Appendix F
Preliminary Engineering & Drainage Report

Established 1969

Preliminary Engineering Report

Maui Research and Technology Park Master Plan Update

Kihei, Maui, Hawaii
TMK: (2) 2-2-24:1-9, 14-18, 31, 32, 34 and 36-46
(2) 2-2-02:54 (por.)

Prepared For:
Pacific Rim Land, Inc.
1300 North Holopono Street, Suite 201
Kihei, Hawaii 96753

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

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for
Maui Research and Technology Park Master Plan Updated

1. INTRODUCTION

1.1 Purpose

This report describes the existing infrastructure in the vicinity of the Maui Research and Technology Park and identifies the key improvements that will be needed to develop the MRTP as proposed in its updated Master Plan.

1.2 Project Description

The Maui Research and Technology Park (MRTP) is located mauka (east) of the intersection of Piilani Highway and Lipoa Parkway.[1] (See Figure 1-1) Prior to its development, the lands comprising the MRTP were part of Haleakala Ranch. The MRTP was the vision of a core group of community leaders in the early 1980's who sought to diversify the economic and employment base on Maui beyond tourism and agriculture. The MRTP is now home to a diverse range of companies and government projects working in such areas as computer science, disaster mitigation, information technology, high performance computing, space surveillance, scientific research, optics, and photonics.

Since its inception in the late 1980's, the approximate 411 acre MRTP is only at approximately 10 percent build-out, with 11 lots sold and approximately 180,000 square feet of structures in five (5) buildings with a total of approximately 400 employees. Today, everyone

[1]Lipoa Parkway is referred to as Lipoa Street makai (west) of Piilani Highway.

working in the Park commutes since the development has no housing and few support services or amenities. The proposed Master Plan Update utilizes the principles of New Urbanism and Smart Growth to transform the current, single-use large lot research and technology campus into an integrated and vibrant mixed-use community focused around a regional knowledge-based industry[2] employment base.

The Master Plan will be implemented in phases, with key infrastructure tied to the phase of development and as the improvements are warranted. Figure 1-2 identifies the current zoning of the MRTP and Figure 1-3 identifies the two phases of the implementation program. Phase 1 will be located directly off of Lipoa and will consist of residential, mixed-use commercial, civic, and the employment core land uses. Building upon the land uses in Phase 1, Phase 2 will consist of residential and employment land uses on either side of Lipoa Parkway.

1.3 Project Location

The Maui Research and Technology Park is located in Kihei, Maui, Hawaii, approximately 0.2 miles east (mauka) of Piilani Highway. The Elleair Golf Course borders its westerly boundary, Waipuilani Gulch borders its northerly boundary and open pasture land currently owned by Haleakala Ranch Company lies along its easterly and southerly boundaries. The MRTP project encompasses approximately 411 acres, of which approximately 37.45 acres have been sold or developed. (See Figure 1-2)

[2]Industries characterized by highly-skilled workers in fields such as science and research, biotechnology, clean technology, information technology, disaster mitigation, education, healthcare and medicine, media production, and professional services and similar knowledge based organizations.

Primary access to the MRTP site is from Lipoa Parkway, which intersects Piilani Highway approximately 0.2 miles west of the project site.

1.4 Project Site Topography

Elevations across the project site range from approximately 270 feet above Mean Sea Level (MSL) along its easterly boundary, to approximately 160 ft. MSL along its westerly boundary and approximately 73 feet at the Lipoa Parkway / Piilani Highway intersection. The average grade across the project site is approximately 3.2%; however, this varies considerably at the many knolls and gullies present throughout the MRTP site. (See Figure 1-4)

1.5 Development Phases

The MRTP is envisioned to be developed in two (2) phases. Phase 1 of the project will include an 86 acre employment core, 58 acre *Village Center*, 39 acre *Makai Residential* and 6 acre existing *Drainage Detention* area encompassing an area of 189 acres. Phase 2 of the project will be comprised of a 90 acre *Knowledge Industry Campus* and a 124 acre *Residential and Knowledge Industry Expansion* area encompassing 214 acres. Lipoa Parkway, which will be subject to further improvement in both Phases, encompasses an area of 7.9 acres. (See Figure 1-3)

The *Employment Core*, which is part of Phase 1 of the MRTP, will remain exclusively in employment uses, although incidental supportive retail uses will also be permitted.

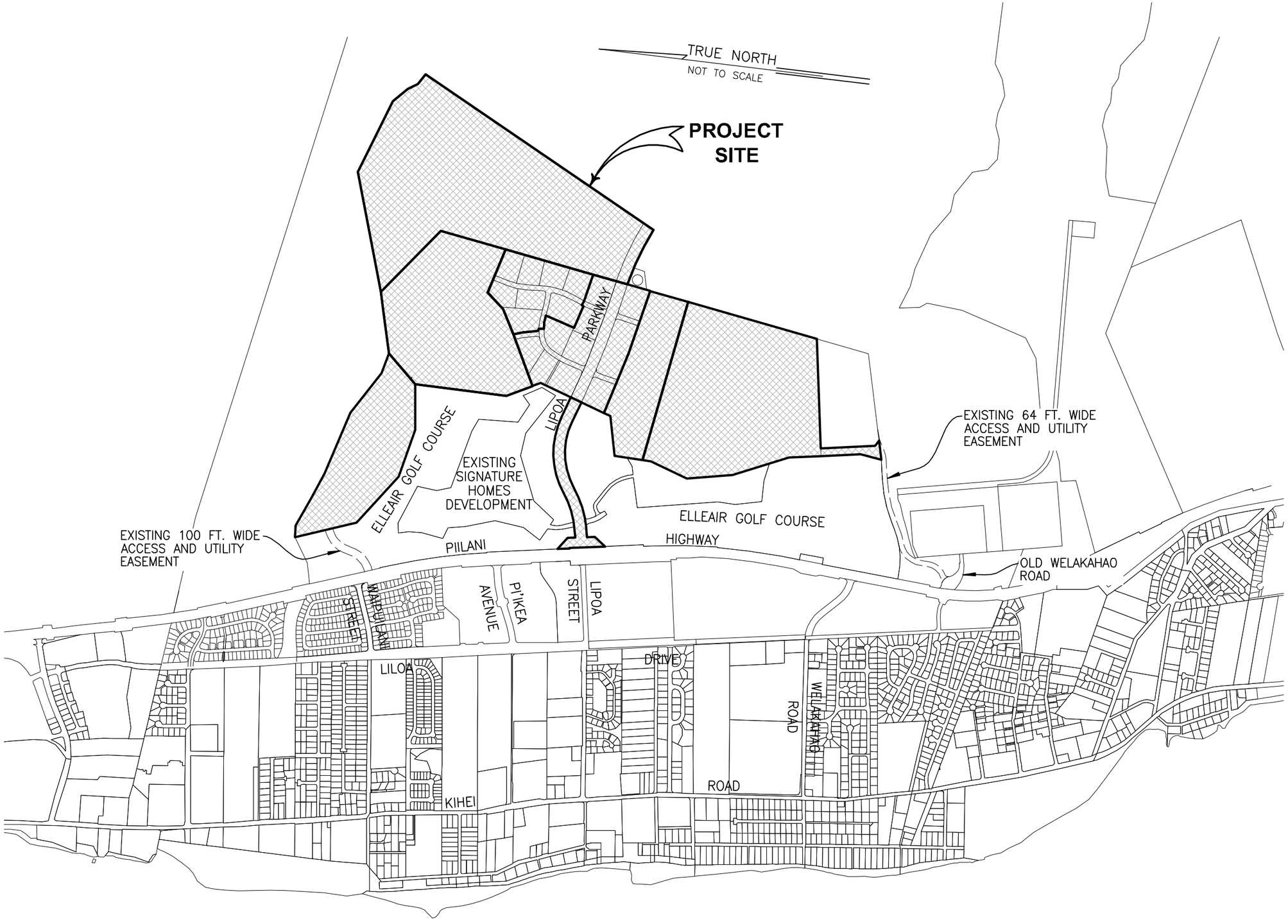
The *Village Center* is included as part of the Phase 1 development and is expected to be a flexible area containing space for incubating new businesses as well as supportive retail, civic uses, residential uses and open space.

The *Makai Residential Area,* an area designated to provide additional housing in a variety of formats appealing to MRTP business owners and employees, will be included as part of the Phase 1 development.

The *Drainage Detention* area located within the limits of Phase 1 is the site of an existing drainage detention basin that was originally designed and constructed to support the Piilani Village development located downstream of the MRTP on the westerly side of Piilani Highway. This detention basin will not be utilized to address the drainage requirements for the MRTP project.

The *Knowledge Industry / Campus* area, which is part of the Phase 2 development, will provide large new areas for employment expansion and diversification.

The *Residential and Knowledge Industry Expansion* area, which will provide land for employment, residential expansion and open space, will also be included as part of the Phase 2 development.



LOCATION MAP

NOT TO SCALE

FIGURE 1-1

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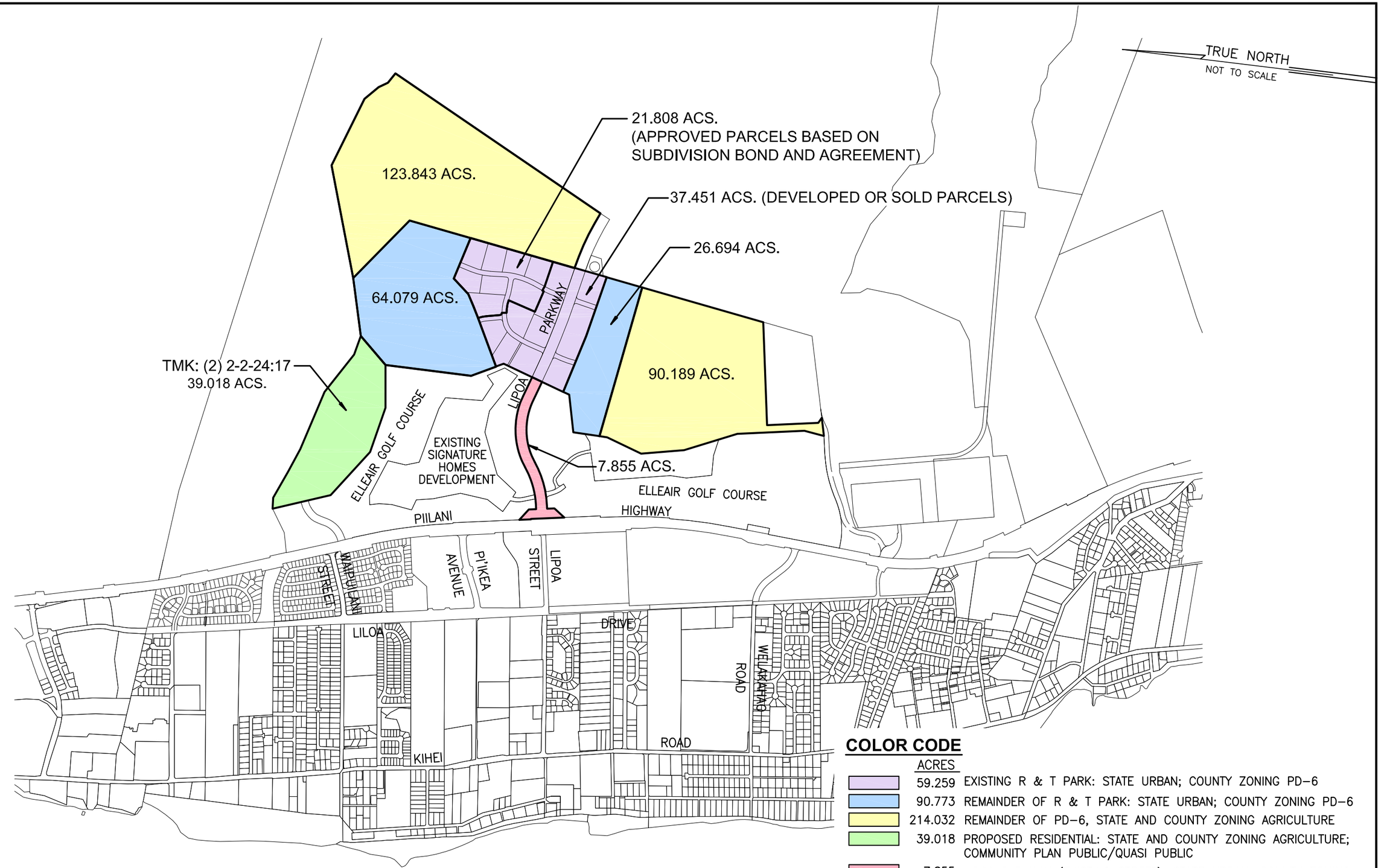

