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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FEA REF-593

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

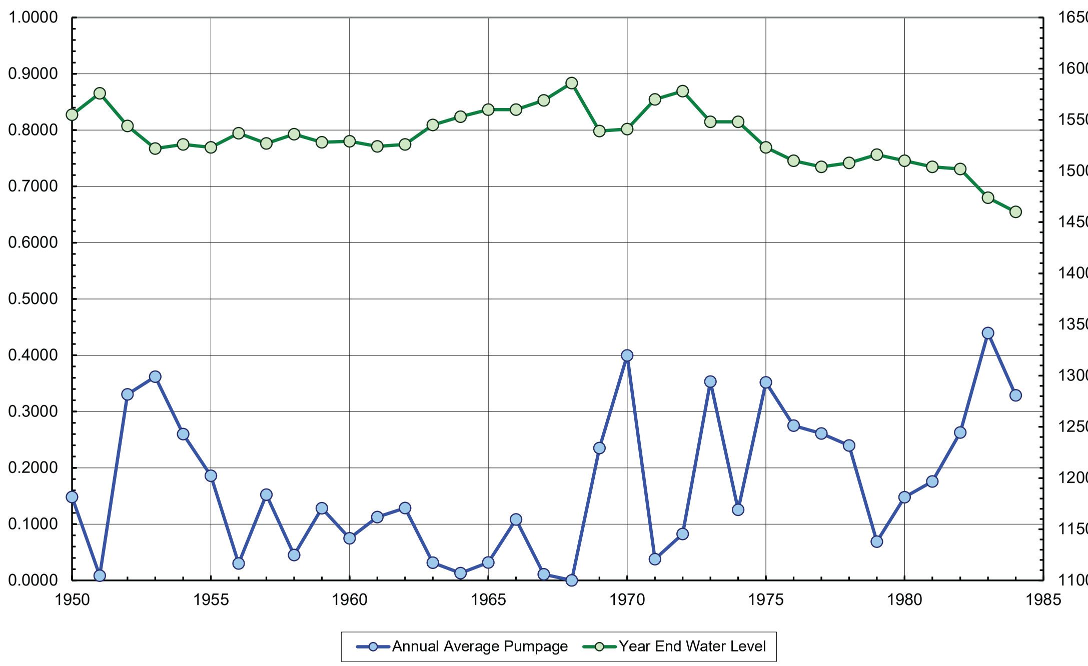

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Figure 9
Pumpage and Water Levels of Well 5 from Janauary 1971 to December 1994

