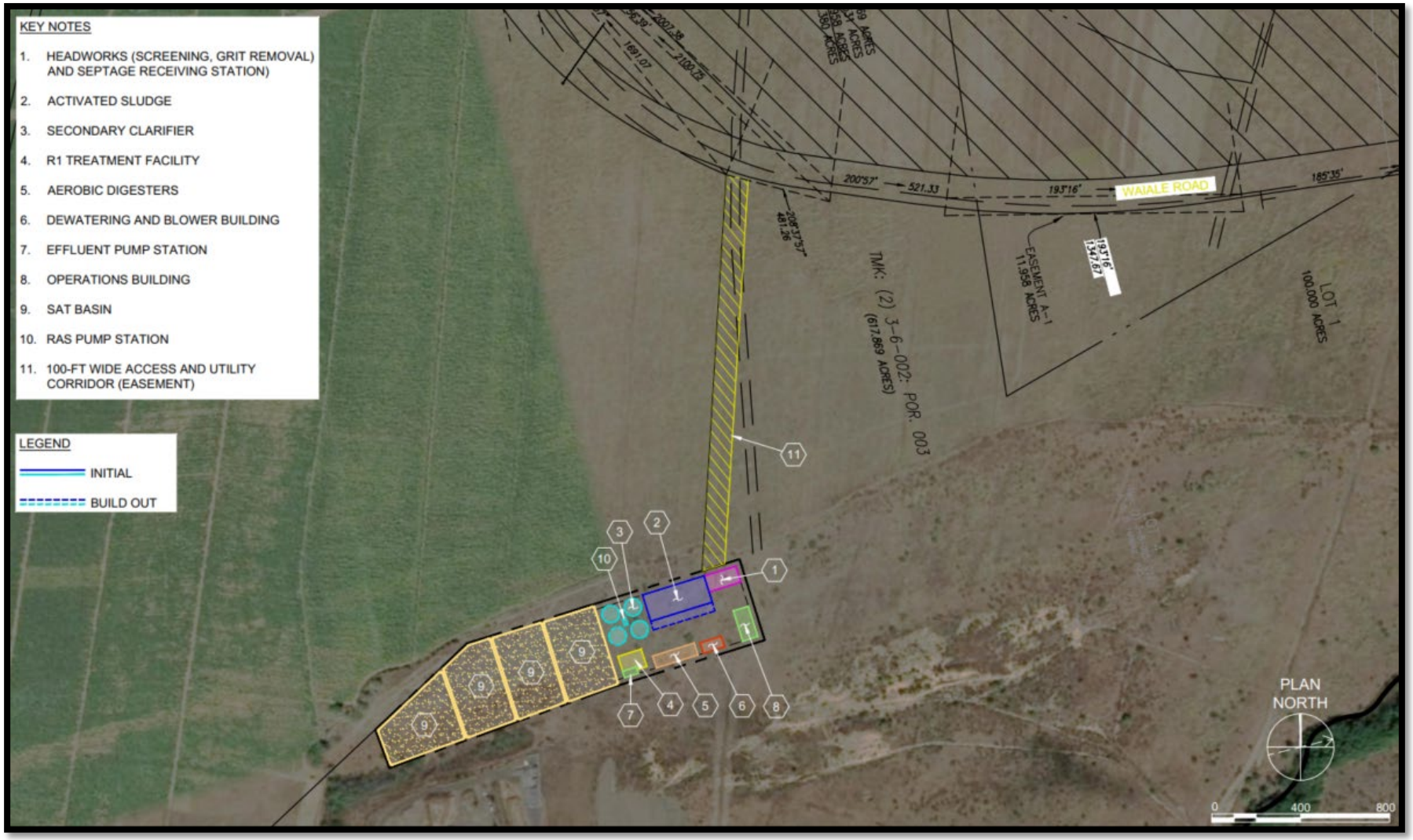


# WASTEWATER TREATMENT 101

- **Preliminary treatment** – physical treatment to remove debris and grit
- **Secondary treatment** – biological treatment to remove solids, carbon, and nutrients
- **Tertiary treatment** – filtration to remove fine particles
- **Disinfection** – kill or inactivate bacteria and virus
- **Solids management** – what's left over

# ACCESS AND UTILITY CORRIDOR

A 100-foot wide access and utility corridor (easement) from future Wai‘ale Road Extension for vehicular access by DEM and contractors.



