ECONOMIC, POPULATION AND FISCAL IMPACTS REPORT

APPENDIX F

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Miki Basin Industrial Park:
• Socio-Economic Conditions
• Economic, Population and Fiscal Impacts

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• Socio-Economic Conditions
• Economic, Population and Fiscal Impacts

PREPARED FOR:

Pūlama Lāna‘i

PREPARED BY:

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Contents

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Executive Summary

1. Planned Development

Miki Basin Industrial Park (the **Project** or **Miki 200**) is a proposed master-planned development on a 200-acre site located in the Miki Basin area on the island of Lāna‘i, Hawai‘i. The project will include approximately 100 acres of light industrial and 100 acres of heavy industrial zoned lands.

Following approval, most Project development is expected to occur over a period of about 10 years, but development could require more or less time, depending on the pace of future economic and population growth, market conditions and lot leases.

By 2030, the use of industrial land at Miki 200 is projected to be as follows:

	Acres
— Committed	
• Infrastructure	20.0
• Renewable energy	127.0
• Concrete/rock-crushing facility	14.5
• Asphalt plant	12.5
— Typical industrial activities	7.6
— Vacant (projected development after 2030)	18.4
— Total	**200.0**

As indicated, about 18.4 acres will accommodate the demand for industrial land beyond 2030. More importantly, this acreage will provide land approved for development and may have major infrastructure in order to take immediate advantage of any new economic opportunities which may arise, thereby diversifying Lāna‘i’s economy.

2. Employment Benefits

a. Construction and Related Employment

During the Project’s initial 10-year development period, construction employment is expected to average about 19 jobs per year. Indirect employment related to Project development is expected to average about 29 jobs per year. Thus, total direct-plus-indirect employment associated with Project development activities will average about 48 jobs per year. The actual job count will fluctuate over time, depending on the pace of construction.

b. Operating Employment, 2030

Onsite operating employment is expected to grow to about 60 new jobs by 2030. These jobs will include entry-level positions to highly skilled professionals.

3. Fiscal Benefits

a. County

Project development activity is expected to have a negligible impact on County finances inasmuch as the developer will provide or pay its fair-share of support infrastructure (interior roads, water distribution, sewers, drainage, etc.).

At full development, the Project is expected to generate net income to the County of approximately $380,000 per year. Net revenues are positive largely because of the property taxes.

Inasmuch as the Miki 200 is expected to be developed in conjunction with forecasted population growth for Lāna‘i, the County is not expected to realize significant additional increases in expenditures as a direct result of the Project.

b. State

Unlike the County, the State derives substantial net revenues from development activity. Over the initial 10-year construction period, the State will net about $5.6 million from construction and related economic activities associated with the Project, or an average of about $560,000 million per year.

At full development, the Project is expected to generate net income to the State of about $670,000 per year. The positive return to the State reflects the various taxes on economic activities associated with Miki 200. As with County services, additional State expenditures are not anticipated to be required to support operations of the Project.

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Miki Basin Industrial Park:
• Socio-Economic Conditions
• Economic, Population, and Fiscal Impacts

Part I: Introduction and Proposed Project

1. Introduction

a. Content and Purpose

Miki Basin Industrial Park (the **Project** or **Miki 200**) is a proposed master-planned development on a 200-acre site located in the Miki Basin area on the island of Lānaʻi, Hawaiʻi.

This report addresses (1) the socio-economic conditions on Lānaʻi, and (2) the economic, population and fiscal impacts of the Project. The purpose is to provide the community, State of Hawaiʻi (**State**) officials and County of Maui (**County**) officials with relevant information about planned development and operations.

Socio-economic conditions includes information about the population, housing, incomes, education, economic activities, employment and labor force on Lānaʻi.

Economic impacts cover expenditures and sales, profits, employment and payroll related to (1) construction and related activities, and (2) operations of the Project.

Population impacts cover the number of residents supported by jobs created by the development and operations, and the number of homes required to house these residents.

Fiscal impacts address the impact of the Project on State and County revenues and expenditures.

b. Methodology

Socio-Economic Conditions

Demographic, social, household and economic characteristics of the population were obtained from the 2010 census by the U.S. Census Bureau, and from the American Community Survey ("**ACS**"). The ACS is an ongoing survey that provides up-to-date information about the nation's population. The ACS includes questions that were not included in the 2010 decennial census (but, historically, were included in the 2000 census). The most up-to-date available data from the ACS are five-year estimates from 2015-2019.

Economic and Fiscal Impacts

Multipliers

The proposed development and operations are translated into economic and fiscal impacts based on a number of multipliers (for example, indirect sales as a percentage of direct sales, construction jobs per $1 million in expenditures, indirect jobs per direct jobs, and tax rates). These multipliers reflect the professional judgment of the consultant, and were based on information from the following sources: U.S. Census data; the *State of Hawai'i Data Book; The Hawaiʻi State Input-Output Study: 2012 Benchmark Report* (I-O Model); employment and labor rates from the Hawaiʻi Department of Labor and Industrial Relations (**DLIR**); State and County tax rates.

Direct and Indirect Impacts

"**Direct**" economic impacts (gross sales, employment, payroll, etc.) are the immediate effects of a change in a particular sector of the economy (e.g., construction activity). Traditionally, "indirect" impacts are changes in other sectors of the economy that are caused by the direct impacts (e.g., transportation of building supplies), but exclude impacts related to the purchase of goods and services by employees and their families (**household spending**). Traditionally, "induced" impacts are changes in the economy that are caused by the household spending by those who are affected by the direct and indirect changes in the economy. In this report, "**indirect**" economic impacts are redefined broadly to include both the traditional indirect economic impacts and the induced economic impacts.

2019 Dollars

For the economic and fiscal impacts (Part III), dollar amounts are expressed in terms of 2019 purchasing power and market conditions. The year 2019 was used because it is the last year of "normal" economic conditions before COVID-19. Values, prices, costs and dollar amounts for prior years are adjusted for inflation to 2019 dollars based on the Honolulu Consumer Price Index (CPI) for Urban Consumers. Dollar amounts after 2019 are not increased to account for inflation, appreciation in property values, changes in labor rates, changes in building costs, or other changes in market conditions. However, fiscal impacts are based on current tax rates (i.e., August 2021 rates).

Accuracy of Estimates

Much of the analysis contained in this report is quantitative in nature, where numbers are used to help communicate anticipated impacts. However, these numbers should not be interpreted as precise predictions. Rather, they represent the best estimates of what is

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expected to occur based on available information about planned development and operations, market conditions, and tax rates.

c. Organization of the Report

The report is divided into three Parts:

— Part I: Introduction and Proposed Project

— Part II: Socio-Economic Conditions

— Part III: Economic, Population and Fiscal Impacts

All Figures in this report are embedded in the text, while all tables are at the end. Socio-economic conditions for Lānaʻi and the County are presented in Tables II-1 and II-2. Economic, population and fiscal impacts are presented in Tables III-1 to III-5. In these tables, the quantities appearing in **bold** highlight the more significant impacts.

d. Economic Consultant

The analysis was conducted by Plasch Econ Pacific LLC (**PEP**), a Hawai'i-based economic-consulting firm specializing in economic development, land and housing economics, feasibility studies, valuations, market analysis, public policy analysis, and the economic and fiscal impacts of projects.

2. Project Overview

a. Project Location

The Miki 200 will be centrally located on a 200-acre site in Miki Basin on the island of Lānaʻi, about 1 mile east of the Lānaʻi Airport terminal, 2.7 miles southwest of Lānaʻi City, and 3.7 miles east of Kaumalapau Harbor (Figures I-1 and I-2). The Tax Map Key (TMK) for the Project area is (2)4-9-002:061(por.).

As shown in Figure I-3, the Project will abut (1) the Hawaiian Electric Company/Maui Electric Co. (**HECO**) power plant, and (2) the "Existing Industrial Condominium" (referred to as **Miki 20** since it is a 20-acre project in the Miki Basin).

b. Project Description

Consistent with the Lānaʻi Community Plan, Miki 200 will include 100 acres designated Light Industrial and 100 acres designated Heavy Industrial. It will be Lānaʻi's first large-scale industrial park. Lot sizes may range from less than a half-acre to 20 acres or more. Also, rental space may be available in industrial buildings if built. Infrastructure may include internal roads, water, power, sewers, drainage, etc.

Miki 200 will provide space for the relocation and/or expansion of existing industrial activities on Lānaʻi, land and warehouses for storing goods and equipment, and land and buildings to accommodate industrial activities new to Lānaʻi. Regarding the last point, it is important to have industrial land readily available and approved for development in order to take immediate advantage of any new economic opportunities which may arise.

c. Development Period

Following approval, most Project development is expected to occur over a period of about 10 years, but development could require more time, depending on the pace of future economic and population growth, market conditions and lot leases. About 9% of the land is expected to be developed after 2030.

d. Land Classifications and Required Approvals

Current land classifications of the Project Area and proposed changes are as follows:

— State Districts
- Current: Agricultural
- Proposed: Urban

— County Designations
- Lānaʻi Community Plan
  + Current: Light and Heavy Industrial
  + Proposed: No change
- Maui County Zoning
  + Current: Agricultural
  + Proposed: Light and Heavy Industrial

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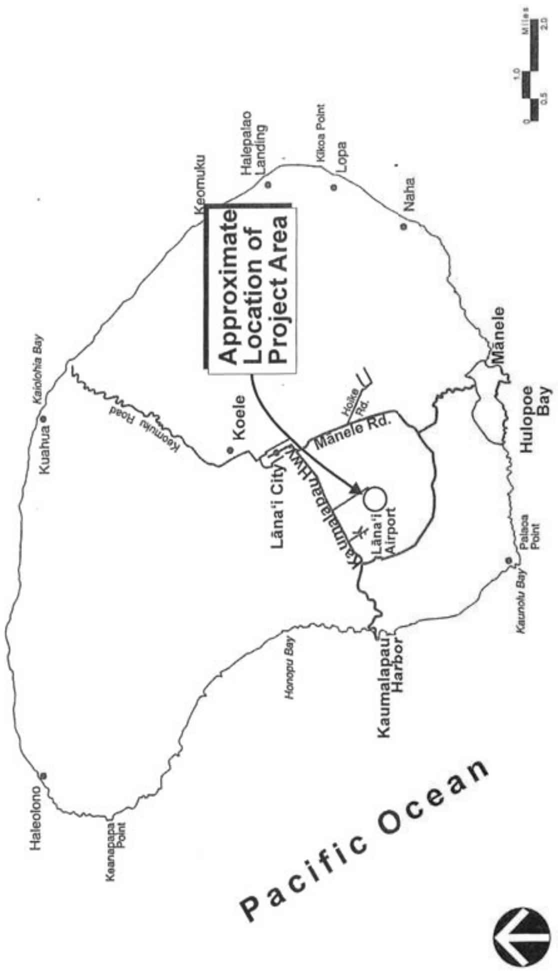

Figure I-1. Project Location, Lānaʻi

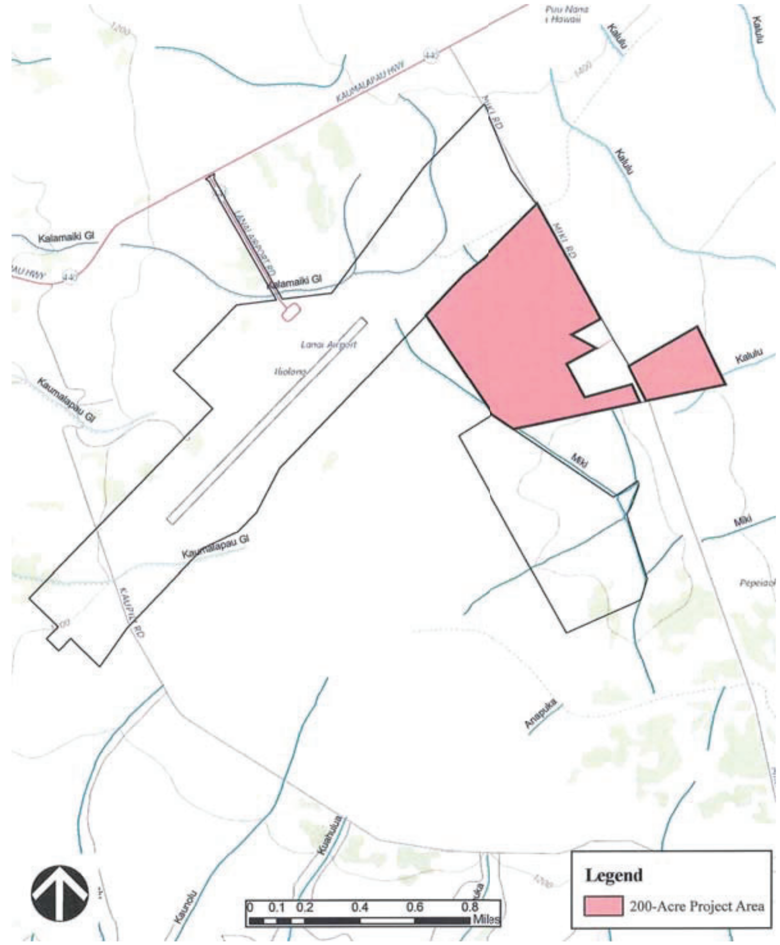

Figure I-2. Project Location, Miki Basin

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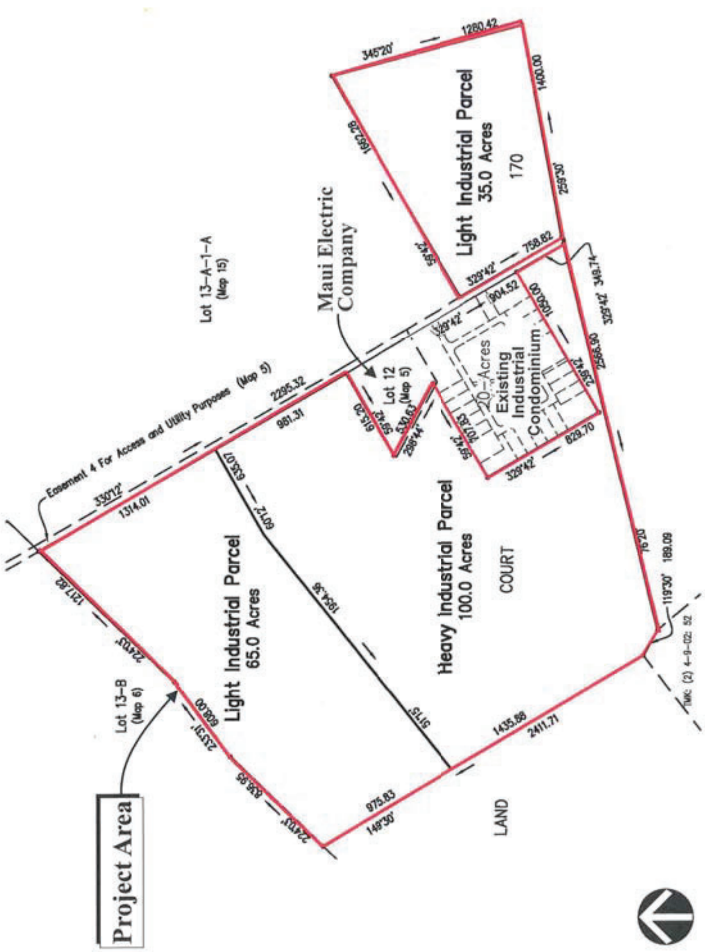

Figure I-3. Site Plan

Part II: Lanai's Economy and Socio-Economic Conditions

1. Economic Overview

From the 1920s to 1992, the primary economic activity on Lānaʻi was growing pineapple for the mainland canned-pineapple market.

Since the 1990s, the two resorts on Lānaʻi (Manele and Kōʻele) have been the primary driving forces for the economy. Manele and Kōʻele feature 213 and 96 luxury rooms and suites, respectively. In addition, both resorts include single-family homes and multi-family homes for retirees, part-time residents, visitors and managers. The purchase of goods and services by visitors, retirees, part-time residents, the hotel, and hotel employees generate most of the jobs on Lānaʻi.

Other economic driving forces on Lānaʻi's include:

- — Sensei Farms, a new hydroponic farm which exports fresh vegetables to markets throughout the Hawaiian Islands, and which employs about 50 workers.
- — Government operations (schools, the airport, the harbors, police, fire, post office, etc.)
- — Social security and retirement income paid to residents.
- — Government income-support payments.
- — Occasional construction activity for the building or renovation of hotels, homes, commercial and industrial buildings, government facilities, etc.

Except for the hotel at Manele, most commercial activities on the island are located in Lānaʻi City, including grocery stores, drug stores, restaurants, service stations, beauty salons, building suppliers, etc.

2. Socio-Economic Conditions

Tables II-1 and II-2 summarize socio-economic conditions for County of Maui and Lānaʻi. The County consists of the islands of Maui, Lānaʻi, Molokaʻi, Kahoʻolawe, and Molokini. Except where stated otherwise, the estimates below were reported by the American Community Survey.

a. Population

Between 2015 and 2019, Lānaʻi had a resident population of approximately 2,730, or 1.64% of the County population of 165,979 residents. Residents include those who live full-

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time or permanently in the County, and exclude visitors and part-time residents (i.e., those who live most of the time in a primary home located elsewhere).

Throughout most of the decade, the U.S. Census Bureau's five-year population estimate for Lānaʻi ranged from approximately 3,100 to 3,500 residents. However, in 2018 and 2019, the five-year estimate dipped below 3,000 residents. As noted above, the 2015-2019 five-year estimate was 2,730 people, which represents a 12.9% decrease from the 2010 population of 3,135 residents. Meanwhile, the population for the County as a whole has increased by 7.2% since 2010 (Table II-1).

The Lānaʻi Community Plan, which was updated and approved by the Maui County Council in 2016, originally projected that an additional 885 residents will live on the island by the year 2030, for a total population of 4,020 (based on the County's Land Use Forecast produced in December 2012). The Lānaʻi Community Plan did note that increased economic activity and development plans on the island may result in the population growing beyond the original forecast of up to 6,000 residents.

Between 2015 and 2019, Asian residents comprised a higher proportion of the Lānaʻi population compared to the County as a whole: 53.4% of residents were estimated to be Asians compared to 29.3% for the County (Table II-1).

The resident profile of Lānaʻi is older than that of the County as a whole. The median age on Lānaʻi was about 49.0 years old between 2015 and 2019 compared to 41.2 years for the County.

b. Households

The average household size on Lānaʻi is estimated to be 2.31 people per household between 2015 and 2019—a decrease from 2.71 people per household in 2010 (Table II-1). On average, households on Lānaʻi are smaller than households for the County —3.00 people per household.

Approximately 59.8% of the households were estimated to be homeowners. Also, an estimated 63.1% of the households were family households.

c. Housing

Between 2015 and 2019, Lānaʻi had an estimated 1,549 housing units (Table II-1). This figure includes resort/residential units that were used as second homes, or were available for visitors, or were vacant. Approximately 23.8% of housing units were vacant, compared to 25.5% for the County.

Most residents live in Lānaʻi City in single family homes of less than 1,500 square feet on lots of about 6,000 square feet or less (Google Maps). According to the County tax records, many of the homes on Lānaʻi were built before 1940.

d. Income and Education

The mean household income on Lānaʻi between 2015 and 2019 was estimated at $73,484, 39.8% lower than the County as a whole (Table II-2). Correspondingly, Lānaʻi had a lower per-capita income.

A slightly lower proportion of residents on Lānaʻi completed some secondary education compared to the County as a whole. An estimated 50.7% of Lānaʻi residents attended some college or received a higher education degree, compared to 60.8% of the residents for the County. About 67.2% of the households spoke only English at home, while 31.5% spoke Asian and Pacific Island languages.

3. ECONOMIC ROLE OF SHIPPING

Inasmuch as Lānaʻi is a small island with a small population and a small economy, few consumer and business goods are produced on the island. Instead, most goods must be imported by barge or airfreight from Honolulu. Barge service is weekly, but the service is canceled occasionally due to kona storms. Airfreight is available daily, but the capacity is low and the shipping rates are higher than the barge rates.

4. IMPLICATIONS FOR INDUSTRIAL ACTIVITIES ON LĀNAʻI

Economic development is needed on Lānaʻi in order to provide jobs and increase incomes for the residents. As mentioned above, the average household income on Lānaʻi is 39.8% lower than the County-wide average.

For both residents and businesses, Lānaʻi needs more storage space than other communities of similar size because most goods must be imported, and shipping is infrequent and occasionally unreliable. And for most residents, home storage is limited by the relatively small lots and homes.

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Part III: Economic, Population and Fiscal Impacts

1. Planned Development

The development plans for Miki 200 are summarized in Table III-1.

a. Zoning and Land Use

Zoning (proposed)

As indicated previously, Miki 200 will include 100 acres designated Light Industrial and 100 acres designated Heavy Industrial, which is consistent with the Lānaʻi Community Plan (Table III, Section 1.a).

Land Use, 2030

As mentioned in Subsection I.2.b, Miki 200 will be Lānaʻi's first large-scale industrial park. Lot sizes may range from less than a half-acre to 20 acres or more. Also, rental space may be available in industrial buildings, if built.

Committed Industrial Uses

About 174 acres are committed for infrastructure and industrial activities, including:

— Infrastructure: about 20 acres

Internal roads, drainage areas and common areas are expected to require about 20 acres (10%) of the Project area.

— Renewable Energy: about 127 acres

HECO has requested proposals for a 17.5 megawatt (**MW**) photo voltaic system on Lānaʻi plus a 70 MW-hour (**MWh**) battery energy storage system (**PV+BESS**). To help meet the need for renewable energy on Lānaʻi, Pūlama Lānaʻi plans to allocate 127 acres at Miki 200 for renewable energy. The acreage is based on the energy facility being developed at the Pacific Missile Range Facility (**PMRF**) on Kauaʻi (14 MW/70MWh PV+BESS).

— Concrete/Rock Crushing Facility: about 14.5 acres

Pūlama Lānaʻi's concrete recycling and rock- crushing facility uses equipment to crush concrete and rocks into various sizes and types of aggregate to construct roadways, sidewalks, etc., and for backfill throughout the island for construction projects.

The facility and equipment are mobile, and are temporarily located on 1.6 acres at Miki 20. Miki 200 will provide a permanent base for the operation, water for washing equipment and controlling dust, and a central location for serving the island. Most of the acreage for the relocated operation will be used for stockpiling (1) various types of material to be crushed and (2) various grades of aggregate. These stockpiles will provide an ample and ready supply of aggregate when needed.

After the relocation of operations to Miki 200, the 1.6 acres now used at Miki 20 will come available for other industrial activities.

— Asphalt Plant: about 12.5 acres

Pūlama Lānaʻi's asphalt plant is a hot-mix batch plant that services both the community and Pūlama Lānaʻi. The asphaltic concrete produced from this plant supplies material required to pave new roads, and to repair and repave existing ones.

This mobile facility will be relocated from its current temporary site near Kaumalapau Harbor to Miki 200 in order to provide a permanent base of operations in a central location for serving the island. The current location near the harbor will be used for stockpiling supplies.

Typical Industrial Activities by 2030

"Typical industrial activities" are defined to include those industrial activities typically found in Hawaiʻi (such as manufacturing, warehouses, base yards, etc.), but excluding those activities listed in the previous section (i.e., PV+BESS, concrete/rock-crushing facilities, and asphalt plants).

A partial list of industrial activities that could or are likely to develop at Miki 200 include the following:

- Vehicle rentals (cars, 4-wheel drive vehicles, trucks, etc.)
- Vehicle maintenance and repair (engines, transmissions, tires, body, etc.)
- Car wash
- All-terrain vehicle sales, maintenance, repair, etc.
- Small-boat supplies, maintenance and repair (including fishing gear)
- Commercial laundry services for residents
- Base yards and storage for construction trucks, equipment and supplies (lumber, bricks, cement, pipes, roofing, sheetrock, etc.)
- A base of operations for home maintenance, repairs and services (roofing, electrical, plumbing, appliances, cleaning services, pools, etc.)

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— A base of operations for maintaining and repairing office equipment (computers, printers, wifi networks, etc.)

— Self-storage space for household goods, records, business supplies, etc.

— Shops and crafts (metal, woodcrafts, taxidermy, lei hulu, etc.)

— Fruit and vegetable processing, possibly with a shared commercial kitchen

— Veterinarian services and pet supplies at a fixed location

— A gym featuring exercise and therapy equipment

— A fixed location for a slaughtering facility and cold storage for hunted animals (i.e., axis deer and mouflon sheep)

— Laboratories (medical, environmental, etc.)

— Shared office facilities for business at Miki 200

The market assessment for Miki 200 forecasts that about 7.6 acres will be used for “typical industrial activities” by 2030.

Industrial Activities After 2030

About 18.4 acres at Miki 200 will accommodate the demand for industrial land beyond 2030. More importantly, this acreage will provide industrial land approved for development and may have major infrastructure in order to take immediate advantage of any new economic opportunities which may arise, thereby diversifying Lāna‘i’s economy. This acreage will also be available to accommodate “typical industrial activities” before 2030 in the event that the pent-up demand is greater than estimated.

Fully Improved and Partially Improved Lots

Improved lots will be offered for lease, with the lots having access to internal roads, water, power, sewers, the drainage system, etc. However, the lots planned for renewable energy, the concrete/rock crushing facilities and the asphalt plant will be partially improved given the nature of these activities. These lots, which will cover about 154 acres, will require less road development, less water or no water, less power or no power, less waste-water disposal or no disposal, etc.

b. Building Space

As mentioned above, estimated 7.6 acres will be used for “typical industrial activities” by 2030. This acreage may accommodate about 114,000 sq. ft. of building space (Table III-1, Section 1.b). It is anticipated that some of this space may be occupied by businesses relocating from home operations in Lāna‘i City.

2. ECONOMIC IMPACTS OF DEVELOPMENT ACTIVITIES

The development of the Project may involve the following activities: (1) grading and other work to prepare the site for development; (2) construction of internal roads, a water delivery system, a sewer system, drainage systems, utilities systems, etc.; (3) rental of lots to component developers; and (4) construction of buildings. Table III-2 summarizes the direct and indirect economic impacts of these development activities. The material in this table gives the development period, construction expenditures, indirect sales generated by the construction activity, profits, and employment and payroll.

a. Development Period

As mentioned previously, most Project development is expected to occur over a period of about 10 years (Table III-2, Section 4.a). Given the current economy and population, along with projected growth, significant demand for industrial space is expected during this period. However, development could require more time, depending on future market conditions, lot leases, and the construction of buildings.

b. Construction Expenditures and Related Sales

Over the 10-year development period, total construction expenditures for the Project are estimated at about $78.8 million (Table III-2, Section 2.b). This translates into average construction expenditures of about $7.9 million per year. In practice, construction expenditures will vary from year to year. Infrastructure costs normally occur in the early years of development as the backbone infrastructure is installed. Construction expenditures associated with possible buildings and other improvements will be made over time as the lots are leased and developed.

In addition to construction, other development expenditures will be incurred for planning, permitting, design, financing, marketing, and sales commissions.

In addition to construction expenditures, development activities will generate indirect sales 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. These indirect sales will include sales by companies supplying building materials (cement, steel, lumber, roofing materials, plumbing equipment, electrical equipment, hardware supplies, lighting, flooring, etc.); rent out construction equipment; repair equipment; provide warehousing services; provide shipping and trucking services; etc. Indirect sales also include sales by grocery stores, drug stores, restaurants, service stations, beauty salons, medical providers, accountants, attorneys, insurance agents, etc.

Based on State economic multipliers, these indirect sales are expected to average about $5.0 million per year, of which about $3.0 million per year will be on the island of Lāna‘i and about $2.0 million on O`ahu (Table III-2, Section 2.b).

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Construction expenditures plus indirect sales related to construction are expected to average about $12.9 million per year. About $9.6 million per year will be subject to the State 4% excise tax on final sales, while about $3.3 million per year will be subject to the 0.5% excise tax on intermediate sales. Depending upon market conditions, development and sales in some years may be much higher or lower than the average.

c. Profits

Profits on construction expenditures and related sales are estimated to average about $1.7 million per year (Table III-2, Section 2.c). These profits will accrue to the various construction companies and subcontractors, and to the various companies that sell goods and services to those companies and the families deriving income from the construction activity.

d. Employment

During the Project's 10-year development period, construction employment is expected to average about 19 jobs per year (Table III-2, Section 2.e). These jobs will include supervisors, heavy-equipment operators (grading, roads, water mains, sewer lines, etc.), cement workers to lay foundations, metal workers, carpenters, plumbers, electricians, roofers, glass and window installers, cabinet makers, carpet and tile layers, painters, equipment installers, interior decorators, landscapers, etc. Other jobs related to construction will include architects, civil engineers, draftsmen, government inspectors, etc. These jobs will range over a variety of skill levels, including entry-level, semi-skilled, skilled, management, and professional positions.

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 (cement, steel, lumber, roofing materials, plumbing equipment, electrical equipment, hardware supplies, lighting, flooring, etc.); 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: grocery workers, store clerks, restaurant workers, service-station workers, beauty technicians, barbers, bankers, pharmacists, veterinarians, computer technicians, medical workers, accountant attorneys, etc. 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 29 jobs per year.

Thus, total direct-plus-indirect employment associated with Project development activities will average about 48 jobs per year.

e. Payroll

Development activities are expected to generate a total payroll of about $3.0 million per year for the Project, of which nearly $1.7 million will be for construction workers, and nearly $1.4 million for indirect employment (Table III-2, Section 2.f). These estimates are based on the average number of direct and indirect jobs multiplied by average wages as reported by the DLIR.

Wages are expected to average about $87,800 per year for construction jobs and about $47,000 for indirect jobs.

f. Sources of Construction Workers

The construction labor force on the island of Lāna‘i is limited. As such, it is assumed that a mix of on-island and off-island construction workers will fill the various jobs generated by the proposed development. In the past, construction workers have commuted to Lāna‘i to fill the labor requirements of building projects.

3. Economic Impacts of Operations, 2030

Table III-3 summarizes economic impacts of operations at Miki 200 in 2030.

a. Economic Activities

As mentioned previously, industrial activities at Miki 200 by 2030 will include the renewable energy facility (ie., PV+BESS), the concrete/rock-crushing facility, the asphalt plant, and "typical industrial activities."

The PV system is expected to generate about 35,800 MWh per year of energy, which is based on HECO's request for proposals.

The concrete/rock-crushing facility and the asphalt plant will be relocated from elsewhere on Lāna‘i, so are not new activities to the island. These operations are owned by Palama Lāna‘i, and generate little or no revenues.

"Typical industrial activities" are expected to use about 114,000 sq. ft. of space at Miki 200 by 2030. About about 23,700 sq. ft. of this space may be used for self-storage facilities (based on the market assessment for Miki 200).

Some of the companies at Miki 200 are expected to be businesses that will relocate from home operations in Lāna‘i City. The space required to accommodate these existing business is estimated at 17,700 sq. ft. based on 5% of the households on Lāna‘i × an average of 300 sq. ft. per household. Thus, the net increase in "typical industrial activities" is projected to be about 96,300 sq. ft., including about 23,700 sq. ft. used for self-storage facilities.

b. Revenues

By 2030, new economic activities at Miki 200 are expected to generate about $17.1 million per year in revenues (Table III-3, Section 3.b).

c. Rental Income

Rental income is expected to reach nearly $1.7 million per year, including (1) rent from the renewable energy facility and (2) rents from the industrial space within buildings (Table III-3, Section 3.c). However, the rental income does not include land rents for those lots having buildings.

d. Profits

Corresponding new profits will amount to about $1.6 million per year by 2030 (Table III, Section 3.d).

e. Employment

The industrial activities at Miki 200 will generate about 60 new jobs by 2030 (Table III-3, Section 3.e). Most of these new jobs will be provided by "typical industrial activities." Also, about 8 additional employees will be hired for concrete/rock-crushing and asphalt operations.

The industrial jobs at Miki 200 will range over a variety of skill levels, including entry-level, semi-skilled, skilled, highly skilled professionals, and management positions.

f. Payroll

By 2030, total payroll for the new jobs is estimated at about $2.8 million per year (Table III-3, Section 3.f).

g. Sources of Skilled Workers

As Miki 200 will be developed over a number of years, skilled workers will be recruited from various schools, companies, and other organizations in Hawai‘i and on the mainland. The jobs will appeal to skilled workers who want to apply their training and skills in order to remain in Hawai‘i or return to Hawai‘i.

Programs to increase the supply of professionals and skilled workers are the responsibility of the various universities, colleges, and technical schools.

h. Supported Population and Housing

New jobs at Miki 200 will support approximately 120 residents in 50 homes by 2030 (Table III, Section 3.g).

4. IMPACTS ON COUNTY REVENUES AND EXPENDITURES

The impact of the Project on County finances is shown in Table III-4. This table summarizes: (1) revenues and expenditures related to development activities, and (2) revenues and expenditures related to operations in 2030.

a. Development Activities

The County derives negligible tax revenues from development activity.

Regarding County expenditures to support the Project, they also are expected to be negligible. As with other major projects in the County, the developer and builders will provide or finance their fair shares of infrastructure and facilities to support the Project. This may include interior roads, interior water distribution, sewers, drainage systems, etc. Also, construction activities require few onsite services from the County. Furthermore, construction companies will provide their own security, sanitation, transportation, etc.

As a result, Project development activity will result in a negligible impact on County finances during the development period.

b. Operations, 2030

By 2030, Miki 200 will generate additional property tax revenues to the County of about $380,000 per year (Table III-4, Section 4.b). Nominal revenues from other taxes and user fees will be generated but are not estimated.

Inasmuch as the Miki 200 is expected to be developed in conjunction with forecasted population growth for Lāna‘i, the County is not expected to realize significant additional increases in expenditures as a direct result of the project. Thus, the Project is projected to generate about $380,000 per year in net revenues to the County.

5. IMPACTS ON STATE REVENUES AND EXPENDITURES

The impact of the Project on State finances is shown in Table III-5. This table summarizes: (1) revenues and expenditures related to development activities, and (2) revenues and expenditures related to operations in 2030.

a. Development Activities

Unlike the County, the State derives substantial revenues from development activity. Over the initial 10-year development period, Project development activities are expected to generate about $5.6 million in revenues for the State, for an average of about $560,000 per year (Table III-5, Section 5.a). Most of the revenues will be derived from (1) excise taxes and (2) corporate and personal income taxes.

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State expenditures to support Project development activities are expected to be negligible. Infrastructure and facilities to support the Project are primarily a County responsibility, with most of the fair share provided or financed by the developer. Also, Construction activities will require few onsite services from the State. Furthermore, most required services will be provided by construction companies.

