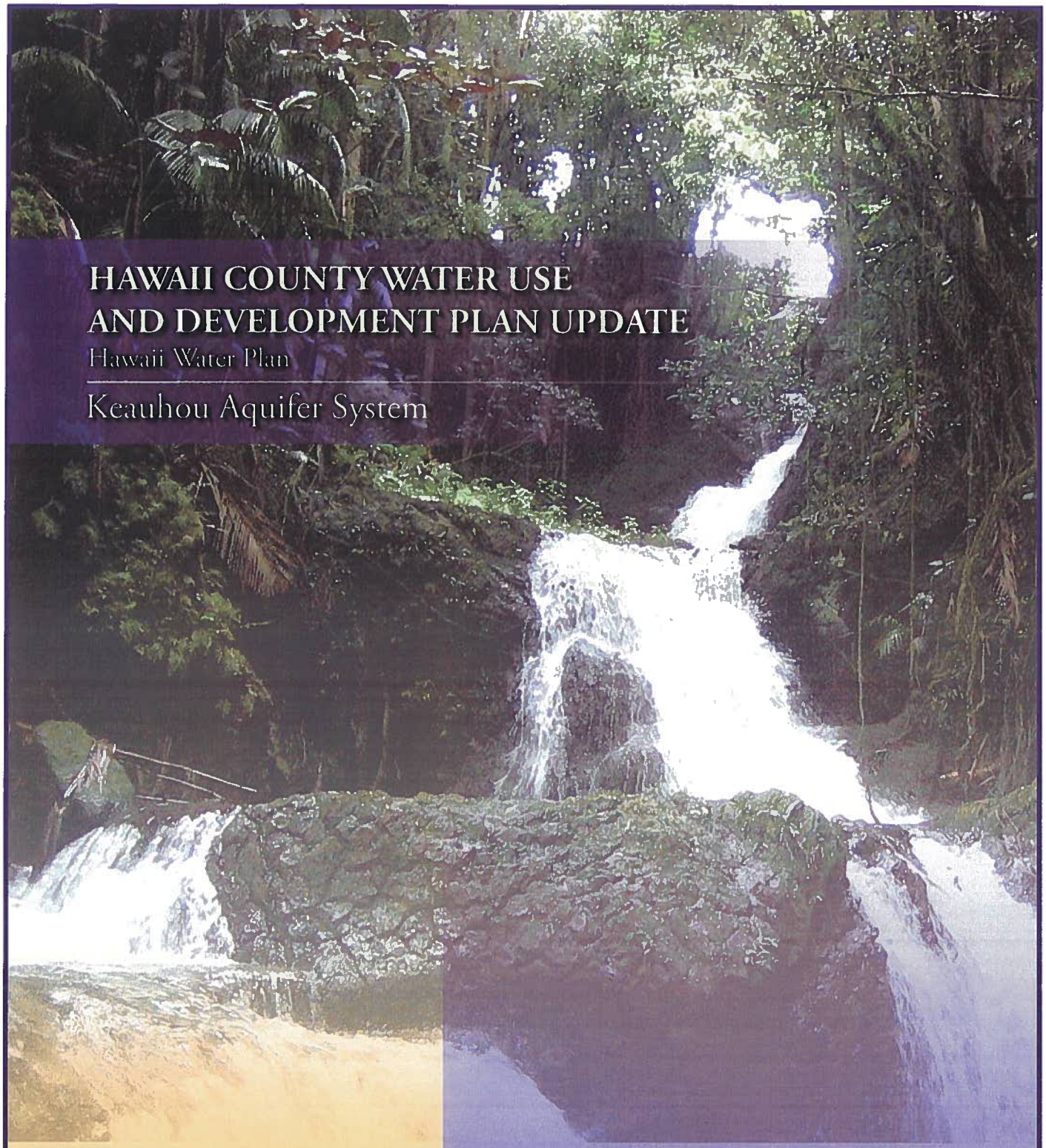

HAWAII COUNTY WATER USE AND DEVELOPMENT PLAN UPDATE

Hawaii Water Plan

Keauhou Aquifer System

Funded by the:

Department of Water Supply

For the:

County of Hawaii

FUKUNAGA & ASSOCIATES, INC.

Consulting Engineers

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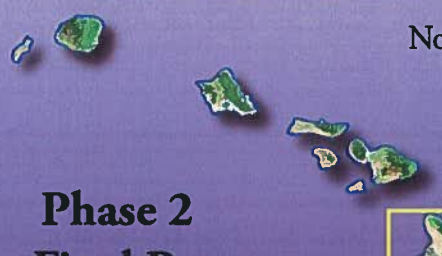
November 2016



Phase 2

Pre-Final Report

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LIST OF ABBREVIATIONS

ASEA	Aquifer Sector Area
ASYA	Aquifer System Area
CIP	Capital Improvement Program
CWRM	State of Hawai'i, Department of Land & Natural Resources, Commission on Water Resource Management
DEM	County of Hawai'i, Department of Environmental Management
DHHL	State of Hawai'i, Department of Hawaiian Home Lands
DOFAW	State of Hawai'i, Department of Land & Natural Resources, Division of Forestry and Wildlife
DLNR	State of Hawai'i, Department of Land & Natural Resources
EA	Environmental Assessment
EIS	Environmental Impact Statement
GIS	Geographic Information System
GPD	Gallons per Day
HAR	Hawai'i Administrative Rules
HDWS	County of Hawai'i, Department of Water Supply
HHFDC	State of Hawai'i, Hawai'i Housing Finance & Development Corporation
HWUDP	County of Hawai'i Water Use and Development Plan
IAL	Important Agricultural Land
KS	Kamehameha Schools
MG	Million Gallon
MGD	Million Gallons per Day
NHO	Native Hawaiian Organization
NPS	National Park Service
OHA	Office of Hawaiian Affairs
OHCD	County of Hawai'i, Office of Housing and Community Development
QLT	Queen Lili'uokalani Trust
SDWB	State of Hawai'i, Department of Health, Safe Drinking Water Branch
SDWP	Stream Diversion Works Permit
SWPP	State Water Projects Plan
SY	Sustainable Yield
TMA	Three Mountain Alliance
T&C	Traditional and Customary Native Hawaiian Rights
UPC	Uniform Plumbing Code
WCPIPA	Well Construction and Pump Installation Permit

WMP	Water Master Plan
WRPP	Water Resources Protection Plan
WWRF	Wastewater Reclamation Facility
WWTP	Wastewater Treatment Plant

CHAPTER 1 INTRODUCTION

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

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

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

The 2010 HWUDP identified two aquifer sectors to be considered for further evaluation and detailed assessment. Prioritization of the aquifer areas identified resulted in the selection of the West Mauna Kea Aquifer Sector Area (ASEA) [803]/Waimea Aquifer System Area (ASYA) [80301] and the Hualalai ASEA [809]/Keauhou ASYA [80901] for update. Per decision of the CWRM, the update consists of two phases. The first phase (Phase 1) refined the water demand scenarios and projections; and the second phase (Phase 2) will involve the development of source development strategies and scenarios. In a letter to the Hawai'i County Department of Water Supply (HDWS), the CWRM further requested that the HWUDP include the following elements:

- Address how proposed source development strategies to meet projected demands may impact cultural uses and rights or other public trust purposes (T&C)
- Identify appropriate mitigation measures for potential impacts or alternative strategies

This document is Phase 2 of the Hawai'i Water Use and Development Plan Update – Keauhou Aquifer System Area.

CHAPTER 2 ENVIRONMENTAL AND CULTURAL ISSUES & PUBLIC CONSULTATION

This section explores methods to identify traditional and customary native Hawaiian rights, cultural uses or other public trust purposes related to, affected or impacted by ground water development and to determine how those impacts should be mitigated.

