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May 14, 2015

Ms. Suzanne D. Case, Chairperson
Department of Land and Natural Resources
State of Hawai'i
ATTENTION: MR. ROY HARDY & MS. LENORE OHYE
Commission on Water Resource Management
P.O. Box 621
Honolulu, HI 96809

HAWAI'I COUNTY DEPARTMENT OF WATER SUPPLY
WATER USE AND DEVELOPMENT PLAN UPDATE – DRAFT SUBMITTAL

The Department of Water Supply is submitting the first draft of the Water Use and Development Plan Update for your review and comment. We are also including a draft memo regarding the anticipated water demands that addresses "Authorized Planned Use" in regards to the petition to designate the Keauhou Aquifer System Area.

Please be aware that the documents are in "draft" form and will likely warrant further refinement as we research information in more detail and compare the different sources of information. We believe that the anticipated demands currently provided in the draft documents are conservatively estimated due to possible overlapping or double counting information.

Should you have any questions, please call Mr. Lawrence Beck of our Engineering Division at (808) 961-8070, extension 260.

Sincerely yours,

Quirino Antonio, Jr., P.E.
Manager-Chief Engineer

KYI/LB:dmj

Enc.

copy – (w/o enc.) Fukunaga & Associates, Inc.

ANTICIPATED WATER DEMAND
Water Use & Development Plan Update – Keauhou Aquifer System

I. BACKGROUND

Authorized planned use (APU) is defined by the State Water Code (Hawai‘i Revised Statutes Chapter 174C) as “the use or projected use of water by a development that has received the proper state land use designation and county development plan/community plan approvals.” There is no timeframe associated with APU.

The following description included in the Commission on Water Resource Management (CWRM) Staff Submittal for the Approval of the Project Description for the Hawaii County Water Use and Development Plan Update for the Keauhou and Waimea Aquifer System Areas dated February 18, 2015 further explains the significance of APU:

> *The only reference to APU in the Water Code appears in PART IV. REGULATION OF WATER USE where it is included under §174C-44 HRS as one of eight criteria that the Commission shall consider in designating a ground water management area. Therefore, the calculation of APU is exclusively tied to ground water management area designation. APU is not mentioned in PART III. HAWAII WATER PLAN, which provides guidance on the development of County WUDPs.*

If authorized planned use may cause the maximum rate of withdrawal from a ground water source to reach 90% of the sustainable yield, CWRM may consider designation of the area as a ground water management area.

II. HISTORY OF AUTHORIZED PLANNED USE

The following excerpt describing the history of APU is from the CWRM Staff Submittal for the Approval of the Project Description for the Hawaii County Water Use and Development Plan Update for the Keauhou and Waimea Aquifer System Areas dated February 18, 2015:

IV. History of APU

Commission staff conducted research to help clarify APU. It was discovered that in 1987, the year the Water Code was promulgated and the legal definition of APU established, the City and County of Honolulu (C&C Honolulu) amended its Ewa Development Plan. Exhibit 6 shows a summary of the proposed amendment. Specific development details are provided, including a description of the location of the development, a map showing its location, the type of development (e.g., single and multi-family housing), and the number of units proposed for development. Further research reveals the 1995 summary of revisions to the Ewa DP shows both previously approved

developments and proposed new developments for approval (Exhibit 7). Therefore, at the time of the passage of the Water Code in 1987, calculation of APU would have been relatively straightforward.

The Central Oahu Sustainable Communities Plan (December 2002) notes that

> *"In 1992 the City Charter Commission recommended, and the voters of Honolulu adopted, amendments to the City Charter. Chief among its findings, the Charter Commission concluded that the Development Plans were overly detailed and had created processes that duplicated the zoning process. To eliminate this unnecessary duplication, the 1992 Charter amendments changed the definition of Development Plans from "relatively detailed plans" to 'conceptual schemes.'"*

This change resulted in developments no longer being approved in the development plans. Staff surmises that the legal definition of APU was based on C&C Honolulu's development plan models at the time. It should be noted that Hawaii County did not create any development plans or community plans until 2008.

Therefore, while the definition of APU includes the "... projected use of water by a development that has received county development plan/community plan approvals", it would not be possible to calculate water demands based on the approved Kona CDP alone because it does not contain specific development projects identifying the number of units or acreages by which water needs may be calculated. The Kona CDP is also more of a conceptual and visionary plan, rather than a prescriptive plan. However, the 2011 financing plan does provide the needed density information. Similarly, a review of recently updated development plans/sustainable community plans for the C&C Honolulu shows that the C&C Honolulu plans are also more conceptual and visionary and no longer contain densities that may be translated to water needs.

V. Prior Analysis of APU

The Commission has acted on four ground water management area designation petitions in the past: the Island of Lanai, Windward Oahu, the Island of Molokai, and the Iao and Waihee ASYAs on Maui. A synopsis of the APU calculation applied for each follows.

a. *Island of Lanai (March 1990). APU was calculated based on "conservative estimates and consideration of maximum demands stated from all development related reports". (March 29, 1990 Staff Submittal). Where provided, the highest projected estimates were used. Where not provided, the County Water System Standards Domestic Consumption Guidelines were used. Alternative non-potable sources were identified which served to reduce projected aquifer withdrawals. The Commission found that none of the criteria for ground water management area were met and did not designate*

the Island. Instead, the decision required specific actions and measures to be taken by Lanai Company to ensure protection of Lanai's water resources (such as requiring water use reporting and monitoring and the formulation of a water shortage plan) and identified triggers that would prompt re-institution of water management area designation proceedings (such as water-level controls, timely development of alternative supplies, and a limit on actual withdrawals).

b. *Windward Oahu (May 1992). APU was based on the upper limit of the General Plan population growth limits in the C&C Honolulu's WUDP for a 20-year projection period for the entire island. Although the water resources of Windward Oahu were the subject of the designation petition, the Commission noted the Honolulu Board of Water Supply's Final Environmental Impact Statement for an island-wide integrated system and plans to move water from windward to leeward Oahu to satisfy increasing urban demands. The use of zoning to calculate APU was discussed but ultimately discarded because the Commission decided that proper zoning along with adequate financing and other requirements must be in place for development to occur. Forecasts based on zoning would be much higher than suggested by APU in the Water Code.*

c. *Island of Molokai (May 1992). The decision to designate the island of Molokai was made eight days after the decision to designate Windward Oahu. Similar to Oahu, APU was calculated based on 20-year population projections. However, APU also assumed all agriculturally zoned lands would be irrigated with ground water.*

d. *Iao and Waihee ASYAs (2002). The Iao and Waihee ASYAs are the sole sources of water for the Maui Department of Water Supply's Central Maui Service Area (CMSA). In addition to current uses within the CMSA, APU included projected additional demand from the CMSA by tallying existing water commitments and pending and approved building permits. This resulted in a calculated APU that exceeded the combined sustainable yield of both aquifers. Projected allocation of total demands for the two aquifers was based on plans for new well development. The Findings of Fact showed that Criteria 1 and 4 were met for the Iao ASYA and Criterion 1 was met for the Waihee ASYA. However, the Commission declined to designate the aquifers and instead set triggers for automatic designation if current pumpage exceeded 90 percent of sustainable yield or if the mid-point of the deep monitor well rose above a specific level. The Commission also conditioned the deferral of designation on the requirement for Maui County to develop a numerical model for managing the Iao and Waihee ASYAs, with a sixty-day deadline to execute the contract. Automatic designation of the Iao ASYA*

occurred in 2003 when pumpage exceeded sustainable yield. The Commission subsequently rescinded all triggers for both ASYAs.

III. KONA COMMUNITY DEVELOPMENT PLAN

The Kona Community Development Plan (CDP) was adopted by ordinance in September 2008. This document alone does not provide enough detail to calculate water needs for the development vision. The Kona CDP encompasses the judicial districts of North and South Kona, and delineates Urban and Rural areas where future growth should be directed. Most of the future growth should be directed to 10 compact villages identified as transit oriented development (TOD) zones and located within the Keauhou ASYA. Development outside of the Kona Urban Area should be directed to existing rural towns and villages. Outside of these Rural areas, protection of the existing agricultural land is a priority.

The Urban Area identified by the Kona CDP encompasses the area spanning from Kona International Airport to Keauhou, makai of Mamalahoa Highway, designated by the General Plan as urban expansion, high density, medium density, low density, resort node, resort area, and industrial area. It excludes the area designated resort node in Kaupulehu (located and served by sources in the Kiholo ASYA; and therefore is not included in the Keauhou ASYA study area) and the medium and low density area in Holualoa. Holualoa is identified as a Rural area, and is evaluated as such. The Urban Area TODs are listed below:

1) University Village (Regional Center)
2) Kalaoa Village (Neighborhood)
3) Kaloko Makai Village (Neighborhood)
4) Honokohau Village (Regional Center)
5) Keahuolu Village (Neighborhood)
6) Makaeo Village (Regional Center)
7) Kailua Village Redevelopment (Regional Center)
8) Puaa-Waiaha Village (Neighborhood)
9) Kahului-Puapuaa Village (Neighborhood)
10) Kahaluu Makai Village (Neighborhood)

IV. KONA CDP – FINANCING PLAN FOR PUBLIC FACILITIES AND BACKBONE INFRASTRUCTURE

The objective of the *Kona CDP Financing Plan for Public Facilities and Backbone Infrastructure*, dated January 2011 (*Financing Plan)* was to evaluate the ability of new development proposed in the Kona CDP to fund required public facilities and backbone infrastructure when they are needed. The report indicates that it is "simply a test of

overall financial feasibility; the assumptions and results presented in this report are estimates, and actual results may vary." In order to accomplish the objective, the *Financing Plan* provides an estimate of the number of dwelling units and commercial/industrial area associated with the Kona CDP based on the best available information and various assumptions. Because the Kona CDP alone did not have sufficient detail to calculate associated water demands, the *Financing Plan* was used.

V. ANTICIPATED WATER DEMAND

In light of the history of APU and the fact that there is no County development plan that provides the approvals which define developments for which water demands can be calculated as seems to be intended by the Water Code, the following discussion on anticipated water demand is provided.

The most recent application of APU calculation was to address the ground water management area designation petition for the Iao and Waihee ASYAs on Maui in 2002 (*Iao And Waihee Aquifer Systems State Aquifer Codes 60102 and 60103 Ground-water Management Area Designation Findings of Fact,* dated November 14, 2002 [Iao FOF]). The Iao FOF total projected demand included the following components:

A. Current Demands, 12 month moving average (12-MAV) pumpage for the Central Maui Service Area
B. Projected Demands
    1. Existing water commitments
    2. Approved building permits without water commitments
    3. Pending and approved building permits
    4. Central Maui Joint Venture

This was used as an initial guide to the Keauhou ASYA anticipated demand calculation which includes demands for the following components:

A. Existing Developed Parcels (Pumpage)
B. Anticipated Development (Anticipated Demands)
    1. Water Entitlements
        - Vacant Service Laterals
        - Developer Agreements
        - Water Credits
        - Approved Open Building Permits

As a result of the December 10, 2014 CWRM meeting held in Kona and subsequent dialogue with CWRM staff, in addition to the similar demand components evaluated for

Iao and Waihee ASYAs, the following demand components are included under anticipated demands:

2. Department of Hawaiian Home Lands reservation
3. State Water Projects Plan projects
4. Kona CDP
5. Other Developments

Each of the demand components is described below. Refer to the *County of Hawaii Water Use and Development Plan – Keauhou Aquifer System, Phase 1* document for additional detail.

A. Existing Developed Parcels (Pumpage)

Water demand for the existing developed parcels is represented by the highest 12-month moving average (12-MAV) or the highest annual average yield calculated from the actual pumpage data reported to CWRM between August 2012 and July 2014. CWRM staff is confident that pumpage data in the Keauhou ASYA is complete and represents the actual amount of water drawn from the aquifer.

