February 25, 2011 DWS Amended Draft

LANA‘I
ISLAND
WATER USE &
DEVELOPMENT
PLAN

Submitted by the Department of Water Supply

Exhibit 12

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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

Acronyms and Abbreviations

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

Lana‘i 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 Lana‘i 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
Lana‘i	6	6	6
Maui	476	386	427
Molokai	81 / 38 Dev	71	79
Oahu	446	419	407

Lana‘i 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 Lana‘i’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 Lana‘iLana‘i 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 membership 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 implementation.”

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 recommendations 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.

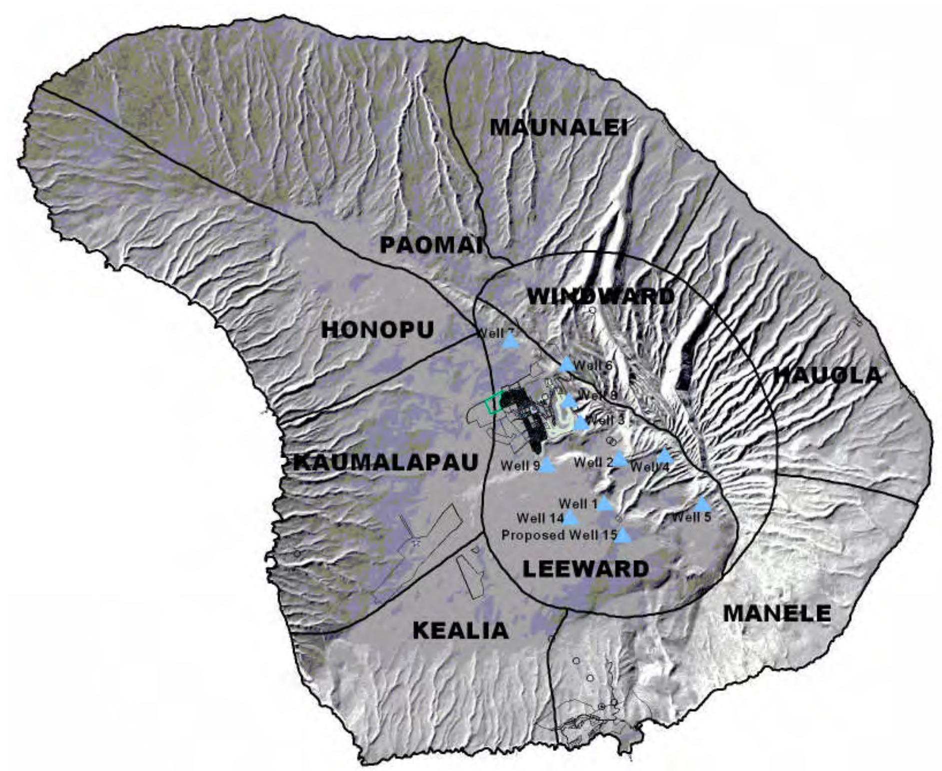

FIGURE 1-2. Lana‘i Aquifers and Wells

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.

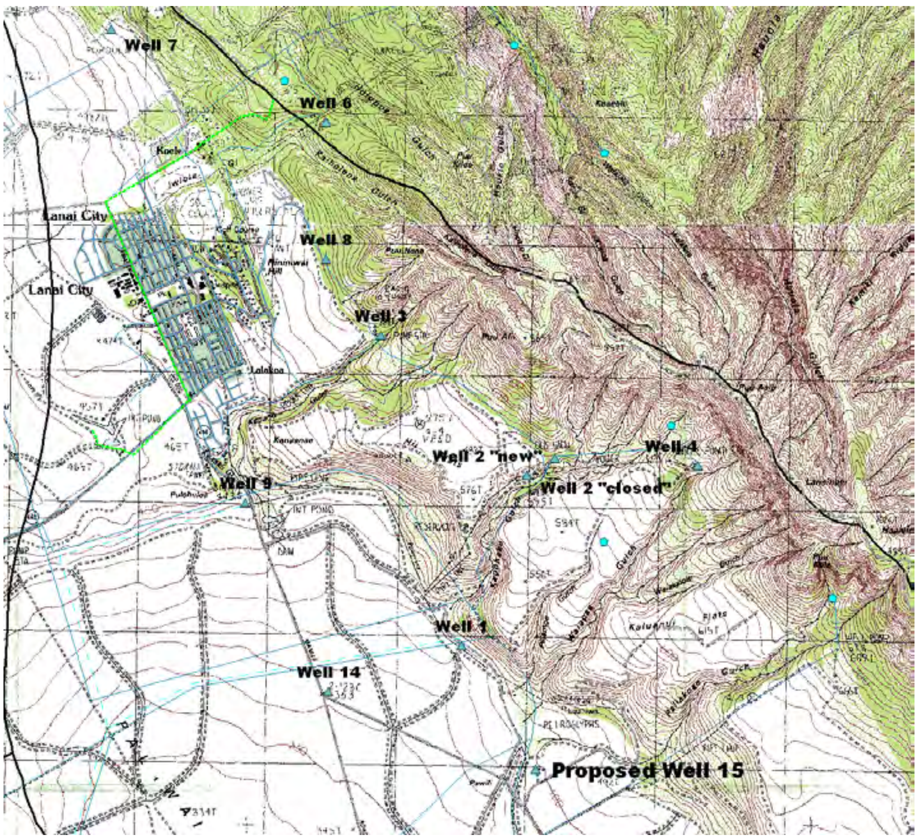

FIGURE 1-3. Lana‘i Wells

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).

Lanaʻi'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 Lanaʻi 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 Lanaʻi 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.

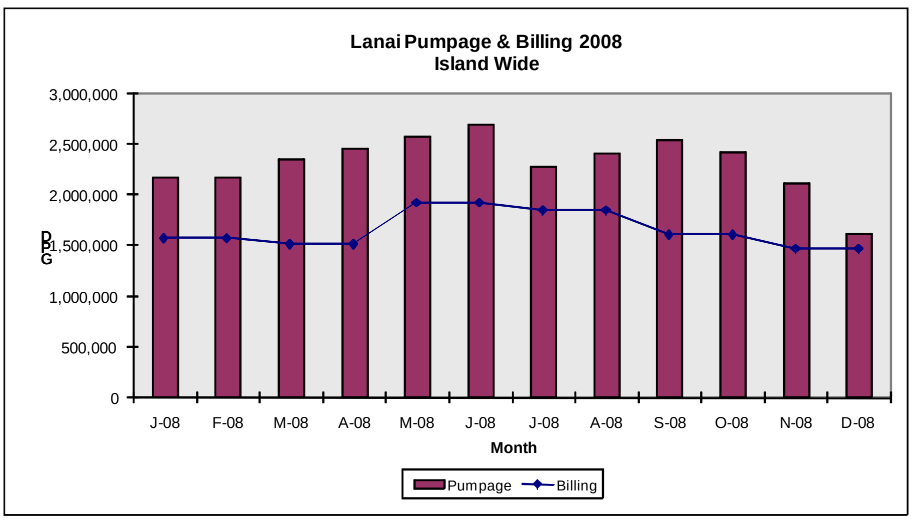

FIGURE 1-7. Lana‘i pumpage and billing - Island-wide unaccounted-for water

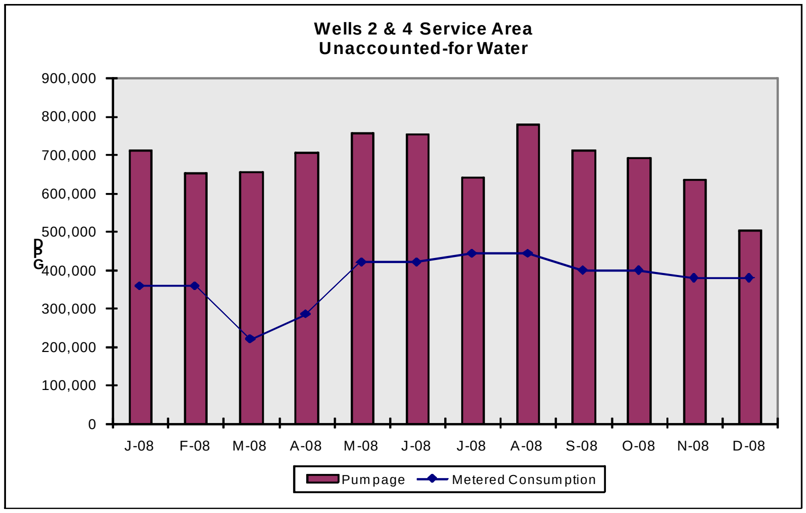

FIGURE 1-8. Pumpage and billing - Palawai grid unaccounted-for water

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

Resource Options

- 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			Capital Cost		Fixed Operating		Variable	Plant	Economic Life Total Discounted Cost				
			Average					Operating	Life	Total	**Total**	Capital	Fixed Op.	Var. Op.
	Installed	Effective	Output	Cost	Unit Cost	Cost	Unit Cost	Cost	Economic	Unit NPV	**Levelized**	Levelized	Levelized	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

Option Name	Plant Capacity: Installed	Plant Capacity: Effective	Plant Capacity: 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
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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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 - 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 (including resource reserve)	1,965,277	2,898,713	3,446,576	3,656,405	4,029,203	4,433,164	4,860,700	5,664,322
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 Well sat 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 Lanaʻihale watershed area is an essential resource that supports the groundwater aquifers that provide all of Lanaʻi's water needs. It is crucial that sufficient programmatic measures are diligently implemented to reestablish and protect the indigenous flora in the Lanaʻihale 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 Lanaʻihale 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 Lanaʻihale 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 Lanaʻi's watershed areas.

Water Resource Protection Measures

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

- Wellhead protection : The County should draft, review and, as appropriate, adopt a wellhead protection ordinance with input from the Lanaʻi 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.

February 25, 2011 DWS Amended Draft

LANA‘I ISLAND WATER USE & DEVELOPMENT PLAN

SUPPORTING DOCUMENTATION

Supporting Documentation

CHAPTER 1

Introduction to Supporting Documentation

The *Supporting Documentation* supplement is part of the *Lana'i Island Water Use and Development Plan* (WUDP). This section presents the detailed information and analysis that support the development of the Lana'i WUDP.

Chapters 2, 3, 5 and 6 of the Supplement are identical to the corresponding Chapters 2, 3, 5 and 6 of the Draft Lana'i WUDP dated June 28, 2010 that was transmitted to the Maui County Board of Water Supply (Board) for public hearings and Board recommendations.

Chapter 4 *Demand Analysis* of the *Supporting Documentation* is identical to the corresponding Chapter 4 of the June 28, 2010 draft with the exception of the addition of several Resource Development Strategy Water Use tables that are edited moved from Chapter 7of the June 28, 2010 draft.

Chapter 7 of the June 28, 2010 draft addressed 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. The recommendations are now addressed in the *Lana'i Island Water Plan Provisions* section of the Lana'i WUDP. The water allocation table in the June 28, 2010 draft has been relabeled and is now included as part of the Resource Development Strategy Water Use Tables documented in Chapter 4.

Chapter 8 of the June 28, 2010 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 Lana'i WUDP. 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-characterization as a list of possible actions that could support the intent of the Lana'i WUDP.

CHAPTER 2 Regulatory Framework

In This Chapter

Key Points

- This chapter summarizes pertinent regulations that affect water and water-related issues on Lana‘i. Several regulations are briefly summarized including
  - Requirements for the Water Use and Development Plan
  - Other provisions of the State Water Code
  - The Safe Drinking Water Act
  - Other Federal Regulations that have bearing on water
  - Various State Requirements that have relevance to water
  - Hawai‘ian principles of water management
  - A Table of Regulations is provided with short summaries of over 50 regulations.

Regulations which must be considered in drafting a Water Use and Development Plan include those which pertain to the drafting and implementation of the plan itself, as well as those which may affect utility operations, strategies or cost of capital decisions, and in Hawai‘i, also those which pertain to traditional Hawai‘ian Uses. Prominent among those affecting utility operations are the requirements of the Safe Drinking Water Act, but other federal environmental requirements such as the Clean Water Act, the Endangered Species Act and Government Accounting Standards must also be considered. For instance, if CCR decides to utilizie the Kehewai wells discussed in Chapter 5 of this document, it will have to consider provisions of the Endangered Species Act. If it decides to develop desalinization plants, it will have to consider the fact that the ocean surrounding Lana‘i is considered Class AA marine waters, meant to remain in as close to their natural state as possible. If CCR decides to use wells in Maunalei, it will have to consider old kuleana parcels in the area. The text below summarizes some of the more notable requirements. The table in Figure 2-1 provides additional detail.

Requirements for the Water Use & Development Plan

Constitution: The duty to conserve and protect water resources is established in the State Constitution. Article XI, Section 1 states, in pertinent part, "The State and its political subdivisions [emphasis added], have the responsibility to......conserve and protect resources...(including) water". Section 7 provides for a Water Resources Agency, which is the Commission on Water Resource Management (CWRM). This agency has primacy in dealing with water resource issues. However, the reference to the State's political subdivisions makes it clear that the counties, which are the political subdivisions of the State, also have responsibility to protect and conserve water resources.

Hawai'i Revised Statutes & Hawai'i Administrative Rules: State requirements for the plan are delineated broadly in HRS §174(C)-31, the State Water Code, and in HAR §13-7-170. More detailed delineation of requirements is found in the Commission's guidelines, known as the *Statewide Framework For Updating the Hawai'i Water Plan*.

HRS Part III - Chapter 174C - 31 requires that there be a Water Use and Development Plan for each County; that these Water Use & Development Plans be consistent with County General and Community Plans, State Land Use Classifications and policies; that the costs to maintain the plan be borne by the Counties, and; that the County Water Use & Development Plans include as a minimum: the status of water and development, an inventory of uses and sources, future uses and related needs; regional plans for development, costs and relationship to water resource protection and quality. It also requires that each county and the Commission incorporate the current and foreseeable development and use needs of the Department of Hawai'ian Homelands.

Hawai'i Administrative Rules - Title 13 Department of Land & Natural Resources - Subtitle 7 - Water Resources - Chapter 170 - Hawai'i Water Plan sets out further guidelines for the Water Use & Development Plans. According to this Chapter, each Water Use & Development Plan shall be consistent with:

- The State Water Resources Protection Plan
- The State Water Quality Plan
- State land use classifications and policies
- County zoning and land use policies

In addition, the Water Use & Development Plans should:

- Be updated to remain consistent with the plans & policies listed above
- Consider a 20 year projection for analysis

Requirements for the Water Use & Development Plan

- Utilize the hydrologic units designated statewide by the CWRM for presentation of data and analysis
- Utilize information from the master water resources inventory identified within the Water Resources Protection Plan.

The Water Use & Development Plans shall include as a minimum:

- The status of water and related land development, including an inventory of existing water uses for domestic, municipal and industrial users, agriculture, aquaculture, hydropower development, drainage, re-use, reclamation, recharge and resulting problems and constraints.
- Future land uses and water related needs
- Regional plans for water development, including recommended and alternative plans, costs, adequacy of plans and relationship to Water Resources Protection and Water Quality Plans.

The ***Statewide Framework for Updating the Hawai'i Water Plan*** requires that the County Water Use and Development Plans:

- Set forth allocations of water to land use, to be adopted by ordinance
- Provide for update of demand, supply, hydrology, infrastrure and capital needs on a five year cycle of update.
- Contain appropriate recognition of the current and future development needs of the Department of Hawai'ian Homelands
- Include preparation of regional plans for water development, including recommended and alternate plans, costs, adequacy of plans and resources to meet proposed or anticipated needs, and relationship of County plans to the State Water Resources Protection Plan and Water Quality Plan
- Comply with all applicable environmental, health & other regulations
- Be consistent with the State Water Resources Protection Plan and Water Quality Plan, and demonstrate integration of the State Water Projects Plan and State Agricultural Water Use & Development Plan
- Be drafted in coordination with the Commission on Water Resources Management, including submittal of the proposed WUDP process description to CWRM (process proposal presented to Board September 2003, to CWRM February, 2004 and to Council April 2004 - approved by all), coordination throughout the process with CWRM, milestone briefings to CWRM including review of demand methodologies, and final project descriptions, including recognition and discussion of how information from the State Water Projects Plan and State Agricultural Water Use & Development Plan are integrated.
- Be drafted with substantial and credible public involvement that shall include as a minimum: identification of essential stakeholders, gathering and analysis of information on community values and incorporation of these into the plan; work with advisory or other groups (technical, focus, workshops, etc.), stakeholder interviews, etc.; possible inclusion of workshops, questionnaires, public meetings, newsletters, fact sheets, web sites, slide shows, press coverage, bill inserts or other public

outreach; clearly described public participation process within the document, and: clearly demonstrated incorporation of the results of public participation and review.

- Include a clear description of the following: planning objectives which form the basis of the resource strategy selection; process by which objectives were identified or defined; resource and supply strategies identified; process of evaluation, assessment and selection; demonstrable public involvement in an objective setting, evaluation and selection of alternatives; well delineated evaluation criteria for alternative resource scenarios; consideration of multiple demand scenarios, including as a minimum low, medium and high forecasts; forecasts for 1, 2, 3, 4, 5, 10, 15 and 20 years, as well as forecasts beyond 20 years if anticipated demand exceeds or may be close to established sustainable limits; incorporation of least cost planning; land use plans and how the WUDP addresses them; resource protection needs and plans; underlying assumptions and data; models or computer programs used in the planning process; existing systems, conveyances, resources, conservation or re-use programs; etc.
- Include screening of resource and supply alternatives by a process to include as a minimum: initial listing of a broad group of possible options for supply, to include as a minimum options in the categories of new supply, transmission, storage, conservation and use of reclaimed water; initial screening of a broad list of options by real criteria which must be specifically explained such that a “poor” option means one that does an unacceptable job of meeting defined objectives; initial screening should leave a “finalist” group in the neighborhood of half a dozen strategies; finalist strategies to be evaluated against uncertainties, contingencies and other defined objectives; final screening selection to result in a flexible sequence of supply, infrastructure, storage, transmission, conservation, reclaimed water, resource protection and other actions to meet the county’s water objectives.
- Include a well described implementation plan, to include near term, medium term and long term as well as allowance for flexibility.

Discussions with Commission on Water Resource Management Staff - Specific to the Lana‘i Plan: Early on in the process of forming the Lana‘i Water Advisory Committee as advisory to the Department of Water Supply, CWRM staff met with DWS staff to delineate specific requirements or targets for inclusion in the Lana‘i Water Use & Development Plan. These included: demand analysis showing various methods and scenarios; discussion of the regulatory framework and context and considerations affecting the plan; description of existing resources and systems; discussion of capital and operational considerations to include supply-side and demand-side options and alternate source development options; discussion of resource issues; discussion of policy considerations including relation to land use policies, preparedness for contingencies, prevention of over-pumpage or other externalities; an implementation matrix and an executive summary of key points.

The Maui County Charter - §8-11.6 requires that the Department of Water Supply prepare up-to-date Water Use & Development Plans for review by the Board of Water Supply and enactment by the Maui County Council by ordinance.

Maui County Code Chapter 14.02 stipulates that updates to the Water Use & Development Plan shall be deemed part of County Code Chapter 14; that the plan shall serve as a guideline to the

Council, Department and all other agencies of the County for approving or recommending the commitment of water resources or funds to develop resources; that the Plan shall be updated and amended as necessary to remain consistent with the Community Plans; that amendments to the plan as proposed by the Council, Director or any agency be referred to the Board of Water Supply for review and recommendation; that the Board of Water Supply shall hold hearings and transmit revisions and recommendations; and that upon receipt of the proposed amendment, the council shall act within forty-five days or the amendment is deemed disapproved. This chapter also stipulates that whenever the Planning Director recommends revisions to the general plan pursuant to §8-8.3(3) of the revised charter of the County of Maui (1983) as amended, the task force shall recommend to the Board amendments to the plan so as to be consistent with any community plan amendment. (Ord 3404 §5 (part), 2006)

Other Provisions of the State Water Code

Aside from requirements for the State Water Plan described above, the State Water Code, HRS 174-C, contains and enables the State Commission on Water Resource Management to establish requirements for: registration of wells, well construction permits, pump installation permits, well construction and installation standards; sealing and filling abandoned wells; and reporting of both pumped water and surface water use. It requires the State Commission on Water Resource Management to establish and maintain an instream use protection program, including setting instream flow standards; issuing permits for construction, alteration or abandonment of stream diversion works. It contains provisions for protection of native Hawai‘ian water rights. The code also sets forth criteria for designation of ground water management areas or surface water management areas, and procedures for designated areas.

The criteria for designation of a groundwater management area under the State Water Code are:

- Whether an increase in water use or authorized planned use may cause the maximum rate of withdrawal from the ground-water source to reach ninety percent of the sustainable yield of the proposed ground water management area
- Whether there is an actual or threatened water quality degradation, as determined by the Department of Health
- Whether regulation is necessary to preserve the diminishing ground-water supply for future needs, as evidenced by excessively declining ground-water levels
- Whether the rates, times, spatial patterns, or depths of existing withdrawals of ground-water are endangering the stability or optimum development of the ground-water body due to up-coning or encroachment of salt water
- Whether the chloride contents of existing wells are increasing to levels which materially reduce the value of their existing uses
- Whether excessive preventable waste of water is occurring
- Whether serious disputes respecting the use of ground-water resources are occurring
- Whether water development projects that have received any federal state or county approval may result in the opinion of the Commission in one of the above conditions

The Hawai'i Administrative Rules - Title 12 - Subtitle 7 are the administrative rules for the State Water Code. HAR §12-7-168 contains rules for well drilling and pump installation permits, well completion reports, registration of existing wells, well inspection, abandoned wells, stream diversion permits, stream diversion completion reports, stream diversion works inspection, and abandoning stream diversions. HAR §12-7-169 sets forth rules for determining instream flow standards, procedures for public notification and adoption, stream channel alteration permits, and provisions for emergency work. HAR § 12-7-171 covers designation and regulation of water management areas.

Safe Drinking Water Act

Laws enacted by Congress are compiled in the United States Code. The Office of the Law Revision Counsel of the U.S. House of Representatives prepares and publishes the United States Code pursuant to section 285b of Title 2 of the Code. The Code is a consolidation and codification by subject matter of the general and permanent laws of the United States. The Code does not include regulations issued by executive branch agencies, decisions of the Federal courts, treaties, or laws enacted by State or local governments. Regulations issued by executive branch agencies are found in the Code of Federal Regulations. Proposed and recently adopted regulations are published in the Federal Register. In the United States Code, the Safe Drinking Water Act is 42 U.S.C. §300 et. seq. or Title 42, Chapter 6A, Subchapter XII. In the Code of Federal Regulations it is 40 CFR Parts 140-149.

The Safe Drinking Water Act was passed by Congress in 1974 and amended in 1986 and 1996. Its purpose is to protect public health by regulating the nation's public drinking water supply. The law requires the United States Environmental Protection Agency (US EPA, EPA) to set national health-based standards for drinking water to protect against both naturally occurring and man-made contaminants, which are the National Primary Drinking Water Regulations.

History The Interstate Quarantine Act of 1893 authorized the Surgeon General of the U.S. Public Health Service to "make and enforce such regulations as in his judgement are necessary to prevent the introduction, transmission or spread of communicable disease from foreign countries into the states or possessions, or from one state or possession into any other state or possession". Interstate Quarantine Regulations were published in 1894. In 1912 the use of a common drinking cup on interstate carriers was prohibited. In 1914 the US Public Health Service issued the first bacteriological drinking water standard. It applied to any system that provided water to an interstate common carrier. The Public Health Service Standards were updated and revised in 1925, 1942, 1946 and 1962. The 1962 Public Health Service Standards were the precursor to the Safe Drinking Water Act, and regulated 25 health and aesthetic parameters in Drinking Water. When the 1974 Safe Drinking Water Act was passed, it enacted interim regulations which referenced the 1962 public health standards, and required the EPA to set national health-based standards for drinking water to protect against both naturally occurring and man-made contaminants. It required the EPA to establish National Primary Drinking Water Regulations within 180 days, and so the National Primary Drinking Water Regulations were first passed in 1975. From that time to 1986, approximately 26 contaminant regulations were completed and issued. The 1986 Amendments to the Safe Drinking Water Act required the EPA to accelerate the pace of regulation. The 1986 Amendments required the EPA to regulate 83 contaminants by 1992, and to regulate 25 more chemicals every three years after 1992. The 1986 Amendments also initiated monitoring of unregulated contaminants, mandatory filtration of surface water systems, mandatory disinfection of all water systems, public notification of violations and established a requirement for States to develop wellhead protection. The 1996 amendments overturned the required schedule, enabling the EPA to establish a process for selecting contaminants based on scientific data. The 1996 amendments also took the source water protection and public information initiatives of the 1986 amendments a few steps further, by requiring States to develop programs for preparing source water assessments for all public water supply systems (not merely those served by wells), and adding requirements for operator training, and consumer confidence reports. The 1996 amendments established the State Revolving Loan Fund, to provide funding for critical water system improvements.

Applicability The Safe Drinking Water Act, and National Primary Drinking Water Regulations under the Safe Drinking Water Act apply to Public Water Systems (PWSs). PWSs are defined as those which either have 15 service connections or more, or serve 25 or more people for more than sixty days of the year.

Lana‘i has two public water systems under the definitions of the National Primary Drinking Water Regulations. The first covers the areas of Lana‘i City to Kaumalapau (PWS 237) and the second includes Manele, Hulopo‘e and the Palawai Irrigation Grid (PWS 238). Public Water Systems under the Safe Drinking Water Act are further broken down into Community Water Systems, Non-Community Water Systems, Non-Transient Non-Community Water Systems and Transient Non-Community Water Systems, with different applicability of regulations for each. Lana‘i's drinking water systems are considered Community Water Systems, in that they each serve 15 or more service connections or 25 or more residents year-round.

There are many rules or sub-parts of the National Primary Drinking Water Regulations under the Safe Drinking Water Act, each with its own applicability provisions based on size or type of water system or type of source or treatment used. Because there are two separate regulated drinking water systems on Lana‘i, the size of each is smaller than the total population. In some cases this can result in a mild time lag in reaching certain regulatory thresholds, such as sampling requirements or compliance deadlines for different sized systems.

Requirements

The National Primary Drinking Water Regulations, first passed in 1975, are legally enforceable standards that apply to public water systems. Primary standards protect the public health by limiting the levels of contaminants in drinking water. Maximum contaminant levels are set for microorganisms, disinfectants, disinfection by-products, inorganic chemicals, organic chemicals, and radionuclides, as well as sampling, analytical and reporting methods. EPA has regulated more than 90 contaminants. MCLs for these contaminants are known as the National Primary Drinking Water Standards.

The EPA prioritizes contaminants for protection using a risk-based analysis that considers both the toxicity or potential harmfulness of the contaminant, and the extent of exposure within the population. EPA sets both a Maximum Contaminant Level Goal (MCLG) and a Maximum Contaminant Level (MCL). The difference is that the Maximum Contaminant Level Goal (MCLG) is based purely on health effects without regard to treatment feasibility or cost. For known or probable carcinogens, the Maximum Contaminant Level Goal is set at zero. For non-carcinogens the Maximum Contaminant Level Goal is set at the "No Observed Adverse Effect Level", or the "Lowest Observed Adverse Effect Level" that has been identified from scientific study of humans and animals. For chemicals that are deemed "potential" carcinogens, either the reference dose with a safety factor is used, or the 1 in 10-5 or 1 in 10-6 risk range is used, where levels are estimated to result in no more than x cancers per 100,000 or million population.

The Maximum Contaminant Level (MCL), on the other hand, is based both on health concerns and other factors such as the available methods for measuring contaminant levels, whether targeted contaminants can even be detected at the MCLGs, available techniques for treating contaminants, and costs and logistics of such treatments. These MCLs and MCLGs are known collectively as the National Primary Drinking Water Standards.

The Public Notification Rule, published in 2000, requires that any exceedances to National Primary Drinking Water Standards (NPDWS) must be reported to the State Department of Health and to the public. Exceedances are classed into three tiers. Tier 1 notifications are those for which immediate notice or notice within 24 hours is required. These include fecal coliform violations, nitrates, nitrites or total nitrate and nitrite Maximum Contaminant Level (MCL) violations, chlorine dioxide Maximum Residual Disinfectant Level (MDRL) violations, exceedance of maximum allowable turbidity levels, waterborne disease outbreak or emergencies, as well as monitoring violations. Tier 1 notifications must be issued within 24 hours of the utility becoming aware of the violation. Notice must be provided via radio, TV, hand delivery, posting or other method (specified by DOH). Consultation with DOH must also be initiated within 24 hours. Tier 2 notifications include any other MCL or MRDL violation other than those designated as tier one, various monitoring violations and failure to comply with variance and exemption conditions. Notice of these must be published as soon as practical, or within thirty days. Notice should be repeated every three months until the violation is resolved. Community Water Systems must also send notice via mail or direct delivery. Tier 3 notifications are for monitoring or procedure violations, except for those which the States have elevated to Tier 1 or 2, operation under variance or exemption (need not be violation) or other special public notices such as secondary maximum contaminant level exceedance, availability of unregulated contaminant monitoring results, etc. These notices go out within 12 months and annually, by mail or direct delivery, and can be combined into one annual mailing.

The National Secondary Drinking Water Regulations are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor or color) in drinking water. EPA recommends secondary standards to water systems, but does not require water systems to comply. However, states may choose to adopt them as enforceable standards. Secondary standards have been set for aluminum, chloride, color, copper, corrosivity, fluoride, foaming agents, iron, manganese, pH, silver, sulfate, total dissolved solids and zinc. The secondary standard for chloride is 250mg/L.

The Drinking Water Contaminant Candidates List consists of both microbiological and chemical contaminants which are not currently regulated, but which are known to cause potential health impacts, anticipated to occur in public water systems, and may require future regulation. The first Contaminant Candidate List was published in 1998. It included 10 microbiological and 50 chemical contaminants. Final regulatory determination for the first Contaminant Candidate List was published on June 3, 2002. It concluded that sufficient data was available to make regulatory determinations for 9 of the contaminants, and that no primary drinking water regulation was necessary for any of these nine, but issued guidance on Acanthamoeba and health advisories for magnesium, sodium and sulfate. The second Contaminant Candidate List was finalized in 2005, and included 51 contaminants. In July 2008, EPA issued final regulatory determination that no regulatory action was appropriate for eleven of the fifty-one contaminants on that list, and that data gaps prevented EPA from making a regulatory determination for the other forty contaminants at this time. One State agency suggested that 2,4-Dinitrotoluene and 2,6-Dinitrotoluene should have been regulated, but EPA replied that these contaminants appeared to be a local and not a national problem. The third Draft Contaminant Candidate List was published in February, 2008. It includes 11 microbial and 93 chemical contaminants, and may be found at http://www.epa.gov/safewater/ccl/ccl3.html.

The Total Coliform Rule, passed in 1989, applies to all public water systems. It establishes a maximum contaminant level (MCL) based on the presence or absence of total coliform. Coliform are a group of ubiquitous, mostly harmless bacteria, used as a surrogate or indicator for a large group of more harmful microorganisms. Presence of these organisms in a drinking water system is taken as a potential indication of problems in the treatment or distribution, environmental contamination, or possible human or animal waste contamination, requiring disinfection of the water. The rule requires a sample siting plan, subject to review by DOH, to insure that samples are collected at sites which are representative of water quality throughout the distribution system. Systems serving 2,501-3,300 people are required to take 3 samples per month. Systems serving 3,301-4,100 people are required to take 4 samples per month. If any routine sample is coliform positive, at least three repeat samples must be taken within 24 hours of learning of the result: at the original sampling site, within five connections upstream, and within five connections downstream. Repeat samples must be analyzed for fecal coliforms or *E coli* as well as total coliform. Systems collecting fewer than 5 routine samples per month and having one or more total coliform positive samples in one month must collect at least 5 samples during the following month unless the State has determined the reason for the positive finding and that the problem has been corrected. The rule requires sanitary surveys every five years for systems collecting fewer than five total coliform samples per month. Systems serving Ground Water Under the Direct Influence of Surface Water (GWUDI) but meeting the criteria for avoidance of filtration must collect and have analyzed one coliform sample each day that the turbidity of the water exceeds 1 NTU. This sample must be collected from a tap near the first service connection.

The Unregulated Contaminant Monitoring Rule (UCMR) The 1986 amendments to the Safe Drinking Water Act required public water systems to monitor for specific unregulated contaminants on a five year cycle and to report the monitoring results to the States. Data was compiled in a federal Unregulated

Contaminant Monitoring Information System. Data on unregulated was collected for 62 contaminants in 40 states from1987 - 1992 (UCM 87), and for 48 contaminants in 35 states from 1993-1997 (UCM 93). The 1993 Amendments to the Safe Drinking Water Act added contaminants to the unregulated contaminant list for required monitoring, and the 1996 Amendments to the Safe Drinking Water Act directed EPA to develop a revised program for Unregulated Contaminant Monitoring, and to limit monitoring requirements to 30 contaminants per five year cycle. This program was published in 1999 as the Unregulated Contaminant Monitoring Rule and updated in 2000, 2001 and 2007. UCMR 1, passed in 1999 established three lists of contaminants for monitoring. List one contaminants had established, available testing methods. Monitoring of these was required by large and selected small systems. List two contaminants had testing methods only recently developed. Monitoring of these was to be required by selected large and small systems. Contaminants on list three had known health effects, and were identified for development of analytical methods, so that they could be included in future UCM. The UCMR 2, was signed in December 2006, and printed in the January 2007 CFR. UCMR 2 established the second cycle of monitoring with an updated list of 25 contaminants, to be monitored during 2008-2010. As before it required list one contaminants to be monitored by large and selected small systems, and list two contaminants to be monitored by selected large and small systems. An added requirement was set that laboratories used in sample analysis have EPA approval to analyze samples for the UCMR 2. The new list of contaminants included (among other contaminants) various flame retardants, explosives, parent acetanilides, acetanilide degradates, and nitrosamines.

The Groundwater Rule, finalized in 2006, provides for additional, multi-level protection against microbial pathogens in Public Water Systems that use groundwater. These protections are source monitoring, compliance monitoring, more frequent sanitary surveys, and corrective action.

Ground water systems have to monitor their sources (wells) if there is a total coliform positive sample in the distribution system. Sources deemed susceptible to contamination may have to monitor the source even if there is no coliform positive in the distribution system. If disinfectants (such as chlorine) are added to the systems, routine monitoring is required. Systems serving less than 3,300 people have to have a daily grab sample. Systems serving more than 3,300 people have to have a continuous analyzer. The Lana‘i City system is currently regulated based on an estimated population of 3,000. This may change with the 2010 population census. States have the authority to require additional source monitoring in aquifers deemed high risk or susceptible to contamination. Examples of criteria that could lead to an aquifer being considered high risk include high population density combined with on-site wastewater treatment; alluvial or coastal plain sand aquifers in which viruses may travel further and faster than bacteria; shallow unconfined aquifers, aquifers with thin or absent soil cover; wells previously identified as having been fecally contaminated, areas in which aquifers of limited geographic extent underlie communities without centralized sewage treatment, etc.