2.1 PRELIMINARY T&C RESEARCH

The County of Hawai'i Department of Water Supply (HDWS) conducted an initial assessment on cultural and environmental issues pertaining to groundwater use in the Keauhou ASYA. The assessment was an amended condition of approval of the submittal made by HDWS at a Commission on Water Resource Management (CWRM) meeting. The assessment was done using available published information, including Environmental Assessments (EA) and Environmental Impact Statements (EIS). HDWS looked at approximately 200 EAs and EISs filed since 1990, 47 of which were reviewed in greater detail, looking for content related to native Hawaiian traditional and customary (T&C) practices and groundwater withdrawal. Most of the cultural issues that were discussed in these documents dealt with archaeological sites or paths through development sites, and only one report addressed the potential impact of groundwater withdrawal on T&C practices and habitat concerns: the more recent Palani Ranch Well No. 1 project. These findings were submitted to CWRM by letter and were presented at a subsequent CWRM meeting.

The Office of Hawaiian Affairs (OHA) Kipuka database was also examined but did not contain information concerning T&C practices, groundwater uses or other public trust purposes. In later discussions, OHA indicated that the Kipuka database is a partial list of historic sites, but is not comprehensive and has not been updated since around 2005. The database does not include information regarding "sensitive" T&C areas, e.g. burials, traditional gathering places or information related to water use.

Also reviewed as part of the assessment was a report prepared for the National Park Service (NPS) entitled "Response to the Commission on Water Resource Management Request for Information on Traditional and Customary Practices," dated May 29, 2015. The report provided information on historic, existing and planned practices within the Kaloko-Honokōhau National Historic Park, the use of fresh and brackish water, and the significance of fishponds within the park.

Aside from information provided by the Park report, this preliminary research did not yield sufficient information to adequately determine locations of significant T&C practices within the Keauhou ASYA. Subsequently, another strategy was developed and is proposed to determine significant T&C issues and areas, by establishing consultation procedures to review and vet T&C issues related to water source development.

2.2 INITIAL OUTREACH

An initial consultation group of potential participants was developed consisting of native Hawaiian individuals and organizations, government agencies, and families with a long standing history in the Keauhou ASYA. Initially, the desired result of preliminary outreach to this group was to obtain

sufficient information to develop a comprehensive geo-spatial database documenting the significant T&C areas within the Keauhou ASYA. Understanding the difficulty in developing such a database, this initial proposed process included establishing a consultation procedure involving this core T&C consultation group to provide input on water source development and to reach out to practitioners as an additional goal.

The initial outreach yielded the following considerations:

1. The proposed consultation process should not shift the burden of reaching out to practitioners and vetting T&C issues/impacts related to water source development from the applicant to the consultation group.
2. Inclusion of the federal Native Hawaiian Organization (NHO) Notification List in the consultation group as a means to contact practitioners.
3. Obtaining information on the significant T&C areas may be difficult because practitioners may not be willing to share information up front about their practices, especially before specific detail on water source development is presented, as some of these practices are closely held family "secrets"; and because practitioners are unlikely to know the impacts of water source development on their practices.
4. Utilization of a disclosure document to notify the public as part of the process to vet T&C issues rather than placing the responsibility solely on the consultation group to identify and/or notify practitioners.
5. Implementation of a public meeting to inform the public of the HWUDP and to welcome practitioners to participate in future T&C processes, i.e. use the public meeting as a means to expand and develop the consultation group that would be notified of specific water source development projects.

2.3 PRELIMINARY FINDINGS AND PROPOSED T&C PROCESS

Based on feedback from the initial consultation group, indications are that a comprehensive database of the significant T&C areas would unlikely be developed. Therefore, in collaboration with CWRM staff, a consultation process could be proposed and established to evaluate how the impact of specific source development projects on T&C issues may be assessed and how such impacts can be mitigated.

The CWRM staff currently seeks input on and addresses T&C issues in its well construction/pump installation permit application (WCPIPA) process through several steps:

1. Comments it solicits from the Department of Land and Natural Resources (DLNR) State Historic Preservation Division (SHPD) and Office of Conservation and Coastal Lands (OCCL), and from County Special Management Areas (SMA).
2. Other agency and public notification of WCPIPAs is via the CWRM's monthly bulletin posted on its website and directly emailed to over 100 individuals and agencies that includes the Office of Hawaiian Affairs (OHA) and DLNR Aquatic Resources Division (DAR – Kona). Although only required for water use permit applications, the bulletin also

includes information for pending well construction and pump installation permit applications (WCPIPA) and stream diversion works permit (SDWP) applications. The applications are listed in the bulletin for 60 days after the permit is granted.

3. Staff review of OHA's online Kipuka database (http://kipukadatabase.com/kipuka/) and Papakilo (http://www.papakilodatabase.com/main/main.php).
4. Standard conditions in well construction and pump installation permits.
5. Conditions on certificates of completed well construction and pump installation.

CWRM staff is developing an additional process with the intent that it would apply to water source development projects involving well construction/pump installation permit application (WCPIPA) requests through the CWRM in Keauhou. Staff is proposing that T&C issues could be further vetted through the permitting process by including a more thorough Ka Pa'akai analysis in the WCPIPA. Ka Pa'akai analysis is an analytical framework to be applied when making decisions with potential impacts to T&C as directed by the Supreme Court ruling in the Ka Pa'akai o ka 'Āina v. Land Use Commission case. The three questions to be answered under Ka Pa'akai include:

1. Identification and scope of "valued cultural, historical, or natural resources" in the impacted area, including the extent to which traditional and customary native Hawaiian rights are exercised in the area;
2. The extent to which those resources, including traditional and customary native Hawaiian rights, will be affected by the proposed actions;
3. The feasible action, if any, to be taken to reasonably protect native Hawaiian rights if they are found to exist.

These questions can be added to the WCPIPAs for the applicant to address and for staff to vet. CWRM staff has identified 'Aha Moku as a potential liaison between applicants/landowners for a WCPIPA and practitioners that could be impacted by the specific project during the WCPIPA review process. Act 288, signed into law in 2012, formally recognizes the 'Aha Moku System and establishes the 'Aha Moku Advisory Committee within the Department of Land and Natural Resources (DLNR). 'Aha Moku's function is to serve in an advisory capacity on issues related to land and natural resources management through the 'Aha Moku System, and to integrate the native Hawaiian cultural and traditional values into the fabric of State policy. The 'Aha Moku System includes several tiers from the Individual Ahupua'a, which includes traditional practitioners within an ahupua'a, to the 'Aha Moku Advisory Committee, which includes a State-wide Committee of traditional practitioners consisting of one representative from each island. Vetting T&C issues using 'Aha Moku as a resource during the permitting process could therefore satisfy the Ka Pa'akai analysis. CWRM staff has begun discussions with 'Aha Moku, and development of this process is ongoing.

Other steps in the aforementioned process still need to be developed and vetted, notably the procedures by which T&C issues will be identified, reviewed and adjudicated. The latter is of particular importance, as proper dispute resolution procedures may be critical to the success of the process.

2.4 PUBLIC CONSULTATION

Although this proposed process will be developed by CWRM staff, and is expected to apply State-wide, the HWUDP for the Keauhou ASYA could serve as a pilot case for its application prior to Hawaii Administrative Rule processing. For now, this process could also be vetted through the core T&C consultation group and through employment of public meetings within the Keauhou ASYA as part of this pilot case during development of this WUDP. Public meetings will also serve to present and vet the source development strategies, discussed in Chapter 3. Feedback from the first public meeting has been addressed herein.

CHAPTER 3 RESOURCE AND FACILITY STRATEGIES

3.1 OVERVIEW AND WATER SOURCE ADEQUACY

One of the criteria for designation of a ground water hydrologic unit is if ground water pumpage reaches 90% of the sustainable yield (SY), which would be 34.2 MGD for the Keauhou ASYA. As indicated in the Phase 1 HWUDP for the Keauhou ASYA (Phase 1 report), the projected demand for the anticipated demand scenario is 28.07 MGD, the zoning water demand scenario is 28.54 MGD, and the 5-year incremental water demand for Growth Rate B (medium growth) projection scenario is 22.94 MGD in 2035. All of these scenarios result in values below the 90% trigger for designation. Conventional ground water well source development would therefore be able to meet the projected demands of all three development scenarios without the need to designate the aquifer system. Source development strategies presented in this Chapter will focus on meeting the anticipated demand scenario.

