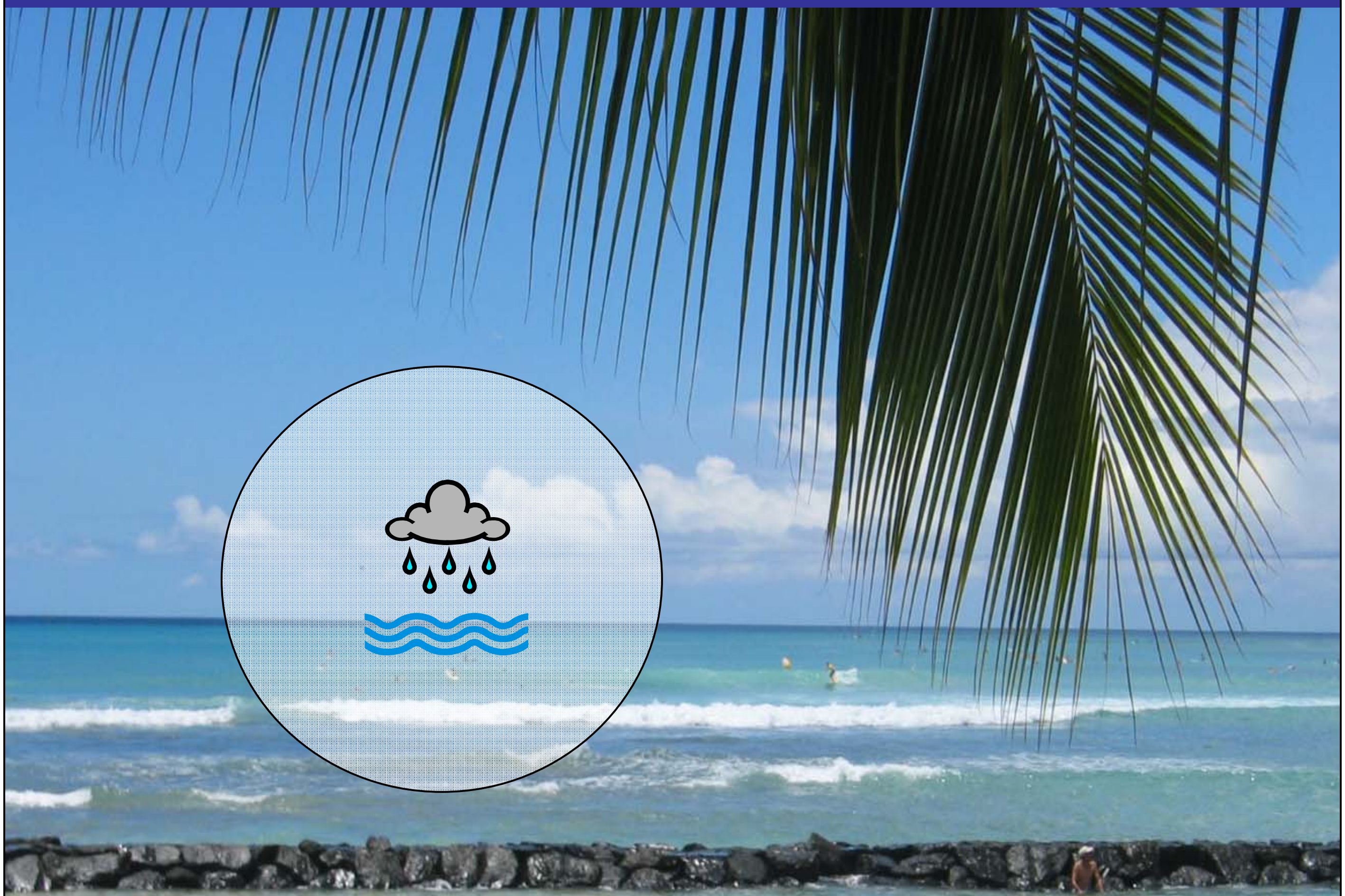
HAWAII COUNTY WATER USE AND DEVELOPMENT PLAN UPDATE

Hawaii Water Plan

August 2010

FINAL REPORT



Funded by the:

Department of Water Supply

For the:

County of Hawaii

FUKUNAGA & ASSOCIATES, INC.
Consulting Engineers
1357 Kapiolani Boulevard, Suite 1530
Honolulu, Hawaii 96814
(808) 944-1821

ADDENDUM NO. 1

The following modifications were made to the Water Use and Development Plan to address comments received through the public hearings held on August 3 and 4, 2011 by the Commission on Water Resource Management.

Page 1-17, Figure 1-6: Note added

Page 1-44, Table 1-10, 2nd data row: Data in first 4 columns revised

Page 801-41, Figure 801-9a: Arrows revised

Page 801-45, Figure 801-9b: Arrows revised

Page 803-28, Figure 803-9: Arrows revised

Page 804-26, Figure 804-9: Arrows revised

Page 809-23, Table 809-10, 1st data row: Data in first column revised

Page 809-23, Section 809.3.6.4, 2nd paragraph: Deleted and replaced with new paragraph

Page 809-43, Section 809.5.2.1.1.1, 2nd paragraph: Revised

Page 809-46, Section 809.5.3: New paragraph added after 1st paragraph

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APPENDICES

LIST OF ABBREVIATIONS

ARMD	State of Hawaii, Department of Agriculture, Agricultural Resource Management Division
ASEA	Aquifer Sector Area
ASYA	Aquifer System Area
AWUDP	Agricultural Water Use and Development Plan
CDP	Community Development Plan
CWRM	Commission on Water Resource Management
DHHL	State of Hawaii, Department of Hawaiian Home Lands
DLNR	State of Hawaii, Department of Land and Natural Resources
DOA	State of Hawaii, Department of Agriculture
DOH	State of Hawaii, Department of Health
DOT	State of Hawaii, Department of Transportation
DPS	State of Hawaii, Department of Public Safety
DWS	County of Hawaii, Department of Water Supply
GIS	Geographic Information Systems
GP	County of Hawaii, General Plan
GPD	gallons per day
HCDC	State of Hawaii, Housing and Community Development Corporation
HELCO	Hawaiian Electric Light Company, Inc.
HSA	Hawaii Stream Assessment
KSBE	Kamehameha Schools Bishop Estate
LHD	Lower Hamakua Ditch
LUPAG	Land Use Pattern Allocation Guide
MAV	Moving Average
MG	million gallons
MGD	million gallons per day
NELHA	National Energy Laboratory of Hawaii Authority
PGV	Puna Geothermal Venture
PRV	Pressure Reducing Valve
PTA	Pohakuloa Military Training Area
SDWA	Safe Drinking Water Act
SKWIS	South Kona Watershed Irrigation Study
SLH	Session Laws of Hawaii
SWPP	State Water Projects Plan
SY	Sustainable Yield
USDA, NASS	United States Department of Agriculture, National Agricultural Statistics Service

LIST OF ABBREVIATIONS

USGS	United States Geological Survey
WQP	Water Quality Plan
WRPP	Water Resource Protection Plan
WS	Water System
WUDP	Water Use and Development Plan
WWRF	Wastewater Reclamation Facility

ES EXECUTIVE SUMMARY

ES.1 INTRODUCTION

In 1987, the State Legislature passed the State Water Code (Hawaii Revised Statutes, Chapter 174C) to protect Hawaii's surface and ground water resources, which called for the establishment of a Commission on Water Resource Management (CWRM) and the formulation of a *Hawaii Water Plan* that would serve as a dynamic, long-range planning guide for the Commission. The *Hawaii Water Plan* consists of five parts: (1) the *Water Resource Protection Plan*, (2) the *Water Quality Plan*, (3) the *State Water Projects Plan*, (4) the *Agricultural Water Use and Development Plan* (AWUDP), and (5) the County Water Use and Development Plans (WUDP). A separate WUDP is to be prepared by each of the four Counties.

In compliance with the State Water Code, the County of Hawaii Department of Water Supply (DWS) was tasked with the responsibility to prepare the *County of Hawaii Water Use and Development Plan* in 1988. The WUDP serves as a continuing long-range guide for the water resource development in the County. Its objective is "to set forth the allocation of water to land use through the development of policies and strategies which shall guide the County in its planning, management, and development of water resources to meet projected demands." Section 13-170-31, Hawaii Administrative Rules states that the WUDP shall include but not be limited to:

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

The original County of Hawaii WUDP was adopted by the County Council by ordinance on May 10, 1990, and was conditionally accepted by the CWRM for incorporation into the *Hawaii Water Plan* on June 27, 1990, with the provisions that the WUDP be reviewed and revised as necessary by the County to coincide with the review process of the *Hawaii Water Plan*.

The *Statewide Framework for Updating the Hawaii Water Plan* (Framework) dated February 2000 was created by the CWRM to facilitate coordination, integration, and consistency of the components of the *Hawaii Water Plan*. In addition, the framework is a guide for preparation of the WUDP to insure effective implementation by the County and utilization by the CWRM for resource management purposes.

The Framework requires data and analyses to be based on ground water and surface water hydrologic units designated by the CWRM. However, the surface water hydrologic units were only recently established and adopted in June 2005; and additional information on the surface water hydrologic units is extremely limited. Therefore, the Hawaii WUDP update is based on the ground water hydrologic units, and references the surface water hydrologic units as applicable. There are nine Aquifer Sector Areas on the island of Hawaii, which are further subdivided into Aquifer System Areas. **Figure ES-1** shows the aquifer areas and indicates the Sustainable Yield, or safe source capacity, established by the *Water Resource Protection Plan* (WRPP).

Sustainable Yield (SY) is defined and described in the *Water Resource Protection Plan* (WRPP) as follows:

> *Sustainable yield refers to the forced withdrawal rate of groundwater that could be sustained indefinitely without affecting either the quality of the pumped water or the volume rate of pumping. It depends upon the head selected as the minimum allowable during continuous pumping. Head is the elevation* [or height] *of the unconfined water table above sea level. There is not a unique value for sustainable yield; the value depends on the head that will preserve the integrity of the groundwater resource at the level decided upon by the manager.*
>
> *Sustainable yield is equal to a fraction of the recharge. In a basal lens the fraction is usually more than half and sometimes greater than three fourths where initial heads are high. In high level aquifers about three fourths of the recharge can be taken as sustainable yield.*
> [Groundwater recharge is the process of adding water to the aquifer through the infiltration of precipitation on the land surface.]
>
> *The estimates of sustainable yield are not meant to be an exact number which could be used in final planning documents. The estimates are constrained not only by the scanty data base but also by the fact that they do not consider the feasibility of developing the groundwater. The estimates should not be equated to developable groundwater. In many regions, taking advantage of a high estimate would not be economically feasible.*

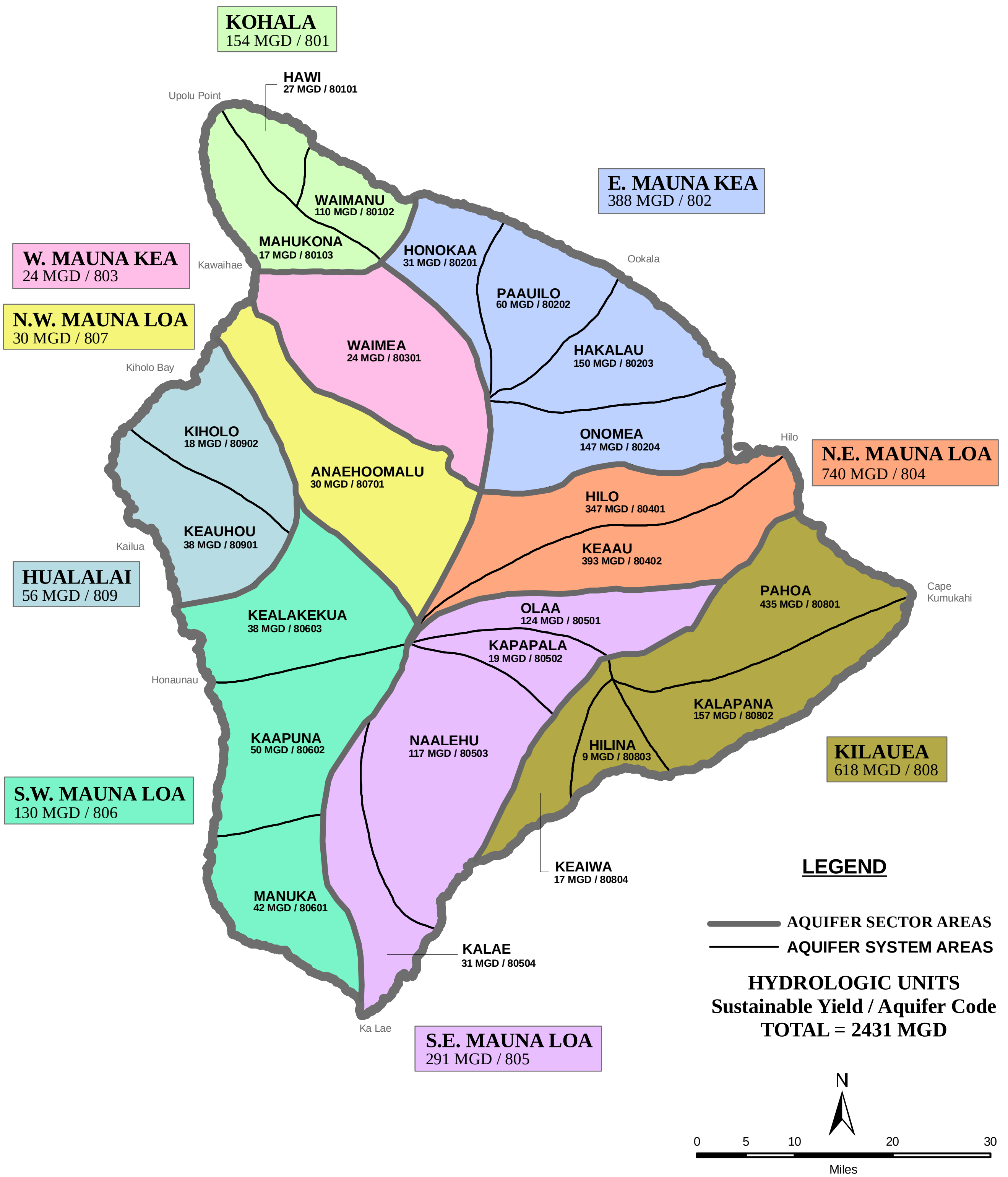
ES.2 METHODOLOGY

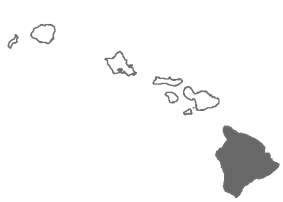
Each Aquifer Sector Area is evaluated with the following methodology.

ES.2.1 Existing Water Resources

Water resources that currently are utilized on the island are examined within each sector area. These resources include the following:

- Groundwater
- Surface water
- Rainwater catchment
- Reclaimed wastewater





Island of Hawaii

FIGURE ES-1

AQUIFER BOUNDARIES

Hawaii County
Department of Water Supply
DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN
Job No. 2003-818

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

ES.2.2 Existing Water Use

Existing water use is calculated based on available data, including well pumpage reported to the CWRM, water purveyor records, Department of Health records, and available GIS data.

ES.2.2.1 Existing Water Use by CWRM Categories

Existing water use is categorized to the extent possible according to preliminary water use categories recently established by CWRM staff. Future WUDP Updates should conform to the finalized water use categories to the extent possible. Water use is assigned to a single category to avoid overlap and confusion.

- Domestic (Individual Household)
- Industrial (Fire Protection, Mining, Thermoelectric Cooling, Geothermal)
- Irrigation (Golf Course, Hotel, Landscape, Parks, School, Dust Control)
- Agriculture (Aquatic Plants & Animals, Crops/Processing, Livestock & Pasture, Ornamental/Nursery)
- Military
- Municipal (County, State, Private Public Water Systems [as defined by DOH])

ES.2.2.2 Existing Water Use by Resource

Existing water use is also categorized according to the four water resources listed previously.

ES.2.3 Future Water Needs

Water resource planning for the Hawaii WUDP update considers both land use based water demand projections and rate of population growth to plan for future water needs. A distinct difference between the scenarios is that the land use based projections are based on planning level standards, while the 20-year projections are based on actual consumption.

ES.2.3.1 Full Build-Out Water Demand Projections

The full build-out water demand projections are land use based. The County General Plan Land Use Pattern Allocation Guide (LUPAG) and County Zoning Land Use classifications are assessed to estimate the projected development densities for each designation at full-build out. The results are used to project the ultimate water demand based on the General Plan, and potential water demand based on land use zoning, which is legally developable, to determine if there are adequate water resources to sustain the land uses.

As required by the Framework, the WUDP considers the most recent *State Water Projects Plan*, and *Agricultural Water Use and Development Plan* forecasts if water requirements are available; and recognizes the current and future development needs of the Department of Hawaiian Home Lands.

ES.2.3.2 5-Year Incremental Water Demand Projections to the Year 2025

Existing population and water use were calculated as the basis of the water demand projections to the year 2025 to assess the adequacy of current and near-term water sources (20 years). Population and growth rate projections were applied in 5-year increments for the next 20 years; and have high-growth, medium-growth (base case) and low-growth (the most conservative) scenarios. The demands are further differentiated into potable and nonpotable demands.

ES.2.4 Water Use Unit Rates

Water use unit rates were based on the *Water System Standards* as listed in **Table ES-1** and actual consumption data. Potable and non-potable water requirements were differentiated where appropriate.

Table ES-1: Water System Standards, Domestic Consumption Guidelines

Zoning Designation	Average Daily Demand
RESIDENTIAL:	
Single Family or Duplex	400 gals/unit
Multi-Family Low Rise	400 gals/unit
Multi-Family High Rise	400 gals/unit
COMMERCIAL:	
Commercial Only	3000 gals/acre
RESORT:	400 gals/unit or 17,000 gal/acre*
LIGHT INDUSTRY:	4000 gals/acre
SCHOOLS, PARKS:	4000 gals/acre or 60 gals/student
AGRICULTURE:	3400 gals/acre**

* Resort ADD of 17,000 gal/acre based on ADD for Maui.
** Agriculture ADD based on AWUDP.

Water use unit rates based on actual consumption data for specific geographic regions were developed by the Hawaii County Department of Water Supply for single family residential units, as listed below:

- South Kohala and North Kona – 2.5 units/lot
- South Kona – 1.5 units/lot
- Elsewhere – 400 gals/unit

These unit rates result in higher water demand projections as compared to the *Water System Standard* unit rates, but are viewed as more realistic based on historic consumption data.

ES.2.5 Agricultural Water Use

Agricultural water use is extremely difficult to determine due to the lack of available data. The proposed methodology to determine agricultural water use was met with strong objection at public meetings. Overwhelmingly, public input suggested that the need for irrigation water was not predicated on the classification of Agricultural lands. Public input further suggested that agricultural users would grow what is feasible according to the climate, and that irrigation from groundwater sources would be minimal. For example, crops requiring large amounts of moisture would be grown in areas that have a higher ambient rainfall. For these reasons, and because it is expected that the next update to the AWUDP will investigate these issues in greater detail, two agricultural water use scenarios are presented for each of the full build-out scenarios (Hawaii County General Plan and Hawaii County Zoning) and the 5-year incremental water demand projection scenario. This identifies a range of agricultural water use, which considers the best and worst case scenarios on an interim basis, until the next phase of the AWUDP is complete.

ES.2.6 Resource and Facility Recommendations

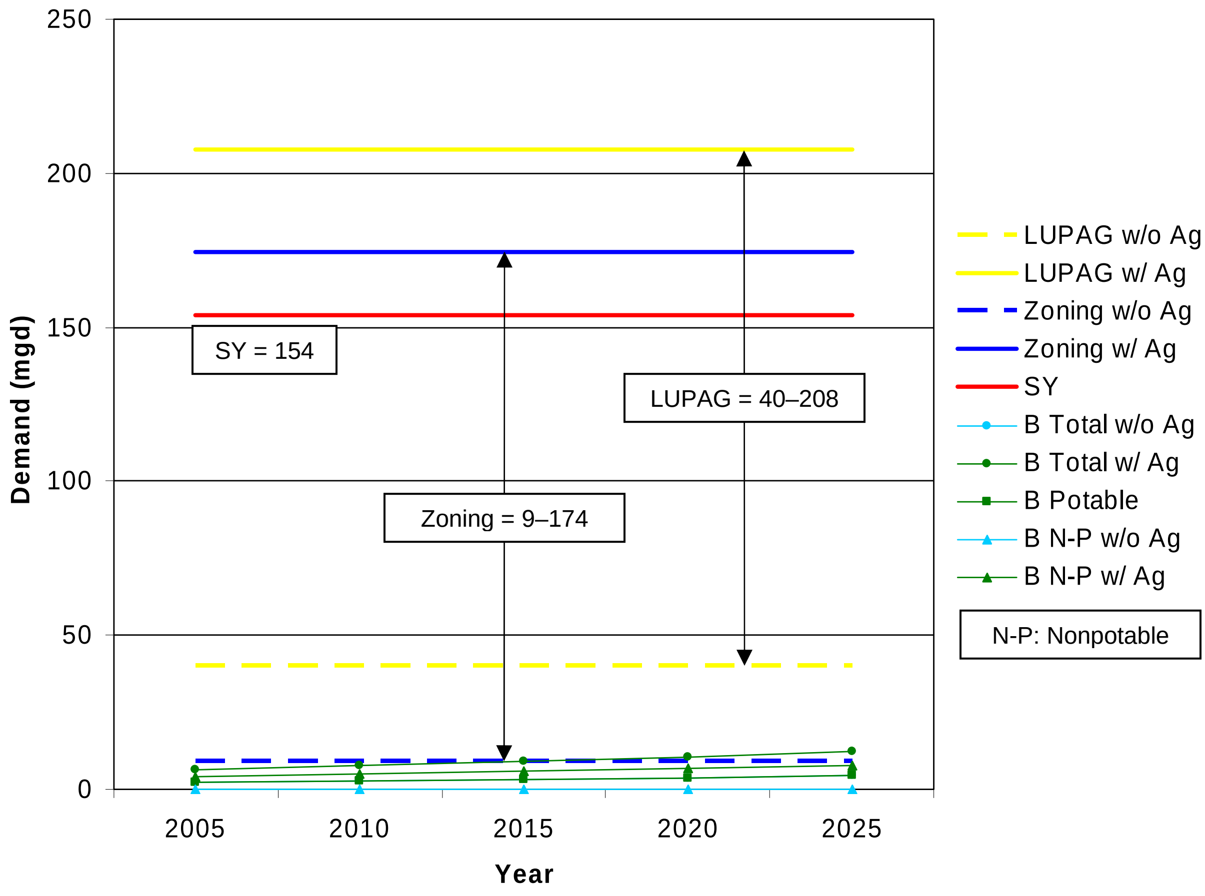
Several water resource enhancement measures were examined to meet the projected water demands. These include conventional supply-side measures such as groundwater and surface water development, alternative supply-side measures such as development of rainwater catchment systems, reclaimed wastewater, and desalination; and demand-side management such as development density control and water conservation measures. The feasibility of these water resource enhancement options was compared to provide a recommended combination of measures.

ES.2.7 Aquifer Sector Area Synopses

A brief synopsis of each Aquifer Sector Area follows.

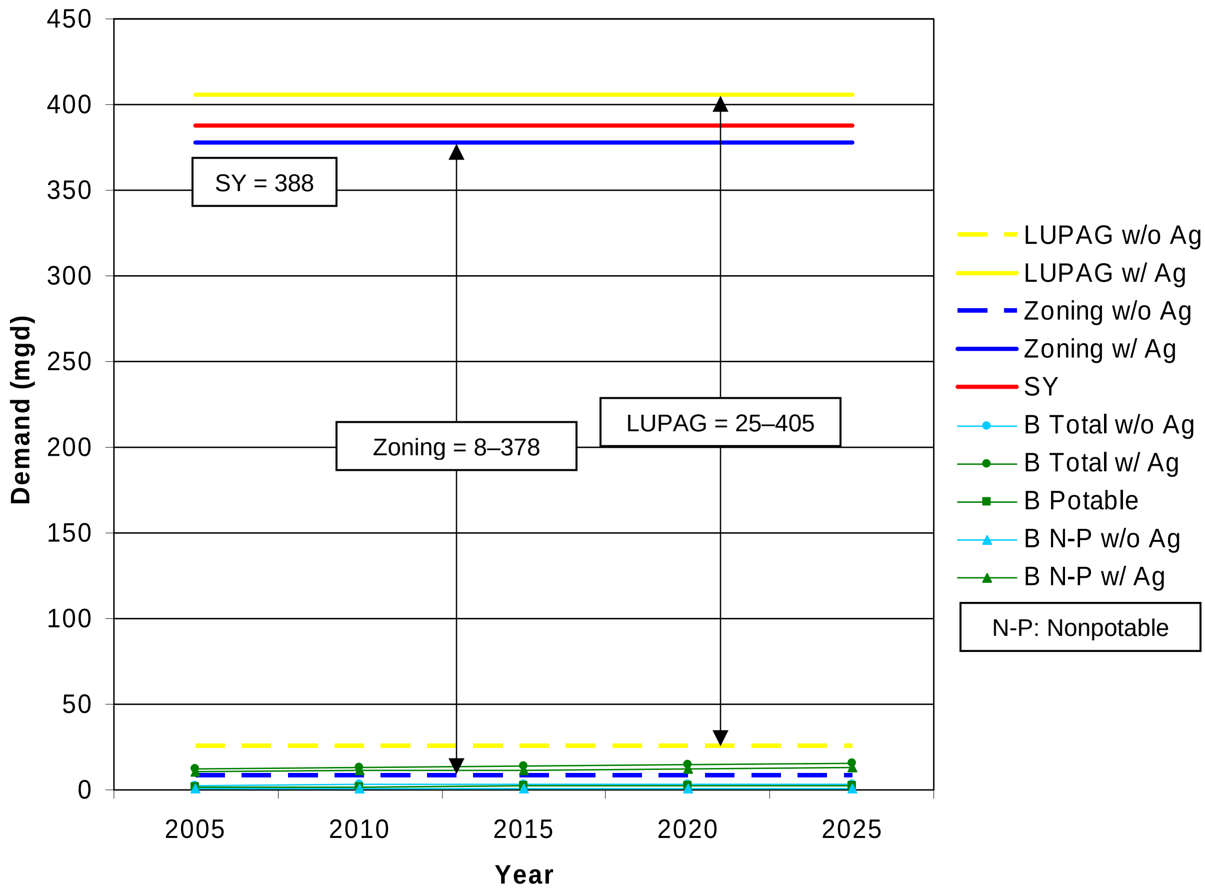
801 – Kohala Aquifer Sector Area

Ground water and surface water are plentiful in the Kohala Aquifer Sector Area, and these may continue as the primary sources of water. Specifically, high-level groundwater could be developed for potable water sources, and the island's four major ditch systems could be restored to satisfy non-potable needs. Including worst-case agricultural demands, full development to the maximum densities of LUPAG and County Zoning are not sustainable within the Kohala Aquifer Sector Area and the Hawi and Mahukona Aquifer System Areas. Without agricultural water demands, the LUPAG and County Zoning scenarios are sustainable within the Kohala Aquifer Sector Area; however, LUPAG maximum density build-out cannot be sustained within the Mahukona Aquifer System Area. This can be mitigated by transfer of water between aquifer system areas, although the projected 20-year demands indicate that this will not be necessary in the near future. Potential shortages of water in adjacent aquifer sector areas can also be addressed through transfer of water from the Kohala Aquifer Sector Area, which will likely necessitate infrastructure upgrades.



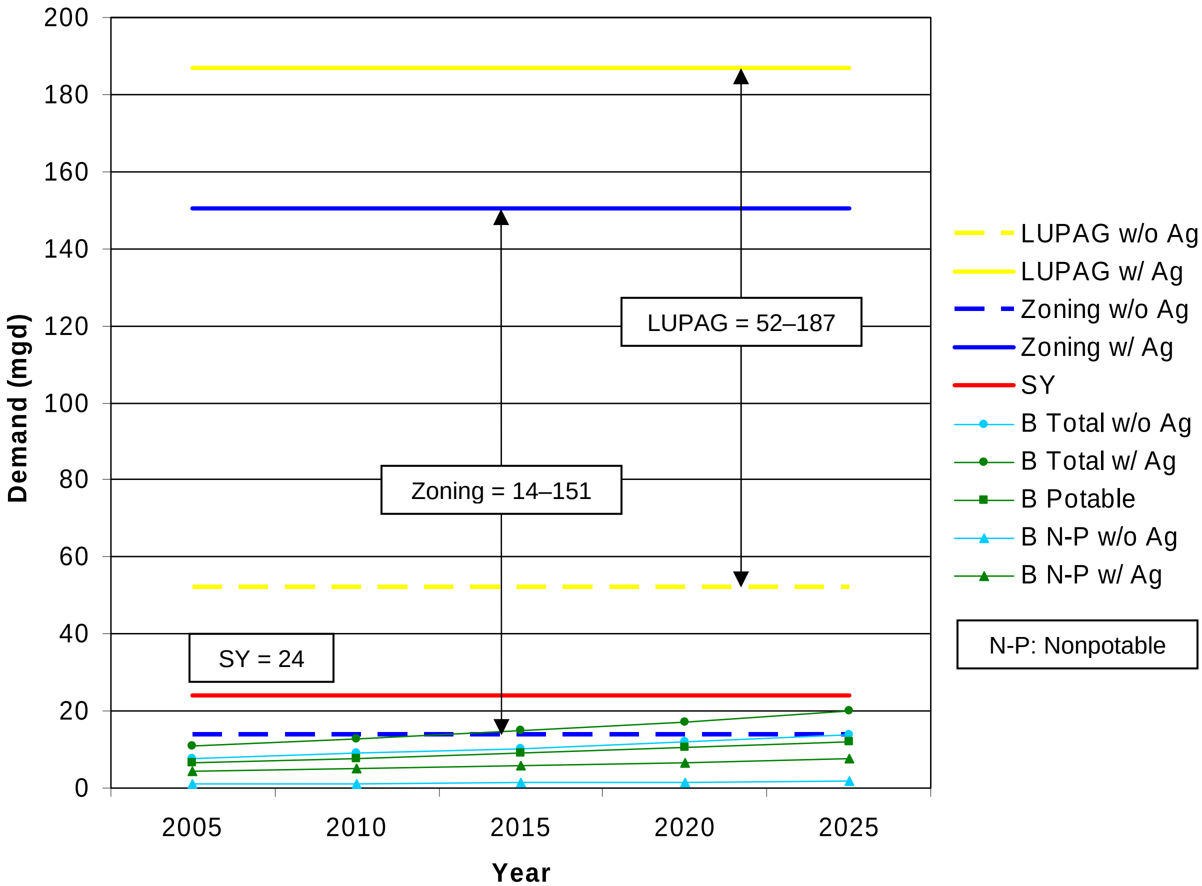
802 – East Mauna Kea Aquifer Sector Area

Ground water and surface water are present in great abundance in the sector area. However, if worst-case agricultural demands are included, the land use full build-out scenarios are close to the sustainable yield. Excluding agricultural demands, the current, 20-year projected, and land use full build-out demands are well below the sustainable yield; therefore, groundwater may be developed as the primary source of potable water. Spring sources used to provide potable water may be replaced by groundwater sources if it is more beneficial and economical than to comply with Federal Safe Drinking Water Act requirements.



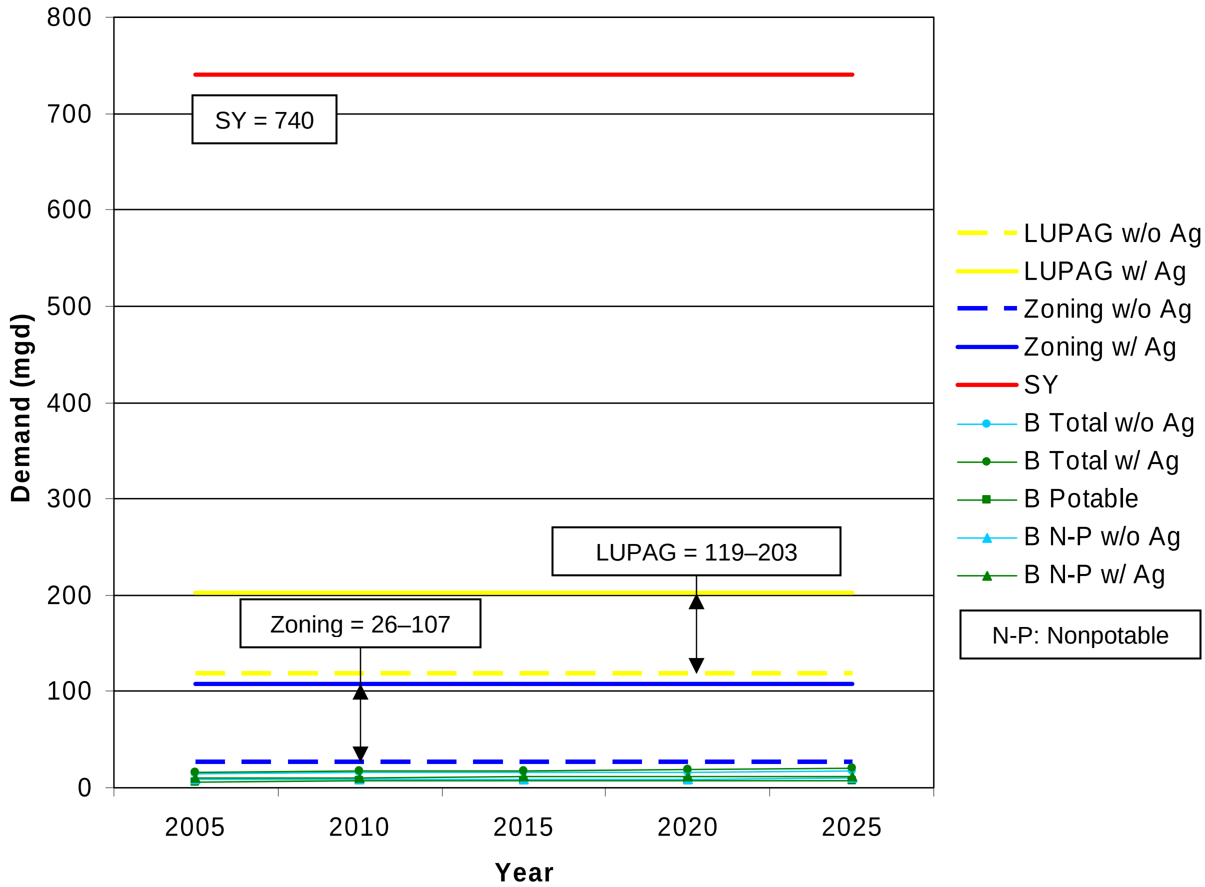
803 – West Mauna Kea Aquifer Sector Area

The sector area encompasses part of the Kohala Coast, including one of the island's three luxury resort complexes (Mauna Kea Resort). Not surprisingly, current water usage is high, nearly one-third of the sector area's sustainable yield. Full build-out to LUPAG maximum density is not sustainable. Full development to the maximum density of County Zoning is sustainable if agricultural demands are excluded, and is not sustainable if worst-case agricultural demands are included. Twenty-year projected demands range between 60 and 80 percent of the sustainable yield. For these reasons, water resource planning for the sector area is important. Development of basal potable water resources should proceed with caution, and the feasibility for water transfer from the adjoining Kohala Aquifer Sector Area should be examined. Water conservation should be a primary focus in the sector area, and utilizing the highest quality water for the highest end use should be promoted. It would be prudent to irrigate primarily with non-potable sources, and take measures to encourage reduction of potable water usage by residential customers closer to average island water usage.



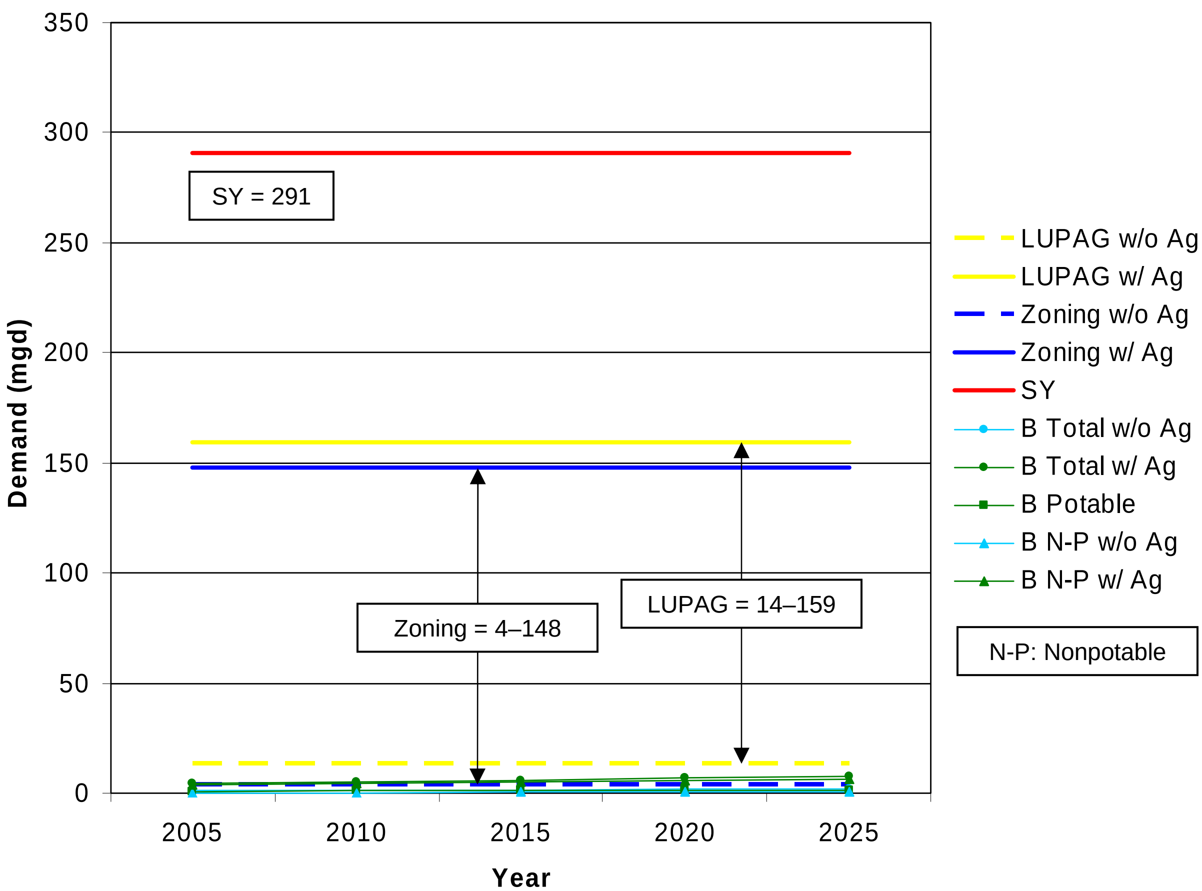
804 – Northeast Mauna Loa Aquifer Sector Area

Encompassing the Urban Hilo area, this sector area has the highest current water usage on the island. Due to the high annual rainfall, it also has the island's highest sustainable yield, which can easily sustain the LUPAG and Zoning maximum density full build-out demands, even if worst-case agricultural demands are included. Development of groundwater sources may continue as land development demands dictate. The recommendation for this sector area is to improve the efficiency of the DWS Hilo Water System; loss of source water through leakage is suspected. The detriment is the excess cost of production, not loss of a limited supply of sources.



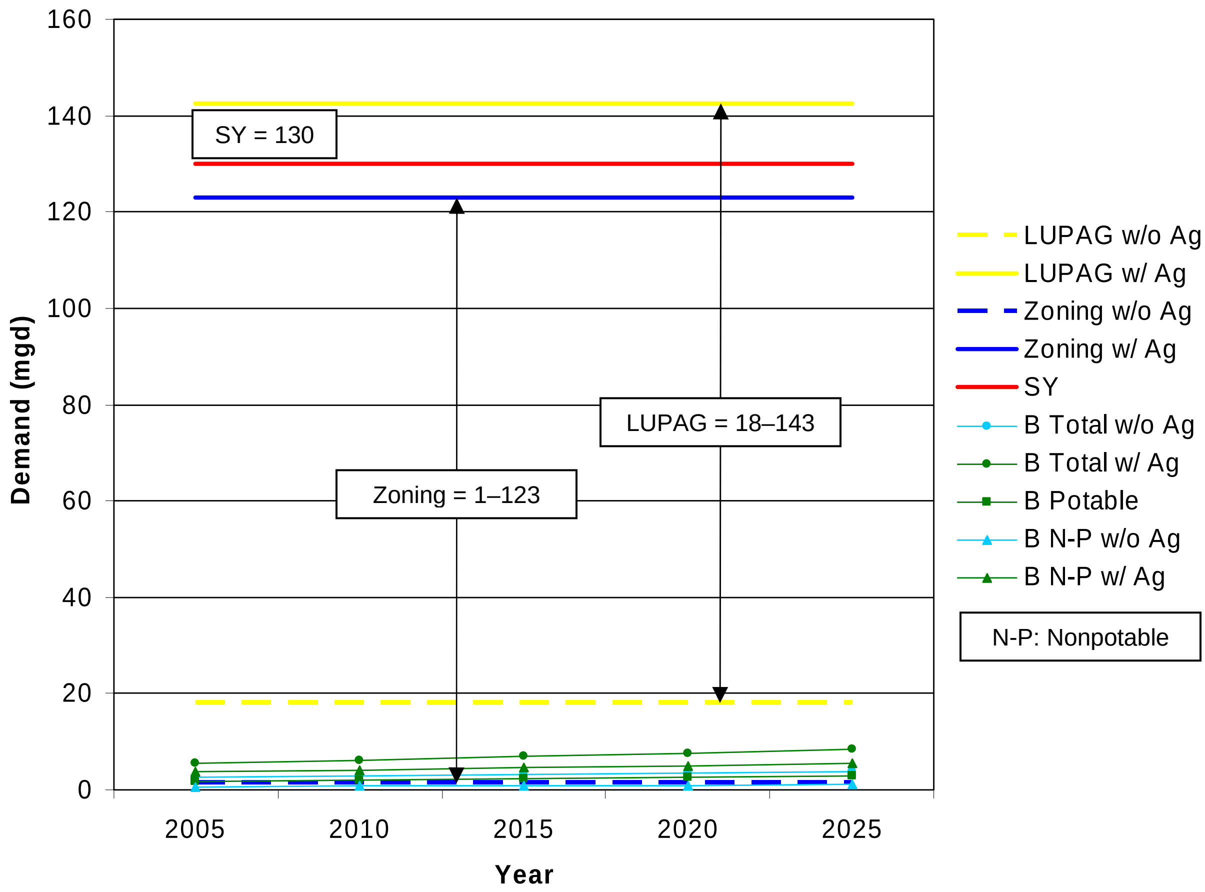
805 – Southeast Mauna Loa Aquifer Sector Area

This sector area is sparsely populated. If agricultural demands are excluded, it has the lowest current water usage, the lowest 20-year projected usage, and the lowest full build-out projected demands of all sector areas on the island; all of these are a small fraction of the sector area's sustainable yield. If worst case agricultural demands are included, the land use full build-out scenarios require approximately half of the sustainable yield. Deep groundwater wells may be developed to suit anticipated development that would require potable water. Groundwater sources may also replace existing tunnel and spring sources, which are influenced by surface water, if costs to comply with DOH regulations are excessive. Formerly used by the sugar plantation, tunnel and spring sources are numerous, and should be examined as a potential resource to supply non-potable demands, both in the Southeast Mauna Loa Aquifer Sector Area and the adjacent Southwest Mauna Loa Aquifer Sector Area.



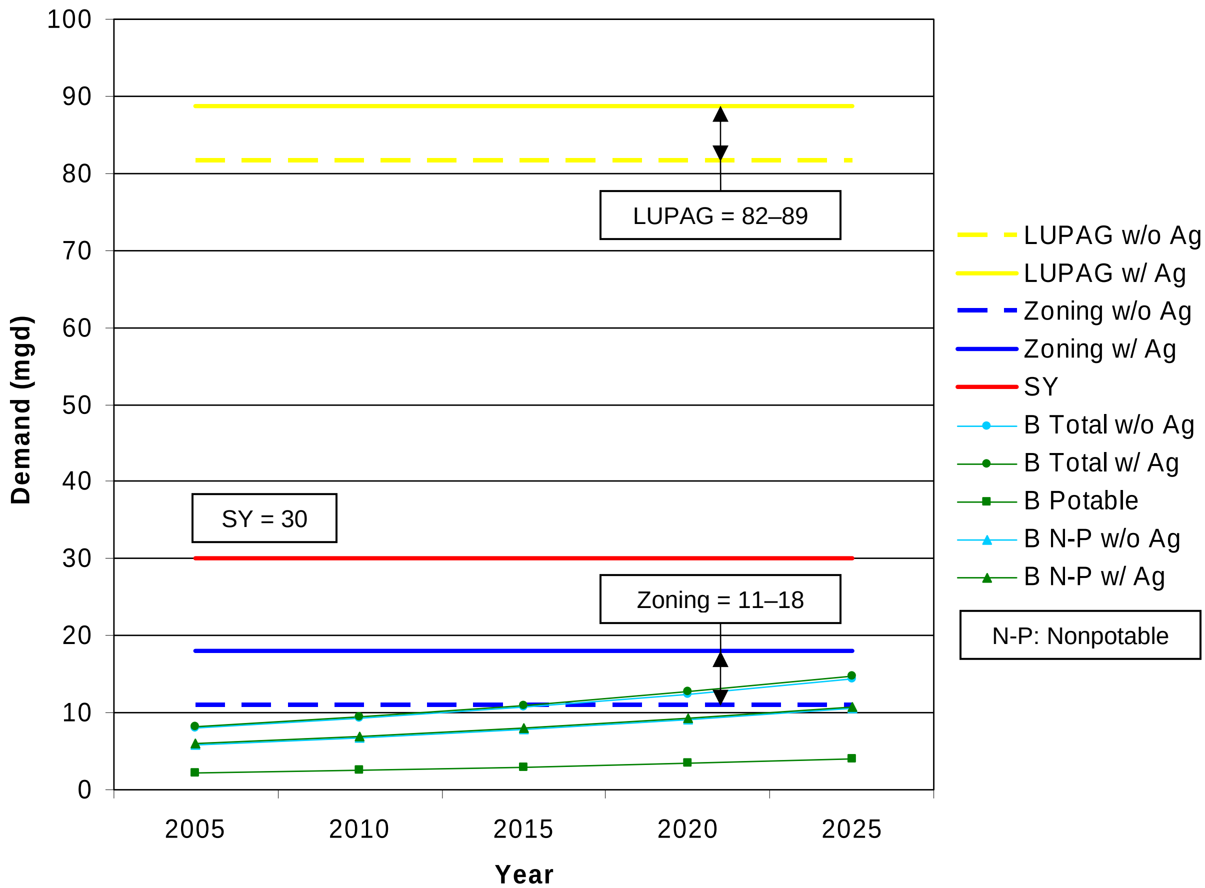
806 – Southwest Mauna Loa Aquifer Sector Area

Current water usage, 20-year projected usage, and full build-out LUPAG and County Zoning maximum density demands within the sector area are a small fraction of its sustainable yield if agricultural demands are not included. If worst-case agricultural demands are included, the LUPAG full build-out demand exceeds the sustainable yield, and the Zoning demand is nearly 95 percent of the sustainable yield. Surface water sources are extremely limited, and due to the limited availability of basal groundwater, high level groundwater is expected to be the primary water resource. The challenge in this sector area is transmission, particularly to areas which are currently supplied by individual rainwater catchments and water hauling. Previous studies have proposed several alternative measures to supply both potable and non-potable water. These alternatives should be further evaluated and compared.



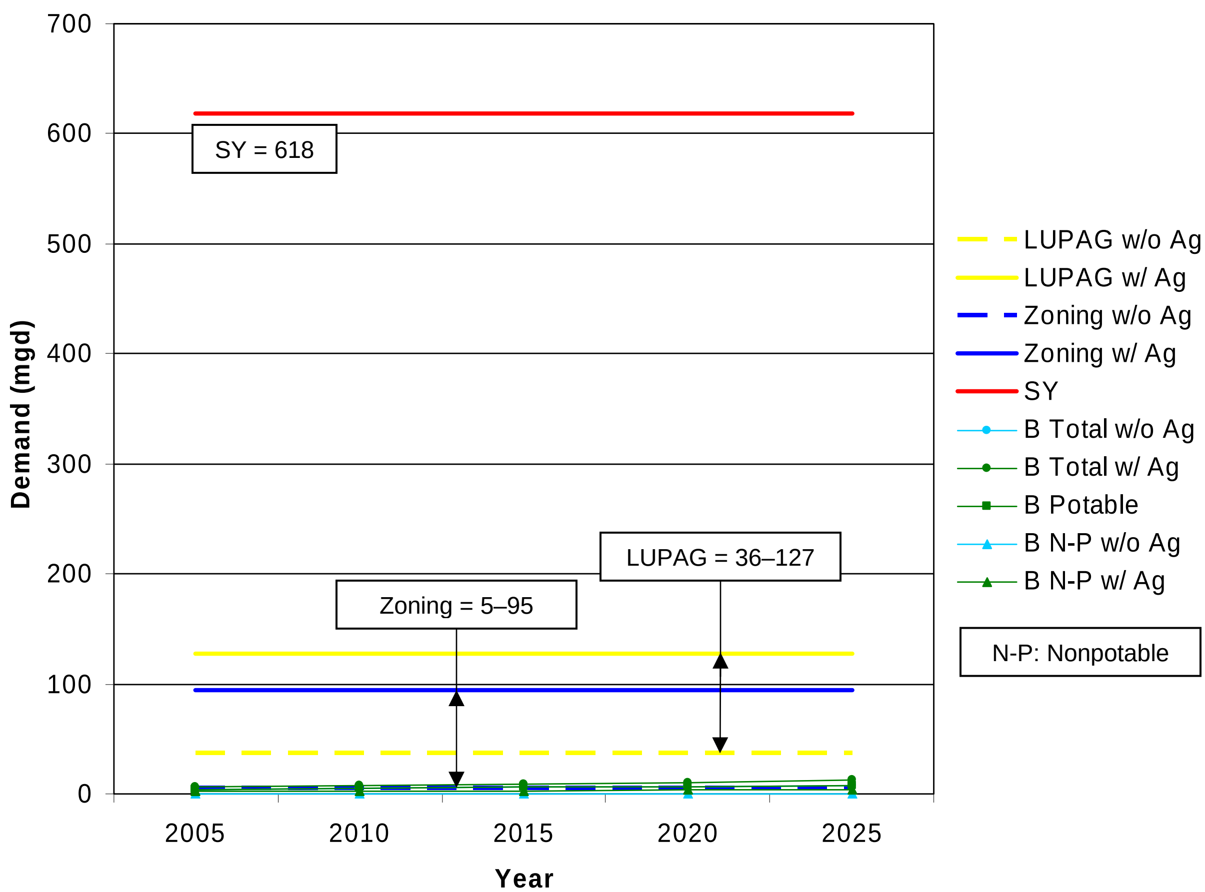
807 – Northwest Mauna Loa Aquifer Sector Area

Two of the island's three luxury resort complexes along the Kohala Coast (Mauna Lani Resort and Waikaloa Resort) are located within the sector area. Existing development demands are over one-quarter of the sustainable yield, and 20-year projected demands will amount to nearly half of the sustainable yield. Full build-out to the maximum density of LUPAG is not sustainable, with and without worst-case agricultural demands. Full build-out to the Zoning maximum density requires 30 to 60 percent of the sustainable yield. Because there are no potable water sources in the sector area, and minimal potential for significant future development of potable sources, a proper balance of water transfer from other aquifer sector areas and water conservation must be achieved. The relative compactness of the two major resort developments increases the possibility of combining non-potable sources into a water system to satisfy the non-potable needs. Wastewater reclamation should be continued. Demand-side conservation programs should be implemented by the potable water purveyors to reduce the average water usage closer to island averages.



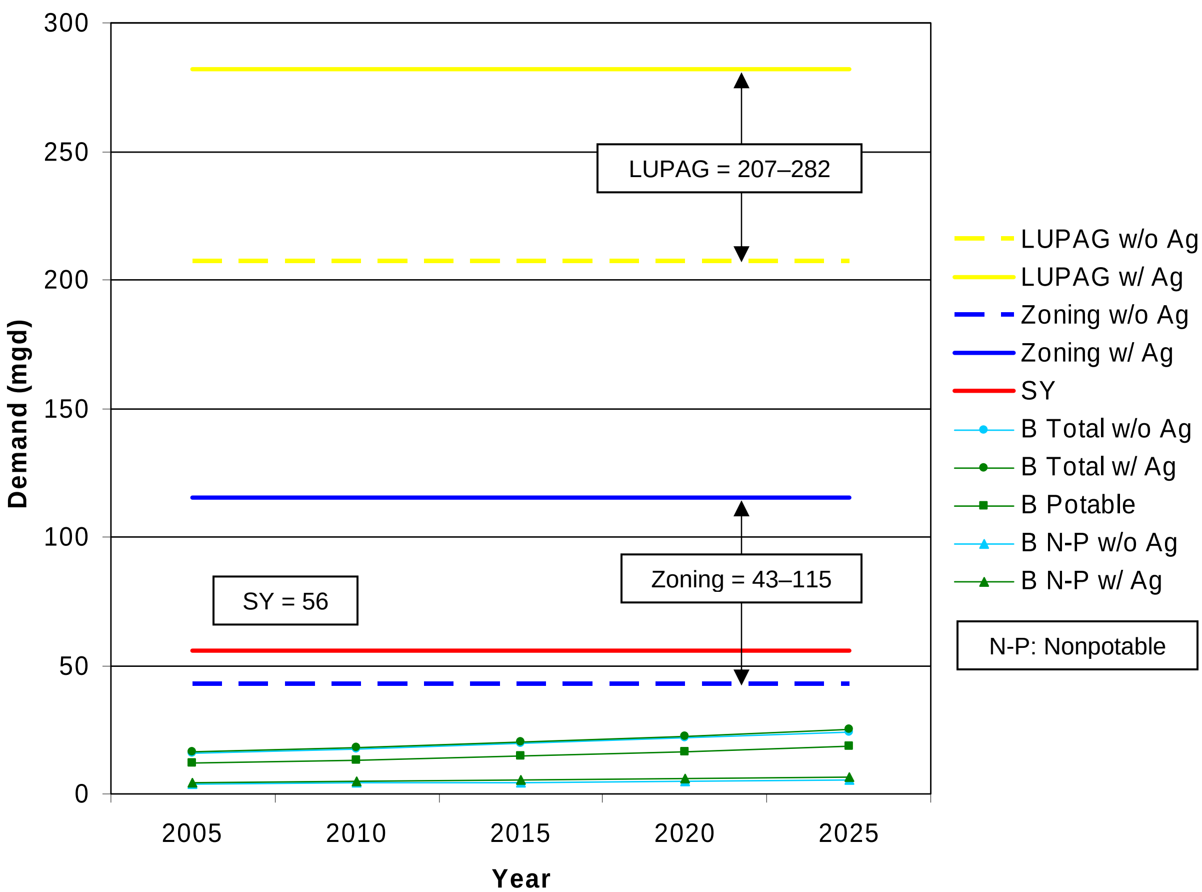
808 – Kilauea Aquifer Sector Area

The sustainable yield of this sector area is the second highest of all sector areas on the island. Water demands associated with the full build-out to the maximum density of LUPAG and County Zoning, and 20-year projections are sustainable with and without agricultural demands. The WRPP indicates that a large quantity of high-level groundwater is developable; therefore, these sources may continue to be the primary source of potable water. The key issue in this sector area is whether to develop a municipal water system in the Central Puna area. Currently, users rely on individual rainwater catchment systems, and the high volume of ambient rainfall suggests that this is adequate. Undoubtedly, development of groundwater sources for such a system is feasible; however, other factors, such as cost and public opinion, need to be considered.



809 – Hualalai Aquifer Sector Area

This sector area includes Kona and the surrounding area, which has expanded significantly in the last 20 years. Water demands in the sector area are the highest on the island due to the increases in population and tourism. Development of high-level groundwater sources, primarily in the Keauhou Aquifer System Area, has relieved some of the stress to the basal aquifer. However, there should be concern with the on-going land development, as demands associated with the full build-out to LUPAG maximum density exceed the sustainable yield by four to five times. County Zoning full build-out demands are close to the sustainable yield if agricultural demands are excluded, and exceed the sustainable yield if worst-case agricultural demands are included. Although the 20-year projections indicate that demands will not approach the sustainable yield for some time, measures should be considered to control future water demands. Demand-side water conservation measures should be implemented by the potable water purveyors. It would be prudent for County Planning officials to re-examine land use policies; controlling the development density may be considered. Most importantly, the concept of using the highest quality water for the highest end use should be followed. Efforts should be initiated to utilize reclaimed wastewater and brackish basal groundwater for non-potable uses, thereby reserving potable water for potable domestic use. Water transfer from the adjacent Southwest Mauna Loa Aquifer Sector, which has a surplus of potable water sources, should also be explored.



ES.2.8 Summary of Conclusions and General Recommendations

The Hawaii Water Use and Development Plan Update promotes several common themes which are applicable island-wide. The themes are as follows:

- Reserve the highest quality of water for the most valuable end use
- Promote water conservation
- Initiate more monitoring and studies

Potable water is considered the highest quality water, and the sustenance of life is considered the most valuable end use. Reclaimed wastewater, brackish groundwater, surface water and other such lower quality water sources should be used for landscaping and agriculture, thereby reserving potable water for human consumption.

Potable water usage above the County standard of 400 gpd per household is considered excessive, and is therefore discouraged. End users, water purveyors and government agencies should work together to conserve potable water.

The Department of Water Supply, as the largest purveyor of potable water on the island, plays a key role in the use and protection of water resources. The goals and policies of DWS are described in detail in Appendix C.

Additional studies and monitoring to determine the "safe" sustainable yields, on which the data and analyses presented in the WUDP are base, are recommended. The next update of the Water Resources Protection Plan should provide updated sustainable yields. Because of the interdependencies between neighboring aquifer system and sector areas, regional studies should be initiated. This is of special concern in West Hawaii. The WUDP proposes to create overall resource management practices, and future updates should promote a policy of well-planned source development.

Water: the lifeline of our islands. It is our most precious resource here in Hawaii. Water is the driving force of our environment, our economy, and our Hawaiian Culture (Commission on Water Resource Management website message).

1 INTRODUCTION

1.1 BACKGROUND

1.1.1 State Water Code

In 1987, the State Legislature passed the State Water Code (Hawaii Revised Statutes, Chapter 174C) to protect Hawaii's surface and ground water resources. The State Water Code (the Code) called for the establishment of a Commission on Water Resource Management (CWRM) that would be responsible for administering the Code. Also, as part of the requirements set forth in the Code, was the formulation of a *Hawaii Water Plan* that would serve as a dynamic, long-range planning guide for the Commission. The Commission established the Hawaii Administrative Rules Chapter 13-170, *Hawaii Water Plan*, which specifies and clarifies definitions, procedures, requirements, etc., required by, but not specified in, the Code.

The *Hawaii Water Plan* consists of five parts: (1) the *Water Resource Protection Plan*, (2) the *Water Quality Plan*, (3) the *State Water Projects Plan*, (4) the *Agricultural Water Use and Development Plan* (AWUDP), and (5) the County Water Use and Development Plans (WUDP). A separate WUDP is to be prepared by each of the four Counties. The AWUDP was added to the *Hawaii Water Plan* by mandate under Act 101, Session Laws of Hawaii (SLH) 1998, by the State Legislature.

The original *Hawaii Water Plan* was completed and adopted by the Commission in July 1990. The Code calls for the *Hawaii Water Plan*, including all of its elements to be updated regularly to reflect the current needs of the State. Each of the Counties is responsible to update their respective WUDP as required. Updates of the various elements except the WQP and AWUDP were drafted in1992, but were not officially adopted by the CWRM.

1.1.2 History of Hawaii County Water Use and Development Plan

In compliance with the State Water Code, the County of Hawaii Department of Water Supply (DWS) was tasked with the responsibility to prepare the *County of Hawaii Water Use and Development Plan* in 1988. The WUDP serves as a continuing long-range guide for the water resource development in the County. Its objective is "to set forth the allocation of water to land use through the development of policies and strategies which shall guide the County in its planning, management, and development of water resources to meet projected demands." Section 13-170-31, Hawaii Administrative Rules states that the WUDP shall include but not be limited to:

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The original County of Hawaii WUDP was adopted by the County Council by ordinance and endorsed by Mayor Tanimoto on May 10, 1990. The WUDP was conditionally accepted by the State Commission on Water Resource Management for incorporation into the *Hawaii Water Plan* on June 27, 1990, with the provisions that the WUDP be reviewed and revised as necessary by the County to coincide with the review process of the *Hawaii Water Plan*.

Adoption of the County of Hawaii WUDP was executed by County of Hawaii Ordinance No. 90-60. The Ordinance requires that the County of Hawaii WUDP be updated every five years. The first update was drafted in 1992, but was not officially adopted by the CWRM. In 2003, the County of Hawaii Department of Water Supply produced the funding and initiated the update to the WUDP.

1.1.3 Statewide Framework for the Update of the Hawaii Water Plan

The *Statewide Framework for Updating the Hawaii Water Plan* (Framework) dated February 2000 was created by the Commission on Water Resource Management to facilitate coordination, integration, and consistency of the components of the *Hawaii Water Plan*. In addition, the framework is a guide for preparation of the WUDP to insure effective implementation by the County and utilization by the CWRM for resource management purposes.

The Framework requires data and analyses to be based on ground water and surface water hydrologic units designated by the CWRM. However, the surface water hydrologic units were only recently established and adopted in June 2005; and additional information on the surface water hydrologic units is extremely limited. Therefore, the Hawaii WUDP update is based on the ground water hydrologic units, and references the surface water hydrologic units as applicable.

1.1.3.1 Ground Water Hydrologic Units

The State, as part of its *Water Resource Protection Plan (WRPP)*, has established an aquifer classification and coding system to describe and identify aquifers in the State of Hawaii. An aquifer is generally described as a water bearing stratum of permeable rock, sand or gravel and constitutes a source of ground water. Under the aquifer coding system, each island is the largest component in the hierarchy, followed by Aquifer Sector Areas (ASEA), then Aquifer System Areas (ASYA) located within the Aquifer Sector Areas.

An Aquifer Sector Area reflects an area with broad hydrogeological (subsurface) similarities while maintaining traditional hydrographic (surface), topographic and historical boundaries where possible. The Aquifer System Area is an area within an Aquifer Sector Area that is more specifically defined by hydrogeologic continuity among aquifers in the System. This classification scheme updates the island's hydrographic areas initially established in 1959.

The aquifer code number begins with the U.S. Geological Service number for each island. The island numbers are 1-Niihau, 2-Kauai, 3-Oahu, 4-Molokai, 5-Lanai, 6-Maui, 7-Kahoolawe, and 8-Hawaii. A two-digit Sector number and a two-digit System number follow the island number. The Sector Areas and System Areas are also assigned geographic names. **Figure 1-1** shows the boundaries, codes and names of the Aquifer Sector Areas and System Areas on the island of Hawaii. A description of each Aquifer System Area may be found in the *Water Resource Protection Plan* component of the *Hawaii Water Plan*.

1.1.3.1.1 Sustainable Yield

Sustainable Yield (SY) is defined and described in the *Water Resource Protection Plan (WRPP)* as follows:

> *Sustainable yield refers to the forced withdrawal rate of groundwater that could be sustained indefinitely without affecting either the quality of the pumped water or the volume rate of pumping. It depends upon the head selected as the minimum allowable during continuous pumping. Head is the elevation* [or height] *of the unconfined water table above sea level. There is not a unique value for sustainable yield; the value depends on the head that will preserve the integrity of the groundwater resource at the level decided upon by the manager.*
>
> *Sustainable yield is equal to a fraction of the recharge. In a basal lens the fraction is usually more than half and sometimes greater than three fourths where initial heads are high. In high level aquifers about three fourths of the recharge can be taken as sustainable yield.*
> [Groundwater recharge is the process of adding water to the aquifer through the infiltration of precipitation on the land surface.]
>
> *The estimates of sustainable yield are not meant to be an exact number which could be used in final planning documents. The estimates are constrained not only by the scanty data base but also by the fact that they do not consider the feasibility of developing the groundwater. The estimates should not be equated to developable groundwater. In many regions, taking advantage of a high estimate would not be economically feasible.*

It should be noted that the Sustainable Yield value represents the sum of potable and non-potable ground water. It is stressed that the SY estimates reflect the average daily pumpage over an entire aquifer system area assuming wells are spaced optimally; and does not consider the feasibility of developing the groundwater; nor whether the groundwater is potable or brackish. Other hydrogeological studies have pointed to the uncertainty in the SY. The *Water Resources Protection Plan*, like the *Water Use and Development Plan*, is a dynamic document, and the SY estimates continue to be evaluated. Subsequent updates of the WRPP should provide updated values of the SY. Therefore, caution should be exercised in comparing the Sustainable Yield to projected water demands. As stated in the WRPP, estimates of the Sustainable Yield should be used as a guide in planning rather than a definitive constraint.

Table 1-1 lists the geographical area of coverage and estimated sustainable yield in million gallons per day (mgd) published in the *Hawaii Water Resource Protection Plan* for the 9 aquifer sector areas on the island of Hawaii.

Table 1-1: Aquifer Sector Areas

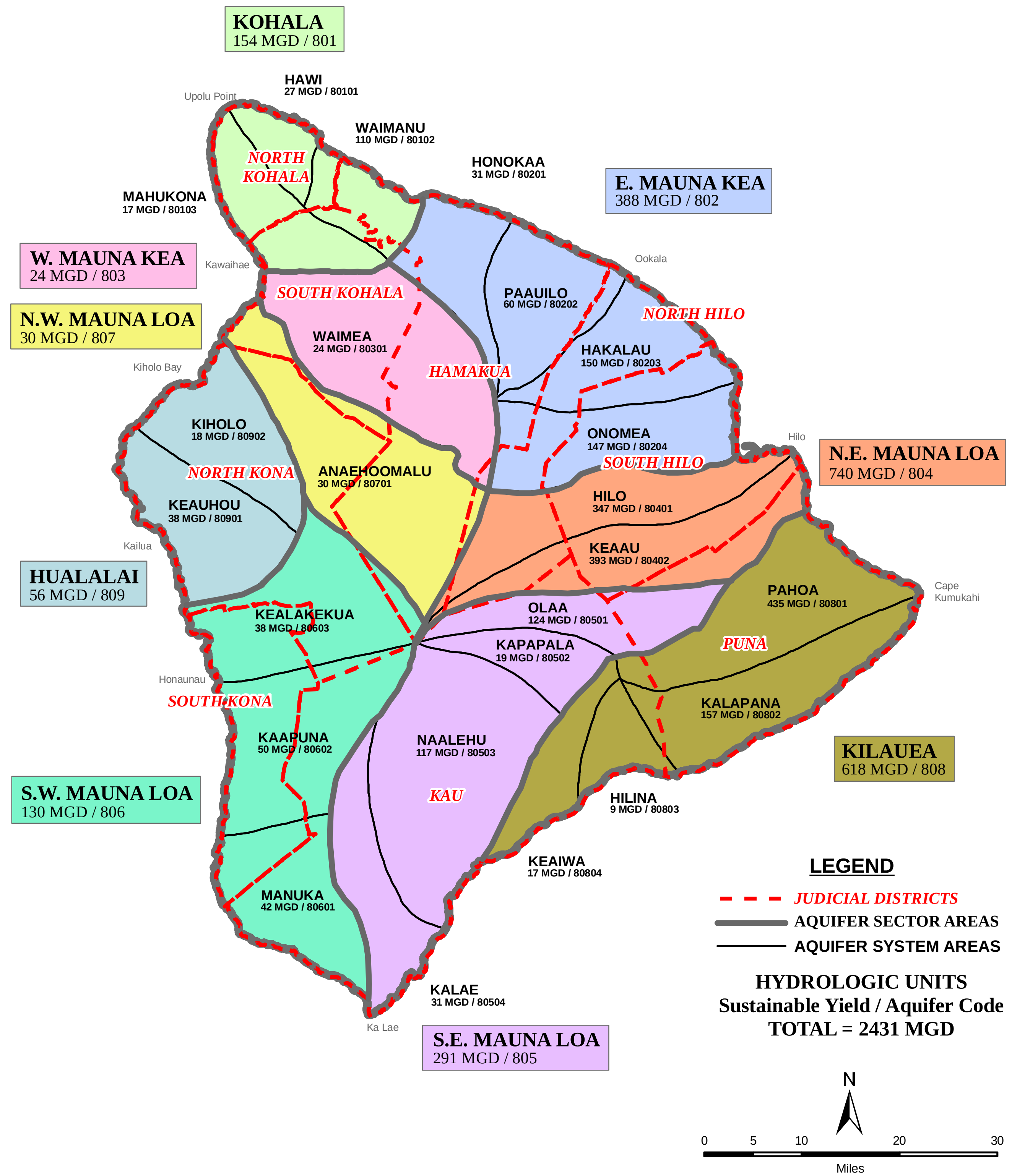
Sector Area Code	Sector Area	Area (Acres)	Sustainable Yield (MGD)
801	Kohala	154,118	154
802	E. Mauna Kea	385,952	388
803	W. Mauna Kea	180,570	24
804	N.E. Mauna Loa	256,640	740
805	S.E. Mauna Loa	447,859	291
806	S.W. Mauna Loa	406,893	130
807	N.W. Mauna Loa	186,246	30
808	Kilauea	361,338	618
809	Hualalai	200,282	56
Total for Island		2,579,898	2,431

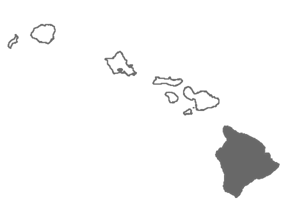
1990 State Water Resource Protection Plan

1.1.3.2 Surface Water Hydrologic Units

The CWRM recently established surface water hydrologic units and a coding system, and adopted the *CWRM Surface-Water Hydrologic Units: A Management Tool for Instream Flow Standards* report in June 2005. Key objectives of the CWRM surface water hydrologic units include the following:

1) *Define and delineate unique units that can accommodate the relational requirements in a database environment, while providing a system that can be easily understood by the general public.*
2) *Develop an information management system which utilizes the coding system to relate surface-water permits and other resource information to a given unit.*
3) *Define hydrologic units to be considered in the analysis and development of instream flow standards.*
4) *Provide a reference system that promotes better information management of other resource inventories.*
5) *Promote the sharing and collection of surface-water resource data between government agencies, the public, private entities, and community organizations.*
6) *Improve the overall coordination of monitoring, data collection, and field investigation efforts.*





Island of Hawaii

FIGURE 1-1

JUDICIAL DISTRICTS AND AQUIFER BOUNDARIES

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A hydrologic unit is defined by the Code as "a surface drainage area or a ground water basin or a combination of the two." The majority of surface water hydrologic units have boundaries which closely match the drainage basins or watershed units. The CWRM defines a watershed unit in accordance with *the State Definition and Delineation of Watersheds* report as follows:

> *A watershed unit is comprised of a drainage basin (or basins) which include both stream and overland flow, whose runoff either enters the ocean along an identified segment of coastline (coastal segment) or enters an internal, landlocked drainage basin. The watershed units for an island are defined so that all segments of coastline are assigned to a unique watershed unit and so that all areas of an island are assigned to one, and only one, watershed unit.*

Similar to the aquifer code system, the surface water hydrologic unit code number begins with the U.S. Geological Service number for each island. The island numbers are 1-Niihau, 2-Kauai, 3-Oahu, 4-Molokai, 5-Lanai, 6-Maui, 7-Kahoolawe, and 8-Hawaii. A three-digit System number follows the island number. The Systems are also assigned geographic names. **Figure 1-2** shows the boundaries of the 166 surface water hydrologic units and the 9 aquifer sector areas for comparison on the island of Hawaii. Information on each surface water hydrologic unit is extremely limited since the coding system is the first-step towards improving the organization and management of surface water information that CWRM collects and maintains.

1.1.4 The Hawaii Water Plan Update Status

As required by the Code, the *Hawaii Water Plan*, including all of its elements, must be updated regularly to reflect the current needs of the State. Currently, the update status of the various elements is as follows:

PLAN ELEMENT	STATUS
Water Resource Protection Plan	Second update in progress
Water Quality Plan	1990 – first update completed
State Water Projects Plan	2003 – Second update completed
Agricultural WUDP	Plan in development: Phase 1 – 2003 Phase 2 – 2004 Phase 3 – In progress
Hawaii County WUDP	2006 – Second update projected completion
Honolulu, Maui & Kauai WUDPs	Second update in progress

Act 101, SLH 1998 requires that the AWUDP should provide a master inventory of irrigation systems, identify the extent of repair and rehabilitation that would be required over a 5-year period, and provide a long-range management plan. The Framework further expands the scope to provide for the development of agricultural water demand projections, which is essential for the WUDP updates. The AWUDP, dated December 2003, and revised in December 2004, was prepared to meet the mandate of Act 101, and to review and discuss the potential for transitioning from monocrop corporate farming into diversified crop farming, along with the potential opportunities available in the new diversified farming. However, due to funding and time constraints, a comprehensive plan has not yet been completed.

1.2 PHYSICAL SETTING

1.2.1 Location and Size

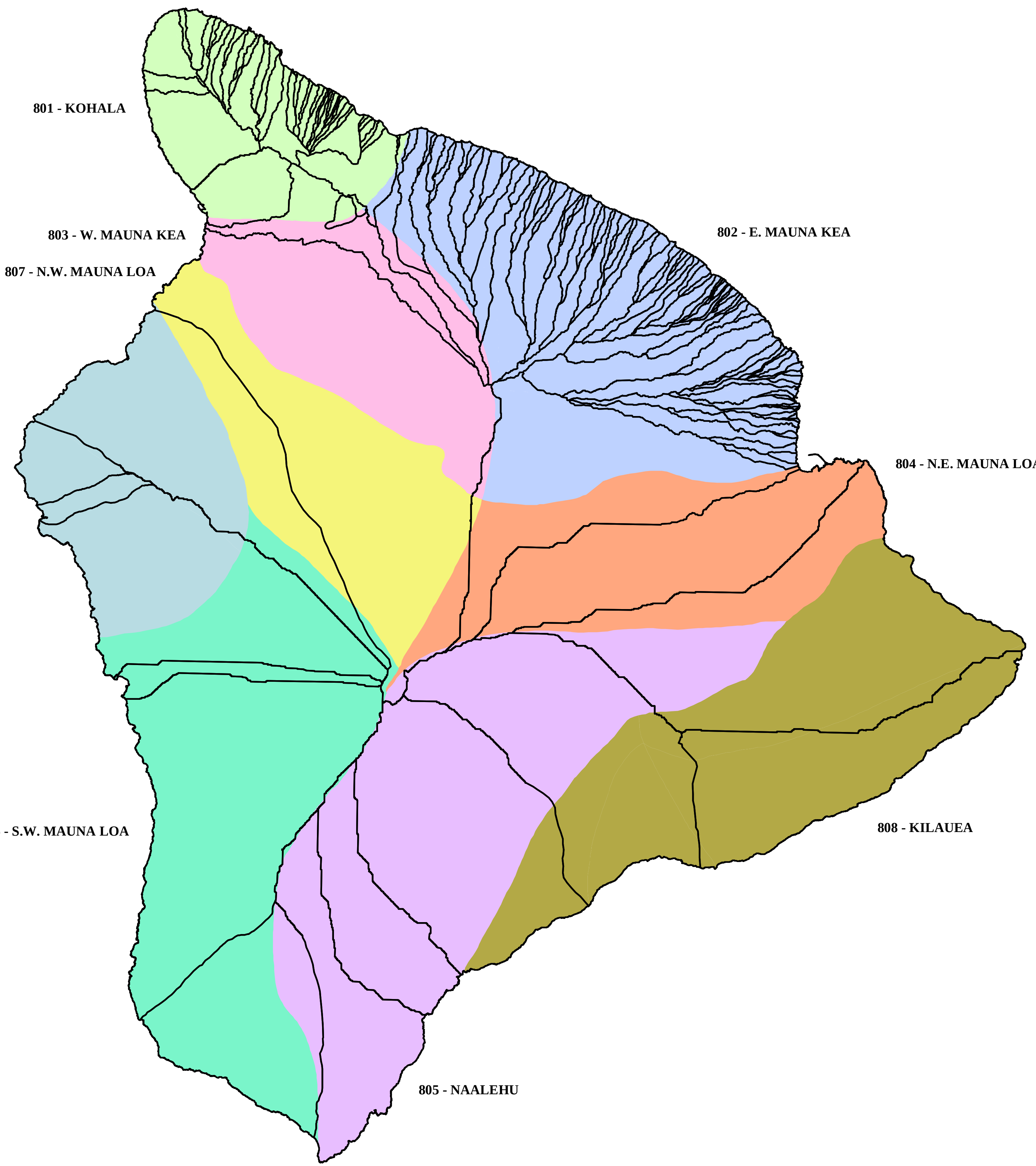
The County of Hawaii encompasses the island of Hawaii, the largest most southeastern island of the Hawaiian archipelago. The total area of the island is approximately 4,028 square miles. The island is divided into 9 judicial districts, and has 9 aquifer sector areas and 166 surface water hydrologic units, as previously shown on **Figures 1-1 and 1-2**. The 2000 U.S. Census reports the island's resident population to be 148,677 residents.

1.2.2 Climate

The size of the island and range of land elevations contribute to a climate of great diversity. The island lies in the path of the northeast trade winds and has an orographic rainfall pattern or a rainfall pattern caused by the mountains, typical of the larger islands in the Hawaiian chain. Rainfall reaches a maximum intensity in areas from 2,000 to 3,000 feet elevation and then diminishes, so that the upper slopes are semi-arid. In northeast Hawaii, the moisture laden trades cool as they rise up the mountain slopes and lose much of their moisture as rain. The prevalence of trades throughout most of the year accounts for the island's high average annual rainfall of 72 inches. Over 300 inches fall annually on parts of the windward or northeast slopes of the island.

As the winds descend along the leeward (southwest) slopes, the air becomes dryer and warmer. Rainfall declines accordingly, resulting in a near arid climate along the leeward coastline. The mean annual rainfall in most leeward areas is approximately 10 inches. Along the Kona coast, however, the difference between land and water temperatures on warm days, particularly in the summer, generates a moderate sea breeze circulation. This results in frequent and heavy showers, which produce a much higher mean rainfall than in other leeward areas. Generally, in areas where trade winds predominate, the dry months are from May through September. The wet months occur from October through April. In the Kona region, sheltered from the trades, summer rainfall predominates.

Under prevailing trade wind conditions, from 50 to 70 percent of the time, temperature inversion greatly influences moisture distribution in the air surrounding the island. Moisture is high and well distributed below the inversion level, which varies between 5,000 and 7,000 feet elevation; air above the inversion is relatively dry. Relative humidity below the inversion is roughly 70 to 80 percent in windward areas, and 60 to 70 percent in the dryer leeward areas. Above the inversion, relative humidity is generally less than 40 percent, often declining to 10 or even 5 percent.



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LEGEND:

Surface Water Hydrologic Units Boundary

NORTH

0 2 4 8 12 Miles

INDEX MAP - Island of Hawaii

FIGURE 1-2

Surface Water Hydrologic Units

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Because of the consistently mild temperatures of the ocean waters surrounding the islands, temperatures in the air moving across the ocean and over the island are also mild and do not vary significantly. The warmest month is August and the coldest is February. Temperatures above 90^{o}F are very unusual, except in the dry leeward area of South Kohala, where maximum temperatures in the low 90's are common. A temperature less than 55 ^{o}F is uncommon, except at elevations above 2,500 feet. The summits of Mauna Kea and Mauna Loa frequently have snow in the winter.

Northeasterly trade winds prevail much of the time on the island of Hawaii, as elsewhere in the state. Although these winds approach the island at a fairly constant speed, the uniform flow is distorted as the trade winds traverse the island. These winds combine with local winds on the mountain slopes and lowlands to form complex patterns. During the cooler winter months, southerly winds generally replace the trades. Occasional tropical storms also generate winds from various directions. Over the ocean surrounding the island, average wind speeds are highest during the summer trade wind period, exceeding 12 miles per hour 50 percent of the time. During the winter months wind speeds exceed 12 miles per hour about 40 percent of the time.

The Island of Hawaii recently experienced continuous drought conditions, lasting from 1998 through 2003, during which the County declared frequent drought emergencies. The County sustained water shortages and heavy damage to agriculture and the cattle industries.

1.2.3 Geology

The Hawaiian Islands are part of a chain of islands that extend southeast from the Aleutian Islands. Most of the islands northwest of the Hawaiian Archipelago have disappeared or only small portions of land or tips of the islands rise above the sea. These islands are called the Leeward Islands, or the Northwestern Hawaiian Islands, and include Midway Island, Kure Atoll and French Frigate Shoals. The Hawaiian Islands are the newest land mass of this chain of islands.

The island of Hawaii is the largest of the eight major islands of the Hawaiian Archipelago, with a total area that exceeds the rest of the other island areas combined. The island is the youngest from a geological viewpoint. Rocks from its earliest volcano indicate an age of about 700,000 years. In contrast, Kauai is over 5 million years old, and Oahu is over 2 million years old.

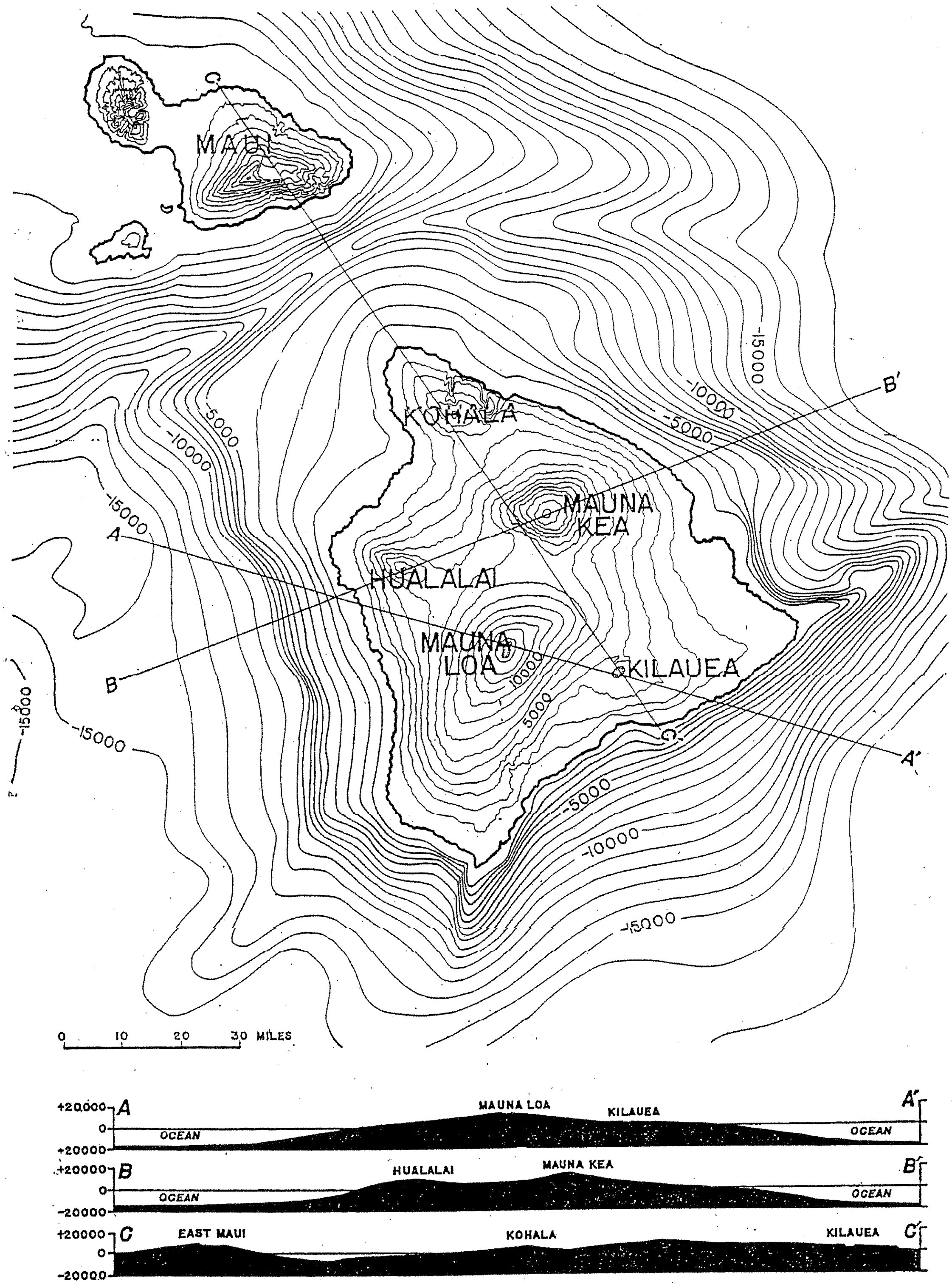
Five shield volcanoes formed the island of Hawaii: Kohala, Mauna Kea, Mauna Loa, Hualalai, and Kilauea. **Figure 1-3** shows the volcano locations. Kohala is considered extinct; Mauna Kea has not erupted for 4,500 years and is dormant; and Hualalai last erupted in 1801 and is considered dormant. Mauna Loa and Kilauea are active volcanoes. A sixth volcano, the Loihi Seamount, is active and forming on the seafloor south of Kilauea.

Each volcanic dome consists primarily of permeable thin-bedded basaltic lava flows. A veneer of andesitic lavas covers much of Mauna Kea; and one of andesite and trachyte covers part of the Kohala Mountain, attesting to the older age of the Kohala volcanic series. The andesitic and trachytic flows are mostly thick-bedded and are poorly permeable.

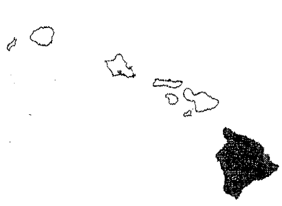
Numerous dikes have intruded lava flows in the rift zones. However, exposed dikes are found only in deeply eroded valleys in the eastern slope of Kohala Mountain. They form almost impermeable vertical barriers, which cut across lava flows and often times impound large quantities of ground water. Volcanic-ash deposits, several feet thick in places, crop out in about 450 square miles of the northern, northeastern, and southeastern parts of the island. Most of the ash deposits were buried by later lava flows. The buried ash deposits, intercalated in permeable lava flows, act as perching members for important high-altitude perched-water bodies in many of the northeastern and southeastern parts of the island. Because of the highly pervious nature of many of the surface rocks, the island has only a limited number of perennial streams. These streams are found on the eastern (or windward) slopes of Mauna Kea and Kohala Mountain. A few streams flow perennially in their wet upper reaches but lose their water flowing over the permeable ground well before reaching the coast. However, these streams are subject to flash floods during heavy rains.

There is little evidence of extensive coastal-plain sedimentation and of deep erosion, except in the northeastern slopes of the Kohala and Mauna Kea mountains. As a result, sedimentary materials are sparse and scattered. They include alluvium, talus, dune and beach deposits, and glacial deposits on Mauna Kea. Due to the sparse distribution, sedimentary material has little impact on hydrology.

Figure 1-4 shows a geologic map of Hawaii Island. Accompanying the geologic map is **Table 1-2** showing the stratigraphic sequence of the volcanic rock units on Hawaii Island.



Source: GEOLOGY AND GROUND-WATER RESOURCES OF THE ISLAND OF HAWAII, H.T.Sterarns & G.A.MacDonald, Hawaii Division of Hydrography, 1946, p.35, Figure 4



Island of Hawaii

FIGURE 1-3

VOLCANOES

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Department of Water Supply

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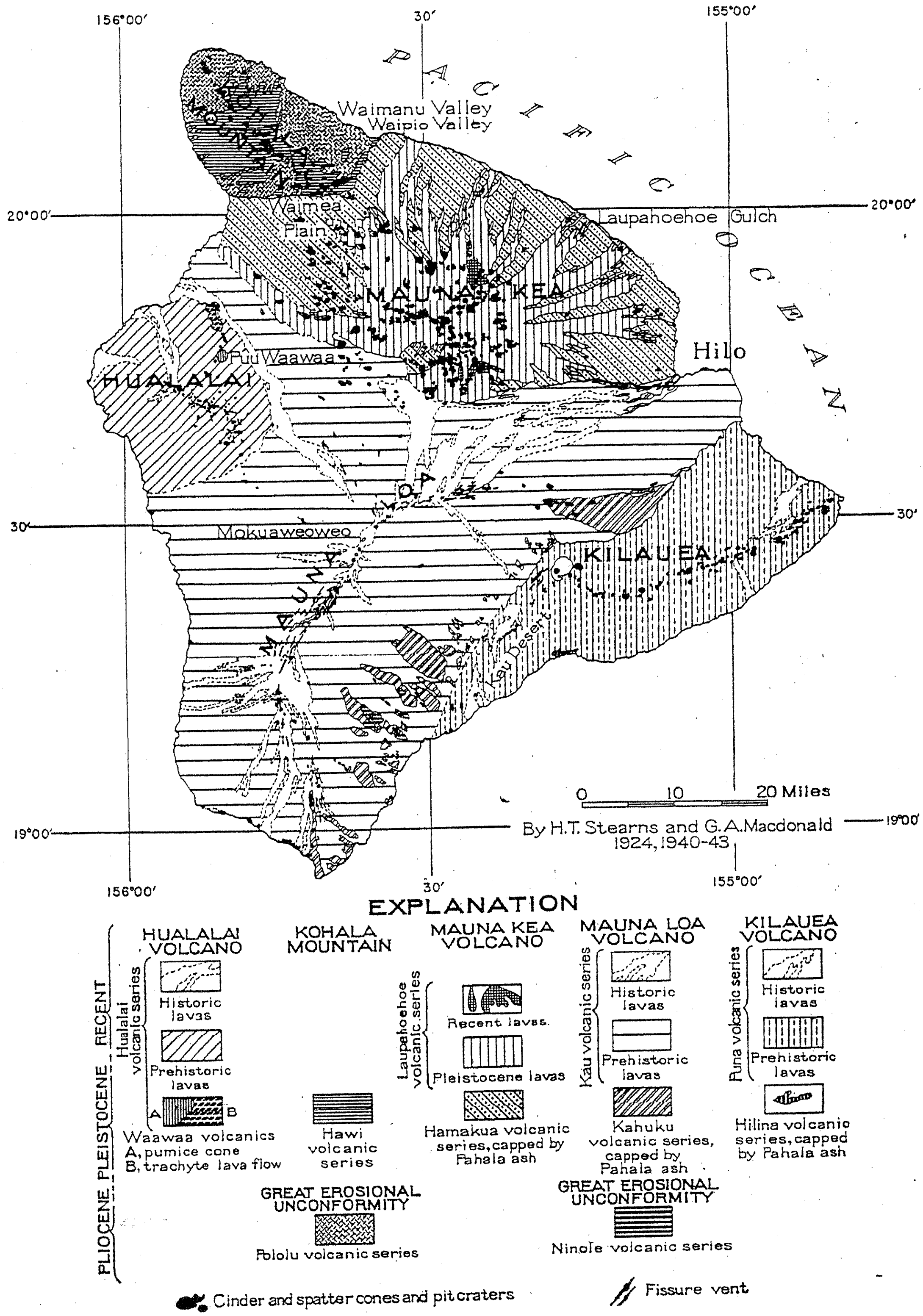

Source: GEOLOGY AND GROUND-WATER RESOURCES OF THE ISLAND OF HAWAII, H.T.Sterns & G.A.MacDonald, Hawaii Division of Hydrography, 1946, p.102, Figure 17

Island of Hawaii

FIGURE 1-4

SIMPLIFIED GEOLOGIC MAP

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Department of Water Supply

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Table 1-2:Stratigraphic Rock Units in the Island of Hawaii

(The volcanic rocks of Mauna Loa, Mauna Kea, and Hualalai, those of Mauna Kea and Kohala, and those of Mauna Loa and Kilauea interfinger)

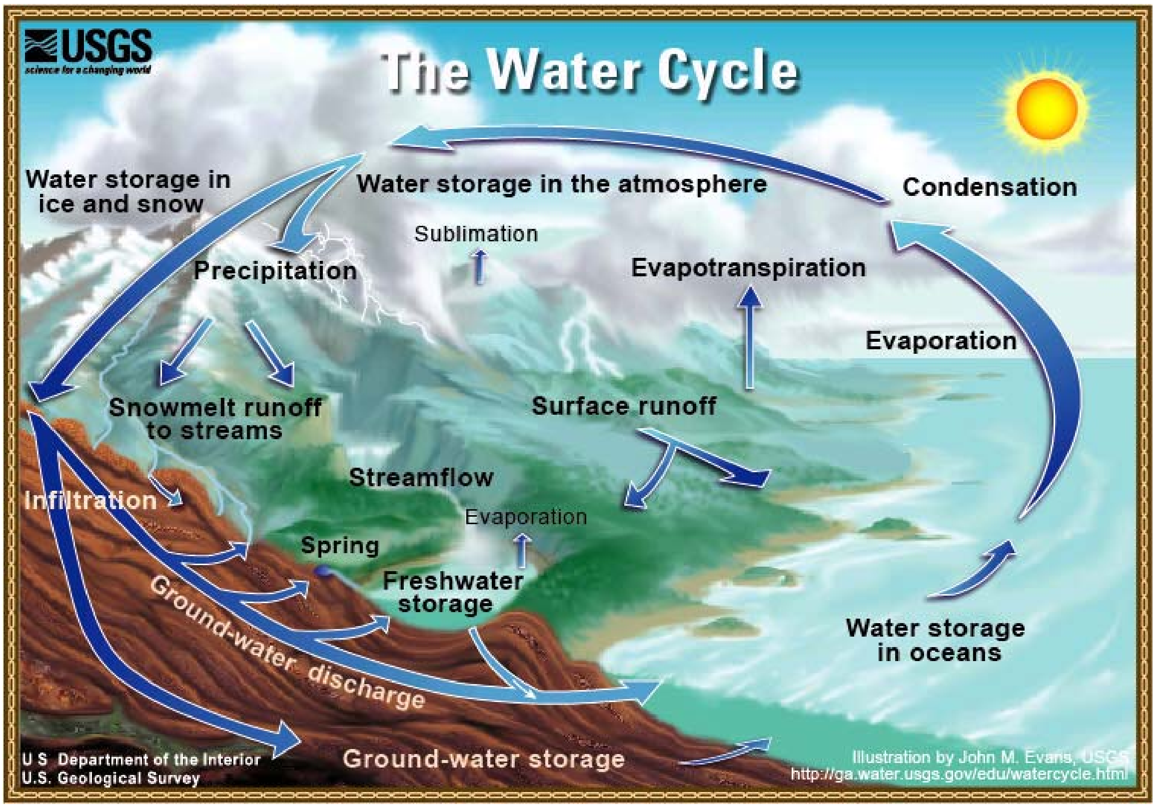
Age	Hualalai	Kohala Mountain	Mauna Loa		Kilauea	Mauna Kea	
Historic	Historic member of Hualalai volcanic series (volcanics of 1801)	Unconsolidated alluvium, dunes and landslides	Historic member of Kau volcanic series (volcanics of 1832-1942)	Mud flow of 1868	Historic rocks of Puna volcanic series (volcanics of 1790-1934)		Ribbons of gravel and small alluvial fans
Recent	Exposed part of prehistoric member of the Hualalai volcanic series		Dunes		Dunes	Upper member of Laupahoehoe volcanic series	
Late Pleistocene		Fluvial conglomerates	Prehistoric member of Kau volcanic series		Prehistoric member of Puna volcanic series	Glacial debris and fluvial conglomerates	
						Lower member of Laupahoehoe volcanic series	
	Pahala ash (exposed on Waawaa volcanics only)	Pahala ash (not differentiated)	Pahala ash		Pahala ash	Pahala ash	
Early and Middle Pleistocene	Waawaa volcanics and lower unexposed part of Hualalai volcanic series	Fluvial conglomerates	Kahuku volcanic series		Hilina volcanic series	Hamakua volcanic series	
		Hawi volcanic series					
		Great erosional unconformity					
Pliocene		Pololu volcanic series	Ninole volcanic series				

Source: GEOLOGY AND GROUND-WATER RESOURCES OF THE ISLAND OF HAWAII, H.T. Sterarns & G.A. MacDonald, Hawaii Division of Hydrography, 1946, p. 62`1

1.2.4 Hydrology

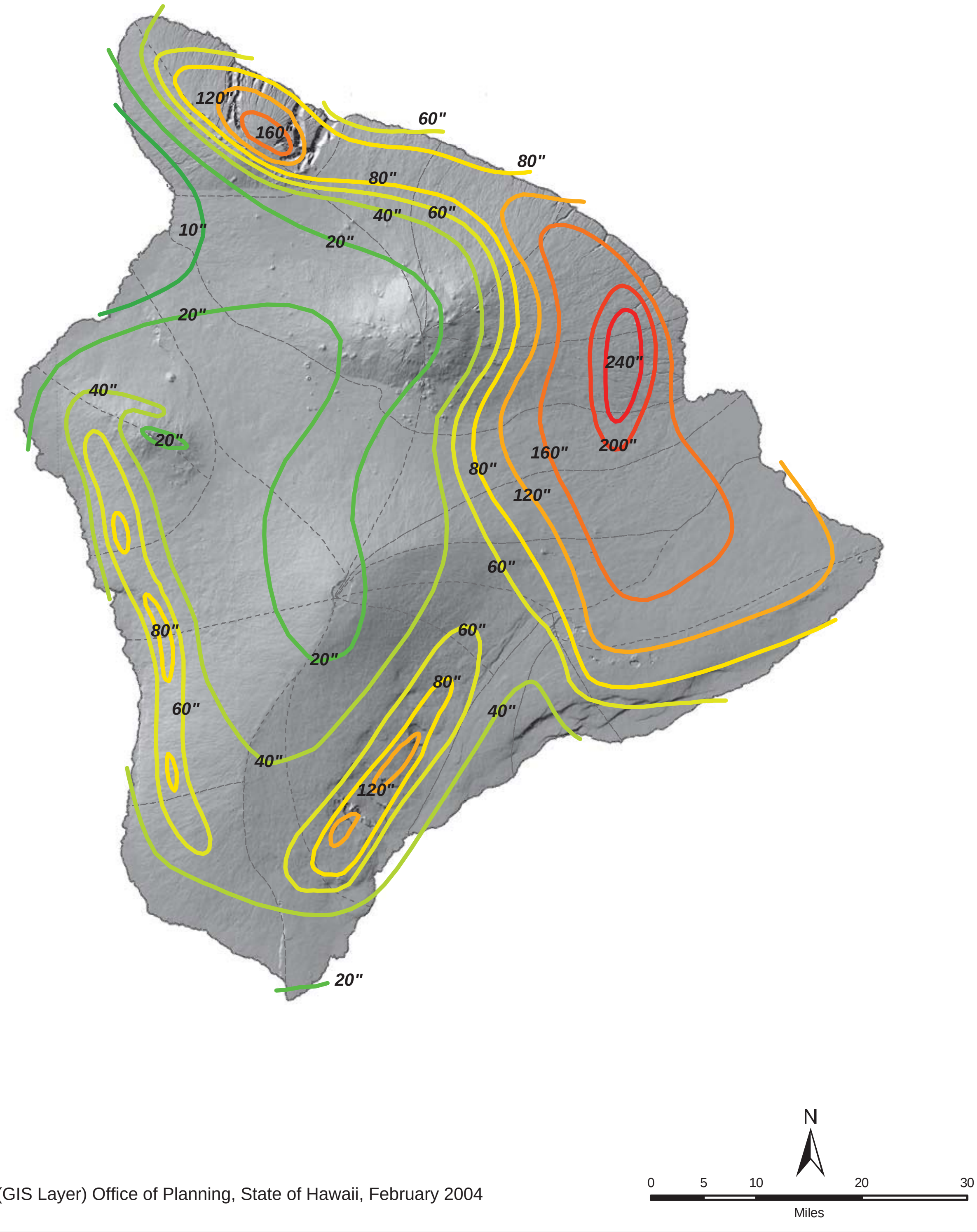
The hydrologic cycle or water cycle is the cyclical movement of water between the air, land and sea, as illustrated in **Figure 1-5**. Generally, it begins with evaporation of water from the ocean and returns to the ground as precipitation. Some of the precipitation or rainfall may be lost through evapo-transpiration; it may become surface runoff or runoff into streams and empty into the ocean; or it may infiltrate the ground to become soil moisture or collect as ground water and eventually escape to the sea. Water supply in the islands is dependent upon this cycle.