B. Anticipated Development (Anticipated Demands)

1. Existing "Water Entitlements"

"Water entitlements" are considered to be parcels or entities that have received an allocation of water or a promise of allocation of water upon fulfillment of certain conditions from DWS and are categorized as follows:

- Installed Service Laterals to Vacant Lots – parcels that currently do not have water service, but where a service lateral exists and a facilities charge has already been paid to DWS. Water demand was calculated by multiplying the Residential unit rate by the number of parcels.
- Developer Agreements – parcels that are tied to an agreement between a developer and DWS, whereby the developer installs a well and/or other necessary infrastructure to be dedicated to DWS in exchange for a set allocation of water.
- Water Commitments – parcels where the owner has received commitments for water service (in terms of 5/8" water meters) from DWS. Note that the credits may be applied to different parcels subject to DWS approval. Water demand was calculated by multiplying the residential unit rate by the number of water credits.

- Approved Open Building Permits – parcels not included in the above three entitlement categories with an existing approved building permit with the County Building Department. Water demand was calculated by multiplying the Residential unit rate by the number of parcels.

2. Department of Hawaiian Home Lands

   On November 24, 2014, DHHL submitted a letter to CWRM formally requesting a water reservation of 3.398 MGD in the Keauhou ASYA. The purpose of the request was to adequately serve DHHL's foreseeable development based on unit counts and area estimates from the 2006 DHHL Villages of Laiopua Water Master Plan. The reservation request considers an ultimate demand scenario and accounts for demands from completed development phases with existing water service and demands from development phases with water commitments.

3. State Projects

   Anticipated State projects with projected demands that are not already accounted for by existing water use, water entitlements and DHHL are listed in Table 1.

Table 1: State Projects Component of Anticipated Water Demand

State Project	State Department	Demand (MGD)
University of Hawaii Center, West Hawaii Long Range Development Plan	University of Hawaii	0.054
West Hawaii Explorations Academy	NELHA	0.003
OTEC Research, Development and Demonstration Facility	NELHA	0.000
Kona Judiciary Complex	Judiciary	0.007
TOTAL		0.064

4. Kona CDP

   The Kona CDP anticipated development component considers the undeveloped parcels (those not included under the Existing Developed Parcel component), and includes anticipated subdivisions with State Land Use "Urban" classification, vacant lots within existing subdivisions, and potential infill of the Holualoa rural area. As discussed earlier, the Kona CDP *Financing Plan* provided an estimate of the number of dwelling units and commercial/industrial area proposed by the Kona CDP.

   The demands associated with each Kona CDP component are listed in Table 2.

Table 2: Kona CDP

Kona CDP Component	Demand (MGD)
Proposed Subdivisions	1.454
Vacant Lots	0.105
Holualoa	0.306
TOTAL	1.865

5. Other Developments

The Kukio development includes the Kukio Golf and Beach Club, the Makalei Golf Course, and luxury real estate in Kukio and Maniniowali. The development is served by five wells owned by Huehue Ranch and operated by the Kona Water Service Company. Three of the wells are located in the Keauhou ASYA. Development plans indicate 269 planned lots, of which 166 have been completed. Therefore, the projected demand associated with the additional 103 lots planned for development is assumed to be 0.45 mgd or 38% of the existing demand of 1.93 mgd. This is a conservative projection since the existing demands account for demands associated with the golf course and other existing development amenities. Although the development is located in the Kiholo ASYA, it is assumed that the ground water serving this future development will originate in the Keauhou ASYA.

C. Anticipated Water Demand Summary

The anticipated water demands for the Keauhou ASYA are summarized in Table 3. Each demand component is associated with the most appropriate CWRM water use category. Table 4 summarizes the existing pumpage, anticipated demand, sustainable yield and the related percentages of SY.

Table 3: Anticipated Water Demand– Keauhou ASYA

Component	CWRM Category	Water Demand (MGD)
Existing Developed Parcels*	Domestic/Irrigation/Municipal	14.86
Water Entitlements:		
Vacant Service Laterals	Municipal	1.10
Developer Agreements	Municipal	3.39
Water Credit Commitments	Municipal	2.65
Approved Open Building Permits	Municipal	0.09
DHHL	Irrigation/Municipal	3.40
State Projects	Irrigation/Municipal	0.06
Kona CDP	Municipal	1.87
Other Developments	Irrigation/Municipal	0.45
TOTAL		27.87

**Highest 12-MAV pumpage between August 2012 and July 2014*

Table 4: Pumpage, Anticipated Demand and Sustainable Yield – Keauhou ASYA

	Sustainable Yield	Pumpage (High 12-MAV)	Total Anticipated Demand
MGD	38	14.86	27.87
% of SY	100	39.09	73.34

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ASEA	Aquifer Sector Area
ASYA	Aquifer System Area
AWUDP	Agricultural Water Use and Development Plan
CDP	Community Development Plan
CWRM	State of Hawaii, Department of Land & Natural Resources, Commission on Water Resource Management
DBEDT	State of Hawaii, Department of Business, Economic Development and Tourism
DHHL	State of Hawaii, Department of Hawaiian Home Lands
DLNR	State of Hawaii, Department of Land & Natural Resources
DOT	State of Hawaii, Department of Transportation
DWS	County of Hawaii, Department of Water Supply
EA	Environmental Assessment
EIS	Environmental Impact Statement
ERU	Equivalent Residential Unit
GC	General Commercial
GIS	Geographic Information System
GP	General Plan
GPD	Gallons per Day
HELCO	Hawaii Electric Light Company
HWUDP	County of Hawaii Water Use and Development Plan
IAL	Important Agricultural Land
MAV	Moving Average
MGD	Million Gallons per Day
MSL	Mean Sea Level
NELHA	Natural Energy Laboratory of Hawaii Authority
OEQC	State of Hawaii, Department of Health, Office of Environmental Quality Control
OTEC	Ocean Thermal Energy Conversion
SLUD	State Land Use Designation
SWPP	State Water Projects Plan
SY	Sustainable Yield
TMK	Tax Map Key
TND	Traditional Neighborhood Development
TOD	Transit Oriented Development

UHERO	Economic Research Organization at the University of Hawaii
WRPP	Water Resources Protection Plan

CHAPTER 1 INTRODUCTION

The primary objective of the Water Use and Development Plan (WUDP) is to set forth the allocation of water to land use. As required by the Hawai`i Administrative Rules (HAR) Title 13, Chapter 170, Hawai`i Water Plan, each of the four counties is responsible to prepare a WUDP to include, but not be limited to the following:

1. Status of county water and related land development including an inventory of existing water uses for domestic, municipal, and industrial users, agriculture, aquaculture, hydropower development, drainage, reuse, reclamation, recharge, and resulting problems and constraints;
2. Future land uses and related water needs; and
3. Regional plans for water developments including recommended and alternative plans, costs, adequacy of plans, and relationship to the water resource protection plan and water quality plan.

The County of Hawai`i adopted by ordinance the Water Use and Development Plan Update dated August 2010 (2010 HWUDP), and the Commission on Water Resource Management (CWRM) granted approval in December 2011. The 2010 HWUDP update implemented a broad, uniform approach island-wide to conservatively evaluate the County's land use policies set forth in the County General Plan and Zoning Code. The General Plan is the long-range conceptual land use plan for the island of Hawai`i; whereas the Zoning Code is the legal instrument that regulates land development, and implements the General Plan policies. The intent of the 2010 HWUDP was to guide the County in prioritization and focus of future assessment efforts.

The 2010 HWUDP identified 2 aquifer sectors to be considered for further evaluation and detailed assessment. Prioritization of the aquifer areas identified resulted in the selection of the West Mauna Kea ASEA [803]/Waimea ASYA [80301] and the Hualalai ASEA [809]/Keauhou ASYA [80901] for update. The update consists of 2 phases. The first phase will be the refinement of the water demand scenarios and projections; and the second phase will involve the development of source development strategies and scenarios.

This document is Phase 1 of the Hawaii Water Use and Development Plan Update – Keauhou Aquifer System.

CHAPTER 2 TECHNICAL APPROACH

The approach used in the update of the County of Hawaii Water Use & Development Plan (HWUDP) for the Keauhou aquifer system area (ASYA) was documented in the Project Description, as required by the Framework. The Project Description, which also addressed the Waimea ASYA, was presented to and conditionally approved by the Commission on Water Resource Management (CWRM) on February 18, 2015, and the final Project Description was submitted to the CWRM on March 4, 2015. The Project Description is presented in Appendix A.

2.1 WATER RESOURCES PLANNING METHODOLOGY

The HWUDP update considers an integrated approach to land use planning and water resource development and is a continually evolving process. This HWUDP update provides an estimate of anticipated future water demands, and refinements to water demand scenarios and projections based on County zoning policies using realistic water use unit rates from actual metered data for undeveloped parcels and actual water use for developed parcels. 5-year incremental water needs for the next 20 years based on population and growth rate projections are also projected.

2.1.1 Existing Sources and Water Uses

Water resources that are currently utilized on the island of Hawaii include the following four categories:

- Ground water
- Surface water or stream diversions
- Rainwater catchment
- Reclaimed wastewater

The CWRM has established water use categories based on water system purveyance and primary use of the system for the purposes of water use permitting and reporting. Existing water use will be described for each of the four water resource categories, and existing water demands will be presented in terms of each of the six CWRM water use categories as indicated in Table 2-1.

Table 2-1: CWRM Water Use Categories

Well Operator	Category	Sub-Category
Individual Operator	**Agriculture**	• Aquatic plants and animals • Crop irrigation and processing • Livestock water, pasture irrigation, and processing • Ornamental and nursery plants • Taro • Other agricultural applications
	Domestic Residential Domestic, includes potable and non-potable water needs	• Single- and multi-family households, including non-commercial gardening
	Non-residential Domestic, includes potable (and non-potable) water needs	• Commercial businesses • Office buildings • Hospitals • Churches • Hotels • Schools
	Industrial	• Fire protection • Mining, dust control • Geothermal, thermoelectric cooling, power development, hydroelectric power • Other industrial applications
	Irrigation	• Golf course • Hotel • Landscape and water features • Parks • Schools • Habitat maintenance
Agency Operator	**Military**	• All military use
	Municipal	• State • County • Private

2.1.1.1 Ground Water Pumpage

The CWRM maintains a ground water well database of all installed wells in the State and requires all well owners to report monthly pumpage data. Although there are several wells with an installed pump for which the CWRM has not received pumpage data, CWRM has confirmed that all well owners who are currently using ground water are reporting. Therefore, this database is the best available information to determine current ground water use. Data from August 2012 through July 2014 was assessed based on the 12-month moving average (12-MAV) of monthly reported pumpage within the aquifer system, as required by CWRM to address seasonal fluctuations. The highest of these 12-MAV calculations, from August 2012 through July 2013,

was taken to represent existing ground water use. Ground water pumpage represents the existing water use component incorporated into water demand scenarios described in Section 2.1.

2.1.1.2 Municipal Water Meter Records

Available meter records for individual accounts were obtained from the County Department of Water Supply (DWS). These records were analyzed from a period between July 2013 and June 2014 to further subcategorize the DWS municipal water use by the CWRM water use categories, and also to evaluate and develop water use unit rates described in the following section. Water use associated with meter records should not be compared to the ground water pumpage because the latter is calculated by determining the high 12-MAV and may be based on a different timeframe.

2.1.1.3 Water Use Unit Rates

Water use unit rates used in the 2010 HWUDP are listed in Table 2-2, and were largely based on the Water System Standards (WSS), which are planning level rates typically used for design of water system infrastructure, including pumping, storage and distribution facilities. These rates are conservative and were established to design infrastructure for service reliability during peak demand conditions. Long-term water resources planning should be based on actual water use data for a more realistic evaluation of anticipated water demand. This is a major undertaking which is reserved for areas requiring greater scrutiny.

The Single Family Residential unit rate used in the 2010 HWUDP was based on historical DWS consumption data from specific developments (not the overall single family residential accounts). The Single Family Residential unit rate is a key component of water system planning for DWS. For example, water commitments and water development agreements are expressed in terms of Equivalent Residential Units (ERU), which represents the planned water demand of 400 GPD from a customer with a 5/8" meter. Analysis of the DWS meter records between July 2013 and June 2014 for accounts categorized as Single Family Residential with a 5/8" meter indicated an average unit rate of 430 GPD. This is marginally higher than the 400 GPD planning unit rate, and may include large-lot subdivisions which, if developed today, would require a larger meter. Therefore, use of the planning unit rate of 400 GPD for future residential demands is reasonable.

