ALAN M. ARAKAWA
Mayor

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OFFICE OF THE MAYOR

DEPARTMENT OF WATER SUPPLY
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February 25, 2011

Honorable Alan M. Arakawa
Mayor, County of Maui
200 South High Street
Wailuku, Hawaii 96793

For Transmittal to:

Honorable Danny A. Mateo, Chair
and Members of the Maui County Council
200 South High Street
Wailuku, Hawaii 96793

APPROVED FOR TRANSMITTAL
2/25/11
Mayor Date

Dear Chair Mateo and Members:

SUBJECT: ADOPTION OF THE DRAFT LANAI WATER USE AND DEVELOPMENT PLAN (LWUDP)

As per County Ordinance 3792-14.02.040.3, attached are: (a) the Director of Water Supply's (Director) version of the referenced draft plan (dated February 25, 2011); and (b) the version of the draft plan that was developed and reviewed by the Lanai Water Advisory Committee (LWAC) and the Board of Water Supply (BWS). The Director's version includes several amendments and some reformatting; the intent is to provide clarity, as well as respond to recommendations by the BWS and stakeholders.

The referenced plan was developed to meet the requirements of HRS Section 174 (C)-31, HAR Section 13-7-170, and Maui County Code 2.88. The undertaken planning process involved continuous public participation through the LWAC, public hearings, and review by the BWS. As part of the mentioned requirements, the BWS transmitted its recommendations to the Department of Water Supply (Department) on December 23, 2010; this transmittal also included transcripts of the public hearings and written testimony. A broad range of recommendations was presented during the public testimony to the BWS. There was considerable support for the adoption of the referenced plan without any changes; however, there was also testimony recommending substantial changes or rejection of this plan.

The BWS, by majority vote, accepted the referenced draft plan with several recommendations as indicated in its attached letter. In this regard, it should be noted that four of the BWS members opposed the draft plan; they recommended that it should be rejected by the Director and reconstructed. In addition, the system operator (Castle and Cook) did not support this plan.

The Department reviewed the above mentioned recommendations and testimonies; this review considered the following points of reference in determining a reasonable approach to adopt the subject plan:

- ***Dissenting Opinions:*** Despite the Board approval, the Department is concerned about the dissenting opinions, especially the lack of support from the system operator;

- ***Lanai Quality of Life:*** This plan is important to the Lanai Community's current and future quality of life; ***and***

- ***Consensus:*** Equally important is to reach a consensus on the best approach to secure a reliable and efficient water system, as well as presenting such an approach in a clear way that facilitates its implementation.

The Department determined that the above mentioned issues could be addressed by achieving the following: reorganizing/reformatting the plan document to provide focus and clarity; and reframing certain aspects of the plan to provide clarification or details that respond to stakeholder comments. The amendment/reformatting task resulted in the Director's draft plan that is being submitted with this letter. Also transmitted via this letter is the original draft plan that was submitted to the BWS.

The following summarizes the major differences between the Director's draft and the draft that was submitted to the BWS on June 28, 2010:

(1) The *Executive Summary* (Chapter 1) of the BWS review draft was amended and expanded to serve as the main text of the LWUDP. The other following detailed chapters of the BWS review draft have been compiled as a separate section titled *Supporting* Documentation. The appendices from the BWS review draft were retained as appendices. The Director's draft is thus reformatted into three parts: (1) a substantially shorter main text; (2) *Supporting Documentation;* and (3) Appendices. All three sections are integral parts of the LWUDP.

(2) All of the implementing directives in the plan have been moved to one identifiable section of the main text titled *Lanai Island Water Plan Provisions.*

(3) Several substantive changes were made to the plan in response to recommendations by the BWS:

(a) The BWS recommended that the several paragraphs to "ALLOW or DO NOT ALLOW" should be removed. These paragraphs have been removed and alternate language is provided in the main text section *Lanai Island Water Plan Provisions*; the intent is to clarify that the plan does not take away or exchange any existing land use entitlements.

(b) The Proposed Allocation Plan tables in Chapter 7 of the BWS draft and related text, that could be interpreted to allocate water according to specific schedules or triggers, have been removed. The Proposed Allocation Plan tables have been relabeled, moved, and reframed as part of the Resource Development Strategy explained in the main text and Chapter 5 of the *Supporting Documentation*. Alternate language regarding land entitlements is provided in the *Lanai Island Water Plan Provisions* section of the main text.

(c) The directive to raise watershed protection fence height in the Implementation Matrix has been deleted.

(d) All of the draft ordinance language in the Appendices is merely draft language for expository purposes and is not being proposed for adoption as part of the LWUDP.

(4) The following amendments were made to the Chapters in the BWS review draft that are now included in the Supporting Documentation:

- Chapter 1 (*Executive Summary*) of the BWS review draft was amended and expanded and now serves as the main text of the Director's draft plan.

- Chapters 2, 3, 5, and 6 of the Supporting Documentation are identical to the corresponding Chapters 2, 3, 5, and 6 of the BWS review draft.

- Chapter 4 *Demand Analysis* of the Supporting Documentation is identical to the corresponding Chapter 4 of the BWS review draft with the exception of the addition of several Resource Development Strategy Water Use tables that are edited and moved from Chapter 7 of the BWS review draft.

- Chapter 7 of the BWS review draft addresses *Policy Issues and Recommendations*. Chapter 7 of the Supporting Documentation has been amended by removing the recommendations, as well as the table and text referring to implementing water allocations. Alternate recommendations are now addressed in the *Lana'i Island Water Plan Provisions* section of the main text of the Director's draft. The Proposed

Allocation Plan tables in the BWS review draft have been relabeled and are now included as part of the Resource Development Strategy Water Use tables, documented in the main text of the Director's draft and Chapter 4 of the *Supporting Documentation*.

- Chapter 8 of the BWS review draft identified several implementing actions, including actions listed in an implementing matrix and several tables. Some of these implementing actions are now identified in the *Lana'i Island Water Plan Provisions* section of the main text of the Director's draft. Chapter 8 of the *Supporting Documentation* omits most of the text and tables from the previous draft but retains the Implementation Matrix with some deletions. The Implementation Matrix is re-characterized as a list of possible actions that could support the intent of the LWUDP.

Thank you for your consideration of this matter. Should further assistance or clarification be necessary, please contact me at Ext. 7816.

Sincerely,

DAVID TAYLOR, P.E.
Director of Water Supply

Attachment
xc: DWS Water Resources Planning Division
DT:MAM:atn
P:\DOCS\2011\Final-022411 Lanai WUDP Adoption.doc

February 25, 2011 DWS Amended Draft

LANA‘I ISLAND WATER USE & DEVELOPMENT PLAN

Submitted by the Department of Water Supply

Members of the Lana'i Water Advisory Committee:

Reynold "Butch" Gima

John Irons

Sol Kaho'ohalahala

Ron McOmber

John Ornellas

Ed Oyama

Clay Rumbaoa

Ricky Sanches

John Stubbart

Julio Russi - Alternate at Large Member

Sally Kaye - Recent Past Chair of the Lana'i Planning Commission

Charley Ice - Ex Officio Representative for CWRM

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Acronyms and Abbreviations

The following acronyms and abbreviations are used throught this document in various text and tables, and are provided here for the convenience of the reader.

AG	Agriculture, Agricultural Uses of Water
CCR	Castle & Cooke Resorts, LLC.
CFR	Code of Federal Regulations
COMM	Commercial, Commercial Uses of Water
CWRM	State of Hawai‘i Commission on Water Resource Management
DBPR	Disinfection By-Products Rule
DEVEL	Development, Use of Water for Development
DOH	State of Hawai‘i Department of Health
DWS	County of Maui, Department of Water Supply
EPA	United States Environmental Protection Agency
GOV	Government, Use of Water for Government
GPD	Gallons Per Day
GPM	Gallons Per Minute
GWUDI	Ground Water Under the Direct Influence of Surface Water
HAR	Hawai‘i Administrative Rules
HOT	Hotel, Use of Water for Hotel(s)
HRS	Hawai‘i Revised Statutes
IGGP	Irrigation Grid in Palawai, Palawai Area
IND	Industry, Industrial Uses of Water (mainly combined into Comm for Lana‘i)
IRR-AG	Agricultural Irrigation
IRR-DEV	Outdoor Uses of Water for Development, Dust Control, Irrigation, Etc.
IRR-GEN	Irrigation Uses Other Than Those Specifically Listed

IRR-GOLF	Irrigation for Golf
IRR-HOT	Irrigation for Hotel Grounds
IRR-MF	Irrigation of Grounds & Common Areas in Multi-Family Developments
IRR-SF	Irrigation Use By Single Family Homes
LHI	Lana‘i Holdings, Inc.
LSG	Lana‘ians for Sensible Growth
LWAC	Lana‘i Water Advisory Committee
LWCI	Lana‘i Water Company, Inc.
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MGD	Million Gallons Per Day
MNPD	Manele Project District, Manele-Hulopo‘e Area
MRDL	Maximum Residual Disinfectant Level
NNP	Not Necessarily Potable
NP	Non-Potable
NPV	Net Present Value
NPDWS	National Primary Drinking Water Standards
P	Potable (used in some tables where there is insufficent space to write POT)
PD	Project District
PER	Percussion Drilled
POT	Potable
PQP	Public Quasi-Public
PUC	Public Utilities Commission
RES-MF	Multi-Family Residential
RES-SF	Single-Family Residential
ROT	Rotary Drilled
SDWA	Safe Drinking Water Act
SHF	Shaft
TUN	Tunnel
UAFW	Unaccounted-for Water
WHPA	Wellhead Protection Area

Summary

Lanaʻi faces some daunting challenges in preparing for its water future. The sustainable yield of the island is small. Recharge is highly dependent on its forested watershed. The watershed itself is mesic and rather low elevation for a cloud forest, making it susceptible to rising inversion layers, climatic change, and fires as well as invasive species. That watershed has been in decline for decades as this report is written. Development programs are ambitious, with total build-out of Project Districts plus other known projects likely to meet or exceed sustainable yields. Unaccounted-for water is high. Much of the pipe on the island, particularly in the Palawai Grid, is old, leaking and in need of replacement. While this represents a conservation opportunity, the rate and fee structure of the Lanaʻi Water Company is not sufficient to enable the necessary replacements. Per-unit consumption rates are also high, both in Manele and Koele.