The implementation strategies provide guidance for further integration and planning coordination of water resource management with the development of land use policies to ensure sustainable management of water resources. The vast majority of development associated with the anticipated demand scenario is expected to be supplied by the HDWS system; hence, source development will principally involve HDWS and include its partnerships with private entities and State agencies. Because development timetables are difficult to predict since development projects are often market and economically driven, conceptual options for long-term source development and infrastructure improvements linked to possible land development scenarios are provided. However, more detailed projects and strategies are provided for HDWS and its partnerships' near-term needs through the 5-year Capital Improvement Program (CIP).

3.2 HDWS FACILITY IMPROVEMENT PROGRAM

3.2.1 History and Objectives

The basal Kahalu'u Shaft was developed by the State and turned over to HDWS with the intent that it would produce up to 10 MGD which would supply the North Kona area. The original transmission system was built with the intent to run the source water from the Shaft along the lower elevations where water use is typically greater and to pump uphill, from makai to mauka, as needed. However, the production of the Shaft fell well short of expectations due to the increase in chlorides upon pumping in excess of 3-4 MGD, and HDWS has subsequently shifted its priority to developing "high-level" wells in the 1,500 – 1,800 foot elevation range. This has presented several different challenges, such as the need for smaller sized pumps and/or larger motors due to the increased water lift and thus increased power requirements. Also, adapting to the high-level wells reversed the "bottom-up" water transmission to "top-down" water transmission, resulting in the need for development of new mauka-makai water transmission pipelines and storage infrastructure. The added infrastructure allows HDWS to deliver the high-level water to the greater use areas at the lower elevations and, also, to blend the higher quality, high-level water with the basal source water to improve overall water quality. HDWS endeavors to significantly reduce the use and dependence on basal well sources.

3.2.2 Implementation of HDWS Long Range Master Plan

In 2006, HDWS developed a 20-year Water Master Plan (WMP) which would serve as a long-range planning tool to guide the development of its water service areas and the use of its resources. The WMP identified the projects expected to be required by HDWS during the 2007–2026 planning period. This WMP was intended to be comprehensive in its scope; however it also noted that the list of projects identified would invariably change over time due to the difficulty in anticipating all projects and because new projects were almost certain to arise during the planning period.

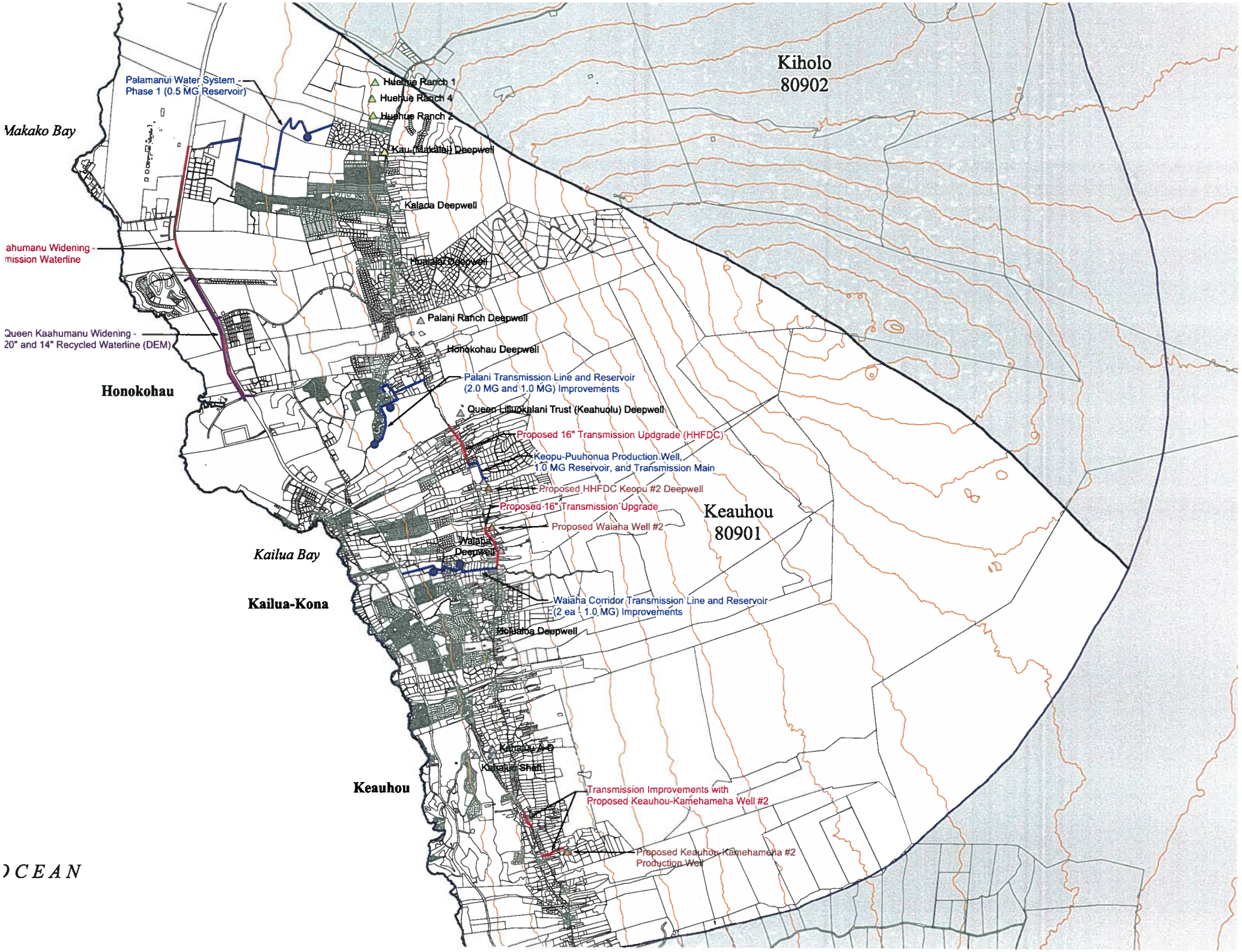
HDWS has already implemented several of the CIP projects outlined in the WMP for the North Kona Water System, including:

- Palani Transmission System, which included transmission water mains and 2.0 MG and 1.0 MG reservoirs to transmit high-level water from three separate sources directly to the Kailua-Kona and Kealakehe areas.
- Pālamanui Water System Phase 1, which included a transmission water main and 0.5 MG reservoir to provide a backup connection between the mauka and makai water systems.
- Wai'aha Corridor Improvements, which was a private/public project that included a transmission water main and two 1.0 MG reservoirs to bring high-level water from the Wai'aha well down to the lower elevations and allow blending with the basal water.
- Keopu-Pu'uhonua Production Well and 1.0 MG Reservoir, including transmission main, to bring high level water to the north where it can be transmitted down to lower elevations via the Palani and Hina Lani transmission systems.

These projects are shown on Figure 3-1. Some departures from the WMP have occurred for these projects, such as changes in storage capacity and transmission infrastructure size and alignment. Certain projects proposed in the WMP were not completed for the following reasons:

- Ka'ū No. 1 Well, a potential basal source north of the Makalei Well, was not developed due to poor water quality.
- 'O'oma Well, a potential high-level source between the high-level Kalaoa and Hualālai wells, was not pursued because the proposed development associated with the well did not proceed.