# CENTRAL MAUI WASTEWATER RECLAMATION FACILITY

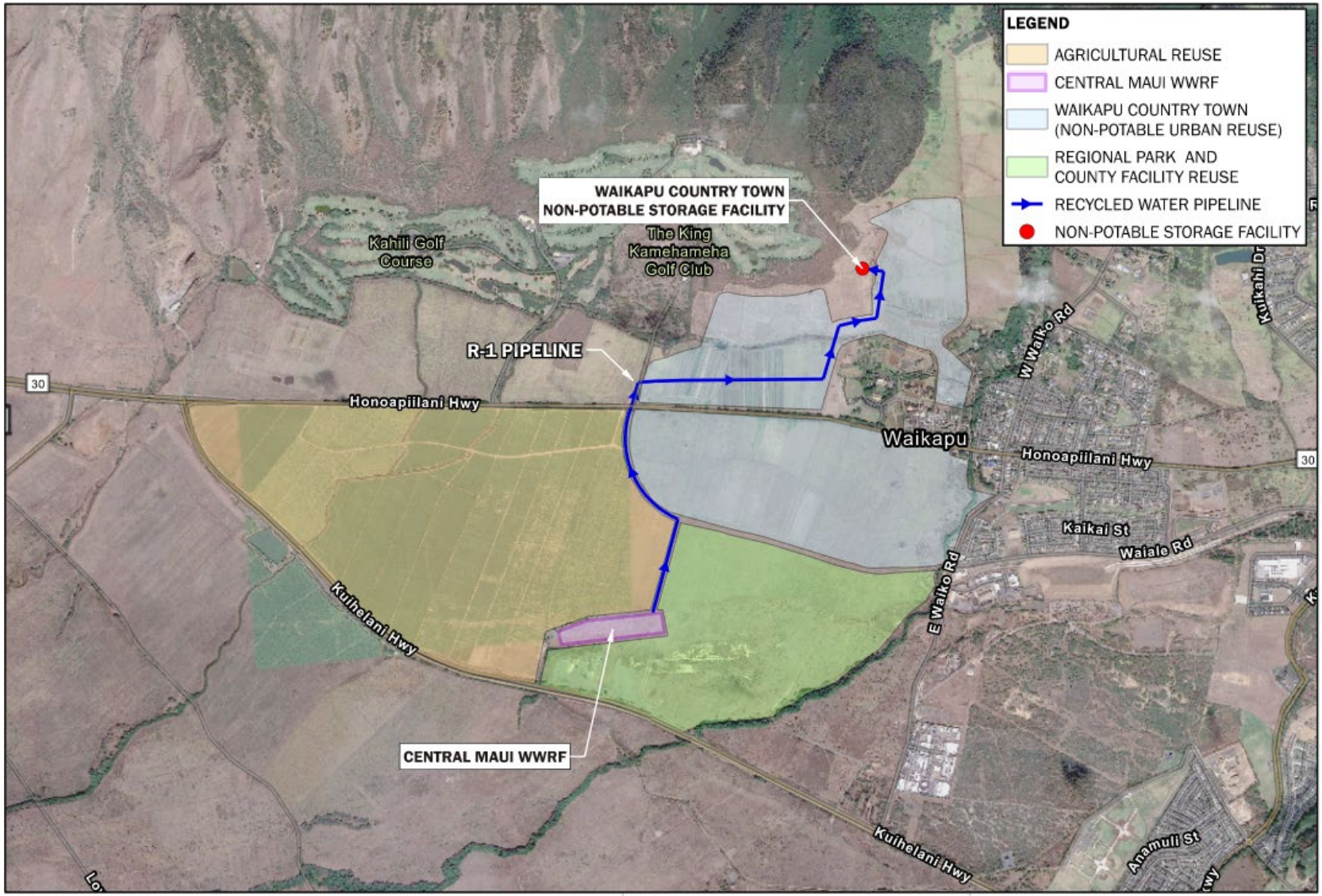


# CMWWRF RECYCLED WATER

- Regulated by Department of Health
- “R-1” recycled water – highest quality
- Safe for irrigation where public contact could occur
  - Parks
  - Schools
  - Golf courses
  - Street landscaping
  - Agriculture

# RECYCLED WATER USERS

Greater than 90% of WWRF effluent is projected to be recycled.