FIGURE 7-1. **Sustainable Yields of Hawaiian Islands**

Island	1990 WRPP Sustainable Yield MGD	2007 Draft WRPP Update Sustainable Yield MGD	June 2008 Final WRPP Sustainable Yield MGD
Hawaii	2,431	2,175	2,410
Kauai	388	306	310
Lanaʻi	6	6	6
Maui	476	386	427
Molokai	81 / 38 Dev	71	79
Oahu	446	419	407

Lanaʻi also faces several regulatory challenges. The Commission of Water Resource Management (CWRM) decided in January 1990 to authorize the Chairperson to reinstitute water management area proceedings if the static water level of any production well should fall below one half its original level above sea level. It granted the same authorization should any source of supply in the Company's plans fail to materialize but full land development continues. In March of 1991, another trigger was set, to reinstitute designation proceedings should total pumpage exceed 4.3 MGD. Even without these triggers, the State may initiate designation proceedings when the withdrawal from any aquifer reaches 90% of its sustainable yield, which in the case of Lanaʻi's aquifer systems would be 2.7 MGD each in the Windward and Leeward systems of the island's Central Aquifer sector.

In response to such challenges, a resource development strategy is identified that includes sufficient conservation and new supply resources to meet expected water demand for the 2030 planning horizon. Conservation opportunities are identified to help bring per-unit consumption and unaccounted-for water rates down. Roughly 485,000 GPD in reasonably achievable conservation opportunity has been identified. New supply resources are identified that, in conjunction with the identified conservation measures can meet water demands resulting from build-out of projects with existing entitlements, staying within groundwater pumping sustainable yield limits.

If conservation and leak reduction targets are achieved, this strategy would result in pumpage between 3.3 MGD and 3.66 MGD in the year 2030 assuming expected levels of water demand and build-out of projects with existing entitlements. Without implementation of the identified conservation measures, pumpage could exceed the 4.3 MGD trigger for proceedings by the State Commission on Water Resource Management (CWRM) to designate LanaʻiLanaʻi as a groundwater management area. Measures for watershed protection and source protection are identified, as well as recommendations for changes to monitoring and data management.

Planning Process

Regulatory Framework

The Water Use & Development Plan (WUDP) for Lana‘i is undertaken to meet the requirements of HRS §174(C)-31, HAR §13-7-170 and Maui County Code §2.88 A. Water Use & Development Plans under these provisions are required to:

- Be consistent with the State Water Resources Protection Plan; State Water Quality Plan, State Water Projects Plan, State Agricultural Projects Plan, State District Land Use Classifications and County General & Community Plans
- Provide an inventory existing water sources and uses
- Discuss existing and future land uses and related water needs
- Set forth a program by which water needs will be met
- Allocate water to land uses
- Discuss resource impacts of proposed capital and other plans
- Incorporate public involvement
- Consider multiple forecasts
- Consider a twenty year time frame for planning analysis
- Include specific suggestions for implementation

Chapter 2 of the Supporting Documentation provides a detailed discussion of the regulatory framework applicable to the WUDP and water resources more generally.

History

In 1990 each county in the State of Hawaii prepared and adopted its initial WUDP. These WUDP’s were incorporated by CWRM into the Hawaii State Water Plan. Each county prepared a 1992 draft update to the 1990 WUDP’s but none were approved by the CWRM. The most recent adopted WUDP for the Island of Lana‘i is part of the Maui County WUDP adopted in 1990.

Resolving a petition filed in 1989, the CWRM in 1990 decided not to designate any of Lana‘i’s aquifers as groundwater management areas. In lieu of designation the CWRM required ongoing monitoring, preparation of a water shortage plan and annual information status hearings. The CWRM also set conditions that would trigger reconsideration of groundwater management area designation.

In 1993 the Maui County Council established a nine-member Lana‘i Water Sub-committee. The Council re-established the sub-committee with amended member-ship in 1995.

In 1996 the CWRM established a Lana‘i Water Working Group as a successor to the County subcommittee. The Working Group met regularly and drafted the *Final Report of the Lana‘i Water Working Group* which it adopted in 1997. This document is included as Appendix A.

The Lana‘i Water Working Group continued to meet under the unofficial auspices of the Maui Board of Water Supply (BWS) until it was formally reconstituted by resolution by the BWS as the Lana‘i Water Advisory Committee (LWAC). The purpose of the LWAC is to “provide public input and involvement during the development of the Lana‘i WUDP and to monitor the Lana‘i WUDP implementa-tion.”

The CWRM adopted a “Statewide Framework for Updating the Hawaii Water Plan” in February 2000. This document serves as a guideline to the state and county agencies to prepare each of the components of the Hawaii Water Plan. Since preparation of Lana‘i’s WUDP update was already underway when the CWRM Framework was adopted, it was agreed by the County and CWRM that the specific requirements of the new Framework would not necessarily apply to the Lana‘i WUDP.

After extensive involvement and review by the LWAC, a draft Lana‘i WUDP, dated June 28, 2010 was submitted by the Maui Department of Water Supply (DWS) to the BWS for public hearings and recommendations. The BWS held public hearings on the Island of Lana‘i and, after deliberations, approved its rec-ommendations transmitted to the Maui DWS on December 23, 2010. The BWS “accepted” the draft Lana‘i WUDP but with several recommendations.

In February 2011, the DWS amended the June 28, 2010 draft Lana‘i WUPD in response to the recommendations by the BWS. Both the June 28,2010 draft and the amended February 25, 2011 draft (this draft) are being transmitted to the Maui County Council for review.

Detailed documentation of the Lana‘i water planning process is provided in Appendix C.

Existing Resources and Systems

Lana‘i’s existing water resources and systems are identified and discussed in detail in the Supporting Documentation Chapter 3.

The sustainable yield of Lana‘i is estimated at 6 MGD. Virtually all of this is located in the Central aquifer sector which is divided into two aquifer systems with 3 MGD each. Total withdrawals in 2008 were about 2.2 MGD, with 1.9 MGD from the Leeward Aquifer System, and 0.33 MGD from the Windward Aquifer System. Withdrawals came primarily from six wells, with the exception of about 2,000 GPD.

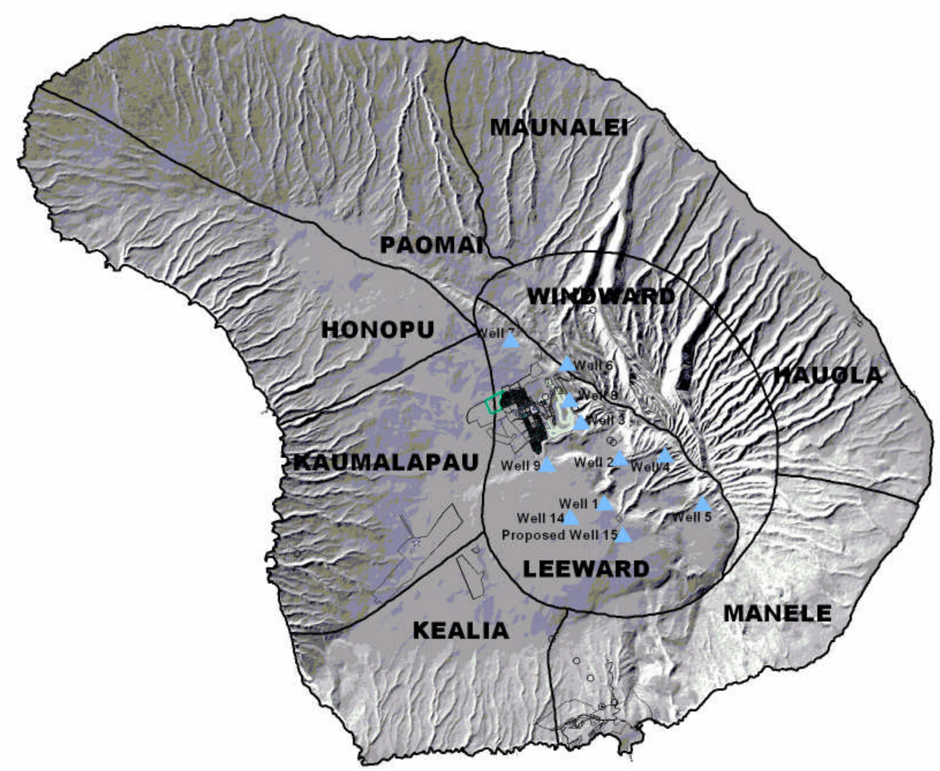

FIGURE 1-2. Lana‘i Aquifers and Wells

The island has no major surface water sources. Taro lo`i are found in Maunalei gulch. Lana'i has 13 ahupua`a in which 110 kuleana claims were made, and 56 awarded.

