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

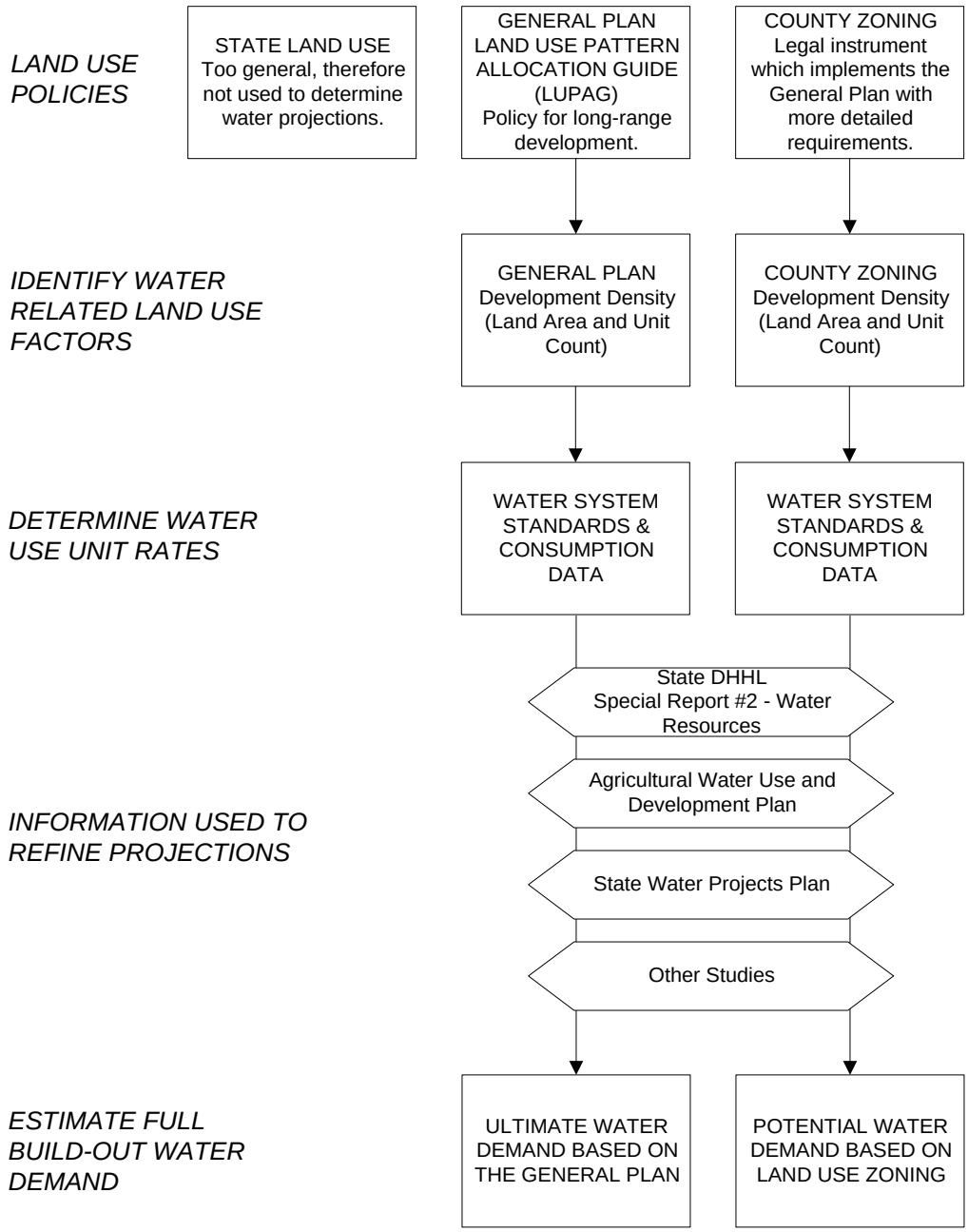


Figure 2-2: 5-Year Incremental