801 KOHALA AQUIFER SECTOR AREA

801.1 SECTOR AREA PROFILE

801.1.1 General

The Kohala Aquifer Sector Area (ASEA) includes the Hawi [80101], Waimanu [80102] and Mahukona [80103] Aquifer System Areas (ASYA), capturing the entire North Kohala district, the northern section of the South Kohala district, and the northeastern tip of the Hamakua district. The southern boundary of the sector stretches from Kawaihae on the leeward coast to Waipio Bay. The sector area includes the Kohala Mountain range and most of Waimea Village.

Rainfall is extremely variable throughout the sector area. The heaviest rainfall of 200 inches per year is on the mountain top while the dry western or leeward slopes of the Kohala Mountain have annual average rainfall of about 10 inches along the coast. The Waimanu ASYA receives the most rainfall, and thus has the highest sustainable yield of 110 mgd. The Mahukona ASYA encompasses the drier leeward side and accordingly has a SY of 17 mgd. The Hawi ASYA has a SY of 27 mgd. The total SY of the Kohala ASEA is 154 mgd.

801.1.2 Economy and Population

801.1.2.1 Economy

Ranching (especially cattle), macadamia nut production, and nursery products continue to be the principal agricultural activities within the Kohala ASEA. The 8,500-acre Kahua Ranch is home to 2,000 cows and 1,500 sheep, and also welcomes over 5,500 visitors a year. The majority of the land formerly in sugar is now utilized for grazing purposes. Truck crops are also grown on smaller tracts.

Tourism and the continuing development of resort complexes and related industries are another important source of income and employment. Plans for a 240-unit resort and residential development have been developed by Chalon International, Inc., one of the major landowners in the sector. North Kohala's abundant natural and historic amenities have also contributed to the tourist industry.

The W.M. Keck Observatory has its headquarters on land in Waimea within the Kohala ASEA donated by Parker Ranch. The observatory on Mauna Kea holds the twin Keck Telescopes, the world's largest optical and infrared telescopes. Keck employs 125 full-time employees and has an annual operating budget of $11 million.

The Upolu Airport, located three miles northwest of Hawi, is used occasionally by sightseeing air taxis and flight training activities; however, there are no regularly scheduled commercial flights.

801.1.2.2 Population

The population contributing to the demand within the Kohala ASEA is from the North Kohala District and the Waimea Village section of the South Kohala District. The significant growth in population in the sector area over the last 20 years can be attributed to the growth in tourism, influx of retirees and other entrepreneurial activities in North Kohala. Additionally, many residents of North Kohala are employed in South Kohala, which has also experienced significant growth in tourism.

Table 801-1: Historical Population

1980	1990	2000	1980-90 % Change	1990-2000 % Change
5,133	7,807	11,000	52.1	40.9

Data Source: 2000 U.S. Census
Data redistributed and evaluated for Kohala Aquifer Sector Area

Table 801-2: Population Projection

Growth Rate	2000	2005	2010	2015	2020	2000-10 % Change	2010-20 % Change
A – Low	11,000	12,447	14,569	17,021	19,913	32.4	36.7
B – Medium	11,000	12,487	14,697	17,271	20,309	33.6	38.2
C – High	11,000	13,008	15,618	18,628	22,140	42.0	41.8

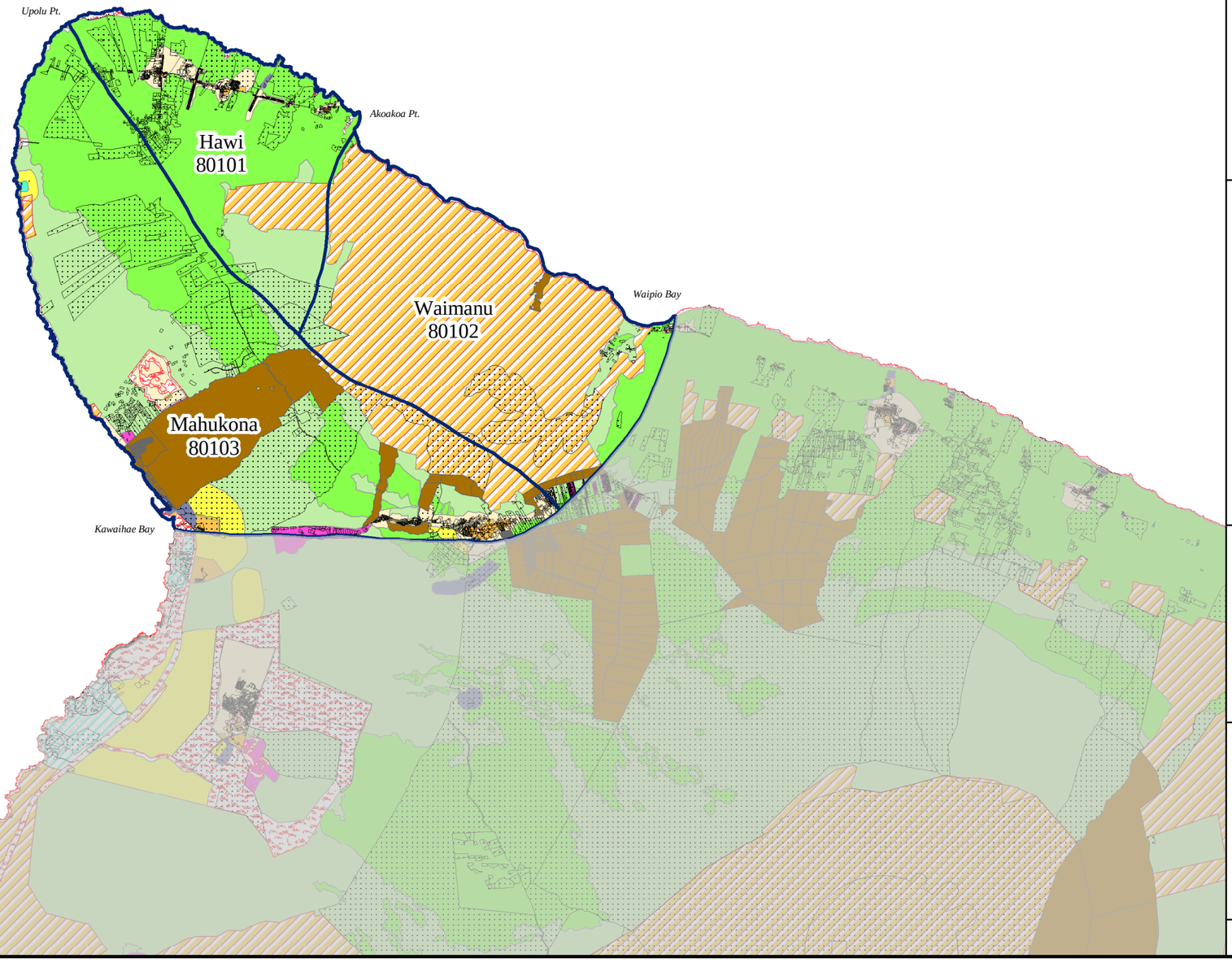
Data Source: County General Plan, February 2005
Data redistributed and evaluated for Kohala Aquifer Sector Area

801.1.3 Land Use

801.1.3.1 Hawaii County General Plan

The Hawaii County General Plan Land Use Pattern Allocation Guide Map for the Kohala ASEA is shown on **Figure 801-1**. The estimated land use allocation acreage for each LUPAG designation within the sector area is listed in **Table 801-3**.

PACIFIC OCEAN



Hawaii County
Department of Water Supply

DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

Job No. 2003-818

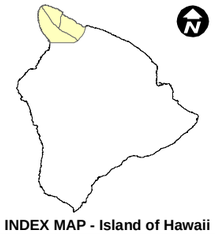
LEGEND:

- 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

2 1 0 2
Miles



INDEX MAP - Island of Hawaii

FIGURE 801-1

AQUIFER SECTOR
KOHALA - 801

Aquifer Systems
Hawi - 80101
Waimanu - 80102
Mahukona - 80103

2005 Revised General Plan Land Use Pattern Allocation Guide Map

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

Table 801-3: LUPAG Map Estimated Land Use Allocation Acreage – Kohala Aquifer Sector Area

LAND USE PATTERN	ACREAGE	% of TOTAL
High Density Urban	0	0
Medium Density Urban	795	0.5
Low Density Urban	4,596	3.2
Industrial	854	0.6
Important Agricultural Land	50,712	32.9
Extensive Agriculture	41,016	26.6
Orchard	0	0
Rural	735	0.5
Resort/Resort Node	47	0.0
Open	2,930	1.9
Conservation	49,869	32.3
Urban Expansion	2,297	1.5
University Use	0	0
TOTAL	154,211	100.0

The water utility courses of action for North Kohala in the Hawaii County General Plan are as follows:

(a) *Pursue a groundwater source for the Makapala-Keokea water system.*
(b) *Explore further sources for future needs.*
(c) *Improve and replace inadequate distribution mains and storage facilities.*
(d) *Encourage efforts to improve the Kohala ditch system and its use for agricultural purposes.*

The water utility course of action for South Kohala in the Hawaii County General Plan relevant to the Kohala ASEA is as follows:

(e) *Continue to seek groundwater sources for the Waimea system.*

801.1.3.2 Hawaii County Zoning

Hawaii County Zoning for the Kohala ASEA is shown on **Figure 801-2**. The estimated land use allocation acreage for each zoning class within the sector area is listed in **Table 801-4**.

Table 801-4: County Zoning Estimated Class Allocation Acreage – Kohala Aquifer Sector Area

ZONING CLASS	ACREAGE	% of TOTAL
Single Family Residential	1,923	1.2
Multi-Family Residential (including duplex)	212	0.1
Residential-Commercial Mixed Use	0	0
Resort	28	0.0
Commercial	297	0.2
Industrial	271	0.2
Industrial-Commercial Mixed	0	0
Family Agriculture	26	0.0
Residential Agriculture	124	0.1
Agriculture	99,770	64.7
Open	963	0.6
Project District	0	0
Forest Reserve	49,289	32.0
(road)	1,307	0.9
TOTAL	154,210	100.0

801.2 EXISTING WATER RESOURCES

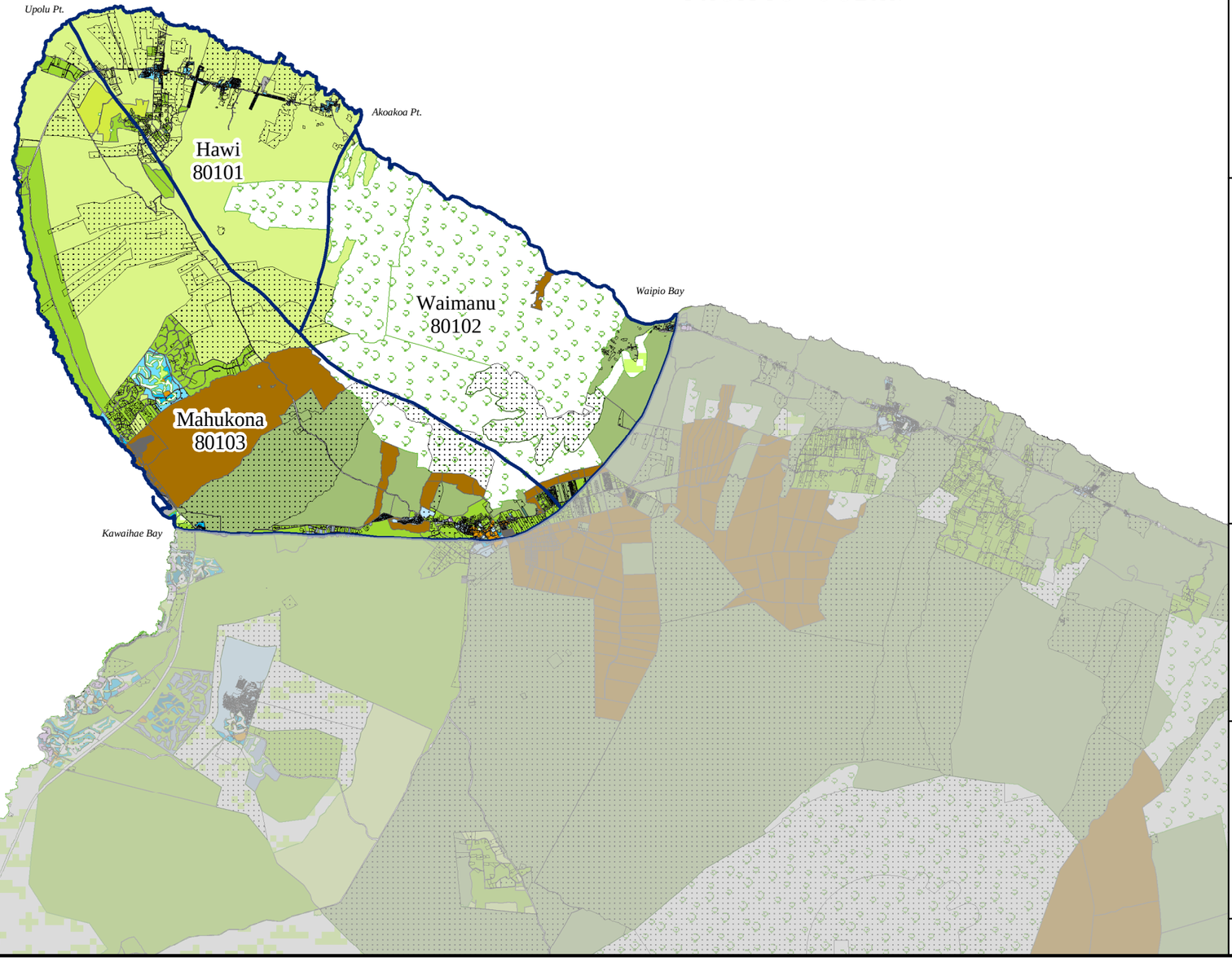
801.2.1 Ground Water

The Kohala ASEA has a sustainable yield of 154 mgd. According to the CWRM database, there are 63 production wells in the sector area, including 18 municipal, 1 domestic, 3 industrial, 33 irrigation and 8 categorized as "other"; however, only 5 wells reported pumpage. The majority of these wells are tunnels or shafts. There are also 30 wells drilled and categorized as "unused. Refer to **Appendix B** for this database. **Figure 801-3** shows the well locations.

801.2.2 Surface Water

There are 40 streams in the Kohala ASEA classified as perennial, of which 34 are considered continuous and 6 are considered intermittent. Seven of the 12 active gages on the island operated by the USGS are located in the sector area. Flow data from these gages were previously listed in **Table 1-8**.

There are 101 declared stream diversions in CRWM database in the sector area shown on **Figure 801-4**, which accounts for half of the declared stream diversions on the island. The stream diversions with declared flows are listed in **Table 801-5**.