Fog drip from Lana'ihale is unusually important on Lana'i. The State Commission on Water Resource Management has estimated that the loss of fog drip from the watershed could cause water levels in the key recharge area to drop by half. Groundwater recharge in the primary aquifer is also closely tied to survival of the watershed forest, and would be diminished by its loss. Precipitation on Lana'ihale summit averages 35"-40" per year, unusually low for a Hawaiian Cloud Forest. This is because Lana'i lies in the rain-shadow of Maui and Molokai.

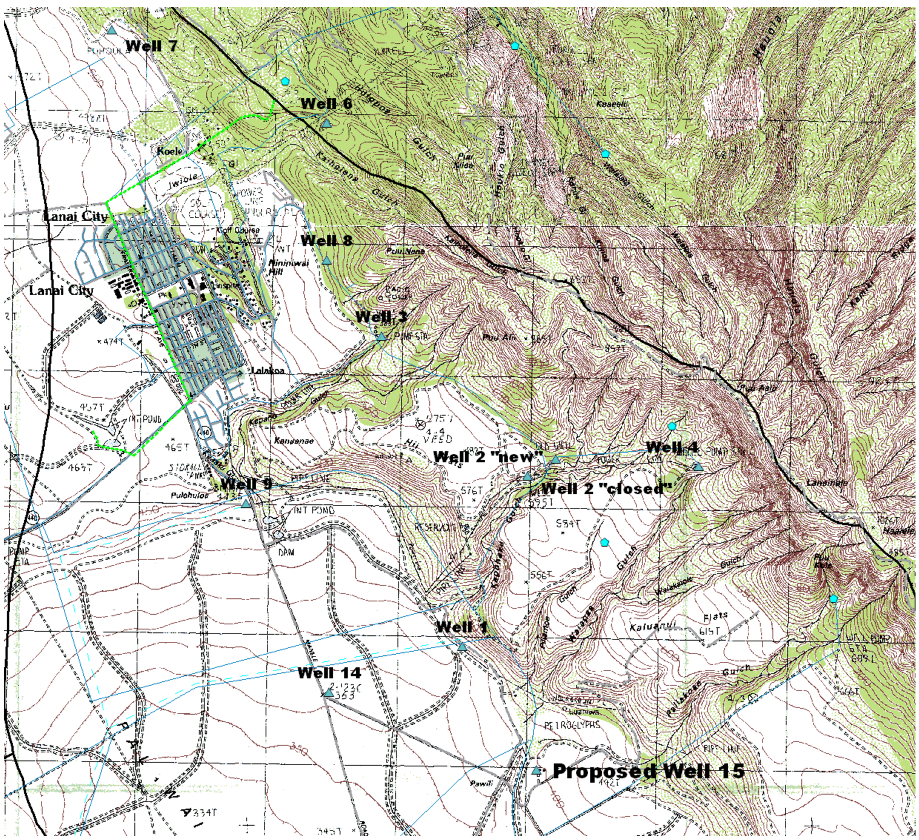

FIGURE 1-3. Lana'i Wells

Lana'i has five water supply systems, including two public drinking water systems, two reclaimed water systems, and a brackish water system. All are owned and operated by wholly owned subsidiaries of Castle & Cooke Resorts, LLC (CCR).

Lana‘i’s water systems include roughly 79 miles of active pipeline, 35 MG of storage (of which about 4.8 is potable water storage in eight tanks), and about 6.394 MGD in installed well capacity (of which 5.04 MGD is potable). About 23 well holes exist, but only 7 are in use, with one of those in use at a tiny rate of only about 2,000 GPD in 2008. The systems serve about 1,573 customers.

Reclamation facilities in Lana‘i have a total design capacity of about 1.9 MGD.

Existing potable water rates (effective in June 2010) are $1.10 for the first 25,000 gallons, and $1.62 thereafter. Existing rates and fees are not sufficient for the utility to be self-supporting. The cost of well operation is estimated at $2.17/Kgal for the Lana‘i City and Koele areas; $1.77 for the Manele and Palawai Grid areas., and $1.71 for brackish service to Manele.

Key system facilities issues include the age and condition of the system, substantial leaks and high pressures in certain areas - especially the irrigation grid, and inadequate revenue streams to support the necessary improvements.

Demand Analysis

Terminology

Water “demand” refers generally to the amount of underlying “need” for water associated with existing and projected end uses. Water demand can be met by supplying sufficient water to users or by conservation measures.

Water “consumption” refers to the amount of water (usually metered) that is delivered at the point of use.

Water “production” refers to the amount of water put in to the water system.

“Pumpage” refers to water production from wells.

“Unaccounted-for water” is the difference between production and metered consumption and consists of system leaks and unmetered consumption (including water used for fire protection, line flushing, unmetered services, illegal use).

On Lana‘i, water is divided into several independent water distribution systems for potable water, brackish water and recycled wastewater.

Historical and Existing Water Demand

Historical pumpage on Lana‘i peaked at around 3.5 million gallons per day (MGD) in 1989. With the end of the pineapple economy in 1992, pumpage dropped to just under 2 MGD, gradually rising to 2.24 MGD in 2008 (2,241,222 GPD).

Metered demand on Lana‘i in 2008 was roughly 1.66 MGD. Of that amount, roughly 0.76 MD was from Wells 1, 9 & 14, serving brackish water for irrigation to the Manele Project District area. Roughly 0.52 MGD was for the areas of Lana‘i City, Koele and Kaumalapau, and roughly 0.38 was fresh water for Manele Project District and the Palawai Irrigation Grid.

By region, metered demand for the Manele Project District was the highest, with consumption in 2008 of 1.08 MGD of combined fresh and brackish water, followed by Lana‘i City with 0.36 MGD of metered demand, Koele Project District with 0.15 MGD of metered demand, the Palawai Irrigation Grid with 0.05 MGD of metered demand, and finally Kaumalapau with 0.015 MGD of metered demand.

FIGURE 1-4. **Metered Consumption by Service District Area**

Service District Area	Abbreviation	2008 GPD	Wells Serving Area
Koele Project District	KOPD	149,128	6 & 8 (potable)
Lana‘i City	LCTY	358,008	6 & 8 (potable)
Kaumalapau	KPAU	15,604	6 & 8 (potable)
Manele Project District	MNPD	1,082,999	2 & 4 (potable) 1, 9 & 14 (brackish)
Palawai Irrigation Grid	IGGP	52,505	2 & 4 (potable)

By type of use, irrigation was the largest, at about 0.9 MGD, followed by hotel use at 0.27 MGD, single-family residential at 0.26 MGD, commercial at 0.08 MGD, multi-family residential at 0.08 MGD, agricultural use at 0.04 MGD, government at 0.016 MGD and public-quasi-public at 0.008 MGD.

FIGURE 1-5. **Metered Consumption by Type of Use**

	By Meters	Adjusted
AG	44,401	44,401
OTHER IRR	897,462	1,087,111
COMM	82,007	66,772
DEVEL	411	411
GOV	15,944	15,944
HOT	272,102	123,200
PQP	8,218	8,218
RES-MF	79,865	79,865
RES-SF	257,835	232,323
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	1,658,244	1,658,244

Unaccounted-for Water

Unaccounted-for water includes water lost due to leaks in water system storage and pipeline components as well as several types of unmetered consumption, including water used for fire protection, line flushing, unmetered services and possible theft.

Fresh and brackish water service on Lana‘i is broken down into three well service areas. Wells 6 and 8 serve Lana‘i City, Koele and Kaumalapau. Wells 1, 9 & 14 serve brackish water to Manele for irrigation. Wells 2 & 4 provide fresh water to Manele and the Palawai Irrigation Grid. An unaccounted-for water analysis was performed for each of these well service areas. About 13.52% of pumped water in Lana‘i City, Koele and Kaumalapau was unaccounted-for. About 18.76% of pumped water on the brackish system was unaccounted-for. About 44. 61% of the fresh water pumped from Wells 2 and 4 to serve the Manele Project District area and the Palawai Irrigation Grid was unaccounted-for. This unaccounted-for water analysis revealed some opportunities for supply side savings, which were included in the proposed capital plan.

FIGURE 1-6. Pumped, Metered & Unaccounted-for Water by Well Service Area

Wells	Areas Served	Pumped Water 2008 MGD	Metered Demand 2008 MGD	Unccounted -For Water 2008%
6 & 8	Koele, Lana‘i City, Kaumalapau	0.605	0.523	13.52%
2 & 4	Manele-Hulopo‘e, Palawai Irrigation Grid	0.683	0.375	44.61%
1, 9 & 14	Manele-Hulopo‘e Irrigation	0.944	0.760	18.76%
		2.232	**1.658**	
Note: Percents are accurate, but are average of twelve individual monthly amounts, so may not match precisely here.				

Lana‘i’s unaccounted water for 2008 was 28% of production. This is depicted in the chart below. This is substantially higher than industry standards and is primarily due to leaks in water storage facilities and deteriorated pipelines.