COLOR CODE

ACRES		
59.259	EXISTING R & T PARK: STATE URBAN; COUNTY ZONING PD-6
90.773	REMAINDER OF R & T PARK: STATE URBAN; COUNTY ZONING PD-6
214.032	REMAINDER OF PD-6, STATE AND COUNTY ZONING AGRICULTURE
39.018	PROPOSED RESIDENTIAL: STATE AND COUNTY ZONING AGRICULTURE; COMMUNITY PLAN PUBLIC/QUASI PUBLIC
7.855	LIPOA PARKWAY (EXISTING STREET): STATE URBAN; COUNTY ZONING AND COMMUNITY PLAN AGRICULTURE
TOTAL: 410.937	

CURRENT ZONING

NOT TO SCALE

FIGURE 1-2

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TRUE NORTH

SCALE: 1 IN. = 800 FT.

LAND AREA

LIPOA PARKWAY		7.855 ACS.
PHASE 1		
AREA A –	EMPLOYMENT CORE	85.953 ACS.
AREA C –	VILLAGE CENTER	64.079 ACS.
AREA D –	MAKAI RESIDENTIAL	39.018 ACS.
	SUBTOTAL	189.050 ACS.
PHASE 2		
AREA B –	KNOWLEDGE INDUSTRY EXPANSION/CAMPUS	90.189 ACS.
AREA E –	RESIDENTIAL AND KNOWLEDGE INDUSTRY EXPANSION	123.843 ACS.
	SUBTOTAL	214.032 ACS.
TOTAL AREA		**410.937 ACS.**

PHASE 2

E – RESIDENTIAL AND KNOWLEDGE INDUSTRY EXPANSION
123.843 ACS.

LIPOA STREET EXTENSION
(2.773 ACS.)

(58.288 ACS.)

C – VILLAGE CENTER
64.079 ACS.

EXISTING DETENTION BASIN
(5.791 ACS.)

EXT'G MAUI RESEARCH AND TECHNOLOGY PARK

A – EMPLOYMENT CORE
85.953 ACS.

PARKWAY

B – KNOWLEDGE INDUSTRY EXPANSION/CAMPUS
90.189 ACS.

PHASE 2

PHASE 1

GULCH

WAIPUILANI

D – MAKAI RESIDENTIAL
39.018 ACS.

ELLEAIR GOLF COURSE

EXISTING SIGNATURE HOMES DEVELOPMENT

LIPOA

LIPOA PARKWAY
7.855 ACS.

ELLEAIR GOLF COURSE

PIILANI HIGHWAY

COUNTY COMMUNITY AQUATIC CENTERS

KIHEI WASTEWATER RECLAMATION FACILITY

PIILANI VILLAGE PH. II

PIILANI VILLAGE PH. III

PIILANI VILLAGE SHOPPING CENTER

PIILANI GARDENS

KIHEI ELEMENTARY & LOKELANI INTERMEDIATE SCHOOLS

SOUTH MAUI COMMUNITY PARK

PHASING PLAN

0 800 1,600 2,400 3,200

SCALE: 1 IN. = 800 FT.

FIGURE 1-3

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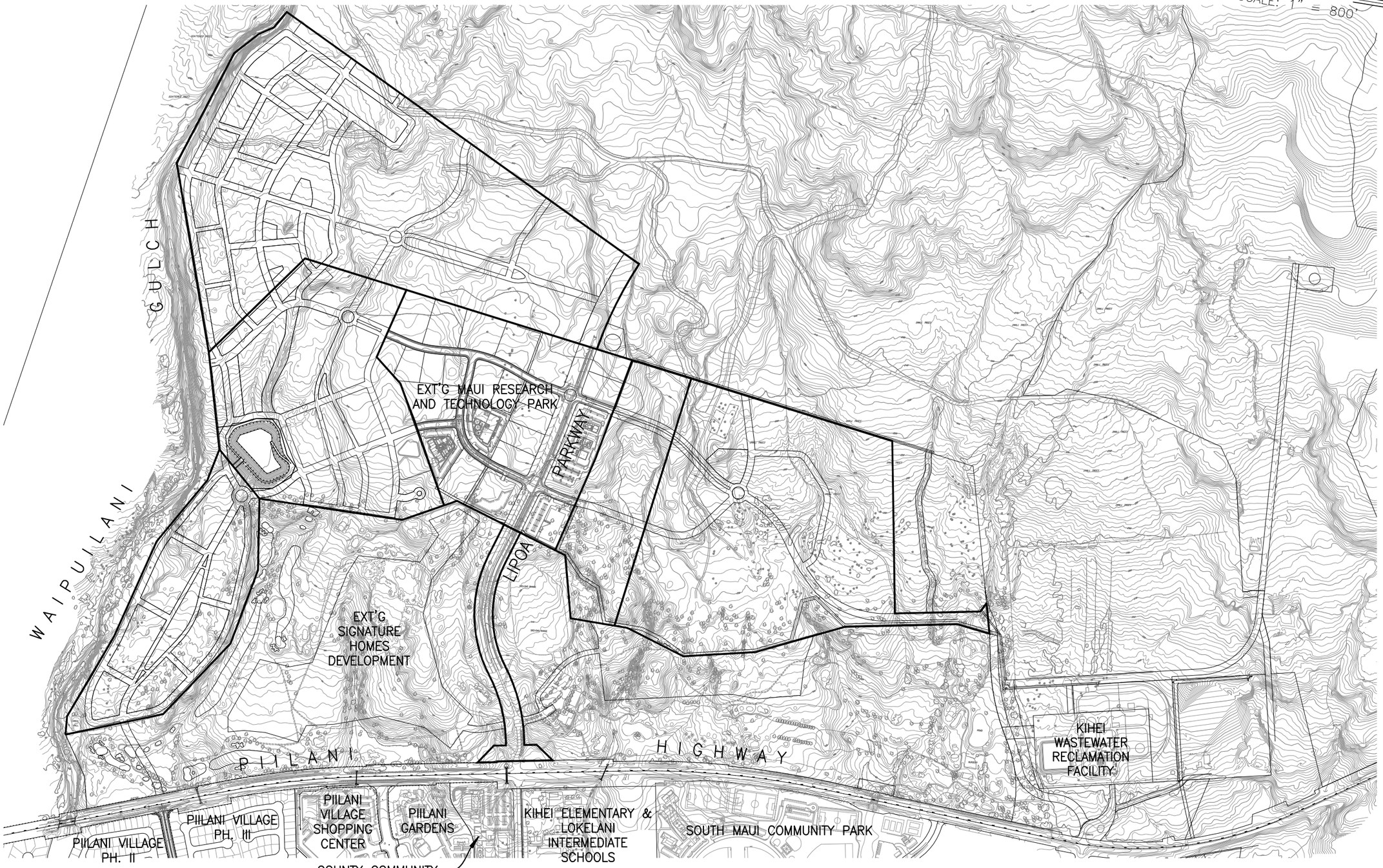

EXISTING SITE TOPOGRAPHY

0 800 1,600 2,400 3,200

SCALE: 1 IN. = 800 FT.

FIGURE 1-4

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2. WASTEWATER SYSTEM

2.1 Existing Infrastructure

The existing lots in the Maui Research and Technology Park (MRTP) are served by a privately owned and maintained wastewater system which collects and conveys their wastewater to the Kihei Wastewater Reclamation Facility (KWWRF) for processing. Existing gravity sewer mains located under existing roads and within designated sewer easements collect wastewater from the existing lots and convey it to an existing sewer pump station located near the western boundary of the MRTP project area. This pump station, in turn, lifts the collected wastewater through a 6-inch force main to a transition manhole located near the southern end of the MRTP project area. The wastewater is then conveyed by a 10-inch gravity sewerline to a second pump station located near the northeast corner of the Kihei Wastewater Reclamation Facility (KWWRF), which then lifts the wastewater through a 6-inch sewer force main directly into the headworks of the KWWRF. (See Figure 2-1)

The existing sewer pump stations have a capacity of approximately 880 gallons per minute (gpm), or 1.26 million gallons per day (mgd); the 6" force mains can accommodate approximately 880 gpm, or 1.26 mgd, of wastewater flow based on a maximum flow velocity of 10 feet per second in the force main.

The Kihei Wastewater Reclamation Facility (KWWRF), located just south of the MRTP project area, has a treatment capacity of approximately 8 mgd and currently has unused treatment capacity. The facility is also capable of producing R-1 quality effluent; however, the County of Maui's reclaimed water system is only able to utilize about 40 to 50 percent of the R-1 effluent generated by the KWWRF -- most of which is used for irrigation by the limited number of properties now within reach of existing reclaimed water distribution pipelines. The unused R-1

effluent which remains is disposed of through existing injection wells located on the KWWRF site.

2.2 Wastewater Demand

Wastewater flow projections for the MRTP were developed using land use, land area and unit count data multiplied by corresponding demand rates adopted from the Maui County Wastewater Reclamation Division.[3] The computed wastewater flows are summarized in Table 2.1 below.[4]

Table 2-1 - Wastewater Flow Projections

Type	Flow, Q (mgd)
Total Project	
Average Daily Wastewater Flow	0.50
Design Average Flow	0.55
Design Maximum Flow	1.85
Design Peak Flow	2.31
Phase 1	
Average Daily Wastewater Flow	0.26
Design Average Flow	0.29
Design Maximum Flow	1.12
Design Peak Flow	1.38
Phase 2	
Average Daily Wastewater Flow	0.24
Design Average Flow	0.26
Design Maximum Flow	1.05
Design Peak Flow	1.24

[3]Maui County Dept. of Environmental Management, Wastewater Reclamation Division, "Wastewater Flow Standards," February 2, 2000.

[4]Supporting calculations may be found in Appendix A.

2.3 Proposed Improvements

Wastewater improvements needed for the expansion MRTP will consist of new gravity sewer mains located primarily within planned roadways to collect wastewater from the developed lots and convey it a new or existing sewer pump station that will then convey the wastewater by force main to the Kihei Wastewater Reclamation Facility for treatment. The expanded wastewater system will be connected to the existing MRTP system and continue to be privately owned and maintained. (See Figure 2-1).

Wastewater generated by the northern portion of Phase 1 and the northeastern portion of Phase 2 (Residential and Knowledge Industry Expansion Area) will be collected by gravity sewer mains and conveyed to a new wastewater pump station that will be located at the low point of the collection system near the western tip of the MRTP. The new pump station will then lift the wastewater through a new force main to a new sewer transition manhole located at the high point on Ho'okena Street near the currently developed portion of the MRTP. The wastewater will then continue on through the existing MRTP wastewater system by gravity flow and force main to the KWWRF for treatment.

Wastewater generated from the southern portion of Phase 2 (Knowledge Industry/ Campus Area) will be conveyed by gravity sewerline to either the existing sewer pump station at the western boundary of MRTP or the existing pump station near the southern end of the MRTP close to the KWWRF. The wastewater will then be conveyed by force main from either pump station to the KWWRF for treatment.