Figure 1-5: The Water Cycle



The island of Hawaii, which lies in the path of the prevailing northeast trade winds, has an orographic rainfall pattern. The heaviest rainfall occurs on the eastern or windward side of the island. The leeward or western slopes receive little of the orographic trade wind rainfall. Rain in the leeward side is generally the result of convective-type showers. The island rainfall averages 72 inches per year, equivalent to 13.82 billion gallons of water per day. As indicated by the isohyetal lines of the rainfall map shown in **Figure 1-6**, rainfall gradients are very steep. The dry leeward side at Kawaihae averages less than 7 inches of rain per year, while the Hilo Forest Reserve averages 300 inches per year. Rainfall can drastically fluctuate from year to year, and has often exceeded 300 percent fluctuation. The intensity of rainfall is also very high with 12

Addendum No. 1, 2/3/2012



Source: (GIS Layer) Office of Planning, State of Hawaii, February 2004

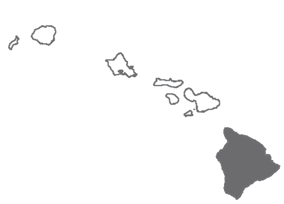


FIGURE 1-6

ANNUAL RAINFALL

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inches or more of rain a day occurring at least once a year, and instances of over 30 inches of rain occurring within a 24-hour period.

The steep and permeable slopes generally result in ephemeral or flashy streams. This can be attributed to the abundant rainfall that is fairly well distributed throughout the year to yield more water than the infiltration capacity of the permeable surfaces. Perennial streams are scarce except on the windward slopes of the Kohala Mountain and Mauna Kea between Hilo and Maulua River near Laupahoehoe.

Ground water is less susceptible to droughts and seasonal changes than surface water, and therefore is a more dependable water source. There are four different types of ground water on the island: 1) basal water floating on salt water; 2) dike confined water; 3) water perched on relatively impervious soil or rock formation; and 4) shallow ground water. The greatest ground water reservoir is the basal water table near sea level, which is a fresh water lens that "floats" on sea water. This phenomenon is known as the Ghyben-Herzberg principle. Due to the difference in specific gravity of sea water and fresh water, theoretically for every foot of fresh water above sea level 40 feet of fresh water extend below sea level to maintain the equilibrium. However, in actuality, there is a zone of mixture or transition zone from sea water to fresh water.

The generalized maps in **Figures 1-7** and **1-8** show ground water areas on the island, and locations where ground water recovery by wells and tunnels is feasible. The maps, prepared by the U.S. Geological Survey in 1946, are still applicable today with a few modifications. One such modification is the high-level ground water encountered in the early 1990's within the Keauhou Aquifer System Area, which is within the Hualalai Aquifer Sector Area 809. Exploratory drilling at elevations above 1600 feet mean sea level (msl) encountered water elevations ranging from 25± feet msl to 460± feet msl. *A Study of the Ground-Water Conditions in North and South Kona and South Kohala Districts, Island of Hawaii, 1991-2002* published by CWRM in September 2003, was the culmination of efforts to collect and analyze ground water data from West Hawaii. The report recommends "that this monitoring work continue, and that new hydrological and geological information be analyzed and incorporated into current understanding of West Hawaii."

1.3 ECONOMY AND POPULATION

1.3.1 Economy

The economy of the County of Hawaii is supported by agriculture, tourism, the manufacturing of export products, and research and development. Support of research and development in emerging fields such as astronomy, high technology, renewable energy, health and wellness, agricultural and eco-tourism, diversified agriculture and aquaculture is an important economic force.

Tourism replaced the sugar industry as the primary economic generator in the mid-1980's, with the last sugar harvest on the island in 1997. Tourism related facilities and activities are primarily on the west side of the island, with continued development concentrated in the Kohala and Kona Districts.

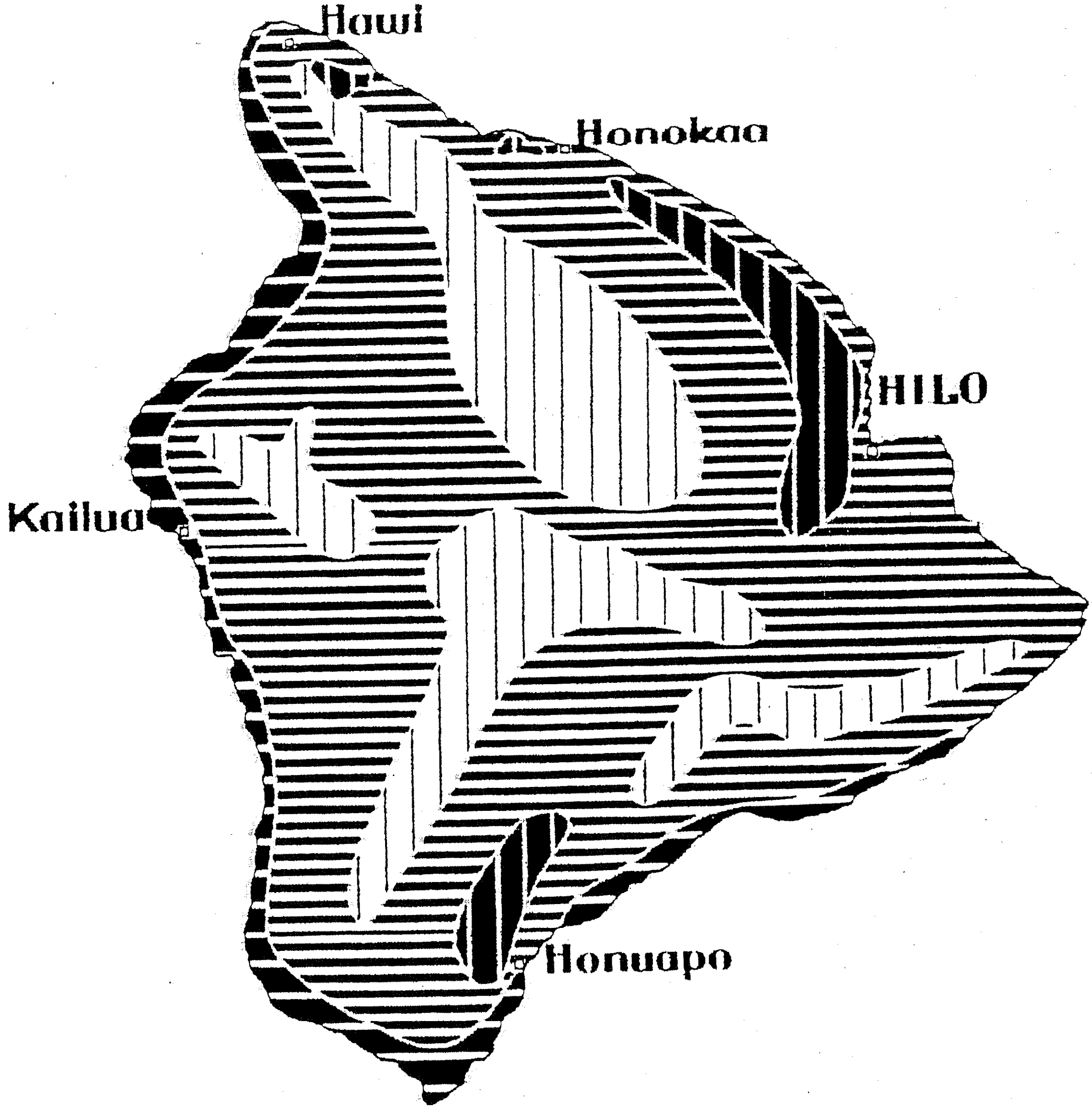
Agriculture continues to be a major economic generator, and includes raising cattle and other livestock, farming of coffee, macadamia nuts, papaya, flowers and nursery products, vegetables, aquaculture, forestry and several processing plants that utilize locally grown products. Livestock production has been declining steadily since the late 1980's primarily due to the high cost of importing feed which resulted in the closing of many feedlots within the State. The market for locally grown products with the growth of local demand and potential of increasing exports indicates promising opportunities for expansion of agriculture. Forestry is a promising industry with the excellent growing climate and the availability of former sugarcane lands, pasture and brush lands. Forest products such as eucalyptus and higher value hardwoods such as toon, maple, and koa are already being produced commercially on the island.

Aquaculture is also a promising industry. According to the County General Plan, "aquaculture operations County-wide have grown from eight operations in 1982 to forty-three in 1996. During this same period, annual revenues have grown from $90,600 to $13,200,000. The County accounts for 37 per cent of the total aquaculture operations within the State but accounts for over 80 per cent of the total production and over 84 per cent of the production value." The Natural Energy Laboratory of Hawaii Authority (NELHA) was first created in 1974 by the Hawaii State Legislature on 322 acres of land in Keahole, North Kona, and continues to be a State subsidized facility now encompassing 870 acres of land. The Pacific Aquaculture and Coastal Resource Center is now being developed on two sites in Hilo, and is funded by the County of Hawaii, State of Hawaii, the U.S. Economic Development Administration, and the University of Hawaii.

1.3.2 Population

The County population has increased at a rate of 23 percent between 1990 and 2000, as compared to 9 percent for the State. According to the County General Plan, "the district of Puna saw the largest increase at 51 per cent, followed by South Kohala (44 per cent), North Kohala (41 per cent), Kau (31 per cent), North Kona (28 per cent), South Kona (12 percent), North Hilo (12 per cent), Hamakua (10 per cent) and South Hilo (6 per cent)." The County General Plan projects that Puna will continue its strong population growth, while growth in North and South Kohala and North and South Kona will be closely associated with the growth of the visitor and agricultural industries in the districts.

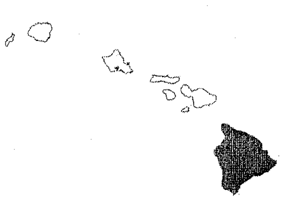
The County General Plan has three population projections for the island to the year 2020, as listed in **Table 1-3**. Series A is a conservative projection, Series B is a medium projection, and Series C projects more rapid growth. More detailed projections for each judicial district are presented in the General Plan.



EXPLANATION

- Brackish basal water
- Basal water floating on salt water
- Water confined by dikes and not floating on salt water
- Water perched on ash, soil or alluvium and underlain with basal water

Source: GEOLOGY AND GROUND-WATER RESOURCES OF THE ISLAND OF HAWAII, H.T.Stearns & G.A.MacDonald, Hawaii Division of Hydrography, 1946, p.35, Figure 4



Island of Hawaii

FIGURE 1-7

GROUNDWATER QUALITY & LOCATION

Hawaii County
Department of Water Supply

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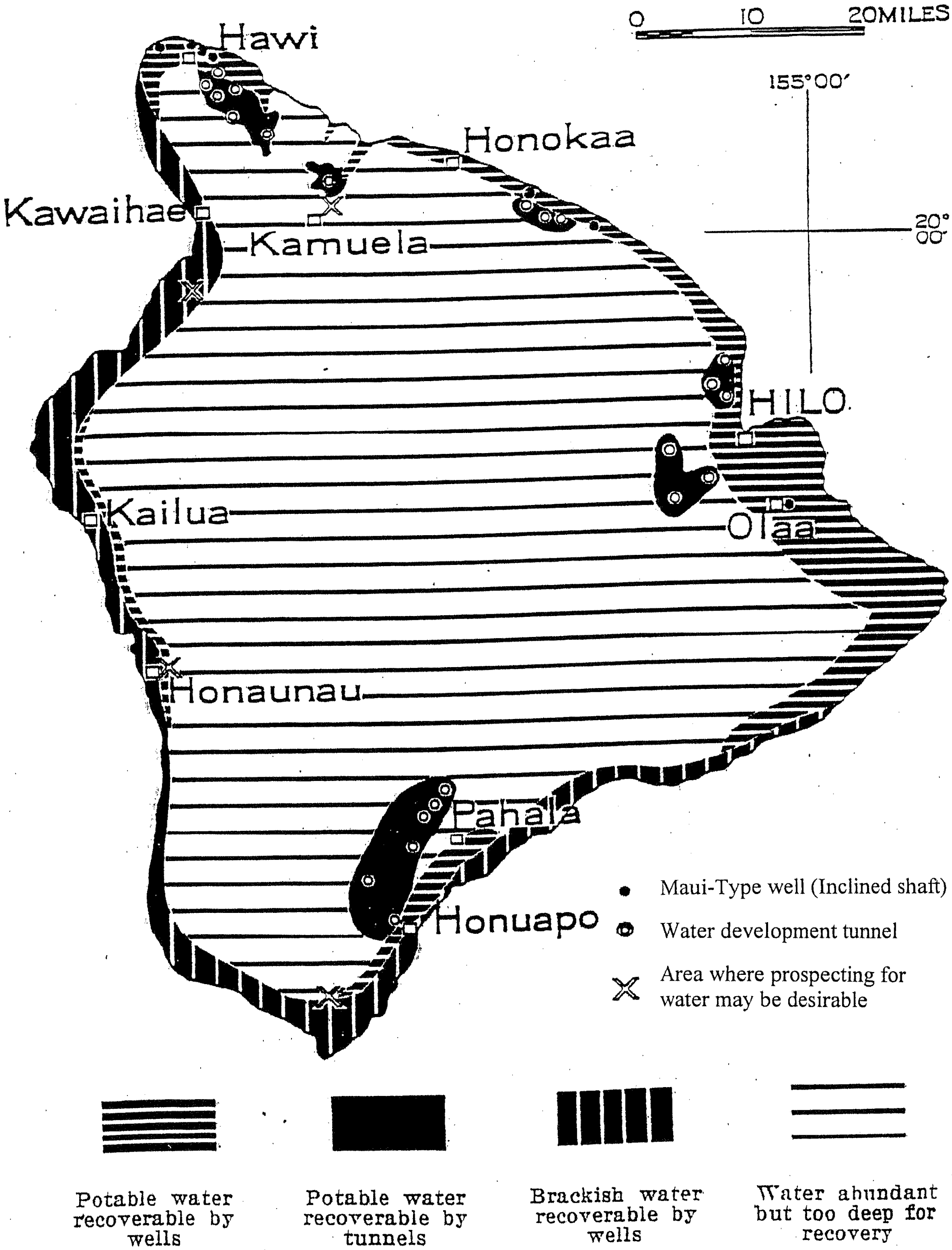
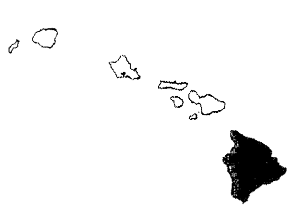


Source: GEOLOGY AND GROUND-WATER RESOURCES OF THE ISLAND OF HAWAII, H.T.Stearns & G.A.MacDonald, Hawaii Division of Hydrography, 1946, p.35, Figure 4



Island of Hawaii

FIGURE 1-8

RECOVERABLE GROUNDWATER BY WELLS & TUNNELS

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DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

Job No. 2003-818

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

Table 1-3: County General Plan Population Projection

GROWTH RATE	2000	2005	2010	2015	2020
A – Low	148,677	159,397	175,388	193,118	213,452
B – Medium	148,677	159,907	176,938	195,965	217,718
C - High	148,677	166,576	188,031	211,357	237,323

1.4 LAND USE

1.4.1 State Land Use

The State Land Use classification is very general with only four land use districts: Urban, Rural, Agriculture and Conservation. The County administers the local land use policy within the Urban, Rural and Agricultural districts, while the State of Hawaii Board of Land and Natural Resources regulates activities within the Conservation district. The County of Hawaii State Land Use acreage by classification is listed in **Table 1-4** and shown in **Figure 1-9**.

Table 1-4: State Land Use Classification

State Land Use	Acreage	% of Total
Urban	54,267	2
Rural	807	<1
Agricultural	1,184,599	46
Conservation	1,338,135	52
Total	2,577,808	100

General Plan, February 2005 (Data as of May 2000)
State of Hawaii, DBEDT, Office of Planning GIS Data
County of Hawaii Planning Department

1.4.2 County General Plan

The County of Hawaii General Plan is the policy document for long-range development, which establishes a balanced land use pattern to guide development based on long-term goals. The General Plan underwent a revision program beginning in 2001; and this program was finalized and adopted in February 2005. The General Plan goals and policies as applicable to the WUDP are listed in **Appendix A**.

The General Plan Land Use Pattern Allocation Guide (LUPAG) Map, indicates the general distribution of various land uses on the island. The land use pattern is a broad, flexible design intended to guide the direction and quality of future developments in a coordinated and rational manner. The land use designations and their associated acreage for the island are listed in **Table 1-5**:

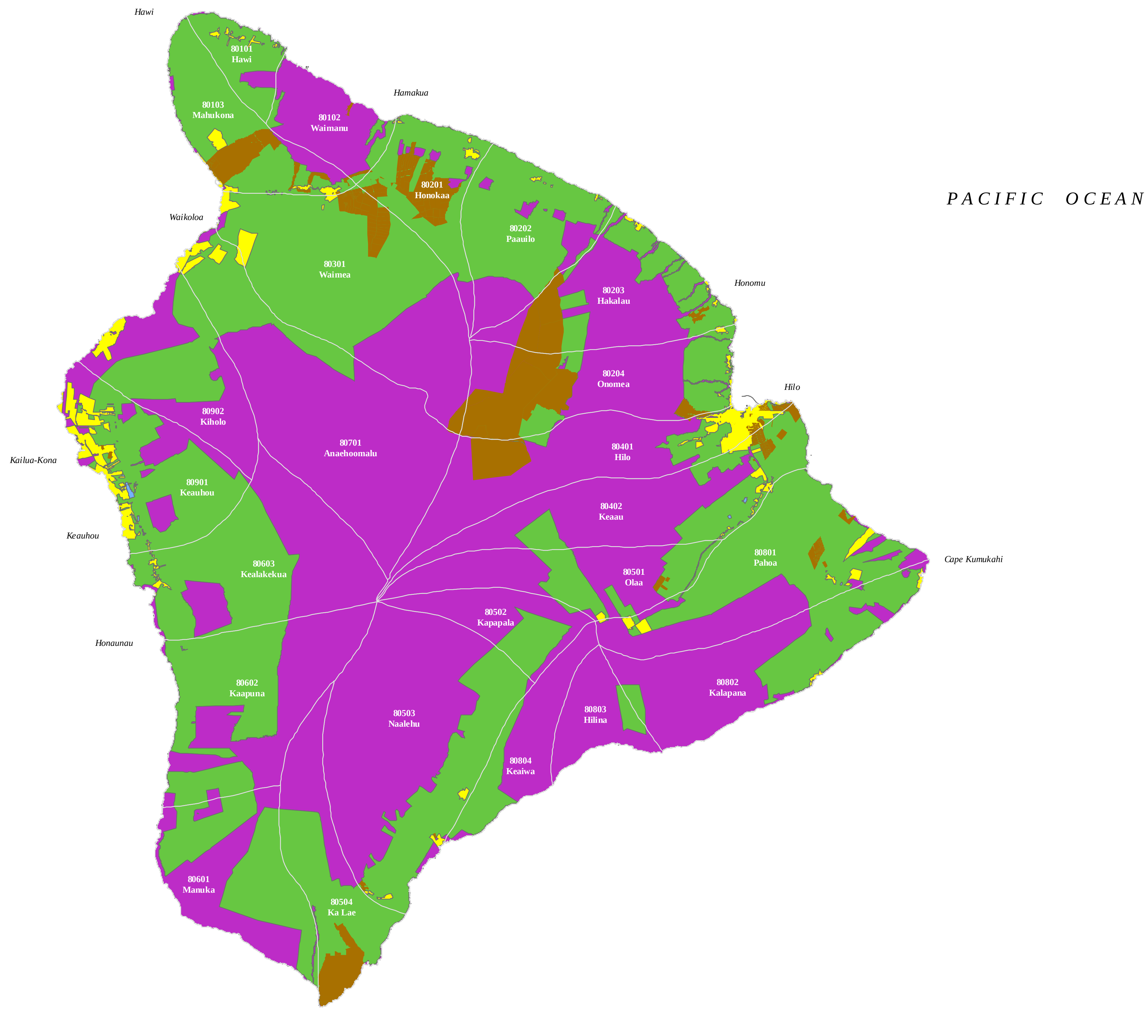
Table 1-5: General Plan Land Use Pattern Allocation Guide

LUPAG	Acreage*	% of Total
High Density Urban	1305	<<1
Medium Density Urban	5,947	<1
Low Density Urban	37,253	1
Industrial	10,977	<1
Important Agricultural Land	386,283	15
Extensive Agriculture	661,382	26
Orchard	1,603	<<1
Rural	47,996	2
Resort/Resort Node	5,676	<1
Open Area	35,696	1
Conservation Area	1,355,021	52
Urban Expansion Area	29,142	1
University Use	1,125	<<1
Total	2,584,274	100

*Planning Department Estimates – GIS Data

The General Plan water utility policies are as follows:

- ***(a)*** *Water system improvements shall correlate with the County's desired land use development pattern.*
- ***(b)*** *All water systems shall be designed and built to Department of Water Supply standards.*
- ***(c)*** *Improve and replace inadequate systems.*
- ***(d)*** *Water sources shall be adequately protected to prevent depletion and contamination from natural and man-made occurrences or events.*
- ***(e)*** *Water system improvements should be first installed in areas that have established needs and characteristics, such as occupied dwellings, agricultural operations and other uses, or in areas adjacent to them if there is need for urban expansion.*
- ***(f)*** *A coordinated effort by County, State and private interests shall be developed to identify sources of additional water supply and be implemented to ensure the development of sufficient quantities of water for existing and future needs of high growth areas and agricultural production.*
- ***(g)*** *The fire prevention systems shall be coordinated with water distribution systems in order to ensure water supplies for fire protection purposes.*
- ***(h)*** *Develop and adopt standards for individual water catchment units.*
- ***(i)*** *Cooperate with the State Department of Health to develop standards and/or guidelines for the construction and use of rainwater catchment systems to minimize the intrusion of any chemical and microbiological contaminants.*
- ***(j)*** *Cooperate with appropriate State and Federal agencies and the private sector to develop, improve and expand agricultural water systems in appropriate areas on the island.*
- ***(k)*** *Promote the use of ground water sources to meet State Department of Health water quality standards.*



Hawaii County
Department of Water Supply

DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

Job No. 2003-818

LEGEND:

State Land Use District Boundaries

- Hawaiian Home Lands
- Agricultural
- Conservation
- Rural
- Urban
- Aquifer System Boundaries

NORTH

0 2 4 8 12
Miles

INDEX MAP - Island of Hawaii

FIGURE 1-9

State Land Use District Boundaries (2004)

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Consulting Engineers
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(l) *Continue to participate in the United States Geological Survey's exploratory well drilling program.*
(m) *Seek State and Federal funds to assist in financing projects to bring the County into compliance with the Safe Drinking Water Act.*
(n) *Develop and adopt a water master plan that will consider water yield, present and future demand, alternative sources of water, guidelines and policies for the issuing of water commitments.*
(o) *Expand programs to provide for agricultural irrigation water.*

1.4.3 County Zoning

The Zoning Code is the County's legal instrument that regulates land development, and implements the General Plan policies; therefore, zoning must be consistent with the General Plan. The zoning districts with associated acreage for the island are listed in **Table 1-6**:

Table 1-6: County Zoning

County Zoning Districts	Acreage *	% of Total
Single-family residential	18,240	<1
Multi-family residential	3,318	<1
Resort	1,213	<1
Commercial	1,994	<1
Industrial	5,684	<1
Industrial-Commercial Mixed	269	<<1
Family Agriculture	332	<<1
Residential Agriculture	3,139	<1
Agriculture	1,243,350	48
Open	345,920	13
Project District	1,744	<1
Agricultural Project District	23	<<1
Lands not zoned (includes Forest Reserves and National Parks)	939,941	37
Total	2,565,167	100

** Estimate – GIS Data, 2004 Zoning*

County Zoning is more detailed than the General Plan, with zoning codes designated for virtually every parcel. The Residential, Resort, Commercial, and Industrial designations specify the required minimum building site area allowed for each unit.

1.4.4 Community Development Plans

The Community Development Plan (CDP) program was mandated by the 2005 General Plan to translate broad goals, objectives, and policies into implementation actions as they apply to specific geographical areas. The CDP are "intended to be a forum for community input into managing growth and coordinating the delivery of government services to the community." The

General Plan states that a CDP is not mandatory for every region on the island; however, the need for a CDP "for a particular area should be assessed considering a number of factors, including how much is public infrastructure challenged by recent or anticipated growth and whether there are significant efforts to change the zoning and land use in the area." Once finalized the CDP would be enacted by the County Council by ordinance.

CDP for North and South Kona, Puna, and North and South Kohala Districts have been initiated. North and South Kona CDP kick-off public information meetings started in September 2005, Puna meetings began in February 2006, North Kohala meetings began in November 2006, and South Kohala meetings began in September 2006. Planning efforts are in progress; final CDP should be considered in future WUDP updates.

1.5 EXISTING WATER RESOURCES

1.5.1 General

Water resources that are utilized currently on the island of Hawaii include ground water, surface water or stream diversions, rainwater catchment and reclaimed wastewater. Water quality varies with the source, and depending on the proposed use, treatment requirements also vary. Water quality protection is covered by the State's *Water Quality Plan*, which describes the Department of Health and other programs which protect existing and potential sources of drinking water. Current available information on water resources is limited, and records on individual rainwater catchment systems and stream diversions is extremely limited.

1.5.2 Ground Water

Ground water is the primary source of supply for the majority of water users on the island, for both county-owned and private water systems. **Figure 1-7,** shown previously, depicts ground water resource areas on the island. **Figure 1-8** shows areas where ground water recovery by wells is feasible. As can be seen from **Figure 1-7**, although there appears to be an abundant supply of basal water underlying the island, the high ground elevations and resulting depth to ground water sources makes it very expensive to recover the basal water in many parts of the island.

1.5.2.1 Wells

"Well" is defined by the Water Code as, "an artificial excavation or opening into the ground, or an artificial enlargement of a natural opening by which ground water is drawn or is or may be used or can be made usable to supply reasonable and beneficial uses within the State." The inventory of the wells or existing ground water sources was obtained from the CWRM database, which was developed with information received from the Well Registration program; and since 1988, has been supplemented with information obtained through the well construction/pump installation permitting process. The database is the best available information and was used to evaluate the existing ground water resources; however, it is not complete and lacks information pertinent to the WUDP for many of the wells, such as installed pump capacity and chloride concentration. The installed pump capacity is critical because it indicates the quantity of water

Figure 1-10: Registered Wells

MAP CURRENTLY NOT AVAILABLE ON-LINE

that may be pumped from each well. The chloride concentration is important because the potability of the water, i.e. potable, brackish or saltwater is not always evident and has varying impacts on the aquifer sustainable yield. The Water Code and Administrative Rules do not require well owners in non-designated water management areas to notify the CWRM of changes in ownership and type of use; however, the CWRM updates its records whenever it becomes aware of such changes. In July 2005, the CWRM began issuing certificates of well construction and pump installation completion that require landowners to notify the CWRM if the well operator or landowner changes.

Based on the CWRM well database and limited additional update information, the island of Hawaii has 355 well sources, which are shown on **Figure 1-10**. The pumping capacity of the well sources reporting pumpage to the CWRM is 274.2 MGD, as listed in **Table 1-7**.

Table 1-7: Summary of Installed Pumps in Existing Well Sources

Category	# of Wells	Capacity* (MGD)	% of Total Capacity
Municipal	97	91.6	33.4
Domestic	30	3.1	1.1
Irrigation	129	45.0	16.4
Industrial	39	102.2	37.3
Others	60	32.3	11.8
Total	355	274.2	100.0

* Capacity based on available installed pump capacity data; many well pump capacities are not listed in the database.

1.5.3 Surface Water

The *Hawaii Stream Assessment* (HSA) lists 376 perennial streams throughout the State. Of the 376 streams, 132 perennial streams are on the island of Hawaii as shown on **Figure 1-11**. The majority of the streams are in the windward areas of higher rainfall, and practically all are on the slopes of Kohala Mountain and Mauna Kea. In other areas, streams are intermittent or non-existent. The HSA notes that the over 100 streams located on the Kohala-Hamakua coast are difficult to access and very little information is available; therefore, the level of confidence of the attributes for most of these streams is low.

Table 1-8 is from the HSA, and lists the available gaging records for the island.

In accordance with the Code, the CWRM must establish and administer instream flow standards on a stream-by-stream basis as necessary to protect public interests. Instream flow standard is defined as, "a quantity or flow of water or depth of water which is required to be present at a specific location in a stream system at certain specified times of the year to protect fishery, wildlife, recreational, aesthetic, scenic, and other beneficial instream uses." According to Section 13-169-46, Hawaii Administrative Rules, "Interim Instream Flow Standard for all streams on Hawaii, as adopted by the commission on water resource management on June 15, 1988, shall be that amount of water flowing in each stream on the effective date of this standard,

Table 1-8: Gaging Records

CODE	Gage is associated with stream with this HSA code	QUAL DATA	USGS assessment of quality of records
NAME	USGS Station Name	DRAIN	Drainage area above gage (sq. mi.)
GAGE #	USGS number of gage station. If all zeros, median and average are calculated flows.	DIV	Diversions per USGS Y Diversion is present above gage N No diversion is present above gage D Gage is on a ditch
ACTIVE	A – Active in January, 1991		
MEDIAN	Flow at gaging station exceeded 50% of time in cubic feet/second (cfs)	TYPE DATA	Type of data collected C Continuous record E Extreme flows only, low and/or peak C-E Converted from continuous to extreme L Low flow P Peak flow new New gage 1988 – continuous record
AVERAGE	Average of yearly mean flow in cubic feet/second (cfs) at gaging station		
YRS REC	Years of record, 19..-19..		

Note: cfs x 0.646 = MGD

CODE	NAME	GAGE #	ACTIVE	MEDIAN	AVERAGE	YRS REC	QUAL DATA	DRAIN	DIV	TYPE DATA
8-1-07	Hapahapai Gulch at Kapaau	752600	A			62-			N	P
8-1-16	East branch Honokane nui Str nr Niulii	747500		21.0		63-69			Y	C
8-1-17	East Honokaa iki intake to Awini Ditch nr Niulii	744000		0.9	1.76	27-72				C
8-1-29	Kukui Str nr Waimanu	742000		0.9		39-66			N	C
8-1-30	Paopao Str nr Waimanu	741000		1.1	3.33	39-52			N	C
8-1-31	Waiaalala Str nr Waimanu	740000		0.6	1.10	39-52			N	C
8-1-32	Punalulu Str nr Waimanu	739000		2.4	6.53	39-52			N	C
8-1-33	Kaimu Str nr Waimanu	738000		3.2	8.68	39-52			N	C
8-1-35	Waiilikahi Str nr Waimanu	737000		4.3	10.00	39-60			N	C
8-1-44	Kawainui Str nr Kamuela	720000	A	4.3	14.80	64-	G	1.58	N	C
8-1-44	Alakahi Str nr Kamuela	725000	A	3.1	6.88	64-	G	0.87	Y	C
8-1-44	Wailoa Str nr Waipio	732200		51.0	75	01-69			Y	C
8-1-44	Kawaiki Str nr Kamuela	720300	A	1.7	4.27	68-	G	1.45	N	C
8-1-55	Honokaia Gulch tributary nr Honokaa	717950	A			62-			N	P
8-1-60	Ahualoa Gulch at Honokaa	717920	A			62-			N	P
8-1-87	Keehia Gulch nr Ookala	717850	A			62-			N	P
8-2-06	Manowaiopae Str nr Laupahoehoe	717820		3.4	8.42	65-71	G	1.04	Y	C
8-2-16	Pahokupuka Str nr Papaaloa	717800	A	7.7	27.10	62-	G	2.76	N	C-P
8-2-37	Kapehu Str nr Pepeekeo	717650	A			62-			N	P
8-2-37	Kapehu Str at Piihonua nr Hilo	709000			50.90	28-37		4.84	N	
8-2-39	Alia Str nr Hilo	717600	A	12.0		62-			N	C-P
8-2-47	Kalaoa Mauka Str nr Hilo	717400	A			62-			N	new
8-2-56	Honolii Str nr Hilo	716000		13.0	52.00	24-32			N	C
8-2-56	Honolii Str nr Papaikou	717000	A	38.0	125.00	11-	F	11.60	N	C
8-2-60	Wailuku R nr Pua Akala	701700				64-65			N	C
8-2-60	Wailuku R at Hilo	713000	A	160.0	386.00	77-	G	256.00	Y	C
8-2-60	Wailuku R nr Humuula	701750			2.82	65-	G	34.80	N	C
8-2-60	Wailuku R nr Kaumana	701800		2.9	27.60	66-	G	43.40	N	C
8-2-60	Wailuku R at Pukamaui nr Hilo	703000		26.7	93.30	23-40			Y	C

CODE	NAME	GAGE #	ACTIVE	MEDIAN	AVERAGE	YRS REC	QUAL DATA	DRAIN	DIV	TYPE DATA
8-2-60	Wailuku R nr Piihonua	704000	A	83.8	279.00	28-	F	230.00	Y	C
8-2-61	Waiakea Str nr Mountain View	700000	A	8.9	11.60	30-	G	17.40	N	C
8-2-61	Wailoa R at Hilo	701300	A			67-			Y	P
8-2-61	Wailoa R nr Hilo	701200				57-67			Y	C
8-3-01	Hilea Gulch tributary nr Honuapo	764000	A	1.2	7.47	66-	F	9.17	N	C
8-3-01	Hilea Gulch tributary no. 2 nr Honuapo	765000			3.00	66-	G	1.86	N	C
8-4-01	Kiilae Str nr Honaunau	759800			0.21	58-	G	0.67	N	C
8-4-02	Right branch Waiaha Str nr Holualoa	759200			0.31	60-	G	1.89	N	C
8-4-02	Waiaha Str nr Holualoa	759500				57-68			Y	C
8-4-02	Waiaha Str at Luawai nr Holualoa	759300	A			60-			Y	C-P
8-5-03	Waikoloa Str nr Kamuela	757000		4.0	7.21	47-71	G	0.78	N	C
8-5-03	Waikoloa at marine dam nr Kamuela	758000	A	4.2	9.00	47-	G	1.18	Y	C
8-5-03	Kohakohau Str nr Kamuela	756000	A	1.9	8.49	56-	G	2.51	Y	C
8-5-03	Hauani Gulch nr Kamuela	759000	A		1.61	56-	G	0.47	Y	C

Figure 1-11: Surface Water Resources

MAP CURRENTLY NOT AVAILABLE ON-LINE

and as that flow may naturally vary throughout the year and from year to year without further amounts of water being diverted offstream through new or expanded diversions, and under the stream conditions existing on the effective date of the standard, except as may be modified [by the commission]."

1.5.4 Rainwater Catchment

Rainwater catchment is the collection of rainwater from a roof or other surface before it reaches the ground. Rainwater is typically a pure and free source of water, and is dependent upon climate. As stated earlier, the island of Hawaii experienced drought conditions from 1998 through 2003. According to the *Kau and South Kona Water Master Plan*, rainfall in the Kau and South Kona region has decreased since 1983 when Kilauea Volcano began erupting. Accordingly, rainfall catchment systems were impacted significantly, and continue to be impacted by the decrease in rainfall. The volcanic activity also impacts rainwater quality in the vicinity of Kilauea, particularly due to the emission of sulfur dioxide which can combine with water forming sulfuric acid. Acid rain has resulted in pH levels of water in catchment tanks as low as pH 4 in the Kau and South Kona areas. The pH of pure water is pH 7.

1.5.5 Reclaimed Wastewater

Reclaimed wastewater potentially is a valuable resource, especially for irrigation purposes. Based on information from the Department of Health, Wastewater Branch, **Table 1-9** lists existing reclaimed water applications, classifications and capacities throughout the island.

Table 1-9: Reclaimed Wastewater Resources

Wastewater Reclamation Facility (WWRF)	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
Waikoloa Beach Resort	R-2	1.3	0.5	Waikoloa Beach Resort Golf Course
Maunalani	R-2	0.75	0.25	Nursery and sod farm
South Kohala Resort	R-2	0.6	0.27	Mauna Kea Golf Course
Kealakehe	R-2	1.3	0.06	Swing Zone Driving Range
Kona International Airport	R-1	0.14	0.03	Landscape
Waimea	R-3	0.1	0.045	Parker Ranch pasture
Punaluu	R-2	0.125	0.012	Sea Mountain Golf Course

Sources: Department of Health, Wastewater Branch
Water Reuse Projects on Hawaii – List as of January 2005,
<http://www.hwea.org/watreuse/wrhawaii.htm>

1.6 EXISTING WATER USE

1.6.1 General

The CWRM staff is working towards establishing and drafting water use categories based on water system purveyance and primary use of the system for the purposes of water use permitting and reporting. Upon finalization of the categories, the CWRM staff will propose incorporation of the categories in the update of the Framework. Water use in this update report is categorized in accordance with the list and definitions to the extent possible. Future WUDP Updates should conform to the finalized water use categories to the extent possible.

- Domestic (Individual Household)
- Industrial (Fire Protection, Mining, Thermoelectric Cooling, Geothermal)
- Irrigation (Golf Course, Hotel, Landscape, Parks, School, Dust Control)
- Agriculture (Aquatic Plants & Animals, Crops/Processing, Livestock & Pasture, Ornamental/Nursery)
- Military
- Municipal (County, State, Private Public Water Systems [as defined by DOH])

Determination of existing water use is difficult due to the lack of detail in available metered water data, and is therefore based on the best available information. DWS meters customer water use and therefore has the most complete database on DWS purveyed water use. DWS metered water data from November 2004 to October 2005 are used in this update. The CWRM requires a monthly report of water use from wells and stream diversions, with exceptions discussed in detail in Section 1.6.8.1. CWRM data includes only that which is reported and therefore is not complete. However, it is the best available data, and data from the same time period, November 2004 through October 2005, also are used. In addition to the data obtained from DWS and the CWRM, Federal and State water system managers and private water system owners were queried on the existing populations served and water production capabilities of their systems, as well as future projections. Disclosed information is incorporated.

1.6.2 Domestic Use

Domestic use is potable and non-potable water use by individual households. There is no government agency that oversees private individual systems. The owner is responsible for the water quantity, quality and maintenance of the system. Individual rainwater catchment systems and private wells for individual domestic use are in this category. Records and data on individual rainwater catchment systems are not readily available. Water use by individual catchment systems is determined by deduction, i.e. if a developed parcel is not served by DWS or other water system of record, then a catchment system is assumed. Developed areas possibly served by catchment systems are shown on **Figure 1-12**. Information on private wells includes details collected through the CWRM well construction/pump installation permitting process. Users are required to measure and report monthly usage in excess of 50,000 gallons to the CWRM.

Hawaii County

Department of Water Supply

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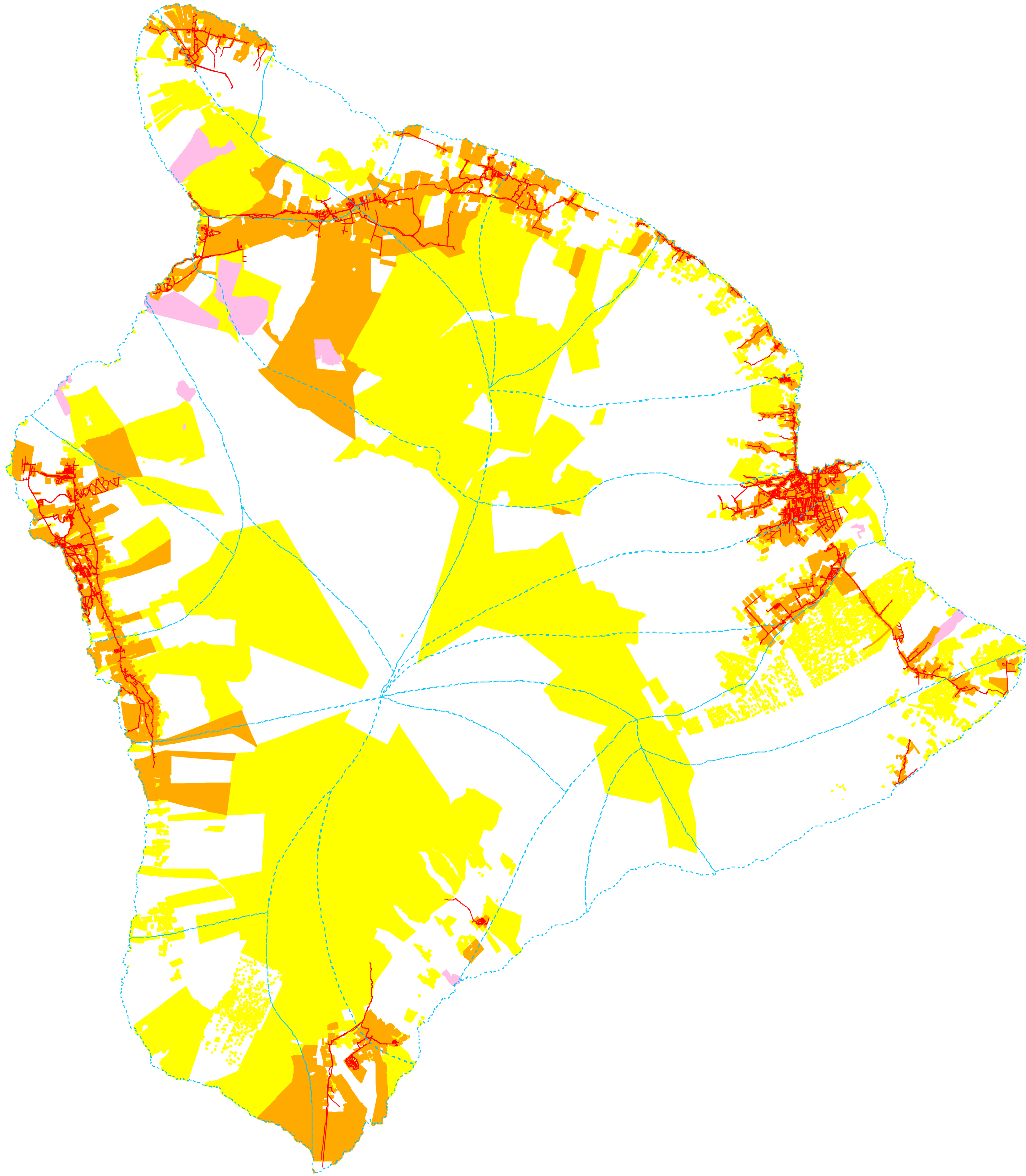


LEGEND:

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

NORTH

0 2 4 8 12

Miles

INDEX MAP - Island of Hawaii

FIGURE 1-12

Water System Service Area Map

FUKUNAGA & ASSOCIATES, INC.
Consulting Engineers

1388 Kapiolani Boulevard, Honolulu, Hawaii 96814

1.6.3 Industrial Use

Industrial use can be potable or non-potable water use for fire protection, mining, thermoelectric cooling, and geothermal uses. Most of the industrial use on the island is for thermoelectric cooling which can use non-potable water; therefore, it is assumed that industrial use is categorized as non-potable water use. Hawaiian Electric Light Company, Inc. (HELCO) reports pumpage from their wells to CWRM; therefore an estimate can be made on thermoelectric cooling by HELCO.

1.6.4 Irrigation Use

The irrigation use category as defined by the CWRM consists of non-potable water uses including irrigation for golf course, hotel, landscape, parks, school, and dust control. Irrigation use is determined from CWRM well pumpage data for irrigation wells.

1.6.5 Agricultural Use

Agricultural use includes water use for aquatic plants and animals, crops/processing, livestock and pasture, and ornamental/nursery, and this does not include water supplied by rainfall. Aquaculture and some agricultural uses are served by municipal systems.

There is great potential for non-potable agricultural irrigation systems as water sources. The major systems include the Waimea Irrigation System, Lower Hamakua Ditch System, Kohala Ditch System, and Kehena Ditch System. However, with the demise of the sugarcane industry in the late 1990's, many of the systems were abandoned and left to deteriorate. Current information on the condition of the systems is limited and typically is obtained by field verification. The current AWUDP is limited in scope and only discusses two of the systems which are owned and operated by the State of Hawaii, Department of Agriculture (DOA), Agricultural Resource Management Division (ARMD), the Waimea Irrigation System and Lower Hamakua Ditch System (Honokaa-Paauilo Irrigation System). According to the AWUDP, most irrigation systems built by the sugarcane and pineapple industries in Hawaii did not have any metering or monitoring of water use. As the industry shifts to diversified agriculture, the lack of water use data continues. However, the Lalamilo section of the Waimea Irrigation System is one of three DOA irrigation systems in the State with years of metered monthly diversified agriculture water use records, as well as acreage served.

The Waimea Irrigation System, Lower Hamakua Ditch System, and Kohala Ditch System are known to have sustained significant damage from the October 15, 2006 earthquake. The impacts of this recent event are not fully realized and are not reflected in this report. However, the earthquake has clearly demonstrated the vulnerability of the ditch systems, and the need for contingency plans to mitigate the impact of another event.

The United States Department of Agriculture, National Agricultural Statistics Service (USDA, NASS) collected and published data for the *2002 Census of Agriculture*. This was supplemented by the *2003 Farm and Ranch Irrigation Survey*. The census indicates that the County of Hawaii has 908 farms defined as, "any place from which $1,000 or more of agricultural products were produced and sold, or normally would have been sold, during the census year;" and also indicates that 9,041 acres of farmland are irrigated (2002 Census, Table 1). The 2003 Survey, Table 11, published the *Estimated Quantity of Water Applied by Source or Supplier: 2003 and 1998, for the State of Hawaii*. A more detailed breakdown of this data was requested from the USDA, NASS; however, the additional data obtained specific to the County of Hawaii indicates 498 farms and 6,284 acres irrigated with 6,106 acre-feet water (or 5.45 mgd). USDA, NASS stated that the discrepancy in the information is due to a difference in collecting and summarizing the data. Due to the discrepancy and uncertain accuracy and completeness of the survey data, and because more detailed breakdown of the data within the County was not available, only the *2002 Census of Agriculture* data are used.

Current agricultural water use is extremely difficult to determine due to the absence of comprehensive, island-wide data. Defining existing agricultural water demands is the objective of the AWUDP, which is a major effort; hence, the AWUDP is being developed in phases. The WUDP uses the best available information; therefore, agricultural water use considers lands classified as Important Agricultural Land in the General Plan and the *2002 Census of Agriculture* data. Important Agricultural Lands are defined as "those with better potential for sustained high agricultural yields because of soil type, climate, topography, or other factors" and have potential sources of irrigation within reasonable proximity if needed. Therefore, Important Agricultural Land is used as the primary basis for agricultural water demand. This is discussed further in detail in **Chapter 2, Technical Approach**. It is assumed that the 9,041 acres of farmland currently irrigated on the island are classified as Important Agricultural Land. Accordingly, the irrigated farmland is divided among each aquifer sector area based on the proportion of the island's Important Agricultural Land within each sector area.

1.6.6 Military Use

There are two potable water systems serving military use on the island. The Kilauea Military Camp, located in the Volcano National Park, relies on an extensive catchment and storage system. The Pohakuloa Training Area is in the saddle area between the slopes of Mauna Kea, Mauna Loa, and Hualalai, and is served by the State owned Mauna Kea State Park water system.

1.6.7 Municipal Use

Municipal use includes County, State and Federal water use served by potable water systems, and private public water systems, as defined by the State Department of Health (DOH). DOH defines "public water system" as "a system which provides water for human consumption, through pipes or other constructed conveyances if the system has at least fifteen service connections or regularly serves an average of at least twenty-five individuals daily at least sixty days out of the year." Refer to **Figure 1-12**, shown previously, for the general service area of the public water systems on the island. Municipal use is subcategorized into the other CWRM uses, domestic, industrial, irrigation, agriculture and military uses, as data is available. DWS meter data is the most detailed, but cannot be precisely subcategorized for each use. Domestic use is based on residential meter data, and is the best defined. Industrial, irrigation and agriculture use can be identified to an extent. This leaves a considerable portion of water use that cannot be subcategorized because it is a mix of the subcategories for such users as schools, hotels, government facilities, etc., and therefore are indicated as "other municipal." These water systems are listed in **Table 1-10**.

Table 1-10: Water Systems

NAME	OWNER	POP**	SVC-CN*	SOURCE
Ninole	DWS Hawaii	146	51	Ground
Kalapana	DWS Hawaii	169	59	Ground
Makapala-Niulii	DWS Hawaii	226	79	Ground
Ookala	DWS Hawaii	229	80	Ground
Hakalau	DWS Hawaii	272	95	Ground
Kapoho	DWS Hawaii	283	99	Ground
Kukuihaele	DWS Hawaii	455	159	Ground
Halaula	DWS Hawaii	526	184	Ground
Honomu	DWS Hawaii	621	217	Ground
Paauilo	DWS Hawaii	704	246	Ground
Laupahoehoe	DWS Hawaii	1,150	402	Ground
Pahala	DWS Hawaii	1,316	460	Ground
Pepeeko	DWS Hawaii	1,359	475	Ground
Lalamilo	DWS Hawaii	1,499	524	Ground
Pahoa	DWS Hawaii	1,928	674	Ground
Papaikou	DWS Hawaii	2,219	776	Ground
Waiohinu-Naalehu	DWS Hawaii	2,225	778	Ground
South Kona	DWS Hawaii	2,774	970	Ground
Haina	DWS Hawaii	3,312	1,158	Ground
Hawi	DWS Hawaii	3,764	1,316	Ground
Olaa-Mountain View	DWS Hawaii	5,686	1,988	Ground
Waimea	DWS Hawaii	8,872	3,102	Surface
North Kona	DWS Hawaii	25,666	8,974	Ground
Hilo	DWS Hawaii	37,563	13,134	Ground
Mauna Kea State Park	DLNR State Parks	25	13	Surface
Kulani Correctional Facility	Department of Public Safety	281	16	Catchment
Kilauea Military Camp***	U.S. Army	220	85	Catchment
Hawaii Volcanoes National Park	U.S. Department of Interior	3,374	76	Catchment

Table 1-10: Water Systems (continued)

NAME	OWNER	POP**	SVC-CN*	SOURCE
Waikii Ranch	Waikii Ranch Homeowners	58	94	Ground
Napuu Water, Inc.	Napuu Water, Inc.	330	147	Ground
Mauna Loa Macadamia Nut	Mauna Loa Macadamia Nut	100	4	Ground
Punaluu	S.M. Investment Partners	200	21	Ground
Kukio Utility Company	WB Kukio Resorts, LLC	260	15	Ground
Kohala Ranch Water Co.	Kohala Ranch Water Co., LLC	575	250	Ground
Kaupulehu	Kaupulehu Water Co.	1,056	9	Ground
Hawaiian Shores	Hawaiian Shores Associates	1,132	283	Ground
Hawaiian Beaches	Miller & Lieb Water Co.	3,040	950	Ground
Waikoloa	West Hawaii Water Co.	8,500	1,436	Ground

*SVC-CN – number of service connections
**POP – population serviced
***Included under "Military Use"
Source: State Department of Health, Safe Drinking Water Branch

1.6.7.1 County Water Systems

The Hawaii County Water Department owns and operates 24 separate systems on the island. These systems are dispersed widely around the island and vary in size from the largest in Hilo with 13,134 services (in 2004), to the smallest in Ninole with 51 services. Several of the systems are interconnected to optimize use of resources. DWS metering data provides the most detailed water use for the island.

From November 2004 through October 2005, the systems accounted for 25.3 mgd. Descriptions of the individual water systems are covered in the pertinent aquifer sector sections of this plan.

1.6.7.2 State Water Systems

The State owns two public water systems, the Mauna Kea State Park Water System and the Kulani Correctional Center Water System. The Mauna Kea State Park WS is located on the southwestern side of Mauna Kea on Saddle Road. By agreement between the State of Hawaii Department of Land and Natural Resources (DLNR) and the U.S. Army Pohakuloa Training Area (PTA), PTA is served by the State owned Mauna Kea State Park WS in exchange for maintenance of the water system sources and transmission lines. The source for the water system is from springs. The Kulani Correctional Center Water System is located in Kulani, off Stainback Highway. The system is supplied by rainwater catchment.

1.6.7.3 Federal Water Systems

There is one Federal water system owned by the Department of the Interior serving the Hawaii Volcanoes National Park. The system includes extensive catchment and storage facilities.

1.6.7.4 Private Public Water Systems

There are ten private public water systems on the island of Hawaii. The largest private water purveyor on the island is the Waikoloa water system which serves the resort, commercial and residential properties in the Waikoloa Resort. There are several small systems serving subdivisions in west Hawaii. There are two small private systems that provide water for domestic use to the Hawaiian Shores and Hawaiian Beaches subdivisions in Puna. Mauna Loa Macadamia Nut has a water system south of Hilo, and there is one private system in Punaluu which serves a golf course, commercial, and residential properties. Some Private Public Water System water consumption data is available, but is typically difficult to obtain and not categorized by use. Therefore, water use for Private Public Water Systems is based primarily on well pumpage reported to CWRM.

1.6.8 Water Use by Resource

Existing water resources include ground water, surface water, rainwater, and reclaimed wastewater. Most of the available water consumption data are categorized by the type of resource. As discussed previously, ground water and surface water are described and identified by hydrologic unit classification and coding systems. Use of water resources from a hydrologic unit are not limited to use within that hydrologic unit, and may be used within other hydrologic units when water systems span more than one hydrologic unit.

1.6.8.1 Ground Water

The CWRM has data on well pumpage, which only includes wells for which data are reported. Consequently, this information is not complete in all areas. The following cases describe uses of water which are exempt from the requirements for measuring and reporting on a monthly basis (unless otherwise determined by the CWRM):

a) individual end uses of water on multi-user distribution systems where the end user does not control or operate the water supply source(s) to the system.
b) water uses from individual systems for average annual uses less than 1,700 gpd.
c) passive agricultural consumption, such as when crops are planted in or adjacent to springs and natural wetland areas.
d) livestock drinking from dug wells or stream channels;

The following cases allow modification of the monthly reporting requirement, to reporting on a quarterly, semi-annual, or annual basis:

a) water uses from individual systems for average annual uses equal to or greater than 1,700 gpd and less than 161,000 gpd.
b) salt water or brackish water sources
c) surface water sources

Water uses from gravity-flow, open ditch stream diversion works which are not already being measured and are not in designated surface water management areas are deferred until the CWRM adopts reasonable guidelines for such systems.

Many of the tunnel and spring sources may be ground water directly under the influence of surface water (GWUDI). DOH takes samples and performs particulate analysis to determine if these sources are GWUDI. DOH officials believe that most of the County springs are GWUDI; however, the only three that have been designated are the Alili Tunnel (DWS Pahala WS), the Kukuihaele Spring (DWS Kukuihaele WS), and the Olaa Flume (formerly used by the DWS Hilo WS, currently not in use). GWUDI is subject to the Surface Water Treatment Rule; however, DOH has granted the two designated GWUDI currently in use “interim disinfection requirement,” which requires higher disinfection. It is anticipated that DWS will be replacing GWUDI sources or provide additional treatment

The CWRM database is the best available information and was used to evaluate the existing ground water resources.

Table 1-11 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) calculated from the actual pumpage data reported for each aquifer system/sector area. Potential well production is based on installed pump capacities, and calculated for both 16 hours of operation a day (ideal operating condition) and 24 hours of operation a day. Data is based on pumpage data from January 2003 through October 2005 reported to CWRM. Many wells in use do not report to CWRM or are not required to report. Refer to **Appendix B** for the CWRM well database.

The CWRM well database and sustainable yield information indicate that under current installed conditions, only the West Mauna Kea Aquifer Sector Area (ASEA), and the Kiholo Aquifer System Area (ASYA) (within Hualalai ASEA) have the potential of exceeding the sustainable yield if the wells are operated 24 hours per day; all other sector areas have sufficient sustainable yield under current installed conditions. Based on the 12-month MAV, actual water withdrawn from the West Mauna Kea ASEA is 38.04 % of SY and water withdrawn from the Kiholo ASYA is 22.56% of SY, or 27.77% of SY for the Hualalai ASEA. For the other sector areas, the 12-month MAV is well under the SY.

Table 1-11: Well Production and Sustainable Yield

Aq Code	Sys Code	Sector Area	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 (%)
801		**Kohala**		**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
802		**E. Mauna Kea**		**2.06**	**23.86**	**35.79**	**388**	**0.53**	**6.15**	**9.22**
	80201		Honkaa	1.41	2.31	3.46	31	4.55	7.44	11.16
	80202		Paauilo	0.14	4.51	6.77	60	0.23	7.52	11.28
	80203		Hakalau	0.13	16.17	24.25	150	0.09	10.78	16.17
	80204		Onomea	0.38	0.87	1.31	147	0.26	0.59	0.89
803		**W. Mauna Kea**		**9.13**	**17.56**	**26.34**	**24**	**38.04**	**73.17**	**109.75**
	80301		Waimea	9.13	17.56	26.34	24	38.04	73.17	109.75
804		**N.E. Mauna Loa**		**59.05**	**62.95**	**94.43**	**740**	**7.98**	**8.51**	**12.76**
	80401		Hilo	42.78	42.15	63.22	347	12.33	12.15	18.22
	80402		Keaau	16.27	20.81	31.21	393	4.14	5.29	7.94
805		**S.E. Mauna Loa**		**0.22**	**5.17**	**7.75**	**291**	**0.08**	**1.78**	**2.66**
	80501		Olaa	0.00	0.00	0.00	124	0.00	0.00	0.00
	80502		Kapapala	0.00	0.00	0.00	19	0.00	0.00	0.00
	80503		Naalehu	0.22	5.17	7.75	117	0.19	4.42	6.62
	80504		Ka Lae	0.00	0.00	0.00	31	0.00	0.00	0.00
806		**S.W. Mauna Loa**		**2.38**	**6.92**	**10.38**	**130**	**1.83**	**5.32**	**7.98**
	80601		Manuka	0.16	0.79	1.18	42	0.38	1.87	2.81
	80602		Kaapuna	0.01	0.40	0.60	50	0.02	0.80	1.20
	80603		Kealakekua	2.17	5.73	8.60	38	5.71	15.09	22.63
807		**N.W. Mauna Loa**		**4.13**	**10.61**	**15.91**	**30**	**13.77**	**35.36**	**53.03**
	80701		Anaehoomalu	4.13	10.61	15.91	30	13.77	35.36	53.03

Aq Code	Sys Code	Sector Area	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 (%)
808		**Kilauea**		**1.53**	**5.53**	**8.29**	**618**	**0.25**	**0.89**	**1.34**
	80801		Pahoa	1.47	3.53	5.30	435	0.34	0.81	1.22
	80802		Kalapana	0.06	1.99	2.99	157	0.04	1.27	1.90
	80803		Hilina	0.00	0.00	0.00	9	0.00	0.00	0.00
	80804		Keaiwa	0.00	0.00	0.00	17	0.00	0.00	0.00
809		**Hualalai**		**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
		Island of Hawaii	**Total**	**95.49**	**183.04**	**274.56**	**2431**	**3.93**	**7.53**	**11.29**

1.6.8.2 Surface Water

1.6.8.2.1 Stream Diversions

The inventory of the existing stream diversions was obtained from the CWRM database. The CWRM database has 197 declared stream diversions and 5 permitted stream diversions. **Figure 1-11** shown previously displays the locations and distribution.

In the past, the sugar plantations built several major ditch and flume systems to utilize surface water sources. According to the *Water Resource Protection Plan* with data based on information prior to 1990, approximately 76 mgd were diverted from streams primarily for irrigation and hydroelectric power serving the sugar industry. **Table 1-12** lists the major stream diversions or ditch systems and corresponding flows.

Table 1-12: Major Stream Diversions

Major Stream Diversion (Ditch System)	Flow (MGD)
Total	**76**
Kehena Ditch	7
Kohala Ditch	27
Upper Hamakua Ditch	10
Lower Hamakua Ditch	32

The sugar industry has declined steadily since 1983. The last sugarcane harvest on the island was in 1997, and many irrigation systems were abandoned and left to deteriorate. According to data published in the *State of Hawaii Data Book 2003, Table 5.22 – Fresh Water Use, By Type, By Counties: 2000 (Data compiled by Hawaii State Department of Business, Economic Development and Tourism from County of Hawaii Department of Water Supply)*, surface water use in 2000 was 8.86 mgd. Surface water remains a significant potential source for irrigation and industrial uses.

1.6.8.2.2 Instream Use

Instream use is defined by the Code as, "beneficial uses of stream water for significant purposes which are located in the stream and which are achieved by leaving the water in the stream. Instream uses include, but are not limited to:

(1) Maintenance of fish and wildlife habitats;
(2) Outdoor recreational activities;
(3) Maintenance of ecosystems such as estuaries, wetlands, and stream vegetation;
(4) Aesthetic values such as waterfalls and scenic waterways;
(5) Navigation;
(6) Instream hydropower generation;
(7) Maintenance of water quality;

(8) The conveyance of irrigation and domestic water supplies to downstream points of diversion; and
(9) The protection of traditional and customary Hawaiian rights."

1.6.8.3 Rainwater Catchment

Rainwater catchment systems are typically located outside of the County water system service areas. There are three rainwater catchment public water systems regulated by the Department of Health, Safe Drinking Water Branch. These serve Kilauea Military Camp, Hawaii Volcanoes National Park and Kulani Correctional Facility. There is no government agency that oversees private individual systems. The owner is responsible for the water quantity, quality and maintenance of the system. There are no records or data on these systems. Therefore, information reflected in this report is based on deductions; i.e. if a developed parcel is not served by DWS or other water system of record, then a catchment system is assumed. Individual rainwater catchment systems are primarily in the Puna, Kau and Hamakua Districts.

Where a large number of private individual water catchments exist, the Civil Defense has established emergency spigots from the County water system to supplement those residents' needs during droughts. If the County decides to extend water service to these areas, then more water sources will be needed.

1.6.8.4 Reclaimed Wastewater

Reclaimed wastewater information was obtained from the Department of Health, Wastewater Branch, as previously listed in **Table 1-9**. Approximately 1.7 million gallons of reclaimed wastewater are used per day on the island, primarily for irrigation of agriculture, golf courses and landscaping.

2 TECHNICAL APPROACH

The approach used in the update of the County of Hawaii WUDP was documented in the Project Description, as required by the Framework. The Project Description was presented to and approved by the CWRM on September 28, 2005. The approach used involved inventory of existing water use and resources, projection of water demand for full build-out of land use policies, and 5-year incremental water demand projections based on rate of population growth to the year 2025. The Framework requires data and analyses to be based on ground water and surface water hydrologic units designated by the CWRM; however, due to the developing stage of the surface water hydrologic units, the WUDP findings described in Chapter 3 are based on the ground water hydrologic units or aquifer sector areas. The various elements of the approach are described in this chapter.

Public meetings were held at various stages of development of the WUDP to obtain input from the public. Four meetings were held in March 2006 in the communities of Hilo, Waimea, Kona and Naalehu. The methodology described in the following section, preliminary results and general recommendations were presented at these meetings. Comments received were used to refine specific elements of the planning methodology. A second series of meetings was held in July 2007 in the same communities to present the revised WUDP, as well as recommendations specific to each aquifer sector area. Subsequent to this second series of meetings, the revised WUDP was posted on the Hawaii County DWS website and comments were accepted for 30 days. Various details were revised within the WUDP based on the comments received; however, the planning methodology and recommendations were not altered.

2.1 WATER RESOURCES PLANNING METHODOLOGY

Water resource planning for the Hawaii WUDP update considers both land use based water demand projections and rate of population growth to plan for future water needs. Land use based evaluations provide full build-out projections, or the ultimate water needs, if the maximum density allowed is developed. This assesses the sustainability of land use policies set by the State of Hawaii and the County of Hawaii in terms of the water needs associated with the potential full build-out development. Incremental water needs for the next 20 years are based on population and growth rate projections. DWS historical water consumption data are also evaluated for comparison. Flowcharts diagramming the conceptual planning methodology are shown in **Figures 2-1** and **2-2**. **Figure 2-3** illustrates a theoretical example of the projected demands.

Figure 2-1: Full Build-Out Water Demand Projection Methodology

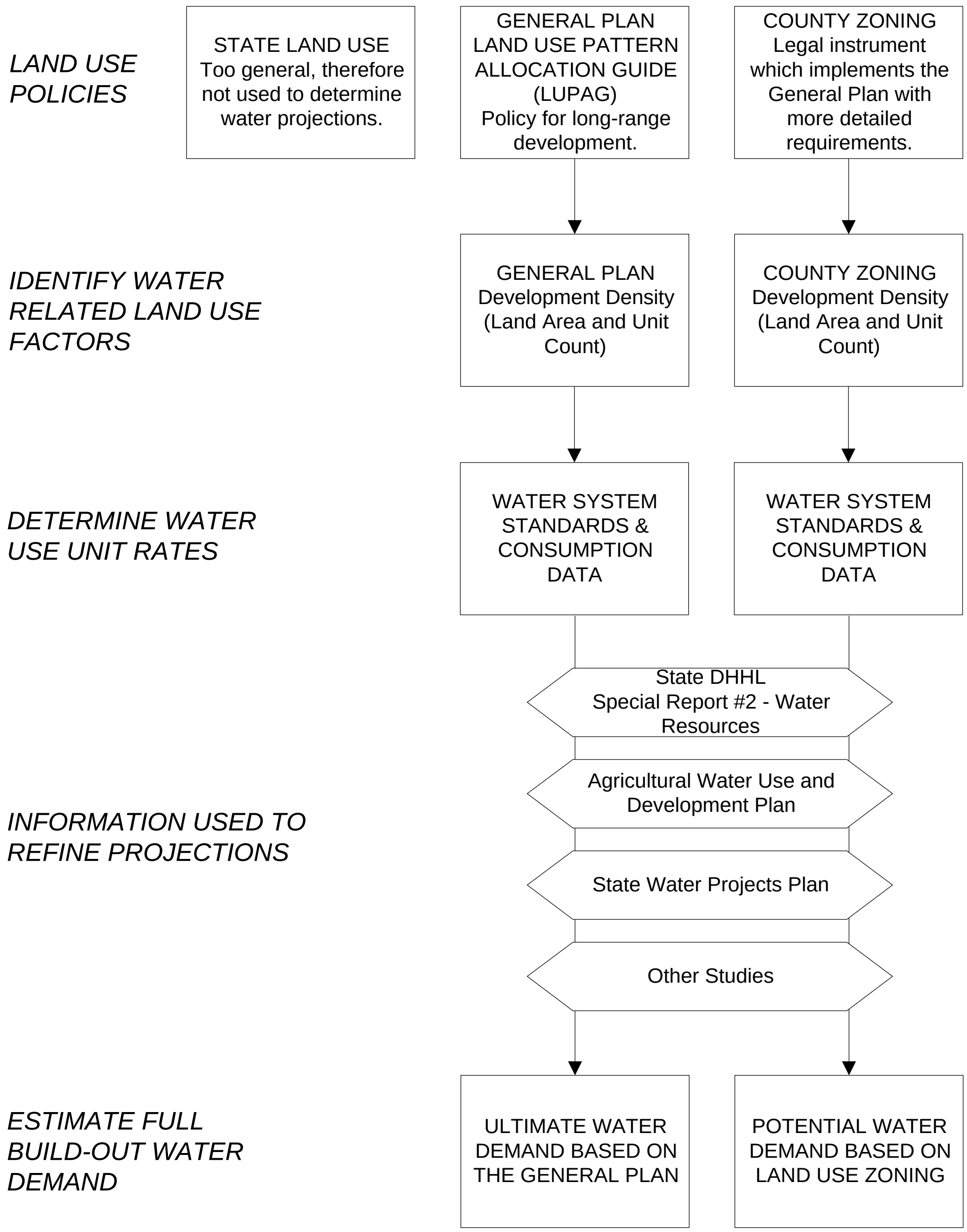


Figure 2-2: 5-Year Incremental Water Demand Projection Methodology

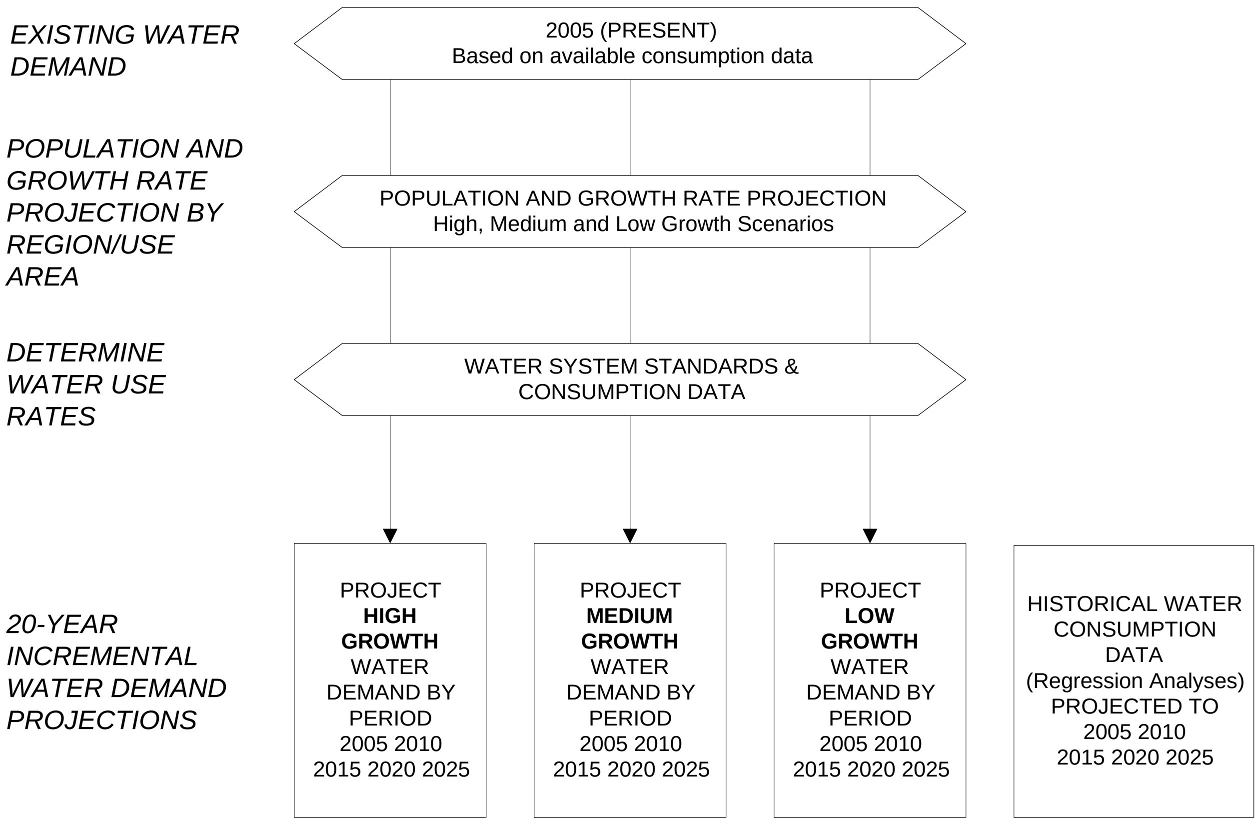
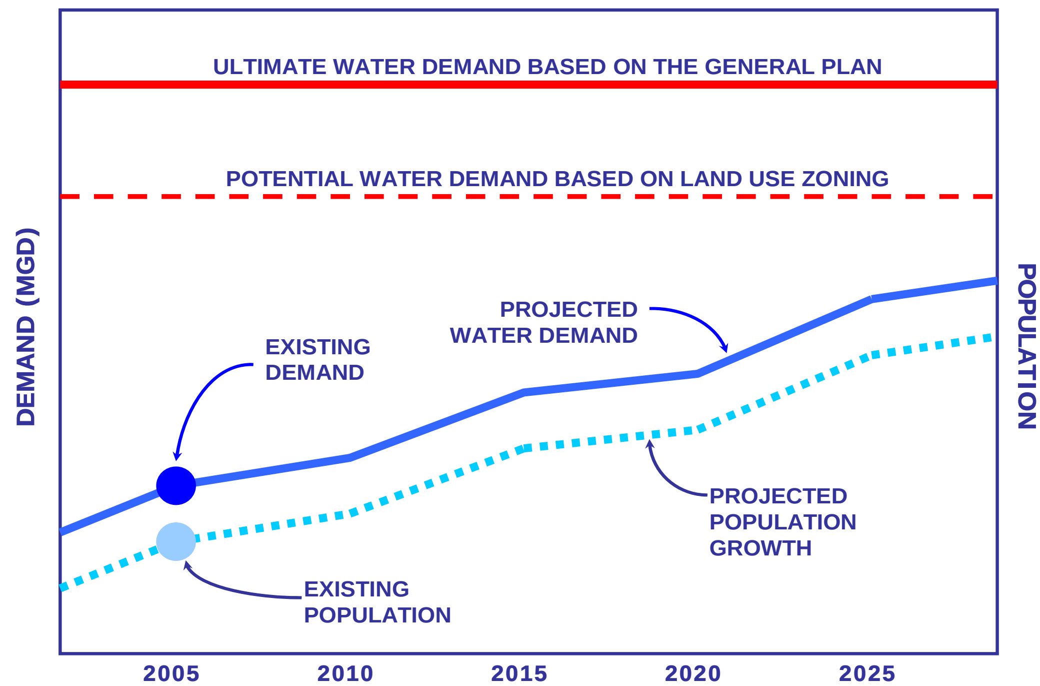


Figure 2-3: Theoretical Projected Demand



2.1.1 Full Build-Out Water Demand Projections

The full build-out water demand projections are land use based. The State Land Use classification has no guidelines to identify the level of development densities within the various districts, and therefore is not used for water demand projections. The County General Plan and County Zoning Land Use classifications are assessed to estimate the projected development densities for each designation at full-build out. The results are used to project the ultimate water demand based on the General Plan, and potential water demand based on land use zoning.

2.1.1.1 Hawaii County General Plan

The General Plan provides the ultimate full-build out water demand projection to determine if there are adequate water resources to sustain the land use pattern adopted by the County. Although the General Plan is more detailed than the State Land Use classification, the land use designations are broad, and density guidelines are only provided for the Urban designations, as listed below:

- High Density Urban – up to 87 units per acre
- Medium Density – up to 35 units per acre
- Low Density – up to 6 units per acre

In addition, Urban Expansion covers a considerable area in comparison to the other Urban designations. The Urban Expansion designation "allows for a mix of high density, medium density, low density, industrial, industrial-commercial and/or open designations…" The Urban Expansion Area has the potential to be developed as High Density Urban, which would drastically increase the unit count projections; or it could be developed as low as the Low Density unit count. However, for planning purposes, the density of the Urban Expansion Area was calculated for each aquifer sector area as the weighted average of Low, Medium, and High Density Urban unit counts based on the proportion of each urban designation within the specific aquifer sector area. Unit counts are multiplied by the appropriate residential water use unit rate to determine the corresponding water demand.

Table 2-1: Proposed Urban Expansion Density Rates

Aquifer Sector Area	Urban Expansion Density (units/acre)
801	10.0
802	8.4
803	11.3
804	15.4
805	13.3
806	12.5
807	12.5
808	7.8
809	15.9

The Rural designation is a new designation added to the 2005 General Plan and "includes existing subdivisions in the State Land Use Agricultural and Rural districts that have a significant residential component. Typical lot sizes vary from 9,000 square feet to two acres." Water projections for Rural areas assume 1 unit per acre multiplied by the appropriate residential water use unit rate.

The General Plan has three designations for Agriculture: Important Agricultural Land, Extensive Agriculture, and Orchard, depicted on **Figure 2-4**, and defined as follows:

- Important Agricultural Land: Those with better potential for sustained high agricultural yields because of soil type, climate, topography, or other factors.

  Some areas that meet the criteria for important agricultural lands on an irrigated basis only were included in the "Extensive Agriculture" category due to their remoteness from potential sources of irrigation.
- Extensive Agriculture: Lands not classified as Important Agricultural Land. Includes lands that are not capable of producing sustained, high agricultural yields without the intensive application of modern farming methods and technologies due to certain physical constraints such as soil composition, slope, machine tillability, and climate.

Other less intensive agricultural uses such as grazing and pasture may be included in the Extensive Agriculture category.

- Orchard: Those agricultural lands which though rocky in character and content support productive macadamia nuts, papaya, citrus and other similar agricultural products.

Extensive Agriculture areas are not economically feasible to irrigate, and the selected uses (e.g. grazing and pasture) can be sustained by natural rainfall and do not require intensive application of modern farming methods and technologies. Orchard crops are typically sustained by rainfall in the region (as indicated by the lack of irrigation wells and stream diversions in the region). Therefore, water demands are not allocated to Extensive Agriculture and Orchard.

The Important Agricultural Land designation is a new designation added to the 2005 General Plan. As stated earlier, Important Agricultural Land has the potential for sustained high agricultural yields, and there are potential sources of irrigation within reasonable proximity if needed. Therefore, agricultural water demand is based on the Important Agricultural Land area multiplied by the agricultural water use unit rate discussed in Section 2.1.1.3.3.

The proposed methodology to determine agricultural water use was met with strong objection at public meetings. Overwhelmingly, public input suggested that the need for irrigation water was not predicated on the classification of Agricultural lands. Public input further suggested that agricultural users would grow what is feasible according to the climate, and that irrigation from groundwater sources would be minimal. For example, crops requiring large amounts of moisture would be grown in areas that have a higher ambient rainfall. Commenters recommended that more realistic agricultural water use unit rates be developed based on historical demands and existing land use. However, such an undertaking would be extremely difficult due to the lack of comprehensive, island-wide data. Projecting agricultural water use is the objective of the AWUDP, which is a major effort; hence, the AWUDP is being developed in phases. The WUDP uses the best available information; therefore, two agricultural water use scenarios are presented for each of the full build-out scenarios (Hawaii County General Plan, and Hawaii County Zoning) and the 5-year incremental water demand projection scenario. This identifies a range of agricultural water use, which considers the best and worst case scenarios on an interim basis, until the next phase of the AWUDP is complete.

Figure 2-4: General Plan Agricultural Designations and Surface Water Sources

MAP CURRENTLY NOT AVAILABLE ON-LINE

2.1.1.2 Hawaii County Zoning

The Zoning Code is the County's legal instrument that regulates land development, and implements the General Plan policies; therefore, zoning must be consistent with the General Plan. County Zoning is the basis for the potential full-build out water demand, to determine if there are adequate water resources to sustain the development of land use already zoned. County Zoning deals with existing conditions and shorter range needs; and the potential full build-out unit count projection based on zoning is less than the ultimate projection based on the General Plan. Full build-out water demand projections for residential and resort uses are based on unit count projections, and commercial and industrial uses are based on land area; both are based on land area and multiplied by the appropriate water use unit rate. Water demand for lands zoned for agriculture considers the specific General Plan agricultural designation. Similar to the projection methodology based on the General Plan, water demand is allocated only to lands zoned for agriculture which are also within the Important Agricultural Land designation.

2.1.1.3 Refine Land Use Based Projection

As required by the Framework, the WUDP considers the most recent *State Water Projects Plan*, and AWUDP forecasts if water requirements are available; and recognizes the current and future development needs of the Department of Hawaiian Home Lands (DHHL).

2.1.1.3.1 State Water Projects Plan

The *State Water Projects Plan* (SWPP), dated February 2003, is a water development plan specific to future State projects through the year 2020. The State projects, with the exception of lands owned by the Department of Hawaiian Home Lands (DHHL), conform to the County zoning (and therefore conform to the General Plan). Therefore, the SWPP was not directly used to refine the land use based projection because the SWPP water projections are accounted for with the WUDP update methodology. The DHHL projects are addressed separately.

The SWPP indicates that, "Hydrological sectors with unmet SWPP water demands of 1.0 mgd or greater will be recommended for State source development. It is anticipated that county water systems will be able to supply the balance of State water demands in all hydrological sectors." Therefore, the WUDP indicates State source development to meet State project water demands of 1.0 mgd or greater. Coordination between appropriate State agencies and the County should be continued to cooperatively and jointly develop future source requirements, and to provide for more expeditious and efficient utilization of government resources whenever possible.

2.1.1.3.2 State Department of Hawaiian Home Lands

The *DHHL Special Report #2 – Water Resources* is a comprehensive report, which evaluates the existing water supply and systems, and projects the future water needs for DHHL development on the island. Currently, DHHL lands are primarily zoned for agriculture. According to the *Memorandum of Agreement between the County of Hawaii and the Department of Hawaiian*

Home Lands, County zoning cannot override the authority of the Hawaiian Homes Commission to control the uses of its property. DHHL will determine the zoning for its lands, and the County Planning Department will modify its zoning map and Land Use Pattern Allocation Guide accordingly. These modifications and coordination are ongoing. Therefore, water needs for DHHL lands are not based on existing zoning maps and were evaluated separately. The water needs were obtained from the *Special Report* and available updated information from DHHL, and allocated to the appropriate aquifer sector areas.

2.1.1.3.3 Agricultural Water Use and Development Plan

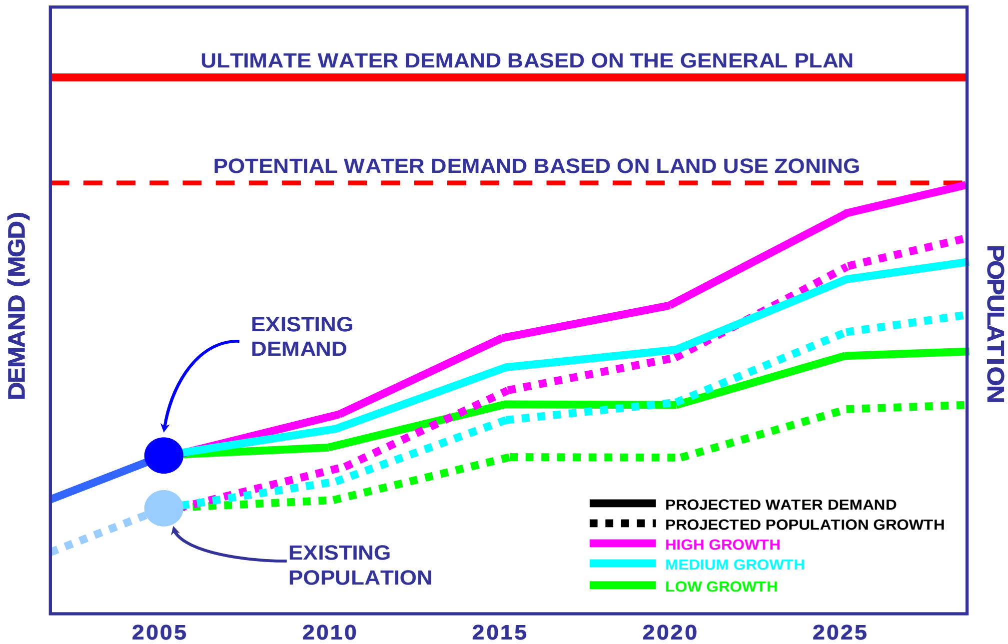
According to the Framework, "the major objective of the AWUDP is to develop a long-range management plan that assesses state and private agricultural water use, supply and irrigation water systems. The plan shall address projected water demands and prioritized rehabilitation of existing agricultural water systems." The AWUDP, dated December 2003 and revised December 2004, is limited in scope due to time and funding constraints; it assesses the needs and proposes improvements only for the Lower Hamakua Ditch and Upper Hamakua Ditch (Waimea) Irrigation Systems. There is no discussion on the Kehena and Kohala Ditches, private irrigation systems, and related factors such as crop types, climatic factors, soil, terrain, etc. The AWUDP predicts water demands for both systems based on a potential range of irrigated area and a unit rate of 3,400 gpd/acre. Due to the uncertainty, these projections were not used to refine projected demands; however, the unit rate of 3,400 gpd/acre was used to calculate agricultural water demands.

2.1.2 5-Year Incremental Water Demand Projections to the Year 2025

Existing population and water use were calculated as the basis of the water demand projections to the year 2025. Population and growth rate projections were applied in 5-year increments for the next 20 years; and have high-growth, medium-growth (base case) and low-growth (the most conservative) scenarios, as shown on **Figure 2-5**. (These were not shown on **Figure 2-3,** for clarity.) The demands are further differentiated into potable and nonpotable demands in Chapter 3 for each sector area.

It was assumed that population growth, and thus water use, from projects described in the State Water Project Plan, the State Department of Hawaiian Home Lands and the Agricultural Water Use and Development Plan are already accounted for by the population projections; therefore, information from these documents was not used to further refine the 5-year incremental water demand projections.

Figure 2-5: Projected Demand H-M-L Growth Scenarios



2.1.2.1 Population and Growth Rate Projections

The population projections to the year 2020 are from the Economic Assessment, PKF Hawaii, January 2000, and were also the basis of the General Plan. The growth rates were derived from this data. The projection from 2020 to 2025 is based on the same growth rate used for 2015 to 2020 in the General Plan.

2.1.3 Water Use Unit Rates

Water use unit rates were based on the *Water System Standards* and actual consumption data. Potable and non-potable water requirements were differentiated where appropriate.

2.1.3.1 Water System Standards

Applicable water use unit rates from the *Water System Standards*, Table 100-18 – Domestic Consumption Guidelines, are listed in **Table 2-2**.

Table 2-2: Water System Standards, Domestic Consumption Guidelines

Zoning Designation	Average Daily Demand
RESIDENTIAL: Single Family or Duplex Multi-Family Low Rise Multi-Family High Rise	 400 gals/unit 400 gals/unit 400 gals/unit
COMMERCIAL: Commercial Only	 3000 gals/acre
RESORT:	400 gals/unit or 17,000 gal/acre*
LIGHT INDUSTRY:	4000 gals/acre
SCHOOLS, PARKS:	4000 gals/acre or 60 gals/student
AGRICULTURE:	3400 gals/acre**

* Resort ADD of 17,000 gal/acre based on ADD for Maui.
** Agriculture ADD based on AWUDP.

2.1.3.2 Water Consumption Data

Water use unit rates based on actual consumption data for specific geographic regions were developed by the Hawaii County Department of Water Supply for single family residential units, as listed below:

- South Kohala and North Kona – 2.5 units/lot
- South Kona – 1.5 units/lot
- Elsewhere – 400 gals/unit

These unit rates result in higher water demand projections as compared to the *Water System Standard* unit rates, but are viewed as more realistic based on historic consumption data.

2.1.4 DWS Historical Water Consumption Data Projection

Historical water consumption data for each DWS water system from 1970 to 2003 were used to project water consumption to the year 2025 for comparison.

2.2 RESOURCE AND FACILITY RECOMMENDATIONS

2.2.1 Water Source Adequacy

2.2.1.1 Full Build-Out

Water demand based on full development of the County General Plan and County Zoning land use classifications are compared to the sustainable yield of each aquifer sector to determine if the land use policies can be sustained.

2.2.1.2 Twenty-Year Projection

The 5-year incremental water demand projections to the year 2025 are assessed to estimate the percentage of the sustainable yield that could be utilized by present and 20-year water requirements, and are compared to the County General Plan and County Zoning water demand requirements to assess relative timing of the full build-out scenarios.

2.2.2 Source Development Requirements

2.2.2.1 Supply-Side Management

Supply-side management, including conventional water resource measures and alternative water resource enhancement measures, is evaluated to meet projected water demands. Reserving the highest quality of water for the highest valued need, i.e. human consumption, is prudent. However, economics often govern supply-side management, such that nonpotable water uses are often served by potable water systems. In most cases, it is not economical to develop a separate nonpotable water system parallel to an existing potable water system to serve the "lower value" needs such as irrigation, industrial and agricultural use. However, when conventional potable water resources become limited and more costly alternative water resource enhancement measures are necessary, reserving the highest quality of water for the highest value need will become a more favorable option, and possibly may eventually become a requirement. Consequently, nonpotable water uses should depend upon available nonpotable water sources whenever available.

2.2.2.1.1 Conventional Water Resource Measures

Ground water and surface water are typically the most cost-effective means for meeting projected water demands. Ground water is usually the least costly potable resource because minimal treatment is required, and monitoring requirements are significantly less in comparison to surface water resources. Surface water is usually the least costly non-potable resource because pumping costs are less than for ground water sources; minimal treatment, if any, is required; and monitoring is not required.

2.2.2.1.2 Alternative Water Resource Enhancement Measures

Alternative water resource enhancement measures are necessary when the conventional water resources, ground water and surface water, are not available. These alternative measures include rainwater catchment systems, wastewater reclamation and desalination; and are considered enhancement measures due to limitations and restrictions on use. Rainwater catchment is not as reliable as conventional water resources because it is extremely sensitive to the climate. The use of reclaimed wastewater is limited, and uses must be approved and in close proximity to the wastewater reclamation facility. Desalination is more costly than conventional water resources, due to treatment and monitoring requirements. Brackish ground water would often be the preferred resource for desalination to meet potable water quality because monitoring requirements are not as stringent and demanding as they are for a surface water source.

However, according to the WRPP, brackish groundwater contributes toward the sustainable yield of the aquifer; therefore, desalinization of seawater is advantageous because it is not a limited resource.

2.2.2.2 Demand-Side Management

Demand-side management, including development density control and water conservation, is a means to meet source development requirements by reducing demand.

2.2.2.2.1 Development Density Control

In area where the potential land use based water demand is projected to exceed the aquifer sector sustainable yield, land use policies should be reevaluated to ensure that the planned development density can be sustained. In particular, County zoning should be reassessed because development in accordance with the Zoning Code already is legally accepted. If the development density is not reduced, alternative resource enhancement measures would be required as the aquifer sustainable yield becomes stressed.

2.2.2.2.2 Water Conservation

Reduction in water demand through water conservation cannot solely ensure sufficient source water to meet demand; however, it is universally recommended that water conservation programs be implemented to ensure protection of valuable water resources.

Water consumption within the aquifer sector area is presented and compared to established standards. Average water consumption per connection on the DWS system compares the usage to the County standard 400 gpd per connection described in Section 2.1.3.1. Average potable water use per capita considers potable water usage from all sources, including the DWS system, private water systems and rainwater catchment, divided by the total population within the aquifer sector area. Comparisons are drawn to the standard range of usage between 100 and 150 gpd per capita. In sector areas where consumption significantly exceeds the standards, water conservation is emphasized to reduce consumption into a more reasonable range; thereby reserving the highest quality of water for the highest valued need.

Water conservation measures are described in the DWS 20-Year Water Master Plan as follows:

Supply side measures include:

- Meter Replacement and Repair – Regular maintenance of existing meters and replacement of failing meters
- Non-Revenue Water Analysis – Accounted-for non-revenue water includes line flushing, reservoir cleaning, fire fighting, sewer flushing and street cleaning. Unaccounted-for non-revenue water includes leaks, unauthorized use, inaccurate metering and inaccurate billing.
- Leak Detection Program – Installation of permaloggers, monitoring and repair of identified leaks.

- Storage Tank Automatic Level Controls – Use of automatic level-control valves at storage facilities to prevent losses and overflows.

Demand side measures include:

- Meter Replacement and Repair – Regular maintenance of existing meters and replacement of failing meters
- Plumbing Code Regulation – New developments required to use low-flow and energy efficient plumbing fixtures.
- Voluntary Water Reduction – Issue conservation notices in local newspapers during times of drought or low water conditions.
- Public Outreach/Education Program – Inform, educate and gain support from the public through informational brochures.
- Xeriscape and Efficient Landscaping – Utilize native, low-water-use plants and vegetation for landscaping and promote efficient use of water for landscaping.

Strict demand side measures such as water restrictions and a stepped rate structure that would charge higher usage unit rates for larger users may be prudent in critical areas.

Other demand side conservation measures could consider requirement of neighborhood development and new construction to be LEED (Leadership in Energy and Environmental Design) certified. LEED is a nationally accepted rating system developed by the U.S. Green Building Council that recognizes performance in five key areas of human and environmental health, one of which is water savings.

2.3 LIMITATIONS

Fulfillment of the Framework requirements for the WUDP update requires significant information, much of which is not available at this time. Therefore, the WUDP should be viewed as a dynamic document and tool which needs to be updated regularly, and becomes a more detailed working document as more information and data become available.

2.3.1 Hawaii Water Plan Update

Phase 3 of the *Agricultural WUDP* is in progress and ultimately will provide agricultural water demand projections, information on irrigation water systems, and consideration of related factors such as crop types, climatic factors, soil, terrain, etc. The *Water Resource Protection Plan* update also is in progress and will have modified sustainable yield information to better assess water use within the aquifer sectors.

2.3.2 Water Use Data

Water use data based on the CWRM categories is needed to fulfill the Framework objective. DWS water meter data is the most detailed consumption data available; however, all of the consumption data cannot be clearly defined by the CWRM categories. Consumption data for private public water systems and for individual household catchment systems are needed.

Finally, water use data will be as accurate as the accuracy of meters used, and system losses are typically not quantified.

2.3.3 CWRM Well and Pumpage Database

Update of the well database would help to better assess which wells are no longer in use, change of ownership, change of use, etc. Pumpage data for all wells would provide more precise information on actual impact on the aquifer sustainable yields.

2.3.4 CWRM Stream Diversion Database

There is minimal information available on stream diversions; therefore, the impact of surface water use is difficult to assess.

3 SECTOR REPORTS

The following Chapters focus on each individual aquifer sector area, presenting background information categorized as shown in Chapter 1, and following the technical approach to water resources planning as described in Chapter 2.

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

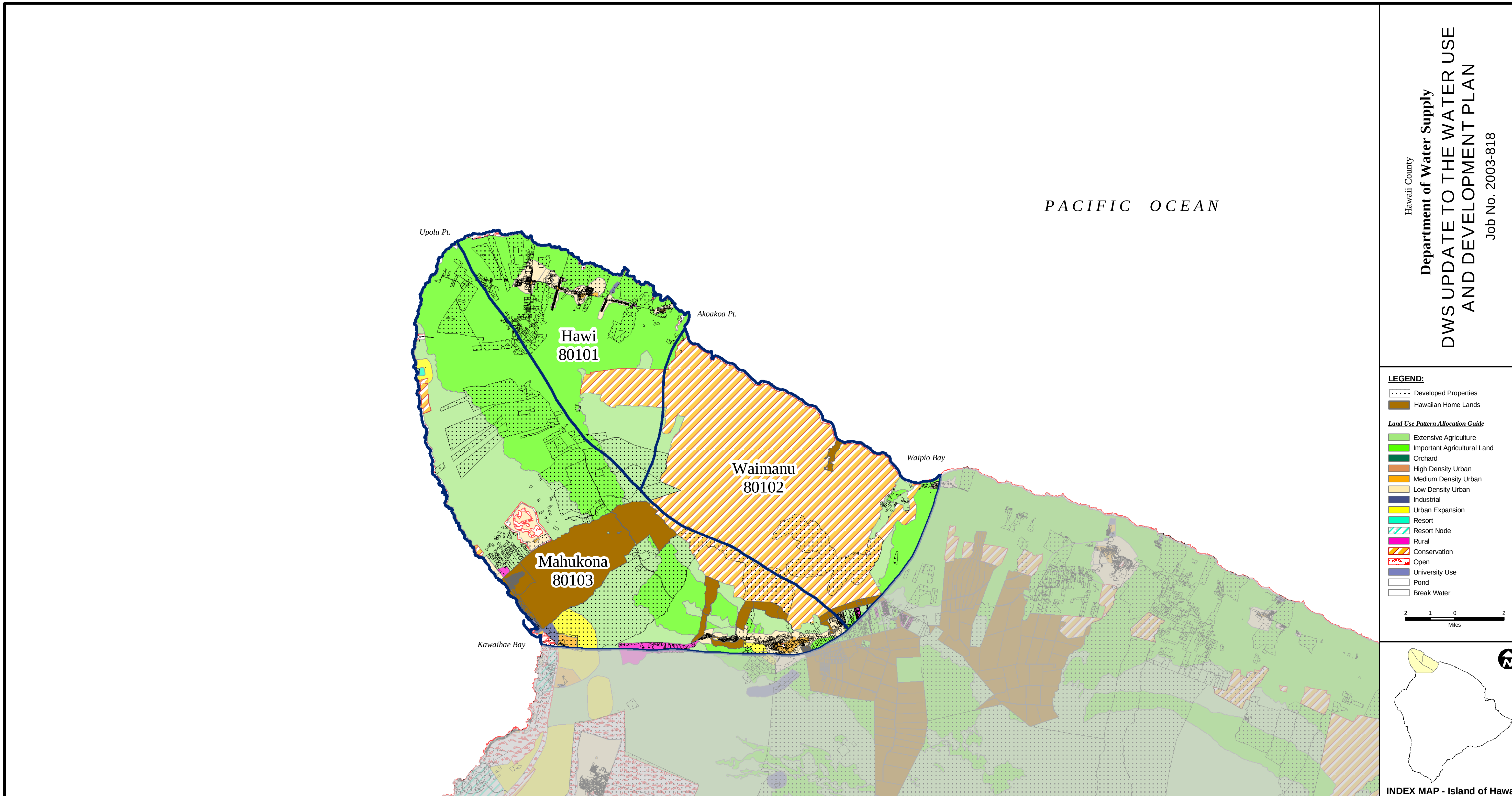
Growth Rate	2000	2005	2010	2015	2020	2000-10 % Change	2010-20 % Change
A – Low	11,000	12,447	14,569	17,021	19,913	32.4	36.7
B – Medium	11,000	12,487	14,697	17,271	20,309	33.6	38.2
C – High	11,000	13,008	15,618	18,628	22,140	42.0	41.8

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**.



Hawaii County
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DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN
Job No. 2003-818

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

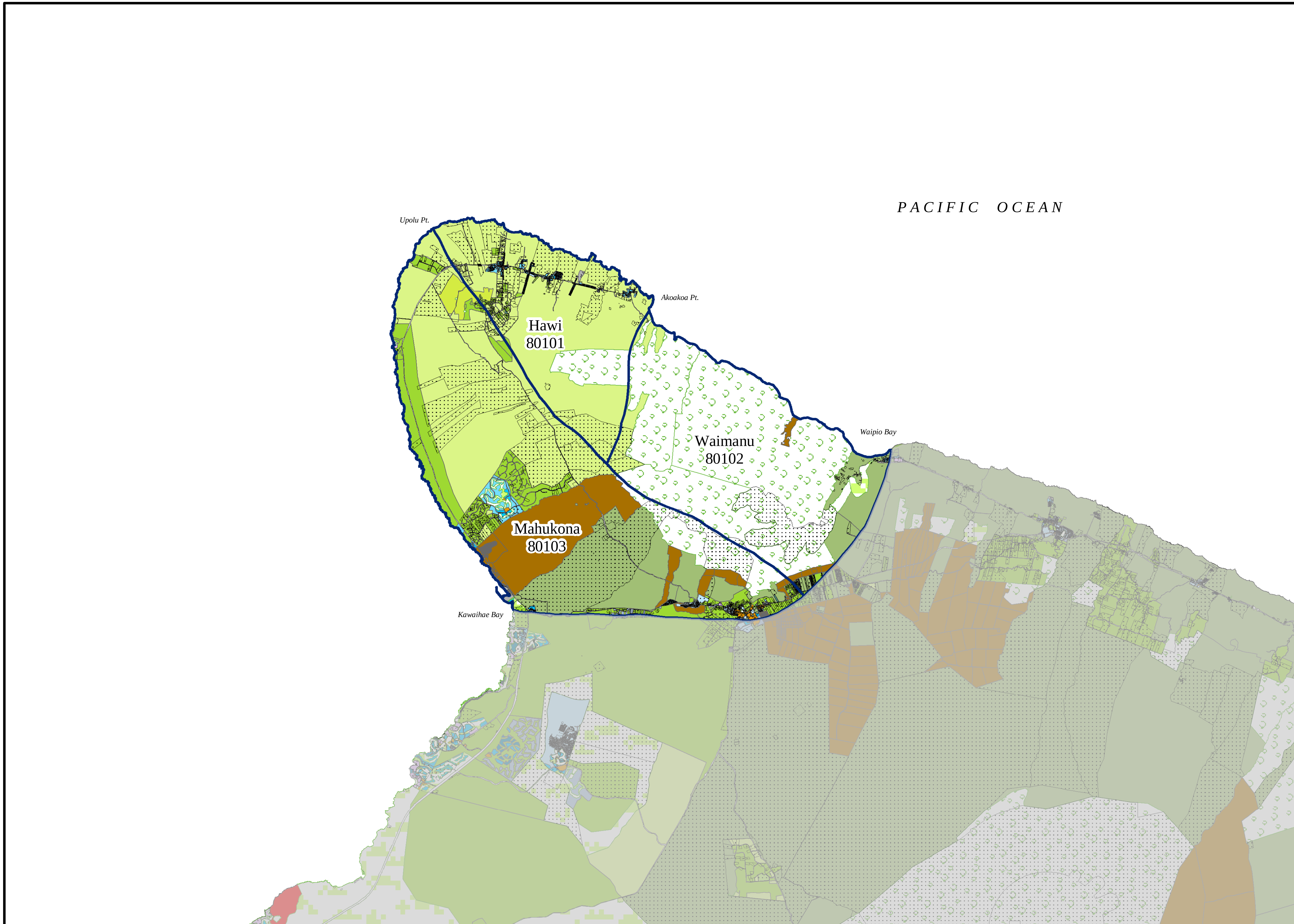
801.2.1 Ground Water

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**.