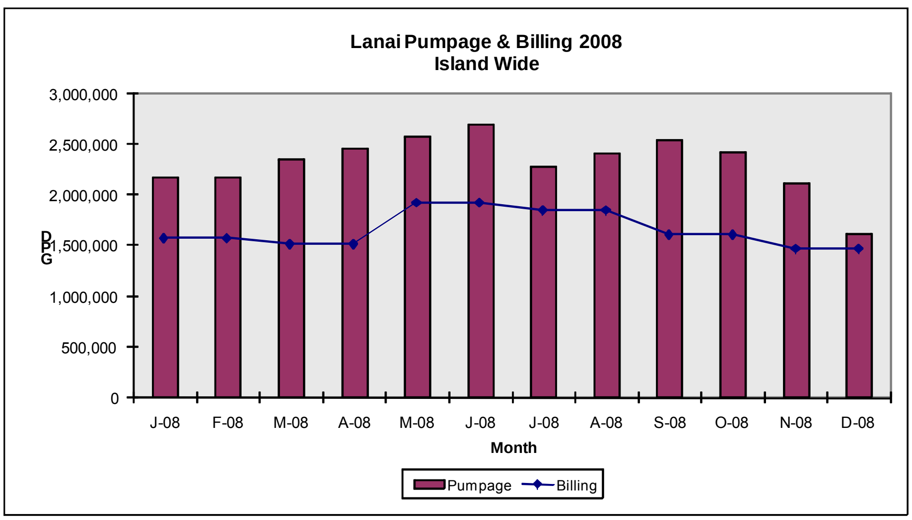

FIGURE 1-7. Lana‘i pumpage and billing - Island-wide unaccounted-for water

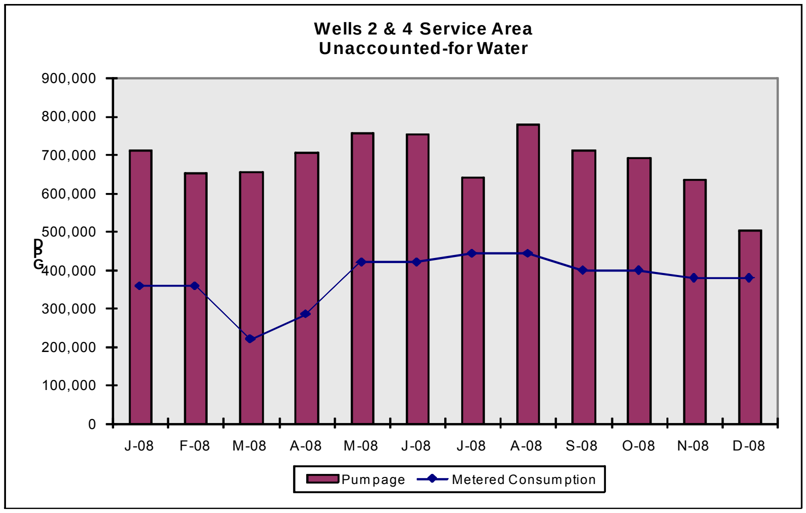

FIGURE 1-8. **Pumpage and billing - Palawai grid unaccounted-for water**

Unaccounted-for water losses on the Palawai grid are particularly high on a percentage basis, totalling 45% for the 2008 period depicted in the chart above. This means that only slightly more than half of the water pumped into the Palawai grid is actually delivered to metered water users.

Chapter 4 of the Supporting Documentation provides detailed information regarding the unaccounted-for water and improvement potential for Lana'i's water systems.

Projected Water Demand

The State's *Framework for Updating the Hawaii Water Plan* recommends that a range of forecasts be considered, and a range of supply options to meet multiple forecasts developed. This guideline was followed for Lana'i. Demand was forecasted to the year 2030 using three methods: simple time trend regressions; projections using forecast coefficients derived based upon the SMS forecast prepared for the ongoing Community Plan update process; and analysis of build-out of CCR project development proposals.

Trending Projections

Time trend analysis yielded projections of water consumption ranging from 2.4 to 3.2 MGD in 2030.

Simplified Econometric Projections

Forecast coefficients were derived for a low case, base case and high case forecast, each of which was run with three assumptions: 1) assuming each new consumer would use about the same amount of water as existing consumers, 2) assuming each new consumer would use one and a half times as much water as existing consumers, and 3) assuming each new consumer would use twice as much as existing consumers. Assuming new consumers would use the same amount per meter as existing consumers, projections of water production to the year 2030 ranged from 2.6 MGD to 3.1 MGD. Assuming new consumers would use one and a half times as much water as existing consumers, projections ranged from 3 MGD to 4 MGD. Assuming new consumers would use twice as much as existing consumers, projections ranged from 3.4 to 5 MGD.

Build-out Demand Analysis

Estimates of demand by analysis of project build-outs was somewhat higher, ranging from about 3.6 MGD for build-out of Phase II approvals, to over 7 MGD, for full build-out of proposals submitted by CCR, plus Project District elements approved by ordinance but not included in the proposals, plus other known projects.

Demand projections were made for both potable and non-potable water uses. The delineation between these types of water use is uncertain because it is affected by future supply resource choices, as well as by demand trends. Projected demands for potable uses ranged from 1.4 to 2.7 MGD. The projection of combined brackish and reclaimed uses ranged from 1.6 to 2.8 MGD. The low end of these projections assumes the low-case forecast, and that each new meter will use about the same amount of water as existing meters. The high end assumes both the high case forecast, and that each new meter will use twice as much pumped water as existing meters.

Two build-out projections were proposed by CCR:

- A 2006 CCR proposal included projects with a total demand of 6,079,523 GPD, of which roughly 4.163 MGD was to be met by pumping potable and brackish water, (3.411 potable and 0.752 brackish), 0.616 MGD was to be met by reclaimed water, and 1.3 MGD was to be met by one or more unidentified “alternative” sources.

A 2009 CCR proposal included projects with a total demand of 6,969,848 GPD, of which roughly 4.208 MGD was to be met through pumping potable and brackish water, (3.374 MGD potable and 0.834 MGD brackish), 1.209 MGD was to be met by reclaimed water, and 1.553 MGD was to be met by one or more unidentified “alternative sources”. Several adjusted versions of the CCR build-out projections were prepared recognizing that the water demand for the CCR build-out projections could be greater than shown, due to project district elements that are not included, known projects for which estimates are not included, and actual unaccounted-for water rates which are higher than what is characterized. Projections that include other known projects and portions of the project districts which are not included in the CCR projections indicate total demands as high as 7.13 MGD.

Combined Econometric and Build-out Projections

For planning purposes, a resource development strategy was developed that incorporates a projection of water demand that (1) includes an estimate of the rate of increase in water demand predicted by economic and demographic considerations through 2030 and (2) identifies the amount of water necessary for build-out of known projects and projects with Phase II approval. The Phase II build-out projection indicates water demand of over 5 MGD. With the conservation measures identified as part of the base plan resource development strategy described below, total pumpage would be 3.7 MGD.

FIGURE 1-9. Island-wide Projections for 2030 - Various Methods - MGD

Method	**Low**	**High**	**Base Range**
Time Trend of Production	2.43	3.23	2.43 - 3.23
Econometric Forecast - 2008 Base Year Production	2.98	5.84	3.03 - 4.10
Econometric Forecast - Metered Consumption Plus 12% UAFW LCTY, 15% MNPD	2.56	5.03	2.61 -3.53
Build-out - CCR 2006 Estimate * includes 12% UAFW			6.08
Build-out - CCR 2009 Estimate *includes 12% UAFW			6.97
Build-out - Re-Analysis of 2006 CCR proposal using system standards or forecast coefficients, adjusting existing uses to billed records, adding other known projects etc.*			6.29
Build-out - Re-Analysis of 2006 CCR proposal as above, adding Existing Phase I Project District Elements not included in proposal, updated scopes for affordable housing and HHL.			7.13
Build-out of Known Projects Plus Projects with Phase II Entitlements			5.07
Note: 2030 build-out numbers shown in this table do NOT include resource reserves, but DO include water demands which may be met by means other than pumpage, such as use of reclaimed water, unidentified sources, desalinization or conservation and efficiency measures.			

As shown in the table above, build-out of the projects with Phase I approval, including the CCR proposals would require more water demand than is available from groundwater sources. For comparison, the sustainable yield of the Windward and Leeward aquifers is 3 MGD each. 90% of the total sustainable yield is 5.4 MGD.

Resource Options

Supply Resource Options

Detailed information regarding a list of potential supply resource options is provided in Chapter 5 of the Supporting Documentation.

New supply resource options that were examined include:

- High level potable well near Well 5 in the Leeward Aquifer
- Well 2-B at the site of Shaft 3 in the Leeward Aquifer
- Recommissioning Well 7 in the Leeward Aquifer
- New wells in the Windward Aquifer at Mala‘au
- Recommissioning the Maunalei Shaft and Tunnels in the Windward Aquifer
- New wells in the Windward Aquifer at or near the Maunalei Shaft and Tunnel sites
  - Two (2) new wells using existing transmission
  - Three (3) new wells using existing transmission
  - Three (3) new wells using new transmission
- New wells in the Windward Aquifer at Kauiki
  - Assuming that these wells can tie into Maunalei Wells transmission
  - Assuming new transmission had to be constructed
- New wells in the Windward Aquifer at Kehewai Ridge
  - At 2,250’ elevation
  - At 2,750’ elevation
- New Brackish Well 15 in the Leeward Aquifer
  - Used without additional desalinization
  - Used with desalinization
- “General” Desalinization Options
  - Brackish to potable
  - Seawater to potable
  - Seawater to brackish for irrigation

Supply Side Efficiency Options include:

- Loss Reduction - Repair of Palawai Grid Pipes
- Loss Reduction - Cover for the 15 MG Brackish Reservoir
  - Floating cover

  - Aluminum cover
  - Hypalon balls
- Expanded use of Lanaʻi City Reclaimed Water
  - Lanaʻi City to Miki Basin
  - Lanaʻi City to Manele
  - Lanaʻi City to Manele via Miki Basin

Description and discussion of each of these potential resources is provided in the Chapter 5 of the Supporting Documentation. In order to develop a meaningful comparison of the value of each option, total costs of each option were derived and expressed as levelized to costs per 1,000 gallons of water produced. A summary is presented in the tables below.