For groundwater systems that already treat drinking water to achieve 4-log (99.99%) removal of viruses, regular compliance monitoring is required to insure that 4-log (99.99%) removal of viruses is maintained. Groundwater systems that do not provide at least 4-log treatment of viruses must conduct triggered source water monitoring upon being notified that a TCR sample is total coliform positive. Within 24 hours of receiving notice of a coliform positive sample, the system must collect at least one ground water sample from each ground water source unless there is a specifically approved triggered source water monitoring plan. Source water samples must be tested for E. coli, enterococci, or coliphage. If the source sample is fecal indicator-positive, the system must notify the State and the public. Unless notified by the State to take immediate corrective action, the system must collect and test five additional source water samples for the presence of the same state-specified indicators within 24 hours. The State also has the option to require assessment source water monitoring, which would require 12 monthly samples.

Regular sanitary surveys are also required. Lana‘i's water systems are required to have a sanitary survey every three years. A sanitary survey is an on-site review of the water source(s), facilities, equipment, operation and maintenance of a Public Water System, performed by the State primacy agency (Department of Health), for the purpose of evaluating the adequacy of such sources, facilities, equipment, operation and maintenance for producing and distributing safe drinking water. State Department of Health staff write descriptions of the system, point out shortcomings, and discuss how to fix them. Elements reviewed generally include sources, treatment processes, supply pumps and pumping facilities, storage facilities, distribution systems, monitoring, reporting and data verification, system management and operations, and operator compliance with state requirements.

Corrective action is required where deficiencies are discovered. Deficiencies are classed in one of three categories: 1) significant or major; 2) moderate, or 3) minor. If deficiencies are identified, the PWS will be notified within 30 days and has 120 days after initial State notification to complete the required corrective actions. Treatment technique requirements are that a system correct all the deficiencies, provide alternate sources of water, eliminate the sources of contamination, or provide treatment that can reliably achieve 4-log (99.99%) removal of viruses. Further, the public must be notified of any uncorrected significant deficiencies and /or fecal contamination. Failure to comply with required corrective actions result in violations.

The Surface Water Treatment Rule, Interim Enhanced Surface Water Treatment Rule, and Long Term Enhanced Surface Water Treatment Rules I & II passed in 1989, 1998, 2002 and 2006 respectively, contain provisions that primarily apply to surface water systems, systems serving mixed ground and surface water, or systems serving Groundwater Under the Direct Influence of Surface Water (GWUDI). They do not currently apply to Lana‘i, with one possible exception worthy of note. The 1998 sanitary survey indicated that the Maunalei Tunnel systems, once a major source for the city, could be possible GWUDI, or ground water under the direct influence of surface water, due to run-off entering the tunnel. If these sources were in fact deemed to be GWUDI, this could trigger Surface Water Treatment Rule requirements, which are not applicable at present. Ground Water Under the Direct Influence of Surface Water is defined as "any water beneath the surface of the ground with significant occurrence of insects or other macroorganisms, algae, or large diameter pathogens such as Giardia lamblia or Cryptosporidium, or significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity, or pH which closely correlate to climatological or surface water conditions" (40CFR 141)

The Disinfection Byproducts Rule applies to all sizes of community water systems that either add a primary residual disinfectant other than ultraviolet light to drinking water, or deliver water that has been treated with primary residual disinfectant other than ultraviolet light. The Stage I Disinfectant and Disinfection Byproduct Rule updated and superseded the 1979 regulations for total trihalomethanes, established Maximum Contaminant Levels and Maximum Contaminant Level Goals (MCLGs) for total trihalomethanes (TTHM), haloacetic acids, bromate (where ozonation is used) and chlorite (where chlorine dioxide is used). It also sets Maximum Residual Disinfectant Levels (MRDLs) for chlorine, chloramine and chlorine dioxide, and requirements for public notification if maximum contaminant levels or maximum residual disinfectant levels are exceeded. Water in Lana‘i is chlorinated, and so Lana‘i Water Company is subject to this rule, and must monitor for trihalomethanes; chloroform, bromodichloromethane, dibromochloromethane, and bromoform; and for five haloacetic acids (HAA5): monochloracetic acid, dichloracetic acid, trichloracetic acid, bromoacetic acid and dibromoacetic acid. Under the Stage II Disinfection ByProducts Rule, all systems will conduct an Initial Distribution System Evaluation (IDSE) to identify locations with high disinfection byproduct concentrations. These locations will then be used as sampling sites for compliance monitoring. Systems will have to perform one year of increased monitoring for TTHM and HAA5. Systems with populations between 500 and 3,300 and systems with populations between 3,301 and 9,999 must monitor twice per quarter. Lana‘i will have to complete its IDSE by March 31, 2010, and submit the report by July 1, 2010. Upgraded compliance monitoring will take effect October 1, 2013. By this date, all systems must have completed their State II DBPR Compliance Monitoring Plan and begin compliance monitoring. Stage II also changes from an average of system results to locational running annual average (LRAA), meaning that systems must now comply at each sampling point, rather than merely by system-wide average.

The Consumer Confidence Report Rule, finalized in 1998, requires Public Water Systems to send to each consumer annual reports which contain fundamental information about their drinking water. The reports should include information on:

- the aquifer river or other source of drinking water;
- a summary of the susceptibility to contamination of the local drinking water source, based on state water assessments;
- information on how to obtain a copy of the system’s complete source water assessment;
- the level or range of levels of any contaminant found in the drinking water, as well as EPA’s Maximum Contaminant Level for comparison;
- the likely source of that contaminant in the local drinking water supply;
- the water system’s compliance with other drinking water-related rules;
- an educational statement for vulnerable populations about avoiding Cryptosporidium;
- educational information on nitrate, arsenic or lead in areas where these commandants may be a concern; and
- phone number of additional sources of information, including the water system and EPA’s Safe Drinking Water Hotline (800-426-4791)

If the island is designated, the company will have to apply for existing use permits for use as of the date of designation, as well as for future use permits for any additional water needed subsequent to that date. Even without designation, the State Water Code requires that water pumpage and surface water use be reported regularly, and that permits be issued for well drilling and pump installation.

The Lead and Copper Rule, passed in 1991 establishes action levels and a treatment technique for lead and copper. It requires public water systems to monitor drinking water at customer taps. If lead concentrations exceed an action level of 15 ppb (parts per billion) or copper concentrations exceed an action level of 1.3 ppm (parts per million) in more than 10% of customer taps, systems must inform consumers about steps they can take to protect their health and must undertake actions to control erosion. The first three years of lead & copper sampling on Lanaʻi were1993-1995. The 10th percentile lead level did not exceed the action level. As a result, Lanaʻi has been on a reduced sampling schedule since 1995, and so its only requirements with regard to the Lead and Copper rule involve monitoring every three years. Corrosion control is not required at this time. Monitoring continues once each three years for a smaller sample size. Based on system size, a minimum 20 samples were required initially. Resident population as of 2005 was expected to exceed 3,301, but official disaggregated census data counts are still not available on which to estimate this anticipated increase. If the island were served by a single system, or if resident population served by PWS 237 were to exceed 3,300, the number of samples required would double. Therefore it is not clear whether additional samples will be required in the near future, even under reduced monitoring.

Operator Certification Rule The 1996 Safe Drinking Water Act amendments directed EPA to initiate a partnership with states, water systems and the public to develop information on recommended operator certification requirements, issue guidelines specifying minimum standards for certification and re-certification of operators, and reimburse training and certification for systems serving 3,300 persons or fewer through grants to the states. Baseline standards were published by EPA in February of 1999. Systems serving 3,300 or fewer persons can be reimbursed the costs of training and certification, including per diem for unsalaried operators. Both systems on Lanaʻi fall within this eligibility criteria according to DOH estimated population served. Operator certification is being implemented by the States. System operators are required to be certified by the Hawaiʻi State Department of Health. As of 2008, Lanaʻi Water Company is required to have one grade 2 certified operator on duty at all times, with two certified operators on staff.

Other Federal Regulations

The Public Health Security and Bioterrorism Preparedness and Response Act of 2002 is divided into five titles with regulations to protect national food, drug and water supplies as well as other provisions. Requirements for drinking water security and safety are found in title IV of the Act. Among the provisions of the act, all community water systems serving over 3,300 people are required to prepare a vulnerability assessment and emergency response plan. Completion of vulnerability assessments was required by June 30, 2004 and emergency response plans by December 31, 2004. Vulnerability assessments are treated as privileged information for security purposes. As of the writing of this Water Use & Development Plan, the State Department of Health lists the population served by the Lanaʻi City Water System as 3,000, so Lanaʻi may not have been technically required to produce a Vulnerability Assessment.

The Occupational Safety and Health Act of 1970 was enacted to assure worker and workplace safety. It established the National Institute for Occupational Safety and Health, as well as a new division of the U.S. Department of Labor called the Occupational Safety and Health Administration. Under OSHA standards are set to limit and protect against exposure to toxic chemicals and fumes, noise levels, mechanical dangers, heat or cold stress and unsanitary conditions. Employers have a legal obligation to inform employees of safety and health standards that apply to their workplace. Provisions for site safety for operations such as pipe replacement and repair, road work, confined space entry in manholes, handling chlorine, and other provisions are among those that would apply to Lana'i Water Company.

The Emergency Planning and Right to Know Act 42 U.S.C. §11011 et. seq. applies to both workers and the public. It requires annual submission of chemical inventories and risk management plans where specified substances over a given quantity are stored - such as chlorine in excess of 2,500 pounds. It also requires that MSDS sheets be available for any substance stored in quantities over the Threshold Planning Quantity - 100 pounds for chlorine. This rule also requires reporting of spills or leaks over "Reportable Quantities" - 10 pounds for chlorine gas release.

Well drilling slurries, lubricating fluids and well purge wastewaters are subject to provisions under the Clean Water Act - National Pollutant Discharge Elimination System 40CFR Parts 100-140, 400-470 (NPEDES part 122) and HAR 11-55.

Pumps and generators can require air pollution and noise pollution permits or controls pursuant to the Clean Air Act 42 U.S.C. 7401-7671q.; 40 CFR 50-95 , HRS 342 B; and the Noise Pollution Control Act 42 USC 4901-4918; 40 CFR Parts 204, 211; HRS 342 F.

The Endangered Species Act, enacted by congress in 1973, provides a legal mechanism for the conservation of endangered and threatened species and the ecosystem on which they depend. The act requires the Secretary of the Interior to list threatened and endangered species based on established criteria; and to determine and designate critical habitats for listed species. The Secretary of the Interior is further required to develop recovery plans for listed species and report to congress on efforts to implement these plans, and to publish agency guidelines for the implementation of the act. The Secretary of the Interior, together with the Secretary of Agriculture for the National Forest System, must establish and implement a program to conserve fish, wildlife and plants, including those listed. The act authorizes acquisition of land for that purpose. It also authorizes cooperative management with the States and financial assistance for the purpose of conserving listed species. Trade in listed species is prohibited. All Federal agencies are required to consult with the Fish and Wildlife Service whenever they wish to fund, authorize, or carry out an action that could affect an endangered or threatened species or adversely modify the species' critical habitat. This includes both direct actions, such as work in a given area, and indirect actions, such as registration of pesticides that may be used in a given area. The act is limited to projects which involve federal funds, licenses or permits.

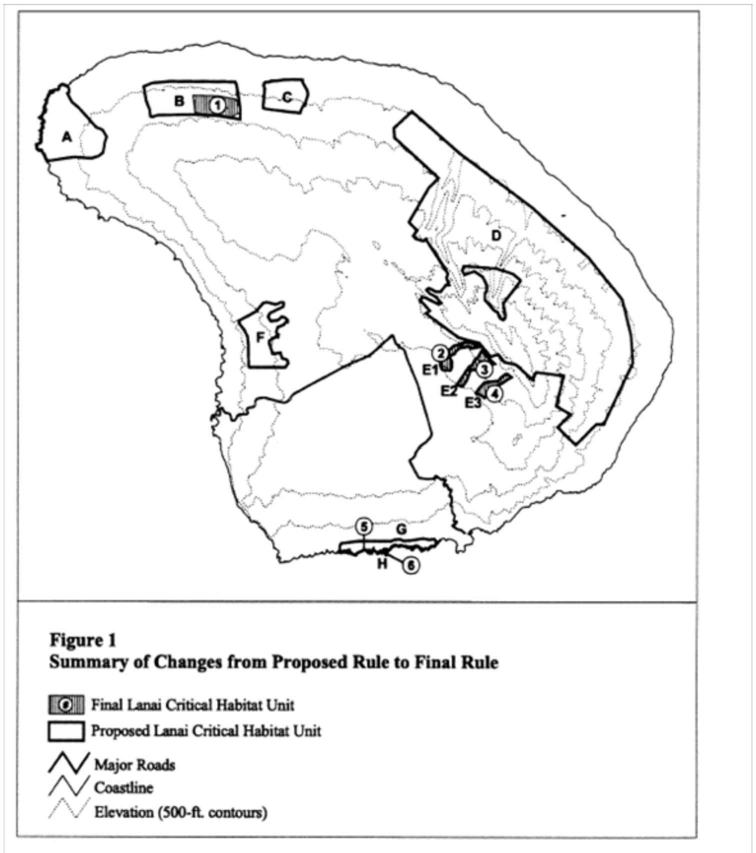
The US Fish and Wildlife Service is the agency within the Department of Interior that has been establishing critical habitat areas. In Hawai'i, the US Fish & Wildlife Service initially found that critical habitat designation for three of the thirty-seven species was prudent, but deemed it not prudent for the other thirty-four plants because it would not benefit the plant or would increase the degree of threat to the species. This determination was challenged in *Conservation Council for Hawai'i vs. Babbitt* 2F, Supp 2d 1280 (D. Haw 1998). In 1998, the US District Court for Hawai'i ordered the US Fish & Wildlife Service to review the prudency findings for 245 Hawai'ian species, including the 37 species on Lana'i, and to publish critical habitat determinations for at least 100 of the species by 2000, and the rest by 2002. At that time thirty seven species on Lana'i were listed as endangered or threatened under the Endangered Species Act. (An updated list of these species is found in Appendix D). In response to these rulings the US Fish and Wildlife Service proposed eight critical habitat units, initially covering about 19,405 acres on the island of Lana'i. However, the majority of these were not included in the final ruling, as illustrated on the image below from the January 9, 2003 Federal Register, (Vol 68, No. 6, also found in Appendix D). This decision was based in part on ongoing management efforts and establishment of the Lana'i Forest and Watershed Partnership. Despite establishing less critical habitat than initially proposed, the final determination as published in the Federal Register was instructive. It indicates critical actions for preservation of the watershed in Lana'i;

"In general, taking all of the above recommended management actions into account, the following management actions are ranked in order of importance:

- Feral ungulate control;
- Wildfire management;
- Non-native plant control;
- Rodent control;
- Invertebrate pest control;
- Maintenance of genetic material of the endangered and threatened plant species;
- Propagation, reintroduction, and augmentation of existing populations into areas deemed essential for the recovery of the species;
- Ongoing management of the wild, outplanted, and augmented populations;
- Maintenance of natural pollinators and pollinating systems, when known;
- Habitat management and restoration in areas deemed essential for the recovery of the species;
- Monitoring of the wild, outplanted, and augmented populations;
- Rare plant surveys; and
- Control of human activities/access

(Service 1995,1996a, 1996b, 1997, 1998a, 1998b, 1999, 2001). On a case-by-case basis, some of these actions may rise to a higher level of importance for a particular species or area, depending on the biological and physical requirements of the species and the location(s) of the individual plants. "

FIGURE 2-1. Endangered Species Act - Critical Habitat Designation - Summary of Changes from Proposed Rule to Final Rule



General Accounting Standards Lana‘i Water Company is also subject to various federal and state accounting and financial reporting requirements. The General Accounting Standards Board (GASB) issues accounting requirements for government agencies and publicly held utilities. Requirements known as GASB 34 passed in June of 1999 and became effective July 1, 2003. GASB 34 was intended to require sound fiscal practices and to create a fiscal connection to infrastructure planning and development. It requires that utilities report the value of their assets on consolidated annual financial reports. Two methods are acceptable: 1) depreciation, and 2) "modified" method. Either method requires that systems maintain an inventory of infrastructure assets. The depreciation method requires that utilities know the initial purchase cost of each asset, ancillary costs, and useful life. Assets can be expensed over their useful life. The modified method involves an asset management program, and allows for reporting based on utility knowledge of the condition of assets and other information. This is especially recommended for old systems, in which many assets typically outlive their "useful life" expectation. In such systems the depreciation is low, but the assets may need replacement and the costs for that will not be low. The modified method would involves inspection, maintenance and a refurbishment plan, to maintain assets above "minimum acceptable" condition. Development of improved system data and mapping will help the Company to maintain compliance with this program. The last rate making for potable water on Lana‘i was in 1994. At that time, depreciation expense was very low, indicating either that assets are fully depreciated, or that the depreciation could not be charged as they were not constructed by the Water Company. While it may not be realistic for the small rate base to cover 100% of the currently required system replacement, having an inventory of age and condition could enable the Lana‘i Water Company to establish rates that would help to recover at least a greater portion of replacement expense.

State Requirements

Enforcement is not limited to the federal level. States may apply to the EPA for a determination that the State has primary enforcement responsibility, called "primacy". The Safe Drinking Water Act gives primary enforcement responsibility to the States, provided that they meet certain requirements, delineated in 40CFR142 Subpart B. These are:

- The State must have regulations for contaminants regulated by the National Primary Drinking Water Regulations
- The State must have adopted and be implementing procedures for the enforcement of State regulations
- The State must maintain an inventory of public water systems within the State
- The State must have a program to conduct sanitary surveys of the systems in the State

- The State must have a program to certify laboratories that will analyze water samples required by the regulations
- The State must have a laboratory that will serve as the State's principal lab, which must be certified by the EPA
- The State must have a program to ensure that new or modified systems will be capable of complying with the State Primary Drinking Water Regulations
- The State must have adequate enforcement authority to compel water systems to comply with National Primary Drinking Water Regulations, including:

  •authority to sue in court

  •right to enter and inspect water system facilities

  •authority to require systems to keep records and release them to the State

  •authority to require systems to notify the public of any system violation of the State requirements, and

  •authority to assess civil or criminal penalties for violations of the State Primary Drinking Water Regulations and Public Notification Requirements
- The State must have adequate recrudescing and reporting requirements
- The State must have adequate variance and exemption requirements, as stringent as EPA's, if the State chooses to allow variances or exemptions
- The State must have an adequate plan to provide for safe drinking water in emergencies like a natural disaster
- The State must have adopted authority to assess administrative penalties for violations of their approved primacy program.

In order to maintain primacy, State regulations must be at least as stringent and protective as those of the EPA. Though they may not be less protective, they may be more protective, particularly in circumstances where exposure levels within a given State are likely to be higher than those within the Country in general. For instance, the Hawaiʻi State MCL for DBCP is more stringent than the federal standard, in part because DBCP was used in pineapple fields and Hawaiʻi had a higher acreage in pineapple than most states. The MCL for DBCP in Hawaiʻi is 40 parts per trillion, or 0.04 parts per billion, versus the federal standard of 0.02 parts per billion.

The Hawaiʻi Revised Statutes Chapter 340 E - Safe Drinking Water (HRS §340-E), and Hawaiʻi Administrative Rules Title 11 - Department of Health - Chapter 20 - Rules Relating to Potable Water Systems (HRS §11-20) are the State level equivalents of the Safe Drinking Water Act and National Primary Drinking Water Regulations. §HRS 340-E directs the Director of the State Department of Health (DOH) to promulgate and enforce State Primary Drinking Water Regulations and enables the DOH Director to promulgate and enforce State Secondary Drinking Water Regulations. HAR §11-20 sets these standards. Also covered are monitoring, analytical requirements, inspections, exemptions, emergency provisions, notification requirements, and the state revolving loan fund.

Similarly, Hawai'i Revised Statutes Chapter 340-F Hawai'i Law for Mandatory Certification of Public Water System Operators, and Hawai'i Administrative Rules Chapter 11-25 - Rules Relating to Certification of Public Water System Operators, are the State corollaries to the Federal Operator Certification Rule.

Hawai'i Administrative Rules Chapter 11-21 address cross connection and backflow. All projects which propose the use of dual water systems or the use of a non-potable water system in proximity to existing potable systems must be carefully designed and operated to prevent cross-connection of these systems and possible backflow of water from the non-potable system into the potable system. Approved backflow devices must be installed and tested periodically. Labelling requirements are set to prevent inadvertent consumption of non-potable water.

The use of reclaimed water over a potable aquifer creates potential regulatory challenge. The use of wastewater effluent for irrigation falls under §11-62-25(b) of Hawai'i Administrative Rules, and under the Guidelines for the Treatment and Use of Recycled Water. If the irrigation rate with reclaimed water were to exceed 1.2 times the agronomic (consumptive) rate, then it would be considered groundwater recharge by means of effluent reclamation. If irrigation were 3 times the natural evapotranspiration rate, then the irrigation on the Koele golf course would be considered "underground injection". This would require additional permitting. In addition, the golf course is within the two year zone of contribution for drinking water well number 6. Under the Groundwater Rule that becomes effective December 1, 2009, if reclaimed water use affected water quality, the system could then be deemed sensitive to fecal contamination - which would require more frequent sanitary surveys. If deemed sensitive, monthly monitoring for fecal contamination would be required.

The State Drinking Water Branch has also established Guidelines Applicable to Golf Courses in Hawai'i to address groundwater protection and environmental concerns relating to Golf Courses.

If the Lana'i Water Company elects to use desalinization for drinking or irrigation water, additional requirements will result. HAR §11-23 refers to brine disposal injection wells. Brine disposal would have to be below the UIC line. HAR §11-54 and §11-55 would apply in the event that ocean outfalls were utilized. Additional safe drinking water requirements would depend upon source water and other factors such as selected treatment, which would be reviewed with new source approvals under §11-20-29.

As a private water utility, Lana'i Water Company is regulated by the Public Utilities Commission. Hawai'i Revised Statutes Chapter 269 delineates the powers of the Public Utilities Commission. §269-7.5 requires utilities to have a certificate of convenience and necessity to operate. To issue such a certificate, the PUC must find that a utility is fit, willing and able to properly perform the proposed service. Certificates may be revoked. The PUC also has the authority to determine the reasonableness of proposed rates, charges, tariffs or other policies affecting the consumer. §269-8 empowers the PUC to inspect books, records, maps or other documents including a complete inventory of a utility's property in such form as the Commission may direct. §269-15 establishes procedures for hearings, investigations, proceedings and complaints. §269-15 states that if the PUC is of the opinion that a utility is neglecting to comply with provisions of Chapter 269 or otherwise failing to perform its obligations, it shall inform the utility and institute proceedings as necessary to require the utility to correct the deficiencies, including citations and civil penalties. §269-16 states that all rate fee and charge structures, or rules shall be reviewed by the PUC. §269-26 authorizes the PUC to investigate charges for water supplied to consumers for domestic purposes, where the water is supplied by virtue of a lease from the state. §269-27 states that if the charges are found to be unreasonable, the PUC shall inform the attorney general, who shall take action to cancel the lease. §269-51 provides for a consumer advocate. §269-54 sets forth the authority and powers of the consumer advocate.

Other State programs have little impact on the Utility, but must still be kept in mind. One such example is the Hawai‘i Coastal Zone Management Program (Chapter 205A HRS, 1977), the State's counterpart to the Federal Coastal Zone Management Act of 1972. These programs were enacted to protect coastal resources, including ecosystems and aquatic resources, but also recreational, historic and scenic resources. Special management areas extend not less than 100 yards inland from the shoreline, but in some places they can extend much further, wherever development activities are deemed to have direct effects on coastal resources. The Counties can amend their special management boundaries to protect coastlines and meet CZM objectives. The Coastal Zone Management program has little impact on day-to-day utility operations, but it may affect utility infrastructure planning.

Hawai‘ian Principles of Water

Traditional Hawai‘ian water law was based upon water rights, rather than land use and possession. *Kanawai*, the word for law in Hawai‘i, means belonging to the waters, and describes a system that ensures that all users receive their fair share. Farmers would take what was required and then close their inlets, so that the next farmers could have their share. Hawai‘ian land divisions also reflected this principle. Hawai‘ian Islands were *moku puni*, and were divided into large land divisions called *moku-o-loko*. Within each *moku-o-loko*, there were smaller land divisions called *ahupua‘a*, which generally, but not always, ran from the mountains to the first reef. Each *ahupua’a* had sufficient natural resources to sustain the people living within it. (Luana L. Kawa‘a, not yet published article entitled "Regional Geography of Na Poko, Na Wai Eha", 2006)

Ahupua‘a boundaries were established in various ways. Munro in *The Story of Lana‘i*, notes that some *ahupua‘a*, including Paoma‘i on Lana‘i, were initially delineated based on the amount of land that a man could run around in a given time. "Pao rather overdid himself when he encircled 17 miles of country on Lana‘i and then had to get back to Lahaina to earn some land there. After all this effort, he was *ma‘i* (ill) - hence the name Paoma‘i". (Munro, pg 18) Smaller land divisions were also delineated, such as *‘ili aina*, which were part of ahupua‘a and *‘ili ku pono*, which were independent of ahupua‘a and paid tribute directly to the king. There were also *mo‘o ‘aina* or *pauku* - sections set aside for specific types of cultivation.

The *ahupua‘a* supplied food and materials to the *maka‘ainana* (commoner residents/tenants) who tended the land, as well as to the *konohiki* (overseers), who administered the *ahupua‘a*, and the *ali‘i* *nui* (chief), who was responsible for several *ahupua‘a*. This responsibility to provide for himself and the *ali‘i* on a long-term basis generally compelled the *konohiki* toward sustainable management of both human and natural resources. (Garovoy, Jocellyn B. "Ua Koe Ke Kuleana O Na Kanaka" (Reserving the Rights of Tenants: Integrating Kuleana Rights and Land Trust Priorities in Hawai‘i, Harvard Law Review Volume 29, 2005) There was no concept of land ownership in the way it is used today.

Prior to the "Great Mahele", King Kamehameha III came under pressure from foreigners wanting lands to provide for fee simple ownership. In response to this, a declaration of rights was issued in 1839 declaring that the chiefs and the people were entitled to the same protection under the same law, that all persons should be secured protection in their lands, building lots and all property; and that nothing should be taken from any individual except by express provision of law . . .

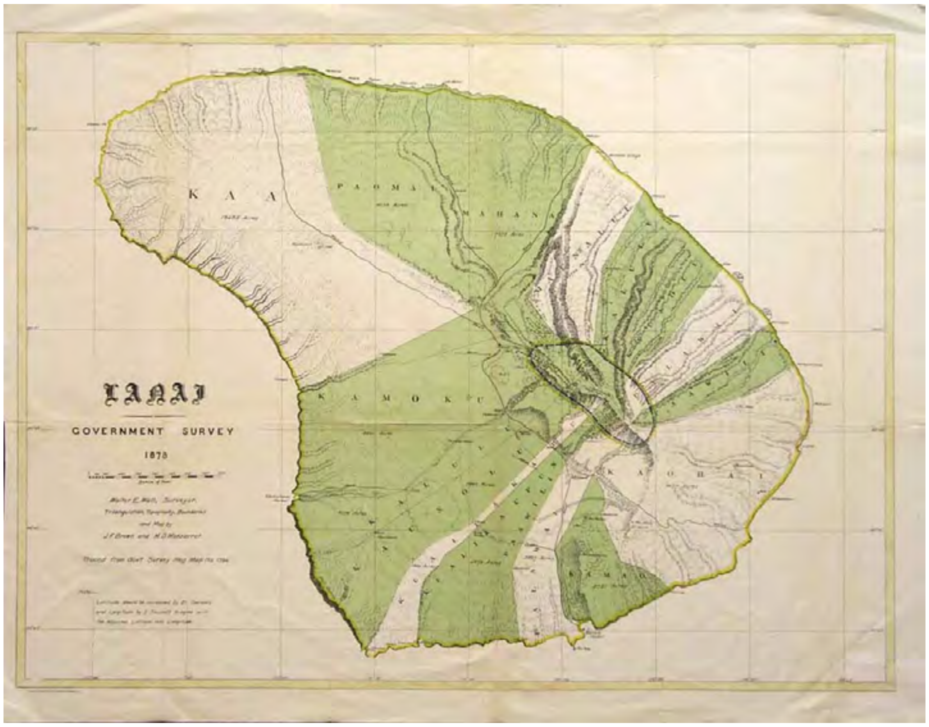
> [In the constitution] is the declaration that to Kamehameha I, the founder, had belonged all the land, but not as his own private property; that the land belonged in common to the chiefs and people, of whom the king was the head, and that it was subject to his management ["The land was not his own property. It belonged to the chiefs and people in common, of whom Kamehameha I was the head and had management of the landed property. This appears to have been the first formal acknowledgement by the government that the common people had some form of ownership interest in the land as distinguished from rights of use.] (source: Miike, Lawrence H.; *Water and the Law in Hawai‘i*, University of Hawai‘i Press, Honolulu, c 2004, pgs. 40-57)

In 1845 the Board of Commissioners to Quiet Land Titles (The Land Use Commission) was formed. In 1846 the Board published "Principles Adopted by the Board of Commissioners to Quiet Land Titles in Their Adjudication of Claims Presented to Them", in which they concluded that foreigners could not acquire title to land under existing law, and that there were only three classes of persons having vested rights in the land, the government, the landlord and the tenant. Since their interest was undivided, there was no mechanism for private property acquisition.

Mahele means division, but it also means share. The reason for the *"Great Mahele"* was established to enable individuals to gain clear title to land, while protecting the rights of the existing users. In 1848 the king and 245 konohiki reached agreement on the division of their lands. The Konohiki were then to make their claims to the Land Commission, and if confirmed the award was made by the Land Commission and title to the land was obtained through issuance of a royal patent with payment. The King also divided the remainder of the lands and established the classes of "Crown Lands" (for the occupant of the throne) and "Government Lands" (for the support of government operations). It is said that the King saw that the foreign system of private ownership was inevitable, and so established the Great Mahele, "that the people of the land sould not be left destitute."

The thirteen *Ahupua‘a* that make up the island of Lana‘i have been described in detail, with comments on place name meanings and traditional uses in *The Island of Lana‘i: A Survey of Native Culture*, (Kenneth P. Emory, 1924) and in *"E ‘Ike Hou Ia Lana‘i: To Know Lana‘i Once Again: A Historical Reference and Guide to the Island of Lana‘i"*, (Lana‘i Culture & Heritage Center, 2008). These are listed below. Descriptions are included in Chapter 3, "Existing Sources and Systems".

FIGURE 2-2. Lana‘i Survey Map - 1878



- Ka‘a 19,468 acres (The Rocky Area)
- Kalulu: 6,078 acres (The Shelter)
- Kama‘o 2,751 acres (The Ma‘o - *Gossypium tomentosum* plant)
- Kamoku: 8,291 acres (The District)
- Ka‘ohai 9,677 acres (The ‘Ohai - *Sesbania tomentosa* plant)
- Kaunolu: 7,860 acres (meaning uncertain)
- Kealia Aupuni 4,679 acres (The Salt Beds of the People/Nation)
- Kealia Kapu 1,829 acres (The Restricted Salt Beds)
- Mahana 7,973 acres (The warmth)
- Maunalei 3,342.38 acres (Mountain Garland)
- Palawai 5,897 acres (Fresh Water Moss)
- Paoma‘i 9,078 acres (Sick Pao)
- Pawili 1,930 acres (Strike and Twist, as of the wind)

Total 88,853.38 acres

The *Kuleana* Act of 1850 authorized the Land Commission to award fee simple titles to all native tenants who lived and worked on parcels of Crown, Government, or *Konohiki* Lands. To receive their *kuleana* award, the Land Commission required native tenants to prove that they had occupied, improved, or cultivated the claimed lands. The Commission also required claimed lands to be surveyed before they would issue an award for the land. (Gavaroy, Jocellyn B. "Ua Koe Ke Kuleana O Na Kanaka" ; Reserving the Rights of Tenants: Integrating Kuleana Rights and Land Trust Priorities in Hawaiʻi, Harvard Law Review Volume 29, 2005 - quoting MacKenzie, Melody *Native Hawaiʻian Rights Handbook*) The *kuleana* award could include land actually cultivated and a house lot of not more than a quarter acre. (Garavoy, Jocelyn). While the Mahele was underway, it was realized that a weakness in the program existed, and parcels of Government land were made available to applicants for lots ranging in size from 1 to 50 acres, with a price ranging from 25 cents to $1.00 per acre. (Kepa Maly, 2008) According to Miike, tenants of government, king or konohiki lands need not pay because payment had in effect already been made by the king and konohiki. Government lands were to be set aside in 1 to 50 acre lots for sale to natives who did not have sufficient land. (Miike, Lawrence)

The most detailed summary of the *Mahele ʻAina* on Lanaʻi is found in a working paper entitled, "*Mahele Claims and Awards on Lanaʻi"*, compiled by Kumu Pono Associates LLC, 2008. It identifies 105 claims for land on Lanaʻi recorded in the Native Register, 88 claims recorded in Native Testimony, 2 claims recorded in the Foreign Register, 21 claims recorded in Foreign Testimony, 64 claims recorded in the Mahele Award Survey Books, and 51 claims recorded in the Royal Patent books. "Of the total number of claims recorded in 331 documents [some overlapping in records of the native and foreign books] identified as being from Lanaʻi; 56 claims were awarded. Of these, five claims were chiefly awardees, who received entire *ahupuaʻa*. Fifty-one awards made to native tenants and individuals of lower chiefly lineage, totaled a little over 600 acres of the approximately 89,000 acres of land on Lanaʻi." (pg. 10) Cultivated crops claimed by land claimants included gourds, taro, ti leaves, sugar cane, *kou* trees, bananas, coconut trees, native tree ferns, sweet potatoes, and paper mulberry and cotton, as well as pasture lands.

Of awarded claims, the document lists:

- 12 in Maunalei
- 7 in Palawai
- 6 in Mahana
- 4 in Kaa
- 2 in Kamao
- 1 in Kealia
- 1 in Pawili
- 1 in Kamoku
- 13 in Kaunolu
- 2 in Kaʻohai
- 7 in Kalulu

According to Kepa Maly of Lanaʻi's Cultural Heritage Center, records of Maunalei alone include claims for at least 71 loʻi kalo and one *ʻauwai*. Other claims included references to *loʻi kalo* and taro lands, but specific numbers of features were not recorded, and are thus difficult to make an accurate count of. In addition, every cove between Kaʻena point at the north, through Kauonolu and down to Hulopoʻe and Manele, and every part of the reef-lined coastline from Kamaiki Point to Polihua, had significant traditional places of residence including house sites, shelters and ceremonial shrines, indicating that water was available and in use at or near these locations. Claims for fisheries were also made at several locations on Lanaʻi, notably at Kaunolu and Kalulu, and fish ponds also occur at Palawai and Kaʻohai. (personal communication with K. Maly, 2008).

In 1850 and 1854 laws were passed that enabled foreigners to acquire title. (source: Miike, Lawrence H.; *Water and the Law in Hawaiʻi*, University of Hawaiʻi Press, Honolulu, c 2004) The first and only patent granted to a non-Hawaiʻian was a 128 acre parcel granted by royal patent of Kamehameha V to William Beder in Kaunolu. (Index of All Grants Issued by the Hawaiʻian Government Previous to march 31, 1886). Following the overthrow of the Hawaiʻian Monarchy, Land Patent Grants were issued to four primary foreigners on Lana'i. These land grants removed all land on Lanaʻi from the Crown and Government (Ceded) Land Inventories by 1907.