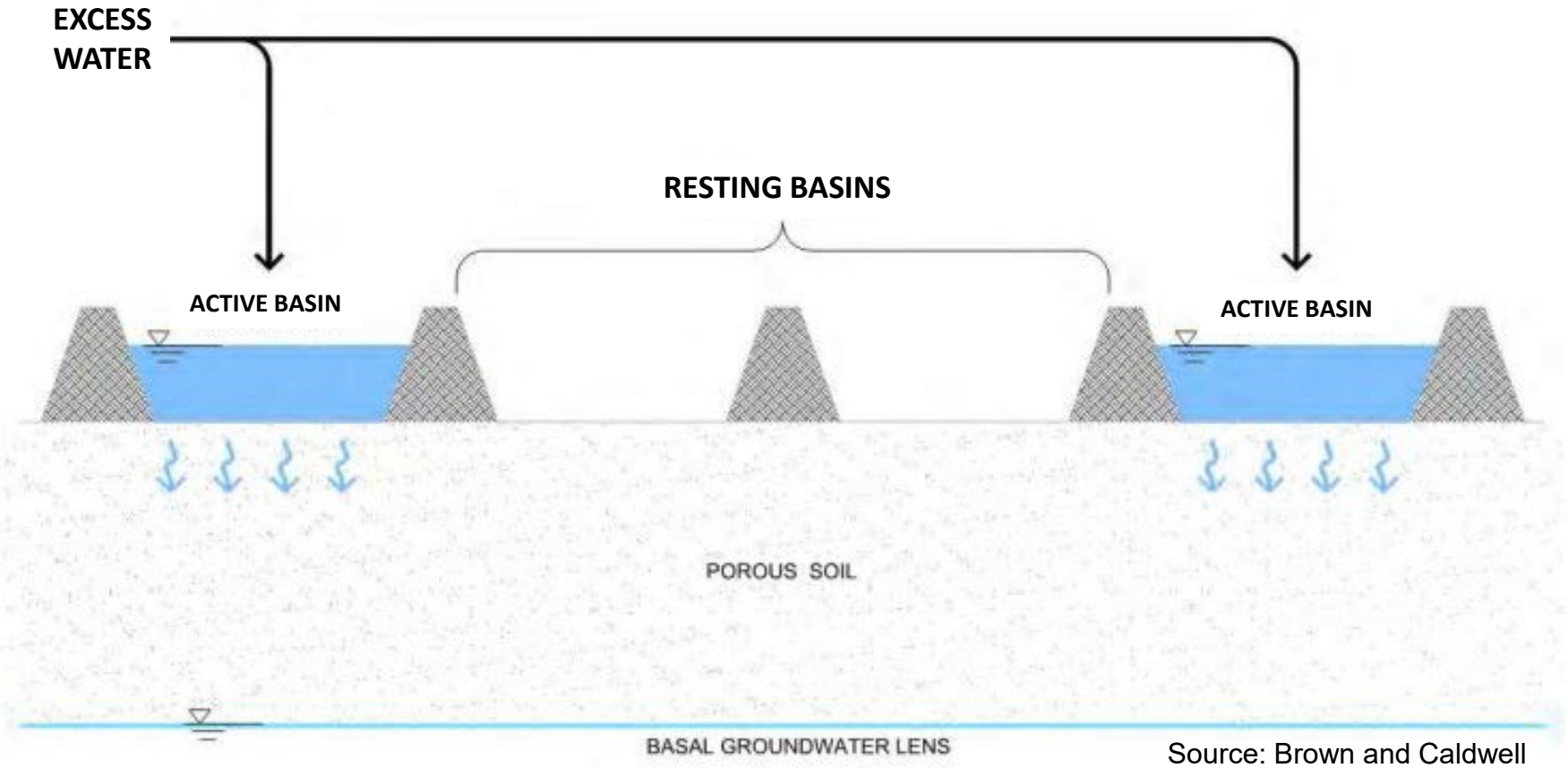


# EFFLUENT DISPOSAL SYSTEM

- DOH requires a secondary disposal system for all recycled water projects
  - Used when supply > demand (i.e., wet weather)
  - Used when effluent doesn't meet R-1 standards
- CMWWRF will use Soil Aquifer Treatment (SAT) for effluent disposal
  - EPA recognized form of land treatment
  - State of the art system for groundwater recharge
  - Removes nutrients, metals, trace organic compounds, pharmaceuticals
- First SAT in Hawai‘i

# WHAT IS SOIL AQUIFER TREATMENT (SAT)?

SAT consists of intermittent application of treated effluent from WWRF at high hydraulic loading rates to basins constructed in highly permeable soils (i.e. sand or gravel).




