809 HUALALAI AQUIFER SECTOR AREA

809.1 SECTOR AREA PROFILE

809.1.1 General

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

Average rainfall in the Keahou ASYA ranges from less than 20 inches along the northwest coast to about 125 inches in the Kahaluu Forest Reserve, resulting in a sustainable yield of 38 mgd. Average rainfall in the Kiholo ASYA varies from less than 10 inches at the coast to 45 inches at mid-elevation, making this system area one of the driest on the island, with a sustainable yield of 18 mgd. The total sustainable yield for the Hualalai ASEA is 56 mgd.

809.1.2 Economy and Population

809.1.2.1 Economy

North Kona continues to be a major visitor industry area with direct national and international flights to the recently expanded Kona International Airport at Keahole, and contains over 45 percent of the total number of hotel rooms on the island.

Part of the Kona coffee belt lies within the Hualalai ASEA. 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 to over $16 million in 1997.

North Kona supports many other industries, including timber, fishing, and 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, and 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. In 2003, the facility hosted 34 projects, employed 206 employees, and together with its tenants, provides a total economic impact of approximately $40 million a year.

809.1.2.2 Population

Most of the North Kona district population lies within the Hualalai ASEA. The population growth rate in the area has decreased since the rapid growth of the 70's and 80's.

Table 809-1: Historical Population

1980	1990	2000	1980-90 % Change	1990-2000 % Change
13,565	21,987	28,163	62.1	28.1

Data source: 2000 U.S. Census
Data redistributed and evaluated for the Hualalai Aquifer Sector Area.

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

Table 809-2: Population Projection

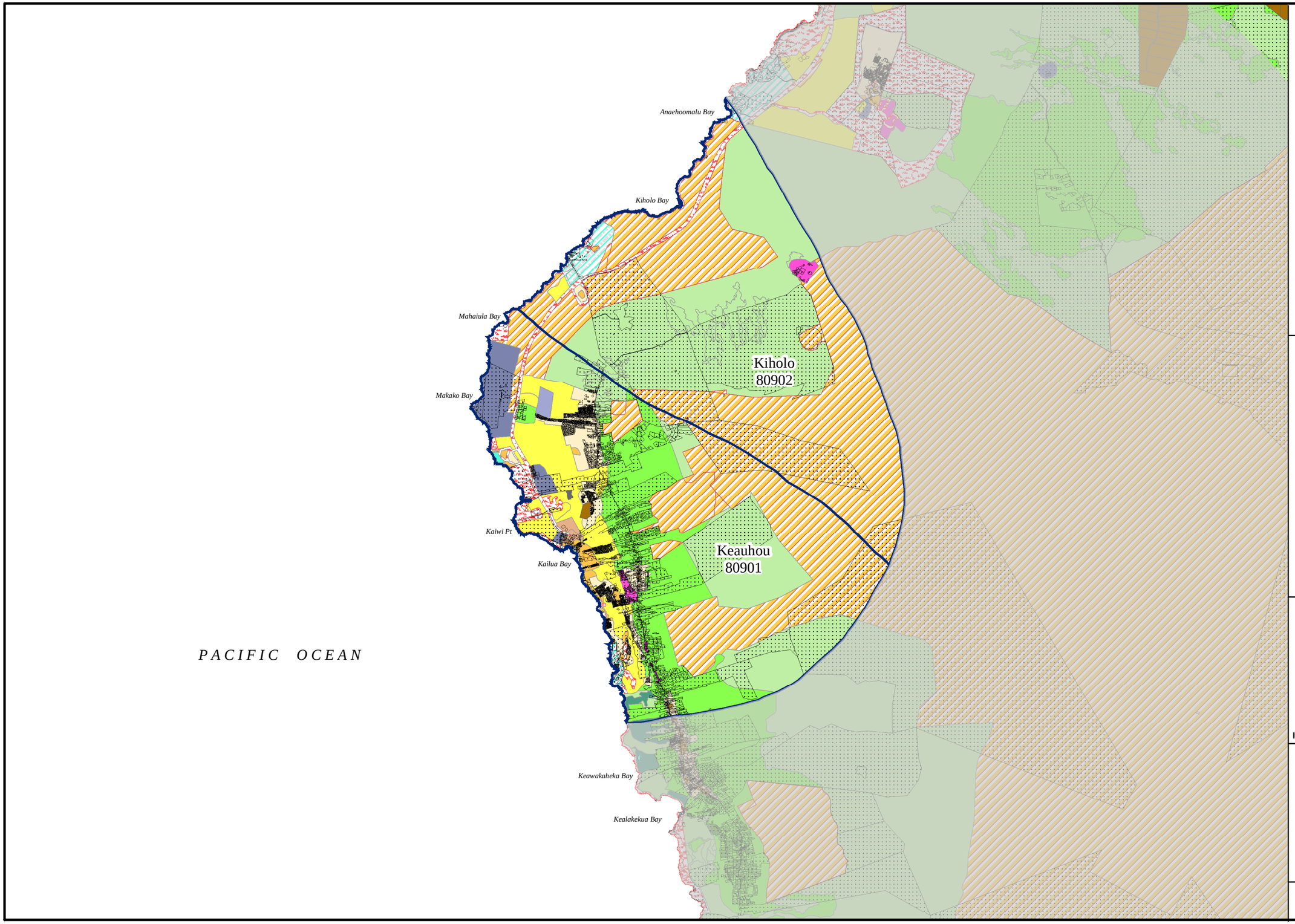
Growth Rate	2000	2005	2010	2015	2020	2000-10 % Change	2010-20 % Change
A – Low	28,163	29,966	33,277	36,874	40,895	18.2	22.9
B – Medium	28,163	30,061	33,571	37,417	41,712	19.2	24.2
C – High	28,163	31,315	35,676	40,356	45,468	26.7	27.4

Data source: County General Plan, February 2005
Data redistributed and evaluated for the Hualalai Aquifer Sector Area.

809.1.3 Land Use

809.1.3.1 Hawaii County General Plan

The Hawaii County General Plan Land Use Pattern Allocation Guide (LUPAG) map for the Hualalai ASEA is shown on **Figure 809-1**. The estimated land use allocation acreage for each LUPAG designation within the sector area is listed in **Table 809-3**.



Hawaii County

Department of Water Supply

DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

Job No. 2003-818

LEGEND:

- Developed Properties
- Hawaiian Home Lands

Land Use Pattern Allocation Guide

- Extensive Agriculture
- Important Agricultural Land
- Orchard
- High Density Urban
- Medium Density Urban
- Low Density Urban
- Industrial
- Urban Expansion
- Resort
- Resort Node
- Rural
- Conservation
- Open
- University Use
- Pond
- Break Water

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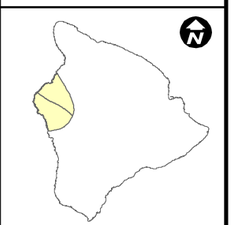
Miles



INDEX MAP - Island of Hawaii

FIGURE 809-1

AQUIFER SECTOR
HUALALAI - 809

Aquifer Systems

Keauhou - 80901
Kiholo - 80902

2005 Revised General Plan Land Use Pattern Allocation Guide

FUKUNAGA & ASSOCIATES, INC.
Consulting Engineers
1388 Kapiolani Boulevard, Honolulu, Hawaii 96814

Table 809-3: LUPAG Map Estimated Land Use Allocation Acreage – Hualalai Aquifer Sector Area

LAND USE PATTERN	ACREAGE	% of TOTAL
High Density Urban	459	0.23
Medium Density Urban	1,493	0.75
Low Density Urban	6,167	3.09
Industrial	3,895	1.95
Important Agricultural Land	22,017	11.04
Extensive Agriculture	59,595	29.87
Orchard	379	0.19
Rural	995	0.50
Resort/Resort Node	2,482	1.24
Open	6,123	3.07
Conservation	83,676	41.94
Urban Expansion	11,770	5.90
University Use	462	0.23
TOTAL	199,512	100.00

The water utility courses of action for North Kona, as put forth in the Hawaii County General Plan, are as follows:

- ***(a)*** *Continue to pursue groundwater source investigation, exploration and development in areas that would provide for anticipated growth and an efficient and economic system operation.*
- ***(b)*** *Continue to evaluate growth conditions to coordinate improvements as required to the existing water system in accordance with the North Kona Water System Master Plan.*
- ***(c)*** *Explore and develop a well in Waiaha.*

809.1.3.2 Hawaii County Zoning

Hawaii County Zoning for the Hualalai ASEA is shown on **Figure 809-2**. The estimated land use allocation acreage for each zoning class within the sector area is listed in **Table 809-4**.

Table 809-4: County Zoning Estimated Class Allocation Acreage – Hualalai Aquifer Sector Area

ZONING CLASS	ACREAGE	% of TOTAL
Single Family Residential	2,679	1.36
Multi-Family Residential (including duplex)	1,115	0.57
Residential-Commercial Mixed Use	24	0.01
Resort	639	0.32
Commercial	691	0.35
Industrial	2,509	1.27
Industrial-Commercial Mixed	205	0.10
Family Agriculture	230	0.12
Residential Agriculture	468	0.24
Agriculture	110,152	55.96
Open	62,555	31.78
Project District	1,743	0.89
Forest Reserve	13,850	7.04
(road)	2,713	1.36
TOTAL	199,572	100.00

809.2 EXISTING WATER RESOURCES

809.2.1 Ground Water

The Hualalai ASEA has a sustainable yield of 56 mgd. According to the CWRM database and additional update information, there are 65 production wells in the sector area, including 21 municipal, 18 irrigation, 1 industrial and 25 other wells. There are also 24 wells drilled, and categorized as "unused." Refer to **Appendix B** for the well database. **Figure 809-3** shows the well locations. The industrial well is owned by Hawaiian Electric Light Company, Inc. and pumps brackish water for cooling, and the majority of the "other" wells 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 1600 feet mean sea level (msl) encountered water elevations ranging from 25± feet msl to 460+feet msl. Notably, 10 of the municipal wells and 14 of the irrigation wells were drilled between 1990 and 2002, 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 over proper planning, well placement and associated problems of well interference; and with the help and partnership

Hawaii County

Department of Water Supply

DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

Job No. 2003-818

LEGEND:

- Hawaiian Home Lands
- Developed Parcels

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
APD	Agricultural Project Districts
CDH	Downtown Hilo Commercial District
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

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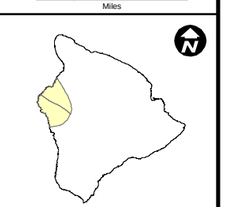
Miles



INDEX MAP - Island of Hawaii

FIGURE 809-2

AQUIFER SECTOR
HUALALAI - 809

Aquifer Systems

Keauhou - 80901
Kiholo - 80902

County Zoning

FUKUNAGA & ASSOCIATES, INC.
Consulting Engineers
1388 Kapiolani Boulevard, Honolulu, Hawaii 96814

Figure 809-3: Well Location

MAP CURRENTLY NOT AVAILABLE ON-LINE

of the private sector, undertook the task to collect and analyze data, and continues to monitor groundwater in West Hawaii.

809.2.2 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 rainbelt, 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 809-5** and shown on **Figure 809-4**; however, flow data is not available.

Table 809-5: Stream Diversions – Hualalai Aquifer Sector Area

FILE REFERENCE	TMK	STREAM NAME	
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.

809.2.3 Rainwater Catchment

The first potable water wells in the Hualalai ASEA 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.

809.2.4 Reclaimed Wastewater

There are three wastewater reclamation facilities (WWRF) in the study area. **Table 809-6** lists the WWRF, reclaimed water classification, facility treatment capacity, current reuse amount, and current application.