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, Geneeral
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

2 1 0 2

Miles

INDEX MAP - Island of Hawaii

FIGURE 801-2

AQUIFER SECTOR
KOHALA - 801

Aquifer Systems

Hawi - 80101
Waimanu - 80102
Mahukona - 80103

County Zoning

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Consulting Engineers
1388 Kapiolani Boulevard, Honolulu, Hawaii 96814

Figure 801-3: Well and Tunnel Location

MAP CURRENTLY NOT AVAILABLE ON-LINE

Figure 801-4: Streams & Diversions

MAP CURRENTLY NOT AVAILABLE ON-LINE

Table 801-5: Stream Diversions – Kohala Aquifer Sector Area

FILE REFERENCE	TMK	STREAM NAME	
CHALON INT	5-2-004:003	Puwaiole Gulch	Stream diversion, Intake #9 from Puwaiole Stream. Temporarily damaged. Declared Q of 5.849 is the total for Hawi Weir.
CHALON INT	5-2-005:001	Waipuni Gulch	Stream diversion, Intake #7 from Waipuhi Stream to Kohala Ditch. Declared Q of 5.849 is the total for Hawi Weir; Verified Q is estimated from flow velocity.
CHALON INT	5-2-005:001	Niulii	Stream diversion, Intake #5 from Niulii Stream to Kohala Ditch. Declared Q of 2.571 is the total for Niulii Weir.
CHALON INT	5-2-005:001	Waikani Gulch	Stream diversion, Intake #6 from Waikane Stream to Kohala Ditch. Declared Q of 5.849 is the total for Hawi Weir; Verified Q is estimated from flow velocity.
CHALON INT	5-2-005:001	Waikama Gulch	Stream diversion, Intake #3 - Waikama Stream to Kohala Ditch. Declared Q of 2.571 is the total for Niulii Weir.
CHALON INT	5-2-005:001	Waikama Gulch	Stream diversion, Intake #4 - Waikama Stream to Kohala Ditch. Declared Q of 2.571 is the total for Niulii Weir; Verified Q is estimated from flow velocity.
CHALON INT	5-2-006:003	Waipunalau Gulch	Stream diversion, Intake #8, Waipunalau Stream to Kohala Ditch. Declared Q of 5.849 is the total for Hawi Weir; Verified Q is estimated from flow velocity.
CHALON INT	5-3-002:001	Halawa Gulch	Stream diversion, Intake #11 from Halawa Stream. Declared Q of 5.849 is the total for Hawi Weir. Intake is damaged. No flow observed during field verification.
CHALON INT	5-3-002:001	Walaohia Gulch	Stream diversion, Intake #10 from Walaohia Stream. Declared Q of 5.849 is the total for Hawi Weir. Intake is damaged.
CHALON INT	5-3-004:001	Waiakanaua Gulch	Stream diversion, Intake #12 Waiakauaua Stream to Kohala Ditch. Declared Q of 5.849 is the total for Hawi Weir.
CHALON INT	5-3-005:006	Hapahapai Gulch	Stream diversion, Intake #14 from Hapahapai. Unused. Declared Q of 5.849 is the total for Hawi Weir.
HAMAKUA SUGAR	4-8-003:006	Hiilawe	Stream diversion, Hiilawe Stream Intake to Lalakea System. Declared Q of 912 MG is the total for three intakes to the Lalakea System.
HAMAKUA SUGAR	4-8-003:006	Hakalaoa	Stream diversion, Hakalaoa Stream Intake to Lalakea System. Declared Q of 912 MG is the total for three intakes to the Lalakea System.
HAMAKUA SUGAR	4-8-003:006	Lalakea	Stream diversion, Lalakea Intake to Lalakea System. Declared Q of 912 MG is the total for three intakes to the Lalakea System.
CRANE J	4-9-010:020	Waiola	Stream diversion, flume from Wailoa Side Stream. Declared Q of 292 MG includes both of declarant's diversions. See new entry created for diversion from waterfall. Declarations were submitted in 1990.
CRANE J	4-9-010:020	Unnamed	Stream diversion, Unnamed waterfall (new entry). Declared Q of 292 MG includes both of declarant's diversions. See other entry for flume. Declarations were submitted in 1990.
RATHBUN C	4-9-011:002	Wailoa	Stream diversion, main auwai from Wailoa Stream. Declared Q = 48 cubic ft per second.
HAMAKUA SUGAR	4-9-012:001	Alakahi	Stream diversion, Alakahi Stream Intake to Lower Hamakua Ditch. Declared Q of 11,000 MG is the total for four intakes to Hamakua Ditch.

HAMAKUA SUGAR	4-9-012:001	Kawainui	Stream diversion, Kawainui Stream Intake to Lower Hamakua Ditch. Declared Q of 11,000 MG is the total for four intakes to Hamakua Ditch.
HAMAKUA SUGAR	4-9-012:001	Koiawe	Stream diversion, Kaiawe Stream Intake to Lower Hamakua Ditch. Declared Q of 11,000 MG is the total for four intakes to Hamakua Ditch.
HAMAKUA SUGAR	4-9-012:001	Waiama	Stream diversion, Waima Stream Intake to Lower Hamakua Ditch. Declared Q of 11,000 MG is the total for four intakes to Hamakua Ditch.
CHALON INT	5-1-001:004	Honokane Nui East Branch	Stream diversion, Honokane Dam Main Intake. East Branch to Kohala Ditch. Declared Q of 2.571 is the total for Niulii Weir
CHALON INT	5-1-001:004	Honokane Nui West Branch	Stream diversion, Intake #2, Honokane Nui West Branch to Kohala Ditch. Declared Q of 2.571 is the total for Niulii Weir.
CHALON INT	5-1-001:019	Tributary to Pololu Stream	Stream diversion, Kohala Ditch Trail Intake #B from Unnamed. Declared Q of 2.571 is the total for Niulii Weir. Intake "A" is inactive.
CHALON INT	5-1-001:019	Waiakalae Gulch	Stream diversion, Twin Falls Intake from Waiakalae Gulch. Declared Q of 2.571 is the total for Niulii Weir.
STATE DOA HAW	6-3- :004	Kawainui	Stream diversion, Kawainui Intake from Kawainui Stream. Declared Q of 366.671 is the total for all 5 intakes.
STATE DOA HAW	6-3-001:004	Unnamed	Stream diversion, Koiawe Intake from comb intake. Declared Q of 366.671 is the total for all 5 intakes.
STATE DOA HAW	6-3-001:004	Unnamed	Stream diversion, Waima Intake from comb intake. Declared Q of 366.671 is the total for all 5 intakes.
STATE DOA HAW	6-3-001:004	Alakahi	Stream diversion, Alakahi Intake from Alakahi Stream. Declared Q of 366.671 is the total for all 5 intakes.
STATE DOA HAW	6-3-001:004	Kawaiki	Stream diversion, Kawaiki Intake from Kawaiki Stream. Declared Q of 366.671 is the total for all 5 intakes.
PARKER RANCH	6-1-001:004	Keawewai	Stream diversion, Keawewai Supply Ditch from Keawewai Stream. Declared Q = 176,596,950,000 gallons per year.
HAWAII DWS	6-3-001:001	Waikoloa	Stream diversion, pipe from Waikoloa Stream. Declared Q of 559.8 is the calculated total for 2 intakes at 1.427 MGD.
HAWAII DWS	6-5-001:011	Kohakohau	Stream diversion, Kohakohau Stream Diversion. Declared Q of 559.8 is the calculated total for 2 intakes at 1.427 MGD.

Stream diversions located in the Kohala ASEA are the sources of flow conveyed by all four of the County's major ditch systems.

The Kohala Ditch system originates at the Waikoloa Stream, which lies between Waimanu and the Honokane Iki valleys, and is known as the Awini Ditch Section. The system was developed by the former Kohala Plantation to irrigate sugarcane in coastal areas. Since the closure of the Kohala Sugar Company in 1975, maintenance of the ditch system has been substantially reduced. Currently, the system is owned by Chalon International of Hawaii; and is used for recreational purposes and limited agricultural and irrigation activities. Groundwater from dike impounded and perched systems and surface water are both conveyed by the ditch. Measurements in the past indicate that the ditch had a maximum capacity of 76 mgd with a mean flow of 23 mgd.

Also developed by the Kohala Plantation, the Kehena Ditch system lies in the upper slopes of the Kohala Mountain. This system collects water from the stream that feeds Honokane Valley at an approximate elevation of 4,300 ft, which is transported along the Kohala mountain ridgeline to

Puuokumau Reservoir located above Kaauhuhu. This system has recorded an average daily flow of 6 mgd with a maximum capacity of 14 mgd, but faced substantial water loss in the transportation and storage process. The Kehena Ditch has not been actively maintained since the 1960's due to a lack of demand.

The Upper Hamakua Ditch is a series of open ditches and tunnels. Its principal water sources are the summit watersheds of the Kohala Mountain, namely Kawainui, Kawaiki, Alakahi, Koiawe, and Waima Streams. The first three are the main contributors to the flow. The ditch was originally constructed to supply water to the Hamakua coast, but was later re-aligned and diverted into a 60 MG reservoir in Waimea, which supplies the Waimea Irrigation System. The ditch is able to handle flows in excess of 30 mgd according to past records of the Hamakua plantation.

The Lower Hamakua Ditch currently utilizes three intakes at the Kawainui, Alakahi, and Koiawe Streams in the Waipio Valley. A fourth, the Waima Intake, is expected to be re-activated. A series of transmission tunnels along the Waipio Valley cliff face transport water to the ditch system in the East Mauna Kea ASEA (802). According to a study conducted by the USGS, a gage located 500 feet upstream of the Kukuihaele Weir recorded an average flow of 6.5 mgd in 2003.

The DWS Waimea WS utilizes dam diversions of the Waikoloa Stream and the Kohakohau Stream. The *2006 DWS 20-Year Water Master Plan* indicates the estimated capacity of the surface water sources used by the water system to be 1.45 mgd.

801.2.3 Reclaimed Wastewater

There are no wastewater reclamation facilities (WWRF) in the study area.

801.3 EXISTING WATER USE

801.3.1 General

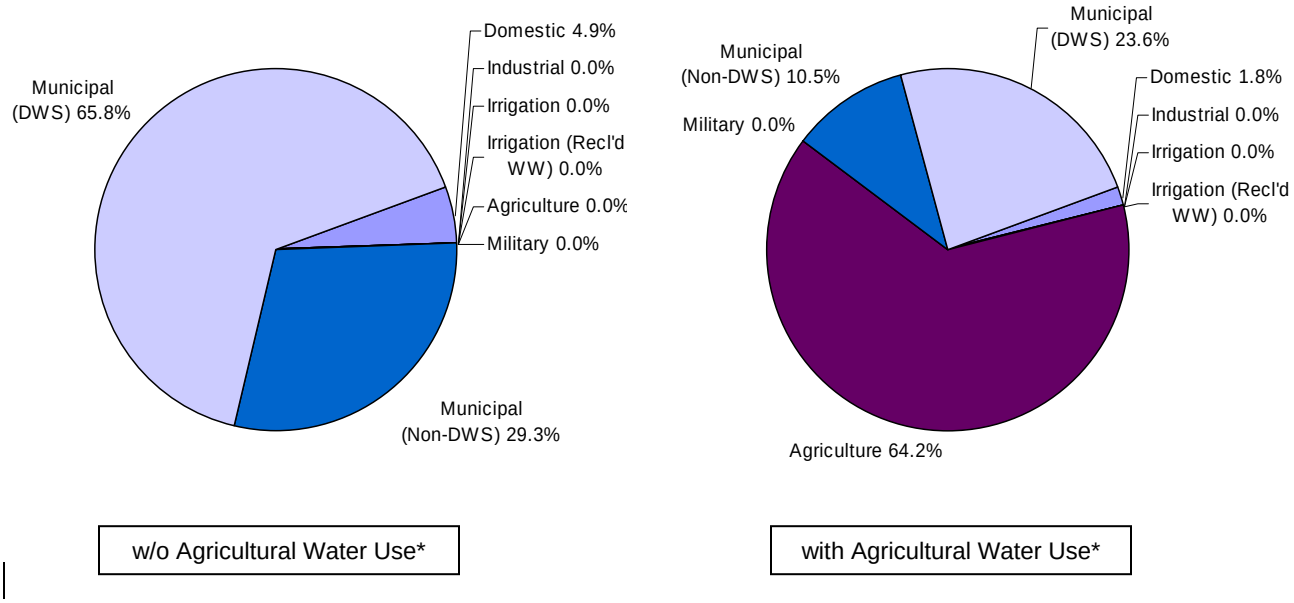
The following section presents the total estimated average water use within the Kohala ASEA, and the Hawi, Waimanu, and Mahukona ASYAs separately. Estimated water use from 2004 to 2005 was estimated using (DWS meter data and CWRM pumpage data from November 2004 through October 2005, and available GIS data) and are listed in **Tables 801-6**, **801-6a**, **801-6b**, and **801-6c** for the sector and system areas, respectively. **Tables 801-6**, **801-6a**, **801-6b**, and **801-6c** and **Figures 801-5**, **801-5a**, **801-5b**, and **801-5c** 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, and non-DWS systems for the sector area and system areas, respectively.

Table 801-6: Existing Water Use by Categories – Kohala Aquifer Sector Area

CWRM Water Use Category	Water Use (MGD)	Percent of Total without Ag*	Percent of Total with Ag*
Domestic	0.11	4.9	1.8
Industrial	0.00	0.0	0.0
Irrigation	0.00	0.0	0.0
Reclaimed WW	0.00	0.0	0.0
Agriculture	4.16	0.0	64.2
Military	0.00	0.0	0.0
Municipal			
DWS System	1.53	65.8	23.6
Private Public WS	0.68	29.3	10.5
Total without Ag	2.32	100.0	
Total with Ag	6.48		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 801-5: Existing Water Use by Categories – Kohala Aquifer Sector Area



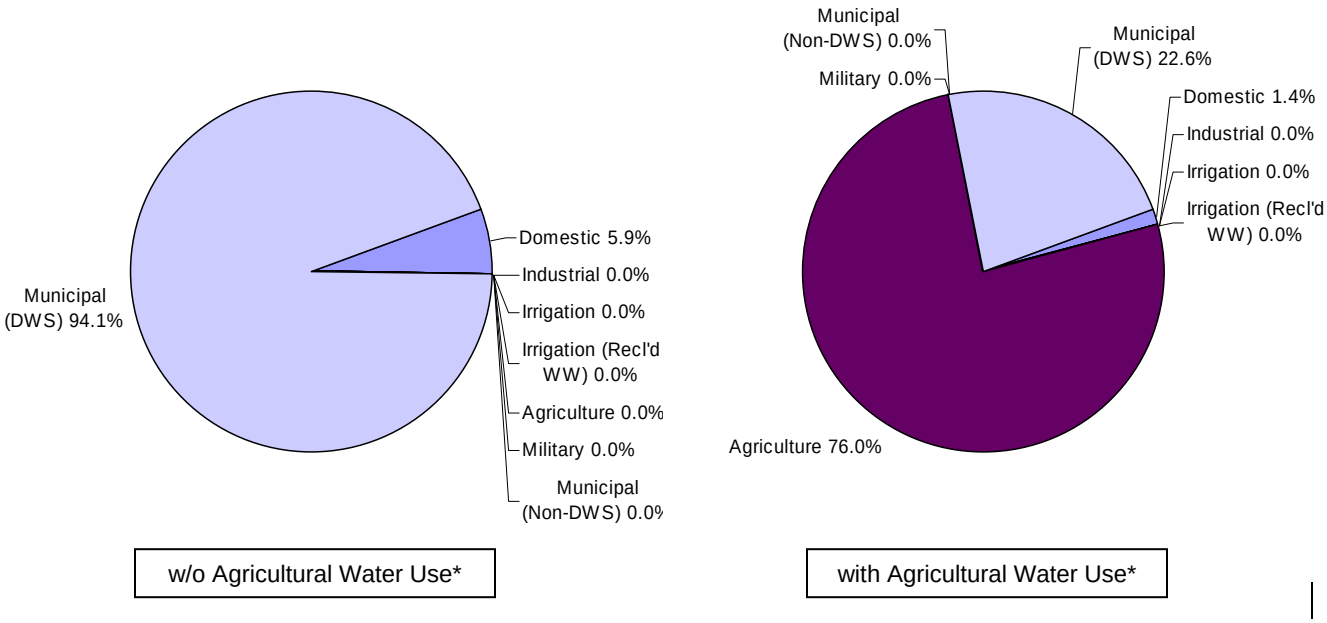
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 801-6a: Existing Water Use by Categories – Hawi Aquifer System Area [80101]