The Commercial, Industrial and Resort rates used in the 2010 HWUDP based on the WSS may not capture the variability in permitted land use associated with each of the zoning districts. For example, the Zoning Code lists over 50 different permitted uses within General Commercial (GC) districts, including schools, laundries, and residential dwellings, all of which would have markedly different water requirements. The average use unit rate would therefore depend on the distribution of these permitted uses within a particular GC district.

Anticipated water demand associated with zoning areas assumed that the existing character of each zoning district would be similar for future development. A single unit rate was developed for each of the three general zoning districts with wide ranges in permitted uses, specifically Commercial, Industrial, Resort, by determining the average existing areal consumption unit rates

based on DWS meter records from July 2013 through June 2014 of all existing parcels connected to the DWS system within each general zoning district.

The 2010 HWUDP utilized a unit rate of 3,400 gallons per acre per day for Agricultural areas, which was developed by the 2004 Agricultural Water Use and Development Plan (AWUDP), and considered General Plan Important Agricultural Land (IAL) areas to be the basis for agricultural irrigation. Public input suggested that the need for irrigation water was not predicated on the classification of agricultural lands, and that users would grow what is feasible according to the climate. Based on available information, most existing agricultural water use in the Keauhou ASYA relies on ambient rainfall and may be supplemented by DWS. The Agricultural water unit rate was determined by determining the average existing areal consumption unit rate based on DWS meter records from July 2013 through June 2014 of all existing parcels with accounts classified as Agricultural and located within lands classified by the General Plan as Important Agricultural Lands (IAL). IAL is described further in Section 2.1.3.3.

Table 2-2: Water Use Unit Rates

	Average Daily Demand (ADD)		
		2015 HWUDP – Keauhou	
Land Use Category	**2010 HWUDP**	**Anticipated Demands**	**Zoning**
Residential	1,000 gal/unit[1]	***400*** gal/unit	***400*** gal/unit
Commercial	3,000 gal/acre	3,000 gal/acre	***940*** gal/acre
Industrial	4,000 gal/acre	4,000 gal/acre	***780*** gal/acre
Resort	400 gal/unit or 17,000 gal/acre[2]	***400*** gal/unit	***2,965*** gal/acre
Agriculture	3,400 gal/acre[3]	N/A	***210 gal/acre***

[1]For North Kona and South Kohala districts
[2]Resort ADD of 17,000 gal/acre based on ADD for Maui
[3]Agriculture ADD based on AWUDP

2.1.1.4 Other Water Resources

Existing use of other water resources was determined where possible; however, these quantities were not used to project future demands. The CWRM stream diversion database was examined for potential declared diversion location and quantities. Reclaimed wastewater data was determined from documents published by the Department of Health, Wastewater Branch. Reclaimed wastewater is primarily used for irrigation of golf courses and landscaping and is a valuable potential resource to meet future non-potable demands in West Hawaii. There are little or no records or data on rainwater catchment systems. Therefore, information reflected in this report is based on deductions. If a developed parcel (building value of greater than $20,000) is not served by or near the service area of DWS or other water system of record, then a catchment system is assumed.

2.1.2 Anticipated Water Demands

The calculation of anticipated water demands was based on a combination of existing water use, projected future water use with varying degrees of entitlement, and projected future water use associated with anticipated land use at varying stages of the approvals process. The latter was based on an estimate of parcels proposed for development according to the Kona Community Development Plan (CDP). The components of the calculated water demands may or may not be associated with an identifiable development and are not associated with a specified timeframe. A flow chart depicting the methodology used to determine anticipated water demands is presented in Figure 2-2.

2.1.2.1 Water Demand for Existing Developed Parcels (Pumpage)

Existing developed parcels are considered to be those with current water service from a municipal water system. The water use associated with existing developed parcels is the existing ground water use discussed in Section 2.1.1.1, and includes private irrigation wells and other wells within the existing service area that supplement the municipal water system for non-potable uses.

2.1.2.2 Water Entitlements

"Water entitlements" for the purpose of the HWUDP are considered to be parcels or entities that have received an allocation of water or a promise of allocation of water upon fulfillment of certain conditions from DWS and are categorized as follows:

- Installed service laterals to vacant lots – parcels that do not currently have water service, but where a service lateral exists and a facilities charge has already been paid to DWS. Water demand was calculated by multiplying the Residential unit rate by the number of parcels.
- Developer agreements – parcels that are tied to an agreement between a developer and DWS, whereby the developer installs a well and/or other necessary infrastructure to be dedicated to DWS in exchange for a set allocation of water.
- Water commitments – parcels where the owner has received commitments for water service (in terms of 5/8" water meters) from DWS. Note that the credits may be applied to different parcels subject to DWS approval. Water demand was calculated by multiplying the residential unit rate by the number of water credits.
- Approved open building permits – parcels not included in the above three entitlement categories with an existing approved building permit with the County Building Department. Water demand was calculated by multiplying the Residential unit rate by the number of parcels.

2.1.2.3 Community Development Plans

Community development plans (CDP) contain varying degrees of detail which, on their own, may or may not be adequate to generate water demands. In accordance with the General Plan (GP) Section 15.1, community development plans were developed by the County of Hawaii Planning Department "to translate the broad GP statements to specific actions as they apply to specific geographical areas." The CDPs are long-term plans with a planning horizon to year 2020 consistent with the GP and were adopted by ordinance, giving them force of law.

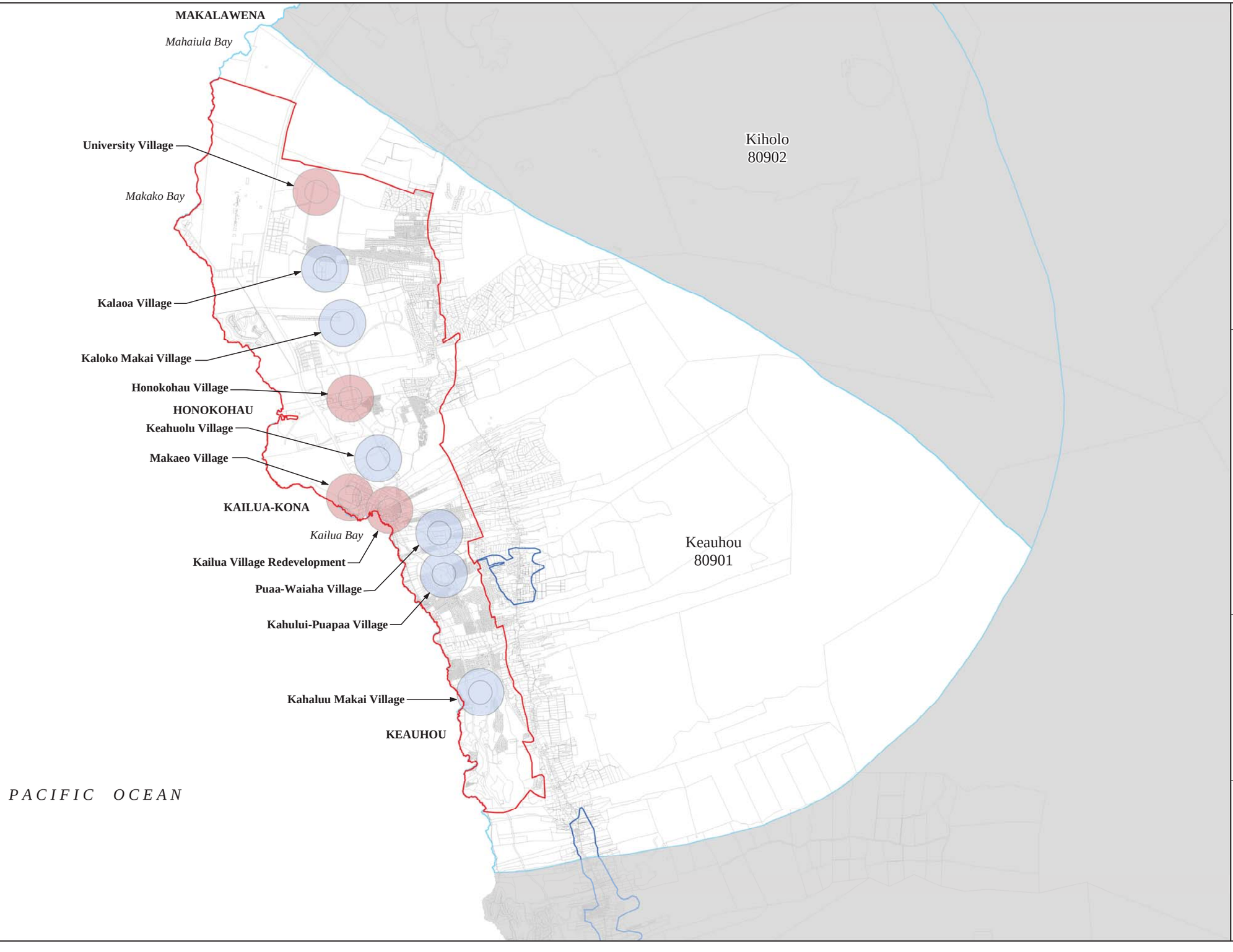
2.1.2.3.1 Kona Community Development Plan

The Kona CDP was adopted by ordinance in September 2008. This document alone does not provide enough detail to calculate water needs for the development vision. The Kona CDP encompasses the judicial districts of North and South Kona, and delineates Urban and Rural areas where future growth should be directed. The Urban Area identified encompasses the area spanning from Kona International Airport to Keauhou, makai of Mamalahoa Highway. The Rural TODs identified include the community of Holualoa, and the area encompassing the communities of Honalo, Kainaliu, Kealakekua, and Captain Cook. The latter area is not within the Keauhou ASYA and was not evaluated further. The CDP indicates that most of the future growth should be directed to 10 compact villages within the Urban Area identified as transit oriented development (TOD) zones, and that outside of the Urban Area, the character of the rural areas should prevail, meaning that future growth should be limited and directed to the rural communities in a way that revitalizes and enhances their existing rural lifestyle and culture. Outside of these Rural TODs, protection of the existing agricultural land is a priority. The Urban Area TODs are listed below, and are shown in Figure 2-1:

- University Village
- Kalaoa Village
- Kaloko Makai Village
- Honokohau Village
- Keahuolu Village
- Makaeo Village
- Kailua Village Redevelopment
- Puaa-Waiaha Village
- Kahului-Puapuaa Village
- Kahaluu Makai Village

2.1.2.3.2 Kona CDP Financing Plan

The objective of the *Kona CDP Financing Plan for Public Facilities and Backbone Infrastructure*, dated January 2011 (Financing Plan) was to evaluate the ability of new development proposed in the Kona CDP to fund required public facilities and backbone infrastructure when they are needed. The report indicates that it is "simply a test of overall financial feasibility; the assumptions and results presented in this report are estimates, and actual results may vary." In order to accomplish the objective, the Financing Plan provides an estimate



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DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

Job No. 2014-0802

LEGEND:

- Kona Urban Area
- Rural Town TODs
- TMK

TOD Type

- Neighborhood
- Regional Center

1 0.5 0 1
Miles

INDEX MAP - Island of Hawaii

FIGURE 2-1

AQUIFER SECTOR HUALALAI - 809

Aquifer Systems
Keauhou - 80901

Kona CDP
Land Use Map

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of the number of dwelling units and commercial/industrial area associated with the Kona CDP based on the best available information and various assumptions. Because the Kona CDP alone did not have sufficient detail to calculate associated water demands, the Financing Plan was used. The build-out projection provided in the Financing Plan has three components:

1. Existing development baseline – an estimate of the number of vacant lots, based on an existing building value of $20,000 or less, scattered within existing subdivisions and proposed developments which could be developed
2. Proposed projects inventory – developers were consulted to estimate the phasing and magnitude of potential development

   Build-out scenario – simulation of the build-out of proposed projects with priority given to future projects in the vicinity of the Urban Area TODs identified in the Kona CDP. The vast majority of the development proposed by the build-out projection is within the Urban Area, and Rural TODs were not considered.