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DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN
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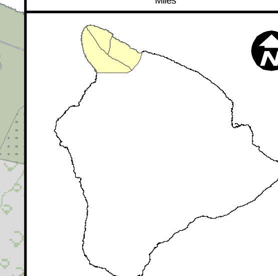
LEGEND:

- 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

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

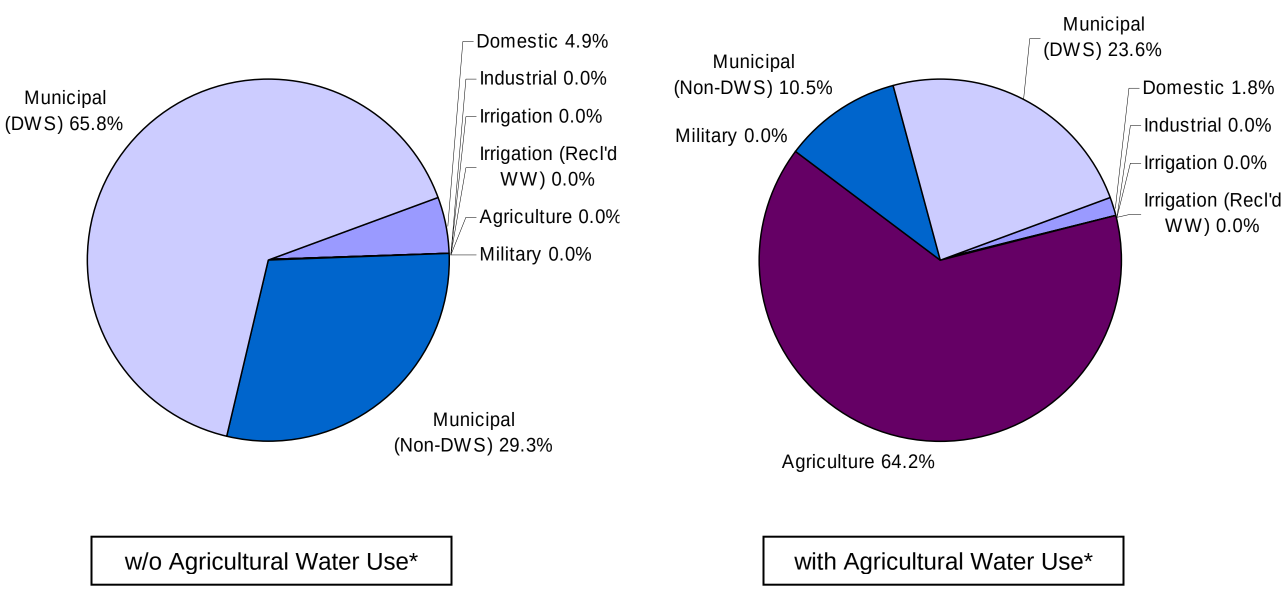
The following section presents the total estimated average water use within the Kohala ASEA, and the Hawi, Waimanu, and Mahukona ASYAs separately. Estimated water use from 2004 to 2005 was estimated using (DWS meter data and CWRM pumpage data from November 2004 through October 2005, and available GIS 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



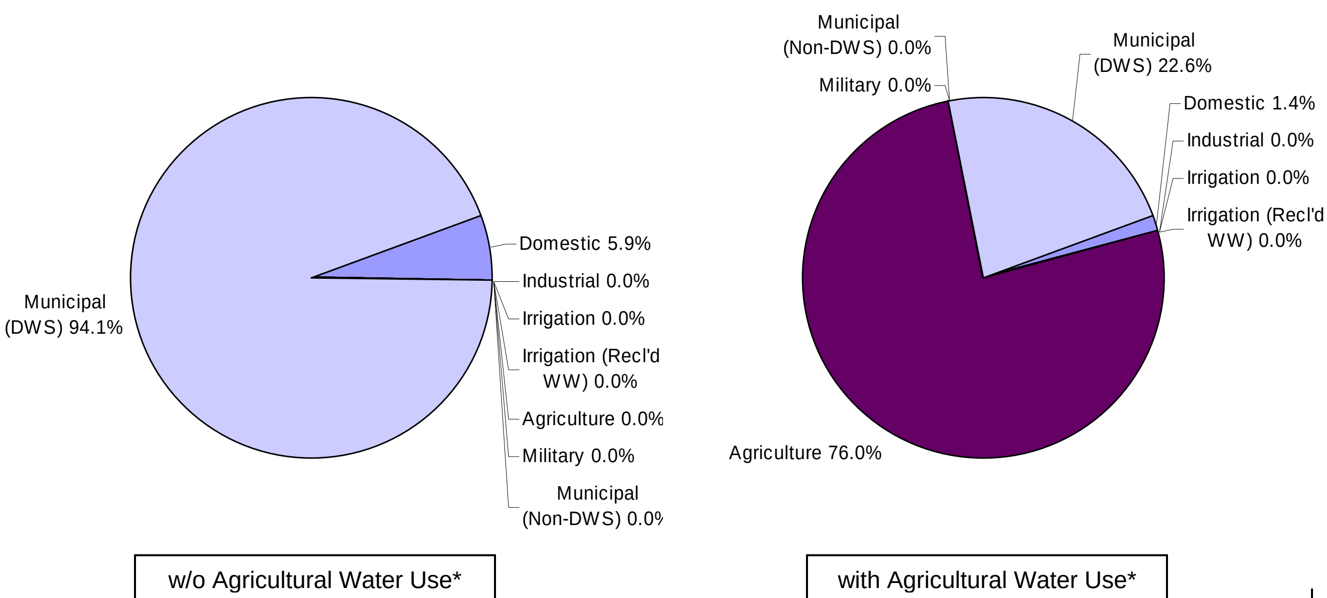
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

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]



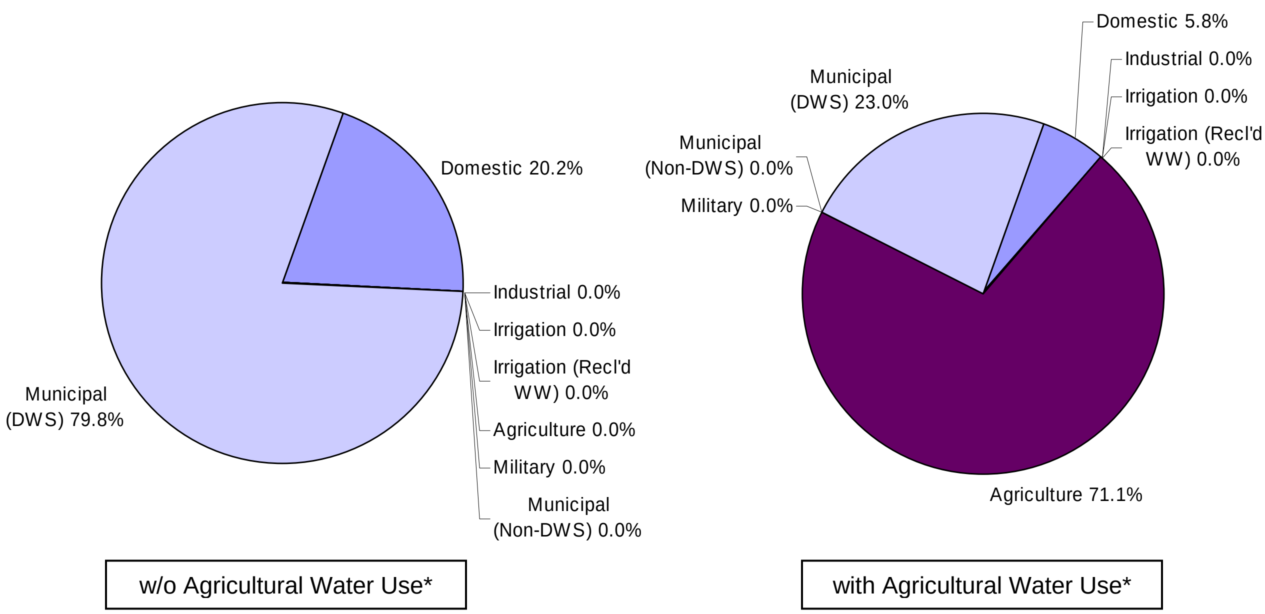
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

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]



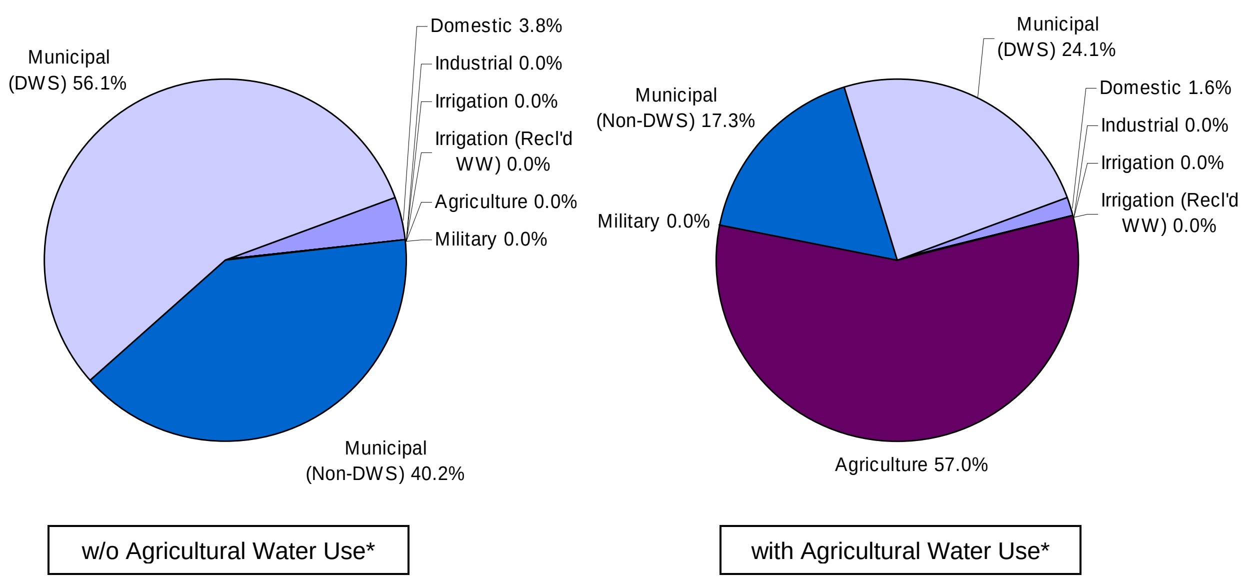
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

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.

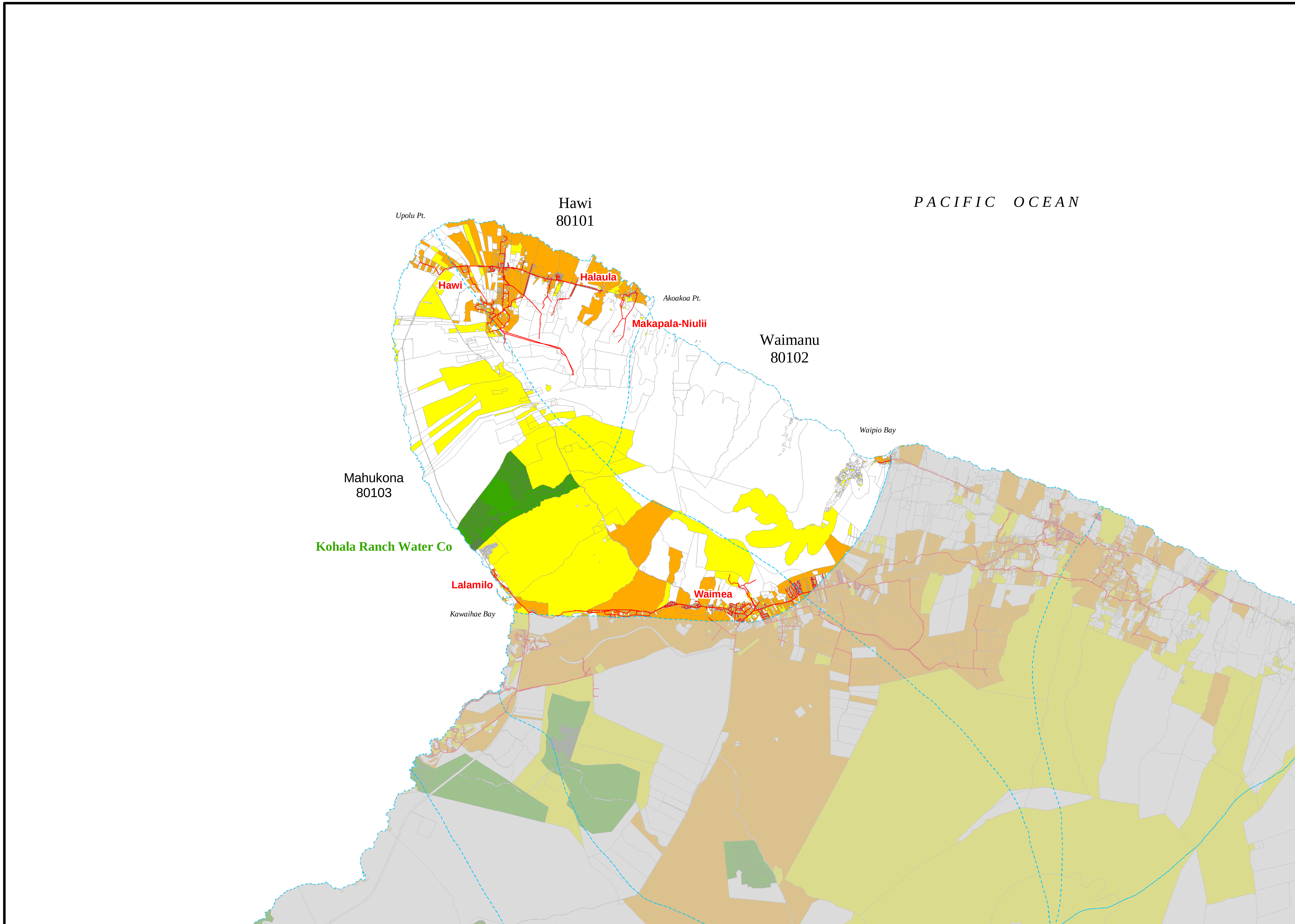
801.3.7 Municipal Use

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.

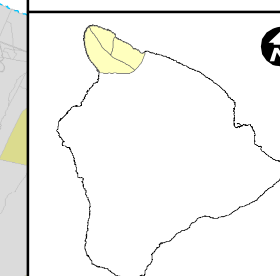
The Hawi Water System (WS) serves the bulk of the Hawi area in North Kohala along Akoni Pule Highway and surrounding area from Puakea Bay Drive in the west to Kapaau Road in the



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

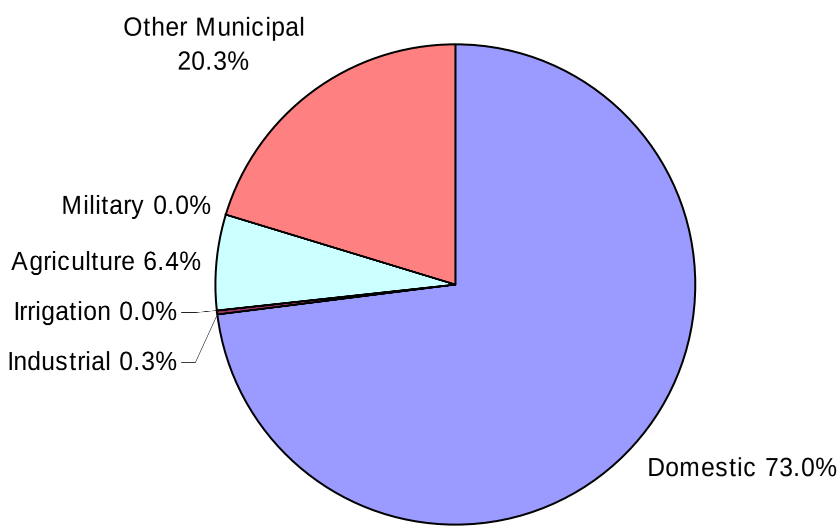


Table 801-7a: DWS Existing Water Use by Categories – Hawi Aquifer System Area [80101]

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]

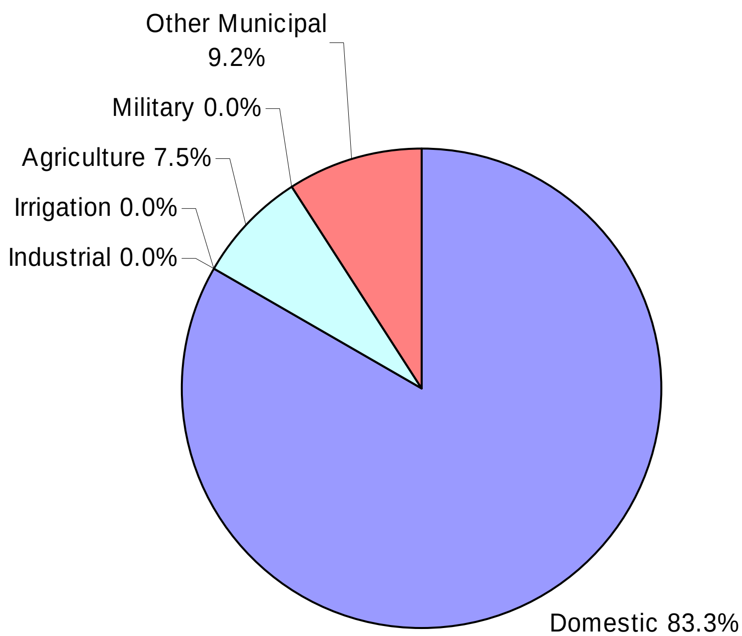


Table 801-7b: DWS Existing Water Use by Categories – Waimanu Aquifer System Area [80102]

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]

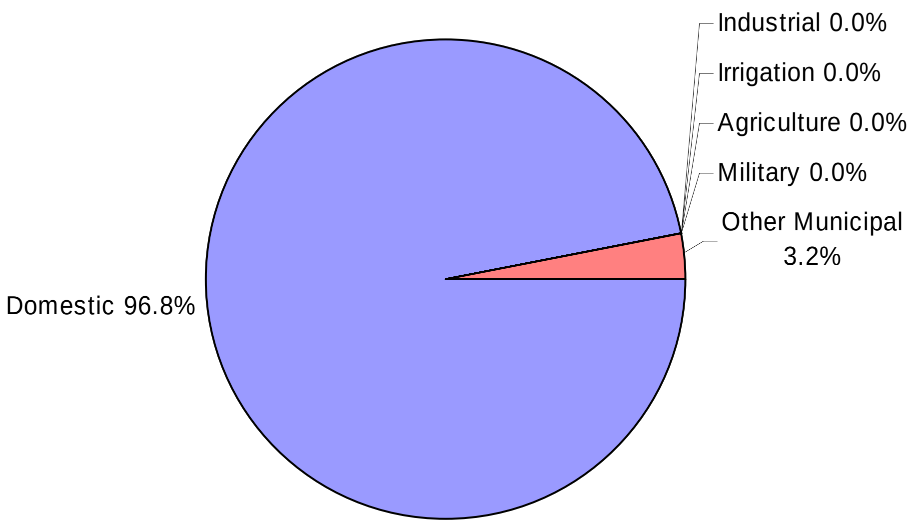
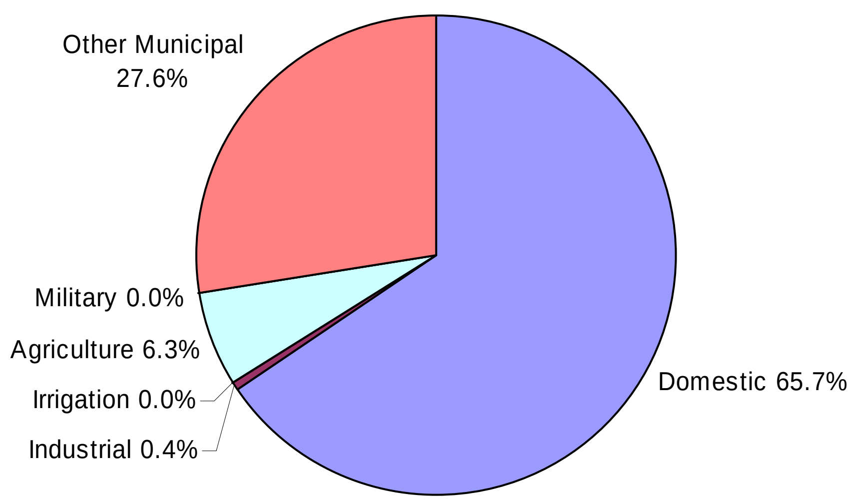


Table 801-7c: DWS Existing Water Use by Categories – Mahukona Aquifer System Area [80103]

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.

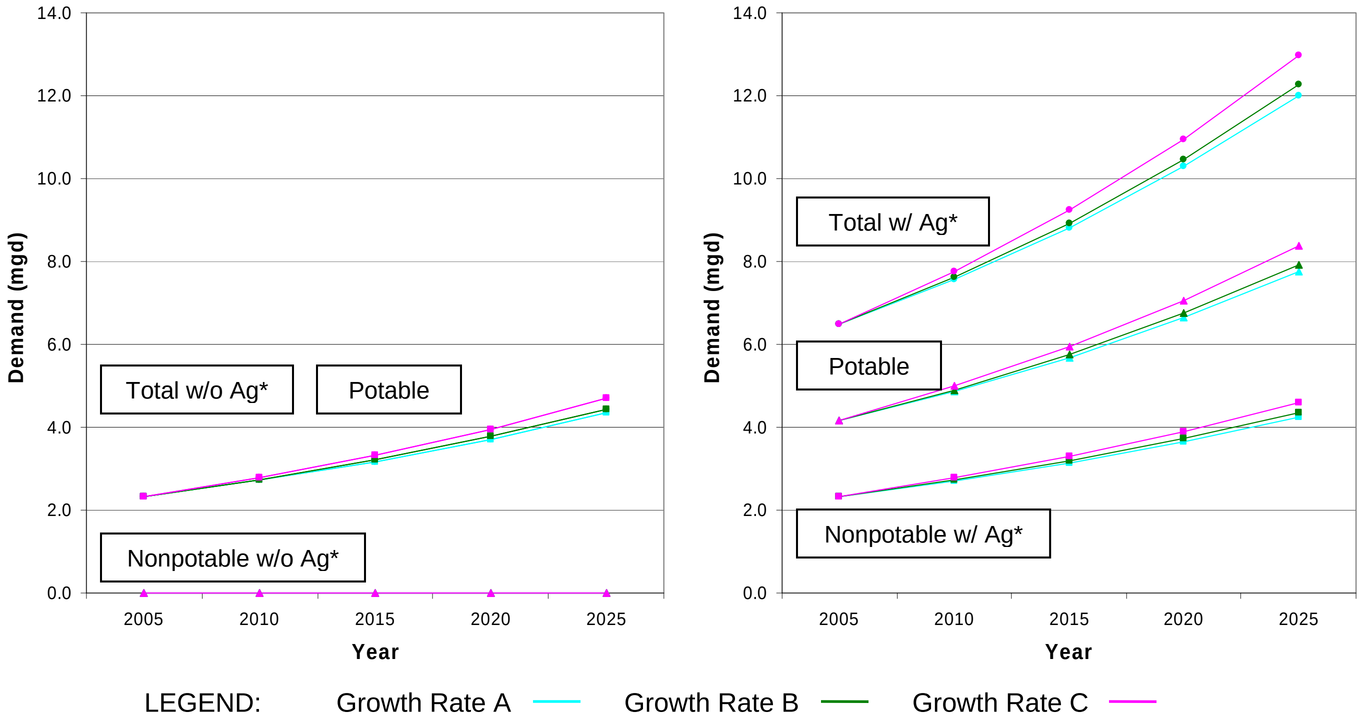
801.4.4.1 Kohala Aquifer Sector Area

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



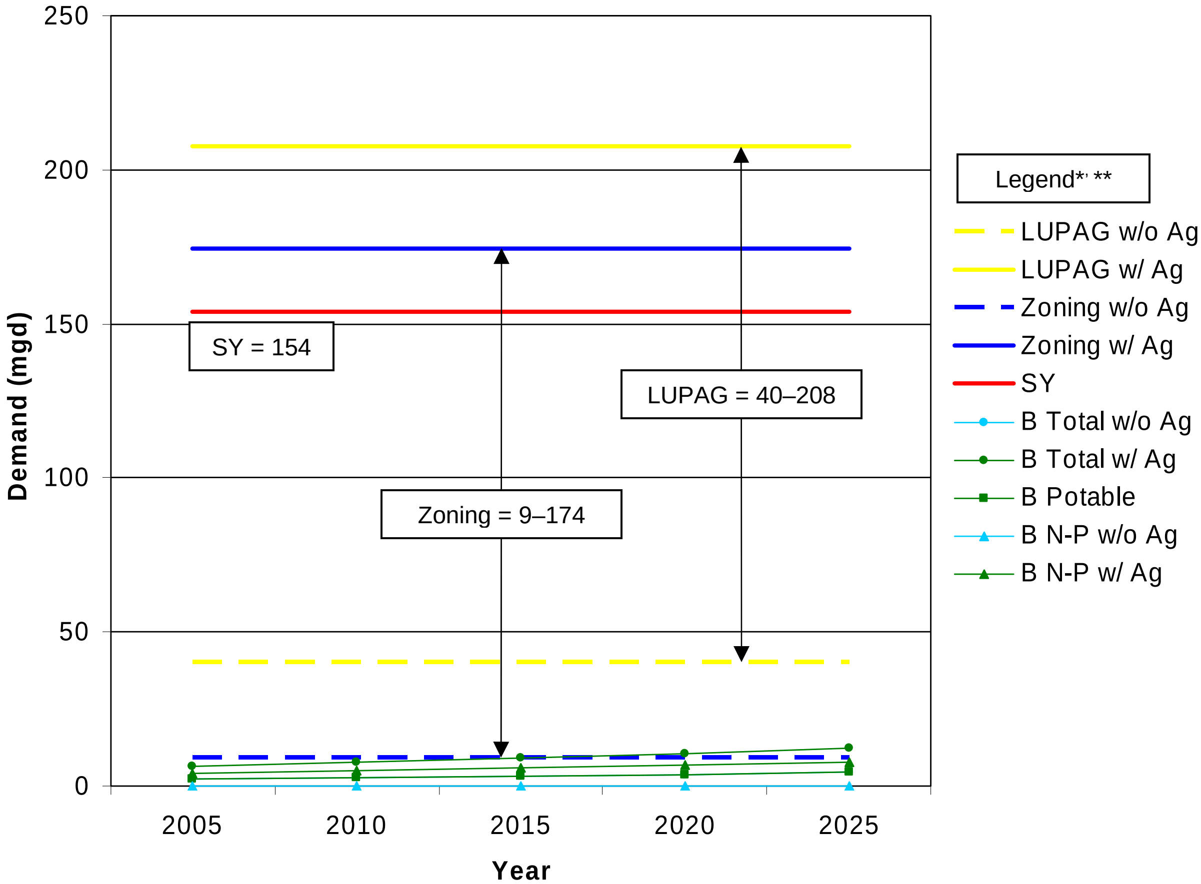
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

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

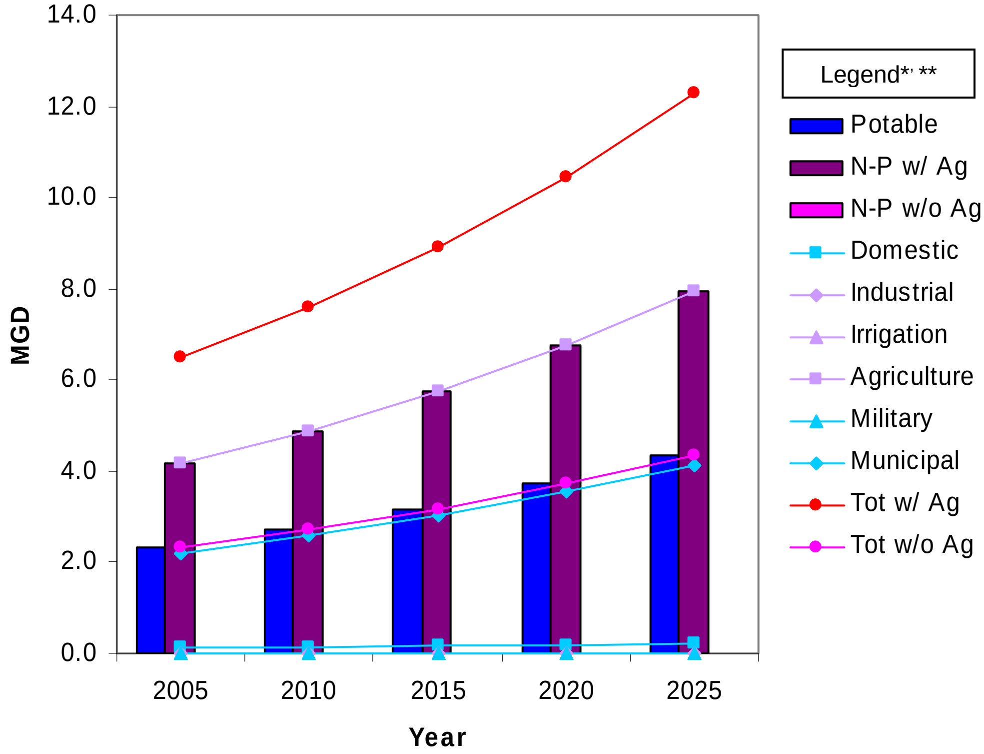
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

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.

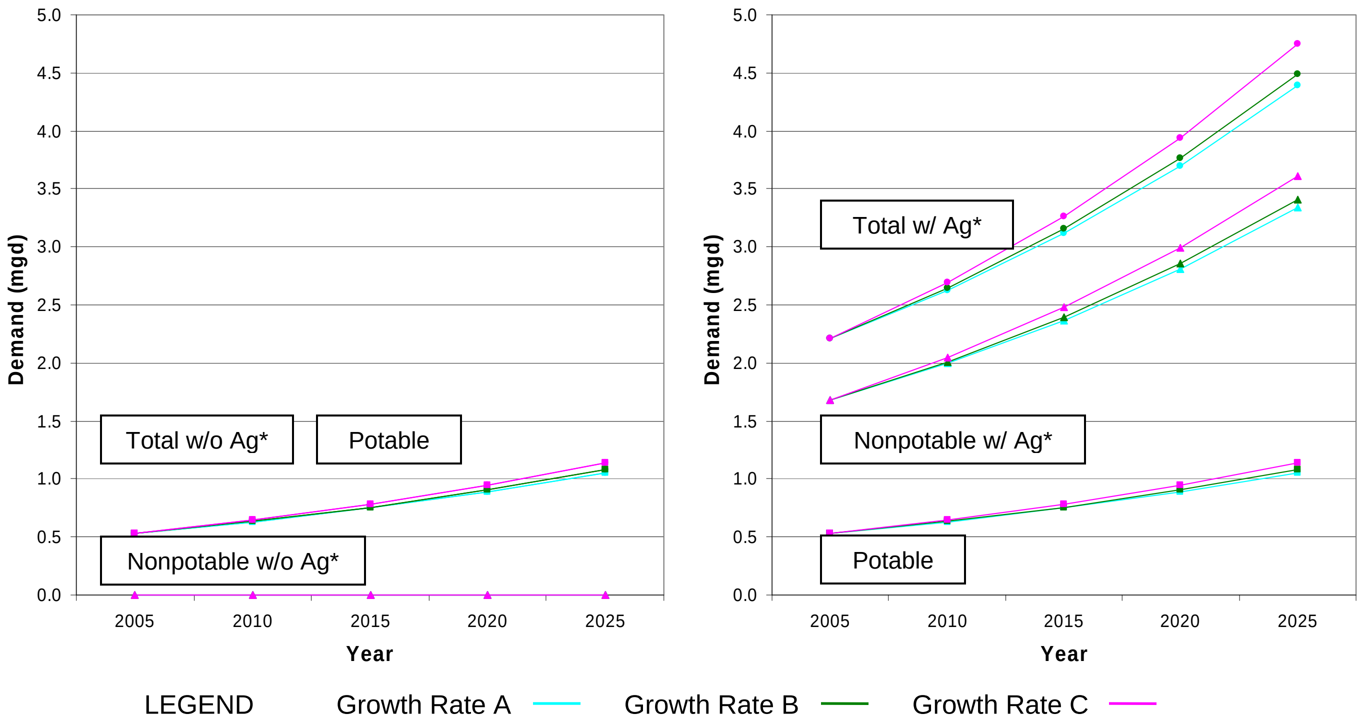
801.4.4.2 Hawi Aquifer System Area [80101]

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]



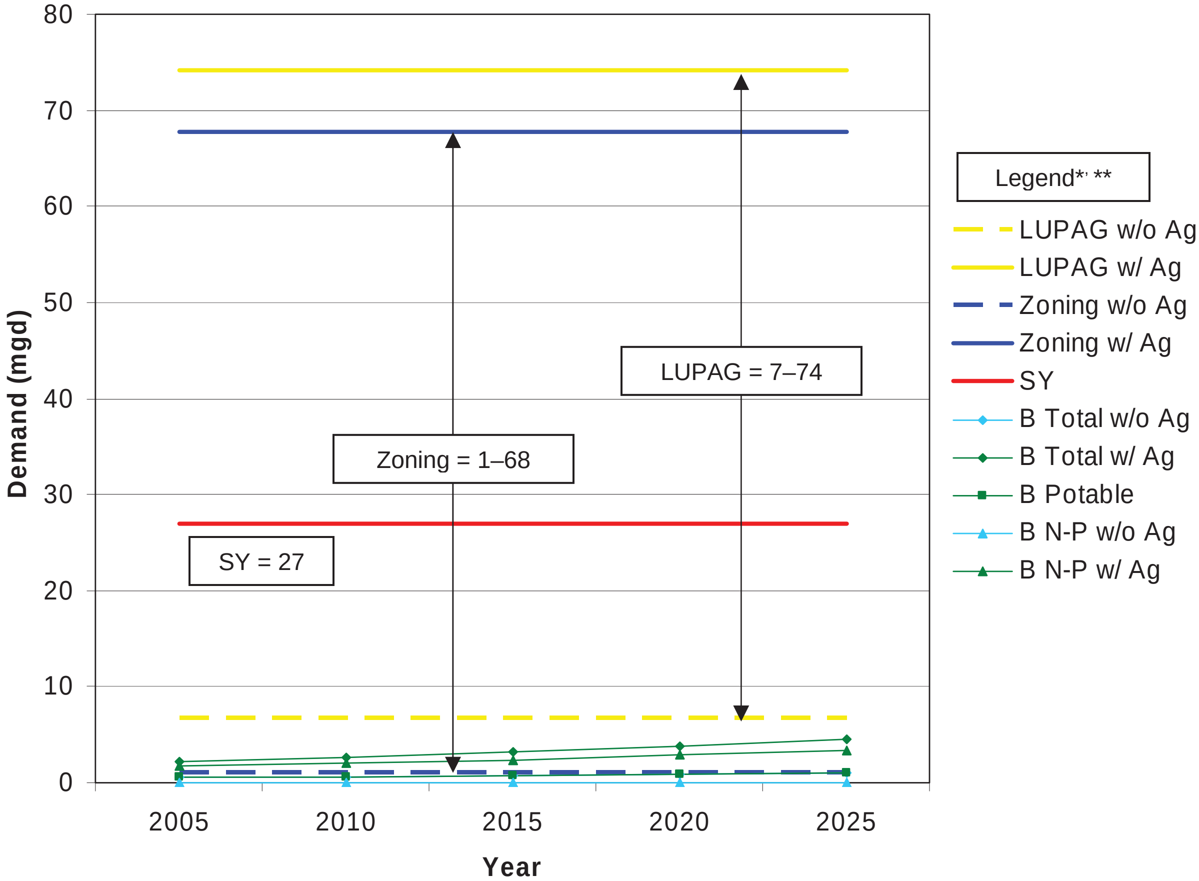
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

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

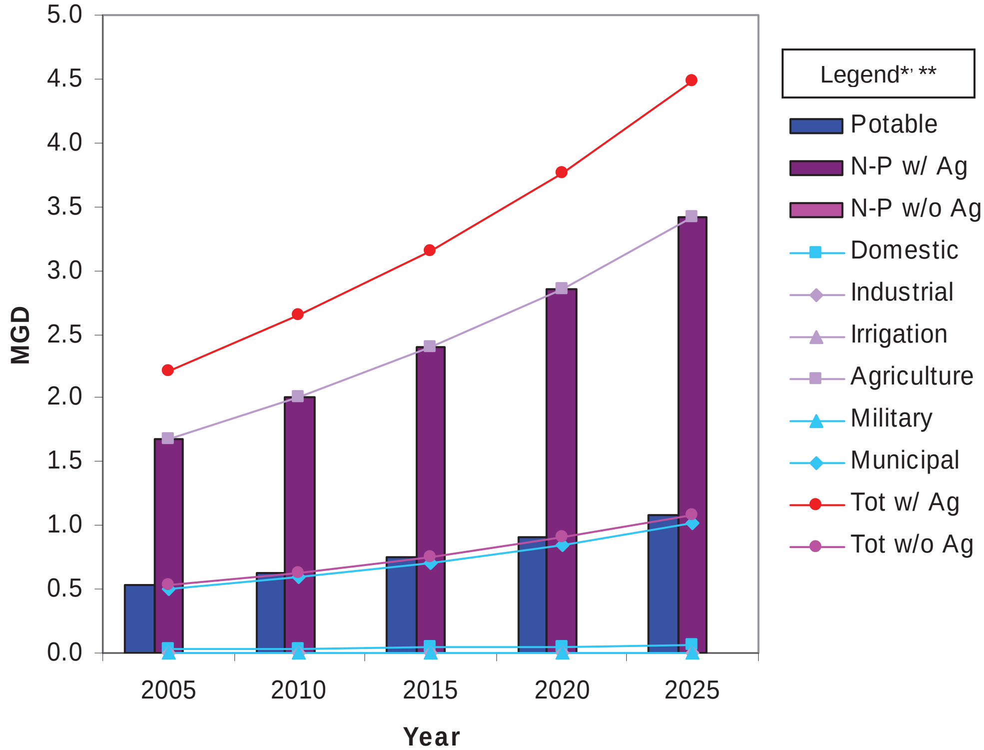
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

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.

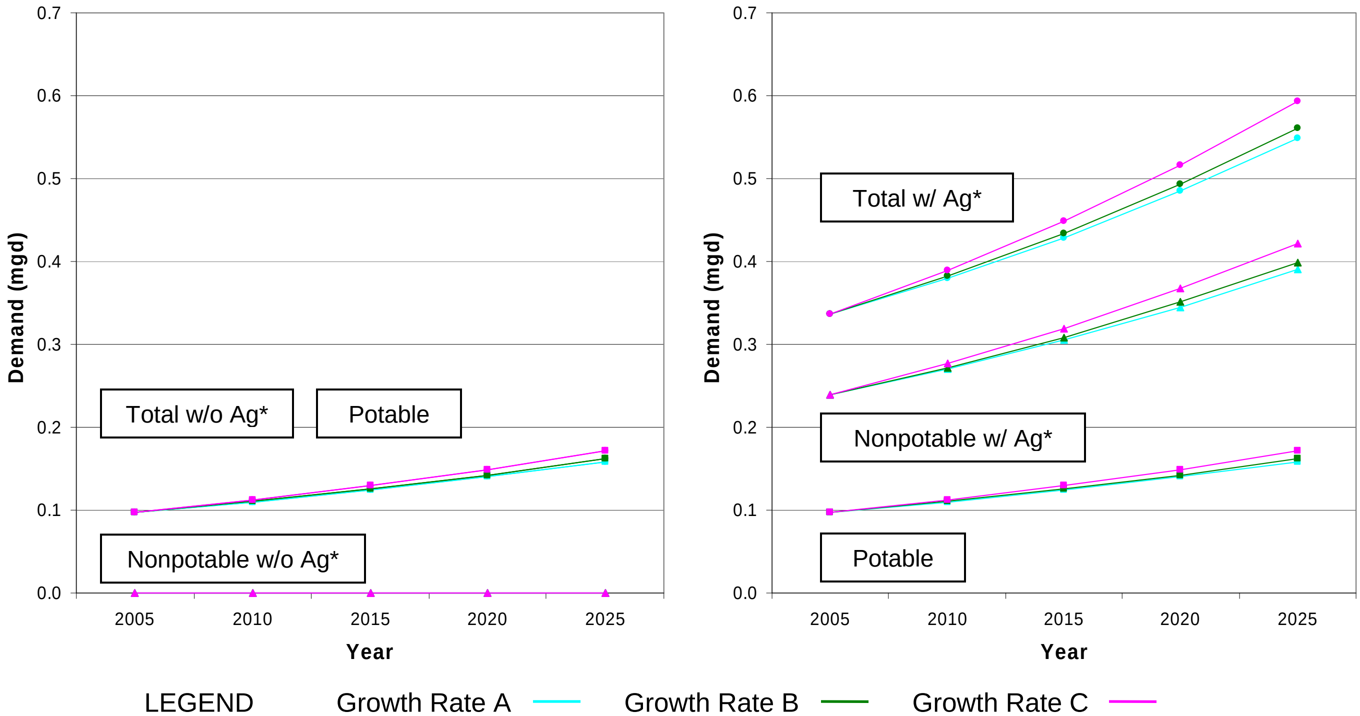
801.4.4.3 Waimanu Aquifer System Area [80102]

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]



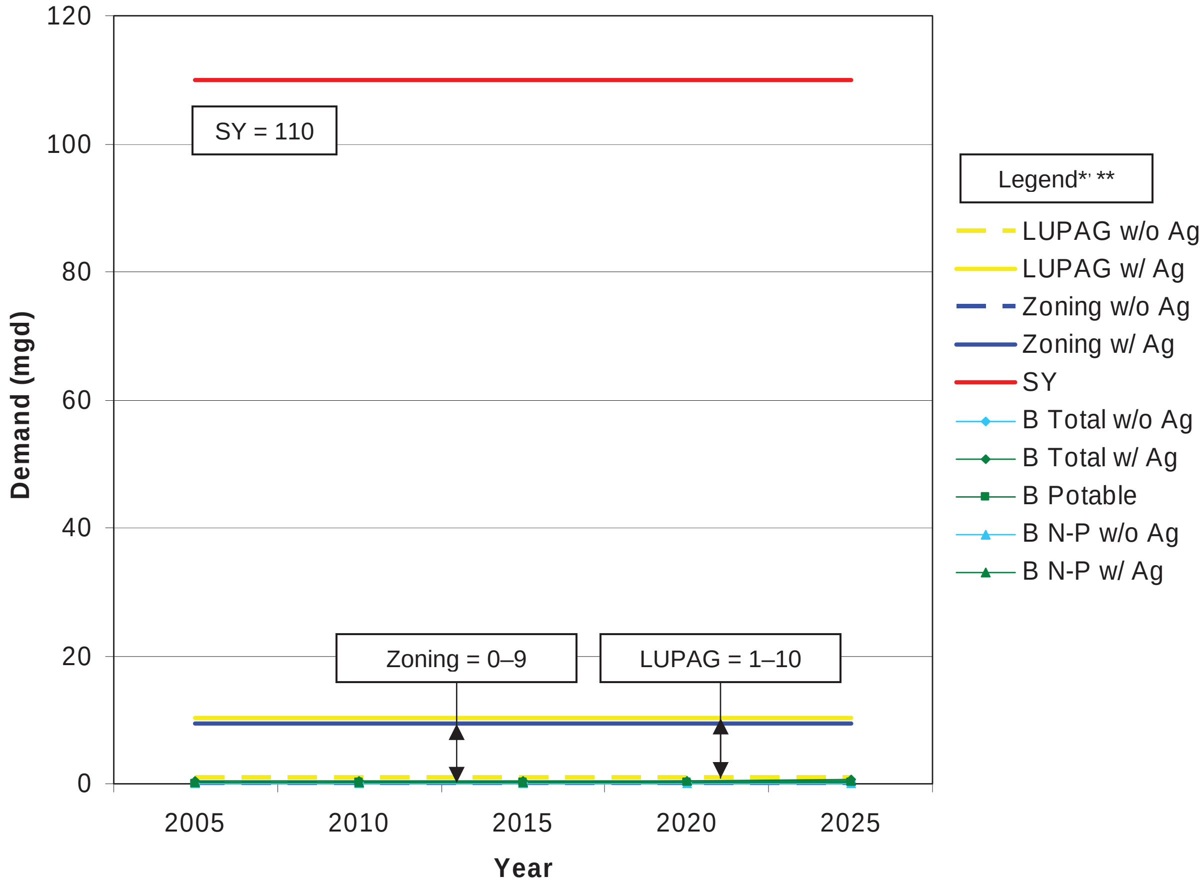
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

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

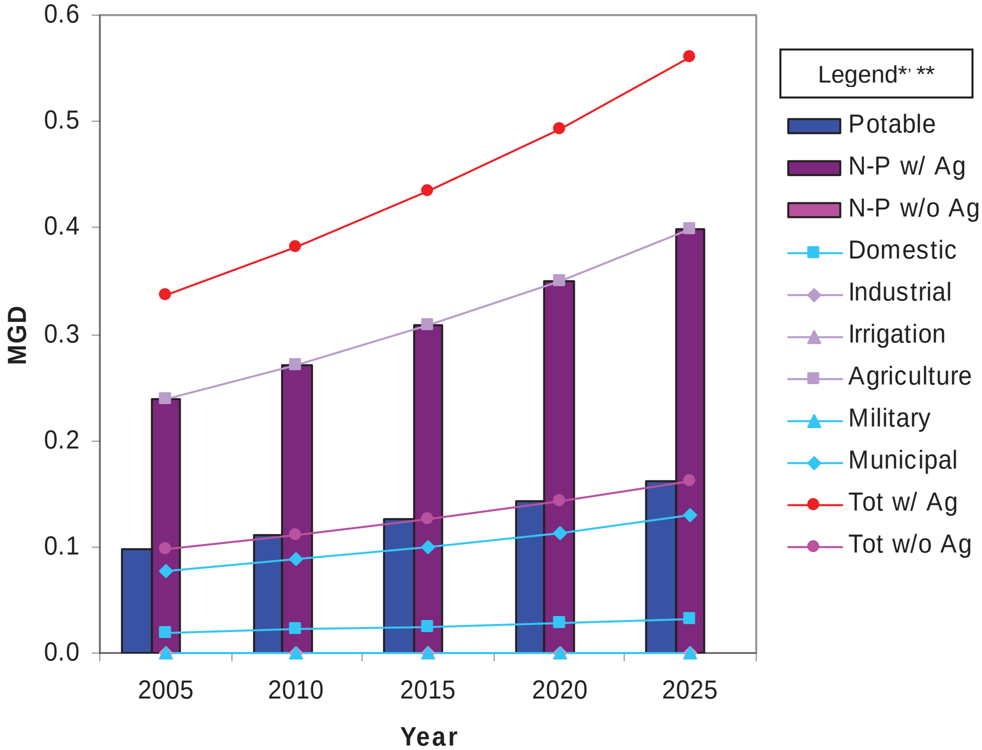
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

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.

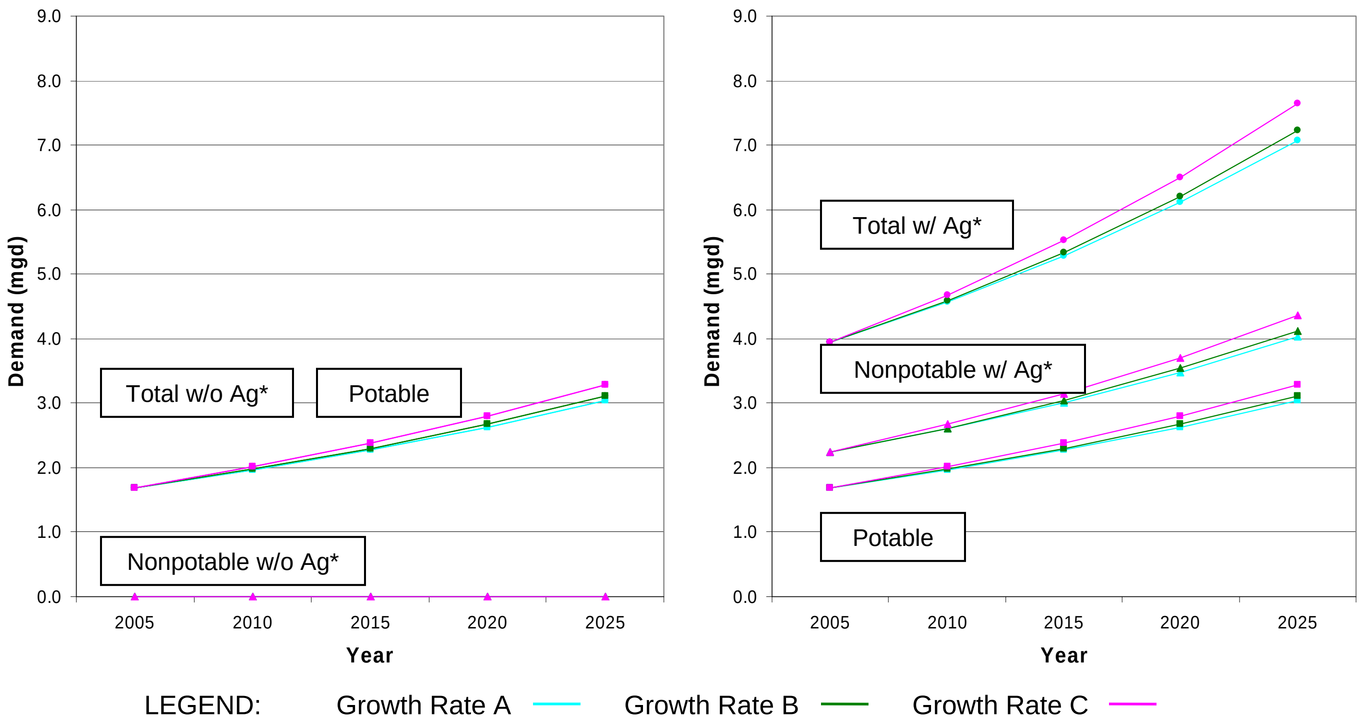
801.4.4.4 Mahukona Aquifer System Area [80103]

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]



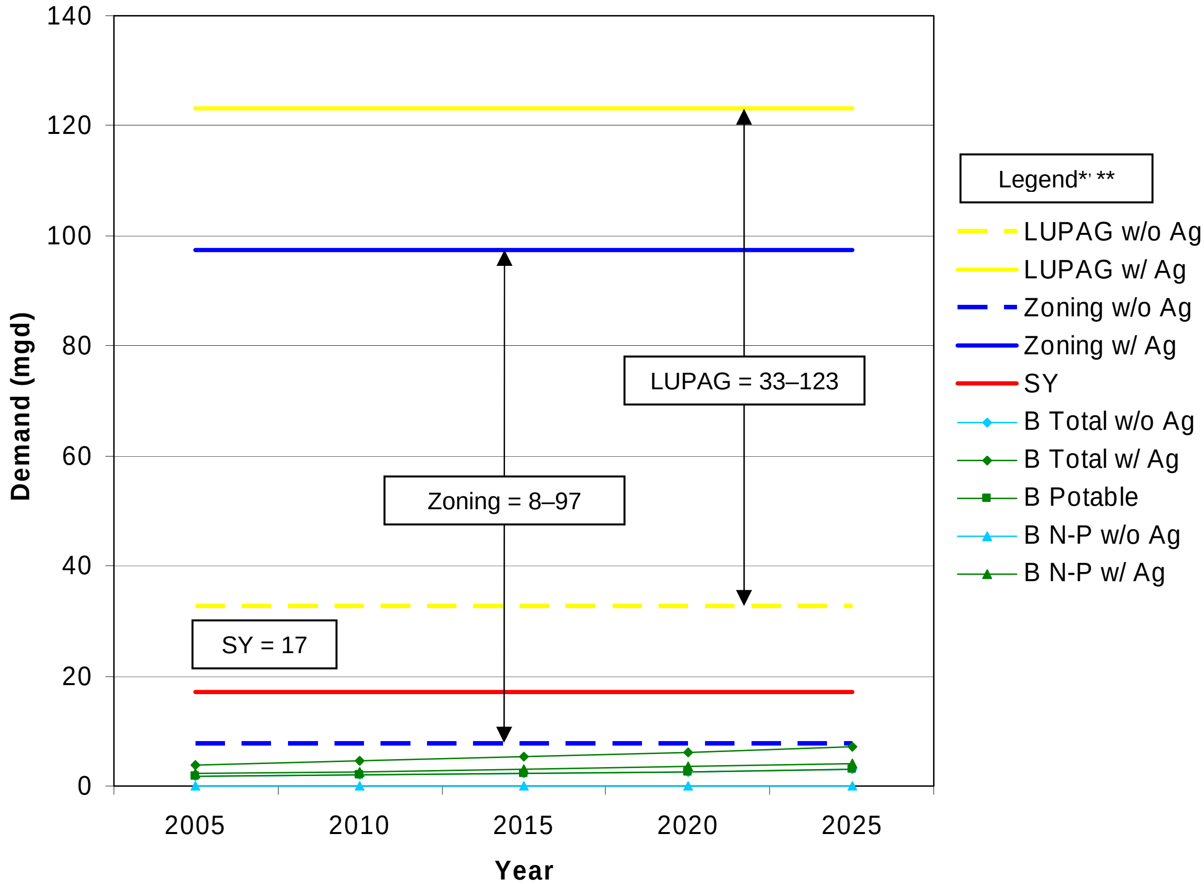
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

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

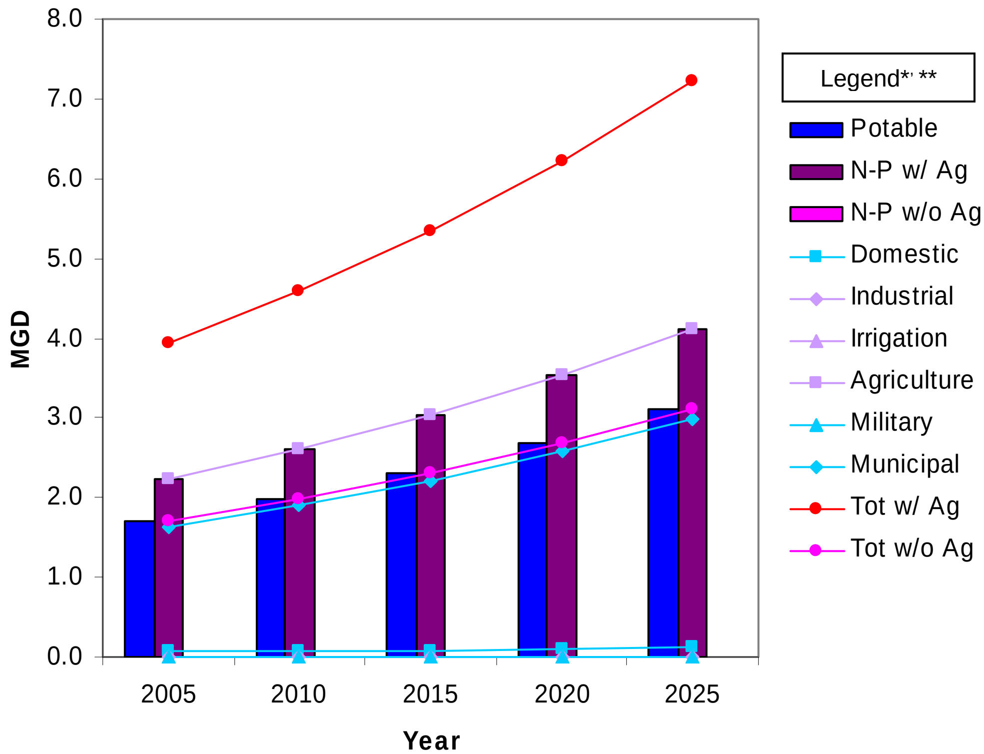
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

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]

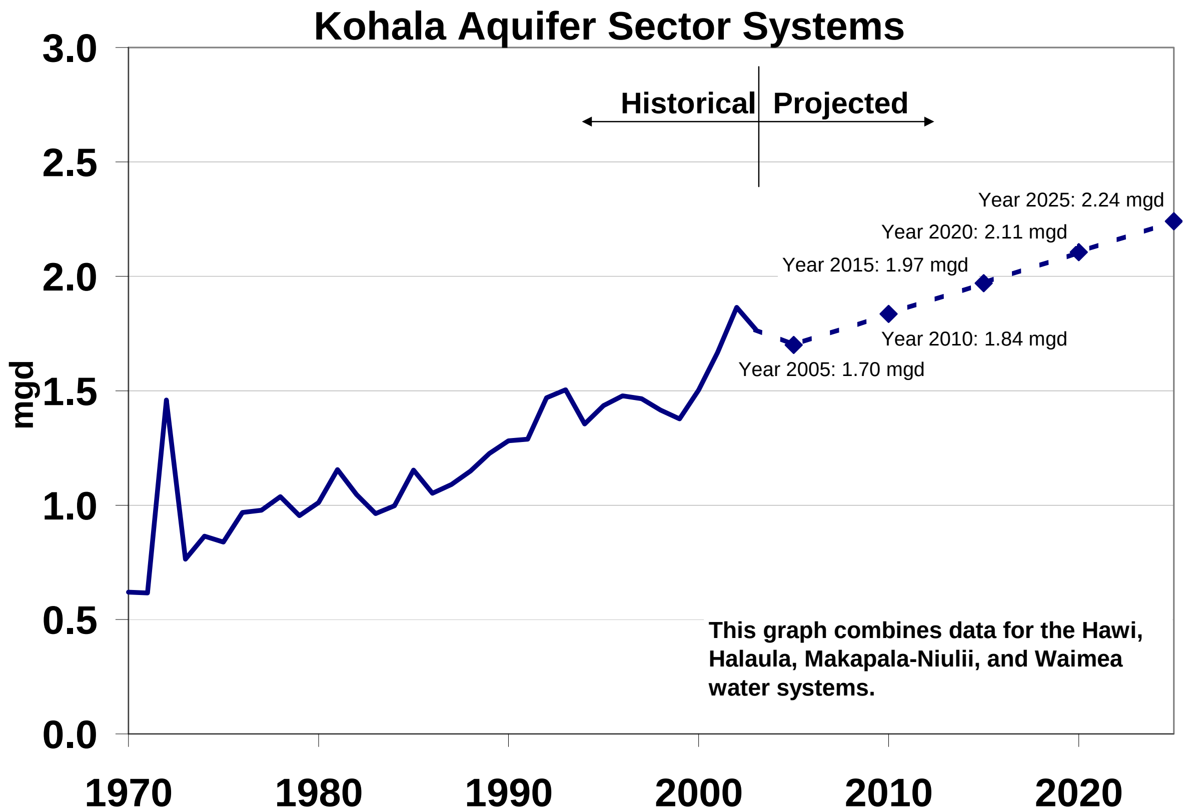


* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.
** "N-P" represents the nonpotable component of the demand.

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.

802 EAST MAUNA KEA AQUIFER SECTOR AREA

802.1 SECTOR AREA PROFILE

802.1.1 General

The East Mauna Kea Aquifer Sector Area (ASEA) includes the Honokaa, [80201] Paauilo [80202], Hakalau [80203], and the Onomea [80204] Aquifer System Areas (ASYA), and spans three districts, capturing most of the northern section of the Hamakua district, and the northern sections of the North Hilo and South Hilo districts. The sector includes the northern and eastern slopes of Mauna Kea and most of the northeastern coast of the island from Waipio Bay to Hilo Bay.

Rainfall is extremely variable throughout the sector area. Rainfall in the coastal areas average less than 100 inches and up to 150 inches per year, which increases to 300 inches per year in a lateral band in the 2,000 to 4,000 foot elevation range 5 miles inland of Hilo. The summits of Mauna Kea experience less than 20 inches per year. The Hakalau ASYA has the highest sustainable yield of the four system areas at 150 mgd, followed by the Onomea ASYA at 147 mgd, the Paauilo ASYA at 60 mgd, and the Honokaa ASYA at 31 mgd. The total sustainable yield of the East Mauna Kea ASYA is 388 mgd.

802.1.2 Economy and Population

802.1.2.1 Economy

Agriculture continues to be the primary source of income and employment within the sector area. The demise of the sugar industry has made lands available for various other crops, including macadamia nuts, eucalyptus trees, flowers, fruits and vegetables. Large tracts of land are also used for cattle grazing and logging of native and planted forests. A new 15,000-acre eucalyptus plantation has created 100 full-time jobs in the sector. State DLNR has partnered with Hawaii Forestry and Communities Initiative to cultivate 40 acres of State land in Ookala with high value hardwoods. The project will be managed by several local groups with assistance from State and Federal agencies.

Visitor accommodations are limited to scattered private bed-and-breakfast operations, with the exception of a 19-unit hotel in Honokaa.

The Hamakua Energy Partners' new 60-MW co-generation power plant in Haina is the largest generating facility on the island, and is anticipated to attract other manufacturing operations that use thermal energy.

802.1.2.2 Population

Over half of the population contributing to the demands from the East Mauna Kea ASEA is within the South Hilo District, and over one third is within the Hamakua District. Population centers are scattered and are generally tied to former plantation areas, and the marginal growth over the past 20 years can be attributed to the activities in other sector areas. Scattered homesteads and ranches are located at higher elevations.

Table 802-1: Historical Population

1980	1990	2000	1980-90 % Change	1990-2000 % Change
13,680	14,997	16,745	9.6	11.7

Data Source: 2000 U.S. Census
Data redistributed and evaluated for East Mauna Kea Aquifer Sector Area

Table 802-2: Population Projection

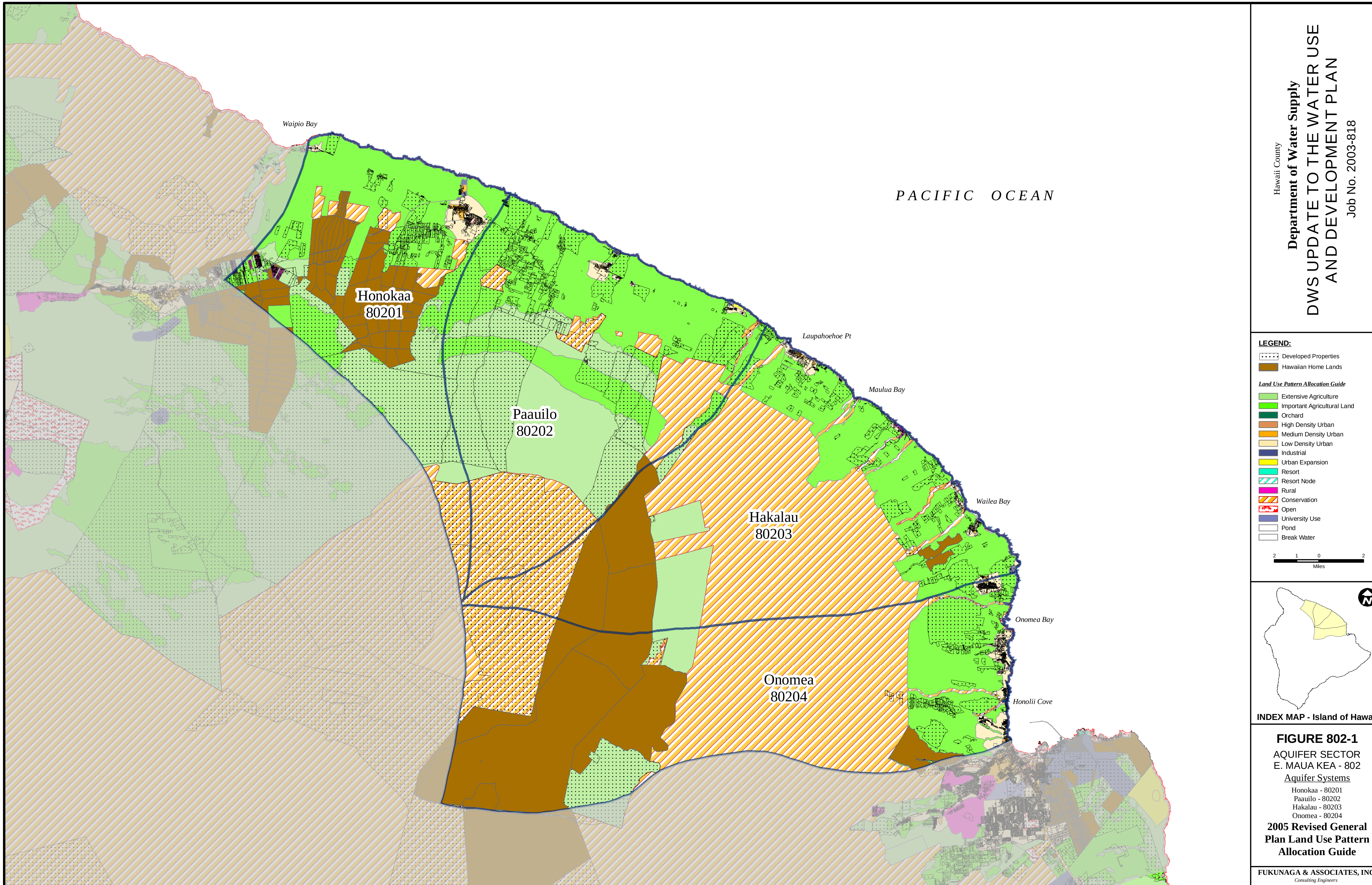
Growth Rate	2000	2005	2010	2015	2020	2000-10 % Change	2010-20 % Change
A – Low	16,745	16,920	17,814	18,745	19,779	6.4	11.0
B – Medium	16,745	16,974	17,971	19,022	20,175	7.3	12.3
C – High	16,745	17,682	19,098	20,515	21,991	14.1	15.1

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

802.1.3 Land Use

802.1.3.1 Hawaii County General Plan

The Hawaii County General Plan Land Use Pattern Allocation Guide Map for the East Mauna Kea ASEA is shown on **Figure 802-1**. The estimated land use allocation acreage for each LUPAG designation within the sector area is listed in **Table 802-3**.



PACIFIC OCEAN
Waipio Bay
Laupahoehoe Pt
Maulua Bay
Wailea Bay
Onomea Bay
Honolii Cove
Honokaa
80201
Paauilo
80202
Hakalau
80203
Onomea
80204
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 802-1
AQUIFER SECTOR
E. MAUA KEA - 802
Aquifer Systems
Honokaa - 80201
Paauilo - 80202
Hakalau - 80203
Onomea - 80204
2005 Revised General
Plan Land Use Pattern
Allocation Guide
FUKUNAGA & ASSOCIATES, INC.
Consulting Engineers
1388 Kapiolani Boulevard, Honolulu, Hawaii 96814

Table 802-3: LUPAG Map Estimated Land Use Allocation Acreage East Mauna Kea Aquifer Sector Area

LAND USE PATTERN	ACREAGE	% of TOTAL
High Density Urban	0	0
Medium Density Urban	507	0.1
Low Density Urban	5,634	1.5
Industrial	241	0.1
Important Agricultural Land	121,310	31.4
Extensive Agriculture	103,668	26.8
Orchard	0	0
Rural	380	0.1
Resort/Resort Node	6	0.0
Open	1,738	0.5
Conservation	152,856	39.6
Urban Expansion	65	0.0
University Use	0	0
TOTAL	386,405	100.0

The water utility courses of action for Hamakua, and North Hilo, and South Hilo in the Hawaii County General Plan relevant to the East Mauna Kea ASEA are as follows:

(a) *Continue to co-ordinate programs with State and Federal Agencies to develop a well at Kukuihaele and Honakaa Hospital to the standards of the DWS.*
(b) *Investigate groundwater sources in the Honokaa and Kukuihaele areas.*
(c) *Develop a stand-by well for the Ookala system.*
(d) *Replace old, sub-standard, or deteriorating lines and storage facilities.*
(e) *Investigate groundwater sources at Kaieie Mauka, Kulaimano, Saddle Road and Honomu areas.*
(f) *Further investigate future ground water resources.*

802.1.3.2 Hawaii County Zoning

Hawaii County Zoning for the East Mauna Kea ASEA is shown on **Figure 802-2**. The estimated land use allocation acreage for each zoning class within the sector area is listed in **Table 802-4**.

Table 802-4: County Zoning Estimated Class Allocation Acreage – East Mauna Kea Aquifer Sector Area

ZONING CLASS	ACREAGE	% of TOTAL
Single Family Residential	1,926	0.5
Multi-Family Residential (including duplex)	41	0.0
Residential-Commercial Mixed Use	0	0
Resort	40	0.0
Commercial	71	0.0
Industrial	132	0.1
Industrial-Commercial Mixed	0	0
Family Agriculture	6	0.0
Residential Agriculture	92	0.0
Agriculture	239,937	62.1
Open	1,270	0.3
Project District	0	0
Forest Reserve	140,305	36.3
(road)	2,584	0.7
TOTAL	386,404	100.0

802.2 EXISTING WATER RESOURCES

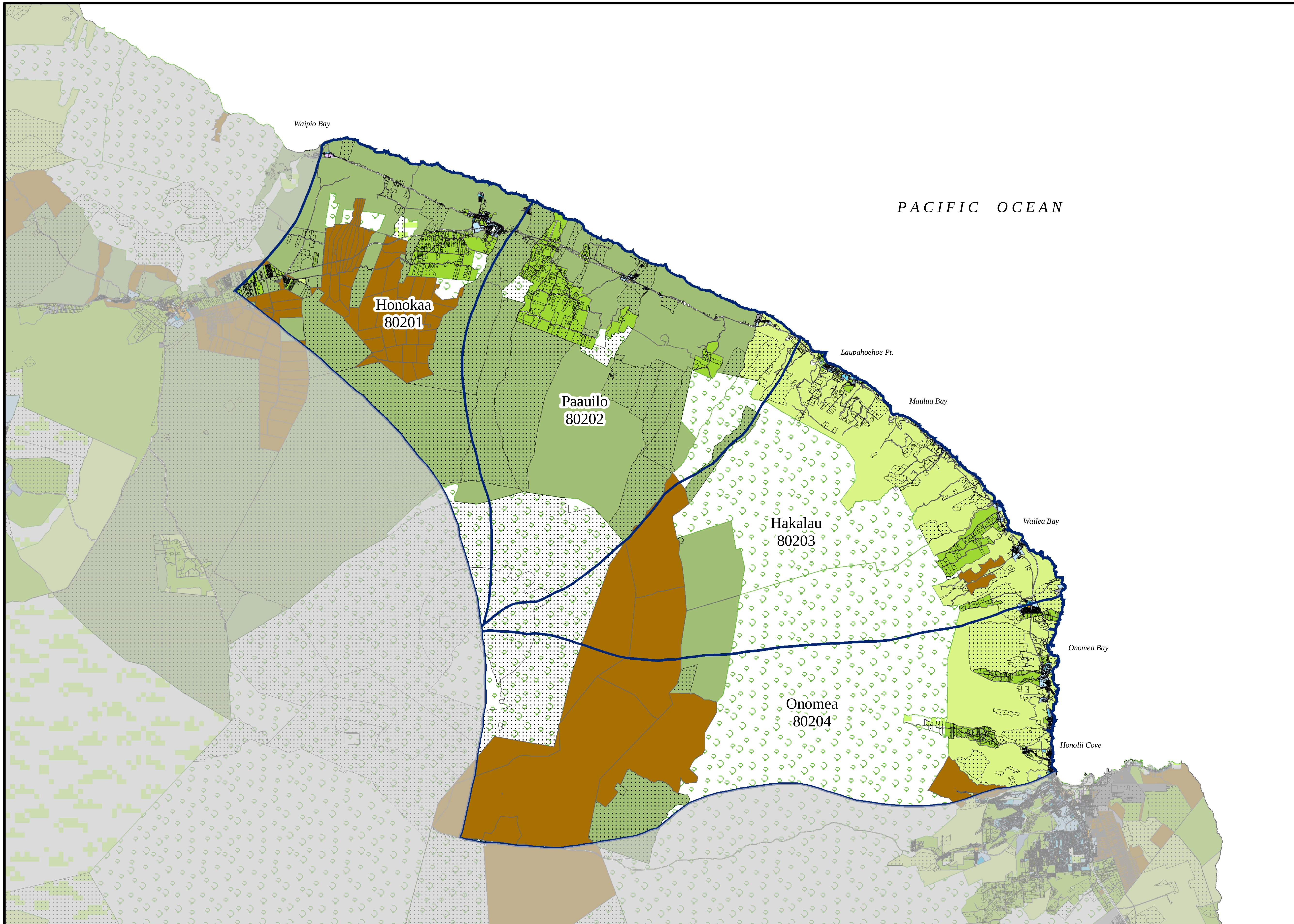
802.2.1 Ground Water

East Mauna Kea ASEA has a sustainable yield of 388 mgd. According to the CWRM database, there are 26 production wells in the sector, including 9 municipal, 5 domestic, 4 irrigation, 7 industrial, and 1 other. There are also 33 wells drilled and categorized as "unused". Refer to **Appendix B** for this database. **Figure 802-3** shows the well locations.

802.2.2 Surface Water

More perennial streams are located in the East Mauna Kea ASEA than on the rest of the island. Of the 85 perennial streams classified in the HSA, 60 are continuous, and the other 25 are intermittent. One gage operated by the USGS is located on the Honolii Stream near Papaikou. Records from the gage were listed previously in **Table 1-8**.

There are 62 declared stream diversions in CRWM database shown on **Figure 802-4**, which accounts for 30 percent of the 202 declared stream diversions on the island. The stream diversions with declared flows are listed in **Table 802-5**.



Hawaii County
Department of Water Supply
DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN
Job No. 2003-818

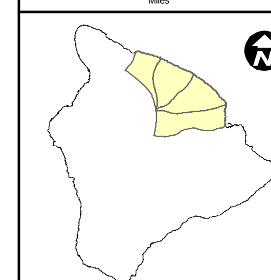
LEGEND:

- 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, 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

2 1 0 2
Miles



INDEX MAP - Island of Hawaii

FIGURE 802-2

AQUIFER SECTOR
E. MAUNA KEA - 802

Aquifer Systems
Honokaa - 80201
Paauilo - 80202
Hakalau - 80203
Onomea - 80204

County Zoning

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

Figure 802-3: Well and Tunnel Location

MAP CURRENTLY NOT AVAILABLE ON-LINE

Figure 802-4: Streams & Diversions

MAP CURRENTLY NOT AVAILABLE ON-LINE

Table 802-5: Stream Diversions – East Mauna Kea Aquifer Sector Area

FILE REFERENCE	TMK	STREAM NAME	
HAWAII DWS	2-8-003:002	Unnamed Spring	Spring diversion, pipe from Maukaloa (Makea). Declared Q = 0.190 MGD.
HAWAII DWS	2-8-010:033	Unnamed/ Unmapped Spring	Spring diversion, pipe from Akaka Falls Spring. Declared Q = 0.09 MGD.
	2-8-011:005	Honomu	Stream diversion, intake from Malamalama Iki Stream (new entry). SCAP-HA-317 After-the-Fact Permit approved for intake. Water used to wash down farm equipment. Maximum Q = 100 gpd.
	3-1-003:002	Peleau	Stream diversion, intake from Peleau. (new entry). SCAP-HA-314 After-the-Fact Permit approved for intake with maximum Q = 8 gpm.
HAWAII DWS	3-2-002:041	Unnamed/ Unmapped Spring	Spring diversion, 2 pumps from Chaves Spring. Declared Q = 0.02 MGD.
GILLMAR JNS	3-3-001:005	Nanue	Stream diversion, dam on Nanaue Stream. Declared Q of 1 cubic foot per second; estimated from flow rate.
HAWAII DWS	3-5-004:035	Unnamed/ Unmapped Spring	Spring diversion, pipe from Kihalani Spring. Declared Q = 0.01 MGD.
HAWAII DWS	3-5-004:050	Unnamed/ Unmapped Spring	Spring diversion, pipe from Manowaiopae Spring. Declared Q = 0.05 MGD.
	3-6-006:018	Manowaiopae	Stream diversion, upper dam and pipe on Manowaiopae Stream. Declared Q = 100 gpm; Verified Q = 48 gpm. SCAP-HA-195 for After-the-Fact permit approved for this diversion.
	3-6-006:018	Manowaiopae	Stream diversion, lower dam and pipe on Manowaiopae Stream (new entry). Declared Q = 100 gpm; Verified Q = 66 gpm. Application for After-the-Fact Permit was denied for this diversion in SCAP-HA-195.
HAWAII DWS	2-7-005:030	Unnamed/ Unmapped Spring	Spring diversion, pipe from Kaieie Spring. Declared Q = 0.030 MGD.

802.2.3 Reclaimed Wastewater

There are no wastewater reclamation facilities within the sector area.

802.3 EXISTING WATER USE

802.3.1 General

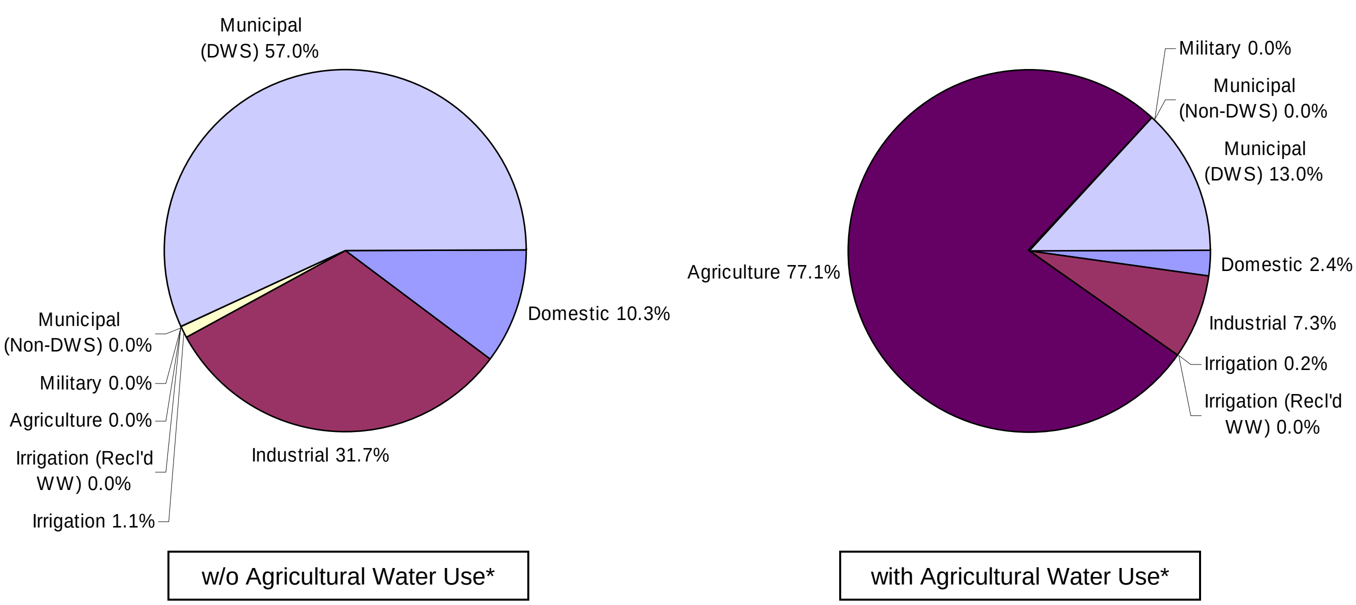
The total estimated average water use within the East Mauna Kea ASEA from November 2004 through October 2005 based on DWS meter data and CWRM pumpage data and available GIS data is listed in **Table 802-6** and summarized in **Figure 802-5,** in accordance with CWRM categories; and indicate the quantities 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.

Table 802-6: Existing Water Use by Categories – East Mauna Kea Aquifer Sector Area

CWRM Water Use Category	Water Use (MGD)	Percent of Total without Ag*	Percent of Total with Ag*
Domestic	0.29	10.3	2.4
Industrial	0.90	31.7	7.3
Irrigation	0.03	1.1	0.2
Reclaimed WW	0.00	0.0	0.0
Agriculture	9.56	0.0	77.1
Military	0.00	0.0	0.0
Municipal			
DWS System	1.62	57.0	13.0
Private Public WS	0.00	0.0	0.0
Total without Ag	2.84	100.0	
Total with Ag	12.40		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 802-5: Existing Water Use by Categories – East Mauna Kea 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.

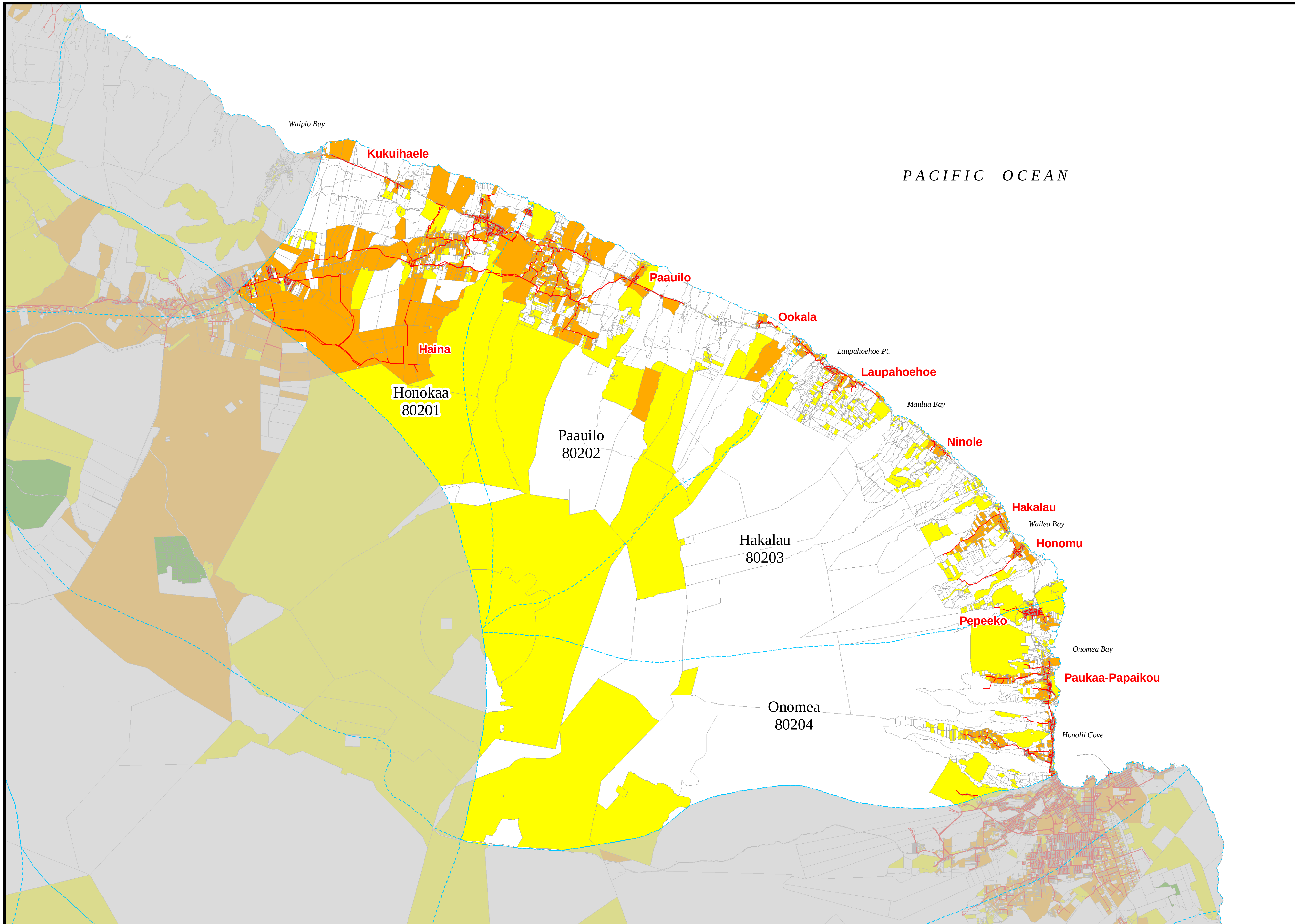
Figure 802-6 generally shows the service areas for the various water systems and indicates the extent of the DWS water system.

Hawaii County

Department of Water Supply

DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

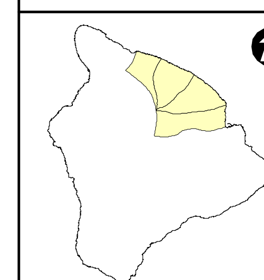
Job No. 2003-818



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 802-6

AQUIFER SECTOR
E. MAUNA KEA - 802

Aquifer Systems
Honokaa - 80201
Paauilo - 80202
Hakalau - 80203
Onomea - 80204

Water System and Service Area

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1388 Kapiolani Boulevard, Honolulu, Hawaii 96814

802.3.2 Domestic Use

Domestic use or water use by individual households is assumed to be supplied by private individual rainwater catchment systems. Based on available GIS data, there are 730 such units or approximately 2,000 people, which is 12 percent of the sector's population. The estimated demand is 0.29 mgd. The 5 wells in the CWRM database classified as "Domestic" have not reported pumpage.

802.3.3 Industrial Use

Hamakua Energy owns two wells for use at the Haina power plant, with a reported pumpage of 0.9 mgd.

802.3.4 Irrigation Use

There are two golf courses within the East Mauna Kea ASEA. The Waimea Country Club is located west of Waimea Village along Mamahaloa Highway. One well classified as "Irrigation" located in the vicinity is owned by Otaka Inc. The reported pumpage is 0.03 mgd. It is not known if the Hamakua Country Club located outside of Honokaa uses irrigation. There is no reported irrigation usage dedicated to other landscaping activities.

802.3.5 Agricultural Use

The Lower Hamakua Ditch originally was built to service the Hamakua Sugar Company's plantation, but was taken over by the HDOA after the closure of the company in 1993. The system consists of five scattered reservoirs and 14 miles of ditch generally parallel to Hawaii Belt Road from the Kukuihaele Weir to the Paauilo Reservoir. According to the AWUDP, the plantation installed service laterals along the length of the ditch, most of which consist entirely of buried pipelines, and are in the process of being located by the HDOA. The system is not fully metered, although a USGS gage located 500 feet upstream of the Kukuihaele Weir recorded an average flow of 6.5 mgd in 2003. Since the closure of the sugar company, only limited farming has taken place along the ditch system.

802.3.6 Military Use

There is no military use in the East Mauna Kea ASEA.

802.3.7 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.

802.3.7.1 County Water Systems

The DWS has 10 systems in the East Mauna Kea ASEA.

The Haina Water System uses a combination of surface and groundwater sources for its supply. The surface water supply comes from the Waimea Water Treatment Plant via the Waimea Water System which crosses into Hamakua from South Kohala via two unmetered connections. Groundwater is supplied from the Haina Deep Well near Honokaa Town. The system is widespread, serving the towns of Honokaa and Haina and extending to the scattered mauka communities, which necessitates 24 storage tanks and 10 booster pump stations.

The Paauilo Water System is a small system serving two zones in the Paauilo area. A single well and two storage tanks serve the system; however, a one-way, normally closed connection is available to receive supply from the Haina Water System if necessary.

The Kukuihaele Water System serves the communities of Kukuihaele and Kapulena and relies on Kukuihaele (Waiulili) Spring for its supply. Two operational zones are served by two booster pump stations and two storage tanks.

The Ookala Water System is a small former plantation system that provides domestic water service to Ookala Village. The supply was once purchased from the Hamakua Sugar Co., but is now obtained from Ookala Well. Storage is achieved through a single concrete tank.

The Laupahoehoe Water System serves the Laupahoehoe community and surrounding areas, extending west to Waipunalei and east to Kapehu. Like many systems along the Hamakua Coast, supply was once obtained from high level springs, namely, the Manowaiopae Spring and the Kihalani Spring (Kuwaikahi Gulch). These springs were not dependable during dry weather periods; therefore, with the installation of two deep wells in Laupahoehoe, the spring sources were eventually phased out of service. A single booster pump station, three storage tanks and a series of pressure reducing valves (PRV) provide service to the six operational zones.

The Ninole Water System is a small system completed in 1977, some of whose services were formerly plantation housing. The system obtains its supply from Chaves Spring. One booster pump station pumps treated water from the spring to the distribution system and storage tank.

The Hakalau Water System serves a former plantation community with water from a combination of the Hakalau Well and the Hakalau Iki Spring. Storage is provided by two tanks in series downstream of the spring source.

The Honomu Water System has a relatively reliable supply from the Akaka Falls Spring. The system has one storage tank.

The Pepeeko Water System obtains its water from the Maukaloa Spring, which is a relatively reliable source, and the Kulaimano Deep Well to supplement the spring when needed. Two tanks provide storage for the system.

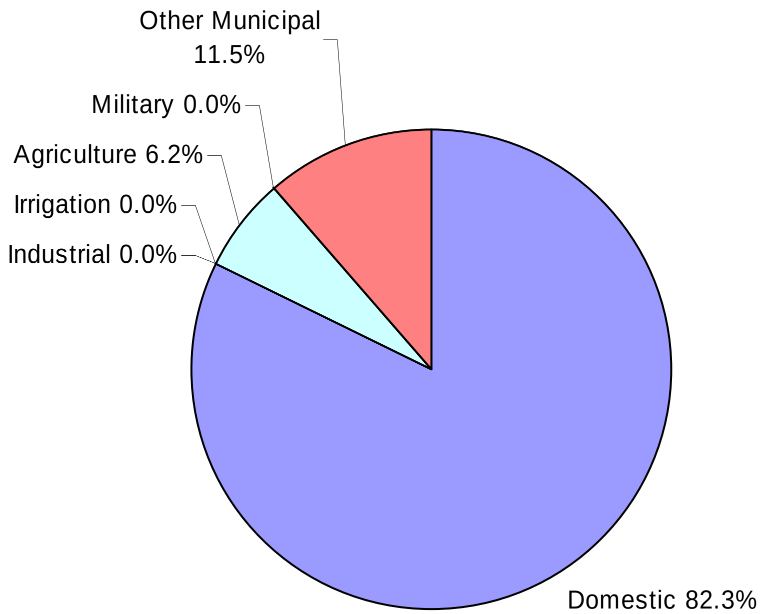
The Paukaa-Papaikou Water System serves the Papaikou and surrounding communities north to Kalaoa Camp and south to Paukaa. The system is supplied by two spring sources, the Kaieie Mauka (Papaikou) and Kaieie Medeiros Springs, and one well source. DWS is currently developing a well source to replace the unreliable Kaieie Mauka Spring, which often runs dry. Four storage tanks and two booster pump stations provide service to eight operational zones. There is also a 6-inch main connecting the Paukaa-Papaikou Water System to the adjacent Hilo Water System. A normally closed valve allows water to flow in both directions if needed.

DWS water use is subcategorized in **Table 802-7,** to the extent possible, based on available meter data, and is depicted in **Figure 802-7**. "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 802-7: DWS Existing Water Use by Categories – East Mauna Kea Aquifer Sector Area

CWRM Water Use Category	DWS Purveyed Water Use (MGD)	Percent of Total
Domestic	1.33	82.3
Industrial	0.00	0.0
Irrigation	0.00	0.0
Agriculture	0.10	6.2
Military	0.00	0.0
Other Municipal	0.19	11.5
Total	1.62	100.0

Figure 802-7: DWS Existing Water Use by Categories – East Mauna Kea Aquifer Sector Area



802.3.7.2 State Water Systems

There are no State water systems in the East Mauna Kea ASEA regulated by the DOH.

802.3.7.3 Federal Water Systems

There are no Federal water systems in the East Mauna Kea ASEA regulated by the DOH.

802.3.7.4 Private Public Water Systems

There are no private public water systems within the East Mauna Kea ASEA regulated by the Department of Health.

802.3.8 Water Use by Resource

802.3.8.1 Ground Water

Table 802-8 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 802-8: Sustainable Yield – East Mauna Kea 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 (%)
		2.06	**23.86**	**35.79**	**388**	**0.53**	**6.15**	**9.22**
80201	Honokaa	1.41	2.31	3.46	31	4.55	7.44	11.16
80202	Paauilo	0.14	4.51	6.77	60	0.23	7.52	11.28
80203	Hakalau	0.13	16.17	24.25	150	0.09	10.78	16.17
80204	Onomea	0.38	0.87	1.31	147	0.26	0.59	0.89

Seven spring sources are utilized in six of DWS's water systems in the East Mauna Kea ASEA. Two additional spring sources currently are not in use. Spring sources are not included in the CWRM well database; therefore, are not reflected in **Table 802-8**. **Table 802-9** lists the quantity of water obtained from each source between November 2004 and October 2005, and the estimated capacities according to the *2006 DWS 20-Year Water Master Plan*.

Table 802-9: Spring Sources – East Mauna Kea Aquifer Sector Area

Source Name	DWS Water System	Estimated Capacity (mgd)	Water Use (mgd)
Kukuihaele Spring	Kukuihaele	0.144	0.03
Chaves Spring	Ninole	0.06	0.02
Hakalau Iki Spring	Hakalau	0.046	0.08
Akaka Falls Spring	Honomu	0.14	0.05
Maukaloa Spring	Pepeeko	0.4	0.00
Kaieie Mauka (Papaikou) Spring	Paukaa-Papaikou	0.03	0.01
Kaieie Medeiros Spring	Paukaa-Papaikou	0.02	0.06
Kihalani Spring	Laupahoehoe	0.1	N/A
Manowaiopae	Laupahoehoe	0.02	N/A

802.3.8.2 Surface Water

Surface water consumption within the sector area includes agricultural users of the Lower Hamakua Ditch. Actual consumption is not readily available.

802.3.8.3 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 802-6** is assumed to be supplied by individual catchment systems. As stated earlier, there is no reported pumpage for domestic wells.

802.3.8.4 Reclaimed Wastewater

There are no wastewater reclamation facilities in the East Mauna Kea ASEA.

802.4 FUTURE WATER NEEDS

802.4.1 General

Table 802-10 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 802-10: 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 E. Mauna Kea ASEA	388	25.4	8.2	2.8	3.0	3.3	3.5	3.8
80201 – Honokaa ASYA	31	9.5	2.1	1.6	1.8	2.0	2.2	2.4
80202 – Paauilo ASYA	60	2.5	0.5	0.3	0.4	0.4	0.4	0.4
80203 – Hakalau ASYA	150	5.2	2.5	0.3	0.3	0.3	0.3	0.3
80204 – Onomea ASYA	147	8.3	3.0	0.6	0.6	0.6	0.6	0.7
With Agricultural Demand*	**SY (mgd)**	**LUPAG (mgd)**	**Zoning (mgd)**	**Growth Rate B Demand Projections (mgd)**				
				2005	**2010**	**2015**	**2020**	**2025**
Total E. Mauna Kea ASEA	388	405.5	378.1	12.4	13.2	14.0	14.8	15.8
80201 – Honokaa ASYA	31	105.2	92.6	4.0	4.4	4.9	5.3	5.9
80202 – Paauilo ASYA	60	135.6	131.8	3.7	3.9	4.1	4.4	4.6
80203 – Hakalau ASYA	150	98.0	93.1	2.6	2.7	2.8	2.9	3.0
80204 – Onomea ASYA	147	66.6	60.7	2.1	2.1	2.2	2.2	2.3

* 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.

For all aquifer system areas, full build-out water demands excluding agricultural demands are considerably less than the SY, and the 2025 demand projection excluding agricultural demand is less than one-tenth the SY. Therefore, analysis of the three demand scenarios does not need to be broken down by aquifer system areas and thus will be presented for the aquifer sector area only.

802.4.2 Full Build-Out Water Demand Projections

The full build-out water demand projections based on the General Plan and County Zoning for the East Mauna Kea ASEA are listed in **Tables 802-11** and **802-12**, and reflect refinement as discussed below. Each land use class is associated with the most appropriate CWRM water use category.

Table 802-11 Hawaii County General Plan Full Build-Out Water Demand Projection – East Mauna Kea Aquifer Sector Area

LUPAG Class	CWRM Category	Water Demand (mgd)
Urban	Domestic/Irrigation/Municipal	20.6
Urban Expansion	Domestic/Irrigation/Municipal	0.2
Resort	Irrigation/Municipal	0.1
Industrial	Industrial	1.0
Agriculture	Agriculture	380.1
University	Irrigation/Municipal	0.0
Rural	Irrigation/Municipal	0.2
DHHL	Irrigation/Municipal	3.4
TOTAL w/o Ag*		25.4
TOTAL w/ Ag*		405.5

* 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 802-12: Zoning Full Build-Out Water Demand Projection – East Mauna Kea Aquifer Sector Area

Zoning Class	CWRM Category	Water Demand (mgd)
Residential	Domestic/Irrigation/Municipal	3.9
Resort	Irrigation/Municipal	0.2
Commercial	Municipal	0.2
Industrial	Industrial	0.5
Agriculture	Agriculture	370.0
DHHL	Irrigation/Municipal	3.4
TOTAL w/o Ag*		8.2
TOTAL w/ Ag*		378.1

* 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.

802.4.2.1 Refine Land Use Based Projection

802.4.2.1.1 State Water Projects Plan

The total projected demand to the year 2020 for 11 State Water Projects within the East Mauna Kea ASEA is 0.02 mgd, all requiring potable sources. The project requiring the largest portion of the total demand is the Honokaa Elementary New 4 Classroom project, by the Department of Education, at 0.0072 mgd.

802.4.2.1.2 State Department of Hawaiian Home Lands

Seven tracts of land are controlled by the DHHL within the East Mauna Kea ASEA, the most on the island.

The Kamoku-Kapulena tract is a u-shaped 3,529-acre tract located northeast of Waimea Village cut by Hawaii Belt and Mamalahoa Highways. The Waikoloa-Waialeale tract lies within the u-part of the Kamoku-Kapulena tract and is 1,206 acres in area. The Nienie tract is further east of the Kamoku-Kapulena tract mauka of Mamalahoa Highway and is 7,135 acres in area. Average rainfall values range between 30 and 75 inches per year. Currently, DHHL has not proposed water demand for the three tracts.

The Honokaia tract lies in on the west side of the Nienie tract. Ground elevations vary between 2,220 feet at the makai end to 3,440 feet at the mauka end. The 3,243 acres of land are proposed primarily for agricultural use, but also for residential and commercial use. Water demand is estimated to be 1.16 mgd.

The Lower Piiohuna tract is bordered by forest reserve northwest of Hilo. The 1,842 acres were formerly used for sugar cane, but are currently uncultivated. Numerous streams traverse the tract, and there is plenty of rainfall, averaging between 170 and 250 inches per year. Potential water supplies are the DWS Hilo Water System, and Wailuku River or other streams and springs for irrigation water. The proposed land uses of the tract are agricultural and residential with an estimated demand of 0.89 mgd.

The Honomu and Kuhua tracts combined are 766 acres of former sugar cane land located above Honomu Village on the coast above Hilo. Average annual rainfall ranges between 150 and 250 inches. The tracts may be serviced by the DWS Honomu Water System; however, the estimated demand of 1.14 mgd far exceeds the capacity of the water system. There are several spring sources in the vicinity; however, their potential as sources of irrigation water has not yet been determined.

The Humuula tract is a 49,100-acre tract of land along the eastern slope of Mauna Kea. Average rainfall varies with elevation in the tract, ranging from 40 inches along the upper boundary to 112 inches along the lower boundary. The Upper Piiohuna tract is a 7,078-acre tract on the east side of the Humuula tract. Because there is no potable water system or perennial stream in feasible proximity, the *DHHL Special Report #2* has recommended that individual roof catchment and storage systems be installed for each unit as developed. The proposed demand is 0.16 mgd.

802.4.2.1.3 Agricultural Water Use and Development Plan

The AWUDP estimates the potential service area of the Lower Hamakua Ditch System to be 4,765 acres, with a 20-year service area of between 1,070 and 6,240 acres. The AWUDP estimates that the average agricultural irrigation water unit rate is 3,400 gallons per acre per day, which translates to a 20-year water requirement of between 3.64 and 21.22 mgd. Because of the uncertainty of the projected service area, the associated water demands were not used to refine the full build-out projections.

802.4.3 Water Use Unit Rates

Water use unit rates are based on the *Water System Standards* as discussed in Chapter 1.

802.4.4 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 East Mauna Kea ASEA. The projected low, medium, and high growth rates are listed in **Table 802-13**, and are graphed in **Figure 802-8**. Potable and nonpotable water demands are also differentiated.

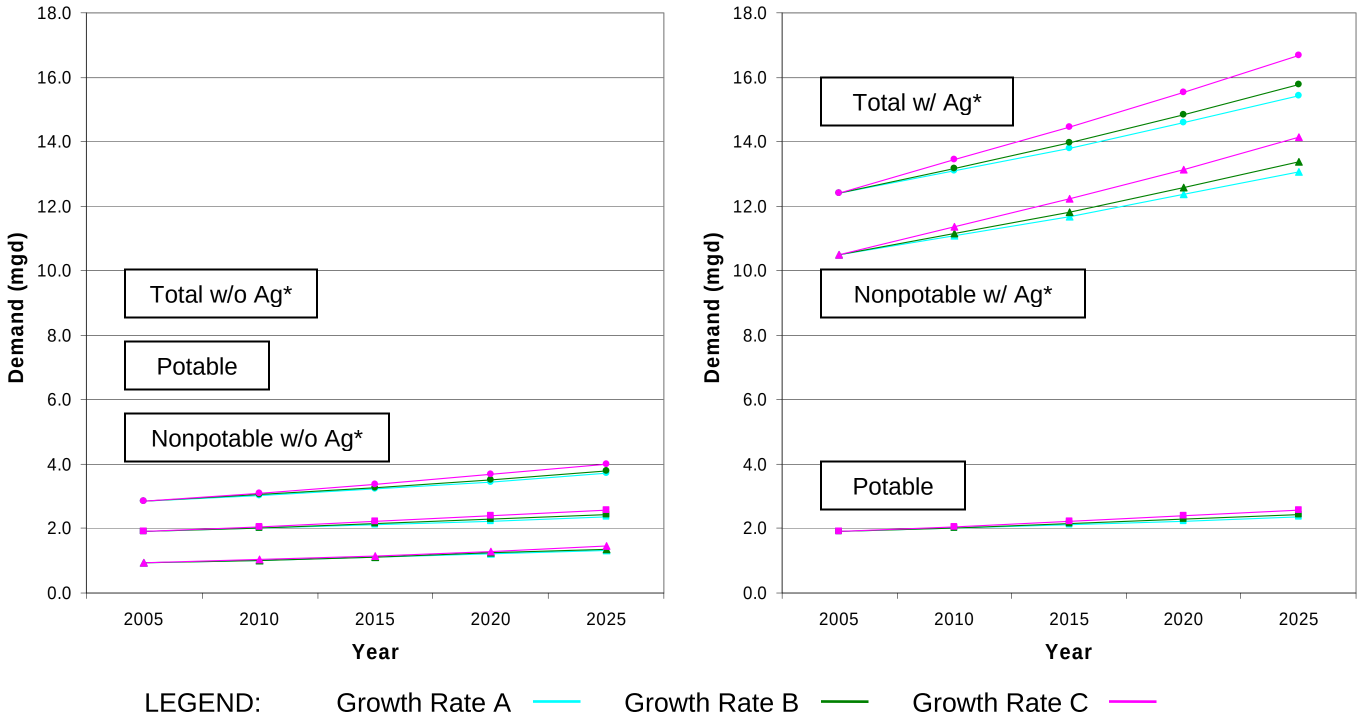
Figure 802-9 illustrates the magnitude of the sustainable yield, both LUPAG and Zoning full build-out water use, and water use projection through the year 2025 focusing on Medium Growth Rate B. **Figure 802-10** shows the breakdown of water demand projections by CWRM categories through the year 2025. **Table 802-14** summarizes these figures.