Table 809-6: Wastewater Reclamation Facilities – Hualalai Aquifer Sector Area

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
Kealakehe	R-2	1.3	0.06	Swing Zone Driving Range
Kona International Airport	R-1	0.14	0.03	Landscape

809.3 EXISTING WATER USE

809.3.1 General

The following section presents the total estimated average water use within the Hualalai ASEA, and the Keauhou and Kiholo ASYAs separately. Estimated water use from 2004 to 2005 was estimated using DWS meter data and CWRM pumpage data from November 2004 through October 2005, available GIS data, and estimated reclaimed wastewater usage, and are listed for the sector and system areas in **Tables 809-7**, **809-7a**, and **809-7b**, respectively. **Tables 809-7**, **809-7a**, and **809-7b** and **Figures 809-5**, **809-5a**, and **809-5b** summarize water use in accordance with CWRM categories. The tables and figures also indicate separately the quantities supplied excluding agricultural demands, and the quantities supplied including worst case agricultural demands (as described in Chapter 2) by the DWS system, non-DWS systems, and reclaimed wastewater for the sector area and system areas, respectively.

Figure 809-4: Streams & Diversions

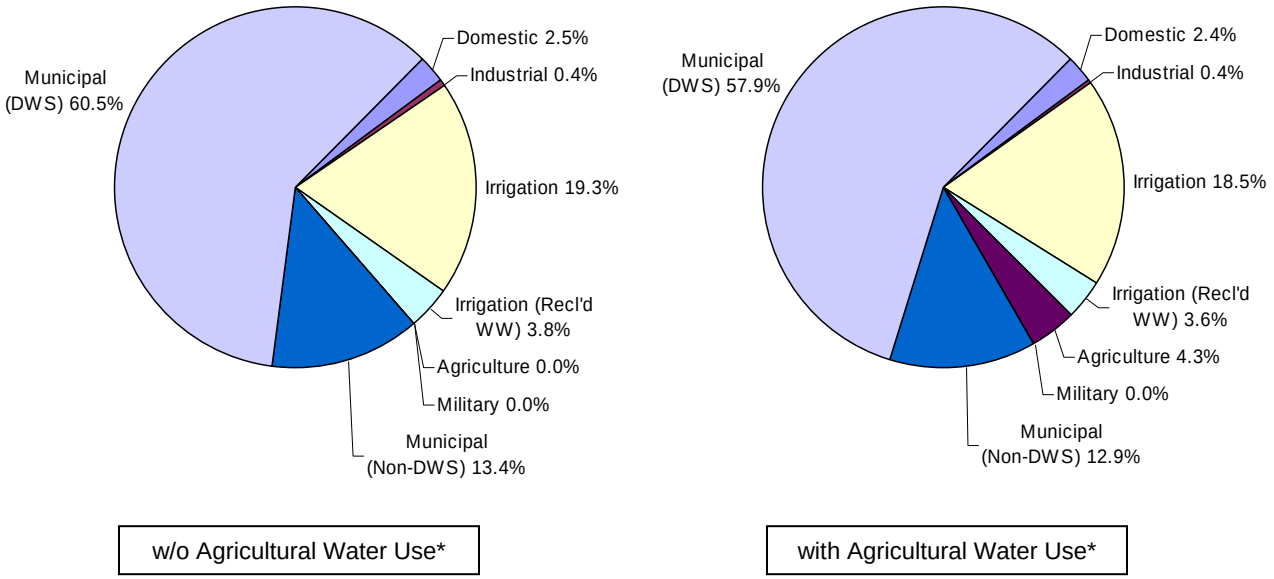
MAP CURRENTLY NOT AVAILABLE ON-LINE

Table 809-7: Existing Water Use by Categories – Hualalai Aquifer Sector Area

CWRM Water Use Category	Water Use (MGD)	Percent of Total without Ag*	Percent of Total with Ag*
Domestic	0.39	2.5	2.4
Industrial	0.07	0.4	0.4
Irrigation	3.02	19.3	18.5
Reclaimed WW	0.59	3.8	3.6
Agriculture	0.70	0.0	4.3
Military	0.00	0.0	0.0
Municipal			
DWS System	9.45	60.5	57.9
Private Public WS	2.10	13.4	12.9
Total without Ag*	15.62	100.0	
Total with Ag*	16.33		100.0

* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 809-5: Existing Water Use by Categories – Hualalai Aquifer Sector Area



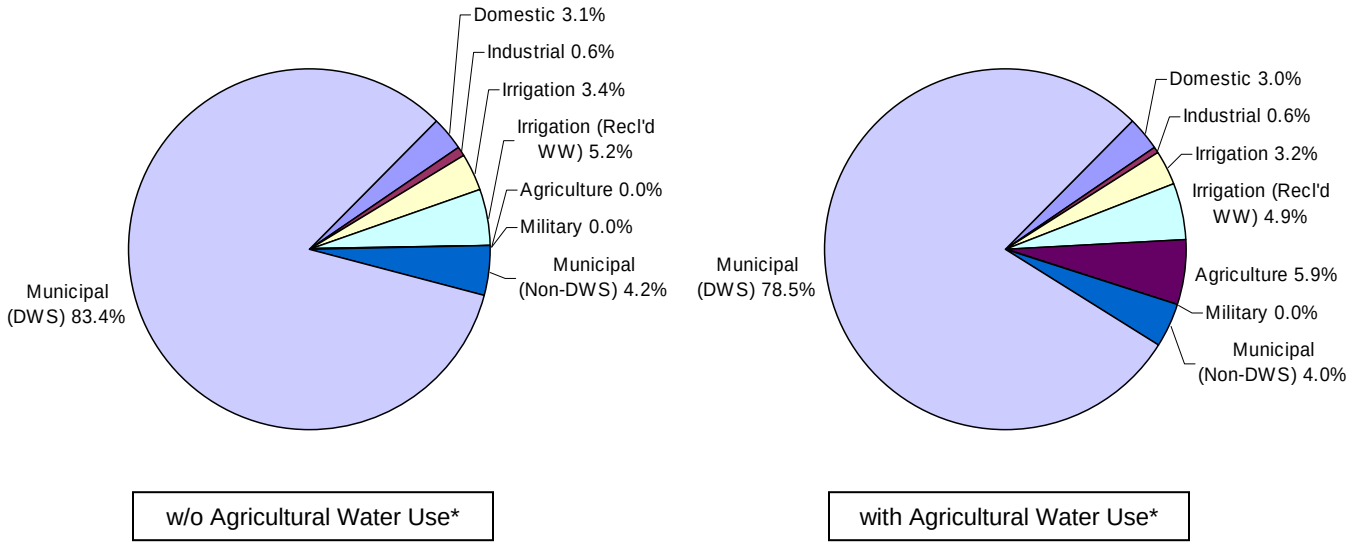
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 809-7a: Existing Water Use by Categories – Keauhou Aquifer System Area [80901]

CWRM Water Use Category	Water Use (MGD)	Percent of Total without Ag*	Percent of Total with Ag*
Domestic	0.35	3.1	3.0
Industrial	0.07	0.6	0.6
Irrigation	0.38	3.4	3.2
Reclaimed WW	0.59	5.2	4.9
Agriculture	0.71	0.0	5.9
Military	0.00	0.0	0.0
Municipal			
DWS System	9.44	83.4	78.5
Private Public WS	0.48	4.2	4.0
Total without Ag*	11.31	100.0	
Total with Ag*	12.02		100.0

* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 809-5a: Existing Water Use by Categories – Keauhou Aquifer System Area [80901]



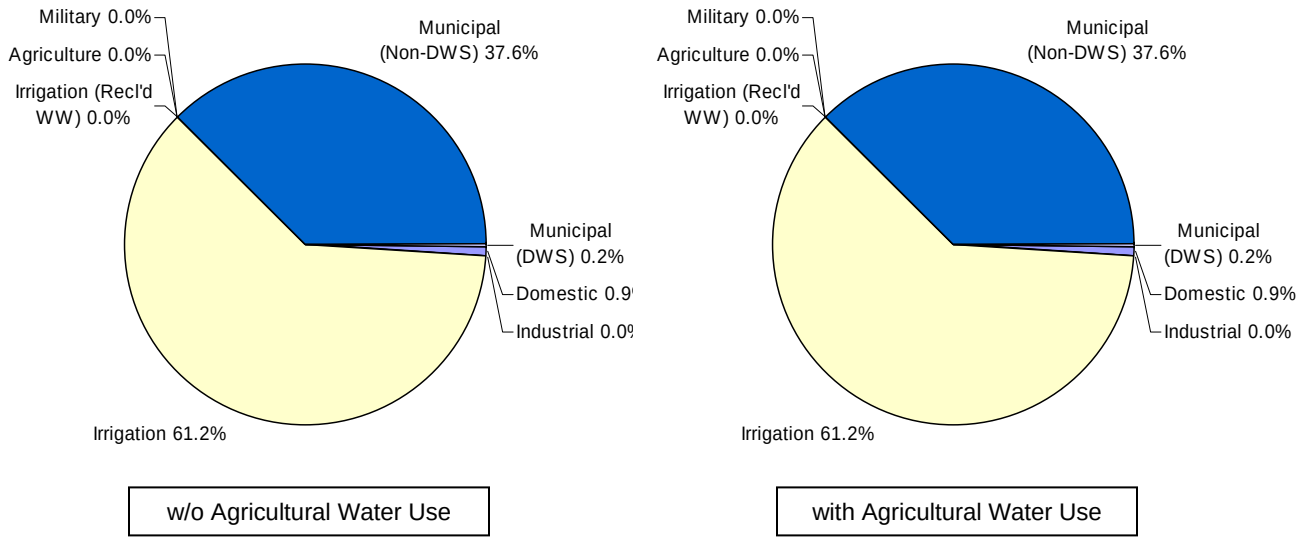
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 809-7b: Existing Water Use by Categories – Kiholo Aquifer System Area [80902]

CWRM Water Use Category	Water Use (MGD)	Percent of Total without Ag*	Percent of Total with Ag*
Domestic	0.04	0.9	0.9
Industrial	0.00	0.0	0.0
Irrigation	2.64	61.2	61.2
Reclaimed WW	0.00	0.0	0.0
Agriculture	0.00	0.0	0.0
Military	0.00	0.0	0.0
Municipal			
DWS System	0.01	0.2	0.2
Private Public WS	1.62	37.6	37.6
Total without Ag*	4.31	100.0	
Total with Ag*	4.31		100.0

* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 809-5b: Existing Water Use by Categories – Kiholo Aquifer System Area [80902]



* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 809-6 shows the approximate service area for the various water systems and indicates the extent of the DWS water system.

809.3.2 Domestic Use

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

809.3.3 Industrial Use

Industrial use is minimal. Hawaiian Electric Light Company, Ltd. has one well in the Keauhou ASYA, which is used for cooling and combustion. Unlike at the HELCO Hilo plant, this water is not injected back into the ground.

809.3.4 Irrigation Use

Irrigation makes up a significant portion of the water used in the Hualalai ASEA. 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 809-6**. **Table 809-8** lists the average private irrigation well pumpage reported to CWRM.