Other projects that have been completed but were not part of the WMP include the Palani Ranch Deepwell, which was a public-private project where HDWS participated financially in upsizing the reservoir that was part of the project in order to better serve the needs of the North Kona community. These departures from the WMP demonstrate the difficulty in predicting specific future water system infrastructure improvement projects.


Kiholo
80902
Keauhou
80901
Makako Bay
Kailua Bay
Honokohau
Kailua-Kona
Keauhou
OCEAN
Palamanui Water System
Phase 1 (0.5 MG Reservoir)
Huehue Ranch 1
Huehue Ranch 4
Huehue Ranch 2
Kau (Makalei) Deepwell
Kalaoa Deepwell
Hualalai Deepwell
Palani Ranch Deepwell
Honokohau Deepwell
ahumanu Widening -
mission Waterline
Queen Kaahumanu Widening -
20" and 14" Recycled Waterline (DEM)
Palani Transmission Line and Reservoir
(2.0 MG and 1.0 MG) Improvements
Queen Liliuokalani Trust (Keahuolu) Deepwell
Proposed 16" Transmission Updgrade (HHFDC)
Keopu-Puuhonua Production Well,
1.0 MG Reservoir, and Transmission Main
Proposed HHFDC Keopu #2 Deepwell
Proposed 16" Transmission Upgrade
Proposed Waiaha Well #2
Waiaha Deepwell
Waiaha Corridor Transmission Line and Reservoir
(2 ea - 1.0 MG) Improvements
Hobiaoa Deepwell
Kahalu'u A-B
Kahalu'u Shaft
Transmission Improvements with
Proposed Keauhou-Kamehameha Well #2
Proposed Keauhou-Kamehameha #2
Production Well

3.2.3 HDWS Capital Improvement Program

Proposed HDWS 5-year CIP projects are focused on increasing high-level source capacity, which will ultimately reduce the use of basal sources, and transmission projects to increase the utilization of existing sources. These projects were also not part of the WMP and are shown on Figure 3-1. They are as follows:

- Proposed 16" Transmission Upgrade, funded by the Hawai'i Housing Finance & Development Corporation (HHFDC), which will increase the size of the transmission main south of the QLT high-level well.
- Proposed 16" Wai'aha Transmission Upgrade, which will increase the size of transmission main between the Wai'aha mauka-makai corridor and proposed Wai'aha wells.
- Proposed Keauhou-Kamehameha #2 Production Well, a new high-level well.
- Keauhou Transmission Improvements, which will deliver water from the proposed Keauhou-Kamehameha #2 well.
- Queen Ka'ahumanu Widening 16" Transmission Waterline.
- North Kona Well (Wai'aha Well #2).

3.3 CONCEPTUAL SOURCE DEVELOPMENT STRATEGIES

Figure 3-2 depicts the additional water demands, not including existing developed parcels, associated with the anticipated water demand scenario developed in the Phase 1 report. The total of these "future" anticipated water demands is 13.21 MGD. The bulk of the water demand is located at elevations 500 feet or lower and in the mid-to northern area of the Keauhou ASYA. Arrows represent the general direction of water transmission from existing and proposed sources to accommodate future anticipated water demands. Conceptual source development strategies will focus on qualitative aspects of developing sources, delivering, and meeting anticipated demands.

3.3.1 Source Development Program

The source development program will employ conventional supply-side measures to meet projected demands, including ground water, and source conveyance and storage.

3.3.1.1 Ground Water

Development of future high-level wells for the HDWS system is encouraged in areas generally between 1,500 foot and 1,800 foot ground elevations mauka of Māmalahoa Highway, generally in the vicinity between the QLT Deepwell in the Keauhou ASYA and the Haleki'i Deepwell in the Kealakekua ASYA with the overall goal of sustainability throughout the region. The goal of this source development strategy is to accommodate the future anticipated demands depicted in Figure 3-2 and to replace basal sources with high-level sources. As discussed in Section 3.2.3, HDWS anticipates development of two wells, the Keauhou-Kamehameha #2 Production Well and the North Kona Well, within the next 5 years. HDWS has also initiated close monitoring of the water

levels in the high-level wells to assure that they will remain sustainable. Utilization of monitoring wells will allow HDWS to analyze the effects of new wells developed in the proposed well development area and adjust parameters such as well spacing and withdrawal rates accordingly to avoid interference with other wells. Published groundwater levels in the proposed water source development area are significantly higher than those in the area to the north, which may indicate a greater recharge.

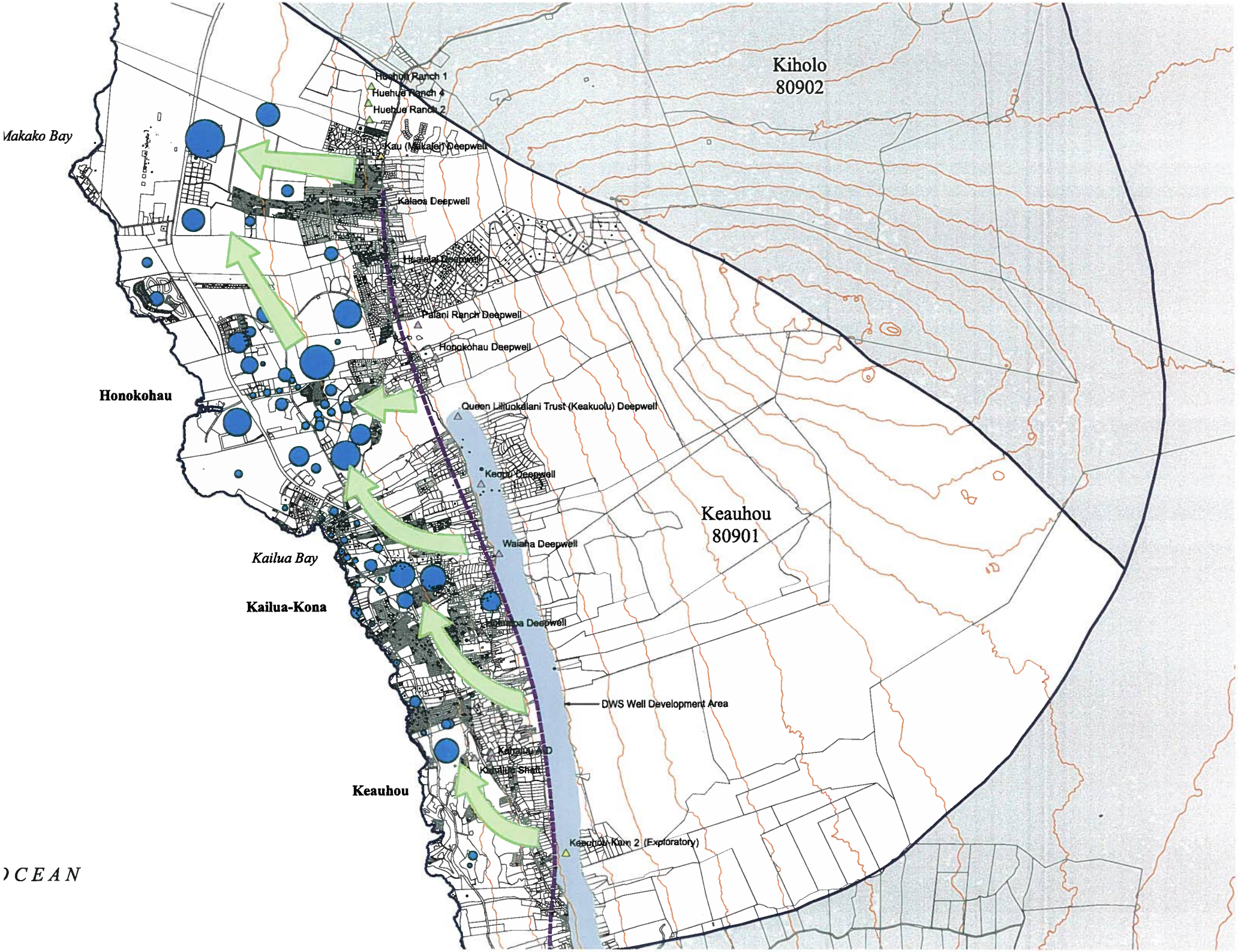
Supply of the future anticipated demands from the proposed well source development area will require additional water system infrastructure generally transmitting water from the south to the north and from mauka to makai, a concept that has already been demonstrated through HDWS' completed and future transmission and storage CIP projects. Future development of wells by private developers to be turned over to HDWS will need to consider transmission and storage improvements necessary to deliver the source water to the development area and potentially other water needs in the area known at that time and, where feasible, be consistent with the overall south-north mauka-makai concept. Wells developed outside of the proposed well source development area will need to be further evaluated for long-term sustainability and potential impacts on adjacent wells. HDWS intends to partner with these developers as they come forth to address their needs based on their development timelines and plans to require developers to include a T&C impact assessment as a condition of agreement. Private wells developed that are not integrated into the HDWS system will be vetted for T&C impacts through the CWRM's WCPIPA process.