Table 802-13: Water Demand Projection – East Mauna Kea 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	2.8	3.0	3.2	3.5	3.7	12.4	13.1	13.8	14.6	15.4
Potable	1.9	2.0	2.1	2.2	2.4	1.9	2.0	2.1	2.2	2.4
Nonpotable	0.9	1.0	1.1	1.2	1.3	10.5	11.1	11.7	12.4	13.1
GROWTH RATE B	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	2.8	3.0	3.3	3.5	3.8	12.4	13.2	14.0	14.8	15.8
Potable	1.9	2.0	2.1	2.3	2.4	1.9	2.0	2.1	2.3	2.4
Nonpotable	0.9	1.0	1.1	1.2	1.4	10.5	11.1	11.8	12.6	13.4
GROWTH RATE C	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	2.8	3.1	3.4	3.7	4.0	12.4	13.4	14.5	15.5	16.7
Potable	1.9	2.1	2.2	2.4	2.6	1.9	2.1	2.2	2.4	2.6
Nonpotable	0.9	1.0	1.2	1.3	1.4	10.5	11.4	12.2	13.1	14.1

* 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 802-8: Water Demand Projection Summary – East Mauna Kea Aquifer Sector Area



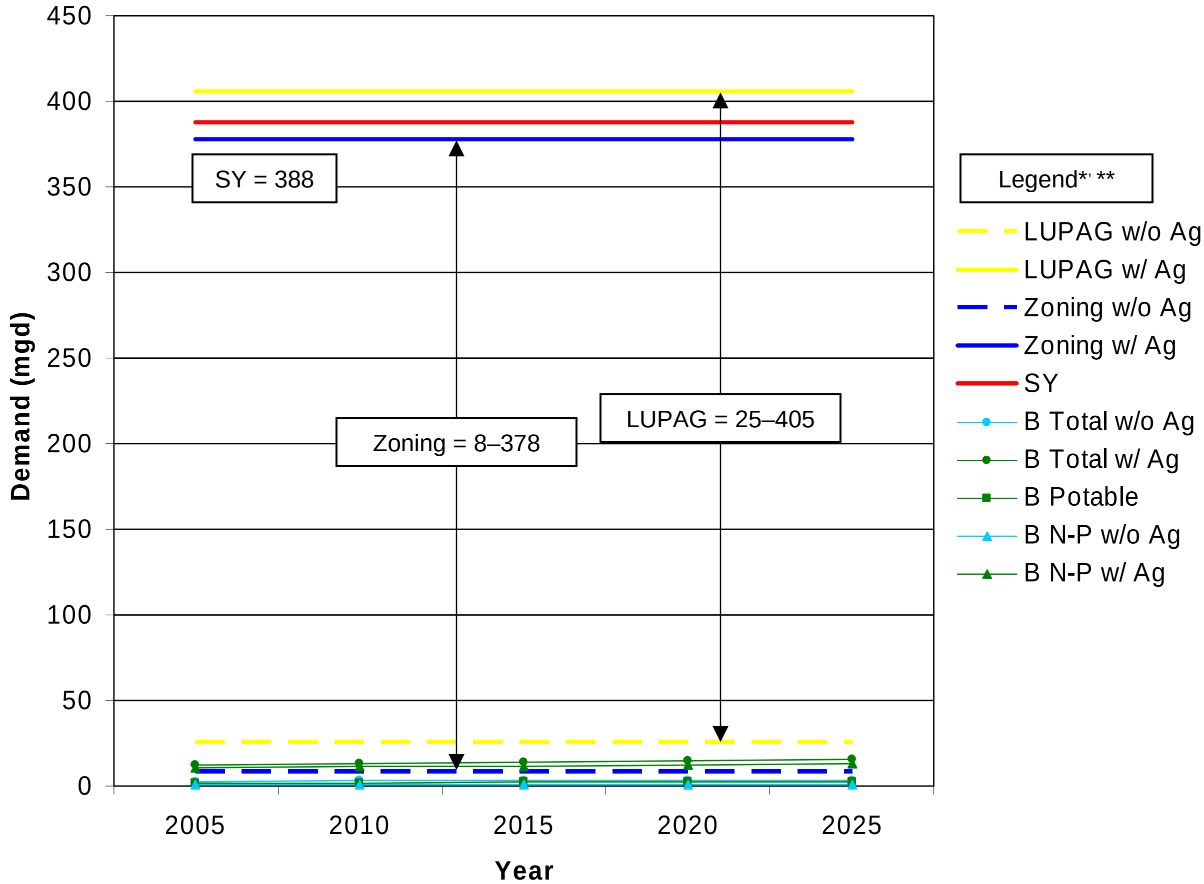
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 802-14: Medium Growth Rate B Water Demand Projection by Category – East Mauna Kea Aquifer Sector Area

Water Use Category	2005 (mgd)	2010 (mgd)	2015 (mgd)	2020 (mgd)	2025 (mgd)
Total without Ag*	2.8	3.0	3.3	3.5	3.8
Total with Ag*	12.4	13.2	14.0	14.8	15.8
Domestic	0.3	0.3	0.3	0.3	0.4
Industrial	0.9	1.0	1.1	1.2	1.3
Irrigation	0.0	0.0	0.0	0.0	0.0
Agriculture	9.6	10.1	10.7	11.3	12.0
Military	0.0	0.0	0.0	0.0	0.0
Municipal	1.6	1.7	1.8	1.9	2.1
Potable	1.9	2.0	2.1	2.3	2.4
Nonpotable w/o Ag*	0.9	1.0	1.1	1.2	1.4
Nonpotable w/ Ag*	10.5	11.1	11.8	12.6	13.4
DWS	1.6	1.7	1.8	1.9	2.1

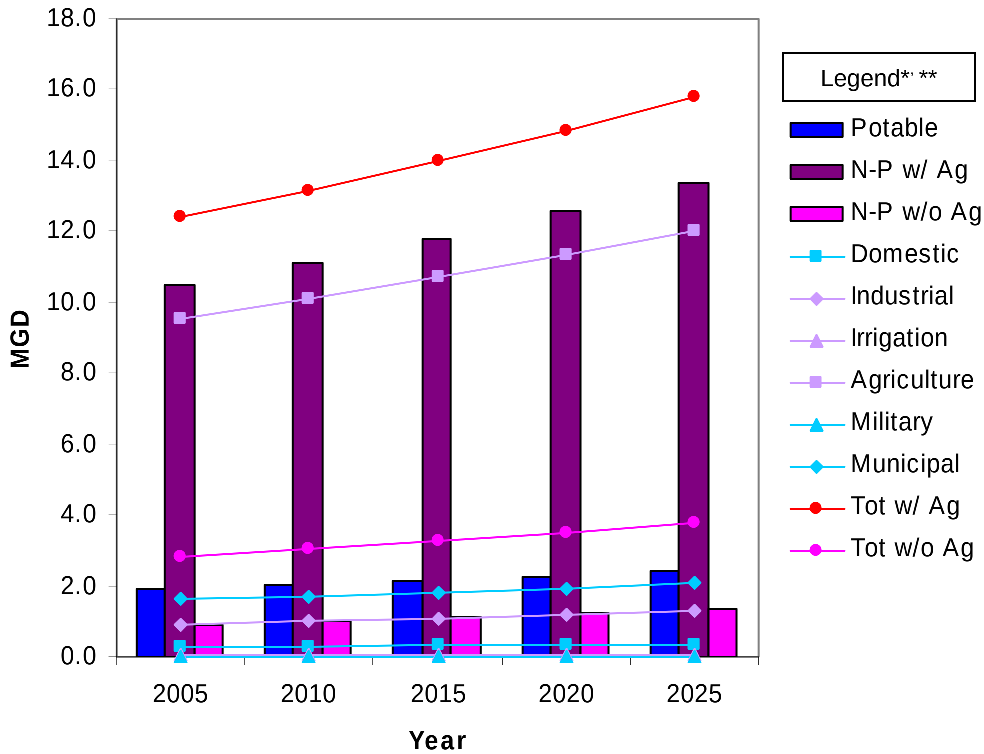
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 802-9: Medium Growth Rate B Water Demand Projections and Full Build-Out – East Mauna Kea 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 802-10: Medium Growth Rate B Water Demand Projection by Category – East Mauna Kea Aquifer Sector Area

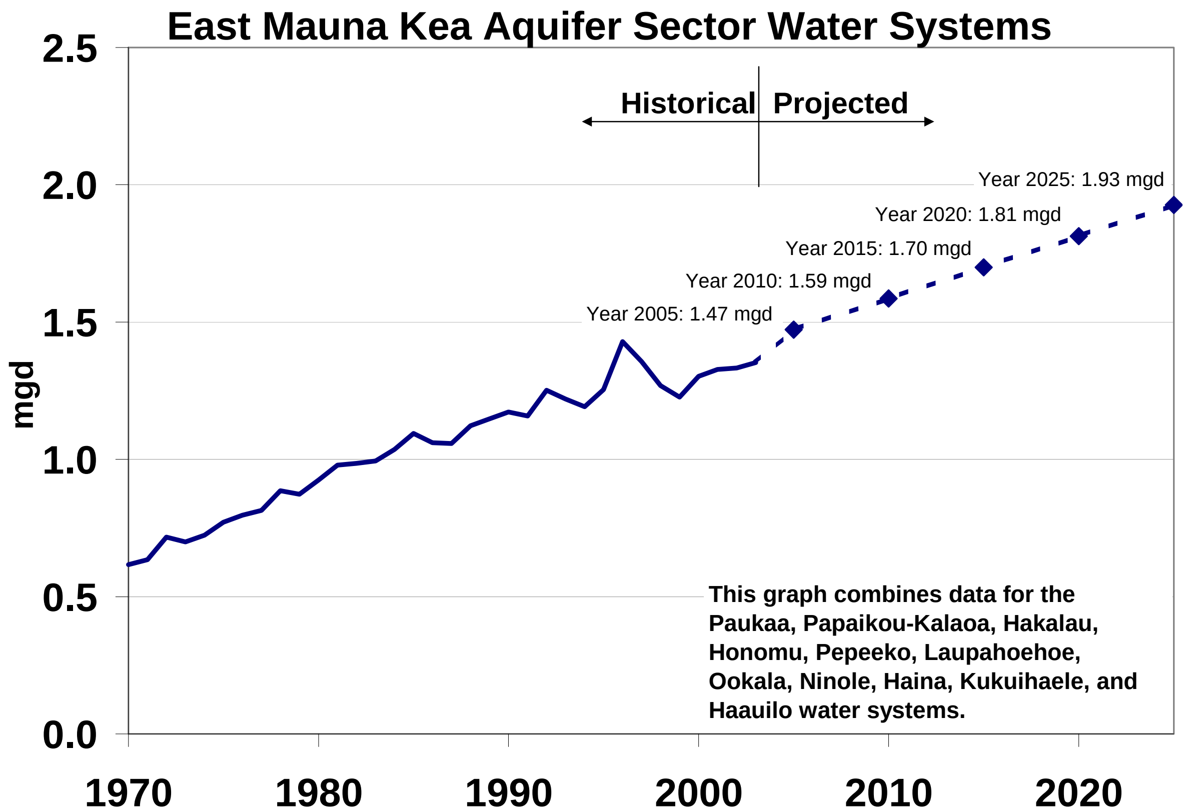


* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.
** "N-P" represents the nonpotable component of the demand.

802.4.5 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 802-11**.

Figure 802-11: DWS Water Demand Projection – East Mauna Kea Aquifer Sector Area



Historical data provided by RW Beck, Inc.

Projections based on historical DWS water consumption data are slightly lower than projections based on population growth rate. Part of the Waimea System is within the East Mauna Kea ASEA, which is not represented on the graph.

802.5 RESOURCE AND FACILITY RECOMMENDATIONS

802.5.1 Water Source Adequacy

802.5.1.1 Full Build-Out

Full build-out water demands associated with the maximum density of LUPAG and Zoning land uses are both sustainable if agricultural demands are not included. The LUPAG full build-out requires approximately 6 percent sustainable yield of the East Mauna Kea ASEA. The existing zoning is legally developable, and requires approximately 2 percent of the existing sustainable yield. If worst case agricultural demands are included, the LUPAG demand exceeds the SY, and the Zoning demand is 97 percent of the SY.

802.5.1.2 Twenty-Year Projection

Present and 20-year projected water demands are miniscule compared to the SY, even including worst case agricultural demands.

802.5.2 Source Development Requirements

802.5.2.1 Supply-Side Management

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

802.5.2.1.1 Conventional Water Resource Measures

802.5.2.1.1.1 Ground Water

The East Mauna Kea ASEA has the third highest sustainable yield of the sectors on the island. High level dike water exists in the rift zone section of Mauna Kea, and perched water is common in the Laupahoehoe series (Refer to **Figure 1.4**). However, these locations are difficult to access and at great distances from end users. Basal water is generally found up to 5 miles inland. Existing potable water wells in the sector are in the vicinity of Hawaii Belt Road up to a few miles from the coast. The 1990 WRPP indicates that a good deal of basal water is developable, and specifically in the Paauilo Aquifer System Area the 60 mgd sustainable yield refers to potable basal groundwater. DWS has several wells planned, including two new sources at Ahualoa and Paauhau in the Haina Water System, one new source in the Ninole Water System, one new source and one backup well in the Honomu-Hakalau Water System, one new source in the Pepeeko Water System, one new source at Kaieie Mauka in the Papaikou Water System, and a backup source well in each of the Paauilo and Ookala Water Systems.

Spring water is a plentiful resource in the sector area. Due to costs associated with infrastructure improvements, treatment and monitoring, which is required to meet the rules and regulations of the Federal Safe Drinking Water Act (SDWA), the usage of these sources has been reduced. Implementing new sources may still be more expensive than developing basal groundwater wells. However, spring sources are available to develop as a secondary potable water resource.

Spring sources that are owned by DWS but currently not in use due to the development of groundwater sources may also be considered for non-potable use.

802.5.2.1.1.2 Surface Water

Most of the surface water used for non-potable requirements originates in the Kohala ASEA (ASEA 801) and is transferred through the Upper and Lower Hamakua Ditch Systems. Surface water can and should be used for localized non-potable uses. The number of stream diversions registered with the CWRM indicates that this is already taking place.

802.5.2.1.1.3 Water Transfer

As mentioned in the previous section, transfer of non-potable source water into the East Mauna Kea ASEA from ASEA 801 is already taking place. This is not viewed as a problem considering the abundance of surface water in the ASEA 801.

Currently, an undetermined quantity of potable water is being transferred into the DWS Haina System from the DWS Waimea Water System, the sources of which are streams and one high-level groundwater well in the ASEA 801. Transfer of potable water into the East Mauna Kea ASEA may continue due to the abundance of potable sources in both sector areas.

802.5.2.1.2 Alternative Water Resource Enhancement Measures

802.5.2.1.2.1 Rainwater Catchment Systems

Most of the developed area within the sector area receives over 60 inches of rainfall per year, which should be adequate to support rainwater catchment systems. This is confirmed by the quantity of domestic usage, which currently is 15 percent of all potable water used in the sector area. Population densities in remote areas where catchment is typically used are not expected to grow significantly and may continue to be served by catchment.

802.5.2.1.2.2 Wastewater Reclamation

Except for the Haina Water System, most of the public water systems service small populations; therefore, the amount of reclaimed wastewater generated at each treatment plant would be minimal. Due to the abundance of other non-potable water from other sources, reclaimed wastewater is not viewed with large scale development potential.

802.5.2.1.2.3 Desalination

Desalination plants would be restricted to coastal areas where brackish groundwater can be drawn. As potable water is readily available in these areas, desalination is not considered a feasible alternative due to the high cost.

802.5.2.2 Demand-Side Management

802.5.2.2.1 Development Density Control

Full build-out water demand associated with LUPAG is three times that of Zoning; however, most of the LUPAG Urban area is already classified as “Low Density”. Furthermore, water demands are miniscule compared to the sustainable yield even with full build-out to maximum density. Development density control is possible, but not considered necessary in the near future.

802.5.2.2.2 Water Conservation

The average usage per connection on the DWS water systems is less than 300 gpd per connection, which is less than the island average. Potable water consumption from all sources per capita is estimated at 110 gpd, which is considered acceptable. Water usage rates should be monitored, and water conservation should continue; but currently, additional water conservation measures are not necessary.

802.5.3 Recommended Alternatives

Basal groundwater source development should continue; and consistent with the General Plan, sources should be investigated in the Kukuihaele, Honakaa, Kaieie Mauka, Kulaimano, and Honomu areas with the intention of replacing existing surface water sources. Specifically, additional groundwater sources should be developed for the Haina Water System so that potable water transfer from the Waimea Water System is not necessary, as sources in the ASEA 801 supplying the Waimea Water System should be conserved for transfer to the aquifer sector areas on the leeward coast that could experience deficiencies in water supply in the future. In the interim, a meter should be installed at the junctions of the Waimea and Haina Water Systems in order to monitor the quantity of water being transferred. Usage of the existing spring sources for potable use may continue, provided that necessary infrastructure improvements and treatment and monitoring required to comply with Federal SDWA regulations are not cost-prohibitive.

Surface water should continue to be the primary source of non-potable water.

The AWUDP has recommended significant improvements to the Lower Hamakua Ditch system which will properly service future diversified agricultural activities. These recommendations may change in light of the damage sustained by the ditch systems during the recent earthquake.

803 WEST MAUNA KEA AQUIFER SECTOR AREA

803.1 SECTOR AREA PROFILE

803.1.1 General

The West Mauna Kea Aquifer Sector Area (ASEA) includes the Waimea Aquifer System Area (ASYA) [80301]. Its boundaries extend from the saddle area between Mauna Kea and Mauna Loa to Waimea and along the western shores at Kawaihae to Puako, capturing most of the South Kohala district and the western portion of the Hamakua district.

Average annual rainfall ranges from 9 inches along the coast to nearly 50 inches, however most of the sector receives less than 30 inches, making this sector area one of the driest on the island. The sustainable yield is 24 mgd.

803.1.2 Economy and Population

803.1.2.1 Economy

Tourism has become the leading economic industry in South Kohala. One of South Kohala's three luxury resorts, the Mauna Kea Resort, which includes two hotels and ten exclusive residential neighborhoods, lies within the West Mauna Kea ASEA.

Agriculture also continues to be a major economic contributor. Cattle ranching utilizes most of the agricultural land area, with pastures running from high mountain slopes to sea level. Parker Ranch, one of the nation's largest ranches, spreads approximately 175,000 acres of land. In addition to producing United States Department of Agriculture (USDA) choice beef from between 30,000 and 35,000 cattle annually, Parker Ranch's businesses include visitor activities, commercial leasing and real estate holdings.

As indicated in the General Plan, "Waimea is one of the most productive areas for vegetable crops on the Big Island" and "the agricultural industry…has the potential for further expansion."

The Canada-France-Hawaii Telescope Corporation, which has a telescope atop Mauna Kea, has a base facility south of Waimea in the West Mauna Kea ASEA with a staff of 51 and an annual operating budget of $6.2 million. Astronomical facilities within the 11,228-acre Mauna Kea Science Reserve are located within the West Mauna Kea ASEA. With 13 observatories and 12 of the world's state-of-the-art telescopes, Mauna Kea is considered the world's premier site for ground-based astronomical observatories. Astronomy generates over $619 million in capital investments and approximately 270 permanent jobs.

803.1.2.2 Population

Nearly all of the population contributing to the water demand of the sector area is within the South Kohala District. The growth in tourism has followed the dramatic increase in the population of South Kohala over the past 30 years; and as a result, South Kohala enjoyed the lowest unemployment rate and the highest median income in 1997.

Table 803-1: Historical Population

1980	1990	2000	1980-90 % Change	1990-2000 % Change
2,084	4,134	5,939	98.4	43.7

Data Source: 2000 U.S. Census
Data redistributed and evaluated for West Mauna Kea Aquifer Sector Area

Table 803-2: Population Projection

Growth Rate	2000	2005	2010	2015	2020	2000-10 % Change	2010-20 % Change
A – Low	5,939	7,060	8,153	9,392	10,831	37.3	32.8
B – Medium	5,939	7,082	8,224	9,531	11,048	38.5	34.3
C – High	5,939	7,378	8,740	10,279	12,042	47.2	37.8

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

803.1.3 Land Use

803.1.3.1 Hawaii County General Plan

The Hawaii County General Plan Land Use Pattern Allocation Guide Map for the West Mauna Kea ASEA is shown on **Figure 803-1**. The estimated land use allocation acreage for each LUPAG designation within the sector area is listed in **Table 803-3**.

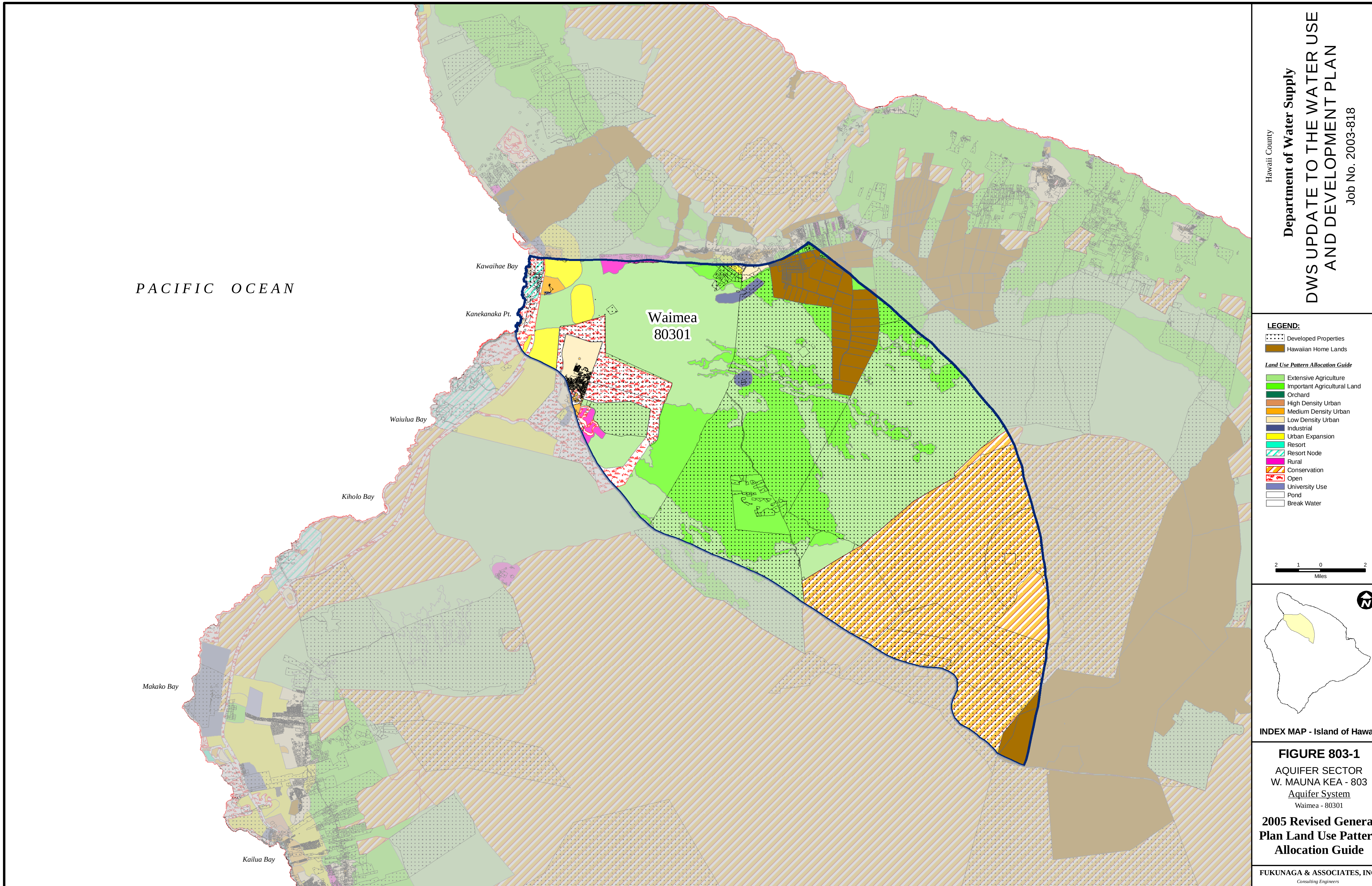


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FIGURE 803-1

AQUIFER SECTOR
W. MAUNA KEA - 803
Aquifer System
Waimea - 80301

2005 Revised General Plan Land Use Pattern Allocation Guide

FUKUNAGA & ASSOCIATES, INC.
Consulting Engineers
1388 Kapiolani Boulevard, 2nd Flr, Honolulu, Hawaii 96814

Table 803-3: LUPAG Map Estimated Land Use Allocation Acreage – West Mauna Kea Aquifer Sector Area

LAND USE PATTERN	ACREAGE	% of TOTAL
High Density Urban	0	0
Medium Density Urban	567	0.3
Low Density Urban	2,516	1.3
Industrial	915	0.5
Important Agricultural Land	47,663	24.8
Extensive Agriculture	73,087	38.1
Orchard	0	0
Rural	927	0.5
Resort/Resort Node	554	0.3
Open	8,283	4.3
Conservation	54,057	28.2
Urban Expansion	3,407	1.8
University Use	0	0
TOTAL	191,976	100.0

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

(a) Seek alternative sources of water for the Lalamilo system.
(b) Improve and replace inadequate distribution mains and steel tanks.
(c) Continue to seek additional groundwater sources for the Waimea System.

803.1.3.2 Hawaii County Zoning

Hawaii County Zoning for the West Mauna Kea ASEA is shown on **Figure 803-2**. The estimated land use allocation acreage for each zoning class within the sector area is listed in **Table 803-4**.

Table 803-4: County Zoning Estimated Class Allocation Acreage – West Mauna Kea Aquifer Sector Area

ZONING CLASS	ACREAGE	% of TOTAL
Single Family Residential	2,391	1.3
Multi-Family Residential (including duplex)	332	0.2
Residential-Commercial Mixed Use	0	0
Resort	82	0.0
Commercial	123	0.1
Industrial	39	0.0
Industrial-Commercial Mixed	0	0
Family Agriculture	0	0
Residential Agriculture	648	0.3
Agriculture	125,786	65.5
Open	7,738	4.0
Project District	0	0
Forest Reserve	53,826	28.0
(road)	1,003	0.5
TOTAL	191,969	100.0

803.2 EXISTING WATER RESOURCES

803.2.1 Ground Water

The West Mauna Kea ASEA has a sustainable yield of 24 mgd. According to the CWRM database, there are 30 production wells in the sector area, including 15 municipal, 11 irrigation, 2 industrial, 2 other. There are also 7 wells drilled and categorized as “unused.” Refer to **Appendix B** for this database. **Figure 803-3** shows the well locations.

803.2.2 Surface Water

The Waikoloa Stream south of Waimea is classified in the HSA as perennial but intermittent at lower elevations.

There are 7 declared stream diversions in the CRWM database listed in **Table 803-5** and shown on **Figure 803-4**; however, flow data is not available for the stream diversions.

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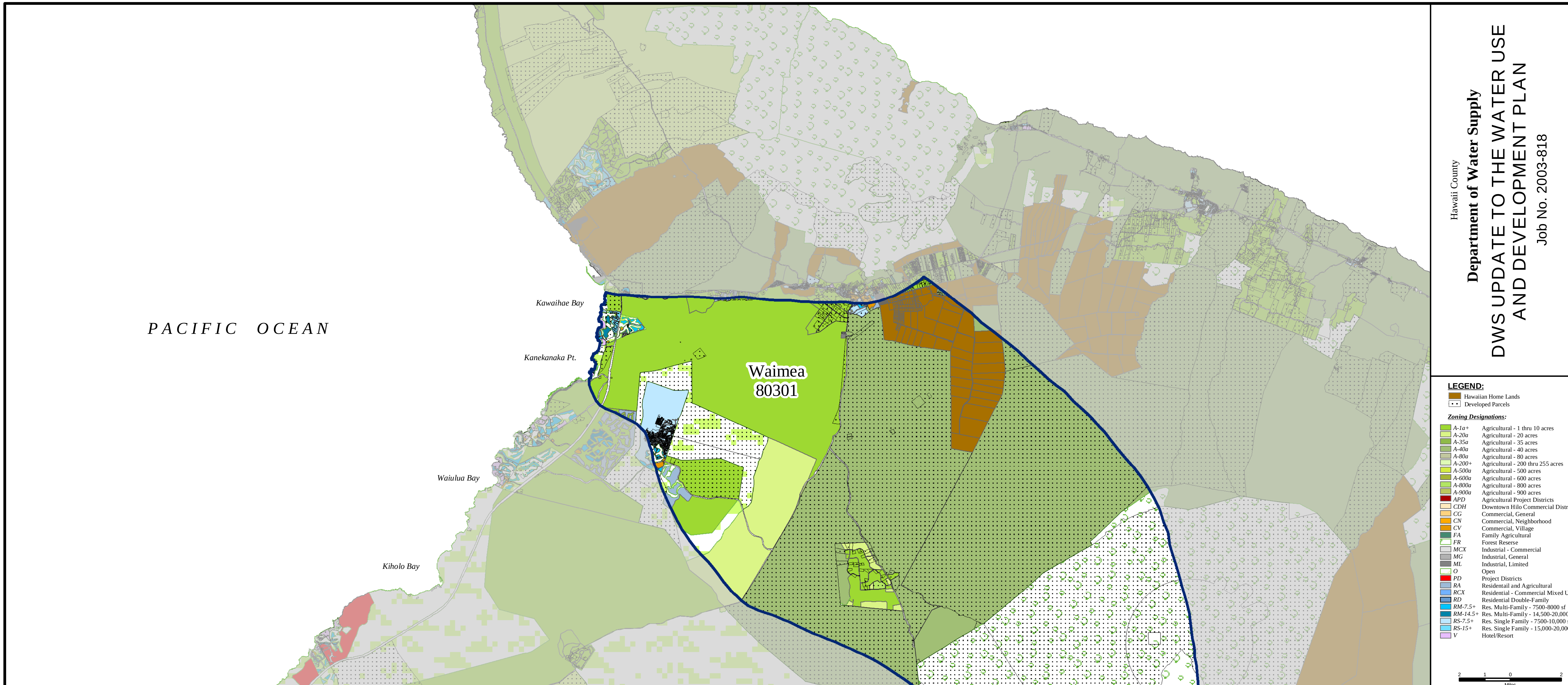

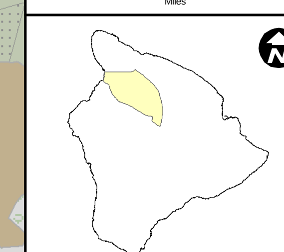

INDEX MAP - Island of Hawaii

FIGURE 803-2

AQUIFER SECTOR
W. MAUNA KEA - 803

Aquifer System
Waimea - 80301

County Zoning

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Figure 803-3: Well and Tunnel Location

MAP CURRENTLY NOT AVAILABLE ON-LINE

Figure 803-4: Streams & Diversions

MAP CURRENTLY NOT AVAILABLE ON-LINE

Table 803-5: Stream Diversions – West Mauna Kea Aquifer Sector Area

FILE REFERENCE	TMK	STREAM NAME	
STATE PARK HAW	4-4-015:001	Hopukani Spring (East)	Spring diversion, pipe from Hopukani Spring #1. See also new entry for declarant.
STATE PARK HAW	4-4-015:001	Hopukani Spring (West)	Spring diversion, pipe from Hopukani Spring #2. See also new entry for declarant.
STATE PARK HAW	4-4-016:003	Waihu Spring	Spring diversion, pipe from Waihu Spring (new entry).
STATE PARK HAW	4-4-016:003	Liloe Spring	Spring diversion, pipe from Liloe Spring (new entry).
WALLACH K	6-2-009:004	Keanuiomano	Stream diversion, pump from Keanuiomano Stream. Use when stream is running.
BALDWIN E	6-2-009:018	Keanuiomano	Stream diversion, 2 pipes from Keanuiomano Stream. Two pipes at one location.
PARKER RANCH	6-6-001:038	Resevoir	Stream diversion, Lihue Intake from reserve overflow.

803.2.3 Reclaimed Wastewater

There are 2 wastewater reclamation facilities (WWRF) in the sector area. **Table 803-6** lists the WWRF, reclaimed water classification, facility treatment capacity, current reuse amount, and current application.

Table 803-6: Wastewater Reclamation Facilities – West Mauna Kea Aquifer Sector Area

Wastewater Reclamation Facility	Reclaimed Water Classification	WWRF Capacity (MGD)	Current Reuse Amount (MGD)	Irrigation Application
South Kohala Wastewater Corp.	R-2	0.6	0.27	Mauna Kea Golf Course – golf course irrigation
Waimea Wastewater Company WRF	R-3	0.1	0.045	Parker Ranch – pasture irrigation

803.3 EXISTING WATER USE

803.3.1 General

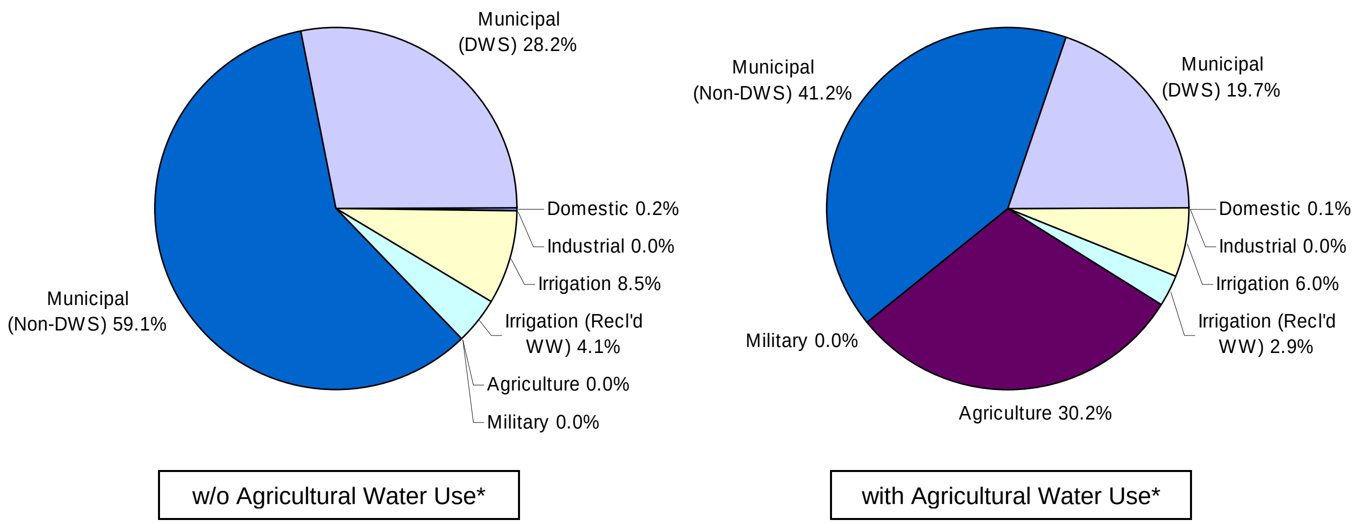
The total estimated average water use within the West Mauna Kea ASEA from 2004 to 2005 (DWS meter data and CWRM pumpage data from November 2004 through October 2005, available GIS data, estimates from the *2003 SWPP*, and estimated reclaimed wastewater usage) is listed in **Table 803-7**. The Waikoloa private water system operated by the West Hawaii Water Company supplied the largest quantity of the total estimated water use within the sector area. **Table 803-7** and **Figure 803-5** summarize water use in accordance with CWRM categories and indicate separately the quantities supplied excluding agricultural demands, and the quantities supplied including worst case agricultural demands (described in Chapter 2) by the DWS system, non-DWS systems, and reclaimed wastewater.

Table 803-7: Existing Water Use by Categories – West Mauna Kea Aquifer Sector Area

CWRM Water Use Category	Water Use (MGD)	Percent of Total without Ag*	Percent of Total with Ag*
Domestic	0.01	0.2	0.1
Industrial	0.00	0.0	0.0
Irrigation	0.66	8.5	6.0
Reclaimed WW	0.32	4.1	2.9
Agriculture	3.34	0.0	30.2
Military	0.00	0.0	0.0
Municipal			
DWS System	2.17	28.2	19.7
Private Public WS	4.56	59.1	41.2
Total without Ag*	7.71	100.0	
Total with Ag*	11.05		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 803-5: Existing Water Use by Categories – West Mauna Kea 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.

Figure 803-6 generally shows the service area for the various water systems and indicates the extent of the DWS water system.

803.3.2 Domestic Use

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

803.3.3 Industrial Use

There are two drilled wells classified as "Industrial" in the CWRM database, owned by Mauna Kea Beach Hotel; however, neither have reported pumpage.

803.3.4 Irrigation Use

Irrigation is based on pumpage reported for private wells categorized by CWRM as irrigation wells and reclaimed water use as indicated earlier in **Table 803-7**. **Table 803-8** lists the average private irrigation well pumpage reported to the CWRM or listed in the *2003 SWPP*.

Table 803-8: Private Irrigation Well Pumpage

Private Irrigation	Irrigation Well Pumpage (mgd)
Mauna Lani Resort	0.62
Mauna Kea Properties	Not Reported
Arlin Trust	0.01
Hapuna State Recreation Area	0.028*
TOTAL	0.66

*Source: 2003 SWPP, Volume 2, Island of Hawaii

Records indicate that the Mauna Kea Beach Resort has brackish water wells for golf course irrigation, however none reported pumpage. The Mauna Lani Resort owns three irrigation wells in the West Mauna Kea ASEA.

The Hapuna State Recreation Area is located south of Kawaihae and is managed by the DLNR, State Parks division. Potable water demand is supplied by the DWS Waimea Water System. Nonpotable water is pumped from a single well with a safe source capacity of 0.33 mgd and stored in a reservoir which feeds the irrigation system. Safe source capacity is described in the *2003 SWPP* as two-thirds of the installed pump capacity,

803.3.5 Agricultural Use

Parker Ranch has a vast water system to service its numerous pasture lots, which consists of 175 miles of pipeline, 9 reservoirs, 145 water tanks, 40 ground tanks, 3 water dams and 650 water troughs. The Ranch also purchases water from the DWS where such supply is available. Since the sources for the Ranch livestock are stream diversions, yearly consumption varies depending on the weather and its related rainfall. The Ranch has a prepared master plan for residential, commercial, and other related uses. It is called the *Parker Ranch 20/20 Plan*.

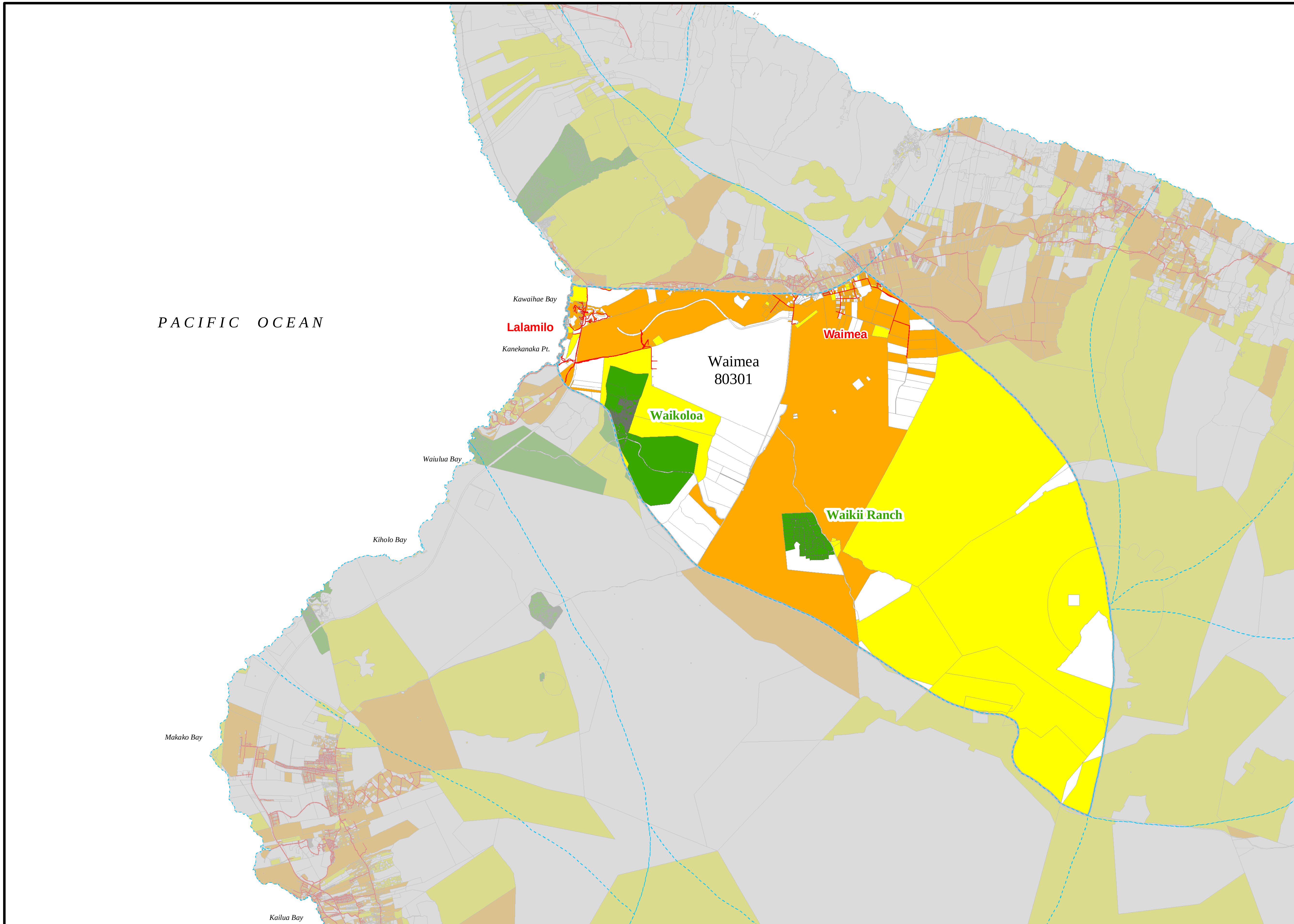
The farm lots in Lalamilo and Puukapu utilize the Waimea Irrigation System. The pressurized distribution system consists of pipelines varying between 8 and 18 inches in diameter. According to the AWUDP, in 2003 the system drew 0.908 mgd from 117 metered accounts. The source water for the system is stream diversions from the Kohala Mountain watersheds, which lie within the Kohala ASEA (801).

803.3.6 Military Use

There is no military use in the West Mauna Kea ASEA.

803.3.7 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.



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

0 1 2 4
Miles

INDEX MAP - Island of Hawaii

FIGURE 803-6

AQUIFER SECTOR
W. MAUNA KEA - 803

Aquifer System
Waimea - 80301

Water System and Service Area

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1388 Kapiolani Boulevard, Honolulu, Hawaii 96814

803.3.7.1 County Water Systems

The DWS has two major water systems that service the sector area. The Waimea Water System (WS) covers the mauka areas and the Lalamilo WS services the coastal areas. Refer to **Figure 803-6**.

The Waimea WS described in Chapter 801 spans three aquifer sector areas, serving areas within the West Mauna Kea ASEA south of Mamalahoa Highway, including the residential lots at Puukapu-Nienie and Kamuela Airport.

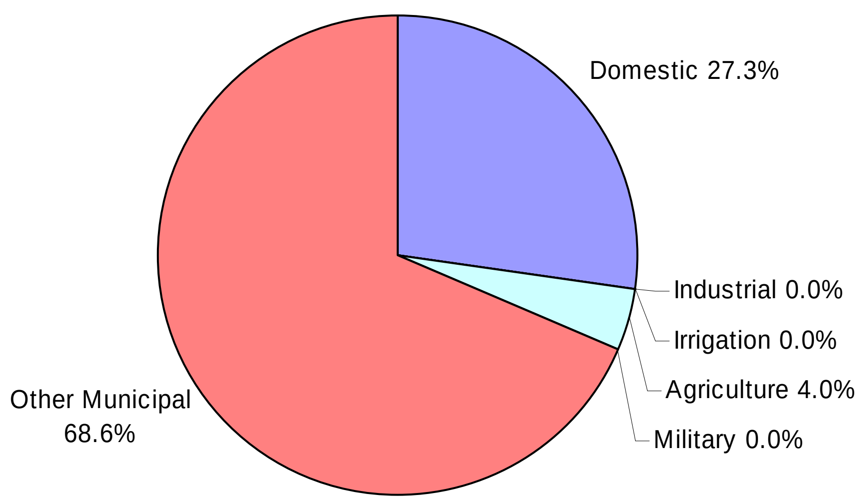
The Lalamilo WS was originally designed to service the small village of Kawaihae. A 2-inch pipeline transported water from the Waimea WS down to Kawaihae, generally following Kawaihae Road. In the 1950's, the State developed the Puako subdivision and a deep draft harbor at Kawaihae. This necessitated replacement of the existing small lines and extension of the system to Puako. The small pipeline from Waimea to Kawaihae was replaced with a 6-inch pipeline and additional storage tanks were erected. In the 1960's, the Rockefeller development at Mauna Kea Beach opened a new era for this region. To develop sufficient supply, high level exploratory deep wells were attempted along Kawaihae Road. This resulted in marginal quality water with high chloride content. The high chloride content and temperature reflected the geothermal anomaly which occurs in this area. However, these wells supplemented the limited supply from Waimea. Water from the wells was blended with the fresh mountain water to supply the emerging developments. Based on the success of the adjacent Waikoloa deep wells, the State drilled an exploratory well on the State lands of Lalamilo at an elevation of approximately 1,200 feet in 1977. The well produced water of good quality with a chloride content of 78 ppm. Subsequently, additional wells were drilled with financing by the Mauna Lani Resort developer which allowed Mauna Lani and Mauna Kea resorts to expand their facilities. The Kawaihae Village area around the harbor has also expanded, and is served by the Lalamilo WS. The two Parker Wells replaced the two Kawaihae Wells in the late 1990's. The system presently services the area from Kawaihae to Mauna Lani in five operational zones, through two booster pump stations and nine storage tanks.

DWS water use is subcategorized in **Table 803-9** to the extent possible based on available meter data and is depicted in **Figure 803-7**. "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 803-9: DWS Existing Water Use by Categories – West Mauna Kea Aquifer Sector Area

CWRM Water Use Category	DWS Purveyed Water Use (MGD)	Percent of Total
Domestic	0.59	27.3
Industrial	0.00	0.0
Irrigation	0.00	0.0
Agriculture	0.09	4.0
Military	0.00	0.0
Other Municipal	1.49	68.6
Total	2.17	100.0

Figure 803-7: DWS Existing Water Use by Categories – West Mauna Kea Aquifer Sector Area



803.3.7.2 State Water Systems

The DLNR, Division of State Parks owns the Mauna Kea State Park water system located on the southwestern side of Mauna Kea on Saddle Road. In exchange for water use by the Pohakuloa Training Area (PTA), the water system sources and transmission lines are maintained by the U.S. Army. The PTA is located in the Northwest Mauna Loa ASEA (807). Sources of water for the system are from five springs, namely Upper Hopukani Spring, Hopukani Spring, Waihu Spring, Lilole Spring and an unnamed spring. The spring water is gravity fed through two above ground

2-inch galvanized pipelines into three 420,000 gallon steel storage reservoirs, then filtered and disinfected with sodium hypochlorite prior to distribution. There are 13 service connections which include the Mauna Kea State Park, the PTA and service to approximately 25 people. The estimated park demand is 0.015 mgd.

803.3.7.3 Federal Water Systems

There are no Federal water systems in the West Mauna Kea ASEA.

803.3.7.4 Private Public Water Systems

There are two private public water systems within the West Mauna Kea ASEA regulated by the Department of Health, which supply a significant percentage of the total estimated water use within the sector. **Table 803-10** lists the average pumpage each system reported to the CWRM, and is assumed to be the system water use.

Table 803-10: Private Public Water System Water Use – West Mauna Kea Aquifer Sector Area

Private Public Water System	Water Use (mgd)
Waikoloa	4.50
Waikii Ranch	0.04

The Waikoloa Resort lands were purchased in 1968 from Parker Ranch by Boise Cascade. The lands are split between the West Mauna Kea ASEA and the Northwest Mauna Loa ASEA (807), with the higher elevation lands above the beach resort used for residential development within the former and the oceanfront lands used for resort hotel development within the latter. Five wells located within the West Mauna Kea ASEA provide potable water for all of the developments. DOH records indicate that the system serves a population of 9,960 through 1,629 service connections.

The Waikii Ranch is a 2,995-acre ranch lot subdivision at elevations 3,800 feet to 4,800 feet on the west slopes of Mauna Kea along the Saddle Road. The potable water source is two deep wells at ground elevations in excess of 4,300 feet with a total pump capacity of 288,000 gallons per day. The water system also includes two booster pump stations and three concrete reservoirs and approximately 8 miles of 6-inch ductile iron watermain.

803.3.8 Water Use by Resource

803.3.8.1 Ground Water

Table 803-11 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 803-11: Sustainable Yield – West Mauna Kea 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 (%)
		9.13	**17.56**	**26.34**	**24**	**38.04**	**73.17**	**109.75**
80301	Waimea	9.13	17.56	26.34	24	38.04	73.17	109.75

Based on available information from the CWRM database, the current groundwater use is over a third of the sustainable yield. If the installed pumps operate 16-hours a day, close to three-quarters would be used, and if the installed pumps operate continuously, the sustainable yield would be exceeded.

803.3.8.2 Surface Water

Parker Ranch has one declared stream diversion in the West Mauna Kea ASEA; however, consumption is not known.

According to the SWPP, the estimated source capacity from the five springs serving the Mauna Kea State Park water system is 0.00125 mgd, which is not adequate to meet the existing consumption of the Park and the PTA.

803.3.8.3 Rainwater Catchment

Water consumption calculated for developed parcels that are not supplied by groundwater or surface water is assumed to be supplied by rainwater catchment. The water use categorized as Domestic Use previously in **Table 803-7** is assumed to be supplied by individual catchment systems.

803.3.8.4 Reclaimed Wastewater

Reclaimed wastewater from the two wastewater treatment plants within the West Mauna Kea ASEA is used for golf course and pasture lot irrigation. Refer to **Table 803-6**, presented earlier.

803.4 FUTURE WATER NEEDS

803.4.1 General

Table 803-12 summarizes the LUPAG, Zoning and 5-year incremental water demand projection scenarios for the total aquifer sector area and the individual aquifer system area. The sustainable yield (SY) is presented to draw comparisons.

Table 803-12: 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 W. Mauna Kea ASEA	24	52.1	13.8	7.7	9.0	10.4	12.0	13.9
80301 – Waimea ASYA	24	52.1	13.8	7.7	9.0	10.4	12.0	13.9
With Agricultural Demand*	**SY (mgd)**	**LUPAG (mgd)**	**Zoning (mgd)**	**Growth Rate B Demand Projections (mgd)**				
				2005	**2010**	**2015**	**2020**	**2025**
Total W. Mauna Kea ASEA	24	186.7	150.6	11.0	12.8	14.9	17.2	20.0
80301 – Waimea ASYA	24	186.7	150.6	11.0	12.8	14.9	17.2	20.0

* 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.

There is only one aquifer system area within the West Mauna Kea ASEA; therefore, demands presented by aquifer sector area and by aquifer system area are one in the same.

803.4.2 Full Build-Out Water Demand Projections

The full build-out water demand projections based on the General Plan and County Zoning for the West Mauna Kea ASEA are listed in **Tables 803-13** and **803-14**, and reflect refinement as discussed below. Each land use class is associated with the most appropriate CWRM water use category.

Table 803-13: Hawaii County General Plan Full Build-Out Water Demand Projection – West Mauna Kea Aquifer Sector Area

LUPAG Class	CWRM Category	Water Demand (mgd)
Urban	Domestic/Irrigation/Municipal	22.1
Urban Expansion	Domestic/Irrigation/Municipal	15.4
Resort	Irrigation/Municipal	9.4
Industrial	Industrial	3.7
Agriculture	Agriculture	134.6
University	Irrigation/Municipal	0.0
Rural	Irrigation/Municipal	0.9
DHHL	Irrigation/Municipal	0.6
TOTAL w/o Ag*		52.1
TOTAL w/ Ag*		186.7

* 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 803-14: County Zoning Full Build-Out Water Demand Projection – West Mauna Kea Aquifer Sector Area

Zoning Class	CWRM Category	Water Demand (mgd)
Residential	Domestic/Irrigation/Municipal	11.5
Resort	Irrigation/Municipal	1.1
Commercial	Municipal	0.4
Industrial	Industrial	0.2
Agriculture	Agriculture	136.8
DHHL	Irrigation/Municipal	0.6
TOTAL w/o Ag*		13.8
TOTAL w/ Ag*		150.6

* 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.

803.4.2.1 Refine Land Use Based Projection

803.4.2.1.1 State Water Projects Plan

The total projected demand to the year 2020 for 19 State Water Projects within the West Mauna Kea ASEA is 15.66 mgd, 0.31 mgd using potable, 15.30 mgd using nonpotable, and 0.06 nonpotable using potable sources. The total demand exceeds the projected 2020 water demand for the sector area; however, it is anticipated that the nonpotable demands will be supplied by nonpotable sources. Furthermore, it is anticipated that the next phase of the *AWUDP* will examine projections and sources in greater detail. The projects which will generate the most significant demands, with the exception of DHHL projects, which are covered separately, are listed in **Table 803-15**.

Table 803-15: Future State Water Projects to Generate Significant Demands

Project Name	Primary Use	State Department	2020 Demand (mgd)
Future Subdivision in Honokaa	Nonpotable	DOA	7.00
Future Subdivision in Paauilo	Nonpotable	DOA	1.25
Waimea/Paauilo Watershed Project	Nonpotable	DOA	4.00

803.4.2.1.2 State Department of Hawaiian Home Lands

The three Puukapu Sections are existing pre-1994 DHHL tracts totaling about 12,000 acres. Puukapu 1 is comprised of three parcels totaling 392 acres, and generally located in the southeast section of Waimea. Some pasture lots have already been awarded. Together the existing and potential pastoral developments have a potable water need of 0.13 mgd and an irrigation water need of 0.48 mgd. Potable water supply would be from the DWS Waimea Water System. Irrigation water supply would be from the Waimea Irrigation System.

803.4.2.1.3 Agricultural Water Use and Development Plan

The AWUDP estimates the 20-year service area of the Waimea Irrigation System between 712 and 880 acres, which, using an estimated 3,400 gpd/acre, translates to a water demand of 2.42 to 2.99 mgd. As discussed, this report presents a range of agricultural nonpotable water use in the demand projections. It is anticipated that the next phase of the *AWUDP* will examine the sources and demand requirements in greater detail.

803.4.3 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 at least 7,500 square foot of County Zoning) consumption is 2.5 units per lot based on historical consumption data.

803.4.4 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 West Mauna Kea ASEA. The projected low, medium, and high growth rates are listed in **Table 803-16**, and are graphed in **Figure 803-8**. Potable and nonpotable water demands are also differentiated.

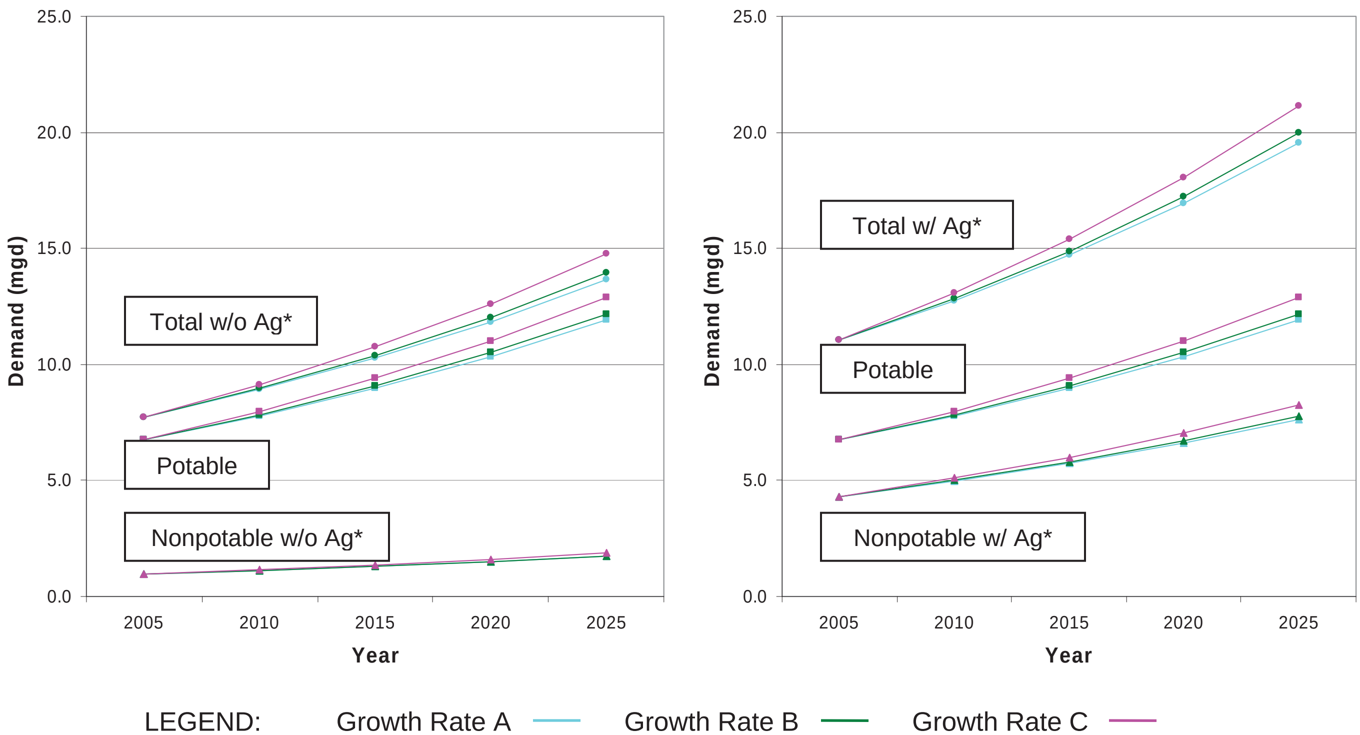
Focusing on Medium Growth Rate B, **Figure 803-9** illustrates the magnitude of the sustainable yield, both LUPAG and Zoning full build-out water use, and water use projection through the year 2025. **Figure 803-10** shows the breakdown of water demand projections by CWRM categories through the year 2025. **Table 803-17** summarizes these figures.

Table 803-16: Water Demand Projection – West Mauna Kea 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	7.7	8.9	10.3	11.8	13.6	11.0	12.8	14.7	16.9	19.5
Potable	6.7	7.8	9.0	10.3	11.9	6.7	7.8	9.0	10.3	11.9
Nonpotable	1.0	1.1	1.3	1.5	1.7	4.3	5.0	5.7	6.6	7.6
GROWTH RATE B	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	7.7	9.0	10.4	12.0	13.9	11.0	12.8	14.9	17.2	20.0
Potable	6.7	7.8	9.1	10.5	12.2	6.7	7.8	9.1	10.5	12.2
Nonpotable	1.0	1.1	1.3	1.5	1.8	4.3	5.0	5.8	6.7	7.8
GROWTH RATE C	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	7.7	9.1	10.7	12.6	14.7	11.0	13.1	15.4	18.0	21.1
Potable	6.7	8.0	9.4	11.0	12.9	6.7	8.0	9.4	11.0	12.9
Nonpotable	1.0	1.2	1.4	1.6	1.9	4.3	5.1	6.0	7.0	8.2

* 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 803-8: Water Demand Projection Summary – West Mauna Kea Aquifer Sector Area



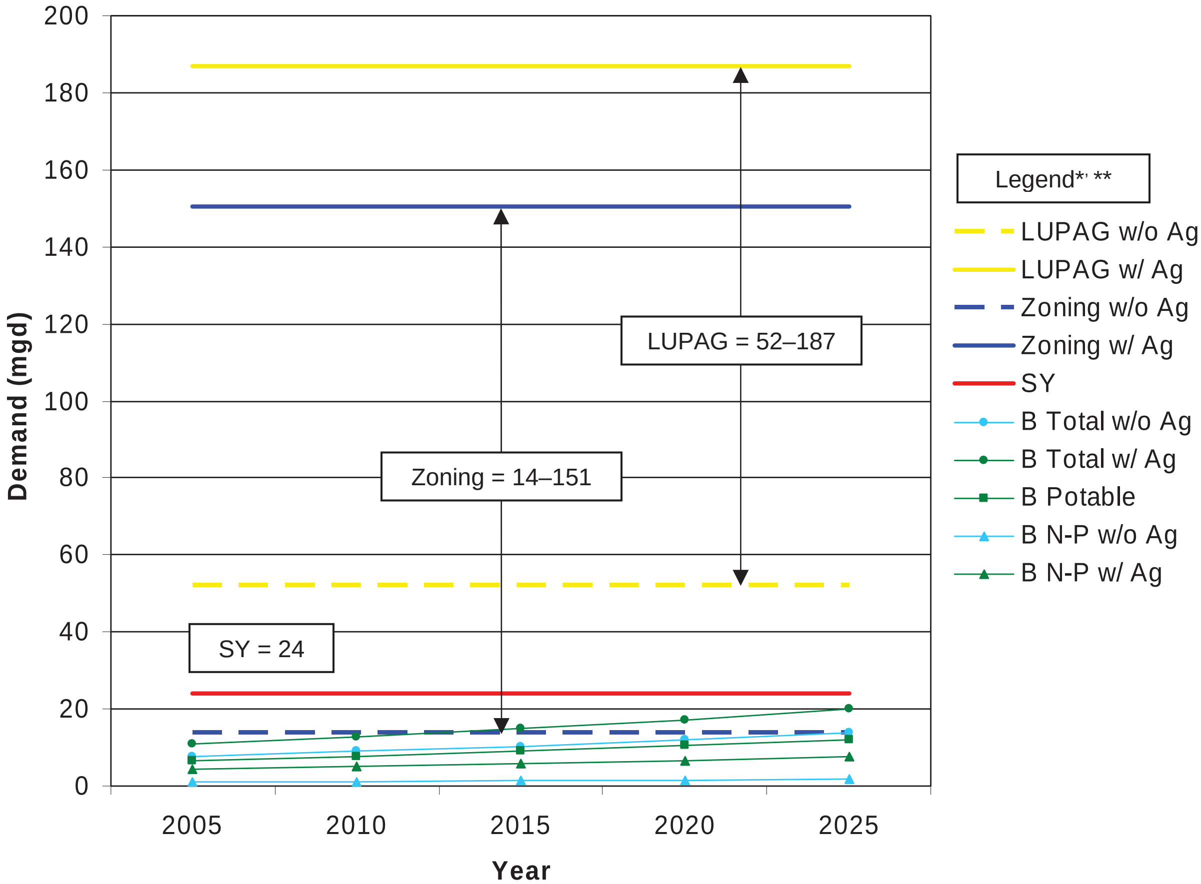
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 803-17: Medium Growth Rate B Water Demand Projection by Category – West Mauna Kea Aquifer Sector Area

Water Use Category	2005 (mgd)	2010 (mgd)	2015 (mgd)	2020 (mgd)	2025 (mgd)
Total without Ag*	7.7	9.0	10.4	12.0	13.9
Total with Ag*	11.0	12.8	14.9	17.2	20.0
Domestic	0.0	0.0	0.0	0.0	0.0
Industrial	0.0	0.0	0.0	0.0	0.0
Irrigation	1.0	1.1	1.3	1.5	1.8
Agriculture	3.3	3.9	4.5	5.2	6.0
Military	0.0	0.0	0.0	0.0	0.0
Municipal	6.7	7.8	9.1	10.5	12.2
Potable	6.7	7.8	9.1	10.5	12.2
Nonpotable w/o Ag*	1.0	1.1	1.3	1.5	1.8
Nonpotable w/ Ag*	4.3	5.0	5.8	6.7	7.8
DWS	2.2	2.5	2.9	3.4	3.9

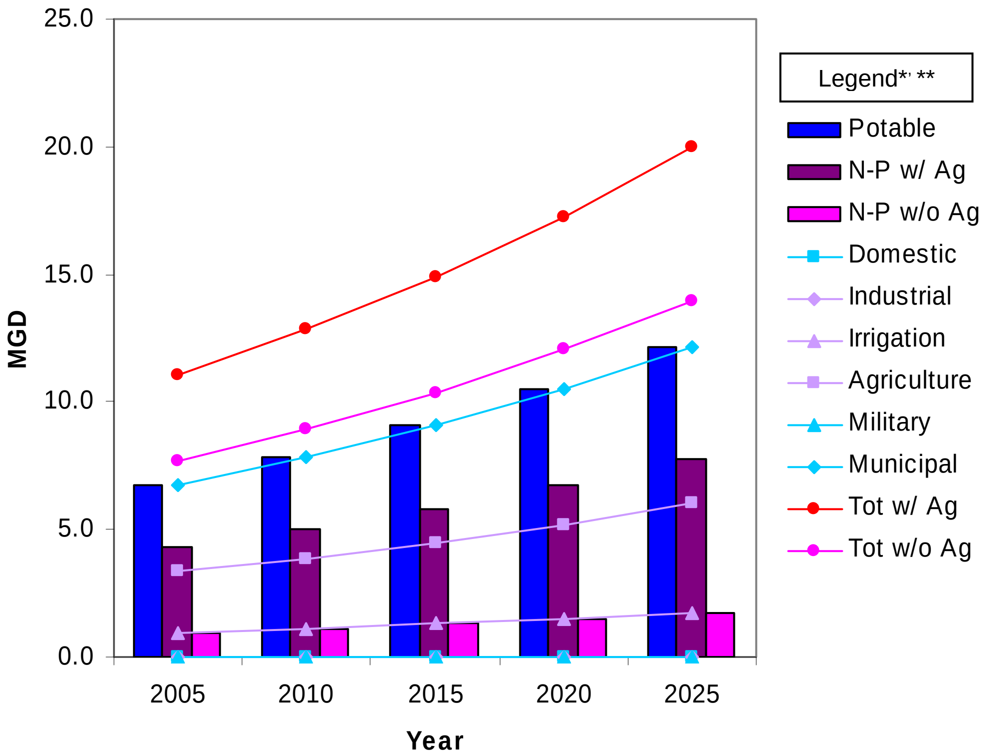
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 803-9: Medium Growth Rate B Water Demand Projections and Full Build-Out – West Mauna Kea 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 803-10: Medium Growth Rate B Water Demand Projection by Category – West Mauna Kea Aquifer Sector Area

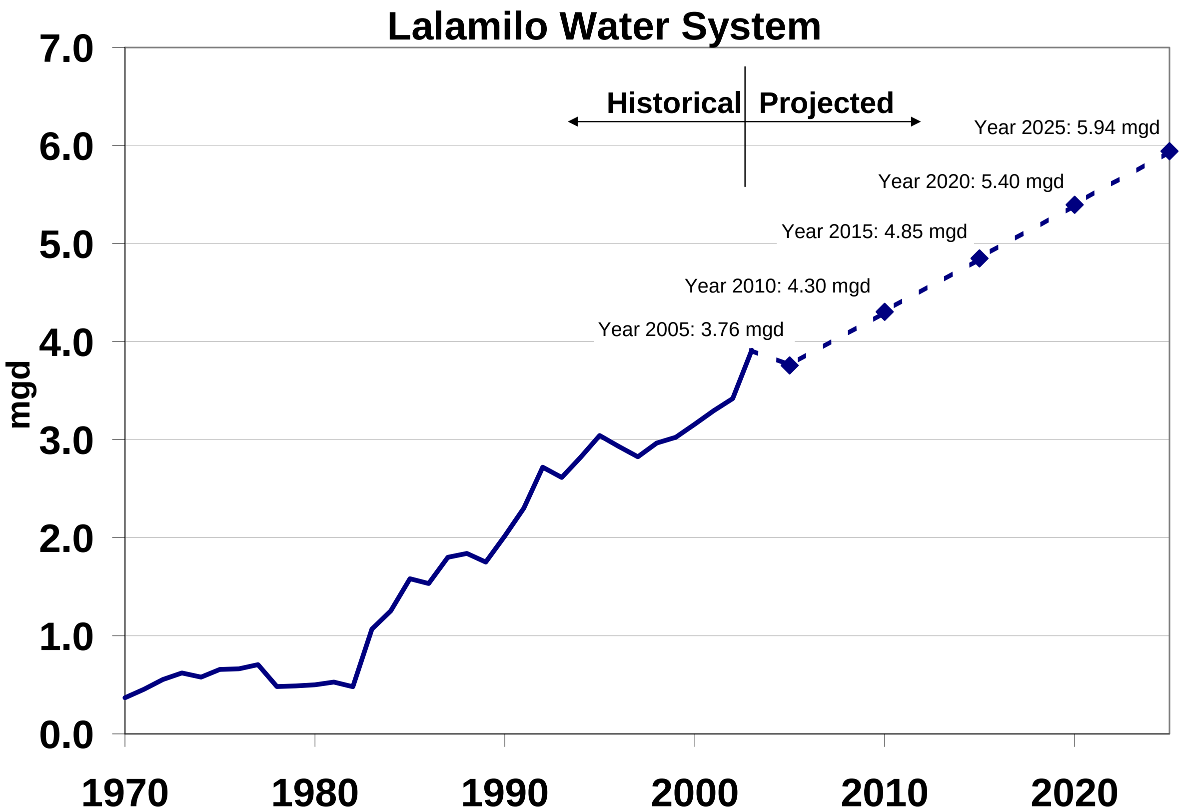


* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.
** "N-P" represents the nonpotable component of the demand.

803.4.5 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 803-11**.

Figure 803-11: DWS Water Demand Projection – West Mauna Kea Aquifer Sector Area



Historical data and graph provided by RW Beck, Inc.

Over half of the Lalamilo Water System, and a small part of the Waimea Water System are within the West Mauna Kea ASEA, therefore, the former was included in the graph above; the latter was not. Projections based on historical DWS water consumption data and projections based on population growth rate cannot be compared as representation of the same area; however, the rate of increase based on population projections are significantly greater than the historical growth rate of the demand.

803.5 RESOURCE AND FACILITY RECOMMENDATIONS

803.5.1 Water Source Adequacy

803.5.1.1 Full Build-Out

Full build-out water demands associated with the maximum density of LUPAG land uses are not sustainable. If agricultural demands are not included, the LUPAG full build-out water demand requires over twice the sustainable yield (SY) of the West Mauna Kea Aquifer Sector Area (ASEA), and nearly eight times the SY if worst case agricultural demands are included. The existing zoning is legally developable, and requires nearly 60 percent of the existing sustainable yield if agricultural demands are not included, and over six times the SY if worst case agricultural demands are included.

803.5.1.2 Twenty-Year Projection

The 2025 water demand projection is nearly 60 percent of the SY not including agricultural demands, and over 80 percent of the SY if worst case agricultural demands are included. Existing water demands range between 32 and 46 percent of the SY of the sector area.

803.5.2 Source Development Requirements

803.5.2.1 Supply-Side Management

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

803.5.2.1.1 Conventional Water Resource Measures

803.5.2.1.1.1 Ground Water

Measurements of the chloride content and height of the basal aquifer in the vicinity of the Lalamilo well field indicate that the quality and potential of this source is lower than the adjoining Waikoloa well field; however, the two Parker wells have shown good results. Kawaihae wells also have a high chloride content and indicate the presence of a geothermal anomaly. Nearby irrigation wells used by Mauna Kea Properties showed high chlorides. These may be reactivated if needed; however, production must be viewed with caution, because the high chloride content may be an indication that the potable basal aquifer is overdrawn.

Impact on the basal aquifer is of high concern because of the proximity of the wells to each other and the large volumes of withdrawal. Although pumpage is not reported to the CWRM, Mauna Kea Properties owns five wells classified as “Irrigation.” Mauna Lani Resort owns three wells classified as “Irrigation,” one of which reports pumpage. Overpumping of the lower level brackish water wells could possibly cause salt water intrusion into the freshwater lens and adversely affect the salinity of the nearby potable water wells. Additional nonpotable wells will need to be carefully placed and monitored.

Exploration should be continued to determine the extent and volume of high level water. The WRPP indicates that high level dike water occurs at great depth in the Hamakua formation towards the crest of Mauna Kea. The Waikii Ranch wells at elevation 4,350 feet above sea level, tap high level water at an elevation over 1,500 feet above sea level.

803.5.2.1.1.2 Surface Water

The Waikoloa Stream and associated tributaries generally run parallel to Kawaihae Road, flowing into the ocean on the north side of the Mauna Kea Resort. The proximity to development areas suggests it is a promising resource for both potable and nonpotable uses. The stream is intermittent at lower elevations. The USGS has several gauges on the stream and its tributaries. Additional stream flow studies would be required to evaluate the potential as a water resource.

803.5.2.1.1.3 Water Transfer

Water already is being transferred both out of and into the West Mauna Kea ASEA. All of the source wells for both the DWS Lalamilo Water System (WS) and the private Waikoloa System are located in the West Mauna Kea ASEA. Both systems supply developments in the Northwest Mauna Loa ASEA (807). Conversely, the well and stream sources supplying the DWS Waimea WS, part of which is in the West Mauna Kea ASEA, are in the Kohala ASEA (801). ASEA 801 has an abundance of both groundwater and surface water. The Waimea and Lalamilo WSs are interconnected by a valved connection. Development of sources in the ASEA 801 and subsequent transfer to the DWS Lalamilo WS within the West Mauna Kea ASEA could be easily accomplished.

803.5.2.1.2 Alternative Water Resource Enhancement Measures

803.5.2.1.2.1 Rainwater Catchment Systems

West Mauna Kea is one of the drier sector areas on the island. Although areas in Waimea near the northeastern boundary receive upward of 50 inches per year, most of the area in the sector receives less than 30 inches per year, which is not enough to sustain rainwater catchment systems.

803.5.2.1.2.2 Wastewater Reclamation

The two wastewater reclamation facilities currently produce 0.315 mgd and are expandable to 0.7 mgd. Effluent from the facility at Mauna Kea Resort is currently combined with brackish water to irrigate the golf course. Future irrigation uses are likely to follow increased development of the resort. Proximity to the facility may not be enough to promote usage, as the purveyor currently charges $0.35 per 1,000 gallons. Reclaimed wastewater from the Waimea

WRF used on Parker Ranch's pasture lots is expected to continue, however additional usage will depend on development in the immediate vicinity requiring nonpotable water.

803.5.2.1.2.3 Desalination

Desalination is a potential source of potable water from brackish wells in the lower lying areas. Chloride content of existing nonpotable wells is generally less than 500 ppm, which would be suitable for desalination. Typically, brackish water with chlorides less than 5,000 ppm is desirable for desalination. As described previously, brackish water should not be overdrawn, therefore the quantity of water available for desalination may be limited. Minimization of pumping costs would be desired to make this alternative feasible, thus restricting the service area to coastal regions such as Mauna Kea Resort and Kawaihae.

803.5.2.2 Demand-Side Management

803.5.2.2.1 Development Density Control

Full build-out of LUPAG demands nearly four times the amount of water than full build-out of Zoning, largely due to the greater proportion of Urban area in LUPAG. Additionally, Urban Expansion areas comprise over half of the Urban areas. Therefore, controlling the development densities of Urban Expansion areas, as well as re-assessing LUPAG Urban area densities could greatly reduce the full build-out water demand.

803.5.2.2.2 Water Conservation

The extremely high average water use unit rate per connection in the DWS water system of over 4,000 gpd can likely be attributed to the large water users in the Mauna Kea Resort. However, DWS accounts classified as "Residential" still consume over 1,000 gpd per connection. The estimated per capita potable water usage from all sources is over 900 gpd, which is also extremely high. This suggests that either a significant quantity of water is being used by the transient population or most people are using a considerable amount of water for non-domestic purposes, such as landscaping. Clearly, there is much room for conservation by resort and residential users. Requirements for efficient irrigation equipment and practices and usage restrictions during drier and warmer periods may be implemented. Several measures may be considered to reduce the residential unit rate consumption, including education, plumbing code regulation, and a rate structure deterring excessive water use. These measures may be more strictly enforced, justified by the climate and limited potable water sources.

Unaccounted water amounts to less than 10 percent of the source water produced in the Waimea WS, therefore supply-side conservation measures to reduce losses would not have a significant impact compared to the associated costs.

803.5.3 Recommended Alternatives

Development of potable basal groundwater should proceed with caution in the Lalamilo WS, and confirmation of its availability should precede expansion of the service area and/or demand in the system. Consistent with the Utility Courses of Action recommended in the General Plan, alternative sources of water for the Lalamilo WS should be sought. Studies should be initiated evaluating these potential alternative sources. Alternatives may include the following: development of sources in the Waimea area within the Kohala ASEA (801) and transfer of water via the Waimea WS, development of surface water sources from the Waikoloa Stream, and desalination of brackish water from low lying wells.

Demand-side water conservation programs should be implemented with the goal of reducing residential unit consumption rates closer to the island average.

The concept of utilizing the highest quality water for the highest end use should continue to be followed. Such is evident in the resort complexes where reclaimed wastewater and brackish water is already used for irrigation purposes. These sources should be expanded as additional irrigation requirements arise. The feasibility of a nonpotable water system within the resort should also be explored. A study of the potable water system within the resort would be prudent, with the objective of identifying potential areas where potable water consumption can be reduced and/or replaced.

804 NORTHEAST MAUNA LOA AQUIFER SECTOR AREA

804.1 SECTOR AREA PROFILE

804.1.1 General

The Northeast Mauna Loa Aquifer Sector Area (ASEA) includes the Hilo [80401] and the Keeau [80402] Aquifer System Areas (ASYA). Geographically, the sector area covers a rectangular area from a western limit along the summit of Mauna Loa to the base of Mauna Kea to the coastline stretching from Hilo Bay south to Keeau. The sector includes the southern halves of the North Hilo and South Hilo districts, as well as northernmost slices of the Puna and Kau districts. The bulk of urban Hilo and Keeau fall within this sector area.

Coastal areas average less than 150 inches a year in rainfall increasing to over 250 inches per year in the higher elevations of Kaumana. Near the summit of Mauna Loa, rainfall averages less than 15 inches per year. The sustainable yield (SY) of the Hilo ASYA is 347 mgd, and the SY of the Keeau ASYA is 393 mgd, combining for a total SY of 740 mgd for the entire sector area, the highest of all aquifer sector areas on the island.

804.1.2 Economy and Population

804.1.2.1 Economy

Hilo is the center of business, industry and government in Hawaii County. Although visitor accommodations have steadily declined in the last 30 years, Hilo still attracts upward of 30 percent of the County's visitors. The continued growth of the cruise ship industry, with annual expenditures in the $20 million range, has also made a significant impact on the economy. Other major sources of income include the international airport, the University of Hawaii at Hilo, and two shopping centers. Manufacturing operations, such as the processing of fruit, food and livestock, and garment manufacturing are also located in Hilo.

Sugar used to be the largest single industry in the South Hilo district. Today, the commercial growing of ornamental plants is the most significant agricultural product, accounting for over half of the County's revenues from flowers and nursery products. Bananas and papayas are also significant agricultural products.

According to the General Plan, "Hilo with its population size, harbor and airport facilities, higher education complex, and new investment has potential for economic growth. However, many public facilities…rely heavily on state funds and must compete with other areas of the State," and "New economic based activities in East Hawaii are needed if the City is to continue its role as the island's commercial and service center in the future." The General Plan indicates several projects that could boost the economy, including improvements to Saddle Road, and a post-harvest fruit treatment plant and a call center, both already in operation.

804.1.2.2 Population

Most of the population contributing to the demands from the Northeast Mauna Loa ASEA is within the South Hilo District, specifically within urban Hilo. Much of the growth within the sector occurred in the Puna District due to the affordability of residences outside Hilo and the job opportunities in Hilo.

Table 804-1: Historical Population

1980	1990	2000	1980-90 % Change	1990-2000 % Change
37,559	40,860	44,707	8.8	9.4

Data Source: 2000 U.S. Census
Data redistributed and evaluated for Northeast Mauna Loa Aquifer Sector Area

Table 804-2: Population Projection

Growth Rate	2000	2005	2010	2015	2020	2000-10 % Change	2010-20 % Change
A – Low	44,707	44,341	45,995	47,699	49,622	2.9	7.9
B – Medium	44,707	44,483	46,401	48,402	50,614	3.8	9.1
C – High	44,707	46,339	49,311	52,203	55,171	10.3	11.9

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

804.1.3 Land Use

804.1.3.1 Hawaii County General Plan

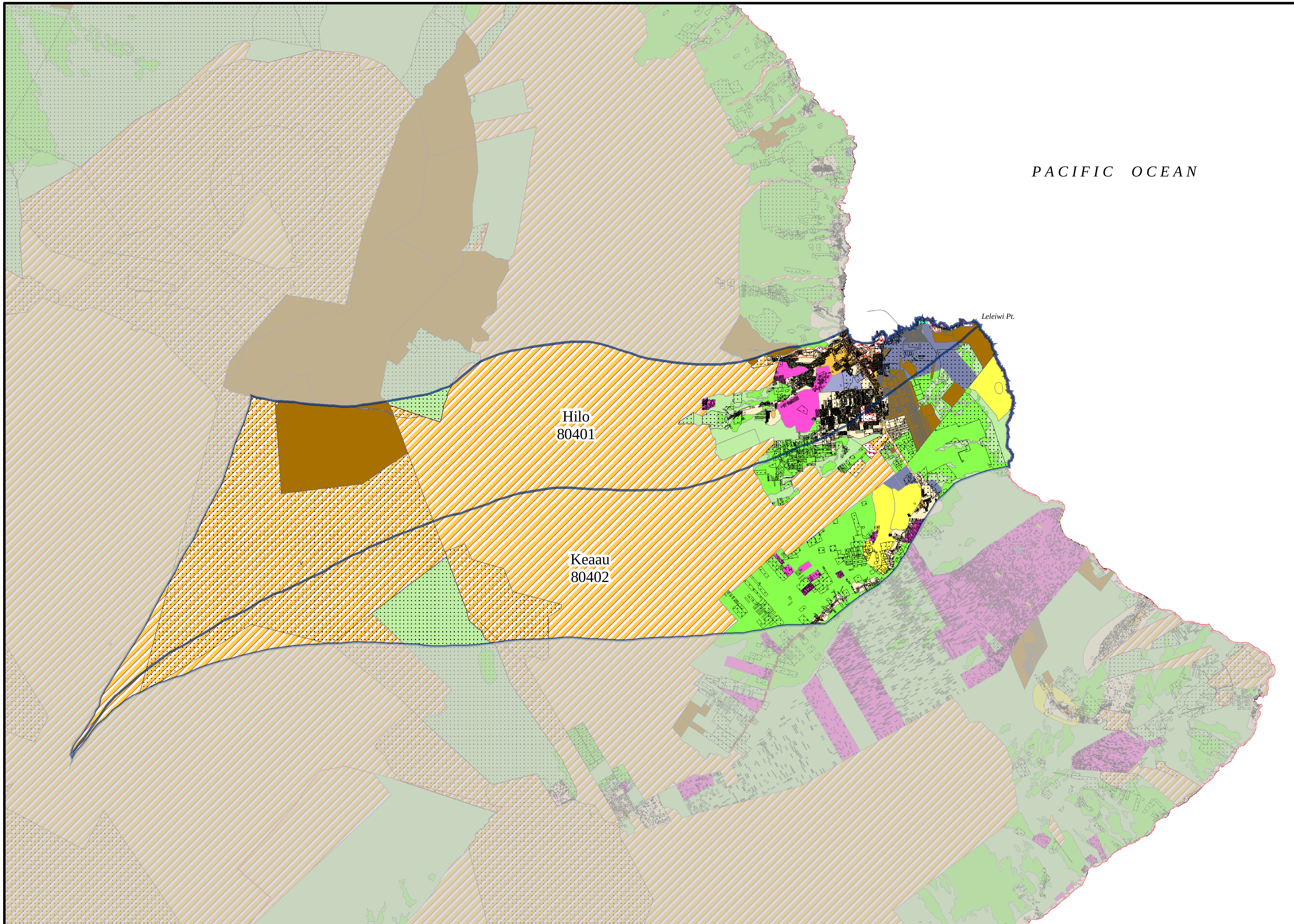
The Hawaii County General Plan Land Use Pattern Allocation Guide Map (LUPAG) for the Northeast Mauna Loa ASEA is shown on **Figure 804-1**. The estimated land use allocation acreage for each LUPAG designation within the sector area is listed in **Table 804-3**.

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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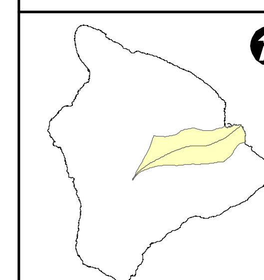
Miles



INDEX MAP - Island of Hawaii

FIGURE 804-1

AQUIFER SECTOR
N.E.MAUNA LOA - 804

Aquifer Systems

Hilo - 80401
Keaau - 80402

2005 Revised General Plan Land Use Pattern Allocation Guide

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

Table 804-3: LUPAG Map Estimated Land Use Allocation Acreage – Northeast Mauna Loa Aquifer Sector Area

LAND USE PATTERN	ACREAGE	% of TOTAL
High Density Urban	850	0.3
Medium Density Urban	1,396	0.6
Low Density Urban	9,350	3.7
Industrial	4,836	1.9
Important Agricultural Land	17,591	7.1
Extensive Agriculture	26,241	10.5
Orchard	0	0
Rural	3,377	1.4
Resort/Resort Node	77	0.0
Open	1,364	0.6
Conservation	178,453	71.6
Urban Expansion	4,922	2.0
University Use	667	0.3
TOTAL	249,124	100.0

The water utility courses of action for South Hilo and Puna in the Hawaii County General Plan relevant to the Northeast Mauna Loa ASEA are as follows:

(a) *Continue to implement water system maintenance and improvement programs in order to provide the city with a dependable and consistently safe drinking water supply.*
(b) *Investigate groundwater sources in the Upper Waiakea Uka area.*
(c) *Further investigate future groundwater sources.*
(d) *Investigate additional groundwater sources in the Olaa area.*

804.1.3.2 Hawaii County Zoning

Hawaii County Zoning for the Northeast Mauna Loa ASEA is shown on **Figure 804-2**. The estimated land use allocation acreage for each zoning class within the Northeast Mauna Loa ASEA is listed in **Table 804-4**.

Table 804-4: County Zoning Estimated Class Allocation Acreage – Northeast Mauna Loa Aquifer Sector Area

ZONING CLASS	ACREAGE	% of TOTAL
Single Family Residential	5,635	2.3
Multi-Family Residential (including duplex)	278	0.1
Residential-Commercial Mixed Use	0	0.0
Resort	125	0.1
Commercial	456	0.2
Industrial	2,662	1.1
Industrial-Commercial Mixed	56	0.0
Family Agriculture	48	0.0
Residential Agriculture	473	0.2
Agriculture	57,992	23.3
Open	6,839	2.7
Project District	0	0.0
Forest Reserve	171,792	68.9
(pond)	45	0.0
(river)	11	0.0
(road)	2,730	1.1
TOTAL	249,142	100.0

804.2 EXISTING WATER RESOURCES

804.2.1 Ground Water

Northeast Mauna Loa ASEA has a sustainable yield of 740 mgd. According to the CWRM database, there are 41 production wells in the sector area, including 15 municipal, 1 irrigation, 19 industrial, 5 other, and 1 domestic. There are also 16 wells drilled and categorized as “unused.” Refer to **Appendix B** for this database. **Figure 804-3** shows the well locations.

804.2.2 Surface Water

There are 3 streams classified as perennial in the Northeast Mauna Loa ASEA, the Wailuku River, the Wailoa River, and the Kaahakini Stream. The USGS has 3 active surface water gages in the sector area, which were listed in **Table 1-8**. Two of the gages are on the Waiakea Stream, which flows into the Wailoa River.

There are 10 declared stream diversions in CRWM database listed in **Table 804-5** and shown on **Figure 804-4**. The only two diversions with declared flows are those owned by DWS.

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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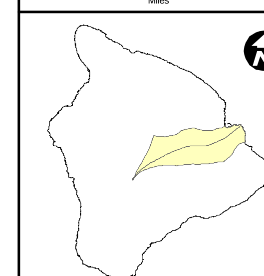
Miles



INDEX MAP - Island of Hawaii

FIGURE 804-2

AQUIFER SECTOR
N.E. MAUNA LOA - 804

Aquifer Systems
Hilo - 80401
Keaau - 80402

County Zoning

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

Figure 804-3 Well and Tunnel Location

MAP CURRENTLY NOT AVAILABLE ON-LINE

Figure 804-4 Streams & Diversions

MAP CURRENTLY NOT AVAILABLE ON-LINE

Table 804-5: Stream Diversions – Northeast Mauna Loa Aquifer Sector Area

FILE REFERENCE	TMK	STREAM NAME	
CALDWELL P	2-3-015:010	Waiuku River	Stream diversion, pipe from Waikapu Stream.
HAWAII ELEC LT	2-3-027:003	Wailuku River	Stream diversion, Puueo Hydro Intake. Declared Q was estimated by the declarant from the number of kilowatt hours produced.
HAWAII DWS	2-5-009:012	Kahoama	Stream diversion, pipe from Kahoama Stream. Declared Q = 4.6 MGD.
MAKANUI C	2-5-014:042	Unnamed Spring	Spring div, trench from Unnamed spring.
WENKO ENERGY	2-5-024:016	Unnamed/ Unmapped	Stream diversion for hydro plant, ditch at upper end of property takes water from Ainako Stream, flows to Hydro plant on property and returns water to stream at the lower end of the property.
OKINO PAE	2-5-025:003	Unnamed/ Unmapped	Stream diversion, channel though yard and back to stream. Diversion is a small inlet from the stream to the garden. Water returns to the stream a short distance downstream at edge of parcel.
HAWAII ELEC LT	2-6-009:025	Wailuku River	Stream diversion, Waiau Hydro Intake. Declared Q was estimated by the declarant from the number of kilowatt hours produced.
HAWAII DWS	2-6-018:004	Hookelekele	Stream diversion, pipe from Hookelekele Stream. Declared Q = maximum of 5.0 MGD.
MALU AINA FARM	1-7-002:002	Unnamed/ Unmapped	Stream diversion, Waterway #2 through parcel (new entry).
MALU AINA FARM	1-7-002:002	Unnamed/ Unmapped	Stream diversion, Waterway #3 through parcel (new entry).

804.2.3 Reclaimed Wastewater

There are no wastewater reclamation facilities within the Northeast Mauna Loa ASEA.

804.3 EXISTING WATER USE

804.3.1 General

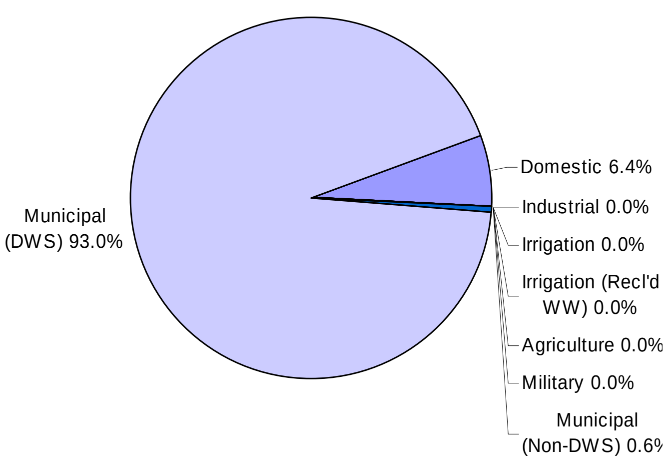
The total estimated average water use within the Northeast Mauna Loa ASEA from November 2004 through October 2005 based on DWS meter data, available GIS data, estimates from the *2003 SWPP*, and CWRM pumpage data is listed in **Table 804-6** and summarized in **Figure 804-5** in accordance with CWRM categories and indicate 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. The quantity listed under the “Industrial (recharge)” category represents brackish groundwater drawn at the HELCO Hill and Puna Plants and recharged back to the aquifer by injection. This quantity is not counted towards the existing or projected water use.

Table 804-6: Existing Water Use by Categories – Northeast Mauna Loa Aquifer Sector Area

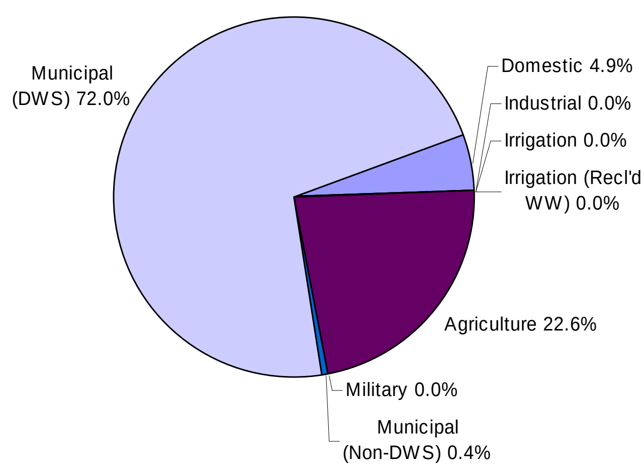
CWRM Water Use Category	Water Use (MGD)	Percent of Total without Ag*	Percent of Total with Ag*
Domestic	0.41	6.4	4.9
Industrial	0.00	0.0	0.0
Industrial (recharge)	44.95	N/A	N/A
Irrigation	0.00	0.0	0.0
Reclaimed WW	0.00	0.0	0.0
Agriculture	1.87	0.0	22.6
Military	0.00	0.0	0.0
Municipal			
DWS System	5.96	93.0	72.0
Private Public WS	0.04	0.6	0.4
Total without Ag*	6.41	100.0	
Total with Ag*	8.27		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 804-5: Existing Water Use by Categories – Northeast Mauna Loa Aquifer Sector



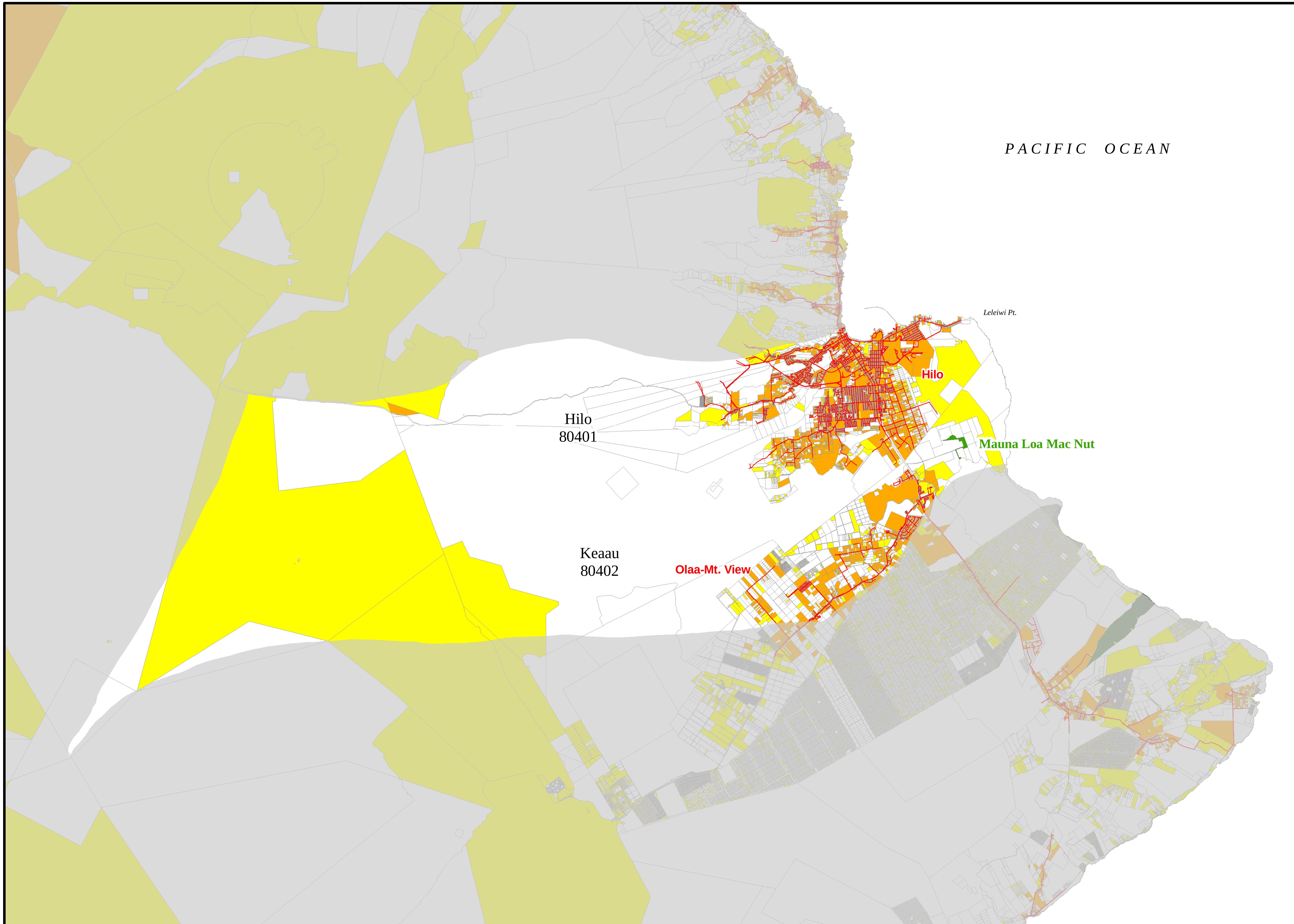
w/o Agricultural Water Use*



with Agricultural Water Use*

* 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.

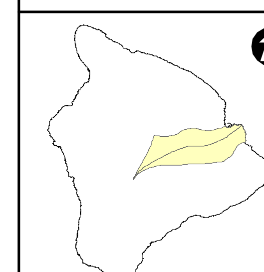
Figure 804-6 generally shows the service area for the various water systems and indicates the extent of the DWS water system.



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 804-6

AQUIFER SECTOR
N.E. MAUNA LOA - 804
Aquifer Systems
Hilo - 80401
Keaau - 80402

Water System and Service Area

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

804.3.2 Domestic Use

Domestic use or water use by individual households is assumed to be supplied by private individual rainwater catchment systems or private wells. Based on available GIS data, there are over 1,000 such developed parcels, which is approximately 2,800 people, or 6 percent of the sector area population. The estimated demand is 0.41 mgd. The single well classified as "Domestic" in the CWRM database does not report pumpage.

804.3.3 Industrial Use

HELCO has seven wells for use at their Hill power generation plant south of Hilo International Airport. Two wells reported to the CWRM a pumpage of 36.7 mgd for use in the Hill 5 and Hill 6 steam turbines. HELCO also has three wells dedicated to the Puna Generating Plant in Keeau used for cooling. One well reported a pumpage of 8.3 mgd. Because the extracted water for both plants is returned to the aquifer via injection wells, the pumpage from these wells were not included in the existing and 20-year projected demand. HELCO has three Shipman wells that extract saltwater for cooling, and possesses an NPDES permit to pump the water back into Suisan Harbor.

Jas Glover Limited owns two wells categorized as "Industrial" in the CWRM database for use at the Glover Quarry; however, pumpage has not been reported.

There are three hydropower plants located on the Wailuku River northeast of Hilo. HELCO's Waiau and Puueo plants each utilize a single stream diversion to power their 2 turbines. The Wailuku River Hydroelectric Power Company sells to HELCO power generated at their 11 MW facility located at the junction of the Wailuku River and the Kaloheahewa Stream. Wenko Energy Company utilizes a stream diversion on the Ainako Stream, a tributary to the Wailuku River, for its hydropower plant and also sells power to HELCO.