Incremental improvements to increase the capacity of the existing MRTP wastewater pumping system will be required to accommodate the larger design peak wastewater flows generated by development Phases 1 and 2 as they are built out. Capacity improvements and modifications to the existing force main connection at the headworks of the KWWRF may also

be required by the County of Maui to accommodate the increased wastewater flow into the facility.

The MRTP has an agreement allowing a wastewater connection and discharge of up to 25,000 gallons per day (gpd) into the existing private wastewater gravity and pump station/force main system in the adjoining Signature Homes Development located west of the MRTP. This wastewater flow is ultimately conveyed to the existing MRTP wastewater pump station located near the western boundary of the MRTP project area. It is not anticipated that the MRTP will exercise this option; however, this option remains available should circumstances change.

2.4 Treatment Capacity

The County of Maui currently treats an *actual* average daily wastewater flow of approximately 3.4 mgd at the Kihei Wastewater Reclamation Facility. Wastewater Reclamation Division records indicate that cumulative *allocated* wastewater flows at the KWWRF total approximately 6.75 mgd as of June 30, 2011. The KWWRF has a treatment capacity of 8 mgd; therefore, the amount of treatment capacity which remains available is 4.6 mgd based on *actual* average daily flows, or 1.25 mgd based on *allocated* wastewater flows. Since the design average wastewater flow from the MRTP is expected to be approximately 0.55 mgd, there is currently sufficient treatment capacity available to accommodate the project. The County of Maui, under the provisions of Hawaii Administrative Rules, Title 11, Chapter 62 - Wastewater Systems, Section 23.1, is required to initiate a facility plan when the *actual* wastewater flow reaches 75 percent of the plant design capacity and implement the facility plan when the actual wastewater flow reaches 90 percent of the plant design capacity. Consequently, treatment capacity at the KWWRF should remain sufficient to accommodate development of the MRTP over time.

TRUE NORTH

SCALE: 1 IN. = 800 FT.

SEWER TRANSITION MANHOLE

EXISTING MAUI RESEARCH AND TECHNOLOGY PARK

Ext'g 1.0 MG Reclaimed Water Tank Site

PHASE 2

PHASE 2

NINAU ST.

PARKWAY

HOLOPONO ST.

LIPOA ST.

HO'OKENA STREET

EXT'G. GRAVITY SEWERLINE

EXT'G. TRANSITION SEWER MANHOLE

EXT'G. CONNECTION TO KIHEI WASTEWATER RECLAMATION FACILITY

EXT'G. 6" FM

EXT'G. PS

EXT'G. PS

NEW PS

ELLEAIR GOLF COURSE

EXISTING SIGNATURE HOMES DEVELOPMENT

ELLEAIR GOLF COURSE

KIHEI WASTEWATER RECLAMATION FACILITY

WAIPUILANI GULCH

PIILANI HIGHWAY

PIILANI VILLAGE PH. II

PIILANI VILLAGE PH. III

PIILANI VILLAGE SHOPPING CENTER

PIILANI GARDENS

COUNTY COMMUNITY AQUATIC CENTERS

KIHEI ELEMENTARY & LOKELANI INTERMEDIATE SCHOOLS

SOUTH MAUI COMMUNITY PARK

LEGEND:

- 6" NEW SEWER FORCE MAIN
- 8" NEW GRAVITY SEWERLINE
- NEW PS — NEW PUMP STATION
- EXISTING GRAVITY SEWERLINE
- EXISTING 6" SEWER FORCE MAIN
- Ext'g PS — EXISTING PUMP STATION

CONCEPTUAL WASTEWATER PLAN

0 800 1,600 2,400 3,200

SCALE: 1 IN. = 800 FT.

FIGURE 2-1

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3. WATER SYSTEM

3.1 Existing Infrastructure

3.1.1 Potable Water System

The Maui Research and Technology Park (MRTP) is located within Maui County Department of Water Supply's Central Maui Water System service area. Potable water for the 18 existing lots within the MRTP currently comes from existing wells located in upper Waiehu and North Waihee which draw groundwater from the Iao and Waihee Aquifers. Potable water from these wells is pumped into to an existing 1.0 million gallon (MG) capacity concrete water storage tank located in upper Waiehu[5], then conveyed across the isthmus by the Central Maui Water System's 36-inch diameter transmission main to consumers in South Maui. Water for the existing lots in MRTP is then taken from the 36-inch Central Maui transmission line into a 16-inch diameter waterline which runs from Liloa Drive near the Lipoa Street intersection, along Lipoa Street and Lipoa Parkway to the project site to supply the existing MRTP potable water distribution system.

MRTP has an agreement with the County of Maui, Department of Water Supply (DWS) to construct a 0.5 MG water storage tank at an approximate elevation of 330 feet by the year 2014 to serve the future needs of the MRTP. Under the terms of this agreement, the existing 18 lots in the MRTP may rely on a connection to the County water system for their potable and fire protection water needs without having to construct a 0.5 MG water storage tank. Development beyond the first 18 lots before the year 2014 would require the completion of the 0.5 MG water storage tank.

[5]The floor elevation of the 1.0 MG Waiehu Storage Tank is approximately 490 feet MSL.

The existing MRTP distribution system consists of 12-inch waterlines located within the existing roadways fed from the 16-inch transmission line on Lipoa Parkway through a pressure reducing valve. Due to the high water pressure in the 16-inch transmission line, a pressure reducing valve was installed at the MRTP water distribution system connection to reduce the water pressure to approximately the same pressure that would be obtained after the 0.5 MG water storage tank is constructed in the future.

3.1.2 Non-Potable Water System

The Kihei Wastewater Reclamation Facility (KWWRF) produces R-1 quality effluent which is the highest quality reclaimed water under the State of Hawaii, Department of Health Standards.

The County of Maui has established a limited reclaimed water distribution infrastructure to facilitate public reuse of the R-1 quality effluent generated by the KWWRF. This system consists of an existing 1.0 million gallon (MG) concrete tank located east of the KWWRF at elevation 300 feet above mean sea level. A distribution system consisting of 16-inch and smaller reclaimed water distribution lines deliver R-1 quality effluent from the 1.0 MG concrete water storage tank to users located primarily north of the KWWRF. The R-1 quality effluent is primarily used for irrigation purposes. The existing irrigation systems for the landscaped common areas and developed parcels in the MRTP now utilize R-1 quality effluent from the KWWRF by drawing it from the existing County 10-inch R-1 waterline which runs along the easterly (mauka) boundary of the MRTP.

3.2 Water Demand Estimate

Potable and non-potable water demand projections were based on land area and unit estimates using consumption rates adopted from the Maui County Department of Water Supply's *Water System Standards.*[6] A 60% potable/40% non-potable demand ratio -- the ratio recommended by the Honolulu Board of Water Supply for dual systems[7] -- was also selectively applied in certain instances to break total demand down into potable and non-potable water demand components.[8] The projected water demand for MRTP is summarized as follows:

Table 3-1 - Summary of the Average Potable and Irrigation Requirements for the Portion of the MRTP Expansion Not Supplied by DWS

Phase	Developed Area	Average Daily Demand (GPD)	
		Potable	Non-Potable Irrigation
1	Employment Core	18,877	19,609
	Village Center	225,743	114,854
	Makai Residential	211,260	25,660
	Drainage Basins	--	9,632
	Total for Phase 1	455,880	169,755
2	Knowledge Exp / Campus	40,084	59,460
	Residential and Knowledge Industry Exp.	302,101	144,114
	Total for Phase 2	342,185	203,574
Total for Both Phases		798,065	373,329

Source: Tom Nance Water Resource Engineering, "Evaluation of Source Supply Alternatives for the Planned Expansion of the Maui Research and Technology Park," March 1, 2012.

[6]County of Maui, Department of Water Supply, *Water System Standards*, 2002, Table 100-18: "Domestic Consumption Guidelines," p.111-3.

[7]See Appendix B-1.

[8]See Appendix B-2.

Table 3-2 - Required Potable Supply Capacities

Stage of	Average Daily Demand (MGD)	Maximum Daily Demand	
		(MGD)	(GPM)
End of Phase 1	0.46	0.69	475
End of Phase 2	0.80	1.20	830

3.3 Proposed Improvements

3.3.1 Potable Water Supply

3.3.1.1 Source Alternatives

The County of Maui Dept. of Water Supply-operated public water system remains the preferred source of water for expansion of the Maui Research and Technology Park. Unfortunately, because the Maui County Dept. of Water Supply has indicated that they cannot commit to providing potable water beyond the existing 18 lots within the MRTP, MRTP has proposed an alternate, privately owned and maintained potable water source and distribution system to support further expansion. (See Figure 3-1)

The Maui Upcountry Community Plan prohibits the use of wells developed in the Upcountry plan area from being used as a water source for another plan area and thereby constrains the location of a new well source. The Upcountry Community Plan boundary in the vicinity of the MRTP is the 600-foot elevation contour, which means that wells developed to serve the MRTP must be located below this elevation contour.

The "Evaluation of Source of Supply Alternatives for the Planned Expansion of the Maui Research and Technology Park"[9] identifies two (2) alternate sources of water for the project and outlines the improvements required to provide the privately owned and maintained potable water system for the MRTP. These alternate systems would all be privately operated and separate from the existing DWS water system currently serving the 18 existing parcels in the MRTP. The two source alternatives are summarized as follows:

1) **Source Alternative 1 - Offsite Brackish Wells at 580-foot Elevation**

This alternative consists of five (5) offsite brackish wells spaced 1250 feet apart with a capacity of 360 gallons per minute (GPM) per well located at the 580-foot elevation on land currently owned by Haleakala Ranch Company. Three wells would be developed to accommodate the needs of the MRTP Phase 1, and the remaining two wells would be required for Phase 2. Offsite improvements associated with this alternative will include a 0.25 million gallon (MG) brackish water head tank located at the 590-foot elevation, a 12-inch transmission waterline to a Reverse Osmosis (RO) treatment plant using a high pressure filtration process to produce potable water, two disposal wells to discharge the concentrate (wastewater) generated by the RO process, potable water storage tanks at the 375 foot elevation, and a 16-inch distribution waterline connecting the storage tanks to the MRTP's potable water distribution system. The RO

[9]Tom Nance Water Resources Engineering, "Evaluation of Source of Supply Alternatives For the Planned Expansion of the Maui Research and Technology Park," February 7, 2012.

treatment plant will consist of three 250 GPM treatment trains for Phase 1 and two additional 250 GPM treatment trains to accommodate Phase 2. (See Figure 3.2a)

2) **Source Alternative 2 - Brackish Wells Within the MRTP**

This alternative consists of five (5) onsite brackish wells located along the easterly portion of the MRTP, spaced 1,500 feet apart with a capacity of 400 GPM per well. Three wells would be developed to accommodate the needs of the MRTP Phase 1, and the remaining two wells would be required for Phase 2. A 0.25 MG brackish water head tank and RO treatment plant with two disposal wells to discharge the concentrate from the RO treatment plant would be located within the MRTP. The RO product water would be pumped from the RO treatment facility into potable water storage tanks also located within the MRTP at the 212-foot elevation. Three wells would initially be developed to accommodate Phase 1 of the MRTP and two more wells developed later with Phase 2. The RO treatment plant would consist of three treatment trains for Phase 1 and two additional treatment trains for Phase 2. (See Figure 3.2b)

3.3.1.2 Storage and Distribution

A total potable water storage capacity of 1.5 MG of will ultimately be needed to supply the combined fire protection and domestic use needs of Phases 1 and 2. This will be provided incrementally by constructing a 1.0 MG tank with Phase 1, followed by a 0.5 MG tank with Phase 2.