The Financing Plan represents the best available data in line with the County vision of future development.

The development proposed by the build-out projection was identified to the extent possible using Geographic Information System (GIS) software and available County Real Property Tax records. An estimate of the number of potential development units not accounted for in other components of anticipated water demands was determined.

The Kona CDP does not provide specific details for how the Holualoa Rural Area should be developed, but states that "rural towns are encouraged to be redeveloped as TODs/TNDs" (TNDs or Traditional Neighborhood Developments are similar to TODs but may be located off of the trunk or secondary transit route at a location approved by a rezoning action). CDP Attachment B – Village Design Guidelines provides standards of development for TODs and TNDs, including guidelines on density calculations. While these guidelines lead to a range of residential densities, the calculated number of units for redevelopment of the Holualoa area at the most conservative end of the range would be nearly 2,000 units, which does not seem to align with the CDP's vision of preserving the rural character. A more realistic approach assumed that the parcels accounted for in the other components of anticipated water demands would not be redeveloped. A unit count for the remaining undeveloped infill areas was determined using the most conservative end of the range of the guidelines on density calculations.

Water use unit rates revised as described in Section 2.1.1.3 were applied to these potential development estimates to project water demand associated with the Kona CDP.

2.1.3 Hawaii County Zoning Water Demands

Hawaii County Code Chapter 25, the Zoning Code, is the County's legal instrument that regulates land development, and implements the General Plan policies; therefore, zoning must be consistent with the GP. County Zoning is the basis for a potential build-out scenario for water demand, to determine if there are adequate water resources to sustain the development of land

use already zoned. The 2010 HWUDP zoning water demands considered build-out to the maximum allowable unit densities for residential and resort zoning districts, and commercial and industrial districts based on land area and multiplied by the appropriate Water System Standards water use unit rates. Several refinements were applied to this methodology to produce a more realistic calculation. A flow chart depicting the methodology used to determine the zoning water demand is presented in Figure 2-3 at the end of this chapter.

2.1.3.1 Water Demand for Existing Developed Parcels (Pumpage)

While the 2010 HWUDP zoning scenario represented a potential water demand associated with the legally allowable build-out of various zoning districts, it is unlikely that all existing areas would be developed in this manner. It is more realistic to assume that the demands associated with most existing developed parcels would remain status quo and would not be redeveloped to maximum potential densities. For parcels connected to the DWS system, although the accounts and corresponding water usage are associated with specific TMKs, it is possible that some parcels are not fully developed. To more accurately estimate the existing area served by the DWS system, all parcels larger than 50 acres were examined further to ascertain how much, if any, of each parcel's area was likely developed. Using satellite imagery and comparison of parcel area to meter consumption records, over 17,000 additional acres of parcels greater than 50 acres were estimated to be undeveloped. The demands are presented in Section 3.4.3.

As described in Section 2.1.1.1, the high 12-MAV reported pumpage for all wells in the ASYA was considered to be the existing water use associated with the developed area. Inclusion of the existing water use in the zoning water demand assumes that existing developed parcels would retain their current zoning designation.

2.1.3.2 Updated Zoning of Undeveloped Parcels

The Planning Department provided the latest GIS zoning layer. The undeveloped parcels were identified using GIS software and the updated existing developed area layer was removed from the total zoning area. This data was sorted to quantify the undeveloped area for each of the four general zoning districts. The revised water use unit rates listed in Section 2.1.1.3 were applied to the undeveloped area to determine the projected water demand associated with the undeveloped parcels.

2.1.3.3 Agricultural Water Use Demands

Agricultural demands for the zoning water demand were calculated based on the General Plan Important Agricultural Land (IAL) area within lands zoned for agriculture districts multiplied by the unit rate developed from existing agricultural use, described in Section 2.1.1.3. A large portion of the IAL within the Keauhou ASYA is utilized for Kona coffee farming, which generally relies on ambient rainfall; however, a small amount of irrigation water may be used for processing. The relatively low consumption unit rate of 210 gpd/acre appears to support this assumption. The agricultural water demands conservatively assumes that all undeveloped agricultural parcels will be irrigated at the existing rate; therefore, agricultural water demands presented in this update represent worst case scenario for lack of better information and on an

interim basis, until addressed by the AWUDP. Furthermore, future agricultural water demands should consider non-potable water source options.

2.1.4 Additional Information Used to Refine Land Use Based Water Demands

The information used to refine both the anticipated water demand and zoning water demand include State Water Projects and Department of Hawaiian Home Lands (DHHL) demands, and information on other developments.

2.1.4.1 State Water Projects Plan Updates and DHHL Demands

The State Water Projects Plan (SWPP) is currently being updated by the State of Hawaii, Department of Land & Natural Resources (DLNR), Engineering Division. A partial update of the SWPP, currently in the Draft stage, covers projects for the Department of Hawaiian Home Lands (DHHL). DLNR also is preparing a separate SWPP for the West Hawaii region, focusing on projected State agency demands proposed in the area.

On November 24, 2014, DHHL submitted a letter to CWRM formally requesting a water reservation of 3.398 MGD in the Keauhou ASYA. The purpose of the request was to adequately serve DHHL's foreseeable development based on unit counts and area estimates from the 2006 DHHL Villages of Laiopua Water Master Plan. The reservation request considers an ultimate demand scenario and accounts for demands from completed development phases with existing water service and demands from development phases with water commitments. The reservation request was considered a better estimate of projected DHHL demands than the demands presented in the DHHL SWPP because, like the land based water demands, it is not associated with a specified timeframe, whereas the DHHL SWPP demands are projected over a 20-year timeframe to 2031. The reservation request was used as the basis for future DHHL demands in the Keauhou ASYA and was included in the demands with consideration of DHHL water entitlements.

Based on evaluation of available environmental documents from the Department of Health Office of Environmental Quality Control (OEQC) and preliminary discussions with State agencies, the agencies with projects requiring water are the University of Hawaii, the Department of Business, Economic Development and Tourism (DBEDT), Natural Energy Laboratory of Hawaii Authority (NELHA), the Department of Transportation (DOT), and the Judiciary:

- University of Hawaii Center, West Hawaii – currently has 15 water credits or 6,000 GPD via a water developer agreement with Palamanui. The Final Environmental Impact Statement (EIS) indicated a maximum enrollment of 1,500 students in 2023, and an estimated water demand of 60,000 GPD. The EIS indicated that potable water was not anticipated to be used for landscape irrigation.
- NELHA West Hawaii Explorations Academy – relocation of the existing campus with facilities to allow an expansion from 195 to 300 students. According to the Final Environmental Assessment (EA), the school would place an emphasis on xerophytic

landscaping, and at full build-out, the school's average water demand including irrigation would be 6,650 GPD. The current demand is 3,500 GPD.

- NELHA OTEC Research, Development and Demonstration Facility – potable water would be required for a new administration building. The Draft EA indicated that the potable water requirement would be 100 GPD.
- NELHA Monk Seal Rehabilitation Facility – the facility will include two buildings for use as office, laboratory, clinic, and fish kitchen. The 2011 Final EA did not include water demand projections.
- Kona Judiciary Complex – the planned facility will be a consolidated replacement of several existing facilities along the Kona coast. The project is currently in design and specific details are not available, but the 2011 Draft EIS estimated the average daily demand based on the maximum anticipated 220-employee and 280-visitor capita at full build-out of 6,640 GPD.
- DOT Airfield, Terminal and Facility Improvements at the Keahole-Kona Airport – water service would need to be extended to new facilities located in areas where there are no previously existing structures; however, the Final EA indicated that the airport is currently operating below its current water allocation and it is anticipated that the current water allotment would be sufficient to serve the proposed improvements.

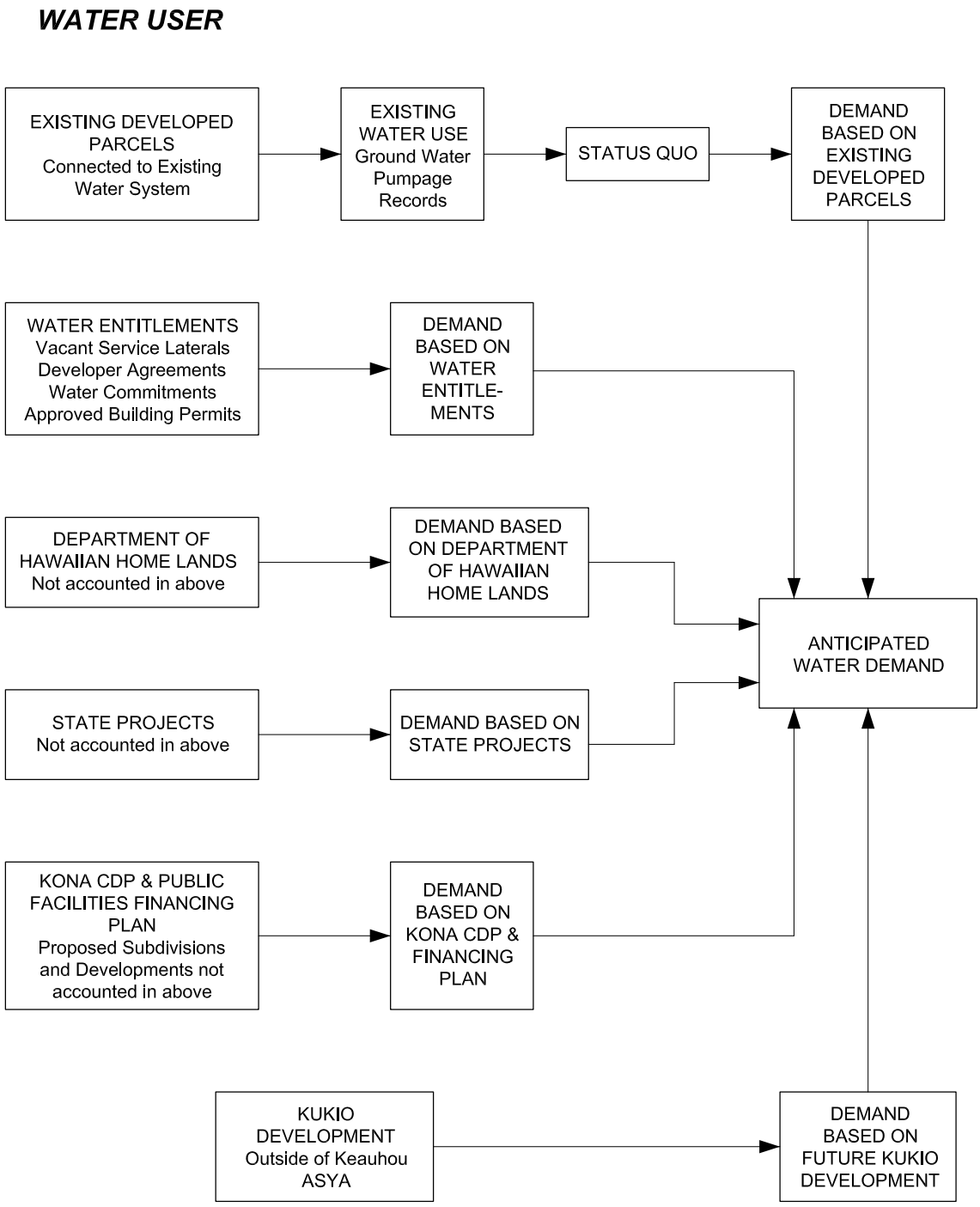
2.1.4.2 Other Development Plans

The Kukio development includes the Kukio Golf and Beach Club, the Makalei Golf Course and luxury real estate in Kukio and Maniniowali. The development is served by five wells, three of which are located in the Keauhou ASYA. See Section 3.3.7.4 for more information on the water system. Development plans indicate that 103 additional lots will be developed. Although the development is located in the Kiholo ASYA, part of the ground water serving this future development will originate in the Keauhou ASYA.

2.1.5 5-Year Incremental Water Demand Projections

Existing population and ground water use were calculated as the basis of the water demand projections to the year 2035. Population and growth rate projections were applied in 5-year increments for the next 20 years; and have high-growth, medium-growth (base case) and low-growth (the most conservative) scenarios. The high 12-MAV of existing ground water pumpage described in Section 2.1.1.1 was considered to be existing water use and was projected forward. The demands are further differentiated into potable and non-potable demands in the Keauhou ASYA chapter report.