In June 2014, Dr. Don Thomas of the University of Hawai'i at Hilo prepared a report that re-evaluated the groundwater hydrology of Hawai'i Island and presented evidence that a multi-layered fresh/saline groundwater system extending well below sea level could exist in the Kona area. Wells in the mid-elevation range, the Kamakana Well and the Keopu Well, encountered a second freshwater layer between 600 feet and 1,100 feet below sea level under strong artesian pressure. Initial indications are that this aquifer is confined below sea level and would have minimal, if any, impact on the basal aquifer. Development of this aquifer may have several advantages, such as reduced energy costs. Further investigation of this aquifer as a potential source to replace the basal sources that supply makai areas in the Keauhou ASYA is recommended.

3.3.1.2 Source Conveyance and Storage

The proposed water source development plan incorporates a system that includes both conveyance (transmission and distribution lines) and storage (reservoir tanks), continuing the conceptual system already implemented in the Kona Water System. Source conveyance within the Keauhou ASYA is already occurring via the extensive North Kona Water System transmission network. Possible extension of the DWS system to incorporate potential well sources south toward the Kealakekua ASYA could be explored. The benefits of developing an integrated water network in this region would be the capability of sharing not only sources, but storage and transmission facilities that could provide backup capacity during times of equipment failure and pipeline breaks. The increased storage capacity in the regional system would allow more normalized (steady-state) pumping, avoiding the need to increase pumping rates during instances of high (peak) demand.

It should be noted that the HDWS South Kona Water System in the Kealakekua ASYA is already connected to the North Kona Water System and separated by a closed valve; however,


Kiholo
80902
Keauhou
80901
Makako Bay
Honokohau
Kailua Bay
Kailua-Kona
Keauhou
OCEAN
Huehue Ranch 1
Huehue Ranch 4
Huehue Ranch 2
Kau (Nikaleh) Deepwell
Kalaoa Deepwell
Hualalai Deepwell
Palani Ranch Deepwell
Honokohau Deepwell
Queen Liliuokalani Trust (Keakuolu) Deepwell
Keopu Deepwell
Waiaha Deepwell
Hualalai Deepwell
DWS Well Development Area
Kamiloiki AD
Kamiloiki Shaft
Keauhou Kam 2 (Exploratory)

infrastructure changes, such as upsizing the transmission mains, would be required to carry an increased quantity of water. Any well sources developed within the Kealakekua ASYA would not count towards the SY of the Keauhou ASYA.

3.3.2 Non-Potable Source Strategies

Non-potable source strategies include surface water and alternative water resource enhancement measures, such as recycled water, rainwater and desalination.

3.3.2.1 Surface Water

Surface water in the Keauhou ASYA is extremely limited. The spring sources in the vicinity of the perennial Wai'aha Stream may continue to provide localized needs but are unlikely to be developed on a larger scale. Surface water thus is not deemed a viable resource to meet anticipated demands.

3.3.2.2 Recycled Water

Recycled water is a valuable resource enhancement measure, and increase in its use may lower the dependence on potable sources. There are five existing wastewater reclamation facilities (WWRF) within the Keauhou ASYA; there are also two wastewater treatment plant facilities (WWTP) operated by the Department of Environmental Management (DEM) with the potential to provide recycled water. These facilities are shown of Figure 3-3.

DEM is undertaking a regional effort to upgrade the existing Kealakehe WWTP to produce R-1 recycled water for irrigation/non-potable uses. DEM anticipates an initial capacity to produce 1.0 MGD of R-1. Phase 1 of the upgrade is anticipated to include irrigation of the buffer parcel surrounding the WWTP and a joint effort between DEM, QLT and the County to construct a recycled water distribution line from the WWTP to the Makae'o Park which could replace the existing irrigation demand from the HDWS system. Future phases may include the installation of recycled water distribution lines to serve Honokōhau Small Boat Harbor and Kohanaiki Golf & Ocean Club, and potential future development areas such as a regional park, QLT, and an industrial area. HDWS provided a 1.0 MG reservoir near the WWTP that could be utilized for recycled water storage. DEM is participating in the Queen Ka'ahumanu Highway Widening project with the installation of a 20" and 14" recycled transmission waterline, shown on Figure 3-1, which may supply recycled water to areas served in future phases.

The Kaloko Housing WWTP is a package treatment plant serving an affordable housing community on Hina Lani Street owned by the Office of Housing and Community Development (OHCD) but currently operated by DEM. The facility was originally intended to provide R-2 recycled water to irrigate the grounds; however, the treatment process is unstable, and the effluent is currently discharged into injection wells. DEM is proposing to replace the WWTP, and if approved, would consider utilizing the R-1 effluent as recycled water.

The WWRFs and WWTPs within the Keauhou ASYA and their associated recycled water design capacity or potential capacity, current recycled water use, and potential additional recycled water use, are listed in Table 3-1.

Table 3-1: Potential Recycled Water Use

Wastewater Facility	Type	Recycled Water Classification	Design Capacity (MGD)	Current Reuse Amount (MGD)	Potential Additional Reuse Amount (MGD)
Keahole-Kona Airport	WWRF	R-1	0.125	0.043	0.082
Kaiser Kona	WWRF	R-3	0.004	0.001	0.003
Heeia	WWRF	R-2	1.800	0.342	1.458
Kohanaiki	WWRF	R-1	0.070	0.000	0.070
Hokulia	WWRF	R-3	0.004	0	0.004
UH West Hawai'i	WWRF	R-3	0.008	0	0.008
Kealakehe	WWTP	R-1	1.000	0	1.000
Kaloko Housing	WWTP	R-1	0.014[1]	0	0.014