Source: Brown and Caldwell

# WHAT IS SOIL AQUIFER TREATMENT (SAT)?

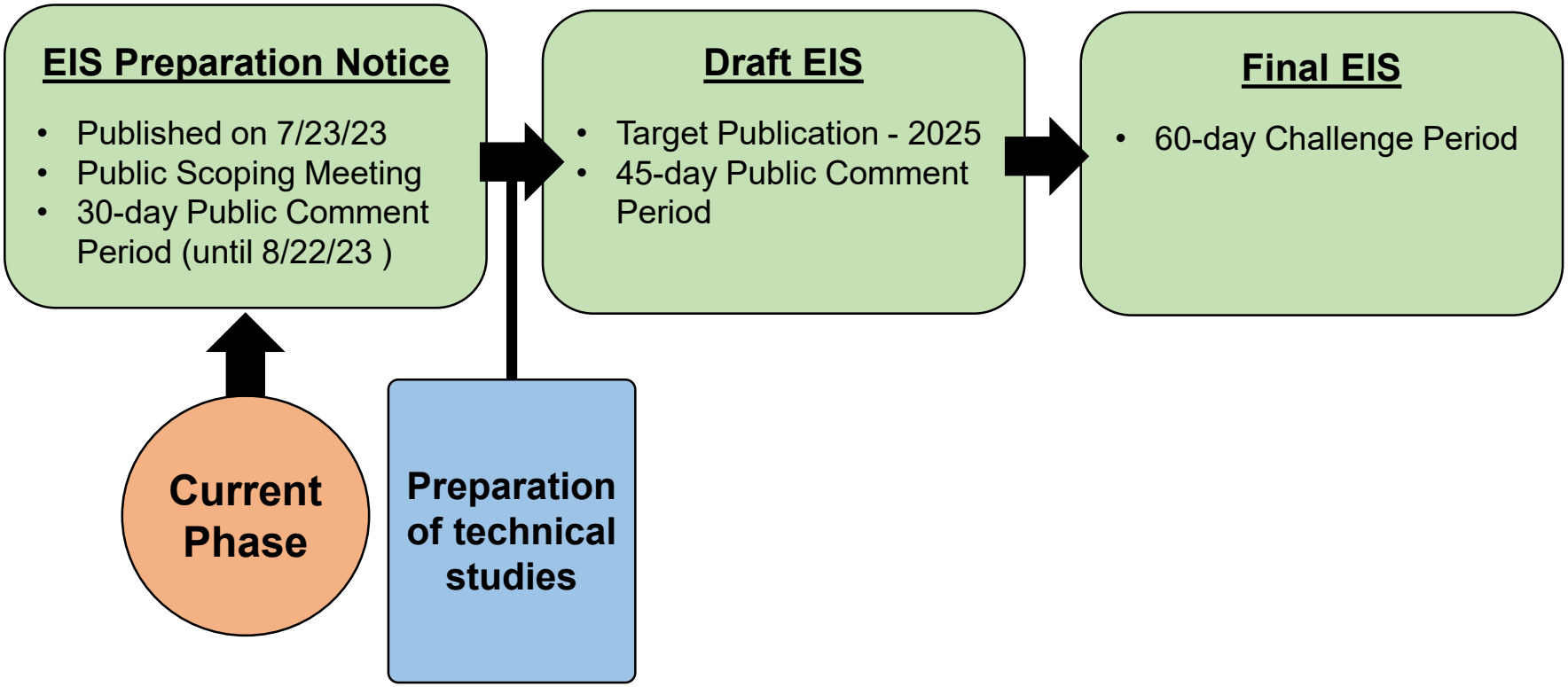


# SUMMARY

- New WWRF will be designed to accommodate 4 million gpd
- Service areas include:
  1. Existing Development (diverted from Wailuku-Kahului WWRF) – 45%
  2. New Anticipated Development – 48%
  3. Future Additional Capacity – 7%
- Effluent will comply with DOH requirements for R-1 recycled water
- Primary method of disposing treated effluent is to deliver R-1 water to future Waikapū Country Town development
- Onsite Soil Aquifer Treatment (SAT) system will be used as a backup system