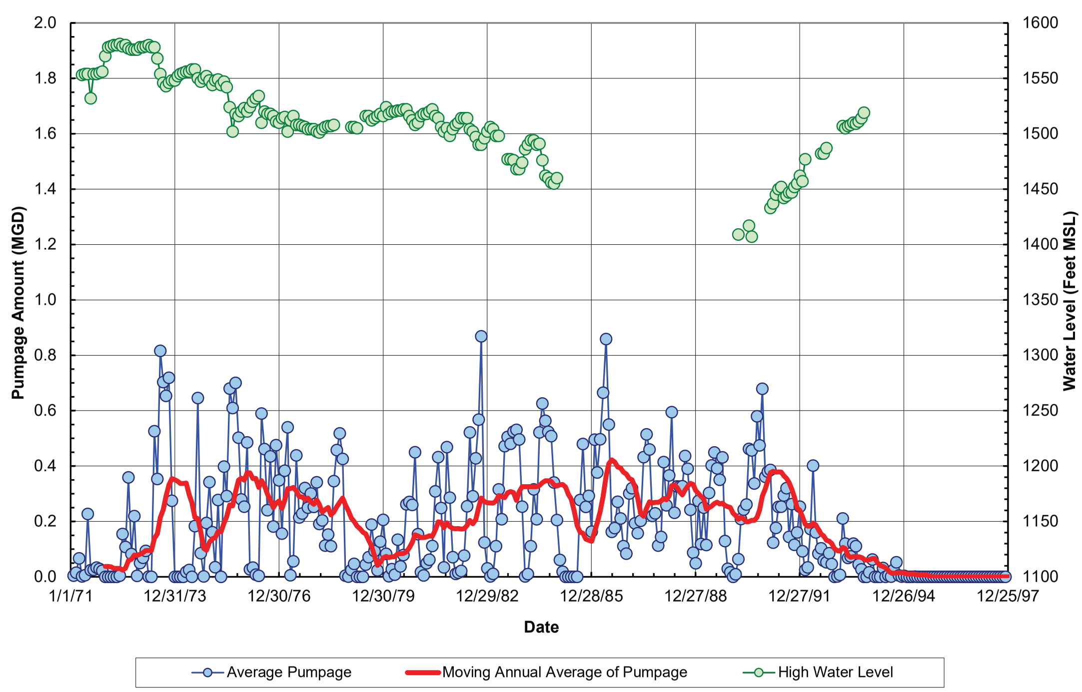

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Figure 10
Pumpage and Water Levels of Shaft 3 from Janauary 1971 to December 1994

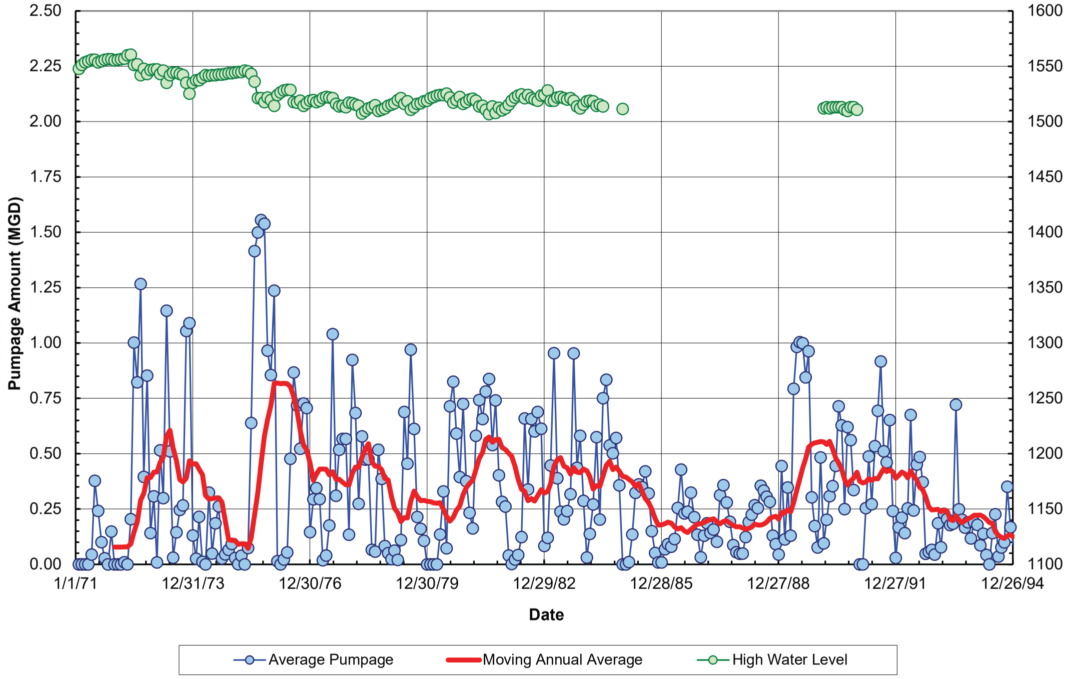

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Figure 11
Pumpage and Water Levels of Well 2 from Janauary 1971 to Decemebr 1994