CWRM Water Use Category	Water Use (MGD)	Percent of Total without Ag*	Percent of Total with Ag*
Domestic	0.03	5.9	1.4
Industrial	0.00	0.0	0.0
Irrigation	0.00	0.0	0.0
Reclaimed WW	0.00	0.0	0.0
Agriculture	1.68	0.0	76.0
Military	0.00	0.0	0.0
Municipal			
DWS System	0.50	94.1	22.6
Private Public WS	0.00	0.0	0.0
Total without Ag	0.53	100.0	
Total with Ag	2.21		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 801-5a: Existing Water Use by Categories – Hawi Aquifer System Area [80101]



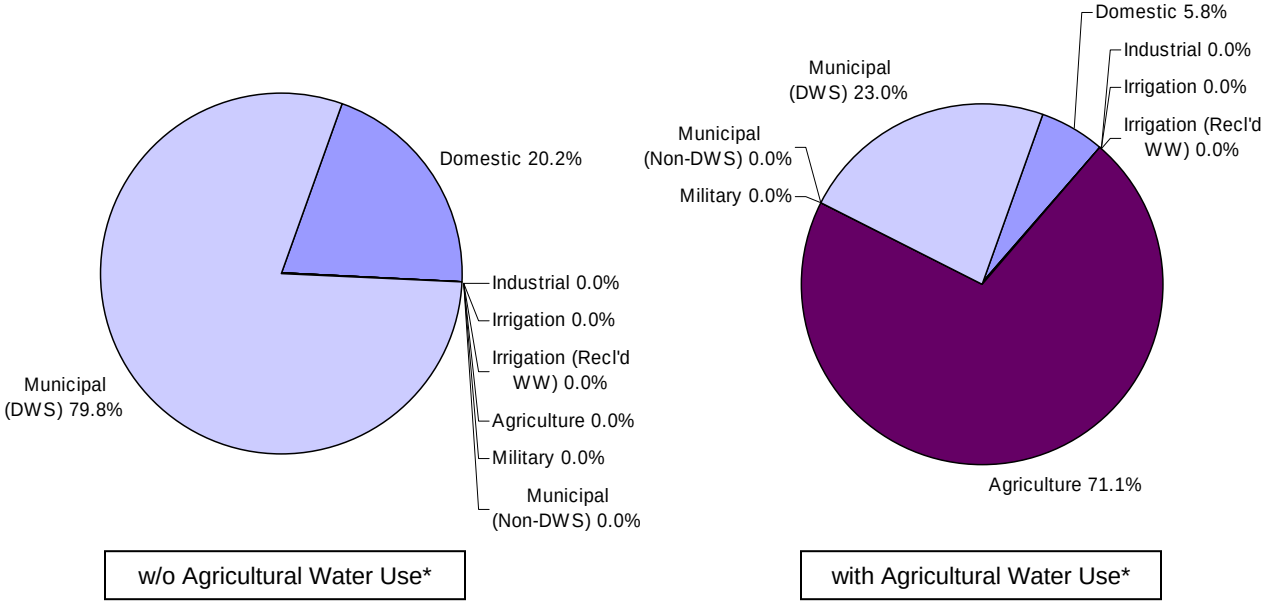
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 801-6b: Existing Water Use by Categories – Waimanu Aquifer System Area [80102]

CWRM Water Use Category	Water Use (MGD)	Percent of Total without Ag*	Percent of Total with Ag*
Domestic	0.02	20.2	5.8
Industrial	0.00	0.0	0.0
Irrigation	0.00	0.0	0.0
Reclaimed WW	0.00	0.0	0.0
Agriculture	0.24	0.0	71.1
Military	0.00	0.0	0.0
Municipal			
DWS System	0.08	79.8	23.0
Private Public WS	0.00	0.0	0.0
Total without Ag	0.10	100.0	
Total with Ag	0.34		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 801-5b: Existing Water Use by Categories – Waimanu Aquifer System Area [80102]



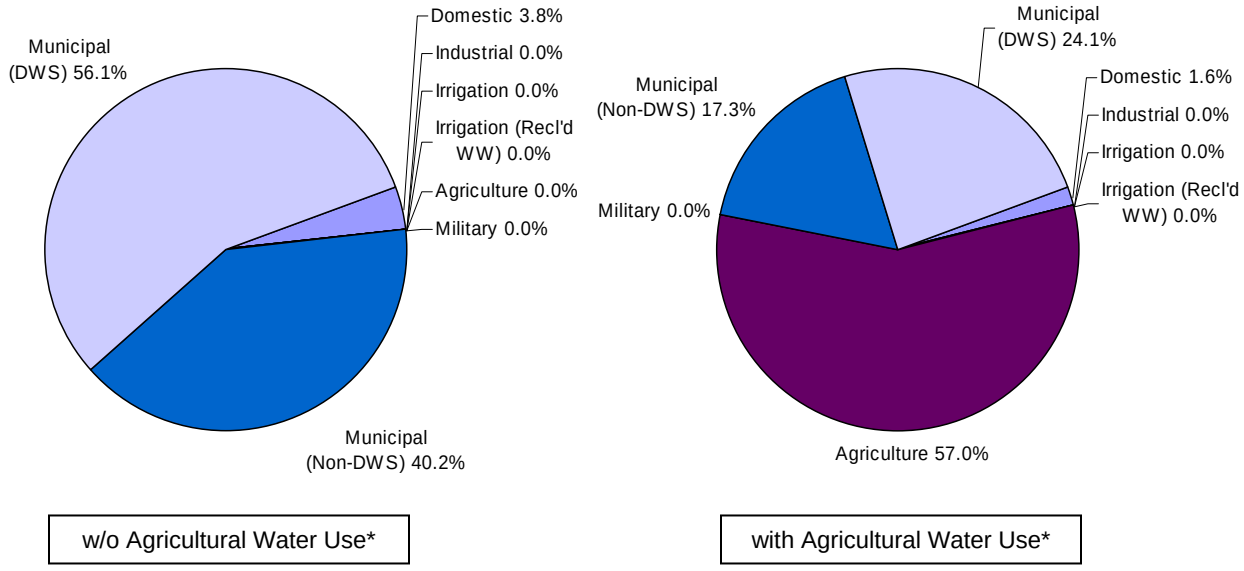
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 801-6c: Existing Water Use by Categories – Mahukona Aquifer System Area [80103]

CWRM Water Use Category	Water Use (MGD)	Percent of Total without Ag*	Percent of Total with Ag*
Domestic	0.06	3.8	1.6
Industrial	0.00	0.0	0.0
Irrigation	0.00	0.0	0.0
Reclaimed WW	0.00	0.0	0.0
Agriculture	2.24	0.0	57.0
Military	0.00	0.0	0.0
Municipal			
DWS System	0.95	56.1	24.1
Private Public WS	0.68	40.2	17.3
Total without Ag	1.69	100.0	
Total with Ag	3.94		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 801-5c: Existing Water Use by Categories – Mahukona Aquifer System Area [80103]



* 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 801-6 generally shows the service area for the various water systems and indicates the extent of the DWS water system.

801.3.2 Domestic Use

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

801.3.3 Industrial Use

There are three wells classified as "Industrial" in the CWRM well database, however none reported pumpage. The hydroelectric plant located just west of Hawi is one of the primary users of the Kohala Ditch, however actual consumption is not known.

801.3.4 Irrigation Use

There are no known irrigation uses dedicated to golf course or other landscaping activities.

801.3.5 Agricultural Use

Kahua Ranch's water resources include a series of stream diversions, tunnel intakes, and one deep well. The main sources are the stream intakes. The two large intakes are the Kahua Watershed at elevation 4,173 ft, and the Kehena Ditch source. Both sources are subject to dry weather conditions which can substantially reduce stream flows. Storage tanks are necessary for ranch operations.

The Kohala Ditch is also utilized for aquacultural and agricultural purposes. According to the AWUDP, little is known of the service areas of the Kohala Ditch; although in areas along the coast and near Hawi ditch, flow is utilized for agricultural uses developed by the Kohala Agricultural Task Force.

801.3.6 Military Use

There is no military use within the Kohala ASEA.

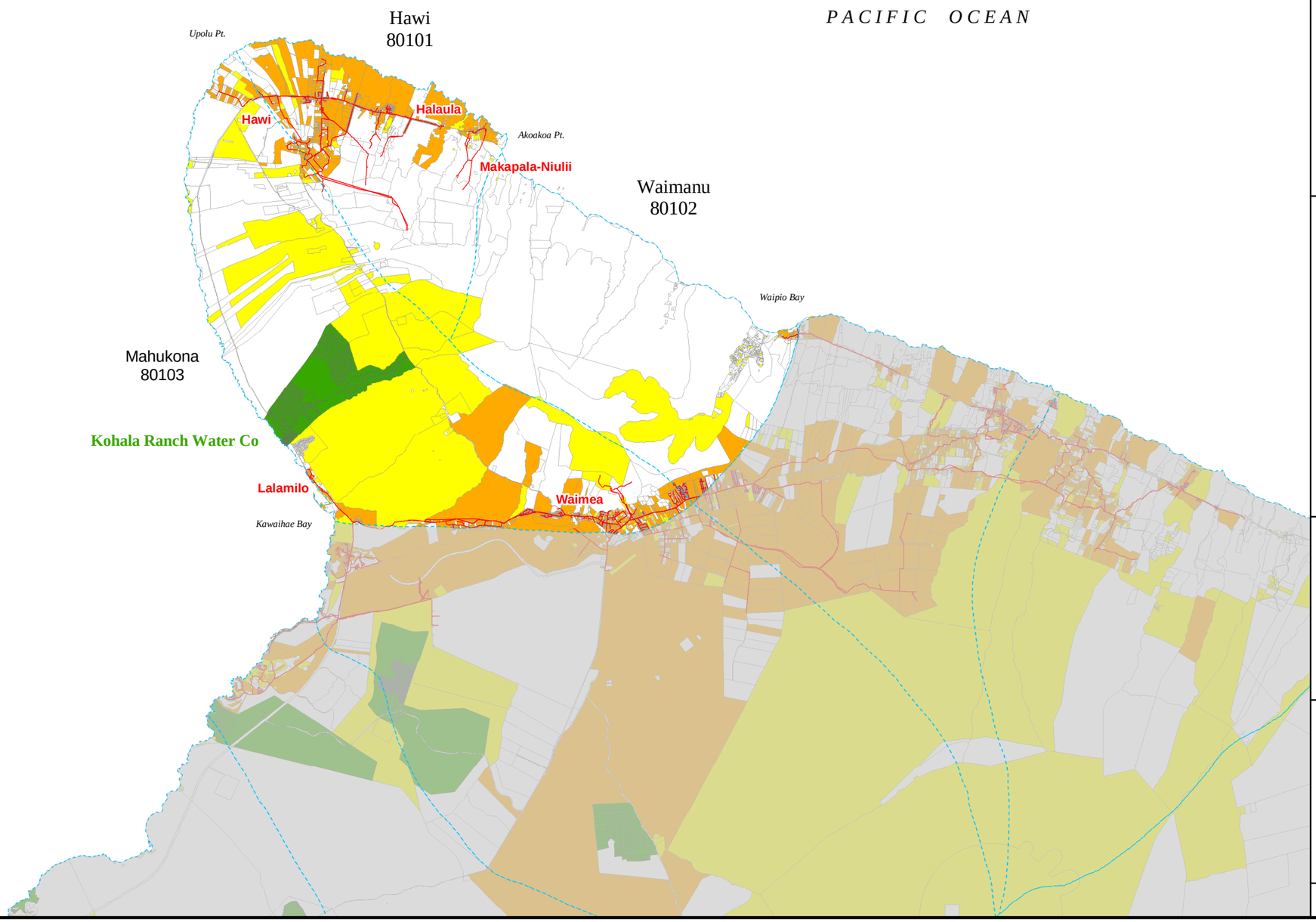
801.3.7 Municipal Use

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

801.3.7.1 County Water Systems

The DWS has four water systems in the Kohala ASEA.

The Hawi Water System (WS) serves the bulk of the Hawi area in North Kohala along Akoni Pule Highway and surrounding area from Puakea Bay Drive in the west to Kapaau Road in the



Hawaii County

Department of Water Supply

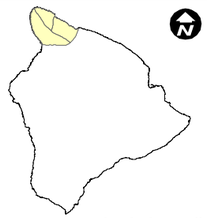
DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

Job No. 2003-818

LEGEND:

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

2 1 0 2
Miles



INDEX MAP - Island of Hawaii

FIGURE 801-6

AQUIFER SECTOR
KOHALA - 801

Aquifer Systems
Hawi - 80101
Waimanu - 80102
Mahukona - 80103

Water System and Service Area

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

east. It is comprised of several smaller rural and plantation water systems formerly served by various sources, including the Kohala Ditch, and the Lindsey, Watt and Hapahapai Tunnels. The system is currently served by Hawi Deep Wells No. 1 and 2, drilled in 1975 and 1993 respectively. Eight operational zones are served through a combination of three booster pump stations and five storage tanks. As a result of merging and discontinuation of the tunnel sources, five other storage tanks in the system are currently not in service.

The Halaula Water System serves Ainakea Village and Halawa. The plantation, as part of its Halaula employee subdivision, improved the water system in this area and turned it over to the Water Department. Once supplied by Bond Tunnel No. 1, the system has been interconnected with and now relies on the Hawi WS to the west for its supply. A single tank maintains the storage requirements of the system.

The Makapala-Niulii Water System is a small water system serving the residents and small business firms in the area. These customers were serviced formerly by a plantation system. The closing of the plantation left this area without a managed water system. With State funds, the old water system, consisting of galvanized pipelines and small redwood storage tanks, was renovated. The new system, which began in 1982, also provides fire protection. The system continues to be supplied by Murphy Tunnel; however, DWS is currently developing a well source at the Makalapa Tank site on Makalapa Road.

The Waimea Water System extends along Mamalahoa Highway and surrounding areas from Kawaihae to the two connections to the Haina Water System at the judicial boundary near Mud Lane. It spans three aquifer sector areas; however, the majority of the service area is within the Kohala ASEA, including the majority of Waimea Village, and the areas north of Mamalahoa Highway from Kawaihae to the Kamuela Highlands subdivision. Since 1950, improvements to the system have increased reservoir capacity, enlarged the distribution pipelines, and extended the system to meet the growth of this rapidly developing community. The principal sources for the Waimea Water System are the mountain supplies from Waikoloa Stream, first developed in 1925, and the Kohakohau Stream diversion which was completed in 1971. Today, the system has been expanded to include seven tanks spanning eight pressure zones. The stream sources have recently been supplemented by the Parker Ranch well, which taps a high-level groundwater source. Due to its origin in the wet mountain regions of the Kohala Mountain forest reserve, the surface water is treated at the Waimea Water Treatment Plant by conventional filtration for odor and color control, and for corrosion control and disinfection. The surface water is blended with the groundwater at the WWTP before distribution.

The Waimea area is subject to extremes in climactic conditions as reflected in stream flows of flood portions at times, and periods of extended low flows during drought weather. For this reason, the Waimea Water System has four large reservoirs with the combined capacity to store 158.5 million gallons of untreated water.

DWS water use is subcategorized separately for the Kohala ASEA, and the Hawi, Waimanu, and Mahukona ASYAs in **Tables 801-7**, **801-7a**, **801-7b**, and **801-7c** to the extent possible based on available meter data and is depicted in **Figures 801-7**, **801-7a**, **801-7b**, and **801-7c**, respectively.