804.3.4 Irrigation Use

There are two golf courses in the sector area, the Hilo Municipal Golf Course and the Naniloa Country Club. Both courses are within the service area of DWS Hilo Water System. Irrigation systems are not necessary due to the ample rainfall in the region. Fire trucks are used in the unlikely event of a drought. There are no known irrigation uses dedicated to other landscaping activities.

804.3.5 Agricultural Use

There is no flow data available on Agricultural use within the sector area. The abundance of rainfall in the sector provides sufficient moisture for most crops. There is a small amount drawn from the DWS Hilo Water System from accounts classified as "Agricultural".

Malu Aina Farm is a 22-acre spiritual retreat also engaging in organic farming and aquaculture, located southwest of Kurtistown on the border of the Northeast Mauna Loa and the Kilauea

ASEAs. According to the CWRM database, the farm has three stream diversions, two of which are in the sector area, and listed previously in **Table 804-5**. The farm grows a wide variety of fruits and vegetables.

804.3.6 Military Use

There is no military use in the Northeast Mauna Loa ASEA.

804.3.7 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.

804.3.7.1 County Water Systems

The DWS has 2 water systems in the Northeast Mauna Loa ASEA.

The Hilo Water System is the largest on the island, serving all of urban Hilo and surrounding areas, extending north to Honolii, south to Panaewa, and west to Kaumana City and Waiakea Homesteads. Seven deep well sources are utilized. These include three Piihouna Wells along Waianuenue Ave, and three Panaewa Wells off of Hawaii Belt Highway. The Piihonuna Wells service the northern portion of the system, while the Panaewa Wells service the southern portion. The Saddle Road A Well servicing the Panaewa area became operational in 2002. The system was formerly supplied by several spring and surface water sources that are no longer in service, including the Waiakea-Uka Tunnels, Olaa Flume Spring, Lyman Spring, Kaohama Intake, Pukamaui Intake and Lauole Intake. The Hilo WS also supplements the adjacent Papaikou system.

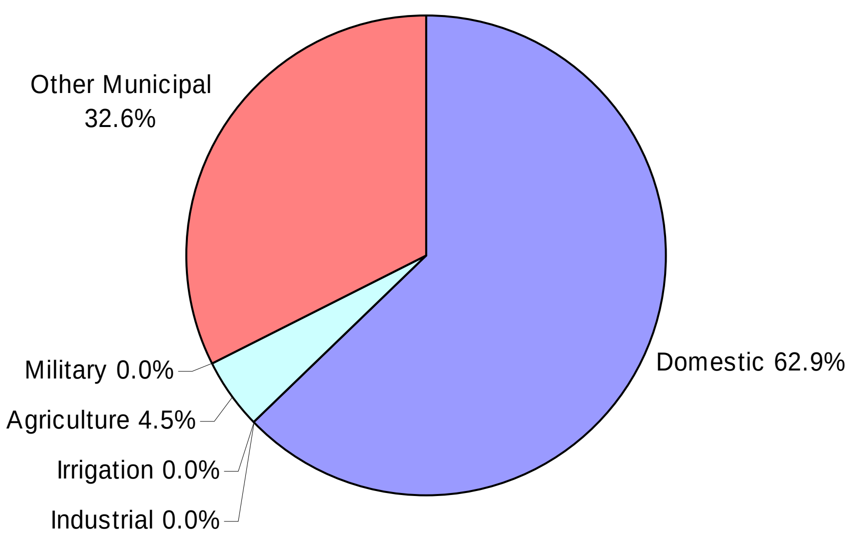
The Olaa-Mt. View Water System is located in the Puna District along Hawaii Belt Road from Keeau to the Olaa Reservation Lots, and along Keeau-Pahoa Road, servicing areas in the Kilauea ASEA. The system's sources are two deep Keeau Wells at the former Puna Sugar Mill, and one deep well, Olaa 3, further south along Hawaii Belt Road. Water is pumped through a series of eight booster pump stations and storage tanks spanning 11 service areas.

DWS water use is subcategorized in **Table 804-7** to the extent possible based on available meter data and is depicted in **Figure 804-7**. "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 804-7: DWS Existing Water Use by Categories – Northeast Mauna Loa Aquifer Sector Area

CWRM Water Use Category	DWS Purveyed Water Use (MGD)	Percent of Total
Domestic	3.75	62.9
Industrial	0.00	0.0
Irrigation	0.00	0.0
Agriculture	0.27	4.5
Military	0.00	0.0
Other Municipal	1.94	32.6
Total	5.96	100.0

Figure 804-7: DWS Existing Water Use by Categories – Northeast Mauna Loa Aquifer Sector Area



804.3.7.2 State Water Systems

The Kulani Correctional System is owned by the Department of Public Safety (DPS). It is located in Kulani, off Stainback Highway. The source of water is a rubber lined sloped catchment area covering approximately 5 acres. The water is stored in an open rubber lined 5.0 mgd reservoir and treated with a packaged treatment plant. The distribution system includes a 0.36 MG steel storage tank and 12-inch and 8-inch watermains, serving the camp facilities which include dormitories, administration building, kitchen, mess hall, laundry boiler, saw mill, garage, gym, lumber shed, woodwork shop, program building and craft display. The estimated consumption according to the SWPP based on an inmate population of 217 and a staff of 85 is 0.037 mgd, with a maximum day demand of 0.06 mgd.

804.3.7.3 Federal Water Systems

There are no Federal water systems in the Northeast Mauna Loa ASEA regulated by the DOH.

804.3.7.4 Private Public Water Systems

The Mauna Loa Macadamia Nut Water System is the only private public water system in the sector area regulated by the DOH. The water system is located on a 114-acre parcel of land southeast of Hilo, which has a visitor center, processing plant, snack bar and gift shop. There is also a “nature walk” showcasing the trees and plants that produce various fruits and vegetables. The primary well source has a pumping capacity of 350 gpm and the secondary source has a capacity of 500 gpm. The system is disinfected with sodium chloride and utilizes a 5,000 gallon hydropneumatic tank. DOH records indicate that there are 4 service connections serving a population of 100. The wells did not report pumpage to the CWRM.

804.3.8 Water Use by Resource

804.3.8.1 Ground Water

Table 804-8 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 804-8: Sustainable Yield – Northeast Mauna Loa 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 (%)
		59.05	**62.95**	**94.43**	**740**	**7.98**	**8.51**	**12.76**
80401	Hilo	42.78	42.15	63.22	347	12.33	12.15	18.22
80402	Keeau	16.27	20.81	31.21	393	4.14	5.29	7.94

804.3.8.2 Surface Water

Malu Aina Farm described in Section 804.3.5 uses two stream diversions, however flow data is not available.

804.3.8.3 Rainwater Catchment

Water consumption calculated for developed parcels that are not supplied by groundwater or surface water is assumed to be supplied by rainwater catchment. The water use categorized as Domestic Use previously in **Table 804-6** is assumed to be supplied by individual catchment systems.

Kulani Correctional Facility described previously in Section 804.3.7.2 utilizes a rainwater catchment system. According to the *2003 SWPP*, the design capacity is 0.024 mgd, which does not meet the estimated demand.

The Malu Aina Farm uses rainwater catchment tanks for its potable water supply, however consumption data is not readily available.

804.3.8.4 Reclaimed Wastewater

There are no wastewater reclamation facilities within the Northeast Mauna Loa ASEA.

804.4 FUTURE WATER NEEDS

804.4.1 General

Table 804-9 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 804-9: 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 N.W. Mauna Loa ASEA	740	118.6	26.3	6.4	6.7	7.0	7.3	7.7
80401 – Hilo ASYA	347	69.2	21.9	4.7	4.8	4.9	5.0	5.2
80402 – Keeau ASYA	393	49.4	4.4	1.7	1.9	2.1	2.3	2.5
With Agricultural Demand*	**SY (mgd)**	**LUPAG (mgd)**	**Zoning (mgd)**	**Growth Rate B Demand Projections (mgd)**				
				2005	**2010**	**2015**	**2020**	**2025**
Total N.W. Mauna Loa ASEA	740	202.6	107.4	8.3	8.7	9.2	9.8	10.4
80401 – Hilo ASYA	347	70.7	28.0	4.7	4.8	4.9	5.1	5.2
80402 – Keeau ASYA	393	132.0	79.4	3.6	3.9	4.3	4.7	5.2

* 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.

For both aquifer system areas, full build-out and 2025 projection water demands excluding agricultural demands are a small fraction the SY. Therefore, analysis of the three demand scenarios does not need to be broken down by aquifer system areas and thus will be presented for the aquifer sector area only.

804.4.2 Full Build-Out Water Demand Projections

The full build-out water demand projections based on the General Plan and County Zoning for the Northeast Mauna Loa ASEA are listed in **Tables 804-10** and **804-11**, and reflect refinement as discussed below. Each land use class is associated with the most appropriate CWRM water use category.

Table 804-10: Hawaii County General Plan Full Build-Out Water Demand Projection – Northeast Mauna Loa Aquifer Sector Area

LUPAG Class	CWRM Category	Water Demand (mgd)
Urban	Domestic/Irrigation/Municipal	64.7
Urban Expansion	Domestic/Irrigation/Municipal	29.6
Resort	Irrigation/Municipal	1.3
Industrial	Industrial	17.0
Agriculture	Agriculture	84.0
University	Irrigation/Municipal	2.7
Rural	Irrigation/Municipal	1.4
DHHL	Irrigation/Municipal	2.0
TOTAL w/o Ag*		118.6
TOTAL w/ Ag*		202.6

* 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 804-11: County Zoning Full Build-Out Water Demand Projection – Northeast Mauna Loa Aquifer Sector Area

Zoning Class	CWRM Category	Water Demand (mgd)
Residential	Domestic/Irrigation/Municipal	11.0
Resort	Irrigation/Municipal	2.9
Commercial	Municipal	1.0
Industrial	Industrial	9.4
Agriculture	Agriculture	81.2
DHHL	Irrigation/Municipal	2.0
TOTAL w/o Ag*		26.3
TOTAL w/ Ag*		107.4

* 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.

804.4.2.1 Refine Land Use Based Projection

804.4.2.1.1 State Water Projects Plan

The total projected demand to the year 2020 for 46 State Water Projects within the sector area is 4.60 mgd, using 0.86 mgd potable, 3.69 mgd nonpotable, and 0.05 nonpotable using potable sources. These demands may account for approximately 30 percent of the total water demand in the sector area. The projects that will generate the most significant demands, with the exception of DHHL projects, which are covered separately, are listed in **Table 804-12**. Projects with large demands greater than 1 mgd may require State funding to develop resources and infrastructure necessary to provide water service.

Table 804-12: Future State Water Projects to Generate Significant Demands

Project Name	Primary Use	State Department	2020 Demand (mgd)
Pacific Aquaculture and Coastal Resources Center	Nonpotable	University of Hawaii	1.65
Pacific Aquaculture and Coastal Resources Center, UHH Farm @ Panaewa	Nonpotable	University of Hawaii	0.75
Panaewa Farm Well and Pump	Nonpotable	University of Hawaii	0.35

804.4.2.1.2 State Department of Hawaiian Home Lands

The Keaukaha-Waiakea-Panaewa Tracts are located in urban Hilo between Hilo Bay and the Puna boundary. The Keaukaha Tract is a mostly vacant 1,700-acre area divided into two tracts along the northeast coast of Hilo Bay. The Waiakea-Panaewa Tract is south of Hilo airport with existing residential and farm lots. New post-1994 land transfers include the Old Airport Terminal, the National Guard Tract and the Puna Boundary lots. The proposed land uses are a combination of residential, agricultural and industrial uses. The total estimated demand for the tracts is 2.01 mgd, which would be supplied by the DWS Hilo Water System. The *DHHL Special Report #2* indicates that the Hilo WS may currently have sufficient supply to meet part of the proposed water requirements; however, full build-out would require additional supply source to supplement the present capacity of the system.

The Hilo Scattered Lots are comprised of 83 scattered lots throughout urban Hilo. 56 lots were transferred from the State in 1994, some of which were subdivided. Water service from the Hilo Water System was already in place for most of the lots. 81 of the 83 lots are proposed for residential use, with an estimated demand of 0.04 mgd.

804.4.2.1.3 Agricultural Water Use and Development Plan

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

804.4.3 Water Use Unit Rates

Water use unit rates are based on the *Water System Standards* as discussed in Chapter 1.

804.4.4 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 Northeast Mauna Loa ASEA. The projected low, medium, and high growth rates are listed in **Table 804-13**, and are graphed in **Figure 804-8**. Potable and nonpotable water demands are also differentiated.

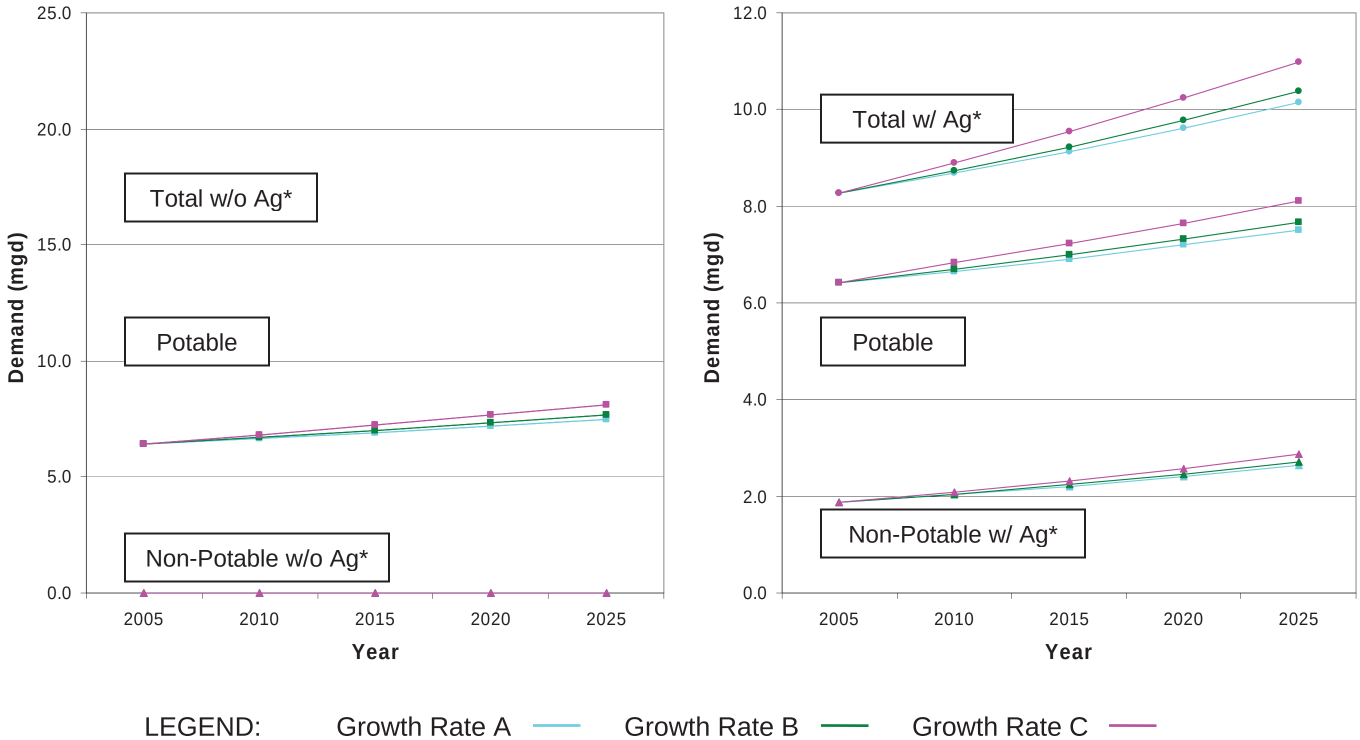
Figure 804-9 illustrates the magnitude of the sustainable yield, both LUPAG and Zoning full build-out water use, and water use projection through the year 2025 focusing on Medium Growth Rate B. **Figure 804-10** shows the breakdown of water demand projections by CWRM categories through the year 2025. **Table 804-14** summarizes these figures.

Table 804-13: Water Demand Projection – Northeast Mauna Loa 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	6.4	6.7	6.9	7.2	7.5	8.3	8.7	9.1	9.6	10.2
Potable	6.4	6.7	6.9	7.2	7.5	6.4	6.7	6.9	7.2	7.5
Nonpotable	0.0	0.0	0.0	0.0	0.0	1.9	2.0	2.2	2.4	2.7
GROWTH RATE B	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	6.4	6.7	7.0	7.3	7.7	8.3	8.7	9.2	9.8	10.4
Potable	6.4	6.7	7.0	7.3	7.7	6.4	6.7	7.0	7.3	7.7
Nonpotable	0.0	0.0	0.0	0.0	0.0	1.9	2.0	2.2	2.5	2.7
GROWTH RATE C	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	6.4	6.8	7.2	7.7	8.1	8.3	8.9	9.5	10.2	11.0
Potable	6.4	6.8	7.2	7.7	8.1	6.4	6.8	7.2	7.7	8.1
Nonpotable	0.0	0.0	0.0	0.0	0.0	1.9	2.1	2.3	2.6	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 804-8: Water Demand Projection Summary – Northeast Mauna Loa Aquifer Sector Area



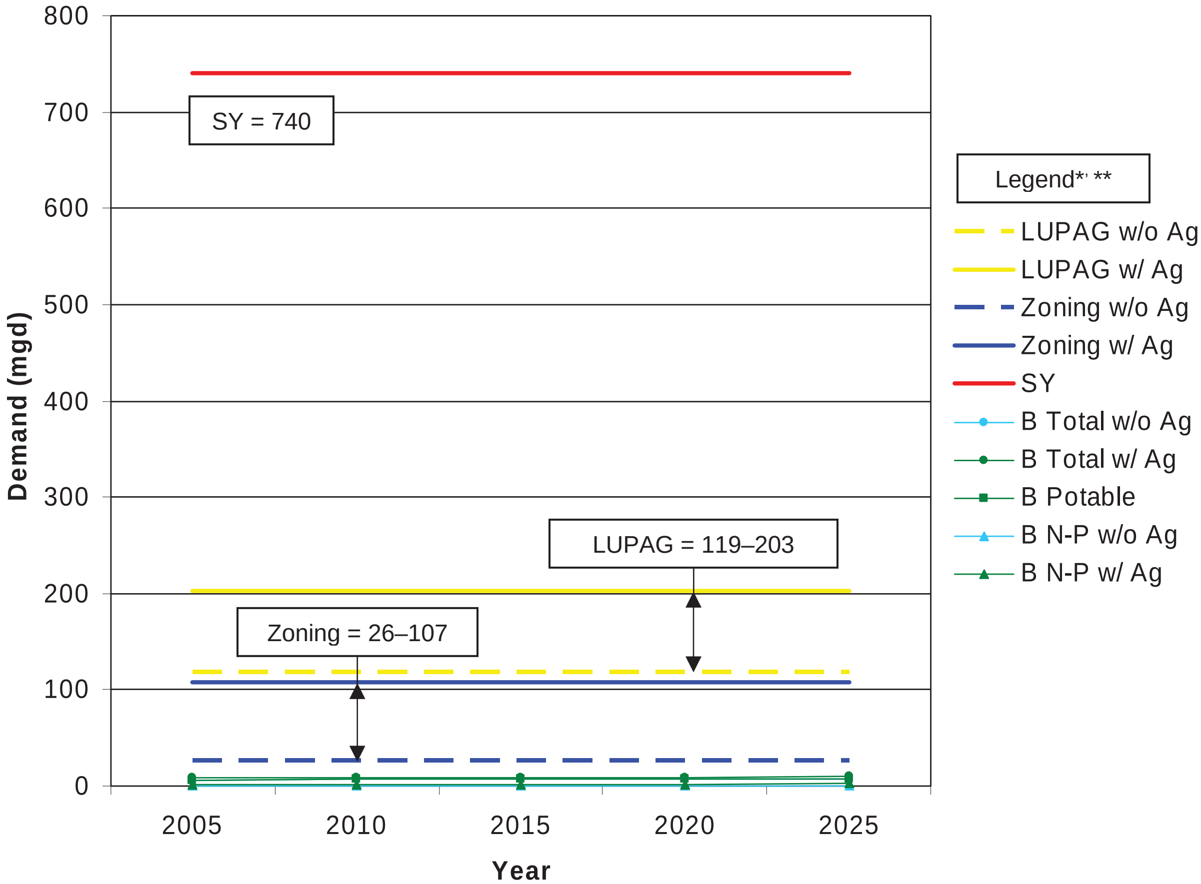
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 804-14: Medium Growth Rate B Water Demand Projection by Category – Northeast Mauna Loa Aquifer Sector Area

Water Use Category	2005 (mgd)	2010 (mgd)	2015 (mgd)	2020 (mgd)	2025 (mgd)
Total without Ag*	6.4	6.7	7.0	7.3	7.7
Total with Ag*	8.3	8.7	9.2	9.8	10.4
Domestic	0.4	0.4	0.5	0.5	0.5
Industrial	0.0	0.0	0.0	0.0	0.0
Irrigation	0.0	0.0	0.0	0.0	0.0
Agriculture	1.9	2.0	2.2	2.5	2.7
Military	0.0	0.0	0.0	0.0	0.0
Municipal	6.0	6.3	6.5	6.8	7.2
Potable	6.4	6.7	7.0	7.3	7.7
Nonpotable w/o Ag*	0.0	0.0	0.0	0.0	0.0
Nonpotable w/ Ag*	1.9	2.0	2.2	2.5	2.7
DWS	6.0	6.2	6.5	6.8	7.1

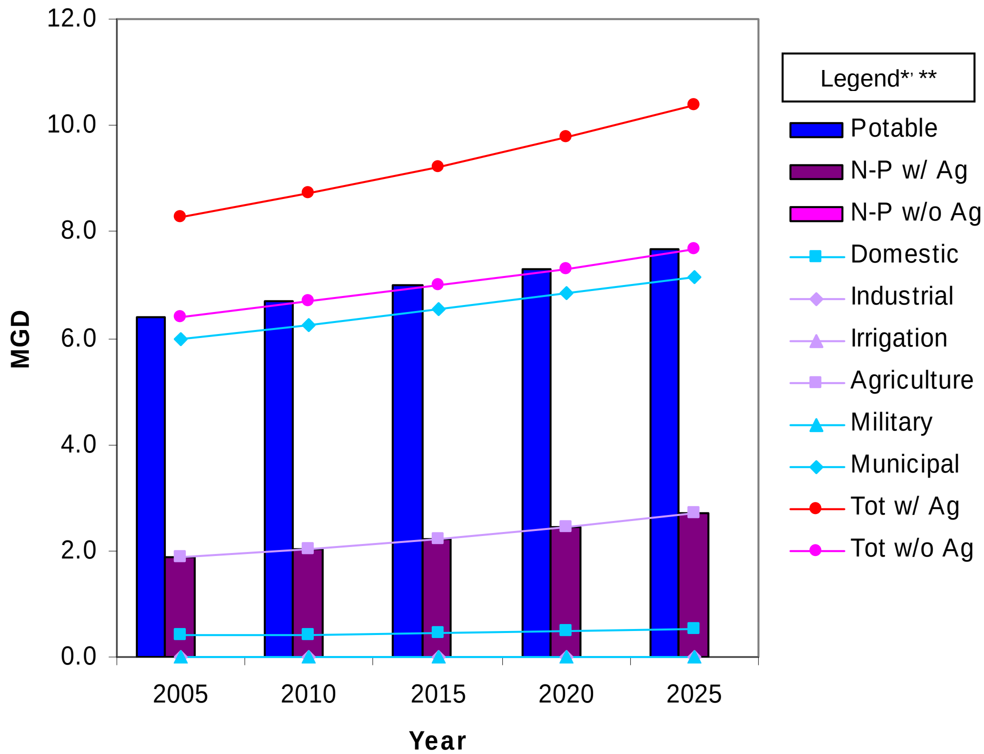
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 804-9: Medium Growth Rate B Water Demand Projections and Full Build-Out – Northeast Mauna Loa 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 804-10: Medium Growth Rate B Water Demand Projection by Category – Northeast Mauna Loa Aquifer Sector Area

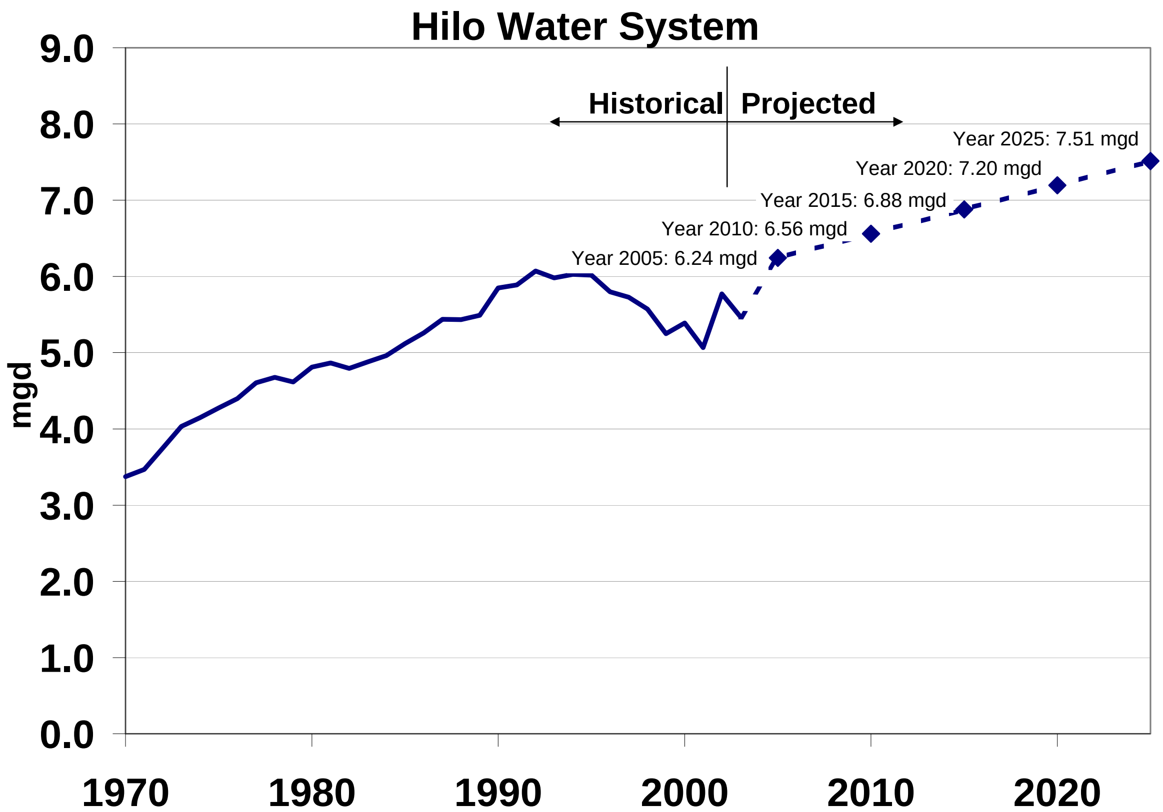


* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.
** "N-P" represents the nonpotable component of the demand.

804.4.5 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 804-11**.

Figure 804-11: DWS Water Demand Projection – Northeast Mauna Loa Aquifer Sector Area



Historical data provided by RW Beck, Inc.

Projections based on historical DWS water consumption data cannot be compared to projections based on population growth rate, because the latter includes part of the Mt. View-Olaa Water System. However, the rate of increase of the two projections is very close. DWS may need to supply potable water equivalent to as much as half of the total projected water supply for the sector area.

804.5 RESOURCE AND FACILITY RECOMMENDATIONS

804.5.1 Water Source Adequacy

804.5.1.1 Full Build-Out

Full development to the maximum density of the County General Plan and Zoning land use within the Northeast Mauna Loa Aquifer Sector Area (ASEA) can be sustained by conventional water resources. If agricultural demands are excluded, LUPAG water demands are approximately 15 percent of the sustainable yield (SY) of the sector area, and existing zoning requires approximately 3 percent of the SY. Including worst case agricultural demands, the LUPAG demand is 27 percent of the SY, and the Zoning demand is 14 percent of the SY.

804.5.1.2 Twenty-Year Projection

20-year projected water demands are approximately 1 percent of the sector area SY.

804.5.2 Source Development Requirements

804.5.2.1 Supply-Side Management

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

804.5.2.1.1 Conventional Water Resource Measures

804.5.2.1.1.1 Ground Water

At 740 mgd, the Northeast Mauna Loa ASEA has the highest sustainable yield of all aquifer sector areas on the island. According to the 1990 WRPP, it is reflective of the high annual rainfall and the infiltrability of the surface rocks. Basal water occurs several miles inland, followed by high level dike and perched water. Both sources are available in great quantities. DWS recently commissioned the Saddle Road A Well, which encountered water at an elevation of nearly 1,000 feet. Whether high level or basal sources are developed will depend on the location of future development.

The usage of nonpotable groundwater for industrial purposes at the power plants may increase if expansions to the facilities are warranted. Because most of the water drawn for industrial purposes is returned to the aquifer, it is expected that such increased usage will not adversely affect the aquifer; however, it would be prudent to confirm the effects of recharge.

804.5.2.1.1.2 Surface Water

As mentioned previously, there are several surface water sources in the sector area formerly used by DWS. New sources are not likely to be developed since groundwater is far more abundant and is less costly to develop due to the requirements for treatment and monitoring of surface water, making groundwater the preferred source. Abandoned surface water sources may be reactivated to meet localized nonpotable demands.

804.5.2.1.1.3 Water Transfer

Water transfer is already taking place; the Hilo Water System (WS) supplements the Papaikou Water System in the East Mauna Kea ASEA (802). The transfer of water is borne out of economics due to the magnitude of the Hilo WS, which can easily supplement the much smaller Papaikou WS, not because of lack of available sources in ASEA 802 in the vicinity of the Papaikou WS. Since both sector areas have ample source water, the effect of the transfer is miniscule.

804.5.2.1.2 Alternative Water Resource Enhancement Measures

804.5.2.1.2.1 Rainwater Catchment Systems

Except for the uninhabited areas towards the summit of Mauna Loa, all areas within the sector area receive enough rainfall to support rainwater catchment systems. A small percentage of domestic users already rely on catchment, and may continue to do so if extension of the municipal water system is not feasible.

804.5.2.1.2.2 Wastewater Reclamation

The magnitude of the Hilo Water System would lend nicely to a large scale wastewater reclamation facility. However, a far-reaching nonpotable reclaimed water system would likely not be implemented due to the availability of other water sources in most of the sector area, therefore usage would be confined to locations in close proximity. The need for such a facility would be contingent on development requiring a significant quantity of nonpotable water in the immediate vicinity that cannot be sustained by the ambient rainfall.

804.5.2.1.2.3 Desalination

According to the CWRM Well Database, chloride contents of existing wells up to 2 miles inland are no greater than 300 ppm. Facilities for desalination of brackish groundwater would only be considered along the coast, out of the service area of the municipal water system. Due to the high cost of desalination, extension of the existing water system is more practical.

804.5.2.2 Demand-Side Management

804.5.2.2.1 Development Density Control

Full build-out demands associated with LUPAG maximum density are over four times greater than that of Zoning. This is in part due to higher maximum density unit rates for Urban areas, and in part due to the significant amount of land designated as "Urban Expansion." However, because of the magnitude of the SY compared to the projected demands, development density control is not considered critical.

804.5.2.2.2 Water Conservation

The average water consumption per connection to the DWS water system in the sector area is 400 gpd, and the average current potable water consumption per capita from all sources is 145 gpd, both of which are exactly the island average. Demand side water conservation should continue, but further measures are not considered necessary at this point.

The Hilo Water System is the most inefficient water system on the island. Between 2001 and 2003, in the neighborhood of 50 percent of the source water produced was unaccounted for, which amounts to approximately 5 mgd. Although this is minimal in comparison to the sustainable yield of the aquifer sector area, significant long-term cost savings could be achieved by implementing supply-side conservation measures. These measures include meter inspection and replacement/repair, leak detection and remediation, and non-revenue water analysis.

804.5.3 Recommended Alternatives

Groundwater should continue to be developed as the primary potable water source in locations of anticipated development. Specifically, as recommended in the General Plan, groundwater sources should be investigated in the Waiakea Uka and Saddle Road areas.

Careful monitoring of the aquifer should accompany increased nonpotable water usage through the HELCO Wells should be due to the enormous quantity drawn and returned to the aquifer through recharge.

DWS should consider supply-side water conservation measures to reduce the unaccounted water to acceptable levels. The quantity of production water saved would be less than 1 percent of the sustainable yield; therefore, these measures would be implemented primarily for cost control.

805 SOUTHEAST MAUNA LOA AQUIFER SECTOR AREA

805.1 SECTOR AREA PROFILE

805.1.1 General

The Southeast Mauna Loa Aquifer Sector Area (ASEA) includes the Olaa [80501], Kapapala [80502], Naalehu [80503] and Ka Lae [80504] Aquifer System Areas (ASYA). It covers the south central portion of the island, primarily in the Kau District, and the northwest section of the Puna District. The boundaries extend from the summit of Mauna Loa to Mountain View in the east, along Hawaii Belt Highway to Punaluu, and along the southeastern coastline to Ka Lae.

Coastal areas have an average rainfall of 20 to 50 inches per year, while the areas approaching the summit of Mauna Loa average as little as 15 inches per year. A pocket of heavier average rainfall of 158 inches per year occurs at approximately 3,000 feet elevation between Naalehu and Pahala. Annual rainfall in the Mountain View area averages up to 196 inches. The Olaa ASYA has the highest SY of the four aquifer system areas at 124 mgd, followed by the Naalehu ASYA at 117 mgd, the Ka Lae ASYA at 31 mgd, and the Kapapala ASYA at 19 mgd. The total sustainable yield of the sector area is 291 mgd.

805.1.2 Economy and Population

805.1.2.1 Economy

Agriculture remains the anchor of Kau's economy. A variety of different products are grown primarily in the strip from Naalehu to Wood Valley, including macadamia nuts, coffee, orchids, and vegetables. The macadamia nut industry is one of the most prominent in the district, boasting Mac Farms of Hawaii in Naalehu, the world's largest macadamia nut tree orchard.

Cattle ranching is also significant, with large tracts of land utilized by several ranches, including the 1,595-acre Kahuku Ranch north of Puueo.

The main tourist destination is the Sea Mountain Resort and Golf Course Complex. Accommodations on the resort are limited to the 56-unit Colony One at Sea Mountain. Other accommodations are scarce, with bed-and-breakfast operations and the 12-unit Shirakawa Hotel in Waiohinu as the only options.

805.1.2.2 Population

Most of the population contributing to the demands from the sector area is within the Kau District. Much of the increase in population can be attributed to the growth in small communities.

Table 805-1: Historical Population

1980	1990	2000	1980-90 % Change	1990-2000 % Change
3,044	4,048	5,554	33.0	37.2

Data Source: 2000 U.S. Census
Data redistributed and evaluated for Southeast Mauna Loa Aquifer Sector Area

Table 805-2: Population Projection

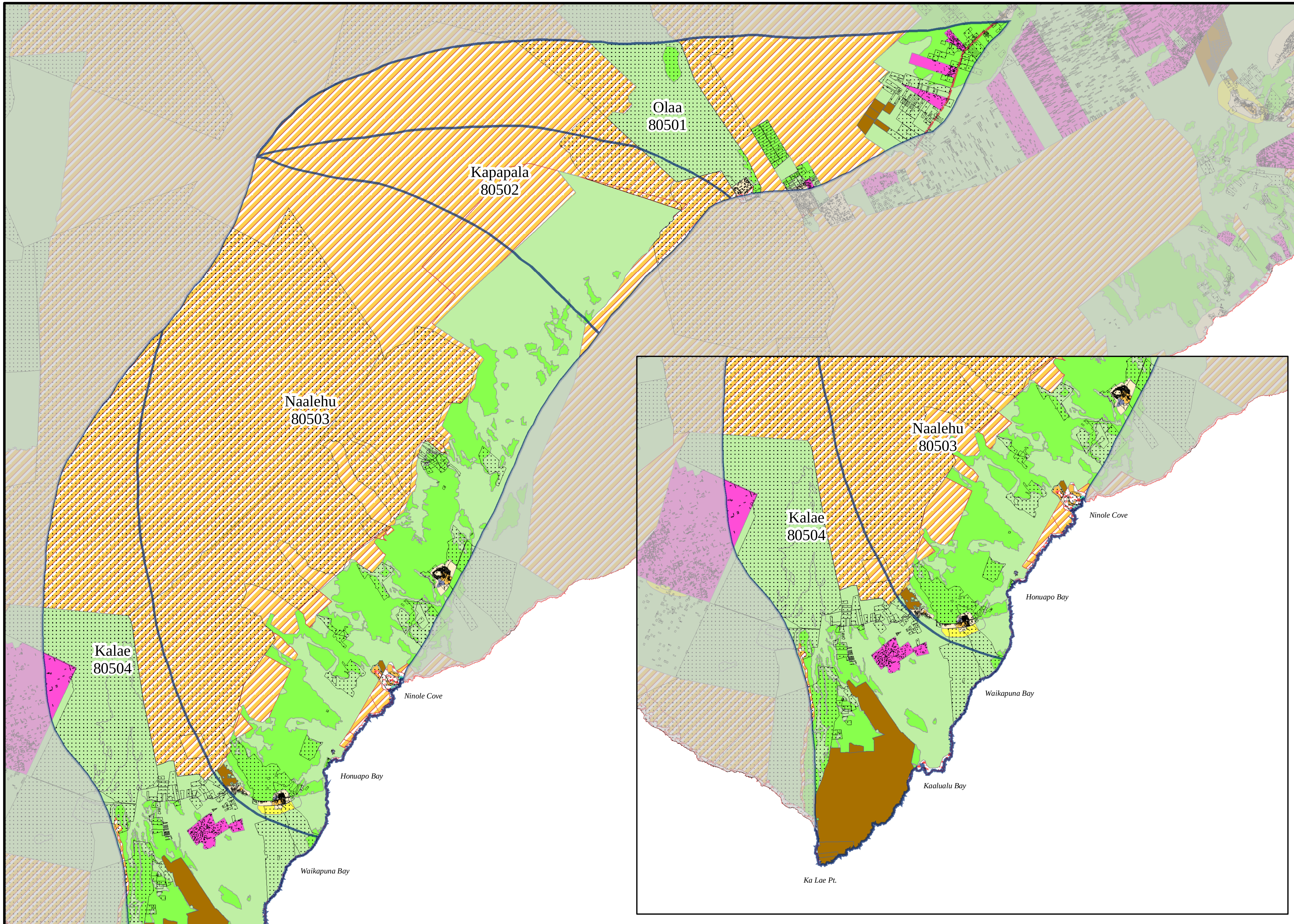
Growth Rate	2000	2005	2010	2015	2020	2000-10 % Change	2010-20 % Change
A – Low	5,554	6,222	6,935	7,721	8,613	24.9	24.2
B – Medium	5,554	6,242	6,997	7,835	8,786	26.0	25.6
C – High	5,554	6,502	7,435	8,451	9,577	33.9	28.8

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

805.1.3 Land Use

805.1.3.1 Hawaii County General Plan

The Hawaii County General Plan Land Use Pattern Allocation Guide Map (LUPAG) for the Southeast Mauna Loa ASEA is shown on **Figure 805-1**. The estimated land use allocation acreage for each LUPAG designation within the sector area is listed in **Table 805-3**.



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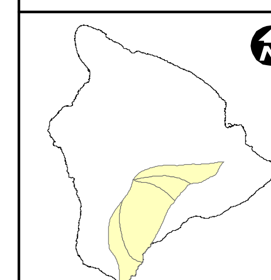
LEGEND:

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 805-1

AQUIFER SECTOR
S.E. MAUNA LOA - 805

Aquifer Systems
Olaa - 80501
Kapapala - 80502
Naalehu - 80503
Kalae - 80504

2005 Revised General Plan Land Use Pattern Allocation Guide

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1388 Kapiolani Boulevard, Honolulu, Hawaii 96814

Table 805-3: LUPAG Map Estimated Land Use Allocation Acreage – Southeast Mauna Loa Aquifer Sector Area

LAND USE PATTERN	ACREAGE	% of TOTAL
High Density Urban	0	0
Medium Density Urban	416	0.1
Low Density Urban	1,247	0.3
Industrial	74	0.0
Important Agricultural Land	49,788	11.2
Extensive Agriculture	109,885	24.8
Orchard	0	0
Rural	3,843	0.9
Resort/Resort Node	29	0.0
Open	2,596	0.6
Pond	0	0
Conservation	274,153	62.0
Urban Expansion	325	0.1
University Use	0	0
TOTAL	442,356	100.0

The water utility courses of action for Kau in the Hawaii County General Plan relevant to the Southeast Mauna Loa ASEA are as follows:

- *(a)* *Provide additional water system improvement for the currently serviced areas of Naalehu, Waiohinu, and Pahala.*
- *(b)* *Pursue groundwater source investigation, exploration and well development at Ocean View, Pahala, and Waiohinu.*
- *(c)* *Continue to evaluate growth conditions to coordinate improvements as required to the existing water system.*
- *(d)* *Investigate alternative means to finance the extension of water systems to subdivisions that rely on catchment.*

805.1.3.2 Hawaii County Zoning

Hawaii County Zoning for the Southeast Mauna Loa ASEA is shown on **Figure 805-2**. The estimated land use allocation acreage for each zoning class within the sector area is listed in **Table 805-4**.

Table 805-4: County Zoning Estimated Class Allocation Acreage – Southeast Mauna Loa Aquifer Sector Area

ZONING CLASS	ACREAGE	% of TOTAL
Single Family Residential	814	0.2
Multi-Family Residential (including duplex)	105	0.0
Residential-Commercial Mixed Use	0	0
Resort	40	0.0
Commercial	65	0.0
Industrial	55	0.0
Industrial-Commercial Mixed	0	0
Family Agriculture	0	0
Residential Agriculture	0	0
Agriculture	181,764	41.1
Open	132,804	30.0
Project District	0	0
Forest Reserve	125,143	28.3
(pond)	2	0.0
(road)	1,562	0.4
TOTAL	442,354	100.0

805.2 EXISTING WATER RESOURCES

805.2.1 Ground Water

The Southeast Mauna Loa ASEA has a sustainable yield of 291 mgd. According to the CWRM database, there are 50 production wells in the sector area, including 6 municipal, 38 irrigation, and 6 industrial. There are also 11 wells drilled and categorized as “unused.” Refer to **Appendix B** for this database. **Figure 805-3** shows the well locations. In the Pahala and Naalehu areas, many of the wells are tunnels dug into the hillsides to develop perched groundwater sources for fluming sugar cane to the old sugar mill.

The *1994 Kau River Basin Study* indicates that the yield of all tunnel sources is in the order of 7 to 8 mgd. Several springs and tunnels are mentioned as potential water sources. Ninole Springs is the second largest basal spring on the island, having an estimated past discharge of 20 to 25 mgd. Kawaa springs was estimated to have a discharge of 10 mgd, however, there are no indications that either has been developed as a water source. The output of the springs and tunnel sources are significantly less during the dry season.

805.2.2 Surface Water

There are no streams classified as perennial in the Southeast Mauna Loa ASEA.

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Job No. 2003-818

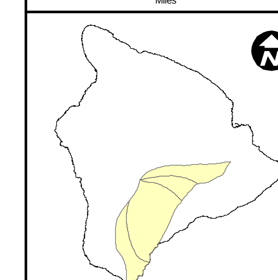
LEGEND:

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

2 1 0 2
Miles



INDEX MAP - Island of Hawaii

FIGURE 805-2

AQUIFER SECTOR
S.E. MAUNA LOA - 805

Aquifer Systems
Olaa - 80501
Kapapala - 80502
Naalehu - 80503
Kalae - 80504

County Zoning

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Figure 805-3: Well and Tunnel Location

MAP CURRENTLY NOT AVAILABLE ON-LINE

Figure 805-4: Streams & Diversions

MAP CURRENTLY NOT AVAILABLE ON-LINE

There are 9 declared stream diversions in CRWM database listed in **Table 805-5** and shown on **Figure 805-4**. Flow data is not available for these diversions.

Table 805-5: Stream Diversions – Southeast Mauna Loa Aquifer Sector Area

FILE REFERENCE	TMK	STREAM NAME	
KAU INSTREAM	9-5-014:007	Honuapo Pond	Spring diversion, hand carry Honuapo Spring Pond and rights claim.
KAU INSTREAM	9-5-016:006	Kawa Springs	Spring diversion, hand carry from Kaalaiki Pond and rights claim.
KAU INSTREAM	9-5-019:012	Ninole Fishpond	Spring diversion, hand carry from Kauwale Pond. Diversion at spring-fed smaller (northern) portion of fishpond. Rights claim.
KAU INSTREAM	9-5-019:012	Ninole Fishpond	Spring diversion, hand carry from Puhau Pond. Diversion at spring-fed main (makai) portion of fishpond. Rights claim.
KAU INSTREAM	9-6-001:003	Kauwila Pond	Spring diversion, hand carry from Kauwila Pond and rights claim.
KAWAIHAE RANCH	9-7-001:001	Haao Spring	Spring diversion, use of overflow from County Haao Spring when available.
KAPAPALA USERS	9-7-001:006	Alili Spring	Stream diversion, hand carry from Alili Kapapala Spring and rights claim.
KAWAIHAE RANCH	9-7-001:020	Mountain House Spring	Spring diversion, use of overflow from County Mountain House Spring.
KAU INSTREAM	9-3-001:003	Palehemo Pond	Spring diversion, hand carry from Palehemo Stream and rights claim.

The Kau Flume System transports perched groundwater from the two Noguchi Tunnels to the Keaiwa Reservoir north of Pahala. A 2000 study completed by the US Army Corps of Engineers estimated the yield of the tunnels between 0.2 and 0.6 mgd, depending on rainfall. At the time of the study, two additional inflows along the flume were not functioning, and the system was in need of major repairs.

805.2.3 Reclaimed Wastewater

There is one wastewater reclamation facility (WWRF) in the study area. **Table 805-6** lists the WWRF, reclaimed water classification, facility treatment capacity, current reuse amount, and current application.

Table 805-6: Wastewater Reclamation Facilities – Southeast Mauna Loa Aquifer Sector Area

Wastewater Reclamation Facility	Reclaimed Water Classification	WWRF Capacity (MGD)	Current Reuse Amount (MGD)	Irrigation Application
Punaluu Water & Sewer	R-2	0.125	0.012	Sea Mountain Golf Course

805.3 EXISTING WATER USE

805.3.1 General

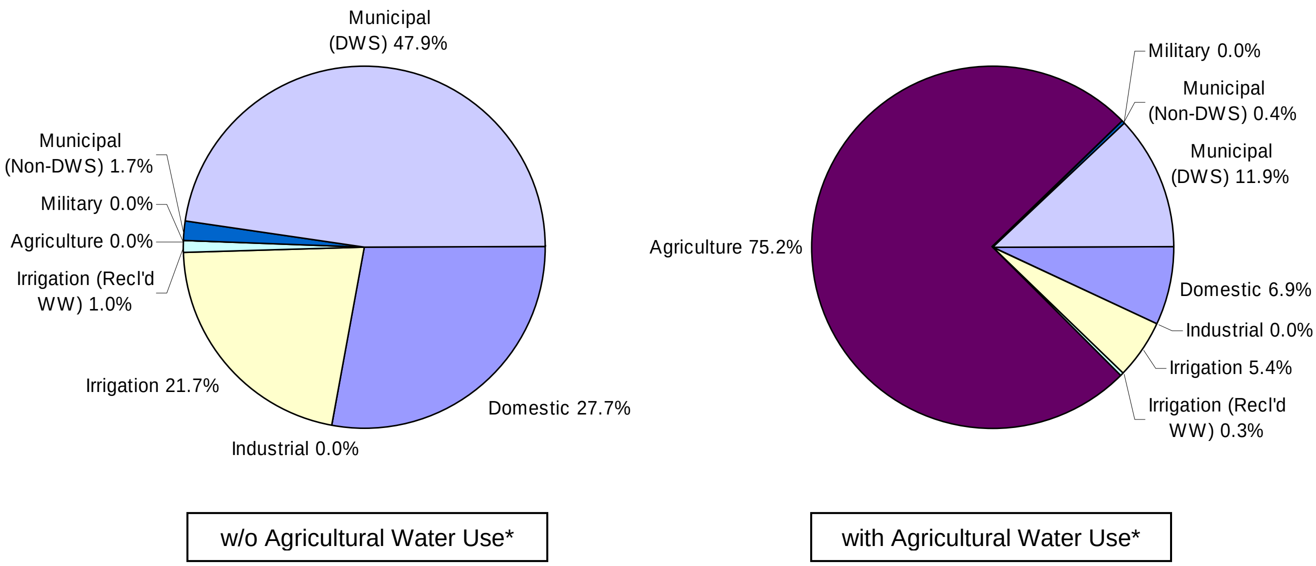
The total estimated average water use within the Southeast Mauna Loa ASEA based on DWS meter data and CWRM pumpage data from November 2004 through October 2005, available GIS information, DOH records, and estimated reclaimed wastewater usage is listed in **Table 805-7**. **Table 805-7** and **Figure 805-5** summarize water use in accordance with CWRM categories and indicate 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.

Table 805-7: Existing Water Use by Categories – Southeast Mauna Loa Aquifer Sector Area

CWRM Water Use Category	Water Use (MGD)	Percent of Total without Ag*	Percent of Total with Ag*
Domestic	0.33	27.7	6.9
Industrial	0.00	0.0	0.0
Irrigation	0.26	21.7	5.4
Reclaimed WW	0.01	1.0	0.3
Agriculture	3.58	0.0	75.2
Military	0.00	0.0	0.0
Municipal			
DWS System	0.57	47.9	11.9
Private Public WS	0.02	1.7	0.4
Total without Ag*	1.18	100.0	
Total with Ag*	4.77		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 805-5: Existing Water Use by Categories – Southeast Mauna Loa 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.

Figure 805-6 generally shows the service area for the various water systems and indicates the extent of the DWS water system.

805.3.2 Domestic Use

Domestic use or water use by individual households is assumed to be supplied by private individual rainwater catchment systems. Based on available GIS data, there are 820 such units serving approximately 2,250 people, which is approximately one-third of the sector's population. The estimated demand is 0.33 mgd.

805.3.3 Industrial Use

There are three tunnels and one shaft classified as "Industrial" in the CWRM database. None have reported pumpage.

805.3.4 Irrigation Use

The Sea Mountain Resort in Punaluu utilizes two sources for its golf course. 0.257 mgd is supplied by the private Punaluu Water System described below in Section 805.3.7.4, augmented with 0.012 mgd of reclaimed wastewater from the Punaluu Sewage Treatment Plant.

The Discovery Harbor Golf Course is located within the service area of the DWS Naalehu-Waiohinu Water System; however, usage is not known. There are no known irrigation uses dedicated other landscaping activities in the sector area.

Many of the wells in the CWRM database classified as "Irrigation" are tunnels or shafts that were used by the sugar plantation to transport sugar by flume to the sugar mill.

805.3.5 Agricultural Use

Over 20 percent of the metered water drawn from the DWS water system is from accounts classified as "Agricultural;" however, this amounts to only 0.12 mgd.

The *Kau River Basin Study* indicates that some of the water from the Noguchi Tunnels, described previously, is diverted for agricultural uses in Wood Valley. The rest of the water flows to the Keaiwa Reservoir, which supplies the Keaiwa Agricultural Park. The study suggests that there is a significant amount of water currently used for agricultural purposes, however current flow data is not readily available.

805.3.6 Military Use

There is no military use in the Southeast Mauna Loa ASEA.

805.3.7 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.

805.3.7.1 County Water Systems

The DWS has 2 water systems in the Southeast Mauna Loa ASEA.

The Pahala Water System relies on the Alili Tunnel for its supply and supplements it with water from the Pahala Well during dry weather. The system has a relatively compact service area in Pahala Village. The Pahala Deep Well No. 2 was drilled in 2003, but it is currently sealed and there is no evidence of usage.

The Waiohinu-Naalehu Water System was assumed by DWS after the closure of the sugar plantation. The system primarily depends on the New Mountain House Tunnel Spring and Haao Spring for its supply. The Naalehu Well supplements the tunnel and spring sources during dry weather. The service area is widespread, covering the communities of Waiohinu, Naalehu and South Point, spanning six service zones through two booster pump stations and nine storage tanks.

DWS water use is subcategorized in **Table 805-8** to the extent possible based on available meter data and is depicted in **Figure 805-7**. "Other Municipal" includes facilities such as schools, and

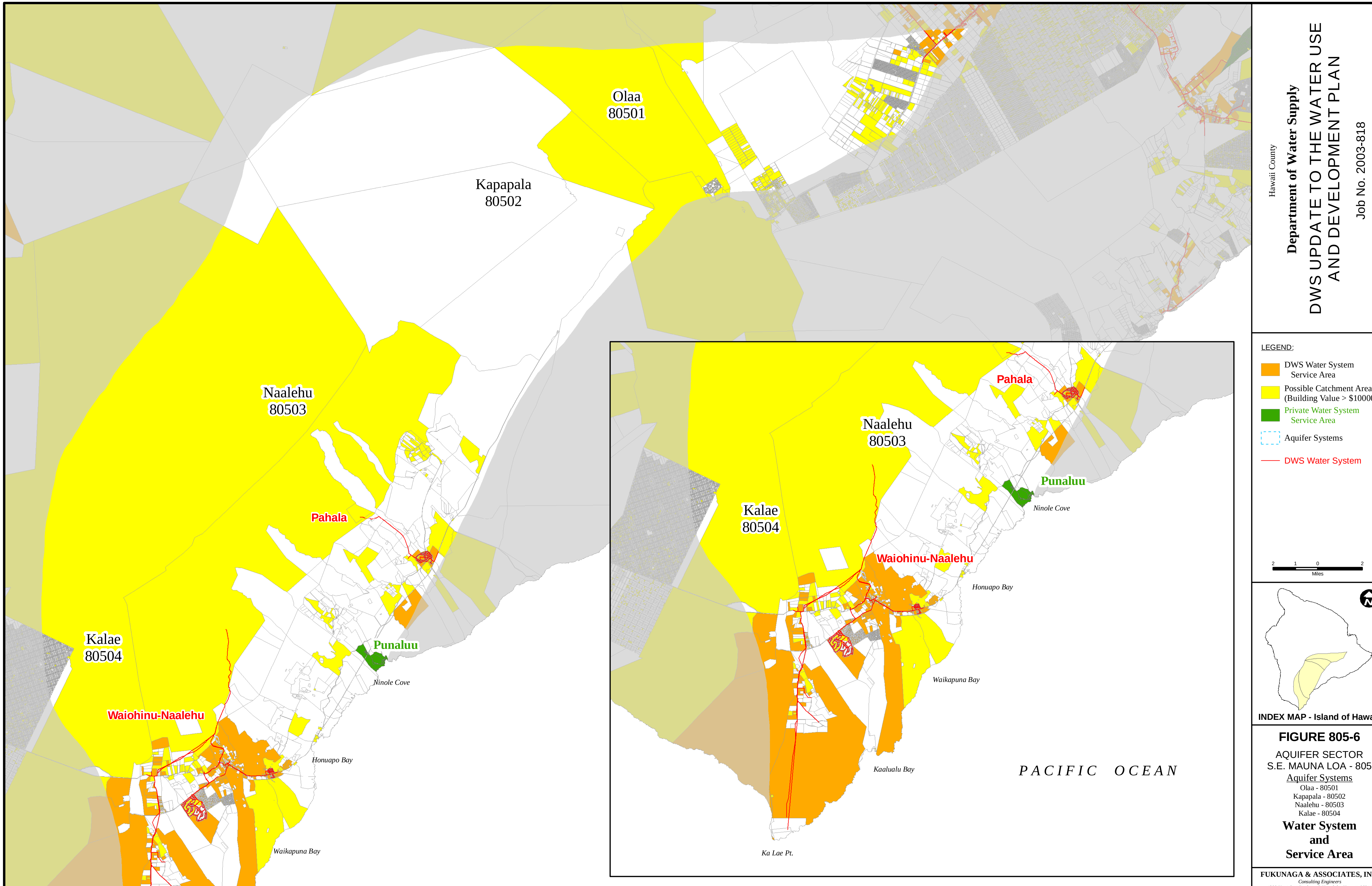


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FIGURE 805-6

AQUIFER SECTOR
S.E. MAUNA LOA - 805
Aquifer Systems
Olaa - 80501
Kapapala - 80502
Naalehu - 80503
Kalae - 80504

Water System and Service Area

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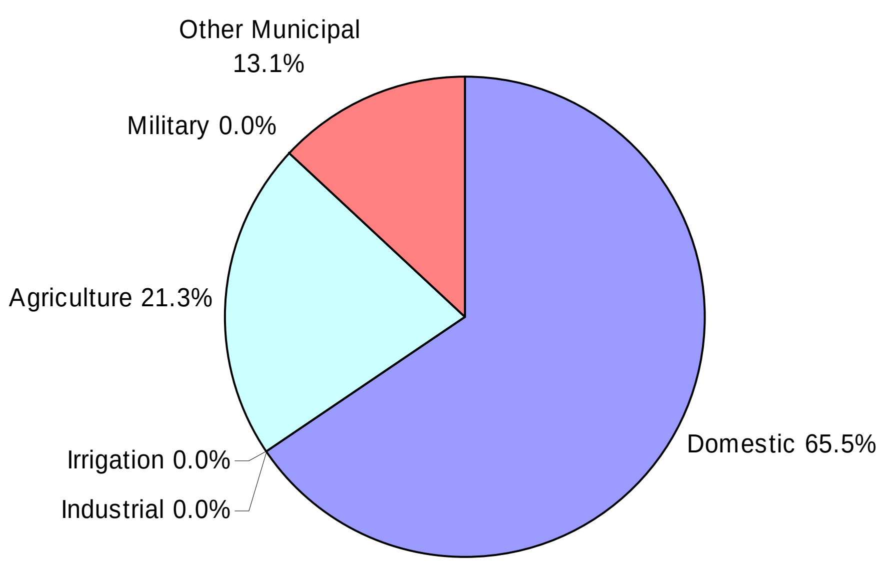
various commercial, government, medical and nonprofit entities which have mixed water use and cannot be specifically allocated to the other categories.

Table 805-8: DWS Existing Water Use by Categories – Southeast Mauna Loa Aquifer Sector Area

CWRM Water Use Category	DWS Purveyed Water Use (MGD)	Percent of Total
Domestic	0.37	65.5
Industrial	0.00	0.0
Irrigation	0.00	0.0
Agriculture	0.12	21.3
Military	0.00	0.0
Other Municipal	0.07	13.1
Total	0.57	100.0

Figure 805-7: DWS Existing Water Use by Categories – Southeast Mauna Loa Aquifer Sector Area



805.3.7.2 State Water Systems

There are no State water systems in the Southeast Mauna Loa ASEA regulated by the DOH.

805.3.7.3 Federal Water Systems

There are no Federal water systems in the Southeast Mauna Loa ASEA regulated by the DOH.

805.3.7.4 Private Public Water Systems

The Punaluu Water & Sanitation Company owns the Punaluu water system, which serves the Sea Mountain Resort and surrounding area. Water is supplied by two Ninole wells and disinfected with chlorine gas prior to distribution. Storage is provided by the 1.0 MG reservoir north of Hawaii Belt Road. The service area includes the nursery taps, administration office, tennis courts, Colony 1 Condos, golf club house, Punaluu Beach Park, Punaluu Village Restaurant, and the Kalana Estates subdivision north of the highway. According to DOH records, domestic usage is 0.02 mgd.

805.3.8 Water Use by Resource

805.3.8.1 Ground Water

Table 805-9 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 805-9: Sustainable Yield – Southeast Mauna Loa 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 (%)
		0.22	**5.17**	**7.75**	**291**	**0.08**	**1.78**	**2.66**
80501	Olaa	0.00	0.00	0.00	124	0.00	0.00	0.00
80502	Kapapala	0.00	0.00	0.00	19	0.00	0.00	0.00
80503	Naalehu	0.22	5.17	7.75	117	0.19	4.42	6.62
80504	Ka Lae	0.00	0.00	0.00	31	0.00	0.00	0.00

DWS utilizes two spring and one tunnel source as described previously. Usage between November 2004 and October 2005 was 0.62 mgd.

805.3.8.2 Surface Water

Flow data is not available for any of the spring and stream diversions listed previously in **Table 805-5**. As described previously, water usage from the Noguchi Tunnels is not readily available.

805.3.8.3 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 805-7** is assumed to be supplied by individual catchment systems.

805.3.8.4 Reclaimed Wastewater

Reclaimed wastewater from the wastewater treatment plant within the Southeast Mauna Loa ASEA is used for golf course irrigation. Refer to **Table 805-6** presented earlier.

805.4 FUTURE WATER NEEDS

805.4.1 General

Table 805-10 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 805-10: 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 S.E. Mauna Loa ASEA	291	13.7	3.7	1.2	1.3	1.5	1.6	1.8
80501 – Olaa ASYA	124	1.5	0.4	0.3	0.3	0.4	0.5	0.5
80502 – Kapapala ASYA	19	0.0	0.0	0.0	0.0	0.0	0.0	0.0
80503 – Naalehu ASYA	117	10.8	2.9	0.7	0.8	0.8	0.9	1.0
80504 – Ka Lae ASYA	31	1.4	0.4	0.2	0.2	0.2	0.3	0.3
With Agricultural Demand*	**SY (mgd)**	**LUPAG (mgd)**	**Zoning (mgd)**	**Growth Rate B Demand Projections (mgd)**				
				2005	**2010**	**2015**	**2020**	**2025**
Total S.E. Mauna Loa ASEA	291	159.3	147.6	4.8	5.3	5.8	6.4	7.1
80501 – Olaa ASYA	124	22.1	20.3	0.8	0.9	1.1	1.3	1.5
80502 – Kapapala ASYA	19	1.0	1.0	0.0	0.0	0.0	0.0	0.0
80503 – Naalehu ASYA	117	113.3	105.1	3.2	3.6	3.9	4.2	4.6
80504 – Ka Lae ASYA	31	22.9	21.3	0.7	0.8	0.8	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.

For all aquifer system areas, full build-out and 2025 projection water demands excluding agricultural demands are a small fraction the SY. Therefore, analysis of the three demand scenarios does not need to be broken down by aquifer system areas and thus will be presented for the aquifer sector area only.

805.4.2 Full Build-Out Water Demand Projections

The full build-out water demand projections based on the General Plan and County Zoning for the Southeast Mauna Loa ASEA are listed in **Tables 805-11** and **805-12**, and reflect refinement as discussed below. Each land use class is associated with the most appropriate CWRM water use category.

Table 805-11: Hawaii County General Plan Full Build-Out Water Demand Projection – Southeast Mauna Loa Aquifer Sector Area

LUPAG Class	CWRM Category	Water Demand (mgd)
Urban	Domestic/Irrigation/Municipal	8.8
Urban Expansion	Domestic/Irrigation/Municipal	1.7
Resort	Irrigation/Municipal	0.5
Industrial	Industrial	0.3
Agriculture	Agriculture	145.6
University	Irrigation/Municipal	0.0
Rural	Irrigation/Municipal	1.5
DHHL	Irrigation/Municipal	0.8
TOTAL w/o Ag*		13.7
TOTAL w/ Ag*		159.3

* 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 805-12: County Zoning Full Build-Out Water Demand Projection – Southeast Mauna Loa Aquifer Sector Area

Zoning Class	CWRM Category	Water Demand (mgd)
Residential	Domestic/Irrigation/Municipal	2.0
Resort	Irrigation/Municipal	0.5
Commercial	Municipal	0.2
Industrial	Industrial	0.2
Agriculture	Agriculture	144.0
DHHL	Irrigation/Municipal	0.8
TOTAL w/o Ag*		3.7
TOTAL w/ Ag*		147.6

* 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.

805.4.2.1 Refine Land Use Based Projection

805.4.2.1.1 State Water Projects Plan

The total projected demand to the year 2020 for 7 State Water Projects within the Southeast Mauna Loa ASEA is 0.05 mgd, using 0.04 mgd potable, and 0.01 nonpotable using potable sources. These demands account for less than 1 percent of the projected total demand for the sector area. The project that will generate the most significant demand, with the exception of DHHL projects, which are covered separately, is listed in **Table 805-13**.

Table 805-13: Future State Water Projects to Generate Significant Demands

Project Name	Primary Use	State Department	2020 Demand (mgd)
Naalehu Elementary New 6 Classroom	Potable	DOE	0.01

805.4.2.1.2 State Department of Hawaiian Home Lands

There are four tracts in the Southeast Mauna Loa ASEA owned by the DHHL.

The Kamaoa-Puueo Tracts are located in the South Point area covering over 11,000 acres up to an elevation of about 1,200 feet. Estimated demand for the existing pastoral and farm, and proposed pastoral lots is 0.38 mgd. The Waiohinu Tract is a small 261-acre tract located on steep terrain north of Waiohinu. The demand for the proposed agricultural lots and a few commercial lots is 0.40 mgd. Both tracts would be supplied by the DWS Naalehu-Waiohinu Water System. *DHHL Special Report #2* indicates that an additional well source would be required to assure reliable and consistent supply.

The Discover Harbor tract was recently acquired by DHHL. It consists of 40 lots within the Discovery Harbor subdivision northeast of Puueo. The lots are already serviced by the DWS Naalehu-Waiohinu Water System with an estimated demand of 0.02 mgd.

The Olaa-Kurtistown tract consists of lots in the Kurtistown, Glenwood, and Volcano areas totaling 707 acres in the Puna District. The total water need 0.03 mgd. Service laterals to the DWS Olaa-Mt.View WS are already in place for the Kurtistown lots. *DHHL Special Report #2* proposes that the remaining lots will be served by rainwater catchment.

805.4.2.1.3 Agricultural Water Use and Development Plan

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

805.4.3 Water Use Unit Rates

Water use unit rates are based on the *Water System Standards* as discussed in Chapter 1.

805.4.4 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 Southeast Mauna Loa ASEA. The projected low, medium, and high growth rates are listed in **Table 805-14**, and are graphed in **Figure 805-8**. Potable and nonpotable water demands are also differentiated.

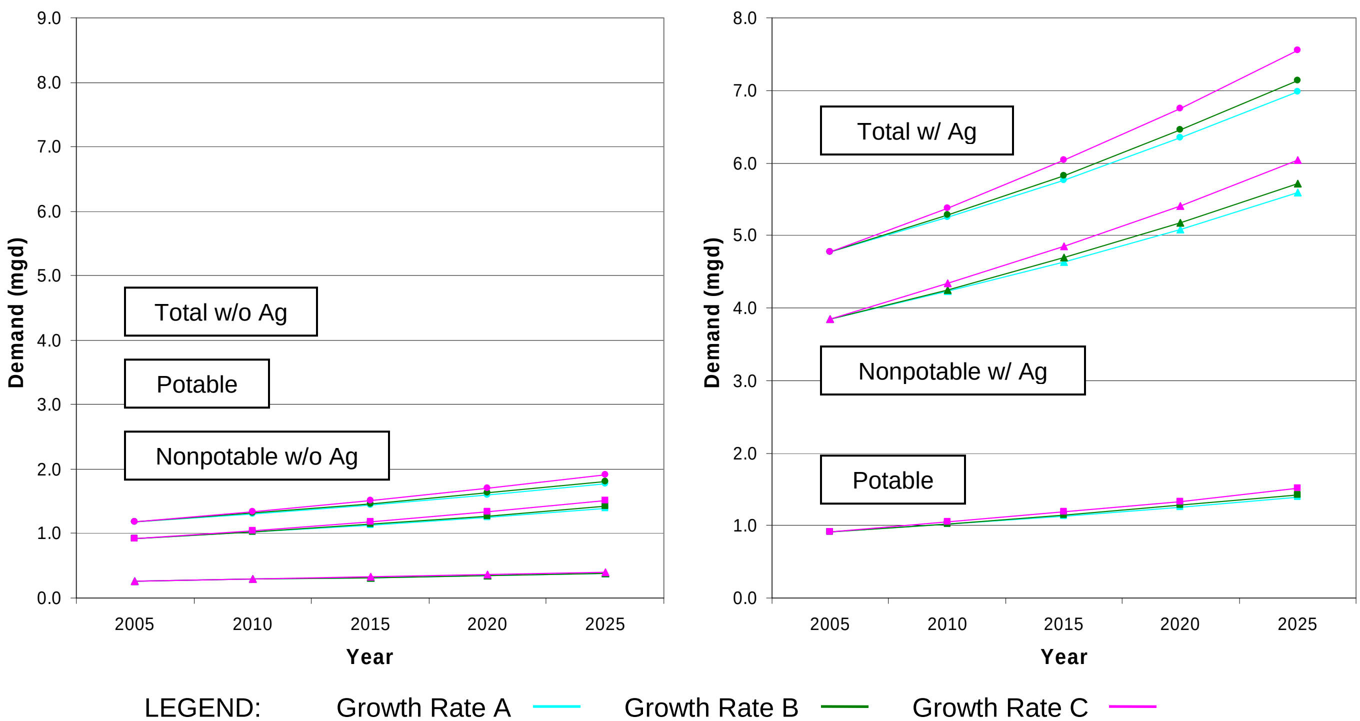
Figure 805-9 illustrates the magnitude of the sustainable yield, both LUPAG and Zoning full build-out water use, and water use projection through the year 2025 focusing on Medium Growth Rate B. **Figure 805-10** shows the breakdown of water demand projections by CWRM categories through the year 2025. **Table 805-15** summarizes these figures.

Table 805-14: Water Demand Projection – Southeast Mauna Loa 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	1.2	1.3	1.4	1.6	1.8	4.8	5.2	5.8	6.3	7.0
Potable	0.9	1.0	1.1	1.3	1.4	0.9	1.0	1.1	1.3	1.4
Nonpotable	0.3	0.3	0.3	0.3	0.4	3.9	4.2	4.6	5.1	5.6
GROWTH RATE B	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	1.2	1.3	1.5	1.6	1.8	4.8	5.3	5.8	6.4	7.1
Potable	0.9	1.0	1.1	1.3	1.4	0.9	1.0	1.1	1.3	1.4
Nonpotable	0.3	0.3	0.3	0.4	0.4	3.9	4.3	4.7	5.2	5.7
GROWTH RATE C	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	1.2	1.3	1.5	1.7	1.9	4.8	5.4	6.0	6.7	7.5
Potable	0.9	1.0	1.2	1.3	1.5	0.9	1.0	1.2	1.3	1.5
Nonpotable	0.3	0.3	0.3	0.4	0.4	3.9	4.3	4.9	5.4	6.0

* 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 805-8: Water Demand Projection Summary – Southeast Mauna Loa Aquifer Sector Area



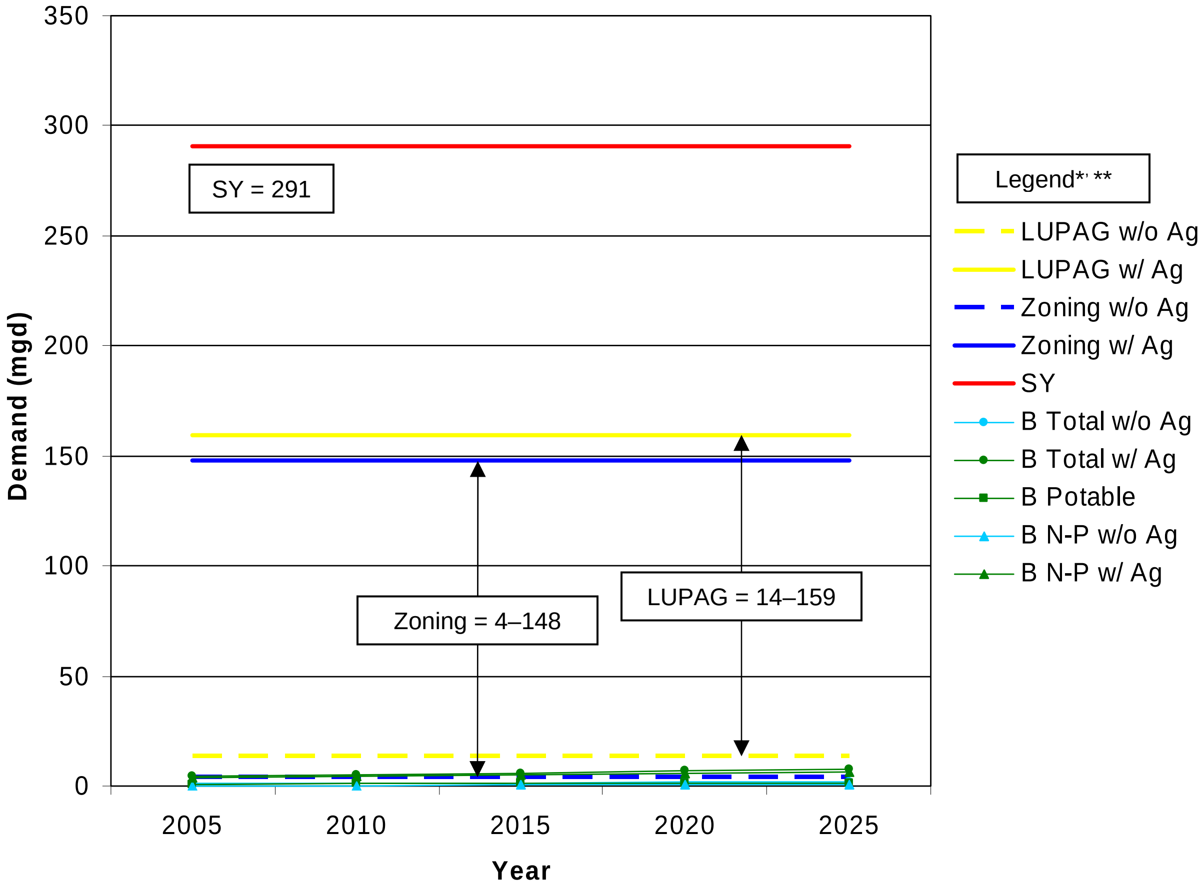
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 805-15: Medium Growth Rate B Water Demand Projection by Category – Southeast Mauna Loa Aquifer Sector Area

Water Use Category	2005 (mgd)	2010 (mgd)	2015 (mgd)	2020 (mgd)	2025 (mgd)
Total without Ag*	1.2	1.3	1.5	1.6	1.8
Total with Ag*	4.8	5.3	5.8	6.4	7.1
Domestic	0.3	0.4	0.4	0.5	0.6
Industrial	0.0	0.0	0.0	0.0	0.0
Irrigation	0.3	0.3	0.3	0.4	0.4
Agriculture	3.6	4.0	4.4	4.8	5.3
Military	0.0	0.0	0.0	0.0	0.0
Municipal	0.6	0.6	0.7	0.8	0.9
Potable	0.9	1.0	1.1	1.3	1.4
Nonpotable w/o Ag*	0.3	0.3	0.3	0.4	0.4
Nonpotable w/ Ag*	3.9	4.3	4.7	5.2	5.7
DWS	0.6	0.6	0.7	0.8	0.8

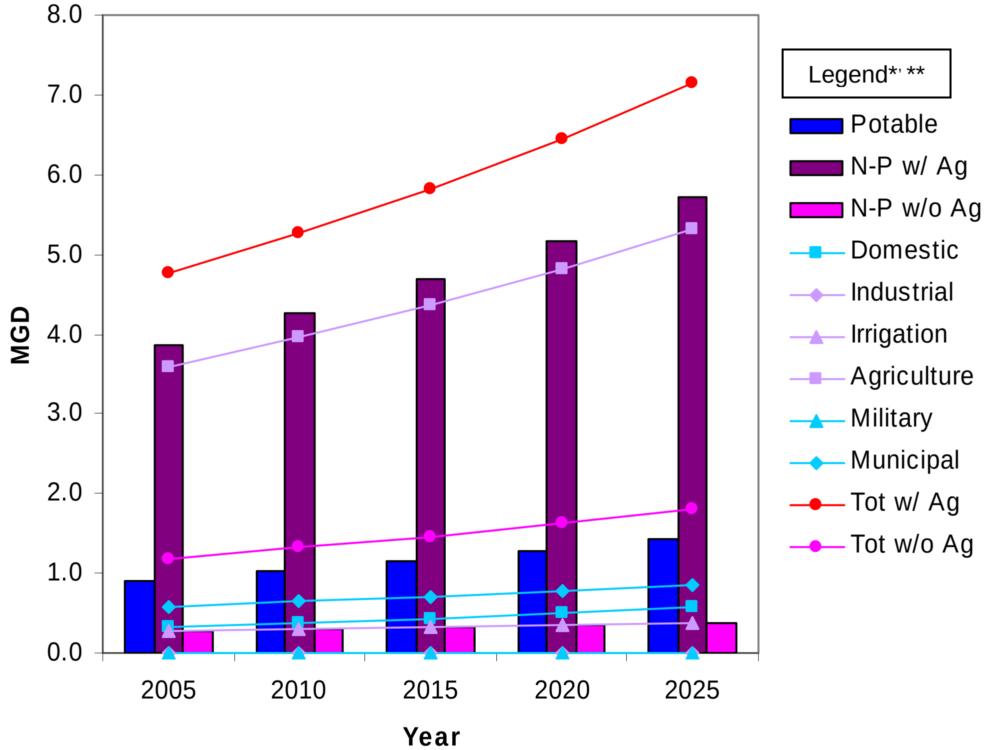
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 805-9: Medium Growth Rate B Water Demand Projections and Full Build-Out – Southeast Mauna Loa 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 805-10: Medium Growth Rate B Water Demand Projection by Category – Southeast Mauna Loa Aquifer Sector Area

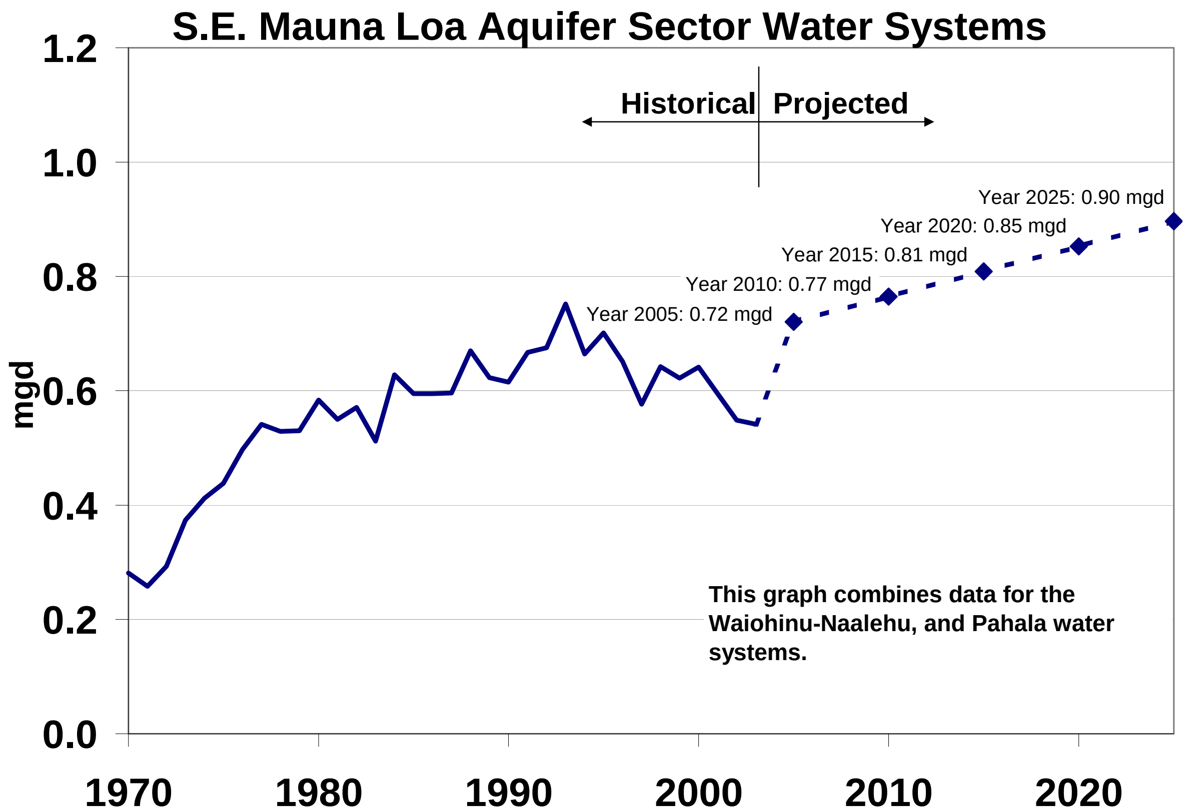


* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.
** "N-P" represents the nonpotable component of the demand.

805.4.5 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 805-11**.

Figure 805-11: DWS Water Demand Projection – Southeast Mauna Loa Aquifer Sector Area



Historical data provided by RW Beck, Inc.

Projections based on historical DWS water consumption data are quite different than projections based on population growth rate. The actual 2005 consumption is considerably lower than the projection based on historical consumption. Also, the projected future growth rate of the population is much greater than the rate of increase of the historical consumption. DWS may need to supply potable water equivalent to as much as half of the total projected water supply for the sector area.

805.5 RESOURCE AND FACILITY RECOMMENDATIONS

805.5.1 Water Source Adequacy

805.5.1.1 Full Build-Out

Full development to the maximum density of the County General Plan and Zoning land uses within the Southeast Mauna Loa Aquifer Sector Area (ASEA) can be sustained by conventional water resources. If agricultural demands are excluded, LUPAG water demands amount to less than 5 percent of the sustainable yield (SY) of the sector area, and existing Zoning requires approximately 1 percent of the SY. If worst case agricultural demands are included, the LUPAG and Zoning demand scenarios would require 51 and 55 percent of the SY, respectively.

805.5.1.2 Twenty-Year Projection

20-year projected demands range between less than 1 and 3 percent of the SY of the sector area.

805.5.2 Source Development Requirements

805.5.2.1 Supply-Side Management

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

805.5.2.1.1 Conventional Water Resource Measures

805.5.2.1.1.1 Ground Water

The nature of the groundwater is very different between the four aquifer system areas that comprise the Southeast Mauna Loa ASEA. The Olaa and Kapapala Aquifer System Areas (ASYA), consist of high level perched and dike water at great depths. Development of this water would be extremely expensive. The Naalehu and Ka Lae ASYAs, both reaching the southern coast, contain basal water several miles inland. The Naalehu ASYA contains perched and dike-impounded high level water further inland.

Development of potable water wells should continue in the Naalehu ASYA, considering most of the proposed development will occur within this system. DWS has proposed a second well in Pahala and a well in Waiohinu to meet the needs of the two respective water systems.

Nonpotable wells may be developed to serve localized nonpotable uses as they arise.

The output of the spring and tunnel sources fluctuates throughout the year, and is greatly diminished during dry periods. Existing potable sources may continue to be used as long as Federal SDWA regulations are met, however new sources are not likely to be developed due to the remoteness from proposed development areas. Nevertheless, a significant quantity of water remains available as an alternative to groundwater wells.

805.5.2.1.1.2 Surface Water

Surface water may continue as the primary resource to supply nonpotable needs. The challenge concerning surface water is the transmission, not the availability of sources.

805.5.2.1.1.3 Water Transfer

Water is currently being transferred between aquifer system areas within the Southeast Mauna Loa ASEA, from the Naalehu ASYA to the Ka Lae ASYA, through the DWS Waiohinu-Naalehu Water System. Refer to **Figure 805.6**. Potable water sources are readily available in the Naalehu ASYA; therefore, water transfer is expected to continue and likely increase with potential Hawaiian Home Lands developments in South Point.

Water transfer may also be considered to supply developments in the southern areas of the Southwest Mauna Loa ASEA (806). This issue will be examined in greater detail in Chapter 806.

805.5.2.1.2 Alternative Water Resource Enhancement Measures

805.5.2.1.2.1 Rainwater Catchment Systems

Most of the developed areas in the Naalehu ASYA and the eastern half of the Olaa ASYA receive enough rainfall to support catchment. Individual systems are unlikely to be used if a municipal water system is available, although a large-scale catchment system may be considered to supplement a municipal system. The majority of homes using individual catchments in the sector area are in the eastern portion of the Olaa ASYA outside the extent of the DWS Olaa-Mt. View Water System. Usage of catchments in these areas could potentially increase if growth proceeds as planned without extension of the municipal water system.

805.5.2.1.2.2 Wastewater Reclamation

Reclaimed wastewater is currently being used for irrigation of the golf course at the Punaluu Resort. Usage is not expected to increase without additional development of the resort. In general, reclaimed wastewater is not considered a significant alternative considering the small service populations contributing to wastewater flow, and the availability of other nonpotable sources.

805.5.2.1.2.3 Desalination

Because potable water is available inland, only coastal areas of the Ka Lae ASYA that where only brackish groundwater exists would be considered for desalination facilities. Potable water service already extends to the South Point and Discovery Harbor areas; furthermore, unit costs would be extremely high considering the small service area. Desalination is unlikely to be implemented in favor of conventional alternatives, such as upgrading the existing source and transmission infrastructure.

805.5.2.2 Demand-Side Management

805.5.2.2.1 Development Density Control

Full build-out demands associated with LUPAG maximum density are nearly four times greater than that of Zoning. Additional sources will eventually be required, however, these demands are sustainable by conventional resources. Therefore, control of development density is not considered critical.

805.5.2.2.2 Water Conservation

The average water use per connection to the DWS water system is 400 gpd, and the average current potable water usage per capita from all sources is approximately 150 gpd, both of which are exactly island averages. Demand-side water conservation should continue, but measures do not need to be implemented.

The water not accounted for in the DWS Waiohinu-Naalehu Water System ranges between 20 and 40 percent, which is high. The total quantity of water unaccounted for amounts to less than 0.25 mgd, therefore supply-side conservation should be planned, but need not be a high priority.

805.5.3 Recommended Alternatives

Potable groundwater development should continue in the Naalehu ASYA to suit anticipated development. Consistent with the General Plan, groundwater source investigation and well development should proceed at Pahala and Waiohinu.

Surface water sources should be developed to meet anticipated nonpotable water demands. Existing irrigation systems should be evaluated to determine the extent of infrastructure improvements and additional source development required to attain optimal function. It is anticipated that the next phase of the update to the *AWUDP* will address these issues in greater detail, specifically considering the Kau Flume System.

Because the sustainable yield of the sector is large compared to the projected demands, and can be reasonably developed, the potential exists to transfer potable water to the neighboring Southwest Mauna Loa ASEA if potable water sources cannot be feasibly developed there.

806 SOUTHWEST MAUNA LOA AQUIFER SECTOR AREA

806.1 SECTOR AREA PROFILE

806.1.1 General

The Southwest Mauna Loa Aquifer Sector Area (ASEA) includes the Manuka [80601], Kaapuna [80602] and the Kealakekua [80603] Aquifer System Areas (ASYA), encompassing the entire South Kona District, the southeastern portion of the North Kona District, and the western portion of the Kau District. The boundaries extend from the summit of Mauna Loa to the western shores near Kealakekua, and along the western coastline to the southern tip of the island at Ka Lae.

Rainfall varies from an average of less than 20 inches per year in some coastal areas to 125 inches per year in higher elevation areas above Honaunau. Rainfall in the Kaapuna and Kealakekua ASYAs are diurnal rather than orthographic due to Mauna Loa blocking the tradewinds. The three aquifer system areas have similar sustainable yields, with the Kaapuna ASYA at 50 mgd, the Manuka ASYA at 42 mgd, and the Kealakekua ASYA at 38 mgd. The total sustainable yield for the entire sector area is 130 mgd.

806.1.2 Economy and Population

806.1.2.1 Economy

Agriculture is the most important economic activity within the sector area. Coffee and macadamia nuts are the primary industries, with over 4,000 acres of macadamia nut orchards, and the famed “coffee belt” mauka of Mamalahoa Highway. Although the coffee industry has proven to be volatile; the number of coffee farms and corresponding sales have fluctuated, varying from a low of $3.7 million in 1992 to $16.2 million in 1997; nevertheless it remains one of the principals of Kona’s economy. Both products’ industries include processing operations. South Kona accounts for 20 to 25 percent of the macadamia nut processing statewide. Cattle ranching and growing of citrus fruits and bananas are also important within the sector area.

Tourism does not play a large part in the sector’s economy. Visitor accommodations are limited; the 88-unit Manago Hotel in Captain Cook is the largest establishment for overnight visitors. The 730-lot and golf course Hokulia development and 80-unit lodge is under construction.

806.1.2.2 Population

More than three quarters of the population contributing to the demands from the Southwest Mauna Loa ASEA is within the South Kona District, and the balance is from the Kau District. The growth of the Ocean Point Community has and will continue to be significant.

Table 806-1: Historical Population

1980	1990	2000	1980-90 % Change	1990-2000 % Change
7,430	9,553	11,068	28.6	15.9

Data Source: 2000 U.S. Census
Data redistributed and evaluated for Southwest Mauna Loa Aquifer Sector Area

Table 806-2: Population Projection

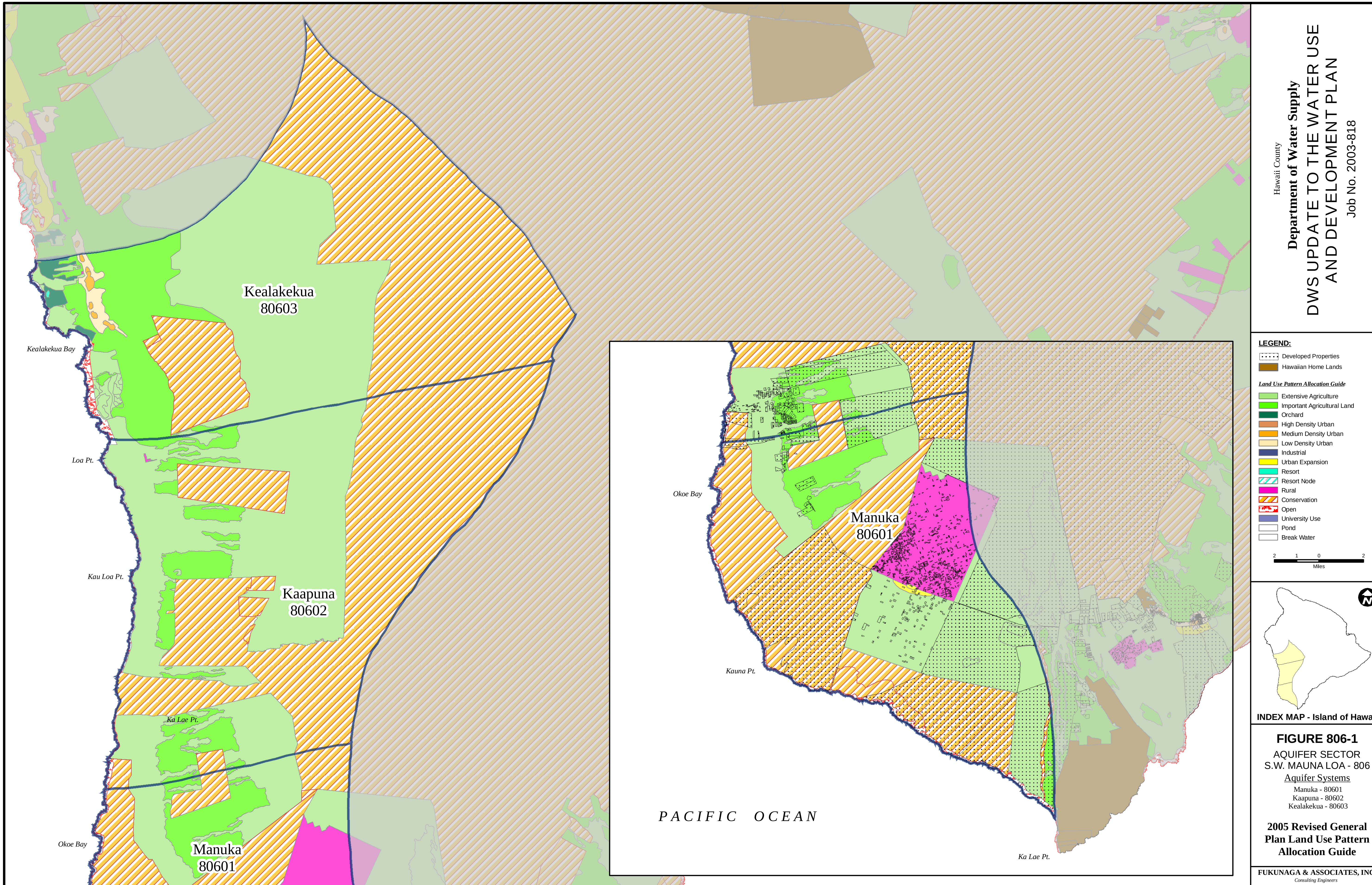
Growth Rate	2000	2005	2010	2015	2020	2000-10 % Change	2010-20 % Change
A – Low	11,068	12,938	14,280	15,727	17,331	29.0	21.4
B – Medium	11,068	12,980	14,407	15,959	17,684	30.2	22.7
C – High	11,068	13,521	15,310	17,212	19,276	38.3	25.9

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

806.1.3 Land Use

806.1.3.1 Hawaii County General Plan

The Hawaii County General Plan Land Use Pattern Allocation Guide Map (LUPAG) for the Southwest Mauna Loa ASEA is shown on **Figure 806-1**. The estimated land use allocation acreage for each LUPAG designation within the sector area is listed in **Table 806-3**.



Hawaii County
Department of Water Supply
DWS UPDATE TO THE WATER USE
AND DEVELOPMENT PLAN
Job No. 2003-818
Kealakekua
80603
Kaapuna
80602
Manuka
80601
Kealakekua Bay
Loa Pt.
Kau Loa Pt.
Ka Lae Pt.
Okoe Bay
Kauna Pt.
PACIFIC OCEAN
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
N
INDEX MAP - Island of Hawaii
FIGURE 806-1
AQUIFER SECTOR
S.W. MAUNA LOA - 806
Aquifer Systems
Manuka - 80601
Kaapuna - 80602
Kealakekua - 80603
2005 Revised General Plan Land Use Pattern Allocation Guide
FUKUNAGA & ASSOCIATES, INC.
Consulting Engineers
1388 Kapiolani Boulevard, Honolulu, Hawaii 96814

Table 806-3: LUPAG Map Estimated Land Use Allocation Acreage Southwest Mauna Loa Aquifer Sector Area

LAND USE PATTERN	ACREAGE	% of TOTAL
High Density Urban	0	0
Medium Density Urban	370	0.1
Low Density Urban	1,291	0.3
Industrial	0	0
Important Agricultural Land	36,622	9.2
Extensive Agriculture	141,946	35.6
Orchard	1,224	0.3
Rural	10,631	2.7
Resort/Resort Node	25	0.0
Open	4,362	1.1
Pond	0	0
Conservation	201,685	50.6
Urban Expansion	273	0.1
University Use	0	0
TOTAL	398,429	100.0

The water utility courses of action for South Kona and Kau in the Hawaii County General Plan relevant to the sector area 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 South Kona Water System Master Plan.*
- ***(c)*** *Pursue groundwater source investigation, exploration and well development at Ocean View.*
- ***(d)*** *Investigate alternative means to finance the extension of water systems to subdivisions that rely on catchment.*

806.1.3.2 Hawaii County Zoning

Hawaii County Zoning for the Southwest Mauna Loa ASEA is shown on **Figure 806-2**. The estimated land use allocation acreage for each zoning class within the sector area is listed in **Table 806-4**.

Table 806-4: County Zoning Estimated Class Allocation Acreage – Southwest Mauna Loa Aquifer Sector Area

ZONING CLASS	ACREAGE	% of TOTAL
Single Family Residential	445	0.11
Multi-Family Residential (including duplex)	6	0.00
Residential-Commercial Mixed Use	0	0
Resort	15	0.00
Commercial	123	0.03
Industrial	0	0
Industrial-Commercial Mixed	0	0
Family Agriculture	13	0.00
Residential Agriculture	150	0.04
Agriculture	215,929	54.20
Open	136,581	34.28
Project District	23	0.01
Forest Reserve	42,949	10.78
(road)	2,194	0.55
TOTAL	398,429	100.00

806.2 EXISTING WATER RESOURCES

806.2.1 Ground Water

Southwest Mauna Loa ASEA has a sustainable yield of 130 mgd. According to the CWRM database, there are 16 production wells in the sector, including 5 municipal, 5 irrigation, 4 domestic, and 2 other. There are also 2 wells drilled and categorized as “unused”. Refer to **Appendix B** for this database. **Figure 806-3** shows the well locations.

806.2.2 Surface Water

There are no streams classified as perennial in the sector area. The Kiilae Stream flowing into Kauhako Bay at Hookena is intermittent.

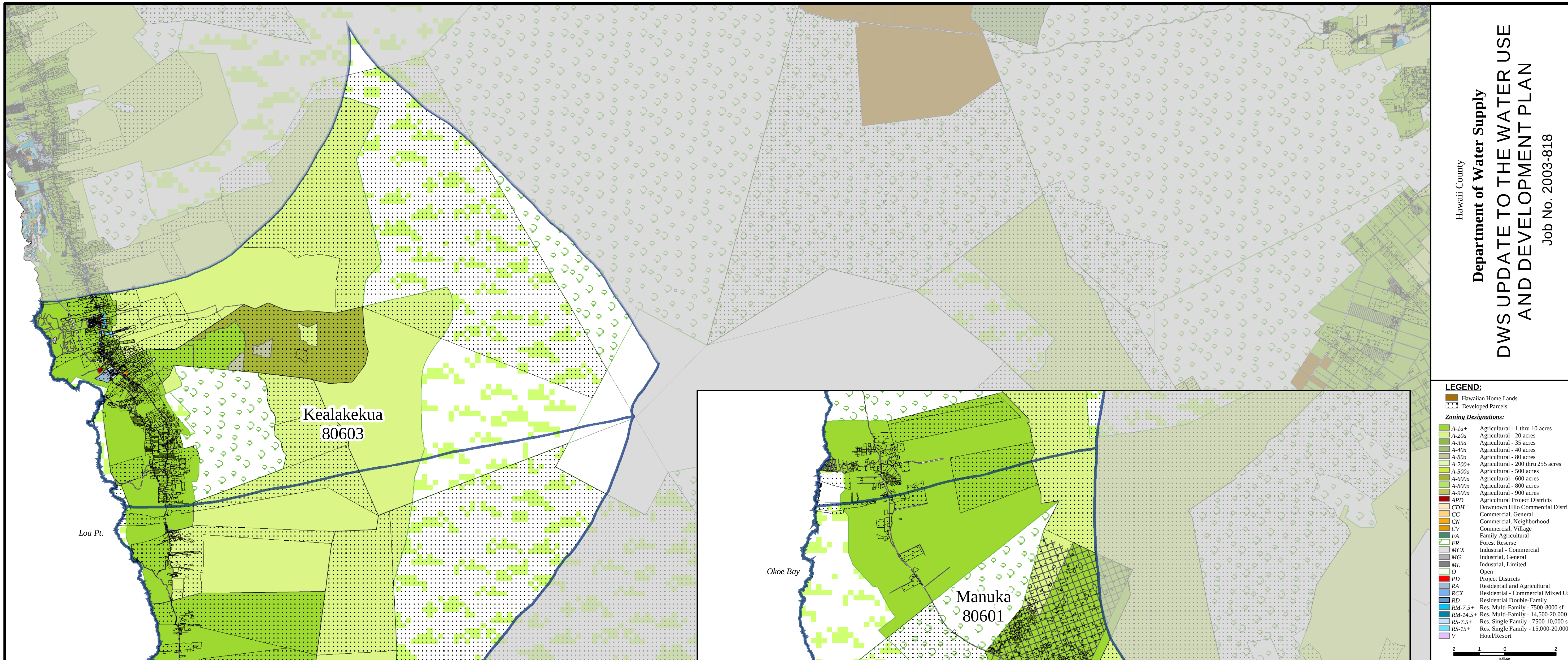
There are 4 declared stream diversions in the CRWM database listed in **Table 806-5** and shown on **Figure 806-4**. The two Kiilae Stream diversions have declared flows, the other two do not.

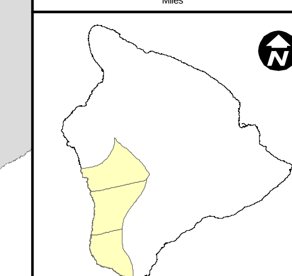
Hawaii County

Department of Water Supply

DWS UPDATE TO THE WATER USE AND DEVELOPMENT PLAN

Job No. 2003-818





INDEX MAP - Island of Hawaii

FIGURE 806-2

AQUIFER SECTOR
S.W. MAUNA LOA - 806

<u>Aquifer Systems</u>

Manuka - 80601
Kaapuna - 80602
Kealakekua - 80603

County Zoning

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

Figure 806-3: Well and Tunnel Location

MAP CURRENTLY NOT AVAILABLE ON-LINE

Figure 806-4: Streams & Diversions

MAP CURRENTLY NOT AVAILABLE ON-LINE

Table 806-5: Stream Diversions – Southwest Mauna Loa Aquifer Sector Area

FILE REFERENCE	TMK	STREAM NAME	
CARLSMITH DW	8-9-010:004	Unnamed Spring	Spring diversion, pipe from Kalihi Spring.
MCCANDLESS RAN	8-5-001:002	Kiilae	Stream diversion Pipe #1 from Kiilae Stream. See also new entry for Pipe #2. Delcared Q of 4.0 MG is the total for both pipes.
MCCANDLESS RAN	8-5-001:002	Kiilae	Stream diversion, Pipe #2 from Kiilae Stream (new entry). Declared Q of 4.0 MG is the total for both pipes.
TANOAI A	8-3-011:043	Unnamed/ Unmapped	Stream diversion, pump from Wailapa Stream. Stream is noted to be located 150 ft from house, but not shown on USGS. Lat/long taken at location of structure on USGS.