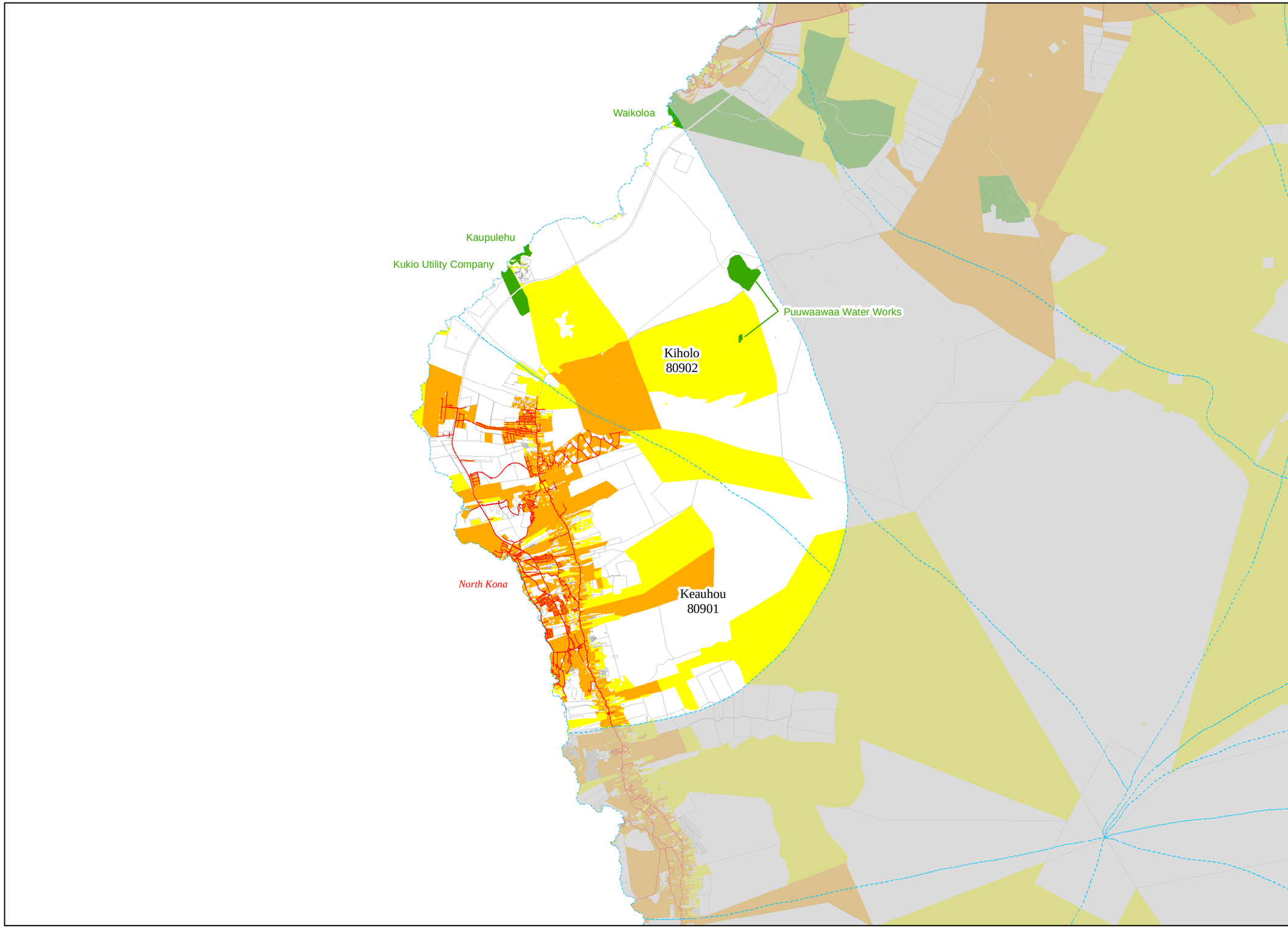
Table 809-8: Private Irrigation Well Pumpage – Hualalai Aquifer Sector Area

Private Irrigation	Irrigation Well Pumpage (mgd)
Big Island Country Club	Not reported
Bishop Estate	0.09
Kona Country Club	0.15
Kona Village	0.10
Hualalai Resort	1.23
Kukio	1.01
Otaka Inc./Kaneyoshi	0.14
West Hawaii Landfill	0.30
TOTAL	3.02

809.3.5 Agricultural Use

Estimated agricultural water use within the Hualalai ASEA is relatively low considering the amount of agricultural activity within the area. A portion of the Kona coffee belt is within the Hualalai ASEA; however, coffee cultivation relies primarily on ambient or available rainfall for production. Agricultural use in the amount of 1.2 mgd is supplied by DWS.

Aquaculture is a notable industry with the Natural Energy Laboratory of Hawaii Authority (NELHA) located within the Hualalai ASEA. This facility primarily uses deep cold seawater. Uwajima Fisheries, Inc. is a commercial tenant of NELHA, and grows coldwater flounder, highly prized for Hawaii's sashimi and sushi markets; and also conducts semi-intensive polyculture of moi (a type of Pacific threadfin fish), milkfish and ogo (seaweed). Uwajima Fisheries owns 11 brackish water wells; however, pumpage data is not available. Cyanotech Corporation also is a commercial tenant of NELHA, and uses cold seawater in their patented Ocean Chill Drying process to grow microalgae. Cyanotech Corporation owns 2 wells used for net washing and dust control. Pumpage data also is not available.



Hawaii County

Department of Water Supply

DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

Job No. 2003-818

LEGEND:

- DWS Water System Service Area
- Possible Catchment Area (Building Value > $10000)
- Private Water System Service Area
- Aquifer Boundary
- DWS Water System

2 1 0 2
Miles

INDEX MAP - Island of Hawaii

FIGURE 809-6

AQUIFER SECTOR
HUALALAI - 809

Aquifer Systems

Kiholo - 80901
Keauhou - 80902

Water System and Service Area

FUKUNAGA & ASSOCIATES, INC.

Consulting Engineers

1388 Kapiolani Boulevard, Honolulu, Hawaii 96814

Military Use

There is no military use in the Hualalai ASEA.

809.3.6 Municipal Use

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

809.3.6.1 County Water Systems

The County Department of Water Supply has one system in North Kona. It is the second largest system on the island. The average water sale from November 2004 through October 2005 was previously listed in **Table 809-7**. The system is supplied by ground water sources, including 10 wells and the Kahaluu inclined shaft.

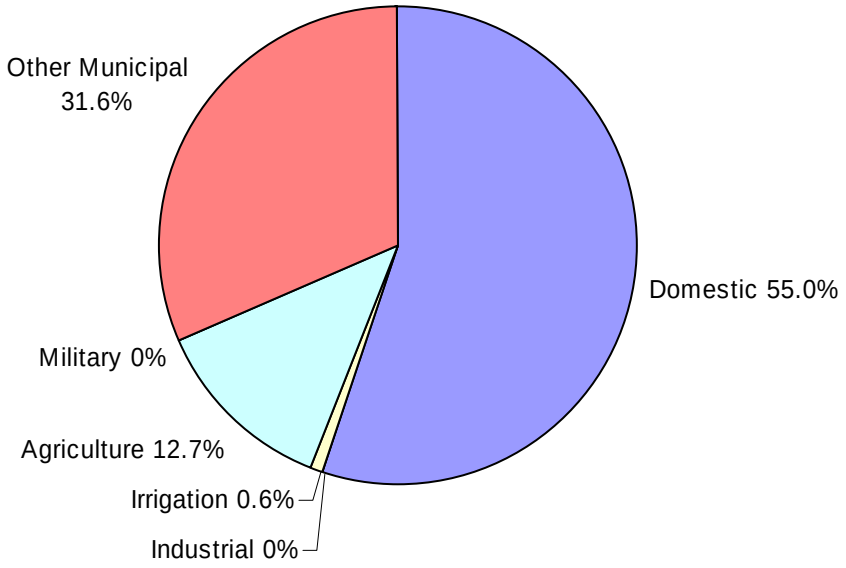
The Kona Water System extends from the Kona International Airport south to the South Kona boundary where interconnection with the South Kona Water System is made. The Kona districts were without any County water systems until funds were provided by the Legislature in 1951. The first increment of the 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 809-9** to the extent possible based on available meter data. There is no DWS water system in the Kiholo ASYA. This use is depicted in **Figure 809-7**. “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 categories.

Table 809-9: DWS Existing Water Use by Categories – Hualalai Aquifer Sector Area

CWRM Water Use Category	DWS Purveyed Water Use (MGD)	Percent of Total
Domestic	5.20	55.0
Industrial	0.00	0.0
Irrigation	0.06	0.6
Agriculture	1.20	12.7
Military	0.00	0.0
Other Municipal	2.99	31.6
Total	9.45	100.0

Figure 809-7: DWS Existing Water Use by Categories – Hualalai Aquifer Sector Area



809.3.6.2 State Water Systems

There are no State water systems in the Hualalai ASEA.

809.3.6.3 Federal Water Systems

There are no Federal water systems in the Hualalai ASEA.

809.3.6.4 Private Public Water Systems

There are three private public water systems within the Hualalai ASEA regulated by the Department of Health. These systems supply a significant percentage of the total estimated water use within the sector area. **Table 809-10** lists the average pumpage of each system reported to the CWRM. This pumpage is assumed to be the system water use.

Table 809-10: Private Public Water System Water Use – Hualalai Aquifer Sector Area

Private Public Water System	Water Use (mgd)
Napuu Water, Inc.	0.04
Hualalai Development Company	1.33
Kukio Utility Company	0.73

Napuu Water, Inc. (NWI) is a member owned non-profit cooperative responsible for providing water to the rural communities of Puuwaawaa, Puuanahulu, and Puu Lani Ranch. The NWI serves a combined community population of 330 people with 147 connections, including 132 residential connections, 3 cattle ranchers with 7 connections, 5 DLNR, Division of Forestry and Wildlife connections including the 5 MG Puuwaawaa reservoir, the Big Island Country Club, the HELCO Puuanahulu substation, and the Puuanahulu Volunteer Fire Station.

The Hualalai Development Company owns several wells that serve the Hualalai Resort and Kona Village Resort. These include eight brackish wells categorized as “Other” which are assumed to be used for resort water features; five wells for irrigation; and four wells currently dedicated as potable water sources which are treated by a 1 MGD reverse osmosis water treatment plant. Potable water needs for ultimate build-out is anticipated to require two additional wells, two additional reservoirs and increased capacity of the reverse osmosis water treatment plant to 3 MGD. Pumpage from the “Other” wells is not reported, and irrigation pumpage is noted in the previous section on Irrigation Use.

WB Kukio Resorts, LLC owns wells which are operated by Kukio Utility Company. These include three brackish wells for irrigation, and two wells categorized as “Other” and used as “Lagoon” wells. WB Kukio Resorts LLC also acquired the five Huehue Ranch wells drilled from the late 80’s through the early 90’s and continues to serve the Huehue Ranch area. These wells require corrosion control and disinfection (not desalination), and the water serving the private oceanfront club and residential community is treated at a new 1.27 MGD reverse osmosis water treatment plant, which will be expanded to 1.7 MGD in the next phase. Irrigation pumpage is noted in the previous section on Irrigation Use.

809.3.7 Water Use by Resource

809.3.7.1 Ground Water

Table 809-11 summarizes the current production, potential production (16 and 24 hour operation), sustainable yield (SY), and percentage of SY for the various productions calculated.

Current production is represented by the highest 12-month moving average (MAV) or the highest annual average yield calculated from the actual pumpage data. Potential well production is based on installed pump capacities, and calculated for both 16 hours of operation a day and 24 hours of operation a day. Data is based on pumpage data reported to CWRM.

Table 809-11: Sustainable Yield and Pumpage – Hualalai Aquifer Sector Area

Sys Code	System Area	High 12-Month MAV (MGD)	Potential 16 -Hour Production (MGD)	Potential 24-Hour Production (MGD)	SY (MGD)	High 12-Month MAV SY (%)	Potential 16-Hour Production SY (%)	Potential 24-Hour Production SY (%)
		15.55	**32.79**	**49.18**	**56**	**27.77**	**58.55**	**87.82**
80901	Keauhou	11.49	16.58	24.87	38	30.24	43.63	65.45
80902	Kiholo	4.06	16.21	24.31	18	22.56	90.04	135.06

809.3.7.2 Surface Water

There is no flow data available for surface water use within the Hualalai ASEA. Due to the limited availability of surface water, use is assumed to be minimal.

809.3.7.3 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 809-7** is assumed to be supplied by individual catchment systems.