Water Demand Projection Methodology

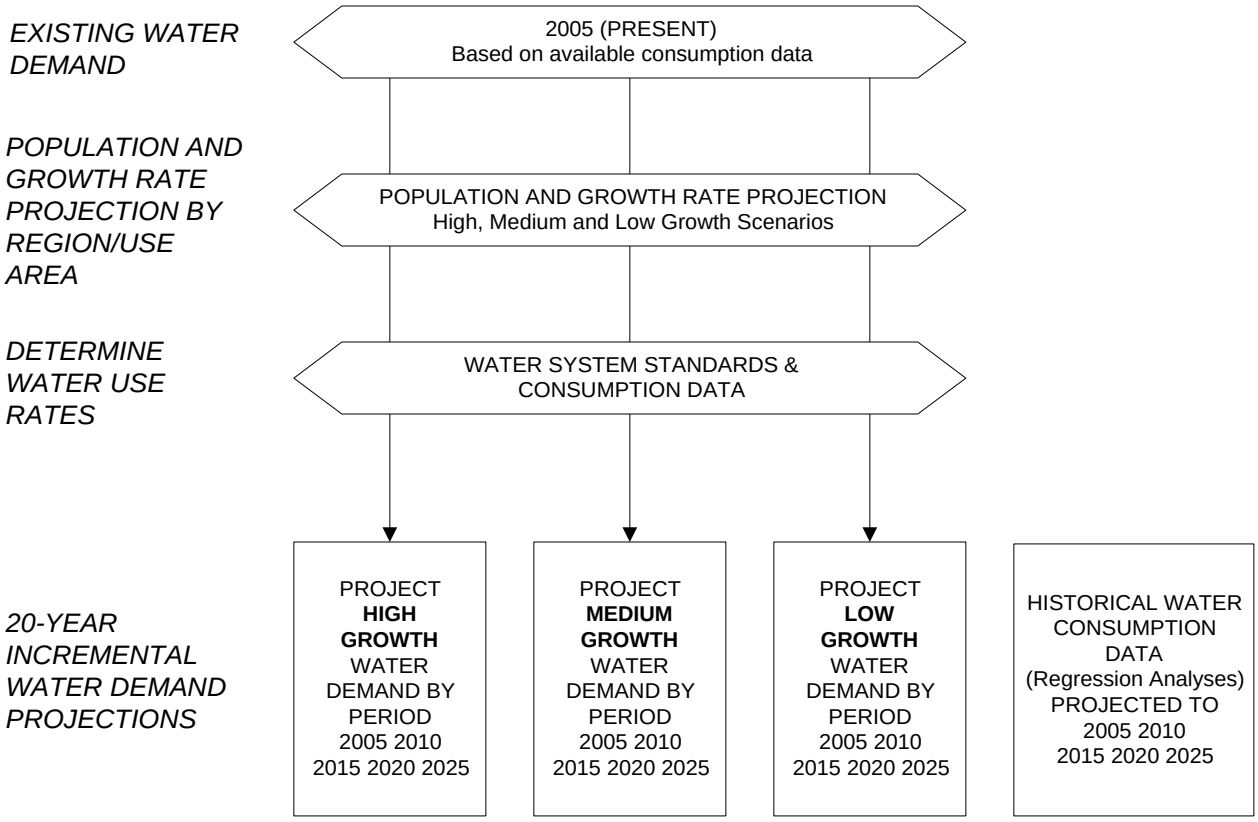
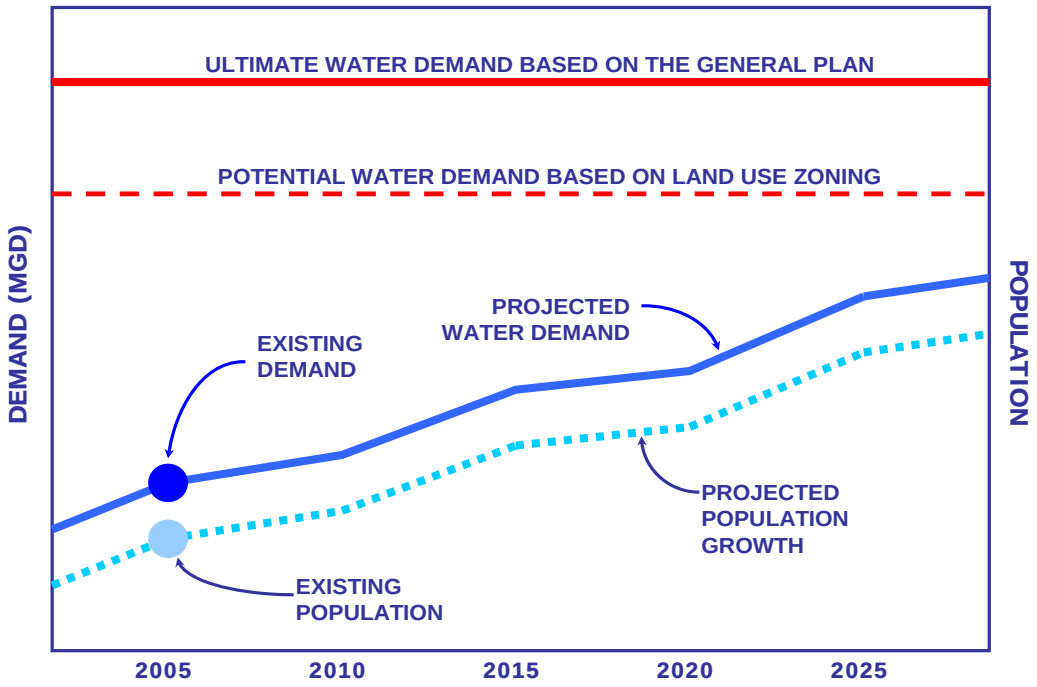