Munro summarized land tenure on Lanaʻi, observing that the first lands owned outright by commoners on Lanaʻi were Land Commission Awards of small lots granted in 1852 and 1853. Between 1864 and 1907 nearly all government and crown lands on Lanaʻi were transferred to private parties, either through lease or sale. By 1921, only 208.25 acres remained in title to Hawaiʻians, and of this only 54.74 still remained in good title, while the other 154.51 were "lost" *kuleana*. Further history of the disposition of these lands, or the statutory or legal history of water rights is beyond the scope of this chapter. However, it is instructive to note that it is conceivable that some *kuleana* rights and protections remain under provisions which exist today. Kepa Maly of the Lanaʻi Cultural Heritage Center is presently conducting a review of all public land records for the island of Lanaʻi, and notes that at the time of this writing, at least four families and several extant *kuleana*, particularly along the windward coast, and at least one active *kuleana* in Palawai basin, exist.

A summary of *kuleana* rights is offered by Garovoy (Gavoroy, Jocellyn B. "Ua Koe Ke Kuleana O Na Kanaka" (Reserving the Rights of Tenants: Integrating Kuleana Rights and Land Trust Priorities in Hawaiʻi, Harvard Law Review Volume 29, 2005).

> Contemporary sources of law, including the Hawaiʻi Revised Statutes, the Hawaiʻi State Constitution, and case law interpreting these laws protect six distinct rights attached to the *kuleana* and/or native Hawaiʻians with ancestral connections to the *kuleana*. These rights are:
>
> (1) reasonable access to the land-locked *kuleana* from major thoroughfares;
>
> (2) agricultural uses, such as taro cultivation;
>
> (3) traditional gathering rights in and around the *ahupuaʻa*;
>
> (4) a house lot not larger than 1/4 acre;

(5) sufficient water for drinking and irrigation from nearby streams, including traditionally established waterways such as *‘auwai*; and

(6) fishing rights in the *kuanalu* (the coastal region extending from beach to reef).

Kuleana rights are often associated with a native Hawai‘ian ancestral connection to specific lands, but in fact these rights can run with the *kuleana* land itself, where the courts and legislature have not explicitly stated otherwise. Land trusts deciding how to plan for properties that contain *kuleanas* within their boundaries should consider developing policies of their own regarding how to approach *kuleana* lands held by Hawai‘ians with ancestral connections to the land, versus *kuleana* owned by non-native Hawai‘ians.

There are five sources of *Kuleana* rights:

(1) Article XII, section 7 of the Hawai‘i Constitution;

(2) Hawai‘i Revised Statutes section 1-1;

(3) Hawai‘i Revised Statutes section 7-1;

(4) Precedent-setting case law that has applied these primary sources to actual scenarios that have tested and refined specific elements of these laws; and

(5) The *Kuleana* Act.

State Constitution Article XII § 7 “The State reaffirms and shall protect all rights, customarily and traditionally exercised for subsistence, cultural and religious purposes, and possessed by ahupua‘a tenants who are descendants of native Hawai‘ians who inhabited the Hawai‘ian Islands prior to 1778, subject to the right of the State to regulate such rights”.

HRS §1-1 The common law of England, as ascertained by English and American decisions, is declared to be the common law of the State of Hawai‘i, in all cases, *except as . . . established by Hawai‘ian usage*; provided that no person shall be subject to criminal proceedings except as provided by the written laws of the United States or the State.

HRS §7-1 Where the landlords have obtained, or may hereafter obtain, allodial titles to their lands, the people on each of their lands shall not be deprived of the right to take firewood, house-timber, *aho* cord, thatch, or *ki* leaf, from the land on which they live, for their own private use, but they shall not have a right to take such articles to sell for profit. The people shall also have a right to drinking water, and running water, and the right of way. The springs of water, running water, and roads shall be free to all, on all lands granted in fee simple; provided that this shall not be applicable to wells and watercourses, which individuals have made for their own use.

The Kuleana Act of 1850 has been briefly described above. Again, it authorized the Land Commission to award fee simple titles to all native tenants who lived and worked on parcels of Crown, Government, or *Konohiki* Lands. To receive their *kuleana* award, the Land Commission required native tenants to prove that they had occupied, improved, or cultivated the claimed lands. Most maka‘ainana never claimed their kuleana. Of 29,221 adult males in Hawai'i eligible to make land claims in 1850, only 8,205 actually received kuleana awards, and these totaled less than 1% of all Crown and Kingdom lands. Several reasons have been posited. Hawai'ians at that time were accustomed to communal property rights and management, and claims to land may have gone against the grain to some. Claims could only be made for actively cultivated land, and the Hawai'ians had a tradition of resting the lands. Some tenants in remote areas may not have received adequate notice to fully understand the implications of the registration process in time. Some tenants may have feared that their ali'i would be displeased by assertions to personal claims, given the traditional shared use of the lands. (Garavoy, 2005)

An exhaustive summary of case law is beyond the scope of this document. What follows is brief and incomplete. Different authors sometimes disagree on the implications of pivotal cases. This document makes no attempt to resolve such questions.

Three major types of water rights are found in Hawai'i common law. These are appurtenant, riparian and correlative rights. Appurtenant water rights refer to those uses associated with a land parcel at the Mahele, the time the land passed into private ownership. Riparian rights are associated with lands with or adjacent to flowing streams. Correlative rights refer to the right to use groundwater under a parcel of land, so long as similar use by adjacent lands over the same aquifer are not adversely effected. Other concepts encountered in case law, though less prominently are prescriptive, appropriative and usufructuary rights. Prescriptive rights refer to the right acquired by adverse use over an extended period of time. Appropriative rights may be simply appropriative or based on prior appropriation. Prior appropriation is used more in the western mainland states than Hawai'i, and refers generally to senior rights based on the principle of first-in-time, first-in-right. Appropriative rights can also refer to water rights issued by permit, as occurs upon designation of a groundwater management area. Usufructuary rights are rights of use and enjoyment of water without ownership, so far as possible without causing damage to other users.

Kuleana parcels have both appurtenant and riparian rights.

Until the 1973 *McBryde V. Robinson* (504 P2d 1330, 1229 Haw 1973) decision, case law on water rights seemed to strengthen prescriptive rights and privatization of water. (Miike *Water Law in Hawai'i*, 2004 pg. 82)

In *McBryde*, the court found that title for water could not be transferred, ownership of water remained the State's, riparian rights are statutory based upon HRS §7-1, appurtenant rights apply only to the parcel of land to which the rights are appurtenant, riparian rights pertain only to lands adjoining a natural water course, there can be no title to State-owned property based upon adverse use, and there can be no "normal daily surplus water" because riparian rights entitle flows and shape of water course as given by nature, and freshet water is the property of the state.

In *Reppun vs. Board of Water Supply* (656 P2d at 57). the court held that "where surface water and groundwater can be demonstrated to be physically interrelated as parts of a single system, established surface water rights may be protected against diversions injure these rights, whether the diversion involves surface water or groundwater."

In *Re:Waihole Ditch Combined Contested Case Hearing* (94 Haw 97, 9 P 3d 409; 2000) the court described the scope substance, powers, duties and burdens of proof of Hawai'i's public trust doctrine and precautionary principle. "... where uncertainty exists, a trustee's duty to protect the resource mitigates in favor of choosing presumptions that also protect the resource." It directs the State to "...preserve the rights of present and future generations in the waters of the State." The decision notes that the counties will be required to articulate their land use priorities with greater specificity. For example, even at the present time, there is more land zoned for various uses than available water to supply those proposed uses. Thus, it is not sufficient to merely conclude that a particular parcel of land is properly zoned and that the use is "beneficial". That minimal conclusion may be inadequate to resolve situations in which competitive demands exceed supply" (p. 187) In response to Honolulu's objections the court stated "the city itself must, as a matter of sound planning policy, actively develop integrated water use plans addressing the contingencies arising from the limitations in supply, see e.g. HRS §174-C-31(d). Such a process, if properly undertaken will necessarily entail prioritizing among competing uses."

Kalipi V. Hawai'ian Trust Co. 656 p2d, 745, 752 (Haw 1982) held that customary rights still practiced, may be protected even if not specifically listed in §HRS 7-1.

Other Kuleana rights include access, cultivation, gathering, residing etc. Access rights have been established in *Kalaukoa v. Keawe* (9 Haw 191, 192; 1993), *Henry V. Ahlo* (9 Haw 490; 1894), *Rogers v. Pedro* (440 P2d 95, 96 Haw. 1968) and others. Gathering rights have been established in *Pele Defense Fund v. Paty* (837 P2d 1247 Haw 1992) and *Public Access Shoreline Hawai'i v. Hawai'i County Planning Commission* (aka PASH) 903 P2d at 1246, 1250 (Haw 1995), and limited somewhat by *State v. Hanapi* (970 P2d 485, 494-95, Haw 1998) Rights to cultivation, grazing and fishing are also granted for kuleana parcels. In *Hatton v. Piopio* (6 Haw 334, 336; 1882) the court held that a tenant of an ahupua'a has a right to fish in the sea appurtenant to the land as an incident of his tenancy.

The State Water Code, HRS §174-C also addresses traditional and customary rights:

HRS §174C-101 (a) Provisions of this chapter shall not be construed to amend or modify rights or entitlements to water as provided for by the Hawai'ian Homes Commission Act, 1920, as amended, and by chapters 167 and 168 relating to the Molokai Irrigation system. Decisions of the Commission on Water Resource Management relating to the planning for, regulation management and conservation of water resources in the State shall, to the extent applicable and consistent with other legal requirements and authority, incorporate and protect adequate reserves of water for current and forseeable development and use of Hawai'ian Home Lands as set forth in section 221 of the Hawai'ian Homes Commission Act. (b) No provision of this chapter shall diminish or extinguish trusts revenues derived from existing water licenses unless compensation is made. (c) Traditional and customary rights of ahupua'a tenants who are descendants of native Hawai'ians who inhabited the Hawai'ian Islands prior to 1778 shall not be abridged or denied by this chapter. Such traditional and customary rights shall include, but not be limited to, the cultivation or propagation of taro on one's own kuleana and the gathering of *hihiwai*, *opae*, *o'opu*, *limu*, thatch, ti leave, aho cord and medicinal plants for subsistence, cultural and religious purposes. (d) the appurtenant water rights of kuleana and taro lands, along with those traditional and customary rights assured in this section, shall not be diminished or extinguished by a failure to apply for or to receive a permit under this chapter. [L 1987, c 45, pt of §2; amL 1991, c 325, §8]

Act 212, A Bill for an Act Relating to Native Hawai'ians, was signed into law on June 27, 2007. The ultimate purpose of this act was to establish a council of indivuals, wise both in in the ways of Hawai'ian cultural practice and in the specifics of their own moku, so that if any project affected a moku, there could be a known contact, knowledgeable in the specifics of the area. Traditionally, each ahupua'a had, not only its own specific flora and fuana, but also its traditions and practices. By establishing a statewide network of "elders" with representation from each moku, there would always be an avenue for accurate cultural and spiritual information about any given area, as well as guidance in indigenous resource management practices. Central to the purpose of the act was the desire for a system whereby knowledge of the values and concerns of each moku could be accessed, so that decisions were not being made by those who knew nothing of the specifics of an area. The proximal purpose of the act was to set up an "'Aha Kiole" advisory committee to oversee the establishment of this 'aha moku council.

Regulatory Schedule Affecting Lana`i - Safe Drinking Water Act

Rule	EPA Status	State Adoption	Actions
Ground Water Rule 40CFR §141 Sub-part S FR65 No. 91 May 10, 2000	Promulgated 11/08/2006 Effective 1/8/2007		♦ Sanitary surveys required every 3 years for groundwater community water systems (CWSs) and every 5 years for non-CWSs ♦ Groundwater systems that do not provide 4-log virus inactivation must make a one time hydrogeologic sensitivity assessment. Monthly source water monitoring for fecal indicators required if deemed sensitive ♦ If groundwater system is notified of source water contamination, it must: 1) eliminate the contamination source, 2) provide alternative source water, or 3) install 4-log virus removal treatment within 90 days ♦ If deficiencies found, all must be corrected. Groundwater systems must inform customers of any uncorrected significant deficiencies or fecal indicator-positive samples. ♦ Groundwater systems that disinfect to 4-log removal in order to avoid source water monitoring must monitor their disinfection process.
Disinfectants & Disinfection By-Products Rule - Stage 1 Dec 16, 1998 63 FR 69389	Promulgated 12/16/1998 Revised 01/16/01 Effective 01/15/01 Revised Rule Effective 02/15/01		♦ All systems that disinfect must comply ♦ Lana‘i would be considered a small system. Small systems must comply by 12/16/03 ♦ Maximum Residual Disinfectant Levels (MRDLs) and Maximum Contaminant Levels (MCLs) based on best available technology described in the rule ♦ Maximum Residual Disinfectant Level Goals (MRDLGs) for chlorine 4mg/L; for chloramine, 4 mg/L and for chlorine dioxide 0.8 mg/L ♦ Maximum contaminant level goals (MCLGS) for four trihalomethanes: chloroform 0; bromodichloromethane 0; dibromocholoromethane 0.06 mg/L; and bromoform 0. for two haloacetic acids (dichloro-acetic acid 0 mg/L and trichloroacetic acid 0.3 mg/L); for bromoate 0 and for chlorite 0.8 mg/L ♦Maximum Residual Disinfectant Levels (MRDLs) for three disinfectants (chlorine 4 mg/L; chloramines 4 mg/L; and chlorine dioxide 0.8 mg/L) ♦ Maximum contaminant levels (MCLs) for Total Trihalomethanes (TTHMs) - a sum of the four listed above, chloroform plus bromodichloromethane plus dibromochloromethane plus bromoform 0.08 mg/L; haloacetic acids (HAA5) 0/06mg/L (sum of dichloro-acetic acid, trichloroacetic acid, monochloroacetic acid and mono and dibromo acetic acids); MCL for two inorganic disinfection byproducts : chlorite 1 mg/L; and bromate 0.01 mg/L ♦ System operators must meet requirements to be listed in State register of qualified operators ♦ Monitoring, reporting & public notification requirements for compounds listed above. Monitoring of TTHMs and HAA5 for 4 consecutive quarters to determine need for disinfection profiling. A monitoring plan must be maintained and made available for DOH inspection and the general public no later than 30 days following the compliance date. Plan must include 1) locations for collecting samples, 2) how compliance with MCLs, MRDLs and treatment techniques are calculated and 3) must reflect the entire distribution system ♦ New analytical methods for TTHM monitoring

Disinfectants & Disinfection By-Products Rule - Stage 2	Promulgated 1/4/06 Effective 3/6/06		• Applies to CWS and NTNCWSs that produce and or deliver water that is treated with a primary or residual disinfectant other than ultra violet light • Requires an initial distribution system evaluation (IDSE) to identify locations with high disinfection byproduct conscentrations. These locations will then be used as sampling sites for compliance monitoring. • Compliance with MCLs for two groups of disinfection byproducts calculated for each location, referred to as the locational running annual average (LRAA). • Requires each system to determine if they have exceeded an operational evaluation level, based upon monitoring results. The operational evaluation level provides an early warning of possible future MCL violations, thereby enabling systems to proactively take steps to remain in compliance. A system that exceeds an operational evaluation level is required to review its operational practices and submit a report that delineates actions taken to mitigate or prevent future high disinfection by-product levels. • Total trihalomethanes (TTHM) and five haloacetic acids (HAA5) monitoring for one year on a regular schedule determined by source type and system size. Systems have the option of performing a site-specific study based on historical data, distribution system models or other means. Waivers available for systems that meet certain criteria. • MCL value same as in Stage 1. Annual average at each sampling location, rather than system-wide used to determine compliance with the MCLs. 0.08mg/L for TTHM; 0.06 mg/L for HAA5. Switching from the system-wide average to the LRAA will reduce exposure to high disinfection by-product concentrations by ensuring that each monitoring site is in compliance. • MCLGs added for cloroform, monocloracetic acid and trichloracetic acid. • Lana'i will have to complete its IDSE by March 31, 2010, and submit the report by July 1, 2010. Upgraded compliance monitoring will take effect October 1, 2013.
Interim Enhanced Surface Water Treatment Rule	Promulgated 12/16/98 Effective 1/16/99 Revised rule effective 1/16/01	12/30/00	• Does not affect Lana`i at this time. Main potential for the surface water treatment rules to impact Lana`i would be if sources were Ground Water Under the Direct Influence of Surface Water (GWUDI). • Ground Water Under the Direct Influence of surface water means "any water beneath the surface of the ground with significance occurrence of insects or other macroorganisms, algae, or large diameter pathogens such as *Giardia lamblia* or (for subpart H systems serving at least 10,000 people) *Cryptosporidium,* or significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity, or pH which closely correlate to climatological or surface water conditions. Direct influence must be determined for individual sources in accordance with criteria established by the State. The State determination of direct influence may be based on site-specific measurements of water quality and/or documentation of well construction characteristics and geology with field evaluation. • Applies to surface water systems & to ground water under the direct influence of surface water (GWUDI) systems serving 10,000 people or more • 2-log *Cryptosporidium* removal (99%) for systems that filter • Strengthened combined filter effluent turbidity performance standards • Individual filter turbidity monitoring provisions • Disinfection profiling required if a system exceeds 80% of MCLs for TTHM or HAA5. Disinfection benchmarking required when significant system change • Covers required on new finished water reservoirs for which construction begins 60 days after rule promulgation minor revisions: • Compliance coincides with calendar quarters • Clarifies some regulatory provisions found in the published rules

Longterm I Enhanced Surface Water Treatment Rule	Proumulgated 01/14/02 Effective 02/13/02	Nov-02	♦ Applies to surface or groundwater under the direct influence of surface water (GWUDI) systems serving <10,000 ♦ 2-log Cryptosporidium removal (99%) for systems that filter ♦ Disinfection profile required unless TTHM and HAA5 disinfection byproduct (DBP) levels levels <0.064 mg/L and 0.048 mg/L respectively can be demonstrated. Systems planning a significant change to disinfection practices must determine their current lowest level of microbial inactivation and consult with the state for approval prior to implementing that change. ♦ Filtered systems must comply with strenghtened combined filter effluent (CFE) turbidity performance. Conventional and direct filtration systems must continuously monitor the turbidity of individual filters and comply with follow-up activities based on this monitoring. ♦Combined, filtered turbidity levels <0.3NTU in at least 95% of measurements, and must at no time exceed 1 NTU ♦Continous turbidity monitoring of individual filters, with results recorded every 15 minutes ♦ Covers required on new finished water reservoirs for which construction begins after March 15, 2002 ♦ Microbial inactivation benchmarking: systems required to develop a profile of microbial inactivation levels unless they perform monitoring which demonstrates that their disinfection byproduct levels are less than 80% of the MCLs established under the Stage I DBPR. Systems making a significant change to their disinfection practice must determine their current lowest level of microbial inactivation and consult with the state for approval prior to implementing the change ♦ Unfiltered systems must comply with updated watershed control requirements that add *Cryptosporidium* as a pathogen of concern. (unfiltered systems not allowed in Hawai'i)
Longterm II Enhanced Surface Water Treatment Rule	Promulgated 2/06 Effective 3/06	May-02	♦ PWSs using surface water or GWUDI required to monitor source influent to determine average *cryptosporidium* level. PWSs serving 10,000-49,999 must begin source water monitoring no later than April 1, 2008. PWSs serving <10,000 people must begin *E coli* monitoring no later than October 1, 2008 and at least once every 2 weeks thereafter for 12 months. ♦ Large PWSs serving >10,000 people must monitor for Cryptosporidium, plus E coli and turbidity in filtered systems) for two years. Small filtered PWSs serving <10,000 people initially monitor for E coli only, for one year and must monitor for Cryptosporidium only if E coli levels exceed trigger values. Small filtered PWSs that exceed E coli triggers must monitor for Cryptosporidicum for one or two years. Specific criteria are set for sampling frequency, schedule, locations, data grandfathering, treatment instead of monitoring, sampling by PWSs that use surface water only part of the year, and monitoring new plants and sources. ♦ Date for PWSs to begin monitoring is staggered by PWS size. Largest systems start Januuary 2008. Requirements are set for monitoring results, analytical methods, use of approved laboratories. ♦ Additional risk-targeted treatment technique for Cryptosporidium ♦ PWSs with uncovered finished water storage facilities must either cover or treat facility discharge to achieve inactivation and or 4-log virus removal, 3 log Giardia lamblia removal and 2 log Cryptosporidium removal on State-approved schedule.

Consumer Confidence Reports Rule 40 CFR §141 Sub-part O 63 FR No. 160 44511	Promulgated 08/19/ 1998 Effective 09/19/1998	Aug-99	♦ Community Water Systems (CWSs) are required to mail annually to each customer a report on the contaminant level in the drinking water purveyed ♦ Reports are required to include but not limited to the following: 1) the water source, a definition of MCLG, MCL, variances & exemptions, 2) if any regulated contaminant is detected in the water purveyed, a statement of MCLG, MCL, level of contaminant in water system, statement regarding the health concerns that resulted in regulation of any regulated contaminant for which there has been an MCL violation during the year covered by the report; 3) information on compliance with the NPDWR (National Primary Drinking Water Regulations), and a notice if the system is operating under a variance or exemption, and the basis on which the variance or exemption was granted; 4) information on the levels of unregulated contaminants for which monitoring is required under section 1445(a)(2), including levels of cryptosporidium and radon where states determine that they may be found; 5) a statement that the presence of contaminants in drinking water does not necessarily indicate that the drinking water poses a health risk, and that more information about contaminants and potential health effects can be obtained by callng the SDW Hotline.
Public Notification Rule	Promulgated 05/18/ 2000 Effective 06/05/2000		♦Public Water Systems (PWSs) are required to notify customers for violations of the National Primary Drinking Water Regulations (NPDWRs), or if they have a variance or exemption from the regulations, have violated the terms of a variance or exemption, or are facing other situations posing a risk to public health. ♦Public notices are divided into three tiers, defined based on the seriousness of the violation or situation, and on potential health effects. The new rule adds to the violations about which PWSs must notfiy customers. ♦ Tier 1 notices are required within 24 hours. Additional notices for the same violation are not required. The system must provide notices to the state for initial and repeat notice cycles. Consultation with the state is required within 24 hours for tier 1 violations. Tier one violations include 5 NTU turbidity exceedence, or turbidity treatment technique resulting from single exceedence in addition to those in the current rule. ♦Tier 2 notices include violations under the disinfection by products rule and the interim enhanced surface water treatment rule (IESWTR) (Note: the IESWTR does not apply on Lana`i, unless tunnel is considered GWUDI) - also serious and persistent monitoring and testing procedure violation as determined by the primacy agency. Notice is required within 30 days. Consultation with the state is required within 24 hours of a maximum turbidity limit exceedence. Repeat notice required every 3 months where the violation persists. ♦Tier 3 notice required to announce availability of unregulated contaminant monitoring results for exceedances of flouride. Notice required within 1 year, and repeated annually. ♦ Notice required to new customers for any outstanding violation requiring notice ♦ Minimum delivery methods include media, hand delivery or posting for tier 1 notices ♦ Simplified standard language and new standard language required for monitoring violations.
Operator Certification Rule	Promulgated 02/ 1999 Effective 02/01	2/5/01	♦ Applies to all Community and Non-Transient Non-Community Water Systems ♦ EPA guidelines require certification of all distribution system workers and plant operators. All operators must maintain certification level equal to or greater than that of the facility that they operate. ♦ HAR 11-25 defines classes of certification, requirements, continuing education units, classification of treatment plants and distribution systems, procedures, remedies, etc.

Lead & Copper Rule	Promulgated 06/ 0791 Effective 12/07/ 1992 Revisions 01/12/00 Effective 04/11/00		♦ Lead action level 15 ppb, or 15ug/L = 0.015 mg/L; copper action level 1.3 ppm, or 1.3 mg/L ♦ Lana'i initially served between 501 & 3,300 people, so was required to sample at 20 sites - Tier I or as nearly Tier 1 sites as possible. With the increase in population, 40 sites would now be required. ♦ Lead free pipe, solder or flux is required after 1/19/86 for any connection to a PWS and well pump ♦ Corrosion control and source water treatment requirements ♦ Public education and supplemental monitoring for customers required if action level exceeded ♦ Monitoring requirements for tap water, source water, and water quality parameters in distribution system ♦ Reporting and record keeping requirements ♦ Systems must perform optimal corrosion control treatment (OCCT) and continue to maintain and operate any corrosion control that is already in place and meet any requirements that the State determines appropriate to ensure OCCT maintained ♦ Systems that are deemed to be optimized due to little or no corrosion in distribution systems, must - monitor for lead and copper at the tap once every three years if lead levels <0.005 mg/L and copper less than 0.65 mg/L - meet the copper action level ♦ Replace lead service lines and notify customers ♦ Report change of source or treatment

National Primary Drinking Water Standards	Various Promulgation dates		Over 90 maximum contaminant levels (MCLs) or treatment techniques (TTs) for various contaminants. Included are: ♦ *Cryptosporidium* ♦ *Giardia lamblia* ♦ Heterotrophic Plate Count ♦ *Legionella* ♦ Total coliforms (including fecal coliform and *E. coli*) ♦ Turbidity ♦ Viruses (enteric) ♦ Bromate ♦ Chlorite ♦ Haloacetic acids (HAA5) ♦ Total Trihalomethanes (TTHMs) ♦ Chloramines as (Cl_2) ♦ Chlorine (as Cl_2) ♦ Chlorine Dioxide ♦ Antimony ♦ Arsenic ♦ Asbestos (fibers >10µm) ♦ Barium ♦ Beryllium ♦ Cadmium ♦ Chromium (total) ♦ Copper ♦ Cyanide (as free cyanide) ♦ Cyanide ♦ Flouride ♦ Lead ♦ Mercury (inorganic) ♦ Nitrate (measured as Nitrogen) ♦ Nitrite (measured as Nitrogen) ♦ Selenium ♦ Thallium ♦ Acrylamide ♦ Alachlor ♦ Atrazine ♦ Benzene ♦ Benzo(a)pyrene (PAHs) ♦ Carbofuran ♦ Carbon tetrachloride ♦ Chlordane ♦ Chlorobenzene ♦ 2,4 D ♦ Dalapon ♦ 1,2-Dibromo-3-chlorpropane (DBCP) ♦ o-Dichlorobenzene ♦ p-Dichlorobenzene ♦ 1,2-Dichloroethane ♦ 1,1-Dichloroethylene ♦ cis-1,2-Dichloroethylene ♦ trans,1,2-Dichloroethylene ♦ Dichloromethane ♦ Dichloromethane ♦ 1,2-Dichloropropane ♦ Di(2-ethylhexyl)adipate ♦ Di(2-ethylhexyl)phthalate ♦ Dinoseb ♦ Dioxin (2,3,7,8-TCDD) ♦ Diquat ♦ Endothall ♦ Endrin ♦ Epichlorohydrin ♦ Ethylbenzene ♦ Ethylene dibromide ♦ Glyphosate ♦ Heptachlor ♦ Heptachlor epoxide ♦ Hexachlorobenzene ♦ Hexachlorocyclopentadiene ♦ Lindane ♦ Methoxychlor ♦ Oxamyl (Vydate) ♦ Polychlorinated biphenyls (PCBs) ♦ Pntachlorophenol ♦ Picloram ♦ Simazine ♦ Styrene ♦ Tetrachloroethylene ♦ Toluene ♦ Toxaphene ♦ 2,4,5-TP (Silvex) ♦ 1,2,4-Trichlorobenzene ♦ 1,1,1-Trichloroethane ♦ 1,1,2-Trichloroethane ♦ Trichloroethylene ♦ Vinyl chloride ♦ Xylenes (total) ♦ Alpha Particles ♦ Beta particles & photon emitters ♦ Radium 226 & Radium 228 (combined) ♦ Uranium
National Primary Drinking Water Standards - Arsenic	Promulgated 01/22/ 2001 Effective 03/23/2001		♦ Systems of all sizes must comply by 01/23/2006 ♦ Final rule changes arsenic MCL from 50ppb to 10ppb (µg/L) ♦ Establishes new analytical method and best available technologies for treatment

National Primary Drinking Water Standards - Radon	Proposed 11/02/1999 Final 1/12/2000 Effective 04/11/2000		♦ appplies to all community water systems using ground water and mixed ground & surface water ♦ MCLG (maximum contaiminant level goal) is zero; MCL is 300 pCi/L alternative MCL is 4000 pCi/L ♦ quarterly monitoring in the first year, and annual monitoring thereafter ♦ PWS qualifies for alternative MCL if it follows a state or local multi-media mitigation (MMM) program that reduces radon levels in indoor air caused by non-water sources. MMM program must satisfy four EPA requirements: public involvement in its development, quantitative goals for fixing existing homes, and building radon-resistant new homes, strategies for achieving these goals and a plan to track and report results. ♦ HI State DOH will not adopt an MMM program, since the average indoor radon level is 0.1 pCi/L. However PWSs can develop MMMs if needed.
National Primary Drinking Water Standards - Radionuclides	Promulgated 12/07/2000 Effective 12/08/03		♦applies to all community water systems ♦ final MCL for uranium set at 30µg/L and MCLG set at 0 ♦ new rule revises monitoring requirements for combined radium-226 and radium-228, gross alpha particle radioactivity, beta particle and photon radioactivity ♦ current MCL for combined radium 226-228 is 5 pCi/L, and for gross alpha particle radioactivity 15 pCi/L retained ♦ current MCL for beta particle and photon radioactivity of 4mrem/year is retained for this rule, but will be further reviewed in near future
National Primary Drinking Water Standards - Chloroform	Effective 05/30/2000		♦ EPA removed the 0 MCLG from the NPDWR in accordance with a recent order of the U.S. Court of Appeals for the District of Columbia Circuit ♦ No other provision of the D/DBP regulation was affected
Contaminant Candidate List	CC 1 03/98 CC 2 02/05 CC 3 02/08		♦ List of unregulated contaminants that may warrent regulation. ♦ The third Draft Contaminant Candidate List was published in February, 2008. It includes 11 microbial and 93 chemical contaminants, and may be found at http://www.epa.gov/safewater/ccl/ccl3.html.
Filter Backwash Recycling	Final 06/08/01 Effective 08/07/01	before 6/9/2003 to retain primacy	♦ Does not currently affect Lana`i ♦ Applies to all PWS that use surface water or GWUDI that utilize direct or conventional filtration processes; and recycle spent filter backwash water, sludge thickener supernatant or liquids from dewatering processes ♦Recycled filter backwash water, sludge thickener supernatant, and liquids from dewatering must pass through all processes of the system's representative treatment in order for conventional and direct filtration systems which recycle to maintain 2-log removal credit ♦ Systems must notify the State in writing that they practice recycle and provide detailed recycling treatment information. States may, after evaluating the information, require a system to modify their recycle location or recycle practices.
Secondary Drinking Water Standards	Various Dates		Sets recommended guideline MCLs for contaminants with cosmetic or aesthetic effects. Standards are set for aluminum, chlorides, color, copper, corrosivity, flouride, foaming agents, iron, manganese, pH, silver, sulfate, total dissolved solids and zinc. Secondary standard for chloride is 250 mg/L.

Unregulated Contaminant Monitoring Rule	Proposed 09/17/00 Final 01/11/01 Effective 05/31/02		♦ Does not currently affect Lana`i ♦ Monitoring of 48 contaminants to be continued until final rule in effect. Community water systems and non-transient, non-community water systems serving >10,000 people, and a nationally representative sample of small systems are required to monitor for not more than 30 contaminants. Monitoring suspended for systems serving <10,000 people on 01/08/1999 ♦ List 1 contaminants must be monitored by all. List 3 methods are being researched ♦ Large systems must monitor for a 12-month period within the years 2001-2003 for 2,4-dinitrotoluene, 2-6 dinitrotoluene, DCPA mono acide degradate, DCPA di acid degradate, 4,4'-DDE, EPTC, molinate, MTBE, nitrobenzene, terbacil, acetochlor, and perchlorate. Systems must also analyze for water quality parameters including, for chemical contaminants; pH; and for microbiological contaminants: pH, temperature, turbidity, free disinfectant residual and total disinfectant residual. Surface water systems must monitor during 4 consecutive quarters. Ground water systems must monitor twice, 5 to 7 months apart. One sampling must be between May 1 and July 31. Composite sampling not acceptable. ♦ Monitoring must be conducted at each entry point to the distribution system, or at other sampling locations previously specified by the State, for sampling points representative of each principal, non-emergency water source in use over the one year of monitoring. In-system points monitoring will be required for List 2 contaminants ♦ Large and small systems must monitor according to the quality control procedures described. Laboratories that are certified to use the indicated methods for the contaminants listed are automatically certified ♦ Test results must be reported electronically, or in an alternate format previously arranged, to EPA, within 30 days following the month they receive the results. EPA will report the results for selected representative small systems. A system can have a laboratory report for its results. Previously collected data can be reported if the data meets specified requirements and includes the applicable water quality parameters and data required to be reported ♦ States can enter into MOA with the EPA concerning the implementation of the monitoring program Additions in Final Rule: ♦ approves the analytical methods for 13 chemical contaminants on List 2 ♦ monitoring required for list 2 contaminants ♦ sets the schedule for monitoring microbiological contaminant, Aeromanas, contingent on promulgation of its analytical method ♦ Modifications affecting the sample collection, analysis and reporting of List 1 and List 2 contaminants, including clarifying source water monitoring, resampling conditions, additonal methods, and clarification of definitions of some data elements for reporting
Total Coliform Rule	Published 6/24/89 Effective 12/31/90		♦ Requires that sanitary surveys be conducted at least once every five years for systems that take fewer than five samples for month. EPA has encouraged the state to perform more frequent sanitary surveys; annually for surface water systems and triennially for ground water systems

HAR Title 11 Chapter 25 Rules Relating to Certification of Public Water System Operators	♦ Contents: purpose; definitions; public water system operation & management; classes of certification; education & work experience requirements for certification; continuing education units; application for certification; examination for certification; issuance and renewal of certification; revocation, suspension & refusal to renew certification; schedule of fees for certification; classification of water treatment plants; classification of distribution systems; procedures of the board; penalties & remedies; severablility clause ♦ Class 1 distribution systems <or= 1,500 persons; Class 2 systems 1,501-15,000 persons; Class 3 systems 15,001 -50,000 persons; Class 4 systems >50,000 persons ♦ Class 1 water treatment plant includes any chemical addition such as chlorination, flouridation; pH control or corrosion control; slow sand filtration, granular activated carbon filtration, or packed aeration towers or air stripping towers. Class 2 treatment plant includes membrane filtration, cartridge filtration, or desalinization (incl. distillation, electrodialysis, reverse osmosis. Class 3 treatment plant includes diatomaceous earth filtration, or package water treatment plants with processes similar to diatomaceous earth filtration; Class 4 water treatment plants use conventional treatment (coagulation with rapid mixing, flocculation, sedimentation and filtration); or direct filtration (conventional treatment without sedimentation); or package plants with features similar to those of conventional treatment or direct filtration. ♦ Applies to all community and non-transient non-community water systems. ♦ Each public water system covered by this chapter shall be under the responsible charge of an operator(s) holding valid certification equal to or greater than the classification of water treatment plant or distribution system. ♦ All operating personnel making daily process control or system integrity decisions about water quality or quantity that affect public health shall be certified. ♦ A designated certified operator shall be available for each operating shift
Drinking Water State Revolving Fund	Established to help public water systems finance important infrastructure improvements. EPA awards grants to states. States establish revolving loan funds to assist with projects needed either for regulatory compliance, source protection or to avert problems from old or failing facilitiies. Act requires 20% State match. All funded projects must comply with all state and federal requirements. Approvals are phased: first a project is put on the prioity list, then there are requirements for the planning process, the loan agreement, the construction, loan payment and close-out and operations.