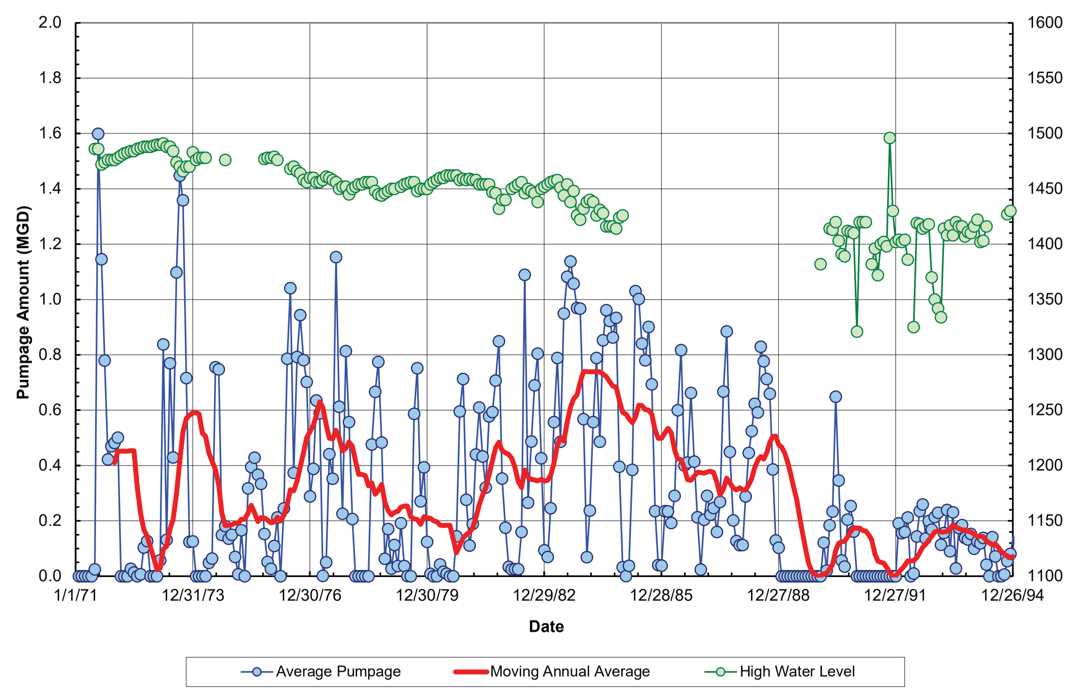

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Figure 12
Response in Shaft 3 During the October 21 to 24, 2015 Pump Test of Lanai Well 2

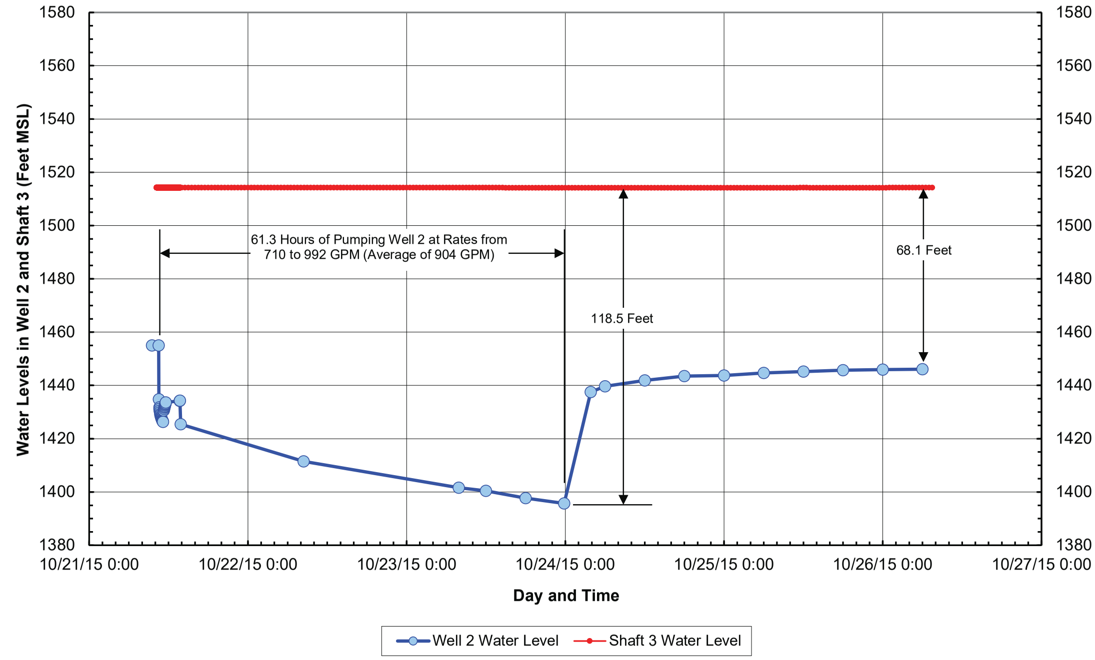

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Figure 13
Response in Shaft 3 During the October 21 to 24, 2015 Pump Test of Lanai Well 2
(Expanded Water Level Scale for Shaft 3)