"Other Municipal" 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 801-7: DWS Existing Water Use by Categories – Kohala Aquifer Sector Area

CWRM Water Use Category	DWS Purveyed Water Use (MGD)	Percent of Total
Domestic	1.11	73.0
Industrial	0.00	0.3
Irrigation	0.00	0.0
Agriculture	0.10	6.4
Military	0.00	0.0
Other Municipal	0.31	20.3
Total	1.53	100.0

Figure 801-7: DWS Existing Water Use by Categories – Kohala Aquifer Sector Area

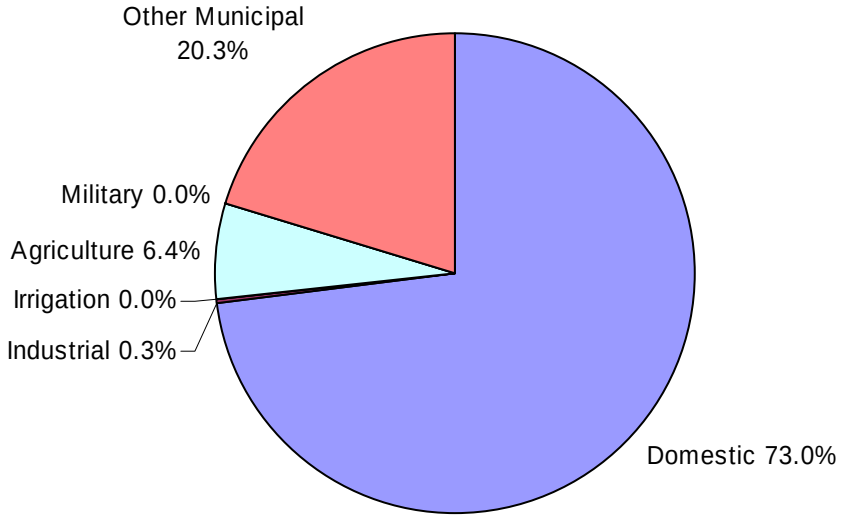


Table 801-7a: DWS Existing Water Use by Categories – Hawi Aquifer System Area [80101]

CWRM Water Use Category	DWS Purveyed Water Use (MGD)	Percent of Total
Domestic	0.42	83.3
Industrial	0.00	0.0
Irrigation	0.00	0.0
Agriculture	0.04	7.5
Military	0.00	0.0
Other Municipal	0.05	9.2
Total	0.50	100.0

Figure 801-7a: DWS Existing Water Use by Categories – Hawi Aquifer System Area [80101]

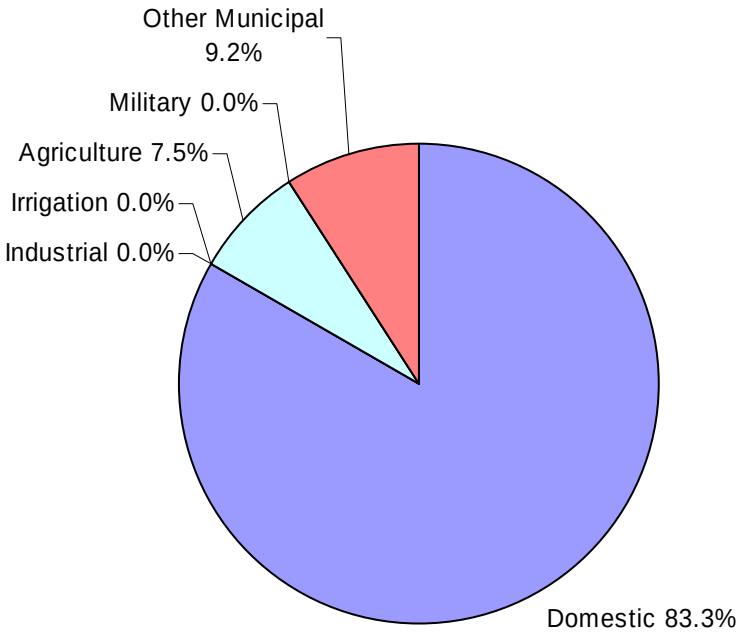


Table 801-7b: DWS Existing Water Use by Categories – Waimanu Aquifer System Area [80102]

CWRM Water Use Category	DWS Purveyed Water Use (MGD)	Percent of Total
Domestic	0.07	96.8
Industrial	0.00	0.0
Irrigation	0.00	0.0
Agriculture	0.00	0.0
Military	0.00	0.0
Other Municipal	0.00	3.2
Total	0.08	100.0

Figure 801-7b: DWS Existing Water Use by Categories – Waimanu Aquifer System Area [80102]

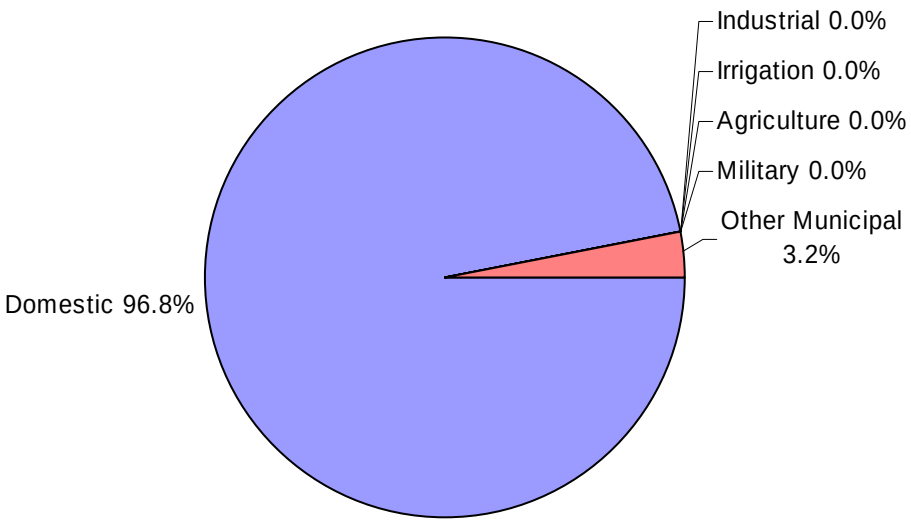
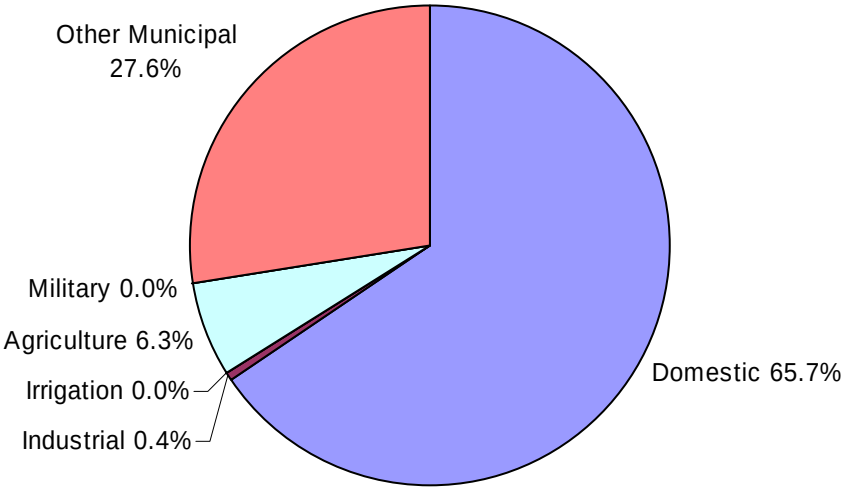


Table 801-7c: DWS Existing Water Use by Categories – Mahukona Aquifer System Area [80103]

CWRM Water Use Category	DWS Purveyed Water Use (MGD)	Percent of Total
Domestic	0.62	65.7
Industrial	0.00	0.4
Irrigation	0.00	0.0
Agriculture	0.06	6.3
Military	0.00	0.0
Other Municipal	0.26	27.6
Total	0.95	100.0

Figure 801-7c: DWS Existing Water Use by Categories – Mahukona Aquifer System Area [80103]



801.3.7.2 State Water Systems

The Waimea Irrigation System is owned by the DOA. Flow is diverted from the Upper Hamakua Ditch into the 60 MG Waimea Reservoir. A second reservoir, the Puu Pulehu Reservoir, with an increased capacity of 100 MG, provides overflow storage for the Waimea Reservoir as well as diverted upstream flow. The transmission system includes two miles of 24-inch and 18-inch diameter pipelines. Distribution to the farm lots in Lalamilo and Puukapu is mostly in the West Mauna Kea ASEA (803).

801.3.7.3 Federal Water Systems

There are no Federal water systems in the Kohala ASEA regulated by the DOH.

801.3.7.4 Private Public Water Systems

There is one private public water system within the Kohala ASEA regulated by the Department of Health. The Kohala Estates/Kohala Joint Venture subdivision initiated by Hilton Head, with lands purchased from Kahua Ranch, expanded beyond its original scope. The Kohala Ranch development developed its own water source by drilling 2 deep wells at elevation 1,470 feet. The wells currently pump an average of 0.68 mgd. The wells are approximately 2.65 miles inland from the coast and have a chloride content of 35 to 70 ppm according to the CWRM well database. Two additional wells were drilled and are classified in the CWRM database as "unused".

801.3.8 Water Use by Resource

801.3.8.1 Ground Water

Table 801-8 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 801-8: Sustainable Yield – Kohala 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 (%)
		1.44	**17.66**	**26.49**	**154**	**0.94**	**11.47**	**17.20**
80101	Hawi	0.65	15.23	22.84	27	2.41	56.40	84.59
80102	Waimanu	0.10	0.96	1.44	110	0.09	0.87	1.31
80103	Mahukona	0.69	1.47	2.21	17	4.06	8.67	13.00

As described in Section 801.3.7.1, the DWS Makapala-Niulii Water System in North Kohala obtains water from Murphy Tunnel. According to DWS records, the amount drawn between November 2004 and October 2005 was less than 0.01 mgd. The *DWS 20-Year Water Master Plan* states that the capacity of the source is 0.1 mgd.

801.3.8.2 Surface Water

The principal sources of the DWS Waimea Water System are the dam diversions at the Waikoloa Stream and the Kohakohau Stream. DWS records indicate the amount of surface water drawn between November 2004 and October 2005 was 1.85 mgd.

The Upper Hamakua Ditch supplies surface water via the Waimea Irrigation System to farm lots in Lalamilo and Puukapu in the West Mauna Kea ASEA (803). According to the AWUDP, the pressurized distribution system is metered at each of its 117 accounts, and drew 0.91 mgd in 2003.

801.3.8.3 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 previously categorized as Domestic Use in **Table 801-6** is assumed to be supplied by individual catchment systems.

801.3.8.4 Reclaimed Wastewater

There are no wastewater reclamation facilities in the Kohala ASEA.

801.4 FUTURE WATER NEEDS

801.4.1 General

Table 801-9 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 801-9: 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 Kohala ASEA	154	40.2	8.9	2.3	2.7	3.2	3.7	4.3
80101 – Hawi ASYA	27	6.8	1.1	0.5	0.6	0.8	0.9	1.1
80102 – Waimanu ASYA	110	0.8	0.1	0.1	0.1	0.1	0.1	0.2
80103 – Mahukona ASYA	17	32.6	7.7	1.7	2.0	2.3	2.7	3.1
With Agricultural Demand*	**SY (mgd)**	**LUPAG (mgd)**	**Zoning (mgd)**	**Growth Rate B Demand Projections (mgd)**				
				2005	**2010**	**2015**	**2020**	**2025**
Total Kohala ASEA	154	207.6	174.5	6.5	7.6	8.9	10.5	12.3
80101 – Hawi ASYA	27	74.2	67.7	2.2	2.6	3.2	3.8	4.5
80102 – Waimanu ASYA	110	10.2	9.3	0.3	0.4	0.4	0.5	0.6
80103 – Mahukona ASYA	17	123.2	97.4	3.9	4.6	5.3	6.2	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.

LUPAG water demands excluding agricultural demands for the Kohala ASEA are approximately one-quarter of the sector area's SY; however, the LUPAG water demands excluding water demands for the Mahukona ASYA greatly exceed 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.

801.4.2 Full Build-Out Water Demand Projections

The full build-out water demand projections based on the General Plan and County Zoning are listed in **Tables 801-10**, **801-10a**, **801-10b**, **801-10c** and **Tables 801-11**, **801-11a**, **801-11b**, **801-11c** for the sector and system areas, respectively, and reflect refinement as discussed below. Each land use class is associated with the most appropriate CWRM water use category.

Table 801-10: Hawaii County General Plan Full Build-Out Water Demand Projection – Kohala Aquifer Sector Area

LUPAG Class	CWRM Category	Water Demand (mgd)
Urban	Domestic/Irrigation/Municipal	28.5
Urban Expansion	Domestic/Irrigation/Municipal	6.5
Resort	Irrigation/Municipal	0.8
Industrial	Industrial	1.3
Agriculture	Agriculture	167.5
University	Irrigation/Municipal	0.0
Rural	Irrigation/Municipal	0.7
DHHL	Irrigation/Municipal	2.4
TOTAL w/o Ag*		40.2
TOTAL w/ Ag*		207.6

* 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 801-11: County Zoning Full Build-Out Water Demand Projection – Kohala Aquifer Sector Area

Zoning Class	CWRM Category	Water Demand (mgd)
Residential	Domestic/Irrigation/Municipal	4.8
Resort	Irrigation/Municipal	0.3
Commercial	Municipal	0.8
Industrial	Industrial	0.6
Agriculture	Agriculture	165.6
DHHL	Irrigation/Municipal	2.4
TOTAL w/o Ag*		8.9
TOTAL w/ Ag*		174.5

* 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 801-10a: Hawaii County General Plan Full Build-Out Water Demand Projection – Hawi Aquifer System Area [80101]

LUPAG Class	CWRM Category	Water Demand (mgd)
Urban	Domestic/Irrigation/Municipal	6.5
Urban Expansion	Domestic/Irrigation/Municipal	0.0
Resort	Irrigation/Municipal	0.0
Industrial	Industrial	0.2
Agriculture	Agriculture	67.5
University	Irrigation/Municipal	0.0
Rural	Irrigation/Municipal	0.0
DHHL	Irrigation/Municipal	0.0
TOTAL w/o Ag*		6.8
TOTAL w/ Ag*		74.2

* 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 801-11a: County Zoning Full Build-Out Water Demand Projection – Hawi Aquifer System Area [80101]

Zoning Class	CWRM Category	Water Demand (mgd)
Residential	Domestic/Irrigation/Municipal	0.8
Resort	Irrigation/Municipal	0.0
Commercial	Municipal	0.1
Industrial	Industrial	0.2
Agriculture	Agriculture	66.6
DHHL	Irrigation/Municipal	0.0
TOTAL w/o Ag*		1.1
TOTAL w/ Ag*		67.7

* 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.

Table 801-10b: Hawaii County General Plan Full Build-Out Water Demand Projection – Waimanu Aquifer System Area [80102]

LUPAG Class	CWRM Category	Water Demand (mgd)
Urban	Domestic/Irrigation/Municipal	0.7
Urban Expansion	Domestic/Irrigation/Municipal	0.0
Resort	Irrigation/Municipal	0.0
Industrial	Industrial	0.0
Agriculture	Agriculture	9.4
University	Irrigation/Municipal	0.0
Rural	Irrigation/Municipal	0.1
DHHL	Irrigation/Municipal	0.0
TOTAL w/o Ag*		0.8
TOTAL w/ Ag*		10.2

* 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 801-11b: County Zoning Full Build-Out Water Demand Projection – Waimanu Aquifer System Area [80102]

Zoning Class	CWRM Category	Water Demand (mgd)
Residential	Domestic/Irrigation/Municipal	0.1
Resort	Irrigation/Municipal	0.0
Commercial	Municipal	0.0
Industrial	Industrial	0.0
Agriculture	Agriculture	9.3
DHHL	Irrigation/Municipal	0.0
TOTAL w/o Ag*		0.1
TOTAL w/ Ag*		9.3

* 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.