Regulatory Schedule Affecting Lana`i - Other Than Safe Drinking Water Act

Rule	EPA Status	State Adoption	Actions
Clean Water Act - National Pollutant Discharge Elimination System	40 CFR Part 122 USC Title 33	HAR 11-55	Before discharging any pollutants into state waters, altering the quality or substantially increasing the quantity of any discharge, a general permit application must be filed for discharges, including: ♦Hydrotesting waters: water used to test the integrity of a tank or pipeline ♦ Construction activity dewatering effluent: dewatering process of construction activities of any size ♦ Treated effluent from well drilling activities; treated process wastewater includes all drilling slurries, lubricating fluids, wastewaters and well purge wastewaters An individual permit may be required where effluent limitation guidelines are promulgated for point sources covered by the general permit; a water quality management plan containing requirements applicable to the point sources is approved, circumstances have changed so that the permittee is no longer appropriately controlled under general permit or a reduction or elimination of the authorized discharge is necessary, or the discharge is a significant contributor of pollutants to state waters. NPDES applications shall be filed no less than 180 days before discharge of any pollutants, or in sufficient time prior to discharge to ensure compliance with national standards of performance for manufacturing type industry, or with any applicable zoning or site requirements under a waste treatment management plan, and any other applicable water quality or effluent standards and limitations. NPDES permits must comply with any applicable standards of performance for new sources, applicable water quality standards, effluent standards, effluent prohibitions and pretreatment standards, and effluent limitations as specified in issued permits Permits must comply with any more stringent limitations, including: 1) standards established by state laws or rules, 2) federal standards an regulations for toxic pollutant effluents, secondary treatment, point source discharges of conventional pollutants, and sludge handling, 3) any waste treatment management plan approved for the area. The permittee shall report planned changes, anticipated non-compliance, transfers, monitoring results at the intervals specified in the permit, compliance schedule and any non-compliance. Any new or increased discharges require a new application, or submission of a notice if the discharge does not violate effluent limitations specified in the permit. Permanent discontinuance of the treatment works or waste outlet must be reported within 30 days

Clean Water Act - Total Maximum Daily Load	Proposed 08/23/99 Final 07/13/2000 64 FR 46057 www.epa.gov/ owow/tmdl		♦Does not apply to Lana'i. ♦Objectives: 1) to progress towards meeting water quality standards, especially in non-attainment water areas, and 2) to assure that TMDLs are implemented ♦ States must develop lists of polluted water bodies every 4 years, and establish a schedule for clean-up within 10 years (or 15 years if needed). Higher prioirity given to polluted waters that are sources of drinking water. ♦ TMDL will identify water body name, location, pollutant, amount of pollutant allowable to meet standards, load reduction to meet standards, sources of the pollutant, wasteload allocation for point sources, load allocation for runoff and other sources,and implementation plan, conssideration fo seasonal variation, allowance for reasonably foreseeable increases in pollutant loads. Plans and actions may be phased in over time. Public to have opportunity to comment. ♦ Implementation plans should have list of actions needed to reduce pollutant loads, time-lines for implementation, reasonable assurances that implementation will occur, monitoring and modeling plans with milestones for measuring progress, plans for revising the TMDL if progress toward cleanup is not made, and anticipated date by wihich water quality standards will be met. ♦ Reasonable assurance is established either through NPDES permit for point sources, or through a four part test for non-point sources: 1) actions must apply to the pollutant; actions will be implemented expeditiosly; actions will be accomplished through effective programs, 4) actions will be supported by adequate water qualtity funding ♦EPA authority to review State TMDLs and will also back-stop State efforts to develop them. Authority to override State-issued, expired, or administratively-continued permits authorizing discharges into impaired water bodies In effect, ability to over-ride allows the EPA to control all legal discharges to ensure that permits are consistent with water quality standards, as well as with applicable wasteload allocations in a TMDL. ♦EPA can require selected dischargers to offset any increase in mass loadings of a pollutant(s) into already impaired waters, or should the increase cause nonattainment of the water body.

Occupational Safety & Health Act (OSHA)	29 CFR Parts 1910 and 1926	HAR 12-9	general safety and health requirements include elimination or reduction of existing or potential hazards, written safety and health program to identify, evaluate and control work place hazards, periodic inspections by trained individuals to identify new or missed hazards, and safety and health training. In addition, there are specific requirements for the following: ♠ safety, training & education ♠ medical and first aid ♠ fire protection ♠ personal protective equipment ♠ housekeeping ♠ illumination ♠ ventilation ♠ signals, signalling & barricading ♠ means of egress ♠ work areas & working surfaces ♠ materials handling, storage & use ♠hazardous materials process/safety mgmt ♠ management of highly hazardous chemicals handling & processes ♠ flammable & combustible liquids mgmt ♠ liquified petroleum gas mgmt ♠ logging operations ♠ welding, cutting and brazing ♠ use of hand & power tools ♠ machinery & machine guarding ♠ motor vehicles & mechanized equipment ♠ ladders, scaffolds, other special working conditions ♠ powered platforms ♠ cranes & derricks ♠ material hoists ♠ abrasive blasting ♠ storage batteries ♠ air receivers ♠ permit-required confined spaces ♠ hazardous waste operations & emergency response ♠ control of hazardous energy (lock-out,tag-out) ♠electrical ♠full-protection systems ♠ demolition ♠ excavation ♠ steel erection ♠ underground lines ♠ asbestos handling ♠ lead handling ♠ retention of DOT markings, placards & labels ♠ rollover protective structures & overhead protection ♠ occupational noise exposure ♠radiation hazards ♠toxic materials & harmful physical agents ♠hazardous chemicals in laboratories ♠hazard communication

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)	40 CFR Part 171		♦ History: The first pesticide control law was enacted in 1910 to protect consumers from ineffective products and improper labeling. FIFRA was initially passed in 1947 was under the US Department of Agriculture. In 1972 it was amended to focus on protection of human health and the environement, with EPA as the lead agency. Mandates that EPA regulate the use and sale of pesticides for this purpose. ♦ Before pesticides can be registered, the burden of proof is on the would-be registrant to prove that the pesticide can be safely used on the product it is intended for. Each pesticide registration applies to one particular use of a chemical, specifying crops and sites on which it may be applied. In some cases conditional registration may be granted pending additional data. ♦ EPA must set a tolerance, or maximum amount that can be used on a raw product and consisered safe, or not cause residues above accepted tolerances. ♦ Data which must be reviewed in registering and setting tolerances include environmental fate, residue chemistry, dietary and non-dietary hazards to humans, animals and non-target organisms; and these data gathered by studies conducted with approved methods. To register a pesticide the composition must warrant the claims proposed for it, its labeling and other materials must comply with the provisions of FIFRA for same, it must perform its intended function without unreasonable adverse effects, when used in accordance with widespread practice. States may register additional uses of a federeally registered pesticide product to meet specific local needs. EPA may disapprove State registrations if the registered pesticide will not stay within acceptable tolerances or if the pesticide has been denied by EPA. ♦ Emergency exemptions may be granted when there is a problem situation that registered pesticides will not alleviate, and the proposed exemption will not cause unreasonable adverse effects. If States concur that necessary conditions have been met they send request to EPA to register for a given situation. ♦ Some pesticides are registered for “restricted use” only. These are pesticides that may only be applied by properly trained and certified applicators. States can certify applicators if their certification training plan meets with EPA approval. Gaseous Chlorine, used in drinking water utilities is a restricted pesticide,and requires a certified applicator . ♦ Pesticide registrations must be reviewed every 15 years. EPA makes re-registration determinations. Pesticdes may also be cancelled where EPA believes that conditions of the rule have not been met. Cancellation procedures are delineated in the rule, but EPA may issue an emergency order and cancellation where an imminent hazard would result if the pesticide continued to be used during cancellation proceedings. ♦ Labeling requirements include contents, registered uses, requirements of rmixing, storage and application, time periods after use before fields may be re-entered, or before crops may be harvested, container disposal requirements, and other information. ♦ Imported pesticides are subject to pesticide regulations. Exported pesticides are subject to recordkeeping and certain procedures for data and for labeling related to safe storage, disposal, handling and transportation. Companies may export pesticides not registered in the United States subject to a signed statement from the foreign purchaser acknowledging the unregistered status of the product before it can be shipped. ♦ Can affect drinking water utiliities in combination with other acts such as ESA or FQPA below: ♦ §7(a)(2) of the Endangered Species Act requires that agencies ensure that their actions are not likely to jeopardize listed species, nor their critical habitat. Pesticide registrations have been challenged on this basis. If species or habitat “may be” affected, an Endangered Species Act consultation is required.

FIFRA (continued)	40 CFR Part 171		♦ The Pesticides and Groundwater State Management Plan Regulation required states to create specific management plans (pesticide manqagement plans) to protect groundwaters from pesticides or lose the ability to register/ use those pesticies.
Food Quality Protection Act	August 13, 1996		♦ Amended both FIFRA and the Federal Food, Drug, and Cosmetic Act (FFDCA) to establish a new safety standard for pesticide residues in food and emphasizing protection of infants and children, and protection from aggregate exposures. ♦ Under FQPA, EPA must be able to conclude with "reasonable certainty that no harm will result from aggregate exposure" to each pesticide from dietary and other sources. In determining allowable levels of pesticide residues in food, the Agency must conduct a comprehensive assessment of each pesticide's risks, considering: • Aggregate exposure of the public to residues from all sources including food, drinking water, and residential uses; ² Cumulative effects of pesticides and other substances with common mechanisms of toxicity; ² Special sensitivity of infants and children to pesticide; and ² Estrogen or other endocrine effects. ♦ Within ten years of enactment of the new law, EPA must reassess all existing "tolerances" (maximum limits for pesticide residues in foods) and exemptions from the requirement of a tolerance, for both the active and inert ingredients in pesticide products. The Agency must consider the pesticides posing the greatest potential risks first, to ensure that they meet FQPA's new safety standard. ♦ FQPA requires EPA to review every registered pesticide on a suggested 15-year cycle.

Emergency Planning & Community Right-to-Know Act (EPCRA) Hawai'i Emergency Planning and Community Right-to-Know Act (HEPCRA)	40 CFR Part 68	HAR 128E-6, 128E-7, and 128E-9; HAR 11-451-7; The State Contingency Plan Title 11 Chapter 451	♦EPCRA applies to processes that have a regulated substance present in more than a threshold quantity as determined under Sec. 68.115 (2,500 lb for chlorine). ♦Requirements include: off- site consequence analysis for worst case and alternate case scenarios: five year history of releases, integrated prevention program; emergency response program; risk management plan, management program supervising implementation of the risk management plan, five year revision provisions. ♦The risk management plan must contain an executive summary, the registration for the facility, the certification statement, at least one worst case scenario to cover all progam 2 and 3 processes involving regulated toxic substances, at least one worst case scenario to cover all program 2 and 3 processes involving regulated flammables; the five year accident history fo reach process, and a summary of the emergency response program for the facility. There are numerous requirements to update and re-submit the RMP based upon whether and what changes occur at the facility. ♦ HEPCRA requires: ♦ reporting for all hazardous substances requireing MSDAS sheets under OSHA that are present at the facility in amounts not less than 10,000 lbs, and extremely hazardous substances present at the facility in amounts not less than 500 lbs., or the Threshold Planning Quantity, (TPQ) whichever is lower. The TPQ for chlorine is 100 lbs. ♦Annual submission of chemical inventories must include the Hawai'i Chemical Inventory Form (HCIF) in place of the Federal Tier II Form; facility maps indicating chemical storage locations; and a $100 filing fee per year per facility. ♦ Reporting of spills or releases that exceed the reportable quantity (RQ). RQ for chlorine gas release is 10 lb.
Endangered Species Act (ESA) Endangered & Threatened Wildlife and Plants: Determination of Prudency and Proposed Designation of Critical Habitat for Plant Species from the Island of Lana`i, Hawai'i; Proposed Rule	50 CFR Part 17 FR 66 No 67 04/06/ 2001 pg. 18223		♦Critical Habitat designation affects activities on State or private lands only if a federal permit, license or funding is involved. ♦Federal agency funding, performing or authorizing activity within CH must ensure that a listed species is not jeopardized and the CH not adversely affected. Federal action agency is responsible for determining whether CH will be affected. ♦On Lana`i, a total of 5,027acres in 10 areas were proposed for critical habitat designation; including 2,619 acres at Lana'ihale. Need to get final decision.

Regulatory Schedule Affecting Lana`i Water - State Legislation & Rules

Rule	Actions
State Water Code HRS 174 C	Part I - Administrative Structure - establishes CWRM, water plan, definitions, funding, proceedings,etc. Part II - Reports of Water Use - declarations of water use, certificates of water use Part III - Hawai'i Water Plan - Resource Protection Plan, Water Use & Development Plans, State Water Projects Plan, Water Quality Plan Part IV - Regulation of Water Use - permits, designation, criteria for designation, declaration of water shortage, procedings and rights, etc. SETS CRITERIA FOR DESIGNATION OF GROUNDWATER AND OF STREAMWATER ♦ Notwithstanding an imminent designation of a water management area conditioned on a rise in the rate of ground water withdrawal to a level of ninety percent of the area's sustainable yield, the commission, when such level reaches the eighty percent level of the sustainable yield, may invite the participation of water users in the affected area to an informational hearing for the purposes of assessing the groundwater situation and devising mitigative measures. Part V - Water Quality - refers to coordination with DOH and to HRS chapters 340 E and 342 Part VI - In Stream Uses of Water - protection, flow standards, etc. Part VII - Wells - registration, permits to construct, pump installation permits, standards, completion reports, abandonment, etc. Part VIII- Stream Diversion Works - registration, permits, completion reports, abandonment Part IX - Native Hawai'ian Water Rights - protects traditional & customary rights, appurtenant rights of kuleana and taro lands, refers to Hawai'ian Homes Commission Act of 1920 §221 and to HRS Chapters 167 and 168

Administrative Rules of the State Water Code - HAR Title 13 - Subtitle 7 Water Resources Chapters 167 through 171	13-7-167 - Rules of Practice and Procedure for the Commission on Water Resource Management 13-7-168 - Water Use, Wells and Stream Diversion Works ♦ Certificate of water use, report of water use, registration of existing wells, well construction and installation permits, well completion reports, well construction and pump installation standards, well inspection, abandoned wells, registration of existing stream diversion works, stream diversion permits, stream diversion completion reports, stream diversion works inspection, abandoned stream diversions ♦ No well shall be constructed altered, or repaired, and no pump or pumping equipment installed, replaced or repaired without an appropriate permit from the CWRM ♦ Well construction and pump installation standards refer to & incorporate by reference ANSI/AWWA E101-77 as may be amended 13-7-169 - Protection of In-Stream Uses of Water ♦ General provisions, in-stream use protection program, in-stream flow standards, interim instream flow standards, stream channel alteration ♦ Defines development of in-stream flow standards, procedures and public notification for adoption ♦ Delineates permit process for stream channel alteration, criteria for ruling on applications, fees, etc. ♦ Provides for emergency repair work 13-7-170 - Hawai'i Water Plan ♦ Elements of plan to include: Resource Protection Plan, Water Use & Development Plans, State Water Projects Plan, Water Quality Plan ♦ Guidelines for preparation, preparing agencies, funding, coordination and integration of plan elements described 13-7-171- Designation and Regulation of Water Management Areas ♦ Criteria for designation as defined in HRS 174-C ♦ 1) Whether an increase in water use, or authorized planned use may cause the maximmum rate of withdrawal from the ground water source to reach ninety percent of the sustainable yield of the proposed water management area ♦ 2) Whether the rates, times, spatial patterns or depths of existing withdrawals of groundwater are endangering the stability or optimum development of the groundwater body due to upconing or encroachment of salt water ♦ 3) Whether the chloride contents of existing wells are increasing to levels which materially reduce the value of their existing uses ♦ 4) Whether excessive or preventable waste of water is occurring ♦ 5) Whether there is an actual or threatened water quality degradation as determined by the Department of Health ♦ 6) Whether there exist serious disputes respecting the use of groundwater resources are occurring ♦ 7) Whether regulation is necessary to preserve the diminishing groundwater supply for future needs, as evidenced by excessively declining groundwater levels ♦ 8) Whether water development projects that have received any federal state or county approval may result in the opinion of the commission in one of the above conditions ♦ Sets procedures and notification for designation, modification of designation and rescinding of designation ♦ Sets permitting procedures for use of water in designated areas, review, duration, modification, revocation, transfer ♦ Sets procedures & criteria for water shortage declaration, including notice, duration, end of water shortage, etc. ♦ Sets procedures & criteria for declaration of water emergency, notification, challenges, etc.

HAR Title 11 Chapter 25 Rules Relating to Certification of Public Water System Operators	♦ Contents: purpose; definitions; public water system operation & management; classes of certification; education & work experience requirements for certification; continuing education units; application for certification; examination for certification; issuance and renewal of certification; revocation, suspension & refusal to renew certification; schedule of fees for certification; classification of water treatment plants; classification of distribution systems; procedures of the board; penalties & remedies; severablility clause ♦ Class 1 distribution systems <or= 1,500 persons; Class 2 systems 1,501-15,000 persons; Class 3 systems 15,001 -50,000 persons; Class 4 systems >50,000 persons ♦ Class 1 water treatment plant includes any chemical addition such as chlorination, flouridation; pH control or corrosion control; slow sand filtration, granular activated carbon filtration, or packed aeration towers or air stripping towers. Class 2 treatment plant includes membrane filtration, cartridge filtration, or desalinization (incl. distillation, electrodialysis, reverse osmosis. Class 3 treatment plant includes diatomaceous earth filtration, or package water treatment plants with processes similar to diatomaceous earth filtration; Class 4 water treatment plants use conventional treatment (coagulation with rapid mixing, flocculation, sedimentation and filtration); or direct filtration (conventional treatment without sedimentation); or package plants with features similar to those of conventional treatment or direct filtration. ♦ Applies to all community and non-transient non-community water systems. ♦ Each public water system covered by this chapter shall be under the responsible charge of an operator(s) holding valid certification equal to or greater than the classification of water treatment plant or distribution system. ♦ All operating personnel making daily process control or system integrity decisions about water quality or quantity that affect public health shall be certified. ♦ A designated certified operator shall be available for each operating shift
HRS 340E	Safe Drinking Water ♦ Part I - Drinking Water Regulations - I. Definitions; 2. Drinking Water Standards; 2.5. Capacity Development; 3. Variances & Exemptions; 4. Imminent Hazard; 4.5. Tampering with Public Water Systems; 4.6. Inspection of Premises; 4.7. Notification to Users of Potential Lead Contamination; 4.8. Water Catchment Systems; 5. Plan for Emergency Provision of Water 6. Notification of Users and Department; 7. Prohibited Acts, 8. Penalties and Remedies; 9. Administration ♦ Part II - State Interim Action Levels for Contaminants in Water - 21. Definitions; 22. Establishment of Interim Action Levels; 23.Rules; 24. Notification of Contamination of underground sources of drinking water and other sources of public drinking water; 25. preemption ♦ Part III - Drinking Water Financing - 31. Definitions; 32. Declaration of Policy; 33. Powers & Duties; 34. Grants; 35. Drinking water treatment revolving loan fund, establishment and purpose; 36. drinking water fund, uses & limitations; types of assistance; 37. drinking water fund, conditions; 38. drinking water fund deposits; 39. drinking water fund fees; 40. drinking water fund interest and investments on accounts; 41. compliance ♦ Definition of "lead free" plumbing revised to NSF Standard 61 section 9 pursuant to 62FR 44684 08/22/1997

HAR Title 11 Chapter 19 Emergency Plan for Safe Drinking Water	♦Defines two types of emergencies: "Type A" disasters include major state or county disasters, such as nuclear disasters, tsunamis, earthquakes, floods, volcanic eruptions, hurricanes and tornadoes. "Type B" disasters are limited situations affecting only water systems, and include drought, major contamination of a system's basic water source, or major destruction or impairment of a system's physical facilities which substantially interferes with quantity and quality of water delivered to the public. ♦DOH responsibilities in a disaster include primarily coordination, sampling, and approval of alternate or emergency sources, aid in notification, etc. ♦No person or agency shall provide emergency supplies of water until and unless they have been deemed safe by DOH. (except in Oahu, where the Department of Water Supply and City & County have dispensation to determine whether an emergency supply is "safe". All other counties must contact DOH through their local District Health Officer. Contact list provided in regulation. ♦All state and county governments shall have an emergency response plan to deal with drinking water emergencies ♦ Each county Department of Water Supply shall have an emergency plan, updated at least annually, which includes: ♦ Designation of key personnel & contact #s ♦ Lists of resources (manpower, equipment, facilities etc.) to help deal with emergencies ♦ Designation of supporting agencies and utilities ♦ Description of alert procedures ♦ Responsibilities of specified department members ♦ Methods of communication to be utilized in an emergency ♦ Private systems shall respond to the extent of their ability, but primary initial support for emergencies will be from the county DWSs. Civil Defense agencies may also provide support. Provision of support by Civil Defense Agencies may require a declaration of emergency by a county Mayor. Either District Health Officer or DWS may request mayor to declare emergency. ♦ Civil defence agencies shall develop and maintain preparedness plans that establish emergency responsibilities and government functions. These plans shall provide for emergency public notification procedures coordinated with the civil defense system, civ-alert emergency radio, television announcements, and the use of fire and police department mobile public address systems as appropriate / necessary.
HRS 179-D 1987 "Dams and Reservoirs" & HRS 179-D-30 Hawai'i Dam & Reservoir Safety Act of 2007	Dam regulation in Hawai'i was initially part of the Federal Dam Inspection Act, Public Law 92-367, passed in August of 1972. In Act 179 D Session Laws of Hawai'i 1987, the State adopted HAR Title 13 - DLNR -Subtitle 7 - Water and Land Development - Chapter 190 "Dams and Reservoirs" which was signed into law April 9, 1990 and became effective April 19, 1990. Federal dams were exempted. Report R88 of DLNR established guidelines under these rules, entitled "Guidelines for the Design and Construction of Small Embankment Dams". Small embankments dams were defined as those under 50' in height. Dams and reservoirs of all sizes should comply with these construction guidelines as updated or amended by DLNR. Dams and reservoirs that have artificial barriers, together with appurtenant works which are 25 feet or more in height, or have an impounding capacity of 50 acre feet (~16.3 MG) or more, and height, together with appurtenant works, of 6' or more are required to meet certain requirements. These include preparation of an emergency action plan, operation and maintenance plan, inspections, reporting, access requirements and others. Dams must be inspected every five years. In 2007, the Hawai'i Dam and Reservoir Safety Act of 2007, established inspections of all of the State's 136 regulated dams. Non-regulated dams are also inventoried and will be inspected to verify whether these flagged bodies of water should be regulated. A reservoir safety special fund was established. Dams constructed prior to July 6, 2007 were required to obtain certificates of approval to impound. Dam and reservoir owners were required to maintain operation and maintenance plans, emergency action plans, for high and significant hazard potential dams, facilitate access by necessary State agencies or representatives, furnish upon requests plans, specifications, operating and maintenance data for each dam. Fifty-four (54) of one hundred thirty six (136) regulated dams listed are in Maui County. While none of these regulated dams are listed on Lana'i, non-regulated dams and reservoirs may be subject to inspection and verification as part of the non-regulated damn safety research.
HAR Title 13 Subtitle 7 Chapter 190 Dams & Reservoirs	Addresses construction, repair, enlargement, alteration or removal, inspection and completion of dams and reservoirs. Also maintenance and operation, emergency work, emergency preparedness plans. Applices to dams and reservoirs of more than 25' in height, or capable of holding more than 50 acre feet (~16.3 MG) and more than 6' in height. Does not apply to dams or reservoirs less than 6' in height, regardless of size, nor to dams or reservoirs less than 15 acre feet (4.9 MG).

HAR Title 11 Chapter 20 Rules Relating to Potable Water Systems	♦ Sections: coverage; definitions; MCLs for inorganic chemicals (15); MCLs for organic chemicals (33); MCL for turbidity (0.5 NTU in general, with clarifications under certain circumstances); Maximum Biological Contaminant Levels; MCLs for radionuclides; sampling & analytical requirements (chemical, microbiological, turbidity, etc.); alternative analytical techniques; approved laboratories; monitoring of consecutive water systems (those served by other water systems); reporting requirements; public notification; records maintenance; requirements, procedures & consideration for variance requests; requirements, procedures and consideration for exemption requests; disposition of variances & exemptions; public hearings on variances & exemptions; final schedule re: variances; use of new sources of raw water for public water systems and preliminary engineering report (PER) requirements for new sources; capacity demonstration & evaluation (technical, operating, infrastructure, financial, managerial, budgetr, credit-worthiness, internal policies, emergency response, backflow & cross-connection prevention; ownership, etc.); rules for new & modified public water systems; use of trucks to deliver drinking water; penalties & remedies; entry & inspection; special monitoring for sodium and for corrosivity characteristics; sampling, reporting and notification for certain unregulated contaminants; special monitoring for inorganic & organic chemicals; additives (must meet ANSI Standard 60); time requirements; criteria and procedures for public water systems using point-of-entry devices; use of other non-centralized treatment devices; bottled water and point-of-use devices; variance from the maximum contaminant levels for synthetic organic chemicals; total trihalomethanes sampling, analytical and other requirements; filtration and disinfection requirements (surface water treatment rule); treatment techniques for acrylamide and epichlorydrin; adoption of the national primary drinking water regulations for lead and copper; consumer confidence reports; severability ♦ §11-20-9(d)(2) in conducting a sanitary survey of a system using groundwater in a site having an EPA approved wellhead protection program under §1428 of the Safe Drinking Water Act, information on sources of contamination within the delineated wellhead protection area that was collected in the course of developing and implementing the program should be considered instead of collecting new information, if the information was collected since the last time the system was subject to a sanitary survey. ♦ §11-20-35 community water systems shall identify whether the following construction materials are present in their distribution system and report to the Department (DOH): 1) lead from piping, solder, caulking, interior lining of distribution mains, alloys, home plumbing; 2) copper from piping, solder, caulking, interior lining of distribution mains, alloys, home plumbing; 3) galvanized piping, service lines & home plumbing; 4) ferrous piping materials such as cast iron and steel; 5) asbestos cement pipe; 6) others, including but not limited to a) vinyl-lined asbestos-cement pipe; b) coal-tar lined pipes and tanks. ♦ Other requirements are described with individual rules under the Safe Drinking Water Act
HAR Title 11 Chapter 21 Cross Connection and Backflow Control	♦ Contents: purpose, definitions; right to inspect; approval of devices; installation & location; existing cross-connections; irrigation systems; maintenance requirements; violations and penalties; effect of county government ordinance; severability ♦ DOH may enter any building or premise at any reasonable hour to inspect plumbing for cross-connections or other structural or sanitary hazards including violations ♦ Devices must meet AWWA standard AWWA C506-78; and must meet the laboratory and field performance specifications of the Foundation for Cross Connection Control and Hydraulic Research of the University of Southern California - FCCC & HR ♦ Specifies vacuum breakers, double check valve assemblies and reduced pressure principal backflow preventers for irrigation systems ♦ All existing cross connections to public water systems shall be removed or the system protected by means of an approved backflow preventer

HAR Title 11 Chapter 23 Underground Injection Control	♦Underground Injection Control (UIC) maps to be updated once every three years ♦"inject" means to dispose of or emplace fluids, either under pressure or by gravity flow, into a subsurface formation or formations. "well" means a bored, drilled, or driven shaft, or a dug hole, whose depth is greater than its widest surface dimension. ♦Contents: purpose, scope, definitions, classification of exempted aquifers & underground sources of drinking water; identification of underground sources of drinking water; classification of injection wells; prohibition; construction conditions; siting & pre-construction conditions; provision for artesian aquifer protection; operating conditions; procedures for UIC permit, submission of data, public notice of proposed wells injecting into underground sources of drinking water; public hearings; permit issuance; existing injection well regulation; monitoring & reporting requirements; plugging & abandonment requirements; revocation, suspension or revision of UIC permits; inspection & entry ♦ 5 classes of injection wells: Only Class V wells are allowed in Hawai. 1) Class I : wells which inject fluids beneath the lowermost formation containing, and within 1/4 mile of the well bore, an underground source of drinking water and which are used by: a) generators of hazardous waste or owners or operators of hazardous waste management facilities; b) disposers of industrial and municipal waste fluids; 2) Class II: a)wells which inject fluids which are ground to the surface in connection with conventional oil or natural gas production and may be comingled with waste waters from gas plants which are an integral part of production operations, unless those waters are clasified as a hazardous waste at the time of injection; b)for enhanced recovery of oil or natural gass; c)for storage of hydrocarbons which are liquid at standard temperature and pressure; 3)Class III: wells which inject for extraction of minerals, including a)mining of sulfur by the Frasch process; b)in-situ production of uranium or other metals, using unconventional techniques to mine ore bodies; and c) solution of mining of salts or potash; 4) Class IV: wells used by generators of hazardous waste or of radioactive waste, by owners or operators of hazardous waste management faciliites, or by owners or operators of radioactive waste disposal sites to dispose of hazardous waste or radioactive waste into any geohydrologic formation or a formation which, within 1/4 mile of the well, contains an underground source of drinking water, even if exempted; 5) Class V: Subclass A - injection wells which inject fluids into an undergound source of drinking water, including a) sewage injection wells, b) industrial disposal wells other than those classified under other subclasses; Class V: Subclass AB - injection wells which inject only into exempted aquifers. Subclass AB wells include sewage injection wells, and industrial disposal wells, other than those classified under subclass B such as brine disposal wells used in a desalinization process; Class V: Subclass B - injection wells which inject non-polluting fluids into any geohydrologic formation, including underground sources of drinking water, including a) air conditioning return flow wells used to return the water used for heating or cooling in a heat pump; b)cooling water return flow wells used to inject water previously used for cooling; c)recharge wells used to replenish, augment or store water in an aquifer; d)salt water intrusion barrier wells, used to prevent the intrusion of salt water into fresh water, if they inject water of equal or lesser chloride concentrations as that portion of the aquifer into which injected; e)wells used in aquaculture, if the water in the receiving formation has either an equal or greater chloride concentration as that of the injected chloride, or a total dissolved solids concentration in excess of 5000 mg/L; f)injection wells used in an experimental technology, which is one that has not been proven feasible under the conditions in which it is being tested, and g) all wells not included in any of the other classes or subclasses; Class V: - Subclass C - injection wells wich inject surface fluids, i.e. storm runoff, into any geohydrologic formation; Class V: Subclass D - injection wells which inject overflows, or relief flows, from potable water systems into any geohydrologic formation; Class V: Subclass E - injection wells associated with the development and recovery of geothermal energy, provided that the geothermal effluent will be injected at a depth that will not be detrimental to underground sources of drinking water. If injection is to occur below the basal water table, the receiving formation water shall be tested and injection allowed if the receiving water has either: an unequal or greater chloride concentration as that of the injected fluid; or a total dissolved solids concentration in excess of five thousand mg/L or an equivalent or lesser water quality than the injected fluid. Subclass E wells include brine injection wells for the disposal of excess water from the steam-flashing process, condensate injection wells for the disposal of condensate from electric generators, and gas injection wells for the disposal of non-condensible gases entrained in an aqueous solution.

HRS 342 B Hawaiʻi Air Pollution Control Act	Air Pollution ♦ § 1) A “stationary source” is any piece of equipment or activity at a building, structure, facility, or installation that emits or may emit any air pollution. A “variance” is special written authorization from the director to cause or emit any regulated air pollutant in a manner or an amount in excess of applicable standards, or to do an act that deviates from the requirements of rules or standards adopted pursuant to this chapter. A “permit” is written authorization from the director to construct, modify, relocate, or operate any regulated air pollutant source, and authorizes the permitee to cause or allow the emission of a regulated air pollutant in a specified manner or amount or to do an act that is not forbidden by this chapter or rules prior to this chapter .♦ § 11) No person, including any public body, shall engage in an activity that causes air pollution or emissions of any regulated air pollutant without first securing approval from the director .♦ § 14) Variance applications shall be made on forms provided by the department, and shall be accompanied by a complete and detailed description of present conditions, how conditions do not conform to applicable standards, and any other information that the department may require. Applications will be reviewed in light of descriptions, statements, plans, histories, other supporting information, and any information requested by the department. For a variance to be approved, the application and supporting information must show that; the continued operation of the cause of the discharge is in the publics interest; does not substantially endanger human health or safety; and that compliance with applicable standards would cause serious hardship without equal or greater benefits to the public. All variances are approved with the requirement that the grantee performs an air or discharge sampling and report back to the department, and all variances are applicable for a period of no more than five years. ♦ § 22) A permit is required to begin construction, relocation, or modification of any air pollutant source. Owners and operators of a source are required to obtain a permit. ♦ § 23) Permit applications will be in a form prescribed by the director, and require a compliance plan. The department may also require other plans, specifications, meteorological monitoring data, ambient air quality monitoring data, best available control technology analysis, as well as any other information required to identify the source, the air emissions, and the air quality impact, and to determine whether the proposed source will be in accord with rules and standards. ♦ § 25) Permits may be subject to reasonable conditions as the director may prescribe, and the director shall not deny an application for the issuance or renewal of a permit without affording the applicant an opportunity for a hearing .♦ § 28) The director may require an owner or operator of a source on a continuous, sporadic, or one-time basis to; establish, maintain, and submit records; draft reports; install, use, and maintain monitoring equipment; sample emissions; keep records on the source and the control equipment parameters, production variables, or other indirect data when direct monitoring is impractical; sample and analyze the substance being burned; submit compliance certificates; and provide any other information the department may require. ♦ § 33) A permit requires the permitee to, minimum, submit to the director the results of any required monitoring, no less than six months, submit a compliance certificate, no less than yearly, and disclose the annual emissions of hazardous air pollutants.