Figure 2-3: Theoretical Projected Demand



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

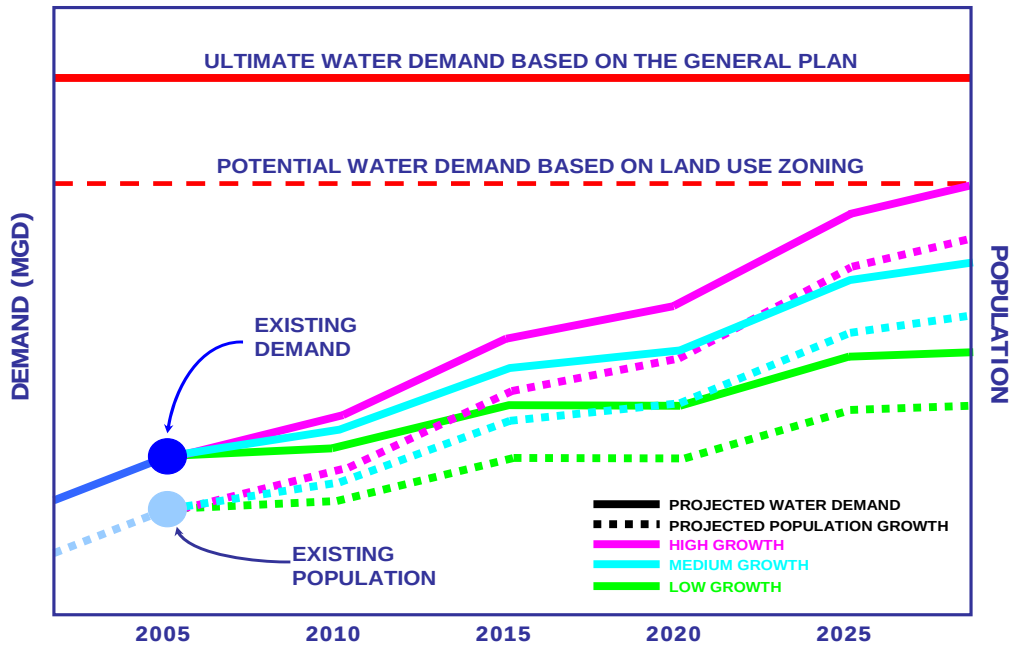
According to the Framework, "the major objective of the AWUDP is to develop a long-range management plan that assesses state and private agricultural water use, supply and irrigation water systems. The plan shall address projected water demands and prioritized rehabilitation of existing agricultural 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	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.

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.