Table 801-10c: Hawaii County General Plan Full Build-Out Water Demand Projection – Mahukona Aquifer System Area [80103]

LUPAG Class	CWRM Category	Water Demand (mgd)
Urban	Domestic/Irrigation/Municipal	21.2
Urban Expansion	Domestic/Irrigation/Municipal	6.5
Resort	Irrigation/Municipal	0.8
Industrial	Industrial	1.1
Agriculture	Agriculture	90.6
University	Irrigation/Municipal	0.0
Rural	Irrigation/Municipal	0.6
DHHL	Irrigation/Municipal	2.4
TOTAL w/o Ag*		32.6
TOTAL w/ Ag*		123.2

* 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 801-11c: County Zoning Full Build-Out Water Demand Projection – Mahukona Aquifer System Area [80103]

Zoning Class	CWRM Category	Water Demand (mgd)
Residential	Domestic/Irrigation/Municipal	3.9
Resort	Irrigation/Municipal	0.3
Commercial	Municipal	0.7
Industrial	Industrial	0.4
Agriculture	Agriculture	89.7
DHHL	Irrigation/Municipal	2.4
TOTAL w/o Ag*		7.7
TOTAL w/ Ag*		97.4

* 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.

801.4.2.1 Refine Land Use Based Projection

801.4.2.1.1 State Water Projects Plan

The total projected demand to the year 2020 for 22 State Water Projects within the Kohala ASEA is 3.70 mgd, using 1.79 mgd potable, 1.83 mgd nonpotable, and 0.08 mgd nonpotable using potable. These demands may account for between 30 percent and 90 percent of the total water demand in the sector area, depending on the actual agricultural water usage. The project which will generate the most significant demand, with the exception of DHHL projects, which are covered separately, is listed in **Table 801-12**. Projects with large demands greater than 1 mgd may require State funding to develop resources and infrastructure necessary to provide water service.

Table 801-12: Future State Water Projects to Generate Significant Demands

Project Name	Primary Use	State Department	2020 Demand (mgd)
Waimea Irrigation System	Nonpotable	DOA	1.83

801.4.2.1.2 State Department of Hawaiian Home Lands

The DHHL owns several tracts of land within the Kohala ASEA.

The Kawaihae Tract is comprised of over 10,000 acres of a wide variety of terrain and climate from the Kohala Coast to the Kohala Mountains. Existing usage of the land includes the 196-lot Kawaihae Unit 1 residential subdivision, which is temporarily being served by the privately owned Kohala Ranch water system; and the 90-acre Kaei Hana II industrial subdivision, currently being served by the DWS Kawaihae-Lalamilo-Puako water system. The rest of the land is used for cattle and horse grazing. The projected demand of 2.04 mgd of potable water will be met either through development of new well sources through partnership with DWS or acquiring a portion of Ouli-1 well production.

The Pauahi and Keoniki Tracts are located northwest of Waimea Village covering 600 and 230 acres, respectively. Upper Lalamilo is a 230-acre tract located on the south side of Kawaihae Road. All three tracts fall within the service area of the DWS Waimea Water System. DWS has estimated an allocation of 0.08 mgd of the 0.32 mgd required by the proposed developments; therefore, DHHL would need to partner with DWS to develop additional sources for the projected needs.

Two of the three Puukapu Tracts are situated within the Kohala ASEA. Puukapu 2 is located in the general area above Puukapu Homesteads mauka of Mamalahoa Highway, and Puukapu 3 is located in the hillside north of Waimea Village within the service area of the DWS Waimea WS. The projected demand is 0.004 mgd.

The Upolu Point Lot is composed of 37 acres of several existing buildings currently serviced by the DWS Hawi-Kokoiki Water System. The Waimanu Tract is a 200-acre tract on the eastern side of the Kohala Mountains with no vehicular access and designated for Conservation use. Currently there are no recommended actions for either tract regarding water supply resources or infrastructure.

801.4.2.1.3 Agricultural Water Use and Development Plan

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

801.4.3 Water Use Unit Rates

Water use unit rates are based on the *Water System Standards* as discussed in Chapter 1, and single family residential (Low Density Urban category of the General Plan and RS-7.5 and greater or Single-Family Residential categories of one lot per 7,500 acres or larger of County Zoning) consumption is 1,000 gallons per unit for South Kohala, and 400 gallons per unit for North Kohala based on historical consumption data.

801.4.4 5-Year Incremental Water Demand Projection to the Year 2025

The following section presents 5-year incremental water demand projections to the year 2025 for the Kohala ASEA and the Hawi, Waimanu, and Mahukona ASYAs separately. The projected low, medium, and high growth rates are listed in **Tables 801-13**, **801-13a**, **801-13b**, and **801-13c** for the sector and system areas, respectively, and are graphed in **Figures 809-8**, **809-8a**, and **801-8b**, and **801-8c**. Potable and nonpotable water demands are also differentiated.

Figures 801-8, **801-8a**, **801-8b**, and **801-8c** 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 801-9**, **801-9a**, **801-9b**, and **801-9c** show the breakdown of water demand projections by CWRM categories through the year 2025. **Tables 801-14**, **801-14a**, **801-14b**, and **801-14c** summarize these figures for the sector and system areas, respectively.

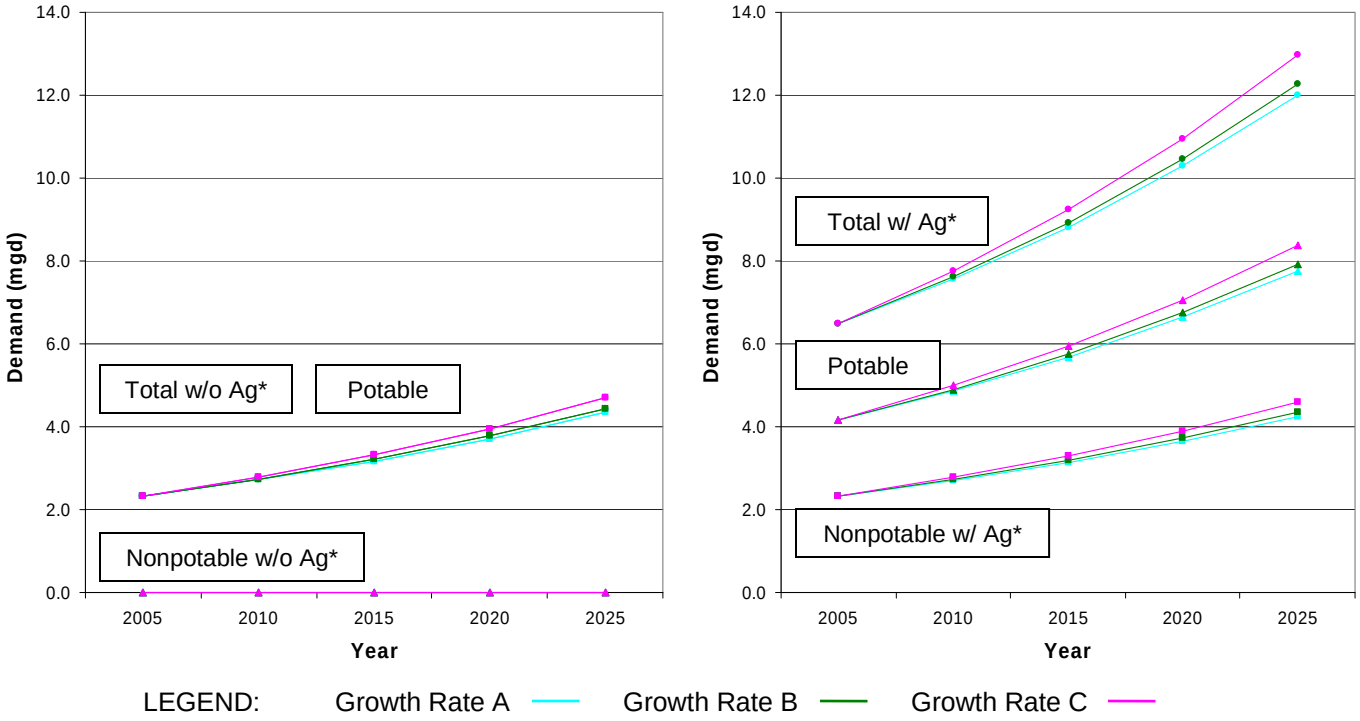
801.4.4.1 Kohala Aquifer Sector Area

Table 801-13: Water Demand Projection – Kohala Aquifer Sector Area

	Without Agricultural Demands* (mgd)					With Agricultural Demands* (mgd)				
GROWTH RATE A	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	2.3	2.7	3.1	3.7	4.3	6.5	7.6	8.8	10.3	12.0
Potable	2.3	2.7	3.1	3.7	4.3	2.3	2.7	3.1	3.7	4.3
Nonpotable	0.0	0.0	0.0	0.0	0.0	4.2	4.9	5.7	6.6	7.8
GROWTH RATE B	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	2.3	2.7	3.2	3.7	4.3	6.5	7.6	8.9	10.5	12.3
Potable	2.3	2.7	3.2	3.7	4.3	2.3	2.7	3.2	3.7	4.3
Nonpotable	0.0	0.0	0.0	0.0	0.0	4.2	4.9	5.7	6.7	7.9
GROWTH RATE C	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	2.3	2.8	3.3	3.9	4.6	6.5	7.8	9.2	11.0	13.0
Potable	2.3	2.8	3.3	3.9	4.6	2.3	2.8	3.3	3.9	4.6
Nonpotable	0.0	0.0	0.0	0.0	0.0	4.2	5.0	5.9	7.1	8.4

* 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.

Figure 801-8: Water Demand Projection Summary – Kohala Aquifer Sector Area



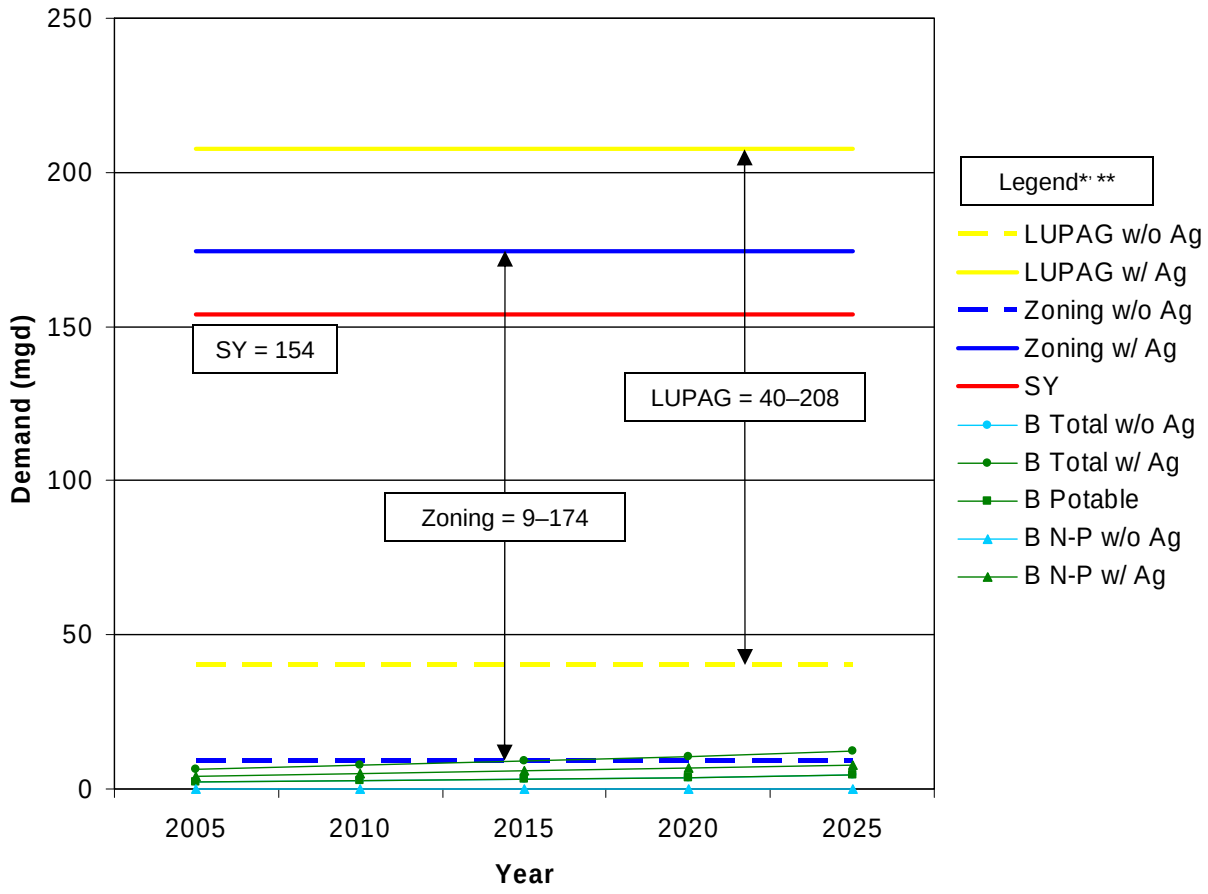
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 801-14: Medium Growth Rate B Water Demand Projection by Category – Kohala Aquifer Sector Area

Water Use Category	2005 (mgd)	2010 (mgd)	2015 (mgd)	2020 (mgd)	2025 (mgd)
Total without Ag*	2.3	2.7	3.2	3.7	4.3
Total with Ag*	6.5	7.6	8.9	10.5	12.3
Domestic	0.1	0.1	0.2	0.2	0.2
Industrial	0.0	0.0	0.0	0.0	0.0
Irrigation	0.0	0.0	0.0	0.0	0.0
Agriculture	4.2	4.9	5.7	6.7	7.9
Military	0.0	0.0	0.0	0.0	0.0
Municipal	2.2	2.6	3.0	3.5	4.1
Potable	2.3	2.7	3.2	3.7	4.3
Nonpotable w/o Ag*	0.0	0.0	0.0	0.0	0.0
Nonpotable w/ Ag*	4.2	4.9	5.7	6.7	7.9
DWS	1.5	1.8	2.1	2.5	2.9

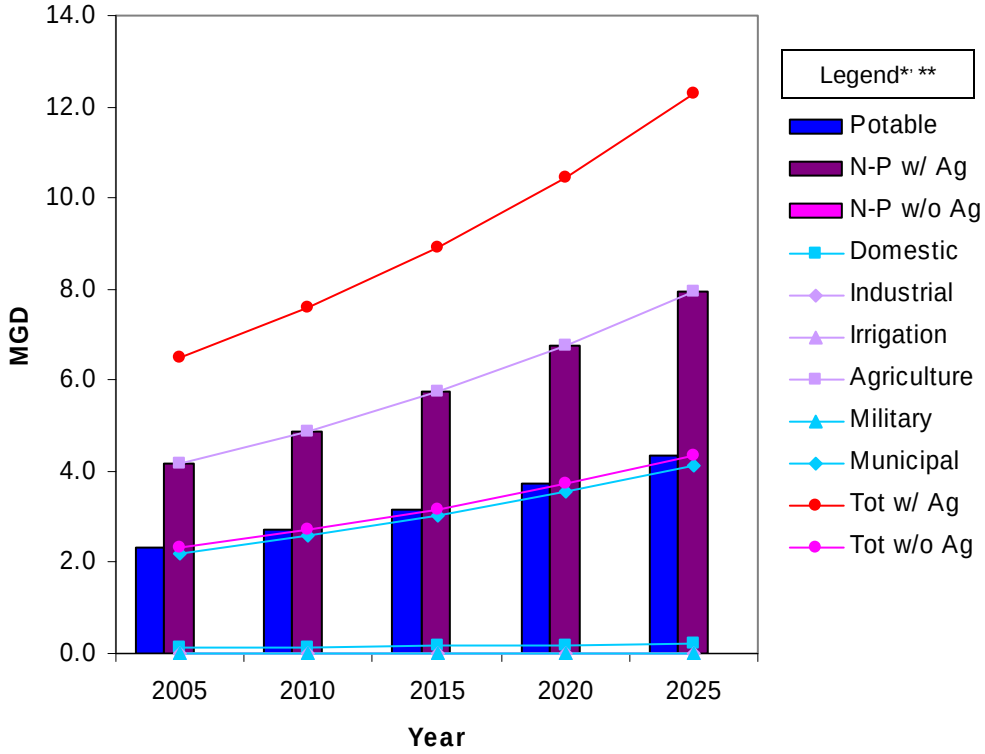
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 801-9: Medium Growth Rate B Water Demand Projections and Full Build-Out – Kohala 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 801-10: Medium Growth Rate B Water Demand Projection by Category – Kohala 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.