809.3.7.4 Reclaimed Wastewater

Three wastewater reclamation facilities within the Hualalai ASEA supply reclaimed wastewater for irrigation use, as previously indicated in **Table 809-7**.

809.4 FUTURE WATER NEEDS

809.4.1 General

Table 809-12 summarizes the LUPAG, Zoning and 5-year incremental water demand projection scenarios for the total aquifer sector area and the individual aquifer system areas. The sustainable yield (SY) is presented to draw comparisons.

Table 809-12: Summary of Demand Projections

Without Agricultural Demand*	SY (mgd)	LUPAG (mgd)	Zoning (mgd)	Growth Rate B Demand Projections (mgd)				
				2005	2010	2015	2020	2025
Total – Hualalai ASEA	56	206.9	42.3	15.6	17.5	19.5	21.7	24.2
80901 – Keauhou ASYA	38	170.8	39.1	11.3	12.6	14.1	15.7	17.5
80902 – Kiholo ASYA	18	36.1	3.2	4.3	4.8	5.4	6.0	6.7
With Agricultural Demand*	**SY (mgd)**	**LUPAG (mgd)**	**Zoning (mgd)**	**Growth Rate B Demand Projections (mgd)**				
				2005	**2010**	**2015**	**2020**	**2025**
Total – Hualalai ASEA	56	281.6	114.8	16.3	18.2	20.3	22.7	25.3
80901 – Keauhou ASYA	38	245.4	111.6	12.0	13.4	15.0	16.7	18.6
80902 – Kiholo ASYA	18	36.2	3.2	4.3	4.8	5.4	6.0	6.7

* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

LUPAG water demands excluding agricultural demands for the Hualalai ASEA and both aquifer system areas exceed the respective SY. Zoning water demands excluding agricultural demands for the Keauhou ASYA exceed its SY; however, for the Kiholo ASYA are less than its SY. Analysis of the three demand projection scenarios will be presented for the aquifer sector area and for each of the aquifer system areas.

809.4.2 Full Build-Out Water Demand Projections

The full build-out water demand projections based on the General Plan and County Zoning for the Hualalai ASEA are listed in **Tables 809-13** and **809-14**, and reflect refinement as discussed below. Each land use class is associated with the most appropriate CWRM water use category.

Table 809-13: Hawaii County General Plan Full Build-Out Water Demand Projection – Hualalai Aquifer Sector Area

LUPAG Class	CWRM Category	Water Demand (mgd)
Urban	Domestic/Irrigation/Municipal	73.1
Urban Expansion	Domestic/Irrigation/Municipal	71.7
Resort	Irrigation/Municipal	42.2
Industrial	Industrial	15.6
Agriculture	Agriculture	74.7
University	Irrigation/Municipal	1.8
Rural	Irrigation/Municipal	1.0
DHHL	Irrigation/Municipal	1.5
TOTAL w/o Ag*		206.9
TOTAL w/ Ag*		281.6

* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 809-14: County Zoning Full Build-Out Water Demand Projection – Hualalai Aquifer Sector Area

Zoning Class	CWRM Category	Water Demand (mgd)
Residential	Domestic/Irrigation/Municipal	18.0
Resort	Irrigation/Municipal	8.9
Commercial	Municipal	2.1
Industrial	Industrial	12.0
Agriculture	Agriculture	72.5
DHHL	Irrigation/Municipal	1.5
TOTAL w/o Ag*		42.3
TOTAL w/ Ag*		114.8

* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

The full build-out water demand projections based on the General Plan and County Zoning for the Keauhou Aquifer System Area are listed in **Tables 809-13a** and **809-14a.**

Table 809-13a: Hawaii County General Plan Full Build-Out Water Demand Projection – Keauhou Aquifer System Area [80901]

LUPAG Class	CWRM Category	Water Demand (mgd)
Urban	Domestic/Irrigation/Municipal	71.5
Urban Expansion	Domestic/Irrigation/Municipal	69.7
Resort	Irrigation/Municipal	10.2
Industrial	Industrial	15.6
Agriculture	Agriculture	74.6
University	Irrigation/Municipal	1.8
Rural	Irrigation/Municipal	0.4
DHHL	Irrigation/Municipal	1.5
TOTAL w/o Ag*		170.8
TOTAL w/ Ag*		245.4

* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 809-14a: County Zoning Full Build-Out Water Demand Projection – Keauhou Aquifer System Area [80901]

Zoning Class	CWRM Category	Water Demand (mgd)
Residential	Domestic/Irrigation/Municipal	17.0
Resort	Irrigation/Municipal	6.8
Commercial	Municipal	2.0
Industrial	Industrial	12.0
Agriculture	Agriculture	72.5
DHHL	Irrigation/Municipal	1.5
TOTAL w/o Ag*		39.1
TOTAL w/ Ag*		111.6

* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

The full build-out water demand projections based on the General Plan and County Zoning for the Kiholo Aquifer System Area are listed in **Tables 809-13b** and **809-14b.**

Table 809-13b: Hawaii County General Plan Full Build-Out Water Demand Projection – Kiholo Aquifer System Area [80902]

LUPAG Class	CWRM Category	Water Demand (mgd)
Urban	Domestic/Irrigation/Municipal	1.6
Urban Expansion	Domestic/Irrigation/Municipal	2.0
Resort	Irrigation/Municipal	32.0
Industrial	Industrial	0.0
Agriculture	Agriculture	0.1
University	Irrigation/Municipal	0.0
Rural	Irrigation/Municipal	0.6
DHHL	Irrigation/Municipal	0.0
TOTAL w/o Ag*		36.1
TOTAL w/ Ag*		36.2

* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 809-14b: County Zoning Full Build-Out Water Demand Projection – Kiholo Aquifer System Area [80902]

Zoning Class	CWRM Category	Water Demand (mgd)
Residential	Domestic/Irrigation/Municipal	1.0
Resort	Irrigation/Municipal	2.1
Commercial	Municipal	0.1
Industrial	Industrial	0.0
Agriculture	Agriculture	0.0
DHHL	Irrigation/Municipal	0.0
TOTAL w/o Ag*		3.2
TOTAL w/ Ag*		3.2

* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

809.4.2.1 Refine Land Use Based Projection

809.4.2.1.1 State Water Projects Plan

The total projected demand to the year 2020 for 30 State Water Projects listed in the Hawaii SWPP, 2003, within the Hualalai ASEA is 4.99 mgd of potable water. These demands may account for over 20 percent of the water demands within the sector area. The projects which will generate the most significant demands, with the exception of DHHL projects, which are covered separately, are listed in **Table 809-15**. Projects with large demands greater than 1 mgd may require State funding to develop resources and infrastructure necessary to provide water service.

Table 809-15: Future State Water Projects to Generate Significant Demands

Project Name	Primary Use	State Department	2020 Demand (mgd)
Natural Energy Laboratory of Hawaii	Potable	NELHA	1.80
Kona International Airport Master Plan	Potable	Department of Transportation	0.24

809.4.2.1.2 State Department of Hawaiian Home Lands

Three tracts within the Hualalai ASEA were transferred from the State Housing and Community Development Corporation (HCDC) to DHHL in 1994. The Keahuolu and Honokohau tracts include 350 acres of land anticipated for residential and commercial development. The Kealakehe tract is a 55-acre portion of the Villages of Laiopua anticipated for 236 residential units. In 2004, the DHHL obtained the remainder of the Villages of Laiopua from HCDC and the State of Hawaii, Department of Land and Natural Resources (DLNR). The entire Villages of Laiopua has an estimated potential of 2,000 residential units, which corresponds to an average daily demand of 0.8 mgd. The total potable water requirement of all DHHL tracts based on the

2002 DHHL Water Resources report, and refined with updated information from DHHL, is 1.46 mgd.

809.4.2.1.3 Agricultural Water Use and Development Plan

There is no information available in the AWUDP specific to activity within the Hualalai ASEA to further refine projections.

809.4.3 Water Use Unit Rates

Water use unit rates are based on the *Water System Standards* as discussed in **Chapter 2, Technical Approach**, and single family residential (Low Density Urban category of the General Plan and RS or Single-Family Residential category of County Zoning) consumption is 400 gallons per unit and 2.5 units per lot based on historical consumption data for the area.

809.4.4 5-Year Incremental Water Demand Projections to the Year 2025

The following section presents 5-year incremental water demand projections to the year 2025 for the Hualalai ASEA and the Keauhou and Kiholo ASYA separately. The projected low, medium, and high growth rates are listed in **Tables 809-16**, **809-16a**, and **809-16b** for the sector and system areas, respectively, and are graphed in **Figures 809-8, 809-8a**, and **809-8b**. Potable and nonpotable water demands are also differentiated.

Figures 809-9, 809-9a, and **809-9b** illustrate the magnitude of the sustainable yield, both LUPAG and Zoning full build-out water use, and water use projection through the year 2025 focusing on Medium Growth Rate B, for the sector and system areas, respectively. **Figures 809-10, 809-10a**, and **809-10b** show the breakdown of water demand projections by CWRM categories through the year 2025. **Tables 809-17, 809-17a**, and **809-17b** summarize these figures for the sector and system areas, respectively.

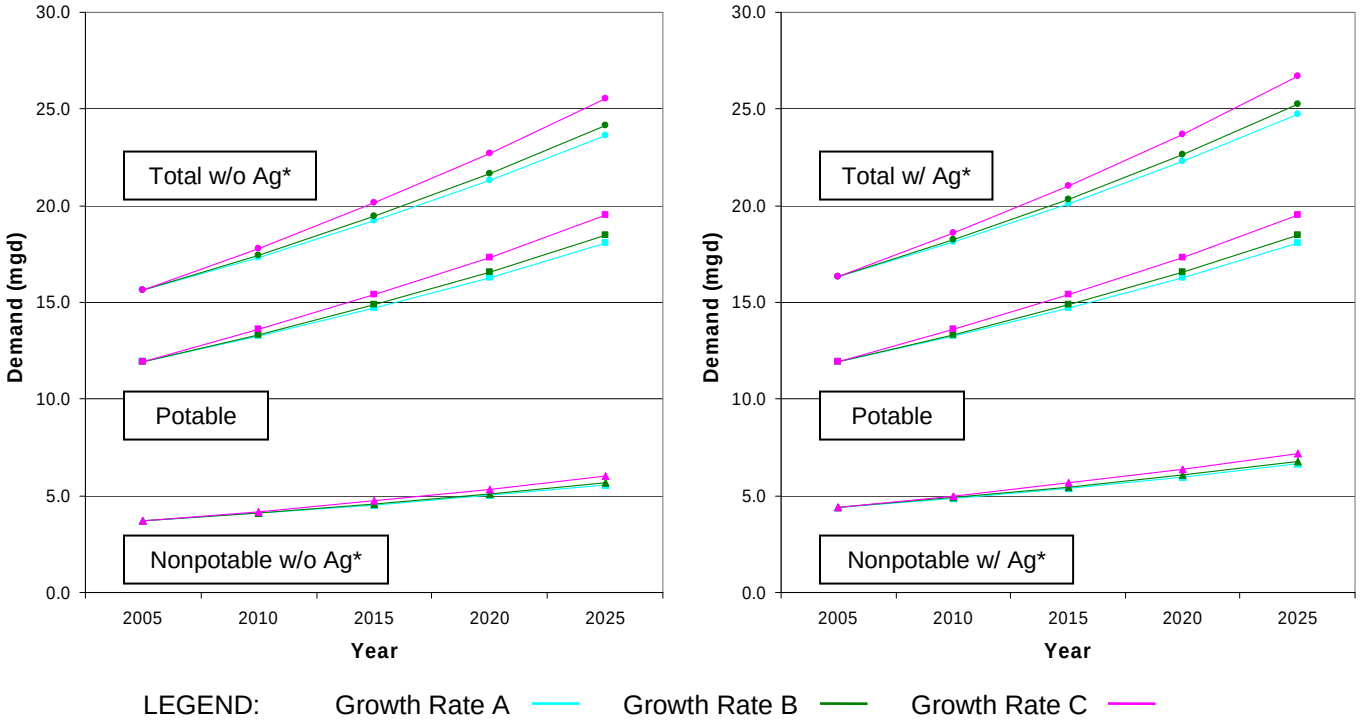
809.4.4.1 Hualalai Aquifer Sector Area

Table 809-16: Water Demand Projection – Hualalai Aquifer Sector Area

	Without Agricultural Demands*					With Agricultural Demands*				
GROWTH RATE A	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	15.6	17.3	19.2	21.3	23.7	16.3	18.1	20.1	22.3	24.7
Potable	11.9	13.3	14.7	16.3	18.1	11.9	13.3	14.7	16.3	18.1
Nonpotable	3.7	4.1	4.5	5.0	5.6	4.4	4.9	5.4	6.0	6.6
GROWTH RATE B	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	15.6	17.5	19.5	21.7	24.2	16.3	18.2	20.3	22.7	25.3
Potable	11.9	13.3	14.9	16.6	18.5	11.9	13.3	14.9	16.6	18.5
Nonpotable	3.7	4.1	4.6	5.1	5.7	4.4	4.9	5.5	6.1	6.8
GROWTH RATE C	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	15.6	17.8	20.1	22.7	25.5	16.3	18.6	21.0	23.7	26.7
Potable	11.9	13.6	15.4	17.3	19.5	11.9	13.6	15.4	17.3	19.5
Nonpotable	3.7	4.2	4.7	5.3	6.0	4.4	5.0	5.7	6.4	7.2

* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 809-8: Water Demand Projection Summary – Hualalai Aquifer Sector Area



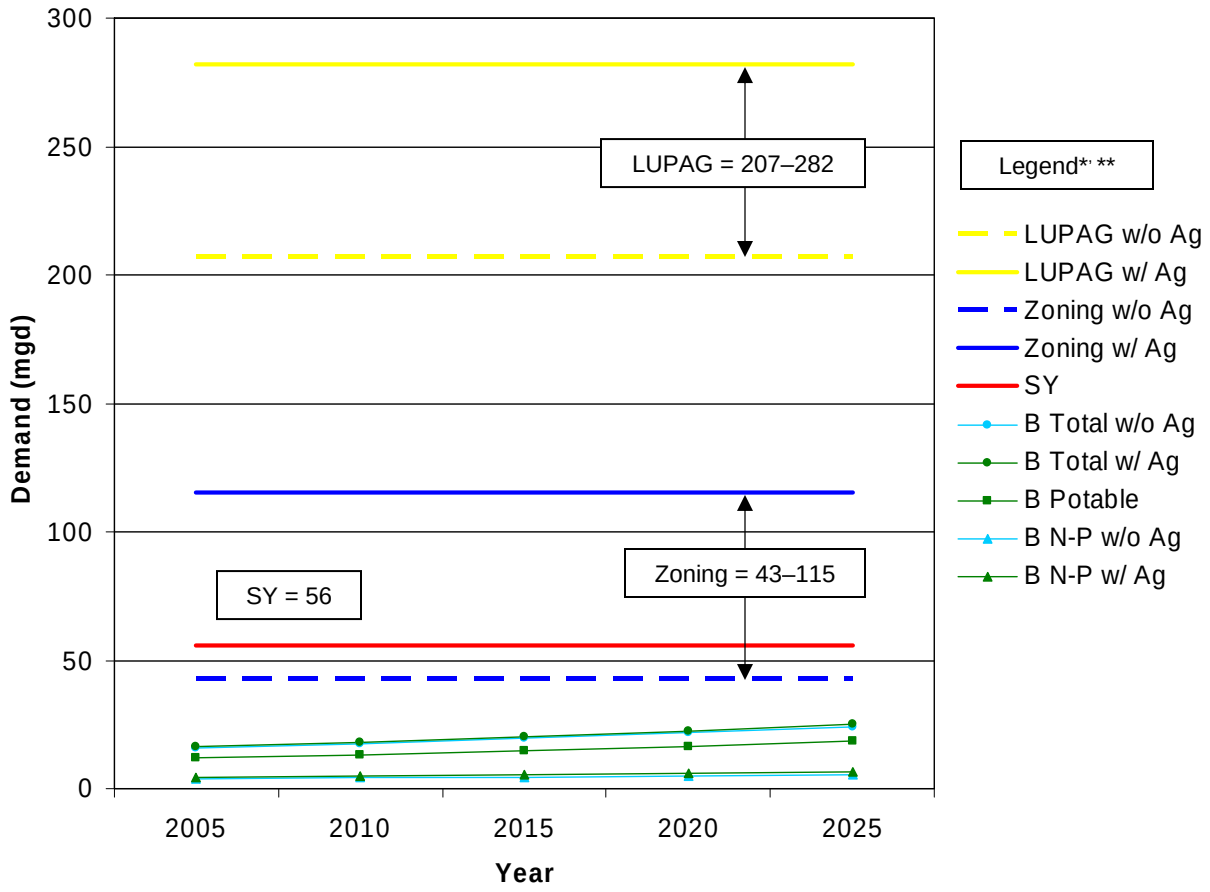
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 809-17: Medium Growth Rate B Water Demand Projection by Category – Hualalai Aquifer Sector Area

Water Use Category	2005 (mgd)	2010 (mgd)	2015 (mgd)	2020 (mgd)	2025 (mgd)
Total without Ag*	15.6	17.5	19.5	21.7	24.2
Total with Ag*	16.3	18.2	20.3	22.7	25.3
Domestic	0.4	0.4	0.5	0.5	0.6
Industrial	0.1	0.1	0.1	0.1	0.1
Irrigation	3.6	4.0	4.5	5.0	5.6
Agriculture	0.7	0.8	0.9	1.0	1.1
Military	0.0	0.0	0.0	0.0	0.0
Municipal	11.5	12.9	14.4	16.0	17.9
Potable	11.9	13.3	14.9	16.6	18.5
Nonpotable w/o Ag*	3.7	4.1	4.6	5.1	5.7
Nonpotable w/ Ag*	4.4	4.9	5.5	6.1	6.8
DWS	9.4	10.6	11.8	13.1	14.6

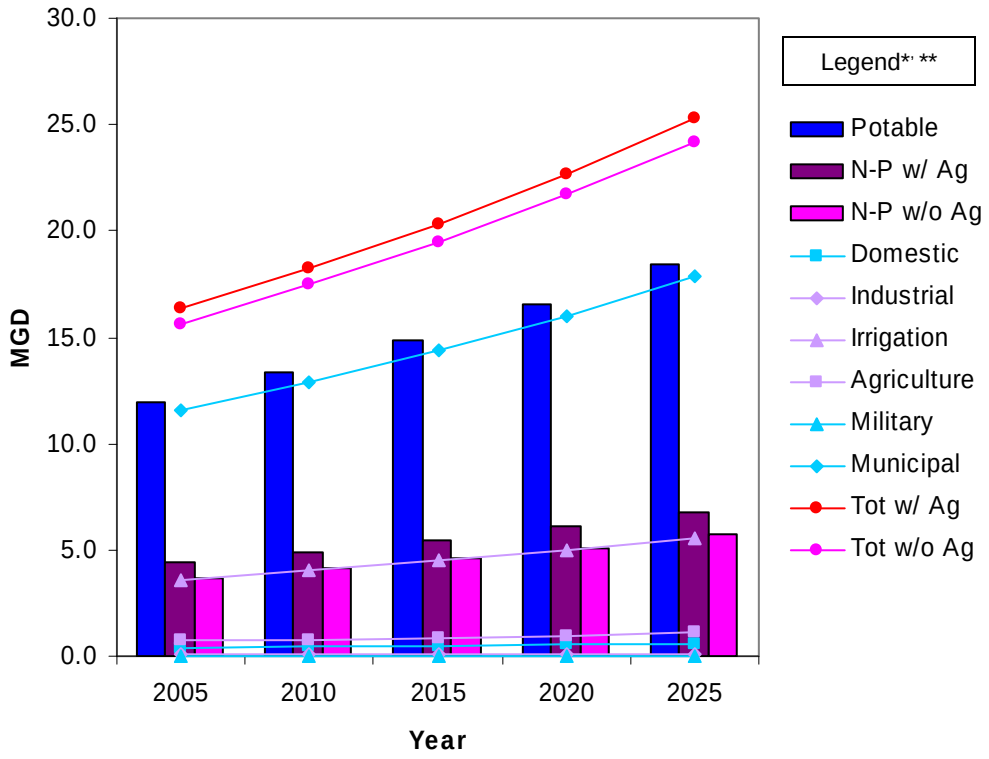
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 809-9: Medium Growth Rate B Water Demand Projections and Full Build-Out – Hualalai Aquifer Sector Area



* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.
** The LUPAG and Zoning scenarios represent demand from full build-out to the maximum density allowed and are not associated with a timeline. The B scenario represents the 5-year incremental demand based on Growth Rate B population projections, with “Potable” representing the potable component, “N-P” representing the nonpotable component and “Total” representing the sum of the two.

Figure 809-10: Medium Growth Rate B Water Demand Projection by Category – Hualalai Aquifer Sector Area



* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.
** "N-P" represents the nonpotable component of the demand.

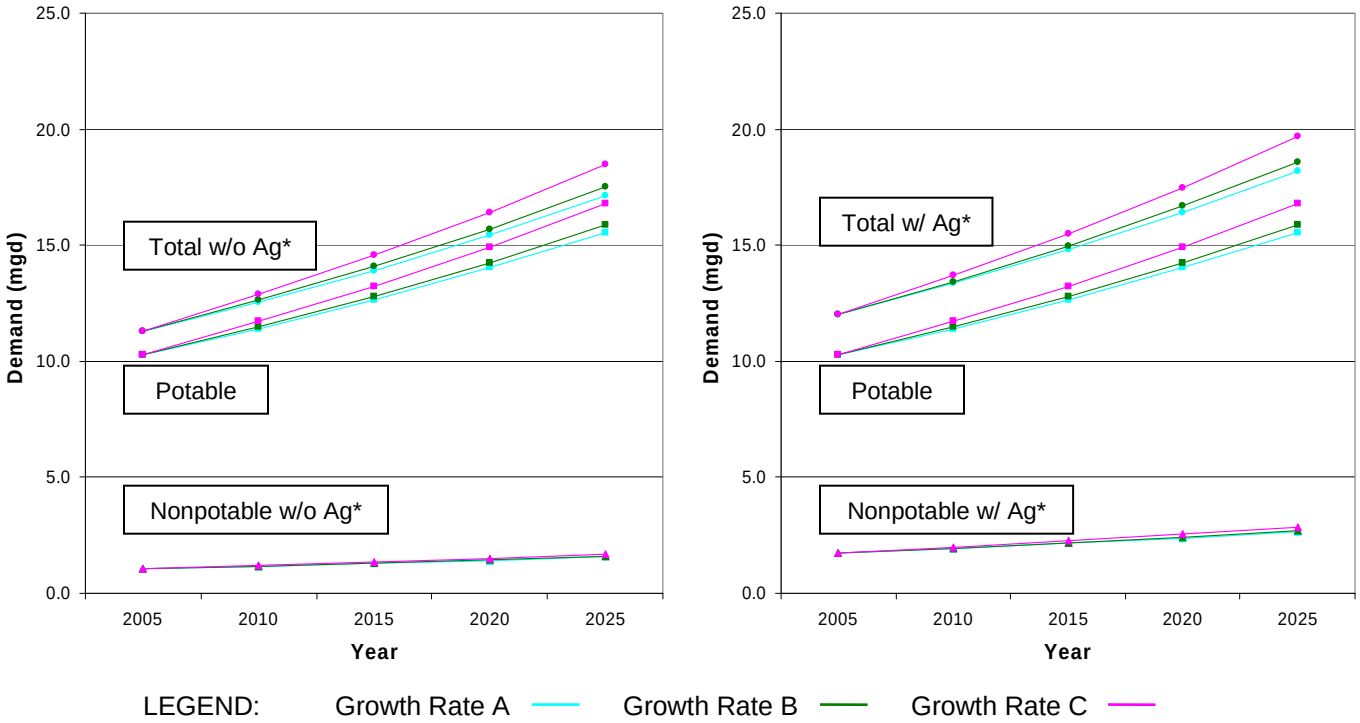
809.4.4.2 Keauhou Aquifer System Area [80901]