Source Alternative 1 will utilize concrete tanks constructed above the MRTP at the 375-foot elevation on land currently owned by Haleakala Ranch Company. Source Alternative 2 will utilize concrete storage tanks constructed within MRTP at the 212-foot elevation and employ pumps to provide water pressure comparable to having storage tanks at the 375-foot elevation.

A 16-inch distribution main will connect the potable storage tanks to MRTP, where a new network of 8- and 12-inch distribution mains will be deployed to supply the individual lots within the development. Figure 3-3 depicts the potable water storage and distribution system described.

3.3.1.3 Water Service Agreement with County of Maui

The MRTP currently has an obligation with DWS to construct a 0.5 MG water storage tank at the 330-foot elevation by the year 2014 to service the existing 18 parcels in the project. However, since alternative sources of water will be utilized for the project, the Owner will address the possible amendment of this obligation with DWS.

3.3.2 Non-Potable Water Supply

3.3.2.1 Primary Source

MRTP will continue to utilize R-1 quality effluent from the Kihei Wastewater Reclamation Facility (KWWRF) as its primary source of non-potable water to supply its landscape irrigation demand. Expanded usage of R-1 reclaimed water from the KWWRF offers the dual benefit of conserving potable

water and reducing the amount of reclaimed water that the County of Maui must dispose of using injection wells.

The County of Maui Wastewater Reclamation Division which oversees the R-1 reclaimed water system has indicated that there may be periods where the R-1 supply may not be sufficient to accommodate the landscape irrigation needs for the entire MRTP because of constant fluctuations in the quantity of wastewater treated at the KWWRF and limited R-1 water storage capacity in the County's reclaimed water system. This may be particularly evident during the drier part of the year when the demand for R-1 quality effluent is the greatest. Therefore, to ensure that there will be a reliable supply of non-potable water available to satisfy MRTP landscape irrigation demand, additional non-potable water sources and associated storage and distribution infrastructure will need to be constructed to supplement the County of Maui's reclaimed water system.

3.3.2.2 Supplemental Sources

The "Evaluation of Source of Supply Alternatives for the Planned Expansion of the Maui Research and Technology Park" identified three (3) alternative sources of water from the development of new wells for the MRTP. Provisions to provide supplemental non-potable water have been incorporated into each of the alternate water sources as follows:

1) **Supplemental Source Alternative 1 - Brackish Wells at 580-Foot Elevation**. Under this alternative, the 5 brackish wells at the 580-foot elevation will pump the water into a 0.25 MG brackish water head tank

located at the 590-foot elevation. A 6-inch waterline from the 0.25 MG brackish water head tank will supply the non-potable brackish water to the non-potable water storage tank at elevation 350 feet that feeds the MRTP non-potable water system in the event that there is insufficient R-1 water from the County of Maui Reclaimed Water System available to supply MRTP's irrigation demand. This alternative will require a booster pump station to lift the R-1 quality effluent from the KWWRF – whose non-potable storage tank is located at elevation 300 feet – to the new MRTP offsite non-potable water storage tank at elevation 350 feet.

2) **Supplemental Source Alternative 2 - Brackish Wells Within MRTP**

Under this alternative, the five (5) brackish wells located within the MRTP will pump the water into a 0.25 MG brackish water head tank located within the MRTP site. Brackish water from the 0.25 MG head tank will be used to fill the 0.4 MG non-potable water storage tank located at elevation 202 feet when needed.

3.3.2.3 Storage and Distribution

A total non-potable water storage capacity 0.4 MG of will be needed to supply the combined irrigation needs of Phases 1 and 2. Source Alternative 1 will utilize a single 0.4 MG capacity concrete or steel storage tank constructed above the MRTP at the 350-foot elevation on land currently owned by Haleakala Ranch Company. Source Alternative 2 will utilize single 0.4 MG capacity concrete or

steel storage tank constructed within MRTP at approximately the 202-foot elevation and utilize pumps to provide water pressure comparable to having storage tank at the 350-foot elevation.[10]

A 14-inch distribution main will connect the 0.4 MG storage tank to MRTP, where a new network of 12-, 8- and 6-inch distribution mains will be constructed to supply the individual lots within the development. Figure 3-4 depicts the non-potable storage and distribution system described.

[10]The MRTP non-potable water storage tank will be sited 25 feet lower in elevation than the potable water storage tanks so that water pressure in the non-potable water mains will be approximately 10 psi lower than in nearby potable water mains, thus minimizing the risk of cross-contamination between the two water systems. The introduction of a pressure differential to the reduce cross-contamination hazard between potable and reclaimed water systems is a practice recommended by the State Dept. of Health and observed by the Maui County Dept. of Environmental Management's Wastewater Reclamation Division. (Ref. State of Hawaii, Department of Health, Wastewater Branch, "Guidelines for the Treatment and Use of Recycled Water," May 15, 2002, p.44.)

TRUE NORTH

SCALE: 1 IN. = 800 FT.

WATER SERVICE TO BE PROVIDED BY PRIVATE WATER SOURCE

E – RESIDENTIAL AND KNOWLEDGE INDUSTRY EXPANSION

WATER SERVICE TO BE PROVIDED BY MAUI COUNTY DEPARTMENT OF WATER SUPPLY

WATER SERVICE TO BE PROVIDED BY PRIVATE WATER SOURCE

EXT'G MAUI RESEARCH AND TECHNOLOGY PARK

C – VILLAGE CENTER

A – EMPLOYMENT CORE

PARKWAY

WATER SERVICE TO BE PROVIDED BY PRIVATE WATER SOURCE

B – KNOWLEDGE INDUSTRY EXPANSION/CAMPUS

GULCH

WAIPUILANI

D – MAKAI RESIDENTIAL

ELLEAIR GOLF COURSE

EXISTING SIGNATURE HOMES DEVELOPMENT

LIPOA

ELLEAIR GOLF COURSE

KIHEI WASTEWATER RECLAMATION FACILITY

PIILANI HIGHWAY

PIILANI VILLAGE PH II

PIILANI VILLAGE PH III

PIILANI VILLAGE SHOPPING CENTER

PIILANI GARDENS

KIHEI ELEMENTARY & LOKELANI INTERMEDIATE SCHOOLS

SOUTH MAUI COMMUNITY PARK

COUNTY COMMUNITY AQUATIC CENTERS

POTABLE WATER SERVICE PLAN

0 800 1,600 2,400 3,200

SCALE: 1 IN. = 800 FT.

FIGURE 3-1

V:\Projdata\08proj\08028 (Maui R&T Park – Master Plan)\dwg2008\exhibits\Prelim Engineering\Exb-Water Service-00.dwg

Source:
Tom Nance Water Resource Engineering, "Evaluation of Source Supply Alternatives for the Planned Expansion of the Maui Research and Technology Park," February 7, 2012.

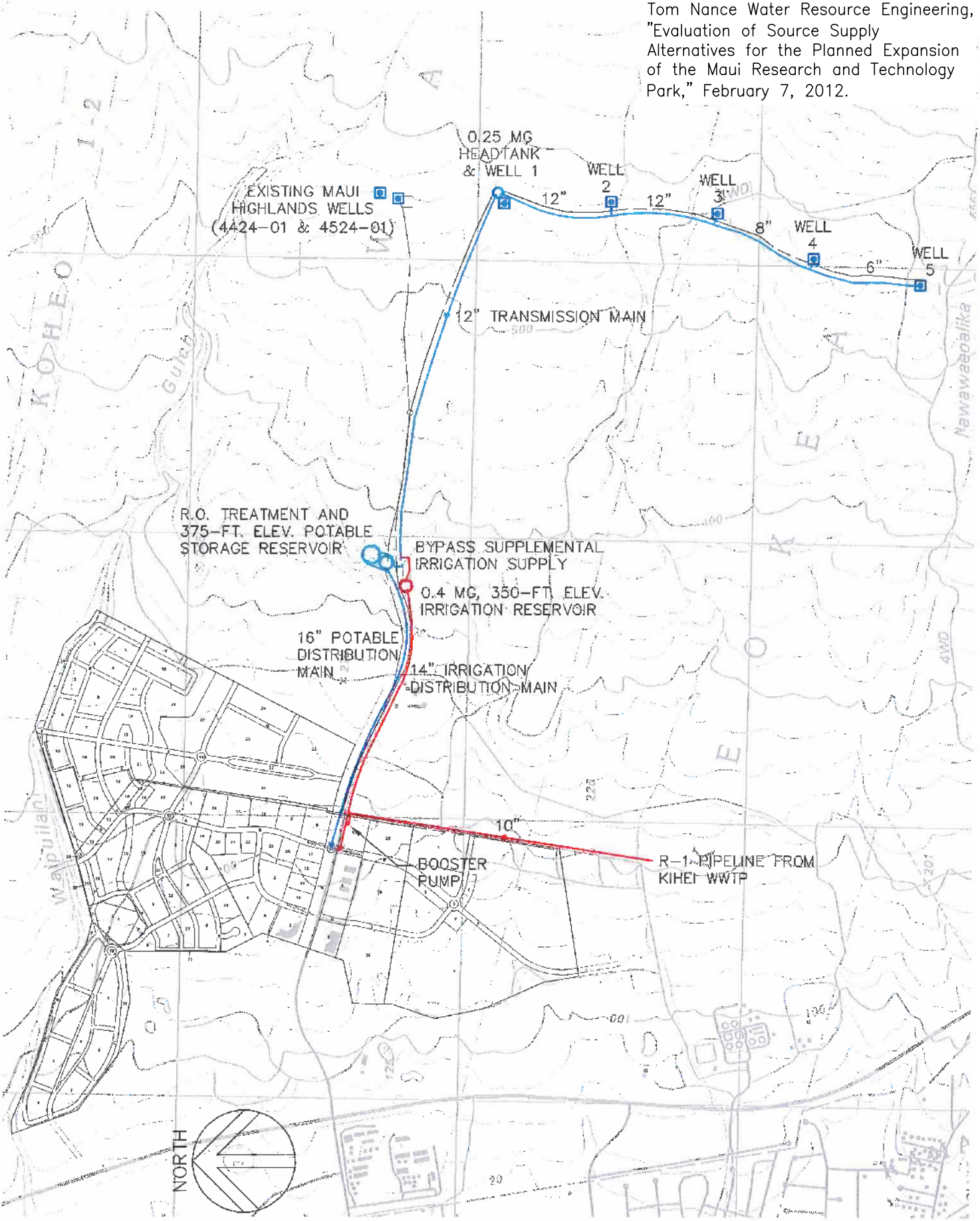
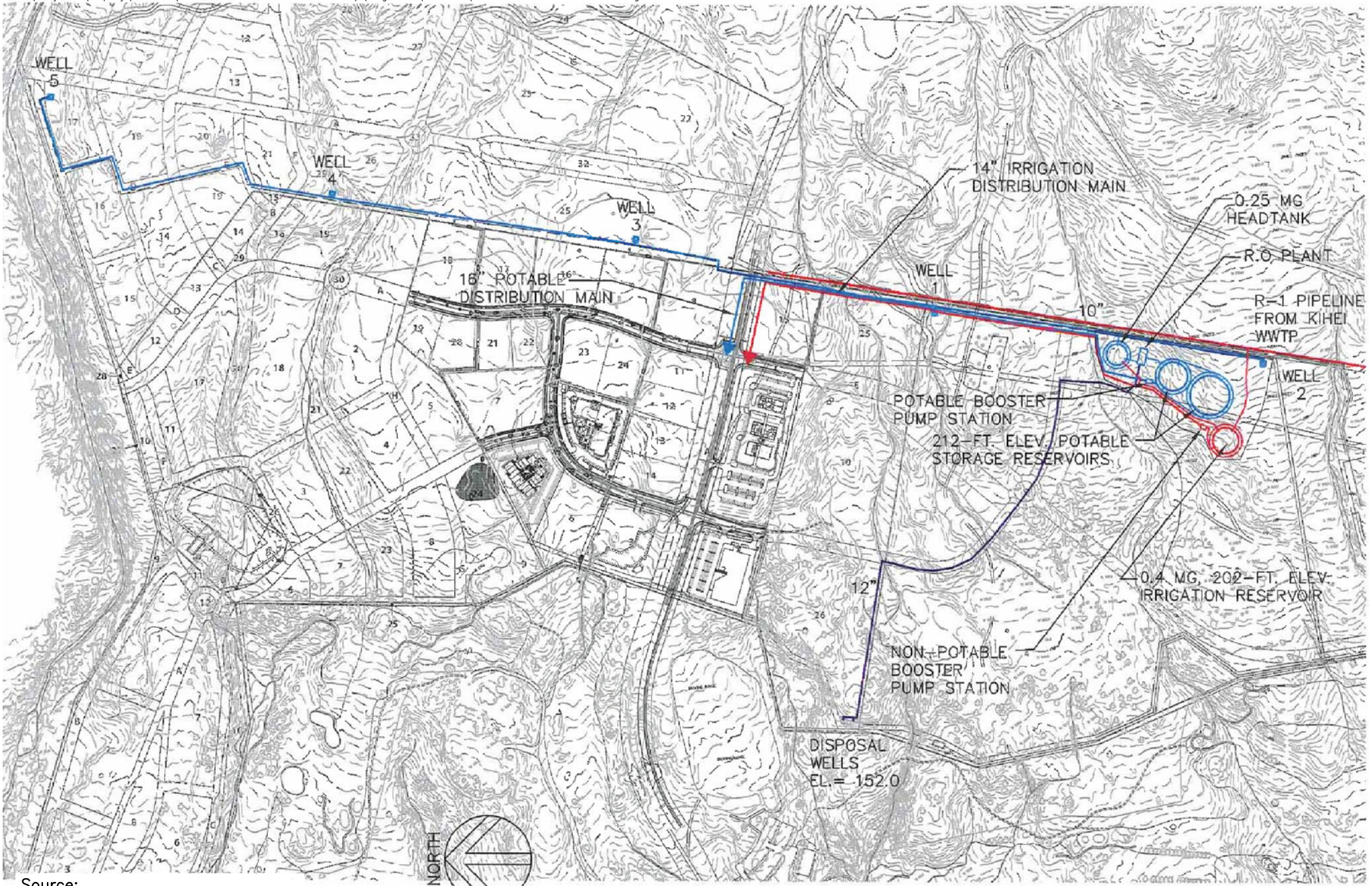