Over the initial 10-year development period, the State will net about $5.6 million from development activities associated with the Project, for an average of about $560,000 per year.

b. Operations, 2030

By 2030, Miki 200 will generate increased revenues to the State of about $670,000 per year (Table III-5, Section 5.b). State revenues will include excise taxes, corporate and personal income taxes. Nominal revenues from other taxes and user fees will be generated but are not estimated.

Additional State expenditures are not anticipated to be required to support operations of the Project.

Thus, the Project is projected to generate about $670,000 per year in net revenues to the State by 2030.

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Part II Tables:
Socio-Economic Conditions

Table II-1. Demographic Characteristics, County of Maui and Island of Lana'i: 2010 and 2015–2019 Estimates

Item	County of Maui			Lana 'i		
	2010	2015-2019	Change	2010	2015-2019	Change
Population (residents)	154,834	165,979	7.2%	3,135	2,730	-12.9%
Male	77,587	82,633	6.5%	1,600	1,396	-12.8%
Female	77,247	83,346	7.9%	1,535	1,334	-13.1%
Distribution						
Male	50.1%	49.8%		51.0%	51.1%	
Female	49.9%	50.2%		49.0%	48.9%	
Population by Age						
Pre-school Age, 4 and Under	10,020	9,907	-1.1%	235	124	-47.2%
School Age, 5 to 19	29,117	29,706	2.0%	621	366	-41.1%
Working Age, 20 to 64	95,894	97,271	1.4%	1,805	1,546	-14.3%
Retirement Age, 65 and Over	19,803	29,095	46.9%	474	694	46.4%
Distribution						
Pre-school Age, 4 and Under	6.5%	6.0%		7.5%	4.5%	
School Age, 5 to 17	18.8%	17.9%		19.8%	13.4%	
Working Age, 18 to 64	61.9%	58.6%		57.6%	56.6%	
Retirement Age, 65 and Over	12.8%	17.5%		15.1%	25.4%	
Median Age	39.6	41.20	4.0%	38.6	49.00	26.9%
Ethnicity						
White alone	53,336	58,891	10.4%	460	488	6.1%
Black or African American alone	870	845	-2.9%	5	0	-100.0%
American Indian and Alaska Native alone	603	424	-29.7%	2	0	-100.0%
Asian alone	44,595	48,579	8.9%	1,745	1,459	-16.4%
Native Hawaiian and Other Pacific Islander alone	16,051	18,093	12.7%	205	186	-9.3%
Some Other Race alone	3,051	2,865	-6.1%	5	52	940.0%
Two or More Races	36,328	36,282	-0.1%	713	545	-23.6%
Distribution						
White alone	34.4%	35.5%		14.7%	17.9%	
Black or African American alone	0.6%	0.5%		0.2%	0.0%	
American Indian and Alaska Native alone	0.4%	0.3%		0.1%	0.0%	
Asian alone	28.8%	29.3%		55.7%	53.4%	
Native Hawaiian and Other Pacific Islander alone	10.4%	10.9%		6.5%	6.8%	
Some Other Race alone	2.0%	1.7%		0.2%	1.9%	
Two or More Races	23.5%	21.9%		22.7%	20.0%	

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Table II-1. Demographic Characteristics, County of Maui and Island of Lana'i: 2010 and 2015–2019 Estimates

(continued)

Item	County of Maui			Lana 'i		
	2010	2015-2019	Change	2010	2015-2019	Change
Households	53,886	54,479	1.1%	1,158	1,181	2.0%
Average Size	2.82	3.00	6.4%	2.71	2.31	-14.8%
Tenure						
Homeowners	30,055	33,232	10.6%	591	706	19.5%
Renters	23,831	21,247	-10.8%	567	475	-16.2%
Distribution						
Homeowners	55.8%	61.0%		51.0%	59.8%	
Renters	44.2%	39.0%		49.0%	40.2%	
Household Type						
Family Household	35,498	38,249	7.7%	788	745	-5.5%
Non-family Household	18,388	16,230	-11.7%	370	436	17.8%
Distribution						
Family Household	65.9%	70.2%		68.0%	63.1%	
Non-family Household	34.1%	29.8%		32.0%	36.9%	
Housing Units	70,379	73,169	4.0%	1,545	1,549	0.3%
Occupied	53,886	54,479	1.1%	1,158	1,181	2.0%
Vacant	16,493	18,690	13.3%	387	368	-4.9%
For seasonal, recreational, or occasional use	9,956	n/a		108	n/a	
Distribution						
Occupied	76.6%	74.5%		75.0%	76.2%	
Vacant	23.4%	25.5%		25.0%	23.8%	
For seasonal, recreational, or occasional use	14.1%	n/a		7.0%	n/a	

Sources:

U.S. Censusu Bureau. Decennial Census. 2010.

U.S. Census Bureau. American Community Survey 5 Year Estimate, 2015-2019.

Table II-2. Income and Education, County of Maui and Island of Lana'i: 2010–2014 and 2015–2019 Estimates

Item	County of Maui			Lana 'i		
	2010-2014	2015-2019	Change	2010-2014	2015-2019	Change
Income						
Mean Household Income	$84,035	$102,759	22.3%	$67,475	$73,484	8.9%
Per Capita Income	$29,499	$35,241	19.5%	$23,262	$33,052	42.1%
Educational Attainment, 25 Years and Older						
Less than 9th Grade	4,393	4,416	0.5%	146	219	50.0%
Grades 9 to 12, No Diploma	6,007	5,057	-15.8%	158	128	-19.0%
High School Graduate, No College	34,941	36,912	5.6%	896	723	-19.3%
Some College, No Degree	27,200	27,584	1.4%	505	408	-19.2%
Associate Degree	9,854	12,029	22.1%	170	229	34.7%
College, Bachelor's Degree	19,374	21,366	10.3%	367	334	-9.0%
Graduate or Professional Degree	9,000	10,753	19.5%	170	136	-20.0%
Total Population, Age 25 and Older	110,769	118,117	6.6%	2,412	2,177	-9.7%
Distrbution						
Less than 9th Grade	4.0%	3.7%		6.1%	10.1%	
Grades 9 to 12, No Diploma	5.4%	4.3%		6.6%	5.9%	
High School Graduate, No College	31.5%	31.3%		37.1%	33.2%	
Some College, No Degree	24.6%	23.4%		20.9%	18.7%	
Associate Degree	8.9%	10.2%		7.0%	10.5%	
College, Bachelor's Degree	17.5%	18.1%		15.2%	15.3%	
Graduate or Professional Degree	8.1%	9.1%		7.0%	6.2%	
Language Spoken at Home (Household)						
English Only	117,369	120,418	2.6%	2,299	1,751	-23.8%
Spanish	2,768	5,896	113.0%	-	33	0.0%
Other Indo-European	2,483	1,647	-33.7%	1	1	0.0%
Asian and Pacific Island languages	25,882	27,466	6.1%	967	821	-15.1%
Others	234	645	175.6%	-	-	0.0%
Distribution						
English Only	78.9%	77.2%		70.4%	67.2%	
Spanish	1.9%	3.8%		0.0%	1.3%	
Other Indo-European	1.7%	1.1%		0.0%	0.0%	
Asian and Pacific Island languages	17.4%	17.6%		29.6%	31.5%	
Others	0.2%	0.4%		0.0%	0.0%	

Sources:

U.S. Census Bureau. American Community Survey 5 Year Estimate, 2010-2014.

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Part III Tables:
Economic, Population and Fiscal Impacts

Table III-1. Planned Development
(Values in 2019 dollars)

Item	Source or Multiplier	Amount	Units
1.a. ZONING AND LAND USE			
Zoning (proposed)			
Light Industrial	Pulama Lanai	100.0	acres
Heavy Industrial		100.0	acres
Total Industrial		**200.0**	**acres**
Land Use, 2030			
Infrastructure	Pulama Lanai	20.0	acres
Renewable Energy	Pulama Lanai	127.0	acres
Concrete/Rock-Crushing Facility	Pulama Lanai	14.5	acres
Asphalt Plant	Pulama Lanai	12.5	acres
Typical Industrial Activities	Market Assessment	7.6	acres
Vacant (to be developed after 2030)	Market Assessment	18.4	acres
Total Use		200.0	acres
Fully Improved and Partially Improved Areas			
Full Improvements	residual	46.0	acres
Partial Improvements	Renewable energy, concrete/rock-crushing facility and asphalt plant	154.0	acres
Total		200.0	acres
1.b. BUILDING SQUARE FOOTAGE			
Typical Industrial Activities	15,000 sq ft per acre	**114,000**	**sq. ft.**

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Table III-2. Economic Impacts of Development Activities

(Values in 2019 dollars)

Item	Source or Multiplier	Amount	Units
2.a. DEVELOPMENT PERIOD			
Duration of Construction (for most development)		**10**	**years**
2.b. CONSTRUCTION AND RELATED EXPENDITURES			
Construction Costs			
Sitework, Infrastructure and Utilities			
Full Improvements	$ 200,000 per acre	$ 9,200,000	
Partial Improvements	$ 20,000 per acre	$ 3,080,000	
Renewable Energy	17.5 MW $ 2.5 million/MW	$ 43,750,000	
Relocation Costs, Crushing Facilities		n.e.	
Relocation Costs, Asphalt Plant		n.e.	
Buildings	$200 per sq. ft.	$ 22,800,000	
Total Construction and Related Expenditures		**$ 78,830,000**	
Construction Expenditures, Annual Average		**$ 7,883,000**	per year
Hawaii	55%	$ 4,335,700	per year
Imports	45%	$ 3,547,400	per year
Indirect Sales, Annual Average	1.15 of Hawaii exp.	**$ 4,986,055**	**per year**
Lanai	60%	$ 2,991,600	per year
Oahu	40%	$ 1,994,455	per year
Total Direct and Indirect Sales, Annual Average		**$ 12,869,055**	**per year**
Other Development Costs [1]		**n.e.**	
Final Sales (taxed at 4%)			
Construction Expenditures	above	$ 7,883,000	per year
Consumption	55% of payroll	$ 1,667,160	per year
Total Final Sales		**$ 9,550,160**	**per year**
Intermediate Sales (taxed at 0.5%)			
Indirect Sales Related to Construction	Section 4.c	$ 4,986,055	per year
Less Consumption	above	$ (1,667,160)	
Total Intermediate Sales		**$ 3,318,895**	**per year**
2.c. PROFITS			
Profits on Total Expenditures & Sales	10.0%	$ 1,286,906	per year
Risk Premium for Construction	5.0%	$ 394,200	per year
Total Profit from Construction & Related Activity		**$ 1,681,106**	**per year**
2.d. EMPLOYMENT (on-site & off-site)			
Construction Jobs	4.31 x sales/$1 mil	19	jobs/year
Indirect Jobs Generated by Construction	1.55 x direct jobs x	29	jobs/year
Total Employment		**48**	**jobs/year**
2.e. PAYROLL			
Construction Payroll	$ 87,800 per job	$ 1,668,200	per year
Payroll for Indirect Employment	$ 47,000 per job	$ 1,363,000	per year
Total Payroll		**$ 3,031,200**	**per year**

[1] Before realizing profits, developers must pay a number of development-related costs in addition to construction costs. These "Other Development Costs" include planning, permitting, design, financing, marketing, and sales commissions.

Table III-3. Economic Impacts of Operations, 2030

(Values in 2019 dollars)

Item	Source or Multiplier	Amount	Units
3.a. ECONOMIC ACTIVITIES			
On Site			
Renewable Energy	HECO	35,800	MWh/yr
Concrete/Rock-Crushing Facility	Table III-1, Section 1.a	14.5	acres
Asphalt Plant	Table III-1, Section 1.a	12.5	acres
Typical Industrial Activities	Table III-1, Section 1.b	114,000	sq. ft.
Typical Industrial Activities, Excluding Self-Storage	derived	90,300	sq. ft.
Self-Storage	Market Assessment	23,700	sq. ft.
Relocated Activities			
Concrete/Rock-Crushing Facility	Pulama Lanai	14.5	acres
Asphalt Plant	Pulama Lanai	12.5	acres
Typical Industrial Activities, Excluding Self-Storage	5% of households 1,181 households 300 sq. ft per household	17,700	sq. ft.
New To Lanai			
Renewable Energy		35,800	MWh/yr
Typical Industrial Activities		96,300	sq. ft.
Typical Industrial Activities, Excluding Self-Storage	residual	72,600	sq. ft.
Self-Storage	Market Assessment	23,700	sq. ft.
3.b. REVENUES			
Revenues, On-Site Activities			
Renewable Energy	$ 0.10 per kWh	$ 3,580,000	per year
Concrete/Rock-Crushing Facility	Pulama Lanai	$ -	per year
Asphalt Plant	Pulama Lanai	$ -	per year
Typical Industrial Activities, Excluding Self-Storage	$ 150 per sq. ft.	$ 13,545,000	per year
Self-Storage	(included with rents)	$ -	per year
Total Revenues, On-Site Activities		**$ 17,125,000**	**per year**
New Revenues			
Renewable Energy	$ 0.10 per kWh	$ 3,580,000	per year
Concrete/Rock-Crushing Facility		$ -	per year
Asphalt Plant		$ -	per year
Typical Industrial Activities, Excluding Self-Storage	$ 150 per sq. ft.	$ 10,890,000	per year
Self-Storage	included with rents	$ -	per year
Total New Revenues		**$ 14,470,000**	**per year**
3.c. RENTAL INCOME			
Renewable Energy	$ 3,000 per acre	$ 381,000	per year
Concrete/Rock-Crushing Facility	Pulama Lanai	$ -	per year
Asphalt Plant	Pulama Lanai	$ -	per year
Typical Industrial Activities			
Land Rent		n.e.	per year
Space Rent			
Typical Industrial Activities, Excluding Self-Storage	$ 10 per sq. ft. 50% rented	$ 451,500	per year
Self-Storage	$ 35 per sq. ft.	$ 829,500	per year
Total Rents		**$ 1,662,000**	**per year**

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Table III-3. Economic Impacts of Operations, 2030

(Values in 2019 dollars)

(continued)

Item	Source or Multiplier	Amount	Units
3.d. PROFITS			
Profits, On-site Activities			
From Operations	10% of revenues	$ 1,712,500	per year
From Rents	10% of rents	$ 166,200	per year
Total Profits, On-Site Activities		**$ 1,878,700**	**per year**
New Profits			
From Operations	10% of revenues	$ 1,447,000	per year
From Rents	10% of rents	$ 166,200	per year
Total New Profits		**$ 1,613,200**	**per year**
3.e. EMPLOYMENT			
Employment, On Site			
Renewable Energy	PEP	2	jobs
Concrete/Rock-Crushing Facility + Asphalt Plant	Pulama Lanai	25	jobs
Typical Industrial Activities	1,500 sf per job	60	jobs
Self-Storage	PEP	2	jobs
Total Jobs, On Site		**89**	**jobs**
New Employment			
Renewable Energy	PEP	2	jobs
Concrete/Rock-Crushing Facility + Asphalt Plant	Pulama Lanai	8	jobs
Typical Industrial Activities	1,500 sf per job	48	jobs
Self-Storage	PEP	2	jobs
Total New Jobs		**60**	**jobs**
3. f. PAYROLL			
Payroll for On-site Jobs			
Renewable Energy	$ 60,000 per job	$ 120,000	per year
Concrete/Rock-Crushing Facility+ Asphalt Plant	$ 56,000 per job	$ 1,400,000	per year
Typical Industrial Activities	$ 45,000 per job	$ 2,700,000	per year
Self-Storage	$ 35,000 per job	$ 70,000	per year
Total Payroll, On Site		**$ 4,290,000**	**per year**
Payroll for New Jobs			
Renewable Energy	$ 60,000 per job	$ 120,000	per year
Concrete/Rock-Crushing Facility+ Asphalt Plant	$ 56,000 per job	$ 448,000	per year
Typical Industrial Activities	$ 45,000 per job	$ 2,160,000	per year
Self-Storage	$ 35,000 per job	$ 70,000	per year
Total Payroll for New Jobs		**$ 2,798,000**	**per year**
3.g. SUPPORTED POPULATION AND HOUSING			
Total New Employment	Section 3.e	60	jobs
Supported Population	1.97 residents per new job	120	residents
Housing for Supported Population	2.31 resident per home	50	homes

Table III-4. Impacts on County Revenues and Expenditures

(Values in 2019 dollars)

Item	Source or Multiplier	Amount	Units
4.a. DEVELOPMENT ACTIVITIES			
Revenues, Cumulative		n.e.	see text
Expenditures, Cumulative [1]		n.e.	see text
Net Revenues, Cumulative		n.e.	see text
4.b. OPERATIONS, 2030			
Tax and Expenditure Base			
Taxable Property Value			
Land	$ 150,000 per acre	$ 30,000,000	
Buildings	Table III-2, Section 2.b	$ 22,800,000	
Total Property Value		**$ 52,800,000**	
Revenues, Annual			
Property Taxes			
Property Tax Revenue	$ 7.20 per $1,000	$ 380,160	per year
Less Current Taxes	County of Maui	$ (490)	per year
New Property Taxes		**$ 379,670**	**per year**
Expenditures, Annual		n.e.	see text
Net Revenues, Annual		**$ 379,670**	**per year**

[1] Infrastructure will be built by Pulama Lanai.

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Table III-5. Impacts on State Revenues and Expenditures

(Values in 2019 dollars)

Item	Source or Multiplier		Amount	Units
5.a. DEVELOPMENT ACTIVITIES				
Tax and Expenditure Base				
Duration (for most development)	Table III-2, Section 2.a		10	years
Final Sales	Table III-2, Section 2.b		$ 9,550,160	per year
Intermediate Sales	Table III-2, Section 2.b		$ 3,318,895	per year
Profits	Table III-2, Section 2.c		$ 1,681,106	per year
Payroll	Table III-2, Section 2.e		$ 3,031,200	per year
Revenues, Average Annual				
Excise Tax on:				
Final Sales	4.0%	of sales and property sales	$ 382,000	per year
Intermediate Sales	0.5%	of sales	$ 16,600	per year
Corporate Income Taxes	1.0%	of profits	$ 16,800	per year
Personal Income Taxes	4.8%	of income	$ 145,500	per year
Total Revenues			**$ 560,900**	**per year**
Revenues, Cumulative			**$ 5,609,000**	
Expenditures, Cumulative			n.e.	see text
Net Revenues, Cumulative			**$ 5,609,000**	
5.b. OPERATIONS, 2030				
Tax and Expenditure Base				
Sales Revenues, New				
Final Sales (Typical industrial activities)	Table III-3, Section 3.b		$ 10,890,000	per year
Intermediate Sales (energy)	Table III-3, Section 3.b		$ 3,580,000	per year
Rental Income	Table III-3, Section 3.c		$ 1,662,000	per year
Profits, New	Table III-3, Section 3.d		$ 1,613,200	per year
Payroll, New	Table III-3, Section 3.f		$ 2,798,000	per year
New Revenues, Annual				
Excise Tax on:				
Final Sales	4.0%	of sales final sales	$ 435,600	per year
Intermediate Sales	0.5%	of sales intermediate sales	$ 17,900	per year
Rents	4.0%	of rents	$ 66,480	per year
Corporate Income Tax	1.0%	of profit	$ 16,130	per year
Personal Income Tax	4.8%	of income	$ 134,300	per year
Total New Revenues			**$ 670,410**	**per year**
Expenditures, Annual			n.e.	see text
Net Revenues, Annual			**$ 670,410**	**per year**

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APPENDIX

G

TRAFFIC IMPACT ANALYSIS REPORT

TRAFFIC IMPACT ANALYSIS REPORT
MIKI BASIN INDUSTRIAL PARK
LANAI CITY, LANAI, HAWAII

DRAFT FINAL

June 3, 2021

Prepared for:
Pulama Lanai
1311 Fraser Avenue
Lanai City, HI 96763

ATA

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TRAFFIC IMPACT ANALYSIS REPORT
MIKI BASIN INDUSTRIAL PARK
Lanai City, Lanai, Hawaii

DRAFT FINAL

Prepared for

Pulama Lanai
1311 Fraser Avenue
Lanai City, HI 96763

Prepared by
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June 3, 2021

FEA REF-545

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

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CIVIL ENGINEERS • SURVEYORS

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

TERRANCE S. ARASHIRO, P.E.
ADRIENNE W.L.H. WONG, P.E., LEED AP
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PAUL K. ARITA, P.E.
ERIK S. KANESHIRO, L.P.L.S., LEED AP
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GARRETT K. TOKUOKA, P.E.

TRAFFIC IMPACT ANALYSIS REPORT

Miki Basin Industrial Park

Lanai City, Lanai, 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 Miki Basin Industrial Park (hereinafter referred to as the "Project") located in Lanai, Hawaii.

1.1 Project Description

The Project proposes to construct a 200-acre industrial park located south of Lanai Airport within a portion of a large parcel (TMK No. (2) 4-9-002:061). The current site plan proposes to include the following:

- Relocated Concrete Crushing Facility and Asphalt Plant (27 acres)
- Renewable Energy Projects (127 acres)
- New Industrial Uses (26 acres)
- Infrastructure (20 acres)

Access to the Project will be provided via Miki Road. It is our understanding that if approved, the 200-acre industrial park will develop over a 20-year period with the concrete crushing facility, asphalt plant and renewable energy projects completed in the first 10 years and the remaining industrial uses completed in the following 10 years. Thus, full build-out of the Project is anticipated by year 2040.

See Figure 1.1 for Project Location. See Figure 1.2 for the Project site plan.

1.2 Study Methodology

This study will address the following:

- Assess existing traffic operating conditions during the weekday AM and PM peak hours of traffic within the study area.
- Traffic Projections for Base Year 2040 (without the Project).

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- Estimate the vehicular trips that will be generated by the Project.
- Traffic projections for the Project for Future Year 2040 (with Project).
- Recommendations for roadway improvements or other mitigative measures, as appropriate, to reduce or eliminate the adverse impacts resulting from traffic generated by the Project.

1.3 Analysis Methodology

Level of Service (LOS) is a qualitative measure used to describe the conditions of traffic flow at intersections, with values ranging from free-flow conditions at LOS A to congested conditions at LOS F. The Highway Capacity Manual (HCM), 6th Edition, includes methods for calculating volume to capacity ratios, delays, and corresponding LOS that were used in this study. See Appendix A for LOS Criteria.

Analyses for the study intersections were performed using the traffic analysis software Synchro, which is able to prepare reports based on the methodologies described in the HCM. These reports contain control delay results as based on intersection lane geometry, signal timing, and hourly traffic volumes. Based on the vehicular delay at each intersection, a LOS is assigned to each approach and intersection movement as a qualitative measure of performance. These results, as confirmed or refined by field observations, constitute the technical analysis that will form the basis of the recommendations outlined in this report.

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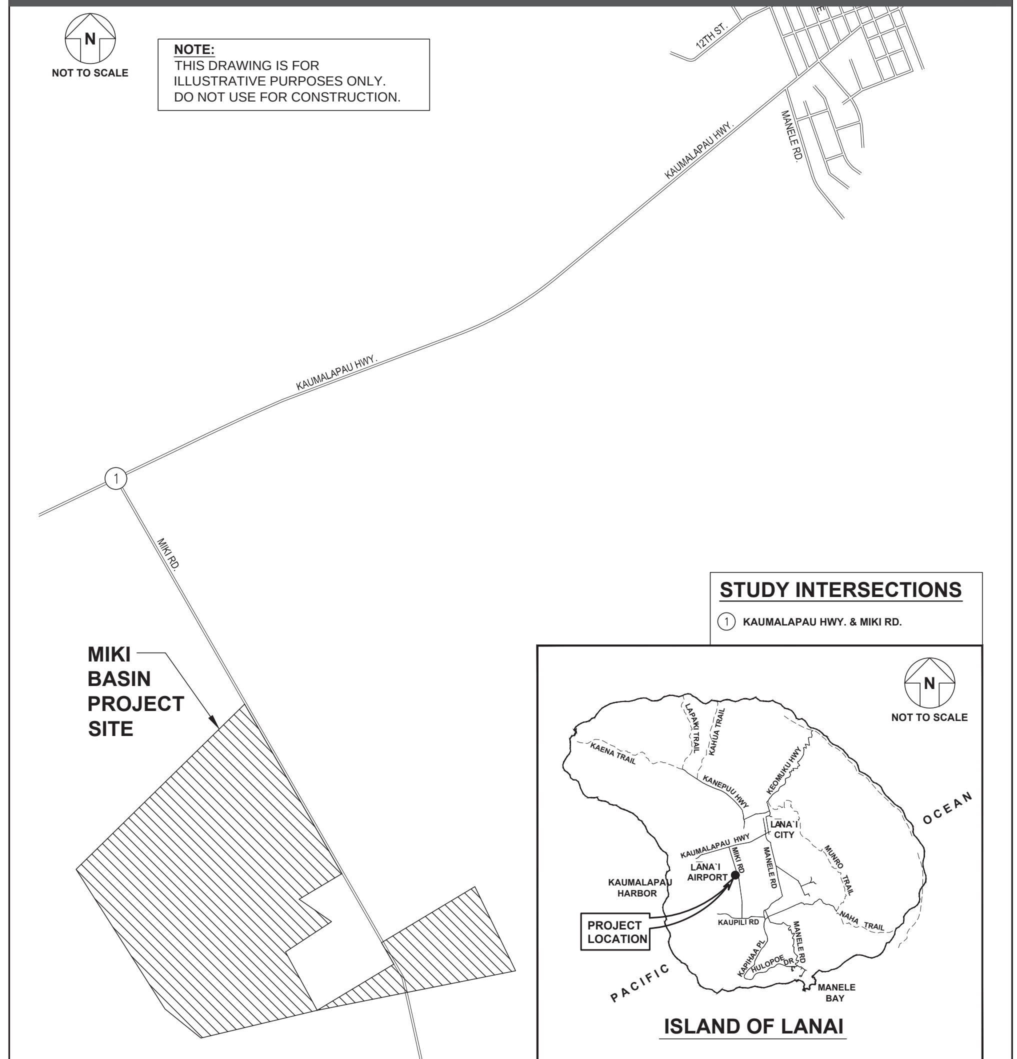
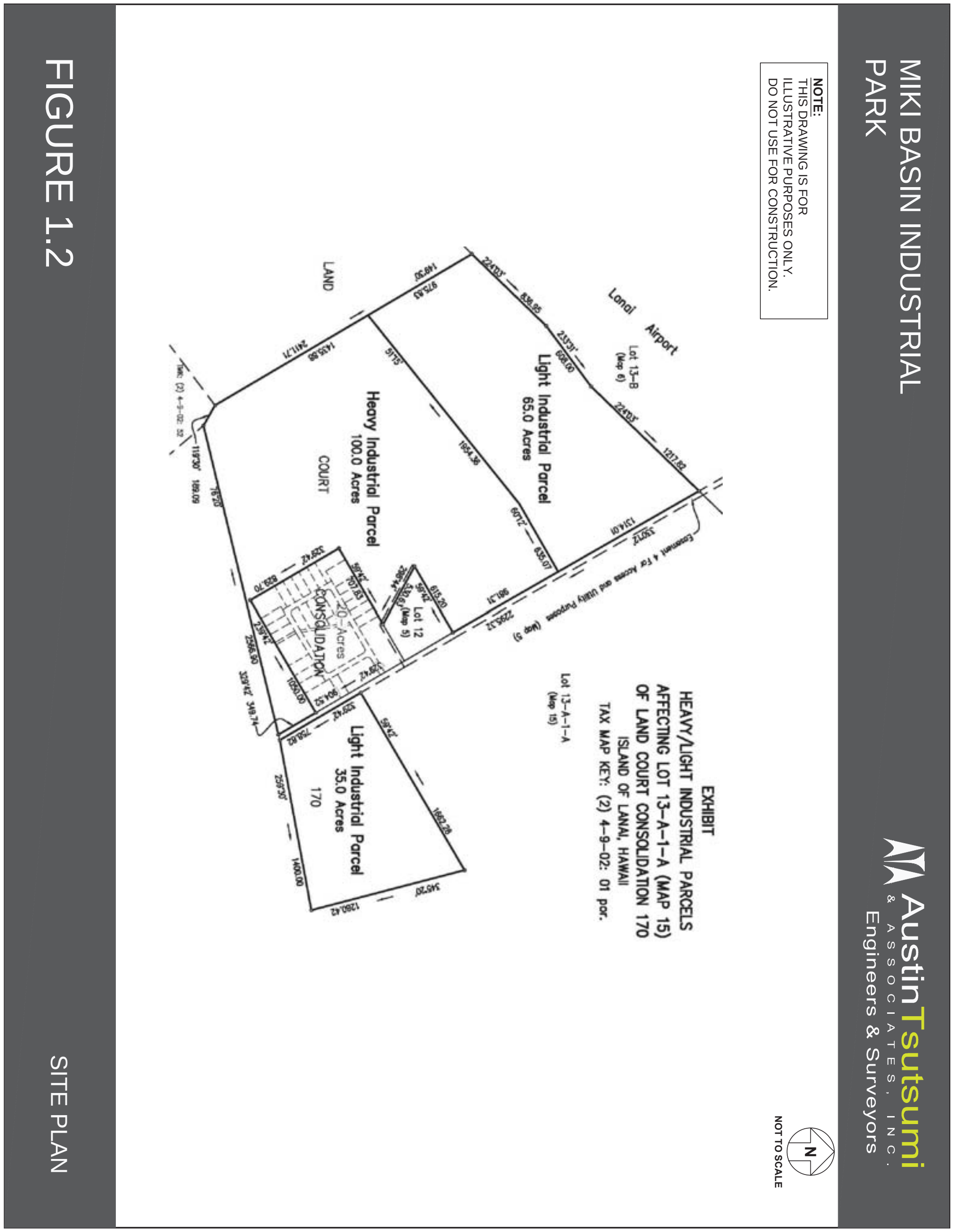


FIGURE 1.1

LOCATION MAP

FEA REF-548



2. EXISTING CONDITIONS

2.1 Roadway System

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

Kaumalapau Highway is generally an east-west, two-way, two-lane state-owned roadway that runs perpendicular to Miki Road. This roadway begins to the west at the Fuel Depot and terminates to the east at its intersection with Lanai Avenue/Queens Street. The speed limit along Kaumalapau Highway is 45 miles per hour (mph) near Miki Road.

Miki Road is generally a north-south, two-way privately owned roadway that begins to the north at its intersection with Kaumalapau Highway and extends approximately 2.95 miles to the south – primarily through undeveloped land. The roadway is only approximately 13-15 feet wide, and therefore requires vehicles to pull off to the unpaved shoulder when encountering approaching vehicles traveling in the opposite direction.

2.2 Existing Traffic Volumes

Due to the prolonged disruptions to both residential and visitor traffic in the Hawaii region as a result of the impacts of the COVID-19 pandemic, collecting new traffic count data at this time would be atypical. Previously collected data in conjunction with available traffic volume data from the Hawaii Department of Transportation (HDOT) were instead used to estimate the existing 2020 traffic volumes at the study intersections. Observations of existing conditions in the study area were also not conducted as part of this study as a result of the atypical traffic conditions. Available traffic count data and adjustments made to estimate existing 2020 traffic volumes are described in the following sections.

2.2.1 Kaumalapau Highway/Miki Road Count Data

12-hour traffic count data was taken between 6:00 AM and 6:00 PM at the Kaumalapau Highway/Miki Road intersection between Wednesday, October 24, 2018 and Friday, October 26, 2018. The Wednesday AM and PM peak hours were the heaviest days in terms of traffic generation, and were therefore used as the basis for the intersection analyses contained within this report. The AM and PM hours of traffic were determined to be 6:30-7:30 AM and 1:00-2:00 PM, respectively. Traffic count data is provided in Appendix A.

2.2.2 Traffic Count Adjustments

Because Kaumalapau Highway serves as the major east-west arterial on Lanai connecting Kaumalapau Harbor, Lanai Airport and Lanai City, the 2018 traffic counts along the highway were adjusted to reflect growth between 2018 and 2020. HDOT traffic volume data collected between 2016 and 2019 along Kaumalapau Highway between Lanai Airport Road and Miki Road were used to determine historical growth along the roadway. The HDOT annual average daily traffic (AADT) are included in Appendix A and summarized in Table 2.1 below.

Based on the HDOT traffic counts, volumes have increased every year along Kaumalapau Highway between 2016 and 2019. However, the annual growth has varied from year to year. Therefore, the average annual growth of 9.7% between 2016 and 2019 was applied to 2018 volumes to estimate existing 2020 volumes.

Table 2.1: HDOT AADT Traffic Volumes

Kaumalapau Highway - West of Miki Road				
Year	EB	WB	Total	Growth
2019	541	543	1084	8.0%
2018	502	502	1004	18.0%
2017	426	425	851	3.2%
2016	413	412	825	
Average	**471**	**471**	**941**	**9.7%**

2.3 Existing Observations and Analysis

2.3.1 Intersection Analysis

The Kaumalapau Highway/Miki Road intersection currently operates with all movements at LOS B or better during the AM and PM peak hours of traffic. No significant delays or queuing were previously observed during the 2018 data collection at the intersection during either peak hour of traffic. See Figure 2.1 and Table 4.2 for traffic volumes and levels of service. LOS worksheets are provided in Appendix C.

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DATE OF COUNTS:
WEDNESDAY, OCTOBER 24, 2018 TO
FRIDAY, OCTOBER 26, 2018

AM PEAK HOUR:
6:30 AM - 7:30 AM

PM PEAK HOUR:
1:00 PM - 2:00 PM

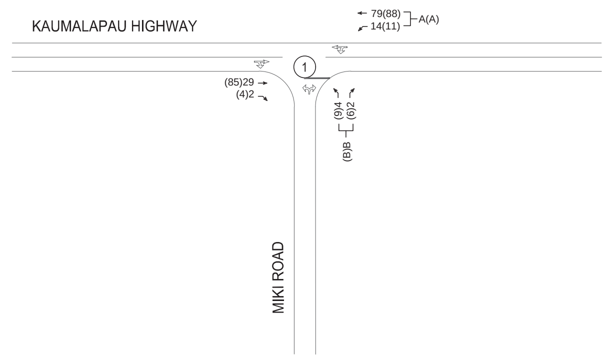
N
NOT TO SCALE

LEGEND

##(##) - AM(PM) VEHICLE VOLUMES

X(X) - AM(PM) LOS

(X) - UNSIGNALIZED INTERSECTION X



NOTES:

1. THIS DRAWING IS FOR ILLUSTRATIVE PURPOSES ONLY. DO NOT USE FOR CONSTRUCTION.
2. THE WEDNESDAY, OCTOBER 24, 2018 AM PEAK HOUR AND THE FRIDAY, OCTOBER 26, 2018 PM PEAK HOUR WERE THE HEAVIEST IN TERMS OF TRAFFIC GENERATION AND REFLECT THE AM PEAK HOUR AND PM PEAK HOUR, RESPECTIVELY.
3. KAUMALAPAU HIGHWAY VOLUMES WERE ADJUSTED BASED ON HISTORIC HDOT TRAFFIC VOLUMES TO REFLECT 2020 CONDITIONS.