It was assumed that population growth, and thus water use, from projects described in the SWPP, the AWUDP and from DHHL projects are already accounted for by the population projections; therefore, information from these documents was not used to further refine the 5-year incremental water demand projections. A flow chart depicting the methodology used to determine the 5-year incremental projected demands is presented in Figure 2-4.



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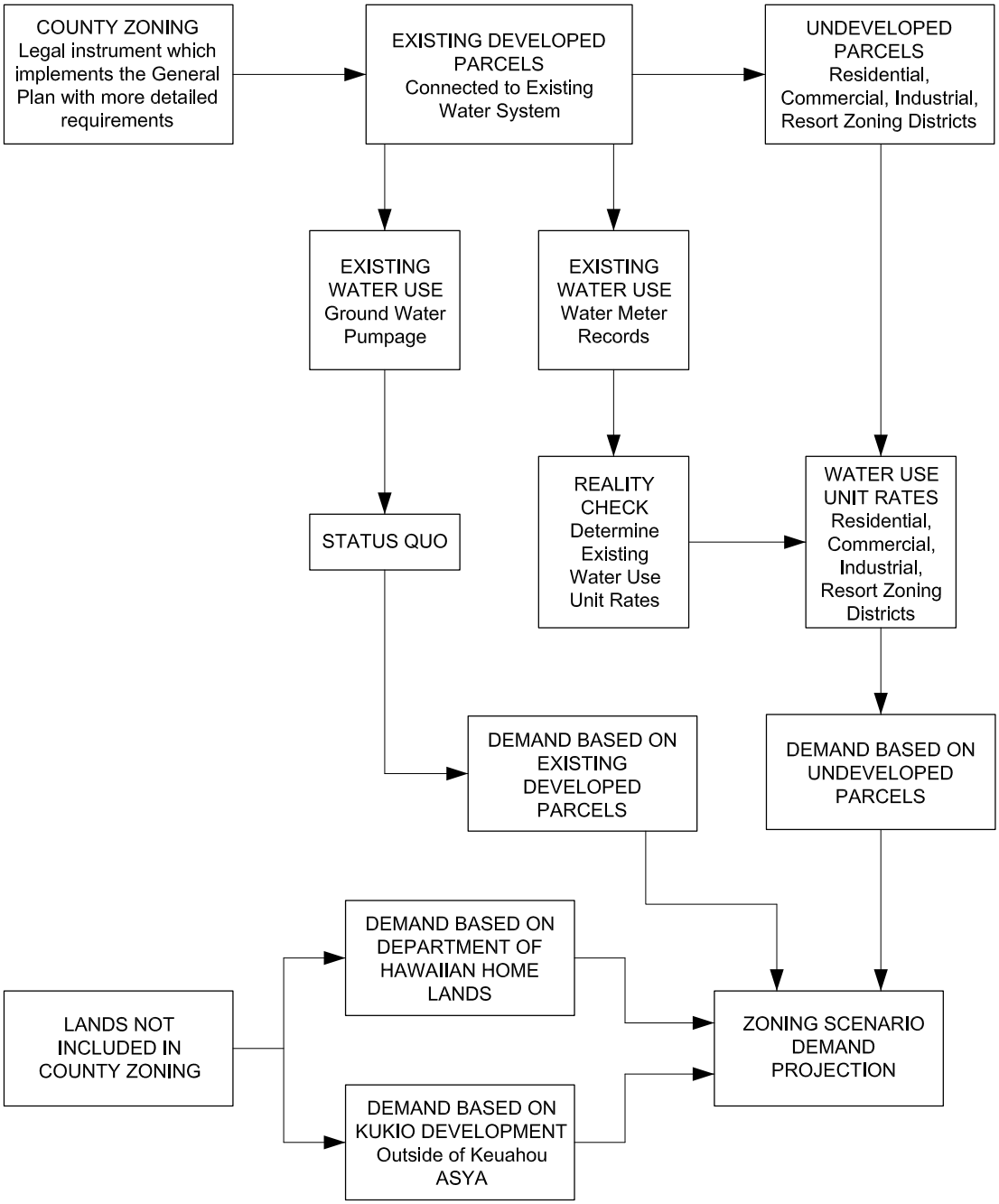
Water Use & Development Plan Update
Keauhou & Waimea Aquifer Systems

FIGURE 2-2: ANTICIPATED WATER DEMAND EVALUATION METHODOLOGY



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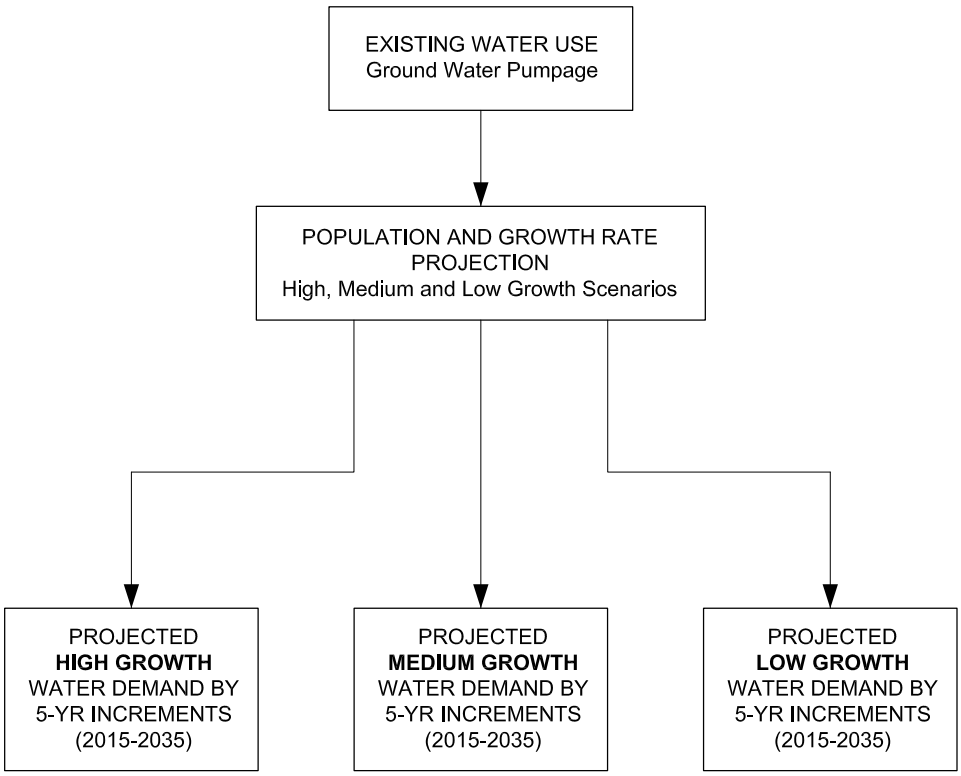
Keauhou & Waimea Aquifer Systems

FIGURE 2-3: COUNTY ZONING WATER DEMAND EVALUATION METHODOLOGY



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Keauhou & Waimea Aquifer Systems

FIGURE 2-4: 5-YEAR INCREMENTAL WATER DEMAND PROJECTION METHODOLOGY

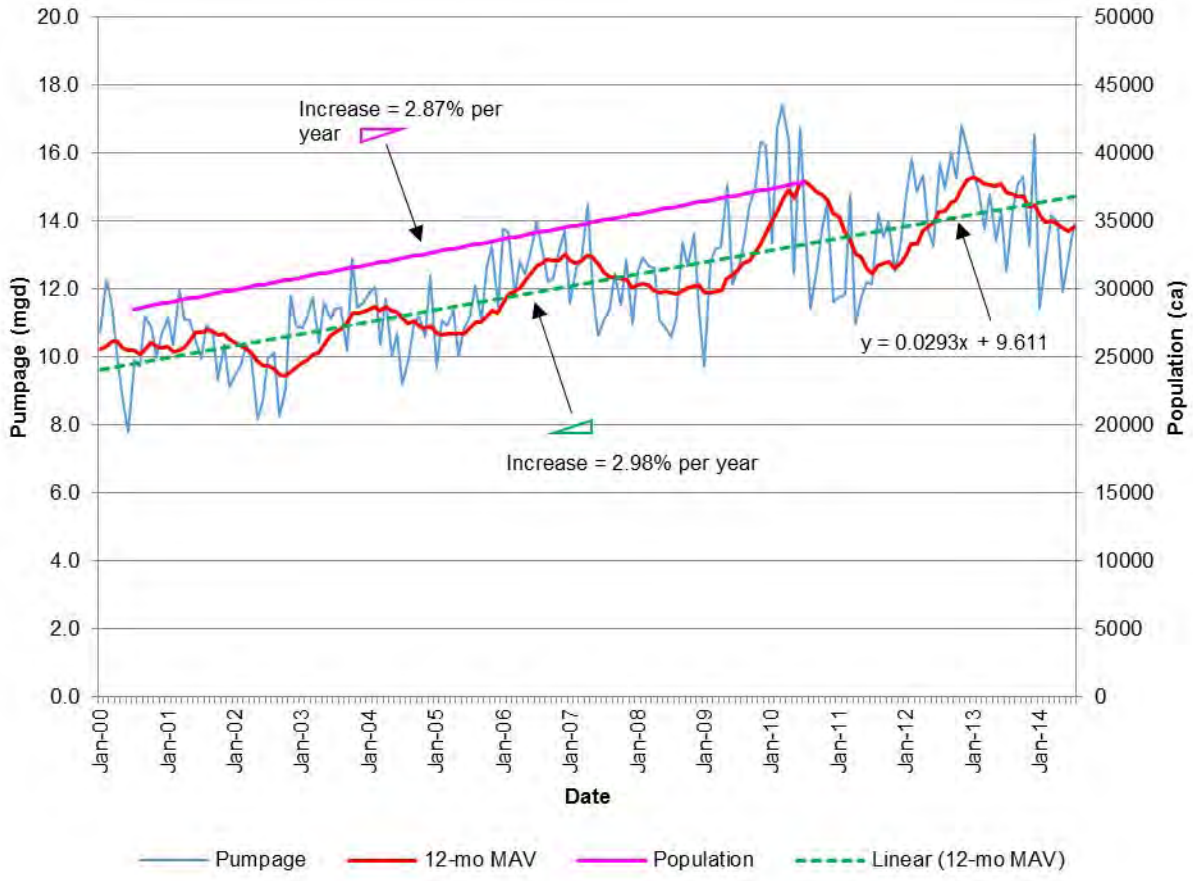
2.1.5.1 Population and Growth Rate Projections

The population projections to the year 2020 are from the Economic Assessment, PKF Hawaii, January 2000, and were also the basis of the 2005 General Plan. The growth rates were derived from this data. At the time of this report, the State Department of Business, Economic Development and Tourism (DBEDT) and the Hawaii County Planning Department did not have more recent population projections specific to judicial districts. The Planning Department is anticipating initiating the update to the GP, which is expected to include population projections by judicial district, in 2015. The 2005 GP represents the best available data; therefore, population projections for each 5-year increment from 2015 to 2035 utilized the growth rate projected between 2015 and 2020 in the GP.

2.1.5.2 Historical Ground Water Use and Population

As a reality check, the annual rate of historical population growth and the annual rate of increase in ground water pumpage between 2000 and 2014 were calculated and compared. Census estimates are only available every 10 years, so the average population growth rate was interpolated between 2000 and 2010. A linear regression analysis was performed on the 12-MAV data. The results of the analysis indicated an average population growth rate for North Kona of 2.87 percent per year, and an average rate of increase in pumpage within the Keauhou ASYA of 2.98 percent per year. Therefore, it is reasonable to utilize population projections as the basis to project future ground water use. The results of the analysis are graphed in Figure 2-5.

Figure 2-5: Historical Ground Water Pumpage and Population Growth Rates



CHAPTER 3 KEAUHOU AQUIFER SYSTEM AREA

3.1 SYSTEM AREA PROFILE

3.1.1 General

The Hualalai Aquifer Sector Area includes the entire Hualalai shield volcano and is surrounded by Mauna Loa. The sector area is divided into the Keauhou [80901] and Kiholo [80902] Aquifer System Areas (ASYA) along Hualalai's main northwest-southeast rift zone.