FIGURE 3-2a

ALTERNATIVE 1
OFFSITE BRACKISH WELLS

v:\Projdata\08proj\08028 (Maui R&T Park - Master Plan)\dwg2008\exhibits\EXB-Well-Alt-1-2-3-00.dwg

V:\Projdata\08proj\08028 (Maui R&T Park – Master Plan)\dwg2008\exhibits\EXB-Well-Alt-1-2-3-00.dwg



Source:
Tom Nance Water Resource Engineering, "Evaluation of Source Supply Alternatives for the Planned Expansion of the Maui Research and Technology Park," February 7, 2012.

FIGURE 3-2b

ALTERNATE 2
ONSITE SYSTEM

NEW 1.0 M.G. STORAGE TANK
w / SPILLWAY ELEV. = 375'
CONSTRUCTED WITH PHASE 1
UNDER SOURCE ALT. 1

NEW 0.5 M.G. STORAGE TANK
w / SPILLWAY ELEV. = 375'
CONSTRUCTED WITH PHASE 2

TRUE NORTH
SCALE: 1 IN. = 800 FT.

45 PSI
ELEV. 270'
EXISTING MAUI RESEARCH AND TECHNOLOGY PARK
16" DISTRIBUTION OUTFLOW LINE FOR SOURCE ALTERNATIVE 2
Ext'g 1.0 MG Reclaimed Water Tank Site
EXT'G PRESSURE REDUCING VALVE
Ext'g 2.0 M.G. Piilani Water Storage Tank
1.0 M.G. AND 0.5 M.G. STORAGE TANK LOCATION FOR SOURCE ALTERNATIVE 2 ELEV.=212'
PRESSURE REDUCING VALVE (PRV)
ELEV. 140' 100 PSI 60 PSI
LOWER SERVICE ZONE
UPPER SERVICE ZONE
ELEV. 60' 100 PSI
100 PSI 60 PSI ELEV. 140'
ELEV. 60'

GULCH
PHASE 2
PHASE 1
PHASE 2
NINAU ST.
HO'OKENA ST.
HOLOPONO ST.
PARKWAY
LIPOA
WAIPUILANI
PIILANI
HIGHWAY
DRIVE
ELLEAIR GOLF COURSE
EXISTING SIGNATURE HOMES DEVELOPMENT
ELLEAIR GOLF COURSE
KIHEI WASTEWATER RECLAMATION FACILITY
PIILANI VILLAGE PH. II
PIILANI VILLAGE PH. III
PIILANI VILLAGE SHOPPING CENTER
PIILANI GARDENS
COUNTY COMMUNITY AQUATIC CENTERS
KIHEI ELEMENTARY & LOKELANI INTERMEDIATE SCHOOLS
SOUTH MAUI COMMUNITY PARK
LILOA

LEGEND:
- WATER SERVICE ELEVATION/PRESSURE CONTOUR
- EXISTING WATERLINE (COUNTY OF MAUI)
- PROPOSED WATERLINE (PRIVATELY OWNED AND MAINTAINED)
- PRV EXISTING PRESSURE REDUCING VALVE

POTABLE WATER SYSTEM: STORAGE AND DISTRIBUTION PLAN

0 800 1,600 2,400 3,200
SCALE: 1 IN. = 800 FT.

FIGURE 3-3

V:\Projdata\08proj\08028 (Maui R&T Park - Master Plan)\dwg2008\exhibits\Prelim Engineering\Exb-Ext'g Water-00.dwg

NEW 0.4 M.G. NON-POTABLE
STORAGE TANK w/SPILLWAY
ELEV.=350'
CONSTRUCTED WITH PHASE 1
UNDER SOURCE ALTERNATIVE 1

TRUE NORTH
SCALE: 1 IN. = 800 FT.

SPACE TO BE ALLOTTED IN
NEW ROADWAY FOR
NORTHWARD EXTENSION OF R-1
RECLAIMED TRANSMISSION
WATERLINE BY COUNTY OF MAUI

35 PSI
ELEV. 270'

NEW BOOSTER PUMP STATION
DRAWING WATER FROM COUNTY R-1 SYSTEM
INTO MRTP IRRIGATION SYSTEM TO FILL
0.4 M.G. NON-POTABLE STORAGE TANK
CONSTRUCTED WITH SOURCE ALTERNATIVE 1

14" DISTRIBUTION
OUTFLOW LINE FOR
SOURCE ALTERNATIVE 2

Existing County 1.0 MG
Reclaimed Water Storage Tank
Elev.=300'

PHASE 2

GULCH

EXISTING MAUI RESEARCH
AND TECHNOLOGY PARK

NINAU ST.

HO'OKENA ST.

HOLOPONO ST.

PARKWAY

PRESSURE
REDUCING VALVE
(PRV)

ELEV. 140'
90 PSI
50 PSI

LOWER SERVICE ZONE

WAIPUILANI

ELLEAIR
GOLF
COURSE

EXISTING
SIGNATURE
HOMES
DEVELOPMENT

LIPOA

UPPER SERVICE ZONE

ELEV. 270'

0.4 M.G. STORAGE TANK
LOCATION FOR SOURCE
ALTERNATIVE 2
ELEV.=202'

ELEV. 60'
90 PSI

PIILANI HIGHWAY

ELLEAIR GOLF COURSE

KIHEI
WASTEWATER
RECLAMATION
FACILITY

PIILANI VILLAGE
PH. II

PIILANI VILLAGE
PH. III

PIILANI
VILLAGE
SHOPPING
CENTER

PIILANI
GARDENS

COUNTY COMMUNITY
AQUATIC CENTERS

KIHEI ELEMENTARY &
LOKELANI
INTERMEDIATE
SCHOOLS

SOUTH MAUI COMMUNITY PARK

LEGEND:

- EXISTING MRTP NON-POTABLE IRRIGATION WATERLINE
- 6" NEW MRTP NON-POTABLE IRRIGATION WATERLINE
- EXISTING COUNTY R-1 RECLAIMED WATERLINE
- NEW COUNTY R-1 RECLAIMED WATERLINE

NON-POTABLE WATER SYSTEM: STORAGE AND DISTRIBUTION PLAN

0 800 1,600 2,400 3,200

SCALE: 1 IN. = 800 FT.

FIGURE 3-4

V:\Projdata\08proj\08028 (Maui R&T Park - Master Plan)\dwg2008\exhibits\Prelim Engineering\Exb-Non-Potable Water-00.dwg

4. DRAINAGE

4.1 Existing Conditions

The 414 acre MRTP project area is flanked by two major drainageways: Waipuilani Gulch to the north, and Keokea Gulch to the south. Undeveloped pasture land owned by Haleakala Ranch Company lies to the east, immediately upstream of the MRTP; the Elleair Golf Course lies to the west, immediately downstream of the MRTP. Piilani Highway and a portion of urban Kihei lie further downstream, closer to the ocean.

4.1.1 Topography and Soils

The undeveloped areas of the project site are currently open pasture lands with brush and scattered trees that are not being used for any particular purpose. The site slopes downward from an elevation of approximately (+) 270 feet M.S.L. on its eastern edge to approximately (+) 60 feet M.S.L. on its western edge at an average slope of roughly 3%. Six minor, natural drainageways run east-to-west across the project site.

According to the United States Department of Agriculture Soil Conservation Service's *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii*, the predominant soil classification found on the project site is Waiakoa extremely stony silty clay loam (WID2). (See Figure 4-1) Waiakoa soil is characterized as having medium runoff and posing a potentially severe erosion hazard if left exposed.[11]

[11]United States Department of Agriculture, Soil Conservation Service, "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii," August 1972, p.127, Map Sheet 107 and 108.

4.1.2 Flood and Tsunami Hazard

The Federal Emergency Management Agency's Flood Insurance Rate Map for Maui County places the MRTP project area in Zone X, which indicates that the project area lies outside of the 500-year floodplain.[12] (See Figure 4-2).

4.1.3 Existing Drainage Pattern

4.1.3.1 Offsite

Storm runoff from the undeveloped lands mauka (east) of the project site flows across the MRTP project area in an east-to-west direction: runoff enters the MRTP project area along its eastern boundary and exits along its western boundary. (See Figure 4-3) Runoff leaving the MRTP project area continues westward, flowing across the Elleair Golf Course to Piilani Highway, where existing culverts pass the runoff under the highway. Various drainage facilities then convey the runoff through urban Kihei to the Pacific Ocean. The magnitude of the combined offsite storm flows which pass through the MRTP is approximately 1,300 cfs.[13]

4.1.3.2 Onsite

Surface runoff from the undeveloped project site drains in a westward direction, flowing into one of the minor drainageways crossing the MRTP and

[12]U.S. Department of Homeland Security, Federal Emergency Management Agency, "Flood Insurance Rate Map, Maui County, Hawaii," Community-Panel Numbers 150003 0576E, 0586E and 0588E, September 25, 2009.

[13]This 1,300 cfs flow figure represents a 100-year recurrence interval, 24-hour duration storm.

commingling with the offsite-generated storm runoff before exiting the MRTP project area toward the Elleair Golf Course, Piilani Highway and the ocean. (See Figure 4-4) Peak pre-development onsite runoff estimates for each drainage area based on a 50-year recurrence interval, 1-hour duration storm are summarized in Table 4-1 below.