HRS 342 D Water Pollution	Water Pollution ♦§ 1) Permits are written authorization from the director to discharge waste or to construct, modify, or operate any water pollution source in a manner and amount that is not forbidden by this chapter. ♦ 6) Permits are issued by the director for a maximum term of five years, and no permits will be issued or denied without the applicants being given an opportunity for a hearing. The department may require that plans, specifications, or other information accompany permit applications. The director may modify, revoke, or suspend a permit after allowing the opportunity for a hearing has been granted and a violation has been found. ♦§ 14) Reports on discharges of waste shall be available to the public during established office hours unless the report contains confidential material. Any employee of the department who divulges classified information shall be fined a maximum of $1,000, except under authorized circumstances, as ordered by a court, or at an administrative hearing on an alleged violation. ♦§ 17) All state and county health authorities and police officers shall enforce this chapter and the rules and orders of the department. ♦§ 32) Any who negligently violates this chapter or introduces water pollutants into the sewer system or a publicly owned treatment plant shall be fined between $2,500 and $25,000 per day of violation or imprisoned for a maximum of one year, or both. If a violation occurs again after a first conviction, the fine is not more than $50,000 or a maximum of two years in jail, or both. ♦§ 33) Any who knowingly violates this chapter or introduces water pollutants into the sewer system or a publicly owned treatment plant shall be fined between $5,000 and $50,000 per day of violation or imprisoned for a maximum of three year, or both. If a violation occurs again after a first conviction, the fine is not more than $100,000 or a maximum of four years in jail, or both. ♦§ 36) A single operational upset that leads to simultaneous violations shall be treated as a single violation. ♦§ 38) A "hazardous substance" is defined as 1) Any substance designated by the Federal Water Pollution Control Act, section 311. 2) Any element, compound, mixture, solution, or substance designated by the Comprehensive Environmental Response, Compensation, and Liability Act. 3) Any hazardous waste having characteristics identified by the Solid Waste Disposal Act (except those that have been suspended by Congress). 4) Any toxic pollutant identified by the FWPCA section 307. 5) Any imminently hazardous chemical substance or mixture with respect to which the administrator has taken action pursuant to section 7 of the Toxic Substances Control Act. ♦§ 50) No person, public body, or industrial group shall discharge any water pollutants into state waters or publicly owned treatment plants in violation of this chapter or the rules of the director. No person or public body shall alter any system of drainage, sewage, or water supply. ♦§ 51) Any person who has caused an unlawful discharge must report the incident to the director within 24 hours, unless a permit has been issued for the specific discharge specifying another reporting period. ♦§ 52) The director may test any water and aquatic or other life that has been subjected to any form of water pollution and assess the environmental effects of the pollution. If the effects are hazardous, the public will be immediately notified. ♦§ 55) The director may require the owner or operator of any effluent source, works, system, or plant to establish and maintain records; make reports and plans that cover existing situations are proposed additions, modifications, or repairs; install, use, and maintain monitoring equipment or methods; sample effluent, state waters, sewage sludge, and recycled water; and provide any information that the department might require. ♦§ 70) The department may authorize any county to use a gray water recycling program. The gray water shall be limited to the use of water from residential units for the purpose of irrigating lawns and gardens. Gray water is any water from domestic plumbing systems except the toilet, provided the water is not contaminated with household hazardous waste.

HAR Title 11 Chapter 54 Water Quality Standards	♦Contents: Definitions, General Policy of Water Anti-Degradation; Classification of State Waters; Classification of Water Uses; Basic Water Quality critieria applicable to all waters; uses and specific criteria applicable to inland waters:definitions; Inland water areas to be protected; inland water criteria; uses and specific criteria applicable to marine waters; uses and specific criteria applicable to marine bottom types; Specific criteria for recreational areas; zones of mixing; water quality certifications (for discharge resulting from activity) ; contents of certification; contents of application; notice and hearing; waiver; adoption of new water quality standards; inspection of facility or activity before operation; notification to licensing or permitting agency; termination or suspension; review and advice; water quality analyses; revision; severability ♦Basic criteria: all waters shall be free of ... 1) materials that will settle to form objectionable sludge or bottom deposits; 2) floating debris, oil grease or scum; 3) substances in amounts sufficient to produce taste in the water or detectable off-flavor in the flesh of fish, or in amounts sufficient to produce objectionable color, turbidity, or other conditions in receiving waters; 4) high or low temperatures, biodices, pathogenic organisms, toxic, radioactive, corrosive or other deleterious substances at levels or in combinations sufficient to be toxic or harmful to human, animal, plant or aquatic life, or in amounts sufficient to interfere with any beneficial use of the water; 5) substances or conditions or combinations thereof which produce undesiriable aquatic life; 6) soil particles resulting from erosion on land involved in earth work, such as the construction of public works, highways, subdivisions, recreational, commercial or industrial developments, or the cultivation and management of agricultural lands ♦ Acute toxicity, chronic toxicity and human health standards are set. Numeric standards are set for 97 contaminants. In addition, criteria for various classes of waters are set for total nitrogen, total dissolved nitrogen, amonia nitrogen, nitrate and nitrite nitrogen, total phosphorous, total dissolved phosphorous, total suspended solids, turbidity and chlorophyll ♦ Various types of waters or ecoystems are identified and classes set - either Class AA or A waters, or Class I or Class II of various other environments, as follows: Class AA Waters - Marine waters surrounding Lana‘i are rated Class AA. Class AA waters should remain as close to pristine as possible. No zones of mixing to be permitted in this class. Should have absolute minimum alteration of water quality from any human sources or actions. Class A Waters - Embayments - Maui: Kahului Bay, Lahaina Boat Harbor; Maalaea Boat Harbor; Molokai: Hale O Lono Harbor, Kaunakakai Harbor, Kaunakakai Boat Harbor; Lana‘i: Manele Boat Harbor, Kaumalapau Harbor Class I Sand Beaches - none listed in Maui, Molokai or Lana`i. those listed are mainly in Northwest Hawai‘ian Islands Class II Sand Beaches - all beaches Class I Solution Benches - none listed in Maui, Molokai or Lana`i (unless named by DLNR under HRS 190 or HRS 195, or by US F&WS as reserves, sanctuaries or etc. Class II Solution Benches - Maui: Kihei, Papaula Point; Molokai: none listed; Lana`i: none listed Class I Marine Pools - none listed in Maui, Molokai or Lana`i (unless named by DLNR under HRS 190 or HRS 195 or by US F&WS as reserves, sanctuaries or etc.) Class II Marine Pools - Maui: Hana, Keanae, Napili, Puu Olai to Cape Hanamanioa, Kipahulu; Molokai: Cape Halawa, Kalaupapa, South Coast; Lana‘i: none listed Shallow Draft Harbors - Class II - Maui: Maalaea Boat Harbor, Lahaina Boat Harbor, Hana Harbor; Molokai: Kalaupapa Anchorage, Kaunakakai Small Boat Harbor, Hale O Lono Harbor; Lana`i: Manele Boat Harbor, Kaumalapau Harbor Deep Draft Commercial Harbors - Class II - Maui: Kahului Harbor; Molokai: Kaunakakai Barge Harbor; Lana`i: none listed Reef Flats & Reef Communities - Near Shore - Class I - Maui: Honolua; Molokai: West Kalaupapa, S.E. Molokai Reef, Honomuni Harbor, Kulaalamihi Fishpond; Lana`i: none listed - again, others may be designated by DLNR or US F&WS (as above) Off Shore Reef Flats - Class I - none listed in Maui, Molokai or Lana`i - (northwest Hawai‘ian islands and Oahu have listings) Wave-Exposed Reef Communities - Class I - Maui: Hana Bay, Makuleia Bay, Honolua, Molokini Island; Molokai: Moanui Kahinapohaku Waikolu - Kalawau and Halawa Bay; Lana`i: none listed Protected Reef Communities - Class I - Maui: Honolula, Ahihi-La Perouse, (including 1790 lava flow at Cape Kinau), Molokini; Molokai: S.E. Molokai, Kalaupapa, Honomuni Harbor; Lana`i: Manele, Hulopoe Class II Reef Habitats: Maui: Lahaina Harbor, Kahului Harbor; Molokai: Kaunakakai Harbor, Hale O Lono Harbor, Palaau (1.5 m e of Pakanaka fishpond); Lana‘i: Manele

HAR Title 11 Chapter 55 Water Pollution Control	• Contents: definitions; general policy of water pollution control; general prohibition; application for NPDES permit, notice of intent or conditional "no exposure" exclusion; receipt of federal data; transmission of data to regional administrator; identity of signatories to NPDES forms; formulation of tentative determination and draft permits; public notice of applications; fact sheet; notice to other government agencies; public access to information; public hearings; public notice of public hearings; issuance of NPDES permits; modification or revocation & reissuance of NPDES permits; termination of permits & denial or removal; reporting discontinuance or dismantlement; application of effluent standards and limitations, water quality standards & other requirements; effluent limitations in issued NPDES permits; schedule of compliance in issued NPDES permits; compliance schedule reports; other terms and conditions of issued NPDES permits; national pre-treatment standards and users of publicly owned treatment works; transmission to regional administrator of proposed NPDES permits; transmission to regional administrator of issued NPDES permits; renewal of NPDES permits; monitoring; recording of monitoring activities and results; reporting of monitoring results; sampling & testing methods; malfunction, maintenance & repair of equipment; agency board membership; general permit definitions; general permit policy; general permit authority and adoption; general permit terms; general permit conditons; requiring an individual permit; relationship of general & individual permits; degree of waste treatment; notice of intent; notice of intent review, notice of general permit coverage, additional conditions, terms, renewals, effective dates, and automatic coverage; review of coverage issues & notice of intent and notice of general permit decisions; notice of general permit coverage modification, revocation, reissuance & termination; general permit compliance; penalties and remedies; severability clause • Sets general requirements for NPDES permitting, individual and general permits. not required if discharge is purely storm water with "no exposure" to materials, activities or processes; issued in increments of 5 years or less; effluent guidelines, monitoring, public notification, data,etc. • General permits may apply to a category of sources that involve the same or substantially similar types of operations, dishcarge the same types of wastes or engage in the same types of sludge use or disposal practices; require the same effluent limitations; operating conditions or standards for sludge or disposal; require the same or similar monitoring; or in the opinion of the director (of DOH) are more appropriately controlled under a general permit than an individual permit • Appendices include standard general permit conditions and 8 general permits: A)standard general permit conditions: and B) through I) are NPDES general permit authorizing dishcarges of: B)storm water associated with industrial activities; C)storm water associated with construction activities; D)treated effluent from leaking underground storage tank remedial activities; E) once-through cooling water less than 1 million gallons per day; F) hydrotesting waters; G) construction dewatering; H) treated effluent from petroleum bulk stations and terminals: I) treated effluent from well drilling activities • Appendix F: NPDES general permit authorizing discharges of hydrotesting waters: hydrotesting waters general permit applies to waters used to test the integrity of tanks or pipelines. does not allow discharge into class AA marine waters or Class I inland waters. Notice of Intent (NOI) requirements include overview of proposed activities, time schedule, dates, water quality analysis of hydrotesting effluent (may use system water data if applicable); hydrotesting bmp plan, description of mitigative measures; shall not exceed basic water quality criteria, report problems, retain records for minimum of 3 years • Appendix I: NPDES general permit authorizing discharges of treated effluent from well drilling activities: applies to well drilling slurries, lubricating fluid wastewaters; well purge wastewaters; does not enable discharge to class AA marine waters or Class I inland waters, nor does it cover discharge to sanitary sewer system, other stormwater drainage system, nor discharges not associated with well drilling; NOI to include history of land use at proposed site, potential and existing contaminants at proposed site; proposed corrective measures; pollutants that may be in effluent; estimated timetable of drilling activities; details of proposed discharges, including estimate of quantity, frequency and time frame of proposed discharges, names of chemicals or materials likely to be found in discharges, any quantitative data on pollutants; names, address, phone, fax of laboratories or consultants involved in sampling and analysis; well drilling plan including equipment to be used, treatment design, design concerns, calculations used in treatment design, proposed mitigative measures, well drilling bmp plan including schedule of activities, prohibited practices, O&M procedures, responsible field person, operations plan, maintenance scheduling or action criteria, maintenance program, effluent monitoring procedures, cessationor of discharge procedures; effluent control plan; other practices, documentation plan; treatment requirements, practices to control site run-off, spillage, leaks, sludge or waste disposal or drainage from raw material storage or stockpiles, etc.; discharges are to be limited to effluent limitations specified ; sampling points, collection, reporting & analysis of samples specified; protocols, test procedures, recording and reporting of results specified; discharge monitoring report form to be used in reporting; operator to report in event of unanticipated violation or bypass or upset. Oral report immediately, written within 5 days to DOH. maintenance schedule to be submitted 14 days prior to maintenance activities that could cause violation or bypass; records to be maintained for minimum of 3 years

HAR Title 11 Chapter 62 Wastewater Systems	♦Contents: Prohibitions & General Requirements: preamble; purpose; definitions; county wastewater advisory committee; critical wastewater disposal areas; general requirements; wastewater sludge disposal; specific requirements for wastewater systems: Wastewater Treatment Works: specific requirements for wastewater treatment works; treatment unit requirements; wastewater effluent disposal system; wastewater effluent requirements applicable to treatment works: Individual Wastewater Systems: general requirements for proposed individual wastewater treatment systems; site evaluation; spacing of individual wastewater systems; specific requirements for proposed treatment units; specific requirements for proposed disposal systems; other proposed individual wastewater systems: Variances, Penalties and Severability: variances, penalties and remedies, severability ♦ Purpose is to insure that wastewater disposal does not contaminate or pollute and drinking water or potential drinking water supply, or the waters of any beaches, shores, ponds, lakes, streams, groundwater, or shellfish growing waters; does not encourage the harborage of insects, rodents or other possible vectors; does not give rise to nuisances; does not become a hazard or a potential hazard to public health, safety & welfare; contributes to the achievement of wastewater management goals contained in approved county water quality management plans; and reinforces state and county planning policies ♦ More stringent critieria may be imposed in critical wastewater areas. Criteria for these areas include high water table; impermeable soil or rock formations; steep terrain; flood zone; protection of coastal waters and inland surface waters; high rates of cesspool failure; protection of groundwaters, etc. ♦ All buildings used or occupied as dwelling, public building or place of assembly and generating wastewater shall have a wastewater disposal system, where in proximity to connect to public sewer shall do so. Criteria set for domestic and non-domestic waste water. ♦ Criteria are set for wastewater treatment, including criteria for design, approval; operation; sampling, monitoring & reporting; safety procedures; etc. table of estimated gallons per person per day and wastewater strength is provided for various uses to aid in system design. ♦Criteria are set for subsurface disposal systems incuding design, flow rates, construction, etc. ♦ Criteria are set for individual wastewater systems; including design, land area; flow rates; capacities; construction; etc. also graywater systems; including design, flow rates, disinfection, etc.; septic system design including design, construction, site specs, etc.; and also for each case for site evaluation including percolation tests, spacing, etc. ♦ Minimum distances are set for cesspools, treatment units, seepage pits and soil absorption systems, from structures, property line, trees, seepage pits, other cesspools, potable drinking water wells and streams, ocean vegetation line, ponds or lakes. all must be at least 50 feet from any water body and at least 1000 feet from any potable drinking well.

	♦ Published by DOH in 1993. Contents: introduction, definitions, treatment design parameters; approval of permits; compliance, reporting and submittals; defines design parameters, operating parameters, sampling protocols, classes & acceptable uses of water; restrictions, etc. ♦ R3 water is oxidized only; may be used for (see specific restrictions in rule):irrigation of non-edible vegetation in areas with limited exposure drip and subsurface irrigation of fodder, fiber & seed crops not eaten by humans; drip and subsurface irrigation of orchards and vineyards bearing food crops; drip and subsurface irrigation of timber & trees not bearing food crops; and drip and subsurface irrigation of food crops which undergo a pathogen destruction process before consumption. ♦ R2 water is oxidized and disinfected; with 7 day median samples showing <23 cfu/100 ml fecal coliform, and no more than 1 sample in a 30 day period >200 cfu/100ml fecal coliform: may be used for (see rule for specific restrictions): all uses for which R3 is allowable, plus freeway & cemetary irrigation; subsurface irrigation or spray irrigation of golf courses with adequate buffer; subsurface irrigation of parks, elementary schools, athletic fields & landscapes around some residential properties; subsurface irrigation or spray irrigation with sufficient buffer of roadside and median landscapes, subsurface or drip irrigation, or spray irrigation with adequate buffer of non-edible vegetation in areas with limited public use; subsurface, drip, or spray irrigation with adequate buffer of sod farms; subsurface, drip, or spray irrigation with adequate buffer of ornamental plants for commercial use; subsurface irrigation of food crops which are above ground and not contacted by irrigation; subsurface irrigation of pastures used for milking and other animals; drip, subsurface or spray irrigation with adequate buffer of fodder, fiber and seed crops not eaten by humans; drip or subsurface irrigation of orchards and vineyards bearing food crops; drip, subsurface or spray irrigation with adequate buffer of orchards and vineyards not bearing food crops during irrigation; subsurface, drip, or spray irrigation with adequate buffer of timber and trees not bearing food crops; drip, subsurface or spray irrigation with adequate buffer of food crops undergoing commercial pathogen destroying process before consumption; flushing of sanitary sewers, industrial processes without exposure of workers; cooling or air conditioning system without tower, evaporative condenser, spraying or other features that emit droplets; industrial boiler feed, water jetting for consolidation of backfill material around piping for reclaimed water, sewage, storm drainage, and electrical conduits, washing aggregate and making concrete; dampening roads and other surfaces for dust control; dampening brushes and street surfaces in street sweeping ♦ R1 water is oxidized, filtered, and disinfected with 4 log (1 in 10,000) reduction in specific bacteriophage MS2 ; 7 day median <2.2 cfu/100ml fecal coliform; no samples >200 cfu/100 ml fecal coliform; may be used for (see rule for specific restrictions): all uses allowable for R2 and R3 water, plus: spray irrigation of roadside and median landscapes and of orchards and vineyards bearing food crops. Buffer for spray irrigation with R-1 water is less than with R-2 water for other uses indicating spray irrigation with buffer. R1 water is also deemed suitable for basins at fish hatcheries, landscape impoundments with or without decorative fountains, restricted recreational impoundments, flushing toilets and urinals, fire fighting, commercial and public landscapes, cooling saws while cutting pavement, decorative fountains, washing yards, lots and sidewalks, high pressure blasting to clean surfaces, industrial processes with or without exposure of workers, cooling or air conditioning systems with or without tower, evaporative condenser, spraying or other features that emit vapor or droplets, and water jetting for consolidation of backfill material around potable water piping during water shortage.
Guidelines for the Treatment and Use of Reclaimed Water	♦ Groundwater recharge criteria vary with whether potable or non-potable aquifer is affected. Surface or subsurface application rates that exceed the consumptive evapotranspiration of the vegetative cover is considered a recharge project if over a potable aquifer. Reclaimed water for groundwater recharge by surface or subsurface application shall be at all times of a quality that fully protects public health and will be based on all relevant aspects of such project, including: treatment provided, effluent quantity and quality, effluent or application spreading area operation, soil characteristics, hydrogeology, resident time and distance to withdrawal. Applies also to unlined water impoundments.

HAR Title 11 Chapter 65 Water Pollution Control Revolving Fund	♦Contents: purpose; definitions; clean water state revolving loan fund; safe drinking water state revolving loan fund. And for each of the latter, fees, administrative account, loan default, and penalty & procedures for loan default ♦ Main point of interest, other than establishing a state revolving loan fund is that the fee for a Clean Water State Revolving Loan is different than that for a Drinking Water State Revolving Loan. For a CWSRF, the interest fee is not to exceed 1% of the outstanding principal balance. For a DWSRF, "..the loan fee shall not exceed the outstanding principal balance of the loan multiplied by an annual rate of the weekly bond buyers twenty year general obligation index bond interest rate, less a percentage rate of up to 1%. In the event that the annual rate of the weekly bond buyers twenty year general obligation index bond interest rate, less a percentage rate of up to 1% falls below 3 and 25 one hundredths of a percent (3.25%), then the loan fee shall be 3.25%".
HRS 269 Public Utilities Commission	♦ §269-7.5 Utilities must have certificate of public convenience and necessity to operate. To grant CPCN, the PUC must find that the utility is fit, willing and able to perperly perform the proposed service. Certficates may be revoked. Government utilities are exempted. PUC is empowered to determine the resasonableness of rates, charges and tariffs. ♦ §269-8 PUC may inspect books, records, maps and other documents, and may rqequire the utility to submit such information including a complete inventory of its propoerties in such form as the commission may direct. ♦ §269-15 If the PUC is of the opinion that a utility is neglecting to comply, that its rates or provisions are not adequate, or that it is not doing what it ought to do, PUC shall inform the utility in writing and institute proceedings as may be necessary to correct the deficiency. Allows citations, civil penalties, etc. Sets forth appeal process. ♦ All rates, fares, charges, classifications, rules, practices made, charged or observed shall be filed with the PUC ♦ §269-26 PUC to investigate charges for water supplied to consumers for domestic purposes where the water is supplied by virtue of a lease from the State ♦ §269-27 if rates for such lesees are found to be unreasonable, attorney general shall take action to cancel the lease ♦ §269-51 Provides for a consumer advocate ♦ §269-54 Sets forth powers and authorities of consumer advocate Lana'i utilities are regulated by the PUC.
HRS 342 E	Non-Point Source Pollution Management - Hawai'i administrative rules not yet finalized. DOH has 16 MOUs with SWCDs to implement specific run-off control programs. Hawai'i's Coastal Non-Point Source Water Pollution Control Plan specified 57 management measures for non-point pollution. For this and other pollutant sources below, see Wellhead Protection Chapter.

HRS 342 F Noise Pollution	Noise Pollution ♦ In the past, the Environmental Protection Agency (EPA) coordinated all federal noise control activities through its Office of Noise Abatement and Control. However, In 1981, the Administration at that time concluded that noise issues were best handled at the State or local government level. As a result, the EPA phased out the office's funding in 1982 as part of a shift in federal noise control policy to transfer the primary responsibility of regulating noise to state and local governments. However, the Noise Control Act of 1972 and the Quiet Communities Act of 1978 were not rescinded by Congress and remain in effect today, although essentially unfunded. ♦ § 1) A "permit" is written authorization from the director to construct, modify, or operate any excessive noise source. The grantee is permitted to cause or emit excessive noise in a manner or amount, or to do any act, not forbidden by this chapter, but requiring review from the department. A "variance" is special written authorization by the director to cause or emit excessive noise in a manner or amount, or to do any act, not forbidden by this chapter, but requiring review from the department. ♦ § 4) Permit applications will be in a form prescribed by the director, and shall be accompanied by plans, specifications, and other information as deemed necessary by the department. A permit shall not be issued for a term of more than five years, and the director shall not deny an application for a permit without affording the applicant an opportunity for a hearing. ♦ § 5) Variance applications shall be done on forms provided by the department and shall be accompanied by a description of present conditions, how present conditions do not conform to standards, and any other information required by the department. Application must clearly show that it is in the public's best interest, does not substantially endanger human health or safety, and complying with standard rules would cause undue hardship without equal or greater benefit to the public. Also, if a variance is granted on the grounds that there is no practical way to control excessive noise, the variance will only be in effect until a practical method is found to control the excessive noise. No variance shall be for a period greater than five years. ♦ § 30) No person, including any public body, shall engage in activity which produces excessive noise without first securing approval in writing from the director. This does not apply to schools. ♦ § 30.5) There are different noise level standards between urban and non-urban areas, and in different counties. Should this section conflict with section 46-17, 46-17 governs.
HRS 342 G Integrated Solid Waste Management	Integrated Solid Waste Management ♦ Covers the establishment and maintenance of a system to manage waste disposal.
HRS 342 H Solid Waste Pollution	Solid Waste Pollution ♦ § 1) A "permit" is written authorization from the director to construct, modify, and operate any solid waste management system or any component of any solid waste management system. A "solid waste management system" is a system for the storage, processing, treatment, transfer, or disposal of waste material. "Disposal" means the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste onto any land or water so that it may enter the environment, be emitted into the air or the water, including ground water.
HRS 342 I Special Wastes Recycling	Special Wastes Recycling (lead-acid batteries, tires, etc.) ♦Covers proper procedures for the disposal of lead batteries and old tires.
HRS 342 J Hazardous Waste	♦ Sets standards for generators, transporters, treatment, storage or disposal of hazardous waste, provisions for hazardous waste release incidents, notification, record keeping and more.

HRS 342 L Underground Storage Tanks	♦ Sets standards for tanks and tank design, permits, release detection, reporting and response, permitting, closure requirements etc. for Underground Storage Tanks ♦Establishes fund for leaking tanks
HRS 342 P Asbestos & Lead	♦ Empowers the Director of Health to establish emission and hazard exposure standards and procedures for abatement of asbestos & lead hazards ♦ Powers include work practice standards and notification for demolition of facilities containing asbestos or lead
HRS 343 Environmental Impact Statements	♦ Contents; purpose, definitions, periodic bulletin, applicability, determination of sgnificance, preparation of draft and final EIS, appeals, NEPA actions; supplemental statements, severability ♦ All agencies and applicants submitting draft environmental assessments, environmental impact statements, acceptance or nonacceptance determinations, addenda supplemental statements, supplemental preparation notices, revised documents, withdrawals or other notices to be published in the bulletin ♦ Triggers include agency actions, actions requiring amendment to general or community plans, amendment to designations within these plans other than for preservation, conservation or agricultural use; use of state or county lands, use of conservation district lands, use of shoreline areas use within historic sites, use involving reclassification of conservation district lands, etc. ♦Exempt actions include operation, repair or maintenance of existing structures and facilities involving no or negligible expansion; replacement or reconstruction of facilties where the new facilities will be located on generally the same site and used for generally the same purpose; construction of single, small structures and facilities in certain conditions where other criteria are not triggered; such as single family homes of less than 3,500 square feet, single multi-unit structure of not more than 4 dwelling units; one store, office or restaurant designed for total occupant load of 20 persons or less, water, sewage, gas, telephone and other essential public utility services extensions to serve such structures or facilities, certain appurtenant structures, minor alteration in the condition of land water or vegetation, basic data collection, research, experimental management and resource evaluation activities which do not result in serious or major disturbance to an environmental resource, construction or placement of minor structures accessory to existing facilities; interior alterations involving partitions, plumbing, electrical conveyances, etc. deomlition of structures not located on any historic site nor designated in any historic register; zoning variances excep;t us, density, height, parking requirements and shoreline set-back, continuing administrative activites including purchase of supplies, personnel related actions and the adoptions, amendment or repeal of rules. ♦Applicant should prepare Environmental Assessments as close to acceptable Environmental Impact Statements as possible with public consultation as early as possible ♦Statements should review impacts, significance criteria, implications of proposed actions, alternatives, etc. File with either anticipated negative declaration or EIS preparation notice, distribute per regulations, respond to public comments and revise assessment as appropriate and append comments and responses to final filing of either negative declaration or EIS preparation notice. ♦For EIS upon publication of preparation notice, public has 30 days to become consulted party. Upon receipt of request to be consulted party, proposing entity shall provide the requestor with a copy of the assessment, respond to all commenters, acknowledgement & response to be published in draft, upon publication of draft, public has 45 days to comment, acknowledgement & response to comments to be publiished in final document with addenda if applicable. If acceptable, accepting agency files notice of acceptance. If not acceptable, accepting agency files notice of non-acceptance with reasons, and proposing agency revises or withdrws. Revisions and notice of withdrawal must notify publiic. ♦ Required contents include description of the action, significant beneficial and adverse impacts, including secondary and cumulative impacts, proposed mitigation measures, alternatives considered, unresolved issues, compatibility with land use plans and policies, listing of permits and approvals, table of contents, statement of purpose and need for proposed action, map, statement of objectives, description of the actions' technical, economic, social and environmental characteristics, use of public funds, phasing and timing of actions, summary of technical data, diagrams and other information necessary to permit any reviewer to genuinely evaluate potential impacts, historic perspectives, alternatives which could obtain the same objectives or benefits but with different impacts, alternative of postponement for futher study, no-action alternative, alternate locations, all alternatives considered to be discussed in sufficient detail to explain why they were rejected; detailed description of environmental setting; relation to land use plans, policies and standards, detailed description of impacts to environment and community, including secondary and cumulative impacts, short term vs. long term impacts and benefits, irreversible impacts or commitments of resources, unavoidable impacts, mitigative measures, unresolved issues, consulted parties and including all substantive comments.

HAR Title 11 Chapter 200 Environmental Impact Statement Rules	♦ Contents: purpose; definitions; periodic bulletin; applicability; determination of significance; preparation of draft and final EIS; appeals; NEPA actions; supplemental statements: severability ♦Pursuant to National Environmental Policy Act (NEPA) of 1969; Public Law 91-190; 42 U.S.C. §§4321-4347, as amended and to HRS chapter 343 ♦ All agencies and appliccants submitting draft environmental assessments, negative declarations, preparation notices, environmental impact statements, acceptance or nonacceptance determinations, addenda, supplemental statements, supplemental preparation notices; revised documents, withdrawals or other notices required to be published in the bulletin shall submit before the close of business eight working days prior to the publication date. Publication dates are the 8th and 23rd of each month. (one day earlier in event of holiday) ♦Triggers include: agency actions; actions requiring amendment to general or community plans, or any amendment to designations within these plans other than preservation, conservation or agricultural; use of state or county lands; use of conservation district lands; use of shoreline areas; use within historic sites; any use involving reclassification of conservation district lands; etc. ♦ Exempt actions include operation, repair or maintenance of existing structures & facilities involving no or negligible expansion; replacement or reconstruction of facilities where the new facilities will be located on generally the same site and used for generally the same purpose; construction of single, small structures and facilities in certain conditions (not where other criteria are triggered) including; one single family residence of less than 3,500 sq feet; one multi-unit structure of not more than 4 dwelling units; one store, office or restaurant designed for total occupant load of 20 persons or less; water, sewage, electrical, gas, telephone & other essential public utility services extensions to serve such structures or facilities; appurtenant structures incuding garage, car port, patio, pool, fences; minor alteration in the condition of land water or vegetation; basic data collection, research, experimental management and resource evaluation activities which do not result in serious or major disturbance to an environmental resource; construction or placement of minor structures accessory to existing facilities; interior alterations involving partitions, plumbing, electrical conveyances, etc.; demolition of structures not located on any historic site nor designated in any historic register; zoning variances except use, density, height, parking requirements & shoreline set-back; continuing administrative activities including purchase of supplies, personnel related actions, and the adoption, amendment, or repeal of rules ♦ Entity should endeavor to prepare an EA or as close to an acceptable EIS as possible with public consultation as early as possible, reviewing impacts, significance criteria, implications of proposed actions, alternatives, etc. as early as possible. file with either anticipated negative declaration or EIS preparation notice; distribute per regulations, respond to public comment; revise assessment as appropriate and append comments and responses to final filing of either negative declaration or EIS; ♦ For EIS: publish prep notice; upon publication of prep notice public has 30 days to become consulted party; upon receipt of request to be consulted party, proposing entity shall provide the requestor with copy of the assessment; respond to all commenters; (acknowledgement/response must be in draft EIS); publish draft EIS, public has 45 days to comment; acknowledgement and point-by-point response to commenters must be in final EIS, with addendum if applicable; if acceptable, accepting agency files notice of acceptance. If not, it files notice of non-acceptance with reasons, and proposing agency revises or withdrawals. Revisions subject to same public notification process. Notice of withdrawal also must be published. ♦ Content requirements include: description of the action; significant beneficial & adverse impacts, including secondary and cumulative impacts; proposed mitigation measures; alternatives considered; unresolved issues; compatibility with land use plans & policies; listing of permits and approvals; table of contents; statement of purpose & need for the proposed action; map; statement of objectives; description of the actions' technical, economic, social and environmental characteristics use of public funds; phasing and timing of action, summary of technical data, diagrams & other information necessary to permit any reviewer to genuinely evaluate potential impacts; historic perspective; alternatives which could obtain the same objectives or benefits but with different impacts; alternative of postpoining for further study; no-action alternative; alternate locations; all alternatives considered to be discussed in sufficient detail to explain why they were rejected; detailed description of environmental setting; relation to land use plans, policies and standards; detailed description of impacts to environment and community, including secondary and cumulative impacts; short term vs. long term impacts and benefits; irreversible impacts; unavoidable impacts; mitigative measures; unresolved issues; consulted parties; and including all substantive comments

GASB34	♦Passed by Government Standards Bureau in 1999. Small systems like Lana'i must comply by July 01, 2003. ♦ Systems must report the value of their assets on consolidated annual financial reports two acceptable methods 1) depreciation, or 2) "modified" method. Modified method requires inspection of condition rather than just dates. ♦ Requires systems to know the date installed, costs and useful life of all assets as a minimum, ♦ In order to comply with modified method, many utilities are developing asset management plans . Implementing such plans could have the potential to help prolong the life of infrastructure by pre-planned and documented inspection and thereby cutting dramatic replacement costs.

CHAPTER 3

Existing Resources & Systems

In This Chapter

Key Points:

- Lanaʻi has an estimated 6 Million Gallons Per Day (MGD) sustainable yield. Fresh water is found only in high level dike confined compartments in the Central Sector. The Central Sector is divided into two aquifer systems, the Windward and the Leeward, with 3 MGD sustainable yield in each.
- Total pumpage during 2008 was about 2.24 MGD.
- All pumping sources but one are currently located in the Leeward aquifer system, with about 85% of total pumpage, just over 1.9 MGD, coming from this system.
- There are currently 7 pumped sources, with one pumped at only 2,000 GPD. At 2008 pumping rates and distribution, water levels in Wells 1, 9, 14, 6 and, to a lesser extent 8, were declining.
- For comparision, the 1996 document, "*A Numerical Ground-Water Model for the Island of Lanaʻi, Hawaii*" (CWRM-1, 1996) modeled withdrawals between 13 sources, 11 of them pumping. It concluded that with the modeled distribution of withdrawals, the aquifer should be able to yield 3.52 MGD without undue damage, though some additional distribution or deepening may be required.
- No surface sources remain on Lanaʻi, although historical evidence points to the fact that the island once had springs, streams and even taro loʻi. Lanaʻi has 13 ahupuaʻa. Of one hundred and ten kuleana claims made within these ahupuaʻa, fifty-six were awarded.
- Lanaʻi has five water systems, two drinking water systems, one brackish water system used for irrigation, and two reclaimed water systems, also used for irrigation. Collectively, these systems include about 79 miles of active pipe, 35 MG of storage, of which about 4.8 MG is potable, and about 6.394 MGD installed well capacity of which 5.04 is potable.

- Average day capacity of potable systems in use, by *System Standards*, equates to about 2.24 MGD.
- Existing potable water rates are $1.10 for the first 25,000 gallons and $1.62 for every 1,000 gallons thereafter. Although non-potable rates are higher, (provided in System Finance and Economics Section), existing rates and fees are not sufficient for the utility to be self-supporting. The cost of well operation, not including the full cost of running the system - is estimated at roughly $2.17 per thousand gallons for the Lana'i City and Koele areas, and $1.77 for the Manele and Palawai Irrigation Grid areas. Declining water levels could exacerbate that shortfall. For example, if water levels were to reach designation trigger elevations, assuming the same pumpage rates and electricity costs, the cost of pumping wells for the Manele and the Palawai Grid could reach as high as $3.07 per Kgal.