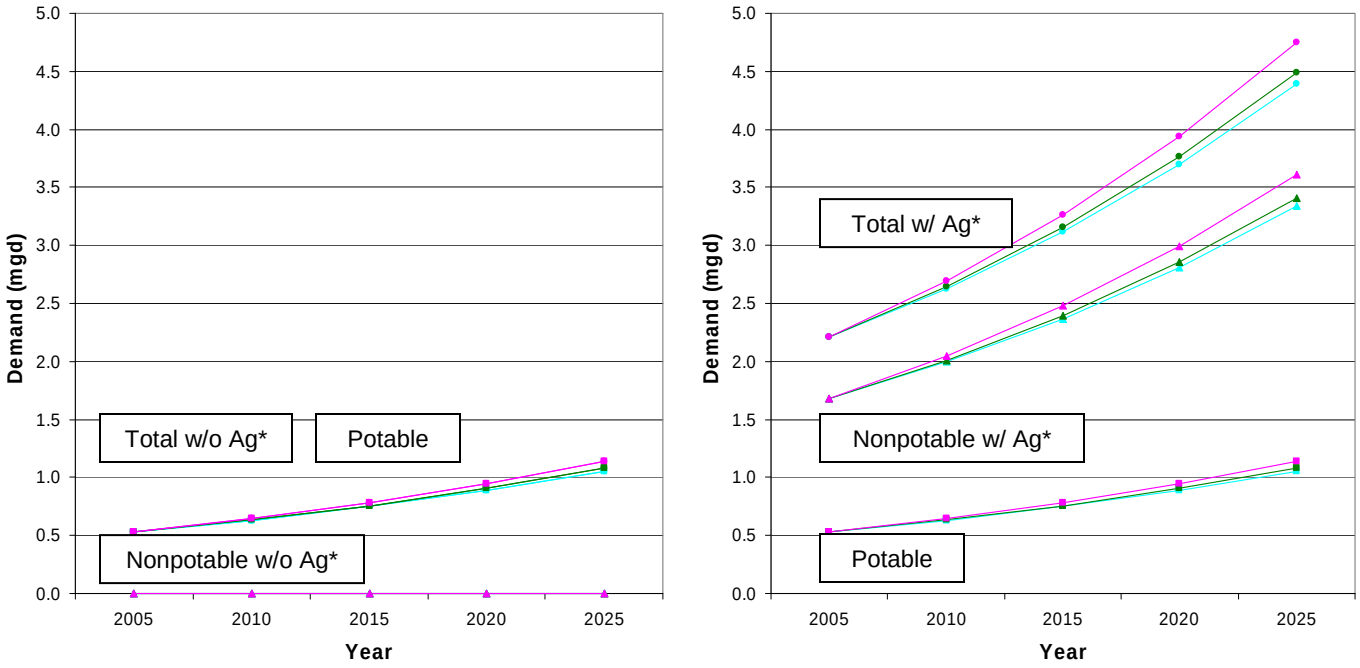
801.4.4.2 Hawi Aquifer System Area [80101]

Table 801-13a: Water Demand Projection – Hawi Aquifer System Area [80101]

	Without Agricultural Demands* (mgd)					With Agricultural Demands* (mgd)				
GROWTH RATE A	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	0.5	0.6	0.7	0.9	1.1	2.2	2.6	3.1	3.7	4.4
Potable	0.5	0.6	0.7	0.9	1.1	0.5	0.6	0.7	0.9	1.1
Nonpotable	0.0	0.0	0.0	0.0	0.0	1.7	2.0	2.4	2.8	3.3
GROWTH RATE B	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	0.5	0.6	0.8	0.9	1.1	2.2	2.6	3.2	3.8	4.5
Potable	0.5	0.6	0.8	0.9	1.1	0.5	0.6	0.8	0.9	1.1
Nonpotable	0.0	0.0	0.0	0.0	0.0	1.7	2.0	2.4	2.9	3.4
GROWTH RATE C	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	0.5	0.6	0.8	0.9	1.1	2.2	2.7	3.3	3.9	4.7
Potable	0.5	0.6	0.8	0.9	1.1	0.5	0.6	0.8	0.9	1.1
Nonpotable	0.0	0.0	0.0	0.0	0.0	1.7	2.0	2.5	3.0	3.6

* 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 801-8a: Water Demand Projection Summary – Hawi Aquifer System Area [80101]



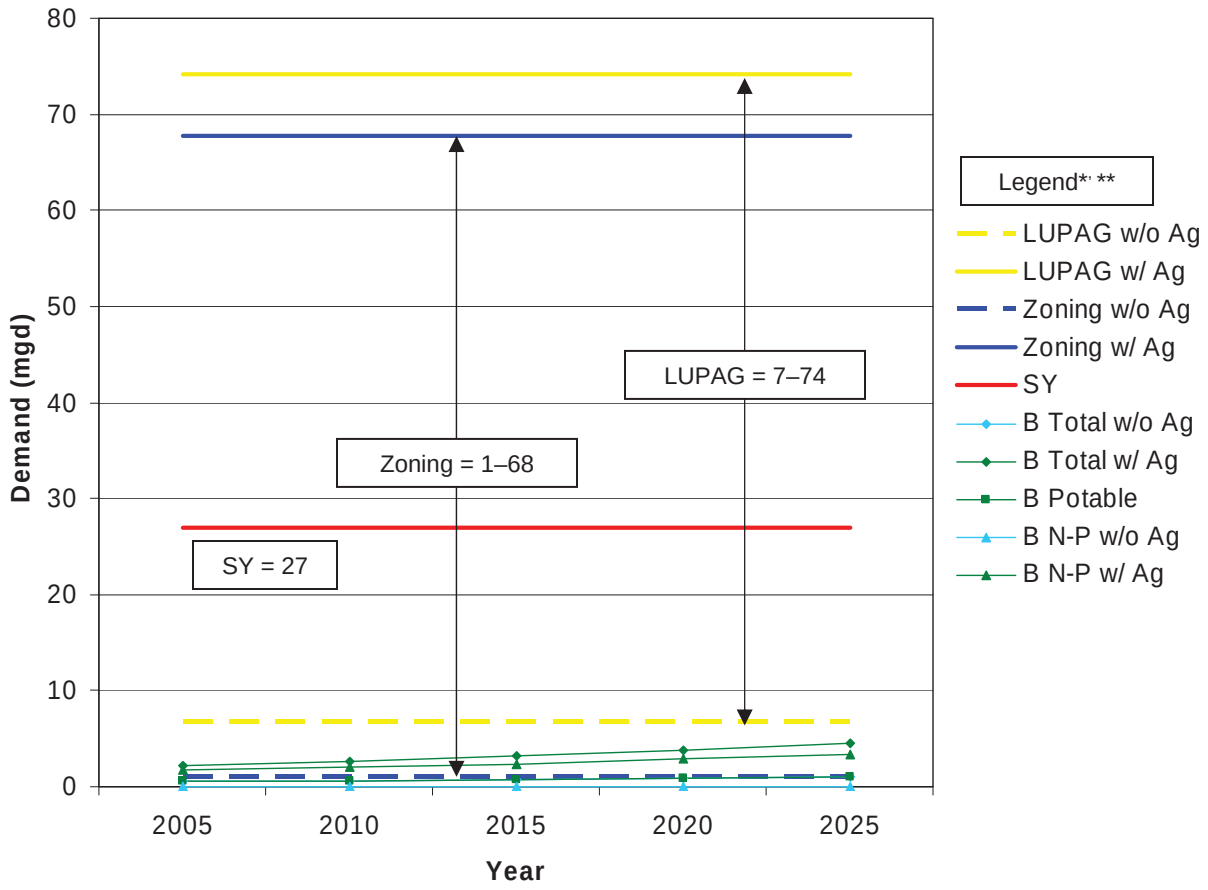
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 801-14a: Medium Growth Rate B Water Demand Projection by Category – Hawi Aquifer System Area [80101]

Water Use Category	2005 (mgd)	2010 (mgd)	2015 (mgd)	2020 (mgd)	2025 (mgd)
Total without Ag*	0.5	0.6	0.8	0.9	1.1
Total with Ag*	2.2	2.6	3.2	3.8	4.5
Domestic	0.0	0.0	0.0	0.1	0.1
Industrial	0.0	0.0	0.0	0.0	0.0
Irrigation	0.0	0.0	0.0	0.0	0.0
Agriculture	1.7	2.0	2.4	2.9	3.4
Military	0.0	0.0	0.0	0.0	0.0
Municipal	0.5	0.6	0.7	0.9	1.0
Potable	0.5	0.6	0.8	0.9	1.1
Nonpotable w/o Ag*	0.0	0.0	0.0	0.0	0.0
Nonpotable w/ Ag*	1.7	2.0	2.4	2.9	3.4
DWS	0.5	0.6	0.7	0.9	1.0

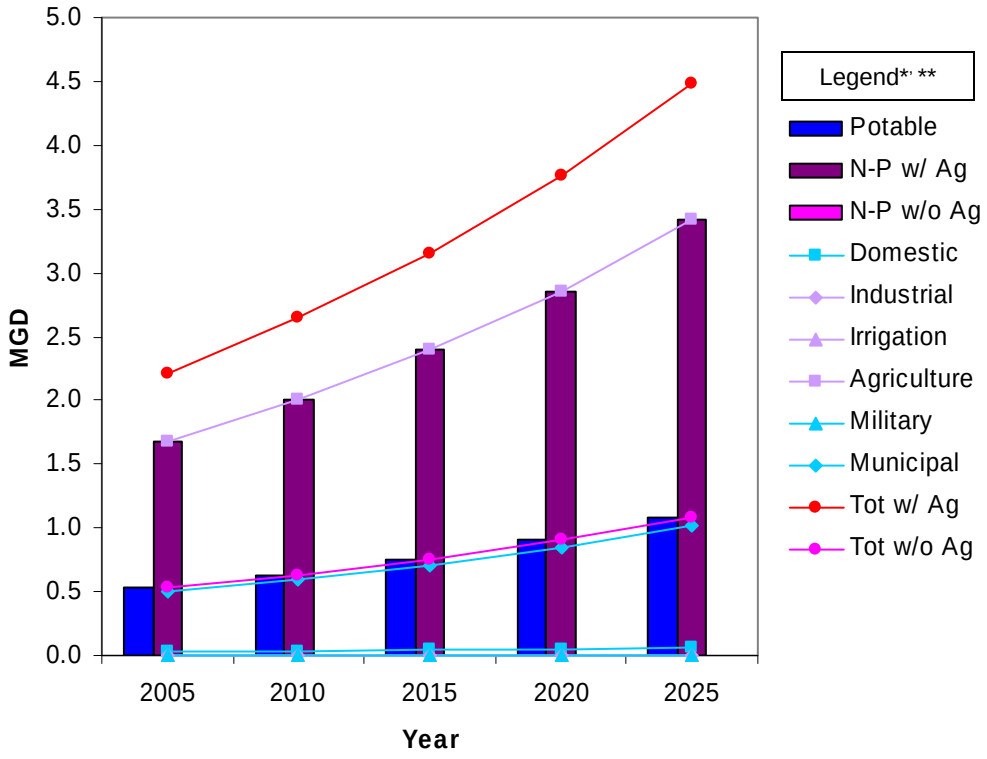
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 801-9a: Medium Growth Rate B Water Demand Projections and Full Build-Out – Hawi Aquifer System Area [80101]



* 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 801-10a: Medium Growth Rate B Water Demand Projection by Category – Hawi Aquifer System Area [80101]



* 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.

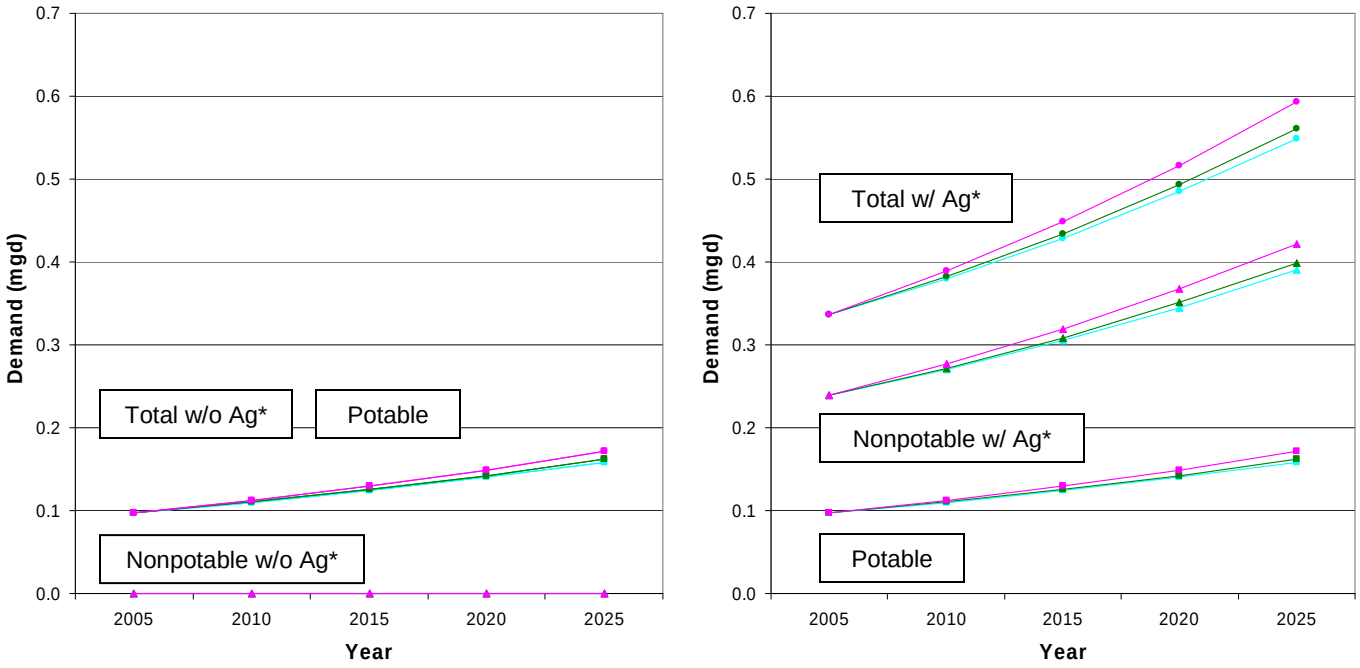
801.4.4.3 Waimanu Aquifer System Area [80102]

Table 801-13b: Water Demand Projection – Waimanu Aquifer System Area [80102]

	Without Agricultural Demands* (mgd)					With Agricultural Demands* (mgd)				
GROWTH RATE A	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	0.1	0.1	0.1	0.1	0.2	0.3	0.4	0.4	0.5	0.5
Potable	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.2
Nonpotable	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.3	0.3	0.4
GROWTH RATE B	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	0.1	0.1	0.1	0.1	0.2	0.3	0.4	0.4	0.5	0.6
Potable	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.2
Nonpotable	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.3	0.4	0.4
GROWTH RATE C	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	0.1	0.1	0.1	0.1	0.2	0.3	0.4	0.4	0.5	0.6
Potable	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.2
Nonpotable	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.3	0.4	0.4

* 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.