# CHAPTER 343, EIS PROCESS

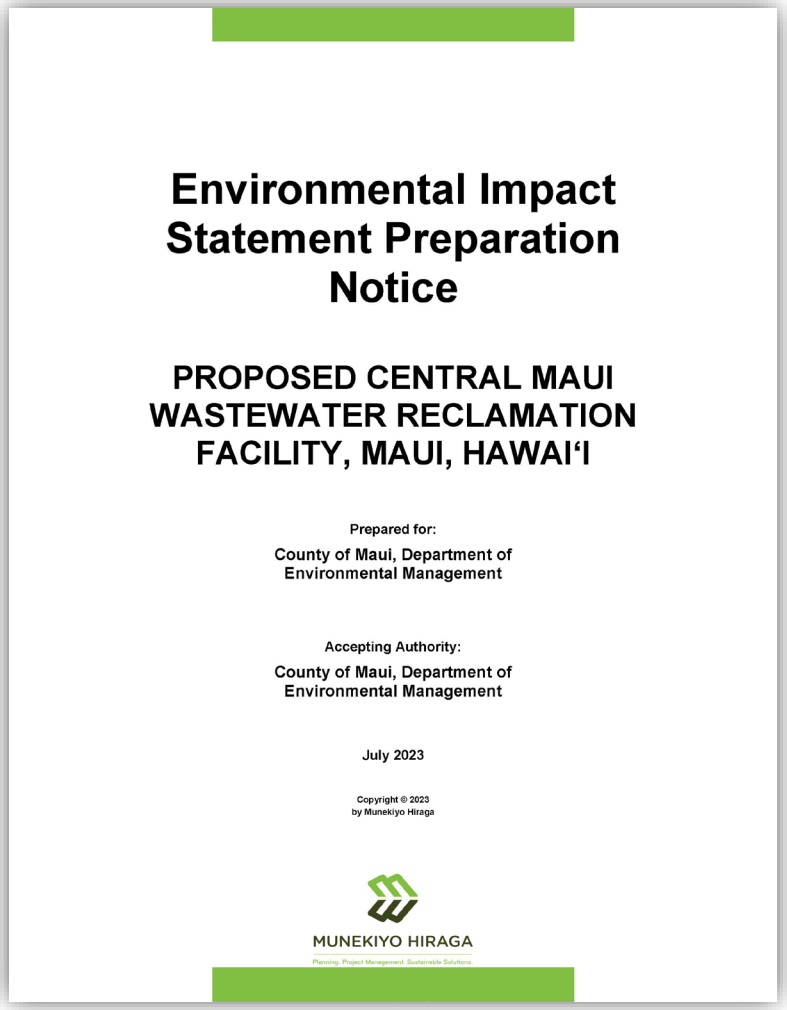
# ENVIRONMENTAL IMPACT STATEMENT (EIS) PROCESS



# TECHNICAL STUDIES FOR EIS

| TECHNICAL STUDY |
| --- |
| Traffic Impact Assessment Report (TIAR) |
| Construction Traffic Management Plan (TMP) |
| Flora and Fauna Survey Report |
| HRS 6E Archaeological Documentations |
| Cultural Impact Assessment (CIA) |
| Air Quality and Greenhouse Gas Emissions Study |
| Noise Study |
| Agricultural Impact Assessment |
| View Analysis |
| Fiscal and Economic Impact Analysis |
| Facilities Plan |
| Preliminary Engineering and Drainage Report |
| Hydrogeological Study |

# EISPN PUBLICATION




The EISPN was published on July 23, 2023 in The Environmental Notice.