FIGURE 2.1

EXISTING LANE CONFIGURATION, VOLUMES AND LOS

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3. BASE YEAR 2040 TRAFFIC CONDITIONS

The Year 2040 was selected to reflect the Project completion year. The Base Year 2040 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 2020 traffic count volumes as well as trips generated by known future developments in the vicinity of the Project.

3.1 Growth Rate

As of 2010, the population on the island of Lanai was about 3,100 residents. According to the Lanai Community Plan Update published by the County of Maui Planning Department in December 2013, the anticipated growth of Lanai's economy may require its population to nearly double in size to about 6,000 residents. This planning document was published as a guide for decision making and implementation through 2030. In order for Lanai's population to reach 6,000 by year 2030, the island would experience an average growth rate of approximately 4.7 percent per year. Therefore, this growth rate was applied along Kaumalapau Highway to represent the anticipated growth by year 2030.

The Population and Economic Projections for the State of Hawaii to 2045, published by the Hawaii Department of Business, Economic Development, and Tourism (DBEDT) in June 2018, was used to estimate the anticipated growth of Lanai's population between year 2030 and year 2040. According to DBEDT population forecasts, the population growth rate will decrease to less than 1.0 percent per year between 2025 and 2045. To be conservative, an average growth rate of 1.0 percent per year was applied along Kaumalapau Highway to represent the anticipated growth between year 2030 and year 2040.

3.2 Background Projects

The following background project was added to Base Year 2040 projections.

1. Miki Basin Heavy Industrial Area – 14-acre expansion to the existing 6 acres of the Miki Industrial Complex. The project is anticipated to generate a total of 43(43) trips per hour during the AM and PM peak hours of traffic, respectively. All trips are expected to pass through the Kaumalapau Highway/Miki Road intersection. The background project is shown in Figure 3.1.

3.3 Planned Roadway Projects

The Lanai Community Plan Update identified two proposed private roadway connections near the Project site. One roadway will travel parallel to Miki Road, east of the Project site connecting Kaumalapau Highway and Manele Road. The other roadway will travel between Miki Road and the proposed road, described in the previous sentence. To be conservative, it is assumed that these proposed private roadways will not provide access to the Project site, which would require all Project traffic to travel along Miki Road.

3.4 Base Year 2040 Analysis

Under Base Year 2040 conditions, the study intersection is forecast to operate similarly to existing conditions with all intersection movements expected to operate at LOS B or better during the AM and PM peak hours of traffic. See Figure 3.2 and Table 4.2 for traffic volumes and LOS. LOS worksheets are provided in Appendix C.

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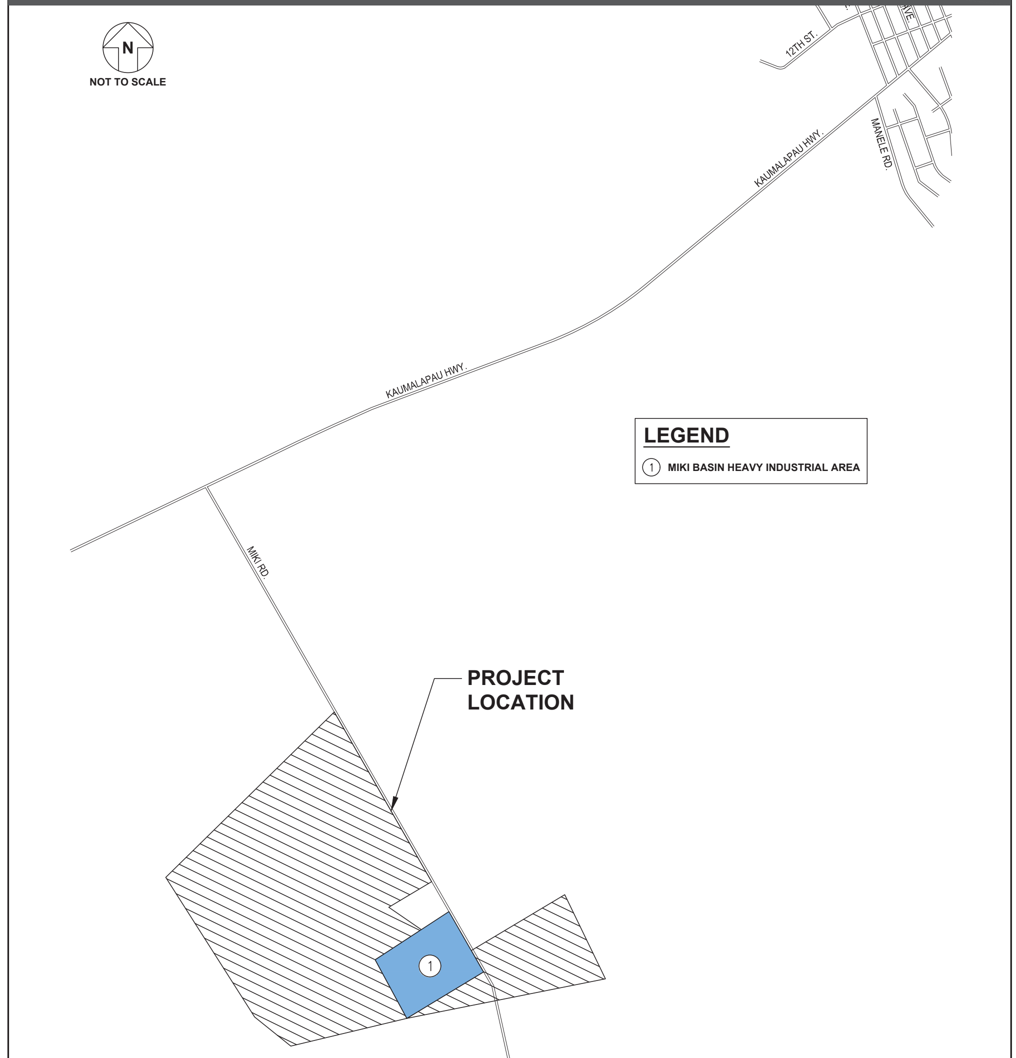

FIGURE 3.1 BACKGROUND PROJECTS

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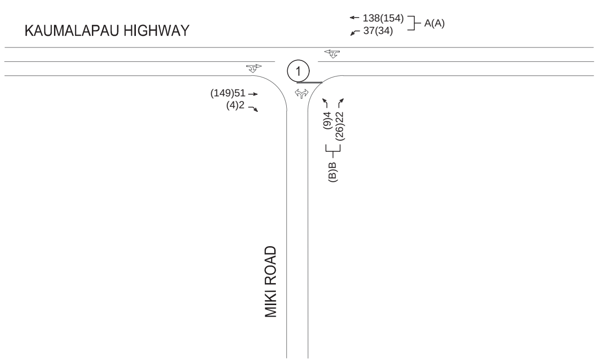

LEGEND

##(##) - AM(PM) VEHICLE VOLUMES

X(X) - AM(PM) LOS

X - UNSIGNALIZED INTERSECTION X

FIGURE 3.2

BASE YEAR 2040 LANE CONFIGURATION, VOLUMES AND LOS

4. FUTURE YEAR 2040 TRAFFIC CONDITIONS

The Future Year 2040 scenario represents the traffic conditions within the Project study area with the full build-out of the Project.

4.1 Project Description

The Project proposes to construct a 200-acre industrial park located south of Lanai Airport within a portion of a large parcel (TMK No. (2) 4-9-002:061). The current site plan proposes to include the following:

- Relocated Concrete Crushing Facility and Asphalt Plant (27 acres)
- Renewable Energy Projects (127 acres)
- New Industrial Uses (26 acres)
- Infrastructure (20 acres)

It is assumed that at least two driveway access points to the Project site will be provided along Miki Road. As shown in Figure 4.1, Project Driveway 1 provides access to the light and heavy industrial areas west of Miki Road and Project Driveway 2 provides access to the light industrial area east of Miki Road. For the purposes of this analysis Project Driveway 2 was assumed to align with the existing driveway west of Miki Road. However, it is important to note that a final decision on the location or number of Project driveways has not been made.

4.2 Travel Demand Estimations

4.2.1 Trip Generation

Trip generation for the proposed Project was estimated based on the anticipated land uses planned for the site. Currently, the known land uses include a concrete crushing facility, asphalt plant and a photovoltaic plus battery energy storage system. The remainder of the Project will be allocated for new industrial uses, which may include, but not be limited to, a slaughter house, warehouse space for cold storage, laboratory/testing facilities, product development, automotive services, a multi-media facility and an animal hospital.

The concrete crushing facility and asphalt plant are existing land uses that will be relocated to the Project site. Based on the current employment and operations at the facilities, it is anticipated that the uses will conservatively generate a total of 35(35) trips during the AM and PM peak hours of traffic. The photovoltaic plus battery energy storage system will be a new land use. Trips generated by the site will be primarily from employees performing normal operation and maintenance activities. It is anticipated that the photovoltaic plus battery energy storage system will have a maximum of 10 employees and is estimated to generate 10(10) trips during the AM and PM peak hours during operation.

Because the new industrial uses have not been finalized yet, general trip generation rates were applied to the remaining 26 acres. The Institute of Transportation Engineers (ITE) publishes trip rates, Trip Generation Manual, 10th Edition, based upon historical data from similar land uses. These trip rates/formulae and their associated directional distributions were used to estimate the increase in the number of vehicular trips generated by the new industrial uses. The rate selected was based on the potential facilities that may be constructed within the 26-acre new

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industrial uses portion of the Project site. Table 4.1 shows the projected traffic generated by the Project during the AM and PM peak hours.

Table 4.1: Project Trip Generation

Land Use	Independent Variable	Weekday AM Peak Hour			Weekday PM Peak Hour		
		Enter (vph)	Exit (vph)	Total (vph)	Enter (vph)	Exit (vph)	Total (vph)
Concrete Crushing Facility & Asphalt Plant	27 Acres	35	0	35	0	35	35
Photovoltaic + Battery Energy Storage System	127 Acres	10	0	10	0	10	10
New Industrial Uses (ITE Code 140 - Manufacturing)	26 Acres	104	12	116	51	67	118
Total		**149**	**12**	**161**	**51**	**112**	**163**

The Project is anticipated to generate 161 trips during the AM peak hour of traffic and 163 trips during the PM peak hour of traffic.

4.2.2 Trip Distribution & Assignment

Approximately 75 percent of the trips were assumed to originate from and be destined towards the east and the remaining 25 percent of the trips were assumed to originate from and be destined towards the west. Figure 4.1 illustrates the Project-generated trip distribution.

As mentioned above, it was assumed that two driveways to the Project site would be provided – one east and one west of Miki Road. The trips were distributed between the two driveways based on the proportion of Project area located on each side of Miki Road.

4.3 Future Year 2040 Analysis

Upon completion of the Project, all intersection movements are forecast to operate at LOS B or better during the AM and PM peak hours of traffic. Miki Road is privately-owned; the levels of service for the proposed uses on such are acceptable and not significant. A westbound left-turn deceleration lane is recommended and is discussed further in section 4.3.2.

See Figure 4.2 and Table 4.2 for traffic volumes and LOS. LOS worksheets are provided in Appendix C.

4.3.1 Signal Warrant Analysis

Although a full traffic signal warrant analysis was not performed as part of this report, the Kaumalapau Highway/Miki Road intersection is not anticipated to warrant a traffic signal by Year 2040 with the Project. Refer to Appendix D for signal warrant analysis.

4.3.2 Left-turn Lane Warrant

Westbound Left-Turn Lane

At the time of this writing, the A Policy on Geometric Design of Highways and Streets ("Green Book", 2011) was the most recent version adopted by the Hawaii Department of Transportation. Based upon the following chart from NCHRP Report 279, which is referenced by the Green Book, a westbound left-turn lane is not warranted but is close to warranting at this intersection for Future Year 2040 with the Project. The westbound left-turn percentages are roughly 52 and 32 percent, respectively for the AM and PM peak hours of traffic as plotted below in Figure 4.3.

Although not warranted, given the proximity of the left-turn lane warranting as well as the understanding that the industrial park will serve a large number of heavy vehicles, a left-turn lane is recommended at the intersection.

4.3.3 Intersection Geometry

The current intersection geometry provides a single, approximately 13-foot wide bi-directional lane at its southern Miki Road approach, which is inadequate to accommodate vehicles traveling side-by-side. As a result of the significant anticipated increase in travel demand, large design vehicle (lowboy with crane), and the 45 mph posted speed along Kaumalapau Highway in the vicinity of Miki Road, widening to two lanes is recommended between the Project site and Kaumalapau Highway with intersection geometries capable of accommodating turning movements by the design vehicle.

Table 4.2: Existing, Base Year 2040, and Future Year 2040 LOS

	Existing Conditions						Base Year 2040						Future Year 2040					
	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
Kaumalapau Highway/Miki Road																		
NB LT/RT	10.3	0.01	B	10.4	0.01	B	11.2	0.01	B	12.2	0.02	B	10.2	0.06	B	11.8	0.23	B
WB LT	7.3	0.01	A	7.5	0.01	A	7.4	0.03	A	7.7	0.03	A	7.7	0.11	A	7.8	0.06	A
Miki Road/Project Driveway 1																		
NB LT/TH	n/a						n/a						0.0	0.00	A	0.0	0.00	A
EB LT/TH													10.1	0.02	B	10.5	0.13	B
Miki Road/Project Driveway 2																		
EB LT/TH/RT	n/a						n/a						0.0	0.00	A	0.0	0.00	A
WB LT/TH/RT													0.0	0.00	A	0.0	0.00	A

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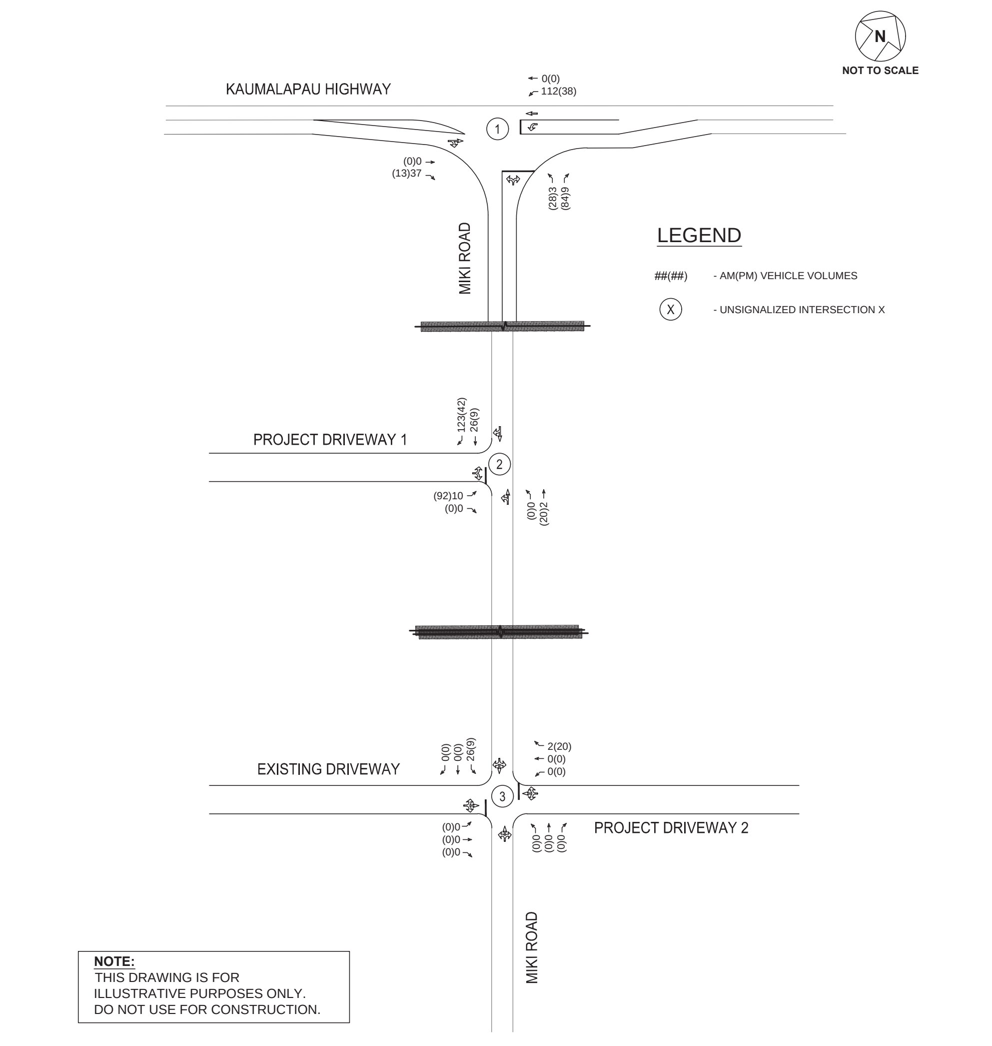

FIGURE 4.1 PROJECT-GENERATED TRIPS

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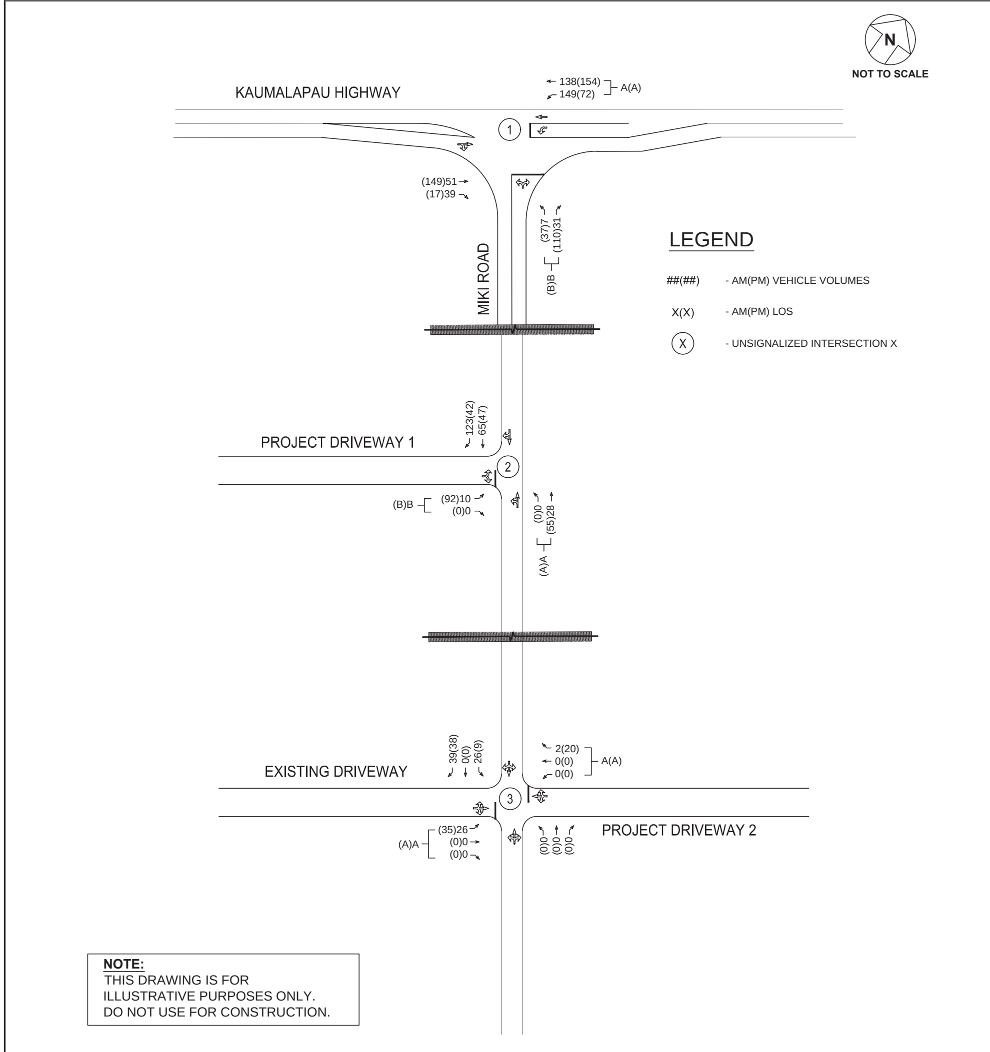

FIGURE 4.2 FUTURE YEAR 2040 LANE CONFIGURATION, VOLUMES AND LOS

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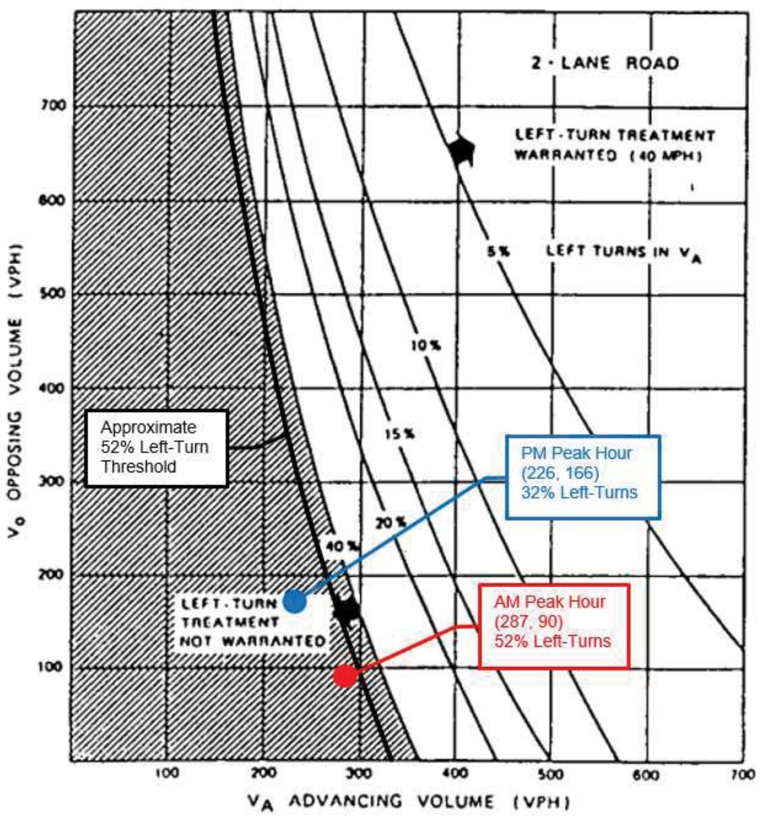
Figure 4.3: Left-Turn Warrant (NCHRP 279)



5. CONCLUSIONS AND RECOMMENDATIONS

The Project proposes to construct a 200-acre industrial park along Miki Road, south of Lanai Airport. The Project is anticipated to generate approximately 161(163) trips during the AM(PM) peak hours of traffic by its 2040 estimated completion.

Upon completion of the Project, all intersection movements are forecast to operate at LOS B or better during the AM and PM peak hours of traffic.

The following geometric modifications are recommended when warranted:

- Widen Miki Road between its intersection with Kaumalapau Highway to the Project Driveway(s). Miki Road is currently estimated to be 13 feet wide, and should be widened to accommodate the design vehicle (lowboy with crane) and full side-by-side bidirectional travel with intersection geometries capable of accommodating turning movements.
- Provide an exclusive westbound left-turn deceleration lane.

6. REFERENCES

1. American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, 2011.

2. Austin, Tsutsumi and Associates, Inc., Traffic Assessment for Miki Basin Heavy Industrial Area, 2013.

3. County of Maui Planning Department, Lanai Community Plan Update, 2013.

4. Institute of Transportation Engineers, Trip Generation, 10th Edition, 2017.

5. Neuman, Timothy R., NCHRP 279 – Intersection Channelization Design Guide, 1985.

6. State of Hawaii Department of Business, Economic Development and Tourism, Population and Economic Projections for the State of Hawaii to 2045, 2018.

7. Transportation Research Board, Highway Capacity Manual, 6th Edition.

APPENDICES

APPENDIX A

LEVEL OF SERVICE CRITERIA

APPENDIX A – 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

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APPENDIX B

TRAFFIC COUNT DATA

Miki Road_Kaumalapau Highway

Start Time	KAUMALAPAU HWY EASTBOUND Thru	KAUMALAPAU HWY EASTBOUND Right	KAUMALAPAU HWY WESTBOUND Left	KAUMALAPAU HWY WESTBOUND Thru	MIKI RD NORTHBOUND Left	MIKI RD NORTHBOUND Right	Int. Total	
6:00	1	0	3	15	0	0	19	100
6:15	3	2	3	12	0	0	20	104
6:30	1	0	5	18	0	0	24	112
6:45	11	1	3	22	0	0	37	108
7:00	8	1	3	9	2	0	23	93
7:15	4	0	3	17	2	2	28	93
7:30	4	1	1	13	0	1	20	89
7:45	6	2	1	9	1	3	22	98
8:00	3	0	3	15	2	0	23	100
8:15	9	0	1	10	2	2	24	107
8:30	11	2	1	13	0	2	29	105
8:45	5	2	3	12	2	0	24	103
9:00	18	2	2	6	2	0	30	103
9:15	9	1	0	9	1	2	22	110
9:30	10	0	2	9	1	5	27	127
9:45	13	0	0	11	0	0	24	135
10:00	13	0	4	18	1	1	37	154
10:15	16	0	0	19	0	4	39	161
10:30	7	2	3	22	0	1	35	156
10:45	20	1	2	14	1	5	43	158
11:00	25	1	2	14	2	0	44	154
11:15	17	1	1	9	1	5	34	149
11:30	29	1	0	5	0	2	37	146
11:45	14	2	2	18	1	2	39	138
12:00	12	1	4	17	1	4	39	138
12:15	11	0	4	14	1	1	31	146
12:30	9	1	2	10	3	4	29	160
12:45	11	3	2	20	0	3	39	169
13:00	17	0	4	22	1	3	47	174
13:15	21	0	4	17	2	1	45	174
13:30	14	1	0	18	4	1	38	168
13:45	19	3	3	16	2	1	44	168
14:00	20	2	3	19	1	2	47	161
14:15	16	2	3	14	1	3	39	158
14:30	17	2	3	12	2	2	38	138
14:45	21	2	2	9	2	1	37	134
15:00	25	2	1	11	3	2	44	119
15:15	7	3	0	4	1	4	19	102
15:30	24	1	2	3	0	4	34	110
15:45	8	0	2	8	1	3	22	91
16:00	14	1	1	9	0	2	27	84
16:15	10	1	6	5	1	4	27	73
16:30	7	0	0	5	0	3	15	56
16:45	9	0	0	2	1	3	15	53
17:00	7	0	0	5	3	1	16	49
17:15	6	0	0	3	0	1	10	
17:30	3	0	0	8	0	1	12	
17:45	2	1	0	8	0	0	11	
24-Oct	**567**	**48**	**94**	**578**	**51**	**91**	**1429**	

AM Peak Hour

PM Peak Hour

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Miki Road_Kaumalapau Highway

	KAUMALAPAU HWY EASTBOUND		KAUMALAPAU HWY WESTBOUND		MIKI RD NORTHBOUND			
Start Time	Thru	Right	Left	Thru	Left	Right	Int. Total	
6:00	0	0	2	6	0	0	8	80
6:15	5	0	2	10	0	0	17	85
6:30	2	0	5	23	0	0	30	91
6:45	4	0	6	15	0	0	25	85
7:00	2	0	3	3	1	4	13	90
7:15	5	0	2	14	1	1	23	103
7:30	3	1	4	15	0	1	24	108
7:45	5	0	5	15	1	4	30	126
8:00	10	0	2	10	1	3	26	125
8:15	6	1	2	13	2	4	28	134
8:30	15	1	2	21	0	3	42	143
8:45	8	2	2	14	0	3	29	143
9:00	15	1	0	17	1	1	35	144
9:15	8	1	5	21	0	2	37	145
9:30	22	1	1	15	0	3	42	135
9:45	10	2	4	11	0	3	30	126
10:00	15	0	2	12	2	5	36	120
10:15	12	1	2	9	1	2	27	107
10:30	12	1	2	13	0	5	33	119
10:45	7	2	1	11	1	2	24	125
11:00	8	1	2	10	0	2	23	132
11:15	20	1	4	11	2	1	39	141
11:30	19	0	2	14	0	4	39	130
11:45	17	0	1	10	0	3	31	123
12:00	12	0	6	11	0	3	32	124
12:15	12	0	3	9	0	4	28	117
12:30	10	0	3	15	1	3	32	124
12:45	8	0	2	17	0	5	32	123
13:00	8	0	3	12	0	2	25	117
13:15	14	1	1	19	0	0	35	137
13:30	11	1	3	11	2	3	31	138
13:45	7	1	3	11	0	4	26	132
14:00	19	1	3	18	0	4	45	151
14:15	17	0	5	9	1	4	36	144
14:30	8	0	0	14	0	3	25	139
14:45	22	1	5	15	2	0	45	155
15:00	22	2	1	9	0	4	38	143
15:15	13	1	2	14	0	1	31	127
15:30	20	2	1	9	1	8	41	111
15:45	20	0	1	11	0	1	33	90
16:00	9	0	2	5	1	5	22	77
16:15	10	0	1	3	0	1	15	70
16:30	6	1	2	10	0	1	20	64
16:45	11	0	0	4	0	5	20	54
17:00	7	0	0	5	1	2	15	44
17:15	3	0	0	5	1	0	9	
17:30	4	1	0	5	0	0	10	
17:45	4	0	2	4	0	0	10	
25-Oct	507	28	112	558	23	119	1347	

Miki Road_Kaumalapau Highway

	KAUMALAPAU HWY EASTBOUND		KAUMALAPAU HWY WESTBOUND		MIKI RD NORTHBOUND			
Start Time	Thru	Right	Left	Thru	Left	Right	Int. Total	
6:00	1	0	0	3	0	0	4	63
6:15	0	0	0	15	0	0	15	76
6:30	1	0	3	20	0	0	24	79
6:45	2	0	5	10	0	3	20	84
7:00	6	0	2	9	0	0	17	87
7:15	2	1	3	11	1	0	18	97
7:30	9	3	1	11	4	1	29	106
7:45	4	0	4	12	0	3	23	105
8:00	10	1	1	9	0	6	27	125
8:15	9	1	2	10	3	2	27	132
8:30	5	1	2	20	0	0	28	141
8:45	11	2	3	21	2	4	43	146
9:00	8	0	2	20	1	3	34	145
9:15	13	0	4	17	0	2	36	148
9:30	14	1	4	12	0	2	33	139
9:45	27	2	2	7	1	3	42	141
10:00	17	1	1	13	2	3	37	136
10:15	10	0	2	12	1	2	27	130
10:30	13	0	0	15	0	7	35	141
10:45	15	1	4	16	0	1	37	134
11:00	12	3	1	13	0	2	31	125
11:15	22	0	2	9	1	4	38	122
11:30	16	0	0	7	0	5	28	111
11:45	10	0	2	12	1	3	28	113
12:00	9	0	2	15	0	2	28	114
12:15	16	0	2	7	0	2	27	127
12:30	10	0	4	15	0	1	30	123
12:45	8	0	3	12	5	1	29	113
13:00	13	3	3	20	0	2	41	113
13:15	10	1	2	9	0	1	23	107
13:30	5	0	2	12	0	1	20	106
13:45	14	0	1	10	2	2	29	115
14:00	13	2	5	13	0	2	35	114
14:15	10	1	0	7	0	4	22	108
14:30	16	0	3	7	1	2	29	123
14:45	8	0	11	8	0	1	28	154
15:00	14	0	4	8	0	3	29	147
15:15	14	0	1	18	0	4	37	136
15:30	30	0	1	20	0	9	60	118
15:45	7	1	1	9	0	3	21	68
16:00	10	0	0	5	1	2	18	56
16:15	8	0	0	10	1	0	19	44
16:30	5	1	1	3	0	0	10	39
16:45	3	0	3	3	0	0	9	43
17:00	1	1	0	2	0	2	6	44
17:15	4	0	0	4	0	6	14	
17:30	7	0	0	5	1	1	14	
17:45	7	0	0	3	0	0	10	
26-Oct	479	27	99	529	28	107	1269	

FEA REF-559

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Existing Conditions

FEA REF-560

Intersection	
Int Delay, s/veh	1.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	29	2	14	79	4	2
Future Vol, veh/h	29	2	14	79	4	2
Conflicting Peds, #/hr	0	1	1	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	74	74	74	74	74	74
Heavy Vehicles, %	10	55	4	8	55	20
Mvmt Flow	39	3	19	107	5	3

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	43	0	187	-
Stage 1	-	-	-	-	42	-
Stage 2	-	-	-	-	145	-
Critical Hdwy	-	-	4.14	-	6.95	-
Critical Hdwy Stg 1	-	-	-	-	5.95	-
Critical Hdwy Stg 2	-	-	-	-	5.95	-
Follow-up Hdwy	-	-	2.236	-	3.995	-
Pot Cap-1 Maneuver	-	-	1553	-	695	0
Stage 1	-	-	-	-	860	0
Stage 2	-	-	-	-	768	0
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1552	-	685	-
Mov Cap-2 Maneuver	-	-	-	-	685	-
Stage 1	-	-	-	-	859	-
Stage 2	-	-	-	-	758	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.1	10.3
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	685	-	-	1552	-
HCM Lane V/C Ratio	0.008	-	-	0.012	-
HCM Control Delay (s)	10.3	-	-	7.3	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0	-	-	0	-

Intersection	
Int Delay, s/veh	0.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	85	4	11	88	9	6
Future Vol, veh/h	85	4	11	88	9	6
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	11	56	7	10	46	11
Mvmt Flow	91	4	12	95	10	6

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	95	0	212	-
Stage 1	-	-	-	-	93	-
Stage 2	-	-	-	-	119	-
Critical Hdwy	-	-	4.17	-	6.86	-
Critical Hdwy Stg 1	-	-	-	-	5.86	-
Critical Hdwy Stg 2	-	-	-	-	5.86	-
Follow-up Hdwy	-	-	2.263	-	3.914	-
Pot Cap-1 Maneuver	-	-	1468	-	688	0
Stage 1	-	-	-	-	831	0
Stage 2	-	-	-	-	808	0
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1468	-	682	-
Mov Cap-2 Maneuver	-	-	-	-	682	-
Stage 1	-	-	-	-	831	-
Stage 2	-	-	-	-	801	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.8	10.4
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	682	-	-	1468	-
HCM Lane V/C Ratio	0.014	-	-	0.008	-
HCM Control Delay (s)	10.4	-	-	7.5	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0	-	-	0	-