Table 809-16a: Water Demand Projection – Keauhou Aquifer System Area [80901]

	Without Agricultural Demands*					With Agricultural Demands*				
GROWTH RATE A	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	11.3	12.6	13.9	15.4	17.1	12.0	13.4	14.8	16.4	18.2
Potable	10.3	11.4	12.6	14.0	15.5	10.3	11.4	12.6	14.0	15.5
Nonpotable	1.0	1.2	1.3	1.4	1.6	1.7	1.9	2.2	2.4	2.6
GROWTH RATE B	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	11.3	12.6	14.1	15.7	17.5	12.0	13.4	15.0	16.7	18.6
Potable	10.3	11.5	12.8	14.3	15.9	10.3	11.5	12.8	14.3	15.9
Nonpotable	1.0	1.2	1.3	1.4	1.6	1.7	2.0	2.2	2.4	2.7
GROWTH RATE C	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	11.3	12.9	14.6	16.4	18.5	12.0	13.7	15.5	17.5	19.7
Potable	10.3	11.7	13.2	14.9	16.8	10.3	11.7	13.2	14.9	16.8
Nonpotable	1.0	1.2	1.3	1.5	1.7	1.7	2.0	2.3	2.5	2.9

* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 809-8a: Water Demand Projection Summary – Keauhou Aquifer System Area [80901]



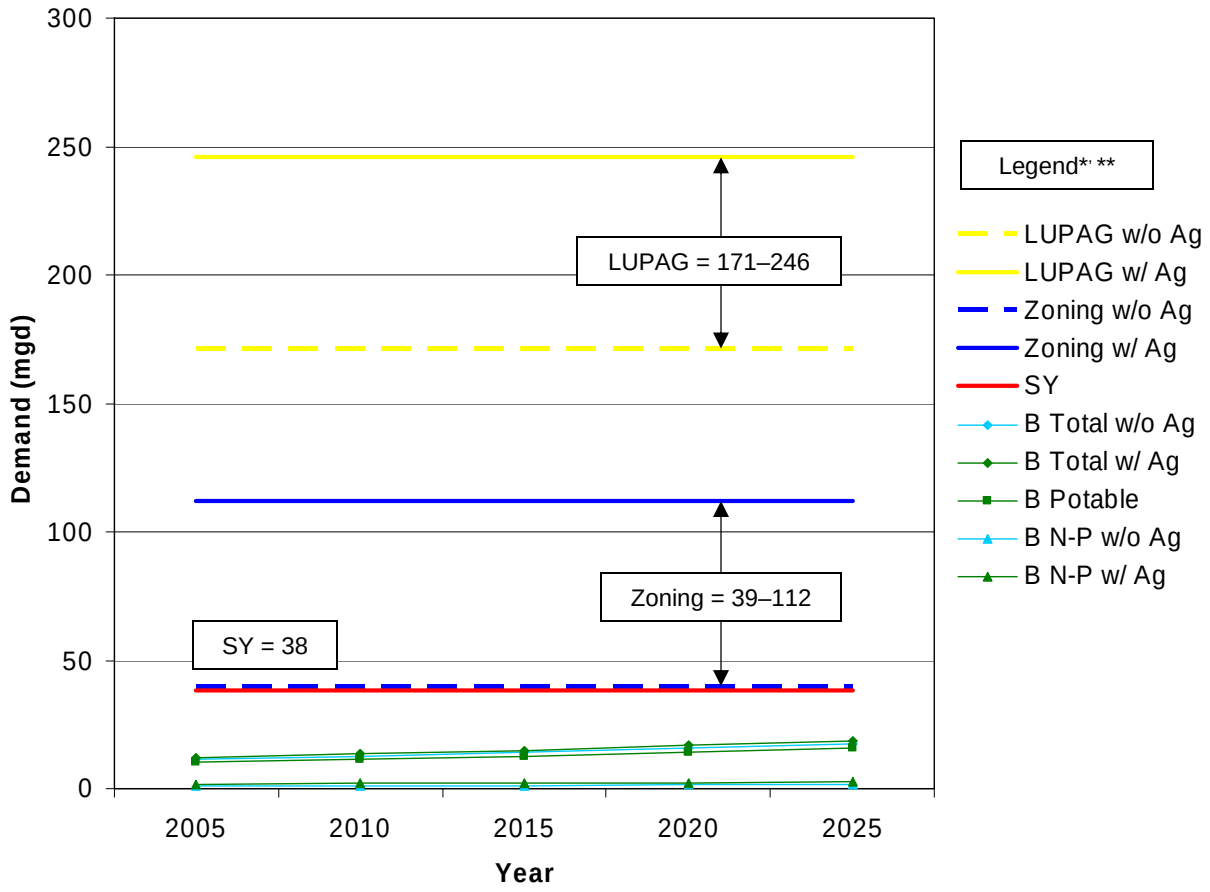
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 809-17a: Medium Growth Rate B Water Demand Projection by Category – Keauhou Aquifer System Area [80901]

Water Use Category	2005 (mgd)	2010 (mgd)	2015 (mgd)	2020 (mgd)	2025 (mgd)
Total without Ag*	11.3	12.6	14.1	15.7	17.5
Total with Ag*	12.0	13.4	15.0	16.7	18.6
Domestic	0.4	0.4	0.4	0.5	0.5
Industrial	0.1	0.1	0.1	0.1	0.1
Irrigation	1.0	1.1	1.2	1.3	1.5
Agriculture	0.7	0.8	0.9	1.0	1.1
Military	0.0	0.0	0.0	0.0	0.0
Municipal	9.9	11.1	12.3	13.8	15.3
Potable	10.3	11.5	12.8	14.3	15.9
Nonpotable w/o Ag*	1.0	1.2	1.3	1.4	1.6
Nonpotable w/ Ag*	1.7	2.0	2.2	2.4	2.7
DWS	9.4	10.5	11.7	13.1	14.6

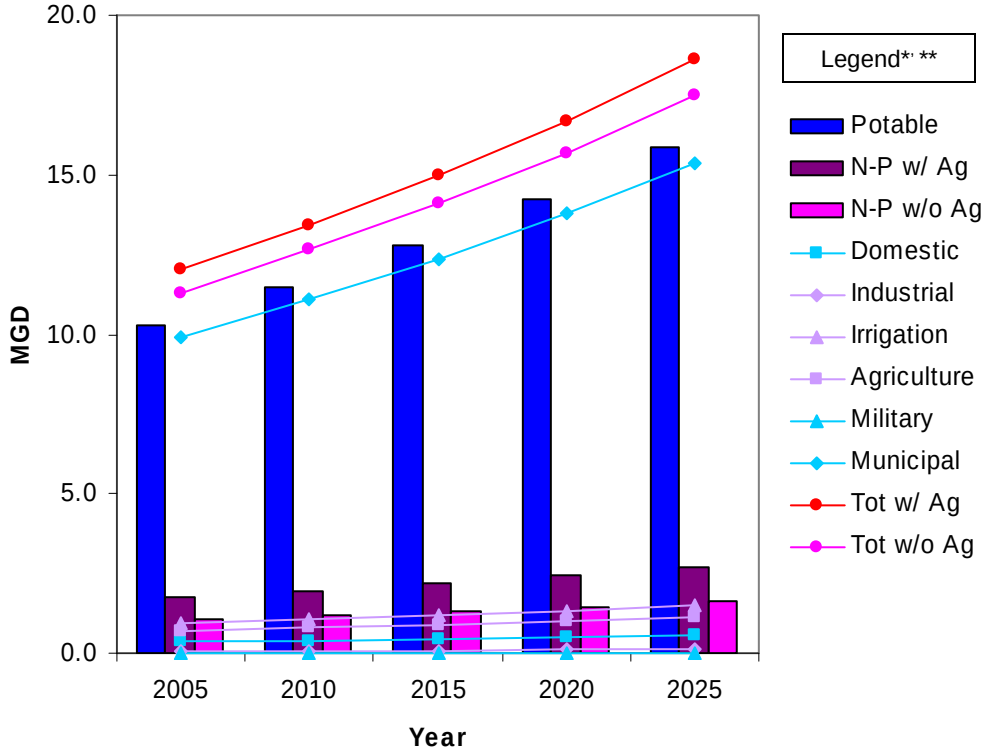
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 809-9a: Medium Growth Rate B Water Demand Projections and Full Build-Out – Keauhou Aquifer System Area [80901]



* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.
** The LUPAG and Zoning scenarios represent demand from full build-out to the maximum density allowed and are not associated with a timeline. The B scenario represents the 5-year incremental demand based on Growth Rate B population projections, with "Potable" representing the potable component, "N-P" representing the nonpotable component and "Total" representing the sum of the two.

Figure 809-10a: Medium Growth Rate B Water Demand Projection by Category – Keauhou Aquifer System Area [80901]



* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.
** "N-P" represents the nonpotable component of the demand.

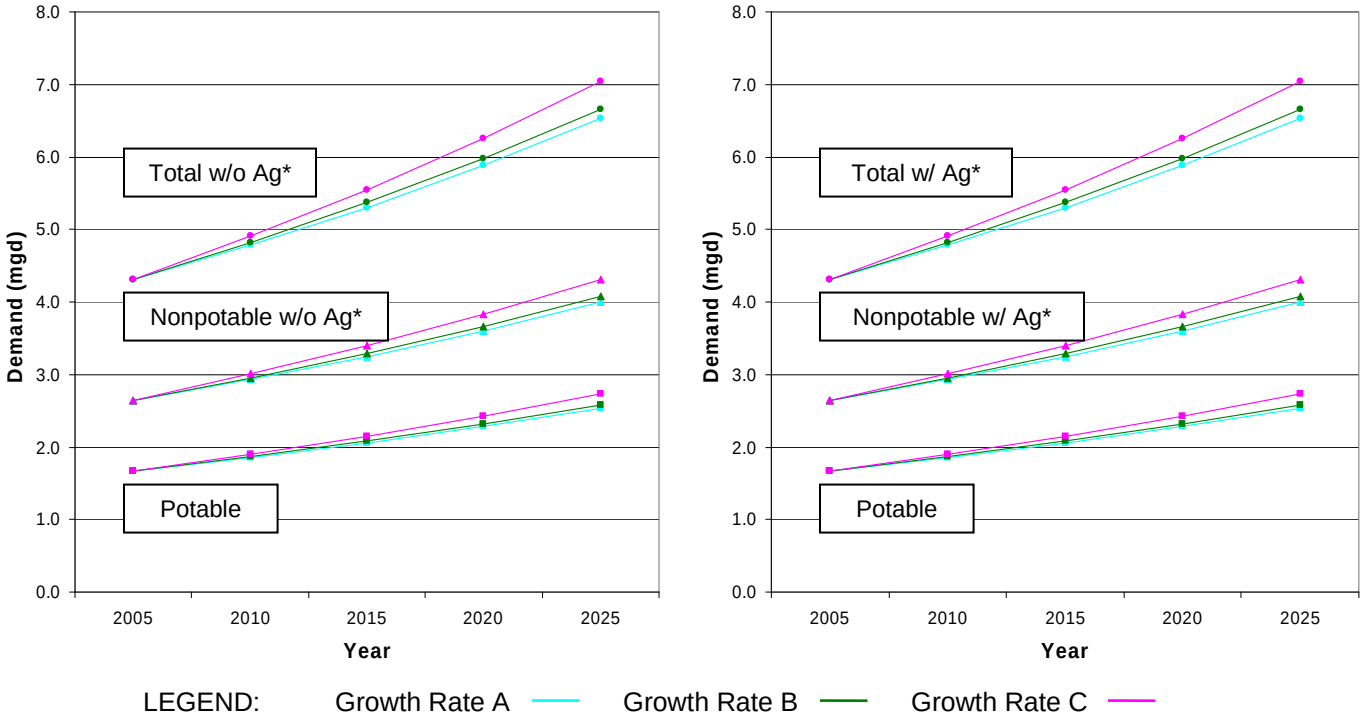
809.4.4.3 Kiholo Aquifer System Area [80902]