Table 4-1 - Pre-Development Peak Runoff Rates

Onsite Drainage Area No.	Pre-Development Q_{50} (cfs)
1	29
2	71
3	54
4	23
5	83
6	53
7	33
8	27
9	6

Note: Drainage Areas correspond to numbered Areas shown on Figure 4-4

4.2 Drainage Plan

4.2.1 Offsite

Offsite runoff will be allowed to pass through the MRTP project site and continue to drain across the Elleair Golf Course and toward the existing culvert crossings at Piilani Highway without further mitigation as permitted under Maui County Drainage Rules.[14]

[14]County of Maui, Department of Public Works and Waste Management, "Rules for the Design of Storm Drainage Facilities in the County of Maui," Title MC-15, Chapter 4, November 2, 1995, Section 15-04-06(14).

4.2.2 Onsite

Development is expected to increase the peak flow rate of runoff generated by the MRTP project area. Peak post-development onsite runoff estimates for each drainage area based on a 50-year recurrence interval, 1-hour duration storm are summarized in Table 4-2 below.

Table 4-2 - Increase in Runoff Attributable to Development of MRTP Project Area

Onsite Drainage Area No.	Pre-Development Q_{50} (cfs)	Post-Development Q_{50} (cfs)	Increase in Q_{50} (cfs)
1	29	79	+50
2	71	186	+115
3	54	140	+86
4	23	60	+37
5	83	167	+84
6	53	95	+42
7	33	86	+53
8	27	72	+45
9	6	19	+13
Total	379	904	+525

Roads and Residential Areas

The increase in runoff attributable to the construction of interior roadways and the development of single-family and multi-family residential areas is summarized in Table 4-3 below.

Table 4-3 - Increase in Peak Runoff Rate Attributable to Development of Roadways and Residential Areas

Onsite Drainage Area No.	Pre-Development Q_{50} (cfs)	Post-Development Q_{50} (cfs)	Increase in Q_{50} (cfs)
1	29	79	+50
2	71	186	+115
3	54	90	+36
4	23	35	+12
5	83	88	+5
6	53	58	+5
7	33	49	+16
8	27	30	+3
9	6	7	+1

This increase will be mitigated by constructing onsite drainage detention basins within each drainage area that will limit discharges to flow rates no greater than experienced under existing conditions.

Commercial and Institutional Areas

The expected increase in peak runoff attributable to the development of commercial and institutional areas is summarized in Table 4-4 below.

Table 4-4 - Increase in Peak Runoff Rate Attributable to Development of Commercial Areas

Onsite Drainage Area No.	Pre-Development Q_{50} (cfs)	Post-Development Q_{50} (cfs)	Increase in Q_{50} (cfs)
1	29	29	0
2	71	71	0
3	54	104	+50
4	23	47	+24
5	83	162	+79
6	53	91	+38
7	33	70	+37
8	27	69	+42
9	6	18	+12

Each commercial and institutional lot will be required to mitigate its own increase in peak runoff due to development, and will be restricted to a downstream stormwater discharge at a peak rate no greater than at its pre-development level.

Overall Post-Development Condition

The collective result of all land uses employing peak runoff mitigation will be no increase in peak runoff downstream of the MRTP, as illustrated by Table 4-5.

Table 4-5 - Result of Peak Runoff Mitigation
by MRTP Project Area

Onsite Drainage Area No.	Pre-Development Q_{50} (cfs)	Post-Development Q_{50} (cfs)	Net Change in Runoff (cfs)
1	29	29	0
2	71	71	0
3	54	54	0
4	23	23	0
5	83	83	0
6	53	53	0
7	33	33	0
8	27	27	0
9	6	6	0
Total	379	379	0

4.3 Proposed Improvements

Figure 4-5 is a Conceptual Drainage Plan illustrating a number of proposed drainage features which have been integrated into the updated MRTP Master Plan.

4.3.1 Stormwater Detention

Storm runoff generated within the MRTP will typically be intercepted by drain inlets located along roadways and in building site parking lots, then conveyed by underground drainline to a stormwater detention facility which will reduce the peak

discharge rate to pre-development levels before the runoff is allowed to continue downstream.

Roads and Residential Areas

Drainage detention basins designed to mitigate the peak runoff from roadways and residential areas will be distributed among the internal drainage areas within the MRTP; these basins will be sized to a 50-year recurrence interval, 1-hour duration storm in conformance with Maui County Drainage Rules.[15] The planned location of these detention basins locations is depicted in Figure 4-6; their approximate capacity and required performance is summarized in Table 4-6 below.

Table 4-6 - Performance of Drainage Basins Serving Roadways and Residential Areas

Onsite Drainage Area No.	Corresponding Basin(s)	Basin Storage Capacity (ac.-ft.)	Increase in Runoff (cfs)	Reduction in Runoff (cfs)	Net Chane in Surface Runoff (cfs)
1	A, B	4	+50	-50	0
2	C, D, F	11	+115	-115	0
3	G	3	+36	-36	0
4	I	1	+12	-12	0
5	H	1	+5	-5	0
6	K	1	+5	-5	0
7	M	1	+16	-16	0
8	N	1	+3	-3	0
9	Subsurface Drain	1	+1	-1	0

[15]County of Maui, Department of Public Works and Waste Management, "Rules for the Design of Storm Drainage Facilities in the County of Maui," Title MC-15, Chapter 4, November 2, 1995, Section 15-04-05(e).

Commercial and Institutional Areas

Each commercial and institutional lot will be required to mitigate its own increase in peak runoff due to development and limited to a downstream stormwater discharge whose peak rate is no greater than its pre-development level. Peak flow mitigation of this type can be achieved by constructing subsurface storage chambers or above-ground drainage ponds within each lot. Individual drainage detention systems such as these will be will be sized to a 50-year recurrence interval, 1-hour duration storm in conformance with Maui County Drainage Rules.[16] Table 4-7 illustrates the collective performance of the individual drainage detention systems installed by the commercial and institutional lots within each drainage area.

Table 4-7 - Collective Performance of Drainage Detention Systems Serving Commercial Areas

Onsite Drainage Area No.	Increase in Runoff (cfs)	Reduction in Runoff (cfs)	Net Change in Surface Runoff (cfs)
1	0	0	0
2	0	0	0
3	+50	-50	0
4	+24	-24	0
5	+79	-79	0
6	+38	-38	0
7	+37	-37	0
8	+42	-42	0
9	+12	-12	0

[16]County of Maui, Department of Public Works and Waste Management, "Rules for the Design of Storm Drainage Facilities in the County of Maui," Title MC-15, Chapter 4, November 2, 1995, Section 15-04-05(e).

4.3.2 Drainage Channels

Drainage Reserve Areas have been incorporated into the MRTP Master Plan to accommodate the safe passage of offsite storm runoff through the MRTP project area. The alignment of drainage channels which convey storm runoff through these Reserve Areas will generally follow the natural flow path of the existing drainageways as they cross the project site. Modification to the sides of these natural drainageways may be necessary in order to stabilize their banks against erosion, confine them to prevent their overflowing during very large storms, and facilitate roadway culvert crossings. Figure 4-7 illustrates the location and proposed treatment of the drainageways crossing the MRTP. When channel linings are required, materials with a natural appearance such as grass, boulders, or a rustic stone masonry finish will be used wherever possible. Figure 4-8 is a conceptual depiction of such an application.

4.3.3. Stormwater Management and Water Quality

The MRTP stormwater management plan emphasizes the use of vegetated surface drainage facilities to treat and infiltrate stormwater in order to control water pollution, reduce peak flows and runoff volumes, and promote groundwater recharge.[17]

1) Vegetated drainage facilities such as swales[18], detention ponds, infiltration basins[19] and filter strips[20] utilize infiltration of stormwater into the soil and absorption by vegetation to remove trash and floating debris, suspended solids, and organic nutrients from stormwater. Reducing the urban pollutants which reach drainageways and coastal waters, in turn, improves the general health of the watershed.

2) Vegetated swales, detention ponds and filter strips slow the movement of stormwater as it passes through them, effectively detaining the runoff and

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[17]Calthorpe Associates and Chris Hart & Partners, "Maui Research and Technology Park Development Code," December 10, 2010. p.70.

[18]Vegetated swales (also called grassy swales) are typically long, narrow, gently sloping landscaped depressions planted with dense vegetation that collect and convey stormwater runoff, allowing pollutants to settle and filter out as the water infiltrates into the ground or flows through the facility. (Source: City of Portland, Oregon, "Stormwater Management Manual," Revision 4, August 1, 2008, Chapter 2: Facility Design, pp.2-48 to 2-52, 2-63 to 2-67.)

[19]Vegetated infiltration basins are flat-bottomed, shallow landscaped depressions used to collect and hold stormwater runoff, allowing pollutants to settle and filter out as the water infiltrates into the ground. An inlet pipe or sheet flow over impervious area conveys the stormwater into the basin, where it is temporarily stored until it infiltrates into the ground. Infiltration basins can be sized to infiltrate large storms where soils drain well, or overflow to an approved discharge point. (Source: City of Portland, Oregon, "Stormwater Management Manual," Revision 4, August 1, 2008, Chapter 2: Facility Design, pp.2-57 to 2-60.)

[20]Vegetated filter strips (or infiltration strips) are gently sloped areas that are designed to receive sheet flows. They are typically linear facilities that run parallel to the impervious surface and are commonly used to receive the runoff from walkways and driveways. Filter strips are covered with vegetation -- typically grasses and groundcovers -- which filter and reduce the velocity of stormwater. Runoff infiltrates into the soil below as it travels downhill through the vegetated filter. (Source: City of Portland, Oregon, "Stormwater Management Manual," Revision 4, August 1, 2008, Chapter 2: Facility Design, pp.2-61 to 2-62.)

reducing its peak flow rate as it moves downstream. This peak flow reduction, in turn, reduces the capacity demanded of both new and existing drainage infrastructure -- enabling the use of smaller diameter underground drain pipes and detention basins, for instance, and preserving the capacity of existing culverts and drainage channels located further downstream.

3) Aggressive use of infiltration close to the source where runoff is generated will reduce the volume of stormwater which drains to the ocean and allow it to replenish the groundwater aquifer, instead. Reducing the volume of stormwater sent downstream as runoff will also reduce erosion of drainage channels and exposed soils; this, in turn, will reduce the amount of sediment entering coastal waters.

Streets and Parking Lots

Roadway and parking lot drainage systems will be designed to infiltrate pavement-generated stormwater onsite to the maximum extent feasible[21] before discharging flows into the underground storm drain system. Pavement runoff will be passed through vegetated drainage facilities located in medians, bulb-outs, curb extensions, tree planters, and landscape strips to the greatest practical extent before entering the underground storm drain system. Where foundation soils are stable and well drained, and highly compacted subgrades are not required to support heavy wheel loads -- under pedestrian walkways or bicycle paths, for example -- porous pavements constructed from pavers or permeable concrete may be used to promote infiltration and reduce the amount of impermeable surface area created.

[21]Infiltration will be most effective in areas where well drained soils are present.

Building Sites

Residential, commercial, and institutional occupants of the MRTP will be encouraged to utilize vegetated drainage facilities in their building site planning to the greatest practical extent. For example:

1) Incorporating vegetated swales in landscaped areas to capture, convey and filter surface runoff from buildings, driveways and parking lots in lieu of direct interception by underground drainage piping;
2) Directing roof and parking lot drainage into vegetated infiltration basins located in landscaped areas instead of piping such runoff directly into the underground storm drainage system;
3) Locating vegetated filter strips between storm drain inlets and public gathering areas or pedestrian walkways to filter out trash and debris before it enters the underground storm drain system.