Figure 801-8b: Water Demand Projection Summary – Waimanu Aquifer System Area [80102]



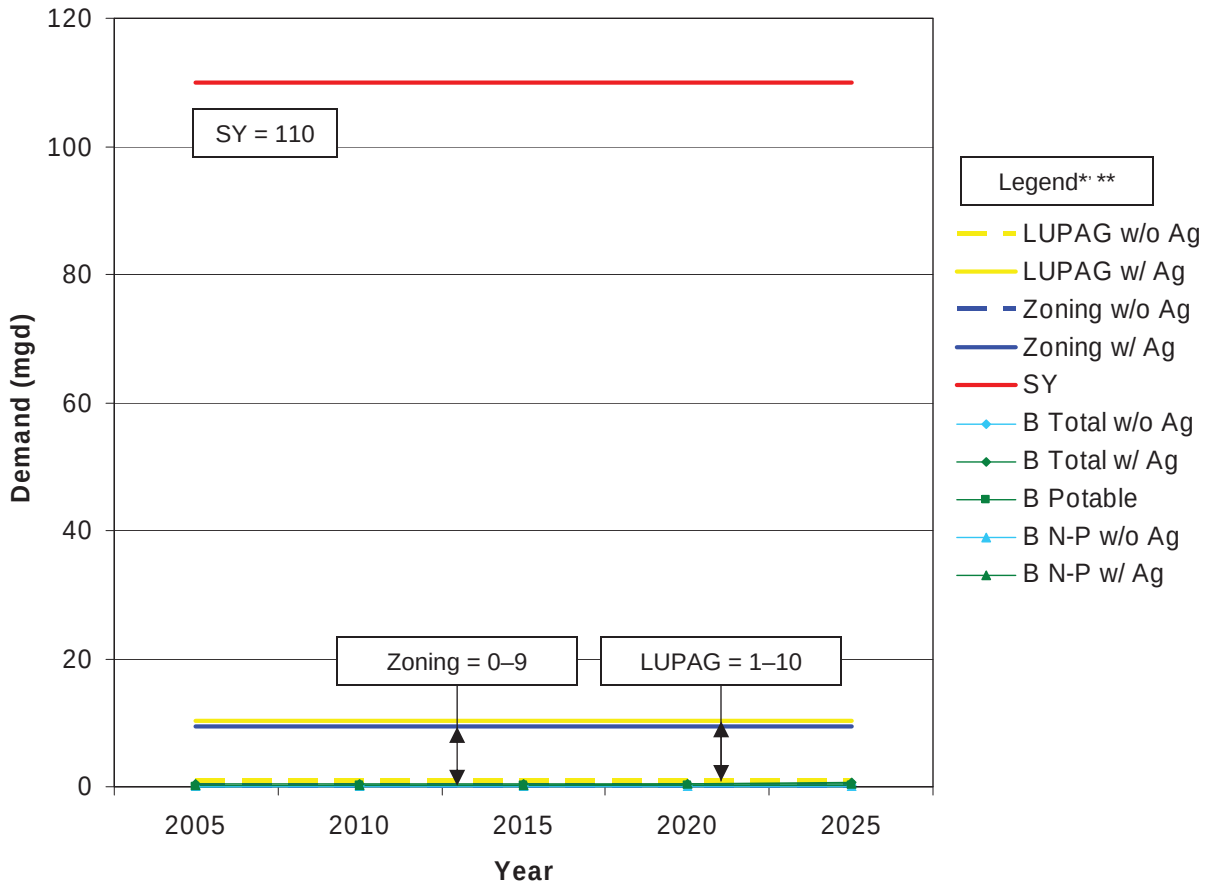
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 801-14b: Medium Growth Rate B Water Demand Projection by Category – Waimanu Aquifer System Area [80102]

Water Use Category	2005 (mgd)	2010 (mgd)	2015 (mgd)	2020 (mgd)	2025 (mgd)
Total without Ag*	0.1	0.1	0.1	0.1	0.2
Total with Ag*	0.3	0.4	0.4	0.5	0.6
Domestic	0.0	0.0	0.0	0.0	0.0
Industrial	0.0	0.0	0.0	0.0	0.0
Irrigation	0.0	0.0	0.0	0.0	0.0
Agriculture	0.2	0.3	0.3	0.4	0.4
Military	0.0	0.0	0.0	0.0	0.0
Municipal	0.1	0.1	0.1	0.1	0.1
Potable	0.1	0.1	0.1	0.1	0.2
Nonpotable w/o Ag*	0.0	0.0	0.0	0.0	0.0
Nonpotable w/ Ag*	0.2	0.3	0.3	0.4	0.4
DWS	0.1	0.1	0.1	0.1	0.1

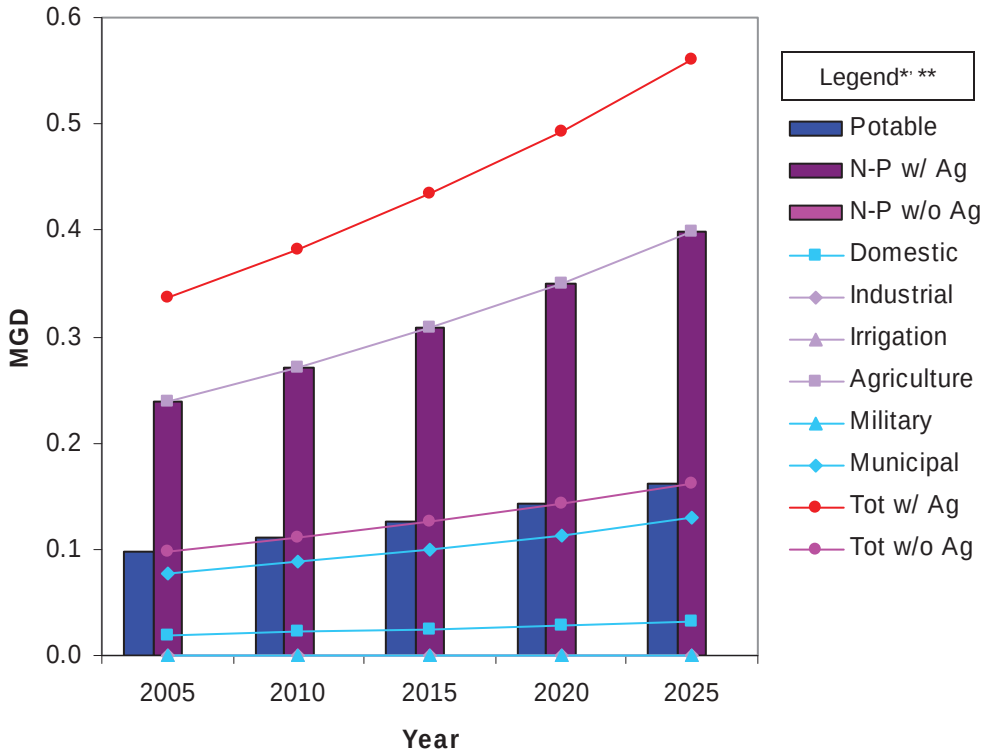
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 801-9b: Medium Growth Rate B Water Demand Projections and Full Build-Out – Waimanu Aquifer System Area [80102]



* 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 801-10b: Medium Growth Rate B Water Demand Projection by Category – Waimanu Aquifer System Area [80102]



* 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.

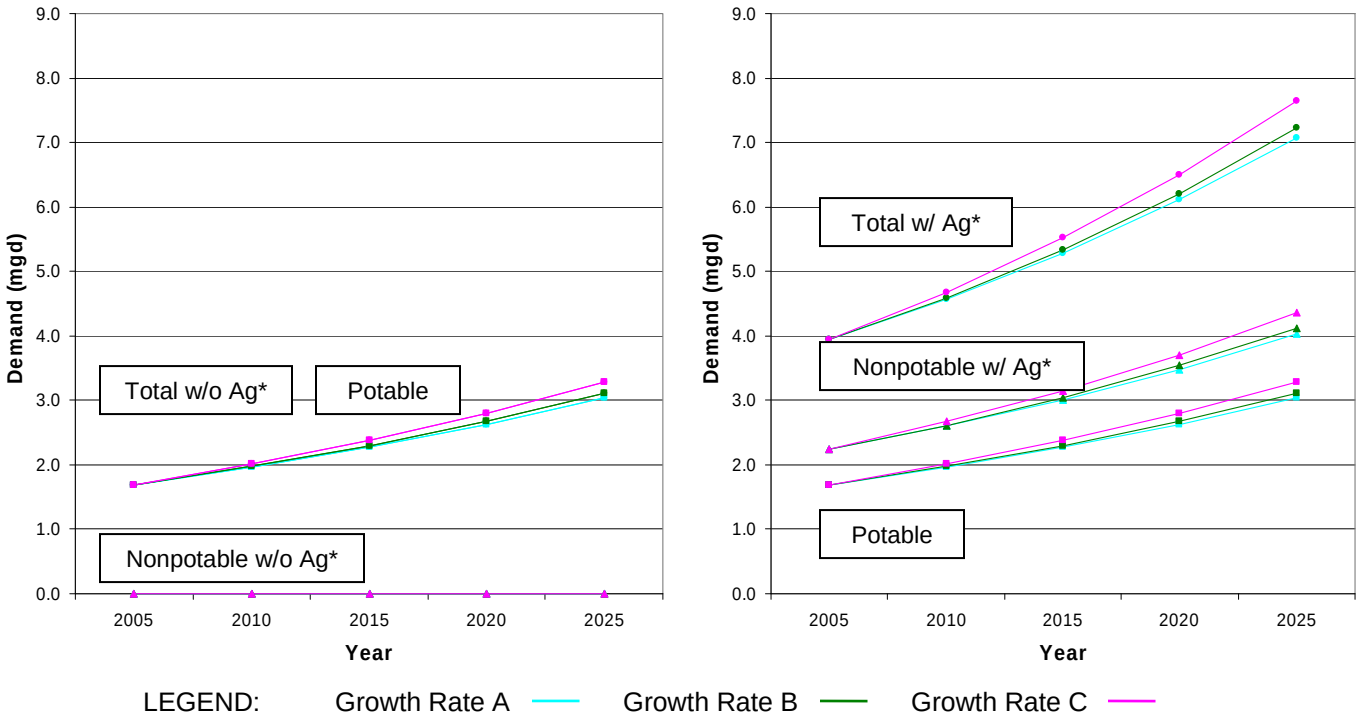
801.4.4.4 Mahukona Aquifer System Area [80103]

Table 801-13c: Water Demand Projection – Mahukona Aquifer System Area [80103]

	Without Agricultural Demands* (mgd)					With Agricultural Demands* (mgd)				
GROWTH RATE A	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	1.7	2.0	2.3	2.6	3.0	3.9	4.6	5.3	6.1	7.1
Potable	1.7	2.0	2.3	2.6	3.0	1.7	2.0	2.3	2.6	3.0
Nonpotable	0.0	0.0	0.0	0.0	0.0	2.2	2.6	3.0	3.5	4.0
GROWTH RATE B	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	1.7	2.0	2.3	2.7	3.1	3.9	4.6	5.3	6.2	7.2
Potable	1.7	2.0	2.3	2.7	3.1	1.7	2.0	2.3	2.7	3.1
Nonpotable	0.0	0.0	0.0	0.0	0.0	2.2	2.6	3.0	3.5	4.1
GROWTH RATE C	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	1.7	2.0	2.4	2.8	3.3	3.9	4.7	5.5	6.5	7.6
Potable	1.7	2.0	2.4	2.8	3.3	1.7	2.0	2.4	2.8	3.3
Nonpotable	0.0	0.0	0.0	0.0	0.0	2.2	2.7	3.1	3.7	4.4

* 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.

Figure 801-8c: Water Demand Projection Summary – Mahukona Aquifer System Area [80103]



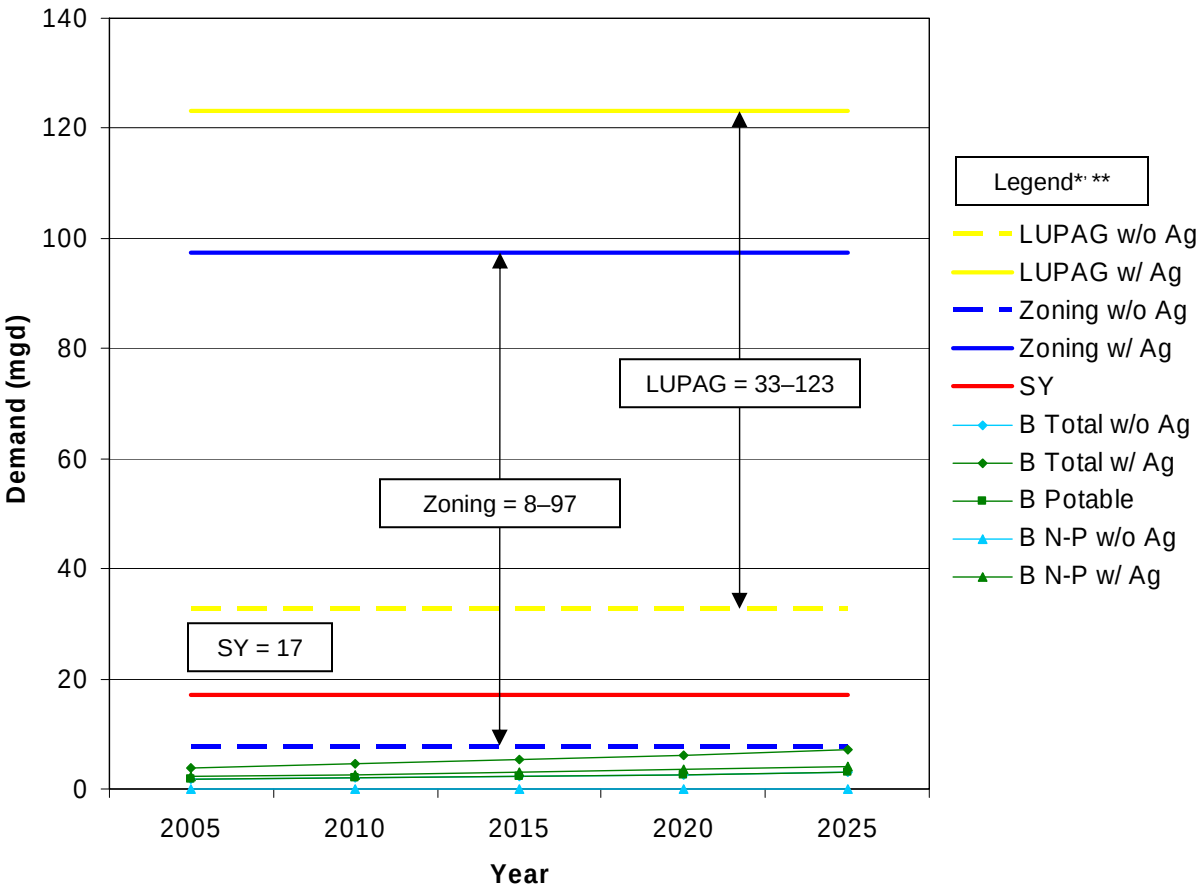
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 801-14c: Medium Growth Rate B Water Demand Projection by Category – Mahukona Aquifer System Area [80103]