Geology

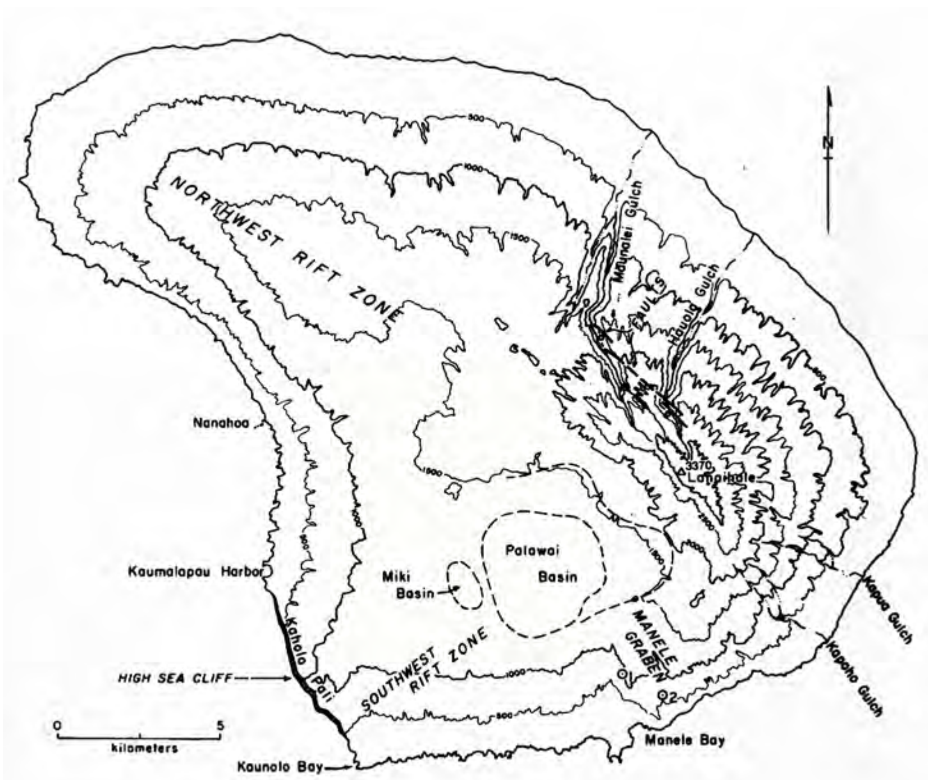


FIGURE 3-1. Map of Lana'i Showing Rift Zones, Palawai & Miki Basins, & Locations of Fossiliferous Deposits. Source: MacDonald, Abbott & Peterson *Volcanoes in the Sea*: the Geology of Hawaii, University of Hawaii Press, Honolulu, 1983.

Lana'i is 18 miles (30 km) long, 12 miles (21 km) wide, and has an area of 141 sq. miles (366 sq. km). The island is 3,370' tall at its highest point. Lana'i was created by a single shield volcano during the Tertiary period. Potassium argon dating places the age of Lana`i between 0.81 and 1.46 million years.

Lana'i was built by eruptions along three rift zones, running northwest, southwest and south, with possibly a fourth, more ancient rift zone running either north or northwest.

Geology

Near the end of volcanic activity, during the subaerial shield building stage, a major collapse occurred around the intersection of the rift zones, to the southwest of Lana‘ihale. Subsequent lava flows ponded in the collapsed caldera, with some outpouring through the south rift trough. The Palawai basin is a remnant of the original caldera.

Lana'i was submerged at various times during its geologic history, with evidence of previous shorelines at the 170 meter (558’) elevation, and possibly also at the 190 meter (623’) elevation. Fossiliferous marine limestone as much as 45 meters (148’) thick extends up to 165 meters (541’) altitude in Kawaiu gulch, with calcerous conglomerate containing many shell fragments and foraminifera as high as 167 meters (548’).

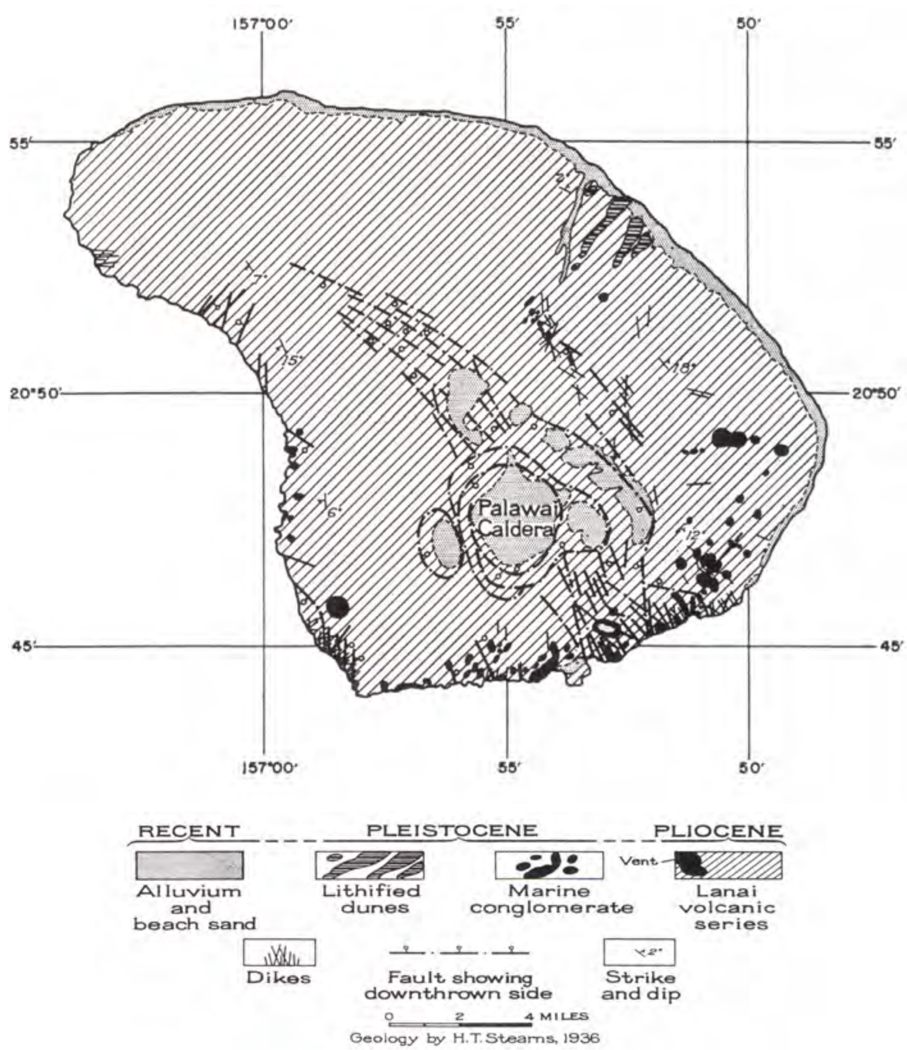


FIGURE 3-2. Geologic Map of Lana‘i. Source: MacDonald, Abbott & Peterson *Volcanoes in the Sea: the Geology of Hawaii*, University of Hawaii Press, Honolulu, 1983

Harold Thornton Stearns, a well-published geologist who was in charge of Hawai‘ian groundwater investigations for the United States Geological Survey in the territory of Hawai‘i during the 1930s and 1940s, thought that the island had at one time been submerged to what is now the 360 meter (1,181’) elevation. Evidence for this lies in thin veins of limestone in the basalt at 321 meter (1,053’) altitude, which contain fragments of coral, coralline algae and marine mollusk shells, probably formed from calcerous sand which sifted into cracks in the basalt, and in the divergent nature of soils above and below the 360 meter (1,181’) level. Dune formations are also found at 306 meters (1,004’) high on the south-eastern shore, and 285 meters (935’) high on the ridge east of Maunalei, and in Kupa‘a gulch along the northeast. Some geologists have speculated that certain marine materials at high elevations could have been deposited by major tsunami events. (Source: *Volcanoes in the Sea: The Geology of Hawaii;* MacDonald, Abbott & Peterson, University of Hawaii Press; ©1983).

Lana`i lavas are theolitic basalts, theolites, oceanites and some phenocrysts of labradorite feldspar. Pahoehoe dominates near the higher elevation vents, and a`a on the lower slopes. Lana`i basalts are highly permeable, except in vertical dike formations. The south side of the island has essentially no caprock, while the north side appears to have either alluvial deposits or caprock which may serve to deter discharge to the ocean.

Lana`i soils are from the Amalu-Olokui; Jaucas-Mala-Pulehu; Kahanui-Kalae-Kanepuu; Molokai-Lahaina; and Very Stony-Rock Land soil associations, with several series within these associations. Most of the soil series are well drained, with permeabilities ranging from 0.63 to 20 inches per hour. Runoff characteristics vary from slow to very rapid.

The hydrogeology of Lana`i is unusual in various respects, among them the predominance of high level water, including the presence of high-level brackish water accompanied by geothermal heating in the area of the Palawai basin. High-level water is found within 3.8 miles of the coast all around the island. Numerous dike and fault boundaries divide the main aquifer into many smaller, relatively independent compartments bounded by vertical walls of lower permeability. Evidence of relative impermeability of confining aquicludes was indicated by a 677' (206 m) difference in water levels between Wells 1 and 2 over a distance of 1 mile, and 733' (223 m) difference between Shafts 1 and 2 over a distance of two miles, noted by V.W. Thalmann in his 1954 report. (Source: *Summary of Lana‘i Water Development from 1954* Report by V.W. Thalmann, in Anderson, *Water Supply Investigation, Lana‘i, Hawaii*, Prepared for Hawaiian Pineapple Co. Ltd., By Keith E. Anderson, October 1957).

Lana`i is also anomalous relative to other Hawaiian Islands in that its windward side has low gradual coasts, while its leeward side exhibits high, dramatic sea cliffs such as the 300 meter (984’) high Kaholo Pali, south of Kaumalapau. This is in part because Lana`i lies in the rainshadow of Western Maui and Eastern Molokai, and is relatively protected from wind and wave action on its "windward" side, whereas the "leeward", or southern - southwesterly side, has no protection for thousands of miles and is subject to southwesterly "kona" storm winds and waves. Long erosional grooves that run parallel to the prevailing wind direction on the west side attest to the fact that wind has also helped to shape Lana‘i.

Large scale landslides have helped to shape the southwestern side of Lana`i, as evidenced by the 6100 km^2 (2,355 sq. mile) submarine Clark Debris avalanche formation, which extends 150 km (93 miles) to the southwest of Lana‘i in two branches (possibly representing two separate events).

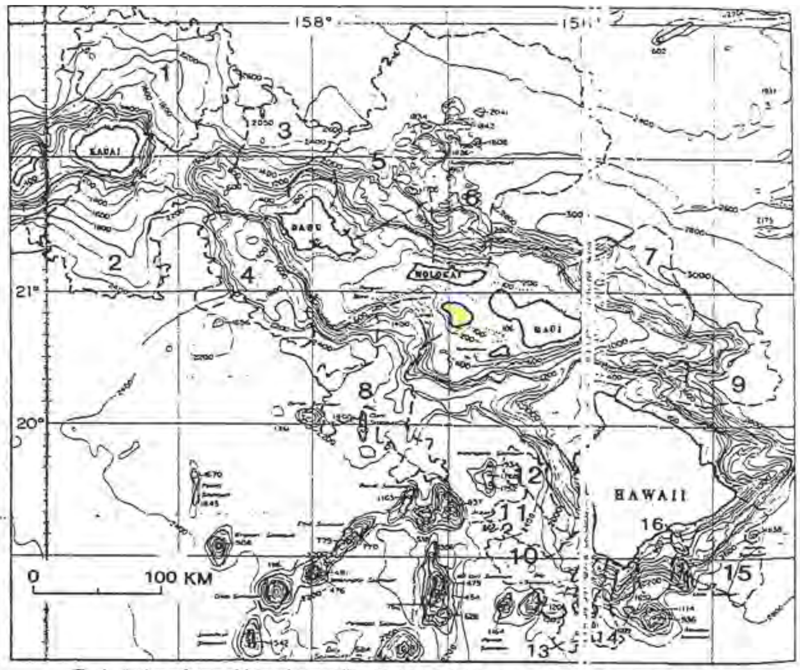


Fig. 1. Bathymetric map of the southeastern Hawaiian Ridge showing major mass wasting features (heavy dashed lines) identified by number in text and Table 1. Contour interval 200 fathoms (366 m). Base from *U.S. Naval Oceanographic Office* [1973].

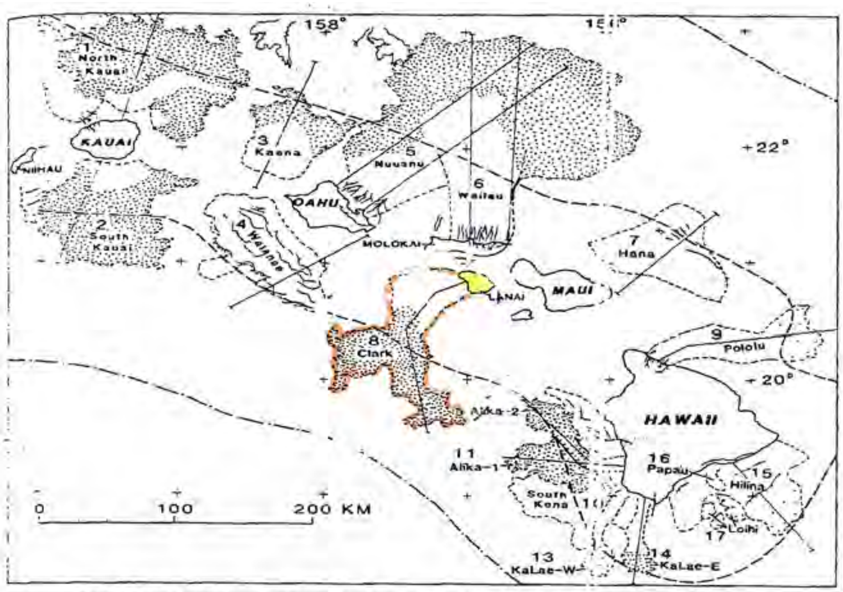


Fig. 2. Map of southeastern Hawaiian Ridge showing major slides bounded by dashed lines identified by number in text and Table 1; compare with Figure 1. Dotted area, hummocky ground (widely spaced where subdued); hachured lines, scarps; thin, downslope-directed lines, submarine canyons and their subaerial counterparts; heavy dashed line, axis of the Hawaiian Deep; dash-dotted line, crest of the Hawaiian Arch.

FIGURE 3-3. Bathymetric Map & Map Showing Major Slides of Southeastern Hawaiian Ridge**, Source: Moore, Clague, Holcomb, Lipman, Normark & Torresan; *Prodigious Submarine Landslides on the Hawaiian Ridge*; Journal of Geophysical Research; Volume 94, No. B12, pgs. 17,465-17,476; Dec. 10, 1989**

Groundwater

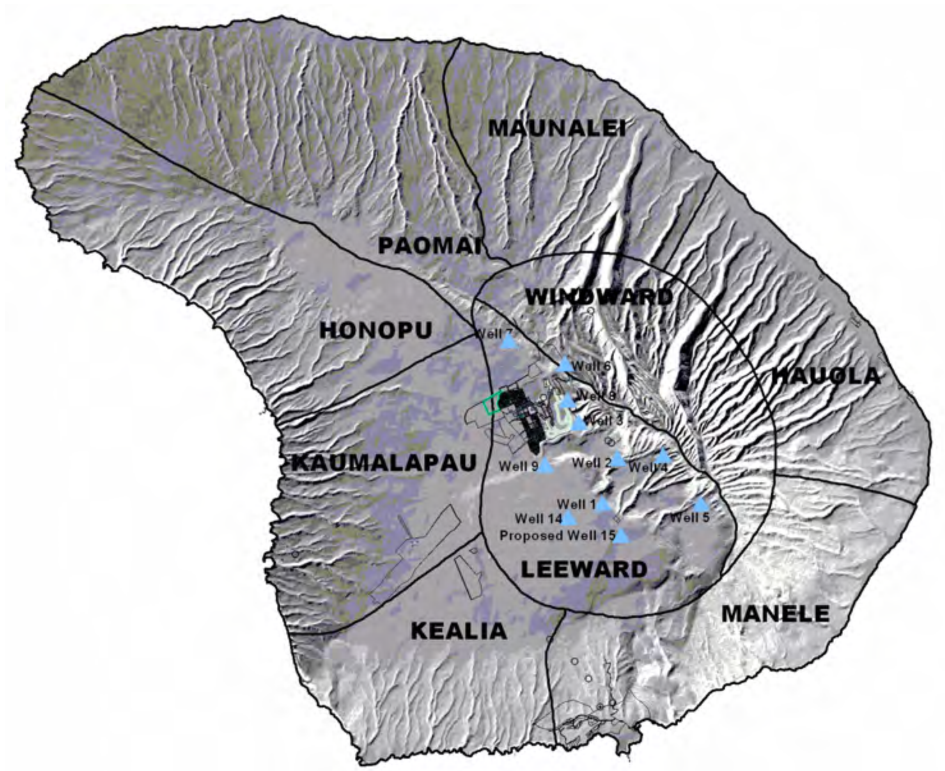


FIGURE 3-4. Lana'i Aquifer Map

Aquifer Systems and Yields

There are nine aquifer systems in four sectors on Lana`i, as follows:

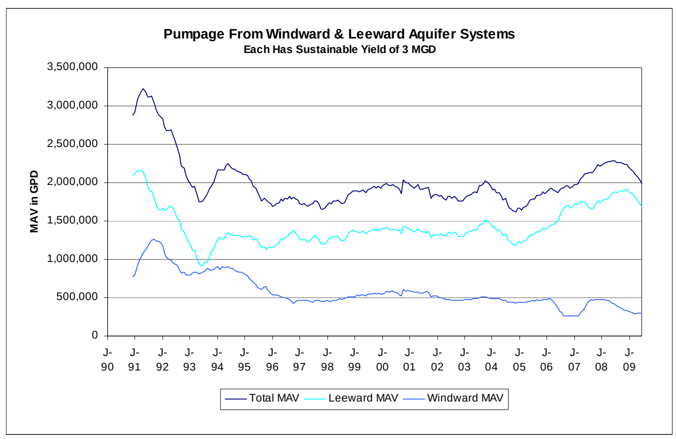
50101 - Windward	50201 - Hauola
50102 - Leeward	50202 - Maunalei
	50203 - Paomaʻi
50301 - Honopu	50401 - Kealia
50302 - Kaumalapau	50402 - Manele

Estimates of sustainable yield on the island have varied from about 5 to 10 MGD, with the current regulatory sustainable yield estimate at 6 MGD. Only the Central Aquifer sector is believed to contain fresh water. The island's entire sustainable yield of 6 MGD is found in this region, according to the sustainable yield classification system utilized by the State. By this system, the total area of this aquifer sector is about 24 square miles, (2008 *State Water Resources Protection Plan*) with water levels above 500' found in a 14 square mile area (1990 *State Water Resources Protection Plan*). Time domain electromagnetic resonance (TDEM) studies undertaken by consultants to Castle & Cooke Resorts in 1993 and 2001 indicated that the impeding structure bounding that aquifer may have an area of twice the regulatory extent. These studies are described later in this chapter. However, neither the regulatory boundary nor the estimated sustainable yield were increased in the 2008 update of the State Water Resources Protection Plan. The State's water model of Lana'i (CWRM-1, 1996), considered water level performance of existing wells using the larger recharge area indicated by TDEM studies. Neither the modeled results nor water level performance to date have appeared to indicate increased sustainable yield.

The sustainable yield of 6 MGD in the Central Aquifer sector is further divided into 3 MGD each in the Leeward and Windward aquifer sectors. All of the currently pumping wells, with the exception of Well 6, are located in the Leeward Aquifer, with a sustainable yield of 3 MGD. Figure 3-5 shows annual MAV pumpage in period 13 from Windward and Leeward aquifers from 1990 through 2008. Of a total MAV of about 2.241 MGD in December of 2008, about 1.913 MGD came from the Leeward Aquifer system, and about 0.328 came from the Windward Aquifer system.

FIGURE 3-5. Lana'i Pumpage in Windward and Leeward Aquifers

Year	Leeward MAV	Windward MAV	Total MAV
1990	2,101,077	774,098	2,875,175
1991	1,643,854	1,213,825	2,857,679
1992	1,233,813	796,911	2,030,724
1993	1,212,182	887,900	2,100,082
1994	1,288,285	820,973	2,109,258
1995	1,158,039	563,115	1,721,154
1996	1,310,474	462,405	1,772,879
1997	1,204,091	456,962	1,661,052
1998	1,378,692	517,096	1,895,788
1999	1,383,930	548,523	1,932,453
2000	1,405,011	590,088	1,995,099
2001	1,320,132	520,288	1,840,421
2002	1,299,692	463,234	1,762,925
2003	1,460,127	493,067	1,953,193
2004	1,226,135	442,593	1,668,728
2005	1,387,184	473,124	1,860,308
2006	1,694,019	258,151	1,952,169
2007	1,736,458	474,741	2,211,199
2008	1,913,310	327,912	2,241,222



Reasonable estimates of potential yield are also dependent upon the configuration of infrastructure and distribution of withdrawals. Here again, estimates have varied. In letters to Lana'i Land Company dated January 23, 1989 and January 25, 1989, respectively, John Mink and Keith Anderson both stated that with the configuration of approximately eight sources at the time, sustainable yield was about 3 MGD. (Sources at the time were Upper and Lower Maunalei Tunnels and Maunalei Shaft 2, and Wells 1 through 5). Both 1989 estimates anticipated an additional 0.8 MGD to be available based on the drilling of Wells 6 & 7. Mink also indicated that neither these nor Wells 9 & 10, also proposed at that time, would prevent the water table from declining to its equilibrium head. In the 1990 *State Water Resources Protection Plan*, although Mink estimated the island's sustainable yield at 6 MGD, he stated that under current conditions of development and operation the sustainable yield was closer to 4 or 5 MGD. (Although Well 6 was not on-line until 1991, it had probably been tested and shown promise as of the time he wrote that document). The 1996 document, *A Numerical Groundwater Model for the Island of Lana'i Hawaii*, (Hardy, CWRM-1, State of Hawaii, 1996) indicated that thirteen sources existing at the time could deliver 3.52 MGD without damage to the aquifer, with the exception that both Maunalei Tunnels would run dry. This scenario included thirteen sources: free flow from the Upper and Lower Maunalei Tunnels (which would run dry in the scenario), and pumpage from Maunalei Shaft 2, Wells 1 through 9 and Well 14. This document is described further below. As of this draft, the Maunalei sources are no longer in use, and Wells 3 and 5 have also failed. Well 2 /Shaft 3 has rarely been used since 1996, though the source is still viable. Although efforts are in progress to restore or replace these sources, this leaves only six sources currently in use. The impacts of these infrastructure changes on safe yields are unclear. Plots of water levels in more recent years seem to indicate some decline, as shown on pages 60-77 of this chapter. Water levels are expected to decline in any case until equilibrium head is reached. The pace at which this occurs, and the amount of decline to equilibrium head, may or may not indicate a concern. In the case of Lana'i, it is not entirely clear whether recent declines are a concern and a function of distribution of withdrawals and aquifer yields, or whether they are simply natural equilibration or even a result of reporting methods.

The 1996 document mentioned above, *A Numerical Groundwater Model for the Island of Lana'i Hawaii*, (Hardy, CWRM-1, State of Hawaii, 1996) was the most recent in-depth examination of potential aquifer responses to different pumpage configurations. This document examined 6 pumping scenarios and gauged the effects of each on the aquifer. All of the scenarios assumed that the Upper and Lower Maunalei tunnels were allowed to flow freely, without pumpage. All of the scenarios but one resulted in some continued decline of water levels in the aquifer until a theoretical equilibrium would be reached. Hardy examined the anticipated drop in water levels to reach equilibrium in each scenario.

Scenario One involved continued pumping at a rate of about 1.707 MGD using ten sources (the Upper and Lower Tunnels, Maunalei Shaft 2, Wells 1 through 6 and Well 9). In this scenario, the aquifer would remain relatively healthy, though Upper Maunalei Tunnel would cease to flow. This scenario resulted in the second smallest decline in water levels of those tested.

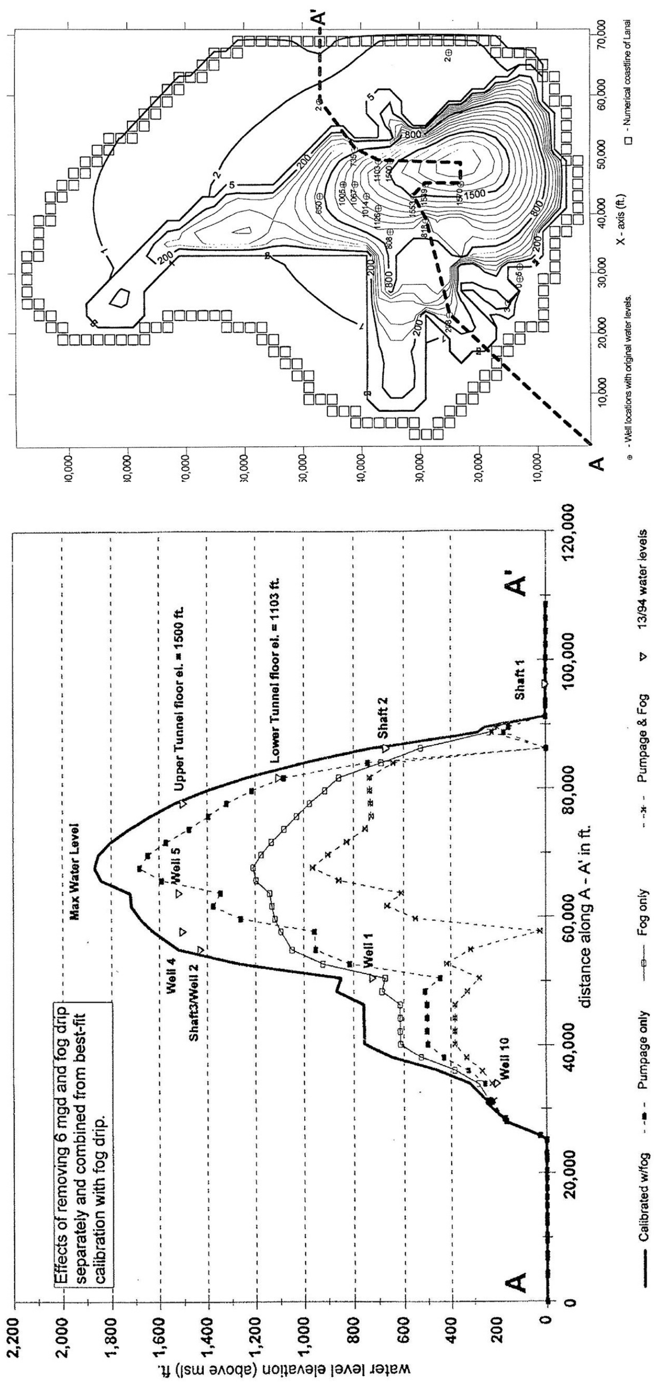
Scenario Two involved no pumping at all, but loss of all fog drip. This scenario had greater impact overall to the aquifer than any pumpage scenario modeled, with water levels in the key recharge area dropping to about half their present levels.

Scenario Three involved pumping from existing wells to 6 MGD using ten sources (the Upper and Lower Tunnels, Maunalei Shaft 2, Wells 1 through 6 and Well 9). This caused regional water level decreases of concern probably due to inadequate distribution of withdrawals for this level of pumpage.

Scenario Four combined loss of fog drip with pumpage to 6 MGD using the same ten sources (the Upper and Lower Tunnels, Maunalei Shaft 2, Wells 1 through 6 and Well 9). This scenario would render many wells useless, with drawdowns over 1,300 feet in some areas. The worst effects were anticipated near the center of the island, in the key recharge area.

Groundwater

FIGURE 3-6. Water Levels as Modeled in *A Numerical Groundwater Model for the Island of Lana'i, Hawaii*; Hardy, CWRM-1, State of Hawaii 1996, showing cross section and aerial view of modeled area.



Scenario Five examined only the effects of pumping two wells in the caldera (Wells 1 and 9). This scenario involved only 0.65 MGD of pumpage. There was little effect on upstream sources.

Finally, Scenario Six involved taking 3.52 MGD (CCR's proposed withdrawals at the time) from thirteen sources (the Upper and Lower Maunalei Tunnels, Maunalei Shaft 2, Wells 1 through 9 and Well 14). The Upper Maunalei tunnel would cease to flow in this scenario. Although water levels would be anticipated to drop in all sources, Hardy stated, "It appears that this pumpage scenario amongst existing wells will not harm the aquifer. However, some changes in the existing well infrastructure may still be necessary as some of the wells specified for future pumping have no track record of water level response to such stresses...".

Hardy concluded that modifications to existing well configuration, including both drilling of additional wells and deepening some, would be necessary in order to realize long term development of groundwater. Updated recharge estimates, developed as part of the modeling effort described above, were higher than those previously estimated. Nevertheless, the State elected to take a conservative approach in estimating sustainable yield, due to the absence of adequate data or studies to corroborate a potentially higher yield. Recharge estimates, though higher, were also very dependent upon the status of the mauka watershed, which has been in decline. Results are shown in Figure 3-6. Distribution of withdrawals used in the model vs. actual for 2008 and recent as of Oct, 2009 are shown in Figure 3-7.

Perhaps the most compelling conclusion resulting from this study was that the reduction of forest cover would affect groundwater levels drastically. The numerical model made a strong case for the maintenance of vegetative cover in the cloudy regions above the 2,000' elevation. The importance of watershed protection and measures contemplated in the plan are discussed further in the watershed protection section of this document.

FIGURE 3-7. Lana‘i Wells In 1996 Numerical Groundwater Model vs. Present Day

	AS MODELED IN 1996 CWRM MODEL	CWRM MODEL WELLS IN USE NOW	2008 MAV	* MOST RECENT ACTUAL MAV	* OTHER RECENT ACTUAL MAV	AVG OF NON-ZERO MAVS OVER PUMP RECORD	Comments
Maunalei Shaft 2	500,000	0	0	0	557,385	525,980	*MAV period 13 1994. In the late 1980s, more than 600 KGal came from Maunalei sources. Shaft 2 operated until 1995 with a running MAV of around 526 KGal. Stopped in early 1995.
Well 1	270,000	270,000	393,981	378,074		291,173	*MAV period 7, 2009. Water levels appear to be declining at current pumping rates.
Well 2 / Shaft 3 future "2-A"	300,000		2,418	0	302,468	228,523	*302,468 was MAV period 13, 2006. However, there have not been 13 straight periods of pumping since 1997. Period 8, 1997 MAV was 157,140 GPD.
Well 3	300,000	0	0	0	233,991	191,281	*MAV period 6, 2006. Last 13 period with continuous non-zero pumpage.
Well 4	400,000	400,000	683,867	598,677		532,729	MAV period 7, 2009.
Well 5	400,000	0	0	0	120,030	153,557	*MAV period 12, 1992. This well started in the 200-300 KGal range for 2 years, and then dropped steadily. Period shown is last continuous non-zero MAV use.
Well 6	300,000	300,000	327,912	303,118		432,557	MAV period 7, 2009.
Well 7	200,000	0	0	0			No continuous pumpage record. One monthly number in 1992.
Well 8	300,000	300,000	276,890	255,469		121,459	*MAV period 7, 2009.
Well 9	270,000	270,000	151,440	127,851		224,302	*MAV period 7, 2009.
Well 12	0	0	0	0	14,305	10,316	*MAV period 13, 1995. Started at 17.8 KGal & declined continously. Use stopped in 1997.
Well 14	280,000	280,000	404,714	323,302		336,913	*MAV period 7, 2009.
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	3,520,000	1,820,000	2,241,222	1,986,491	1,228,179	3,048,790	Average over pump record is high. These wells have not pumped at same time. Difference between 2,238,804 and 2,241,222 is less than 1%, and results from different averaging method.

Groundwater

FIGURE 3-8. Lana‘i Wells and Water Levels

Well	Initial Water Level (+MSL)	Action Level Nance	Lowest Allowable Level Nance	Trigger Levels for Designation Proceedings CWRM 3/29/1990	Current Level Period 7 2009 (except where noted *)	Notes**
1	818	550	410	414	575	
2 / Shaft 3	1,544 / 1,553	1050	750	772	1441	Initial head per Nance. "0" per CWRM database. Most recent WL reading period 13, 2002. Well rarely used since 1996. Used 8 months in '06, only few months each in '97, '02, '08.
3	1,124	750	562	562	992	Last WL reading from period 7, 2006. Well also not in operation since period 5 of 2006.
4	1,589	1100	750	794.2	1501	Initial head per Nance. "1078" per CWRM database.
5	1,570	1100	750	735	1496	Last WL reading from period 4, 2004. Well not in operation since roughly end of 1994.
6	1,005	750	500	502.5	924	
7	650			325		Initial head per CWRM. Only reported pumpage period 4 of 1992. First WL report - period 5,1999 - 980'. Last WL report period 4, 2004 973'. Not clear why heads are 300'+ higher than that recorded by CWRM.
8	1,014	750	500	507	944	Prior to period 6 of 2002, reported water levels were running in the mid 800s. In Period 6, 2002 they were 867. In Period 7, 2002, they jumped to 970' and have stayed in the 900s thus far. The increase may be due to a reporting method change in 2002.
9	808	550	410	404	650	Minimum reported water level was 566' for periods 3, 4 and 5 of 2006. (Water level corrected by Takasaki survey per Hardy '96)
10	208			104		
11						Well missing from CWRM database or named differently there. Initial Head 95', if same as Palawai Exploratory. Never used.
12	5			2.5		
13	0					
14	551	400	292	275.5	497	Min high water level 418' - period 5, 2004.
15						Well to commence 2010.

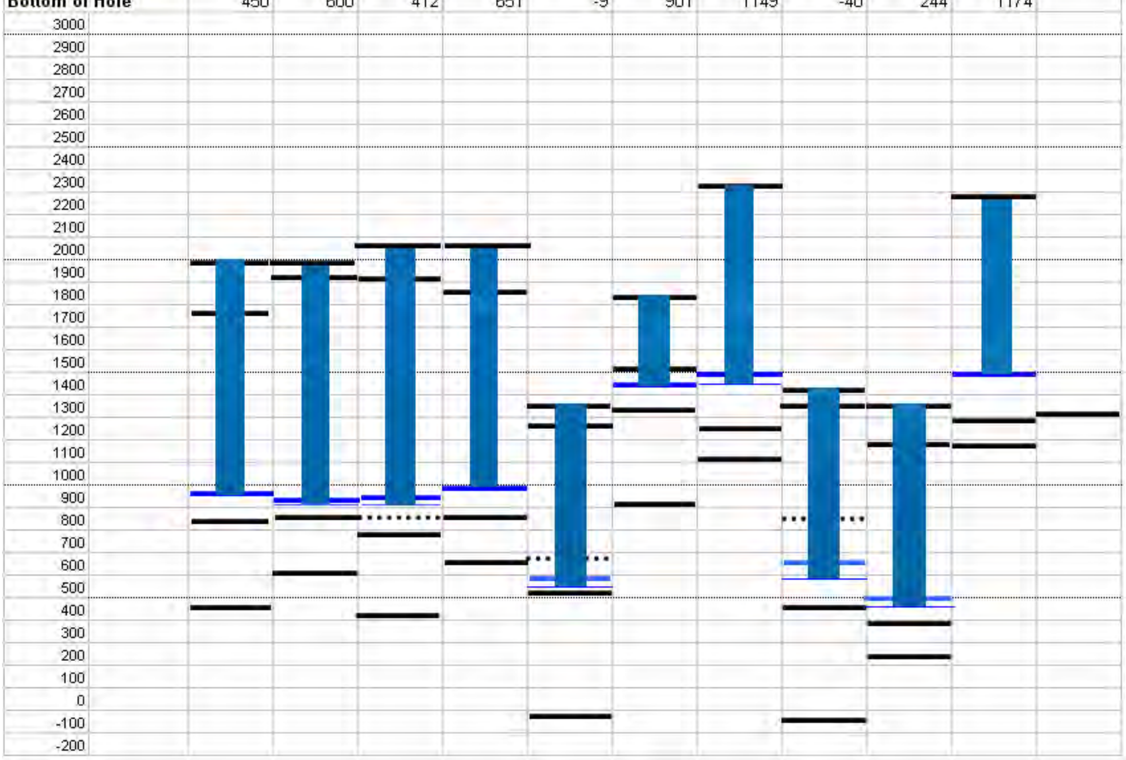
** Current and recent water levels refer to High Water Levels from the Periodic Pumpage Reports & are in elevation above Mean Sea Level. Designation triggers refer to static water levels. High water levels from pumping wells serve as a preliminary indicator for static water levels.