806.2.3 Reclaimed Wastewater

There are no wastewater reclamation facilities in the Southwest Mauna Loa ASEA.

806.3 EXISTING WATER USE

806.3.1 General

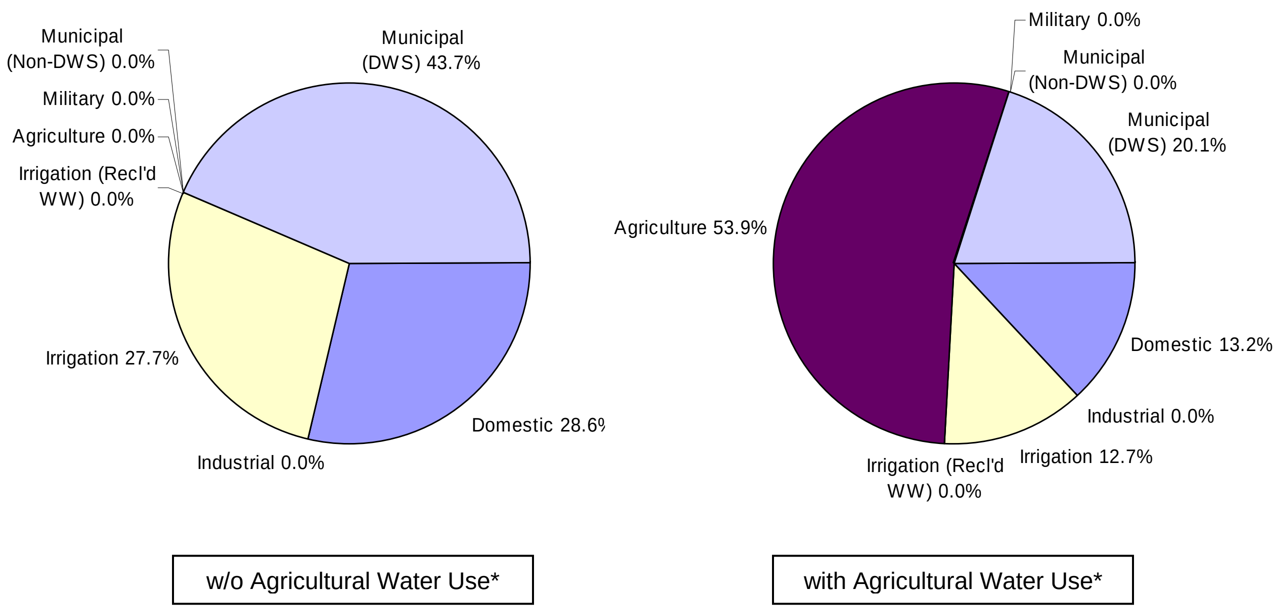
The total estimated average water use within the Southwest Mauna Loa ASEA from 2004 to 2005 (DWS meter data and CWRM pumpage data from November 2004 through October 2005 and available GIS data) is listed in **Table 806-6**. **Table 806-6** and **Figure 806-5** summarize water use in accordance with CWRM categories and 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.

Table 806-6: Existing Water Use by Categories – Southwest Mauna Loa Aquifer Sector Area

CWRM Water Use Category	Water Use (MGD)	Percent of Total without Ag*	Percent of Total with Ag*
Domestic	0.73	28.6	13.2
Industrial	0.00	0.0	0.0
Irrigation	0.71	27.7	12.7
Reclaimed WW	0.00	0.0	0.0
Agriculture	3.01	0.0	53.9
Military	0.00	0.0	0.0
Municipal			
DWS System	1.12	43.7	20.1
Private Public WS	0.00	0.0	0.0
Total without Ag*	2.57	100.0	
Total with Ag*	5.57		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 806-5: Existing Water Use by Categories – Southwest Mauna Loa 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.

Figure 806-6 generally shows the service area for the various water systems and indicates the extent of the DWS water system.

806.3.2 Domestic Use

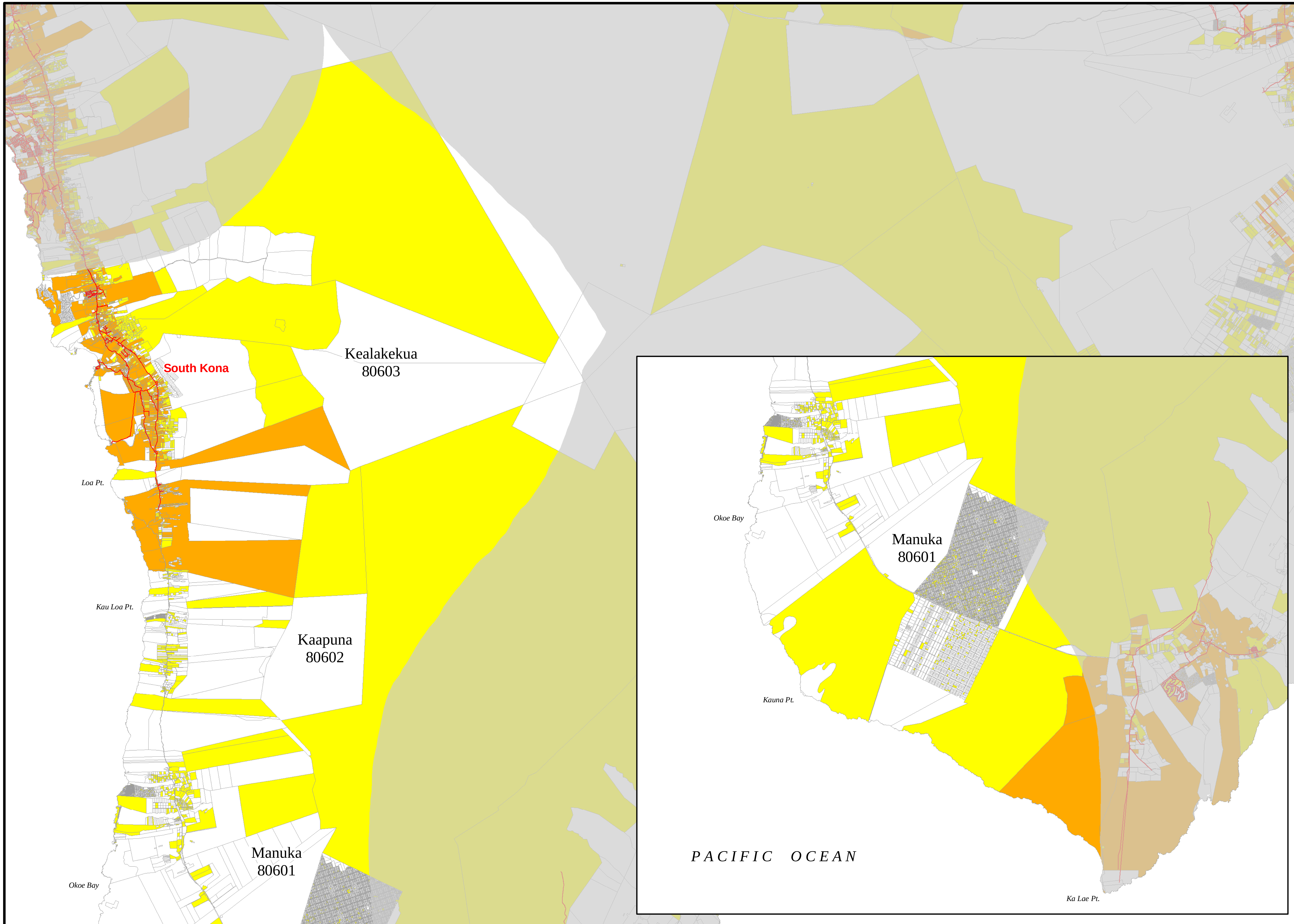
Domestic use or water use by individual households is assumed to be supplied by private individual rainwater catchment systems or private wells. Based on available GIS data, there are 1,731 developed parcels serving approximately 4,700 people, which is 37 percent of the sector area population. The estimated demand is 0.73 mgd. None of the four wells classified as "Domestic" in the CWRM database report pumpage.

806.3.3 Industrial Use

There is no reported industrial usage in the CWRM well database.

806.3.4 Irrigation Use

Irrigation is based on pumpage reported for private wells categorized by CWRM as irrigation wells. **Table 806-7** indicates the average for private irrigation well pumpage reported to CWRM or listed in the 2003 SWPP.



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)
- Aquifer Systems
- DWS Water System

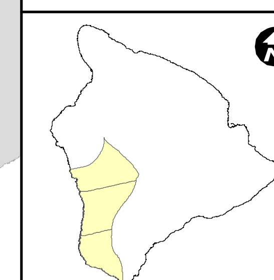

INDEX MAP - Island of Hawaii

FIGURE 806-6

AQUIFER SECTOR
S.W. MAUNA LOA - 806
Aquifer Systems
Manuka - 80601
Kaapuna - 80602
Kealakekua - 80603

Water System and Service Area

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

Table 806-7: Private Irrigation Well Pumpage

Private Irrigation	Irrigation Well Pumpage (mgd)
Mac Farms Hawaii	0.16
Kona Horizons Ltd.	0.01
1250 Oceanside Partners	0.54
TOTAL	0.71

There are no golf courses located within the Southwest Mauna Loa ASEA.

806.3.5 Agricultural Use

According to the *2003 South Kona Watershed Irrigation System Study (SKWIS),* the agricultural water usage within the 15,000-acre study area immediately south of the Papa Bay Homesteads is supplied by catchment systems. Water trucks have provided water from the DWS South Kona Water System during drought periods, which may contribute to the 0.12 mgd drawn from the DWS water system from accounts classified as "Agricultural."

806.3.6 Military Use

There is no military use in the Southwest Mauna Loa ASEA.

806.3.7 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.

806.3.7.1 County Water Systems

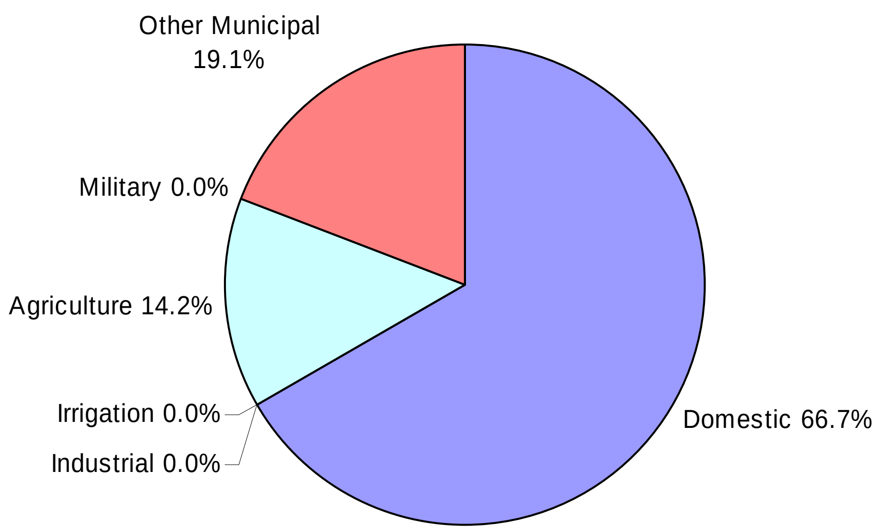
The DWS has one system in the Southwest Mauna Loa ASEA. The South Kona Water System interconnects with the North Kona Water System a short distance from the district boundary at Konawaena School. The principal source for the water system is the Keei Well field, however three of the four wells are used as backup only. In 1997, the Halekii Well at Kealakekua was brought into service. The water system extends south to Hookena, a distance of 16 miles. Eight booster pump stations, nine storage tanks and over twenty PRV's allow eleven operational zones to be serviced. A connection to the North Kona System exists along Mamalahoa Highway. The normally closed valve may be opened in case of emergencies.

DWS water use is subcategorized in **Table 806-8** to the extent possible based on available meter data and is depicted in **Figure 806-7**. "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 806-8: DWS Existing Water Use by Categories – Southwest Mauna Loa Aquifer Sector Area

CWRM Water Use Category	DWS Purveyed Water Use (MGD)	Percent of Total
Domestic	0.75	66.7
Industrial	0.00	0.0
Irrigation	0.00	0.0
Agriculture	0.16	14.2
Military	0.00	0.0
Other Municipal	0.21	19.1
Total	1.12	100.0

Figure 806-7: DWS Existing Water Use by Categories – Southwest Mauna Loa Aquifer Sector Area



806.3.7.2 State Water Systems

There are no State water systems in the Southwest Mauna Loa ASEA regulated by the DOH.

806.3.7.3 Federal Water Systems

There are no Federal water systems in the Southwest Mauna Loa ASEA regulated by the DOH.

806.3.7.4 Private Public Water Systems

There are no private public water systems in the Southwest Mauna Loa ASEA regulated by the DOH.

806.3.8 Water Use by Resource

806.3.8.1 Ground Water

Table 806-9 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 806-9: Sustainable Yield – Southwest Mauna Loa 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 (%)
		2.38	**6.92**	**10.38**	**130**	**1.83**	**5.32**	**7.98**
80601	Manuka	0.16	0.79	1.18	42	0.38	1.87	2.81
80602	Kaapuna	0.01	0.40	0.60	50	0.02	0.80	1.20
80603	Kealakekua	2.17	5.73	8.60	38	5.71	15.09	22.63

806.3.8.2 Surface Water

The 15,000-acre McCandless Ranch near Kalahiki uses two diversions of the Kiilae Stream with a total declared flow of 8.0 mgd; however, the actual quantity used is not readily available.

806.3.8.3 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 806-6** is assumed to be supplied by individual catchment systems.

As mentioned previously, the SKWIS Study indicates that catchment reservoir systems are utilized by agricultural users to supplement natural precipitation.

806.3.8.4 Reclaimed Wastewater

There is no reclaimed wastewater usage in the sector area.

806.4 FUTURE WATER NEEDS

806.4.1 General

Table 806-10 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 806-10: 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 S.W. Mauna Loa ASEA	130	18.0	1.5	2.6	2.8	3.2	3.5	3.9
80601 – Manuka ASYA	42	7.7	0.0	0.5	0.6	0.7	0.7	0.8
80602 – Kaapuna ASYA	50	0.0	0.0	0.3	0.3	0.3	0.4	0.4
80603 – Kealakekua ASYA	38	10.3	1.4	1.7	1.9	2.2	2.4	2.7
With Agricultural Demand*	**SY (mgd)**	**LUPAG (mgd)**	**Zoning (mgd)**	**Growth Rate B Demand Projections (mgd)**				
				2005	**2010**	**2015**	**2020**	**2025**
Total S.W. Mauna Loa ASEA	130	142.5	123.1	5.6	6.2	6.8	7.6	8.4
80601 – Manuka ASYA	42	33.2	25.2	1.2	1.3	1.4	1.6	1.7
80602 – Kaapuna ASYA	50	40.8	40.4	1.3	1.4	1.6	1.8	2.0
80603 – Kealakekua ASYA	38	68.5	57.5	3.1	3.4	3.8	4.3	4.7

* 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.

For all aquifer system areas, full build-out water demands excluding agricultural demands are considerably less than the SY, and the 2025 demand projections excluding agricultural demands are less than 10 percent of the system area SY. Therefore, analysis of the three demand scenarios does not need to be broken down by aquifer system areas and thus will be presented for the aquifer sector area only.

806.4.2 Full Build-Out Water Demand Projections

The full build-out water demand projections based on the General Plan and County Zoning for the Southwest Mauna Loa ASEA are listed in **Tables 806-11** and **806-12**, and reflect refinement as discussed below. Each land use class is associated with the most appropriate CWRM water use category.

Table 806-11: Hawaii County General Plan Full Build-Out Water Demand Projection – Southwest Mauna Loa Aquifer Sector Area

LUPAG Class	CWRM Category	Water Demand (mgd)
Urban	Domestic/Irrigation/Municipal	9.8
Urban Expansion	Domestic/Irrigation/Municipal	1.4
Resort	Irrigation/Municipal	0.4
Industrial	Industrial	0.0
Agriculture	Agriculture	124.5
University	Irrigation/Municipal	0.0
Rural	Irrigation/Municipal	6.4
DHHL	Irrigation/Municipal	0.0
TOTAL w/o Ag*		18.0
TOTAL w/ Ag*		142.5

* 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 806-12: County Zoning Full Build-Out Water Demand Projection – Southwest Mauna Loa Aquifer Sector Area

Zoning Class	CWRM Category	Water Demand (mgd)
Residential	Domestic/Irrigation/Municipal	1.0
Resort	Irrigation/Municipal	0.0
Commercial	Municipal	0.4
Industrial	Industrial	0.0
Agriculture	Agriculture	121.6
DHHL	Irrigation/Municipal	0.0
TOTAL w/o Ag*		1.5
TOTAL w/ Ag*		123.1

* 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.

806.4.2.1 Refine Land Use Based Projection

806.4.2.1.1 State Water Projects Plan

The total projected demand to the year 2020 for 15 State Water Projects within the Southwest Mauna Loa ASEA is 0.12 mgd, using 0.02 mgd potable, and 0.10 mgd nonpotable using potable sources. These projects may account for 3 percent of the total projected water demand in the sector area. The projects that will generate the most significant demands are listed in **Table 806-13**.

Table 806-13: Future State Water Projects to Generate Significant Demands

Project Name	Primary Use	State Department	2020 Demand (mgd)
Kealakekua Bay Ship	Nonpotable using Potable	State Parks	0.08
Kona Civic Center	Nonpotable using Potable	DAGS – Planning	0.02

806.4.2.1.2 State Department of Hawaiian Home Lands

There are no tracts of land in the Southwest Mauna Loa ASEA owned by the DHHL.

806.4.2.1.3 Agricultural Water Use and Development Plan

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

806.4.3 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 at least 7,500 acres of County Zoning) consumption is based on 1.5 units per lot.

806.4.4 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 Southwest Mauna Loa ASEA. The projected low, medium, and high growth rates are listed in **Table 806-14**, and are graphed in **Figure 806-8**. Potable and nonpotable water demands are also differentiated.

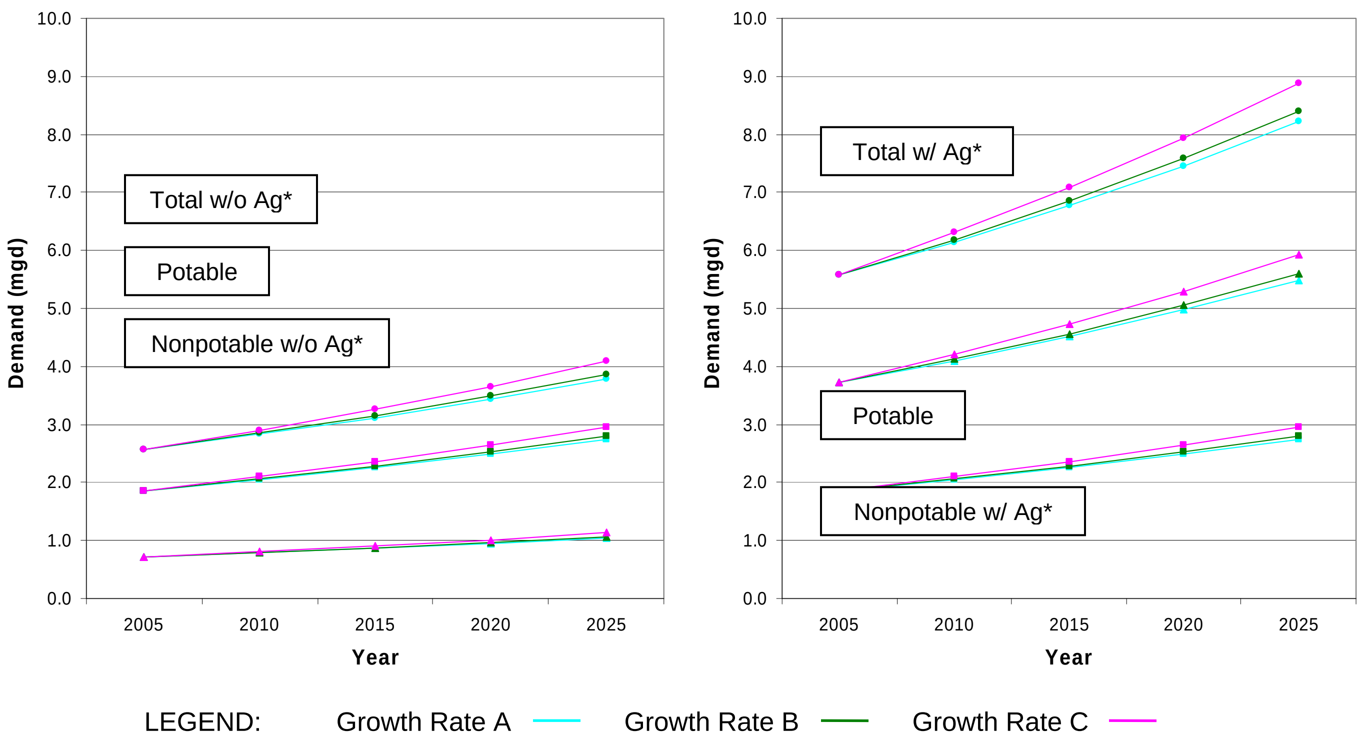
Focusing on Medium Growth Rate B, **Figure 806-9** illustrates the magnitude of the sustainable yield, both LUPAG and Zoning full build-out water use, and water use projection through the year 2025. **Figure 806-10** shows the breakdown of water demand projections by CWRM categories through the year 2025. **Table 806-15** summarizes these figures.

Table 806-14: Water Demand Projection – Southwest Mauna Loa 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	2.6	2.8	3.1	3.4	3.8	5.6	6.1	6.8	7.5	8.2
Potable	1.9	2.0	2.3	2.5	2.7	1.9	2.0	2.3	2.5	2.7
Nonpotable	0.7	0.8	0.9	0.9	1.0	3.7	4.1	4.5	5.0	5.5
GROWTH RATE B	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	2.6	2.8	3.2	3.5	3.9	5.6	6.2	6.8	7.6	8.4
Potable	1.9	2.1	2.3	2.5	2.8	1.9	2.1	2.3	2.5	2.8
Nonpotable	0.7	0.8	0.9	1.0	1.1	3.7	4.1	4.6	5.1	5.6
GROWTH RATE C	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	2.6	2.9	3.3	3.7	4.1	5.6	6.3	7.1	7.9	8.9
Potable	1.9	2.1	2.4	2.6	3.0	1.9	2.1	2.4	2.6	3.0
Nonpotable	0.7	0.8	0.9	1.0	1.1	3.7	4.2	4.7	5.3	5.9

* 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 806-8: Water Demand Projection Summary – Southwest Mauna Loa Aquifer Sector Area



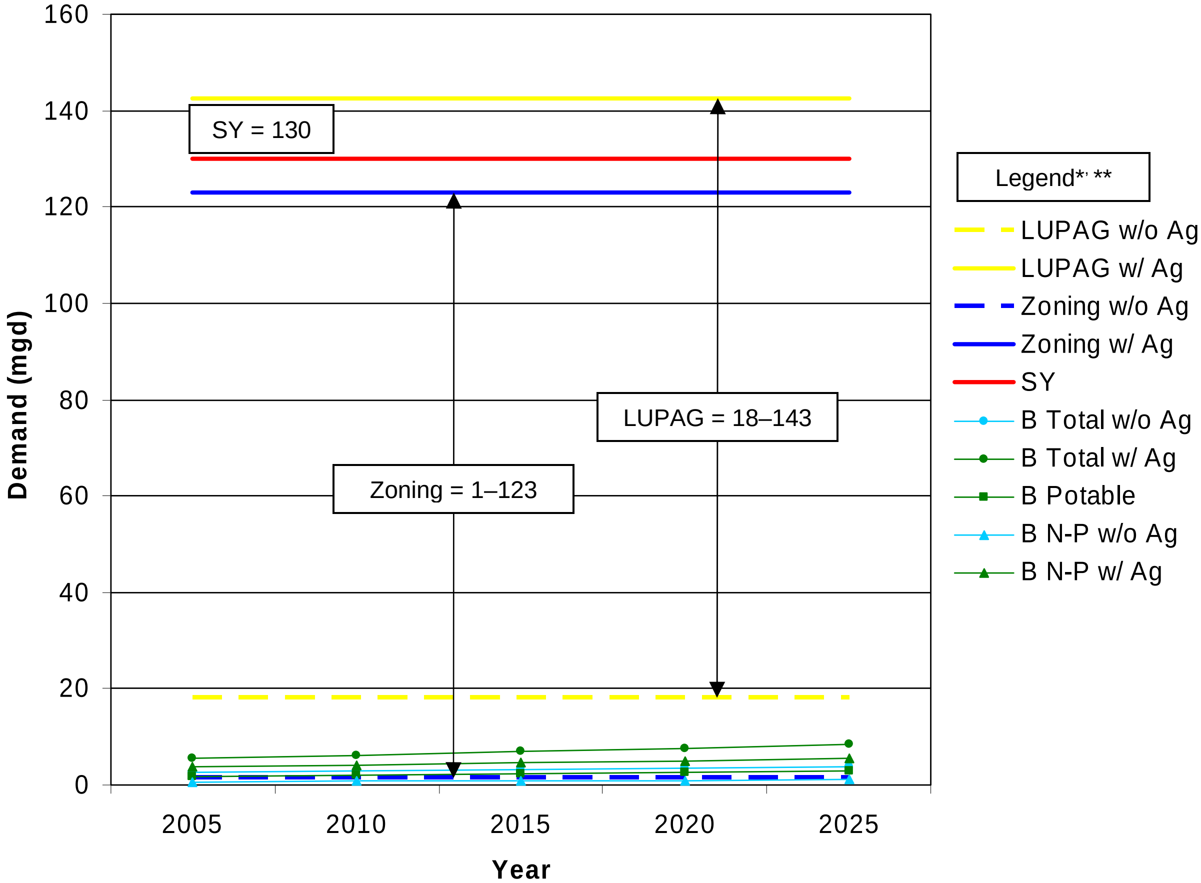
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 806-15: Medium Growth Rate B Water Demand Projection by Category – Southwest Mauna Loa Aquifer Sector Area

Water Use Category	2005 (mgd)	2010 (mgd)	2015 (mgd)	2020 (mgd)	2025 (mgd)
Total without Ag*	2.6	2.8	3.2	3.5	3.9
Total with Ag*	5.6	6.2	6.8	7.6	8.4
Domestic	0.7	0.8	0.9	1.0	1.1
Industrial	0.0	0.0	0.0	0.0	0.0
Irrigation	0.7	0.8	0.9	1.0	1.1
Agriculture	3.0	3.3	3.7	4.1	4.5
Military	0.0	0.0	0.0	0.0	0.0
Municipal	1.1	1.2	1.4	1.5	1.7
Potable	1.9	2.1	2.3	2.5	2.8
Nonpotable w/o Ag*	0.7	0.8	0.9	1.0	1.1
Nonpotable w/ Ag*	3.7	4.1	4.6	5.1	5.6
DWS	1.1	1.2	1.4	1.5	1.7

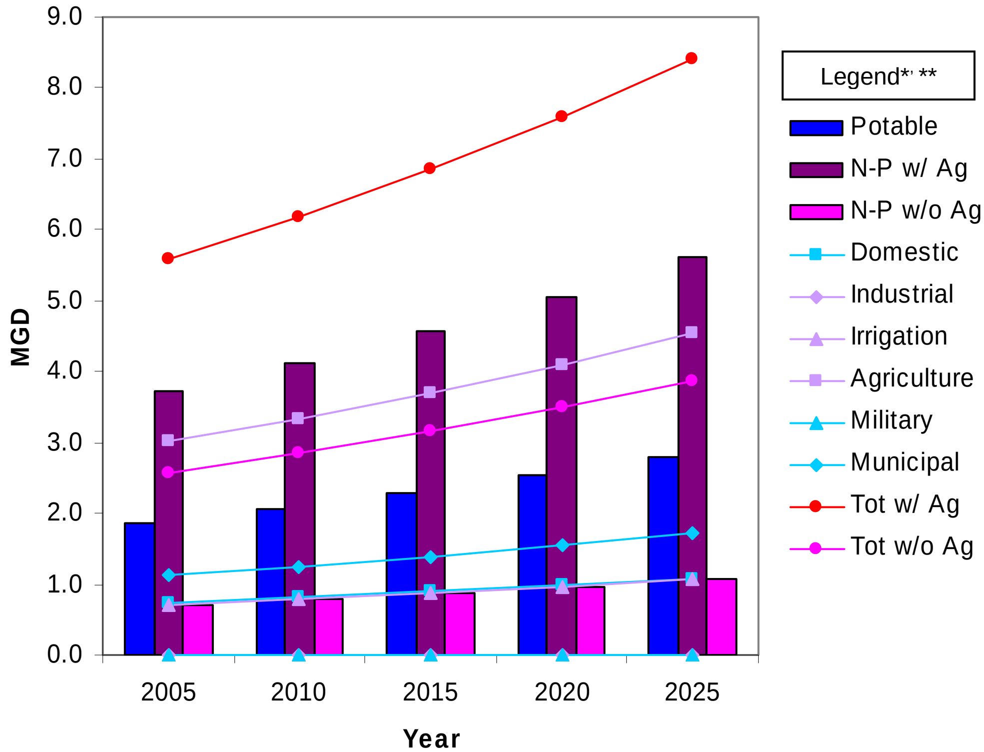
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 806-9: Medium Growth Rate B Water Demand Projections and Full Build-Out – Southwest Mauna Loa 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 806-10: Medium Growth Rate B Water Demand Projection by Category – Southwest Mauna Loa Aquifer Sector Area

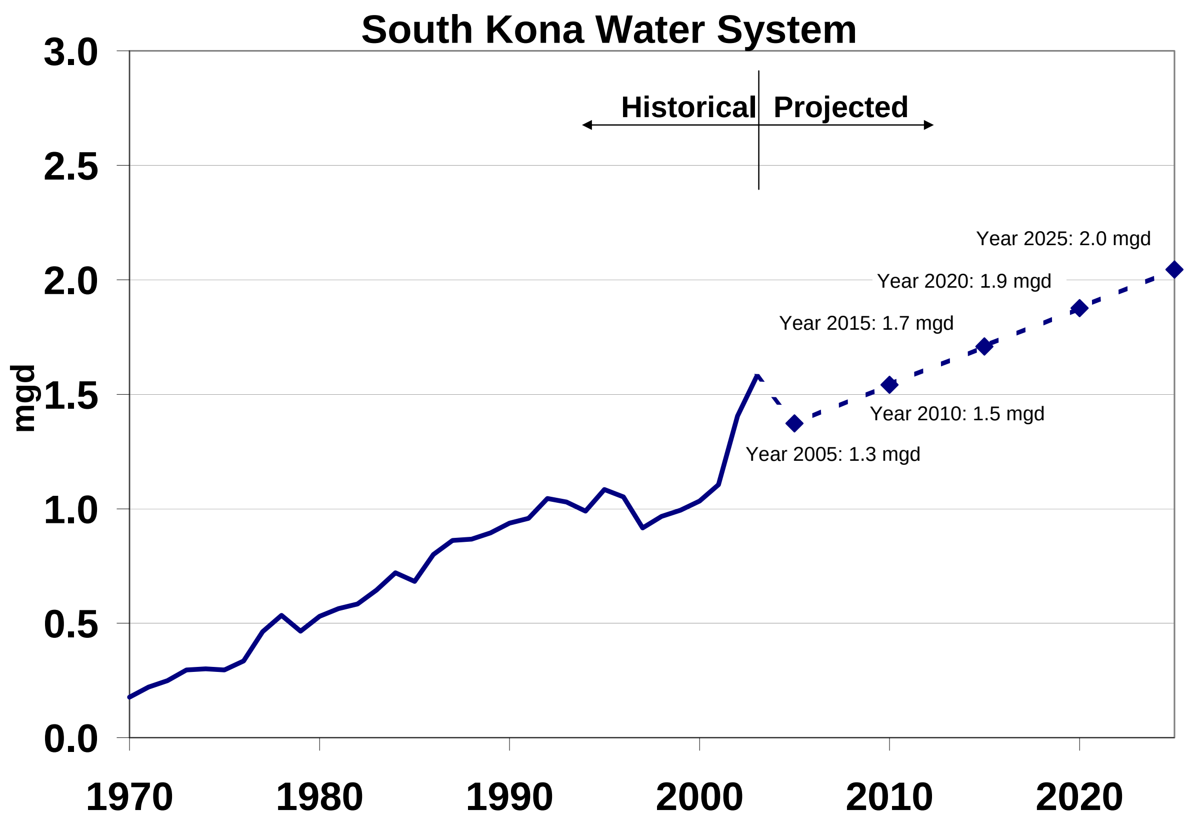


* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.
** "N-P" represents the nonpotable component of the demand.

806.4.5 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 806-11**.

Figure 806-11: DWS Water Demand Projection – Southwest Mauna Loa Aquifer Sector Area



Historical data and graph provided by RW Beck, Inc.

Projections based on historical DWS water consumption data are slightly lower than projections based on population growth rate, primarily because the projected demand for 2005 is lower 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 of as much as half of the total projected water supply for the Southwest Mauna Loa ASEA.

806.5 RESOURCE AND FACILITY RECOMMENDATIONS

806.5.1 Water Source Adequacy

806.5.1.1 Full Build-Out

Full development to the maximum density of the County General Plan land use within the Southwest Mauna Loa Aquifer Sector Area (ASEA) can be sustained by conventional water resources. If agricultural demands are excluded, LUPAG water demands amount to less than 15 percent of the sustainable yield (SY) of the sector area, and the existing Zoning requires approximately 1 percent of the sector area SY. If worst case agricultural demands are included, the LUPAG demand scenario would exceed the SY, and Zoning demand scenario would require 95 percent of the SY.

806.5.1.2 Twenty-Year Projection

Existing demands range between 2 and 3 percent of the SY of the sector area, and 20-year projected demands range between 4 and 7 percent of the SY.

806.5.2 Source Development Requirements

806.5.2.1 Supply-Side Management

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

806.5.2.1.1 Conventional Water Resource Measures

806.5.2.1.1.1 Ground Water

The basal groundwater lens extends at least six miles inland, is thin, difficult to develop, and a significant portion may be brackish according to the WRPP. The existence of high-level water has been shown by the development of the DWS Halekii and Keei 4 Wells in the Kealakekua Aquifer System Area (ASYA). Further inland, high level water is present at 1,000 to 1,500 feet beneath the ground surface. High level groundwater remains the most viable resource and should continue to be developed. DWS has planned another high level well further south of the existing Halekii Well. As no wells have been drilled mauka of Mamalahoa Highway south of Keei in the sector area, the potential for high level groundwater is uncertain and needs to be investigated further.

Potable basal water is one of the many potential options to the Ocean View area. Multiple wells with smaller pumping rates spread out would be necessary to avoid drawing brackish water.

The *2003 SKWIS* study indicates that either high level potable sources or low level nonpotable sources may be developed to supply a future agricultural irrigation system in the study area, which is split by Mamalahoa Highway and is bound by Ocean View to the south and Papa Bay Homesteads to the north. The service area may also be extended to supply the Ocean View area.

806.5.2.1.1.2 Surface Water

Surface water is not considered a viable resource as shown by the limited number of stream diversions and the lack of perennial streams in the sector area.

806.5.2.1.1.3 Water Transfer

One of the alternatives to supply potable water to the southern areas in the Manuka ASYA proposed for development is to develop sources in the Southeast Mauna Loa ASEA (805) and transfer water to the Southwest Mauna Loa ASEA. As described in the *2004 Kau to South Kona Water Master Plan*, several water transfer alternatives might be considered, including different combinations of development of wells north of South Point and extension of the DWS Waiohinu-Naalehu System, construction of a pipeline to deliver such sources to South Point, and standpipes north of the South Point area to reduce water hauler distances.

Water transfer may also be considered to supply nonpotable water for agricultural purposes. Should DWS abandon tunnel sources in the Naalehu Aquifer System, which may be under surface water influence, in favor of groundwater sources due to Federal Safe Drinking Water Act requirements, these sources may be available to transfer to areas proposed for development in the Manuka ASYA.

806.5.2.1.2 Alternative Water Resource Enhancement Measures

806.5.2.1.2.1 Rainwater Catchment Systems

Some of the area within the sector area proposed for development receives sufficient rainfall to support catchment, however most do not. Notably, the Ocean View area, which relies on individual rainwater catchment systems, receives less than 60 inches of rainfall per year, which is generally less than adequate. Evidence of this inadequacy is Ocean View’s frequent dependency on hauled water.

Rainwater catchment systems may be used to supplement nonpotable sources. Runoff could be to collected from land and road areas and stored in ponds, which in turn could be used for irrigation or fire protection.

806.5.2.1.2.2 Wastewater Reclamation

Wastewater reclamation facilities can only be implemented if a sanitary collection system and a wastewater treatment facility exist. Currently, only areas in the Kealakekua ASYA have such systems in place. In future development areas, community planning may structure land uses requiring nonpotable water around the placement of a wastewater treatment and wastewater reclamation facility. Wastewater flows would need to be large enough to justify the cost of a reclamation facility. Projections indicate the population of the sector area is expected to grow by 8,000 over the next 20 years; therefore, this alternative might become feasible.

806.5.2.1.2.3 Desalination

Although costly, desalination of brackish groundwater might be one of the more cost-effective alternatives in southern areas of the Manuka ASYA. Chloride content in the Kahuku Well was reported at 300 ppm, which is promising. Desalination of water with such low chlorides would require significantly less energy.

806.5.2.2 Demand-Side Management

806.5.2.2.1 Development Density Control

Full build-out demands associated with LUPAG maximum density are over ten times greater than that of Zoning. The Ocean View area is classified as “Rural” in the LUPAG. The area consists of over 12,000 subdivided lots, almost all of which are one acre in size; therefore, the density assumption of 1 lot per acre for LUPAG “Rural” designations is consistent.

Urban LUPAG areas only exist in the Kealakekua ASYA, where potable water sources are available. Water requirements associated with development of these areas to the maximum density area less than 10 mgd, which is less than 5 percent of the SY; therefore, development density control in these locations is not necessary.

806.5.2.2.2 Water Conservation

The average water consumption per connection to the DWS system in the Southwest Mauna Loa ASEA is over 500 gpd per connection, which is higher than the island average; however, the average potable water consumption per capita from all sources is estimated at 145 gpd, which is exactly the island average. Water conservation should continue; however, strict demand-side conservation practices do not need to be implemented. Some measures include voluntary water conservation during dry periods, education programs, and requirement for more efficient landscaping practices.

806.5.3 Recommended Alternatives

Exploration and development of high-level groundwater sources should continue as the primary source to meet potable water requirements in the Kealakekua ASYA, and for potential transfer to the Hualalai ASEA (809).

DWS should strive to reduce the average consumption per connection closer to the island average. Although sources are readily available, conservation efforts would make available more source water to transfer to the Hualalai ASEA (809).

Alternatives to supply potable and nonpotable water to the area in the Manuka ASYA proposed for development should be considered in conjunction with public input to determine near term and far term water supply strategies.

807 NORTHWEST MAUNA LOA AQUIFER SECTOR AREA

807.1 SECTOR AREA PROFILE

807.1.1 General

The Northwest Mauna Loa Aquifer Sector Area (ASEA) includes the Anaehoomalu [80701] Aquifer System Area (ASYA). It extends from the summit of Mauna Loa, northwest to the western shores of Anaehoomalu; and spans three districts, capturing the southern coastal portion of the South Kohala District, the northeastern portion of the North Kona District and the southern portion of the Hamakua District.

Average rainfall ranges from 10 inches along the coast to 45 inches in the low-lying areas between Mauna Kea and Mauna Loa. The sustainable yield is 30 mgd.

807.1.2 Economy and Population

807.1.2.1 Economy

Tourism has become the leading economic industry in South Kohala. Two of South Kohala's three luxury resorts lie within the Northwest Mauna Loa ASEA. The Mauna Lani Resort includes a hotel and several condominium resorts and villas. The Waikoloa Resort includes two hotels and six condominium resorts on 1,150 acres. Both resorts sport two golf courses and other amenities.

The Pohakuloa Military Training Area (PTA) is also located in the saddle area between Mauna Kea and Mauna Loa within the southern portion of the sector area. The PTA consists of 108,863 acres, however much of this is designated as a conservation district. As the largest training area in Hawaii, Pohakuloa can be used to accomplish nearly all of the varying types of training required by the military forces. A support area of 600 acres containing logistic and administrative facilities plus quarters for approximately 2,000 troops is located to the north at the base of Mauna Kea.

807.1.2.2 Population

Nearly all of the population contributing to the demands from the sector area is within the South Kohala District. The growth in tourism has followed the dramatic increase in the population of South Kohala over the past 30 years; and as a result, South Kohala enjoyed the lowest unemployment rate and the highest median income on the island in 1997.

Table 807-1: Historical Population

1980	1990	2000	1980-90 % Change	1990-2000 % Change
173	344	494	98.8	43.6

Data Source: 2000 U.S. Census
Data redistributed and evaluated for Northwest Mauna Loa ASEA

Table 807-2: Population Projection

Growth Rate	2000	2005	2010	2015	2020	2000-10 % Change	2010-20 % Change
A – Low	494	587	678	781	901	37.2	32.9
B – Medium	494	589	684	793	919	38.5	34.4
C – High	494	614	727	855	1,002	47.2	37.8

Data Source: County General Plan, February 2005
Data redistributed and evaluated for Northwest Mauna Loa ASEA

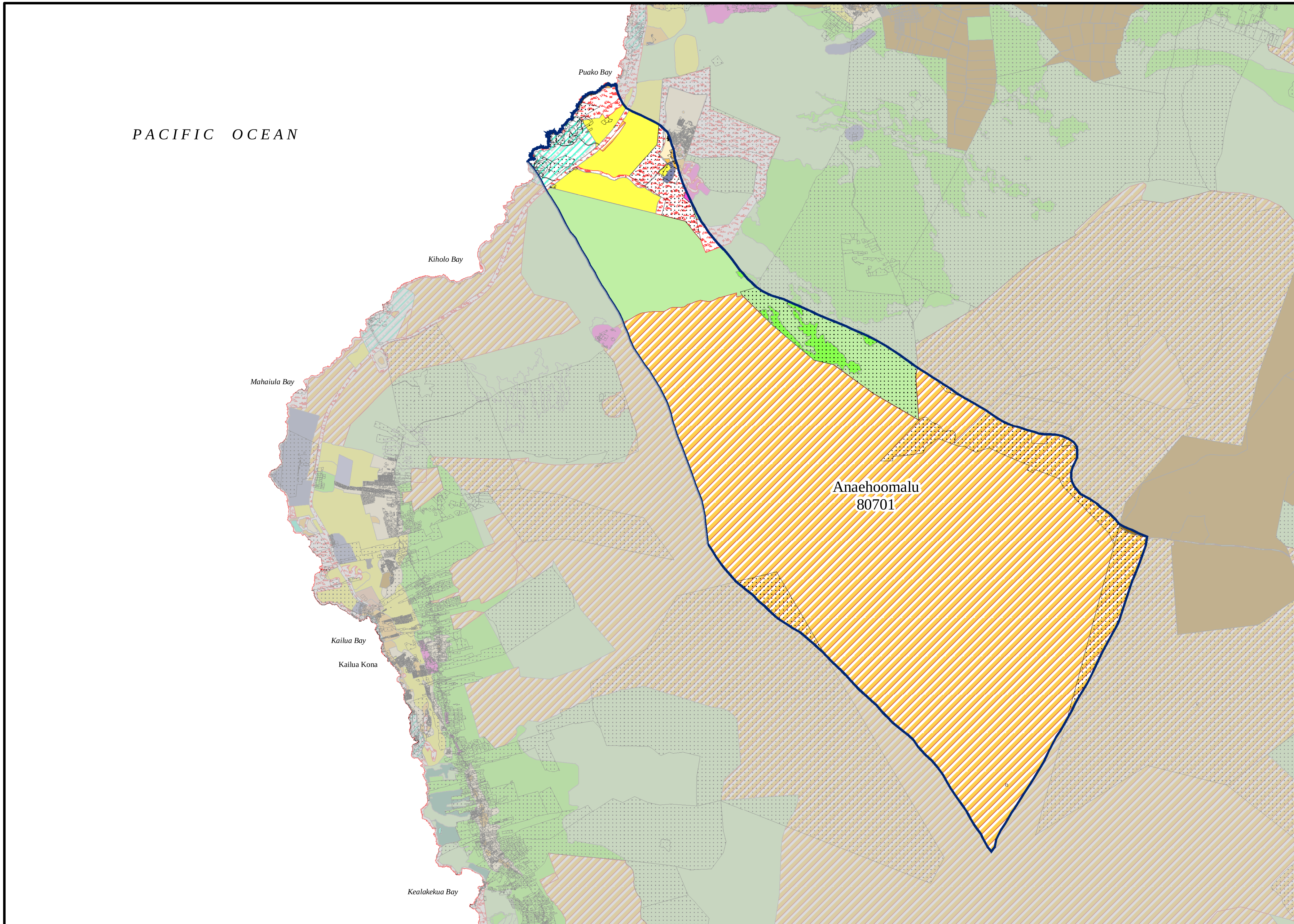
807.1.3 Land Use

807.1.3.1 Hawaii County General Plan

The Hawaii County General Plan Land Use Pattern Allocation Guide Map (LUPAG) for the sector area is shown on **Figure 807-1**. The estimated land use allocation acreage for each LUPAG designation within the Sector is listed in **Table 807-3**.

Table 807-3: LUPAG Map Estimated Land Use Allocation Acreage – Northwest Mauna Loa Aquifer Sector Area

LAND USE PATTERN	ACREAGE	% of TOTAL
High Density Urban	0	0
Medium Density Urban	99	0.05
Low Density Urban	343	0.17
Industrial	155	0.08
Important Agricultural Land	2,079	1.02
Extensive Agriculture	23,100	11.31
Orchard	0	0
Rural	44	0.02
Resort/Resort Node	2,551	1.25
Open	5,472	2.68
Conservation	163,573	80.08
Urban Expansion	6,842	3.35
University Use	0	0
TOTAL	204,257	100.00



Hawaii County
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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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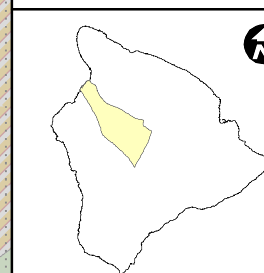
Miles



INDEX MAP - Island of Hawaii

FIGURE 807-1
AQUIFER SECTOR
N.W. MAUNA LOA - 807
Aquifer System
Anaehoomalu - 80701

2005 Revised General Plan Land Use Pattern Allocation Guide Map

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The water utility courses of action for South Kohala in the Hawaii County General Plan relevant to the Northwest Mauna Loa ASEA are as follows:

(a) Seek alternative sources of water for the Lalamilo system.
(b) Improve and replace inadequate distribution mains and steel tanks.

807.1.3.2 Hawaii County Zoning

Hawaii County Zoning for the sector area is shown on **Figure 807-2**. The estimated land use allocation acreage for each zoning class within the sector area is listed in **Table 807-4**.

Table 807-4: County Zoning Estimated Class Allocation Acreage – Northwest Mauna Loa Aquifer Sector Area

ZONING CLASS	ACREAGE	% of TOTAL
Single Family Residential	349	0.17
Multi-Family Residential (including duplex)	1,222	0.60
Residential-Commercial Mixed Use	0	0
Resort	234	0.11
Commercial	127	0.06
Industrial	2	0.00
Industrial-Commercial Mixed	0	0
Family Agriculture	0	0
Residential Agriculture	868	0.42
Agriculture	32,869	16.09
Open	60,274	29.51
Project District	0	0
Forest Reserve	107,774	52.76
(road)	537	0.26
TOTAL	204,254	100.00

807.2 AVAILABLE WATER RESOURCES

807.2.1 Ground Water

The Northwest Mauna Loa ASEA has a sustainable yield of 30 mgd. According to the CWRM database, there are 19 production wells in the sector, including 11 irrigation, 1 industrial, and 7 other. Refer to **Appendix B** for this database. **Figure 807-3** shows the well locations.

807.2.2 Surface Water

There are no declared stream diversions in the sector area in CRWM database.

807.2.3 Reclaimed Wastewater

There are 2 wastewater reclamation facilities (WWRF) in the study area. **Table 807-5** lists the WWRF, reclaimed water classification, facility treatment capacity, current reuse amount, and current application.

Table 807-5: Wastewater Reclamation Facilities – Northwest Mauna Loa Aquifer Sector Area

Wastewater Reclamation Facility	Reclaimed Water Classification	WWRF Capacity (MGD)	Current Reuse Amount (MGD)	Irrigation Application
Waikoloa Beach Resort WRF	R-2	1.3	0.5	Beach Resort/Golf Course
Mauna Lani WWRF	R-2	0.75	0.25	Nursery/Sod Farm/Composting

807.3 EXISTING WATER USE

807.3.1 General

The total estimated average water use within the Northwest Mauna Loa ASEA from November 2004 through October 2005 based on DWS meter data, CWRM pumpage data, available GIS data, SWPP estimates, and estimated reclaimed wastewater usage is listed in **Table 807-6** and summarized in **Figure 807-5** in accordance with CWRM categories; and indicate 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.

Table 807-6: Existing Water Use by Categories – Northwest Mauna Loa Aquifer Sector Area

CWRM Water Use Category	Water Use (MGD)	Percent of Total without Ag*	Percent of Total with Ag*
Domestic	0.00	0.0	0.0
Industrial	0.00	0.0	0.0
Irrigation	5.05	63.3	62.0
Reclaimed WW	0.75	9.4	9.2
Agriculture	0.18	0.0	2.2
Military	0.03	0.4	0.4
Municipal			
DWS System	2.14	26.9	26.3
Private Public WS	0.00	0.0	0.0
Total without Ag*	7.97	100.0	
Total with Ag*	8.15		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.

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Department of Water Supply

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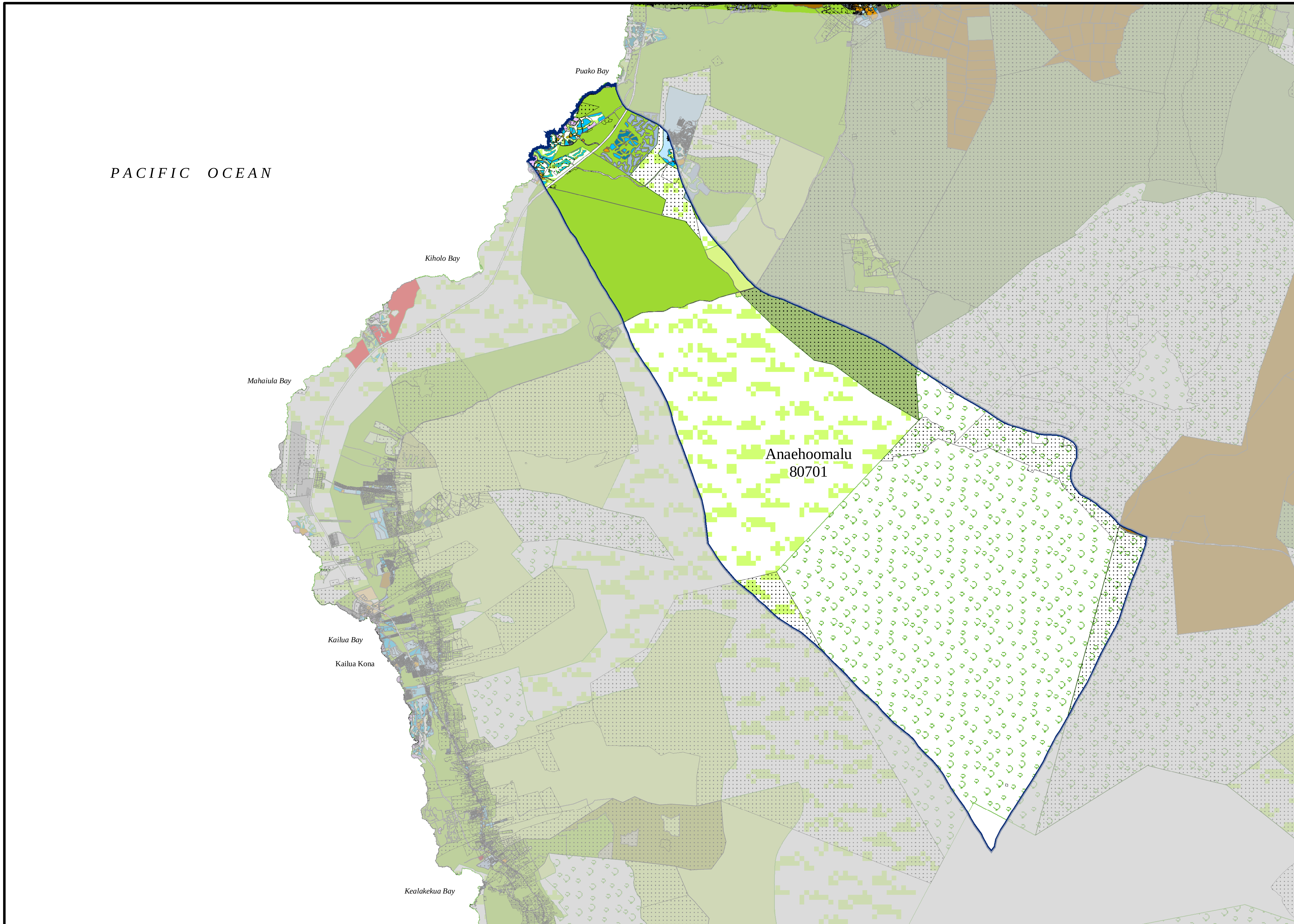
Job No. 2003-818



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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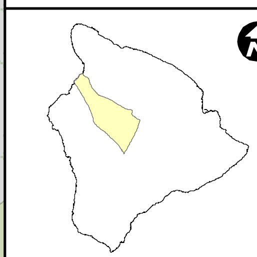

INDEX MAP - Island of Hawaii

FIGURE 807-2

AQUIFER SECTOR
N.W. MAUNA LOA - 807

Aquifer System

Anaehoomalu - 80701

County Zoning

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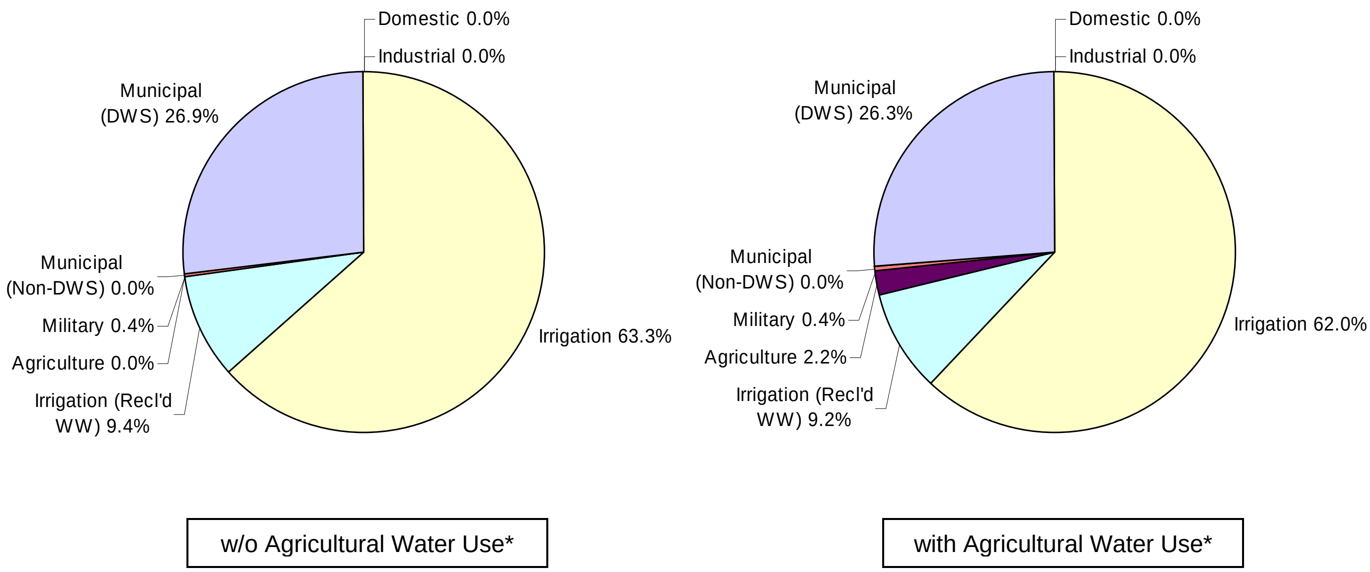
Figure 807-3: Well and Tunnel Location

MAP CURRENTLY NOT AVAILABLE ON-LINE

Figure 807-4: Streams & Diversions

MAP CURRENTLY NOT AVAILABLE ON-LINE

Figure 807-5: Existing Water Use by Categories – Northwest Mauna Loa 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.

Figure 807-6 generally shows the service area for the various water systems and indicates the extent of the DWS water system.

807.3.2 Domestic Use

Domestic use or water use by individual households is assumed to be supplied by private individual rainwater catchment systems. However, there is no evidence of such usage within the sector.

807.3.3 Industrial Use

There is no reported industrial usage in the CWRM well database.

807.3.4 Irrigation Use

Irrigation accounts for nearly two-thirds of the water used in the sector area, and is based on pumpage reported for private wells categorized by CWRM as irrigation wells and reclaimed water use as indicated in previously **Table 807-6**. **Table 807-7** indicates the average for private irrigation well pumpage reported to CWRM.

Table 807-7: Private Irrigation Well Pumpage

Private Irrigation	Irrigation Well Pumpage (mgd)
Mauna Lani Resort	1.56
Waikoloa	2.56
Parker Ranch	0.83
TOTAL	5.05

The Mauna Lani Resort maintains seven brackish water wells for golf course irrigation, four of which are located in the Northwest Mauna Loa ASEA.

The Waikoloa Resort lands were purchased in 1968 from Parker Ranch by Boise Cascade. The lands are split between the Northwest Mauna Loa ASEA and the West Mauna Kea ASEA (803), with the higher elevation lands above the beach resort used for residential development within the former and the oceanfront lands used for resort hotel development within the latter. Six wells located within the Northwest Mauna Loa ASEA provide brackish water for golf course irrigation.

807.3.5 Agricultural Use

There is no agricultural usage from known sources in the sector area.

807.3.6 Military Use

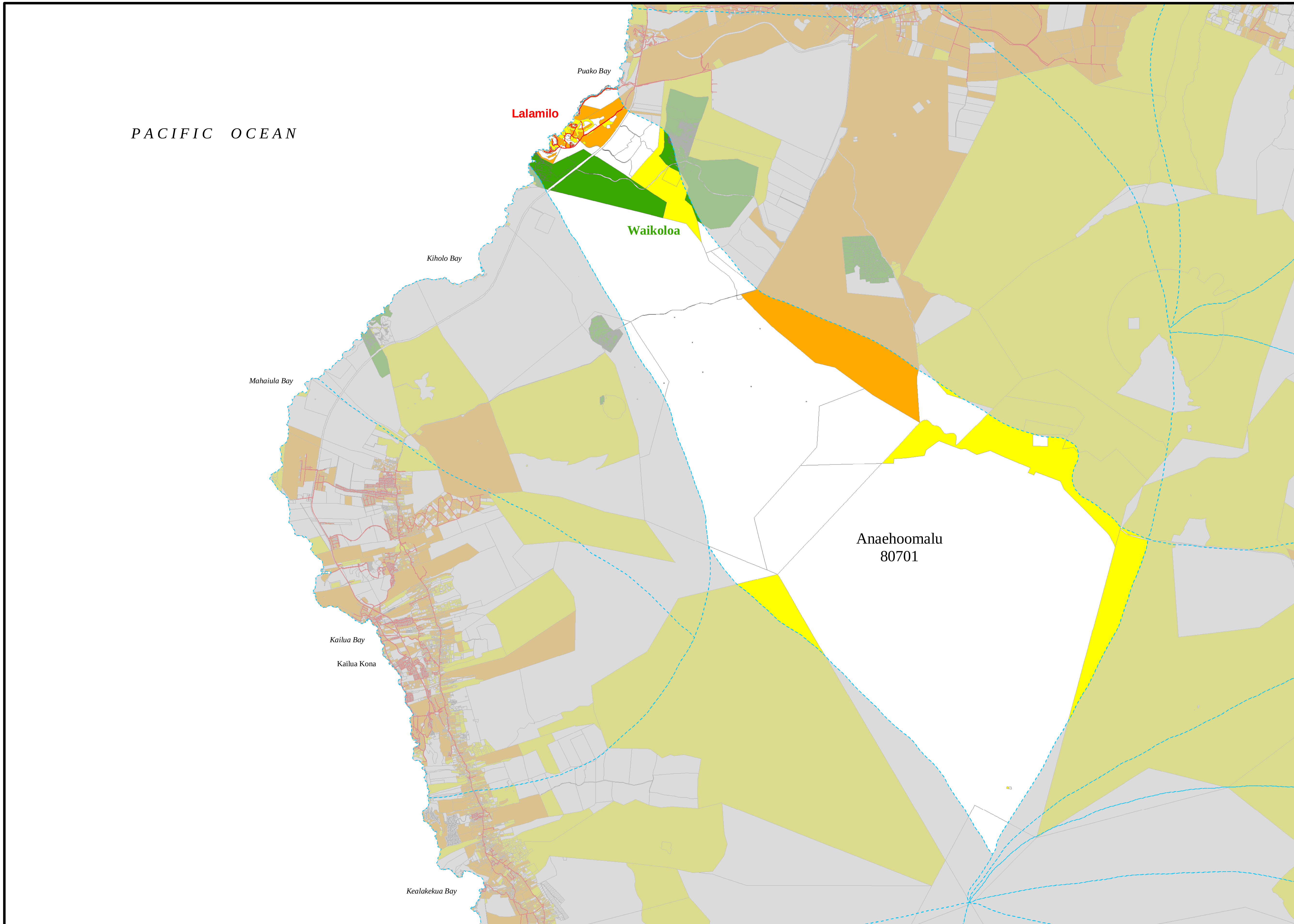
One of the county's two military water systems is located at the Pohakuloa Training Area (PTA) in the saddle region between Mauna Kea and Mauna Loa. Not including the small permanent staff, the population of this military training camp fluctuates with the number of troops involved in the training being held at a specific time and water demand fluctuates accordingly. For example, the population can increase up to 5,000 troops for major exercises, usually held during May to October. The average day demand estimated in the Hawaii SWPP is 30,000 gpd with a peak during training periods of 80,000 gpd. The system obtains its water from the Mauna Kea State Park Water System, which is supplied by five springs in the West Mauna Kea ASEA. During periods of high consumption, additional water is hauled by private and military tankers from municipal systems either in Hilo or Kamuela.

807.3.7 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.

807.3.7.1 County Water Systems

The Lalamilo Water System described in Chapter 803 services the Mauna Lani Resort. DWS records indicate that the Mauna Lani Bay Hotel is one of the largest single water users served by DWS.



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

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Miles

INDEX MAP - Island of Hawaii

FIGURE 807-6

AQUIFER SECTOR
N.W. MAUNA LOA - 807

Aquifer System

Anaehoomalu - 80701

Water System and Service Area

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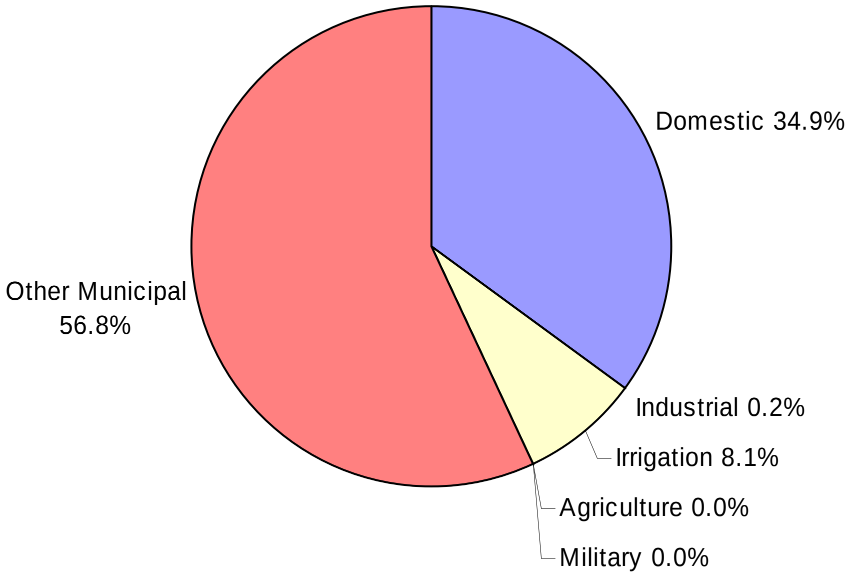
DWS water use is subcategorized in **Table 807-8** to the extent possible based on available meter data and is depicted in **Figure 807-7**. "Other Municipal" includes facilities such as schools, and various commercial, government, medical and nonprofit entities which have mixed water use and cannot be specifically allocated to the other categories.

Table 807-8: DWS Existing Water Use by Categories – Northwest Mauna Loa Aquifer Sector Area

CWRM Water Use Category	DWS Purveyed Water Use (MGD)	Percent of Total
Domestic	0.75	34.9
Industrial	0.00	0.2
Irrigation	0.17	8.1
Agriculture	0.00	0.0
Military	0.00	0.0
Other Municipal	1.22	56.8
Total	2.14	100.0

Figure 807-7: DWS Existing Water Use by Categories – Northwest Mauna Loa Aquifer Sector Area



807.3.7.2 State Water Systems

There are no State water systems in the Northwest Mauna Loa ASEA.

807.3.7.3 Federal Water Systems

The PTA Water System described in Section 807.3.6 is the only Federal water system in the Northwest Mauna Loa ASEA.

807.3.7.4 Private Public Water Systems

Potable water wells supplying the Waikoloa Water System described in Chapter 803 are located in the West Mauna Kea ASEA (803); however, the water system service area extends into the Northwest Mauna Loa ASEA to the Waikoloa Resort.

807.3.8 Water Use by Resource

807.3.8.1 Ground Water

Table 807-9 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.

Talbe 807-9: Sustainable Yield – Northwest Mauna Loa 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 (%)
		4.13	**10.61**	**15.91**	**30**	**13.77**	**35.36**	**53.03**
80701	Anaehoomalu	4.13	10.61	15.91	30	13.77	35.36	53.03

807.3.8.2 Surface Water

There are no known surface water uses in the Northwest Mauna Loa ASEA.

807.3.8.3 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. According to available GIS information, no such parcels exist within the sector area.

807.3.8.4 Reclaimed Wastewater

Reclaimed wastewater from the two wastewater treatment plants within the Northwest Mauna Loa ASEA is used for golf course, landscaping, nursery, sod farm and compost irrigation. Refer to **Table 807-5** presented earlier.

807.4 FUTURE WATER NEEDS

807.4.1 General

Table 807-10 summarizes the LUPAG, Zoning and 5-year incremental water demand projection scenarios for the total aquifer sector area and the individual aquifer system area. The sustainable yield (SY) is presented to draw comparisons.

Table 807-10: 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 N.W. Mauna Loa ASEA	30	81.7	11.0	8.0	9.3	10.7	12.4	14.4
80701 – Anaehoomalu ASYA	30	81.7	11.0	8.0	9.3	10.7	12.4	14.4
With Agricultural Demand*	**SY (mgd)**	**LUPAG (mgd)**	**Zoning (mgd)**	**Growth Rate B Demand Projections (mgd)**				
				2005	**2010**	**2015**	**2020**	**2025**
Total N.W. Mauna Loa ASEA	30	88.7	18.1	8.2	9.5	11.0	12.7	14.7
80701 – Anaehoomalu ASYA	30	88.7	18.1	8.2	9.5	11.0	12.7	14.7

* 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.

There is only one aquifer system area within the Northwest Mauna Loa ASEA; therefore, demands presented by aquifer sector area and by aquifer system area are one in the same.

807.4.2 Full Build-Out Water Demand Projections

The full build-out water demand projections based on the General Plan and County Zoning for the Northwest Mauna Loa ASEA are listed in **Tables 807-11** and **807-12**, and reflect refinement as discussed below. Each land use class is associated with the most appropriate CWRM water use category.

Table 807-11: Hawaii County General Plan Full Build-Out Water Demand Projection – Northwest Mauna Loa Aquifer Sector Area

LUPAG Class	CWRM Category	Water Demand (mgd)
Urban	Domestic/Irrigation/Municipal	3.4
Urban Expansion	Domestic/Irrigation/Municipal	34.2
Resort	Irrigation/Municipal	43.4
Industrial	Industrial	0.6
Agriculture	Agriculture	7.1
University	Irrigation/Municipal	0.0
Rural	Irrigation/Municipal	0.0
DHHL	Irrigation/Municipal	0.0
TOTAL w/o Ag*		81.7
TOTAL w/ Ag*		88.7

* 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 807-12: County Zoning Full Build-Out Water Demand Projection – Northwest Mauna Loa Aquifer Sector Area

Zoning Class	CWRM Category	Water Demand (mgd)
Residential	Domestic/Irrigation/Municipal	7.3
Resort	Irrigation/Municipal	3.3
Commercial	Municipal	0.4
Industrial	Industrial	0.1
Agriculture	Agriculture	7.1
DHHL	Irrigation/Municipal	0.0
TOTAL w/o Ag*		11.0
TOTAL w/ Ag*		18.1

* 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.

807.4.2.1 Refine Land Use Based Projection

807.4.2.1.1 State Water Projects Plan

There is only one State Water Project within the Northwest Mauna Loa ASEA. The projected demand required by the Puako Boat Ramp in the year 2020 is 0.005 mgd of potable water.

807.4.2.1.2 State Department of Hawaiian Home Lands

There are no tracts of land owned by the DHHL within the Northwest Mauna Loa ASEA.

807.4.2.1.3 Agricultural Water Use and Development Plan

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

807.4.3 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 at least 7,500 square foot of County Zoning) consumption is 2.5 units per lot based on historical consumption data.

807.4.4 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 Northwest Mauna Loa ASEA. The projected low, medium, and high growth rates are listed in **Table 807-13**, and are graphed in **Figure 807-8**. Potable and nonpotable water demands are also differentiated.

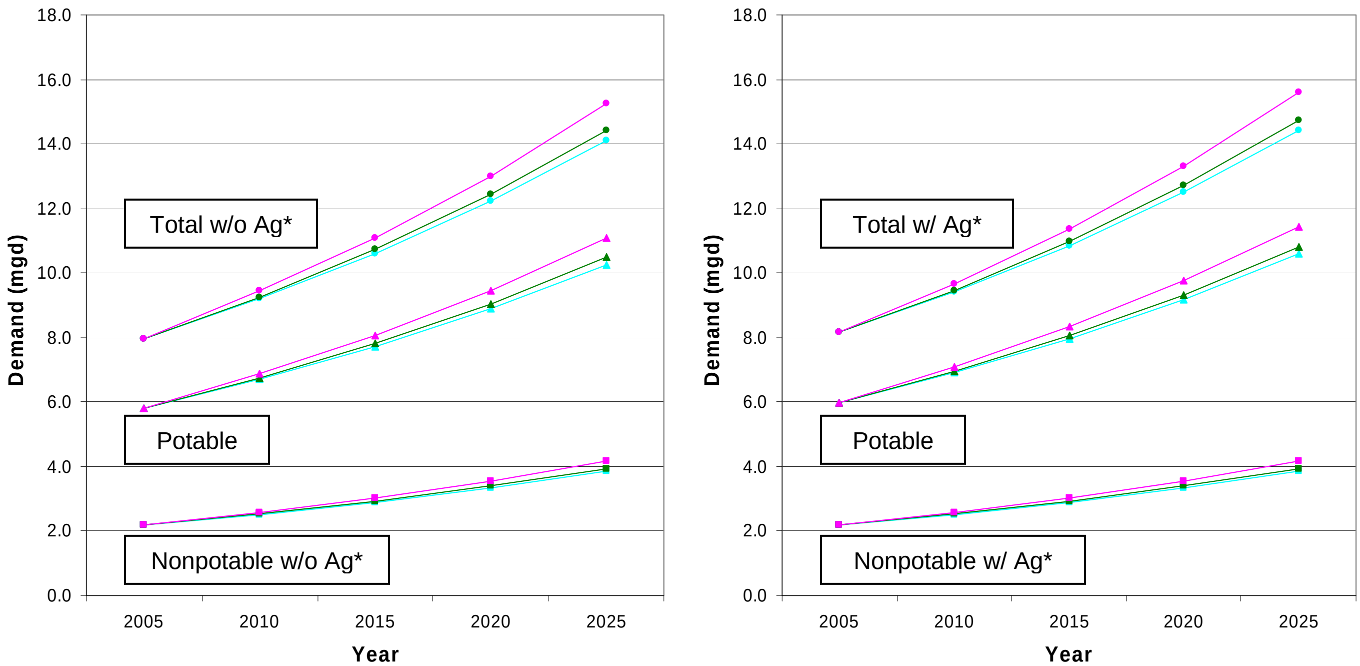
Figure 807-9 illustrates the magnitude of the sustainable yield, both LUPAG and Zoning full build-out water use, and water use projection through the year 2025 focusing on Medium Growth Rate B. **Figure 807-10** shows the breakdown of water demand projections by CWRM categories through the year 2025. **Table 807-14** summarizes these figures.

Table 807-13: Water Demand Projection – Northwest Mauna Loa 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	8.0	9.2	10.6	12.2	14.1	8.2	9.4	10.8	12.5	14.4
Potable	2.2	2.5	2.9	3.3	3.8	2.2	2.5	2.9	3.3	3.8
Nonpotable	5.8	6.7	7.7	8.9	10.3	6.0	6.9	8.0	9.2	10.6
GROWTH RATE B	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	8.0	9.3	10.7	12.4	14.4	8.2	9.5	11.0	12.7	14.7
Potable	2.2	2.5	2.9	3.4	3.9	2.2	2.5	2.9	3.4	3.9
Nonpotable	5.8	6.7	7.8	9.0	10.5	6.0	6.9	8.1	9.3	10.8
GROWTH RATE C	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	8.0	9.4	11.1	13.0	15.2	8.2	9.7	11.4	13.3	15.6
Potable	2.2	2.6	3.0	3.5	4.2	2.2	2.6	3.0	3.5	4.2
Nonpotable	5.8	6.9	8.1	9.5	11.1	6.0	7.1	8.3	9.8	11.4

* 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 807-8: Water Demand Projection Summary – Northwest Mauna Loa Aquifer Sector Area



LEGEND: Growth Rate A Growth Rate B Growth Rate C

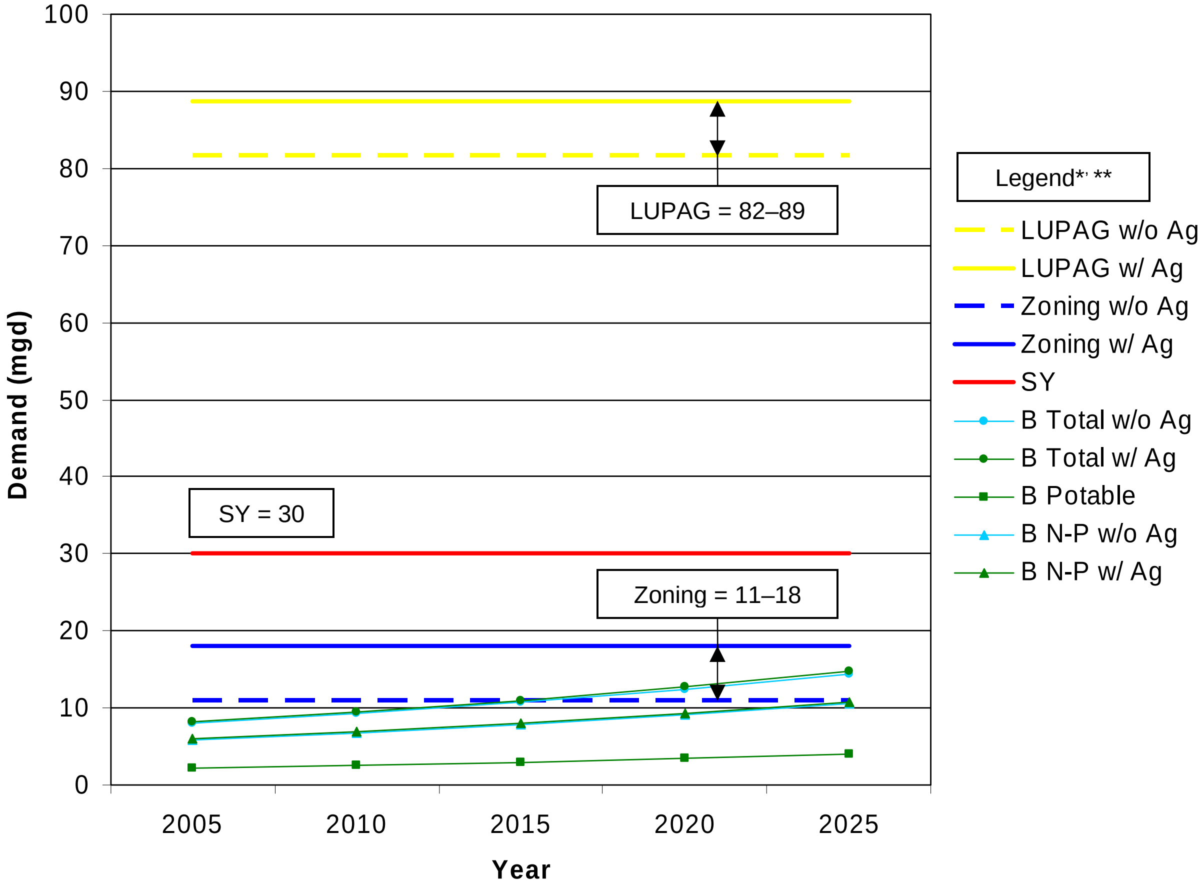
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 807-14: Medium Growth Rate B Water Demand Projection by Category – Northwest Mauna Loa Aquifer Sector Area

Water Use Category	2005 (mgd)	2010 (mgd)	2015 (mgd)	2020 (mgd)	2025 (mgd)
Total without Ag*	8.0	9.3	10.7	12.4	14.4
Total with Ag*	8.2	9.5	11.0	12.7	14.7
Domestic	0.0	0.0	0.0	0.0	0.0
Industrial	0.0	0.0	0.0	0.0	0.0
Irrigation	5.8	6.7	7.8	9.0	10.5
Agriculture	0.2	0.2	0.2	0.3	0.3
Military	0.0	0.0	0.0	0.0	0.1
Municipal	2.1	2.5	2.9	3.3	3.9
Potable	2.2	2.5	2.9	3.4	3.9
Nonpotable w/o Ag*	5.8	6.7	7.8	9.0	10.5
Nonpotable w/ Ag*	6.0	6.9	8.1	9.3	10.8
DWS	2.1	2.5	2.9	3.3	3.9

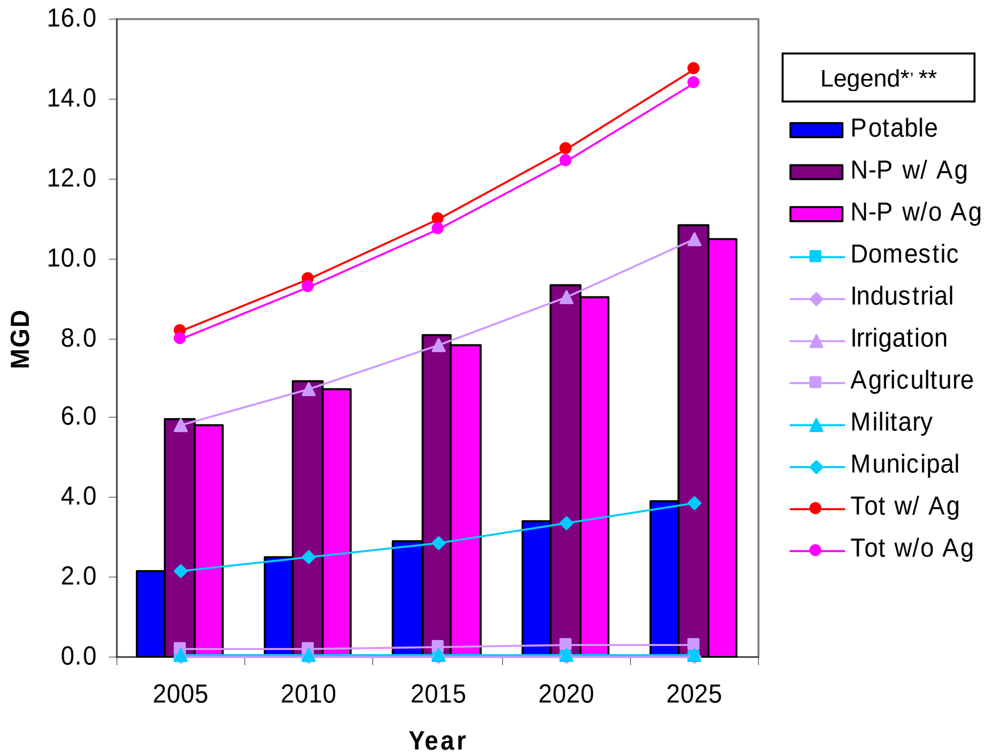
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 807-9: Medium Growth Rate B Water Demand Projections and Full Build-Out – Northwest Mauna Loa 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 807-10: Medium Growth Rate B Water Demand Projection by Category – Northwest Mauna Loa Aquifer Sector Area

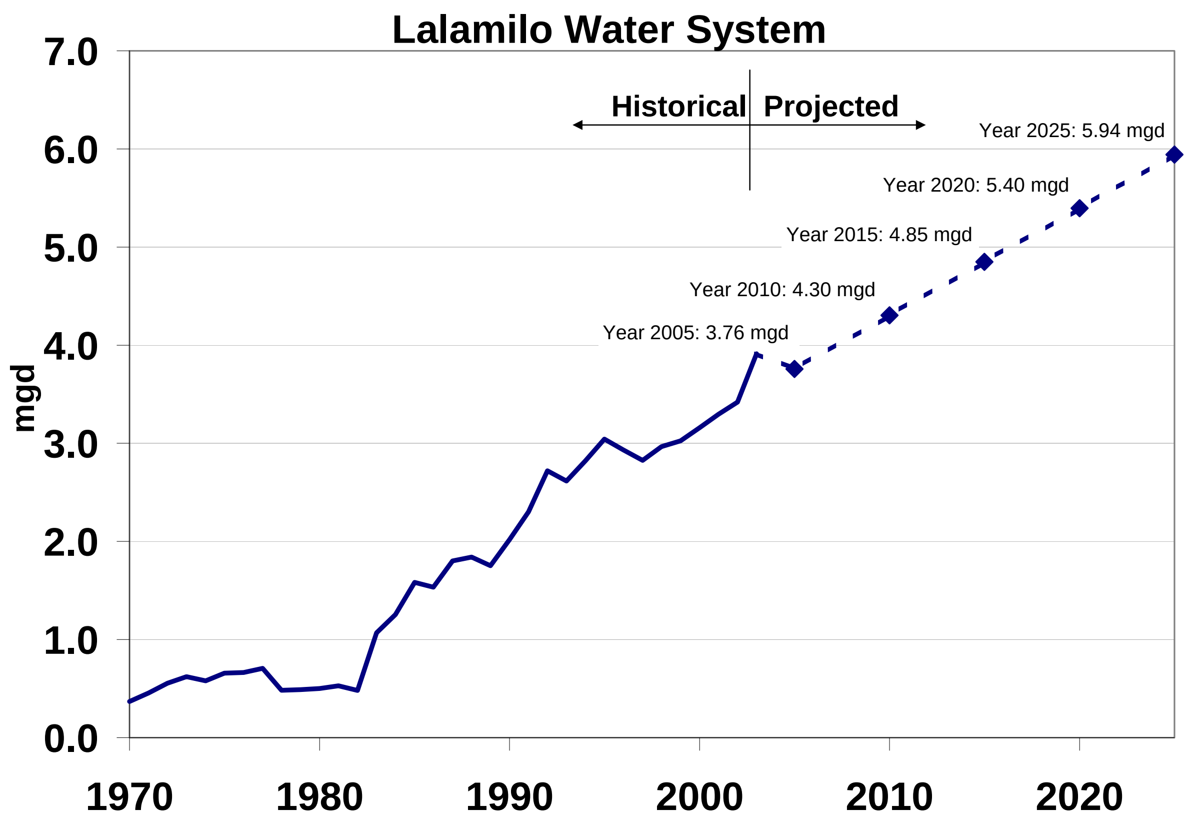


* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.
** "N-P" represents the nonpotable component of the demand.

807.4.5 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 807-11**.

Figure 807-11: DWS Water Demand Projection – Northwest Mauna Loa Aquifer Sector Area



Historical data provided by RW Beck, Inc.

Projections based on historical DWS water consumption data cannot be compared to projections based on population growth rate, because the Lalamilo Water System spans the Northwest Mauna Loa and West Mauna Kea (803) ASEAs. The projected rate of growth of the future population is slightly higher than the rate of increase based on historical consumption.

807.5 RESOURCE AND FACILITY RECOMMENDATIONS

807.5.1 Water Source Adequacy

807.5.1.1 Full Build-Out

The full development to the maximum density of the County General Plan land use within the Northwest Mauna Loa ASEA cannot be sustained by water sources in the sector area if agricultural demands are not included. Full build-out water demands based on LUPAG are nearly three times the sustainable yield of sector area. The existing Zoning requires approximately one third of the existing sustainable yield. If worst case agricultural demands are included, the LUPAG demand is three times the SY, and the Zoning demand is 60 percent of the SY.

807.5.1.2 Twenty-Year Projection

Existing demands are less than 30 percent of the SY, and 20-year projected demands are close to 50 percent of the SY.

807.5.2 Source Development Requirements

807.5.2.1 Supply-Side Management

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

807.5.2.1.1 Conventional Water Resource Measures

807.5.2.1.1.1 Ground Water

According to the *1990 Water Resources Protection Plan*, the basal lens extends at least five miles inland, and approximately 10 miles from the coast high level water may occur at great depth. Due to the remoteness and high cost of developing the high level aquifer, exploitation of this resource to supply existing developed areas and adjacent expansion areas is not likely. High level water may be utilized should localized development occur in areas over the high-level aquifer.

The basal aquifer is thin in most accessible areas which would prevent development of potable water. However, additional brackish water may be developed to some extent as evidenced by the irrigation wells located along Queen Kaahumanu Highway. Care should be exercised to avoid overdrawing which may lead to intrusion of saltwater in the wells. Chloride levels should be continuously monitored.

807.5.2.1.1.2 Surface Water

There are no perennial streams nor are there any registered stream diversions in the Northwest Mauna Loa ASEA, therefore surface water is not a viable water resource enhancement measure.

807.5.2.1.1.3 Water Transfer

Currently, all potable water is obtained from the West Mauna Kea ASEA (803) by water transfer via the DWS Lalamilo Water System, which supplies the Mauna Lani Resort, and the private Waikoloa System, which supplies the Waikoloa Resort. An undetermined quantity of water is also transferred into ASEA 803 from the Kohala ASEA (801) through the Waimea SystemDue to the difficulty in developing potable sources in the Northwest Mauna Loa ASEA, additional water transfer from the ASEA 803 will continue ; however, the feasibility of developing additional sources in the ASEA 803 for transfer needs to be examined further.

807.5.2.1.2 Alternative Water Resource Enhancement Measures

807.5.2.1.2.1 Rainwater Catchment Systems

The Northwest Mauna Loa ASEA is the driest on the island. Most of the sector area receives between 10 and 30 inches of rainfall per year, which is not sufficient to support rainwater catchment systems. This is not considered a viable alternative.

807.5.2.1.2.2 Wastewater Reclamation

The two existing wastewater reclamation facilities currently reuse 0.75 mgd but are expandable to 2.05 mgd. Reuse of the up to 75% of the capacity of a WWRF is generally the maximum percentage achievable. The facilities use wastewater from the two major resort developments, Mauna Lani and Waikoloa, which together account for nearly all of the potable water used in the sector area. Increase in reclaimed wastewater production is therefore limited by the amount of water used by and hence growth of the two resorts. However, reclaimed wastewater is currently used for irrigation purposes within the resort complexes, and since increased irrigation uses are expected to follow additional development of the resorts, expansion of the existing facilities is a logical choice.

807.5.2.1.2.3 Desalination

Desalination of groundwater from brackish wells in the lower lying areas may be considered. The chloride content of the existing irrigation wells is generally less than 1,000 ppm, indicating that the brackish water from the aquifer is suitable for desalination. However, there are limits to the amount of water that can be drawn without degrading the water table. As in the West Mauna Kea ASEA (803), the service area would be limited to the coastal regions, such as in the vicinity of the Mauna Lani and the Waikoloa Resorts.

807.5.2.2 Demand-Side Management

807.5.2.2.1 Development Density Control

The water requirements of full-build out under maximum density LUPAG are over eight times greater than those of legally developable land under Zoning, largely due to the difference in areas of land classified as "Resort" and "Urban/Residential." Proposed land uses according to the General Plan should therefore be examined in greater detail. In particular, there is nearly 7,000 acres designated as "Urban Expansion." Control of the density of these future expansion areas could conserve a significant quantity of water.

807.5.2.2.2 Water Conservation

Water use unit rates for users on the DWS Water System in the sector area are the highest on the island. Accounts classified as "Residential" use an average of over 2,700 gpd per connection, and the average usage for all accounts is over 6,300 gpd per connection, although this average is likely greatly skewed by the large hotel and resort users. The per capita potable water consumption unit rate is not a reliable indicator of average water usage since nearly all of the potable water demand is from the transient population. Nonetheless, existing residential usage is over six times the island average. Both resort complexes include private villa and mansion style homes that possibly use potable water for landscaping.

Water purveyors could easier justify implementing conservation measures in the Northwest Mauna Loa ASEA than any other sector area, because it is the driest sector area on the island. Financial conservation measures, such as a rate structure incorporating higher unit costs for increased usage, may not be effective, because many of the end users are in a higher income bracket and are not likely to be deterred by cost. Water conservation measures such as water restrictions during drier and/or warmer periods, and implementation of requirements for more efficient irrigation practices would be most effective.

807.5.3 Recommended Alternatives

The lack of conventional water sources places the emphasis on water conservation. Average usage in the Northwest Mauna Loa ASEA is the highest on the island; the demand can be reduced considerably by lowering per unit usage rates closer to the island average.

Transfer of potable water from the West Mauna Kea ASEA (803) to the Northwest Mauna Loa ASEA must continue, and may be increased in the near term to supply the projected demands. However, existing sources in the ASEA 803 will not be adequate past 2010.

Brackish groundwater should be developed to satisfy nonpotable needs, but should be preceded by studies evaluating the potential of brackish water sources.

Wastewater reclamation should be emphasized due to the limited availability of groundwater and non-existence of surface water sources. It may be prudent for County Planning to consider linking additional development in the vicinity of the resort complexes that require irrigation to increase in wastewater reclamation capacity to ensure that nonpotable water demands are met by nonpotable sources. Because of the compactness of the two major resort developments, studies should be undertaken to investigate the possibility of combining reclaimed wastewater and brackish groundwater sources into a nonpotable water system to satisfy the nonpotable needs. This, along with other alternatives consistent with the concept of using the highest quality water for the highest intended use, should be considered.

In light of the fact that the sustainable yield is not fully developable, and maximum density LUPAG full build-out demands cannot be sustained by existing sources, it is important that a long-range water plan for the Northwest Mauna Loa ASEA be developed, in which all of the recommended alternatives are evaluated.

808 KILAUEA AQUIFER SECTOR AREA

808.1 SECTOR AREA PROFILE

808.1.1 General

The Kilauea Aquifer Sector Area (ASEA) includes the Pahoa [80801], Kalapana [80802], Hilina [80803], and Keaiwa [80804] Aquifer System Areas (ASYA). It captures most of the Puna District and the southeastern portion of the Kau District, and extends along most of the island's southeastern coastline as far south as Kuhua Bay outside Punaluu. The sector area includes most of the Kilauea Crater and Hawaii Volcanoes National Park.

Average annual rainfall in coastal areas ranges from less than 40 inches along the dryer, southern coastline to 118 inches along the windward or eastern coastline. Average annual rainfall at the summit of Kilauea is as low as 20 inches, and in the Mountain View area is almost 200 inches. The Pahoa ASYA has by far the highest SY of the four system areas at 435 mgd, followed by the Kalapana ASYA at 157 mgd, the Keaiwa ASYA at 17 mgd, and the Hilina ASYA at 9 mgd. The total sustainable yield of the Kilauea ASEA is 618 mgd.

808.1.2 Economy and Population

808.1.2.1 Economy

Agriculture is the primary economic function in the Puna District. Papayas in the Kapoho area, flowers in the Pahoa and Kapoho areas, and bananas are the principal products. Truck farming in the Volcano area is also significant. The majority of the State's papayas and bananas are grown in Puna.

There are some tourist attractions in the sector area, including Hawaii Volcanoes National Park; however, these have had little impact on the economy, evident by the limited number of tourist accommodations and roadside stands.

The Puna Geothermal Venture (PGV) plant located outside of Kapoho generates 30-MW of electricity using three geothermal wells. Plans are already under way to expand the facility to double its output. Currently, PGV employs 30 people. The geothermal industry is promising, as waste geothermal heat may be used for a variety of different functions, which may attract other business to the sector area.

808.1.2.2 Population

Nearly all of the population contributing to the demands from the Kilauea ASEA is within the Puna District. The rate of growth of Puna's population has slowed, but still ranks as the island's highest. The growth can be attributed to the affordability of residences outside of Hilo and the job opportunities in Hilo. Puna's status as a "bedroom community" for Hilo is evident from much slower growth in employment, and the worsening traffic on its roads leading into Hilo.

Table 808-1: Historical Population

1980	1990	2000	1980-90 % Change	1990-2000 % Change
9,385	16,587	25,007	76.7	50.8

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

Table 808-2: Population Projection

Growth Rate	2000	2005	2010	2015	2020	2000-10 % Change	2010-20 % Change
A – Low	25,007	28,916	33,688	39,158	45,561	34.7	35.2
B – Medium	25,007	29,009	33,986	39,736	46,471	35.9	36.7
C – High	25,007	30,218	36,116	42,858	50,656	44.4	40.3

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

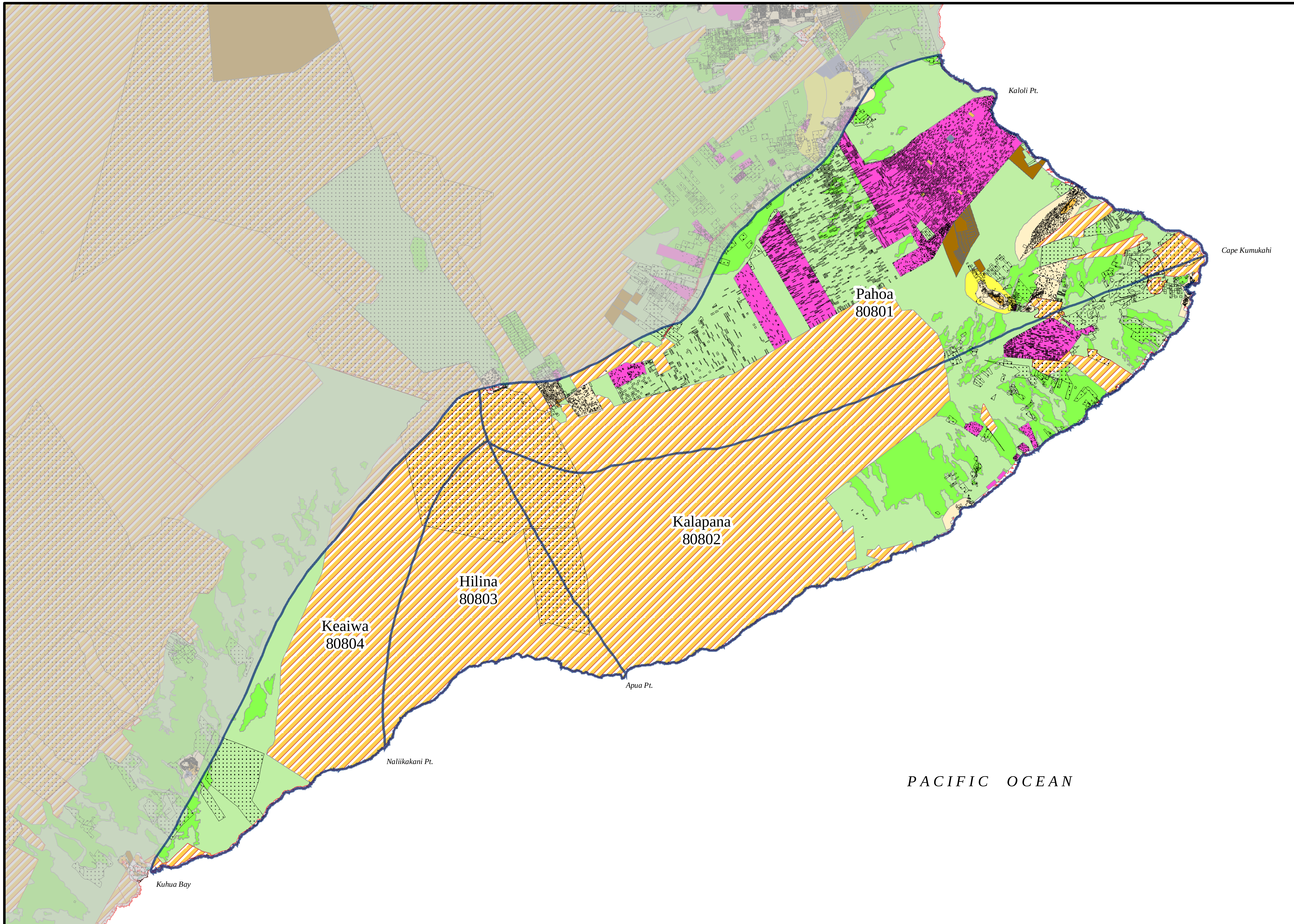
808.1.3 Land Use

808.1.3.1 Hawaii County General Plan

The Hawaii County General Plan Land Use Pattern Allocation Guide Map (LUPAG) for the Kilauea ASEA is shown on **Figure 808-1**. The estimated land use allocation acreage for each LUPAG designation within the sector area is listed in **Table 808-3**.

Table 808-3: LUPAG Map Estimated Land Use Allocation Acreage – Kilauea Aquifer Sector Area

LAND USE PATTERN	ACREAGE	% of TOTAL
High Density Urban	0	0
Medium Density Urban	410	0.1
Low Density Urban	6,218	1.8
Industrial	42	0.0
Important Agricultural Land	26,719	7.5
Extensive Agriculture	93,911	26.2
Orchard	0	0
Rural	27,211	7.6
Resort/Resort Node	4	0.0
Open	2,587	0.7
Conservation	199,697	55.8
Urban Expansion	1,072	0.3
University Use	0	0
TOTAL	357,871	100.0



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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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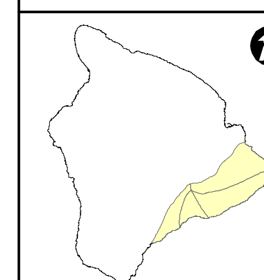

INDEX MAP - Island of Hawaii

FIGURE 808-1

AQUIFER SECTOR
KILAUEA - 808

Aquifer Systems
Pahoa - 80801
Kalapana - 80802
Hilina - 80803
Keaiwa - 80804

2005 Revised General Plan Land Use Pattern Allocation Guide

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Consulting Engineers
1388 Kapiolani Boulevard, Honolulu, Hawaii 96814

The water utility courses of action for Puna in the Hawaii County General Plan relevant to the Kilauea ASEA are as follows:

(a) *Continue to improve inadequate water system facilities.*
(b) *Water source investigation and exploration should be continued in order to provide service for anticipated needs.*
(c) *Investigate additional groundwater sources in the Olaa area.*
(d) *Investigate alternative means to finance the extension to subdivisions that rely on catchment.*

808.1.3.2 Hawaii County Zoning

Hawaii County Zoning for the Kilauea ASEA is shown on **Figure 808-2**. The estimated land use allocation acreage for each zoning class within the sector area is listed in **Table 808-4**.

Table 808-4: County Zoning Estimated Class Allocation Acreage – Kilauea Aquifer Sector Area

ZONING CLASS	ACREAGE	% of TOTAL
Single Family Residential	2,041	0.6
Multi-Family Residential (including duplex)	4	0.0
Residential-Commercial Mixed Use	0	0
Resort	1	0.0
Commercial	40	0.0
Industrial	0	0
Industrial-Commercial Mixed	9	0.0
Family Agriculture	8	0.0
Residential Agriculture	137	0.0
Agriculture	179,106	50.1
Open	139,914	39.1
Project District	0	0
Forest Reserve	31,857	8.9
(road)	4,571	1.3
TOTAL	357,688	100.0

808.2 AVAILABLE WATER RESOURCES

808.2.1 Ground Water

Kilauea ASEA has a sustainable yield of 618 mgd. According to the CWRM database, there are 45 production wells in the sector, including 8 municipal, 8 irrigation, 19 domestic, and 10 other.