**Scan QR code for EISPN or go to link provided below**

**https://tinyurl.com/CMauiWWRF**

# NEXT STEPS

# NEXT STEPS

- Draft EIS to be prepared following completion of technical studies
  - Publication of Draft EIS anticipated in 2025
  - 45 Day Public Comment Period
- Final EIS to be prepared
- After EIS process is complete, land use entitlements for the 14.9-acre WWRF site will be processed by the County:
  - District Boundary Amendment
  - Community Plan Amendment
  - Change of Zoning
- Construction permitting and construction anticipated in 2027 – 2029
- Operation initiation anticipated to be late 2029

# PUBLIC COMMENTS

# HOW TO PROVIDE COMMENTS

- **OPTION 1** - Complete a comment card at this meeting
- **OPTION 2** - Provide oral comments at this meeting
- **OPTION 3** - Provide a comment letter and send the letter to addresses below:

  Yukino Uchiyama, AICP, Manager
  Munekiyo Hiraga
  305 High Street, Suite 104 Wailuku, Hawai‘i 96793

  Via Email: CentralMauiWWRF@munekiyohiraga.com

**DEADLINE FOR COMMENTS: AUGUST 22, 2023**

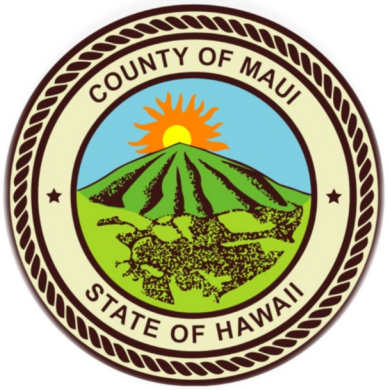
# GUIDELINES FOR PROVIDING COMMENTS

1. As a friendly reminder, this is not a Question and Answer session and no decisions or approvals are being made at this time. The purpose of the meeting is to receive comments on issues to be studied in the EIS.

2. Comments are invited on:
   - The proposed project (range of actions), alternatives, impacts, and mitigation measures to be considered in the Draft EIS
   - Significant issues to be analyzed in depth in the Draft EIS

3. Please limit comments to 3 minutes. If time permits, individuals may be presented with a second 3-minute comment period after everyone has had the opportunity to speak. Additional comments may be submitted in writing.

# MAHALO!



# REPRESENTATIVE CONSULTATION REQUEST (EISPN) LETTER

# APPENDIX U

MUNEKIYO HIRAGA
Planning. Project Management. Sustainable Solutions.

Karlynn K. Fukuda
PRESIDENT
Mark Alexander Roy AICP, LEED AP
VICE PRESIDENT
Tessa Munekiyo Ng AICP
VICE PRESIDENT

Michael T. Munekiyo AICP
SENIOR ADVISOR

July 20, 2023

NAME, TITLE
AGENCY
DIVISION
ADDRESS
CITY, STATE ZIP CODE

SUBJECT: Environmental Impact Statement Preparation Notice for the Proposed Central Maui Wastewater Reclamation Facility; Maui, Hawai‘i

Dear SALUTATION:

On behalf of the County of Maui, Department of Environmental Management (DEM), we are providing for review and comment the Environmental Impact Statement Preparation Notice (EISPN) for the proposed Central Maui Wastewater Reclamation Facility prepared pursuant to Hawai‘i Revised Statutes (HRS), Chapter 343, and Hawai‘i Administrative Rules, Title 11, Chapter 200.1.

The EISPN was published in the July 23, 2023 edition of the Environmental Review Program's (ERP) *Environmental Notice* bulletin and can be accessed through the ERP website via the link below:

https://files.hawaii.gov/dbedt/erp/Doc_Library/2023-07-23-MA-EISPN-Central-Maui-Wastewater-Reclamation-Facility.pdf

We would appreciate any comments you may have on the EISPN no later than **Tuesday, August 22, 2023**.

Please send your comments to the following:

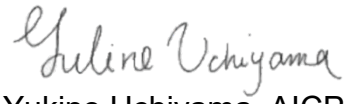
**Consultant:** Yukino Uchiyama, AICP
Munekiyo Hiraga
305 High Street, Suite 104
Wailuku, Hawai‘i 96793
(808)983-1233
CentralMauiWWRF@munekiyohiraga.com

**AND**

**Agency:** Juan Rivera, P.E.
County of Maui
Department of Environmental Management
Wastewater Reclamation Division
2200 Main Street, Suite 610
Wailuku, Maui, Hawai'i 96793
(808)270-7268
environmental.mgmt@co.maui.hi.us

Thank you for your participation in the environmental review process.

Very truly yours,



Yukino Uchiyama, AICP
Manager

YU: ab
cc: Juan Rivera, Department of Environmental Management
Eric Nakagawa, Department of Environmental Management
Scott Rollins, Department of Environmental Management
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MUNEKIYO HIRAGA

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