Site Management Practices

Residential, commercial and institutional developments within the MRTP will be encouraged to adopt operational policies aimed at reducing urban pollutants in storm runoff by actively controlling what enters the storm drain system. The following are examples of site management practices which can reduce water pollution.

1) Routinely inspect subsurface drain sumps, basin floors, drain inlets and drain pipes and remove all accumulated sediment, trash and debris to minimize the volume of pollutants washed through the storm drainage system to the ocean.
2) Limit irrigation-induced runoff to minimize the amount of fertilizer, pesticides and herbicides washed into the storm drainage system during the drier months of

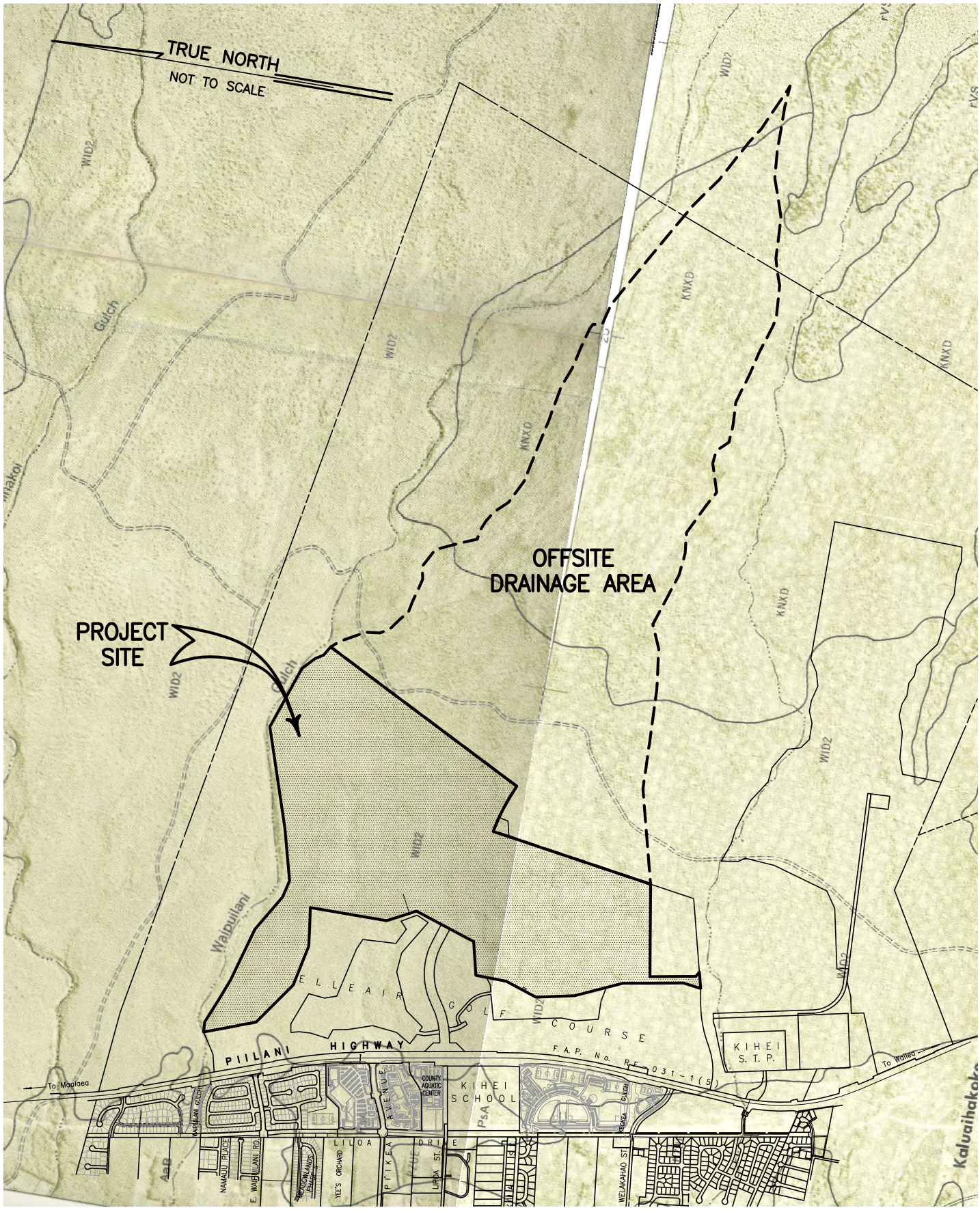
the year. Monitor and adjust irrigation sprinkler watering times to minimize irrigation runoff; monitor and adjust sprinkler coverage to minimize overspray onto driveways, walkways and other paved surfaces.

3) Encourage residents and require landscape maintenance personnel to gather lawn clippings, leaves, and cuttings and haul them to a composting facility to minimize the amount of green waste left behind and washed into the storm drain system.

4) Encourage residents and require landscape maintenance personnel to use non-polluting ("environmentally friendly") fertilizers, herbicides and pesticides when maintaining lawns and landscaping and/or adopt maintenance techniques which do not introduce chemical pollutants into the open environment.

5) Install sediment / pollution filters on storm drain inlets draining the designated car wash areas used by apartment and condominium residents and maintain these filters regularly.

6) Prohibit non-emergency fueling or vehicle repair and maintenance work by residents or service personnel in uncovered areas exposed to weather.



Source:
U.S. Department of Agriculture, Soil Conservation Service, "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai and Lanai, State of Hawaii", 1972, Map Sheets 107 and 108.

SOIL SURVEY MAP

FIGURE 4-1

V:\Projdata\08proj\08028 (Maui R&T Park - Master Plan)\dwg2008\exhibits\Prelim Engineering\exh-soil-survey.dwg

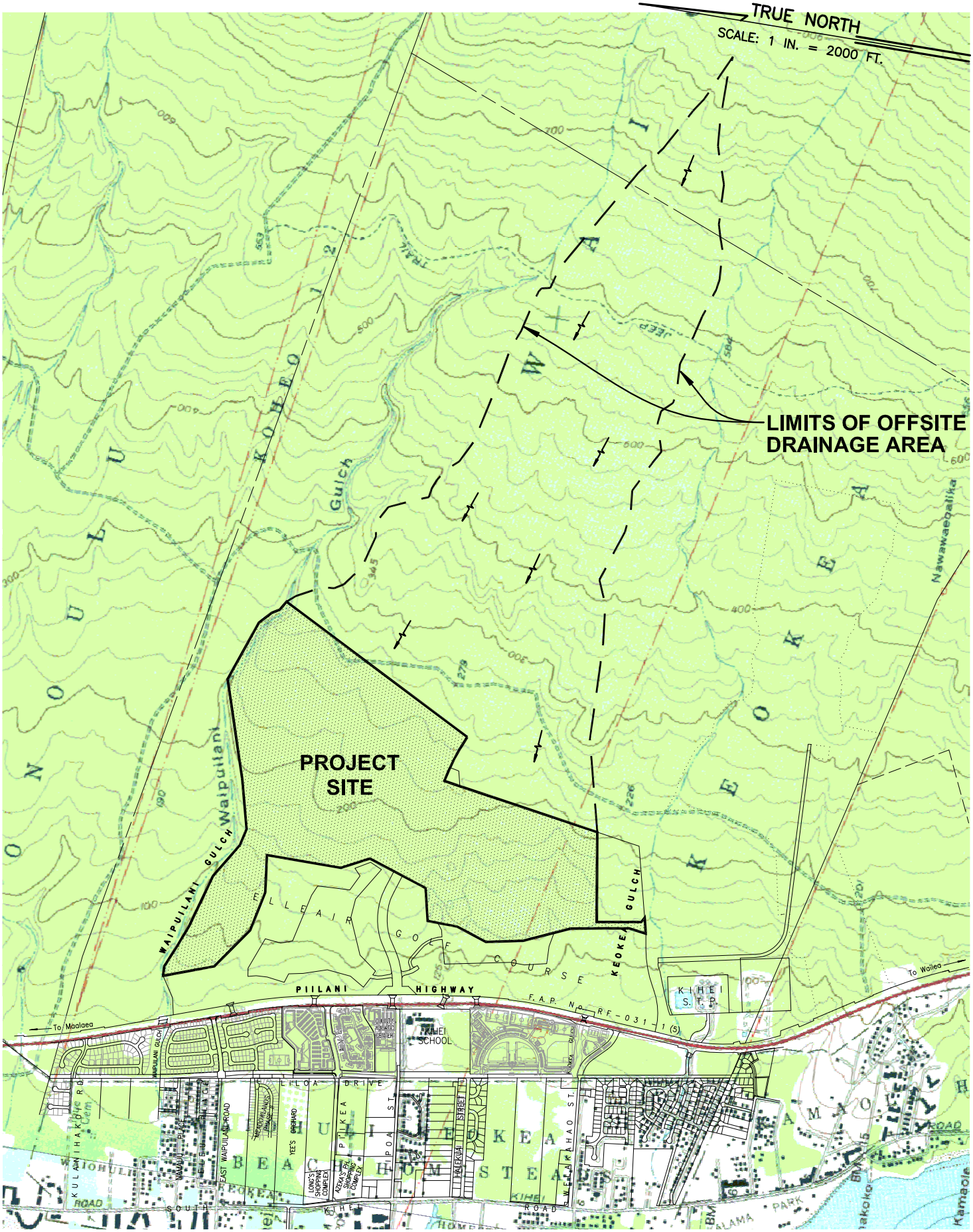
Source:
U.S. Department of Homeland Security, Federal Emergency Management Agency, "Flood Insurance Rate Map, Maui County, Hawaii", Map Numbers 1500030576E, 1500030586E and 1500030588E September 25, 2009.

FLOOD INSURANCE RATE MAP

FIGURE 4-2

January 25, 2012

V:\Projdata\08proj\08028 (Maui R&T Park - Master Plan)\dwg2008\exhibits\Prelim Engineering\exh-flood-insurance-00.dwg



OFFSITE DRAINAGE AREA

FIGURE 4-3

V:\Projdata\08proj\08028 (Maui R&T Park - Master Plan)\dwg2008\exhibits\Drainage Report\exb-offsite drainage area-00.dwg

TRUE NORTH
SCALE: 1 IN. = 1000 FT.

OFFSITE DRAINAGE AREA

EXISTING BASIN

EXISTING BASINS

EXT'G. 54" CULVERT

EXT'G. 90" CULVERT

EXT'G. 60" CULVERT

EXT'G. WAIPUILANI GULCH BRIDGE

EXT'G. 60" ARCH CULVERT

EXT'G. 2-66" CULVERT

EXT'G. KEOKEA GULCH BRIDGE

1 2 3 4 5 6 7 8 9

WAIPUILANI GULCH

KEOKEA GULCH

ELLEAR GOLF COURSE

PILANI HIGHWAY

F.A.P. NO. RF-031-1(5)

To Maalaea

To Wailea

KIHEI S.T.P.

KIHEI SCHOOL

COUNTY AQUATIC CENTER

PARK PLAZA

M.E.D.B.

LIPOA PARKWAY

M.R.T.C.

PREMIER PLACE

M.H.P.C.C.

KULANIHAKOI RD.

NAMAUU PLACE

ELEU PLACE

EAST WAIPUILANI ROAD

MEADOWLANDS PHASE II

YEE'S ORCHARD

LONG'S SHOPPING COMPLEX

AZEKA'S PH. II SHOPPING COMPLEX

LILOA DRIVE

PI'IKEA ST.

LIPOA ST.

HALEKUAI STREET

WELAKAHAO ST.