Water Levels

Figure 3-8 shows existing water levels at pumping wells versus water levels set by the CWRM as triggers for designation proceedings in its March 29, 1990 decision on designation, and action levels recommended by Tom Nance in 1996. When water levels reach triggers established by CWRM, designation proceedings are triggered. Based on Nance's 1996 proposal, when an action level is reached, pumpage data will receive a thorough public and scientific review with the aim to determine whether and what further actions, such as lowering the pump or replacing the affected well, distributing withdrawals or other measures, are indicated. When water levels reach the "lowest allowable level" proposed by Nance, pumpage of the affected well is to stop altogether until the well is able to recover. The historical and current status of individual wells are discussed on pages 60 to 77 of this chapter.

FIGURE 3-9. Side View Schematic of Well Water Levels Running North to South.

	Well 7	Well 6	Well 8	Well 3	Well 1	Well 2	Well 4	Well 9	Well 14	Well 5	Well 15
Tank Spillway	1980	1980	2057	2057	1353	1823.5	1823.5	1353	1353		
Well Ground Elev.	1775	1910	1902	1850	1265	1510	2327	1411	1193	2296	1310
High H2O Level P7/09	973	924	944	992	575	1441	1495	650	497	1496	
Low H2O Level P7/09		913	904		555		1457	598	478		
Pump Intake or Elev.	840	863	782	866	516	1335	1253	466	400	1293	
Bottom of Hole	450	600	412	651	-9	901	1149	-40	244	1174	



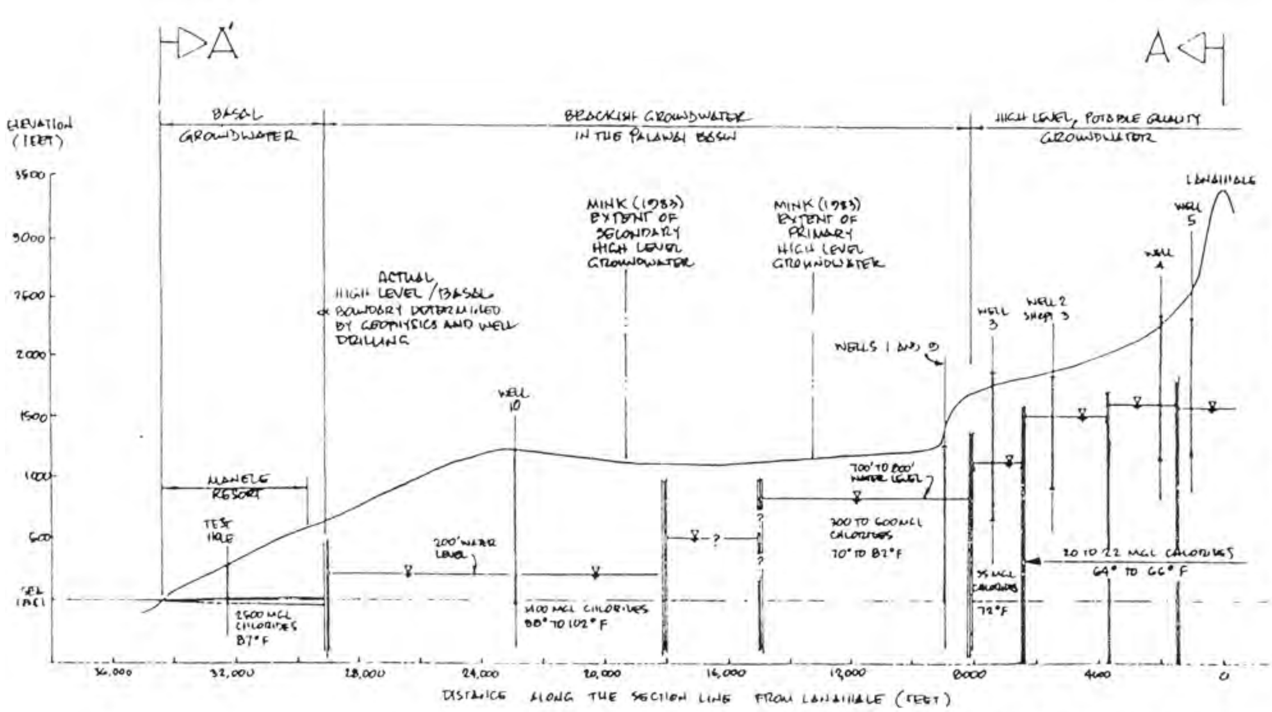
**** Ground elevation for Well 4 higher than tank spillway, so only ground elevation is shown. Wells 1, 9 & 14 used to pump to a control tank at 1,420' with a 1,434.5' spillway. This tank has now been bypassed, so the high point in the line, at 1,353' is the highest point to which Wells 1 & 14 now pump.

Figures 3-9 and 3-10 are recent (3-9) and historical (3-10) snapshots of water levels in pumping wells, running from north to south on Lana‘i.

In Figure 3-9, lines marking elevations read top to bottom. The top black line represents the tank spillway level to which the well pumps, followed in descending order by ground elevation, high water levels in thick blue, low water levels in thin blue, pump intake levels, and the bottom of the hole. Dotted black lines represent past pump elevations. For instance, Well 8 pump level as of period 7, 2009 was 863.17’. The pump was lowered in early September of 2009 to 783.17’ to avoid cavitation, as pumping water levels were within 17’ of the pump.

Figure 3-10 provides the locations of the wells relative to Lana‘i’s topography. Although more recent data regarding depths and water levels are provided in Figure 3-9, and more recent data regarding apparent aquifer extents are provided in the next section, Figure 3-10 provides a useful reference for visualizing such data.

FIGURE 3-10. Hydrogeologic Section from Manele to Lana‘ihale Illustrating the Comparative Locations of the Outer Limit of High Level Groundwater Occurrence. Source: *Lana‘i Company Water Resources Management Plan, 1996*.



Hydro-Geologic Section From Manele to Lanaihale Illustrating the Comparative Locations of the Outer Limit of High Level Groundwater Occurrence

Aquifer Extent - Time Domain Electromagnetic Resistivity Surveys

Water levels at pumping wells are described above. In addition to such measured levels, the depth, nature and extent of an aquifer can be characterized by other methods. Once such method is a time domain electromagnetic resistivity survey.

Time domain electromagnetic resistivity surveys are used to examine subsurface aquifer characteristics, including depth to water, lateral extent of water, degree of salinity and impeding structures or geologic features that would indicate areas where an aquifer may be present.

Electrical resistivity measurements are made by passing weak electrical currents through the ground and measuring the resultant voltage field. The behavior of the currents in the ground is sometimes compared to “smoke rings”. After the initial “puff”, the “smoke rings” expand, weaken, and travel down through the earth. The rate of diffusion depends on the conductivity or resistivity of the layers below. In resistive media, the currents diffuse rapidly, so the voltage drops quickly. In conductive media, they diffuse more slowly. After the initial pulse, the transmitter is turned off, and timed measurements are made of the resulting currents or “smoke rings”. By making measurements at different time increments, a resistivity survey can identify variations in resistivity with depth, indicating different layers in the subsurface material. A series of soundings at different positions along a profile line can reveal lateral changes in resistivity, or changes across a section of ground. Changes in resistivity can reveal the presence of groundwater as well as provide some indication of the degree of salinity of water found.

Resistivity surveys were conducted as early as 1935. In *A Numerical Groundwater Model for the Island of Lana`i, Hawaii* (Hardy, State of Hawaii, CWRM-1996), Hardy discusses historical resistivity surveys of the island of Lana`i. Results vary but certain key points emerge. The island is characterized by high level water within 3.8 miles of the coast from any direction; the basal lens around the outside of the island is extremely thin; there is effectively no caprock on the southern side of the island but alluvium deposits on the north side may act as a sort of low permeability caprock; and finally, the presence of dikes and faulting in the main recharge area renders interpretation of resistivity studies for Lana`i a complex and uncertain undertaking. Even so, valuable data has been gained with regard to the general location of the confined high water boundary.

The most recent resistivity studies were performed in 1993 and 2001 by Blackhawk GeoSciences. Time Domain Electromagnetic Resistivity surveys (TDEM) were utilized to determine the location of the groundwater damming structure bounding the high level water, and to explore for anomalous basal groundwater occurrences. Data from the 2001 study are presented in Figures 3-11 through 3-13. Study areas referred to in Figure 3-13 are shown on the map in Figure 3-12. A larger version of this map is available on line in the large exhibits section of the Lanaʻi WUDP page.

Both the 1993 and 2001 TDEM surveys found that the aerial extent of the high level damming structure was broader than that originally estimated. The 2001 study also sought anomalous basal groundwater occurrences outside the damming structure. Results in the areas of Maunalei gulch, Haua gulch and an un-named gulch east of Manele Road indicated poor water resources in these areas. Possible basal lens occurrences were identified in Kahea gulch and Hauola Gulch. However, both of these sites were anticipated to yield low production wells. To date, CWRM has not elected to adjust the sustainable yield of the island based on these findings.

FIGURE 3-11. Cross Section of Lana'i showing inferred extents of high level water, basal water & damming structure

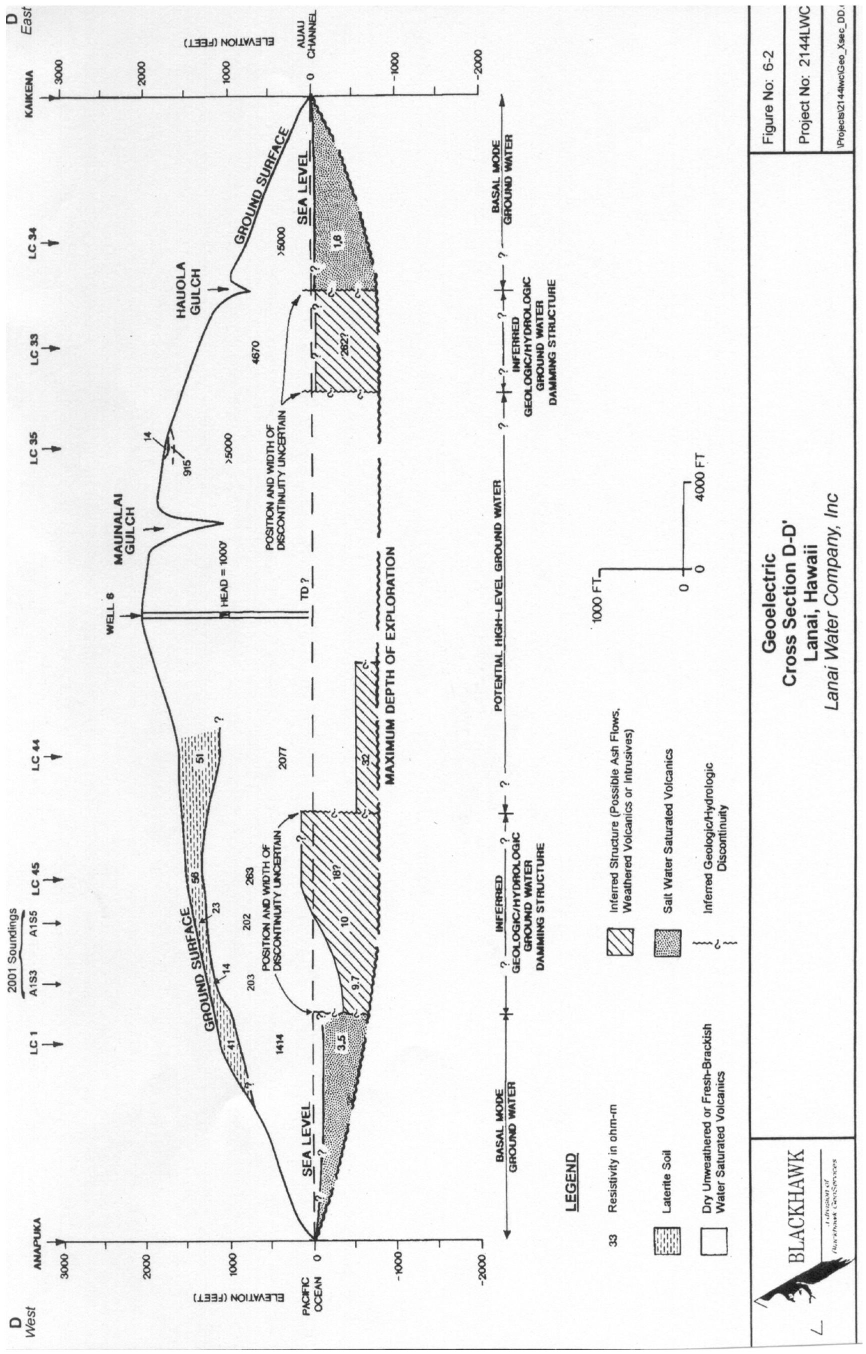


FIGURE 3-12. Blackhawk GeoSciences TDEM Sounding Location Map, August, 2001. Red crosshatch = inferred geologic/hydrologic discontinuity. Blue = soundings in which groundwater is expected to be basal. Green = soundings interpreted to be in the groundwater barrier. Gold = soundings in which groundwater is expected to be controlled by geologic structure, or potential high-level water**.**

Note: This figure is also provided as an 11x17 exhibit in the large exhibits file.

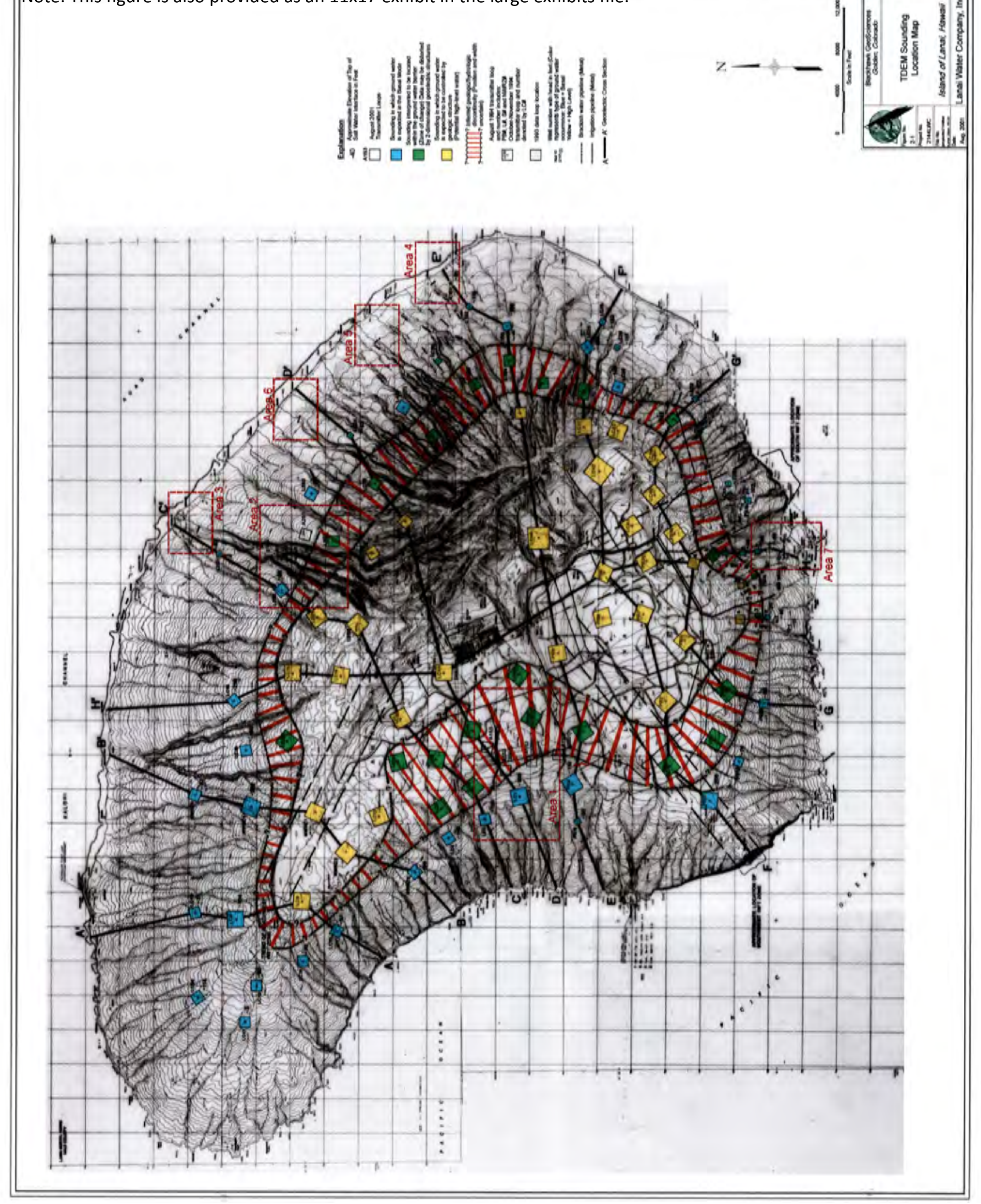


FIGURE 3-13. 2001 TDEM Results - Blackhawk GeoSciences

Time Domain Electromagnetic Survey of Lana`i Groundwater
by Blackhawk Geosciences, Sept 2001

	Resistivity (ohm-m)	Thickness (meters)	Elevation (meters)	Conductance (Siemens)	Interpretation / Comments
Area 1					North of Airport
Sounding 2			428		
Layer 1	12.49	18.9	409	1.51	
Layer 2	1106.3	346.7	62.33	0.313	Soundings in Area 1 repositioned the
Layer 3	9.47				previously interpreted groundwater
Sounding 3			405		damming structure 800'-1,000'
Layer 1	14.4	25.64	379.3	1.78	further seaward than had been
Layer 2	203.5	456.2	-76.86	2.24	interpreted from previous studies in
Layer 3	9.69				this area. This move reduced the
Sounding 4			417		available basal groundwater
Layer 1	23.73	38.58	378.4	1.62	resource estimates in the area,
Layer 2	95.45	198	180.3	2.07	while increasing estimates of high
Layer 3	2.87				level water.
Sounding 5			460		
Layer 1	22.65	31.69	428.3	1.39	
Layer 2	202.1	380.5	47.74	1.88	
Layer 3	10.35				
Area 2					Maunalei Gulch
Sounding 1			300		
Layer 1	13.05	30.29	269.7	2.31	
Layer 2	924.5	290	-20.37	0.313	Results did not change previously
Layer 3	2.36				interpreted position of damming
Sounding 2			128		structure. However, results
Layer 1	114.6	6.97	121	0.0608	indicated a rift zone in the area,
Layer 2	15.42	25.89	95.13	1.67	and a thin brackish/fresh basal lens.
Layer 3	160.5	45.83	49.3	0.285	Basal brackish/fresh water resource
Layer 4	3.97				expected to be poor in this area.
Sounding 3			110		
Layer 1	94.87	7.06	102.9	0.0745	
Layer 2	21.69	26.14	76.78	1.2	
Layer 3	117.1	61.46	15.32	0.524	
Layer 4	6.13				
Sounding 4			100		
Layer 1	139	9.33	90.66	0.0671	
Layer 2	13.46	11.03	79.63	0.819	
Layer 3	83.85	30.43	49.2	0.362	

	Layer 4	17.24				
Sounding 5				78		
	Layer 1	199.6	11.9	66.09	0.0596	
	Layer 2	5.66	3.3	62.78	0.583	
	Layer 3	422.1	60.81	1.96	0.144	
	Layer 4	5.24				
Sounding 6				70		
	Layer 1	153.2	5.57	64.42	0.0363	
	Layer 2	42.47	50.18	14.24	1.18	
	Layer 3	148.8	11.08	3.15	0.0744	
	Layer 4	3.93				
Area 3						Maunalei Gulch -
Sounding 7				17		More Detailed Surveys
	Layer 1	78.04	6.56	10.43	0.0841	
	Layer 2	2.2	17.2	-6.77	7.81	
	Layer 3	0.812				Interpreted results indicated streambed gravels, underlain by laterite and altered volcanics, underlain by fresh/brackish water saturated volcanics below sea level underlain by saltwater saturated volcanics. Still indicates thin brackish/fresh water lens. Poor groundwater resources anticipated.
Sounding 8				19		
	Layer 1	91.6	6.13	12.86	0.0669	
	Layer 2	3.56	16.85	-3.98	4.72	
	Layer 3	1.8				
Sounding 9				15		
	Layer 1	85.02	2.43	12.56	0.0286	
	Layer 2	3.04	16.6	-4.03	5.45	
	Layer 3	1.23				
Sounding 10				13		
	Layer 1	101.3	1.74	11.25	0.0172	
	Layer 2	2.4	26.53	-15.28	11.03	
	Layer 3	0.973	22.51	-37.79	23.13	
	Layer 4	18.09				
Sounding 11				12		
	Layer 1	98.25	4.36	7.63	0.0444	
	Layer 2	3.01	15.83	-8.19	5.24	
	Layer 3	1.53	52.21	-60.41	34.07	
	Layer 4	11.97				
Sounding 12				11		
	Layer 1	74.68	2.39	8.6	0.032	
	Layer 2	5.84	20.79	-12.19	3.55	
	Layer 3	1.39	173.2	-185.4	124.5	
	Layer 4	11.83				
Sounding 13				17		
	Layer 1	39.4	9.85	7.14	0.25	
	Layer 2	9.83	19.44	-12.29	1.97	

Groundwater

Layer 3	1.77	128.2	-140.5	72.04	
Layer 4	11.64				
Area 4					Kahea Gulch / Club Lana`i Area
Sounding 1			8		
Layer 1	36.1	44.39	-36.39	1.22	
Layer 2	2.12				Basal conductive layer found at
Sounding 2			7		unexpectedly great depth
Layer 1	6.82	2.32	4.67	0.34	considering that sites were only
Layer 2	35.78	36.89	-32.22	1.03	600'-700' inland from ocean.
Layer 3	2.13				Apparently anomolous basal lens.
Sounding 3			6		Could indicate better than usual
Layer 1	117	6.05	-0.0558	0.0517	groundwater resources. However,
Layer 2	19.08	33.93	-33.98	1.77	anomalous readings could also be
Layer 3	2.27				caused by low-permeability area or
Sounding 4			8		altered volcanics.
Layer 1	161	13.86	-5.86	0.0861	
Layer 2	25.18	30.22	-36.09	1.2	
Layer 3	2.81				
Sounding 5			15		
Layer 1	165.9	16.88	-1.88	0.101	
Layer 2	34.02	32.86	-34.74	0.965	
Layer 3	2.39				
Area 5					Haua Gulch
Sounding 1			28		
Layer 1	36.81	46.98	-18.98	1.27	
Layer 2	1.6	16.62	-35.6	10.35	Results indicate poor basal
Layer 3	2.5				groundwater resources. Basal
Sounding 2			26		conductive layer at modest depth
Layer 1	66.71	24.93	1.06	0.373	considering that the tests were
Layer 2	20.63	23.39	-22.33	1.13	2,000' inland from the ocean.
Layer 3	1.95				
Sounding 3			26		
Layer 1	41.07	42.28	-16.28	1.02	
Layer 2	2.76	42.47	-58.76	15.33	
Layer 3	9.61				
Sounding 4			29		
Layer 1	49.16	44.39	-15.39	0.903	
Layer 2	2.52	40	-55.4	15.83	
Layer 3	6.95				
Sounding 5			50		
Layer 1	343.2	64.8	-14.8	0.188	
Layer 2	2.42				

Area 6					Hauola Gulch
Sounding 1			20		
Layer 1	75.7	3.29	16.7	0.0435	
Layer 2	15.95	29.27	-12.56	1.83	Unexpected depth to basal seawater may indicate better than normal basal brackish/fresh groundwater resources in this area. However, this could also be caused by a low-permeability formation or altered volcanics.
Layer 3	1.78				
Sounding 2			18		
Layer 1	85.02	5.57	12.42	0.0655	
Layer 2	13.29	31.79	-19.36	2.39	
Layer 3	1.93				
Sounding 3			16		
Layer 1	83.91	3.89	12.1	0.0464	
Layer 2	14.82	33.02	-20.91	2.22	
Layer 3	1.84				
Sounding 4			14		
Layer 1	85.24	4.67	9.32	0.0548	
Layer 2	15.75	32.72	-23.4	2.07	
Layer 3	1.95				
Sounding 5			12		
Layer 1	78.22	3.79	8.2	0.0485	
Layer 2	13.99	33.04	-24.84	2.36	
Layer 3	1.5				
Sounding 6			12		
Layer 1	57.71	1.32	10.67	0.0229	
Layer 2	18.6	33.9	-23.23	1.82	
Layer 3	1.45				
Sounding 7			20		
Layer 1	172.6	8.71	11.28	0.0504	
Layer 2	18.65	29.22	-17.94	1.56	
Layer 3	1.61				
Area 7					Gulch East of Manele Road
Sounding 1			102		
Layer 1	79.4	113.2	-11.23	1.42	
Layer 2	0.117				Significant geologic structure identified in this area. Groundwater resources expected to be poor.
Sounding 2			101		
Layer 1	380.7	102.3	-1.39	0.268	
Layer 2	3.42				
Sounding 3			95		
Layer 1	60.37	59.79	35.2	0.99	
Layer 2	0.0152				
Sounding 4			85		
Layer 1	176.9	86.06	-1.06	0.486	

	Layer 2	2.49			
Sounding 5				80	
	Layer 1	118.7	37.65	42.34	0.317
	Layer 2	0.00241			
Sounding 6				90	
	Layer1	94.06	69	20.99	0.733
	Layer 2	0.0607			

Precipitation

Rainfall is a major source of recharge to aquifers, streams and springs, as well as being an indicator of the effects of climate change. Rainfall measurements have been taken at 52 rain gauges on Lana`i since 1914. Eight rain gauge stations are still in service and are followed by the National Weather service. The longest rain station records are those for Lana`i City and Koele. (Koele station # 693, not included in Figure 3-14 below, monitored from 1949 to 1963, showed an average annual precipitation of 37.3 inches.)

FIGURE 3-14. Lana'i Monthly Mean Precipitation

Lana`i Monthly Mean of Precipitation (01/1970-02/2002)

Station Name	Sta. No	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual
Kanepuu	690	4.44	3.04	2.65	1.58	1.31	1.24	0.71	0.87	1.05	1.81	2.51	3.21	23.32
Kaumalapau Harbor	658	2.02	2.42	1.46	1.41	1.34	1.1	1.01	0.89	1.01	1.47	2.14	2.6	10.71
Lana`i Airport	656	2.85	2.16	1.24	0.9	0.83	0.78	0.55	0.5	0.76	1.29	2.22	3.25	15.86
Lana`i City	672	5.24	3.81	2.73	2.53	2.12	1.63	1.64	1.42	1.99	2.45	3.39	4.16	33.83
Lanai`hale	684	5.62	4.5	3.82	2.42	2.46	1.84	1.57	1.97	2.17	2.78	4.2	3.03	41.65
Mahana	694	4.51	3.29	2.65	1.27	1.19	0.79	0.44	0.42	0.82	1.71	2.74	3.06	20.69
Malauea	676	3.16	2.34	1.56	0.98	0.5	0.45	0.27	0.18	0.81	1.1	1.98	2.73	14.16
Waiakeakua	685	3.66	3.31	2.17	1.81	1.28	0.73	0.49	0.41	1.08	1.61	2.02	3.39	21.22

Source: School of Ocean & Earth Science & Technology http://www.soest.hawaii.edu/MET/Hsco/upt/ppt/ppt4.html Unit: Inches

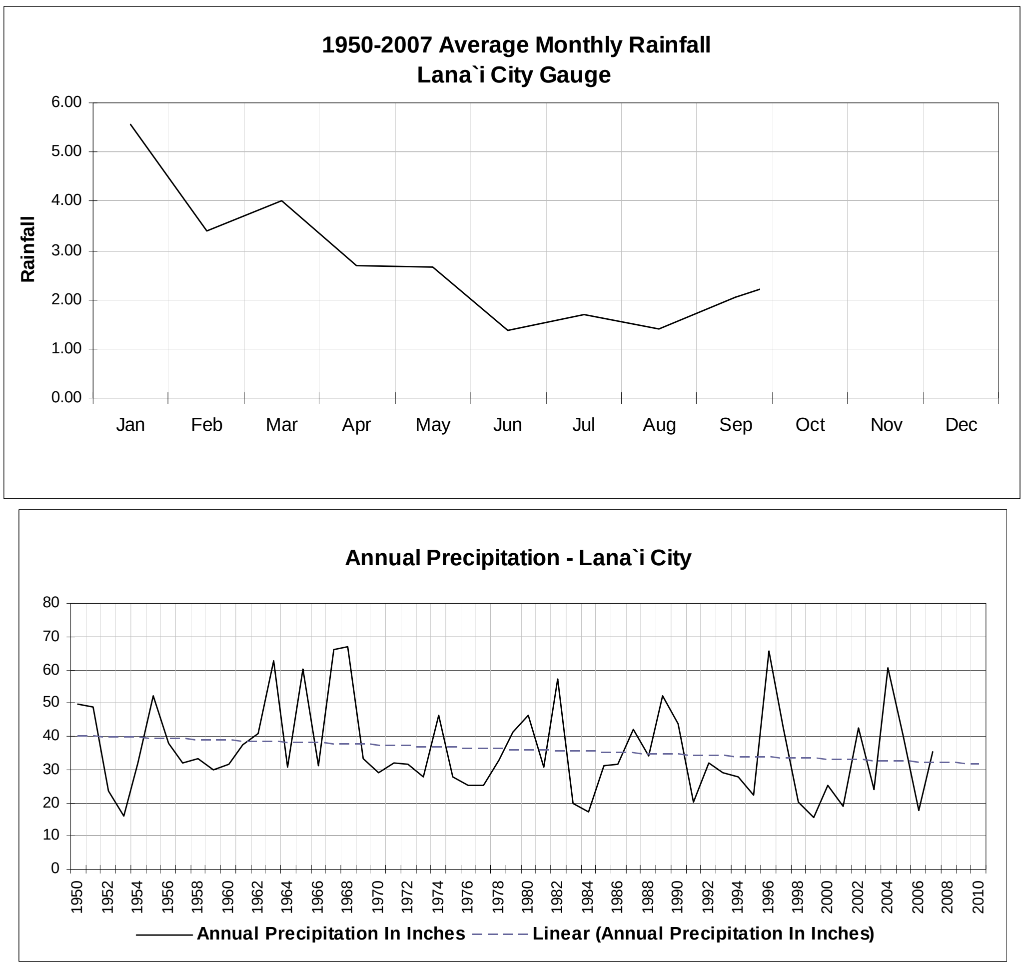
* note annual numbers do not match totals due to method of handling missing data days - totals given are those reported by SOEST

Most sources estimate that rainfall on Lana`i averages less than ten inches per year along the coast, (generally 6 to 8 inches), and thirty-five to forty (35-40) inches at the summit along the main ridge from Lana'ihale to Koele. Much of this rainfall comes from orographic lifting of the northeasterly trades over the central ridge.

Fog-drip is also a major contributor to recharge on Lana'i. The island experiences frequent cloud cover above the 2,000 to 2,500 foot range. Despite the relatively low rainfall, a 1967 state Land Bureau study investigating soils and vegetation on Lana'ihale concluded that they were more typical of an area receiving 60" per year than the 35" - 40" that actually fall on the summit. This seeming anomaly was attributed to the importance of fog drip from the watershed. (Mirabayashi, Ching, Kuwahara, Fujimura, Awai & Baker, *Detailed Land Classification - Island of Lana'i*, Bulletin No. 8, Land Study Bureau, 1967).

A 1964 paper by Paul Ekern reached a similar conclusion about the importance of fog drip. Ekern monitored a network of rain gauges beneath a Norfolk Island Pine tree and compared rainfall in these gauges to that collected by a network in the open for three years. (*"Direct Interception of Cloud Water on Lana'ihale, Hawaii"*, Ekern, Paul C., Soil Physicist, Pineapple Research Institute of Hawaii, Honolulu, Soil Science Society of America Journal, Wisoncsin, © 1964, & Technical Paper No. 294 of the Pineapple Research Institute of Hawaii, Honolulu.) More recent studies have borne out such statements about fog drip. The 2009 Lana‘i Fog Drip Study, by Pacific Environmental Planning, found that precipitation caused by fog drip and through-fall under Cook Pines was substantially higher than estimated in 1964, possibly due to the increased stature of the trees, and substantially higher than precipitation from rainfall alone.

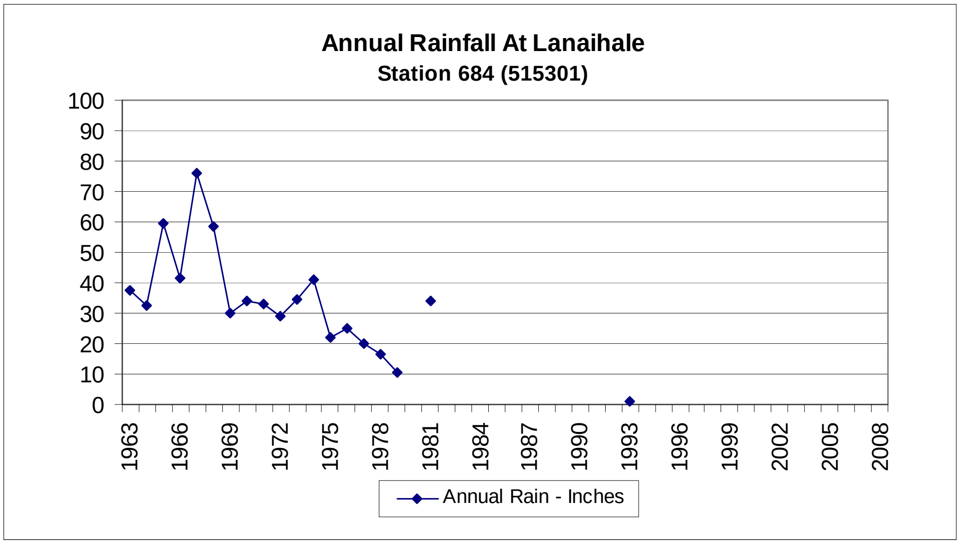
FIGURE 3-15. Monthly and Annual Precipitation - Lana‘i City



Being in the rain-shadow of Maui, Lana‘i’s seasonal variation is somewhat more subtle than other islands, but there is still a notable seasonal pattern as shown in Figure 3-15.

Data from the Western Regional Climate Center for Lana‘i City and Lana‘ihale are plotted above and below, respectively. (Source: http://www.wrcc.dri.edu/cgi-bin/cliMONtpre.pl?hi5301). Lana‘i City plots seem to reveal a slight declining trend, though data from both this and the Lana‘ihale gauge plotted below are inadequate to say whether such trends reach the level of statistical significance.

FIGURE 3-16. Rainfall at Lana'ihale Source:Western Regional Climate Center Source: http://www.wrcc.dri.edu/cgi-bin/cliMONtpre.pl?hi5301 Note: Although measurements at the rain gauge continued until 2004, there isan inadequate number of measured rain daysreported on the web to accurately plot this data.