Option Name	Plant Capacity Installed	Plant Capacity Effective	Average Output	Capital Cost: Cost	Capital Cost: Unit Cost	Fixed Operating: Cost	Fixed Operating: Unit Cost	Variable Operating Cost	Plant Life Economic	Economic Life Total Discounted Cost: Total Unit NPV	Total Levelized	Capital Levelized	Fixed Op. Levelized	Var. Op. Levelized
	MGD	MGD	MGD	$M	$M/MGD	$/Year	$/Year/MGD	$/kgal	Years	NPV $2007 $M /MGD	**Levelized $ / kgal**	Levelized $ / kgal	Levelized $ / kgal	Levelized $ / kgal
Proposed New Well #2B @ Shaft 3 Site	0.864	0.300	0.300	$1.883	$6.276	$15,415	$51,383	$0.92	30	$14.901	**$2.97**	$1.25	$0.20	$1.51
Proposed New Brackish Well #15	0.864	0.300	0.300	$2.657	$8.856	$19,519	$65,063	$1.30	30	$20.894	**$4.16**	$1.76	$0.26	$2.14
Well - High Level Potable (1) 1mgd near Hi`i Tank	0.864	0.300	0.300	$2.867	$9.556	$20,599	$68,663	$1.41	30	$22.554	**$4.49**	$1.90	$0.27	$2.31
Well - High Level Potable (1) 1MGD near Well #5	0.864	0.300	0.300	$2.957	$9.856	$22,759	$75,863	$1.61	30	$24.650	**$4.91**	$1.96	$0.30	$2.64
Recommission Well#7	0.720	0.300	0.300	$2.678	$8.927	$26,719	$89,062	$2.37	30	$30.266	**$6.02**	$1.78	$0.35	$3.89
Wells - Windward (3)1MGD at Maunalei w/Existing Transmission	3.000	0.750	0.750	$8.001	$10.668	$118,144	$157,525	$2.43	30	$33.860	**$6.74**	$2.12	$0.62	$3.99
Wells - Windward (2) 1 MGD Maunalei w/Existing Transmission	2.000	0.500	0.500	$6.766	$13.531	$78,763	$157,525	$2.43	30	$36.723	**$7.31**	$2.69	$0.62	$3.99
Windward Well at Malau	0.864	0.300	0.300	$6.377	$21.256	$23,839	$79,463	$1.71	30	$36.948	**$7.35**	$4.23	$0.31	$2.81
Windward Well at Kauiki (Incremental)	0.864	0.300	0.300	$4.865	$16.216	$40,334	$134,445	$2.73	30	$41.431	**$8.25**	$3.23	$0.53	$4.49
Recommission Maunalei Shaft/Tunnels	1.000	0.500	0.500	$10.110	$20.220	$48,513	$97,025	$2.43	30	$42.213	**$8.40**	$4.02	$0.38	$3.99
Wells - Windward (3)1MGD at Maunalei w/New Transmission	3.000	0.750	0.750	$14.607	$19.476	$118,144	$157,525	$2.43	30	$42.668	**$8.49**	$3.87	$0.62	$3.99
Windward Well at Kehewai Ridge 2250ft.	0.864	0.300	0.300	$9.275	$30.916	$28,159	$93,863	$2.11	30	$50.200	**$9.99**	$6.15	$0.37	$3.47
Windward Well at Kehewai Ridge 2750ft.	0.864	0.300	0.300	$9.659	$32.196	$32,479	$108,263	$2.51	30	$55.073	**$10.96**	$6.40	$0.43	$4.12
Windward Well at Kauiki	0.864	0.300	0.300	$10.925	$36.416	$40,334	$134,445	$2.73	30	$61.631	**$12.27**	$7.24	$0.53	$4.49
Desalination - Seawater to 400 ppm Chlorides	0.250	0.250	0.250	$3.335	$13.338	$100,348	$401,390	$6.37	30	$73.969	**$14.72**	$2.65	$1.58	$10.48
Desalination - 50% Seawater to 225 ppm Chlorides	0.250	0.250	0.250	$3.272	$13.086	$111,598	$446,390	$9.97	30	$104.372	**$20.77**	$2.60	$1.76	$16.40
Desalination - Seawater to 225 ppm Chlorides	0.250	0.250	0.250	$3.382	$13.527	$121,598	$486,390	$13.17	30	$132.062	**$26.29**	$2.69	$1.92	$21.66

Levelized costs are calculated based on 3.0% inflation, 6.0% cost of capital and 6.0% discount rate. Operating costs are estimates of Haiku Design & Analysis.
Electricity costs included in Variable Operating Costs are $0.40 per KWH (= $125/bbl crude oil price) escalated at 4.0% for levelization.
All engineering assumptions, estimated costs and impacts are planning projections that will need to be verified by specific studies prior to implementation.
NPV = net present value MGD = millions of gallons per day kgal = one thousand gallons $2007 = constant (real) dollars

Resource Options

Option Name	Plant Capacity Installed	Plant Capacity Effective	Plant Capacity Average Output	Capital Cost	Capital Unit Cost	Fixed Operating Cost	Fixed Operating Unit Cost	Variable Operating Cost	Plant Life Economic	Economic Life Total Discounted Cost: Total Unit NPV	Total Levelized	Capital Levelized	Fixed Op. Levelized	Var. Op. Levelized
	MGD	MGD	MGD	$M	$M/MGD	$/Year	$/Year/MGD	$/kgal	Years	NPV $2007 $M /MGD	**Levelized $ / kgal**	Levelized $ / kgal	Levelized $ / kgal	Levelized $ / kgal
Pipe Replacement / Loss Reduction IGGP	0.202	0.202	0.202	$3.840	$19.010	-$3,737	-$18,500	-$1.49	20	$9.782	**$2.34**	$4.54	-$0.07	-$2.14
Recycled Water Line to Miki Basin Industrial Prk	0.060	0.060	0.060	$1.536	$25.600	$248	$4,140	$0.40	30	$28.974	**$5.77**	$5.09	$0.02	$0.65
Recycled Water Line to Manele (2030)	0.500	0.500	0.500	$16.896	$33.792	$2,070	$4,140	$0.40	30	$37.166	**$7.40**	$6.72	$0.02	$0.65
Phase II Recycled Water Line Miki Basin to Manele	0.440	0.440	0.440	$15.456	$35.127	$1,822	$4,140	$0.40	30	$38.501	**$7.66**	$6.99	$0.02	$0.65
Phase I Recycled Water Line to Miki Basin Industrial Park	0.060	0.060	0.060	$2.304	$38.400	$248	$4,140	$0.40	30	$41.774	**$8.31**	$7.64	$0.02	$0.65
Floating Cover on 15 MG Reservoir	0.017	0.013	0.013	$0.366	$27.692	$0	$0	$0.00	10	$27.692	**$10.31**	$10.30	$0.00	$0.00
Hypalon Balls on 15 MG Reservoir	0.017	0.014	0.014	$0.495	$35.294	$0	$0	$0.00	10	$35.294	**$13.14**	$13.13	$0.00	$0.00
Aluminum cover on 15 MG Reservoir	0.017	0.013	0.013	$4.024	$304.821	$0	$0	$0.00	30	$304.821	**$60.67**	$60.63	$0.00	$0.00

Notes: Levelized costs are calculated based on 3.0% inflation, 6.0% cost of capital and 6.0% discount rate. Operating costs are HDA estimates.
Electricity costs included in Variable Operating Costs are $0.40 per KWH (= $125/bbl crude oil price) escalated at 4.0% for levelization.
All engineering assumptions, estimated costs and impacts are planning projections that will need to be verified by specific studies prior to implementatic

Abbreviations: NPV = net present value MGD = millions of gallons per day kgal = one thousand gallons $2007 = constant (real) dollars

Conservation "Demand-Side" Resource Options

A list of "demand-side" management (DSM) conservation measures was analyzed. DSM refers to measures that are implemented on the customer "side" of the water meter. DWM programs are implemented by the utility or other agency to encourage, finance or directly install conservation measures on the premises of water users.

Discussion and detailed information regarding the characterization and analysis of conservation measures is provided in Chapter 5 of the Supporting Documentation. A table showing economic analysis of some of the DSM measures is provided below. In order to provide meaningful comparison of the costs of various measures with one another and with supply resource options, costs are expressed as levelized life-cycle costs per thousand gallons of reduced water consumption.