LEGEND:

EXT'G. CULVERT

DIRECTION OF FLOW

DRAINAGE AREAS

9 ONSITE DRAINAGE AREA NO. (FOR TABLES 4-1 THRU 4-7)

EXISTING DRAINAGE PATTERN

FIGURE 4-4

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V:\Projdata\08proj\08028 (Maui R&T Park - Master Plan)\dwg2008\exhibits\Drainage Report\exhibit5-00.dwg

DIVERT NORTH TO WAIPUILANI GULCH
DIVERT SOUTH
DIVERT NORTH
DIVERT SOUTH
DIVERT NORTH
DIVERT SOUTH
DIVERT NORTH
DIVERT NORTH
DIVERT SOUTH
DIVERT NORTH
DIVERT SOUTH
DIVERT NORTH
DIVERT SOUTH
TRUE NORTH
UNDERGROUND PIPE CULVERT
INUNDATION LIMITS OF CONFINED CHANNEL
UNDERGROUND PIPE CULVERT
EXISTING DRAINAGE BASIN
INUNDATION LIMITS OF NATURAL (UNCONFINED) CHANNEL
TRANSITION FROM NATURAL TO CONFINED CHANNEL
INUNDATION LIMITS OF CONFINED CHANNEL
INUNDATION LIMITS OF NATURAL (UNCONFINED) CHANNEL
BASIN
UNDERGROUND PIPE CULVERT
INUNDATION LIMITS OF NATURAL (UNCONFINED) CHANNEL
EXISTING DRAINAGE SYSTEM
INUNDATION LIMITS OF NATURAL (UNCONFINED) CHANNEL
UNDERGROUND PIPE CULVERTS
UNDERGROUND PIPE CULVERT
INUNDATION LIMITS OF NATURAL (UNCONFINED) CHANNEL
INUNDATION LIMITS OF CONFINED CHANNEL
INUNDATION LIMITS OF NATURAL (UNCONFINED) CHANNEL
EXISTING DRAINAGE BASIN
EXISTING DRAINAGE SYSTEM
UNDERGROUND PIPE CULVERT
INUNDATION LIMITS OF NATURAL CHANNEL
INUNDATION LIMITS OF CONFINED CHANNEL
INUNDATION LIMITS OF CONFINED CHANNEL
BASIN
BASIN
BASIN
BASIN
EXISTING DRAINAGE BASIN
UNDERGROUND PIPE CULVERT
TRANSITION FROM CONFINED CHANNEL BACK TO NATURAL CHANNEL
EXISTING FLOW PATH FOR BASIN DISCHARGE LINE
INUNDATION LIMITS OF CONFINED CHANNEL
BASIN
NEW FLOW PATH FOR BASIN DISCHARGE LINE
BASIN
EXISTING KEOKEA GULCH BRIDGE AT PI'ILANI HIGHWAY
EXISTING 60" CULVERT AT PI'ILANI HIGHWAY
EXISTING 60" CULVERT AT PI'ILANI HIGHWAY
EXISTING 2 - 66" CULVERT AT PI'ILANI HIGHWAY
EXISTING 54" CULVERT AT PI'ILANI HIGHWAY
EXISTING 90" CULVERT AT PI'ILANI HIGHWAY
EXISTING WAIPUILANI GULCH BRIDGE AT PI'ILANI HIGHWAY
TO WAILEA
TO WAILUKU
WAIPUILANI GULCH
KEOKEA GULCH
PI'ILANI HIGHWAY

LEGEND:

9 — ONSITE DRAINAGE AREA NO. (FOR TABLES 4-1 THRU 4-7)

DRAINAGE AREAS

CONCEPTUAL DRAINAGE PLAN

0 1000 2000 3000

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FIGURE 4-5

V:\Projdata\08proj\08028 (Maui R&T Park - Master Plan)\dwg2008\exhibits\Exb-Land Plan-00.dwg

TRUE NORTH

BASIN G

BASIN H

BASIN G

EXISTING BASIN J

BASIN A

BASIN D

BASIN I

EXISTING BASIN E

BASIN F

BASIN B

BASIN K

BASIN M

BASIN N

1

2

3

4

5

6

7

8

9

WAIPUILANI GULCH

KEOKEA GULCH

PILLANI HIGHWAY

TO WAILUKU

TO WAILEA

LEGEND:

9 ONSITE DRAINAGE AREA NO. (FOR TABLES 4-1 THRU 4-7)

DRAINAGE AREAS

DRAINAGE BASINS

0 1000 2000 3000

FIGURE 4-6

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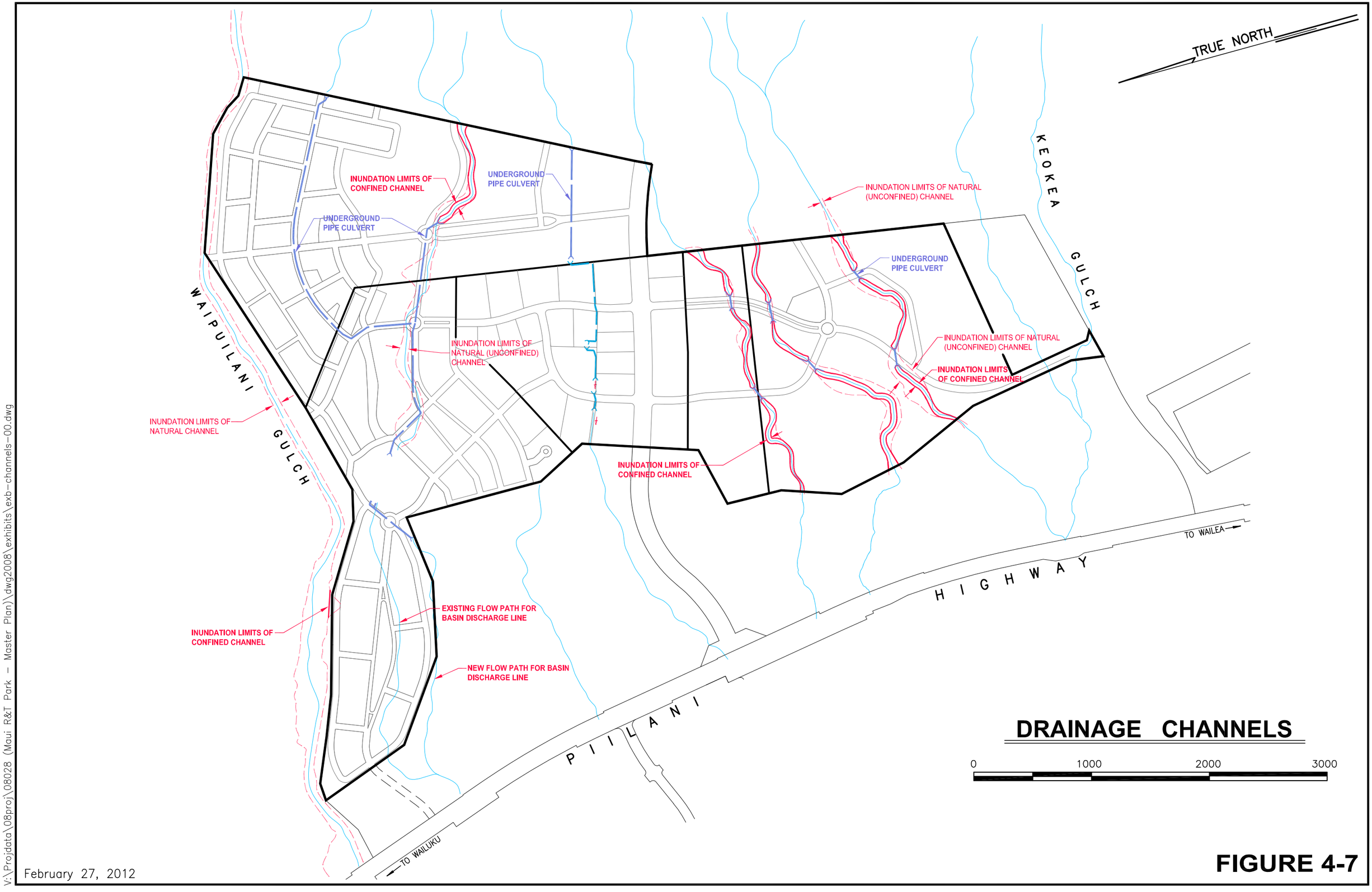
V:\Projdata\08proj\08028 (Maui R&T Park - Master Plan)\dwg2008\exhibits\exb-basins-00.dwg



DRAINAGE CHANNELS

0 1000 2000 3000

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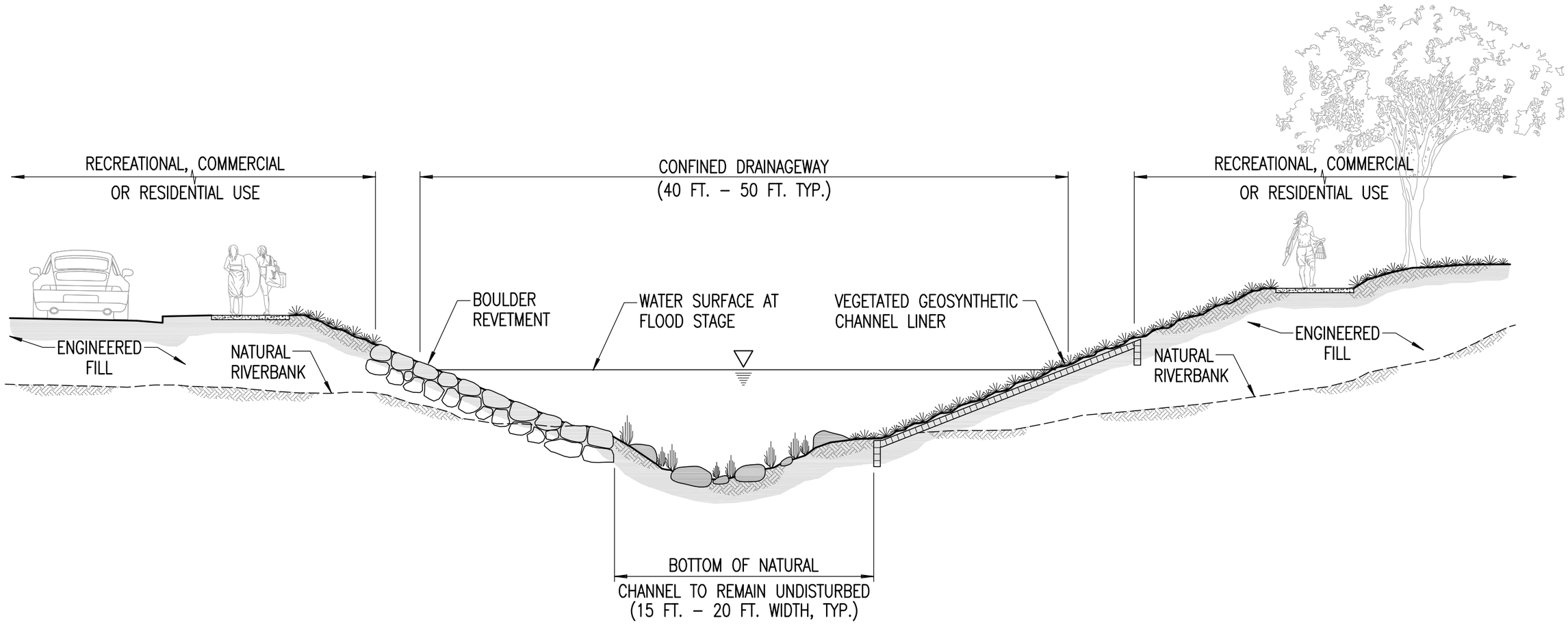
FIGURE 4-7

V:\Projdata\08proj\08028 (Maui R&T Park - Master Plan)\dwg2008\exhibits\exb-channels-00.dwg



CROSS SECTION AT CONFINED DRAINAGEWAY

APPROX. SCALE: 1/8" = 1'–0"

FIGURE 4-8

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