Table 809-16b: Water Demand Projection – Kiholo Aquifer System Area [80902]

	Without Agricultural Demands*					With Agricultural Demands*				
GROWTH RATE A	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	4.3	4.8	5.3	5.9	6.5	4.3	4.8	5.3	5.9	6.5
Potable	1.7	1.9	2.1	2.3	2.5	1.7	1.9	2.1	2.3	2.5
Nonpotable	2.6	2.9	3.2	3.6	4.0	2.6	2.9	3.2	3.6	4.0
GROWTH RATE B	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	4.3	4.8	5.4	6.0	6.7	4.3	4.8	5.4	6.0	6.7
Potable	1.7	1.9	2.1	2.3	2.6	1.7	1.9	2.1	2.3	2.6
Nonpotable	2.6	3.0	3.3	3.7	4.1	2.6	3.0	3.3	3.7	4.1
GROWTH RATE C	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	4.3	4.9	5.5	6.3	7.0	4.3	4.9	5.5	6.3	7.0
Potable	1.7	1.9	2.2	2.4	2.7	1.7	1.9	2.2	2.4	2.7
Nonpotable	2.6	3.0	3.4	3.8	4.3	2.6	3.0	3.4	3.8	4.3

* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 809-8b: Water Demand Projection Summary – Kiholo Aquifer System Area [80902]



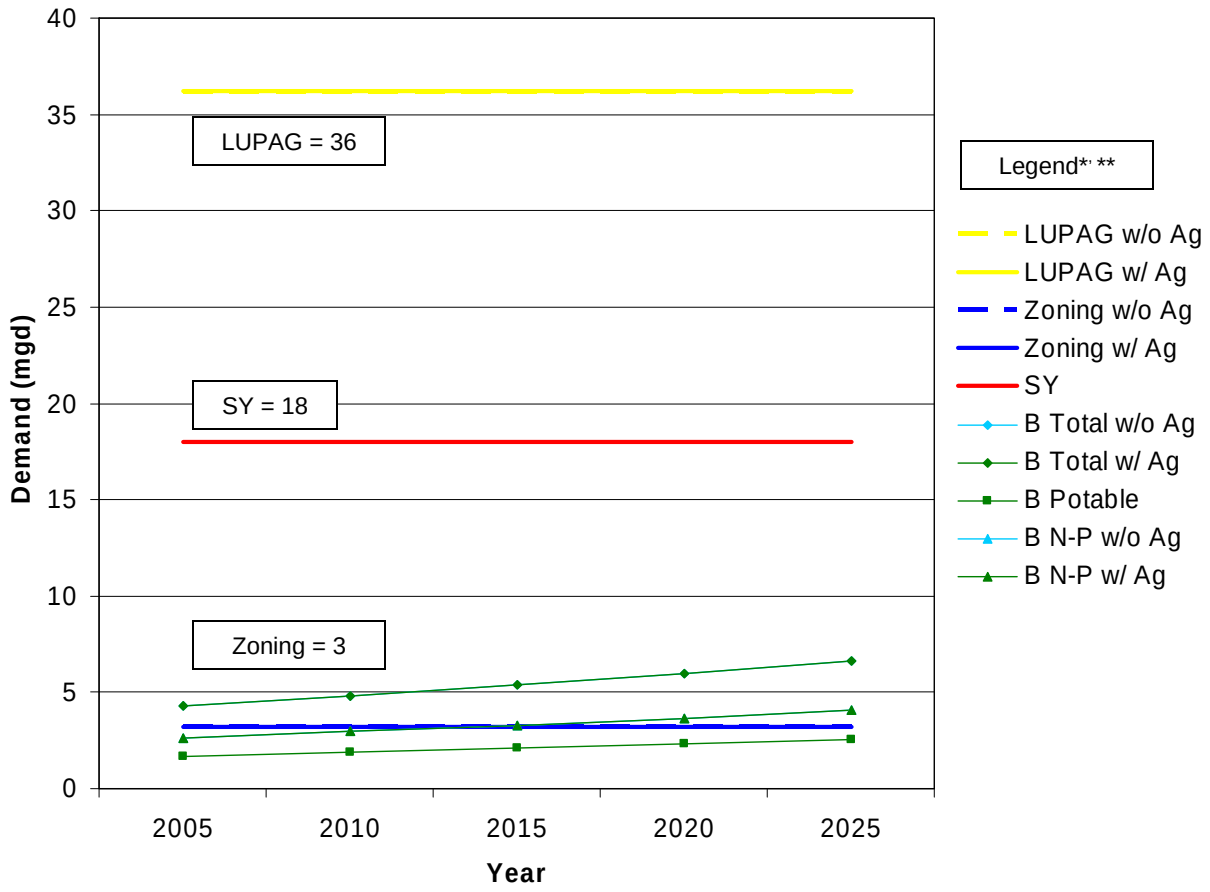
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 809-17b: Medium Growth Rate B Water Demand Projection by Category – Kiholo Aquifer System Area [80902]

Water Use Category	2005 (mgd)	2010 (mgd)	2015 (mgd)	2020 (mgd)	2025 (mgd)
Total without Ag*	4.3	4.8	5.4	6.0	6.7
Total with Ag*	4.3	4.8	5.4	6.0	6.7
Domestic	0.0	0.0	0.0	0.0	0.0
Industrial	0.0	0.0	0.0	0.0	0.0
Irrigation	2.6	3.0	3.3	3.7	4.1
Agriculture	0.0	0.0	0.0	0.0	0.0
Military	0.0	0.0	0.0	0.0	0.0
Municipal	1.7	1.8	2.1	2.3	2.6
Potable	1.7	1.9	2.1	2.3	2.6
Nonpotable w/o Ag*	2.6	3.0	3.3	3.7	4.1
Nonpotable w/ Ag*	2.6	3.0	3.3	3.7	4.1
DWS	0.0	0.0	0.0	0.0	0.0

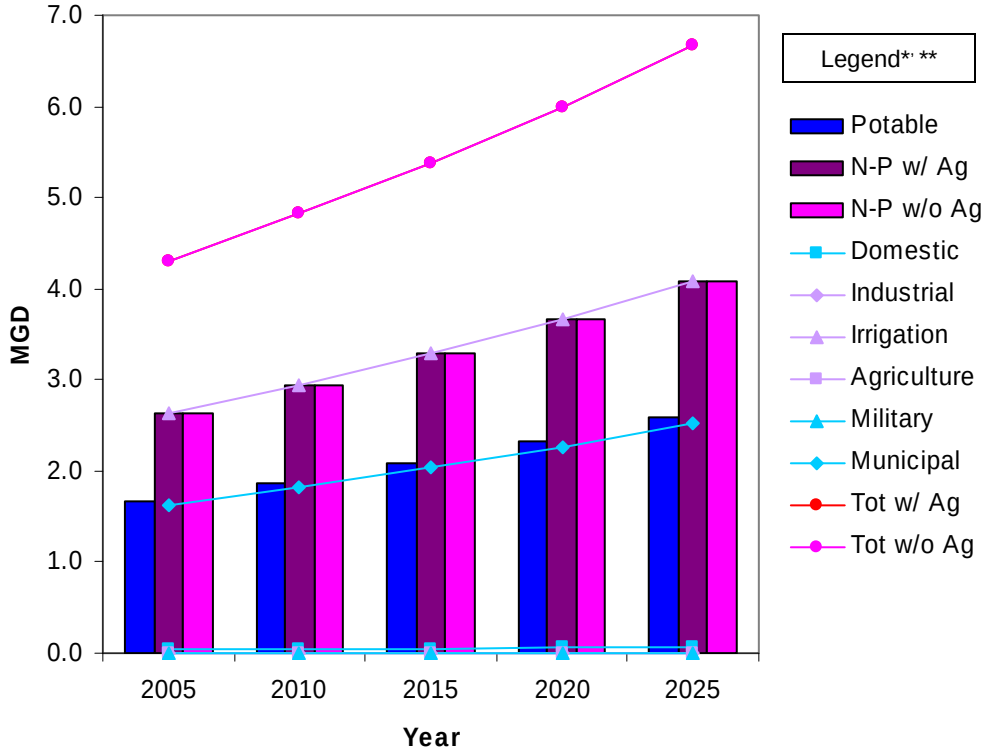
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 809-9b: Medium Growth Rate B Water Demand Projections and Full Build-Out – Kiholo Aquifer System Area [80902]



* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.
** The LUPAG and Zoning scenarios represent demand from full build-out to the maximum density allowed and are not associated with a timeline. The B scenario represents the 5-year incremental demand based on Growth Rate B population projections, with "Potable" representing the potable component, "N-P" representing the nonpotable component and "Total" representing the sum of the two.

Figure 809-10b: Medium Growth Rate B Water Demand Projection by Category – Kiholo Aquifer System Area [80902]

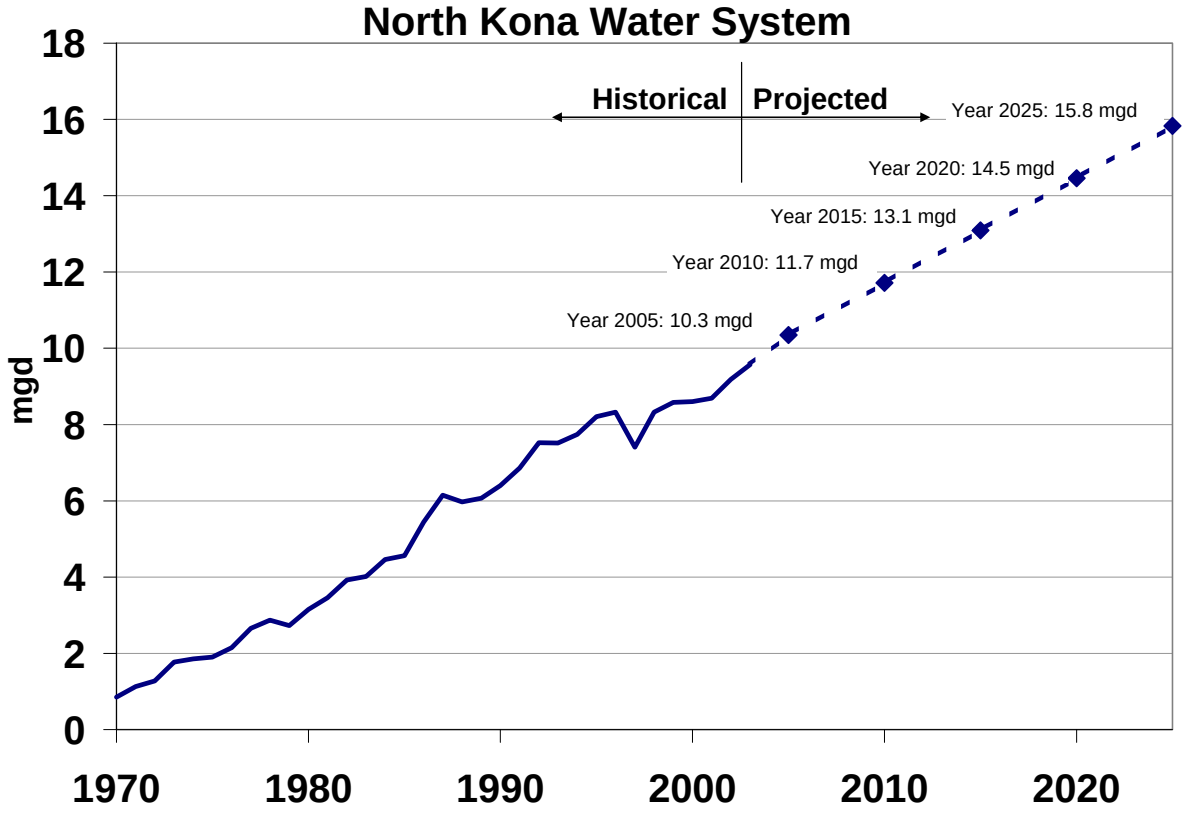


* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.
** "N-P" represents the nonpotable component of the demand.