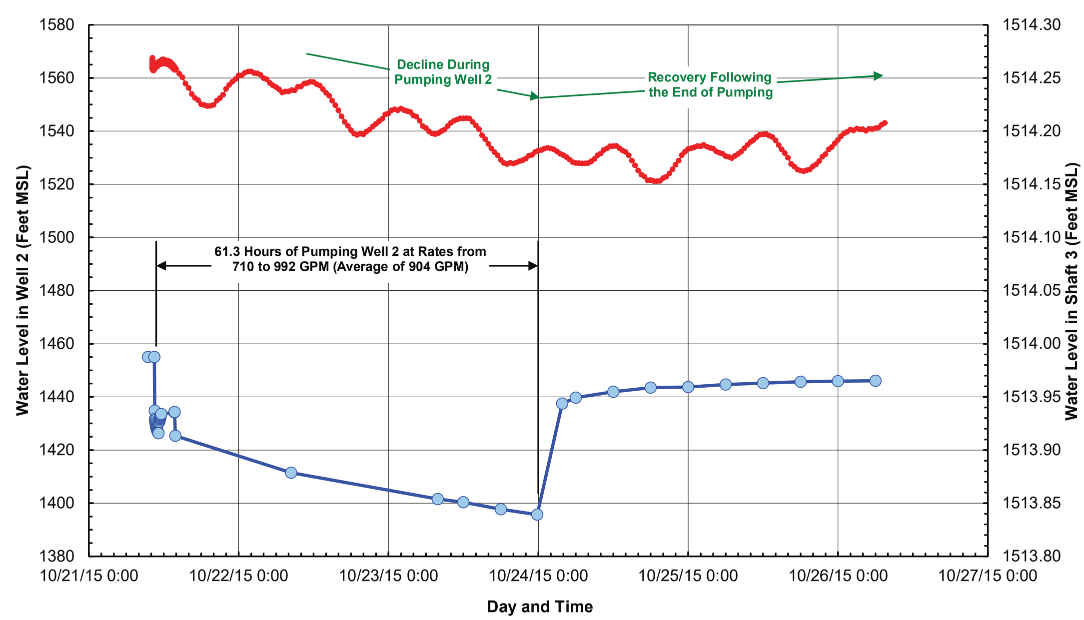

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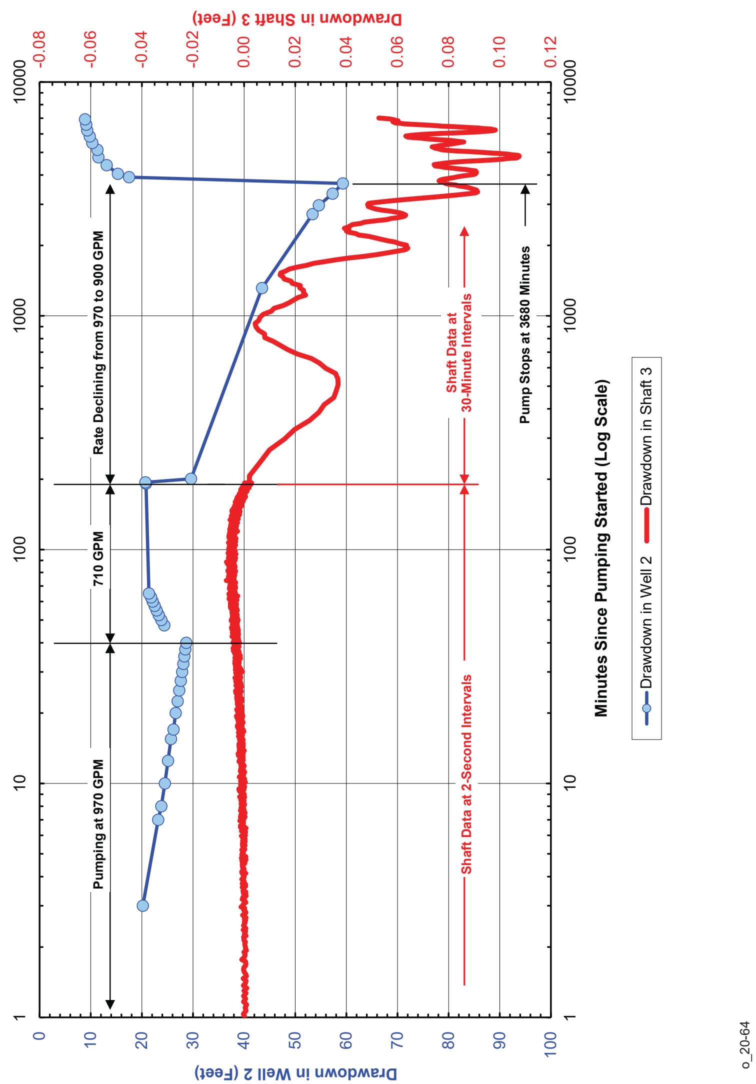
Figure 14
Response in Shaft 3 to the Pumping of Well 2 (Log Time Scale)



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.