Average rainfall in the Keauhou ASYA ranges from less than 20 inches along the northwest coast to about 125 inches in the Kahaluu Forest Reserve, and according to the 2008 Water Resources Protection Plan, has a sustainable yield of 38 MGD.

3.1.2 Economy and Population

3.1.2.1 Economy

North Kona continues to be a major visitor industry area with direct national and international flights to the Keahole-Kona International Airport, and contains a large percentage of the number of hotel rooms on the island.

Part of the Kona coffee belt lies within the Keauhou ASYA. The coffee belt has the ideal climate without the need for irrigation for this crop. The demand and value of Kona coffee continues to grow and has steadily increased, and the crop generates over $30 million annually.

North Kona supports many other industries, including timber, fishing, quarrying, manufacturing, service, wholesale and retail activities. According to the County General Plan, Kona is considered the center for government, commercial and industrial activities for West Hawaii. Additionally, Kona is also home to "big-box" retailers such as Costco, K-Mart, Walmart and international sporting events such as the IronMan Triathlon, the Hawaiian International Billfish Tournament, and the Senior PGA Tournament of Champions at the Hualalai Resort.

The Natural Energy Laboratory of Hawaii Authority (NELHA) is an ocean science and technology park located at Keahole Point. According to the Economic Research Organization at the University of Hawaii (UHERO), in 2013, the NELHA facility hosted 37 tenants, and together with these tenants, provided a total State economic impact of approximately $123 million a year and 617 jobs through their $99 million in expenditures.

3.1.2.2 Population

Over 95% of the North Kona district population lies within the Keauhou ASYA. The population growth rate in the area has decreased since the rapid growth of 1970's and 80's.

Table 3-1: Historical Population – Keauhou ASYA

1980	1990	2000	2010	1980-90 % Change	1990-2000 % Change	2000-2010 % Change
13,304	21,565	27,622	36,653	62.1	28.1	32.7

Data source: 2000 and 2010 U.S. Census
Data redistributed and evaluated for the Keauhou ASYA

The population projection for the system area, in five-year increments for low, medium and high growth cases, show slower growth than in the past. According to the GP, growth in North Kona will be closely associated with the growth of the visitor and agricultural industries.

Table 3-2: Population Projection – Keauhou ASYA

Growth Rate	2000	2005	2010	2015	2020	2000-10 % Change	2010-20 % Change
A – Low	27,622	29,390	32,638	36,165	40,110	18.2	22.9
B – Medium	27,622	29,484	32,926	36,698	40,911	19.2	24.2
C – High	27,622	30,714	34,990	39,581	44,595	26.7	27.4

Data source: Hawaii County General Plan, February 2005
Data redistributed and evaluated for the Keauhou ASYA

3.1.3 Land Use

3.1.3.1 Anticipated Water Demands

The land use area associated with anticipated water demands is shown on Figure 3-1.

3.1.3.2 Hawaii County Zoning Water Demand

The land use area associated with the Hawaii County Zoning build-out scenario is shown on Figure 3-2. The existing developed parcels currently connected to the County Department of Water Supply (DWS) North Kona Water System are also shown. The estimated land use allocation acreage of undeveloped area for each zoning district is listed in Table 3-3.

Makalawena

Mahaiula Bay

Makako Bay

Kiholo
80902

Honokohau

Keauhou
80901

Kailua Bay

Kailua-Kona

Keauhou

PACIFIC OCEAN

Hawaii County
Department of Water Supply

DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

Job No. 2014-0802

LEGEND:

- Hawaiian Home Lands
- Kona CDP Subdivisions
- Kona CDP Vacant Lots
- Existing Water Service
- Water Commitments
- Developer Agreements
- Vacant Laterals
- Open Building Permits
- TMK

1 0.5 0 1
Miles

INDEX MAP - Island of Hawaii

FIGURE 3-1

AQUIFER SECTOR HUALALAI - 809

Aquifer Systems
Keauhou - 80901

Anticpated Water Demands Map

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Makalawena

Mahaiula Bay

Makako Bay

Honokohau

Kiholo
80902

Keauhou
80901

Kailua Bay

Kailua-Kona

Keauhou

PACIFIC OCEAN

Hawaii County
Department of Water Supply

DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

Job No. 2014-0802

LEGEND:

- Hawaiian Home Lands
- Existing Water Service

Zoning Designations:

A-1a+	Agricultural - 1 thru 10 acres
A-20a	Agricultural - 20 acres
A-35a	Agricultural - 35 acres
A-40a	Agricultural - 40 acres
A-80a	Agricultural - 80 acres
A-200+	Agricultural - 200 thru 255 acres
A-500a	Agricultural - 500 acres
A-600a	Agricultural - 600 acres
A-800a	Agricultural - 800 acres
A-900a	Agricultural - 900 acres
CG	Commercial, General
CN	Commercial, Neighborhood
CV	Commercial, Village
FA	Family Agricultural
FR	Forest Reserse
MCX	Industrial - Commercial
MG	Industrial, General
ML	Industrial, Limited
O	Open
PD	Project Districts
RA	Residentail and Agricultural
RCX	Residential - Commercial Mixed Use
RD	Residential Double-Family
RM-7.5+	Res. Multi-Family - 7500-8000 sf
RM-14.5+	Res. Multi-Family - 14,500-20,000 sf
RS-7.5+	Res. Single Family - 7500-10,000 sf
RS-15+	Res. Single Family - 15,000-20,000 sf
V	Hotel/Resort

1 0.5 0 1
Miles

INDEX MAP - Island of Hawaii

FIGURE 3-2

AQUIFER SECTOR HUALALAI - 809

Aquifer Systems
Keauhou - 80901

County Zoning Build-out Map

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Table 3-3: County Zoning Undeveloped District Allocation Acreage – Keauhou ASYA

ZONING DISTRICT	ACREAGE	% of TOTAL
Single Family Residential	910	1.03
Multi-Family Residential (including duplex)	532	0.60
Residential-Commercial Mixed Use	0	0.00
Resort	193	0.22
Commercial	406	0.46
Industrial	889	1.00
Industrial-Commercial Mixed	277	0.31
Family Agriculture	132	0.15
Residential Agriculture	237	0.27
Agriculture	54,518	61.67
Open	20,180	22.83
Project District	0	0.00
Forest Reserve	7,980	9.03
(road)	2,148	2.43
TOTAL	88,401	100.00

3.2 EXISTING WATER RESOURCES

3.2.1 Ground Water

The Keauhou ASYA currently has a sustainable yield of 38 MGD. According to the CWRM database, there are 47 production wells in the system area, including 16 municipal, 12 irrigation, 1 industrial, 5 agricultural, and 13 wells drilled, but categorized as "unused". Figure 3-3 shows the well locations. The industrial well is owned by Hawaiian Electric Light Company, Inc. (HELCO) and pumps brackish water for cooling, and several of the wells categorized as "other" are used for aquaculture or resort water features.

High-level groundwater was encountered in the early 1990's within the Keauhou ASYA, which is reflected in the WRPP sustainable yield; however, the extent to which it could be developed was not known. Exploratory drilling at elevations above 1,600 feet mean sea level (MSL) encountered water elevations ranging from 25± feet MSL to 241± feet MSL. Notably, 10 of the municipal wells and 11 of the irrigation wells were drilled since 1990, as this new resource was rapidly developed. Growth in the area and the associated increase in demand for water supplies led to competition among large landowners/developers for the new sources of water supply and well sites. The CWRM became concerned with proper planning, well placement and associated problems of well interference, and with the help and partnership of the private sector, undertook the task to collect and analyze data, and continues to monitor groundwater in West Hawaii.

3.2.2 Surface Water

Waiaha Stream is the only perennial stream in the area, due to the high permeability of the basaltic lava flows from Mauna Loa and Hualalai volcanoes. In the wettest part of the rain belt, a few small springs may occur, such as Waiaha Springs; however, the small and intermittent springs can sustain only small needs. There are 8 declared stream diversions in the CWRM database listed in Table 3-4 and shown on Figure 3-4; however, flow data is not available.

Table 3-4: Stream Diversions – Keauhou ASYA

FILE REFERENCE	TMK	STREAM NAME	DESCRIPTION
PALANI RANCH	7-4-001:003	Unnamed	Stream diversion, Pipe #1 from tributary of Waiaha Stream and rights claim.
GOMES J	7-5-014:002	Waiaha	Stream diversion, pipe in concrete from Waiaha Stream.
PALANI RANCH	7-6-001:002	Unnamed	Stream diversion, Pipe #2 from tributary of Waiaha stream and rights claim.
PALANI RANCH	7-6-001:002	Tributary to Waiaha	Stream diversion, pipe from Waiaha Tributary and rights claim (new entry).
TWIGG-SMITH C	7-7-005:002	Unnamed/ Unmapped	Stream diversion, mauka dam on Unnamed stream and rights claim. See new entries for 2 other dams.
TWIGG-SMITH C	7-7-005:002	Unnamed/ Unmapped	Stream diversion, makai dam on Unnamed (new entry).
TWIGG-SMITH C	7-7-005:002	Unnamed/ Unmapped	Stream diversion, old Hawaiian dam on Unnamed (new entry).
WALL RANCH	7-9-008:010	Unnamed/ Unmapped	Stream diversion, pipe from Kawanui Stream.

3.2.3 Rainwater Catchment

The first potable water wells in the Keauhou ASYA were drilled in 1959 and were placed in service in 1967. Prior to these sources, potable water was supplied primarily from individual rainwater catchment systems. Rainwater catchment remains a viable resource for the area.

3.2.4 Reclaimed Wastewater

There are two active wastewater reclamation facilities (WWRF) in the study area. Table 3-5 lists the WWRF, reclaimed water classification, facility treatment capacity, current reuse amount, and current application. The County Kealakehe WWRF formerly supplied the privately-owned Swing Zone Golf Facility in Kona; however, Swing Zone at one point obtained brackish water at a lower cost but has since closed. The County Wastewater Division has plans to upgrade the WWRF to produce R-1 quality effluent and has acquired a State Revolving Fund (SRF) loan to

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LEGEND:

- ABNSLD - Sealed
- AGRAQ - Aquatic Plants and Animals
- AGRCP - Crops and Processing
- INDEL - Geothermal, Thermoelectric Cooling, Power Develop
- IRR - Irrigation (non-domestic, non-agriculture)
- IRRGC - Golf Course
- IRRLA - Landscape/Water Features
- MUNCO - County
- MUNPR - Private (but Public - DOH definition)
- OBS - Observation
- OBSDM - Deep (through transition zone)
- OBSWL - Water Level
- UNU - Unused
- TMK

1 0.5 0 1
Miles

INDEX MAP - Island of Hawaii

FIGURE 3-3

AQUIFER SECTOR HUALALAI - 809

Aquifer Systems
Keauhou - 80901

Well Location

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Makalawena

Mahaiula Bay

Makako Bay

Kiholo
80902

Honokohau

Waiaha Stream

Kailua Bay

Keauhou
80901

Kailua-Kona

Keauhou

PACIFIC OCEAN

Hawaii County
Department of Water Supply

DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

Job No. 2014-0802

LEGEND:

- Diversion
- Perennial Stream
- TMK

1 0.5 0 1
Miles

INDEX MAP - Island of Hawaii

FIGURE 3-4

AQUIFER SECTOR HUALALAI - 809

Aquifer Systems
Keauhou - 80901

Streams and Diversions

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fund the project, but design details such as capacity and service area have not yet been determined.