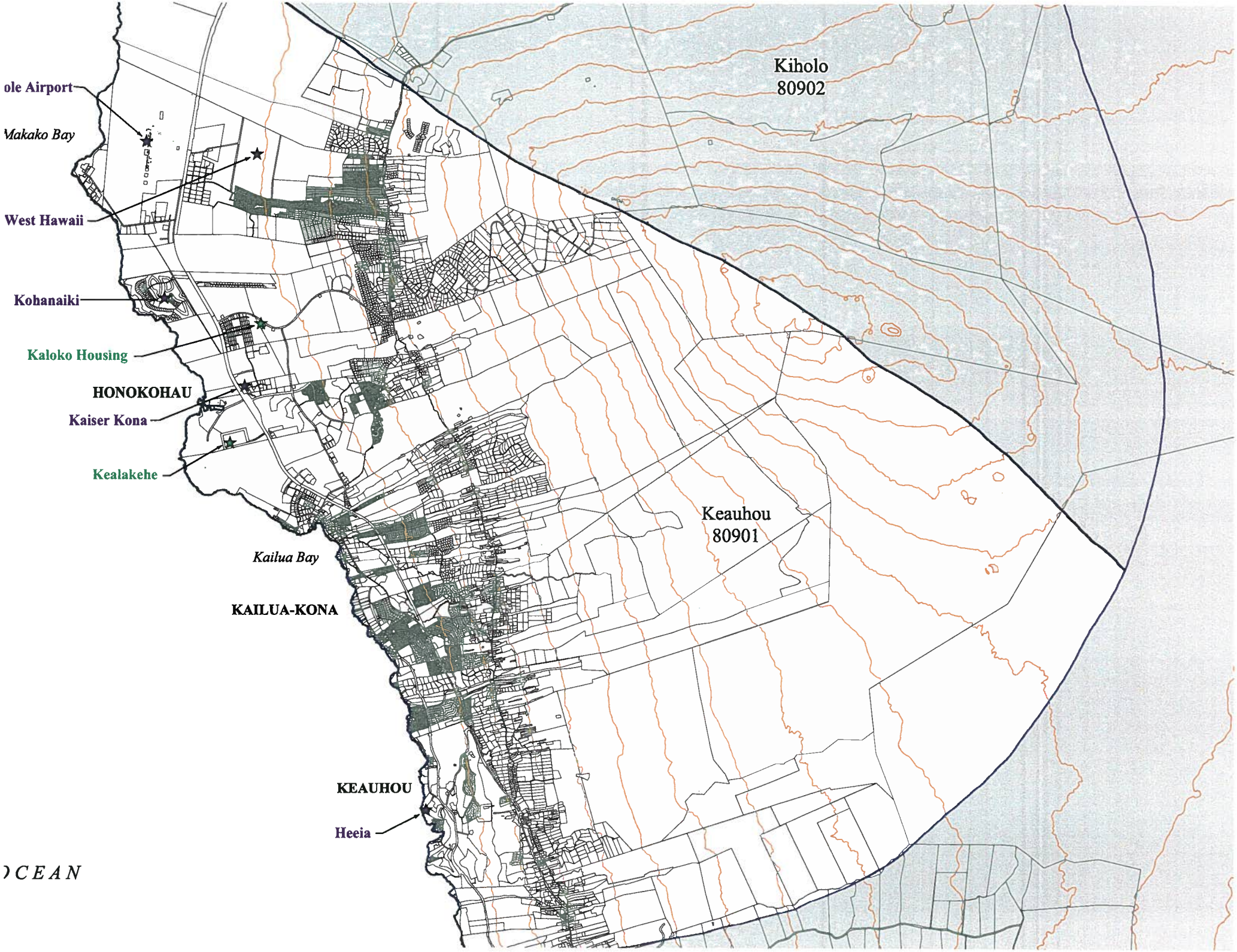
Sources: Department of Health, Wastewater Branch; County of Hawai'i, Department of Environmental Management, Wastewater Division
[1]Assumed, based on current wastewater generation rate

The potential additional recycled water use quantities indicated in Table 3-1 represent the maximum amount of recycled water available considering only the difference between the design capacity of the facility and the existing usage. The actual additional recycled water use will be dependent on several factors, including the amount of wastewater generated, which may be significantly less than the design capacity, demand for recycled water and the number of viable users within close proximity of the facility.

3.3.2.3 Rainwater

Rainwater can be considered as a water resource enhancement measure in two ways. It can be harvested in rainwater catchment systems which can be utilized to supply domestic potable water needs, and it can supplement or satisfy agricultural non-potable water needs through ambient rainfall. Typically, annual ambient rainfall of 60 inches is sufficient to support both rainwater catchment and diversified agricultural crops. Within the Keauhou ASYA, the areas that receive greater than 60 inches of rainfall annually are generally limited to the area mauka of Māmalahoa Highway and south of Kaloko Mauka, as shown in Figure 3-4. Of the parcels that represent future anticipated demands, 22 are located in this area; therefore, up to 0.0088 MGD of the future anticipated demands could be supplied by rainwater catchment.

Nearly all of the agricultural area contributing to the agricultural demands associated with the Zoning demand scenario in the Phase 1 report receives at least 30 inches of rainfall annually, and the majority of the area receives greater than 60 inches of rainfall annually. Typically, agricultural land owners grow what is feasible according to the climate, and irrigation water is only used if readily available. Most of the agricultural area is within the Kona coffee belt. Although optimal annual rainfall for coffee ranges between 60 and 85 inches, some coffee-producing areas receive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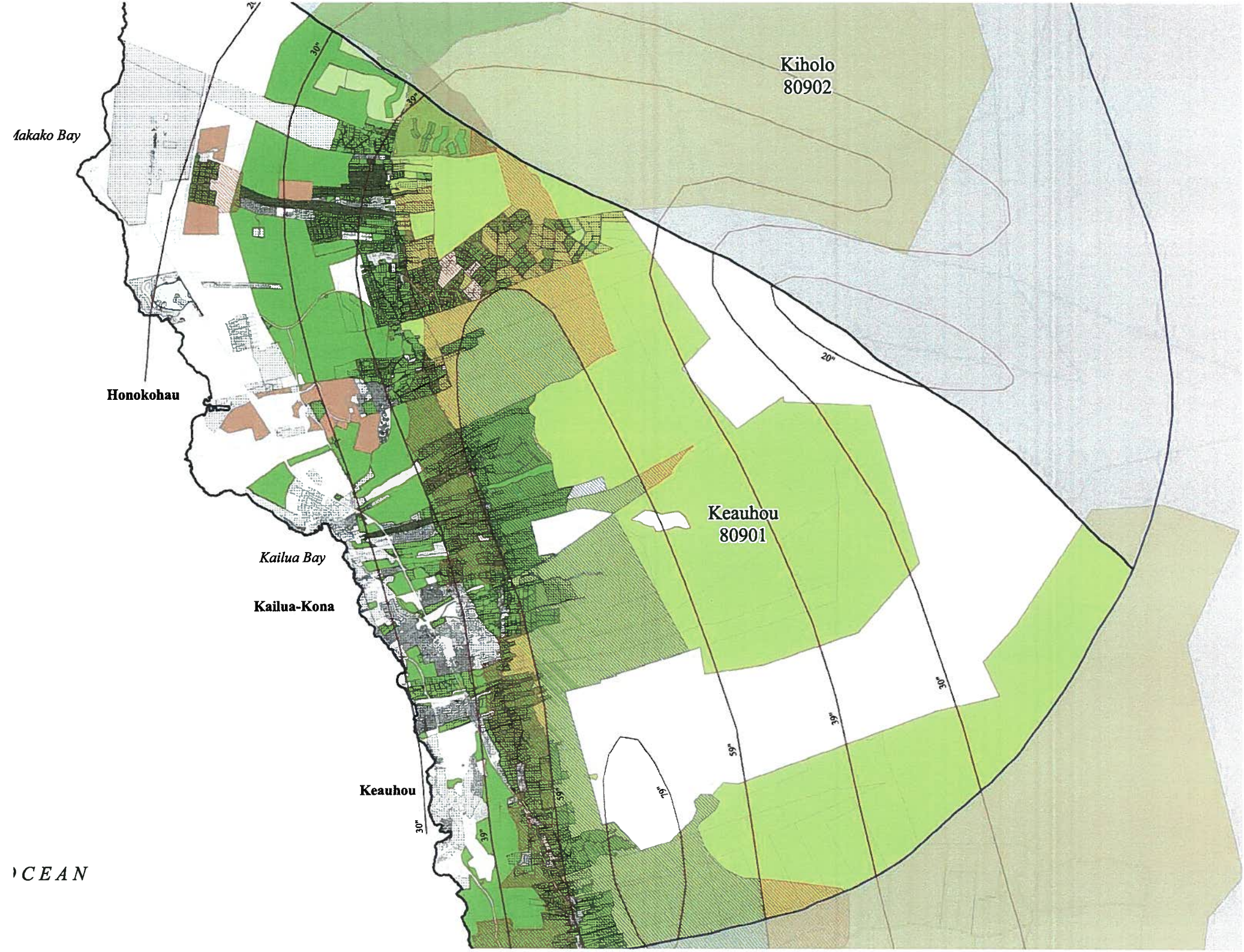
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Honokohau
Kailua Bay
Kailua-Kona
Keauhou
Makako Bay
OCEAN
20"
30"
39"
59"
79"

as little as 30 inches of rainfall annually. It is therefore reasonable to infer that all agricultural water demands can be satisfied by ambient rainfall.