FEA REF-561

ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Base Year 2040 without Project Conditions

Intersection	
Int Delay, s/veh	1.4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	51	2	37	138	4	22
Future Vol, veh/h	51	2	37	138	4	22
Conflicting Peds, #/hr	0	1	1	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
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, %	10	55	4	8	55	20
Mvmt Flow	55	2	40	150	4	24

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	58	0	287	-
Stage 1	-	-	-	-	57	-
Stage 2	-	-	-	-	230	-
Critical Hdwy	-	-	4.14	-	6.95	-
Critical Hdwy Stg 1	-	-	-	-	5.95	-
Critical Hdwy Stg 2	-	-	-	-	5.95	-
Follow-up Hdwy	-	-	2.236	-	3.995	-
Pot Cap-1 Maneuver	-	-	1533	-	605	0
Stage 1	-	-	-	-	846	0
Stage 2	-	-	-	-	698	0
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1532	-	587	-
Mov Cap-2 Maneuver	-	-	-	-	587	-
Stage 1	-	-	-	-	845	-
Stage 2	-	-	-	-	678	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.6	11.2
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	587	-	-	1532	-
HCM Lane V/C Ratio	0.007	-	-	0.026	-
HCM Control Delay (s)	11.2	-	-	7.4	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0	-	-	0.1	-

FEA REF-562

Intersection						
Int Delay, s/veh	1.1					

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	149	4	34	154	9	26
Future Vol, veh/h	149	4	34	154	9	26
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	11	56	7	10	46	11
Mvmt Flow	160	4	37	166	10	28

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	164	0	402	-
Stage 1	-	-	-	-	162	-
Stage 2	-	-	-	-	240	-
Critical Hdwy	-	-	4.17	-	6.86	-
Critical Hdwy Stg 1	-	-	-	-	5.86	-
Critical Hdwy Stg 2	-	-	-	-	5.86	-
Follow-up Hdwy	-	-	2.263	-	3.914	-
Pot Cap-1 Maneuver	-	-	1385	-	528	0
Stage 1	-	-	-	-	771	0
Stage 2	-	-	-	-	707	0
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1385	-	513	-
Mov Cap-2 Maneuver	-	-	-	-	513	-
Stage 1	-	-	-	-	771	-
Stage 2	-	-	-	-	686	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.4	12.2
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	513	-	-	1385	-
HCM Lane V/C Ratio	0.019	-	-	0.026	-
HCM Control Delay (s)	12.2	-	-	7.7	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.1	-	-	0.1	-

ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Future Year 2040 with Project Conditions

FEA REF-563

Intersection	
Int Delay, s/veh	3.7

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	51	39	149	138	7	31
Future Vol, veh/h	51	39	149	138	7	31
Conflicting Peds, #/hr	0	1	1	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	900	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	10	55	4	8	55	20
Mvmt Flow	55	42	162	150	8	34

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	98	0	551	77
Stage 1	-	-	-	-	77	-
Stage 2	-	-	-	-	474	-
Critical Hdwy	-	-	4.14	-	6.95	6.4
Critical Hdwy Stg 1	-	-	-	-	5.95	-
Critical Hdwy Stg 2	-	-	-	-	5.95	-
Follow-up Hdwy	-	-	2.236	-	3.995	3.48
Pot Cap-1 Maneuver	-	-	1483	-	416	936
Stage 1	-	-	-	-	828	-
Stage 2	-	-	-	-	529	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1482	-	370	935
Mov Cap-2 Maneuver	-	-	-	-	370	-
Stage 1	-	-	-	-	827	-
Stage 2	-	-	-	-	471	-

Approach	EB	WB	NB
HCM Control Delay, s	0	4	10.2
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	730	-	-	1482	-
HCM Lane V/C Ratio	0.057	-	-	0.109	-
HCM Control Delay (s)	10.2	-	-	7.7	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.2	-	-	0.4	-

Intersection	
Int Delay, s/veh	0.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	0	0	28	65	123
Future Vol, veh/h	10	0	0	28	65	123
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, %	50	50	50	50	50	50
Mvmt Flow	11	0	0	30	71	134

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	168	138	205	0	-	0
Stage 1	138	-	-	-	-	-
Stage 2	30	-	-	-	-	-
Critical Hdwy	6.9	6.7	4.6	-	-	-
Critical Hdwy Stg 1	5.9	-	-	-	-	-
Critical Hdwy Stg 2	5.9	-	-	-	-	-
Follow-up Hdwy	3.95	3.75	2.65	-	-	-
Pot Cap-1 Maneuver	723	797	1126	-	-	-
Stage 1	783	-	-	-	-	-
Stage 2	882	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	723	797	1126	-	-	-
Mov Cap-2 Maneuver	723	-	-	-	-	-
Stage 1	783	-	-	-	-	-
Stage 2	882	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.1	0	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1126	-	723	-	-
HCM Lane V/C Ratio	-	-	0.015	-	-
HCM Control Delay (s)	0	-	10.1	-	-
HCM Lane LOS	A	-	B	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

FEA REF-564

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	26	0	0	0	0	2	0	0	0	26	0	39
Future Vol, veh/h	26	0	0	0	0	2	0	0	0	26	0	39
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	50	50	50	50	50	50	50	50	50	50	50	50
Mvmt Flow	28	0	0	0	0	2	0	0	0	28	0	42

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	78	77	21	77	98	0	42	0	0	0	0	0
Stage 1	77	77	-	0	0	-	-	-	-	-	-	-
Stage 2	1	0	-	77	98	-	-	-	-	-	-	-
Critical Hdwy	7.6	7	6.7	7.6	7	6.7	4.6	-	-	4.6	-	-
Critical Hdwy Stg 1	6.6	6	-	6.6	6	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.6	6	-	6.6	6	-	-	-	-	-	-	-
Follow-up Hdwy	3.95	4.45	3.75	3.95	4.45	3.75	2.65	-	-	2.65	-	-
Pot Cap-1 Maneuver	807	730	933	808	710	-	1308	-	-	-	-	-
Stage 1	825	746	-	-	-	-	-	-	-	-	-	-
Stage 2	910	-	-	825	730	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	-	730	933	808	710	-	1308	-	-	-	-	-
Mov Cap-2 Maneuver	-	730	-	808	710	-	-	-	-	-	-	-
Stage 1	825	746	-	-	-	-	-	-	-	-	-	-
Stage 2	910	-	-	825	730	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s			0	
HCM LOS	-	-		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1308	-	-	-	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-	-	-	-	-
HCM Control Delay (s)	0	-	-	-	-	-	-	-
HCM Lane LOS	A	-	-	-	-	-	-	-
HCM 95th %tile Q(veh)	0	-	-	-	-	-	-	-

Intersection	
Int Delay, s/veh	4.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	149	17	72	154	37	110
Future Vol, veh/h	149	17	72	154	37	110
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	900	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	11	56	7	10	46	11
Mvmt Flow	160	18	77	166	40	118

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	178	0	489	169
Stage 1	-	-	-	-	169	-
Stage 2	-	-	-	-	320	-
Critical Hdwy	-	-	4.17	-	6.86	6.31
Critical Hdwy Stg 1	-	-	-	-	5.86	-
Critical Hdwy Stg 2	-	-	-	-	5.86	-
Follow-up Hdwy	-	-	2.263	-	3.914	3.399
Pot Cap-1 Maneuver	-	-	1368	-	467	852
Stage 1	-	-	-	-	765	-
Stage 2	-	-	-	-	647	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1368	-	441	852
Mov Cap-2 Maneuver	-	-	-	-	441	-
Stage 1	-	-	-	-	765	-
Stage 2	-	-	-	-	611	-

Approach	EB	WB	NB
HCM Control Delay, s	0	2.5	11.8
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	690	-	-	1368	-
HCM Lane V/C Ratio	0.229	-	-	0.057	-
HCM Control Delay (s)	11.8	-	-	7.8	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.9	-	-	0.2	-

FEA REF-565

Intersection	
Int Delay, s/veh	4.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	92	0	0	55	47	42
Future Vol, veh/h	92	0	0	55	47	42
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, %	50	50	50	50	50	50
Mvmt Flow	100	0	0	60	51	46

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	134	74	97	0	-	0
Stage 1	74	-	-	-	-	-
Stage 2	60	-	-	-	-	-
Critical Hdwy	6.9	6.7	4.6	-	-	-
Critical Hdwy Stg 1	5.9	-	-	-	-	-
Critical Hdwy Stg 2	5.9	-	-	-	-	-
Follow-up Hdwy	3.95	3.75	2.65	-	-	-
Pot Cap-1 Maneuver	758	869	1243	-	-	-
Stage 1	841	-	-	-	-	-
Stage 2	854	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	758	869	1243	-	-	-
Mov Cap-2 Maneuver	758	-	-	-	-	-
Stage 1	841	-	-	-	-	-
Stage 2	854	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.5	0	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1243	-	758	-	-
HCM Lane V/C Ratio	-	-	0.132	-	-
HCM Control Delay (s)	0	-	10.5	-	-
HCM Lane LOS	A	-	B	-	-
HCM 95th %tile Q(veh)	0	-	0.5	-	-

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	35	0	0	0	0	20	0	0	0	9	0	38
Future Vol, veh/h	35	0	0	0	0	20	0	0	0	9	0	38
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	50	50	50	50	50	50	50	50	50	50	50	50
Mvmt Flow	38	0	0	0	0	22	0	0	0	10	0	41

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	52	41	21	41	61	0	41	0	0	0	0	0
Stage 1	41	41	-	0	0	-	-	-	-	-	-	-
Stage 2	11	0	-	41	61	-	-	-	-	-	-	-
Critical Hdwy	7.6	7	6.7	7.6	7	6.7	4.6	-	-	4.6	-	-
Critical Hdwy Stg 1	6.6	6	-	6.6	6	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.6	6	-	6.6	6	-	-	-	-	-	-	-
Follow-up Hdwy	3.95	4.45	3.75	3.95	4.45	3.75	2.65	-	-	2.65	-	-
Pot Cap-1 Maneuver	840	766	933	855	746	-	1309	-	-	-	-	-
Stage 1	865	775	-	-	-	-	-	-	-	-	-	-
Stage 2	899	-	-	865	759	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	-	766	933	855	746	-	1309	-	-	-	-	-
Mov Cap-2 Maneuver	-	766	-	855	746	-	-	-	-	-	-	-
Stage 1	865	775	-	-	-	-	-	-	-	-	-	-
Stage 2	899	-	-	865	759	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s			0	
HCM LOS	-	-		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1309	-	-	-	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-	-	-	-	-
HCM Control Delay (s)	0	-	-	-	-	-	-	-
HCM Lane LOS	A	-	-	-	-	-	-	-
HCM 95th %tile Q(veh)	0	-	-	-	-	-	-	-

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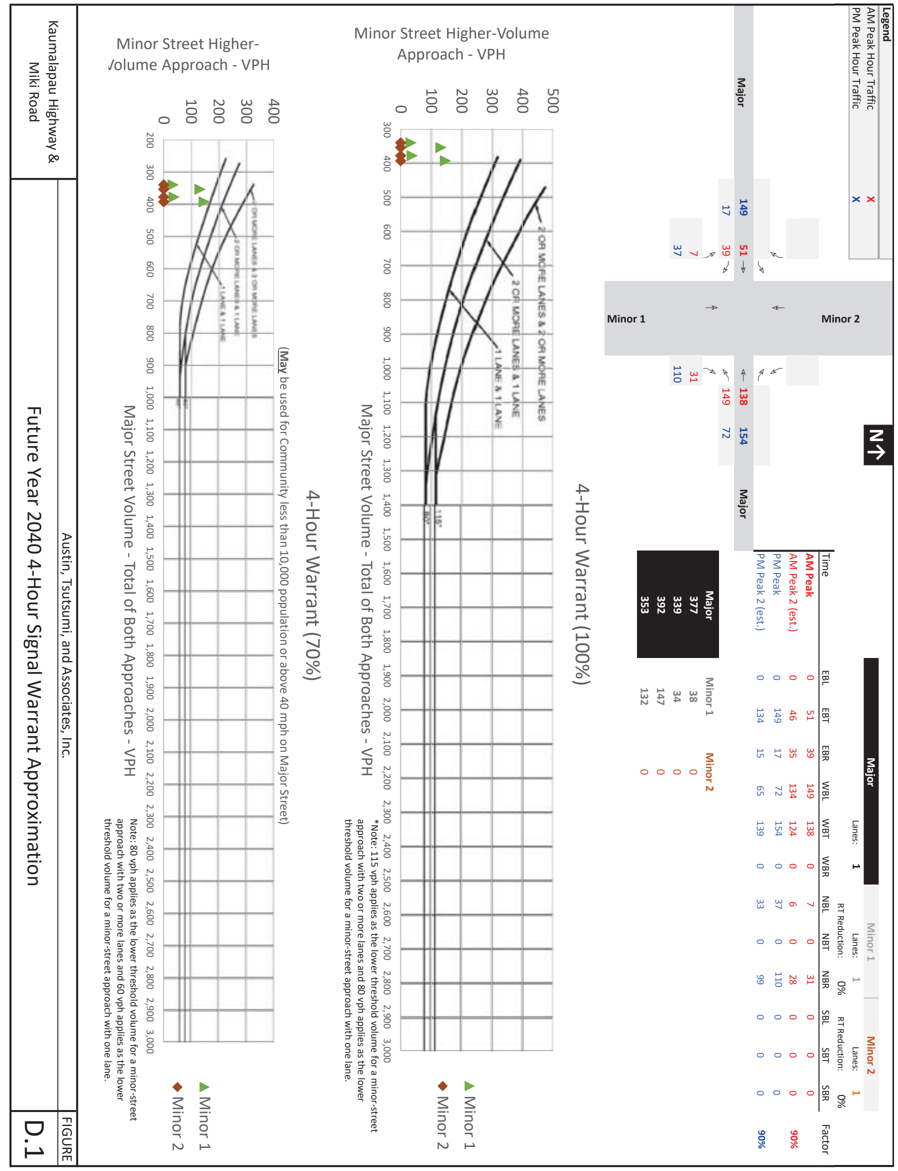
AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

APPENDIX D
SIGNAL WARRANT



FEA REF-567

WATER MASTER PLAN

APPENDIX

H-1

FEA REF-568

PŪLAMA LĀNAʻI MIKI BASIN

200 ACRE INDUSTRIAL PARK

TMK: 4-9-002:061
(Portion)

Lānaʻi, Hawaiʻi

WATER MASTER PLAN

Prepared By: Akinaka & Associates, Ltd.
1100 Alakea Street, Suite 1800
Honolulu, Hawaii 96813

Date: October 2021

TABLE OF CONTENTS

1. **Appendix A1: Water Calculations**
2. **Appendix A2: Water Calculations – Adjusted PRV**
3. **Appendix B: 0% Design Construction Costs**

X. REFERENCES (Not attached)

1. County of Water Supply, Department of Water Supply, Water System Standards, dated 2002.
2. County of Water Supply, Department of Water Supply, Lānaʻi Island Water Use and Development Plan, dated 2011.

I. INTRODUCTION

The Water Master Plan for Pūlama Lānaʻi Miki Basin 200-Acre Industrial Park provides the basic information for the design of the water distribution system for the Miki Basin 200-Acre Industrial Park (Industrial Park) based on zoning requirements. The purpose of this master plan is to analyze the condition of the existing water distribution system and provide a plan for the new projected water demands as part of the Environmental Assessment (EA) submission required to complete the Land Use Commission (LUC) rezoning process.

The Industrial Park consists of approximately 200 acres of agricultural zoned lands. Pūlama Lānaʻi is in the process of rezoning the area for light and heavy industrial lands. The project area (Industrial Park) is located directly south of Lānaʻi Airport within the Pālāwai Irrigation Grid (See **Exhibit 1: Location Map**). The majority of Miki Basin is currently undeveloped with the exception of the Maui Electric Company (MECO) Miki Basin diesel generating facility and substation and a portion of the 20-acre approved subdivision which is currently used by Pūlama Lānaʻi for mobile concrete batch plant (CBP), Pūlama Lānaʻi warehouses and by other commercial industrial tenants uses (e.g., Hawaii Gas, Maui Disposal, etc.). Pūlama Lānaʻi has submitted a Special Use Permit to the County of Maui Planning Department for the relocation of the interim industrial uses. The 200-acres of the proposed Industrial Park do not include the MECO facility and the 20-acre subdivision.

II. EXECUTIVE SUMMARY

Water for Miki Basin is currently provided by the Mānele Bay Water System (Public Water System 238) which is owned, operated, and maintained by the Lānaʻi Water Company. The system, sourced by Wells No. 2 (State Well No. 5-4953-001) and 4 (State Well No. 5-4952-002), currently services Mānele, Hulopoʻe and the Pālāwai Irrigation Grid. Water from the wells is either stored in the existing 0.5 million gallon (MG) Hiʻi Tank or 1.0 MG concrete Hiʻi Reservoir or fed directly into the distribution system depending on need. The existing Mānele Bay Water System (PWS 238) consists of 10-inch, 12-inch and 16-inch transmission mains. The Mānele Bay Water System (PWS 238) is interconnected with the Lānaʻi City Water System (Public Water System 237). During emergencies, the Lānaʻi City Water System (PWS 237) can be connected to the Mānele Bay Water System (PWS 238) by opening a valve.

The existing average daily water usage of the Mānele Bay Water System (PWS 238) is currently estimated at 433,000 gallons per day (gpd).

In accordance with the Water System Standards (WSS), available source capacity is governed by the well with the smallest pumping unit. Well No. 2 has an existing maximum pump capacity of 500 gallons per minute (gpm). Well No. 4 has a maximum pump capacity of 900 gpm. Since Well No. 2 currently has the smaller pump capacity, available source capacity for the Mānele Bay Water System (PWS 238) is governed by Well No. 2, which has a maximum day pumping capacity of 480,000 gpd and is equivalent to an average day pumping capacity of 320,000 gpd. Once this capacity is used/committed, the construction of a new well will be required. According to the 2011 Lānaʻi Water Use and Development Plan, Well No. 2 can be outfitted with a pump with a capacity of up to 1,200 gpm. However, based upon analysis of a pump test of the well in October 2015, we do not recommend increasing the current pump capacity.

Proposed water use for the full buildout of the Industrial Park is based on the existing demands on the Mānele Bay Water System (PWS 238) and potential development plans. The potential development plans that are contemplated in the Industrial Park include an asphalt plant, CBP, renewable energy projects, infrastructure, and new industrial uses.

The Industrial Park's incremental or new estimated water demand on Mānele Bay Water System (PWS 238) is 159,625 gpd. The estimated water demand on Mānele Bay Water System (PWS 238) for the full buildout of the Industrial Park is 163,125 gpd.

The projected average day demand for the Mānele Bay Water System (PWS 238), including full buildout of the Industrial Park and existing demands serviced by the Mānele Bay Water System (PWS 238), is 592,625 gpd. The pie chart in Section 4 (**Figure B)** provides a visual summary of the percentages of existing, new or incremental water demands on the Mānele Bay Water System (PWS 238). After evaluating the full buildout of the project, the Mānele Bay Water System (PWS 238), does not have adequate well-pump capacity (source). There is enough storage to support the full buildout with the existing tank and reservoir. Although the transmission mains do meet WSS for fire flow protection, the existing Mānele Bay Water System (PWS 238) does not meet the WSS in other aspects. There is an existing pressure reducing valve (PRV) that has an outflow limit that could be lowered. If a booster pump could be added to the system, the PRV can be set lower, and the booster could pump the water from nodes J-4 to J-5 through pipe P-6 so that there can be enough pressure to distribute water uphill (See **Exhibit 6: Proposed Mānele Bay Water System (Public Water System 238) Improvements Nodal Map**).

The following improvements will be required to support full buildout of the Industrial Park (See **Exhibit 5: Existing Mānele Bay Water System (Public Water System 238)**):

- The existing water PRV could be lowered to at least acquire an outflow of 55 pounds per square inch (psi) to reach the best possible pressures for the distribution main. If there are cavitation issues, a new PRV should be installed that has an anti-cavitation trim.
- Drilling a new source or multiple sources to obtain an additional total minimum pump capacity of 426 gpm.
- While Lānaʻi Water Company has replaced and has abandoned sections of the Pālāwai Irrigation Grid, there remains sections that are in need of repair, replacement or possible abandonment. Since the condition and use of these pipes are unknown, those pipes were excluded from this evaluation. A conditional assessment and analysis for those pipes should be conducted separately, but from the water calculations in this water master plan (See **Appendix A1 & A2**), existing pipes will need to be assessed and potentially replaced at high pressures.
- Construction costs of offsite improvements can be revised based off of the condition assessment for the existing pipes and the existing PRV.

III. EXISTING WATER SUPPLY AND DISTRIBUTION SYSTEM

Water for Miki Basin is currently serviced by the Mānele Bay Water System (PWS 238) which is owned, operated and maintained by Lānaʻi Water Company (See **Exhibit 2: Existing Mānele Bay Water System (Public Water System 238)**). Mānele Bay Water System (PWS 238) services Mānele, Hulopoʻe and the Pālāwai Irrigation Grid.

1. SOURCE

Water is provided by Wells No. 2 (State Well No. 5-4953-001) and 4 (State Well No. 5-4952-002) and either stored in the existing 0.5 MG Hiʻi Tank or 1.0 MG concrete Hiʻi Reservoir or fed into the tank, then into the distribution system depending on need.

a. Well No. 2 has a pump capacity of 500 gpm or an average day capacity of 320,000 gpd based on an operating time of 16 hours. According to the 2011 Lānaʻi Water Use and Development Plan, Well No. 2 can be outfitted with a pump with a capacity of up to 1,200 gpm. However, based upon analysis of a pump test of the well in October 2015, we do not recommend increasing the current pump capacity.

b. Well No. 4 has a pump capacity of 900 gpm or an average day capacity of 576,000 gpd.

c. The existing average daily water usage from Mānele Bay Water System (PWS 238) is currently estimated at 433,000 gpd.

d. WSS requires sources to be able to meet maximum day demand with an operating time of 16 hours, assuming that the largest pumping unit is down. Since Well No. 4 has the larger pump capacity of the two wells, available source capacity for the system is governed by Well No. 2. The incremental estimated water demand for the full buildout of the Miki 200 project (excluding existing water use) is 159,625 gpd.

e. Lānaʻi has a sustainable yield of 6 million gallons per day (MGD), with 3 MGD allocated to both the Leeward and Windward aquifer sector areas. The majority of the pumping wells are located in the Leeward Aquifer. According to the Lānaʻi Water Company Periodic Water Report, the current moving average pumping is 1.53 MGD.

2. STORAGE

a. 500,000 gallon Hiʻi Tank (Spillway Elevation = 1823')
Serves as the water distribution storage tank for Mānele, Hulopoʻe and the Pālāwai Irrigation Grid.

b. 1,000,000 gallon Hiʻi Reservoir (Spillway Elevation = 1823')
Primarily serves as storage for the two well water sources to supply water into the distribution system

3. TRANSMISSION

a. A 12-inch transmission main transports water from the 1,000,000 gallon Hiʻi Reservoir to the 500,000 gallon Hiʻi Tank and into the

Mānele Bay Water System (PWS 238). The 12-inch main splits at a junction to serve both Mānele and Pālāwai Irrigation Grid.

b. To Mānele and Hulopoʻe – From the junction, the 12-inch line feeds into three pressure breaker storage tanks that service Mānele.

c. To Pālāwai Irrigation Grid – From the junction, the waterline upsizes to a 16-inch main that delivers water to the Pālāwai Irrigation Grid area. The existing 12-inch Pālāwai PRV downstream of the junction reduces the pressure in the waterline to 95 psi.

4. CONNECTION TO OTHER WATER SYSTEMS

a. The Mānele Bay Water System (PWS 238) is interconnected with the Lānaʻi City Water System (PWS 237). During emergencies, the Lānaʻi City System (PWS 237) can be connected to the Mānele Bay Water System (PWS 238) by opening a valve.

IV. LAND USE

Pūlama Lānaʻi is in the process of rezoning approximately 200 acres of land from LUC agricultural to urban, which will include both light and heavy industrial uses.

The Industrial Park project is in the entitlement phase. Proposed water use for the full build out of the Industrial Park is based on the existing demands on the Mānele Bay Water System (PWS 238) and potential development plans. The potential development plans that are contemplated in the Industrial Park include an asphalt plant, CBP, renewable energy projects, infrastructure, and new industrial uses.

The asphalt plant and the CBP are being relocated to the Industrial Park. Although the relocation of the asphalt plant is not anticipated to create any additional water demand on for the entire island, the relocation will shift the existing demand from Lānaʻi City (PWS 237) to Mānele Bay Water System (PWS 238).

The renewable energy projects and infrastructure do not consider any new or incremental water demands on Mānele Bay Water System (PWS 238). The only "new" or "incremental" water demands for the Industrial Park include the new industrial uses and a minor increase for the CBP. The estimated water demand for new industrial uses is determined by the guidelines set in the WSS, which contemplates 6,000 gpd, per acre.

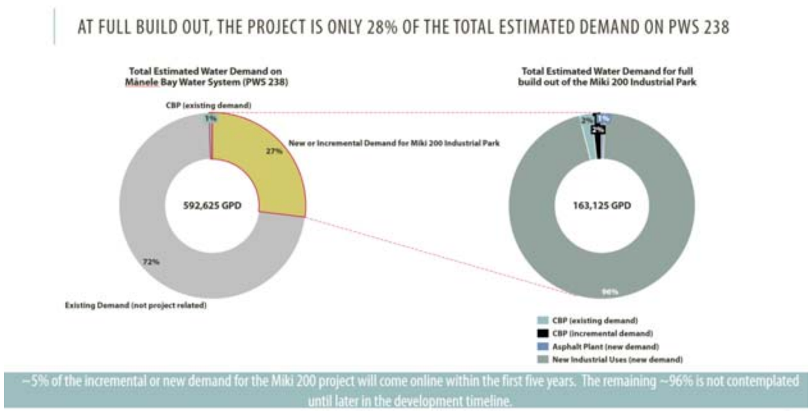
The Industrial Park's incremental or new estimated water demand on Mānele Bay Water System (PWS 238) is 159,625 gpd. The estimated water demand on Mānele Bay Water System (PWS 238) for the full build out of the Industrial Park is 163,125 gpd. The table below (**Figure A**) provides a summary for convenience.

Figure A

Description	Acres	Existing water demand on Mānele Bay Water System (PWS 238) (GPD)	New or incremental water demand on Mānele Bay Water System (PWS 238) (GPD)	Full Build Out of Industrial Park water demand on Mānele Bay Water System (PWS 238) (GPD)
CBP	14.5	3,500	2,625	6,125
Asphalt Plant	12.5	-	1,000	1,000
Renewable Energy Projects	127.0	-	-	-
New Industrial Uses	26.0	-	156,000	156,000
Infrastructure	20.0	-	-	-
Total	**200.0**	**3,500**	**159,625**	**163,125**

The projected average day demand for the Mānele Bay Water System (PWS 238), including full build out of the Industrial Park and existing demands serviced by the Mānele Bay Water System (PWS 238), is 592,625 gpd. The pie chart (**Figure B**) below provides a visual summary of the percentages of existing, new or incremental water demands on the Mānele Bay Water System (PWS 238).

Figure B



V. SAFE DRINKING WATER SYSTEM DESIGN CRITERIA

As outlined in the County of Maui WSS, the following criteria are used in determining the minimum requirements for the safe drinking water system.

1. CONSUMPTION GUIDELINES

a. The average demand for industrial land uses for planning purposes is 6,000 gpd / acre.

2. DEMAND FACTORS

a. Maximum Daily Demand = 1.5 x Average Day

b. Peak Hour Demand = 3.0 x Average Day

3. FIRE FLOW REQUIREMENTS

a. Light Industrial = 2,000 gpm for 2 hour duration

b. Heavy Industrial = 2,500 gpm for 2 hour duration

4. PIPELINE SIZING

a. Maximum daily flow plus fire flow with a residual pressure of 20 psi at critical fire hydrant.

b. Peak hour flow with a minimum residual pressure of 40 psi.

c. In determining the carrying capacity of the mains, the "C" values to be applied are:

Size	"C"
4" & 6"	100
8" & 12"	110
16" & 20"	120

d. The maximum velocity in transmission mains (without fire flow) is 20 feet per second. The maximum velocity in distribution mains with fire flow shall be 10 feet per second.

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e. Maximum static or pumping pressure, whichever is greater, shall not exceed 125 psi.

f. Ductile iron pipe is required by County of Maui WSS and is recommended for this project. The design pressures for ductile iron pipe are as follows:

i .	Maximum design working pressure	=	250 psi
ii.	Maximum desirable working pressure	=	125 psi
iii.	Maximum expected working pressure	=	150 psi

g. The working pressure for distribution mains servicing residences:

i.	Maximum	=	125 psi
ii.	Minimum	=	40 psi

h. In-line Pālāwai's for distribution mains are required where pressure exceeds 125 psi.

i. Cleanouts are required at the end of all transmission and distribution waterlines.

j. Sampling spigots: For collection of water samples to determine water quality at dead ends of pipeline.

5. RESERVOIR CAPACITY

a. Meet maximum day consumption. Reservoir fills at the beginning of the 24-hour period with no source input to the reservoir.

b. Meet maximum day consumption plus fire flow for duration of fire. Reservoir ¾-full, with credit for incoming flow from pumps.

c. Minimum reservoir size shall be 100,000 gallons.

d. Where there are two or more reservoir serving the same system, the design shall be made on the basis of combined protection by all facilities available.

6. PUMP CAPACITY

a. Meet maximum day demand with an operating time of 16 hours simultaneously with maximum fire flow required independent of the reservoir. The standby unit may be used to determine the total flow required.

b. Meet maximum day demand during the duration of the fire plus fire demand less ¾ of reservoir storage.

c. Meet maximum day demand with an operating time of 16 hours with the largest pumping unit considered out of service.

VI. INDUSTRIAL PARK WATER DEMAND

1. The Industrial Park's incremental or new estimated water demand on Mānele Bay Water System (PWS 238) is 159,625 gpd.

2. The estimated water demand on Mānele Bay Water System (PWS 238) for the full build out of the Industrial Park is 163,125 gpd.

3. The projected average day demand for the Mānele Bay Water System (PWS 238), including full build out of the Industrial Park and existing demands serviced by the Mānele Bay Water System (PWS 238), is 592,625 gpd. (See **Exhibit 3: Existing and Projected Water Flow Summation**, **Exhibit 4: Water Demand Map for Mānele Bay Water System (PWS 238)**).

4. The existing system does not meet the WSS criteria for pipe sizing based on the maximum static pressure shall not exceed 125 psi. The system does meet the WSS criteria to have a maximum of 2,000 gpm for Fire Flow plus Maximum Daily flow for Light Industry and 2,500 gpm for Fire Flow plus Maximum Daily flow for Heavy Industry with a maximum velocity of 10 feet per second for Light and Heavy Industrial Uses. The system also meets the criteria for the Peak Hour flow with a minimum residual pressure of 20 psi.

5. **Exhibit 5: Existing Mānele Bay Water System (PWS 238) Nodal Map** shows the overall water system facilities and nodal map.

VII. PROPOSED SAFE DRINKING WATER SYSTEM (BASED ON LAND USE/ZONING)

1. **WATER SOURCE**

a. In accordance with the WSS, available source capacity is governed by the well with the smallest pumping unit. Well No. 2 has an existing pump capacity of 500 gpm. Well No. 4 has a pump capacity of 900 gpm. Since Well No. 2 has the smaller pump capacity, available source capacity for the Mānele Bay Water System (PWS 238) is governed by Well No. 2, which has an average day pumping capacity of 320,000 gpd, which is equivalent to a maximum day pumping capacity of 480,000 gpd. The current average daily water usage of the Mānele Bay Water System (PWS 238) is 433,000 gpd. The full build out of the Industrial Park is anticipated to add an incremental demand of 159,625 gpd to the Mānele Bay Water System (PWS 238), resulting in a total demand of 163,125 gpd for the Industrial Park on the Mānele Bay Water System (PWS 238). Since there are no definite plans to utilize the full amount of water in these estimations, the actual water use may be lower than anticipated.

b. Well Pump Sizing - Mānele Bay Water System (PWS 238)

i. Existing PWS 238 average day capacity = 320,000 gpd
Existing PWS 238 maximum day capacity = 480,000 gpd

ii. PWS 238 with Full Buildout of Industrial Park average day demand = 592,625 gpd
PWS 238 with Full Buildout of Industrial Park maximum day demand = 888,937 gpd

iii. Additional average day capacity required = 272,625 gpd
Additional maximum day capacity required = 408,937 gpd

408,937 gallons / 16 hours / 60 min	=	426 gpm
Additional required pump capacity	=	426 gpm

Full Buildout of the Industrial Park will require increasing the existing well pump, the development of a new well, or multiple wells with an additional total minimum total capacity of 426 gpm.

b. Source Options

The Lānaʻi Water Use and Development Plan (WUDP) discusses the following options for development of to meet future water demand requirements:

i. Drilling a new source or multiple sources to obtain a total minimum pump capacity of 426 gpm.

ii. Installing a permanent interconnection with the Lānaʻi City System. This will require a separate analysis for possible interconnection.

iii. Well 7 is currently in the permitting process for another project in Lānaʻi City to bring online (See **Exhibit 2: Existing Mānele Bay Water System (PWS 238)**). Recommissioning the well will provide reliability for both the Lānaʻi City system and the Irrigation Grid.

2. **RESERVOIR CAPACITY**

a. Case A: Meet maximum day demand in 24-hours
<u>Capacity required = 888,937 gallons</u>

Case B: Meet maximum day + fire flow, reservoir ¾ full
Max day rate = 888,937 gpd
Fire flow = 2,500 gpm
Smallest pump capacity = 500 gpm

Max day rate + fire flow – smallest pump for 120 minutes
= 888,937 gpd + 2,500 gpm x 120 min
= 1,188,937 gallons

Size required = 1,188,937 gallons * 1.25 = <u>1,486,171 gallons</u>

Case B governs:

Minimum Reservoir Capacity = 1,486,171 gallons

Existing Reservoir Capacity = 1,500,000 gallons

Therefore, existing reservoir capacity is adequate for full buildout.