809.4.5 DWS Historical Water Consumption Data Projections

DWS supplied water consumption was projected in 5-year increments to the year 2025 based on DWS historical water system consumption data from 1970 to 2003, as shown in **Figure 809-11**.

Figure 809-11: DWS Water Demand Projection – Hualalai Aquifer Sector Area



Historical data and graph provided by RW Beck, Inc.

Projections based on historical DWS water consumption data are slightly higher than projections based on population growth rate primarily because the projected demand for 2005 is higher than actual data. The growth rate, however is consistent with the projections for the total sector area, and indicates that DWS may need to supply potable water equivalent to over 50 percent of the total projected water supply for the Hualalai ASEA.

809.5 RESOURCE AND FACILITY RECOMMENDATIONS

809.5.1 Water Source Adequacy

809.5.1.1 Full Build-Out

The full development of the County General Plan land use maximum density within the Hualalai Aquifer Sector Area (ASEA) cannot be sustained by conventional water resources, even if agricultural demands are not included. The existing zoning would require over twice the existing sustainable yield of the Hualalai ASEA if agricultural demands are included, and over 75 percent of the SY if agricultural demands are not included. Demands from existing zoning for the Keauhou Aquifer System Area (ASYA) would exceed its SY even if agricultural demands are not included.

809.5.1.2 Twenty-Year Projection

Present water requirements are less than 30 percent of the Hualalai ASEA sustainable yield. This is expected to increase to between 43 and 45 percent by 2025. The percentage of current and projected water requirements of the sustainable yield within the Keauhou and Kiholo ASYAs are similar.

809.5.2 Source Development Requirements

809.5.2.1 Supply-Side Management

Supply-side management, including conventional water resource measures and alternative water resource enhancement measures, are evaluated to meet projected water demands.

809.5.2.1.1 Conventional Water Resource Measures

809.5.2.1.1.1 Ground Water

Until the implementation of the high-level Kalaoa Well in 1992, only basal well sources served the DWS system. However, the permeability of the ground and the low hydraulic gradient of the basal water table does not permit wells with high yields, which was evidenced with the rise in chloride content of the Kahaluu Shaft. Small clusters of basal wells with smaller yields spread out over a large area would be required.

Discovery of high-level ground water has triggered significant potable ground water resource development in the Hualalai ASEA with seemingly promising potential. Most of the high-level wells discovered within the Hualalai ASEA are located in the Keauhou ASYA. However, there is also evidence of the occurrence of high-level ground water in the Kiholo ASYA. The 2003 report “A Study of the Ground-Water Conditions in North and South Kona and South Kohala Districts” by the CWRM found that some of the high-level wells studied showed a slow decline of water levels. The report also suggests that more than one geological mechanism may have

created the high-level aquifer, and that the flux of the aquifer flows in a north-south direction with Keopu being the drain. Due to these uncertainties associated with the high-level aquifer, development of this resource accompanied by advance studies would be prudent.

There are several potable water wells drilled which are unused, most of which are owned by private entities. DWS has one well drilled, a second well planned, and is negotiating with private developers for additional water resources which are already drilled. Because the high-level aquifer lies within ground elevations above the 1,600 foot elevation, installation of new wells would require drill depths in the 1,500-foot range, which would be substantially more costly than wells in the basal aquifer. Energy costs would also be much greater due to the high pumping head. The 1995 "North Kona Water Master Plan" by Fukunaga & Associates suggested a water development shaft at Keopu-Puuhonua in lieu of a cluster of wells. A near horizontal tunnel would head inland to a point above the high-level aquifer where shallow vertical wells could be implemented. Limited well tests in the area suggest low drawdown and rapid recovery of the aquifer.

Plans for future nonpotable water sources are not available. Current usage of existing brackish wells primarily for irrigation purposes indicate brackish water is available in areas generally makai of Mamalahoa Highway.

809.5.2.1.1.2 Surface Water

Surface water in the Hualalai ASEA is extremely limited. The spring sources in the vicinity of Waiaha Stream may continue to provide localized needs but cannot be developed on a larger scale. Surface water thus is not deemed a viable resource.

809.5.2.1.1.3 Water Transfer

Water requirements in the Keauhou ASYA will approach the system area's sustainable yield faster than in the Kiholo ASYA. The privately owned Huehue Ranch Water System has wells in both system areas, therefore water transfer is already occurring between system areas. The DWS North Kona Water System is contained entirely within the Keauhou ASYA. Development of sources in the Kiholo ASYA would require extension of the existing water system.

Water transfer from the adjacent Southwest Mauna Loa ASEA (806) is an option to provide water without increasing source production in the sector area. The 2025 potable water projection for ASEA 806 is 2.6 mgd, and the potential 16-hour production of all potable water wells is 3.5 mgd, suggesting that up to 0.9 mgd may be transferred without stressing the existing sources in ASEA 806. Because the sustainable yields of the ASEA 806 and more specifically the Kealakekua ASYA (80603) far exceed the projected demands, developing additional sources in the adjacent ASYA 80603 and transferring water into the Hualalai ASEA is a viable option.

The DWS North Kona Water System is already connected to the South Kona Water System in ASEA 806 by a valve. Minor infrastructure changes would be needed to allow regular water transfer.

809.5.2.1.2 Alternative Water Resource Enhancement Measures

809.5.2.1.2.1 Rainwater Catchment Systems

Most of the area within the Hualalai ASEA does not receive enough rainfall to support individual catchments, although these may be viable in the wetter areas of the rainbelt mauka of Mamalahoa Highway, such as within the vicinity of the Kahaluu Forest Reserve. These areas are mainly zoned for Agricultural uses and are remote from the municipal water system; therefore, catchment may be an option for satisfying the domestic water needs of family agriculture users. Because most of the urban areas within the sector area are within the service area of a municipal system, use of catchments as a sole source is unlikely; however, utilizing catchment systems to supplement a municipal system might be a feasible alternative.

809.5.2.1.2.2 Wastewater Reclamation

The existing wastewater reclamation facilities have the potential capacity to produce approximately 2 mgd of reclaimed wastewater for additional approved nonpotable uses. Effluent reuse is dependent upon viable users within close proximity to the wastewater reclamation facilities; otherwise, this is not a cost-effective alternative. Accordingly, smaller satellite facilities combining a wastewater treatment plant and reclamation facility could be implemented. This would require a carefully coordinated planning effort by several stakeholders, including community development groups, and County Planning, DWS, and Department of Environmental Management staff. Key factors to consider would include service area, proposed land use, costs, and public opinion. Such facilities would be more effective to implement in new communities rather than retrofitting or replacing existing systems; therefore, incorporating the analysis of this alternative at the planning level is desirable.

809.5.2.1.2.3 Desalination

Desalination is a costly, but viable resource enhancement measure. Generally, desalination plants favor economies of scale, so a single larger plant would be more cost-effective than several smaller satellite plants. Preferable locations would be at moderate ground elevations to reduce drilling and pumping costs, and outside the influence of potable water wells. As most of the potable wells are located in a band mauka of Mamalahoa Highway, the area between Queen Kaahumanu Highway and Mamalahoa Highway might be a suitable location for brackish water wells. To reduce transmission system pumping costs, the service area would need to be restricted to lower elevations.

809.5.2.2 Demand-Side Management

809.5.2.2.1 Development Density Control

The full build-out water demand projections are extremely high in comparison with the aquifer sector area sustainable yield. The General Plan and existing zoning should be assessed in light of the fact that the water resources may not be able to sustain the ultimate and potential planned

development. The full build-out demand is based on worst-case scenario development densities; therefore, reduction of current planned development densities should be considered. Preliminary proposals for the Kona Community Development Plan currently being prepared by Wilson Okamoto Corp. indicate urban densities in the 6 to 8 development units per acre range, which would lead to significantly less demand than the ultimate scenarios presented.

809.5.2.2.2 Water Conservation

According to metering records, the average usage of DWS accounts in the Hualalai ASEA is over 1,000 gpd per connection, with average usage of over 600 gpd per connection for residential users, and over 5,000 gpd per connection for non-residential users, both of which are considerably higher than planning level standards. Potable water usage averaged per capita for the aquifer sector area is approximately 350 gpd. Average consumption for purely domestic purposes is generally around 100 gpd per capita; therefore, it can be assumed that a significant quantity, potentially as much as 250 gpd per capita, is being used for irrigation purposes. Consumption could be significantly reduced through end-user conservation. A number of measures may be implemented to facilitate end-user conservation, including water restrictions during drier periods, public education, and more efficient landscaping practices. Water purveyors could more easily justify implementing conservation measures in the Hualalai ASEA than most other ASEAs, because it is one of the driest and warmest areas on the island, and considering the volume of water used.

The DWS North Kona Water System is one of the most efficient on the island, having 97% of its source water production accounted for by metering records. The costs to implement practices to account for non-revenue water would not justify the minimal savings in source water.

809.5.3 Recommended Alternatives

Continued groundwater development is recommended; however, exploitation of the aquifer sustainable yield, especially of the high-level aquifer, should be closely monitored in both Aquifer System Areas. The forthcoming update to the *Water Resource Protection Plan* may provide further insight into the extent to which the high-level aquifer can be developed. Groundwater development in the adjacent Kealakekua ASYA (80603) and subsequent transfer of water is also recommended if sources in the Keauhou ASYA become stressed.

The Kaloko-Honokohau National Historic Park is a 1,200-acre site located makai of Queen Kaahumanu Highway. The park encompasses extraordinary and unique cultural and natural resources which include terrestrial ecosystems, coral reef ecosystems, and significant archeological sites such as modified anchialine pools and significant Hawaiian fishponds. It has been brought to the attention of the CWRM that groundwater quality and discharge are vital to the sustainability of these resources, and concerns have been raised over the potential cumulative effects that increased groundwater extraction may have on these resources. The WUDP proposes additional monitoring and studies to comprehensively evaluate the impacts on the park's resources, and utilization of this information to coordinate responsible planning of resource development.

The concept of using the highest quality water for the highest end use cannot be emphasized enough. According to DWS metering records, 1.19 mgd was drawn by users classified as agricultural, which could be satisfied by nonpotable sources. Other non-residential uses comprise a large portion of the potable water consumed, some of which could also be supplied by nonpotable water, such as irrigation for commercial developments. Further studies on the feasibility of transferring nonpotable users to nonpotable sources, and the other aforementioned alternative water resource enhancement measures would be prudent. The benefits and drawbacks of each alternative, along with input from the various stakeholders, should be considered to develop an optimal combination of resource enhancement measures.

Water conservation is the responsibility of the community but must be facilitated by the water purveyors. It is recommended that the Department of Water Supply, being the largest provider of potable water in the Hualalai Aquifer Sector Area, develop water conservation programs, primarily aimed at demand-side measures in order to reduce the average consumption per user closer to the island-wide average.