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Resource Options

Candidate DSM Program Characterization

Program Name	Delivery Mechanism	Measure Cost Equip Cost	Measure Cost Instal Cost	Measure Cost Total per unit	Utility Cost Rebate per unit	Utility Cost Admin per unit	Utility Cost Total per unit	Program Cost Participant per unit	Program Cost Utility per unit	Program Cost TRC per unit	Savings Efficacy gpdpf	Measure Life Years	Levelized Unit Cost Participant $ / kgal	Levelized Unit Cost Utility $ / kgal	Levelized Unit Cost TRC $ / kgal
Toilet Flapper Install	Per SPU CPA	$8	$0	$8	$8	$12	$20	$0	$20	$20	9.25	10	$0.000	$0.804	**$0.804**
Toilet Targeted Retro	Direct installation of fixtures in targeted buildings with existing 5-7 gpf fixtures	$80	$100	$180	$180	$75	$255	$0	$255	$255	50.00	15	$0.000	$1.438	**$1.438**
Urinal Retro Rebate	Rebate Application similar to Honolulu toile rebate program	$250	$100	$350	$150	$50	$200	$200	$200	$400	55.55	15	$1.015	$1.015	**$2.031**
Toilet Retro Rebate	Bounty for old fixtures brought to depo (dumpster) and destroyed.	$80	$100	$180	$100	$50	$150	$80	$150	$230	30.00	15	$0.752	$1.410	**$2.162**
Toilet Retro Rebate	Rebate Application based on Honolulu program	$80	$100	$180	$100	$50	$150	$80	$150	$230	30.00	15	$0.752	$1.410	**$2.162**
Shwrhd Direct Install	Showerheads installed by trained technicians				$0	$30	$30	$0	$30	$30	7.29	10	$0.000	$1.531	**$1.531**
Shwrhd Canvass	Showerheads distributed by door to doo canvase with choice of type				$0	$20	$20	$0	$20	$20	4.86	10	$0.000	$1.531	**$1.531**
Showerhead Giveaway	Showerheads distributed at public events or by request				$0	$10	$10	$0	$10	$10	1.62	10	$0.000	$2.296	**$2.296**
Shwrhd Mass Mail	Showerheads mailed to all customers				$0	$15	$15	$0	$15	$15	1.62	10	$0.000	$3.444	**$3.444**
Water Eff Clothes Wash	Rebate Application with purchase documentation	$350	$0	$350	$150	$70	$220	$200	$220	$420	16.91	10	$4.400	$4.840	**$9.240**
Water Eff Dish Washer	Rebate Application with purchase documentation	$50	$0	$50	$50	$70	$120	$0	$120	$120	1.00	10	$0.000	$44.640	**$44.640**
Improve Irr. Scheduling	Per SPU CPA - Improve irrigation efficiency by better scheduling	$25	$0	$25	$25	$9	$34	$0	$34	$34	23.77	10	$0.000	$0.534	**$0.534**
Low Water Use Plantings	Per SPU CPA - Replace 300sq.ft. lawn with low water req. plants	$25	$0	$25	$25	$9	$34	$0	$34	$34	10.31	10	$0.000	$1.231	**$1.231**
Xeriscaping	HDA per SPU CPA - Replace irrigated landscaping with zeriscape	$500	$1,000	$1,500	$500	$300	$800	$1,000	$800	$1,800	500.00	10	$0.744	$0.595	**$1.339**
Soil Moisture Sensor	Per SPU CPA - Install soil moisture sensors on automatic irrigation systems	$150	$0	$150	$150	$9	$159	$0	$159	$159	34.11	10	$0.000	$1.735	**$1.735**
Improve Perf. of Irr. Sys.	Per SPU CPA - repair, replacement, adjustmen of in-ground irr. system	$188	$0	$188	$188	$9	$197	$0	$197	$197	38.03	10	$0.000	$1.923	**$1.923**
Auto Rain Shut Off	Per SPU CPA - Install automatic rain shut-off on automatic irrigation systems	$50	$0	$50	$50	$9	$59	$0	$59	$59	10.66	10	$0.000	$2.063	**$2.063**
Rain Barrel Catchment	Per SPU CPA - Install 50 gallon barrels to gutte downspouts for irrigation	$50	$0	$50	$50	$9	$59	$0	$59	$59	1.99	10	$0.000	$11.050	**$11.050**
Greywater for Irrigation	Per SPU CPA - Install grey water collect/dist. system -new and remod. with sand filtratior	$2,000	$0	$2,000	$2,000	$9	$2,009	$0	$2,009	$2,009	16.11	15	$0.000	$35.169	**$35.169**

Notes:
Shaded cells are data entry cells; other numerical cells are calculated
SPU CPA = Seattle Public Utilities Conservation Potential Assessment Final Project Report, May 1998. Delivery mechanisms were not explicitly identified for several programs
Documentation, calculations of estimates and sources are identified on a more detailed source spreadsheet
Levelized costs are calculated according to the identified measure life assuming a 3.0% inflation rate, 6.0% cost of capital, 6.0% discount rate.
All estimates and calculated costs and savings impacts should be considered rough approximations for purposes of intial measure and program assessment.

Abbreviations: gpd = gallons per day; gpdpf = gallons per day per fixture; kgal = thousand gallons; TRC = Total Resource Cost Test HDA = Haiku Design & Analysis (Carl Freedman)

Resource Development Strategy

A base case "resource development strategy" was developed to investigate and identify a viable approach to meet anticipated planning period water needs most economically within resource availability constraints. The strategy identifies new supply resources and conservation measures sufficient to provide for existing water needs as well as anticipated water needs for known new projects and projects with Phase II project district entitlements.

The resource development strategy serves as a planning and analysis tool to determine what new resources and conservation measures will be necessary and will most economically and effectively meet water demands that could develop during the planning period. In the context of Lana'i's limited water resources, the resource development strategy also serves to show what economic challenges can be expected in conjunction with build-out of entitled land developments.

Resource Strategy Demand Projections

The resource development strategy incorporates a projection of water demand through the year 2030 based on econometric analysis of the Socio-Economic forecast used in the current County general plan update. Projections beyond 2030 include estimate of water needs for build-out of known projects and projects with Phase II project district entitlements.

The table below shows the projected water production broken down by water system and service area for five year increments to the year 2030. The rightmost column shows production requirements to meet the needs of build-out of known projects and projects with Phase II entitlements. The projections identify and include the impacts of the conservation and leak reduction measures identified below.

A 10% percent aquifer pumping reserve (to keep pumping below 90% of sustainable yield) is included in the projections. Totals are shown both including and excluding this pumping reserve. Production requirements in the year 2030 and for Phase II build-out exceed the pumpage sustainable yield of the Leeward aquifer (3 MGD) and would therefore require some contribution from resources developed in the Windward aquifer.

A more detailed version of the table below, along with clarifying footnotes, is provided in Chapter 4 *Demand Analysis* in the Supporting Documentation starting at page 4-113.

Resource Development Strategy

RESOURCE DEVELOPMENT STRATEGY - SOURCE USE TO THE YEAR 2030

Land Use Category	Present Metered (2008)	Source Requirement with Target UAFW 12% in LCTY,KOPD,KPAU 15% in MNPD, IGGP	Pumped Water For Each Demand Stream Including UAFW 2010	2015	2020	2025	2030	Phase II Plus Other Known Projects
Koele PD - Fresh	149,128	169,464	185,149	157,403	185,909	206,816	229,426	335,507
Koele PD - Brackish	0	0	0	0	0	0	0	0
Koele PD - Reclaimed Water	234,093	234,093	258,235	261,552	278,477	297,204	316,798	316,798
Lana`i City & Related Areas - Residential - Fresh	268,127	304,690	333,374	287,071	348,037	379,530	421,030	367,508
Lana`i City & Related Areas - Other - Fresh	105,486	119,870	131,173	116,067	134,386	151,973	165,457	165,592
Lana`i City Housing Project				87,290	155,551	223,813	257,943	292,074
County Lana`i City Recreation Area				15,455	15,455	15,455	15,455	15,455
DHHL Project				11,591	112,386	115,114	129,091	143,068
Lana`i City Redevelopment Project				41,081	82,161	133,071	144,604	156,136
Kaumalapau Subdivision								30,682
Lana`i City & Kaumalapau - Conservation Target - Fresh			5,750	91,200	95,800	100,400	105,000	105,000
Potable Resource Reserve - 10% of Aquifer Sustainable Yield (300 KGal each)		600,000	600,000	600,000	600,000	600,000	600,000	600,000
Palawai IGGP - Agricultural - Fresh	28,044	32,993	35,590	19,616	22,707	28,074	28,524	28,067
Palawai IGGP - Agricultural - Reserve - Fresh			588,235	588,235	588,235	588,235	588,235	588,235
Palawai IGGP - Other - Fresh - incl. warehouse (total is offset by reclaimed)	24,461	28,778	30,755	17,109	16,712	21,544	29,267	23,523
Palawai IGGP - Miki Basin Industrial Park (120 Kgal total offset by reclaimed)							86,629	93,262
Palawai IGGP - Agricultural - Brackish	0	0	0	0	0	0	0	0
Palawai IGGP - Other - Brackish	0	0	0	0	0	0	0	0
Palawai IGGP - Reclaimed Water from Lana`i City							60,000	60,000
Manele PD - Potable	322,641	441,348	405,819	189,448	149,726	242,046	284,311	474,603
Manele PD - Brackish (2008 actual metered)	760,357	650,000	650,000	650,000	650,000	650,000	650,000	650,000
Manele PD - Brackish Water Over 650,000 (2008 pumpage was 943,776, w/19% UAFW & water levels declini		244,538	112,634	163,191	199,091	240,285	270,220	294,639
Manele PD - Reclaimed Water from Lana`i City								124,666
Seawater to Brackish Desalt or Other Approved Source								300,000
Manele PD & IGGP - Conservation Target - Fresh			15,400	250,800	266,200	291,600	297,000	297,000
Manele PD & IGGP - Conservation Target - Brackish			14,000	27,800	41,600	55,400	83,000	83,000
Manele PD - Reclaimed Water	72,940	72,940	80,462	81,496	86,769	92,605	98,711	119,507
TOTAL	1,965,277	2,898,713	3,446,576	3,656,405	4,029,203	4,433,164	4,860,700	5,664,322
including resource reserve								
TOTAL REMOVING RESOURCE RESERVE	1,965,277	2,298,713	2,846,576	3,056,405	3,429,203	3,833,164	4,260,700	5,064,322
(above i.e. POTENTIAL PUMPED Including System Losses WITHOUT Conservation, Reclaimed Water or Desalt)								
SUBTOTAL PUMPED FROM AQUIFER Incl System Losses WITH Conservation & Etc.	**1,658,244** (metered)	**1,991,680** a	**2,472,728** b	**2,343,557** c	**2,660,357** d	**2,995,955** e	**3,300,191** f	**3,658,351** g