There are also 19 wells drilled and categorized as “unused”. Refer to **Appendix B** for this database. **Figure 808-3** shows the well locations.

808.2.2 Surface Water

There are no perennial streams in the sector area. There is 1 declared stream diversion in CRWM database listed in **Table 808-5** and shown on **Figure 808-4**.

Table 808-5: Stream Diversions – Kilauea Aquifer Sector Area

FILE REFERENCE	TMK	STREAM NAME	
MALU AINA FARM	1-7-002:002	Unnamed/ Unmapped	Stream diversion, waterway from Malu Aina Stream. See also two new entries for declarant.

808.2.3 Reclaimed Wastewater

There are no wastewater reclamation facilities within the Kilauea ASEA.

808.3 EXISTING WATER USE

808.3.1 General

The total estimated average water use within the Kilauea ASEA from November 2004 through October 2005 based on DWS meter data, available GIS data, DOH records, and CWRM pumpage data is listed in **Table 808-6**. **Table 808-6** and **Figure 808-5** summarize water use in accordance with CWRM categories and indicate 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.

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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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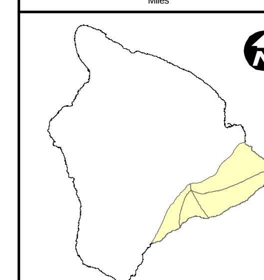

INDEX MAP - Island of Hawaii

FIGURE 808-2

AQUIFER SECTOR
KILAUEA - 808

Aquifer Systems
Pahoa - 80801
Kalapana - 80802
Hilina - 80803
Keaiwa - 80804

County Zoning

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1388 Kapiolani Boulevard, Honolulu, Hawaii 96814

Figure 808-3: Well and Tunnel Location

MAP CURRENTLY NOT AVAILABLE ON-LINE

Figure 808-4: Streams & Diversions

MAP CURRENTLY NOT AVAILABLE ON-LINE

Table 808-6: Existing Water Use by Categories – Kilauea Aquifer Sector Area

CWRM Water Use Category	Water Use (MGD)	Percent of Total without Ag*	Percent of Total with Ag*
Domestic	2.69	61.6	40.9
Industrial	0.00	0.0	0.0
Irrigation	0.00	0.0	0.0
Reclaimed WW	0.00	0.0	0.0
Agriculture	2.22	0.0	33.7
Military	0.00	0.0	0.0
Municipal			
DWS System	0.70	16.0	10.6
Private Public WS	0.98	22.4	14.8
Total without Ag*	4.37	100.0	
Total with Ag*	6.58		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 808-5: Existing Water Use by Categories – Kilauea Aquifer Sector Area

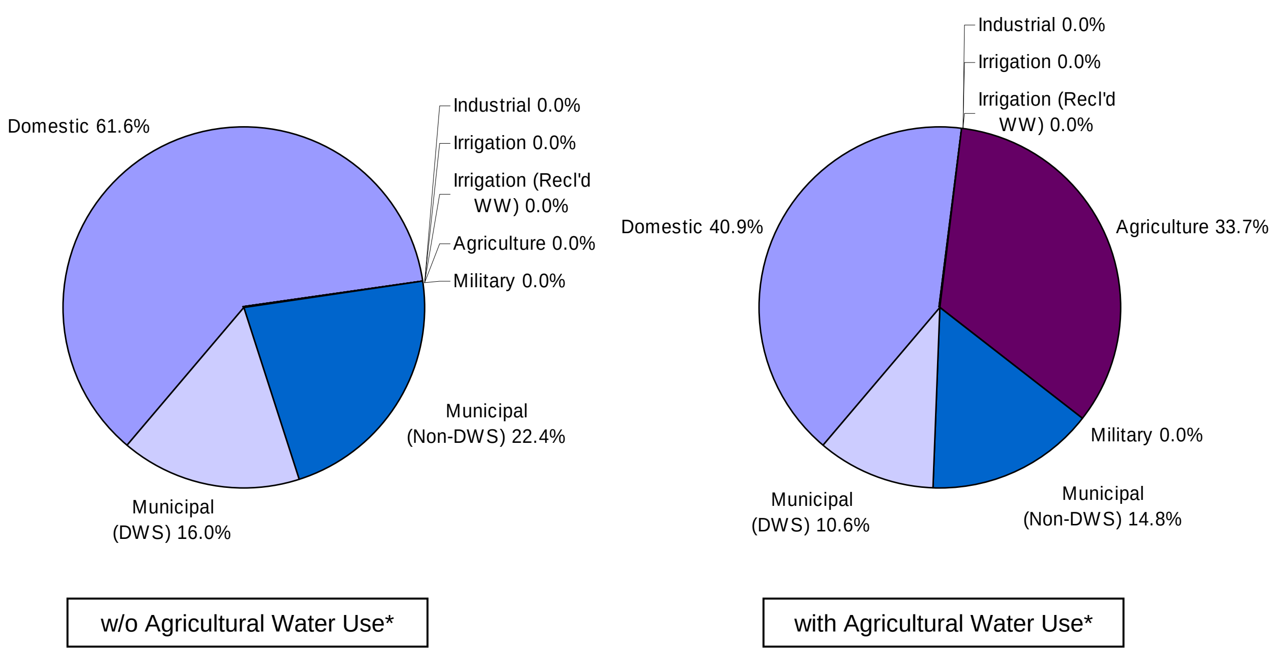

Figure 808-6 generally shows the service area for the various water systems and indicates the extent of the DWS water system.

808.3.2 Domestic Use

Domestic use or water use by individual households is assumed to be supplied by private individual rainwater catchment systems or private wells. Based on available GIS data, there are 6,668 such parcels which would serve an estimated 18,000 people or nearly two-thirds of the sector area population. The estimated demand from rainwater catchment usage of 2.7 mgd is by far the most of all sector areas on the island. None of the 19 wells in the CWRM database classified as "Domestic" have reported pumpage.

808.3.3 Industrial Use

There are no wells classified as "Industrial" in the CWRM database.

Puna Geothermal Venture has two wells classified as "Other" and one well classified as "Observation," which are used as monitoring wells to conduct chemical analyses on the groundwater twice a year. PGV also has three production wells which extract geothermal fluid and three injection wells which return the used fluid. Because the temperature of the fluid is greater than 150 degrees Fahrenheit, the wells are regulated by the Land Division, Engineering Branch of the DLNR.

808.3.4 Irrigation Use

There is one golf course in the sector area. The Volcano Golf & Country Club is situated along Hawaii Belt Road opposite Hawaii Volcanoes National Park. There is no irrigation system; rainfall in the area is sufficient to maintain the course.

There are no known irrigation uses dedicated other landscaping activities.

808.3.5 Agricultural Use

Although agricultural activity is significant in the sector area, abundant ambient rainfall is sufficient for most of the agricultural products, such as papayas and bananas. According to DWS records, a significant portion of the water consumed in the Kapoho and Kalapana Water Systems is by accounts classified as "Agricultural;" however, altogether this amounts to less than 0.1 mgd.

808.3.6 Military Use

The Kilauea Military Camp is located within the Kilauea ASEA. The camp is a resort facility for active and retired military personnel and their families, including 90-1, 2 and 3 bedroom cottages and apartments, and several amenities including restaurants, stores, sports and games. The camp has 100 full-time employees. DOH records indicate that water is supplied via catchment; however, details of the system and consumption are not known.

808.3.7 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.

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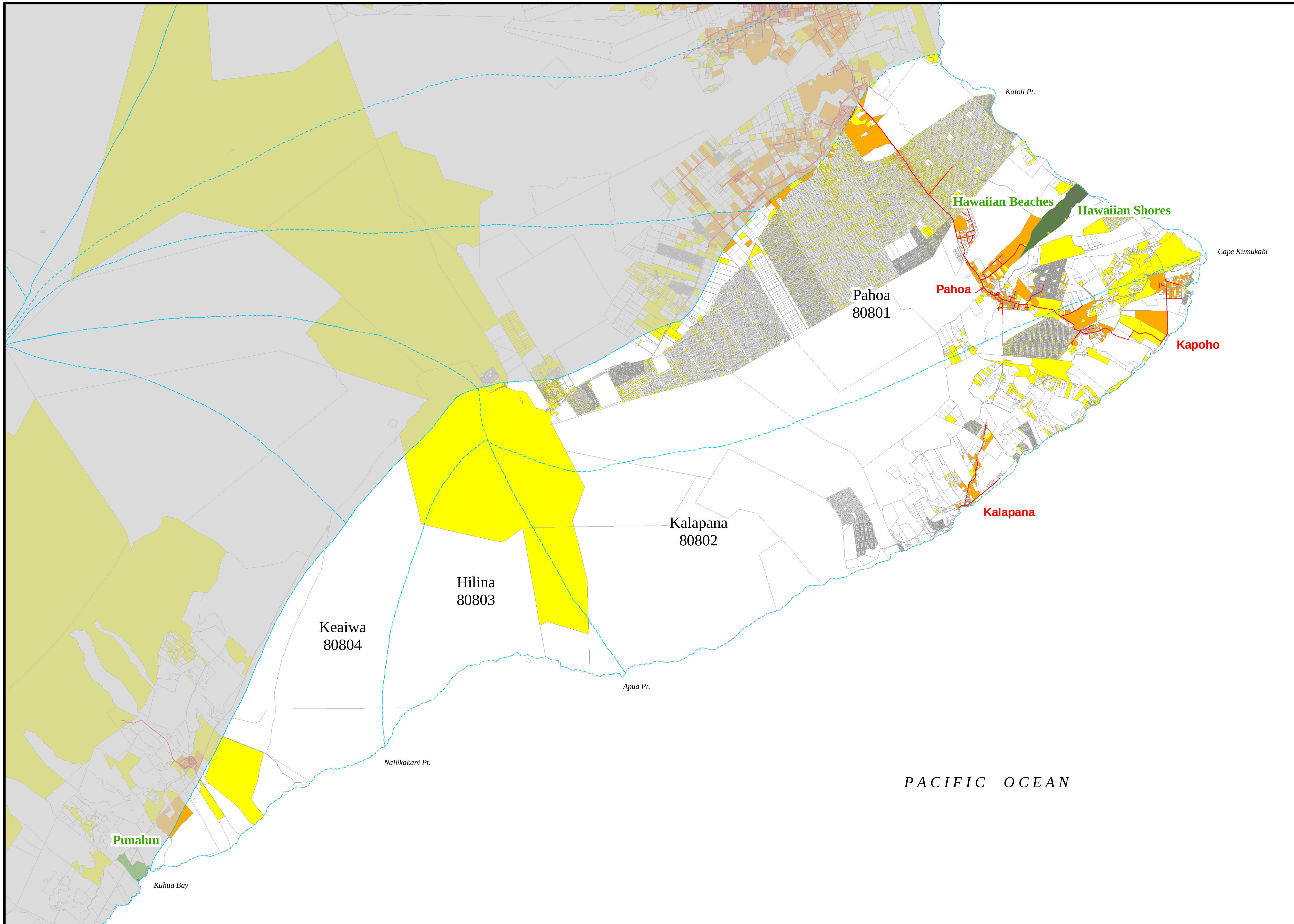

LEGEND:

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

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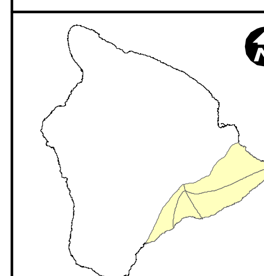

INDEX MAP - Island of Hawaii

FIGURE 808-6

AQUIFER SECTOR
KILAUEA - 808

Aquifer Systems
Pahoa - 80801
Kalapana - 80802
Hilina - 80803
Keaiwa - 80804

Water System and Service Area

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Consulting Engineers
1388 Kapiolani Boulevard, Honolulu, Hawaii 96814

808.3.7.1 County Water Systems

The DWS has 3 water systems in the Kilauea ASEA.

The Olaa-Mt. View Water System described in Chapter 804 services areas in the Kilauea ASEA south of Hawaii Belt Road and along Keeau-Pahoa Road to Kaloli Drive. The water system is connected along Keeau-Pahoa Drive to the Pahoa Water System, allowing water to flow in either direction.

The Pahoa Water System obtains its water from two wells at Keonepoko Nui and two wells at the Pahoa well field. Both sources have good quality water with chloride content between 4 and 27 ppm. The water system services six operational zones in the Pahoa area using one booster pump station and four storage tanks.

The Kapoho Water System formerly depended on an infiltration gallery type of well, and now relies entirely on the Pahoa Water System for its supply. A single tank provides storage for the water system.

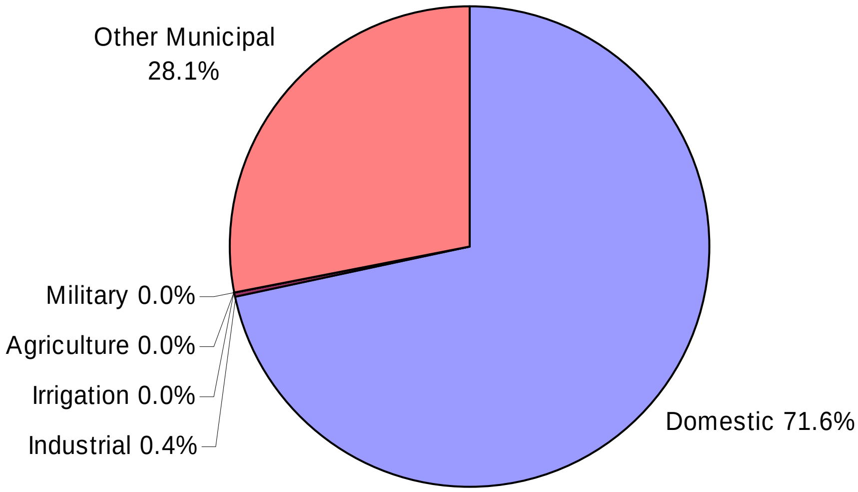
The Kalapana Water System obtains its water supply from two wells located at the southwesterly edge of Keauohana Forest Reserve near the Pahoa-Kalapana Highway. The water has a relatively high chloride content of between 107 and 124 ppm. The water system's service area runs from the forest reserve along the highway to Kaimu area and along the coastal road to Queens Bath area. However, the lava flow has buried long segments of the highway and watermains and destroyed many residences in the area. Presently, two operational zones are serviced using two storage tanks. There are no booster pump stations in the water system.

DWS water use is subcategorized in **Table 808-7** to the extent possible based on available meter data and is depicted in **Figure 808-7**. "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 808-7: DWS Existing Water Use by Categories – Kilauea Aquifer Sector Area

CWRM Water Use Category	DWS Purveyed Water Use (MGD)	Percent of Total
Domestic	0.43	71.6
Industrial	0.00	0.4
Irrigation	0.00	0.0
Agriculture	0.00	0.0
Military	0.00	0.0
Other Municipal	0.17	28.1
Total	0.61	100.0

Figure 808-7: DWS Existing Water Use by Categories – Kilauea Aquifer Sector Area



808.3.7.2 State Water Systems

There are no State water systems in the Kilauea ASEA regulated by the DOH.

808.3.7.3 Federal Water Systems

There are two federal water systems in the Kilauea ASEA regulated by the DOH.

The Kilauea Military Camp water system described in Section 808.3.6 is operated by the U.S. Military Joint Forces.

The Hawaii Volcanoes National Park water system is operated by the Department of the Interior. DOH records indicate that a catchment supplies water to the system, which serves several buildings, including the Kilauea Visitor Center, the restrooms at Thurston Lava Tube, Volcano House restaurant and hotel, USGS Volcano Observatory, Namakani Paio Compound, park offices and workshops, and park staff residences. The average demand is 0.027 mgd.

808.3.7.4 Private Public Water Systems

There are two private public water systems in the Kilauea ASEA regulated by the DOH.

The Hawaiian Beaches Water System includes a 100,000 gallon steel tank serving approximately 3,388 people through 1,059 service connections to residential lots. The average pumpage from one well is 0.82 mgd. The Hawaiian Shores subdivision is comprised primarily of residential lots, with lots dedicated to parks, recreation center and water yard. The water system includes one well and storage tank serving approximately 400 service connections. The average pumpage from one well is 0.13 mgd. The two systems are connected by a valve that may be opened in an emergency situation.

808.3.8 Water Use by Resource

808.3.8.1 Ground Water

Table 808-8 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 808-8: Sustainable Yield – Kilauea 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 (%)
		1.53	**5.53**	**8.29**	**618**	**0.25**	**0.89**	**1.34**
80801	Pahoa	1.47	3.53	5.30	435	0.34	0.81	1.22
80802	Kalapana	0.06	1.99	2.99	157	0.04	1.27	1.90
80803	Hilina	0.00	0.00	0.00	9	0.00	0.00	0.00
80804	Keaiwa	0.00	0.00	0.00	17	0.00	0.00	0.00

808.3.8.2 Surface Water

There are no known surface water uses in the sector area.

808.3.8.3 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 808-7** is assumed to be supplied by individual catchment systems.

808.3.8.4 Reclaimed Wastewater

There are no wastewater reclamation facilities within the Kilauea ASEA.

808.4 FUTURE WATER NEEDS

808.4.1 General

Table 808-9 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 808-9: 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 Kilauea ASEA	618	36.5	4.6	4.4	5.1	6.0	7.0	8.2
80801 – Pahoa ASYA	435	33.3	3.8	3.8	4.4	5.2	6.1	7.1
80802 – Kalapana ASYA	157	3.1	0.8	0.6	0.7	0.8	0.9	1.1
80803 – Hilina ASYA	9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
80804 – Keaiwa ASYA	17	0.1	0.0	0.0	0.0	0.0	0.0	0.0
With Agricultural Demand*	**SY (mgd)**	**LUPAG (mgd)**	**Zoning (mgd)**	**Growth Rate B Demand Projections (mgd)**				
				2005	**2010**	**2015**	**2020**	**2025**
Total Kilauea ASEA	618	127.3	94.5	6.6	7.7	9.0	10.4	12.2
80801 – Pahoa ASYA	435	67.6	37.6	4.6	5.4	6.3	7.4	8.6
80802 – Kalapana ASYA	157	53.1	50.4	1.8	2.1	2.5	2.9	3.4
80803 – Hilina ASYA	9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
80804 – Keaiwa ASYA	17	6.6	6.5	0.2	0.2	0.2	0.2	0.2

* 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.

For all aquifer system areas, full build-out and 2025 projection water demands excluding agricultural demands are a small fraction the SY. Therefore, analysis of the three demand scenarios does not need to be broken down by aquifer system areas and thus will be presented for the aquifer sector area only.

808.4.2 Full Build-Out Water Demand Projections

The full build-out water demand projections based on the General Plan and County Zoning for the Kilauea ASEA are listed in **Tables 808-10** and **808-11**, and reflect refinement as discussed below. Each land use class is associated with the most appropriate CWRM water use category.

Table 808-10: Hawaii County General Plan Full Build-Out Water Demand Projection – Kilauea Aquifer Sector Area

LUPAG Class	CWRM Category	Water Demand (mgd)
Urban	Domestic/Irrigation/Municipal	20.7
Urban Expansion	Domestic/Irrigation/Municipal	3.3
Resort	Irrigation/Municipal	0.2
Industrial	Industrial	0.2
Agriculture	Agriculture	90.8
University	Irrigation/Municipal	0
Rural	Irrigation/Municipal	10.9
DHHL	Irrigation/Municipal	1.4
TOTAL w/o Ag*		36.5
TOTAL w/ Ag*		127.3

* 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 808-11: County Zoning Full Build-Out Water Demand Projection – Kilauea Aquifer Sector Area

Zoning Class	CWRM Category	Water Demand (mgd)
Residential	Domestic/Irrigation/Municipal	3.1
Resort	Irrigation/Municipal	0.0
Commercial	Municipal	0.1
Industrial	Industrial	0.0
Agriculture	Agriculture	89.9
DHHL	Irrigation/Municipal	1.4
TOTAL w/o Ag*		4.6
TOTAL w/ Ag*		94.5

* 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.

808.4.2.1 Refine Land Use Based Projection

808.4.2.1.1 State Water Projects Plan

The total projected demand to the year 2020 for 23 State Water Projects within the Kilauea ASEA is 1.71 mgd, using 0.23 mgd potable, 1.47 mgd nonpotable, and 0.01 nonpotable using potable sources. These demands account for up to 25 percent of the projected total demand for the sector area. The projects that will generate the most significant demands, with the exception of DHHL projects, which are covered separately, are listed in **Table 808-12**.

Table 808-12: Future State Water Projects to Generate Significant Demands

Project Name	Primary Use	State Department	2020 Demand (mgd)
Hawaiian Paradise Park Elementary School	Potable	DOE	0.06
Keeau High School 2nd Increment	Potable	DOE	0.048

808.4.2.1.2 State Department of Hawaiian Home Lands

The Makuu Tract consists of two pre-1994 sections with a total area of 2,000 acres; including Makuu 1 north of Pahoa Village below the highway, and Makuu-2 above the highway, and the Makai section along the coast south of Hawaiian Paradise Park Subdivison. DHHL has proposed demands only for the mauka sections. The total average demand for the existing farm lots, and the proposed agricultural, residential and commercial lots is 1.38 mgd. Water would be supplied by the DWS Pahoa Water System, which pumped 0.55 mgd of its 4 wells' 1.91 mgd pump capacity in 2005.

Keonepoko is a small tract a short distance south of Makuu-1. No demands have been proposed by DHHL.

808.4.2.1.3 Agricultural Water Use and Development Plan

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

808.4.3 Water Use Unit Rates

Water use unit rates are based on the *Water System Standards* as discussed in Chapter 1.

808.4.4 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 Kilauea ASEA. The projected low, medium, and high growth rates are listed in **Table 808-13**, and are graphed in **Figure 808-8**. Potable and nonpotable water demands are also differentiated.

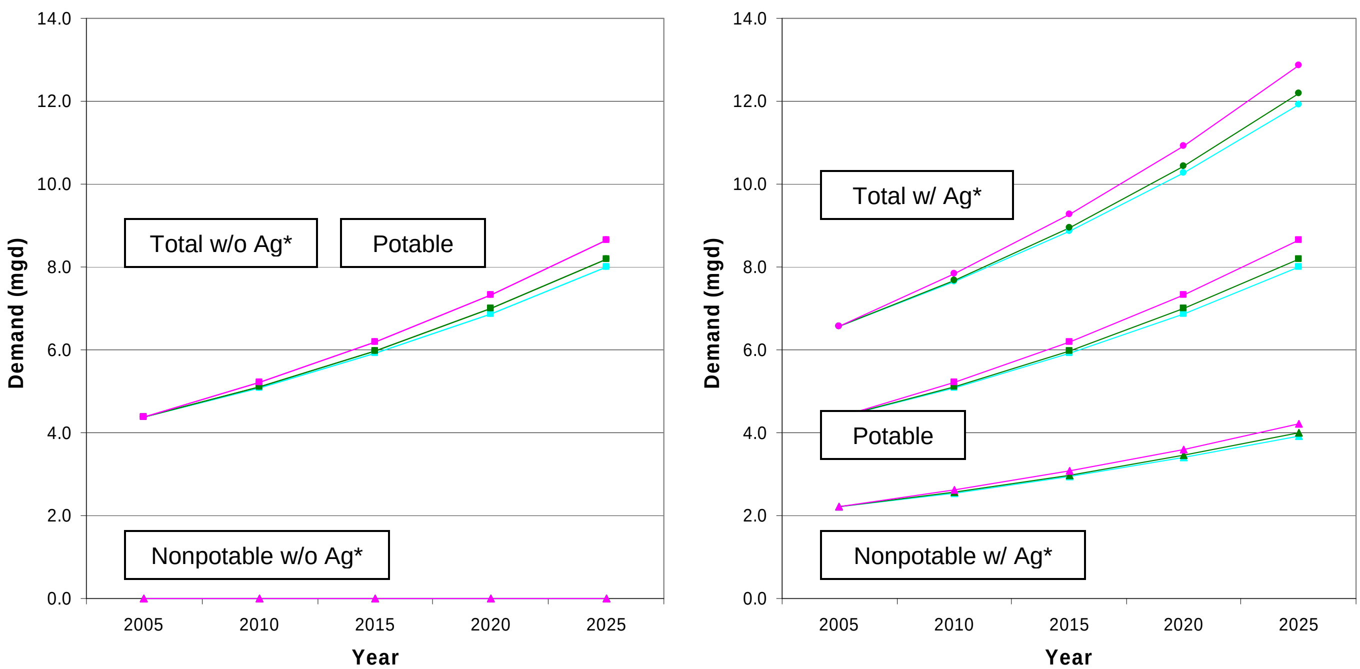
Figure 808-9 illustrates the magnitude of the sustainable yield, both LUPAG and Zoning full build-out water use, and water use projection through the year 2025 focusing on Medium Growth Rate B. **Figure 808-10** shows the breakdown of water demand projections by CWRM categories through the year 2025. **Table 808-14** summarizes these figures.

Table 808-13: Water Demand Projection – Kilauea 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	4.4	5.1	5.9	6.9	8.0	6.6	7.6	8.9	10.3	11.9
Potable	4.4	5.1	5.9	6.9	8.0	4.4	5.1	5.9	6.9	8.0
Nonpotable	0.0	0.0	0.0	0.0	0.0	2.2	2.6	2.9	3.4	3.9
GROWTH RATE B	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	4.4	5.1	6.0	7.0	8.2	6.6	7.7	9.0	10.4	12.2
Potable	4.4	5.1	6.0	7.0	8.2	4.4	5.1	6.0	7.0	8.2
Nonpotable	0.0	0.0	0.0	0.0	0.0	2.2	2.6	3.0	3.4	4.0
GROWTH RATE C	**2005**	**2010**	**2015**	**2020**	**2025**	**2005**	**2010**	**2015**	**2020**	**2025**
Total	4.4	5.2	6.2	7.3	8.6	6.6	7.8	9.3	10.9	12.9
Potable	4.4	5.2	6.2	7.3	8.6	4.4	5.2	6.2	7.3	8.6
Nonpotable	0.0	0.0	0.0	0.0	0.0	2.2	2.6	3.1	3.6	4.2

* 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 808-8: Water Demand Projection Summary – Kilauea Aquifer Sector Area



LEGEND: Growth Rate A Growth Rate B Growth Rate C

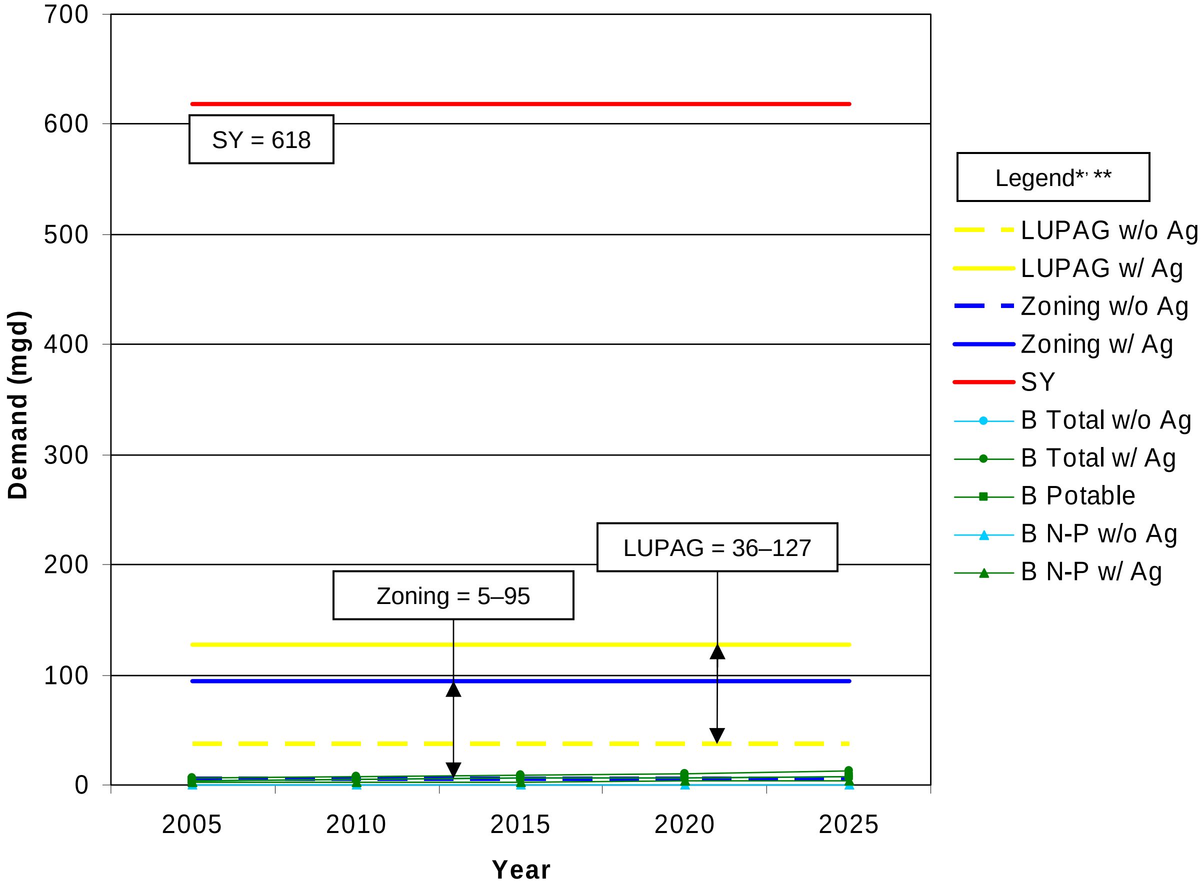
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Table 808-14: Medium Growth Rate B Water Demand Projection by Category – Kilauea Aquifer Sector Area

Water Use Category	2005 (mgd)	2010 (mgd)	2015 (mgd)	2020 (mgd)	2025 (mgd)
Total without Ag*	4.4	5.1	6.0	7.0	8.2
Total with Ag*	6.6	7.7	9.0	10.4	12.2
Domestic	2.7	3.1	3.7	4.3	5.0
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	3.4	4.0
Military	0.0	0.0	0.0	0.0	0.0
Municipal	1.7	2.0	2.3	2.7	3.1
Potable	4.4	5.1	6.0	7.0	8.2
Nonpotable w/o Ag*	0.0	0.0	0.0	0.0	0.0
Nonpotable w/ Ag*	2.2	2.6	3.0	3.4	4.0
DWS	0.7	0.8	1.0	1.1	1.3

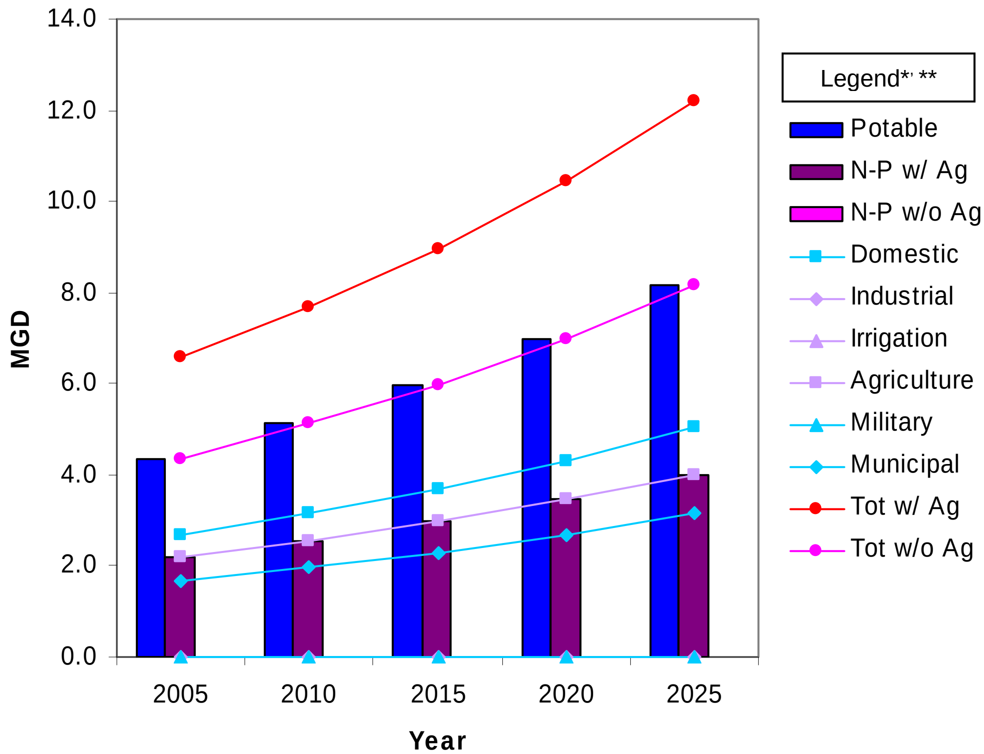
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

Figure 808-9: Medium Growth Rate B Water Demand Projections and Full Build-Out – Kilauea 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 808-10: Medium Growth Rate B Water Demand Projection by Category – Kilauea Aquifer Sector Area

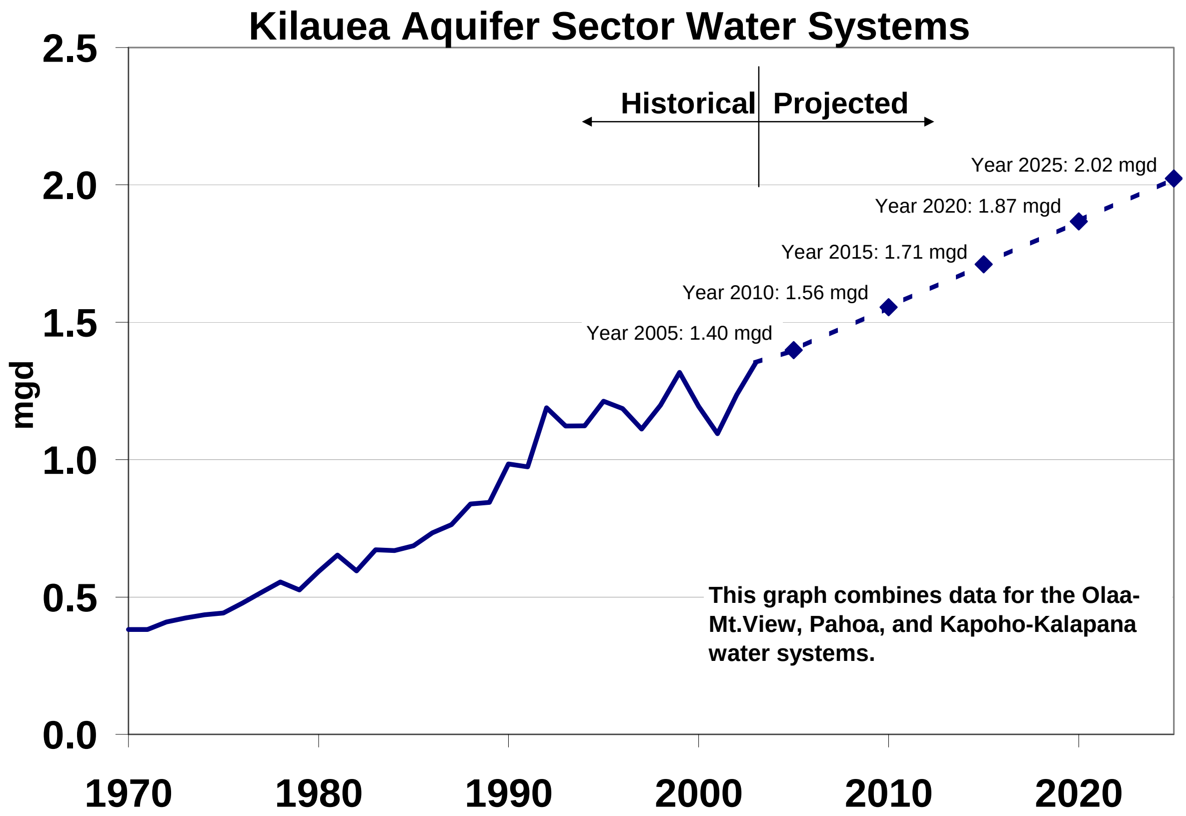


* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.
** "N-P" represents the nonpotable component of the demand.

808.4.5 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 808-11**.

Figure 808-11: DWS Water Demand Projection – Kilauea Aquifer Sector Area



Historical data provided by RW Beck, Inc.

Projections based on historical DWS water consumption data cannot be compared to projections based on population growth rate, because most of the Olaa-Mt.View Water System is within the Northeast Mauna Loa ASEA. However, the projected rate of growth of the future population is considerably higher than the rate of increase based on historical consumption.

808.5 RESOURCE AND FACILITY RECOMMENDATIONS

808.5.1 Water Source Adequacy

808.5.1.1 Full Build-Out

Full development to the maximum density of the County General Plan and Zoning land use within the Kilauea Aquifer Sector Area (ASEA)can be sustained by conventional water resources if agricultural demands are not included. Water demands associated with the LUPAG scenario amount to approximately 5 percent of the sustainable yield (SY) of the sector area, and the existing zoning requires less than 1 percent of the SY. If worst case agricultural demands are included, the LUPAG and Zoning full build-out water demand scenarios would require 21 and 15 percent of the SY, respectively.

808.5.1.2 Twenty-Year Projection

Existing and 20-year projected water demands are insignificant compared to the SY of the sector area. Existing water demands are approximately 1 percent of the SY, and 2025 projected demands range between 1 and 2 percent of the SY.

808.5.2 Source Development Requirements

808.5.2.1 Supply-Side Management

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

808.5.2.1.1 Conventional Water Resource Measures

808.5.2.1.1.1 Ground Water

Because of the continuing activity of Kilauea, and the youth of the geology, the groundwater relationships are complex. Basal water exists along the coast of the Kalapana Aquifer System Area (ASYA) and extends several miles inland. This is evidenced by the development of existing potable water wells. Geothermal fluids also exist, and interestingly, are being developed a few miles from existing potable water wells. Large volumes of high-level water exist in the rift zone of Kilauea, but is likely accessible only in the Pahoa ASYA. Exploratory wells in the Glenwood area of the adjacent Southeast Mauna Loa ASEA (805) have tapped high level water at over 1,000 feet, however, high level potable water wells have yet to be put in service. Based on chloride content of existing wells, development of basal groundwater sources should continue at least a few miles inland of the coast. Undoubtedly, based on the measured head in the existing wells, a large volume of basal water exists.

As indicated in the *1999 Central Puna Water Master Plan*, it may be more economical to develop high level water instead of basal water. In systems serving multiple pressure zones, high level water would be pumped at a higher elevation and thus may be transmitted downhill by gravity and a series of pressure reducing valves, whereas basal water would require initial pumping and a series of booster pumps.

808.5.2.1.1.2 Surface Water

Surface water is nearly non-existent in the Kilauea ASEA; there are no perennial streams and only one registered stream diversion. Surface water sources are not considered a viable water resource.

808.5.2.1.1.3 Water Transfer

Some degree of water transfer is already taking place. The service area of the DWS Olaa-Mt. View Water System, sources for which are in the Northeast Mauna Loa ASEA (804), extends into the Kilauea ASEA. The water transfer is not a concern as the DWS demands in the water system are insignificant compared to the large sustainable yield of both aquifer sector areas. Potable sources may be developed in either sector area and transferred to the other sector areas without impacting the aquifer.

808.5.2.1.2 Alternative Water Resource Enhancement Measures

808.5.2.1.2.1 Rainwater Catchment Systems

The Kilauea ASEA is unique in that most of the residents within the sector area rely on rainwater catchment systems as their sole potable water source. Most significantly, units within the 89-square foot area in Central Puna comprised of 12 subdivisions, with the exception of the immediate vicinity of Keeau-Pahoa Road, all utilize individual catchment systems. Except for the uninhabited Hilina and Keaiwa ASYAs, the sector area receives sufficient ambient rainfall to support catchment systems.

Larger scale rainwater catchment systems are also an option to supply nonpotable needs if necessary. Many agricultural crops and irrigation needs can be satisfied by the ambient rainfall.

808.5.2.1.2.2 Wastewater Reclamation

Wastewater reclamation facilities are not considered a viable option at this time due to the small service population of the municipal wastewater systems in the sector area. However, the potential population of the Central Puna area, with an estimated 30,000 lots, could justify a wastewater reclamation facility. Additionally, availability of reclaimed wastewater could help supplement the significant contingent of 1-acre lots in the area that engage in live-grow operations.

808.5.2.1.2.3 Desalination

The potential for desalination plants exist where brackish water is present from the coastline to a few miles inland. In general, these areas typically are not served by a municipal water system, have small service populations, and significant growth is not anticipated. In these areas, it is probably more cost-effective to extend the municipal water system rather than construct desalination facilities.

808.5.2.2 Demand-Side Management

808.5.2.2.1 Development Density Control

Full build-out demands associated with LUPAG maximum density are nearly eight times greater than that of Zoning. The discrepancy results from vast areas classified as Rural in the LUPAG, compared to Agricultural in Zoning. Many of these lots will likely be used for family agricultural operations or residential dwellings. Additional sources eventually will be required; however, these demands are sustainable by conventional resources. Development density of the Rural designation was assumed to be 1 unit per acre, which is considerably lower than the island average Urban and Residential land use unit density rates; therefore, development density control is not considered necessary.

808.5.2.2.2 Water Conservation

The average water consumption per connection to the DWS water system in the Kilauea ASEA is 550 gpd, which is higher than the island average, but the average consumption of DWS accounts classified as “Residential” is less than 400 gpd per connection. The average potable water consumption per capita from all sources is 150 gpd, which is acceptable.

The DWS Pahoa and Kalapana Water Systems have a significant percentage of water not accounted for, with the Kalapana Water System having between 30 and 50 percent of the water produced unaccounted. Although source production is still adequate to meet the projected demands, and the amount of water lost is insignificant compared to the SY of the sector area, it would be prudent for DWS to examine the economic impact of the water losses.

Demand and supply side conservation measures should continue to be stressed, but strict enforcement is not critical at this point.

808.5.3 Recommended Alternatives

Consistent with the utility goals for the Puna District stated in the General Plan, alternative means to finance the extension of water systems to subdivision that rely on catchment should be considered. A feasibility study to investigate both the need and desire for a municipal water system, either by extension of the existing system, or new system altogether, would be prudent. The key consideration is that a municipal system should not be imposed on residents if it is not desired.

Groundwater sources in Olaa also should be investigated. A cost-benefit analysis would determine whether to seek high level or basal potable water sources. Currently, DWS has planned a new production well in the center of Mountain View. An observation well in the vicinity indicates that high-level water over 1,000 feet in elevation should be expected.

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

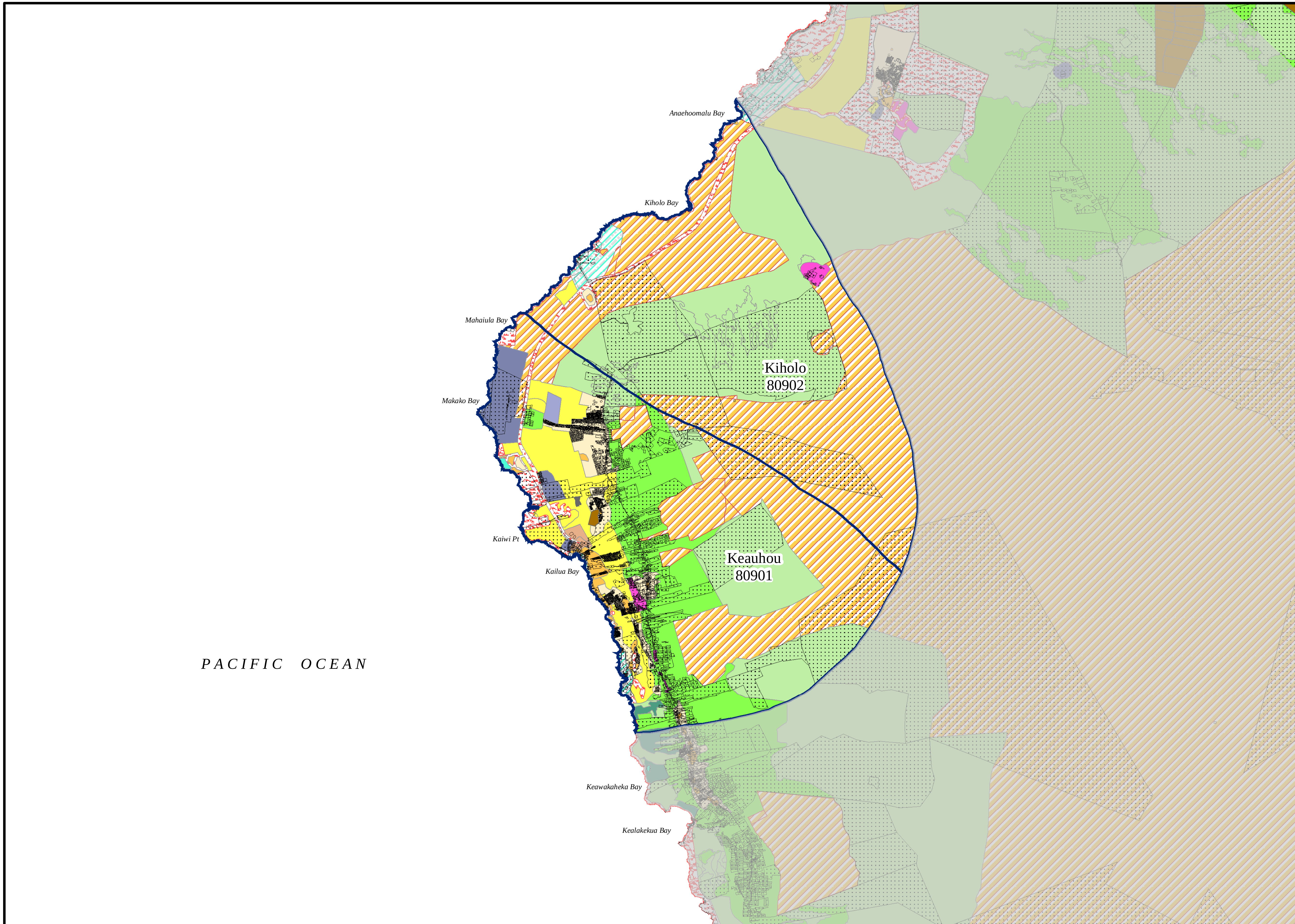
Growth Rate	2000	2005	2010	2015	2020	2000-10 % Change	2010-20 % Change
A – Low	28,163	29,966	33,277	36,874	40,895	18.2	22.9
B – Medium	28,163	30,061	33,571	37,417	41,712	19.2	24.2
C – High	28,163	31,315	35,676	40,356	45,468	26.7	27.4

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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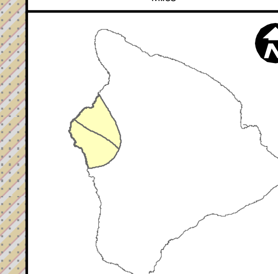
Miles



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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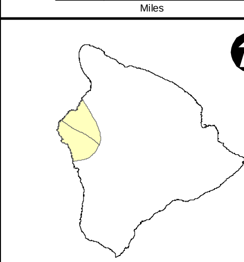
Miles



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

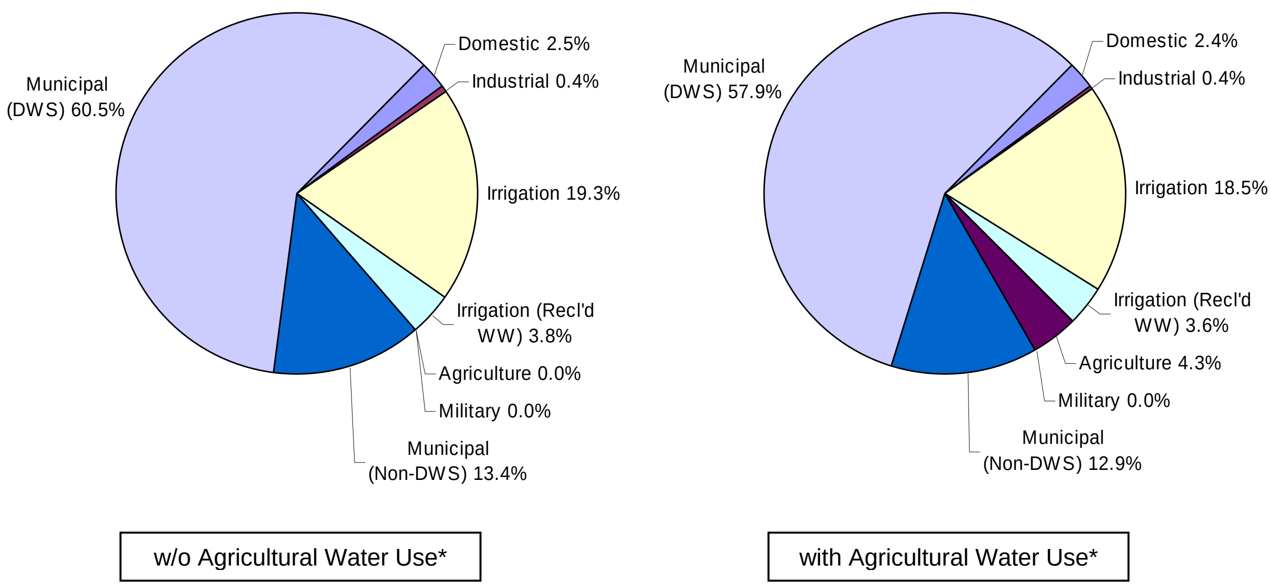
MAP CURRENTLY NOT AVAILABLE ON-LINE

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



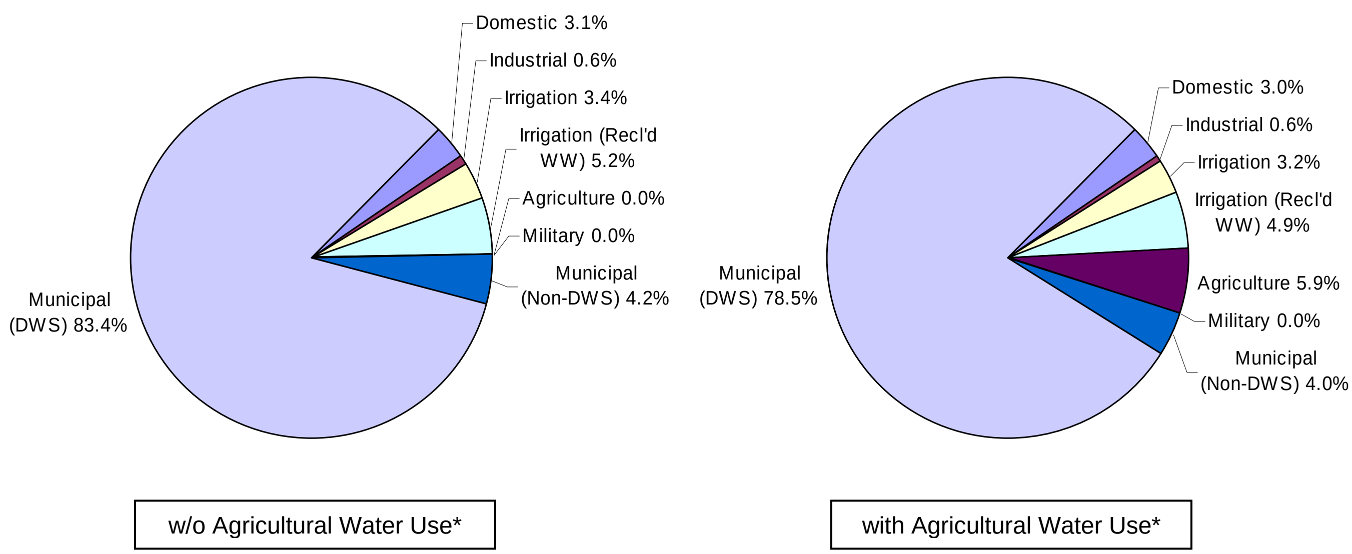
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

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]



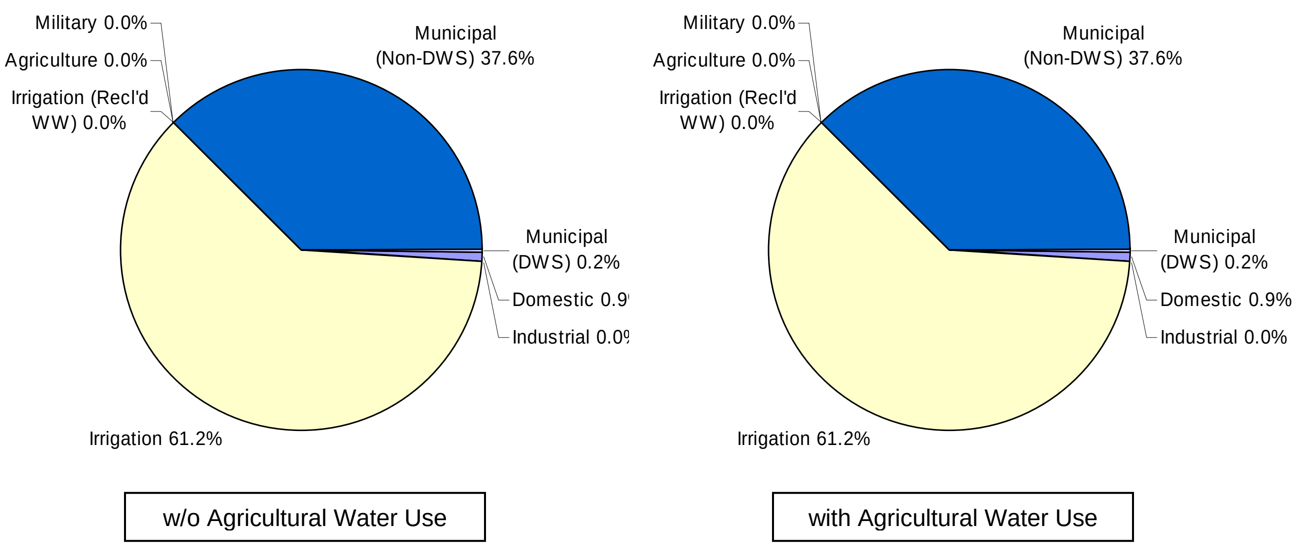
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

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.

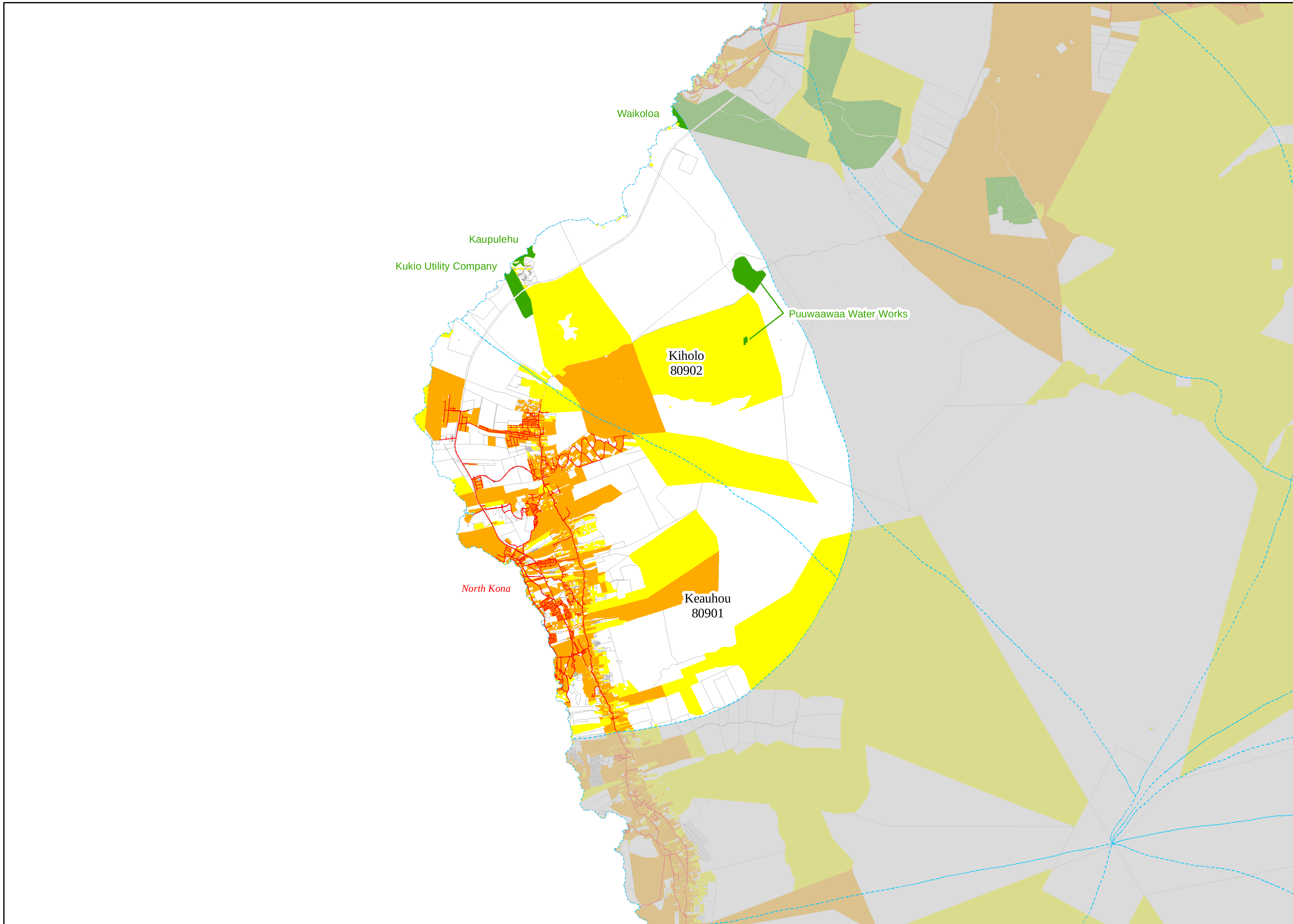
Table 809-8: Private Irrigation Well Pumpage – Hualalai Aquifer Sector Area

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

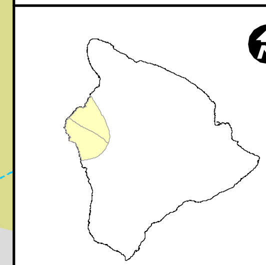
Department of Water Supply

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



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.

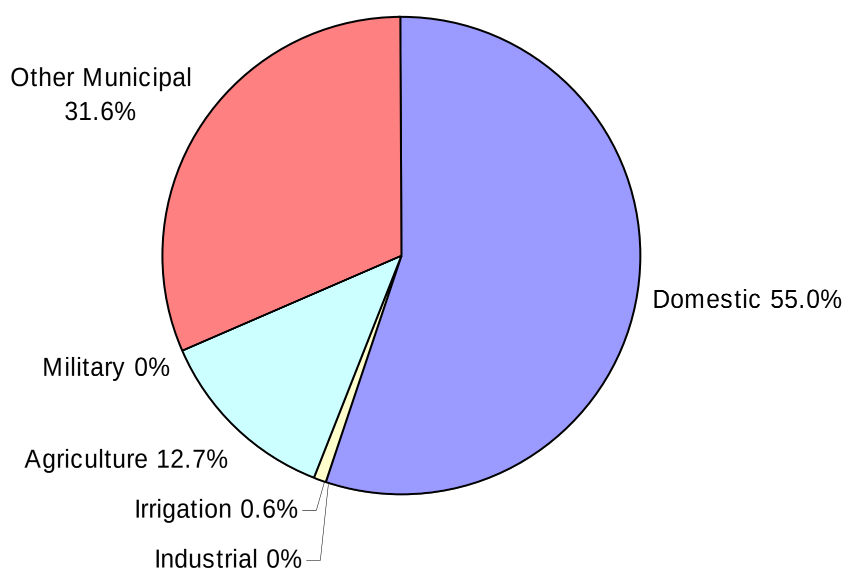
The Kona Water System extends from the Kona International Airport south to the South Kona boundary where interconnection with the South Kona Water System is made. The Kona districts were without any County water systems until funds were provided by the Legislature in 1951. The first increment of the 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.

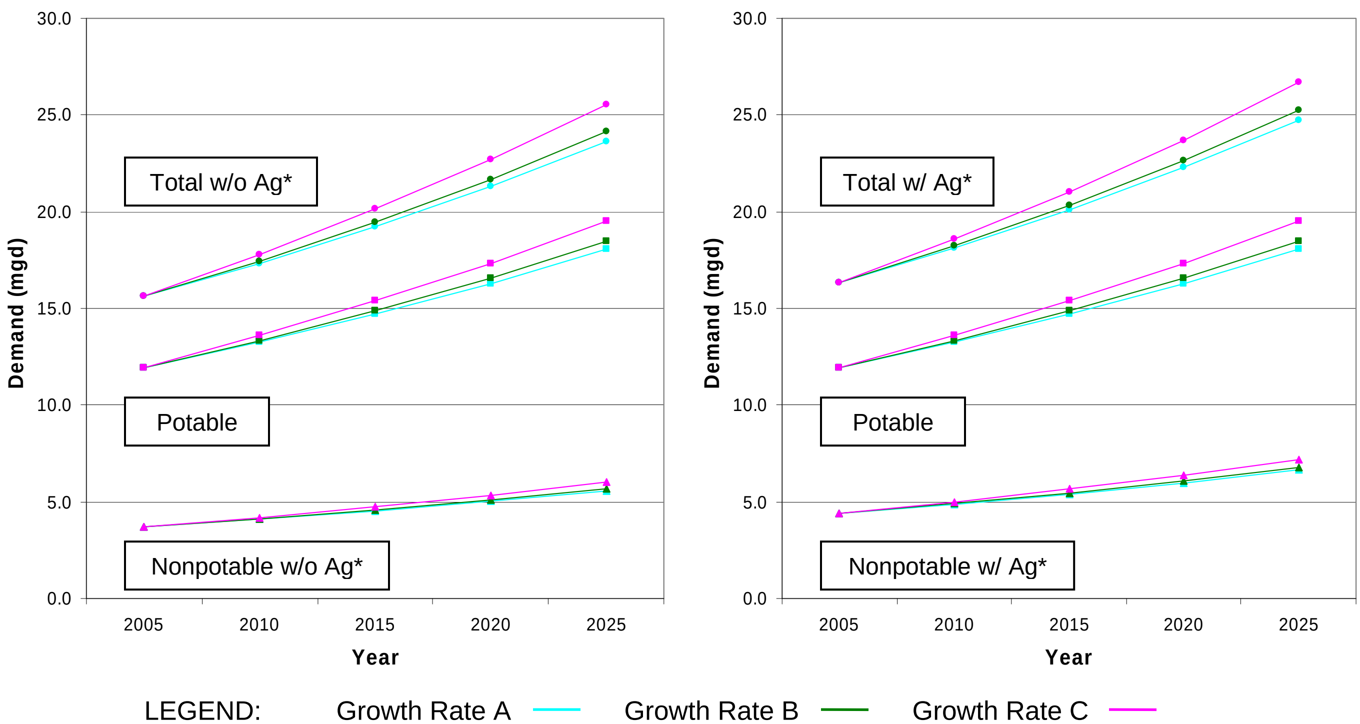
809.4.4.1 Hualalai Aquifer Sector Area

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



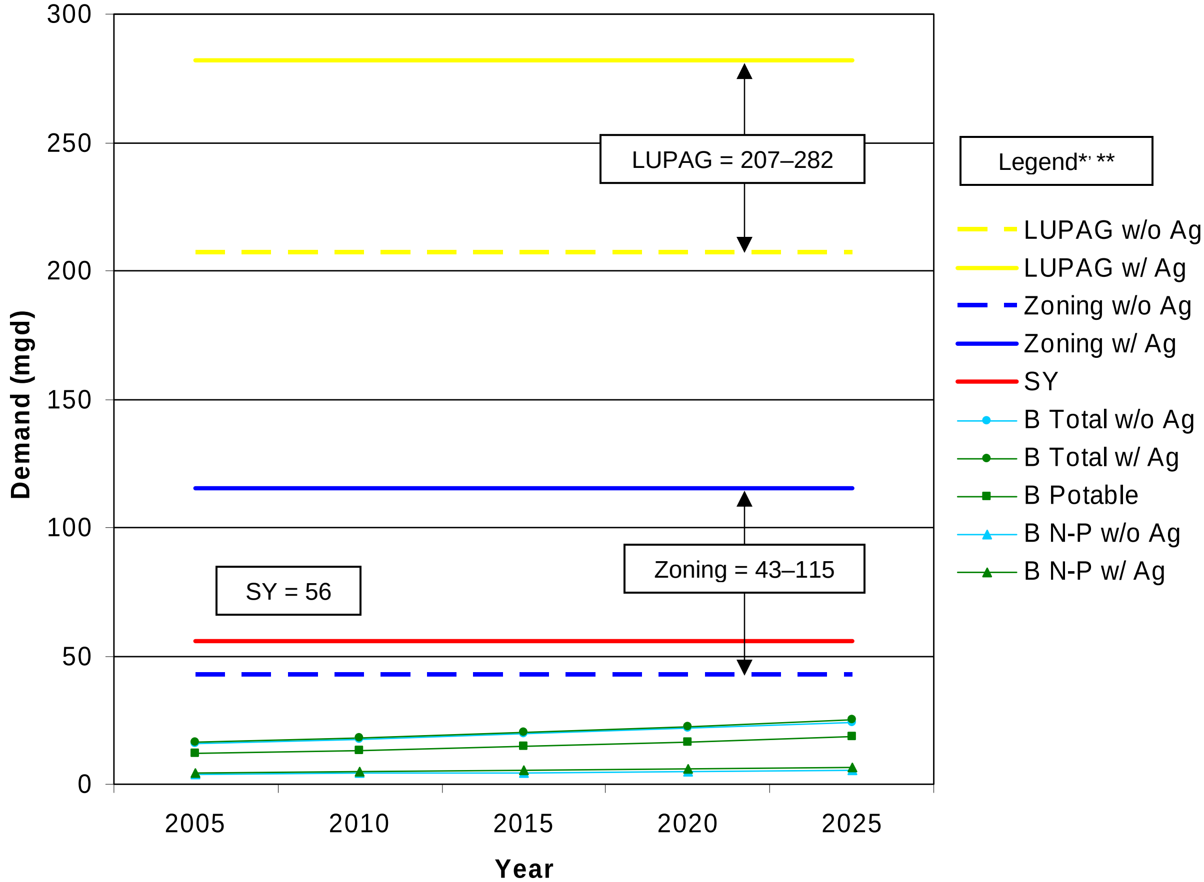
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

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

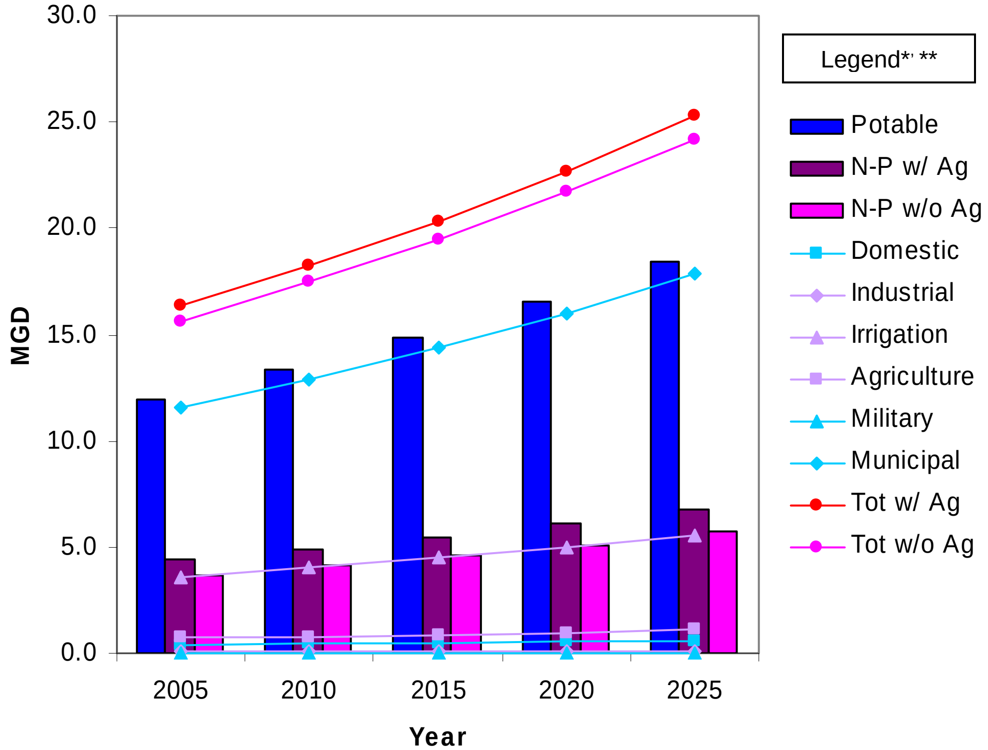
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

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.

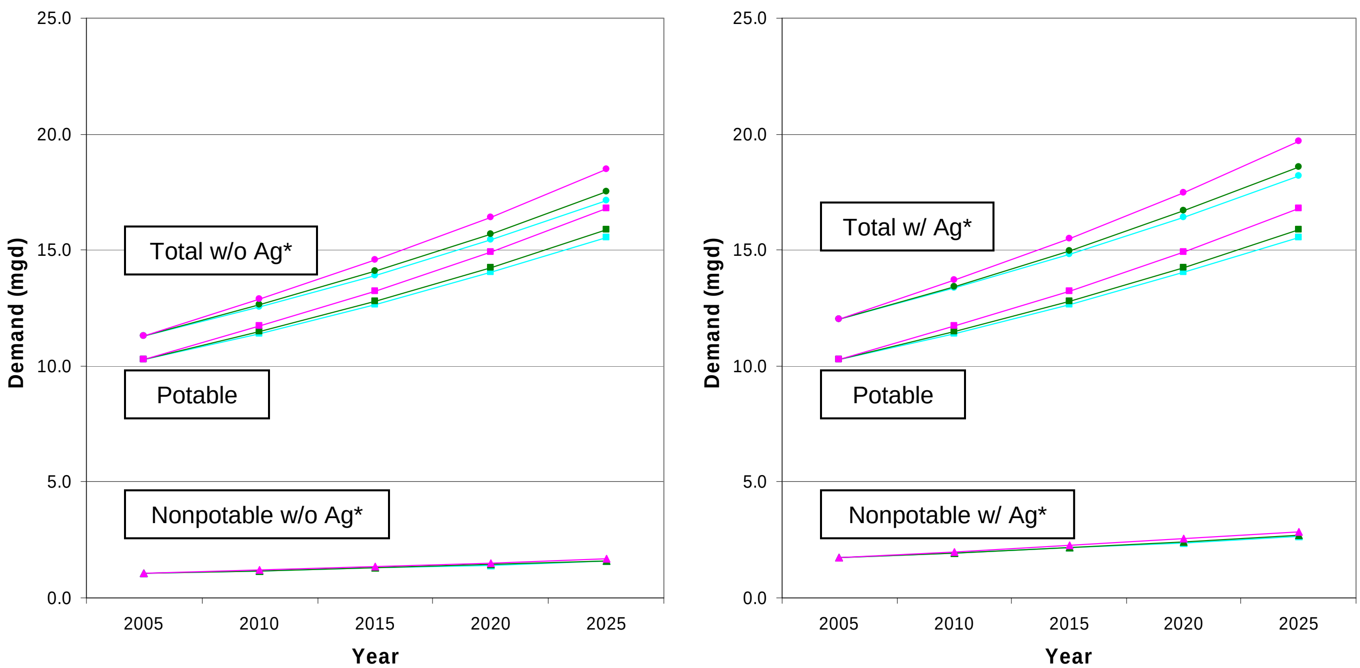
809.4.4.2 Keauhou Aquifer System Area [80901]

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]



LEGEND: Growth Rate A — Growth Rate B — Growth Rate C —

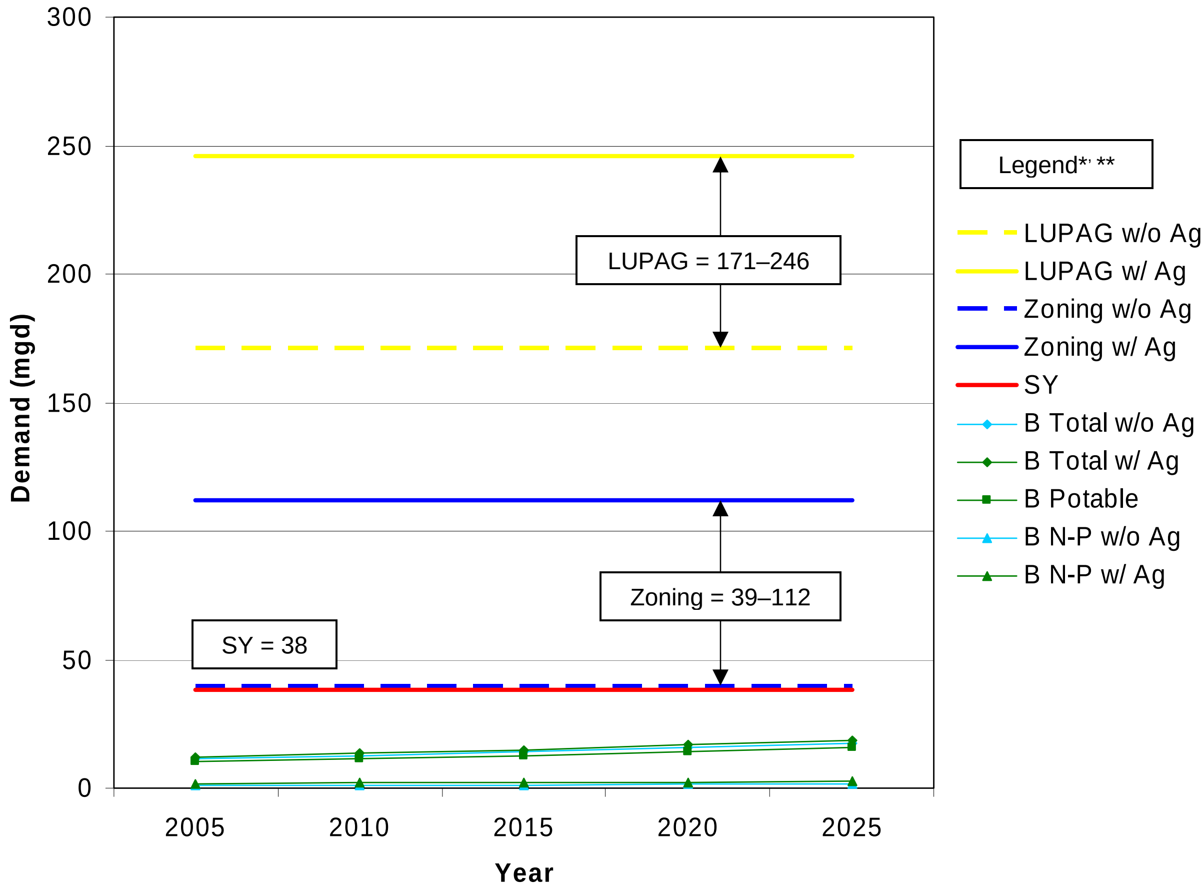
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

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

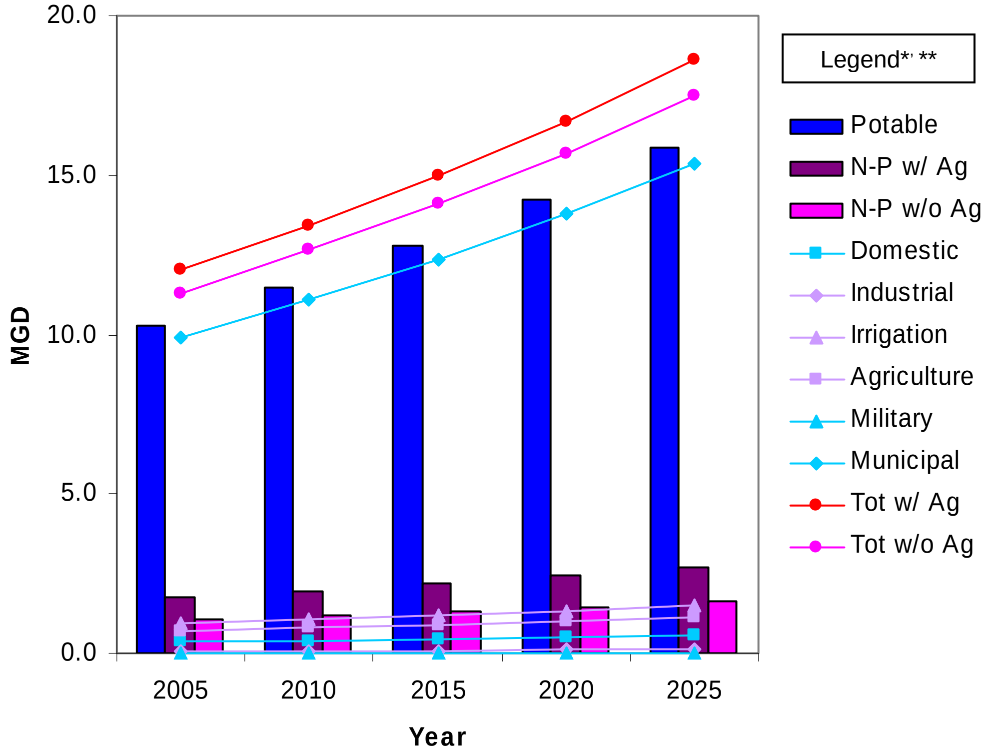
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

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.

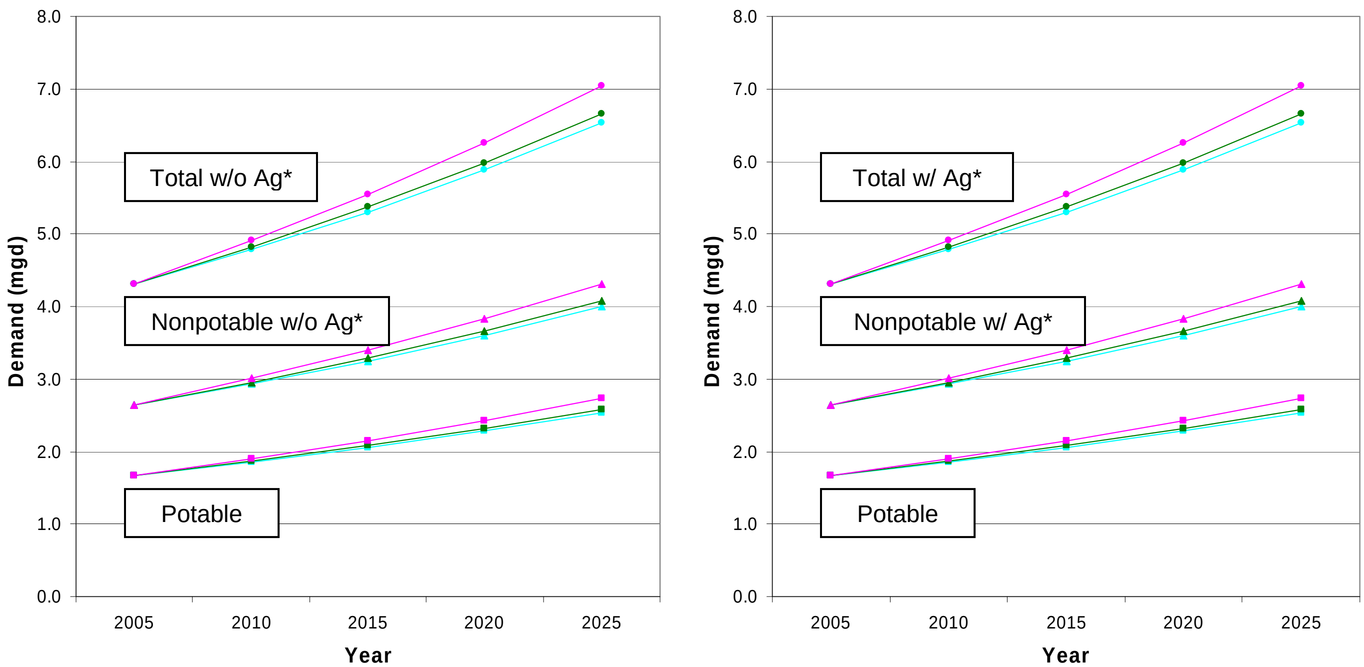
809.4.4.3 Kiholo Aquifer System Area [80902]

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]



LEGEND: Growth Rate A Growth Rate B Growth Rate C

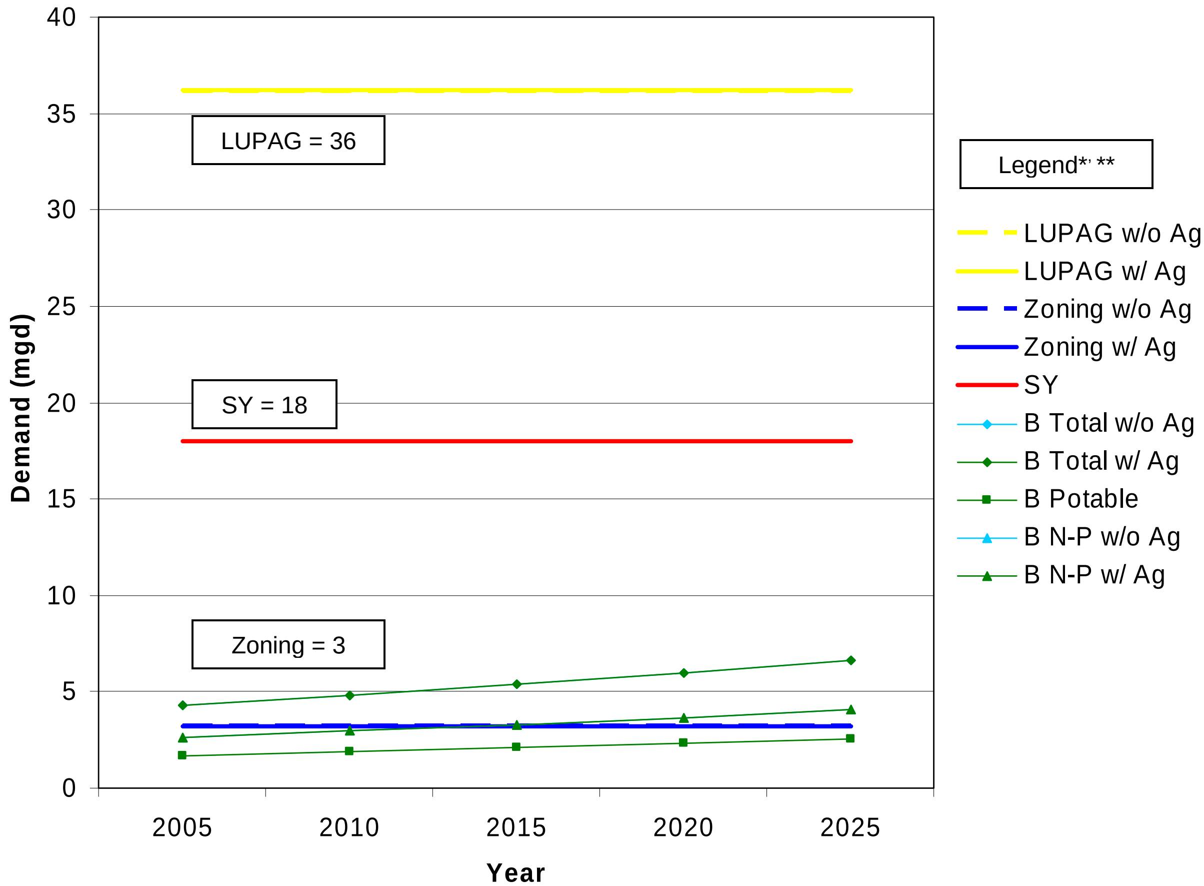
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

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

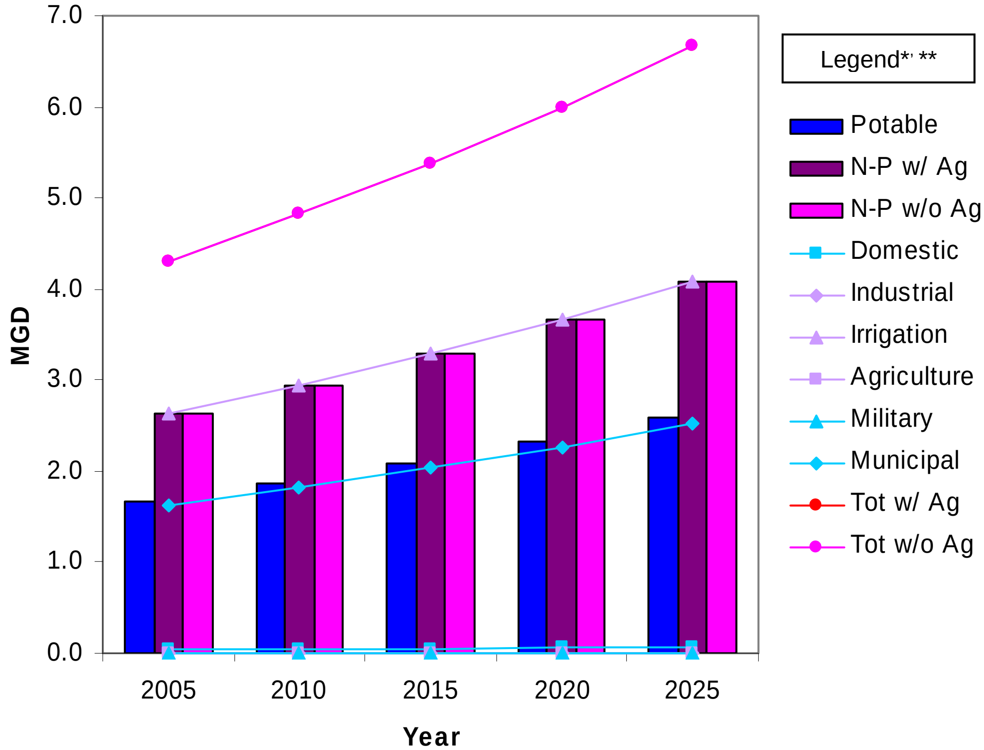
* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.

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]

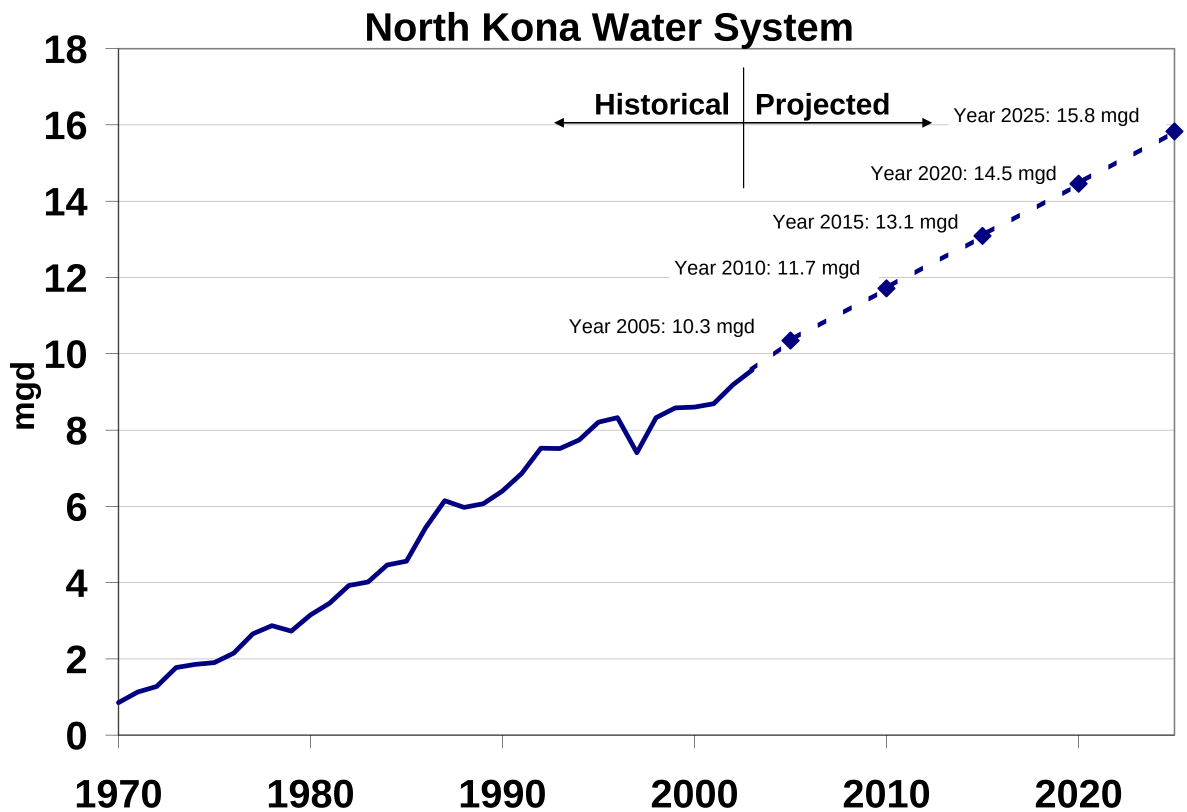


* Demand scenarios without and with agricultural demands represent the potential minimum and maximum agricultural demand, respectively, with the expectation that the actual demand will fall somewhere in between.
** "N-P" represents the nonpotable component of the demand.

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.

4 SUMMARY OF CONCLUSIONS AND GENERAL RECOMMENDATIONS

Specific recommendations were presented for each aquifer sector area in Chapter 3; however, the Hawaii Water Use and Development Plan Update promotes several common key themes which are applicable island-wide.

1) Reserve the Highest Quality of Water for the Most Valuable End Use

The highest quality water should be reserved for the most valuable end use, thus the "need" for water is emphasized. Potable water is considered the highest quality water; and the sustenance of life is considered the most valuable end use. Landscaping is viewed as a luxury, not a necessity for life; hence, usage of potable water for landscaping is considered unessential and is discouraged. Lower quality nonpotable water, such as reclaimed wastewater, brackish groundwater and untreated surface water, should be utilized for landscaping and agriculture where feasible, thereby reserving potable water for human consumption. Usage of nonpotable water can be promoted by installing nonpotable systems in the proximity of concentrated development. Proper community planning and development is necessary to ensure the success of this process.

2) Promote Water Conservation

Water should not be considered a commodity to be bought and sold, but rather, a public trust and a valuable resource, which is the right of all people to share responsibly. Potable water usage above the County standard of 400 gpd per household is considered excessive, and is therefore discouraged. Both end users and water purveyors should work together to conserve potable water. End users can follow the demand-side conservation practices described in Chapter 2 to reserve potable water only for the sustenance of life, and water purveyors can follow the supply-side conservation measures described in Chapter 2. County Planning can to an extent limit future development water usage in potential water-short areas through land use and zoning policies and by requiring LEED certified construction.

3) Initiate More Monitoring and Studies

The data and analyses presented in the WUDP are based on groundwater hydrologic units; therefore, the accuracy of these units is essential. Additional monitoring and studies are recommended to determine the "safe" sustainable yields of groundwater. The aquifer system area sustainable yields currently are being updated in the WRPP; subsequent updates to the WUDP should reflect the updated sustainable yields. The Framework also requires data and analyses to be based on surface water hydrologic units; therefore, additional information on surface water hydrologic units is required for future updates of the WUDP. Permitted use of stream diversions is "status quo" until instream flow standards have been determined.

Data and analysis presented within each aquifer sector area chapter is specific to the individual aquifer sector area. However, as demonstrated by the water transfers, source availability and water usage are not confined within each individual aquifer sector area, but rather, are interrelated between neighboring aquifer sector areas. Particularly in West Hawaii, there are areas that will eventually begin to see significant competition for water resources. As such, it is expected that the magnitude and extent of water transfers will increase in the future. **Figures 4-1** and **4-2** show the location of present and expected future water transfers, respectively. Because of these interdependencies, it is strongly recommended that regional studies be initiated that examine such issues in greater depth and on a broader scale.

The WUDP proposes to create overall resource management practices that, where possible, will include obtaining water development easements and sites for well fields, water tanks, reservoirs, and transmission lines, as well as identifying hydraulic service zones on State lands to facilitate strategic transmission between hydrologic zones proximate to lands designated for growth. Qualified utility development of these resources will facilitate a long-term management and protection strategy to the benefit of the greater community. Such development, whether on government or privately-owned lands, will preclude undue competition for the resources as they become more limited. To promote aquifer integrity, future updates of the WUDP should promote a policy of well-planned source development.

The Department of Water Supply, as the largest purveyor of potable water on the island, plays a key role in the use and protection of water resources. The goals and policies of DWS are described in detail in Appendix C.

Water development coordination and cooperation between public and private sectors are emphasized to assist the success of future planning. Involvement of collaborative and advisory groups has had a positive impact on water resources planning, and it is encouraged that these groups continue to provide input and insight.

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APPENDIX A

County of Hawaii General Plan
February 2005
Goals and Policies

The following list includes only the goals and policies pertinent to the County of Hawaii Water Use and Development Plan.

A.1 ECONOMIC

A.1.1 Economic Goals:

(a) Provide residents with opportunities to improve their quality of life through economic development that enhances the County's natural and social environments.

(b) Economic development and improvement shall be in balance with the physical, social, and cultural environments of the island of Hawaii.

(c) Strive for diversity and stability in the economic system.

(d) Provide an economic environment that allows new, expanded, or improved economic opportunities that are compatible with the County's cultural, natural and social environment.

(e) Strive for an economic climate that provides its residents an opportunity for choice of occupation.

(f) Strive for diversification of the economy by strengthening existing industries and attracting new endeavors.

(g) Strive for full employment.

(h) Promote and develop the island of Hawaii into a unique scientific and cultural model, where economic gains are in balance with social and physical amenities. Development should be reviewed on the basis of total impact on the residents of the County, not only in terms of immediate short run economic benefits.

A.1.2 Economic Policies:

(a) Assist in the expansion of the agricultural industry through the protection of important agricultural lands, development of marketing plans and programs, capital improvements and continued co-operation with appropriate State and Federal agencies.

(b) Encourage the expansion of the research and development industry by working with and supporting the University of Hawaii at Hilo and West Hawaii, the Natural Energy Laboratory at Hawaii Authority and other agencies' programs that support sustainable economic development in the County of Hawaii.

(c) Encourage the development of a visitor industry that is in harmony with the social, physical, and economic goals of the residents of the County.

(d) Require a study of the significant cultural, social and physical impacts of large developments prior to approval.

(e) Encourage the sustainable development of the fishing industry, various forms of aquaculture, and other fresh and sea water-based activities.

(f) Support all levels of educational, employment and training opportunities and institutions.

(g) Capital improvements program shall improve the quality of existing commercial and industrial areas.

(h) The land, water, air, sea, and people shall be considered as essential resources for present and future generations and should be protected and enhanced through the use of economic incentives.

(i) Continue to encourage the research, development and implementation of advanced technologies and processes.

(j) Support the development of high technology industries.

(k) Continue to encourage development and utilization of by-products from alternate energy conversion processes.

(l) Identify and encourage primary industries that are consistent with the social, physical, and economic goals of the residents of the County.

(m) Encourage active liaison with the private sector with respect to the County's requirements for establishing businesses on the island.

(n) Encourage the development of the retirement industry.

(o) Promote a distinctive industry for the island of Hawaii to enable government, business and travel industries to promote the County of Hawaii as an entity unique within the State of Hawaii.

(p) Identify the needs of the business community and take actions that are necessary to improve the business climate.

(q) Support research and development that would lead to the removal of marketing restrictions on Hawaiian fruits and other perishables.

(r) Assist in the development of a film and video industry program to market Big Island sites and co-ordinate film and video activities on the Big Island.

(s) Assist the further development of agriculture through the protection of important agricultural lands.

(t) Assist in the promotion of the agricultural industry whose products are recognized as being produced on the island of Hawaii.

(u) Encourage the establishment of open farmers markets to allow local agricultural producers to market their products.

(v) Assist in the co-operative marketing and distribution endeavors to expand opportunities for local agricultural products for export as well as to the local market.

(w) Encourage the further development of the overseas capacity of Hilo International Airport for the exportation of agricultural crops.

(x) Encourage the health/wellness industry.

(y) Encourage new industries that provide favorable benefit-cost relationships to the people of the County. Benefit-cost relationships include more than fiscal considerations.

A.2 ENVIRONMENTAL

A.2.1 Environemental Quality Goals:

(a) Define the most desirable use of land within the County that achieves an ecological balance providing residents and visitors the quality of life and an environment in which the natural resources of the island are viable and sustainable.

(b) Maintain and, if feasible, improve the existing environmental quality of the island.

(c) Control pollution.

A.2.2 Environmental Quality Policies (Applicable to Water):

(a) Take positive action to further maintain the quality of the environment.

(b) Reinforce and strengthen established standards where it is necessary, principally by initiating, recommending, and adopting ordinances pertaining to the control of pollutants that affect the environment.

(c) Advise the public of environmental conditions and research undertaken on the island's environment.

(d) Encourage the concept of recycling agricultural, industrial, and municipal waste material.

(e) Encourage the State to establish air and water quality monitoring stations in areas of existing and potential urban growth.

(f) Participate in watershed management projects to improve stream and coastal water quality and encourage local communities to develop such projects.

(g) Work with the appropriate agencies to adopt appropriate measures and provide incentives to control point and non-point sources of pollution.

(h) Require golf courses to implement best management practices to limit leaching of nutrients to groundwater in areas where they may affect streams or coastal ecosystems.

(i) Require implementation of the management measures contained in Hawaii's Coastal Nonpoint Pollution Control Program as a condition of land use permitting.

(j) Review the County grading and grubbing ordinances to ensure that they adequately address potential erosion and runoff problems.

A.3 NATURAL RESOURCES

A.3.1 Natural Resources Goals (Applicable to Water):

(a) Protect and conserve the natural resources from undue exploitation, encroachment and damage.

(b) Protect and effectively manage Hawaii's open space, watersheds, shoreline, and natural areas.

(c) Ensure that alterations to existing land forms, vegetation, and construction of structures cause minimum adverse effect to water resources, and scenic and recreational amenities and minimum danger of floods, landslides, erosion, siltation, or failure in the event of an earthquake.

A.3.2 Natural Resources Policies (Applicable to Water):

(a) Encourage a program of collection and dissemination of basic data concerning natural resources.

(b) Co-ordinate programs to protect natural resources with other governmental agencies.

(c) Encourage public and private agencies to manage the natural resources in a manner that avoids or minimizes adverse effects on the environment and depletion of energy and natural resources to the fullest extent.

(d) Encourage an overall conservation ethic in the use of Hawaii's resources by protecting, preserving, and conserving the critical and significant natural resources of the County of Hawaii.

(e) Encourage the protection of watersheds, forest, brush, and grassland from destructive agents and uses.

(f) An identification of forest lands suitable for watershed purposes should be conducted jointly by County, appropriate State and Federal agencies, and private landowners.

(g) Encourage appropriate State agencies to review and designate forest and watershed areas into the conservation district during State land use boundary comprehensive reviews.

(h) Ensure that activities authorized or funded by the County do not damage important natural resources.

(i) Within the Kona high rainfall/fog-drip belt, ground disturbing activities such as excessive soil compaction and excessive removal of vegetative cover should be minimized and mitigated consistent with management strategies that encourage the retention of existing forested and pasture areas, reforestation, minimal coverage by the impervious surfaces and other strategies that encourage effective infiltration to groundwater.

A.4 PUBLIC UTILITIES

A.4.1 Public Utilities Goals:

(a) Ensure that properly regulated, adequate, efficient and dependable public and private utility services are available to users.

(b) Maximize efficiency and economy in the provision of public utility services.

(c) Design public utility facilities to fit into their surroundings or concealed from public view.

A.4.2 Public Utilities Policies (Applicable to Water):

(a) Water system improvements shall correlate with the County's desired land use development system.

(b) All water systems shall be designed and built to Department of Water Supply standards.

(c) Improve and replace inadequate systems.

(d) Water sources shall be adequately protected to prevent depletion and contamination from natural and man-made occurrences of events.

(e) Water system improvements should first be installed in areas that have established needs and characteristics, such as occupied dwellings, agricultural operations and other uses, or in areas adjacent to them if there is need for urban expansion.

(f) A co-ordinated effort by County, State and private interests shall be developed to identify sources of additional water supply and be implemented to ensure the development of sufficient quantities of water for existing and future needs of high growth areas and agricultural production.

(g) The fire prevention systems shall be co-ordinated with water distribution systems in order to ensure water supplies for fire protection services.

(h) Develop and adopt standards for individual water catchment units.

(i) Co-operate with the State Department of Health to develop standards and/or guidelines for the construction and use of rainwater catchment systems to minimize the intrusion of any chemical and microbiological contaminants.

(j) Co-operate with appropriate State and Federal agencies and the private sector to develop, improve and expand agricultural water systems in appropriate areas on the island.

(k) Promote the use of ground water sources to meet State Department of Health water quality standards.

(l) Continue to participate in the United States Geological Survey's exploratory well drilling program.

(m) Seek State and Federal funds to assist in financing projects to bring the County into compliance with the Safe Drinking Water Act.