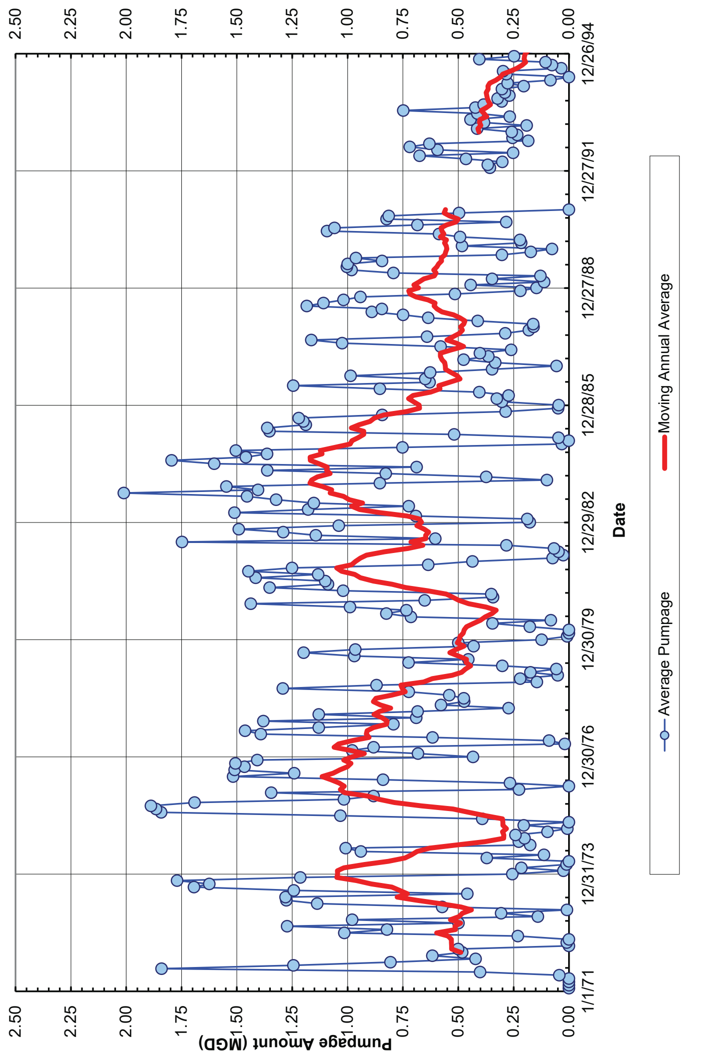
Recommended Well Site

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

I

WASTEWATER MASTER PLAN

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

TABLE OF CONTENTS

1. County of Maui, Wastewater Reclamation Division. Wastewater Flow Standards. February 2, 2006.
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)

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.