Water Use Category	2005 (mgd)	2010 (mgd)	2015 (mgd)	2020 (mgd)	2025 (mgd)
Total without Ag*	1.7	2.0	2.3	2.7	3.1
Total with Ag*	3.9	4.6	5.3	6.2	7.2
Domestic	0.1	0.1	0.1	0.1	0.1
Industrial	0.0	0.0	0.0	0.0	0.0
Irrigation	0.0	0.0	0.0	0.0	0.0
Agriculture	2.2	2.6	3.0	3.5	4.1
Military	0.0	0.0	0.0	0.0	0.0
Municipal	1.6	1.9	2.2	2.6	3.0
Potable	1.7	2.0	2.3	2.7	3.1
Nonpotable w/o Ag*	0.0	0.0	0.0	0.0	0.0
Nonpotable w/ Ag*	2.2	2.6	3.0	3.5	4.1
DWS	0.9	1.1	1.3	1.5	1.7

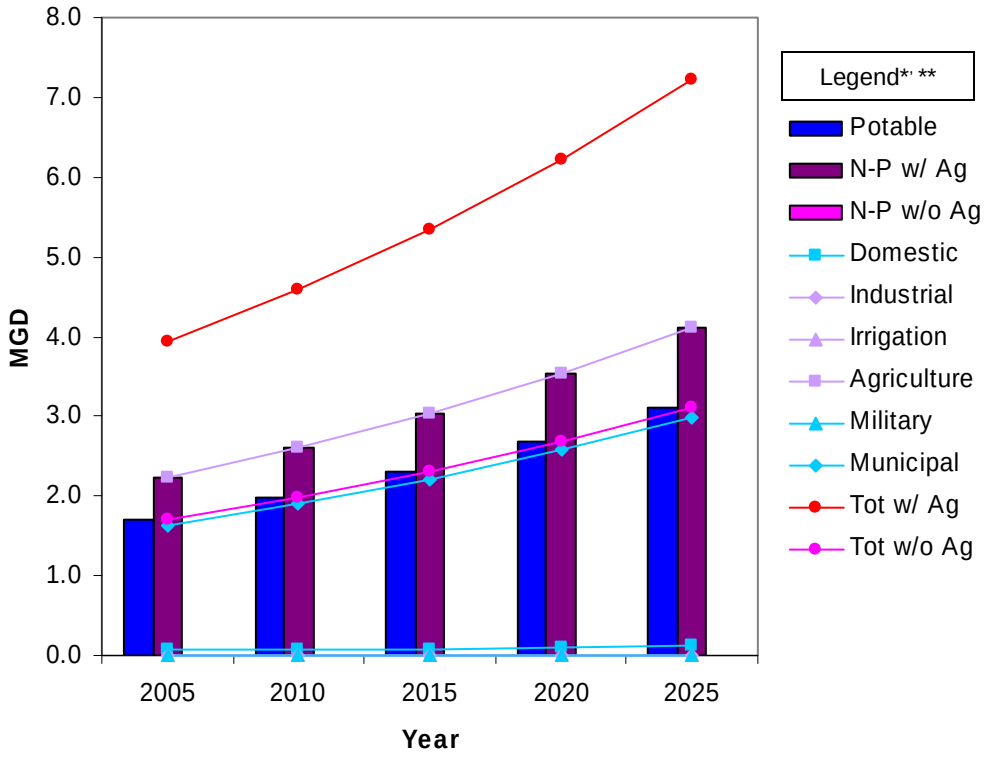
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 801-9c: Medium Growth Rate B Water Demand Projections and Full Build-Out – Mahukona Aquifer System Area [80103]



* 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 801-10c: Medium Growth Rate B Water Demand Projection by Category – Mahukona Aquifer System Area [80103]

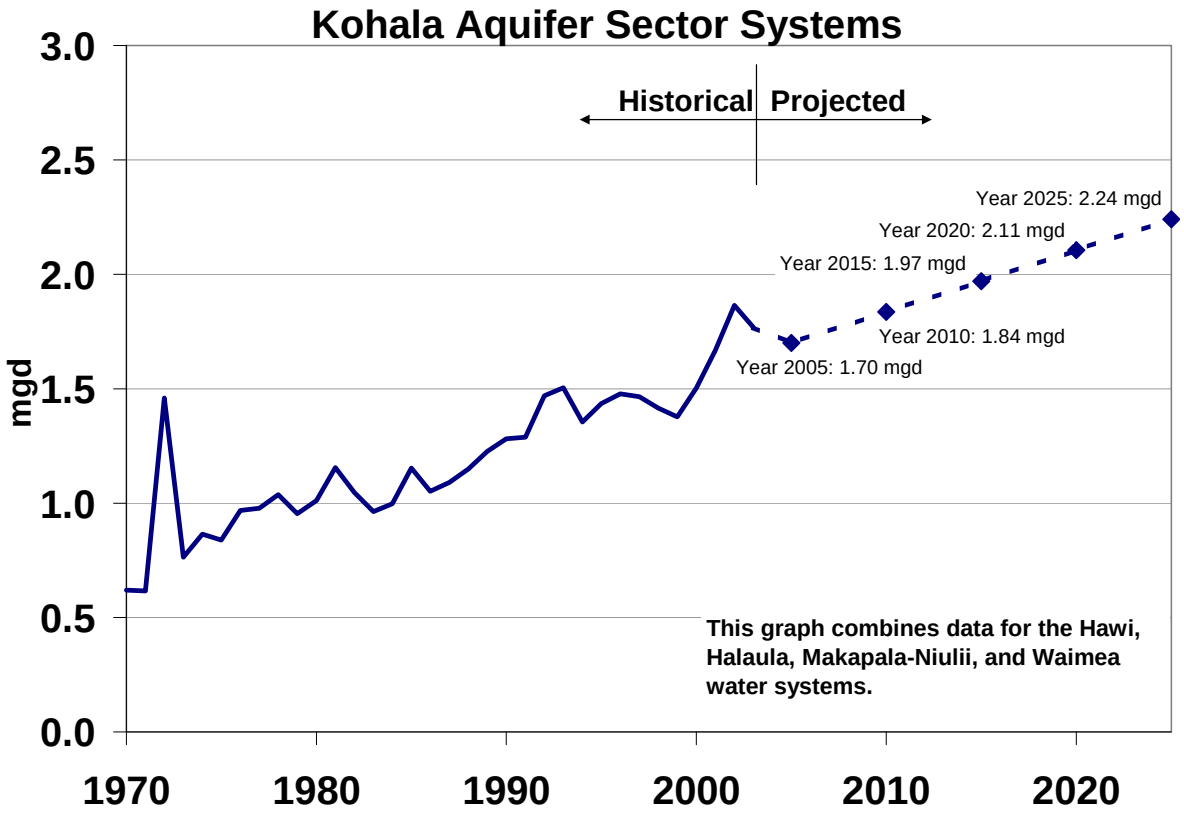


* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.
** "N-P" represents the nonpotable component of the demand.

801.4.5 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 on **Figure 801-11**.

Figure 801-11: DWS Water Demand Projection – Kohala Aquifer Sector Area



Historical data provided by RW Beck, Inc.

Projections based on historical DWS water consumption data differ greatly from projections based on population growth rate, although the 2005 estimates are close. This is because the projected future rate of increase of the population is much higher than that of the historical demand. DWS may need to supply potable water equivalent to approximately 50 percent of the total projected water supply for the Kohala ASEA.

801.5 RESOURCE AND FACILITY RECOMMENDATIONS

801.5.1 Water Source Adequacy

801.5.1.1 Full Build-Out

Excluding agricultural demands, full development to the maximum density of the County General Plan and Zoning within the Kohala Aquifer Sector Area (ASEA) is sustainable, with water demands requiring 26 and 6 percent of the 154 mgd sustainable yield (SY), respectively. However, the water demands associated with maximum density full build-out LUPAG scenario within the Mahukona Aquifer System Area (ASYA) will exceed the system area SY of 17 mgd. The existing Zoning within the Mahukona ASYA will require approximately 45 percent of the SY. If worst case agricultural demands are included, the LUPAG and Zoning scenarios for the Kohala ASEA and both the Hawi and Mahukona ASYAs are not sustainable. Water demands associated with all scenarios within the Waimanu ASYA are sustainable.

801.5.1.2 Twenty-Year Projection

Existing and 20-year projected water demands within the Kohala ASEA are less than 10 percent of the sector area SY. Existing water demands within the Mahukona ASYA range between 10 and 23 percent of the system area SY, and 20-year projected demands range between 18 and 43 percent of the system area SY. Existing and 20-year projected demands within the Hawi and Waimanu ASYAs are less than 20 percent and less than 1 percent of the system area sustainable yields, respectively.

801.5.2 Source Development Requirements

801.5.2.1 Supply-Side Management

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

801.5.2.1.1 Conventional Water Resource Measures

801.5.2.1.1.1 Ground Water

Most of the sustainable yield of the Kohala ASEA is within the Waimanu ASYA. It has been speculated that much of that estimate actually is carried by the Upper and Lower Hamakua Ditch Systems; however, the 1990 WRPP indicates that undoubtedly a large quantity of groundwater is developable. Unfortunately, of the three aquifer system areas in the Kohala ASEA, the land over the Waimanu ASYA is the least accessible and therefore the most difficult area on which to develop groundwater sources. Most of the high level groundwater is impounded in dikes. Evidence of the high-level aquifer has been shown by development of high level wells in the Kohala Forest Reserve and in areas north of Waimea by DWS. Indications are that continued development of this resource is viable.

The basal aquifer may also be developed as a potable source. On the leeward side, it may be brackish within a few miles from the coast; therefore, new wells should be located as far inland as feasibly possible. DWS has installed a deep well to replace the spring sources in the Makapala Water System, and has wells planned in the Halaula and Kokoiki areas of the Hawi Water System.

801.5.2.1.1.2 Surface Water

The Kohala ASEA has one of the most abundant supplies of surface water on the island. One of the utility courses of action in the General Plan is to "Encourage efforts to improve the Kohala Ditch System and its use for agricultural purposes." Farmers generally grow what is feasible in the area; therefore, it is anticipated that agricultural water use will follow the availability of irrigation water. Increase in the amount and accessibility of nonpotable water would likely promote additional usage.

The primary sources of the DWS Waimea Water System are stream diversions. Although large volumes of storage are necessary to provide adequate supply during dry periods, the available supply of surface water is plentiful. Infrastructure improvements, such as tapping other streams above Waimea Village, are an option; however, usage of surface water to supply potable water requires strict adherence to DOH regulations including treatment and monitoring.

A significant challenge with developing surface water for either potable or nonpotable uses is transmission. The four major ditch systems on the island originate and obtain sources from the Kohala ASEA; systems to supply nonpotable source water are already in place but are in need of repair. The AWUDP includes the study of and proposal of a capital improvement program to reinstate the Lower Hamakua Ditch, and the Waimea Irrigation System, which is supplied by the Upper Hamakua Ditch. As previously stated in Chapter 1, the impacts of the October 15, 2006 earthquake are not fully understood; therefore, the extent to which the ditch systems can feasibly be utilized is not known.

801.5.2.1.1.3 Water Transfer

Some of the source water that is produced in the Kohala ASEA is currently being transferred to other sectors. Surface water sources originating in the Kohala ASEA supply the DWS Waimea WS; however, part of the system south of Mamalahoa Highway is located in the West Mauna Kea Sector. Additionally, there is an unvalved, unmetered connection between DWS's Waimea and Haina Water Systems in the vicinity of the Waimea Country Club. The exact amount that is being transferred is not known.

Transfer of water to the West Mauna Kea ASEA (803) and potentially the Northwest Mauna Loa ASEA (807) is expected to increase due to limited supply of groundwater in those sectors, and anticipated growth of the three major resort complexes along the coast. It has been proposed to construct a large transmission pipeline to transfer at least 20 mgd from the Hawi area to the Lalamilo Water System. This is one of many alternatives to facilitate the transfer of potable water. Another alternative might be to develop high-level groundwater in the Waimea area,

which could be transferred via the Waimea WS to the Lalamilo WS. Infrastructure improvements would likely be required, such as larger mains, pressure reducing valves, and storage tanks. The high elevation of Waimea would allow most of the water to flow by gravity, thereby reducing pumping costs.

Potable water also will eventually need to be transferred from the Waimanu ASYA to the Mahukona ASYA in order to sustain the full build-out demands associated with the General Plan. Growth trends indicate that this would be in the distant future, but should be considered.

801.5.2.1.2 Alternative Water Resource Enhancement Measures

801.5.2.1.2.1 Rainwater Catchment Systems

Rainwater catchment systems are a viable option in areas that receive abundant rainfall, which includes the entire sector area except from the leeward coast to about halfway up the slopes of the Kohala Mountain. Catchment systems are a suitable source of potable water for individual domestic users in areas outside the limits of municipal water systems, and may continue to be if implementing a municipal system is not feasible. Generally, these areas are remote and are not expected to expand significantly, because most development will be concentrated within existing urban areas. Therefore, usage of this source likely will not increase.

801.5.2.1.2.2 Wastewater Reclamation

Wastewater reclamation is a possible resource enhancement measure, but would be limited to uses within the immediate vicinity of the treatment facility. The quantity of wastewater available for reclamation is also dependent on the amount of potable water used. Indications are that the potential quantity of reclaimed wastewater would be insignificant compared to the magnitude and availability of other sources of nonpotable water.

801.5.2.1.2.3 Desalination

Desalination of brackish groundwater is a potential alternative, but due to the high cost, likely would not be used if other sources of potable water are available. The most favorable location meeting these criteria is along the leeward coast, remote from the municipal water systems, and where groundwater is brackish. Currently, these areas are classified as “Agricultural” under both LUPAG and Zoning, and a significant quantity of potable water may not be required.

801.5.2.2 Demand-Side Management

801.5.2.2.1 Development Density Control

The full build-out demand associated with LUPAG is nearly five times that of Zoning, due to the greater urban area proposed under LUPAG, and due to the difference in urban unit density rates. In particular, Urban Expansion areas comprise one-third of the LUPAG Urban area. There is greater flexibility to control the densities of these areas because they are currently undesignated.

County Planning may consider re-examining proposed urban areas because the full build-out demands in the Mahukona ASYA cannot be met by the sustainable yield.

801.5.2.2.2 Water Conservation

The average water consumption of all accounts on the DWS system is approximately 550 gpd per connection, which is slightly higher than the island average. Additionally, the estimated potable water usage per capita from all sources is approximately 180 gpd.

The concept of water conservation should be stressed everywhere, but focused on the Mahukona ASYA. Potential demand side-conservation measures include voluntary water reduction, efficient landscaping infrastructure and practices, and public education.

The DWS Hawi and Makapala Water Systems average less than 15 percent of unaccounted water. Because of the small quantity produced, this is not considered critical.

801.5.3 Recommended Alternatives

Development of high-level groundwater sources should continue to be the primary source of potable water, with close monitoring of water levels. Although the cost of drilling and pumping is expensive, cost savings may be achieved in the transmission process by allowing water to flow by gravity to lower elevation areas. Basal water sources may be developed to supply localized areas in the vicinity of Hawi.

Feasibility and cost studies should be initiated to assess the potential to increase development of surface water for potable water use, if groundwater sources become stressed. Surface water should continue to be the primary source of nonpotable water. Restoration of the four major ditch systems should be investigated and planned to meet anticipated future irrigation and agricultural needs. It is anticipated that the next update to the AWUDP will address these issues in greater detail.

Due to the availability and abundance of water sources in the Kohala ASEA, potable water should be developed for the purpose of transfer out of the Sector to the West Mauna Kea (803) and Northwest Mauna Loa (807) ASEAs, and also within the Sector from the Waimanu ASYA to the Mahukona ASYA, where shortfalls of potable water supply may arise. A detailed water balance should be established for the Kohala ASEA; quantities of water transferred into and out of the sector should be monitored, which would necessitate the installation of meters on all watermains that cross into other aquifer sector areas. Several alternatives, such as those described previously, should be examined to determine the most financially and sociably acceptable method of accomplishing this task.