3. **TRANSMISSION/DISTRIBUTION MAINS**

a. Offsite Improvements

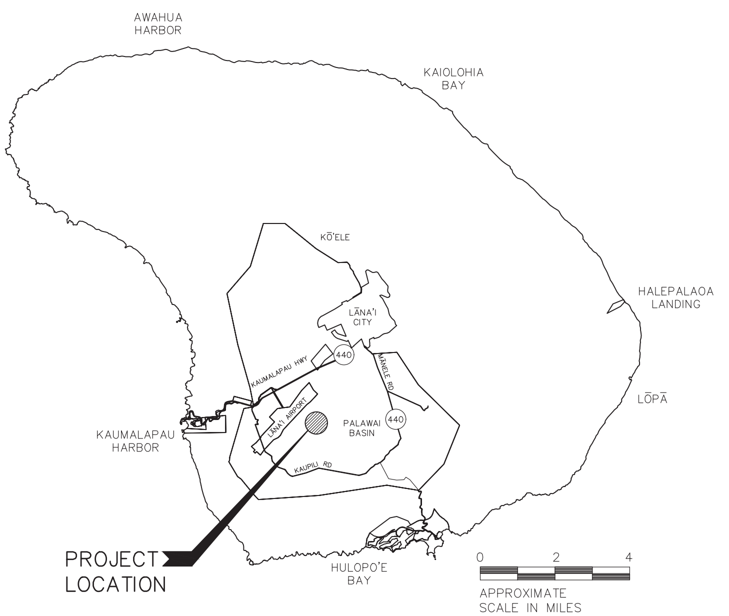
i. Option 1. The existing water PRV could be lowered to at least acquire an outflow of 55 psi to reach the best possible pressures for the distribution main. If there are cavitation issues, a new PRV should be installed that has an anti-cavitation trim.

ii. Option 2. While Lānaʻi Water Company has replaced and has abandoned sections of the Pālāwai Irrigation Grid, there remains sections that are potentially in need of repair, replacement, or possible abandonment. Since the condition and use of these pipes are unknown, those pipes were excluded from this evaluation. A conditional assessment and analysis for those pipes should be conducted separately, but from the water calculations in this water master plan (see **Appendix A1 & A2**), existing pipes will need to be assessed and potentially replaced at high pressures.

VII. COST CONSIDERATIONS

Budgetary cost for the water improvements is provided in Appendix B.

EXHIBITS



ISLAND OF LĀNA'I

EXHIBIT 1

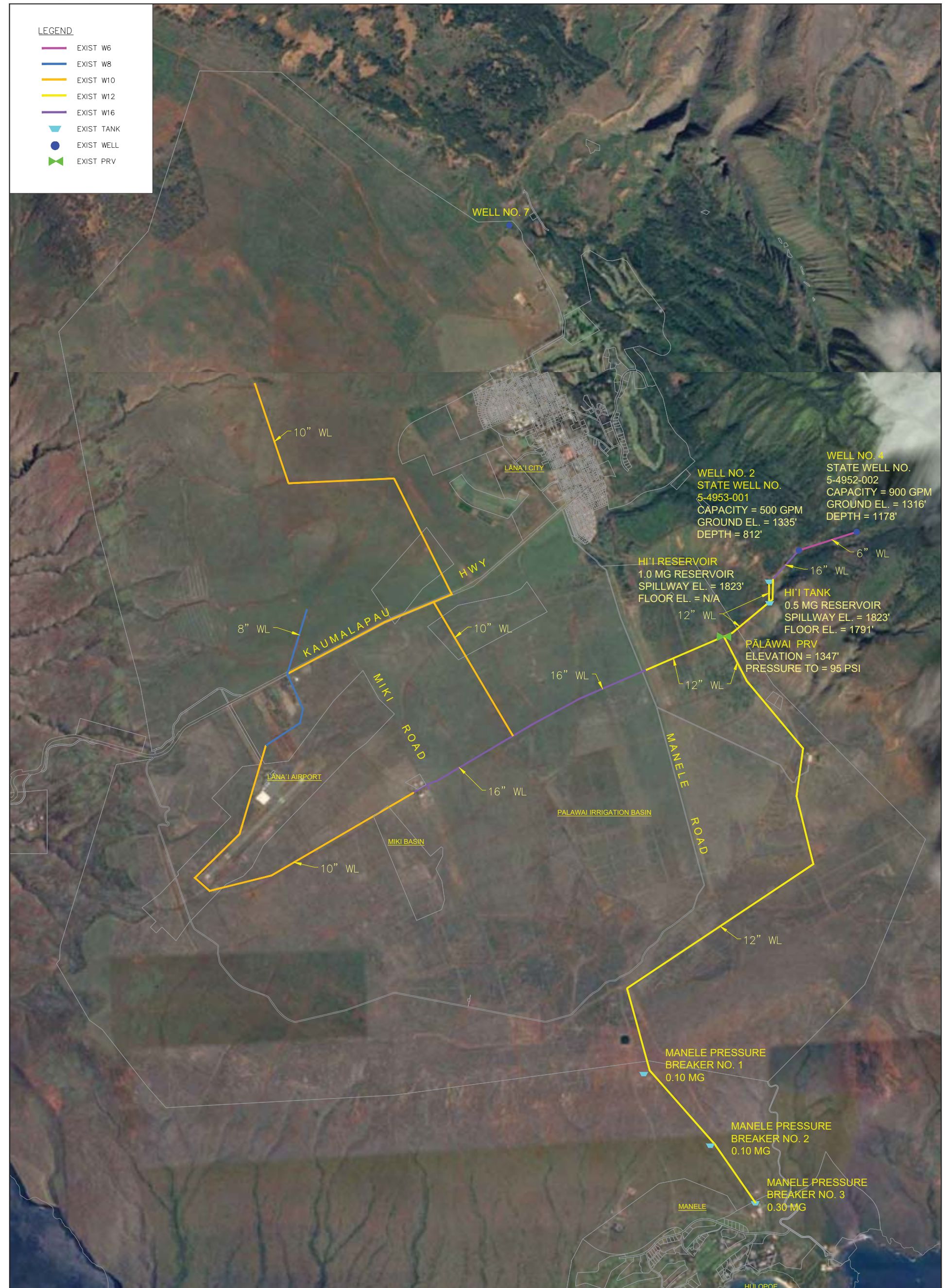
NORTH

PŪLAMA LĀNA'I MIKI BASIN
200–ACRE INDUSTRIAL PARK

LOCATION MAP

AKINAKA & ASSOCIATES, LTD.

SCALE: AS SHOWN DATE: OCTOBER 2021



NOT TO SCALE

PŪLAMA LĀNAʻI MIKI BASIN 200-ACRE INDUSTRIAL PARK

EXHIBIT 2

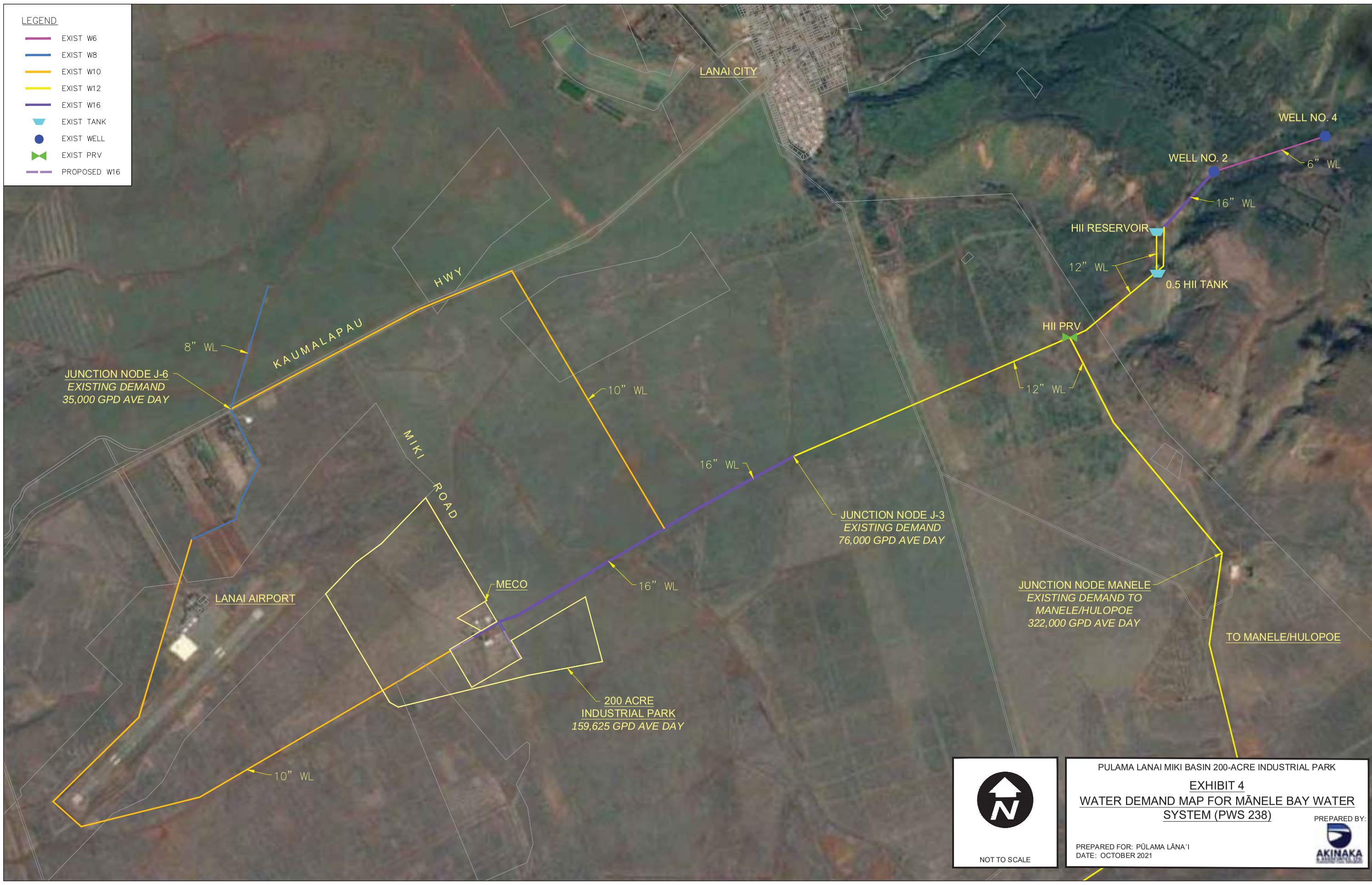
EXISTING MĀNELE BAY WATER SYSTEM (PWS 238)

PREPARED BY:

AKINAKA

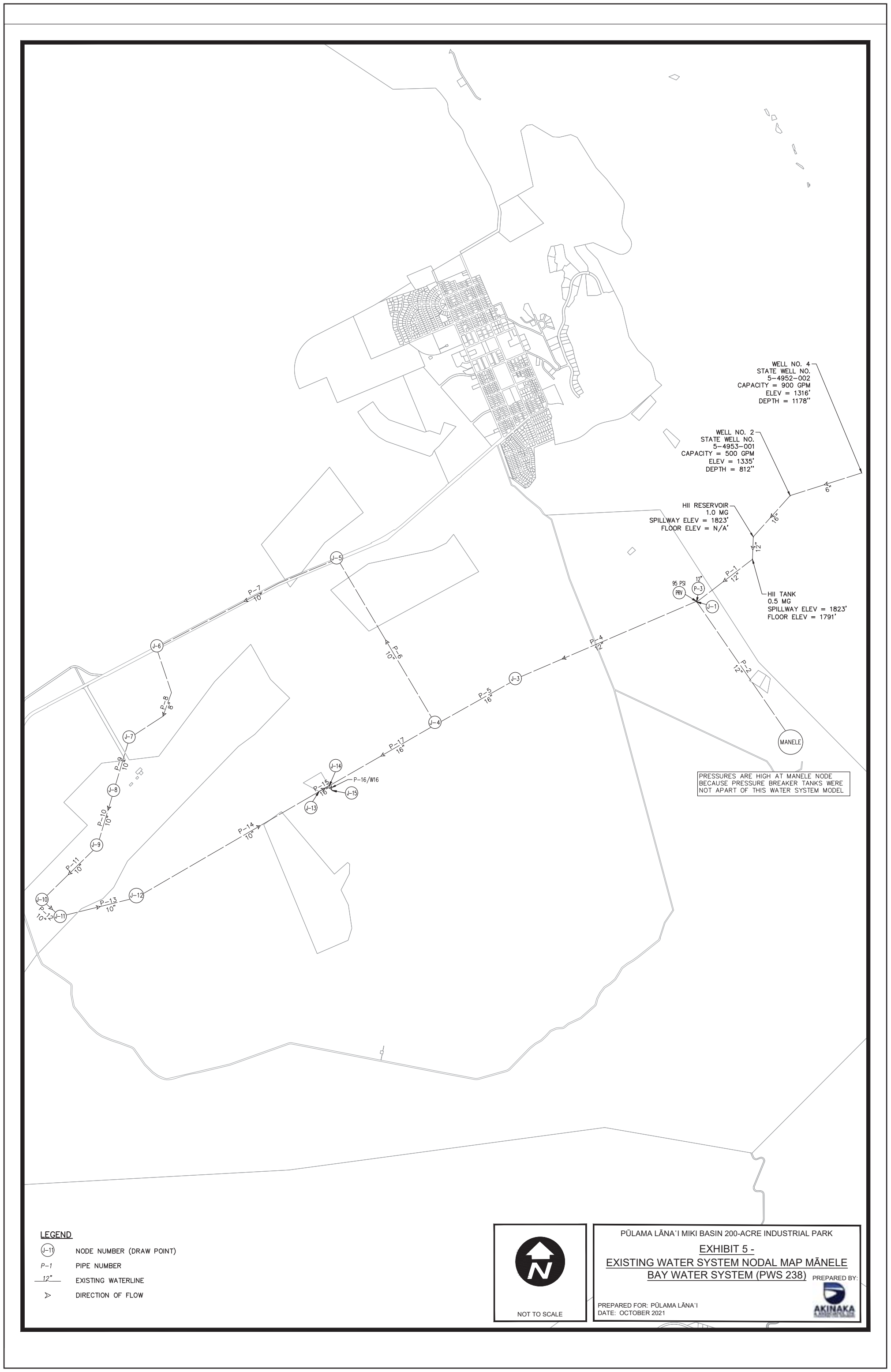
PREPARED FOR: PŪLAMA LĀNAʻI
DATE: OCTOBER 2021

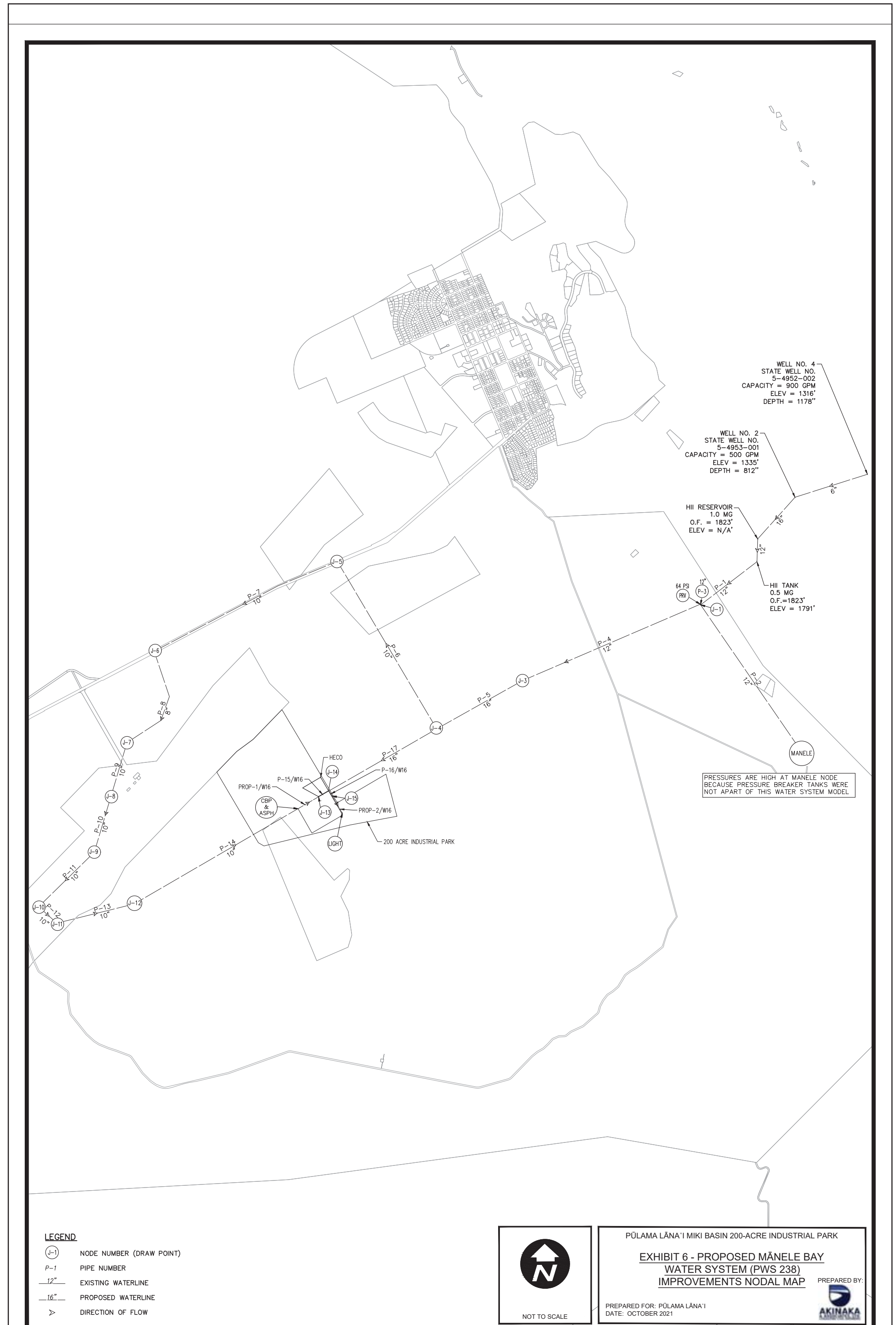
FEA REF-577



FEA REF-578

EXHIBIT 3: EXISTING AND PROJECTED WATER FLOW SUMMATION PŪLAMA LĀNAʻI MIKI BASIN 200 ACRE INDUSTRIAL PARK OCTOBER 2021										
Point No	Description	Land Use	Proposed Area (ac)	Avg Daily Demand (gal/ac)	Avg Day Rate (GPD)	Max Day Rate (GPD)	Peak Hour Rate (GPD)	Avg Day Rate (GPM)	Max Day Rate (GPM)	Peak Hour Rate (GPM)
MANELE	*Exist Demand*		-	-	*322,000.00*	*483,000.00*	*966,000.00*	*223.61*	*335.42*	*670.83*
J-3	*Exist Demand*		-	-	*76,000.00*	*114,000.00*	*228,000.00*	*52.78*	*79.17*	*158.33*
J-6	*Exist Demand*		-	-	*35,000.00*	*52,500.00*	*105,000.00*	*24.00*	*36.00*	*72.00*
CBP & ASPH	Concrete Crushing Facility	CBP & Toilet Facility	14.50	-	2,625.00	3,937.50	7,875.00	1.82	2.73	5.47
LIGHT	Other Industrial Uses	Light Industrial	26.00	6,000.00	156,000.00	234,000.00	468,000.00	108.33	162.50	325.00
CBP & ASPH	Asphalt Plant	Emission Process	12.50	-	1,000.00	1,500.00	3,000.00	0.69	1.04	2.08
	Renewable Energy Projects		127.00	-	-	-	-	-	-	-
	Infrastructure		20.00	-	-	-	-	-	-	-
			200.00	**Total**	592,625.00	888,937.50	1,777,875.00	411.24	616.86	1,233.72


WELL NO. 4
STATE WELL NO. 5-4952-002
CAPACITY = 900 GPM
ELEV = 1316'
DEPTH = 1178''
WELL NO. 2
STATE WELL NO. 5-4953-001
CAPACITY = 500 GPM
ELEV = 1335'
DEPTH = 812''
HII RESERVOIR
1.0 MG
SPILLWAY ELEV = 1823'
FLOOR ELEV = N/A'
HII TANK
0.5 MG
SPILLWAY ELEV = 1823'
FLOOR ELEV = 1791'
MANELE
PRESSURES ARE HIGH AT MANELE NODE BECAUSE PRESSURE BREAKER TANKS WERE NOT APART OF THIS WATER SYSTEM MODEL
LEGEND
NODE NUMBER (DRAW POINT)
PIPE NUMBER
EXISTING WATERLINE
DIRECTION OF FLOW
NOT TO SCALE
PŪLAMA LĀNA'I MIKI BASIN 200-ACRE INDUSTRIAL PARK
EXHIBIT 5 - EXISTING WATER SYSTEM NODAL MAP MĀNELE BAY WATER SYSTEM (PWS 238)
PREPARED BY:
AKINAKA
PREPARED FOR: PŪLAMA LĀNA'I
DATE: OCTOBER 2021


WELL NO. 4
STATE WELL NO. 5-4952-002
CAPACITY = 900 GPM
ELEV = 1316'
DEPTH = 1178''
WELL NO. 2
STATE WELL NO. 5-4953-001
CAPACITY = 500 GPM
ELEV = 1335'
DEPTH = 812''
HII RESERVOIR
1.0 MG
O.F. = 1823'
ELEV = N/A'
HII TANK
0.5 MG
O.F.=1823'
ELEV = 1791'
MANELE
PRESSURES ARE HIGH AT MANELE NODE BECAUSE PRESSURE BREAKER TANKS WERE NOT APART OF THIS WATER SYSTEM MODEL
HECO
P-15/W16
P-16/W16
PROP-1/W16
PROP-2/W16
200 ACRE INDUSTRIAL PARK
LEGEND
NODE NUMBER (DRAW POINT)
PIPE NUMBER
EXISTING WATERLINE
PROPOSED WATERLINE
DIRECTION OF FLOW
NOT TO SCALE
PŪLAMA LĀNA'I MIKI BASIN 200-ACRE INDUSTRIAL PARK
EXHIBIT 6 - PROPOSED MĀNELE BAY WATER SYSTEM (PWS 238) IMPROVEMENTS NODAL MAP
PREPARED BY:
AKINAKA
PREPARED FOR: PŪLAMA LĀNA'I
DATE: OCTOBER 2021

FEA REF-579

APPENDIX A1

Water Calculations

PŪLAMA LĀNAʻI MIKI BASIN
200 ACRE INDUSTRIAL PARK
EXISTING PIPES & PRV @ 95 PSI : STATIC

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-1	2088.00	T-1	J-1	12.00	Ductile Iron	110.00	0.00	0.00	0.00
P-2	5145.00	J-1	MANELE	12.00	Ductile Iron	110.00	0.00	0.00	0.00
P-3	11.00	J-1	PRV	12.00	Ductile Iron	110.00	0.00	0.00	0.00
P-4	5931.00	PRV	J-3	12.00	Ductile Iron	110.00	0.00	0.00	0.00
P-5	2675.00	J-3	J-4	16.00	Ductile Iron	120.00	0.00	0.00	0.00
P-6	5732.00	J-4	J-5	10.00	Ductile Iron	110.00	0.00	0.00	0.00
P-7	6012.00	J-5	J-6	10.00	Ductile Iron	110.00	0.00	0.00	0.00
P-8	3194.00	J-7	J-6	8.00	Ductile Iron	110.00	0.00	0.00	0.00
P-9	1561.00	J-8	J-7	10.00	Ductile Iron	110.00	0.00	0.00	0.00
P-10	1989.00	J-9	J-8	10.00	Ductile Iron	110.00	0.00	0.00	0.00
P-11	2294.00	J-10	J-9	10.00	Ductile Iron	110.00	0.00	0.00	0.00
P-12	723.00	J-11	J-10	10.00	Ductile Iron	110.00	0.00	0.00	0.00
P-13	2338.00	J-12	J-11	10.00	Ductile Iron	110.00	0.00	0.00	0.00
P-14	6275.00	J-12	J-13	10.00	Ductile Iron	110.00	0.00	0.00	0.00
P-15	361.00	J-13	J-14	16.00	Ductile Iron	120.00	0.00	0.00	0.00
P-16	170.00	J-14	J-15	16.00	Ductile Iron	120.00	0.00	0.00	0.00
P-17	3654.00	J-4	J-14	16.00	Ductile Iron	120.00	0.00	0.00	0.00

Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)
J-1	1347.17	1818.00	204.00	0.00
J-3	1345.73	1566.82	96.00	0.00
J-4	1134.61	1566.82	187.00	0.00
J-5	1350.00	1566.82	94.00	0.00
J-6	1339.00	1566.82	99.00	0.00
J-7	1301.00	1566.82	115.00	0.00
J-8	1287.75	1566.82	121.00	0.00
J-9	1249.00	1566.82	138.00	0.00
J-10	1207.00	1566.82	156.00	0.00
J-11	1223.00	1566.82	149.00	0.00
J-12	1281.00	1566.82	124.00	0.00
J-13	1224.41	1566.82	148.00	0.00
J-14	1221.15	1566.82	150.00	0.00
J-15	1221.91	1566.82	149.00	0.00
MANELE	1128.00	1818.00	299.00	0.00

Label	Elevation (Base) (ft)	Elevation (Min) (ft)	Hydraulic Grade (ft)	Elevation (Max) (ft)	Volume (MG)	Diameter (ft)	Flow (Out) (gpm)	Percent Full (%)
Hi'i Tank	1791.00	1812.00	1818.00	1823.00	0.50	26.00	0.00	54.50

FEA REF-580

PŪLAMA LĀNAʻI MIKI BASIN
200 ACRE INDUSTRIAL PARK
EXISTING PIPES & PRV @ 95 PSI : MAX DAY

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-1	2088.00	T-1	J-1	12.00	Ductile Iron	110.00	616.86	1.75	0.00
P-2	5145.00	J-1	MANELE	12.00	Ductile Iron	110.00	335.42	0.95	0.00
P-3	11.00	J-1	PRV	12.00	Ductile Iron	110.00	281.44	0.80	0.00
P-4	5931.00	PRV	J-3	12.00	Ductile Iron	110.00	281.44	0.80	0.00
P-5	2675.00	J-3	J-4	16.00	Ductile Iron	120.00	202.27	0.32	0.00
P-6	5732.00	J-4	J-5	10.00	Ductile Iron	110.00	27.95	0.11	0.00
P-7	6012.00	J-5	J-6	10.00	Ductile Iron	110.00	27.95	0.11	0.00
P-8	3194.00	J-7	J-6	8.00	Ductile Iron	110.00	8.05	0.05	0.00
P-9	1561.00	J-8	J-7	10.00	Ductile Iron	110.00	8.05	0.03	0.00
P-10	1989.00	J-9	J-8	10.00	Ductile Iron	110.00	8.05	0.03	0.00
P-11	2294.00	J-10	J-9	10.00	Ductile Iron	110.00	8.05	0.03	0.00
P-12	723.00	J-11	J-10	10.00	Ductile Iron	110.00	8.05	0.03	0.00
P-13	2338.00	J-12	J-11	10.00	Ductile Iron	110.00	8.05	0.03	0.00
P-14	5359.00	CBP & ASPH	J-12	10.00	Ductile Iron	110.00	8.05	0.03	0.00
P-15	361.00	J-14	J-13	16.00	Ductile Iron	120.00	11.82	0.02	0.00
P-16	170.00	J-14	J-15	16.00	Ductile Iron	120.00	162.50	0.26	0.00
P-17	3654.00	J-4	J-14	16.00	Ductile Iron	120.00	174.32	0.28	0.00
PROP-1	916.00	J-13	CBP & ASPH	16.00	Ductile Iron	120.00	11.82	0.02	0.00
PROP-2	461.00	J-15	LIGHT	16.00	Ductile Iron	120.00	162.50	0.26	0.00

Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)
CBP & ASPH	1230.00	1564.46	145.00	3.77
J-1	1347.17	1809.47	200.00	0.00
J-3	1345.73	1564.87	95.00	79.17
J-4	1134.61	1564.57	186.00	0.00
J-5	1350.00	1564.50	93.00	0.00
J-6	1339.00	1564.44	98.00	36.00
J-7	1301.00	1564.45	114.00	0.00
J-8	1287.75	1564.45	120.00	0.00
J-9	1249.00	1564.45	136.00	0.00
J-10	1207.00	1564.45	155.00	0.00
J-11	1223.00	1564.45	148.00	0.00
J-12	1281.00	1564.46	123.00	0.00
J-13	1236.46	1564.46	142.00	0.00
J-14	1239.00	1564.46	141.00	0.00
J-15	1250.00	1564.46	136.00	0.00
LIGHT	1255.00	1564.45	134.00	162.50
MANELE	1128.00	1799.62	291.00	335.42

Label	Elevation (Base) (ft)	Elevation (Min) (ft)	Hydraulic Grade (ft)	Elevation (Max) (ft)	Volume (MG)	Diameter (ft)	Flow (Out) (gpm)	Percent Full (%)
Hi'i Tank	1791.00	1812.00	1818.00	1823.00	0.50	26.00	616.86	54.50

PŪLAMA LĀNAʻI MIKI BASIN
200 ACRE INDUSTRIAL PARK
EXISTING PIPES & PRV @ 95 PSI : PEAK HOUR

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-1	2088.00	T-1	J-1	12.00	Ductile Iron	110.00	1233.71	3.50	0.01
P-2	5145.00	J-1	MANELE	12.00	Ductile Iron	110.00	670.83	1.90	0.00
P-3	11.00	J-1	PRV	12.00	Ductile Iron	110.00	562.88	1.60	0.00
P-4	5931.00	PRV	J-3	12.00	Ductile Iron	110.00	562.88	1.60	0.00
P-5	2675.00	J-3	J-4	16.00	Ductile Iron	120.00	404.55	0.65	0.00
P-6	5732.00	J-4	J-5	10.00	Ductile Iron	110.00	55.89	0.23	0.00
P-7	6012.00	J-5	J-6	10.00	Ductile Iron	110.00	55.89	0.23	0.00
P-8	3194.00	J-7	J-6	8.00	Ductile Iron	110.00	16.11	0.10	0.00
P-9	1561.00	J-8	J-7	10.00	Ductile Iron	110.00	16.11	0.07	0.00
P-10	1989.00	J-9	J-8	10.00	Ductile Iron	110.00	16.11	0.07	0.00
P-11	2294.00	J-10	J-9	10.00	Ductile Iron	110.00	16.11	0.07	0.00
P-12	723.00	J-11	J-10	10.00	Ductile Iron	110.00	16.11	0.07	0.00
P-13	2338.00	J-12	J-11	10.00	Ductile Iron	110.00	16.11	0.07	0.00
P-14	5359.00	CBP & ASPH	J-12	10.00	Ductile Iron	110.00	16.11	0.07	0.00
P-15	361.00	J-14	J-13	16.00	Ductile Iron	120.00	23.66	0.04	0.00
P-16	170.00	J-14	J-15	16.00	Ductile Iron	120.00	325.00	0.52	0.00
P-17	3654.00	J-4	J-14	16.00	Ductile Iron	120.00	348.66	0.56	0.00
PROP-1	916.00	J-13	CBP & ASPH	16.00	Ductile Iron	120.00	23.66	0.04	0.00
PROP-2	461.00	J-15	LIGHT	16.00	Ductile Iron	120.00	325.00	0.52	0.00

Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)
CBP & ASPH	1230.00	1558.30	142.00	7.55
J-1	1347.17	1787.22	190.00	0.00
J-3	1345.73	1559.76	93.00	158.33
J-4	1134.61	1558.67	183.00	0.00
J-5	1350.00	1558.44	90.00	0.00
J-6	1339.00	1558.20	95.00	72.00
J-7	1301.00	1558.24	111.00	0.00
J-8	1287.75	1558.25	117.00	0.00
J-9	1249.00	1558.25	134.00	0.00
J-10	1207.00	1558.26	152.00	0.00
J-11	1223.00	1558.27	145.00	0.00
J-12	1281.00	1558.28	120.00	0.00
J-13	1236.46	1558.30	139.00	0.00
J-14	1239.00	1558.30	138.00	0.00
J-15	1250.00	1558.28	133.00	0.00
LIGHT	1255.00	1558.24	131.00	325.00
MANELE	1128.00	1751.64	270.00	670.83

Label	Elevation (Base) (ft)	Elevation (Min) (ft)	Hydraulic Grade (ft)	Elevation (Max) (ft)	Volume (MG)	Diameter (ft)	Flow (Out) (gpm)	Percent Full (%)
Hi'i Tank	1791.00	1812.00	1818.00	1823.00	0.50	26.00	1233.71	54.50

FEA REF-581

PŪLAMA LĀNAʻI MIKI BASIN
200 ACRE INDUSTRIAL PARK
EXISTING PIPES & PRV @ 95 PSI : MAX DAY FLOW + FIRE FLOW @ CONCRETE CRUSHING FACILITY & ASPHALT PLANT

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-1	2088.00	T-1	J-1	12.00	Ductile Iron	110.00	3116.86	8.84	0.03
P-2	5145.00	J-1	MANELE	12.00	Ductile Iron	110.00	335.42	0.95	0.00
P-3	11.00	J-1	PRV	12.00	Ductile Iron	110.00	2781.44	7.89	0.02
P-4	5931.00	PRV	J-3	12.00	Ductile Iron	110.00	2781.44	7.89	0.02
P-5	2675.00	J-3	J-4	16.00	Ductile Iron	120.00	2702.27	4.31	0.01
P-6	5732.00	J-4	J-5	10.00	Ductile Iron	110.00	245.17	1.00	0.00
P-7	6012.00	J-5	J-6	10.00	Ductile Iron	110.00	245.17	1.00	0.00
P-8	3194.00	J-7	J-6	8.00	Ductile Iron	110.00	-209.17	1.34	0.00
P-9	1561.00	J-8	J-7	10.00	Ductile Iron	110.00	-209.17	0.85	0.00
P-10	1989.00	J-9	J-8	10.00	Ductile Iron	110.00	-209.17	0.85	0.00
P-11	2294.00	J-10	J-9	10.00	Ductile Iron	110.00	-209.17	0.85	0.00
P-12	723.00	J-11	J-10	10.00	Ductile Iron	110.00	-209.17	0.85	0.00
P-13	2338.00	J-12	J-11	10.00	Ductile Iron	110.00	-209.17	0.85	0.00
P-14	5359.00	CBP & ASPH	J-12	10.00	Ductile Iron	110.00	-209.17	0.85	0.00
P-15	361.00	J-14	J-13	16.00	Ductile Iron	120.00	2294.60	3.66	0.00
P-16	170.00	J-14	J-15	16.00	Ductile Iron	120.00	162.50	0.26	0.00
P-17	3654.00	J-4	J-14	16.00	Ductile Iron	120.00	2457.10	3.92	0.00
PROP-1	916.00	J-13	CBP & ASPH	16.00	Ductile Iron	120.00	2294.60	3.66	0.00
PROP-2	461.00	J-15	LIGHT	16.00	Ductile Iron	120.00	162.50	0.26	0.00

Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)
CBP & ASPH	1230.00	1375.82	63.00	2503.77
J-1	1347.17	1646.73	130.00	0.00
J-3	1345.73	1430.61	37.00	79.17
J-4	1134.61	1394.11	112.00	0.00
J-5	1350.00	1390.55	18.00	0.00
J-6	1339.00	1386.81	21.00	36.00
J-7	1301.00	1382.43	35.00	0.00
J-8	1287.75	1381.70	41.00	0.00
J-9	1249.00	1380.78	57.00	0.00
J-10	1207.00	1379.72	75.00	0.00
J-11	1223.00	1379.39	68.00	0.00
J-12	1281.00	1378.30	42.00	0.00
J-13	1236.46	1378.91	62.00	0.00
J-14	1239.00	1380.13	61.00	0.00
J-15	1250.00	1380.12	56.00	0.00
LIGHT	1255.00	1380.11	54.00	162.50
MANELE	1128.00	1636.88	220.00	335.42

Label	Elevation (Base) (ft)	Elevation (Min) (ft)	Hydraulic Grade (ft)	Elevation (Max) (ft)	Volume (MG)	Diameter (ft)	Flow (Out) (gpm)	Percent Full (%)
Hi'i Tank	1791.00	1812.00	1818.00	1823.00	0.50	26.00	3116.86	54.50

PŪLAMA LĀNAʻI MIKI BASIN
200 ACRE INDUSTRIAL PARK
EXISTING PIPES & PRV @ 95 PSI : MAX DAY FLOW + FIRE FLOW @ LIGHT INDUSTRIAL PARCEL

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-1	2088.00	T-1	J-1	12.00	Ductile Iron	110.00	2616.86	7.42	0.02
P-2	5145.00	J-1	MANELE	12.00	Ductile Iron	110.00	335.42	0.95	0.00
P-3	11.00	J-1	PRV	12.00	Ductile Iron	110.00	2281.44	6.47	0.02
P-4	5931.00	PRV	J-3	12.00	Ductile Iron	110.00	2281.44	6.47	0.02
P-5	2675.00	J-3	J-4	16.00	Ductile Iron	120.00	2202.27	3.51	0.00
P-6	5732.00	J-4	J-5	10.00	Ductile Iron	110.00	180.84	0.74	0.00
P-7	6012.00	J-5	J-6	10.00	Ductile Iron	110.00	180.84	0.74	0.00
P-8	3194.00	J-7	J-6	8.00	Ductile Iron	110.00	-144.84	0.92	0.00
P-9	1561.00	J-8	J-7	10.00	Ductile Iron	110.00	-144.84	0.59	0.00
P-10	1989.00	J-9	J-8	10.00	Ductile Iron	110.00	-144.84	0.59	0.00
P-11	2294.00	J-10	J-9	10.00	Ductile Iron	110.00	-144.84	0.59	0.00
P-12	723.00	J-11	J-10	10.00	Ductile Iron	110.00	-144.84	0.59	0.00
P-13	2338.00	J-12	J-11	10.00	Ductile Iron	110.00	-144.84	0.59	0.00
P-14	5359.00	CBP & ASPH	J-12	10.00	Ductile Iron	110.00	-144.84	0.59	0.00
P-15	361.00	J-14	J-13	16.00	Ductile Iron	120.00	-141.07	0.23	0.00
P-16	170.00	J-14	J-15	16.00	Ductile Iron	120.00	2162.50	3.45	0.00
P-17	3654.00	J-4	J-14	16.00	Ductile Iron	120.00	2021.43	3.23	0.00
PROP-1	916.00	J-13	CBP & ASPH	16.00	Ductile Iron	120.00	-141.07	0.23	0.00
PROP-2	461.00	J-15	LIGHT	16.00	Ductile Iron	120.00	2162.50	3.45	0.00

Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)
CBP & ASPH	1230.00	1437.75	90.00	3.77
J-1	1347.17	1694.11	150.00	0.00
J-3	1345.73	1472.46	55.00	79.17
J-4	1134.61	1447.46	135.00	0.00
J-5	1350.00	1445.44	41.00	0.00
J-6	1339.00	1443.31	45.00	36.00
J-7	1301.00	1441.09	61.00	0.00
J-8	1287.75	1440.73	66.00	0.00
J-9	1249.00	1440.26	83.00	0.00
J-10	1207.00	1439.72	101.00	0.00
J-11	1223.00	1439.55	94.00	0.00
J-12	1281.00	1439.00	68.00	0.00
J-13	1236.46	1437.73	87.00	0.00
J-14	1239.00	1437.72	86.00	0.00
J-15	1250.00	1437.21	81.00	0.00
LIGHT	1255.00	1435.82	78.00	2162.50
MANELE	1128.00	1684.25	241.00	335.42

Label	Elevation (Base) (ft)	Elevation (Min) (ft)	Hydraulic Grade (ft)	Elevation (Max) (ft)	Volume (MG)	Diameter (ft)	Flow (Out) (gpm)	Percent Full (%)
Hi'i Tank	1791.00	1812.00	1818.00	1823.00	0.50	26.00	2616.86	54.50

APPENDIX A2

Water Calculations – Adjusted PRV

PŪLAMA LĀNAʻI MIKI BASIN
200 ACRE INDUSTRIAL PARK
PROPOSED PRV @ 55 PSI : STATIC

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-1	2088.00	T-1	J-1	12.00	Ductile Iron	110.00	0.00	0.00	0.00
P-2	5145.00	J-1	MANELE	12.00	Ductile Iron	110.00	0.00	0.00	0.00
P-3	11.00	J-1	PRV	12.00	Ductile Iron	110.00	0.00	0.00	0.00
P-4	5931.00	PRV	J-3	12.00	Ductile Iron	110.00	0.00	0.00	0.00
P-5	2675.00	J-3	J-4	16.00	Ductile Iron	120.00	0.00	0.00	0.00
P-6	5732.00	J-4	J-5	10.00	Ductile Iron	110.00	0.00	0.00	0.00
P-7	6012.00	J-5	J-6	10.00	Ductile Iron	110.00	0.00	0.00	0.00
P-8	3194.00	J-7	J-6	8.00	Ductile Iron	110.00	0.00	0.00	0.00
P-9	1561.00	J-8	J-7	10.00	Ductile Iron	110.00	0.00	0.00	0.00
P-10	1989.00	J-9	J-8	10.00	Ductile Iron	110.00	0.00	0.00	0.00
P-11	2294.00	J-10	J-9	10.00	Ductile Iron	110.00	0.00	0.00	0.00
P-12	723.00	J-11	J-10	10.00	Ductile Iron	110.00	0.00	0.00	0.00
P-13	2338.00	J-12	J-11	10.00	Ductile Iron	110.00	0.00	0.00	0.00
P-14	5359.00	CBP	J-12	10.00	Ductile Iron	110.00	0.00	0.00	0.00
P-15	361.00	J-14	J-13	16.00	Ductile Iron	120.00	0.00	0.00	0.00
P-16	170.00	J-14	J-15	16.00	Ductile Iron	120.00	0.00	0.00	0.00
P-17	3654.00	J-4	J-14	16.00	Ductile Iron	120.00	0.00	0.00	0.00
PROP-1	916.00	J-13	CBP	16.00	Ductile Iron	120.00	0.00	0.00	0.00
PROP-2	461.00	J-15	LIGHT	16.00	Ductile Iron	120.00	0.00	0.00	0.00

Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)
CBP	1230.00	1474.34	106.00	0.00
J-1	1347.17	1818.00	204.00	0.00
J-3	1345.73	1474.34	56.00	0.00
J-4	1134.61	1474.34	147.00	0.00
J-5	1350.00	1474.34	54.00	0.00
J-6	1339.00	1474.34	59.00	0.00
J-7	1301.00	1474.34	75.00	0.00
J-8	1287.75	1474.34	81.00	0.00
J-9	1249.00	1474.34	97.00	0.00
J-10	1207.00	1474.34	116.00	0.00
J-11	1223.00	1474.34	109.00	0.00
J-12	1281.00	1474.34	84.00	0.00
J-13	1236.46	1474.34	103.00	0.00
J-14	1239.00	1474.34	102.00	0.00
J-15	1250.00	1474.34	97.00	0.00
LIGHT	1255.00	1474.34	95.00	0.00
MANELE	1128.00	1818.00	299.00	0.00

Label	Elevation (Base) (ft)	Elevation (Min) (ft)	Hydraulic Grade (ft)	Elevation (Max) (ft)	Volume (MG)	Diameter (ft)	Flow (Out) (gpm)	Percent Full (%)
Hi'i Tank	1791.00	1812.00	1818.00	1823.00	0.50	26.00	0.00	54.50

FEA REF-583

PŪLAMA LĀNAʻI MIKI BASIN
200 ACRE INDUSTRIAL PARK
PROPOSED PRV @ 55 PSI : MAX DAY

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-1	2088.00	T-1	J-1	12.00	Ductile Iron	110.00	616.86	1.75	0.00
P-2	5145.00	J-1	MANELE	12.00	Ductile Iron	110.00	335.42	0.95	0.00
P-3	11.00	J-1	PRV	12.00	Ductile Iron	110.00	281.44	0.80	0.00
P-4	5931.00	PRV	J-3	12.00	Ductile Iron	110.00	281.44	0.80	0.00
P-5	2675.00	J-3	J-4	16.00	Ductile Iron	120.00	202.27	0.32	0.00
P-6	5732.00	J-4	J-5	10.00	Ductile Iron	110.00	27.95	0.11	0.00
P-7	6012.00	J-5	J-6	10.00	Ductile Iron	110.00	27.95	0.11	0.00
P-8	3194.00	J-7	J-6	8.00	Ductile Iron	110.00	8.05	0.05	0.00
P-9	1561.00	J-8	J-7	10.00	Ductile Iron	110.00	8.05	0.03	0.00
P-10	1989.00	J-9	J-8	10.00	Ductile Iron	110.00	8.05	0.03	0.00
P-11	2294.00	J-10	J-9	10.00	Ductile Iron	110.00	8.05	0.03	0.00
P-12	723.00	J-11	J-10	10.00	Ductile Iron	110.00	8.05	0.03	0.00
P-13	2338.00	J-12	J-11	10.00	Ductile Iron	110.00	8.05	0.03	0.00
P-14	5359.00	CBP & ASPH	J-12	10.00	Ductile Iron	110.00	8.05	0.03	0.00
P-15	361.00	J-14	J-13	16.00	Ductile Iron	120.00	11.82	0.02	0.00
P-16	170.00	J-14	J-15	16.00	Ductile Iron	120.00	162.50	0.26	0.00
P-17	3654.00	J-4	J-14	16.00	Ductile Iron	120.00	174.32	0.28	0.00
PROP-1	916.00	J-13	CBP & ASPH	16.00	Ductile Iron	120.00	11.82	0.02	0.00
PROP-2	461.00	J-15	LIGHT	16.00	Ductile Iron	120.00	162.50	0.26	0.00

Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)
CBP & ASPH	1230.00	1471.98	105.00	3.77
J-1	1347.17	1809.47	200.00	0.00
J-3	1345.73	1472.38	55.00	79.17
J-4	1134.61	1472.08	146.00	0.00
J-5	1350.00	1472.02	53.00	0.00
J-6	1339.00	1471.95	58.00	36.00
J-7	1301.00	1471.96	74.00	0.00
J-8	1287.75	1471.96	80.00	0.00
J-9	1249.00	1471.96	96.00	0.00
J-10	1207.00	1471.97	115.00	0.00
J-11	1223.00	1471.97	108.00	0.00
J-12	1281.00	1471.97	83.00	0.00
J-13	1236.46	1471.98	102.00	0.00
J-14	1239.00	1471.98	101.00	0.00
J-15	1250.00	1471.97	96.00	0.00
LIGHT	1255.00	1471.96	94.00	162.50
MANELE	1128.00	1799.62	291.00	335.42

Label	Elevation (Base) (ft)	Elevation (Min) (ft)	Hydraulic Grade (ft)	Elevation (Max) (ft)	Volume (MG)	Diameter (ft)	Flow (Out) (gpm)	Percent Full (%)
Hi'i Tank	1791.00	1812.00	1818.00	1823.00	0.50	26.00	616.86	54.50

PŪLAMA LĀNAʻI MIKI BASIN
200 ACRE INDUSTRIAL PARK
PROPOSED PRV @ 55 PSI : PEAK HOUR

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-1	2088.00	T-1	J-1	12.00	Ductile Iron	110.00	1233.71	3.50	0.01
P-2	5145.00	J-1	MANELE	12.00	Ductile Iron	110.00	670.83	1.90	0.00
P-3	11.00	J-1	PRV	12.00	Ductile Iron	110.00	562.88	1.60	0.00
P-4	5931.00	PRV	J-3	12.00	Ductile Iron	110.00	562.88	1.60	0.00
P-5	2675.00	J-3	J-4	16.00	Ductile Iron	120.00	404.55	0.65	0.00
P-6	5732.00	J-4	J-5	10.00	Ductile Iron	110.00	55.89	0.23	0.00
P-7	6012.00	J-5	J-6	10.00	Ductile Iron	110.00	55.89	0.23	0.00
P-8	3194.00	J-7	J-6	8.00	Ductile Iron	110.00	16.11	0.10	0.00
P-9	1561.00	J-8	J-7	10.00	Ductile Iron	110.00	16.11	0.07	0.00
P-10	1989.00	J-9	J-8	10.00	Ductile Iron	110.00	16.11	0.07	0.00
P-11	2294.00	J-10	J-9	10.00	Ductile Iron	110.00	16.11	0.07	0.00
P-12	723.00	J-11	J-10	10.00	Ductile Iron	110.00	16.11	0.07	0.00
P-13	2338.00	J-12	J-11	10.00	Ductile Iron	110.00	16.11	0.07	0.00
P-14	5359.00	CBP & ASPH	J-12	10.00	Ductile Iron	110.00	16.11	0.07	0.00
P-15	361.00	J-14	J-13	16.00	Ductile Iron	120.00	23.66	0.04	0.00
P-16	170.00	J-14	J-15	16.00	Ductile Iron	120.00	325.00	0.52	0.00
P-17	3654.00	J-4	J-14	16.00	Ductile Iron	120.00	348.66	0.56	0.00
PROP-1	916.00	J-13	CBP & ASPH	16.00	Ductile Iron	120.00	23.66	0.04	0.00
PROP-2	461.00	J-15	LIGHT	16.00	Ductile Iron	120.00	325.00	0.52	0.00

Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)
CBP & ASPH	1230.00	1465.81	102.00	7.55
J-1	1347.17	1787.22	190.00	0.00
J-3	1345.73	1467.27	53.00	158.33
J-4	1134.61	1466.19	143.00	0.00
J-5	1350.00	1465.96	50.00	0.00
J-6	1339.00	1465.72	55.00	72.00
J-7	1301.00	1465.75	71.00	0.00
J-8	1287.75	1465.76	77.00	0.00
J-9	1249.00	1465.77	94.00	0.00
J-10	1207.00	1465.78	112.00	0.00
J-11	1223.00	1465.78	105.00	0.00
J-12	1281.00	1465.79	80.00	0.00
J-13	1236.46	1465.81	99.00	0.00
J-14	1239.00	1465.81	98.00	0.00
J-15	1250.00	1465.80	93.00	0.00
LIGHT	1255.00	1465.76	91.00	325.00
MANELE	1128.00	1751.64	270.00	670.83

Label	Elevation (Base) (ft)	Elevation (Min) (ft)	Hydraulic Grade (ft)	Elevation (Max) (ft)	Volume (MG)	Diameter (ft)	Flow (Out) (gpm)	Percent Full (%)
Hi'i Tank	1791.00	1812.00	1818.00	1823.00	0.50	26.00	1233.71	54.50

FEA REF-584

PŪLAMA LĀNAʻI MIKI BASIN
200 ACRE INDUSTRIAL PARK
PROPOSED PRV @ 55 PSI : MAX DAY FLOW + FIRE FLOW @ CONCRETE CRUSHING FACILITY & ASPHALT PLANT

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-1	2088.00	T-1	J-1	12.00	Ductile Iron	110.00	3116.86	8.84	0.03
P-2	5145.00	J-1	MANELE	12.00	Ductile Iron	110.00	335.42	0.95	0.00
P-3	11.00	J-1	PRV	12.00	Ductile Iron	110.00	2781.44	7.89	0.02
P-4	5931.00	PRV	J-3	12.00	Ductile Iron	110.00	2781.44	7.89	0.02
P-5	2675.00	J-3	J-4	16.00	Ductile Iron	120.00	2702.27	4.31	0.01
P-6	5732.00	J-4	J-5	10.00	Ductile Iron	110.00	245.17	1.00	0.00
P-7	6012.00	J-5	J-6	10.00	Ductile Iron	110.00	245.17	1.00	0.00
P-8	3194.00	J-7	J-6	8.00	Ductile Iron	110.00	-209.17	1.34	0.00
P-9	1561.00	J-8	J-7	10.00	Ductile Iron	110.00	-209.17	0.85	0.00
P-10	1989.00	J-9	J-8	10.00	Ductile Iron	110.00	-209.17	0.85	0.00
P-11	2294.00	J-10	J-9	10.00	Ductile Iron	110.00	-209.17	0.85	0.00
P-12	723.00	J-11	J-10	10.00	Ductile Iron	110.00	-209.17	0.85	0.00
P-13	2338.00	J-12	J-11	10.00	Ductile Iron	110.00	-209.17	0.85	0.00
P-14	5359.00	CBP & ASPH	J-12	10.00	Ductile Iron	110.00	-209.17	0.85	0.00
P-15	361.00	J-14	J-13	16.00	Ductile Iron	120.00	2294.60	3.66	0.00
P-16	170.00	J-14	J-15	16.00	Ductile Iron	120.00	162.50	0.26	0.00
P-17	3654.00	J-4	J-14	16.00	Ductile Iron	120.00	2457.10	3.92	0.00
PROP-1	916.00	J-13	CBP & ASPH	16.00	Ductile Iron	120.00	2294.60	3.66	0.00
PROP-2	461.00	J-15	LIGHT	16.00	Ductile Iron	120.00	162.50	0.26	0.00

Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)
CBP & ASPH	1230.00	1283.34	23.00	2503.77
J-1	1347.17	1646.73	130.00	0.00
J-3	1345.73	1338.13	-3.00	79.17
J-4	1134.61	1301.62	72.00	0.00
J-5	1350.00	1298.06	-22.00	0.00
J-6	1339.00	1294.32	-19.00	36.00
J-7	1301.00	1289.94	-5.00	0.00
J-8	1287.75	1289.22	1.00	0.00
J-9	1249.00	1288.30	17.00	0.00
J-10	1207.00	1287.23	35.00	0.00
J-11	1223.00	1286.90	28.00	0.00
J-12	1281.00	1285.82	2.00	0.00
J-13	1236.46	1286.42	22.00	0.00
J-14	1239.00	1287.64	21.00	0.00
J-15	1250.00	1287.64	16.00	0.00
LIGHT	1255.00	1287.62	14.00	162.50
MANELE	1128.00	1636.88	220.00	335.42

Label	Elevation (Base) (ft)	Elevation (Min) (ft)	Hydraulic Grade (ft)	Elevation (Max) (ft)	Volume (MG)	Diameter (ft)	Flow (Out) (gpm)	Percent Full (%)
Hi'i Tank	1791.00	1812.00	1818.00	1823.00	0.50	26.00	3143.50	54.50

PŪLAMA LĀNAʻI MIKI BASIN
200 ACRE INDUSTRIAL PARK
PROPOSED PRV @ 55 PSI : MAX DAY FLOW + FIRE FLOW @ LIGHT INDUSTRIAL PARCEL

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-1	2088.00	T-1	J-1	12.00	Ductile Iron	110.00	2616.86	7.42	0.02
P-2	5145.00	J-1	MANELE	12.00	Ductile Iron	110.00	335.42	0.95	0.00
P-3	11.00	J-1	PRV	12.00	Ductile Iron	110.00	2281.44	6.47	0.02
P-4	5931.00	PRV	J-3	12.00	Ductile Iron	110.00	2281.44	6.47	0.02
P-5	2675.00	J-3	J-4	16.00	Ductile Iron	120.00	2202.27	3.51	0.00
P-6	5732.00	J-4	J-5	10.00	Ductile Iron	110.00	180.84	0.74	0.00
P-7	6012.00	J-5	J-6	10.00	Ductile Iron	110.00	180.84	0.74	0.00
P-8	3194.00	J-7	J-6	8.00	Ductile Iron	110.00	-144.84	0.92	0.00
P-9	1561.00	J-8	J-7	10.00	Ductile Iron	110.00	-144.84	0.59	0.00
P-10	1989.00	J-9	J-8	10.00	Ductile Iron	110.00	-144.84	0.59	0.00
P-11	2294.00	J-10	J-9	10.00	Ductile Iron	110.00	-144.84	0.59	0.00
P-12	723.00	J-11	J-10	10.00	Ductile Iron	110.00	-144.84	0.59	0.00
P-13	2338.00	J-12	J-11	10.00	Ductile Iron	110.00	-144.84	0.59	0.00
P-14	5359.00	CBP & ASPH	J-12	10.00	Ductile Iron	110.00	-144.84	0.59	0.00
P-15	361.00	J-14	J-13	16.00	Ductile Iron	120.00	-141.07	0.23	0.00
P-16	170.00	J-14	J-15	16.00	Ductile Iron	120.00	2162.50	3.45	0.00
P-17	3654.00	J-4	J-14	16.00	Ductile Iron	120.00	2021.43	3.23	0.00
PROP-1	916.00	J-13	CBP & ASPH	16.00	Ductile Iron	120.00	-141.07	0.23	0.00
PROP-2	461.00	J-15	LIGHT	16.00	Ductile Iron	120.00	2162.50	3.45	0.00

Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)
CBP & ASPH	1230.00	1345.26	50.00	3.77
J-1	1347.17	1694.11	150.00	0.00
J-3	1345.73	1379.97	15.00	79.17
J-4	1134.61	1354.98	95.00	0.00
J-5	1350.00	1352.95	1.00	0.00
J-6	1339.00	1350.83	5.00	36.00
J-7	1301.00	1348.61	21.00	0.00
J-8	1287.75	1348.24	26.00	0.00
J-9	1249.00	1347.77	43.00	0.00
J-10	1207.00	1347.24	61.00	0.00
J-11	1223.00	1347.07	54.00	0.00
J-12	1281.00	1346.52	28.00	0.00
J-13	1236.46	1345.24	47.00	0.00
J-14	1239.00	1345.24	46.00	0.00
J-15	1250.00	1344.73	41.00	0.00
LIGHT	1255.00	1343.33	38.00	2162.50
MANELE	1128.00	1684.25	241.00	335.42

Label	Elevation (Base) (ft)	Elevation (Min) (ft)	Hydraulic Grade (ft)	Elevation (Max) (ft)	Volume (MG)	Diameter (ft)	Flow (Out) (gpm)	Percent Full (%)
Hi'i Tank	1791.00	1812.00	1818.00	1823.00	0.50	26.00	2643.50	54.50

FEA REF-585

APPENDIX B

0% Design Construction Costs

PULAMA LANAI MIKI BASIN - OCTOBER 2021 200 ACRE INDUSTRIAL PARK 0% DESIGN CONSTRUCTION COSTS FOR PROPOSED WATER IMPROVEMENTS				
ITEM	**APPROX QTY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
OFFSITE IMPROVEMENTS				
New Well:				
Well Studies, including environmental and hydrologic studies for siting exploratory well		Lump Sum	Lump Sum	$ 250,000.00
Exploratory Well, including siting, drilling and testing	1	Each	Each	$ 1,000,000.00
Well Construction, including reaming of exploratory well, drilling, installation of casing and pump installation	1	Each	Each	$ 2,300,000.00
PRV Replacement:				
Replacement and installation of 12" Cla-val Model 90-01 Pressure Reducing Valve with Anti-Cavitation SST Trim and 150lb Flanged End connections, epoxy coated, opening speed control, valve position indicator and gauges	1	Each	Each	$ 55,000.00
*TOTAL OFFSITE IMPROVEMENTS AND CONTINGENCY (20%)				**$ 4,326,000.00**
*Not included in this estimate is the piping cost from a new well to the existing piping and/or exisiting tank or reservoir. Once the new well is sited, an estimate can be provided based on the distance.				
ONSITE IMPROVEMENTS				
16-inch water line along Miki Road within the parcel, including trench excavation, cushion and backfill, fittings and connections to existing water lines	450	LF	$ 200.00	$ 90,000.00
16-inch water line along Road A, including trench excavation, cushion and backfill, fittings and connections to existing water lines	1,050	LF	$ 200.00	$ 210,000.00
CONTINGENCY (20%)		Lump Sum	Lump Sum	$ 60,000.00
TOTAL ONSITE IMPROVEMENTS				**$ 360,000.00**

NEW WELL SUPPLY ALTERNATIVES FOR THE MANELE BAY WATER SYSTEM, PUBLIC WATER SYSTEM NO. 238

APPENDIX H-2

FEA REF-587

New Well Supply Alternatives
for the Manele Bay Water System,
Public Water System No. 238

Prepared for:

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Revised October 2021
August 2021

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Introduction

Pulama Lanai proposes to develop a 200-acre industrial subdivision in Miki Basin. The subdivision site is next to the airport and in the service area of the Manele Bay System, identified as Public Water System (PWS) No. 238. At present, PWS No. 238 is supplied by Well 2 (State No. 4953-001) and by Well 4 (State No. 4952-002). The October 2021 Water Master Plan prepared by Akinaka & Associates, Ltd. determined that the pumping capacities of these two wells are not sufficient to supply current users and the proposed industrial subdivision. Although there is connection between the Lanai City (PWS No. 237) and Manele Bay systems, it is just a back-up for emergencies. The Akinaka report concluded that new well supply for the Manele Bay System of at least 426 gallons per minute (GPM) capacity will be required. This report evaluates alternatives to provide this new well supply.

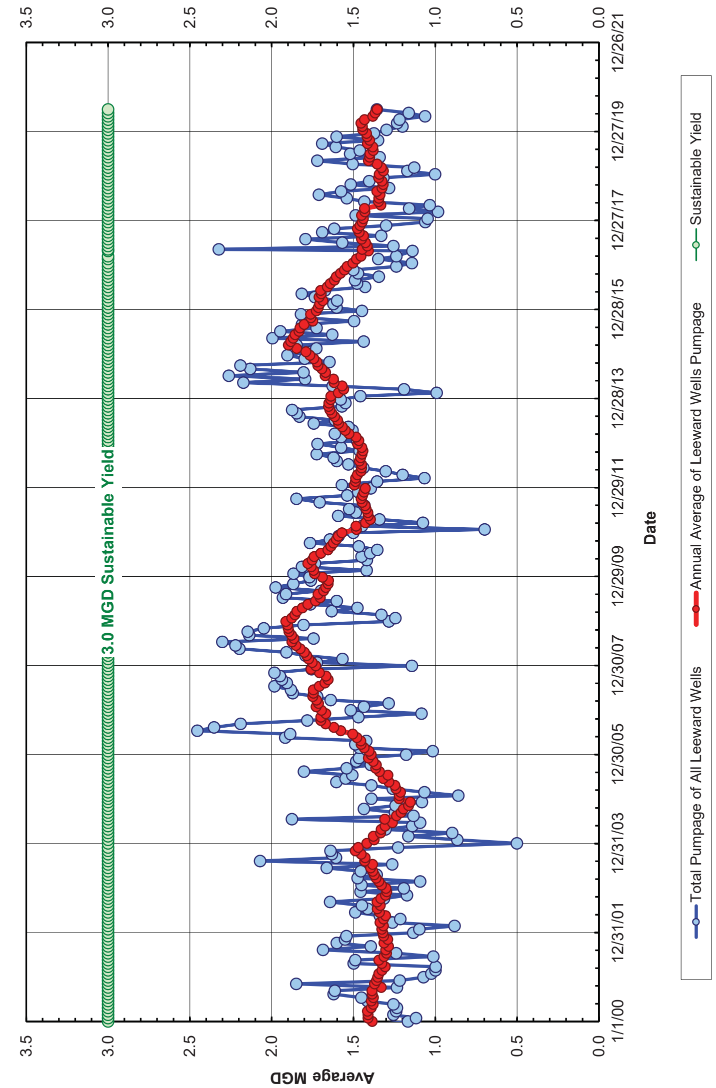
Basic Considerations in the Identification of Well Development Alternatives

<u>Available Supply in the Leeward Aquifer System</u>. As a practical matter of geography, a new well for PWS No. 238 would be located in the Leeward Aquifer System (No. 50102). The Commission on Water Resource Management (CWRM) has set the sustainable yield for this Aquifer at 3.0 million gallons per day (MGD). All of the presently active wells, with the single exception of Well 6 (State No. 5054-002), are located in and are pumping from the Leeward Aquifer system. Figure 1 depicts the combined pumpage of these wells over the last 20 years in comparison to the 3.0 MGD sustainable yield limit. The sustainable yield is expressed as the moving annual average. That average is shown as the bold red line on Figure 1. It reached a peak of 1.9 MGD in December 2008 and again in March 2015 and has been less than 1.5 MGD since early 2017. Based on this data, it can be concluded that the planned addition of Well 7 (State No. 5055-001) in PWS No. 237 and a new well in PWS No. 238 to supply the Miki industrial subdivision can both be readily accommodated within the Leeward Aquifer System's 3.0 MGD sustainable yield.

<u>Well Installed Pumping Capacity Versus its Long-Term Sustainable Supply</u>. Without exception, the following aspects of well performance apply to all presently active and planned pumping wells. First, all of these wells tap into separate high-level groundwater compartments. No two wells draw from the same groundwater compartment. Second, the long-term sustainable supply of each of these compartments is less than the well's installed pump capacity if the pump were to be operated continuously. Third, based on the available storage in each of these groundwater compartments, the well pumps can be operated for extended periods in excess of the compartment's long-term sustainable supply as long as the pumping is then cut back to allow recharge to recover the depletion in storage. Fourth and finally, the long-term sustainable supply of a compartment can only be accurately determined by the response of its water level to pumping over an extended period. As such, determination of the long-term sustainable supply of any well must rely on the available pumping and water level data in Anderson & Kelly (1985) from the start of use of the wells in the 1950s through 1984 and on the Lanai Water Company's Periodic Water Reports for the pumping and water level data since that time. Up through December 1988, pumpage and water levels were reported as monthly amounts. Starting in January 1988, reporting has been at 28-day intervals.

<u>Sustainable Supplies of Wells 2 and 4, the Current Sources of Supply for PWS No. 238</u>. Wells 2 and 4 were drilled in 1946 and 1950, respectively. Anderson & Kelly (1985) provides pumpage and water level data starting in 1948 for Well 2 and in 1950 for Well 4. For Well 2 up to July 2012, the pump was located on the floor of the inclined access tunnel to Shaft 3 at an elevation of about 1505 feet. A decision was then made to shut down use of Shaft 3 and the cart used for access up and down the inclined shaft

Figure 1. Combined Pumpage of Wells in the Leeward High Level Aquifer from Janauary 2000 to June 2020



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FEA REF-589

and move the pump for Well 2 to the ground surface at the location where the well was originally drilled at an elevation of 1905 feet.

As a new pump for Well 2 would be required for this change, a pump test of the well was run in October 2015 to determine the appropriate capacity of the new pump. At an average pumping rate of 904 GPM, the drawdown was substantial and did not stabilize by the end of the 61-hour test (Figure 2). Based on the results of this test, a 500 GPM capacity pump was selected and installed. The well was put back into service in December 2017. Its use since then has averaged about 0.20 MGD with only a modest impact on its water level (Figure 3). Based on this record, the well's long-term sustainable supply appears to be about 0.3 MGD. It should be noted that the 2011 Water Use and Development Plan for Lanai states that Well 2 could be outfitted with a pump of up to 1200 GPM capacity. If this was actually the case, the lease expensive alternative for new supply would simply be to remove the 500 GPM pump now in the well and replace it with one of at least 426 GPM capacity. Very clearly based on the October 2015 pump test results, this is not a viable option. However, some discussion of pump capacity to provide some perspective is warranted:

- The basis for the reported capacity of up to 1200 GPM in the Water Use and Development Plant is not known.
- CWRM records prior to the conversion of the well to a 500 GPM pump listed its pump capacity as 1400 GPM.
- There is no way the well itself could sustain a 1400 GPM rate. It would drop the water level precipitously and begin sucking air in a matter of minutes.
- The 1400 GPM listed pump capacity in the CWRM records is likely to be the capacity of the booster pump in the pump room of Shaft 3. It pumped the combined delivery from Well 2 and Shaft 3 up the inclined shaft and on to the Hii storage tank.

Well 4 is outfitted with a 900 GPM (1.3 MGD) pump. Particularly in the post-plantation period, this well has been far and away the most productive of any on Lanai. Based on its performance in this period, its long-term sustainable supply is estimated to be about 0.7 MGD (Figure 4). That puts the combined long-term sustainable supply of Wells 2 and 4 at approximately 1.0 MGD. In contrast, their combined use since Well 2 was put back into service in December 2017 has typically been between 0.4 and 0.5 MGD (Figure 5).

Evaluation of Alternatives for New Well Development for Public Water System No. 238

The October 2021 Water Master Plan by Akinaka & Associates, Ltd. determined that new well pumping capacity of at least 426 GPM would need to be installed to supply the full build out and occupancy of the proposed industrial subdivision as well as ongoing uses and commitments. Three alternative well sites have been evaluated to provide that supply. They are: a new well at the site of Lanai Well 5; a new well directly inland of Well 2 and drilled into the groundwater compartment tapped by Shaft 3; and a new well to the northwest of Well 2 and above Hii Flats. Figure 6 shows these three locations. The site for a new well at Well 5 would be about 25 feet from the existing well. The site for a new well drilled into the groundwater tapped by Shaft 3 would be about 400 feet upgradient from Well 2. The third alternative, labeled “Possible Well Site” on Figure 6, is about 2000 feet northwest of Well 2 and at the upper end of a former pineapple field.