Note: 500 Kgal Ag Reserve is assumed to be pumped in all but "present" years

Water Conservation Measures

The resource development strategy includes a mix of conservation measures and new supply resource development. The conservation measures identified and assumed in the resource development strategy are shown in the table below. The derivation of these estimates of conservation measure impacts is presented in Chapter 5 of the Supporting Documentation.

FIGURE 1-10. Supply and Demand Side Conservation Measures Included in Resource Development Plan

	Manele & Grid Fresh	Manele Brackish	Lanai City Koele & Kaumalapau	
Palawai Grid	200,000.0			200,000
Landscape	50,000.0	50,000.0	11,000.0	111,000
Fixture Replacement	20,000.0		80,000.0	100,000
Leak Detection & Repair	15,000.0	13,000.0	12,000.0	40,000
Hypalon Cover		14,000.0		14,000
Hotel & Landscape Incentives	12,000.0	6,000.0	2,000.0	20,000
Rate Structure				
	297,000.0	83,000.0	105,000.0	485,000

Supply Resource Measures

A supply resource strategy was developed based on the supply resource options investigated and characterized as presented in Chapter 5 of the Supporting Documentation at pages 5-10 through 5-61. A schedule of potential new supply resources was identified that indicates how much water demand could be met with cumulative implementation of the new supply resources. This schedule is shown in the table below. The schedule identifies more new resources than are necessary to meet the needs of the base case resource development strategy. The supply resource schedule is explained in Chapter 5 of the Supporting Documentation starting at page 5-76.

FIGURE 1-11. Cumulative Capacity of Additional Supply Resources

Options in Order of Levelized Cost w/Adjustments	Gal	Average Day Ability to Meet Demand	Cumulative Aquifer Withdrawals	Cumulative Leeward Aquifer	Cumulative Windward Aquifer	Conservation and Reclaimed
Existing System		1,685,224	2,241,222	1,913,310	327,912	307033
Well 2 Replacement (2-A)	300,000	1,985,224	2,541,222	2,213,310	327,912	
Shaft 3 Replacement (2-B) * , **	150,000	2,135,224	2,691,222	2,363,310	327,912	
Well 15 * , **	100,000	2,235,224	2,791,222	2,463,310	327,912	
Well 3 Replacement**	200,000	2,435,224	2,991,222	2,663,310	327,912	
Well Near Hi'i Tank (btwn Hi`i and Well 3) **						
High Level Well Near Well 5 / Well 5 Replacement						
Well 7 Recommission						
Palawai Grid Pipe Replacement	200,000	2,635,224	2,991,222	2,663,310	327,912	200,000
Toilet and Fixture Replacement Program	100,000	2,735,224	2,991,222	2,663,310	327,912	300,000
Landscape Conservation	111,000	2,846,224	2,991,222	2,663,310	327,912	411,000
Hypalon Cover on 15 MG Reservoir	14,000	2,860,224	2,991,222	2,663,310	327,912	425,000
Annual Water Audit and Leak Detection Program	40,000	2,900,224	2,991,222	2,663,310	327,912	465,000
Hotel Incentives Program	20,000	2,880,224	2,991,222	2,663,310	327,912	485,000
Tiered Rate Structure						
Reclaimed Water Lana`i City & Koele	82,710	2,962,934	2,991,222	2,663,310	327,912	567,710
Reclaimed Water Manele	25,771	2,988,705	2,991,222	2,663,310	327,912	593,481
Windward Well at Malau	300,000	3,288,705	3,291,222	2,663,310	627,912	
Windward Wells at Maunalei (3)	750,000	4,038,705	4,041,222	2,663,310	1,377,912	
Windward Wells at Kauiki	300,000	4,338,705	4,341,222	2,663,310	1,677,912	
Windward Wells at Kauiki - Incremental	300,000	4,638,705	4,641,222	2,663,310	1,977,912	
Windward Well at Kehewai Ridge - 2,250' /oth wndwrd	300,000	4,938,705	4,941,222	2,663,310	2,277,912	
Windward Well at Kehewai Ridge - 2,750' /oth wndwrd	300,000	5,238,705	5,241,222	2,663,310	2,577,912	
Reclaimed Water Lana`i City & Koele	184,661	5,423,366	5,241,222	2,663,310	2,577,912	778,142
Reclaimed Water Manele	20,796	5,444,162	5,241,222	2,663,310	2,577,912	798,938
Ocean to Brackish	250,000	5,694,162	5,241,222	2,663,310	2,577,912	

* Wells are assumed to be installed, though they do not yield as much as anticipated.

** Levelized cost fof Well 2-B at 150,000 instead of 300,000 goes from $2.97 to $4.35. Well 15 goes from $4.16 to $8.05, & Well 7 from $6.02 to $8.08.

*** Well between Hi'i Tank and Well 3 could serve either system & appears to be less expensive than Well 7. Levelized costs go from 4.49 at 300KGal to 6.60 at 150 Kgal.

**** It may be desirable to go straight to Malau Well rather than Hi'i Tank or Well 7

***** As conservation savings are achieved, leeward aquifer wells can raise closer to design pumpage. Some resource reserve is still recommended.

Resource Strategy Costs

A list of resources and system improvements necessary to implement the resource development strategy needs was developed to determine the cost of implementing the strategy. These include: source development, pipe replacements, storage improvements, pump improvements, needs for monitoring and telemetry, etc. The assumptions and derivation of costs are provided on pages 5-65 through 5-79 of Chapter 5 of the Supporting Documentation.

In order to determine the rate impacts associated with the necessary capital improvements, schedules of bi-monthly charges, water rates and new meter fees were developed. Several potential rate designs were considered. To estimate rate impacts, capital needs were converted to approximate carrying costs, and added to annual revenues and revenue losses as reported to the PUC and to anticipated increased costs in labor and facilities identified by Brown & Caldwell in the *Lana'i Water System Acquisition Appraisal.* The rate impact and design analysis is described on pages 5-80 to 5-84 of Chapter 5 of the Supporting Documentation.

Source Water Protection

Source water protection measures discussed for Lana‘i include watershed protection, wellhead protection and operational management to avoid over-pumpage.

- Lana`i is unusually dependent upon its mauka watershed, because Lana‘i is dependent upon fog drip. Over 65% of the recharge in the primary high level aquifer for Lana‘i is believed to be attributable to fog drip. Loss of fog drip from Lana‘i Hale would lead to the loss of over 50% of the water levels in the Central aquifer, essentially the only viable water source for the island. Estimates from studies elsewhere indicate that fog drip interception by mountain forests increase precipitation by as much as 30%, and recharge by 10-15%.
    - The watershed on Lana‘i is a low elevation cloud forest, with a strong mix of mesic species. Maintaining native cover becomes especially important in light of its role in the water budget for Lana‘i and the rising inversion layer. Yet less than 30% of the native cover in the cloud forest remains.
    - Threats to the watershed include: habitat alteration by feral animals, human activity and invasive species; continuing intrusion of exotic plant and animal species which can trample, prey on or out-compete native species; loss of critical populations; loss of native pollinators and other keystone species; introduced pathogens and insects; erosion; drought, and; high vulnerability to fire due to mesic conditions combined with the spread of fire inducing weeds.
    - Key management measures include: fencing the most valuable watershed; eliminating feral animal ingress to fenced areas; removal of non-desirable weed and animal species; planting of desirable native species; erosion and fire prevention measures; and limiting human activities in key areas. More specifics are provided in Chapter 6.
    - During the course of the planning process, a statewide sky bridge meeting of forestry experts was held to determine the most critical measures for watershed protection. This meeting resulted in recommendations for a fence on the Lana‘ihale. This was followed by a joint effort between the LWAC, The Nature Conservancy, and the community group *Hui Malama* to present fence options to the public, and finally by the establishment of the Lana‘i Forest and Watershed Partnership. Because this was deemed a crucial aspect of the plan by LWAC members, Chapter 6-A of this document is dedicated to measures to protect the Lana‘ihale forest. It is

hoped that inclusion of these items in the Water Use and Development Plan will lend weight to funding efforts to protect Lana‘ihale.

- Where drinking water is concerned, prevention of pollution is less expensive and more efficient than cleaning it up. One of the first tasks in any effective prevention program is to identify and inventory wells to be protected, areas that feed them and activities or sources of pollutants that pose a potential risk or could degrade water quality.