Table 3-5: Wastewater Reclamation Facilities – Keauhou ASYA

Wastewater Reclamation Facility	Reclaimed Water Classification	WWRF Capacity (MGD)	Current Reuse Amount (MGD)	Irrigation Application
Heeia	R-2	1.8	0.5	Kona and Alii Country Club Golf Course
Kona International Airport	R-1	0.14	0.03	Landscape
Kealakehe	R-2	1.3	0	None

3.3 EXISTING WATER USE

3.3.1 General

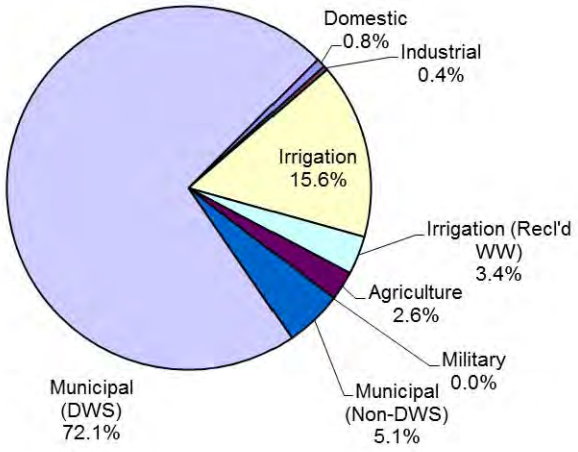
The following section presents the total estimated existing water use within the Keauhou ASYA. Total estimated water use was based on DWS meter data from July 2013 to June 2014, CWRM pumpage data from August 2012 through July 2014, available GIS data and reclaimed wastewater usage. The water use is presented and summarized for the Keauhou ASYA in Table 3-6 and Figure 3-5 in accordance with CWRM categories. The table and figure also indicate the quantities associated with the DWS system, private public water system and reclaimed wastewater.

Table 3-6: Existing Water Use by Categories – Keauhou ASYA

CWRM Water Use Category	Ground Water (MGD)	Other Sources (MGD)	Total (MGD)	Percentage of Total
Domestic	0	0.12[1]	0.12	0.80
Industrial	0.06		0.06	0.41
Irrigation	2.42	0.53[2]	2.95	19.05
Agriculture	0.41		0.41	2.61
Military	0		0	0
Municipal				
DWS System	11.18		11.18	72.05
Private Public WS	0.79		0.79	5.05
Total	14.86	0.64	15.51	100.00

[1]Catchment
[2]Reclaimed Wastewater

Figure 3-5: Existing Water Use by Categories – Keauhou ASYA



3.3.2 Domestic Use

Domestic use or water use by individual households is minimal, and is assumed to be supplied by private individual rainwater catchment systems.

3.3.3 Industrial Use

Industrial use is minimal. HELCO has one well in the Keauhou ASYA, which is used for cooling. Unlike at the HELCO Hilo plant, this water is not injected back into the ground. As indicated in Table 3-6, the industrial use is 0.06 MGD.

3.3.4 Irrigation Use

Irrigation makes up a significant portion of the water used in the Keauhou ASYA. Estimated irrigation use is based on pumpage reported for private wells categorized by CWRM as irrigation wells and reclaimed water use as indicated previously in Table 3-5. Table 3-7 lists the private irrigation well pumpage reported to CWRM.

Table 3-7: Private Irrigation Well Pumpage – Keauhou ASYA

Private Irrigation	Irrigation Well Pumpage (MGD)
Kona Country Club	0.95
Smith	0.00
Kohanaiki	1.47
TOTAL	2.42

3.3.5 Agricultural Use

Estimated agricultural water use within the Keauhou ASYA is relatively low considering the amount of agricultural activity within the area. A portion of the Kona coffee belt is within the system area; however, coffee cultivation relies primarily on ambient or available rainfall for production. Agricultural use in the amount of 1.43 MGD is supplied by DWS. The Keahole agricultural park on the mauka side of Queen Kaahumanu Highway across from the airport is comprised of several significant users of water connected to the DWS system.

Aquaculture is a notable industry with the Natural Energy Laboratory of Hawaii Authority (NELHA) located within the Keauhou ASYA. This facility primarily uses deep cold seawater, but also uses a significant amount of potable water from the DWS system. King Ocean Farm, Inc. is a commercial tenant of NELHA that produces superior quality macroalgae and other ocean products, according to the NELHA website. King Ocean Farm Inc. owns 11 brackish water wells. The pumpage from the four wells reporting to the CWRM is 0.41 MGD.

3.3.6 Military Use

There is no military use in the Keauhou ASYA.

3.3.7 Municipal Use

Municipal use is subcategorized into the other CWRM water use categories, namely Domestic, Industrial, Irrigation, Agriculture, and Military, if detailed metered information is available.

3.3.7.1 County Water Systems

The DWS has one system in North Kona. It is the second largest system on the island. The existing use associated with meter records from July 2013 through June 2014 was previously listed in Table 3-6. The system is supplied entirely by ground water sources, including 12 wells and the Kahaluu inclined shaft.

The Kona Water System extends from the Keahole-Kona International Airport south to the South Kona boundary where interconnection with the South Kona Water System is made. The Kona districts were without any County water systems until funds were provided by the Legislature in 1951. The first increment of the North Kona Water System was completed in 1953. Surface water from Waiaha Stream was diverted into large storage tanks located in Waiaha above Mamalahoa Highway, filtered, then piped down to Kailua by a small transmission line to large tanks above Kailua Village. This provided the impetus for the resort development which occurred in subsequent years. The first potable water wells were placed in service in 1967. Expansion of the system, mainly through legislative funds, continued for years. Most of the small pipelines initially installed have been replaced with larger mains. The system expanded to Keauhou, permitting the development of hotels along this coastline. Expansion to Kona International Airport opened up a new area for development, such as the Honokohau Small Boat Harbor. The expansion program did not neglect the existing farming community in the mauka

areas, as the system eventually was extended to service the North Kona District from Kalaoa Homesteads to the South Kona boundary, a distance of over 18 miles.

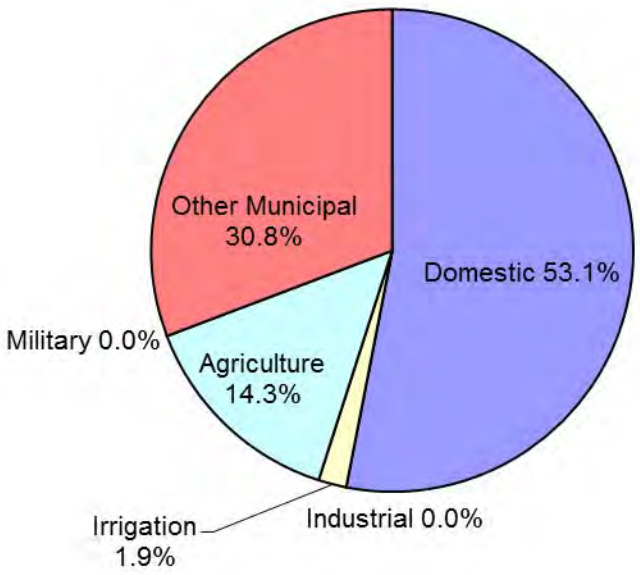
DWS water use is subcategorized in Table 3-8 to the extent possible based on available meter data. This use is depicted in Figure 3-6. "Other Municipal" subcategory includes facilities such as schools, and various commercial, government, medical and nonprofit entities which have mixed water use and cannot be specifically allocated to the other CWRM categories.

Table 3-8: DWS Existing Water Use by Categories – Keauhou ASYA

CWRM Water Use Category	DWS Metered Water Use* (MGD)	Percent of Total
Domestic	5.30	53.07
Industrial	0	0
Irrigation	0.19	1.88
Agriculture	1.42	14.29
Military	0	0
Other Municipal	3.07	30.76
Total	9.98	100.00

**Metered water use should not be compared to pumpage because the latter is calculated by determining the high 12-MAV and may be based on a different timeframe*

Figure 3-6: DWS Existing Water Use by Categories – Keauhou ASYA



3.3.7.2 State Water Systems

There are no State water systems in the Keauhou ASYA.

3.3.7.3 Federal Water Systems

There are no Federal water systems in the Keauhou ASYA.

3.3.7.4 Private Public Water Systems

Huehue Ranch owns five wells categorized as "Municipal" that are operated by the Kona Water Service Company. Three of the wells are located in the Keauhou ASYA, and the other two are located in the Kiholo ASYA. The water system is classified by the Department of Health, Safe Drinking Water Branch as Public Water System No. 165. The water system serves approximately 260 people through 15 service connections and provides approximately 260,000 GPD to the Makalei Golf Course and 630,000 GPD to Kukio Golf and Beach Club. The water is disinfected, treated for corrosion control, and the lower part of the water system is also treated using reverse osmosis. The total pumpage from the three wells within the Keauhou ASYA is 0.79 MGD.

3.3.8 Water Use by Resource

3.3.8.1 Ground Water

Table 3-9 summarizes the current production, sustainable yield (SY), and percentage of SY for the production calculated. Current production is represented by the highest 12-month moving average (12-MAV) or the highest annual average yield calculated from the actual pumpage data reported to CWRM between August 2012 and July 2014.

Table 3-9: Pumpage and Sustainable Yield – Keauhou ASYA

High 12-MAV (MGD)	Sustainable Yield (MGD)	High 12-MAV Sustainable Yield (%)
14.86	38	39.09

3.3.8.2 Surface Water

There is no flow data available for surface water use within the Keauhou ASYA.

3.3.8.3 Rainwater Catchment

Water consumption calculated for developed parcels that are not supplied by groundwater or surface water is assumed to be supplied by rainwater catchment. The water use categorized as Domestic Use in Table 3-6 is assumed to be supplied by individual catchment systems. Only

parcels mauka of Mamalahoa Highway were considered, as other areas would not receive adequate rainfall to support catchment systems.

3.3.8.4 Reclaimed Wastewater

Two wastewater reclamation facilities within the Keauhou ASYA supply reclaimed wastewater for irrigation use, and one is currently inactive, as previously indicated in Table 3-6.

3.4 FUTURE WATER NEEDS

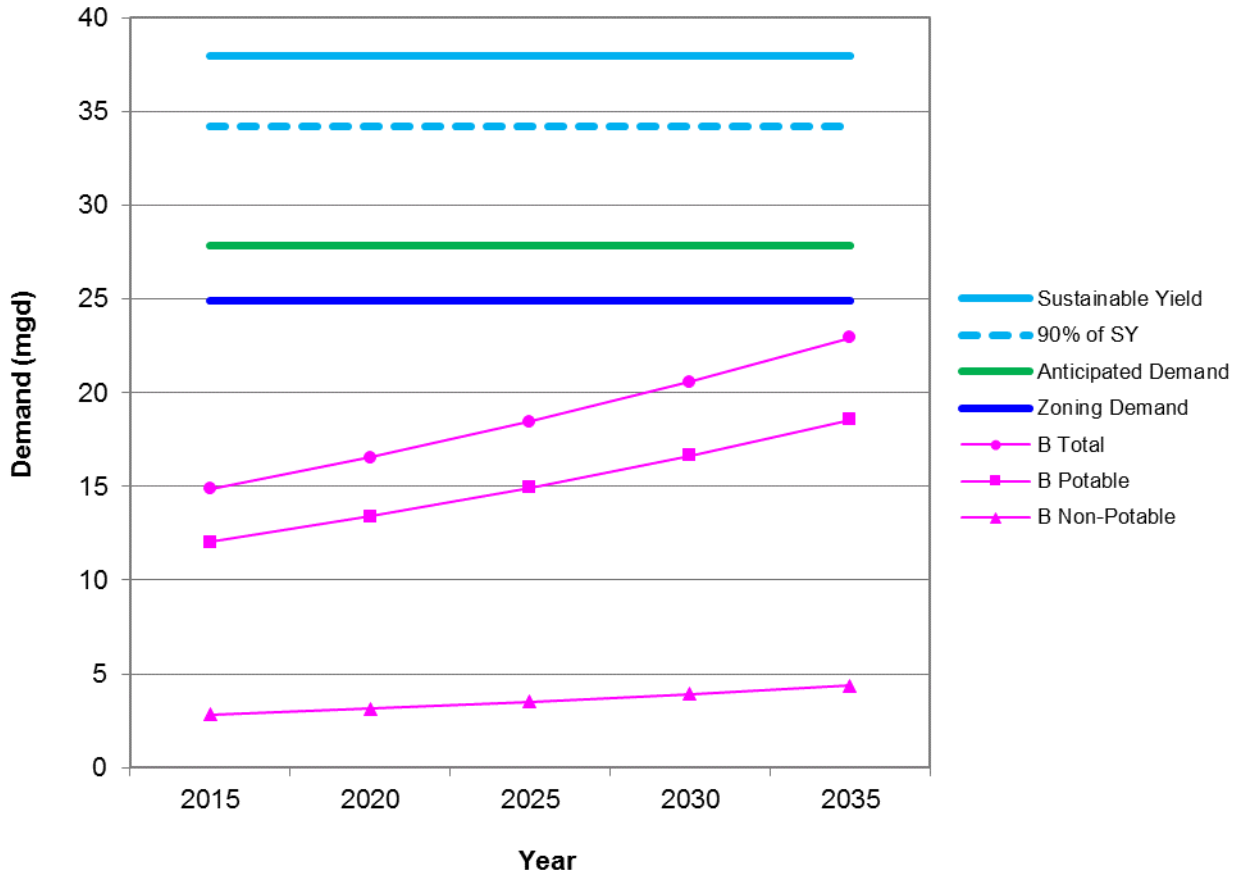
3.4.1 General

Table 3-10 summarizes the anticipated water demand (Antic.), Zoning, and 5-year incremental water demand for Growth Rate B (medium growth) projection scenarios for the Keauhou ASYA. The SY is presented for comparison. Figure 3-7 graphically illustrates this data.