Figure 2
Drawdown as a Function of Duration of Pumping
During the October 21 to 24, 2015 Pump Test of Lanai Well 2 (Log Scale of Time)

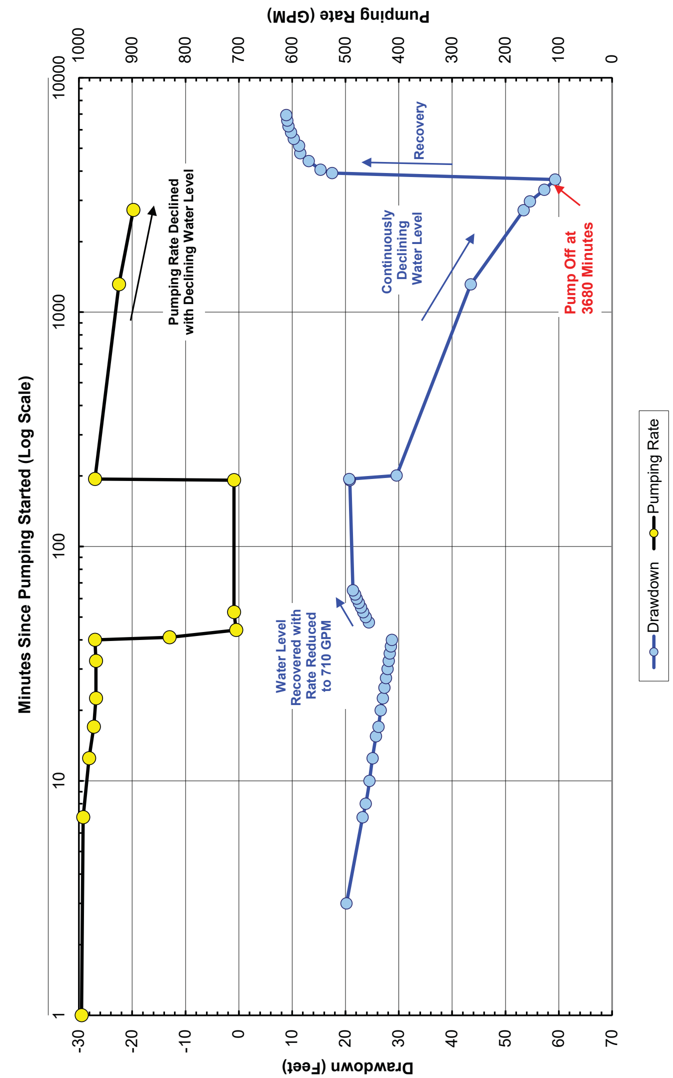

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Figure 3
Pumpage and Water Level Response in Well 2 from December 2017 through August 2021

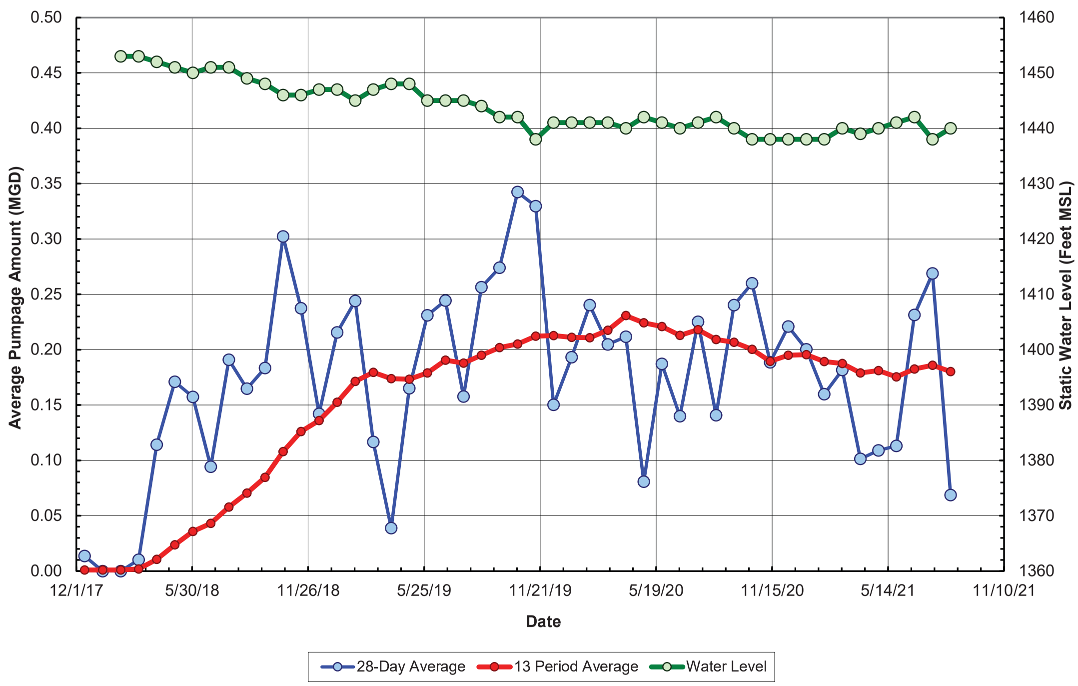

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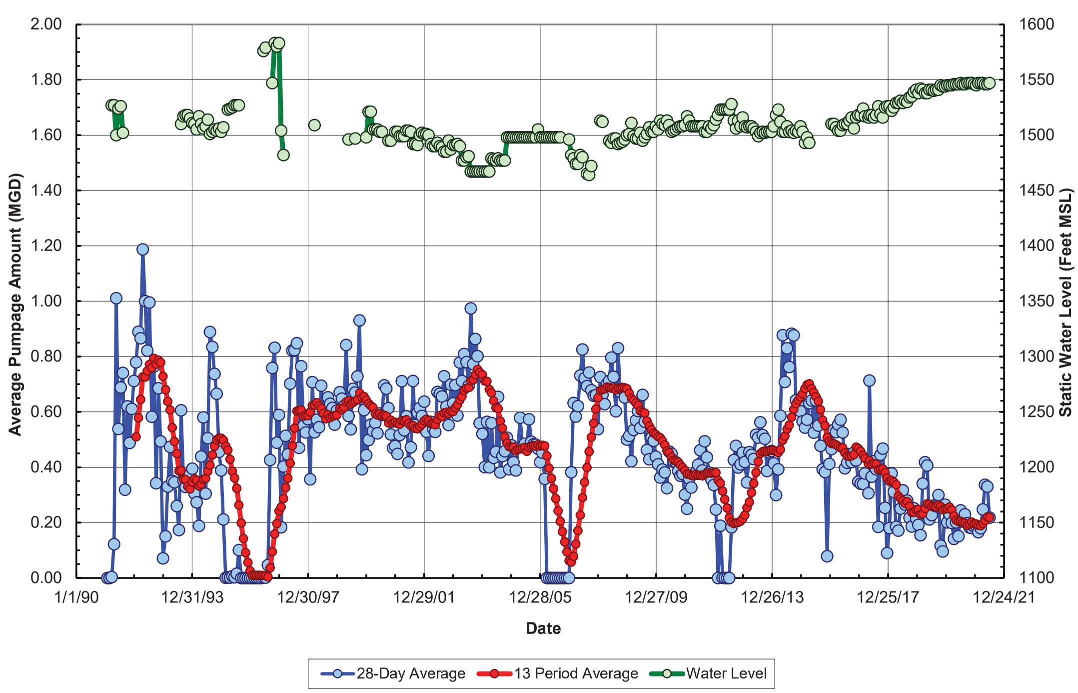
Figure 4
Pumpage and Water Level Response in Well 4 in the Post-Plantation Period



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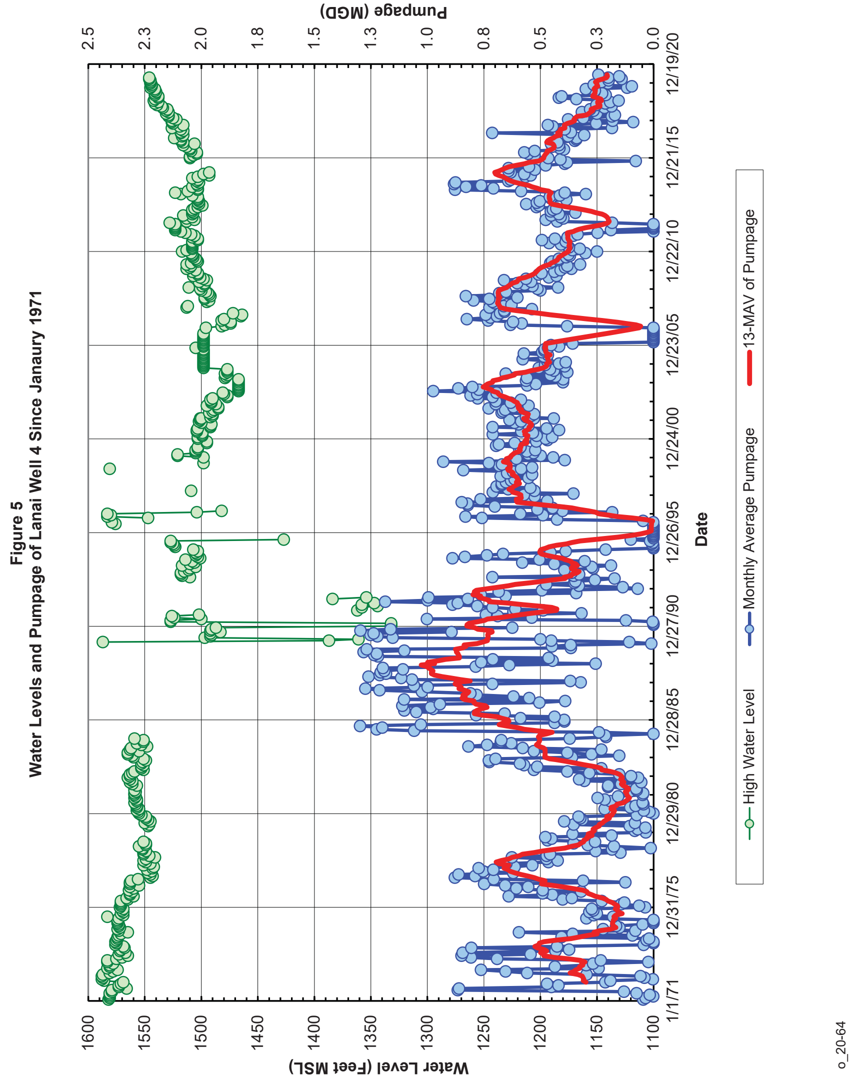

Figure 5
Water Levels and Pumpage of Lanai Well 4 Since Janaury 1971
Pumpage (MGD)
2.5
2.3
2.0
1.8
1.5
1.3
1.0
0.8
0.5
0.3
0.0
Water Level (Feet MSL)
1600
1550
1500
1450
1400
1350
1300
1250
1200
1150
1100
Date
1/1/71
12/31/75
12/29/80
12/28/85
12/27/90
12/26/95
12/24/00
12/23/05
12/22/10
12/21/15
12/19/20
High Water Level
Monthly Average Pumpage
13-MAV of Pumpage
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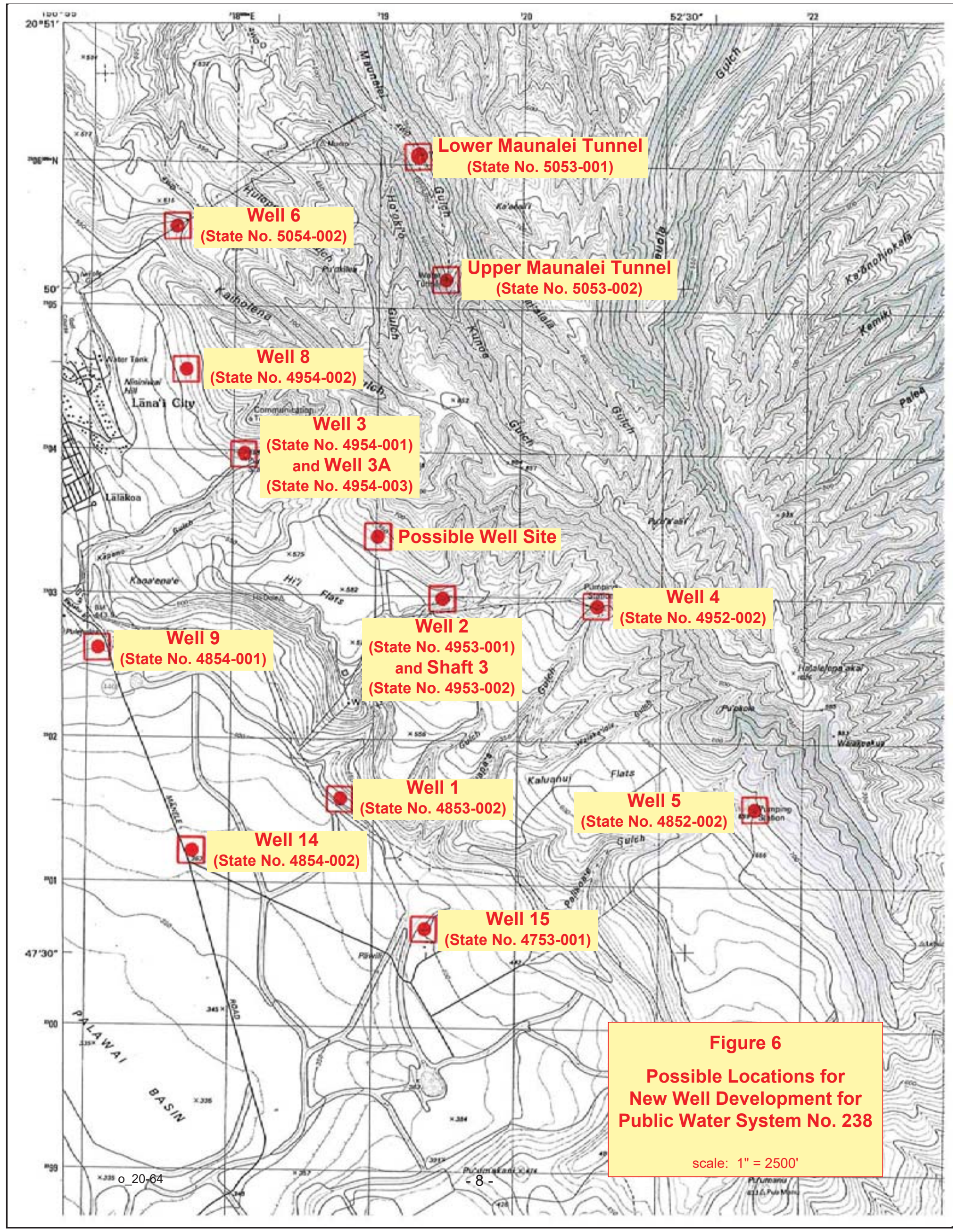

Lower Maunalei Tunnel
(State No. 5053-001)
Well 6
(State No. 5054-002)
Upper Maunalei Tunnel
(State No. 5053-002)
Well 8
(State No. 4954-002)
Well 3
(State No. 4954-001)
and Well 3A
(State No. 4954-003)
Possible Well Site
Well 4
(State No. 4952-002)
Well 9
(State No. 4854-001)
Well 2
(State No. 4953-001)
and Shaft 3
(State No. 4953-002)
Well 1
(State No. 4853-002)
Well 5
(State No. 4852-002)
Well 14
(State No. 4854-002)
Well 15
(State No. 4753-001)
Lāna'i City
Lalakoa
Palawai Basin
Figure 6
Possible Locations for
New Well Development for
Public Water System No. 238
scale: 1" = 2500'
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A New Well at the Site of Well 5. The use of existing Well 5, State No. 4852-002, was terminated in 1995 due to a collapsing casing and heaving cinders. Since then, it was converted to a permanent monitoring well and cannot be converted back to a production well. Its record as a production well prior to the end of its use in 1995 provides the best way to evaluate the potential sustainable supply of a new well at this location. Well 5 was completed in 1950 and was drilled from an elevation of 2296 feet to a depth of 1122 feet (1174 feet above sea level). It was cased to its full depth with 18-inch diameter solid casing for 630 feet and 490 feet of perforated casing below that. Its initial water level was generally of similar elevation as Well 4, but there is no data to indicate that pumping of either well has had an impact on the water level of the other. After Well 5 was converted to a monitoring well, its water level was recorded over the 10-year period from April 2008 through March 2018. Figure 7 compares this water level recording to the water levels in Well 4 as reported in the Lanai Water Company's Periodic Reports. The trends were reasonably similar but the water levels in Well 4 were, for the most part, 10 to 30 feet higher than in Well 5, despite the ongoing use of Well 4.

Well 5 was outfitted with a 900 GPM pump. Anderson & Kelly (1985) provides pumpage and water level data for Well 5 from 1950 through December 1984. Annual average pumpage of Well 5 over that period is presented on Figure 8. Its use varied widely over that period. During the peak use period from 1973 through 1984, pumpage average 0.25 MGD and the water level declined 100 feet. More recent data in the early 1990s showed a substantial rise in the water level during an average pumpage of 0.19 MGD (Figure 9). These pumping rates likely bracket the long-term sustainable supply for a new well at this location.

Collapse of the well's casing and a buildup of cinders in the bottom of the well ultimately led to the termination of its use in 1995. In drilling a new well at this site, the heaving cinders could be handled by an experienced driller during construction and by the use of an appropriately sized filter pack in completing the well, both at only a modest cost increase in the cost of the construction contract.

A New Well Upgradient of Well 2 and Drawing Water from the Groundwater Compartment Tapped by Shaft 3. The horizontal development tunnel known as Shaft 3 and identified as State No. 4953-002 was completed in 1954, eight years after the completion of the adjacent Well 2. There is a concrete bulkheaded at a nearly vertical dike which separates the groundwater compartment tapped by Well 2 from the one tapped by the Shaft 3. The lateral distance from Well 2 to the Shaft 3 bulkhead is less than 200 feet. Historically, water levels in Shaft 3 were 60 to 100 feet higher than in Well 2 (compare the water levels in Figures 10 and 11). However, extending all the way back to 1954 when concurrent use of both wells started, there has never been a period of sufficient duration when one or the other pump was out of service to determine if pumping either Well 2 or Shaft 3 impacted the water level in the adjacent groundwater compartment tapped by the other well.

The October 2015 pump test of Well 2 provided an opportunity to document the possible impact of pumping Well 2 on the water level in Shaft 3. Figure 12 shows the respective water levels during and following the pump test. At the start of the test, the water in Well 2 was 59.3 feet lower than in Shaft 3. After 61.3 hours of pumping Well 2 at an average of 904 GPM, its water level was then 118.5 feet below that in Shaft 3. At the elevation scale plotted on Figure 12, no response in the Shaft's water level is visually obvious. However, when the scale of the water level in Shaft 3 is expanded, it is clear that a drawdown did actually occur, but it was less than 0.10 feet in response to a drawdown of 60 feet in Well 2 (Figures 13 and 14). In other words, there is a hydraulic connection between the adjacent groundwater compartments, but it is obviously a very modest one. So, with this modest hydraulic connection established, it appears that the sustainable supply of Shaft 3 is about 0.35 MGD (refer back to Figure 10),

Figure 7
Comparison of the Water Level in Well 5 with that in Well 4 from April 2008 to March 2018

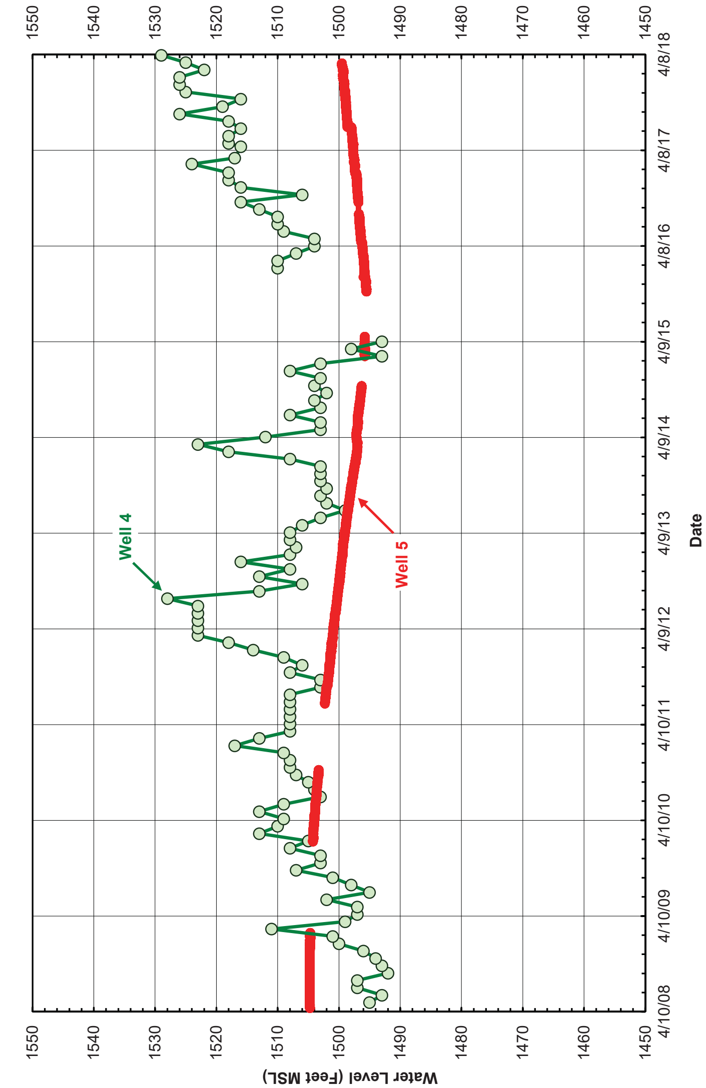

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Figure 8
Annual Average Pumpage of Lanai Well 5 and its Year End Water Levels from 1950 through 1984

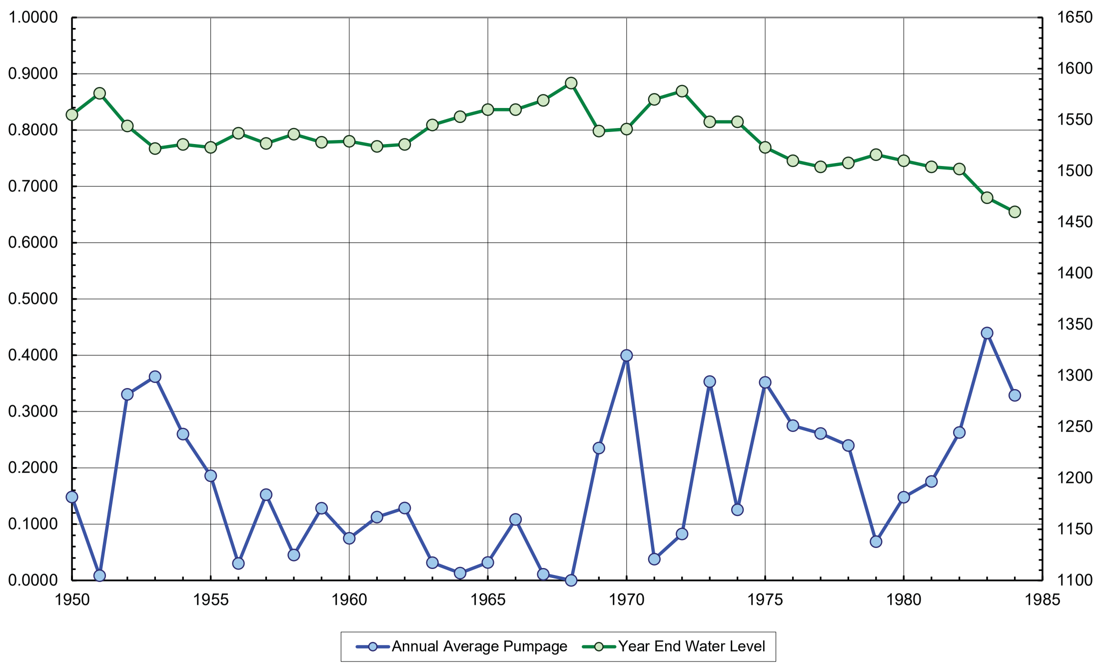

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Figure 9
Pumpage and Water Levels of Well 5 from Janauary 1971 to December 1994

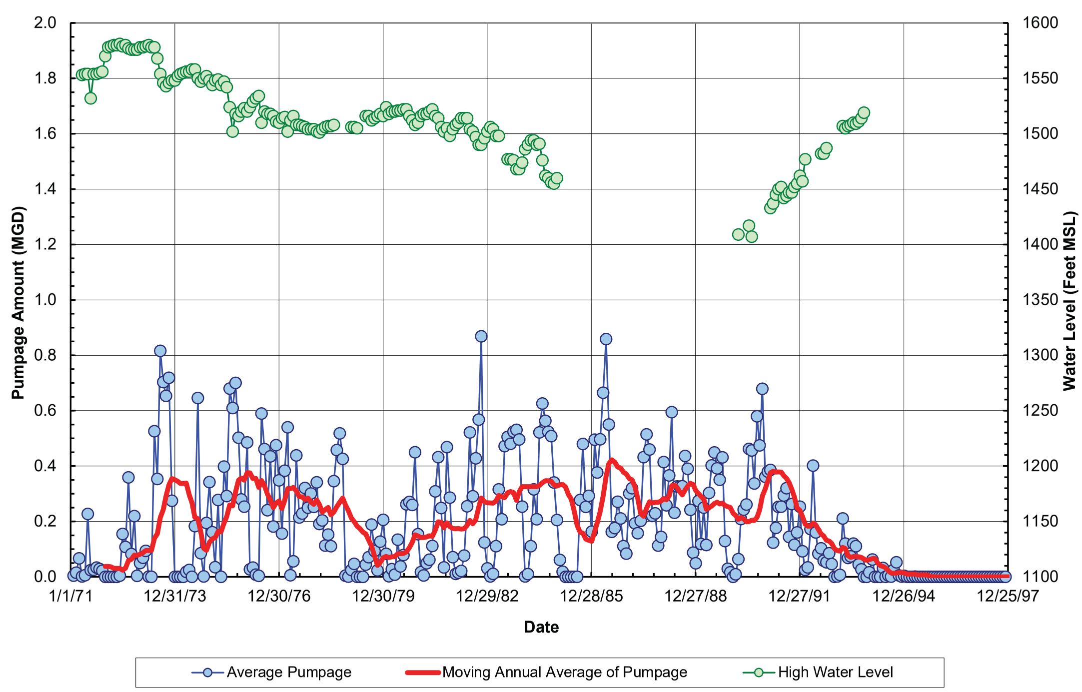

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Figure 10
Pumpage and Water Levels of Shaft 3 from Janauary 1971 to December 1994

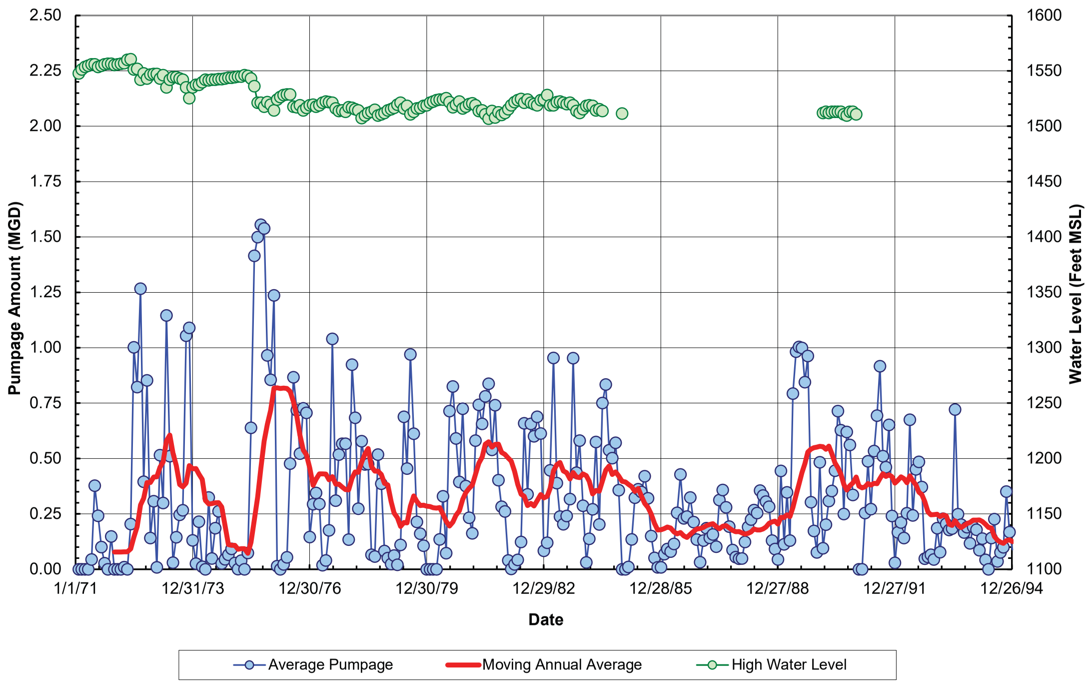

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Figure 11
Pumpage and Water Levels of Well 2 from Janauary 1971 to Decemebr 1994

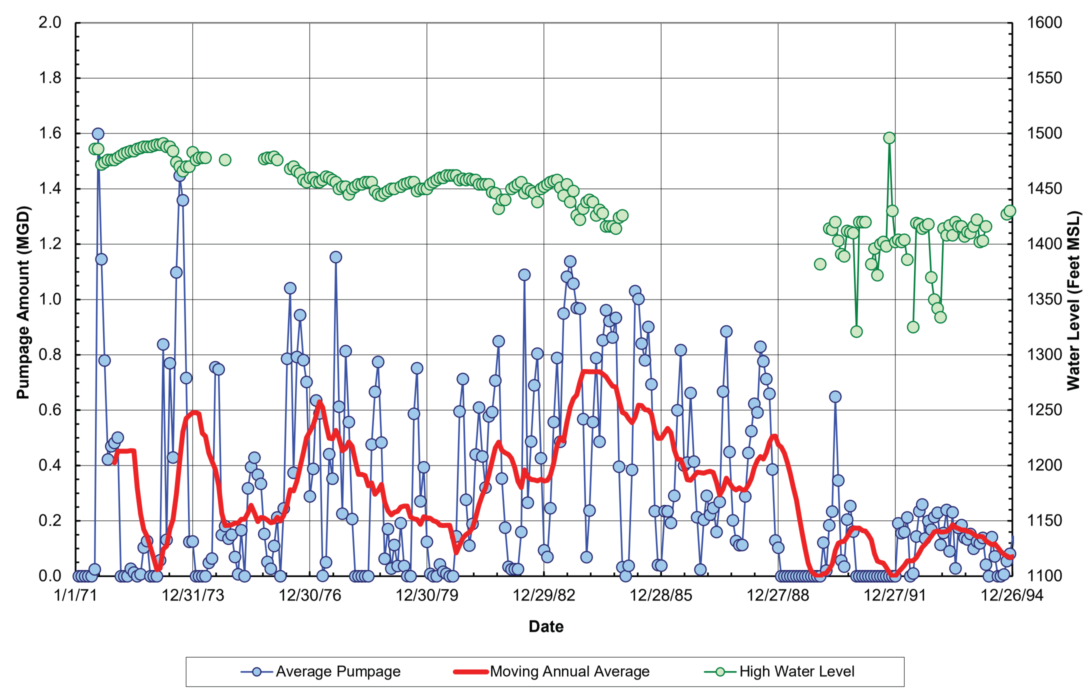

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Figure 12
Response in Shaft 3 During the October 21 to 24, 2015 Pump Test of Lanai Well 2

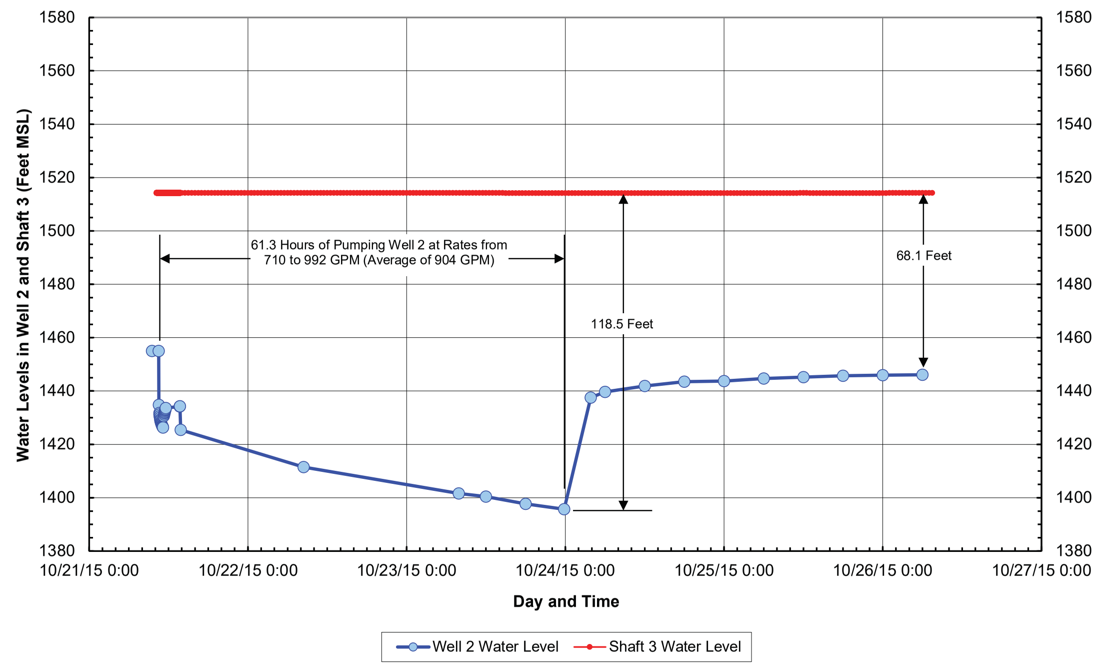

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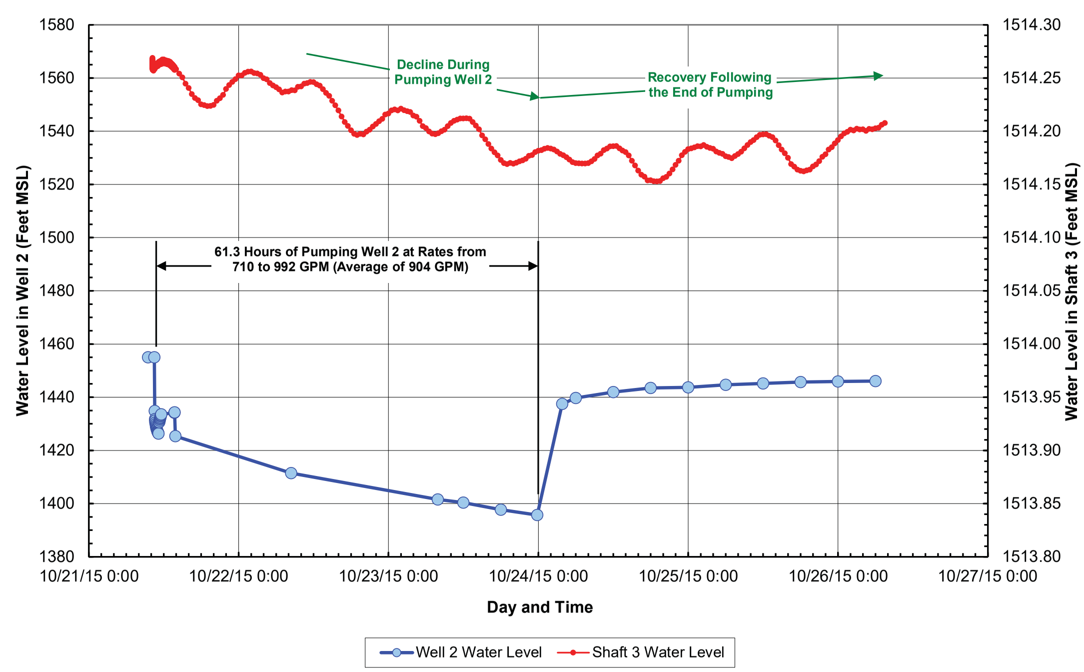
Figure 13
Response in Shaft 3 During the October 21 to 24, 2015 Pump Test of Lanai Well 2
(Expanded Water Level Scale for Shaft 3)



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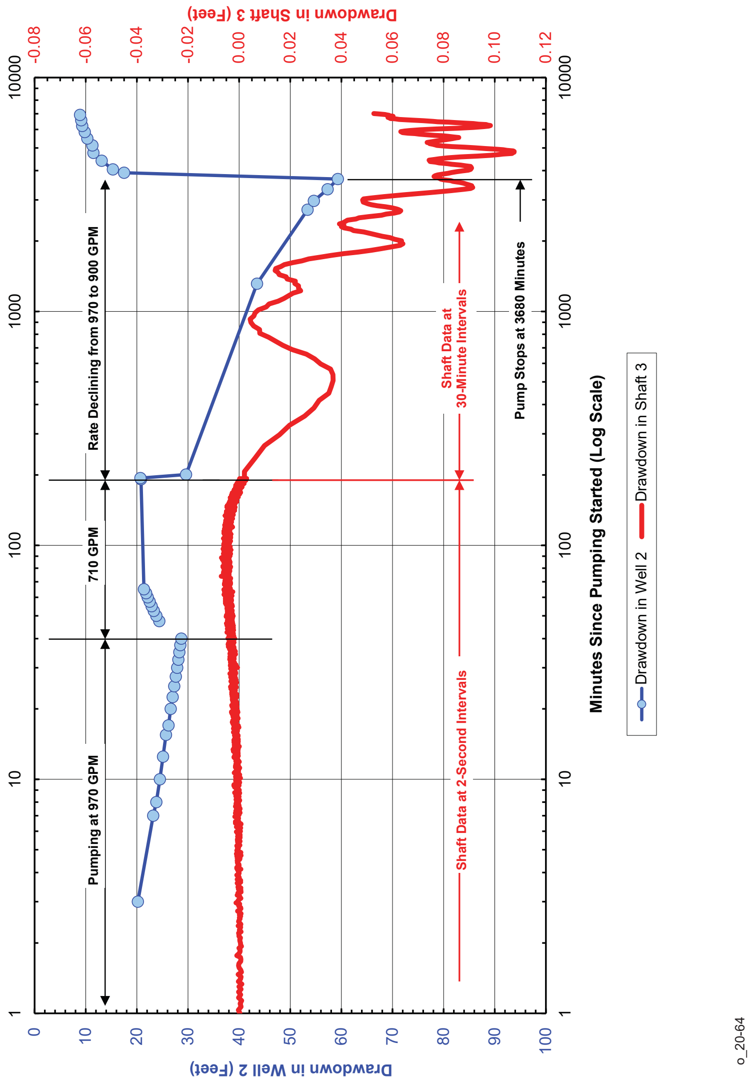
FEA REF-596

Figure 14
Response in Shaft 3 to the Pumping of Well 2 (Log Time Scale)



an estimate derived from a period when the combined pumpage of both sources was 0.70 MGD (Figure 15).