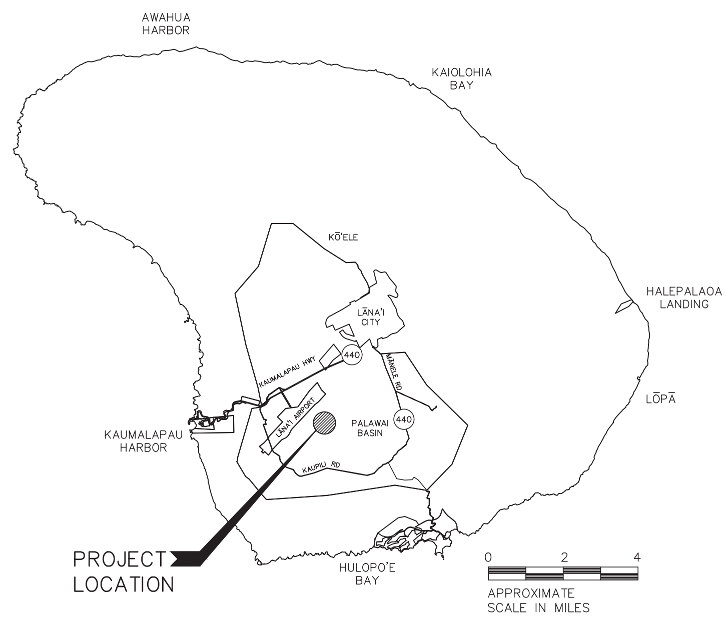
IX. COST CONSIDERATIONS

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

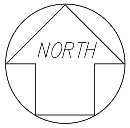
FEA REF-603

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

FEA REF-605

APPENDIX

J

DRAINAGE REPORT

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

FEA REF-607

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

FEA REF-608

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.

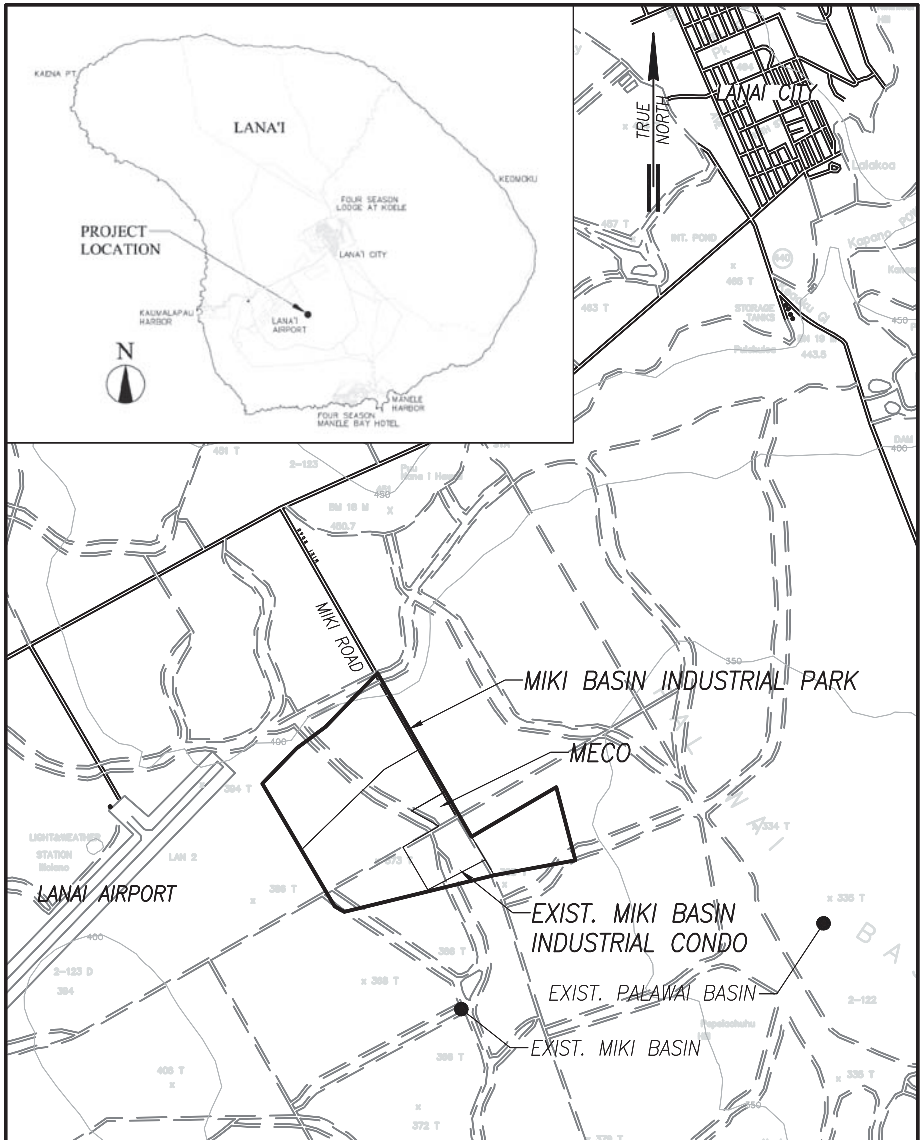
Runoff from the proposed 35-acre light industrial area (Drain Area 3) will be discharged at the eastern side of the area (see Figure 4). Onsite runoff flow for this area is 112.00 cfs and ultimately flows to Palawai Basin. Offsite runoff south of the 35-acre area from DA Offsite 4 will be intercepted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