3.3.2.4 Desalination

Desalination is a costly, but viable resource enhancement measure. Generally, desalination plants favor economies of scale, which suggests that a single larger plant would be more cost-effective than several smaller satellite plants; however, small-scale desalination has already been employed in the West Hawaii region by private developers. Seawater desalination plants would likely not be cost-effective. The preferable location for brackish well water desalination plants would be at moderate ground elevations to reduce drilling and pumping costs, and outside the influence of potable water wells. Any increased draw on the basal aquifer is not recommended; therefore, desalination plants would need to utilize existing brackish wells. Based on CWRM well pumping records, most of these wells are currently being used for irrigation. Because of the high cost and anticipated availability of other potable water sources, desalination should be considered as one of the last recourses for resource enhancement.

3.3.3 Other Resource Enhancement Measures

3.3.3.1 Water Conservation

Water conservation, including water loss management, may reduce both existing and future water use. As the largest water user in the Keauhou ASYA, HDWS' conservation measures can have a significant effect on water use system-wide.

HDWS' supply-side measures include an active water management program to evaluate unaccounted-for water, including leaks and purge water on well startup; and installation of Variable Frequency Drives for well pumps which would reduce the amount of times that a well shuts down and therefore reduce the amount of times the well will purge in a day. HDWS' leak detection program employs acoustic leak detection loggers within the water system to continuously monitor for leaks. HDWS is striving to improve this program by deploying additional loggers and replacing defective loggers with new units. Per Act 169, all County-owned public water systems will be required to submit annual water audits to CWRM beginning in 2018. CWRM will also be providing training and technical assistance to public water system operators. These water audits will further strengthen HDWS' water management program.

For demand-side measures, HDWS has entered into an agreement with WaterSmart, a company that uses a software data analytics platform to provide solutions through behavioral water efficiency and customer engagement. Using advanced technology such as messages and reports, customers are educated about how much water their household is using, how it compares to others (i.e., leveraging normative comparisons) and how they can save money. Customers can also be alerted to potential leaks. WaterSmart anticipates measureable outcomes of its program, including a 23% decrease in leak duration, and a 2 to 7% water savings rate. Other demand-side measures include HDWS collaborating with the State Department of Education and County of Hawai'i Department of Parks and Recreation to provide education regarding minimizing irrigation

demands. The intent is to promote conservation and efficient water use, which ultimately would result in reduced source water pumping.

Other factors affecting demand-side conservation on, but not limited to, the HDWS system include the recent Uniform Plumbing Code (UPC) amendments specifying maximum allowable flow rates for certain types of plumbing fixtures, which would require the use of low-flow devices. For example, the Energy Policy Act of 1992, which became law in 1994, mandates a maximum flush volume of 1.6 gallons for toilets manufactured and installed after this date, and modern day high efficiency toilets can use even less water. Flush volumes for older toilets can be 3.5, 5, or even up to 7 gallons. The anticipated effect of these amendments would be lower water use unit rates for newer developments compared to historical use rates.

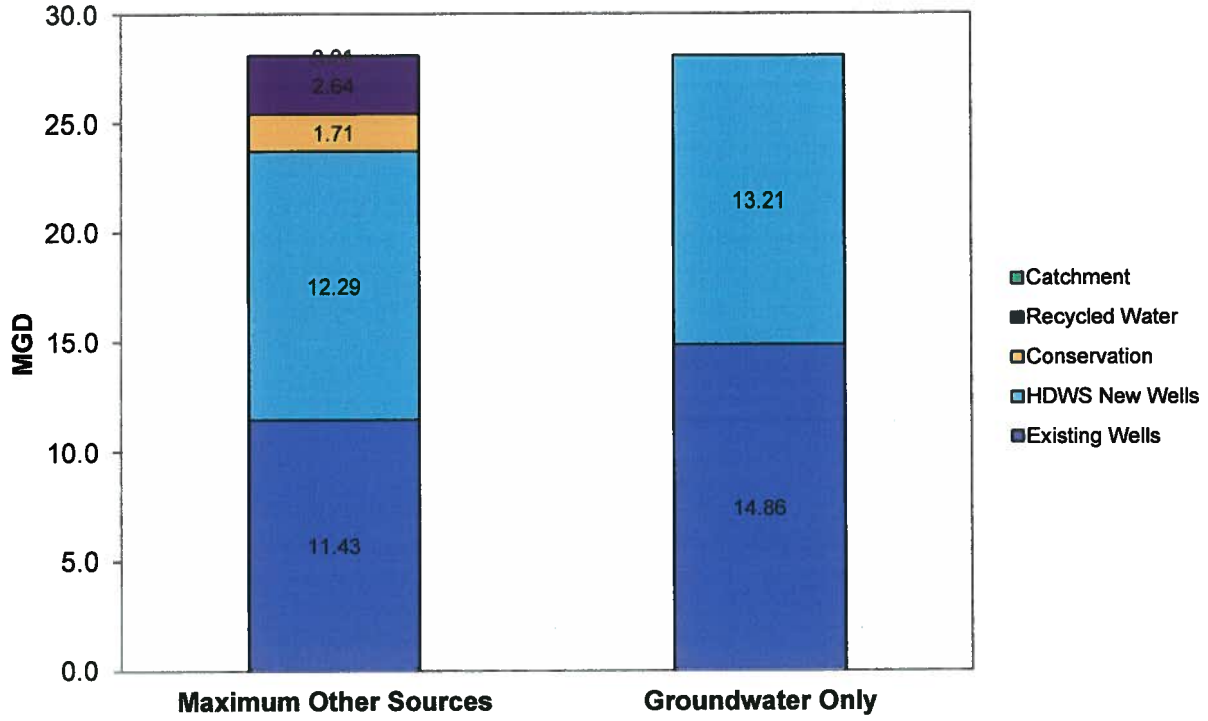
3.4 MEETING ANTICIPATED DEMANDS

Figure 3-5 and Table 3-2 present two potential scenarios to meet the 28.07 MGD anticipated demands by type of water source or resource enhancement measure. The Maximum Other Sources scenario assumes the maximum potential usage of non-potable sources and other resource enhancement measures. The Groundwater Only scenario assumes that the anticipated demands would be met entirely by ground water. These two scenarios therefore represent the minimum and maximum ground water required to supply the anticipated demands. Actual ground water required will likely be somewhere in between the two.

Table 3-2: Source Development Scenarios to Meet Anticipated Demands

Source / Resource Enhancement Type	Maximum Other Sources Scenario	Groundwater Only Scenario
Recycled Water	• Maximum potential recycled water usage per Section 3.3.2.2 and Table 3-1, assumed to replace use from existing wells ***2.64 MGD***	• None
Rainwater Catchment	• 22 parcels per Section 3.3.2.3, assumed to replace use from existing wells ***0.01 MGD***	• None
Existing Wells	• Reduced by recycled water usage and rainwater catchment usage, then reduced by 7% conservation of HDWS sources ***14.86 – 2.64 – 0.01 – 11.18 * 7%*** ***= 11.43 MGD***	• From Phase 1 report ***11.18*** *(HDWS)* ***+ 3.79*** *(Other)* ***= 14.86 MGD***
HDWS New Wells (well source development area)	• Reduced by 7% water conservation ***13.21 * 93% = 12.29 MGD***	• ***13.21 MGD***
Water conservation	• Maximum 7% conservation assumed for existing HDWS well sources and maximum 7% conservation for new HDWS well sources per Section 3.3.3.1 ***11.18 * 7% + 13.21 * 7% = 1.71 MGD***	• None

Figure 3-5: Anticipated Demands by Source Type



It should be noted that the potential ground water that could be developed in the well source development area should be more than enough to meet the anticipated demands under both scenarios.