Table 3-10: Summary of Water Demand Scenarios – Keauhou ASYA

Keauhou ASYA	SY	Anticipated	Zoning	Growth Rate B Demand Projections (Year)				
				2015	2020	2025	2030	2035
MGD	38	27.87	24.88	14.86	16.56	18.46	20.58	22.94
% of SY	100	73.34	65.47	39.09	43.58	48.59	54.16	60.38

Figure 3-7: Summary of Water Demand Scenarios – Keauhou ASYA



One of the criteria for designation of a ground water hydrologic unit is if ground water pumpage reaches 90% of the SY, which would be 34.2 MGD for the Keauhou ASYA. Both the anticipated and zoning water demand scenarios are well under 90% of the SY of the Keauhou ASYA. Analysis of the three water demand scenarios are presented in the following sections.

3.4.2 Anticipated Water Demands

The anticipated water demand for the Keauhou ASYA is summarized in Table 3-11, and reflects refinement as discussed below and as indicated in Section 2.1.1.3. Each land use classification is associated with the most appropriate CWRM water use category.

Table 3-11: Anticipated Water Demands – Keauhou ASYA

Component	CWRM Category	Water Demand (MGD)
Existing Developed Parcels*	Domestic/Irrigation/Municipal	14.86
Water Entitlements:		
Vacant Service Laterals	Municipal	1.10
Developer Agreements	Municipal	3.39
Water Credit Commitments	Municipal	2.65
Approved Open Building Permits	Municipal	0.09
Other Developments (Kukio)	Irrigation/Municipal	0.45
DHHL	Irrigation/Municipal	3.40
State Projects	Irrigation/Municipal	0.06
Kona CDP	Municipal	1.87
TOTAL		27.87

**Highest 12-MAV pumpage between August 2012 and July 2014*

As described in Section 2.1.4.1, the DHHL component of the anticipated water demand was based on the November 24, 2014 reservation request in lieu of the State Water Projects Plan Update for DHHL.

Known State projects with projected demands that are not already accounted for by existing water use, water entitlements and DHHL are listed in Table 3-12.

Table 3-12: State Projects Component of Anticipated Water Demands

Project	State Department	Demand (MGD)
University of Hawaii Center, West Hawaii Long Range Development Plan	University of Hawaii	0.054
West Hawaii Explorations Academy	NELHA	0.003
OTEC Research, Development and Demonstration Facility	NELHA	0.000
Kona Judiciary Complex	Judiciary	0.007
TOTAL		0.064

The Kona CDP component of the anticipated water demand accounts for the proposed subdivisions with appropriate State Land Use Designation (SLUD) approval, vacant lots within existing subdivisions, and potential infill of the Holualoa rural area, which are not already accounted for by existing developed parcels, water entitlements and DHHL. The demands accounted for by the Kona CDP component are listed in Table 3-13.

Table 3-13: Kona CDP Demand Component of Anticipated Water Demands

Kona CDP Component	Demand (MGD)
Proposed Subdivisions with SLUD Approval	1.454
Vacant Lots	0.105
Holualoa	0.306
TOTAL	1.865

3.4.3 Hawaii County Zoning Water Demands

The water demand based on the County Zoning for the Keauhou ASYA is listed in Table 3-14, and reflect refinement as discussed below and as indicated in Section 2.1.1.3. Each zoning district is associated with the most appropriate CWRM water use category.

Table 3-14: Hawaii County Zoning Water Demand – Keauhou ASYA

Zoning District/ Component	CWRM Category	Water Demand (mgd)
Existing Developed Parcels*	Domestic/Irrigation/Municipal	14.86
Residential	Domestic/Irrigation/Municipal	4.31
Resort	Irrigation/Municipal	0.57
Commercial	Municipal	0.38
Industrial	Industrial	0.91
Kukio	Irrigation/Municipal	0.45
DHHL	Irrigation/Municipal	3.40
TOTAL		24.88

**Highest 12-MAV pumpage between August 2012 and July 2014*

As described in Section 2.1.4.1, the DHHL component of the zoning build-out water demand was based on the November 24, 2014 reservation request in lieu of the State Water Projects Plan Update for DHHL.

3.4.3.1 Agricultural Water Demands

The estimated maximum agricultural water demand based on irrigation of all Important Agricultural Land (IAL) area within the undeveloped agriculturally zoned areas and the revised unit rate of 210 GPD/acre is 3.45 MGD. Figure 3-8 shows the IAL and agriculturally zoned areas, the existing DWS system and average annual rainfall isohyets.

3.4.4 5-Year Incremental Water Demand Projection

The following section presents 5-year incremental water demand projections to the year 2035 for the Keauhou ASYA. Figure 3-9 shows the breakdown of water demand projections by CWRM categories, potable (Domestic, Industrial, Military and Municipal) and non-potable (Irrigation and Agriculture), and DWS through the year 2035, and Table 3-15 summarizes this figure.

The projected low, medium, and high growth rates are listed in Table 3-16 and are graphed in Figure 3-10. Potable and non-potable water demands are also differentiated.

Table 3-15: Growth Rate B Water Demand Projection by Category – Keauhou ASYA

Water Use Category	2015 (MGD)	2020 (MGD)	2025 (MGD)	2030 (MGD)	2035 (MGD)
Total	14.86	16.56	18.46	20.58	22.94
Domestic	0.00	0.00	0.00	0.00	0.00
Industrial	0.06	0.07	0.08	0.09	0.10
Irrigation	2.42	2.70	3.01	3.36	3.74
Agriculture	0.41	0.45	0.50	0.56	0.63
Military	0.00	0.00	0.00	0.00	0.00
Municipal	11.96	13.34	14.87	16.57	18.48
Potable	12.03	13.41	14.95	16.66	18.57
Non-potable	2.83	3.15	3.52	3.92	4.37
DWS	11.18	12.46	13.89	15.48	17.26

Hawaii County
Department of Water Supply

DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

Job No. 2014-0802

Makalawena

Mahaiula Bay

Makako Bay

Honokohau

Kiholo
80902

Keauhou
80901

Kailua Bay

Kailua-Kona

Keauhou

20"
30"
35"
45"
75"

PACIFIC OCEAN

LEGEND:

- Annual Rainfall
- Hawaiian Home Lands
- Existing Water Service
- Important Agricultural Land

Agricultural Zoning:

A-1a+	1 thru 10 acres
A-20a	20 acres
A-35a	35 acres
A-40a	40 acres
A-80a	80 acres
A-200a+	200 thru 255 acres
A-500a	500 acres
A-600a	600 acres
A-900a	900 acres

TMK

1 0.5 0 1
Miles

INDEX MAP - Island of Hawaii

FIGURE 3-8

AQUIFER SECTOR HUALALAI - 809

Aquifer Systems
Keauhou - 80901

Undeveloped Agricultural Lands

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Figure 3-9: Growth Rate B Water Demand Projection by Category – Keauhou ASYA

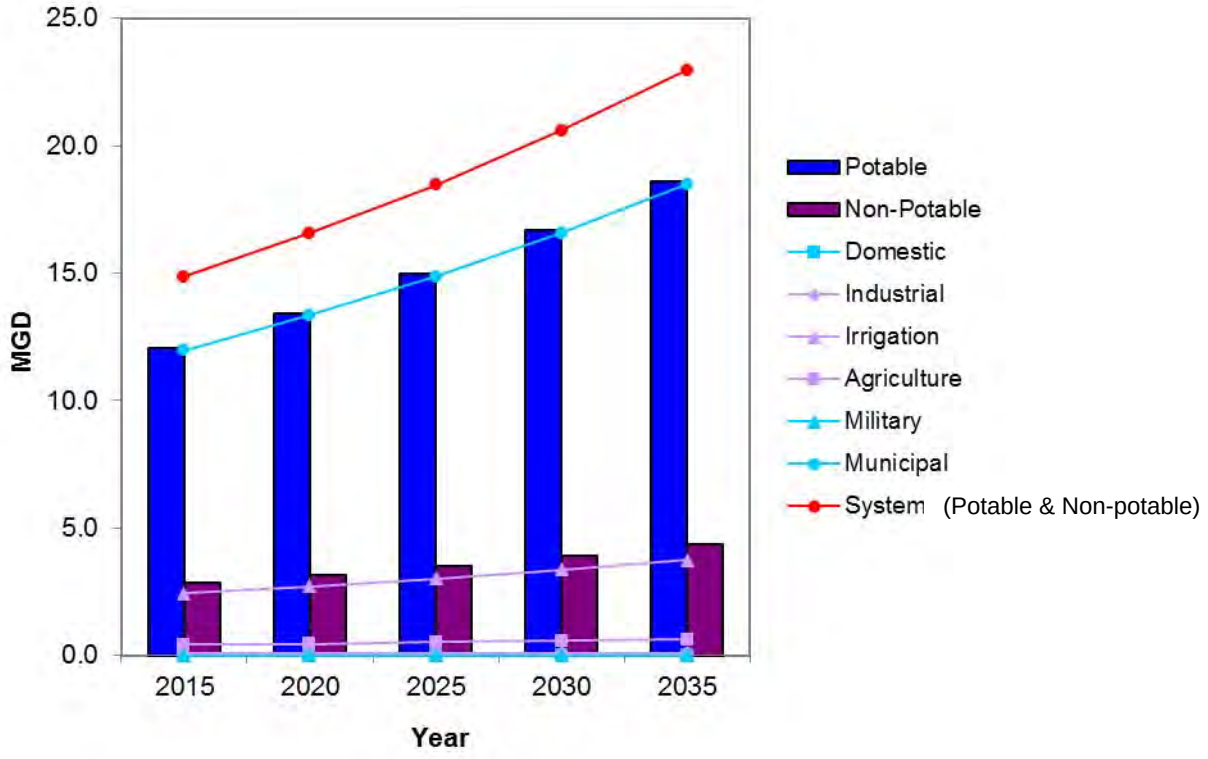

Table 3-16: Growth Rates A, B, C Water Demand Projections – Keauhou ASYA

Growth Rate		2015 (MGD)	2020 (MGD)	2025 (MGD)	2030 (MGD)	2035 (MGD)
A – Low	Total	14.86	16.48	18.27	20.27	22.48
	Potable	12.03	13.34	14.79	16.41	18.20
	Non-potable	2.83	3.14	3.48	3.86	4.28
B – Medium	Total	14.86	16.56	18.46	20.58	22.94
	Potable	12.03	13.41	14.95	16.66	18.57
	Non-potable	2.83	3.15	3.52	3.92	4.37
C – High	Total	14.86	16.74	18.86	21.25	23.94
	Potable	12.03	13.55	15.27	17.20	19.38
	Non-potable	2.83	3.19	3.59	4.05	4.56

Figure 3-10: Growth Rates A, B, C Water Demand Projections – Keauhou ASYA