(n) Develop and adopt a water master plan that will consider water yield, present and future demand, alternative sources of water, guidelines and policies for the issuing of water commitments.

(o) Expand programs to provide for agricultural irrigation water.

A.5 LAND USE

A.5.1 Land Use Goals:

(a) Designate and allocate land uses in appropriate proportions of mix and in keeping with the social, cultural, and physical environments of the County.

(b) Protect and encourage the intensive and extensive utilization of the County's important agricultural lands.

(c) Protect and preserve forest, water, natural and scientific reserves and open areas.

A.5.2 Land Use Policies (Applicable to Water):

(a) Zone urban-types of uses in areas with ease of access to community services and employment centers and with adequate public utilities and facilities.

(b) Promote and encourage the rehabilitation and use of urban areas that are serviced by basic community faculties and utilities.

(c) Allocate appropriate requested zoning in accordance with the existing or projected needs of neighborhood, community, region and County.

(d) Encourage urban development within existing zoned areas already served by basic infrastructure, or close to such areas, instead of scattered development.

APPENDIX B

CWRM
Island of Hawaii
Well Database
(as of October 2005)

Aquifer System	Well No.	Well Name	Owner User	Type	Casing Dia. in.	Ground Elev. ft.	Well Depth ft.	Use Cat.	Yr. Drill.	Use Yr.	Init. Head ft.	Init. Chl. ppm	Max. Chl. ppm	TMK	Pump Capacity gpm	Average Pumpage mgd	High Avg. Pumpage mgd
HAWI AQUIFER SYSTEM [80101]																	
80101	7345-01	Aamakoa Gu TH 2	Kohala Sugar	ROT	3	171	255	UNU	1964	73	6.8	25	37				
80101	7549-02	Alaalae Gu TH-7	Kohala Sugar	ROT	3	362	84	UNU	1965	73	5.2	25	25				
80101	7549-01	Alaalae Shaft	Kohala Sugar	DUG		75		UNU	1900	46							
80101	7145-05	Amau Tunnel	Kohala Sugar	TUN		1000		IRR	1939	46							
80101	7247-01	Bond 1 Tunnel	Hawaii Dws	TUN		978		MUN	1937	46				5-3-005:028	700		
80101	7247-02	Bond 2 Tunnel	Kohala Sugar	TUN		1450		MUN	1934	46							
80101	7148-01	Cowpen 1 Tunnel	Kohala Sugar	TUN		1700		IRR		46							
80101	7148-02	Cowpen 2 Tunnel	Kohala Sugar	TUN		1740		IRR		46							
80101	7148-03	Cowpen 3 Tunnel	Kohala Sugar	TUN		1740		IRR		46							
80101	7248-01	Dr Bond Tunnel	Kohala Sugar	TUN		968		IRR		74							
80101	7448-03	Gusman Gu TH 5	Kohala Sugar	ROT	3	306	402	UNU	1964	73	6.2	12	33				
80101	7347-02	Halaula	Kohala Sugar	PER	16	342	505	IND	1948	72	7.8	26	43		1200		
80101	7347-05	Halaula B	U S G S	ROT	10	628	730	OBS	1989	89	11.4	19		5-3-004:			
80101	7347-03	Halaula Makai E	U S G S	ROT	8	341	405	OBS	1989	89	9.8			5-3-004:005			
80101	7347-04	Halaula Mauka B	U S G S	ROT	8	630	730	OBS	1989	89	11.4			5-3-004:			
80101	7346-01	Halawa Gu TH 1	Kohala Sugar	ROT	3	170	267	UNU	1964	73	7.4	54	54	5-3-008:026			
80101	7246-01	Halawa Tunnel	Kohala Sugar	TUN		1000		IRR	1938	46							
80101	7248-03	Hapahapai Tunnel	Hawaii Dws	TUN		1350		MUN	1935	46				5-3-001:009	35		
80101	7445-01	Hapuu Bay D	U S G S	ROT	8	109	460	OBS	1989	89	7.2			5-3-007:010			
80101	7449-01	Hawi	Kohala Sugar	TUN		500	84	UNU	1898								
80101	7449-02	Hawi 1	Hawaii Dws	PER	12	542	591	MUN	1975					5-5-002:089	400	0.29	0.64
80101	7349-01	Hawi 2	Hawaii Dws	ROT	18	791	847	MUN	1993	97	7.16	20		5-5-016:018	700	0.25	0.65
80101	7549-03	Hawi Makai I	U S G S	ROT	10	299	436	OBS	1989	89	2.2						
80101	7449-03	Hawi Obs H	U S G S	ROT	8	541	585	OBS	1989	89	7	21		5-5-002:023			
80101	7650-01	Hoea Shaft	Kohala Sugar	SHF		52	61	UNU	1900	74	2		875				
80101	7448-07	Honopueo F	U S G S	ROT	10	415	429	OBS	1989	89	8	36		5-4-004:			
80101	7347-01	Iole-Bond Tunnel	Kohala Sugar	TUN		650		MUN		46							
80101	7147-05	J D Bond Tunnel	Kohala Sugar	TUN		1500		IRR	1935	46							
80101	7248-02	Kaala Tunnel	Kohala Sugar	TUN		1025		IRR	1934	46							
80101	7147-01	Kay Tunnel	Kohala Sugar	TUN		1700		IRR		46							
80101	7147-07	Koelling Tunnel	Kohala Sugar	TUN		1600		MUN	1937	46							
80101	7448-06	Kohala Obs F	U S G S	ROT	8	412	440	OBS	1989	89	8.21			5-4-009:001			
80101	7446-01	Kohala Shaft	Kohala Sugar	SHF		123	135	IRR	1900				3441		6940		
80101	7348-01	Kohala Sugar	Kohala Sugar	TUN		900		IRR									
80101	7047-01	Lindsay Tunnel	Hawaii Dws	TUN		2150		MUN	1933	72				5-3-002:001			
80101	7345-05	Makapala	Hawaii Dws	PER	10	399	547	UNU	2002	02	8.73	40		5-2-005:010			
80101	7345-03	Makapala A	U S G S	ROT	12	396	495	OBS	1989	89	10.3			5-2-005:			
80101	7345-04	Makapala Obs A	U S G S	ROT	8	395	440	OBS	1989	89	10.2			5-2-005:010			
80101	7245-01	Maulua Tunnel	Hawaii Dws	TUN		750		MUN	1939	46				5-2-005:001			
80101	7147-02	Mcgill 1 Tunnel	Kohala Sugar	TUN		2000		SLD		46							
80101	7147-04	Mcgill 2 Tunnel	Kohala Sugar	TUN		2060		IRR	1932	46							
80101	7147-03	Mcgill 3 Tunnel	Kohala Sugar	TUN		2040		IRR	1932	46							
80101	7145-02	Murphy Tunnel	Hawaii Dws	TUN		1250		MUN		46				5-2-005:001	37		

Aquifer System	Well No.	Well Name	Owner User	Type	Casing Dia. in.	Ground Elev. ft.	Well Depth ft.	Use Cat.	Yr. Drill.	Use Yr.	Init. Head ft.	Init. Chl. ppm	Max. Chl. ppm	TMK	Pump Capacity gpm	Average Pumpage mgd	High Avg. Pumpage mgd
80101	7148-05	Olding Tunnel	Kohala Sugar	TUN		1600		IRR		46							
80101	7145-04	Paa Tunnel	Kohala Sugar	TUN		1200		IRR	1939	46							
80101	7248-04	Pahei Tunnel	Kohala Sugar	TUN		1000		IRR	1939	46							
80101	7145-03	Puu Mini Tunnel	Kohala Sugar	TUN		1200		MUN	1937	46							
80101	7448-01	Union Mill	Kohala Sugar	ROT	4	420	425	UNU	1898	68							
80101	7448-04	Union Mill 1	Kohala Sugar	PER	16	311	412	IND	1965	72	7	47	73		1850		
80101	7448-05	Union Mill 2	Kohala Sugar	PER	16	420	522	IND	1969	72			129		1850		
80101	7451-02	Upolu J-B	U S G S	ROT	10	567	632	OBS	1989	89	4.2			5-5-006:003			
80101	7451-01	Upolu Obs J-A	U S G S	ROT	8	567	632	OBS	1989	89	4.2			5-5-006:003			
80101	7552-01	Upolu TH 6	Kohala Sugar	ROT	3	293	360	UNU	1964	73	2.8	349	1550				
80101	7652-01	Waikane Shaft	Kohala Sugar	SHF		33	42	IRR	1920	66					2080		
80101	7345-02	Waikani Gu TH 3	Kohala Sugar	ROT	3	161	265	UNU	1964	73		25	29				
80101	7145-01	Waikani Tunnel	Kohala Sugar	TUN		1500		MUN		46							
80101	7146-01	Waipunalau Tunnel	Kohala Sugar	TUN		1600		MUN	1934	46							
80101	7148-04	Watt 1 Tunnel	Hawaii Dws	TUN		1750		MUN		72			14	5-3-001:008			
80101	7147-06	Watt 2 Tunnel	Kohala Sugar	TUN		1700		IRR	1936	46							
Total - Hawi Aquifer System [80101]																**0.54**	**1.29**
WAIMANU AQUIFER SYSTEM [80102]																	
80102	6843-04	Honokane TH 2	Kohala Ditch	ROT	2	1031	90		1964								
80102	6843-06	Honokane 1	State Doa														
80102	6843-07	Honokane 3	State Doa						1976								
80102	6843-01	Honokane Nui Tun	Kohala Sugar	TUN		1535		IRR	1932								
80102	6843-02	Honokane Nui Tun	Kohala Sugar	TUN		1229		IRR	1932								
80102	6843-03	Honokane Nui Tun	Kohala Sugar	TUN		950		IRR	1932								
80102	6844-01	Honokane TH 1	Kohala Ditch	ROT	2	965	150	UNU	1964	73							
80102	6843-05	Honokane TH 3	Kohala Ditch	ROT	2	1050	300	UNU	1964	73							
80102	6743-02	Honokane TH 4	Kohala Ditch	ROT	2	1196	150	UNU	1964	73							
80102	6743-01	Honokane Tunnel	Kohala Sugar	TUN		1900		IRR	1941	72							
80102	6340-05	Kohala TH 1	State Land	ROT	6		103	LOS	1987								
80102	6440-02	Kohala TH 3	State Land	ROT	2		160	LOS	1987								
80102	6440-01	Kohala TH 4	State Land	ROT			130	LOS	1987								
80102	6440-03	Kohala TH 5	State Land	ROT	2		105	LOS	1987								
80102	6734-01	Kukuihaele A	Hawaii Dws					MUN	1966					4-8-007:030	100	0.00	0.00
80102	6536-01	Lalakea Gulch Tu	Kohala Sugar	TUN		2200		UNU		46							
80102	7144-01	Opaepilau 1 Tunn	Kohala Sugar	TUN		1100		OTH	1934	46							
80102	7144-02	Opaepilau 2 Tun	Kohala Sugar	TUN		1182		IRR	1934	46							
80102	7244-01	Pae Tunnel	Kohala Sugar	TUN		720		IRR	1937	46							
80102	6745-01	Puu Laalaau TH	Kahua Ranch		14	3950	151	UNU	1962	72				5-9-002:001			
80102	6337-01	Puukapu	State Land	ROT	16	3023	1744	MUN	1987	96	1740	9		6-3-001:004	1000		
80102	6337-02	Puukapu Shallow	State Land	PER	12	3020	355	UNU	1993	93				6-3-001:004			
Total - Waimanu Aquifer System [80102]																**0.00**	**0.00**

MAHUKONA AQUIFER SYSTEM [80103]

Aquifer System	Well No.	Well Name	Owner User	Type	Casing Dia. in.	Ground Elev. ft.	Well Depth ft.	Use Cat.	Yr. Drill.	Use Yr.	Init. Head ft.	Init. Chl. ppm	Max. Chl. ppm	TMK	Pump Capacity gpm	Average Pumpage mgd	High Avg. Pumpage mgd
80103	6249-01	Akau 1	Akau H	ROT	4	25	30	IRR	1981	81				6-1-002:061	27		
80103	6752-01	Heffner 1	Heffner C	ROT	6	162	169	UNU	1999	99	1.5	2500		5-8-001:009	0		
80103	6550-01	Kahua	Max Sherrod	PER	8	675	700	IRR	1986	86	3.7	260		5-9-008:006	21		
80103	6853-01	Kaiholena 1	Kaiholena LLC	ROT	8	405	415	IRR	2000	00	0.85	3000		5-8-001:016	60		
80103	6448-01	Kawaihae	State Dowrm	ROT		1341	1465	UNU	1990	90	1	2500		6-1-001:003			
80103	6250-02	Kawaihae	HELCO		4	49	180	SLD	1974	98				6-1-006:003			
80103	6147-01	Kawaihae 3	State Dowald	ROT	8	982	1046	UNU	1963	73	4.6	229					
80103	6250-01	Kawaihae TH	HELCO	ROT	1	78	500	SLD	1974	98							
80103	6549-03	Kawaihae-DHHL	State DHHL	ROT	18	1651	1700	UNU	1992	92	6.3			6-1-001:003			
80103	6451-02	Kawamata 1	Kawamata N	PER	6	238	245	IRR	1987	87	2.6	1235	1245	5-9-005:015	40		
80103	6451-03	Kawamata 2	Kawamata N	PER	6	395	405	IRR	1987	87	6.7	700	700	5-9-006:008	45		
80103	6340-01	Kohakohau TH 1	State Dowald	ROT	3	3910	100	OTH	1964	73							
80103	6340-02	Kohakohau TH 2	State Dowald	ROT	3	3850	100	OTH	1964	73							
80103	6340-03	Kohakohau TH 3	State Dowald	ROT	3	3770	100		1964								
80103	6341-02	Kohakohau TH 4	State Dowald	ROT	3	3790	100	OTH	1964	73							
80103	6341-03	Kohakohau TH 5	State Dowald	ROT	3	3850	100	OTH	1964	73							
80103	6450-01	Kohala Estates	Place V A	PER	4	395	412	UNU	1980	80		1320		5-9-006:009			
80103	6549-01	Kohala Ranch 1	Kohala J V	ROT	12	1460	1550	MUN	1979	86	7.25	25	65		325	0.32	0.43
80103	6549-02	Kohala Ranch 2	Kohala J V	ROT	12	1449	1560	MUN	1982	86			70	5-9-001:010	700	0.36	0.41
80103	6649-01	Kohala Ranch 3	Kohala J V	ROT	18	1840	1925	UNU	1989		136			5-9-010:044			
80103	6649-02	Kohala Ranch 4	Kohala J V	ROT	18	1746	1830	UNU	1993		17.7			5-9-013:085			
80103	6340-04	Kohala TH 2	State Land	ROT	6		105	LOS	1987								
80103	7352-01	Kukuipahu A	Kukuipahu Ranch	ROT	6	800	830	UNU	2003	03	2.95	275		5-6-001:019	0		
80103	6148-03	M Kea Bch	M Kea Bch Htl					OTH									
80103	7154-01	Mahukona	Hawaii R R Co	PER		25	800	OTH	1881	46							
80103	7352-02	Miller 1	Miller L	ROT	8	475	493	DOM	2004	05	2.57	340		5-6-001:111	150		
80103	6953-02	Paoo-Gordy	Gordy D	PER	6	148	155	UNU	2001	01	1.53			5-7-001:020	0		
80103	6953-01	Paoo-Reardon	Reardon M	PER	6	37	40	IRR	1986	86	0.1	5600		5-7-001:005	25		
80103	6239-02	Parker Ranch 1	R Smart Trust	ROT	14	2822	1679	UNU	1994	94	1264	7		6-4-001:050			
80103	6341-01	Waiaka Gulch TH	State Dowald	ROT	3	3613	924	OTH	1964	73							
80103	6141-01	Waiakaa Tank	U S G S	ROT	4	2506	1507	OBS	1999	99	1243			6-6-001:070			
80103	6451-01	Waiakailio TH	Kahua Ranch	ROT	2	60	90	UNU	1963	72							
80103	6450-04	Waika-Fischer	Fischer P & S	PER	6	653	670	IRR	1996	96	2	230		5-9-008:019	16		
80103	6450-05	Waika-Keanaholu	Place Virgil A	PER	8	370	383	IRR	1996	96	2.81	960		5-9-005:005	48		
80103	6238-01	Waimea	U S Government	PER	8	2855	890	UNU	1944	44							
80103	6240-02	Waimea Exploratory	State Dlnr	ROT	16	2969	2000	UNU	2000	00	1263	6		6-5-001:003			
80103	6240-01	Waimea Obs.	U S G S	ROT	4	2970	2016	OBS	1991	91				6-5-001:003			
80103	6450-02	Walsh Lot 39	Walsh B T	PER	12	801	835	IRR	1984					5-9-007:004	80		
Total - Mahukona Aquifer System [80103]																**0.68**	**0.84**
HONOKAA AQUIFER SYSTEM [80201]																	
80201	6331-01	Ahualoa Plant	U S G S	ROT	12		1725	SLD	2004	04				4-6-011:038	0		
80201	6528-02	Enserch 1	Hamakua Energy	ROT	14	450	486	IND	1998	00	3.46	145		4-5-002:023	700	0.42	0.78
80201	6528-03	Enserch 2	Hamakua Energy	ROT	12	451	491	IND	2000	01	2.71	85		4-5-020:056	700	0.48	0.90

Aquifer System	Well No.	Well Name	Owner User	Type	Casing Dia. in.	Ground Elev. ft.	Well Depth ft.	Use Cat.	Yr. Drill.	Use Yr.	Init. Head ft.	Init. Chl. ppm	Max. Chl. ppm	TMK	Pump Capacity gpm	Average Pumpage mgd	High Avg. Pumpage mgd
80201	6528-01	Haina	Hawaii Dws	ROT	12	855	909	MUN	1979	83	4.51	57		4-5-002:048	400	0.37	0.41
80201	6428-01	Honokaa A	State Dowald		14		1452	OBS	1993	96	12			4-5-019:020	0		
80201	6428-02	Honokaa B	State Land Division	ROT	14	1335	1800	UNU	2003	03	42	100		4-5-019:020	0	0.00	0.00
80201	6734-03	Kukuihaele	Hawaii Dws	ROT	12	955	1005	MUN	2002	02	5.78	450		4-8-008:026	0	0.00	0.00
80201	6235-01	Waimea C C	Otaka Inc	ROT	14	2814	1415	IRR	1991	92	1657			4-7-007:007	500	0.03	0.05
Total - Honokaa Aquifer System [80201]																**1.30**	**2.14**
PAAUILO AQUIFER SYSTEM [80202]																	
80202	6424-01	Hamakua 2	Hamakua Sugar					UNU						4-4-002:004			
80202	5917-01	Humuula Tunnel	Laupahoehoe Su	TUN		1600		UNU									
80202	6016-01	Island Dairy	Island Dairy Inc	ROT	8	538	600	UNU	2001	01	10.07	60		3-9-001:002	0		
80202	5816-02	Kaawalii Gu Tun1	Laupahoehoe Su	TUN		2010		UNU									
80202	5816-03	Kaawalii Gu Tun2	Laupahoehoe Su	TUN		2000		UNU									
80202	5816-01	Kaawalii Tunnel	Laupahoehoe Su	TUN		2000		UNU		46							
80202	6121-02	Kainehe Str Tun	Laupahoehoe Su	TUN		1200		UNU									
80202	6122-01	Kanui Gulch Tun	Laupahoehoe Su	TUN		1350		UNU									
80202	6017-01	Kaula Gulch Tun1	Laupahoehoe Su	TUN		1200		UNU									
80202	6017-02	Kaula Gulch Tun2	Laupahoehoe Su	TUN		1200		UNU									
80202	6017-03	Kaula Gulch Tun3	Laupahoehoe Su	TUN		1200		UNU									
80202	6017-04	Kaula Gulch Tun4	Laupahoehoe Su	TUN		640		UNU									
80202	6121-01	Kawaiili Str Tun	Laupahoehoe Su	TUN		1500		UNU									
80202	6220-01	Kukaiau	Laupahoehoe Su		12	245	265	UNU									
80202	6222-01	Manienie Gu Tun	Laupahoehoe Su	TUN		700		UNU					832				
80202	6017-05	Ookala	Hawaii Dws	ROT	12	641	700	MUN	1995	96	7.67	10		3-9-001:034	250	0.03	0.06
80202	6117-01	Ookala Shaft	Laupahoehoe Su	SHF		300	600	IND	1937	72	6	10	279		2500		
80202	6322-01	Paauilo	Laupahoehoe Su	PER	12	175		UNU	1894	46							
80202	6122-02	Paauilo Gu Tun	Laupahoehoe Su	TUN		1540		UNU									
80202	6122-03	Paauilo Gu Tun	Laupahoehoe Su	TUN		1580		UNU									
80202	6321-01	Paauilo Mill	Laupahoehoe Su	PER	12	215	217	UNU	1894								
80202	6321-02	Paauilo Shaft	Laupahoehoe Su	SHF		273	626	IRR	1944	02	3	60	320	4-3-001:002	700		
80202	6222-02	Paauilo Str Tun	Laupahoehoe Su	TUN		1060		UNU									
80202	6222-03	Paauilo Str Tun	Laupahoehoe Su	TUN		700		UNU									
80202	6223-01	Paauilo-DWS	Hawaii Dws	ROT	12	1054	1148	MUN	1985	94	11.6			4-3-007:006	300	0.09	0.15
80202	6119-01	Puumaile Str Tun	Laupahoehoe Su	TUN		800		UNU									
80202	6120-01	Puumaile Str Tun	Laupahoehoe Su	TUN		1075		UNU									
80202	6120-02	Puumaile Str Tun	Laupahoehoe Su	TUN		1075		UNU									
80202	6120-03	Puumaile Str Tun	Laupahoehoe Su	TUN		850		UNU									
80202	6323-01	Slaughter House	Hamakua Sugar	PER	14	509	575	IND	1987					4-3-005:002	950		
Total - Paauilo Aquifer System [80202]																**0.12**	**0.21**
HAKALAU AQUIFER SYSTEM [80203]																	
80203	5206-02	Buyers	Buyers J W A	ROT	5	89	105	DOM	1997	03	39.38	16		2-8-015:001	15		
80203	5005-03	Cooling 1	Hilo Cst Proc	PER	26	77	381	IND	1971	72	8	110	9000	2-8-007:001	5200		
80203	5005-04	Cooling 2	Hilo Cst Proc	PER	26	74	375	IND	1972	72	6.83	372	9000	2-8-007:001	5200		

Aquifer System	Well No.	Well Name	Owner User	Type	Casing Dia. in.	Ground Elev. ft.	Well Depth ft.	Use Cat.	Yr. Drill.	Use Yr.	Init. Head ft.	Init. Chl. ppm	Max. Chl. ppm	TMK	Pump Capacity gpm	Average Pumpage mgd	High Avg. Pumpage mgd
80203	5005-05	Cooling 3	Hilo Cst Proc	PER	26	76	380	IND	1972	72	6.8	285	9000	2-8-007:001	5200		
80203	5307-01	Hakalau School	Hawaii Dws	PER	10	235	317	MUN	1976		11.9	10		2-9-002:005	50	0.00	0.00
80203		Honomu	Hawaii Dws					UNU	2005	05				2-8-013:055			
80203	5716-01	Kapili Str Tun	Laupahoehoe Su	TUN		2075		UNU		46							
80203	5206-03	Kiko 1	Parisi C	PER	6		110	UNU	2004	04				2-8-013:010	0	0.00	0.00
80203	5814-01	Laupahoehoe 1	Hawaii Dws	ROT	10	659	700	MUN	1968	72	5.93	115	128	3-6-003:035	100	0.01	0.11
80203	5814-02	Laupahoehoe 2	Hawaii DWS	ROT	12	665	711	MUN	1979	83				3-6-003:036	300	0.11	0.15
80203	5005-02	Makai Dom	Hilo Cst Proc	PER	18	247	309	DOM	1947	72	11.03	18	22	2-8-007:001	250		
80203	5005-01	Mauka Dom	Hilo Cst Proc	PER	13	304	333	DOM	1946		11.43	16		2-8-007:001	500		
80203	5307-02	Wailea-Hamakua C	Santos R J	ROT	4	101	130		1981		80			2-9-003:001			
80203	5307-03	Wailea-Mccully	Mccully J W	ROT	5	163	182	IRR	1994	94	72.5			2-9-003:013	25		
Total - Hakalau Aquifer System [80203]																**0.12**	**0.26**
ONOMEA AQUIFER SYSTEM [80204]																	
80204	4606-01	Honolii Str Tun	M Kea Sugar Co	TUN		575											
80204	4708-03	Kaieie Mauka	Hawaii Dws	ROT	14	1130	1300	UNU	2002	02	27	3	120	2-7-002:003		0.00	0.00
80204	4708-02	Kaieie Mauka	U S G S	ROT	4	1134	1030	OBS	1999	99				2-7-002:003			
80204	4708-01	Kapue Stream Tun	Mauna Kea Agri	TUN		1275		UNU									
80204	4906-01	Kawainui Str Tun	Mauna Kea Agri	TUN		600		OTH		89				2-7-007:001			
80204	4806-01	Kim 1	Kim Y S	ROT	6	402	420	UNU	2001	01	19.8	20		2-7-009:017	0		
80204	5006-01	Kulaimano	Hawaii Dws	PER	12	378	492	MUN	1976		12.29	7		2-8-007:076	300	0.18	0.21
80204	4905-02	Lutkenhouse	Lutkenhouse D	PER	5	152	162	IRR	1993	93	26.2	20		2-7-010:001	20		
80204	4805-01	Onomea 1	Rogers H	ROT	6	319	350	DOM	1998	98	21.4	15		2-7-010:003	16		
80204	4905-01	Onomea-Doty	Doty J	PER	8	256	308	DOM	1990		10			2-7-010:027	100		
80204	4607-01	Pahoehoe Str Tun	Mauna Kea Agri	TUN		900		UNU									
80204	4706-01	Papaikou	Hawaii Dws	PER	12	369	425	MUN	1972		21	4	15	2-7-037:044	375	0.20	0.23
Total - Onomea Aquifer System [80204]																**0.38**	**0.44**
WAIMEA AQUIFER SYSTEM [80301]																	
80301	6049-06	Arlin Trust	Arlin Trust	PER	8	92	111	IRR	1996	02	2.32	830		6-2-002:024	40	0.01	0.02
80301	5949-01	Camp Drewes	U S MC	DUG		90		UNU	1944				560				
80301	6047-04	Hapuna 3	Mauna Kea Properties	ROT	12	720	765	IRR	2003	04	4.94	200		6-2-001:051	450		
80301	5948-01	Hapuna Bch Park	State Parks	ROT	10	244	268	IRR	1970	73	2.6		430				
80301	6049-07	Hoffee	Hoffee J	ROT	8	54	157	OTH	2000	00				6-2-014:001	450		
80301	6148-01	Kawaihae 1	Hawaii Dws	PER	10	583	601	MUN	1961	74	4.4	302	385	6-2-001:061	150		
80301	6048-01	Kawaihae 2	Mauna Kea Prop	PER	10	392	430	UNU	1961	73	3.3	504		6-2-013:014			
80301	6148-02	Kawaihae 4	Hawaii Dws	ROT	10	583	601	MUN	1969	72	4.4	330	460	6-2-001:061	450		
80301	5946-01	Lalamilo A	Hawaii Dws	ROT	12	1172	1277	MUN	1977		8.2	78		6-6-001:068	700	0.04	0.21
80301	5946-02	Lalamilo B	Hawaii Dws	ROT	16	1088	1164	MUN	1980	81	6.6	32		6-6-001:066	1000	0.69	1.25
80301	5946-03	Lalamilo C	Hawaii Dws	ROT	16	1087	1158	MUN	1980	81	7.6	55		6-6-001:067	1000	0.49	0.78
80301	5946-04	Lalamilo D	Hawaii DWS	PER	16	1085	1144	MUN	1985	89	7	60		6-6-001:069	1000	0.00	0.00
80301	6049-04	M Kea Bch	M Kea Bch Htl	PER	18	82	93	OTH	1971	72							
80301	6048-02	M Kea Bch Htl 1	Mauna Kea Prop	ROT	10	340	376	IRR	1963	72	4.5		750				
80301	6049-01	M Kea Bch Htl 2	Mauna Kea Prop	PER	12	188	218	IRR	1963	72	2		700	6-2-001:056			

Aquifer System	Well No.	Well Name	Owner User	Type	Casing Dia. in.	Ground Elev. ft.	Well Depth ft.	Use Cat.	Yr. Drill.	Use Yr.	Init. Head ft.	Init. Chl. ppm	Max. Chl. ppm	TMK	Pump Capacity gpm	Average Pumpage mgd	High Avg. Pumpage mgd
80301	6049-02	M Kea Bch Htl 3	M Kea Bch Htl	PER	14	40	76	IND	1960	72			2800				
80301	6049-03	M Kea Bch Htl 4	M Kea Bch Htl	ROT				IND	1972	72			5250				
80301	5849-02	Mauna Lani 8	Mauna Lani Resort	ROT	12	147	165	IRR	1999	02	2.85			6-8-001:052	550		
80301	5849-03	Mauna Lani 9	Mauna Lani Resort	ROT	12	143	161	IRR	1999	02				6-8-001:052	450		
80301	5749-01	North	Mauna Lani Res	ROT	12	93	100	IRR	1991	92	2	600		6-8-001:052	450	0.62	1.49
80301	6046-01	Ouli 1	Nansay Haw Inc	ROT	14	1302	1400	UNU	1989	89	13.6			6-2-001:75			
80301	6049-05	Ouli A	Mauna Kea Prop	PER	14	300	340	UNU	1979		3.2			6-2-001:019			
80301	6048-03	Ouli B	Mauna Kea Prop	PER	14	315	347	UNU	1980		2.9			6-2-001:078			
80301	6047-01	Ouli C	Mauna Kea Prop	ROT	12	724	764	IRR	1990	93	4.6			6-2-001:051	450		
80301	6047-02	Ouli D	Mauna Kea Prop	ROT	12	706	758	IRR	1991	92	4.3			6-2-001:051	450		
80301	5745-02	Parker 4	Waikoloa Water	ROT	12	1203	1231	MUN	1969	73	16	30	30	6-8-002:019	800	0.50	0.74
80301	5745-01	Parker 5	Waikoloa Water	ROT	12	1207	1242	MUN	1969	73	16	30	30	6-8-002:019	800	0.77	1.22
80301	4534-01	Pohakuloa TH	State Dowald	ROT	3	6000	350	UNU	1969	72							
80301	5849-01	Puako 3	Parker Ranch	DUG	66	27		IRR		64							
80301	5239-01	Waikii 1	Waikii Ranch	ROT	13	4260	4350	MUN	1983	87	1509	18		6-7-001:003	100	0.03	0.05
80301	5239-02	Waikii 2	Waikii Ranch	ROT	6	4260	3300	MUN	1988	88	1280			6-7-001:003	100	0.01	0.04
80301	5745-03	Waikoloa 1	Waikoloa Water	PER	16	1196	1330	MUN	1988	89	17	30	30	6-8-002:019	1400	0.86	2.07
80301	5546-01	Waikoloa 2	Waikoloa Water	ROT	16	1193	1317	MUN	1989	91	8	70		6-8-002:017	1000	0.99	1.21
80301	5546-02	Waikoloa 3	Waikoloa Water	ROT	16	1217	1285	MUN	1991	97	7.23	25		6-8-002:017	1000	1.38	1.65
80301	5545-01	Waikoloa DW-6	West Hawaii Water Co.	ROT	16	1319	1390	UNU	2004	04	6.8	85		6-8-002:017	0		
80301	5846-01	Waikoloa MLR 1	Mauna Lani Res	ROT	20	1147	1242	MUN	1992	99				6-8-001:046	1000	1.71	1.69
80301	5846-02	Waikoloa MLR 2	Mauna Lani Res	ROT	20	1178	1275	MUN	1993	98	6.3			6-8-001:045	1000	1.52	1.69
Total - Waimea Aquifer System [80301]																**9.62**	**14.11**
HILO AQUIFER SYSTEM [80401]																	
80401	4203-13	Glover Quarry A	Jas Glover Ltd	DUG	72	23	25	IND	1948	84			13		600		
80401	4203-14	Glover Quarry B	Jas Glover Ltd	DUG	72	23	25	IND	1948	84			13		350		
80401	4203-12	Helco Kan 6-4	HELCO	ROT	30	49	210	IND	1974	74	6			2-2-058:019	6250		
80401	4203-05	Hill Unit 5A	HELCO		29	50	200	IND	1965	72			28	2-2-058:019	4500	14.90	19.45
80401	4203-06	Hill Unit 5B	HELCO		29	50	200	IND	1965	72	6.5		24	2-2-058:019	4500		
80401	4203-07	Hill Unit 5C	HELCO		29	50	585	IND	1965	72				2-2-058:019	4500		
80401	4203-09	Hill Unit 6A	HELCO	ROT	32	55	210	IND	1974	74	6			2-2-058:019	6250		
80401	4203-10	Hill Unit 6B	HELCO	ROT	32	55	210	IND	1973	74	6			2-2-058:019	6250	21.78	27.00
80401	4203-11	Hill Unit 6C	HELCO	DUG	72	43	20	OTH	1974		6			2-2-058:019			
80401	4202-01	Hilo Airport 1	HIARNG	PER	16	59	76	UNU	1944	50	4		186	2-1-012:029			
80401	4202-02	Hilo Airport 2	HIARNG	PER		71	55	UNU	1944	50	5			2-1-012:131			
80401	4203-08	Kanoelehua Disp	HELCO	DUG	192	39	33	OTH	1965	72							
80401	4010-01	Kaumana	U S G S	ROT	4	1796	1397	OBS	1995	95	996.8			2-5-002:024			
80401	4211-01	Olaa Flume Tun	Hawaii Dws	TUN		1960		MUN		73	1960			2-5-001:013	3000		
80401	4306-01	Piihonua A	Hawaii Dws	PER	18	278	423	MUN	1973		42.1	2		2-3-026:009	2100	1.34	2.17
80401	4306-02	Piihonua B	Hawaii Dws	PER	18	278	445	MUN	1987		42.3	2		2-3-026:009	2100	2.01	2.93
80401	4208-01	Piihonua C	Hawaii Dws	PER	20	975	1032	MUN	1995	98	263.9	2		2-5-009:003	2100	1.21	1.42
80401	4206-01	Ponohawai 3	Isf Develop Co	PER	12	380	465	UNU	1993	93	243			2-3-044:009			
80401	4110-01	Saddle Road A	Hawaii Dws	ROT	20	1910	1400	MUN	1998	02	950.6	2		2-5-041:047	700	0.39	0.44

Aquifer System	Well No.	Well Name	Owner User	Type	Casing Dia. in.	Ground Elev. ft.	Well Depth ft.	Use Cat.	Yr. Drill.	Use Yr.	Init. Head ft.	Init. Chl. ppm	Max. Chl. ppm	TMK	Pump Capacity gpm	Average Pumpage mgd	High Avg. Pumpage mgd
80401	4304-01	Shipman 1A, 1B	HELCO		54	12	20	IND	1943	72				2-1-001:024	saltwater		
80401	4304-02	Shipman 2	HELCO	DUG	84	10	26	UNU	1957	83				2-1-001:024			
80401	4304-03	Shipman 3	HELCO	DUG		10	20	IND	1971	72				2-1-001:024	saltwater	0.56	3.53
80401	4304-04	Shipman 4A, 4B	HELCO	DUG		10	20	IND	1970	72				2-1-001:024	saltwater		
80401	4203-15	Waiakea	Hawaiian Host	PER	8	81	130	IND	1987		8.75	21					
80401	4203-04	Waiakea 4	HELCO	PER	16	47	201	SLD	1961	72	7.06	22					
80401	4007-01	Waiakea Monitor	Okahara & Assc	ROT	7	915	955	OBS	1991	91	257.6			2-4-006:034			
80401	4203-01	Waiakea TH 1	HELCO		5	40	54	UNU	1960		6.7	4					
80401	4203-02	Waiakea TH 2	HELCO		5	41	55	UNU	1960		9.1	6					
80401	4203-03	Waiakea TH 3	HELCO		5	41	56	OTH	1960		5.8	4					
80401	4204-01	Waiakea Village	Hawn Rsrt Vill	PER	14		35	IND	1971	73					700		
Total - Hilo Aquifer System [80401]																**42.19**	**56.94**
KEEAU AQUIFER SYSTEM [80402]																	
80402	3802-06	Hawaiian Natural	Hawaii Brewery Dev Co.	ROT	10	226	251	DOM	1981	98	14			1-6-141:001	230		
80402	3800-01	Keaau	W H Shipman	PER	10	40	60	SLD	1950	72							
80402	3802-01	Keaau 1	Hawaii Dws		12	215	450	MUN	1921	72			9	1-6-003:055	1020	0.01	0.07
80402	3802-02	Keaau 2	Hawaii Dws		12	215	450	MUN	1921	72			5	1-6-003:055	1000	0.13	0.23
80402	3900-01	Keaau Orchard 1	Mauna Loa Mac	PER	8	92	137	MUN	1949	67	8.5	31	136		350		
80402	3900-02	Keaau Orchard 2	Mauna Loa Mac	PER	12	95	129	MUN	1964		8.1	207	248		500		
80402	3801-01	Keaau Recharge	Puna Sugar	DUG	120		70	OTH		72							
80402	3804-01	Keaau-Shipman	W H Shipman	PER	12	552	698	OTH	1987	87	32.8			1-6-003:007	100		
80402	4189-01	Kings Landing 1	Paradise Park		10	36	58	UNU	1959	72	3.4			1-6-001:025			
80402	4100-01	Kings Landing 2	Watumull Inv	PER	10	46	54	UNU	1971	89	6	280	380	1-6-001:025			
80402	4002-01	Kings Landing 3	Watumull Inv	PER	12	120	133	UNU	1972	72	9.7	16		1-6-001:002			
80402	3810-01	Middle Flume Tun	Puna Sugar	TUN		2100		IND	1900	42							
80402	3810-02	Middle Flume Tun	Puna Sugar	TUN		2050		IND	1900	42							
80402	3810-04	Middle Flume Tun	Puna Sugar	TUN		2150		UNU	1900								
80402	3810-03	Middle Flume Tun	Puna Sugar	TUN		2150			1900								
80402	3505-01	Mt View TH 1		ROT		1125	158	UNU	1936								
80402	3504-01	Mt View TH 10		ROT		815	150	UNU	1936								
80402	3308-01	Mt View TH 4		ROT		1905	117	UNU	1936								
80402	3508-01	Mt View TH 5		ROT		1940	155	UNU	1936								
80402	3406-01	Mt View TH 6		ROT		1445	160	UNU	1936								
80402	3306-01	Mt View TH 7		ROT		1530	106	UNU	1936								
80402	3603-01	Olaa 3	Hawaii Dws	PER	16	602	664	MUN	1988		0			1-6-003:087	1275	0.87	1.05
80402	3702-01	Olaa Shaft	Puna Sugar	SHF	120	220	203	IND	1936	66	14.5			1-6-003:005	2800		
80402	4003-01	Panaewa 1	Hawaii Dws	PER	16	206	306	MUN	1963	72	13.12		8	2-2-048:006	1700	2.10	2.43
80402	4003-02	Panaewa 2	Hawaii Dws	PER	18	201	302	MUN	1968	72	13.1			2-2-048:006	2200	2.14	2.56
80402	4003-03	Panaewa Deep 3	Hawaii Dws	PER	18	206	303	MUN	1983	85	12.2			2-2-048:006	2100	1.18	2.48
80402	3802-03	Puna Plnt Pump 1	HELCO	ROT	16	214	379	IND	1969	69	28	8		1-6-003:005	2800	8.28	11.00
80402	3802-04	Puna Plnt Pump 2	HELCO	ROT	16	214	371	IND	1969	69	19.7	8	6	1-6-003:005	2800		
80402	3802-05	Puna Plnt Pump 3	HELCO	ROT	16	214	375	IND	1969	69		8		1-6-003:005	2800		
80402	4003-04	Toyama Gardens	Toyama Gardens	PER	10	195	235	IRR	1988	89	8	14		2-2-048:013			

Aquifer System	Well No.	Well Name	Owner User	Type	Casing Dia. in.	Ground Elev. ft.	Well Depth ft.	Use Cat.	Yr. Drill.	Use Yr.	Init. Head ft.	Init. Chl. ppm	Max. Chl. ppm	TMK	Pump Capacity gpm	Average Pumpage mgd	High Avg. Pumpage mgd
80402	3809-01	Waiakea-Uka Tun	Hawaii Dws	TUN		1550		MUN	1890	72				2-4-008:			
80402	3809-02	Waiakea-Uka Tun	Hawaii Dws	TUN		1560		MUN	1890	72				2-4-008:			
Total - Keeau Aquifer System [80402]																**14.71**	**19.82**
OLAA AQUIFER SYSTEM [80501]																	
80501	3010-01	Flagg 1	Flagg C E	ROT	14	2654	1537	UNU	1997	97	1491	4		1-8-011:063			
80501	3117-01	Kulani Prison	State Of Haw	PER	8	5080	80	UNU	1947	66	5000						
80501	3207-01	Mt View TH 2		ROT		1810	58	UNU	1936								
80501	3207-02	Mt View TH 3		ROT		1835	160	UNU	1936								
80501	3207-03	Mt View TH 9		ROT		1685	139	UNU	1936								
80501	3207-04	Olaa-Mt. View	U S G S	ROT	4	1687	1143	OBS	1995	95	1008			1-8-005:018			
80501	2714-03	Volcano A	State Dowald	PER		3802	245	SLD	1976	76	3577						
80501	2815-02	Volcano B	State Dowald	PER	8	3865	365	SLD	1977	77	3532						
80501	2715-02	Volcano TH 3	State Dowald	ROT	1	3838	350	OBS		73	3495						
80501	2815-01	Volcano TH-1	State Dowald				375		1973					1-9-001:009			
80501	2715-01	Volcano TH2	State Dowald	ROT	3	3910	400	SLD	1973	73							
80501	2714-01	Volcano TH-4	State Dowald	ROT	3	3802	328	OBS	1973	73	3620						
80501	2714-02	Volcano TH5	State Dowald		3	3802	500	OBS	1976	76	3577						
Total - Olaa Aquifer System [80501]																**0.00**	**0.00**
KAPAPALA AQUIFER SYSTEM [80502]																	
No inventory in this system																	
NAALEHU AQUIFER SYSTEM [80503]																	
80503	1331-01	Alili Tunnel	Hawaii Dws	TUN		2900		MUN	1930	74				9-7-001:018	310		
80503	1530-01	Double Arch Tunn	Kau Agri Co	TUN		3700		IRR									
80503	1630-04	Fault Tunnel	Kau Agri Co	TUN		3500		IRR									
80503	1333-03	Fukuda Tunnel	Kau Agri Co	TUN		3000		IRR									
80503	1229-03	H Brothers	Hester E	PER			1170	UNU	2004	04					0		
80503	0537-01	Haao Tunnel	Kau Agri Co	TUN		2300		IRR						9-7-001:001			
80503	1630-03	Heio Tunnel	Kau Agri Co	TUN		3600		IRR									
80503	0533-02	Honuapo 1	Kau Agri Co	PER	14	94	130	IRR	1965		2	156	580		1150		
80503	0632-01	Honuapo 2	Kau Agri Co	PER	14	103	140	UNU	1965	74	2.9	624					
80503	0533-03	Honuapo 3	Kau Agri Co	PER	14	89	125	IRR	1965		3.2				1150		
80503	0533-01	Honuapo Mill	Kau Agri Co	ROT	3	22	34	UNU	1946	74			1220				
80503	1730-03	Horita Tunnel	Kau Agri Co	TUN		4150		IRR									
80503	1529-01	Ipuu Ridge Tun	Kau Agri Co	TUN		2600		IRR									
80503	1530-04	Kaalaala Gu Tunn	Kau Agri Co	TUN		3250		IRR									
80503	0536-01	Kahilipali Tun	Kau Agri Co	TUN		2250		IND	1922								
80503	0436-01	Kapuna Tunnel	Kau Agri Co	TUN		1900		IRR									
80503	1232-01	Kaumaikeohu Tun	Kawaihae Ranch	TUN		2750		IND	1929								
80503	1332-01	Kaumaikeohu Tun	Kau Agri Co	TUN		2900		IRR	1929								
80503	1729-01	Makakupu Tun 1	Kau Agri Co	TUN		3600		IRR						9-7-001:001			
80503	1729-02	Makakupu Tun 2	Kau Agri Co	TUN		3700		IRR	1929					9-7-001:001			

Aquifer System	Well No.	Well Name	Owner User	Type	Casing Dia. in.	Ground Elev. ft.	Well Depth ft.	Use Cat.	Yr. Drill.	Use Yr.	Init. Head ft.	Init. Chl. ppm	Max. Chl. ppm	TMK	Pump Capacity gpm	Average Pumpage mgd	High Avg. Pumpage mgd
80503	0933-01	Makanau Tun 1	Kawaihae Ranch	TUN		1750		IND									
80503	0833-01	Makanau Tun 2	Kau Sugar	TUN		1500								9-5-018:001			
80503	1730-01	Makua Rch Tun	Kau Agri Co	TUN		4300		IRR									
80503	1333-01	Moaula Gluch Tun	Kau Agri Co	TUN		3500		IRR									
80503	1333-02	Moaula Trib Tun	Kau Agri Co	TUN		3100		IRR									
80503	1530-02	Mudflow 3 Tunnel	Kau Agri Co	TUN		3500		IRR									
80503	1630-08	Mudflow Tun 2	Kau Agri Co	TUN		3500		IRR									
80503	1530-03	Mudflow Tunnel	Kau Agri Co	TUN		3400		IRR									
80503	0335-01	Naalehu 1	Hawaii DWS	PER	12	748	896	MUN	1971	71	10	11		9-5-022:007	440	0.04	0.20
80503	0936-01	New Mtnhouse Tun	Hawaii DWS	TUN		3400		MUN	1925	46			15	9-7-001:001	450		
80503	1033-01	Ninole	Kau Agri Co	ROT	1	2000	877	IRR	1969								
80503	0831-02	Ninole A	Kau Agri Co	PER	18	128	172	MUN	1969		5.7	130	183	9-5-019:011	1500		
80503	0831-03	Ninole B	Kau Agri Co	PER	18	128	172	MUN	1971		4.87	147		9-5-019:011			
80503	0831-01	Ninole Gu TH-1	Hawaiiana Inv	ROT	3	123	174	OBS	1968	68	4	114	174	9-5-019:011			
80503	1033-02	Ninole-Wailau 1	Kau Agri Co	ROT	3	1792	859	IRR	1968								
80503	1032-01	Ninole-Wailau 3	Kau Agri Co	ROT	1	1280	941	IRR	1969								
80503	1630-05	Noguchi 1 Tunnel	ML Mac Orchards L.P.	TUN		3400		IRR						9-7-001:001			
80503	1630-10	Noguchi 2 Tunnel	ML Mac Orchards L.P.	TUN		3450	2480	IRR	1930					9-7-001:001			
80503	1630-09	Noguchi Mauka Tu	ML Mac Orchards L.P.	TUN		3600		IRR	1922					9-7-001:001			
80503	0836-01	Old Mtnhouse Tun	Kau Agri Co	TUN		3070		IRR	1928								
80503	1229-01	Pahala	Hawaii Dws	ROT	10	1112	938	MUN	1974	76	383.6	7		9-6-005:048	380	0.03	0.11
80503	1129-01	Pahala 2	Brewer Orchard	PER	18	671	820	IRR	1974	75	14	150					
80503	1229-02	Pahala Deep 2	Hawaii Dws			1112	260	SLD		03				9-6-005:048	0		
80503	1128-01	Pahala Shaft	ML Mac Orchards L.P.	SHF		774	547	IND	1947	72	228						
80503	1630-06	Piikea Gul Tun 1	Kau Agri Co	TUN		4150		IRR									
80503	1630-07	Piikea Gul Tun 2	Kau Agri Co	TUN		3900		IRR									
80503	1136-01	Plant N Spr Tun	Kau Agri Co	TUN		3650		IRR	1928								
80503	0830-01	Punaluu	Hawaiiana Inv		10	22	20	SLD	1972	73		212					
80503	1333-04	Shirakura Tunnel	Kau Agri Co	TUN		3700		IRR	1929								
80503	0436-02	Tanaka Tunnel	Kau Agri Co	TUN		2100		IRR	1923								
80503	1035-01	Vischer Tunnel	Kau Agri Co	TUN		2150		IRR									
80503	0437-01	Waiohinu Expl	U S G S	ROT	4	1299	972	OBS	1994	94	1014			9-5-005:002			
80503	1630-01	Weda 1 Tunnel	Kau Agri Co	TUN		3700		IRR									
80503	1730-02	Weda 2 Tun 1	Kau Agri Co	TUN		3750		IRR									
80503	1630-02	Weda 2 Tunnel	Kau Agri Co	TUN		3600		IRR									
80503	1629-01	Weda 3 Tunnel	Kau Agri Co	TUN		3400		IRR									
Total - Naalehu Aquifer System [80503]																**0.07**	**0.31**
KA LAE AQUIFER SYSTEM [80504]																	
80504	8836-01	Kaalualu TH 1	Kawaihae Ranch	ROT	2	40		IND	1966			700					
80504	8837-01	Kaalualu TH 2	Kawaihae Ranch	ROT	2	40		IND	1966			700					
80504	0240-01	Kau Citrus 1	Bassan M	ROT	10	1690	1690	UNU		00	239.9	6		9-3-004:027			
80504	0139-01	Kau Expl.	State Dowrm	PER	14	1259	1325	UNU	1990	90	7.2			9-3-003:014			
80504	8540-01	South Point	U S Army	ROT	6	51	64	UNU	1941	46		600					

Aquifer System	Well No.	Well Name	Owner User	Type	Casing Dia. in.	Ground Elev. ft.	Well Depth ft.	Use Cat.	Yr. Drill.	Use Yr.	Init. Head ft.	Init. Chl. ppm	Max. Chl. ppm	TMK	Pump Capacity gpm	Average Pumpage mgd	High Avg. Pumpage mgd
80504	0339-01	South Point Tank	U S G S	ROT	4	1944	1946	OBS	1997	97	436.1			9-3-004:024			
Total - Ka Lae Aquifer System [80504]																**0.00**	**0.00**
MANUKA AQUIFER SYSTEM [80601]																	
80601	0247-01	FMT 1	Thibedeau F M			612	612	DOM		92	7.85			9-2-192:042	20		
80601	0246-01	Kahuku	Hawaii Kau Rch	PER	8	1037	1095	UNU		87	9.5	300		9-2-001:072			
80601	0953-01	Okoe	Mac Farms Haw	PER	12	848	880	IRR	1980	84	3.8	700		3-7-012:002	800	0.16	0.51
80601	8741-01	Pali O Kulani TH		ROT	2				1967		2						
Total - Manuka Aquifer System [80601]																**0.16**	**0.51**
KAAPUNA AQUIFER SYSTEM [80602]																	
80602	1953-01	Kaohe 2 S Kona	Magoon Estate	ROT	8	206	226	DOM	1965	65		1530	2300		150		
80602	2354-01	Kealia-O'Shea	O'Shea D	Dug		9	13	DOM	1994	94		2640		8-5-005:009	200		
80602	1154-01	Milolii-Hceoc	Hceoc	DUG	60		5	SLD		96							
80602	1652-01	Opihihale	Kona Horizons, Ltd	ROT	12	1201	1222	IRR	1993	99	2.6	110		8-7-014:006	65	0.01	0.02
Total - Kaapuna Aquifer System [80602]																**0.01**	**0.02**
KEALAKEKUA AQUIFER SYSTEM [80603]																	
80603	3155-02	Halekii-DWS	Hawaii Dws	ROT	20	1747	1747	MUN	1993	97	484.5			8-1-001:028	1400	0.80	0.93
80603	3155-03	Hoku 1	1250 Oceanside	ROT	14	1155	1196	IRR	2002	03	51.18	15		8-1-004:056	780	0.42	0.58
80603	3056-01	Hokukano Irr 1	Oceanside 1250	ROT	14	811	849	IRR	1993	02	4	300		7-9-012:003	600	0.11	0.21
80603	3156-01	Hokukano Irr 2	1250 Oceanside	ROT	14	751	791	IRR	2000	02	1.29	900	1040	8-1-004:003	600	0.01	0.12
80603	3157-01	Hokukano Mon 1	Hokulia	PER	2		46	OBS	2000	00				8-1-004:003	0		
80603	3057-01	Hokukano Mon 2	Hokulia	PER	2		106	OBS	2000	00				8-1-004:003	0		
80603	3153-01	Hokukano Ranch	Hokukano Ranch Inc.	PER	16	2530	1350	DOM	1996	96	1300			7-9-001:001	400		
80603	3153-02	Hokukano Ranch 2	Hokukano Ranch Inc.	PER	13	2875	1675	UNU	2004	04	1316			7-9-001:001	0		
80603	2554-01	Honaunau S Kona	Bishop Estate	PER	10		193		1956			1140					
80603	3255-02	Kainaliu Test	State Land	ROT	18	1542	1600	UNU	1993	93	306.5	5		7-9-009:010			
80603	3155-01	Kealakekua Obs.	U S G S	ROT	4	1741	1505	OBS	1991	91				8-1-001:028			
80603	2753-03	Keei 4	Hawaii Dws	ROT	18	1347	1343	MUN	1992		357.7	10		8-3-011:008	1000	0.74	0.86
80603	2753-01	Keei A	Hawaii Dws	PER	12	744	791	MUN	1958	72	2.75	96	210	8-3-008:067	320	0.00	0.01
80603	2753-02	Keei B	Hawaii Dws	PER	12	737	774	MUN	1963	72	2.29	99	344	8-3-008:070	375	0.00	0.02
80603	2653-01	Keei C	Hawaii Dws	PER	12	882	913	MUN	1978	85	4.25	22	78	8-3-008:041	500	0.00	0.03
80603	2755-01	Napoopoo	Thompson W		2	45	40	OTH	1955	74							
80603	2855-01	Napoopoo	Thompson W	DUG	72	20	20	OTH	1939	74							
Total - Kealakekua Aquifer System [80603]																**2.08**	**2.76**
ANAEHOOMALU AQUIFER SYSTEM [80701]																	
80701	5648-03	Aina Lea 1	Bridge Aina Lea LLC	PER	15	597	637	UNU	1992		4.4	750		6-8-001:036			
80701	5751-02	Cogen Salt 1	Fairmont Orchid Hawaii	ROT	18	10	80	OTH	2001	02				6-8-022:008	3500		
80701	5751-04	Cogen Salt 2	Fairmont Orchid Hawaii	PER	18	12	80	IND	2004	04				6-8-022:008	saltwater		
80701	5650-02	Culvert	Mauna Lani Res	ROT	12	124	160	IRR	1991	92		875		6-8-001:052	350	0.25	0.33
80701	5650-01	Entrance	Mauna Lani Res	ROT	8	137	180	IRR	1991	92	2	910		6-8-001:052	250	0.04	0.18
80701	5850-01	Fabyonic # 1	Fabyonic Properties LLC	DUG	6	7	17	UNU	2001	01	2	1500		6-9-002:023	0		

Aquifer System	Well No.	Well Name	Owner User	Type	Casing Dia. in.	Ground Elev. ft.	Well Depth ft.	Use Cat.	Yr. Drill.	Use Yr.	Init. Head ft.	Init. Chl. ppm	Max. Chl. ppm	TMK	Pump Capacity gpm	Average Pumpage mgd	High Avg. Pumpage mgd
80701	5452-02	Fifty-One Ft STP	Waikoloa Util	DUG	72	51	53	IRR	1980	80			900	6-8-001:029	350	0.38	0.41
80701	5750-03	Fire Station	Mauna Lani Res	PER	12	60	70	IRR	1988	88	1.3			6-8-001:052	425	0.44	0.61
80701	5651-01	Highway	Mauna Lani Res	PER	12	121	130	IRR	1988	92	2			6-8-001:052	425	0.48	0.56
80701	4959-04	Hualalai Salt 4	Hualalai Dev	ROT	12	5	40	OTH	1995	96		900		7-2-003:004	1100		
80701	5651-02	Mauna Lani SW 1	Mauna Lani Res	PER	18	45	310	OTH	1991	91	1.8			6-8-001:052	3000		
80701	5651-03	Mauna Lani SW 2	Mauna Lani Res	PER	18	28	188	OTH	1991		1.5			6-8-001:052			
80701	5452-01	Nursery	Waikoloa Util	DUG		40	40	IRR	1980	80			920	6-8-001:032	900	0.43	0.71
80701	5548-01	Parker 1	Waikoloa Water	PER	10	813	865	IRR	1968	72	6.1		600	6-8-002:027	450	0.45	0.61
80701	5648-01	Parker 2 TH	Waikoloa Water	ROT	3	620	651	UNU	1968	72	5.1			6-8-002:027			
80701	5553-01	Parker 6	Waikoloa Util					UNU									
80701	4532-01	Pohakuloa TH	State Dowald	ROT	5	6375	1001	UNU	1965	65							
80701	5750-01	Puako 4	Parker Ranch	TUN		37	36	IRR		64	2.8	590				0.83	1.71
80701	5750-02	Puako 6	Parker Ranch	DUG	66	51	55	UNU		64	3	570					
80701	5347-01	Puu Anahulu	State Land	ROT		1517	1548	UNU		94				7-1-003:001			
80701	5452-03	Resort 1	Waikoloa Util	PER	12	51	62	IRR	1988	88	1		720	6-8-001:005	350	0.34	0.53
80701	5552-01	Resort Irr 2	Waikoloa Util	PER	12	81	91	IRR	1988	90			720	6-8-001:005	700	0.56	0.75
80701	5750-04	Stp	Mauna Lani Res					OTH		90						0.35	0.46
80701	5551-01	Waikoloa Irr 3	Waikoloa Util	PER	12	92	110	IRR	1990	90	2	585		6-8-001:005	500	0.50	0.74
80701	5553-02	Waikoloa Saltwtr	Waikoloa Util	PER	12	30	160	OTH	1990	90	0.2	18000		6-9-007:023	350		
80701	5553-03	Waikoloa SW	Hilton Waikoloa	PER	16	24	170	OTH	1997	98		17280		6-9-007:014	3000		
Total - Anaehoomalu Aquifer System [80701]																**5.05**	**7.60**
PAHOA AQUIFER SYSTEM [80801]																	
80801		Bartlett	Bartlett M					DOM	2005	05				1-5-062:086			
80801	3587-05	Bazin	Bazin B	PER	6		95	DOM	2002	02		38		1-5-028:144	0		
80801	3487-01	Bloemen	Bloemen R H V	PER	6		110	IRR	2004	04				1-5-026:164	30		
80801		Camp	Camp R & T					DOM	2005	05				1-5-054:018			
80801	3787-02	Chesnut	Chesnut J A	ROT	5	78	85	DOM	1997	97	7	70		1-5-053:029	25		
80801		Connie	St. Laurence P					DOM	2005	05				1-5-059:057			
80801	3389-02	Diamond	Diamond R & L	ROT	6	411	426	UNU	2002	02	11.58	20		1-5-017:012	0	0.00	0.00
80801		Fenn	Fenn I J					DOM	2005	05				1-5-055:129			
80801		Gapp	Gapp J					DOM	2005	05				1-5-060:076			
80801	3486-01	Golden	Glattauer Lawrence	PER	6		130	UNU	2004	04				1-5-027:158	0		
80801		Hale O Kai	Taylor B					UNU	2004	04				1-5-057:088			
80801	3588-01	Hawn Paradise 1	Watamull Inv	PER	12	145	168	UNU	1981	89	8.08	40		1-5-047:173			
80801	3185-01	Hawn Shores 1	Hwn Sh Comm		8	402	446	MUN	1964		10.6	18	16		500	0.82	0.88
80801	3185-02	Hawn Shores 2	Hwn Sh Comm	ROT	10	380	430	MUN	1971				28		500	0.13	0.14
80801	3587-03	Hwn Par Pk-Olmst	Olmstead M G	ROT	4		107	DOM	1995	95				1-5-049:078	30		
80801	3081-01	Kapoho Airstrip	Hawaii Dws	PER	8	287	337	UNU	1961	73	3.2	331		1-4-002:045			
80801	3589-01	Keaau-Hay	Hay G & D	ROT	4	195	200	IRR	1995	95		60		1-5-037:005	60		
80801	3687-03	Keaau-May	May J D	ROT	6	57	70	DOM	2000	00	1.54	250		1-5-056:099	20	0.00	0.00
80801	3389-01	Keaau-Pahoa Rd	Hawaii Dws	PER	8	427	475	UNU	1960		19	6	12	1-6-009:321			
80801	2987-01	Keonepoko Iki	Hawaii DWS	ROT	16	711	740	UNU	2000	00	16.46	10		1-5-008:006			
80801	3188-01	Keonepoko Nui 1	Hawaii Dws	PER	14	603	650	MUN	1977	77	15.11	0	7	1-5-008:001	680	0.00	0.00

Aquifer System	Well No.	Well Name	Owner User	Type	Casing Dia. in.	Ground Elev. ft.	Well Depth ft.	Use Cat.	Yr. Drill.	Use Yr.	Init. Head ft.	Init. Chl. ppm	Max. Chl. ppm	TMK	Pump Capacity gpm	Average Pumpage mgd	High Avg. Pumpage mgd
80801	3188-02	Keonepoko Nui 2	State DHHL	ROT	16	604	650	MUN	1997	99	16.77	10		1-5-008:001	730	0.45	0.55
80801		Love	Love D					DOM	2005	05				1-5-052:098			
80801	3487-02	Luawai	St. Laurence P	ROT	6		135	DOM	2005	05				1-5-026:226	0		
80801	3585-01	Makuu I	Intercontl Dev	ROT	8	20	30	OTH	1991	92	4.5	315		1-5-010:033	200		
80801	3585-02	Makuu II	Intercontl Dev	PER	8	10	256	OTH	1992	92				1-5-010:033	200		
80801	3686-01	McDonald	McDonald J	ROT	5		47	IRR	1997	97		325		1-5-056:001	13		
80801	3687-06	Monica 1	O' Sullivan J	ROT	6		41	DOM	2003	04		234		1-5-057:024	0		
80801	3206-01	Mt View TH 8		ROT		1565	150	UNU	1936								
80801		Noni Kai	Fix P					UNU	2004	04				1-5-054:049			
80801	2986-01	Pahoa Battery 2A	Hawaii Dws	PER	8	711	755	MUN	1960	72	17.8		6	1-5-003:040	200	0.03	0.10
80801	2986-02	Pahoa Battery 2B	Hawaii Dws	PER		705	754	MUN	1960	72	17.8		27	1-5-003:040	380	0.07	0.19
80801	3787-01	Pryor	Pryor J	ROT	5	76	85	IRR	1997	97	6.4	70		1-5-053:049	25		
80801	3081-02	Puna Therml TH 4	Haw Therml Pwr	PER	14	250	290	UNU	1961								
80801	3489-01	Rozett	Rozett Nursery	PER	6	275	273	IRR	1999	99	14.29	21		1-5-025:081	50		
80801	3586-03	Shea	Shea R	ROT	6	34	42	DOM	2002	03	3	140		1-5-056:035	15		
80801	3485-02	Silverstein	Silverstein R		6		79	IRR	1995	95				1-5-010:022	10		
80801	3688-03	Travis	Travis J	ROT	6	92	100	UNU	2002	02	4	60		1-5-053:118	0		
80801	3500-01	Wai Pahoehoe	Hawaii Dws	PER	12	311	361	UNU	1961		16.18	6		1-6-004:048			
80801	3688-04	Watson	Watson R	ROT	6	103	108	DOM	2002	03	5.18			1-5-052:073	12		
80801		Webb	Webb C					DOM	2005	05				1-5-052:193			
Total - Pahoa Aquifer System [80801]																**1.50**	**1.86**
KALAPANA AQUIFER SYSTEM [80802]																	
80802	2685-01	Ashida No. Geo	Barnwell Gedco	ROT		802	8300	UNU	1980	87	8	460					
80802	2883-01	Hgp-A Geo	Nat Energy Lab	ROT		600	6455	OTH	1976	87							
80802	3080-01	Kapoho Crater	Hawaii Dws	DUG	66	38	46	UNU	1965	72	3.2	64	190	1-4-091:011			
80802	2983-01	Kapoho PGV MW1	Puna Geo Ventr	ROT	10	610	720	OTH	1990	91	8	20			250		
80802	2983-02	Kapoho PGV MW3	Puna Geo Ventr	ROT	13	610	720	OTH	1991	91	16	18			1250		
80802	2883-03	Kapoho St 1 Geo	Puna Geo Ventr	ROT		619	7290	OTH	1981	87	11.3	1200					
80802	2883-04	Kapoho St 2	Puna Geo Ventr	ROT		718	8605	OTH	1982	87							
80802	2883-06	Kapoho St. 1-A	Puna Geo Ventr	ROT					1985		11	1098					
80802	2487-01	Keauohana 1	Hawaii Dws	PER	8	752	802	MUN	1961	76	2.94	72		1-2-009:039	200	0.02	0.06
80802	2487-02	Keauohana 2	Hawaii Dws	PER	12	753	803	MUN	1970	72	3.1	124	124	1-2-009:039	340	0.03	0.05
80802	2883-02	Lanipuna 1 Geo	Barnwell Geo	ROT		600	8389	OTH	1981	87							
80802	2883-05	Lanipuna 6 Geo	Barnwell Geo	ROT		600	4956	OTH	1984	87							
80802	2783-01	Malama Ki	State Dowald	PER	8	274	319	UNU	1962	73	0.9	5530	6600				
80802	2881-01	Pohoiki Puna	Oneloa Co Inc	ROT	4	132	140	OTH	1973	88	5	722	2300	1-4-002:069			
80802	2102-01	Pulama	State Dowald	PER	8	230	250	UNU	1963	73	3.3	278	270	1-1-001:009			
80802	2883-07	Puna Geo MW2	Puna Geo Ventr	ROT	4	588	640	OBS	1991	91	18.7	370					
80802	2686-01	Puna Therml TH 1	Haw Therml Pwr	PER	14	1009	217	UNU	1961	73							
80802	2686-02	Puna Therml TH 2	Haw Therml Pwr	PER	14	1035	558	UNU	1961	73							
80802	2982-01	Puna Therml TH 3	Haw Therml Pwr	PER	18	563	690	UNU	1961								
80802	2979-02	Vacationland #1	Harms A B	ROT	6	6	13	SLD	2000	01		250		1-4-070:028	0		
80802	2979-03	Vacationland #2	Harms A B	ROT	6	11	19	SLD	2000	01		250		1-4-070:027	0		

Aquifer System	Well No.	Well Name	Owner User	Type	Casing Dia. in.	Ground Elev. ft.	Well Depth ft.	Use Cat.	Yr. Drill.	Use Yr.	Init. Head ft.	Init. Chl. ppm	Max. Chl. ppm	TMK	Pump Capacity gpm	Average Pumpage mgd	High Avg. Pumpage mgd
80802	2979-04	Vacationland #3	Harms A B	ROT	6	12	19	SLD	2000	01		250		1-4-070:015	0		
80802	2979-05	Vacationland #4	Harms A B	ROT	6	12	25	SLD	2000	01		250		1-4-070:028	0		
80802	2979-06	Vacationland 1A	Harms A B	ROT	6	7	12	DOM	2002		0.56			1-4-067:039	12		
80802	2979-07	Vacationland 2A	Harms A B	ROT	6	12	15	DOM	2002	02	1.5			1-4-070:027	12		
80802	2979-08	Vacationland 3A	Harms A B	ROT	6	12	15	DOM	2002	02	0.9			1-4-070:015	12		
80802	2979-09	Vacationland 4A	Harms A B	ROT	6	12	15	DOM	2002	02	1.13			1-4-070:028	12		
Total - Kalapana Aquifer System [80802]																**0.05**	**0.11**
HILINA AQUIFER SYSTEM [80803]																	
80803	2317-01	Haw Vol Nat Pk	Haw Vol Nat Pk	ROT	14	3606	4127	OBS	1973	73	1806						
Total - Hilina Aquifer System [80803]																**0.00**	**0.00**
KEAIWA AQUIFER SYSTEM [80804]																	
80804	1128-02	Palima	ML Mac Orchards L.P.	PER	18	304	375	IRR	1970		8.7	9	12				
80804	0830-02	Punaluu TH-2	Kau Agri Co	ROT	3	56	90	IRR	1968			240	240				
Total - Keaiwa Aquifer System [80804]																**0.00**	**0.00**
KEAUHOU AQUIFER SYSTEM [80901]																	
80901	4461-01	Cooper	Cooper M B		4		185	UNU	1985	90			2300	7-3-049:005			
80901	3957-04	Doutor Coffee #1	Doutor Coffee Co.	ROT	12	1445	1462	IRR	2001	01	43.03	10		3-7-011:023	230		
80901	4463-04	Dust Control	Cyanotech Corp				22	OTH	1987	87							
80901	3657-01	Holualoa	Hawaii Dws	ROT	14	1123	1172	MUN	1983	84	5.64	18		7-6-006:018	500	0.57	0.71
80901	4060-01	Honokohau Quarry	Honokohau Prop	ROT	6	121	137	OTH	1995	95	2	500		7-4-028:026	25		
80901	4158-02	Honokohau-DWS	Hawaii Dws	ROT	20	1681	1735	MUN	1991	98	109.5	8		7-4-006:006	1200	1.60	1.93
80901	4258-03	Hualalai Expl	Hawaii Dws	ROT	18	1683	1822	MUN	1993	98	292.9	5		7-3-006:003	1200	0.96	1.42
80901	4559-01	Huehue Ranch 1	Huehue Ranch	PER	10	1579	1690	MUN	1985	88	7.8	60		7-2-006:009	350	0.20	0.27
80901	4459-01	Huehue Ranch 2	Huehue Ranch	ROT	14	1534	1642	MUN	1991	03	7.3		151	7-2-006:009	570	0.28	0.41
80901	4459-02	Huehue Ranch 4	Huehue Ranch	ROT	14	1533	1625	MUN	1992	92	7	110		7-2-006:009	490	0.00	0.00
80901	3557-01	Kahaluu A	Hawaii Dws	ROT	12	833	878	MUN	1959	74	4.34	40	97	7-8-009:054	700	0.89	1.03
80901	3557-02	Kahaluu B	Hawaii Dws	ROT	12	839	881	MUN	1959	74	3.2	13	230	7-8-009:067	700	0.01	0.03
80901	3557-03	Kahaluu C	Hawaii Dws	ROT	12	834	868	MUN	1969	70	4.66	8	78	7-8-009:077	700	0.56	0.81
80901	3557-04	Kahaluu D	Hawaii Dws	ROT	14	855	905	MUN	1970	74	4	8	112	7-8-009:076	720	0.96	1.09
80901	3457-04	Kahaluu Deep Monitor	State Cwrm	PER	8	308	738	OBS	2000	00	1.86			7-8-010:028	0		
80901	3557-05	Kahaluu Shaft	Hawaii Dws	SHF	156	590	595	MUN	1976	77	4	34	344	7-8-010:054	4200	3.53	4.42
80901	4061-01	Kaho Obs 3	Natl Park Serv	ROT	2	37	52	OBS	1996	96	2.5			7-4-008:010			
80901	4161-01	Kaho Obs. 1	Natl Park Serv	ROT	2	23	34	OBS	1996	96	0.5			7-4-008:010			
80901	4161-02	Kaho Obs. 2	Natl Park Serv	ROT	2	55	69	OBS	1996	96	2.7			7-4-008:010			
80901	3758-01	Kailua Kona	Hawaii Dws	PER	6	595	615	UNU	1944	49	3.32	463	600	7-5-017:011			
80901	3255-01	Kainalu Obs.	U S G S	ROT		1693	1543	OBS	1991	91	420	18		7-9-008:003			
80901	4358-01	Kalaoa A	Hawaii Dws	ROT	14	1799	1850	MUN	1990	91	237.9	10	12	7-3-004:005	300	0.00	0.06
80901	3858-01	Kalaoa Keopu Deep	State Cwrm	ROT	8	736	1310	OBS	2001	01				7-5-010:016	0		
80901	4360-01	Kalaoa N Kona	State Dowald	ROT	10	680	702	UNU	1968	72	3.2	600		7-3-010:033			
80901	4160-01	Kaloko Irr 1	Tokyo Grn Haw	PER	12	565	584	UNU	1985	92	2.5	940		7-3-009:017			
80901	4160-02	Kaloko Irr 2	Tokyo Grn Haw	PER	12	542	561	UNU	1985	92	1.5	955		7-3-009:017			

Aquifer System	Well No.	Well Name	Owner User	Type	Casing Dia. in.	Ground Elev. ft.	Well Depth ft.	Use Cat.	Yr. Drill.	Use Yr.	Init. Head ft.	Init. Chl. ppm	Max. Chl. ppm	TMK	Pump Capacity gpm	Average Pumpage mgd	High Avg. Pumpage mgd
80901	3759-01	Kaneyoshi Irr	Kaneyoshi Co Ltd	ROT	5	37	47	IRR	1999	99	0.8	5000		7-5-020:024	75		
80901	4461-02	Keahole Helco	HELCO	PER	12	208	253	IND	1993	04	1	5900		7-3-010:002	500	0.07	0.14
80901	4462-05	Keahole MW-11	State Dot-Airp	ROT	2	140	172	OBS	1996	96	1.4			7-3-043:003			
80901	4462-06	Keahole MW-13A	State Dot-Airp	ROT	2	55	83	OBS		96	2.4			7-3-043:003			
80901	4462-07	Keahole MW-13B	State Dot-Airp	ROT	2	55	64	OBS		96	2.4			7-3-043:003			
80901	4463-01	Keahole MW-14A	State Dot-Airp	ROT	2	21	50	OBS		96	2.6			7-3-043:003			
80901	4463-02	Keahole MW-14B	State Dot-Airp	ROT	2	21	40	OBS		96	2.6			7-3-043:003			
80901	4463-03	Keahole MW-14C	State Dot-Airp	ROT	2	21	30	OBS	1996	96	2.6			7-3-043:003			
80901	4363-01	Keahole Point 1	Uwajima Fisheries	ROT	4	15	32	OTH	1989	89	1	15000		7-3-043:003	250		
80901	4363-10	Keahole Point 10	Uwajima Fisheries	ROT	4	15	32	OTH	1989	89	1	15000		7-3-043:003	250		
80901	4363-11	Keahole Point 11	Uwajima Fisheries	ROT	4		50	OTH						7-3-043:003			
80901	4363-12	Keahole Point 12	Uwajima Fisheries	ROT	4		50	OTH						7-3-043:003			
80901	4363-02	Keahole Point 2	Uwajima Fisheries	ROT	4	15	32	OTH	1989	89	1	15000		7-3-043:003	250		
80901	4363-03	Keahole Point 3	Uwajima Fisheries	ROT	4	15	32	OTH	1989	89	1	15000		7-3-043:003	250		
80901	4363-04	Keahole Point 4	Uwajima Fisheries	ROT	4	15	32	OTH	1989	90	1	15000		7-3-043:003	250		
80901	4363-05	Keahole Point 5	Uwajima Fisheries	ROT	4	15	32	OTH	1989	90	1	15000		7-3-043:003	250		
80901	4363-06	Keahole Point 6	Uwajima Fisheries	ROT	4	15	32	OTH	1989	90	1	15000		7-3-043:003	250		
80901	4363-07	Keahole Point 7	Uwajima Fisheries	ROT	4	15	32	UNU	1989	89	1	15000		7-3-043:003			
80901	4363-08	Keahole Point 8	Uwajima Fisheries	ROT	4	15	32	OTH	1989	89	1	15000		7-3-043:003	250		
80901	4363-09	Keahole Point 9	Uwajima Fisheries	ROT	4	15	32	OTH	1989	89	1	15000		7-3-043:003	250		
80901	4462-02	Keahole-DOT	State Dot-Airp	PER	8	134	165	OTH	1992	93	1.5	3825					
80901	4057-01	Keahuola QLT 1	Hawaii Dws	ROT	16	1765	1787	MUN	1994	96	187.8	10		7-4-002:006	960	1.09	1.40
80901	3457-01	Keauhou 1	Bishop Estate	PER	10	175	193	IRR	1956	92				7-8-010:002	450	0.09	0.20
80901	3357-01	Keauhou 2	Bishop Estate	ROT	10	385	430	UNU	1966	97						0.00	0.00
80901	3457-02	Keauhou A	Hawaii Dws	PER	16	723	765	UNU	1985	87	2.9			7-8-010:050			
80901	3456-01	Keauhou B	Kam Inv Corp	PER	14	1018	1047	UNU	1989	89	3.5			7-8-010:006			
80901	3457-03	Keauhou Irr 3	Otaka Inc	PER	12	366	387	IRR	1985					7-8-010:077	500	0.14	0.28
80901	3355-01	Keauhou-Kam 2	Kam Inv Corp	Rot	18	1618	1585	UNU	1991	91	278.1	5		7-8-004:015			
80901	3355-02	Keauhou-Kam 3	Kam Inv Corp	ROT	18	1658	1658	UNU	1992	92	386	5		7-8-004:075			
80901	3355-03	Keauhou-Kam 4	Kam Inv Corp	ROT	18	1650	1650	UNU	1994	94	228	6		7-8-002:001			
80901	3357-04	Keauhou-Kona C C	Otaka Inc	PER	12	397	415	IRR	1990	90	2			7-8-010:051	470	0.15	0.27
80901	3957-01	Keopu-Puuhonua	Haseko-Hawaii	ROT	14	1675	1706	UNU	1993	93	47	10		7-5-001:001			
80901	4458-01	Kohanaiki 1	Nansay Hawaii	ROT	14	1799	1952	UNU	1991	91	9.9	35		7-2-005:001			
80901	4458-02	Kohanaiki 2	Nansay Hawaii	ROT	18	1800	1880	UNU	1991	91	10.2	15		7-2-005:001			
80901	3957-02	Komo Monitor	U S G S	ROT	4	1601	1623	OBS	1991	91				7-5-001:055			
80901	3859-01	McCaskill	Mc Caskill J					UNU	1942	89				7-5-018:019	0		
80901	4363-13	Net Washing	Cyanotech Corp	ROT	36		26	OTH	1987	87				7-3-043:042	80		
80901	3657-02	Pahoehoe	Hawaii Dws	PER	16	1146	1180	UNU	1990	92	4.28	400		7-7-006:018			
80901	4059-01	Palani	State Dowald	PER	12	800	853	SLD	1958	72	1.6	2800	4300				
80901	3857-04	Waiaha-DWS	Hawaii DWS	ROT	20	1542	1752	UNU	2000	00	59.56	10		7-5-015:015			
80901	3857-01	Waiaha-DWS	Hawaii Dws	ROT	20		1602	SLD		00				7-5-014:016			
Total - Keauhou Aquifer System [80901]																**11.10**	**14.47**

KIHOLO AQUIFER SYSTEM [80902]

Aquifer System	Well No.	Well Name	Owner User	Type	Casing Dia. in.	Ground Elev. ft.	Well Depth ft.	Use Cat.	Yr. Drill.	Use Yr.	Init. Head ft.	Init. Chl. ppm	Max. Chl. ppm	TMK	Pump Capacity gpm	Average Pumpage mgd	High Avg. Pumpage mgd
80902	4959-05	Beach Pool	Hualalai Dev	PER	6	3	8	OTH	1996	96	0.3			7-2-003:005	150		
80902	4950-01	Big Island C C 1	Big Isle C C	ROT	16	2105	2181	IRR	1992	95	8	43		7-1-005:026	700		
80902	4950-02	Big Island C C 2	Big Isle C C	ROT	16	2130	2208	IRR	1995	96	11.41			7-1-005:041	700		
80902	4959-08	Fitness Center	Hualalai Dev	ROT	6	13	26	OTH	1996	96				7-2-003:005	100		
80902	4859-01	Hualalai Makai	Hualalai Dev	ROT	10	250	270	UNU	1994	94	1.6			7-2-003:006			
80902	4959-01	Hualalai Salt 1	Hualalai Dev	ROT	12	3	40	OTH	1995	96		2400		7-2-003:004	1100		
80902	4959-02	Hualalai Salt 2	Hualalai Dev	ROT	12	3	40	OTH	1995	96		2500		7-2-003:004	1100		
80902	4959-03	Hualalai Salt 3	Hualalai Dev	ROT	12	4	80	OTH	1995	96		2800		7-2-003:004	1100		
80902	4558-01	Huehue Ranch 3	Huehue Ranch	PER	14	1519	1598	MUN	1991	91	7			7-2-004:007	570	0.24	0.52
80902	4558-02	Huehue Ranch 5	Huehue Ranch	ROT	14	1529	1600	MUN	1992	92	22.5	35		7-2-004:014	570	0.01	0.02
80902	4856-01	Kaupulehu	Hualalai Develoment	ROT	12	934	985	IRR	2001	01	5.39	250		7-2-003:003	590	0.60	0.81
80902	4757-01	Kaupulehu Irr 1	Kaupulehu Land Co.	PER	12	848	975	IRR	1991	94	2.8	250		7-2-003:003	350	0.11	0.30
80902	4757-02	Kaupulehu Irr 2	Kaupulehu Land Co.	PER	12	868	980	IRR	1990	95	6			7-2-003:003	550	0.52	0.76
80902	4757-03	Kaupulehu Irr 3	Kekaha Venture	ROT	12	888	1000	IRR	2001	02	3.91	220		7-2-003:003	550		
80902	4757-04	Kaupulehu Irr 4	Kekaha Venture	ROT	12	915	1013	IRR	2002	02	2.56	240		7-2-003:003	550		
80902	4658-01	Kaupulehu Pot 1	Kaupulehu Wtr	ROT	12	1343	1440	MUN	1981	96	6.9	38		7-2-003:003	450	0.33	0.53
80902	4658-02	Kaupulehu Pot 2	Kaupulehu Wtr	ROT	12	1343	1444	MUN	1986	95	7			7-2-003:003	450	0.25	0.36
80902	4657-01	Kaupulehu Pot 3	Hualalai Dev	ROT	16	1321	1421	MUN	1999	99	5.8	110		7-2-003:003	450	0.30	0.56
80902	4657-02	Kaupulehu Pot 4	Kaupulehu Makai	ROT	16	1345	1454	MUN	2002	02	4.81	190		7-2-003:003	450	0.45	0.66
80902	4657-03	Kaupulehu Pot 5	Kaupulehu Makai	ROT	16	1335	1416	UNU	2004	04	5.16	90		7-2-003:003	0		
80902	4759-01	KI-1	Wb Kukio Llb	PER	14	591	610	IRR	1990	01	1.6	590		7-2-004:016	500	0.31	0.33
80902	4759-02	KI-2	Wb Kukio Llb	PER	12	551	570	IRR	1991	00	1.2	460		7-2-004:016	500	0.38	0.40
80902	4759-03	KI-3	Wb Kukio Llb	PER	16	592	618	IRR	1992	01	0	720		7-2-004:016	500	0.32	0.36
80902	4953-01	Kiholo	State Dowald	ROT	12	932	971	UNU	1972	73	2.6	340		7-1-002:001			
80902	4858-01	Kona Village 1	Pia-Kona Ltd	ROT	4	501	528	UNU	1960	74	0.8	385	410	7-2-003:003			
80902	4858-02	Kona Village 2	Kona Vil Assoc	ROT	8	503	523	IRR	1968	72	1.8		593	7-2-003:003	232	0.01	0.08
80902	4858-03	Kona Village 3	Kona Vil Assoc	ROT	10	500	534	IRR	1973	73	2.8	300	830	7-2-003:003	174	0.09	0.17
80902	4859-03	Kukio Lagoon 1	WB Kukio Resorts	DUG	72	7	12	OTH	2002	03	0.94			7-2-016:002	1500		
80902	4959-19	Kukio Lagoon 2	WB Kukio Resorts	DUG	72	8	12	OTH	2002	03	0.94			7-2-016:003	1500		
80902	4960-04	Kukio Obs A	Huehue Ranch	DUG	2	3	10	OBS	1991	91	0.5			7-2-004:005	0		
80902	4960-03	Kukio Obs B	Huehue Ranch	DUG	2	3	15	OBS	1991	91	0.11			7-2-004:005	0		
80902	4959-10	Kukio Obs C	WB Kukio Resort	ROT	2	9	20	OBS	2001	01	0.25			7-2-004:005	0		
80902	4959-13	Kukio Obs C	Huehue Ranch	DUG	2	9	20	SLD	1991	01	0.25			7-2-004:005	0		
80902	4960-01	Kukio Obs D	WB Kukio Resort	ROT	2	8	18	OBS	2001	01	0.25			7-2-004:005	0		
80902	4959-16	Kukio Obs D	Huehue Ranch	DUG	2	7	18	SLD	1991	01	0.47			7-2-004:005	0		
80902	4959-11	Kukio Obs E	WB Kukio Resort	ROT	2	8	20	OBS	2001	01	0.25			7-2-004:005	0		
80902	4959-14	Kukio Obs E	Huehue Ranch	DUG	2	9	20	SLD	1991	01	0.53			7-2-004:005	0		
80902	4959-12	Kukio Obs F	WB Kukio Resort	ROT	2	7	17	OBS	2001		0.5			7-2-004:005	0		
80902	4959-15	Kukio Obs F	Huehue Ranch	DUG	2	7	15	SLD	1991	01	0.53			7-2-004:005	0		
80902	4959-06	Main Pool	Hualalai Dev	PER	6	4	11	OTH	1996	96	1			7-2-003:005	90		
80902	4760-01	Maniniowali 1	Maniniowali Equity Co.,	ROT	12		281	UNU	2002	02				7-2-004:018	0		
80902	4959-07	Palm Grove	Hualalai Dev	PER	6	3	9	OTH	1996	96	1.1			7-2-003:004	60		
80902	4850-01	Puu Lani	Puuwaawaa Rch	ROT	10	2314	6800	MUN	1978	92	18.8	60		7-1-006:019	72	0.02	0.03
80902	4650-01	Puu Waawaa	Puuwaawaa Rch	ROT	7	2550	5595	MUN	1978	92	231.6	45		7-1-001:002	74	0.02	0.06

Aquifer System	Well No.	Well Name	Owner User	Type	Casing Dia. in.	Ground Elev. ft.	Well Depth ft.	Use Cat.	Yr. Drill.	Use Yr.	Init. Head ft.	Init. Chl. ppm	Max. Chl. ppm	TMK	Pump Capacity gpm	Average Pumpage mgd	High Avg. Pumpage mgd
80902	4959-20	Raptor Residence	Raptor Residence LLC	PER	8	5	65	UNU	2003	03	1.5	17119		7-2-017:001	0		
80902	4959-09	Ryan Salt	Hitherandthirthering	ROT	4		60	OTH	1999					7-2-011:008	0		
80902	5352-01	West Haw Landfil	Waste Mgmt Haw	ROT	8	192	220	IRR	1993	94	2	910		7-1-003:001	100	0.30	2.33
Total - Kiholo Aquifer System [80902]																**4.26**	**8.28**
TOTAL - ISLAND																**93.94**	**131.97**

APPENDIX C

Description of the
County of Hawaii
Department of Water Supply

-Ka Wai A Kane!
Water…Our most Precious Resource!

The County of Hawai'i Department of Water Supply

"The Department of Water Supply does not sell water; water is free – the department sells service…the charges collected by the Department of Water Supply are to cover the cost of pumping, treating, storing, and delivering potable water."

Water Board
The Department of Water Supply (DWS) is a semi-autonomous agency of the County of Hawai'i, which is governed by rules and regulations adopted by a nine-member Water Board. The board members are selected by the county mayor to represent the nine council districts around the county. As such, the county council is not involved in the Department of Water Supply's budgetary or policy decisions. The Water Board makes policy decisions, approves all of DWS' contracts and sets the budget for the Department. While each of the nine council districts are represented, the Board members do not so much advocate for their own particular districts as they do work together for the benefit of all DWS customers. The board also hires the Water Manager who runs the day to day operations of the Department. Currently, the Water Manager is Milton D. Pavao, P.E.

Function
The primary function of the Department is to deliver safe, clean, good tasting, potable water to its customers throughout its 24 water systems and 67 sources located around the island. Because of the immense size of the Big Island and the isolated nature of many of the communities, these individual water systems are typically not interconnected, except in the more densely populated districts of South Hilo and Kona. The Department continually strives to provide highly dependable, excellent quality water at a reasonable cost. The Department is fortunate to have dedicated water system operators. They routinely have to work late at night, weekends and Holidays to provide seamless service to DWS customers, and occasionally have to put their jobs ahead of their personal lives during emergencies and difficult times.

Revenues
The Department operates and maintains its water systems with revenues generated wholly through the sales of its water service. The DWS does not receive any money from the County's General Fund. It does not receive any property taxes or other taxes. DWS is purely customer-driven and must operate on revenue from the service it provides. In 2008, the Department had approximately 41,000 accounts serving well over 100,000 residents. Rates are structured such that monthly rates from customers pay only for normal operations and maintenance. Another fee, which is known as a facilities charge (FC), is a one-time charge to new customers for the privilege of connecting to the Department's water system infrastructure in order to obtain county water service (where available). Water systems are expensive and the existing infrastructure was paid for by past and current customers. The FC paid by the new customer is simply a "buy-in" to the existing water system. Over time, the FC monies help to provide for major capital improvement projects including new wells, reservoirs and transmission lines. An example of

such a project is the recent construction of a two-million gallon reservoir and production well in the Waiaha region in Kona.

Other Funds and Expenditures
For the past 15 plus years, the Department has not received any state appropriations. It has only received revolving fund loans provided by the U.S. Environmental Protection Agency (USEPA) via the state Department of Health for certain projects. Those funds are minimal and are used only to help update and bring the existing water systems into compliance with the USEPA's often changing criteria. In 2007, a $25M General Obligation Bond was secured by DWS in order to complete several critical, major water supply projects, including the Palani Road Transmission Waterline Project. Already underway, when completed, this $12.3M project will bring high quality, excellent tasting water from wells located above the Mamalahoa Highway down into Kailua-Kona. These wells produce very high quality water pumped from perched aquifers and the new pipeline will allow transmission of this water to large segments of North Kona, improving water quality for many of DWS' existing customers. For 2010, DWS is securing another $30M bond to carry out several more critical source, storage and transmission projects around the island.

There are many financial challenges associated with providing water service, including fixed costs and legal mandates that must be covered by DWS revenues. A good part of DWS operating funds are used to ensure that the water quality provided to our existing customers is in compliance with EPA standards. These standards are getting stricter over time. DWS spends more than $600,000.00 a year to test the water to ensure compliance. EPA mandates often require large expenditures from capital funds for well development and upgrades to existing water sources.

DWS is Hawaii Electric Light Company's (HELCO) biggest customer. It may be surprising for many to learn that 1/3 or more of DWS' total budget goes to pay HELCO for energy costs. In 2007 that amounted to $16.5 million dollars primarily to pay for the energy to operate the department's well and booster pumps around the island. The Water Board has recently approved a new policy giving the Department the ability to make adjustments every two months to the ***power cost*** portion of the customer billing as needed. This will allow DWS to better track changes in the energy costs, either up or down, which are administered by HELCO to DWS. Previously, the power cost adjustment only occurred annually. Power rates have been trending downward more recently and the ***power cost*** portion of customer billing has been reduced to follow suit.

Subdivisions and System Expansion
County Subdivision code requires that new subdivisions have a water system meeting county standards. Therefore, most expansion of the county water systems is accomplished by land owners and developers in conjunction with building their own projects, by adding onto and tying in to the county's existing water system infrastructure. When the proposed growth from new a development exceeds the water availability in a particular area, the developers are also responsible for adding source, storage, and transmission to provide the water needed for their own projects and allow them to move forward.

DWS' financial structure does not provide funding for significant expansion of its water systems to reach new customers in non-service areas, including existing subdivisions that were subdivided previously without water, prior to current subdivision code. Water rates and facilities charges are structured only to maintain the facilities and service of existing water systems. The rates do not provide for the high cost of expanding water systems in order to take on limited numbers of additional customers. It is important to note that because DWS does not receive any funding from property taxes, anyone not receiving county water is not paying into the county water system. Only DWS' customers pay into the water systems. DWS cannot put the financial burden of extending infrastructure to serve limited numbers of new customers spread out in scattered areas onto its existing customer base. Not when the cost to expand infrastructure is too great compared to the return gained by adding those new customers. If DWS did so, the department could go bankrupt or the water rates charged to existing and new customers would need to be drastically increased to pay for system expansion. Spending tens of thousands, hundreds of thousands, or even millions of dollars extending the water systems to pick up relatively low numbers of additional customers would never be cost effective or fair for our existing customers. It does not make economic sense. DWS' greater responsibility is to its existing customer base. DWS has to keep water costs as low as financially responsible. Instead, the financial burden of expansion is placed on the applicants wishing to become new customers and obtain water service from the county. The investment on the part of the land owners is typically compensated by an increase in the value of their properties because of the availability of county water. The cost of expanding county water systems needs to be borne by those benefitting directly from the new service, both in terms of the convenience and increased property values. Usually, landowners and homeowners who bought property without access to county water paid a proportionately lower price for their property than landowners and homeowners whose property has county water. Accordingly, the annual real property tax assessment of a lot without water also tends to be lower than a lot enhanced by having access to county water.

Improvement Districts

In the past, DWS has acquired or accepted substandard water systems from others, such as the old camp systems from the sugar cane days. Many years later, DWS is still in the process of paying to upgrade some of these systems to meet DWS standards. Nowadays, it is a requirement that any privately owned water systems wishing to be given over to DWS, must first be brought up to all DWS standards before the Water Board will accept the dedication of the system.

Another way that the county's water systems expand is through the efforts of existing communities using external funding such as low interest loans and the USDA's Rural Development Loan Grant program. Using a mechanism known as Improvement Districts (ID's), these low interest loans and federal grant funds can be made available to the communities desiring county water service. DWS encourages and works with those existing subdivision communities that wish to go through the ID process in order to become new DWS customers. An example is the Kona Coastview/ Wonderview subdivision. In that case, the Improvement District process, in combination with the USDA Rural Development Loan Grant Program, provided the funding to construct an upgraded water system meeting DWS standards to replace the existing sub-standard water system. By reconstructing a water system and meeting all of the county's water system standards, the subdivision's community was able to turn the system over to DWS, who will then operate and maintain the water system in perpetuity and provide service to the community.

Out-of-Bounds Service

Currently, DWS does have an "*Out-of-Bounds*" policy, which may allow individual property owners to obtain county water even though their property does not front a county waterline or they may not be within a DWS pressure service zone. Where possible, these owners are limited to just one equivalent unit (EU) of water, which is adequate to serve a single-family residence. An EU allows a maximum day usage of 600 gallons for any one day. Maximum day usage is defined as 1.5 times the average day use, therefore one EU allows for an average day usage of 400 gallons.

To obtain an "*Out of Bounds*" service, the owners must sign a DWS policy agreement recognizing the customer's responsibilities in these cases, which may include obtaining legal easements over neighboring properties to run customer-maintained, private waterlines from the Department's water meter to their property. In addition, when the property is partially or completely outside of the pressure service zone, the owner is also required to execute an Elevation Agreement stating that the owner understands and accepts that the pressure to the property may be substandard and recognizes all conditions, limitations, and requirements placed upon the owner. When serving properties located outside the service pressure zone, the Department's water meter itself still needs to be located within the pressure service zone.

These "*Out-of-Bounds"* policies can lead to what are commonly known as "spaghetti lines" servicing some neighborhoods. Although there are a number of negative issues associated with these "spaghetti lines", this practice accommodates as many members of the community as possible without imposing extreme financial hardship on them by, instead, imposing greater responsibility upon the customer.

Land Applications and Water Commitments

New private development projects require water and the Hawaii County Planning Department works to ensure that water is available when considering approval of any changes in current zoning. When applications for projects affecting land use are submitted to the County Planning Department, such as for change of zone, subdivision, boundary amendments, additional farm dwellings, ohana dwellings, special management areas, etc., DWS is consulted as to whether water is available to meet the needs of the subject project. Copies of the applications are submitted to the Water Resources and Planning (WRAPS) branch of the Engineering Department. Water availability is researched for the subject area and WRAPS provides a letter to the Planning Department stating whether water is available for the proposed project and what improvements may be required to make water available. When looking at proposed projects, DWS often requires water usage demand calculations, which must include average day usage and peak hour flow rates, provided by the developer's engineer for DWS review and approval. Based on those calculations and the water availability policy for the subject area, DWS determines if it can support a particular project. If the water source, storage and transmission capabilities of the existing water system are adequate to meet the requirements of the project, the developer is then responsible for extending the water system infrastructure to serve the project.

This includes, but is not limited to, water lines of sufficient size and capacity to provide adequate pressure and flow to meet both domestic needs and fire protection.

DWS is not part of the building permit approval process. DWS is not generally consulted for building projects when there are no required changes to land use or zoning classification. On rare occasions, this has led to conflict when adequate water has not been available to projects already approved by the building department but most developers do come in beforehand to check with DWS to verify water is available before building their project. It is strongly recommended by the Department that they do so.

When applications are filed and it is determined that adequate water is available, which may or may not require onsite and offsite water system infrastructure improvements to be constructed at the expense of the applicant, the Department is able to provide water commitments to the applicant. Water commitments ensure that the water that is deemed to be available to the project at the time of the request is reserved and therefore will still be available to the project at the time of completion. This is important because water availability can change without notice. Water commitments are not issued unless a water commitment deposit of $150.00 per equivalent unit (EU) of water is paid to DWS. The commitment expires after three years but DWS, at its discretion, may extend water commitments a year at a time by an additional payment of $150.00 per EU, so long as tangible progress has been made on the project. Money paid as a deposit for water commitments and extensions will later be applied toward the customer's payment of the prevailing facilities charges at the time service is granted.

Water commitments ***go with the land*** and are not sellable, tradable, transferable or otherwise exchangeable, except upon rare approval by the Water Board and only to adjacent lands served by the same water system.

Water Availability and Developer Contributions

The Department's water availability policy varies around the island as different supply sources, system robustness, demand and potential demand based on zoning type, are encountered. The Department sets water availability policy based on the existing water system and the projects currently under construction relative to factors particular to an area or system, per the Rules and Regulations set forth and adopted by the Water Board:

> "If the Department, on the basis of population data, availability of water, existence of water sources, waterlines or other facilities, engineering requirements, and other related and relevant data, anticipates that a consumer, developer or subdivider can be provided with sufficient water for the estimated usage of a proposed new project or development, meeting the Department's minimum standards, the Department may commit to the consumer, developer or subdivider that there is, or it is anticipated that there will be, sufficient water to service the proposed new project or development. The Department, in giving such a water commitment, may impose time limits and other conditions for the use of such commitment upon the consumer, developer or subdivider, as the Department deems necessary. The Board may establish guidelines and policies for the issuance of formal written water commitments."

When DWS responds to a land application sent over by the Planning Department, DWS indicates in writing whether the affected water system has the capacity to accommodate the project being proposed. If the project's water demands fall within the water availability policy for the subject areas and the system is capable of handling the additional demand, DWS indicates the point of adequacy within the system and gives a very brief outline of system improvements, if any, required of the applicant to bring the water service to the subject property. The applicant would then need to provide the engineered design for any necessary offsite improvements such as storage, transmission, and distribution infrastructure required for the project. If the system does not have the capacity to meet the needs of the project, then the developer may need to scale back, combine adjacent properties, or provide additional source to meet the needs of the project.

In those cases where DWS simply does not have adequate source, storage and or transmission to satisfy the needs of a proposed development, major developers may enter into an agreement with DWS whereby the developer promises to provide a new water source, storage reservoirs and transmission systems. The agreements state the proportional share of the source water going to the developer and the proportional share going to DWS, which is currently allocated two-thirds to the developer and one-third to DWS for use by the its customers. As an example, a well capable of producing 700 gallons per minute (gpm) or one million gallons per day (1.0 MGD) provides enough water for 1,666 equivalent units of water. For a well this size, the developer's share at two-thirds would be 1,111 equivalent units and DWS' share at one-third would be 555 equivalent units.

When completed, those developer-paid facilities are dedicated to the Water Board. DWS then operates and maintains the facilities. The developer receives a credit toward the facilities charge on each equivalent water unit it receives based on standard percentages for each type of facility constructed by the developer. However, the investment by the developer must meet or exceed the total of the facilities charge for the equivalent units allocated to the developer in order to receive the credit. More information about these percentages can be found in the department's Rules and Regulations which are posted online at *www.hawaiidws.org*.

Water for the Future

It is important to take a look at the long term effects of continued development on the island's resources, especially water. Some areas of the island have more water than could ever be used by even the full build-out of potential development based on land classification and zoning. Other areas may have more limited ability to meet future demands. However, it is not a runaway train as far as potential overuse of the islands aquifers. Developers will always have to prove that they have source available before they are allowed to construct their projects. They not only have to commit to developing source wells, storage and transmission, they also have to prove that the water is actually accessible to their projects. In a practical sense, finding suitable locations to tap into the aquifers and still be able to serve specific project locations is typically a much greater limiting factor than the official safe yield of the underlying aquifers.

More information about the Department of Water Supply can be found at the DWS website at *www.hawaiidws.org*.

DISCLAIMER: All statements and ideas herein are believed to be reliable, truthful and accurate to the best of DWS' knowledge at the time of this writing. They are not guaranteed in any way by anybody and are subject to change over time. The Water Board and DWS disclaim and are not liable for any claims or losses which may be incurred by third parties while relying on the information published herein.