3.5 IMPLEMENTATION PLAN

A plan to implement the resource and facility strategies for the near-term, medium-term and long-term is described below.

3.5.1 Near-Term

The near-term (next 5 years) implementation plan includes HDWS 5-year CIP projects, implementation of the WaterSmart program (water conservation), continued monitoring and reduction of non-revenue water losses, including compliance with CWRM's water audit program through Act 169, and a DEM recycled water project. HDWS 5-year CIP projects discussed in Section 3.2.3 are focused on increasing high-level source capacity with the installation of two production wells in the source development area identified in Figure 3-2, and four transmission main improvement projects to increase the utilization of existing sources. HDWS, through its partnership with WaterSmart, has recently mailed out invitation letters to its customers within the North Kona Water System to participate in the WaterSmart Program through a survey. Participants will have their water consumption analyzed and compared to other users with similar background information and then offered suggestions on how they can conserve and use water efficiently.

The near-term implementation plan also includes installation of the DEM 20" and 14" recycled transmission waterline as part of the Queen Ka'ahumanu Highway Widening project. As discussed in Section 3.3.2.2, this waterline may provide recycled water to future reuse projects upon completion of the Kealakehe WWTP upgrade to produce R-1 recycled water. DEM has executed a contract to begin preliminary design and an Environmental Impact Statement for the WWTP upgrade.

3.5.2 Medium-Term and Long-Term

The medium-term (5-10 years) and long-term (10-20 years) implementation plan includes development of new wells in the source development area identified in Figure 3-2. Specific location of the well sites and magnitude of ground water produced will depend on several factors, such as land ownership, accessibility, and most importantly, cumulative effects on ground water. These effects will be evaluated using monitoring wells. HDWS proposes to seek funding and explore partnerships for monitoring wells. Implementation of new wells will be as needed based on timelines of future development. HDWS may also consider development of wells in the mid-elevation range drawing fresh ground water from a confined aquifer well below sea level, should studies prove this to be a viable option.

The medium-term and long-term implementation plan includes the upgrade of the existing Kealakehe WWTP to produce R-1 recycled water for irrigation/non-potable uses, which will initially provide 1.0 MGD of R-1, although a timetable for completion is not yet available. The plant may be expanded to provide additional R-1 water to future reuse areas, such as Honokōhau Small Boat Harbor and Kohanaiki Golf & Ocean Club, and potential future development areas such as a regional park, QLT, and an industrial area; however, DEM has stated that future expansion will be on an as-needed basis. DEM is also proposing to replace the existing OHDC Kaloko Housing WWTP, and if approved, would consider a treatment system to produce R-1 effluent.

The medium-term and long-term implementation plan also includes the realization of measurable outcomes of the HDWS WaterSmart Program, for example, a 23% decrease in leak duration, and a 2 to 7% water savings rate.

CHAPTER 4 WATERSHED MANAGEMENT STRATEGIES

4.1 OVERVIEW

Watershed management strategies strive to achieve several goals, including providing a sustainable supply of water for sustenance, improving water quality, conserving and restoring native plants, animals and a healthy ecosystem, and protecting native Hawaiian T&C rights and practices. Nearly all of the water for sustenance within the Keuahou ASYA is provided by ground water. Accordingly, this section will focus on watershed management strategies affecting the protection of ground water resources.

4.2 WATERSHED PROTECTION

Sustainability of ground water resources in the Kona area relies on recharge from upland forested areas. Within elevations in the 1,500 to 3,000 foot range, rainfall is the primary contributor to the recharge; above 3,000 feet, fog collecting on vegetation and then dripping to the ground (fog drip) and dew contribute significantly to the recharge. Some of the water that infiltrates into the ground in these areas also contributes to springs and anchialine pools. Ungulates pose a major threat to these upland forested areas by removing and preventing regeneration of native vegetation through grazing and advancing the spread of invasive vegetative species by transporting seeds on their coats. Some non-native invasive vegetative species have the ability to take over native vegetation ecosystems, which can alter soil moisture, nutrient balance, and habitat. Many of these invasive species also contribute significantly less to the recharge and pose a greater fire risk. Wildfires can destroy extensive areas of forest quickly and therefore pose a major threat to recharge.

Over the past century, domestic and feral ungulates have considerably altered native forest communities in the area by devastating native vegetation, which in turn allowed non-native invasive vegetative species, particularly fountain grass, to proliferate. In addition to affecting the ground water recharge, the abundance of fountain grass increased the risk of wildfires due to its dried leaves and fire-adapted nature. Fire, fountain grass, and ungulates pose the most severe threats to the area. Watershed management strategies should focus on removing these threats.

The Three Mountain Alliance (TMA) is a watershed partnership of 10 members encompassing over one million acres on Hawai'i island consisting of four priority management areas: 'Ōla'a-Kīlauea, Ka'ū-Kapāpala, South Kona, and North Kona. All of the area encompassed is divided amongst 6 owner members. In the Kona area, the major land owner is Kamehameha Schools (KS), and other land owners include the State DLNR, Division of Forestry and Wildlife (DOFAW) and the National Park Service (NPS). In 2007, the TMA prepared a Management Plan that identified management goals, objectives, and operational protocols; and developed strategies for each of its four priority management areas to address the high priority management issues that affect multiple landowners and natural resources across its landscape. HDWS participates in the TMA.

4.3 WELLHEAD PROTECTION

The State Department of Health, Safe Drinking Water Branch (SDWB) has set aside 15% of its allotted funding for the Drinking Water State Revolving Fund (DWSRF) to be utilized for its Wellhead Protection – Financial Assistance Program. The projected available funds for each fiscal year is $500,000. The goal of the program is to support water utilities to plan and implement drinking water source protection actions. Eligible recipients include public water systems that use ground water as the source of drinking water, government agencies, and planning agencies/community groups partnered with a public water system on source water protection activities. Eligible projects involve both planning and implementation and cover a wide range of activities including planning documents, strategies, inventories, management, education, staffing and remediation.

HDWS has participated in the SDWB Wellhead Protection program with projects primarily focused on public education.

CHAPTER 5 SUMMARY AND RECOMMENDATIONS

The Hawai'i Water Use and Development Plan Update for Keauhou Aquifer System Area promotes overall themes common to several other Hawai'i Water Plan components:

- Public Trust Doctrine – the State holds ownership over public water resources as a trustee for the benefit of the people of the State.
- Water is a most precious resource, shall be used wisely and conserved, not wasted.
- The highest quality water shall be used for the public's highest beneficial uses.
- Lower quality water (e.g. recycled water, surface water, brackish water) should be used whenever feasible.

Specific recommendations for the Keauhou ASYA are as follows:

1. Development of new ground water well sources is encouraged in areas within the high-level aquifer generally from the vicinity of the HDWS Queen Lili'uokalani Trust Deepwell extending south into the Kealakekua ASYA.

2. Continue studies of the ground water hydrology in the Keauhou ASYA, particularly the mid-elevation deep water source, which potentially could be a long-term solution.

3. Water purveyors are encouraged to assist in the development of non-potable water resource enhancement measures that do not involve ground water, such as recycled water, to satisfy non-potable demands. This may reduce reliance on ground water sources.

4. State and County agencies and private entities with water interests in the Keauhou ASYA are encouraged to participate and/or coordinate with the Three Mountain Alliance major landowners (KS, DOFAW and NPS) to assist in the preservation and restoration of watersheds in the Keauhou ASYA which will ultimately protect and potentially augment the ground water resources.

5. State and County agencies are encouraged to develop and implement ground water well protection initiatives and to participate in the SDWB Wellhead Protection Financial Assistance Program.