  - Drinking water wells on Lana‘i were mapped, and a computer model was used to evaluate the area surrounding each well which could contribute to its water withdrawals within a 2, 5, 10, 15, 20 and 25 year time periods.

  - Water that can reach a well within two years can contribute bacteria and viruses to the drinking water in that well. Although chemical contaminants may be persistent well beyond 10 years, this is the time frame broadly used in wellhead protection programs, as it is assumed that within that time frame protective measures may be taken in the event of a spill.

  - Among the potential contaminant sources identified were the following: Wells 1, 9 and 7 are located in or near former pineapple fields. Well 9 is also near some former underground storage, and Well 7 near some old above ground storage. Traces of atrazine have been found in Well 1 in the past. Well 8 is within 1,000 feet of the Koele golf course. A list of contaminants that may be generated by the types of activities found is provided.

  - Potential management strategies and measures are described. These include regulatory measures such as overlay zones and prohibitions, non-regulatory measures such as purchase of easements or incentivization of best management practices, guidelines, education and others.

  - The recommended wellhead protection strategy involves an overlay zoning ordinance which either prohibits or prescribes best management practices for various uses at different times of travel. Also included in the strategy are non-regulatory measures, such as guidelines for mixed use developments, protective land agreements, incentives and education for best management practices or protective measures, and measures to improve well siting. Implementation of this ordinance would require coordination between the DWS and other agencies, particularly the Planning Department.

  - A draft wellhead protection ordinance is included in this document as Appendix F. The purpose of the wellhead protection strategy and ordinance is to ensure the protection of public health and safety by minimizing the risk of contamination to aquifers and sources used for drinking water supply. The proposed ordinance establishes a zoning overlay district to be known as the Wellhead Protection Overlay District. The wellhead protection strategy sets forth measures for the protection of this district, both through public education and public cooperation, as well as by creating appropriate land use regulations that may be imposed.

- The Wellhead Protection Overlay District is superimposed on current zoning districts and, based on the proposed strategy and ordinance, applies to new construction, reconstruction, or expansion of existing buildings and new or expanded uses. Applicable activities/ uses allowed in a portion of one of the underlying zoning districts which fall within the Wellhead Protection Overlay District must also comply with the requirements of this district. Requirements are set based upon whether a proposed use is within 1,000’, two year time of travel or ten year time of travel to a well.

- If water levels in pumping wells reach half their initial head level, this is now grounds for designation proceedings, based on a January 31, 1990 decision by the CWRM.

  - Operating guidelines for withdrawals from Lana‘i’s wells were designed by Tom Nance for CCR. These guidelines were reviewed by the State Commission on Water Resource Management, and are included in the Source Water Protection Chapter.
  - These voluntary guidelines set action levels at about 2/3 of initial head in addition to the lowest allowable levels, consistent with the CWRM level of half initial head.
  - Upon reaching an action level, a well is to receive scientific review and investigation, as well as some public scrutiny.
  - Upon reaching a designation trigger or lowest allowable level, pumpage in a well is expected to stop.
  - Action levels and lowest allowable levels from CCR’s voluntary well operating and management guidelines, as well as designation triggers, are provided on page 6-101.

Lana‘i Island Water Plan Provisions

Overview

Lana‘i faces several substantial water resource use and development challenges.

- Lana‘i has the smallest amount of total water resources of any major inhabited Hawaiian island.
  - Gross water demands for build-out of projects with existing land use entitlements (without conservation) could exceed 90% of the total sustainable yield of the Island.
  - With conservation and supply system leak reduction measures identified in this plan, water demand for build-out of projects with existing land use entitlements would be within total Island sustainable yield but would still exceed the sustainable yield of the currently developed Leeward aquifer.
- The Lana‘ihale watershed area, which provides rainfall capture essential to support Lana‘i’s groundwater aquifers, is critically threatened by feral deer and muflon and by invasive plants.
- The existing plantation-era water supply system infrastructure is in need of substantial repair and replacement.

To address these challenges the Lana‘i WUDP identifies several strategies that, together, may ensure adequate water supply for Lana‘i’s existing communities as well as planned growth. These strategies include:

- Diligent measures to re-establish and maintain the integrity of Lana‘i’s essential watershed areas
- Conservation measures to ensure that water is produced, distributed and used efficiently
- Development of new supply sources to distribute groundwater withdrawals and provide for increased system capacity to meet growing demand
- Deferral of additional or incremental discretionary land use development entitlements pending careful consideration of the adequacy of long term water supply sources and infrastructure.

The provisions below are identified as elements of a plan for responsible use and development of Lana‘i’s water resources necessary to maintain the long term adequacy and quality of water supplies for existing and future Lana‘i residents and businesses.

Watershed Protection Measures

The Lana‘ihale watershed area is an essential resource that supports the groundwater aquifers that provide all of Lana‘i's water needs. It is crucial that sufficient programmatic measures are diligently implemented to reestablish and protect the indigenous flora in the Lana‘ihale watershed area. Herbivores and invasive plants must be removed and effectively excluded from the watershed area.

The following measures have been identified as essential program components to improve and maintain the integrity of the Lana‘ihale watershed area:

- Development of a new publicly reviewed and supported comprehensive watershed protection plan incorporating the watershed protection provisions identified in Chapter 6 of the Supporting Documentation.
- Installation and maintenance of fencing adequate to exclude deer, muflon and other ungulates.
  - Maintain fencing Increments I and II and complete Increment III
  - Resolve issues regarding watershed area access
  - Eliminate ungulates from fenced watershed areas
  - Manage populations of deer and muflon outside fenced areas
- Review, funding and implementation of adequate fire protection measures for the Lana‘ihale watershed area
- Eradication or control and ongoing exclusion of invasive plants from the watershed area.
- Investigation and implementation of reasonable erosion management and appropriate reforestation measures

Existing agreements to implement these measures should be honored and enforced and further agreements, partnerships and measures as necessary should be identified, funded and implemented to effectively restore and protect Lana‘i's watershed areas.

Water Resource Protection Measures

Several measures are identified to monitor and protect the integrity of Lana‘i's groundwater aquifers:

- Wellhead protection : The County should draft, review and, as appropriate, adopt a wellhead protection ordinance with input from the Lana‘i community

- Aquifer monitoring and reporting: The existing required *Periodic Water Reports* should be broken down by the 3 well service areas or the 5 individual districts and, if feasible, should be reported monthly.
- Watershed monitoring: The County and CWRM should support appropriate research and monitoring to improve understanding of aquifer recharge and determine measures to maintain or improve effective groundwater sustainable yield
- The CWRM should monitor aquifer use, conditions and contested issues on an ongoing basis to determine whether any of Lana‘i’s aquifers should be designated as groundwater management areas.
- All participating parties should abide by and enforce existing water management and allocation agreements

Water Conservation Measures

Efficient use of water and reductions in supply system leakage are essential to reduce waste of Lana‘i’s limited water resources.

- Lana‘i’s water and wastewater utilities should implement water recycling and water conservation programs targeting landscape and indoor water uses to substantially reduce water consumption to the extent allowed by the Public Utilities Commission.
- The County and public utilities should implement education and supporting measures to encourage planting of low-water-use plants for new and existing landscaping
- Lana‘i’s public water utility should reduce unaccounted for water to reasonable levels including implementation of the following measures:
    - Replace and/or repair deteriorating or leaking supply pipes including replacement of deteriorated Palawai grid pipeline
    - Implement programmatic leak detection and repair programs
    - Install floating or Hypalon Ball cover on existing 15MG brackish water reservoir

New Supply Resource Development

Sufficient new water supply resources are necessary to meet anticipated growth in water demands, distribute pumpage in the Leeward aquifer and, ultimately, to distribute pumpage as necessary to the Windward aquifer.

- Based on the analysis performed in the preparation of this plan, implementation of the following specific new supply resources is recommended in conjunction with any other measures necessary to provide economical and reliable water service:

- Develop planned Well 15 to distribute brackish groundwater withdrawals
- Replace Well 2-A equipment as necessary to provide operable system reliability
- Replace Well 3 equipment or drill new well as necessary to provide system reliability and distribution of groundwater withdrawals
- Evaluate and implement future expansion of wastewater recycling facilities
- Plan and ultimately develop operable groundwater sources in the Windward aquifer to distribute groundwater pumping and provide resources, as necessary, to provide for system growth beyond the capacity of the Leeward aquifer.

Land Use Entitlements

Water demand for build-out of projects with existing land use entitlements would exceed the capacity of the existing water system infrastructure. With implementation of the conservation and supply system leak reduction measures identified in this plan, build-out of these projects would exceed the sustainable yield of the currently developed Leeward aquifer.

Prior to issuing new land use development entitlements or subdivision approvals, the determining County agencies and any other determining administrative and regulatory agencies should ensure that sufficient water resources and infrastructure are available to meet resulting additional water demands without unreasonable risk or harm to existing or previously entitled water users and without overtaxing Lana‘i’s water resources. In making determinations the following factors should be considered:

- No groundwater aquifer should be drafted exceeding the 90% existing trigger for groundwater management area designation of the aquifer sustainable yield as periodically amended by the CWRM
- 500,000 GPD should be reserved for development of an agricultural park on Lana‘i
- Projections of future water resource development should be based on resources that are identified and funded, with firm commitments for implementation.

Supporting Documentation

Appendices