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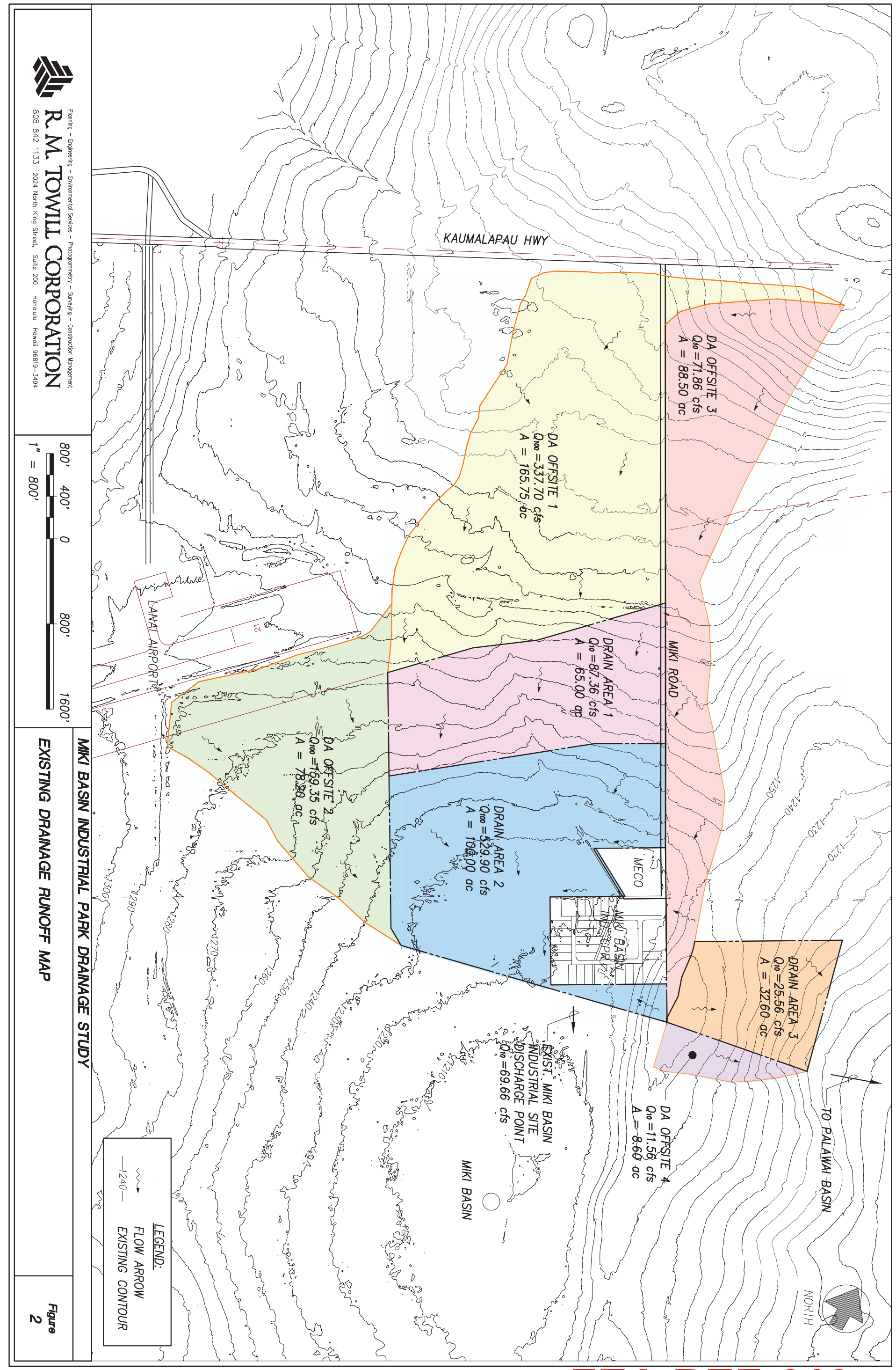
MIKI BASIN INDUSTRIAL PARK DRAINAGE STUDY

PROJECT LOCATION

Figure 1



FEA REF-610