A New Well About 2000 Feet to the Northwest of Well 2. A third possible site would be at about 2000-foot elevation, about 2000 feet to the northwest of Well 2, and at the top of a former pineapple field (its location is shown on Figure 6). The site could be accessed by old plantation roads, the present condition of which are unknown. The site is far enough away from Wells 2 and 3 so as not to impact their sustainable supplies. A well at this site would definitely encounter high level, drinking water quality groundwater. With sufficient depth into groundwater, a pump of sufficient capacity to meet or exceed the necessary 426 GPM capacity to ensure adequate supply for the industrial subdivision could be developed.

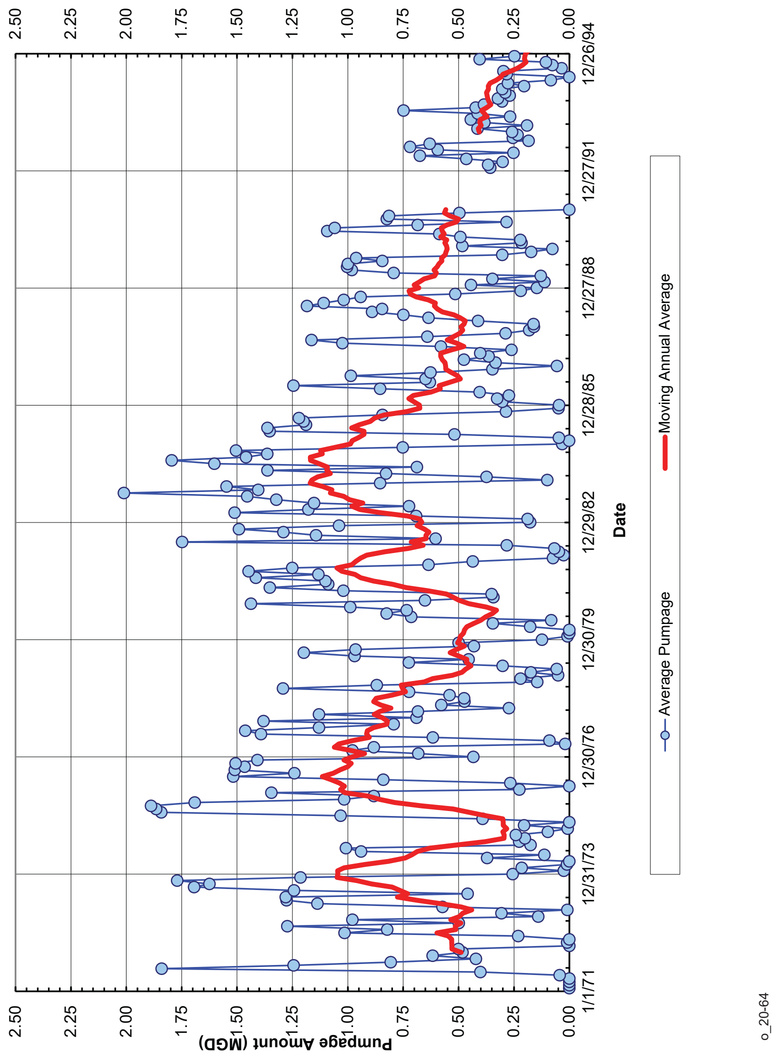
Recommended Well Site

1. Existing Well 5 has been converted to a permanent monitoring well. A new well at this site is not recommended for the following reasons: it would have a relatively modest long term sustainable yield; there are issues with cinder zones in the water bearing strata that would need to be overcome; its transmission pipeline which connects directly to the distribution system has not been used since 1995 and is almost certainly not usable; and its water would not go into one of the system's storage reservoirs to augment fire protection as well as to provide chlorine contact time.

2. A new drilled well to tap into the groundwater compartment which supplied Shaft 3 could, based on the Shaft's past performance, have significant yield. However, there is some risk concerning its successful development:
   - As there are no known construction plans, the orientation of the Shaft is not known and a well drilled to intercept it may not encounter it; and
   - On a long-term basis, it may reduce the sustainable yield of Well 2.

3. The site about 2000 feet northwest of Well 2 is the recommended choice. It has sufficient lateral spacing between existing Wells 2 and 3 to almost certainly be in a groundwater compartment not tapped by either of these wells, has relatively easy access, and could be positioned to be outside the Conservation District to avoid the permitting process that the other two sites would necessarily be required to do. Its connection to the PWS No. 238 system would be at the Hii storage tank, providing chlorine contact time and augmenting fire protection.

Figure 15
Combined Pumpage Shaft 3 and Well 2 from Janauary 1971 to Decemebr 1994



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FEA REF-598

APPENDIX

WASTEWATER MASTER PLAN

I

FEA REF-599

PŪLAMA LĀNAʻI MIKI BASIN

200 ACRE INDUSTRIAL PARK

Lānaʻi, Hawaiʻi

WASTEWATER MASTER PLAN

Prepared By: Akinaka & Associates, Ltd.
1100 Alakea Street, Suite 1800
Honolulu, Hawaii 96813

Date: August 2021

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2. City and County of Honolulu, Department of Environmental Services. Wastewater System Design Standards. July 2017
3. Hawaii Administrative Rules (HAR), Title 11, Chapter 62, Subchapter 3
4. United States Department of Agriculture (USDA), Web Soil Survey (online)
5. United States Federal Emergency Management Agency (FEMA), Flood Insurance Maps (online)
6. Hawaii Statewide GIS Program, Streams (online)

FEA REF-600

I. INTRODUCTION

The Wastewater Master Plan for Pūlama Lānaʻi Miki Basin 200-Acre Industrial Park provides the basic information for the design of the wastewater treatment system for the Miki Basin 200-Acre Industrial Park, herein referred to as the "Industrial Park", based on zoning requirements.

The Miki Basin 200 Acre Industrial Park consists of approximately 200 acres of agricultural zoned lands. Pūlama Lānaʻi is in the process of rezoning the area for light and heavy industrial lands. The project area is located directly south of Lānaʻi Airport within the Palawai Irrigation Grid (see **Exhibit 1: Location Map**). The majority of the proposed Industrial Park is currently undeveloped and is adjacent to the Maui Electric Company (MECO) Miki Basin substation and the 20-acre approved subdivision which is currently used by Pūlama Lānaʻi for concrete batch plant (CBP), Pūlama Lānaʻi warehouses and by other commercial industrial on-island uses (e.g., Hawaii Gas, Maui Disposal, etc.). Pūlama Lānaʻi is in the process of finalizing documents for the relocation of the CBP to the 200-acre Industrial Park via a State Special Use Permit in the interim. The 200-acres of the proposed Industrial Park do not include the MECO facility and the 20-acre subdivision.

The purpose of the wastewater master plan is to provide engineering planning services for the project site as part of the Environmental Assessment (EA) submission required to complete the Land Use Commission (LUC) rezoning process.

II. EXECUTIVE SUMMARY

There is currently no existing County or privately owned or operated wastewater treatment system in the vicinity of Miki Basin. The construction of onsite Individual Wastewater Systems (IWS), decentralized Wastewater Treatment Plants (WWTP) and collection systems will be required to support development activity.

Since development plans for the Industrial Park are not yet available, proposed wastewater flows for buildout of the Industrial Park is based on the proposed land use and an estimated developable area for each area. Ten (10) percent of the overall land (approximately 20 acres) has been allocated to infrastructure that will consist of areas with no wastewater flows such as roads and parking areas. Some of the areas have been designated as having no contribution. Large areas with little onsite development will have wastewater flows based off the projected number of employees. The

proposed design average wastewater flow for full buildout of the Industrial Park is 80,179 gpd, with a design peak flow of 333,688 gpd.

III. EXISTING WASTEWATER SYSTEM

There is currently no existing County or privately owned or operated wastewater treatment system in the vicinity of Miki Basin. Wastewater is currently treated via onsite individual wastewater systems (IWS).

IV. LAND USE

Pūlama Lānaʻi is in the process of rezoning approximately 200 acres of land from agriculture to urban for light and heavy industrial uses as shown below:

Description	Land Use	Area (ac.)
Renewable Energy Projects	Light Industrial / Heavy Industrial	127.0
Concrete Crushing Facility	Heavy Industrial	14.5
Asphalt Plant	Heavy Industrial	12.5
New Industrial Uses	Light Industrial	26.0
Infrastructure	Light Industrial / Heavy Industrial	20.0

This conceptual plan is intended to provide a basis for the design of the wastewater system and may not reflect the final development densities. The area designated for Renewable Energy Projects will contain no facilities and will not contribute any wastewater flows. Since development plans for the Industrial Park are not yet available, proposed wastewater flows for buildout of the Industrial Park is based on the proposed land use or the estimated number of employees and an estimated developable area for each area. For areas that contain vast area for stockpiling and little building development (the Concrete Crushing Facility and Asphalt Plant), the wastewater flow contributions will be based on the number of employees servicing the area. Ten (10) percent of the overall land (approximately 20 acres) has been allocated to infrastructure that will consist of areas with no wastewater flows such as roads, parking, common areas, etc.

V. GEOGRAPHY AND TOPOGRAPHY

According to the U.S. Department of Agriculture (USDA) Web Soil Survey, the project area soil consists mainly of silty clay loams with moderate to high water infiltration. The Hawaii Statewide GIS Program for streams shows potentially two (2) non-perennial streams located within or near the project area, the Miki stream east of Miki Road, and the Kalulu stream west of Miki Road. The project site does not lie within flood zones as shown on the Federal Emergency Management Agency (FEMA) Flood Insurance maps. Any potential sewer line will be above the water table. In the absence of a topographical survey of the project site, a site development grading plan, or contour maps from Hawaii Statewide GIS or the U.S. Geological Survey (USGS) with contours less than 100 feet spacing, Google Earth was used to estimate the topographical features for certain areas within the project site. Of note is an apparent hill just west of Miki Road in the light industrial area allocated for "New Industrial Uses."

VI. WASTEWATER FLOW STANDARDS

As outlined in the County of Maui's Wastewater Flow Standards and the Design Standards of the Department of Wastewater Management, the following criteria are used in determining the minimum requirements for the wastewater system.

1. Design Flows

a. For planning purposes, flows are based on estimated occupancy as determined by the standards.

b. The unit flows for the various land uses that may be found in typical industrial zoned area are as follows:

Land Use	Unit	Average Flows (Gal/Unit/Day)
Factory	Employee	30
Industrial Shop	Employee	25
Laundry (coin operated)	Machine	300
Office	Employee	20
Storage, w/offices	Employee	15
Storage w/ offices and showers	Employee	30
Store Customer bathroom usage	Use	5

The following standards were used to compute the minimum number of units required per land use type:

Storage/Industrial Employees	1 per 500 square feet of floor area

c. The maximum flow factor for the flow entering a sewer system is determined by the Babbit formula. For populations less than 1,000, the Babbit flow factor shall be 5.

d. For an IWS with a flow less than 1,500 gpd, the peak flow is calculated using a flow factor of 1.5.

e. The wet weather infiltration/inflow was calculated using the rates as shown on the County of Maui Wastewater Reclamation Division Wastewater Flow Standards. For areas with little developed area, 25 feet on either side of the sewer line was used to find the area for wet weather infiltration/inflow in lieu of the entire area as defined in the Wastewater System Design Standards, City and County of Honolulu (July 2017) Section 2.2.I.

f. For an IWS, no infiltration/inflow is added to the peak flow due to the short run of closed piping to the septic system.

VII. INDUSTRIAL PARK WASTEWATER FLOWS

Since site layouts, land uses and unit densities for each area are not yet determined, wastewater flows were based on the minimum number of units required by land use type. For the areas containing the asphalt and concrete plants, it is estimated that 30 employees will share facilities. This was used to calculate the generated wastewater flow in lieu of the 1 employee per 500 feet of floor area above. Since the majority of onsite flows will be generated by employees, the industrial activity with the highest average flow for employees, "Factory", was used to estimate wastewater flows. Based on the proposed land use, the design peak flow for full buildout of the Industrial Park is 333,688 gpd (see **Exhibit 2: Wastewater Flow Summation**). Of that, 1,350 is ideally serviced by an IWS (for the New Concrete Facility and Asphalt Plant) and 332,338 is serviced by a gravity sewer and decentralized WWTP.

VIII. PROPOSED WASTEWATER SYSTEM

Since there is no existing wastewater treatment system in the vicinity of the Industrial Park, wastewater flows within the Industrial Park will be treated by onsite IWS systems and a decentralized WWTP. These systems are ideal for areas that are remote and have factors that can make tying into an existing wastewater system difficult or infeasible. Each development within the Industrial Park will be required to provide its own wastewater treatment system and associated wastewater collection system. The type of treatment system used will be determined by the size and type of development. Sizing of each system will be determined during the design phase of each development.

Onsite IWS systems and decentralized WWTPs are regulated by the Department of Health (DOH) under Chapter 62 of Title 11, Hawaii Administrative Rules (HAR). Under Subchapter 3 of the rules, IWS systems can be used as a temporary onsite means of wastewater disposal in lieu of a wastewater treatment works under the following conditions:

1. There is 10,000 square feet of land area for each individual wastewater system;
2. The total wastewater flow of the development does not exceed 15,000 gpd;
3. Area of the lot is not less than 10,000 square feet; and
4. The total wastewater flow into each individual wastewater system will not exceed one thousand gallons per day.

Multiple IWS systems may be used provided that the building is owned by one person. At DOH's discretion, multiple buildings may connect to one IWS provided that the buildings are located on the same lot and generate wastewater of similar strength and character. IWS are required to consist of a septic tank and soil absorption system, sand filter, subsurface irrigation system or other treatment unit as approved by DOH. Cesspools are prohibited as adequate treatment is not provided.

Where developments do not meet the requirements for an IWS, decentralized WWTPs are recommended. WWTPs can be sized to accommodate flows from multiple properties located in the same general area. Depending on the development timeline, construction of the WWTP can be phased such that the system can be adapted and expanded to accommodate additional flows at a later date. WWTPs should be located in the lowest region of the service area to allow for gravity flow into the WWTP and avoid the use of pump stations and force mains. The lowest point in the project site is on the southwestern edge of the light industrial area west of Miki Rd.

The areas for the New Concrete Facility and Asphalt Plant are likely to be the first sites developed and will require the installation of an IWS septic system. The wastewater flow generated from the facilities on these areas are minimal compared to the lots designated for new industrial uses and could be managed with an IWS even after development of a nearby decentralized WWTP. Connection of this flow to the WWTP will likely require the need for pump stations and force mains.

The light industrial area west of Miki Rd. produces the majority of the projected design wastewater flow. A WWTP located in the location stated above in this area could collect the wastewater from this development by gravity without the need for pump stations and force mains (see **Exhibit 3: Wastewater Flow Map**). If the WWTP was to be moved to the unused area of the project site just below the old CBP location, pump stations and a force main would be required to move the sewage over the hill to the WWTP, greatly increasing the capital and operating/maintenance cost for the wastewater system.

Site development grading plans are needed to further verify the practicality of the wastewater system designs.

IX. COST CONSIDERATIONS

Since site layouts are not yet available, budgetary costs for development of the Industrial Park could not be determined. General costs for the various improvements are as follows:

Sewer Pipe, PVC	
8-inch sewer pipe	$200 per linear foot
10-inch sewer pipe	$250 per linear foot
15-inch sewer pipe	$325 per linear foot
Treatment Systems	
IWS, Septic tank with absorption trenches	$26,500 – 66,000 / 1,000 gallons
WWTP (1,000 to 10,000 gpd)	$31,000 – 88,000 / 1,000 gallons
WWTP (greater than 10,000 gpd)	$68,000 - 125,200 / 1,000 gallons

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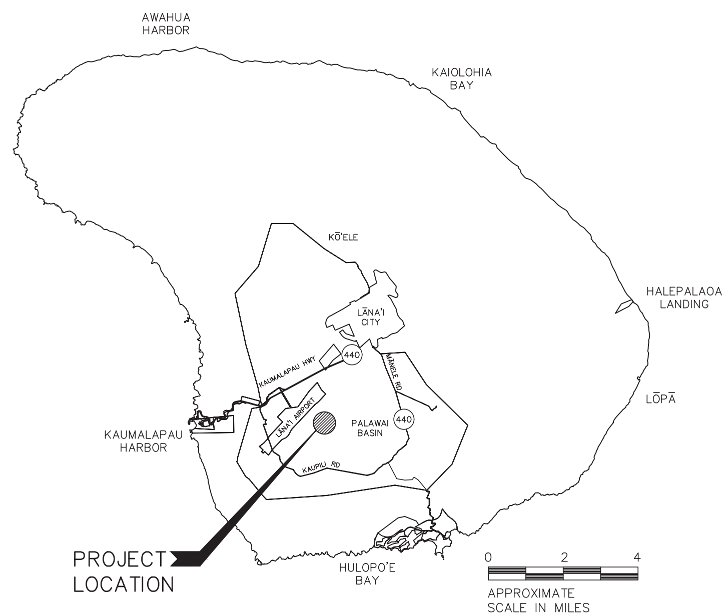
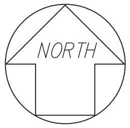
EXHIBITS



ISLAND OF LĀNA'I

EXHIBIT 1



PŪLAMA LĀNA'I MIKI BASIN
200–ACRE INDUSTRIAL PARK

LOCATION MAP

AKINAKA & ASSOCIATES, LTD.

SCALE: AS SHOWN DATE: AUGUST 2021

G:\PL2101 PULAMA LANAI WATER&WASTEWATER MASTER PLAN V2\200 PLANNING\02 WASTEWATER\EXHIBIT\PL2101– EXHIBIT 1 – LOCATION MAP.DWG

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EXHIBIT 2: WASTEWATER FLOW SUMMATION

Description	Land Use	Area (ac.)	Estimated Floor Area (ac.)	Estimated Floor Area (sf)	Estimated Required Employees (1 per 500 sf of floor area)	Avg. Daily Flow Per Capita (gpdc)	Avg. Wastewater Flow (gpd)	Max. Flow Factor	Max. Wastewater Flow (gpd)	Dry Weather Infiltration/Inflow (gpd)	Wet Weather Infiltration/Inflow (gpd)	Design Avg. Flow (gpd)	Design Max. Flow (gpd)	Design Peak Flow (gpd)
Renewable Energy Projects	Light Industrial / Heavy Industrial	127	0.0	0	0	0	0	0	0	0	0	0	0	0
Concrete Crushing Facility	Heavy Industrial	14.5	0.3	15,000	30	30	900	1.5*	1,350	0	0	900	1,350	1,350
Asphalt Plant	Heavy Industrial	12.5	0.0	0	0	0	0	0.0	0	0	0	0	0	0
New Industrial Uses	Light Industrial	26	26.0	1,132,560	2,265	30	67,954	4.2**	288,512	11,326	32,500	79,279	299,838	332,338
Infrastructure	Light Industrial / Heavy Industrial	20	0.0	0	0	0	0	0	0	0	0	0	0	0
											Total Design Avg. Flow (gpd)	80,179	Total Design Peak Flow (gpd)	333,688

*Flow factor determined using IWS with flow less than 1,500 gpd

**Flow factor determined using the Babbit Formula

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APPENDIX

DRAINAGE REPORT

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DRAINAGE REPORT - FINAL

Project: Miki Basin Industrial Park Drainage Study
Lanai City, Lanai
TMK: (2)4-9-002: 061

Owner: Pulama Lanai

Consultant: R. M. Towill Corporation
2024 North King Street, Suite 200
Honolulu, Hawaii 96819

Prepared by: Gordon Ring

Checked by: Gordon Ring

Date: July 9, 2021

GORDON T. RING
LICENSED PROFESSIONAL ENGINEER
No. 9300-C
HAWAII, U.S.A.

This work was prepared by me or under my supervision. Construction of this project will be under my observation.

Signature 4/30/22 Lic. Expiration

1.0 PURPOSE

To determine the offsite and onsite drainage system requirements for the proposed Miki Basin Industrial Park that meets the County of Maui Storm Drainage Standards. The Miki Basin Industrial Park project is located adjacent to Miki Road, within a portion of a large parcel (TMK (2)4-9-002: 061). The project site will consist of light and heavy industrial uses. For the location of the proposed site, see Figure 1.

2.0 REFERENCES

2.1 *Rules for the Design of Storm Drainage Facilities in the County of Maui*, Department of Public Works and Waste Management, County of Maui, July 14, 1995.

2.2 LIDAR Countour Maps provided by Pulama Lanai dated December 2006.

2.3 Hydraflow Hydrographs Extensions for AutoCAD Program by Auto Desk dated August 2017 to February 2018.

2.4 *Grading and Drainage Report for Miki Basin Heavy Industrial Site*, Austin Tsutsumi & Associates, October 2015.

3.0 EXISTING SITE CONDITIONS

The proposed project site is mostly undeveloped and adjacent to the existing Miki Basin Industrial Condominium site and MECO facility. Existing improvements bordering the project site include the Miki Basin Industrial Condominium project and MECO facility. The existing onsite terrain is covered with vegetation and slopes at about 5% from Miki Road toward the southeast. There is no existing storm drain system within the project area. Runoff collected in Drain Area (DA) 1 and 2 of the project site flows into existing natural drainage ways and discharges into the existing Miki Basin sump, located approximately 2000 feet away (see Figure 2). Runoff collected in Drain Area 3 flows to the existing Palawai Basin.

Southeast of the proposed 100 acre heavy industrial area are the Miki Basin Industrial CPR and an existing MECO facility (see Figure 2). Runoff generated within the existing Miki Basin Industrial CPR site is collected by an onsite drainage system and is discharged offsite. Runoff from the Miki Basin Industrial CPR site will not impact the proposed development since it has a separate discharge point, located south of the heavy industrial area. See “Grading and Drainage Report for Miki Basin Heavy Industrial Site” by Austin Tsutsumi & Associates, Inc. for drainage calculations. Offsite runoff, including runoff generated from the MECO facility, is diverted around the Miki Basin Industrial CPR site (within the heavy industrial area) and is discharged into the existing drainage way. These existing offsite flows will need to be addressed by the development of the heavy industrial area.

Offsite runoff generated from the area north of Miki Road sheet flows and is intercepted by an unlined ditch along Miki Road (see Figure 2). Once in the unlined ditch, the runoff flows towards the southeast direction to a low point in Miki Road, near the existing MECO facility.

4.0 PROPOSED SITE CONDITIONS

The proposed 200 acre industrial development will consist of a 65-acre light industrial area (Drain Area 1), 100-acre heavy industrial area (Drain Area 2), and a 35-acre light industrial area (Drain Area 3). The proposed development breakdown is as follows:

Proposed Use	Area (acres)
Renewable Energy Projects	127
Concrete Crushing Facility	14.5
Asphalt Plant	12.5
Other Industrial Uses	26
Infrastructure	20
Total	**200**

The proposed development will increase the amount of impervious area within the project. Offsite runoff will be intercepted before entering the project site by proposed drainage ditches. The drainage ditches will divert runoff around the perimeter of the project site to an

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offsite discharge point downstream. Onsite runoff will be collected by a proposed underground storm drain system consisting of pipes and inlets. Runoff from 65-acre light industrial area, 100-acre heavy industrial area, and DA Offsite 1 through 3 will be discharged to the existing drainageway that drains to Miki Basin (see Figure 4). Runoff generated from the 35-acre light industrial area and DA Offsite 4 drain to the existing Palawai Basin.

5.0 CALCULATIONS FOR RUNOFF INCREASE

Onsite

Runoff flow rates for areas less than 100 acres were calculated for a 10-year, 1-hour storm event using the rational method for the existing and proposed site conditions of Drain Area 1 and Drain Area 3. The runoff flow rate for a 100-year, 24-hour storm event were calculated using the SCS method for the existing and proposed site conditions of Drain Area 2 since the drainage area is 100 acres. See Tables 1 and 2 for a summary of the existing and proposed runoff quantities. The proposed industrial park will increase the runoff generated within the project site by 141.36 cfs (see Table 3).

Offsite

Runoff flow rates for a 100-year, 24-hour storm event were calculated using the SCS method for the existing site conditions of DA Offsite 1 and DA Offsite 2, since these offsite areas are greater than 100 acres. Runoff flow rates for a 10-year, 1-hour storm event were calculated using the rational method for the existing and proposed site conditions of DA Offsite 3 and DA Offsite 4, since these offsite areas are less than 100 acres. See Tables 1 and 2 for the existing and proposed runoff quantities.

Runoff generated from areas DA Offsite 1, 2, and 4 will be collected by interceptor ditches located along the project site exterior boundary and will ultimately discharge into the existing drainageway south of the project site and to Miki Basin per existing conditions. Offsite runoff for DA Offsite 3 will be diverted under Miki Road by a culvert and around the existing Miki Basin Warehouse area. Runoff from DA Offsite 3 will be discharged into an existing offsite drainageway adjacent to the industrial CPR site. Therefore, the offsite runoff will not affect the design of the onsite drain systems.

At a depth of 10 feet, the existing Miki Basin has a capacity of 891 ac-ft. Since the increase in runoff from Drain Area 1 and Drain Area 2 only contributes 8.7 acre-feet, the increase in runoff depth and flow rate will be contained within the existing basin. See Table 4 for the volume summary.

At a depth of 10 feet, the existing Palawai Basin has a capacity of 3010 ac-ft. Since the increase in runoff from Drain Area 3 contributes only 2.5 acre-feet, the increase in runoff depth and flow rate will be contained within the existing basin. See Table 4 for the volume summary.

Table 1 – Existing Runoff Quantities

Drainage Area Name	Area (Acres)	Q_{10} (cfs)	Q_{100} (cfs)
DA 1*	65.0	87.36	-
DA 2**	100.0	-	529.9
DA 3*	32.6	25.56	-
DA OFFSITE 1**	165.8	-	337.7
DA OFFSITE 2**	78.2	-	159.4
DA OFFSITE 3*	88.5	71.86	-
DA OFFSITE 4*	8.6	11.56	-
	Total	196.34	1027.0

* Calculated using Rational Method
**Calculated using SCS Method

Table 2 – Proposed Runoff Quantities

Drainage Area Name	Area (Acres)	Q_{10} (cfs)	Q_{100} (cfs)
DA 1*	65.0	106.1	-
DA 2**	100.0	-	566.1
DA 3*	35.0	112.00	-
DA OFFSITE 1**	165.8	-	337.7
DA OFFSITE 2**	78.2	-	159.4
DA OFFSITE 3*	86.1	69.9	-
DA OFFSITE 4*	8.6	11.6	-
	Total	299.6	1063.20

* Calculated using Rational Method
**Calculated using SCS Method

Table 3 – Runoff Summary

Drainage Area Name	Existing Q (cfs)	Proposed Q (cfs)	Increase in Q (cfs)
DA 1	87.36	106.1	18.72
DA 2	529.9	566.10	36.2
DA 3	25.56	112.00	86.44
		Total	141.36

Table 4 – Volume Summary

Drainage Area Name	Existing Volume (ac-ft)	Proposed Volume (ac-ft)	Increase in Volume (ac-ft)
DA 1 + DA 2 (to Miki Basin)	74.9	83.6	8.7
DA 3 (to Palawai Basin)	3.2	5.7	2.5

6.0 STORM WATER MANAGEMENT

Existing drainage patterns will be maintained by discharging intercepted offsite runoff to its original flow path. Offsite runoff will be collected by interceptor ditches located on the perimeter of the site that discharge to existing drainage way and ultimately to Miki Basin (see Figure 4). The proposed concrete rectangular drainage ditches vary in size from 8 feet by 8 feet to 2 feet by 3 feet. The ditches are sized to accommodate the peak runoff flow from the 100-yr, 24-hour storm and 10-yr, 1-hour storm where necessary and provide a minimum 2-foot freeboard.

Runoff from the proposed 65-acre light industrial area (Drain Area 1) will be discharged to the interceptor ditch at the southwest corner of the area (see Figure 4). Runoff flow for this area is 106.1 cfs and ultimately flows to Miki Basin. Offsite runoff from DA Offsite 1 flowing towards the 65-acre area is 337.70 cfs and will be intercepted by a 6 ft. by 6 ft. interceptor ditch on the north perimeter of the area.

Runoff from the proposed 100-acre heavy industrial area (Drain Area 2) will be discharged at the south end of the area (see Figure 4). Runoff flow for this area is 566.1 cfs. The runoff from DA Offsite 3 that is diverted around the existing Miki Basin Industrial site is also discharged at the south end of the area. Runoff flow for DA Offsite 3 is 69.91 cfs. Both the runoff flow from the proposed 100-acre site and the DA Offsite 3 flow to Miki Basin. Design of the drainage system for the 100-acre site should consider the impacts of incorporating the existing flows into the proposed drainage system versus keeping them separate. Offsite runoff from DA Offsite 2 flowing towards the 100-acre area is 159.35 cfs and will be intercepted an 8 ft. by 8 ft. interceptor ditch on the west perimeter of the area.

Runoff from the proposed 35-acre light industrial area (Drain Area 3) will be discharged at the eastern side of the area (see Figure 4). Onsite runoff flow for this area is 112.00 cfs and ultimately flows to Palawai Basin. Offsite runoff south of the 35-acre area from DA Offsite 4 will be intercepted by a 2 ft. by 3ft. interceptor ditch on the south perimeter of the area and will discharge to Palawai Basin. Runoff flow for the offsite area is 11.56 cfs.

The increase in onsite runoff volume from Drain Area 1 and Drain Area 2 will be conveyed to the existing drainage way and can be easily accommodated in the existing Miki Basin. The additional runoff volume is negligible compared to the available basin capacity. The increase in onsite runoff volume from Drain Area 3 will be conveyed to the existing Palawai Basin. The additional runoff volume is negligible compared to the available basin capacity.

Storm water treatment will not be provided for this project since the runoff flows into an existing offsite sump with no outlet to the ocean.

7.0 CONCLUSION

The development of the proposed industrial park will increase the runoff onsite by 141.36 cfs (see Table 3). The additional flow generated within the proposed project can be accommodated by the existing Miki Basin and Palawai Basin. Therefore, the proposed 200-acre industrial development will not have an adverse impact on any existing downstream properties.