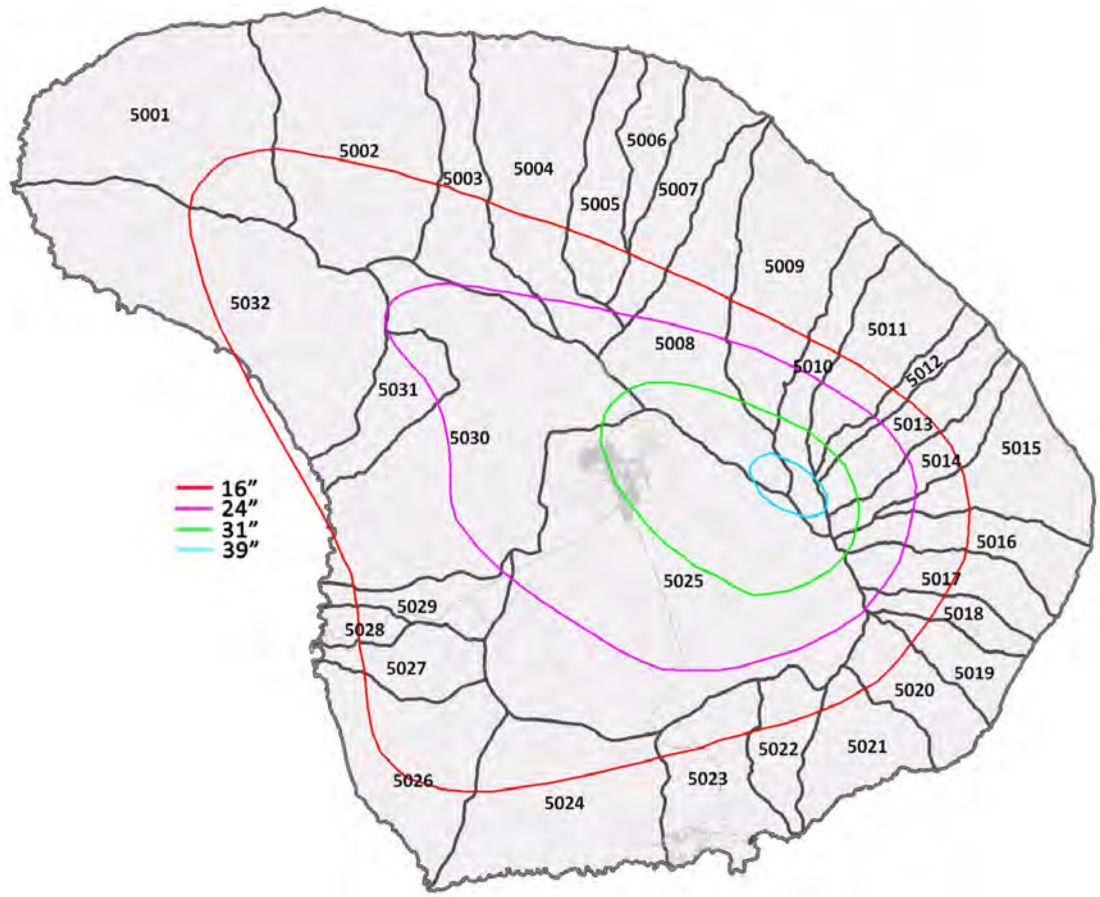
Surface Water Hydrologic Units

The 2008 update of the State Water Resources Protection Plan divides Lana'i into 32 hydrologic units, shown below. Despite having units identified, no stream flows, stream flow standards, diversions or gauges are present on Lana'i.

FIGURE 3-17. Lana'i's Surface Water Hydrologic Units

Unit	Name	Unit	Name
5001	Puumaiekahi	5017	Awehi
5002	Lapaiki	5018	Kapua
5003	Hawaiilanui	5019	Naha
5004	Kahua	5020	Kapoho
5005	Kuahua	5021	Kawaiu
5006	Poaiwa	5022	Mahanalua
5007	Halulu	5023	Manele
5008	Maunalei	5024	Anapuka
5009	Whane	5025	Palawai Basin
5010	Hauola	5026	Ulaula
5011	Nahoko	5027	Kaumalapau
5012	Kaa	5028	Kalamanui
5013	Haua	5029	Kalamaiki
5014	Waiopa	5030	Paliamano
5015	Kahea	5031	Honopu
5016	Lopa	5032	Kaapahu

FIGURE 3-18. Lana‘i Surface Water Hydrologic Units with Isohyets Source: State Commission on Water Resource Management



The only perennial stream known to have existed on Lana‘i originated in the upper reaches of Maunalei gulch where it is deeply incised into the dike complex of the northwest rift. This flow was diverted by the Maunalei tunnels. (Source: Keith Anderson, “*Water Supply Investigation: Island of Lana‘i, Hawaii*”, prepared for Hawaiian Pineapple Co., Ltd., and including a summary of Lana‘i Water Development from a 1954 report by V. W. Thalman).

At one time there were also various seeps and springs at Kaiholena, Waipa‘a and Waiakeakua, Kaohai and Paliakoa‘e Gulch. There are historical accounts of growing rice in a kuleana using the watercourse from Paliakoa‘e, and even of a deep water hole. (George C. Munro, *The Story of Lana‘i*, Honolulu, 2006).

Historical Water Resources

Historical and anecdotal evidence suggest that Lana‘i once had more available water than it has now. Maunalei Stream was once perennial, running to the ocean. It supported taro lo`i in the upper reaches of that ahupua‘a until the late 1800s. During the late 1800s taro production was discontinued because goats had so denuded the cliffs above that work in the lo‘i had become hazardous. The stream stopped running with the development of Maunalei Tunnels in 1940, but even before that time it had stopped running all the way to the ocean.

John Lydgate, in his memoirs of botanizing on Lana‘i with W.F. Hillebrand and W.M. Gibson, noted a small pond, the size of a dining table, that was always full of water regardless of the weather. Stearns (1940) mentioned two seeps upstream of Waipaa tunnel. Munro, in *The Story of Lana‘i*, (2006, Honolulu), notes a water course at Paliakoa‘e Gulch, and mentions a 5 acre kuleana growing rice with that water. He also notes seeps and springs at Kaiholena, Waipa‘a, Waiakeakua and Kaohai.

Kenneth P. Emory, in *"The Island of Lana‘i; A Survey of Native Culture"; (Bernice P. Bishop Museum Bulletin 12; Honolulu, Hawaii 1969)* not only notes the historical cultivation of taro, but provides maps of historic sites which give the location of a number of springs (at least nine), and other water-related features.

Emory created a map of historical houses and heiau, which is presented in Figure 3-19. Note the number of dots, indicating home sites, near to the shore. Such settlements would not have been located at unreasonable walking distances from water. The presence of home sites, as well as several historical dug-wells seems to indicate the likelihood that water along the coast was once fresher, and that water may generally have been more readily available at one time. This is supported by various historical accounts that refer to Lana‘i as a place with abundant water.

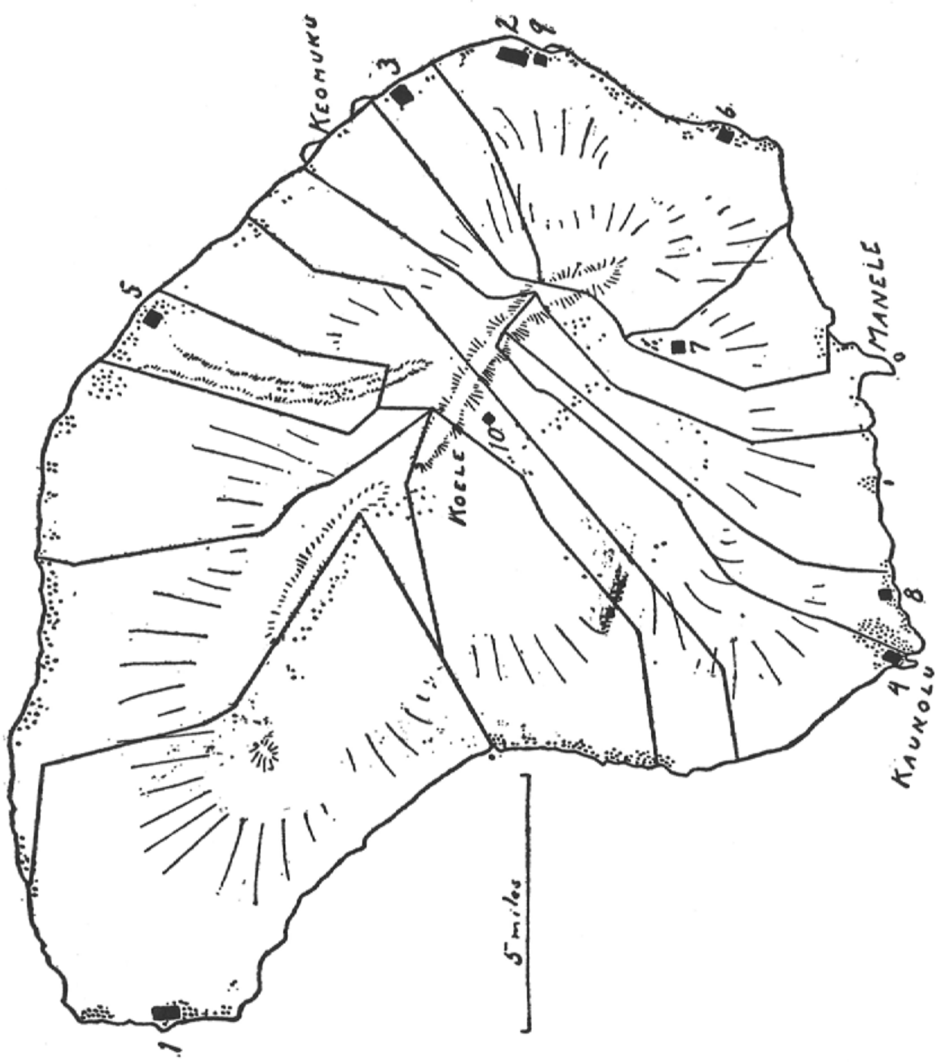
Emory also developed a gazetteer of Lana‘i place names, providing translation from Hawaiian to English and mapping the location of these places. Place names are provided on the map in Figure 3-20. An 11x17 version of this map is also available on the web in the 11x17 pdf section. A list of those place names which seem to refer to water or water-related conditions (such as taro growing) is provided in Figure 3-21. These names are numbered, and can also be located on the map in Figure 3-20. Such names as "Water of the God", "Glistening Water", "Column of Rain" lead one to infer that water was indeed more plentiful at one time. Some of the higher elevation places specifically denoted as springs are shown in Figure 3-22.

A review of the map in Figure 3-22 will prompt one to note that many of the developed wells on Lana‘i are sited at or near of some of these historical water features. The loss of these water features could stem from several factors, including water development, diminished forest cover causing decreased recharge, climate change, cracks in confining rock barriers allowing water to seep out, or various combinations of such factors. Bowles (1974) and Hardy (1996) both noted that a significant portion of drawdown observed in Lana‘i wells may be attributed to changes in the forest cover in the cloudy regions above 2,000’. With regard to Maunalei, V.W. Thalman noted in his 1954 report to the company, "...this flow is now diverted by tunnels and provides part of the domestic water supply for Lana‘i City."

More recently, data from USGS, Tom Giambelluca and others indicate a thinning of the inversion layer and decreases in stream flow and in overall precipitation, affecting all Hawaiian islands, including Lana‘i.

Additional historical data on water is found in the source water protection chapter of this plan, in the table entitled, *A Chronology of Land Use, Conservation and Water in Lana‘i.*

FIGURE 3-19. Settlement on Lana'i - Heiau and House Sites; Source: Emory, K.P.; *The Island of Lana'i: A Survey of Native Culture*; Bishop Museum Bulletin 12; Honolulu, 1969



Map of Lanai. Dots represent visible house sites; rectangles represent heiaus. Figures give the order of the heiaus according to size.

FIGURE 3-20. Map of Lana'i Showing Place Names. Source: Kenneth P. Emory, *The Island of Lana'i; A Survey of Native Culture*, Bishop Museum Bulletin 12; Honolulu; 1969

Note: This figure is also provided as an 11x17 exhibit in the large exhibits file.

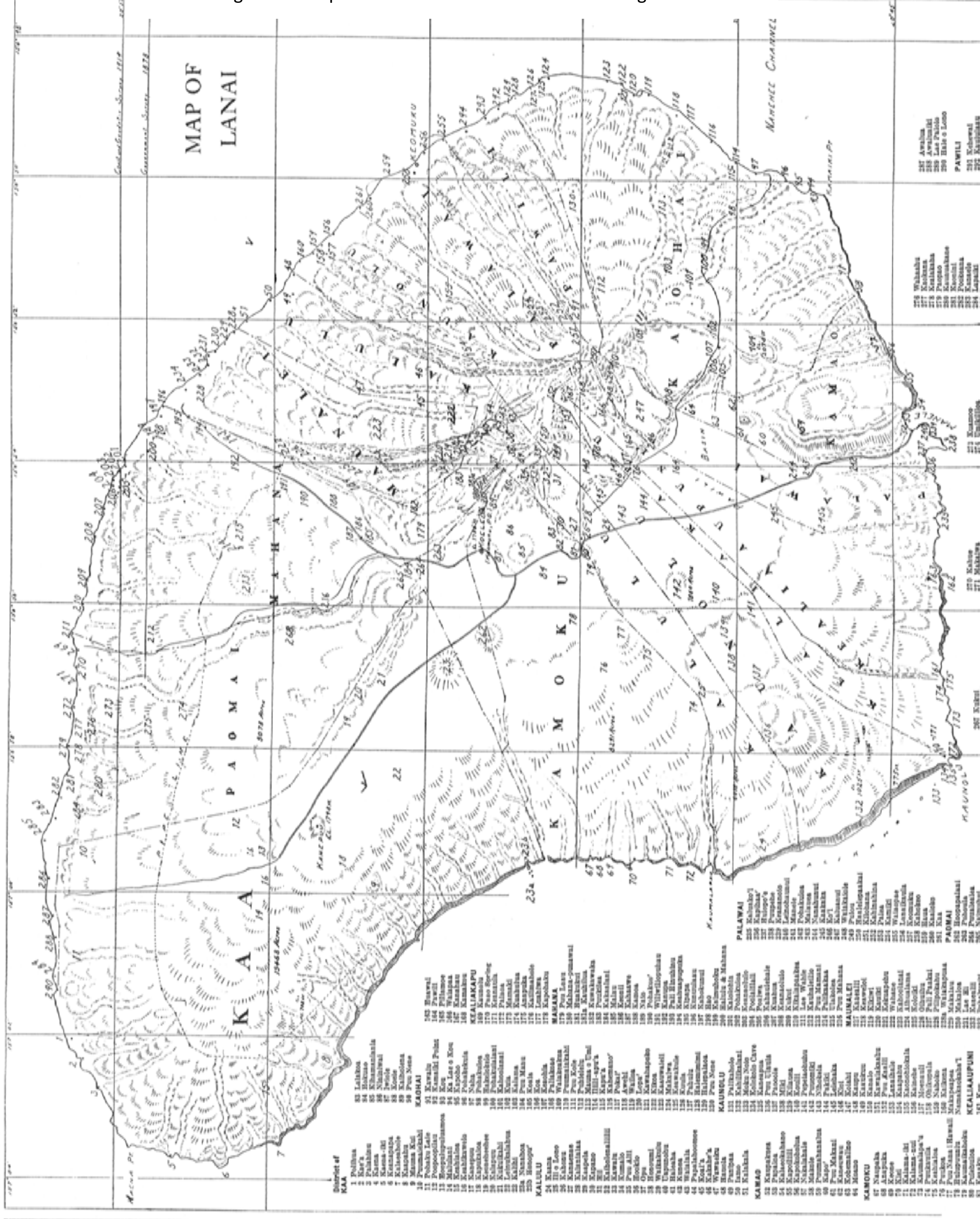


FIGURE 3-21. Water Place Names in Lana'i From Gazetteer of Lana'i in Emory, K.P.; *The Island of Lana'i, A Survey of Native Culture*; Bishop Museum Bulletin 12, Honolulu 1969 **-** *Springs or flowing water highlighted in cyan*

Partial List Lana`i Place Names Related to Water

Name	Meaning
Ai-lau	Leaf eating. Taro land in Maunalei, near Kaaealii, according to Namilimili.
Ana-iki	Little cave. Taro land in Maunalei (26a).
Awa-lua	Deep harbor (descriptive). Bay. 287.
Awa-lua-iki	Lesser Awalua (descriptive). Bay. 288.
Hale-aha	Assembly house (once descriptive). Taro land. Head of water tunnel. 41.
Hale O Lono	House of Lono (once descriptive?) Bay. A house of worship to Lono was a common form of heiau. 290.
Hauola	Healing water (descriptive?) Valley mouth. 48.
Hono-umi	Collecting place of Umi, ten stitches. Section of valley. Upper end of Maunalei Valley, against precipice. 38
Hono-wae	Bay. 286
Hua-wai	Water gourd. Bay. 163.
Hulopo'e	Name of a man (personal). Bay. Hulopo'e lived here. 237.
Iamo	A leap feet first into water. Beach. 50.
Ka'a-loko	Pond of Ka'a (descriptive). Bay, fish-pond. 260.
Kaa-pela	Rolling over soft grass (once descriptive). Plateau land. Site of a school house; old name of place close by is Mauipapahu. 29.
Ka-auwai-eli	The dug water course (once descriptive). Small valley mouth. 123.
Kahe'a	Fishing in shallow water (once descriptive?). Beach. 294.
Kahe-mano	Place where sharks habitually run (descriptive). Beach 294.
Ka-hili-ka-lani	Brushing the heavens (descriptive). Cliff. Highest point of Palikaholo and the slope of Kaumalapa'u. 132.
Ka-hoku-nui	The large star (once descriptive?). Beach. A meteor once fell nearby. 197.
Ka-hue	The gourd (once descriptive?). Bay. 270.
Kai-kena	Rustling sea (descriptive). Beach. 160.
Ka-imu-hoku	The star oven (descriptive). Beach. A pit in the sand where a meteor fell. 199.
Kai-nehe	Murmuring sea (descriptive). Beach. 156.
Kai-olohia	Choppy sea (descriptive). Bay. 201.
Kalua-ko'I	The adz pit (descriptive?). Bay. 235.
Kamakou	Lamp with red flame (Andrews), young kou grove (Thrum). Spring. Location approximate. 168
Kanahau	Disagreeable, cold. (descriptive). Spring. Gulch just south of Captain Soule's place. 167.
Ka-piha'a	The driftwood (descriptive). Bay. 236.
Ka-uhi-lua	The double veil (descriptive of rain). Taro land. 181a.
Kau-iki	The small portions (descriptive). Section of valley. This site now marked by a pump. 220.
Ka-ulu-laau	Name of the hero who killed the goblins of Lana'i (legendary). Beach. (See page 13 for story). 292.
Kau-mala-pa-u	Bay. The Kekoewa family say this name should be Kamuela-pa'u; but Mrs. Awili Shaw says that her parents and grandparents called the place Kau-molo-pa'u. None of these names can be translated with any meaning. 73.

FIGURE 3-21. Water Place Names in Lana'i From Gazetteer of Lana'i in Emory, K.P.; *The Island of Lana'i, A Survey of Native Culture*; Bishop Museum Bulletin 12, Honolulu 1969 **-** *Springs or flowing water highlighted in cyan*

Kau-no-lu	To give property on a wager secretly, the akua of Molokai. Bay and district. In this word every vowel is accepted equally. Incorrectly given as Kaunalu and Kaonolu. 169.
Ka-wai-a-ka-ahu	Water of Kaahu. Spring. 151.
Ka-walu	The milk. Valley. 33.
Ka-walu	The milk. Valley mouth. 91.
Ke-ana-puka	The arch (descriptive). A sea cave. In his story of Puupehe, W. M. Gibson calls this cave Malauea. 201.
Ke-awa-kule	The bay of the kule fish (descriptive). Bay. 125.
Ke-awe-loi	Keawe making fun. Section of valley. Site of an old pump station. 218.
Kehe-wai	Rivulet (Mrs. Lahilahi Webb). Ridge. Ridge ending at Waiopae. 291.
Ke-kua-pehu	The swelling god. Small valley. 221.
Keone	The sand (descriptive ?). Bay. A little sand here. 69.
Ke-ono-hau	The six hau (trees). Small bay. 269.
Kiei	High. Bay. 70.
Kikiwi	Bending down (descriptive). Taro land. Kiki (26a).219.
Koa	Koa tree (descriptive). Plateau lands. Area covered by koa forest. 106.
Koai'a	A variety of koa tree (descriptive). Valley. Koai'a forest formerly at this place. 45.
Koai'a	A variety of koa tree (descriptive). Valley. Koai'a forest formerly at this place. 105.
Koele	Place seized by a chief (descriptive?). Village. Koele means also dry, but this is not a dry place. 88.
Kolo-kolo	Loud rumbling (descriptive). Sea cave. Freshwater is supposed to be obtainable here. 134.
Lae Hi	Flowing point (descriptive). Point. A point composed of limestone. 231.
Lana'i-hale	House hump (descriptive metaphor). Highest point on Lana'i and spring. Name of spring is Nanaihale. (See 19, p 516). 153.
Mahana-punawai	Spring of Mahana (descriptive). Spring. 181.
Malu-lani	Heavenly shade (legendary). Blend in ridge. Malulani, sister of Pele and Hi'iaka dwelt here. 14.
Mamaki	Name of bush from which mamaki tapa was made. Old village site on coast. 173.
Mauna-lei	Wreath mountain (borrowed?). Village. From name of valley. 234.
Moena-uli	Blue mat. Beach. 157
Paao	The Kahuna, Paao (legendary). Well, tapu to women. 170. aka Paao Spring.
Pahulu	When the goblin Pahulu was killed by Kaululaau (legendary). Well. Rock lined well now in use. 127.
Pali-hinuhinu	Shining as if anointed with oil (descriptive). Cliff. 193
Po-kai-I	Name of a celebrity from Kahiki (Thrum) (legendary?). Old village site. Name of a land section on Oahu. 117.
Pookeana	Beach. 282.
Poo-lali-lali	Greasy head. Beach. 204.
Pulou	Covered out of sight (descriptive). Spring. Makakehau, lover of the girl, Puupehe, was killed here. 249.
Puu-kilea	Hummock hill (descriptive). Hill. Incorrectly given on government map as Puu Kukai. 183.
Puu-maia-kahi	Hill of dropping bananas (descriptive). Hill. Very prominent crater cone. Gibson, in story of Puupehe, refers to banana groves of Waiakeakua which is below this hill. 110.

FIGURE 3-21. Water Place Names in Lana‘i From Gazetteer of Lana‘i in Emory, K.P.; *The Island of Lana‘i, A Survey of Native Culture*; Bishop Museum Bulletin 12, Honolulu 1969 **-** *Springs or flowing water highlighted in cyan*

Puu Nene	Goose hill (once descriptive). Hill. Feeding ground for geese. 90.
Puu Nene	Goose hill (once descriptive). Hill. Feeding ground for geese. 130.
Ua-punohu	Column of rain (descriptive). Section of valley. 40.
Wai-a-hoo-lai	Calm waters, or water of Hoolai. Beach. 293
Wai-a-ka-pua'a	Pig water. Valley mouth. 228a.
Wai-a-ke-akua	Water of the god (descriptive). Spring. There is another Waiakeakua in Waipaa gulch. 109.
Wai-a-ka-iole	Rat water. Valley. 248.
Wai-alala	Water of Lala, or glistening water (descriptive). Valley. Large tributory gulch to Maunalei on the east. Not Waialala, as given in Andrews Dictionary. 43.
Wai-a-opae	Shrimp polluting waters (Thrum) (descriptive). Valley mouth. 166.
Wai-a-paa	Held water (descriptive?). Valley. 166.
Wai-ka-kulu	Tumbling waters (descriptive). Valley. 39.
Wailoa	Long water (descriptive?). Beach. 119
Wai-lehua	Lehua water. Beach. A landing place on the north shore of Lana‘i(19, p. 424)
Wawae-ku	Foot print (Thrum) (descriptive of shape). Hill. 47.
Wili-wili-opu-hau	Grunting of a horse (descriptive). Section of a ridge. At the water trough. A recent name. 191.

FIGURE 3-22. Historical Springs of Lana'i Source: A Survey of Native Culture, Bishop Museum Bulletin 12, Honolulu, 1969 - *Not all of the springs noted in this reference are plotted here. Some are beyond the extent of this map.*

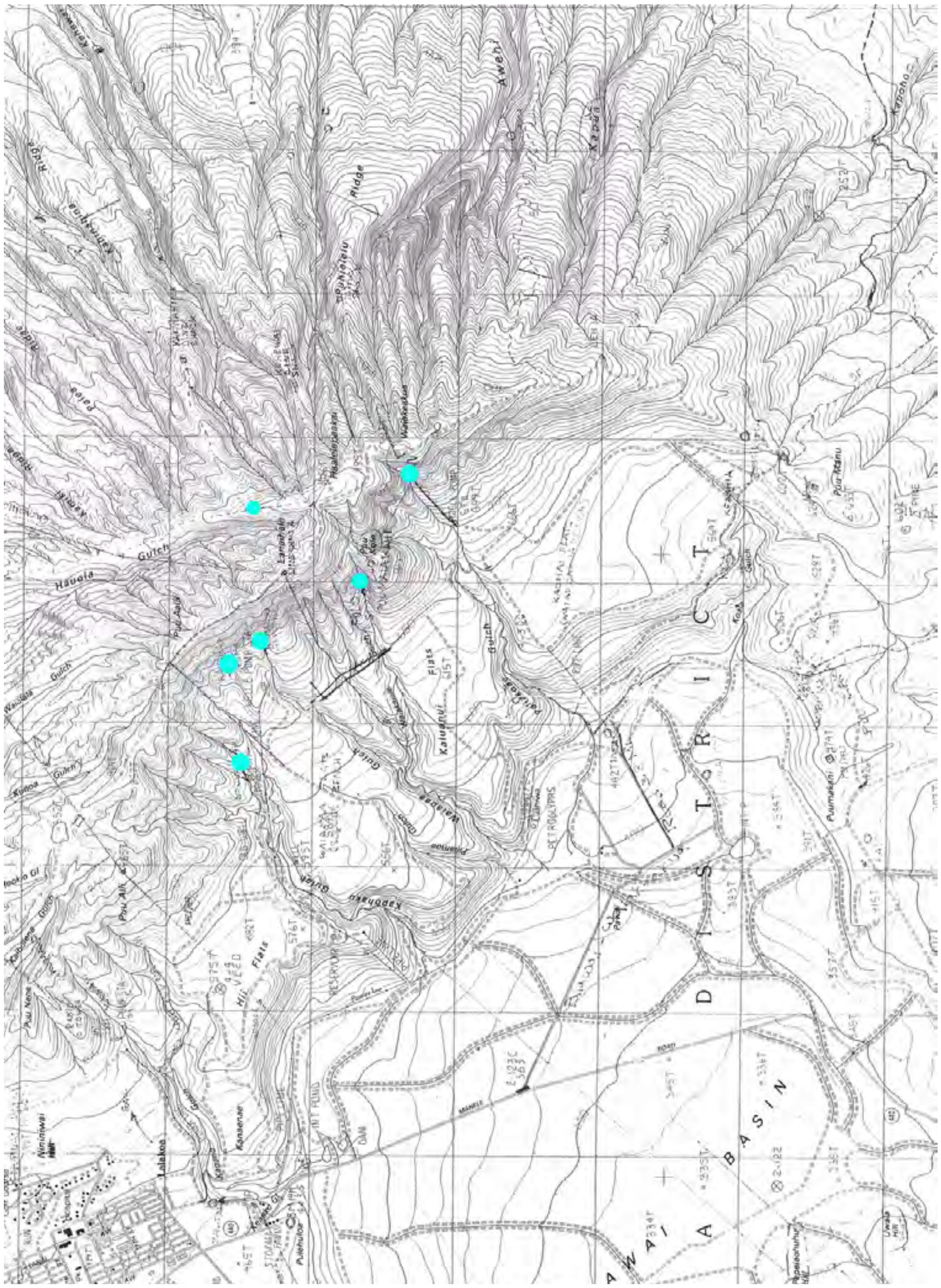
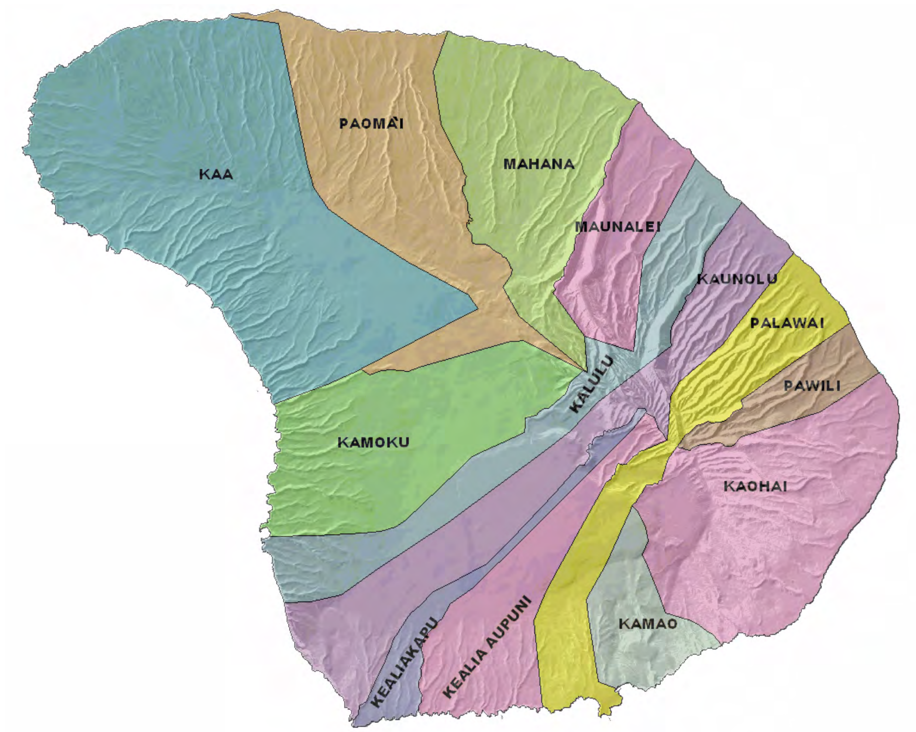


FIGURE 3-23. Ahupua'a of Lana'i - Source: Robert Hobdy



Ahupua'a

The thirteen ahupua'a that make up the island of Lana'i have been described in detail, with comments on place name meanings and traditional uses, in "*The Island of Lana'i: A Survey of Native Culture*" (K.P. Emory, 1924); "The Story of Lana'i" (G.C. Munro, 2007); and "E 'Ike Hou Ia Lana'i: To Know Lana'i Once Again: A Historical Reference and Guide to the Island of Lana'i" (Lana'i Culture & Heritage Center, 2008). The following notes from Kumu Pono Associates summarize their descriptions: (Source: *Kumu Pono Associates LLC, 2008)*

Ka'a (literally, the Rocky area): Ka'a is the largest ahupua'a on Lana'i, comprising some 19,468 acres. It makes up the entire northern end of the island, and hosted many near-shore settlements, from which the rich fisheries were accessed-the turtles of Polihua, once being an important resource of traditional subsistence. In addition to village sites, the near shore lands also hosted many ceremonial sites, including the largest heiau on the island. Near shore springs provided residents with water supplies, and in the uplands, the dry forest zone of the Keahiakawelo-Kanepu'u region supported an extensive dry land agricultural system. Keahiakawelo is one of the most significant storied landscapes on Lana'i, connected with traditions of how people were able to live on Lana'i, and why at one time, Lana'i was noted for purple colored lehua (Metrosideros) blossoms. During the Mahele, Chiefess Victoria Kamamalu, claimed and retained the ahupua'a of Ka'a. Uhu (parrot fish) was identified as the kapu fish, and koko (Euphorbia spp.), identified as the kapu tree. Four awarded kuleana claims were noted in Ka'a.

Kalulu (literally, The shelter): Containing 6,078 acres, Kalulu is one of three unique ahupua'a divisions on Lana'i. On the (kona) leeward side of the island, Kalulu is bounded by Kamoku on the north. It then runs across the island, passing the western banks of Palawai Basin, up the mountain, and then continues to the (ko'olau) windward coast, bounding Maunalei on the north. Along its southern boundary, on both the leeward and windward regions, Kalulu is bounded by Kaunolu Ahupua'a. The leeward and windward coasts of Kalulu take in two significant fisheries-one being a part of the deep sea fisheries of Kaholo (shared with Kaunolu), and the other being the near shore reef-lined fisheries of the windward coast. In the Palawai Basin and mountain lands were extensive agricultural fields, ranging from open kula lands noted for sweet potato plantings, to forest-sheltered dry land field systems. The forest resources included stands of koa and other native woods, and small valleys and gulches where water sources were found. Daniel I'i claimed Kalulu as his personal property during the Mahele, but relinquished it to the King, who retained it as a Crown land. He'e (octopus) was the kapu fish, and 'ahakea (Bobea) was the kapu wood. Seven awarded kulaena claims were noted in Kalulu.

Kama'o (literally, The ma'o (Gossypium tomentosum) plant): Kama'o Ahupua'a is a southerly facing land division, that is bounded by Palawai on the west and Ka'ohai on the east. Comprising 2,751 acres, Kama'o includes two-thirds of Manele Bay. This bay was the site of a major canoe landing-sandy beach, and was watered by springs, some of which were tapped by diving along the shore with gourds to catch water as it escaped from holes in the caprock. The village of Manele (shared between Palawai and Kama'o Ahupua'a) was a major complex on the coast, with residences, ceremonial sites and lowland agricultural features. In the uplands, native tenants also tended dry land crops, and a major nesting area of 'ua'u (petrels) occurred on the upper slopes which the natives tended, and from which they harvested birds as a source of protein. One of the noted mountain heiau on Lana'i and a major burial site also occur in the upper section of Kama'o. Three place names in Kama'o also bear the name "Kapo," a Hawaiian goddess. One site in the uplands, and two forming coves on the shore. The chief Kahanaumaika'i claimed Kama'o as a personal property, but relinquished it to the Government Land Inventory during the Mahele. He'e (octopus) was the kapu fish, and koko (Euphorbia spp.) was the kapu wood. Two awarded kuleana claims were noted in Kamaʻo.

Kamoku (literally, The district): Kamoku Ahupua'a contains 8,291 acres, and is situated on the kona (leeward) side of Lana'i. On the north, it is bounded by Ka'a Ahupua'a. On the south, it is bounded by Kalulu Ahupua'a. Kamoku was noted for its upland forest and springs, with areas developed into an extensive forested dry land agricultural system. Along the shore, its sheltered coves were developed into temporary and long-term residences, from which the rich fisheries fronting the ahupua'a were accessed. At the time of the Mahele, Pali was the Konohiki of Kamoku under the King, and the ahupua'a was retained as a Crown Land. Uhu (parrot fish) was the kapu fish, and koko (Euphorbia spp.) was the kapu wood. The important spring watered bay of Kaumalapa'u (an 'ili of Kamoku) was claimed by Oleloa, a woman of chiefly lineage, but relinquished to the government during the Mahele. One awarded kuleana claim was noted in Kamoku.

Ka'ohai (literally, The Sesbania tomentosa plant): Situated in the southeastern region of Lana'i, Ka'ohai contains 9,677 acres. The coastal zone hosted villages and rich fisheries, including fishponds. Springs were developed to supply water along the coast, and the upper valleys provided seasonal water sources. A major spring in the mountain lands also provide upland residents with water for personal use and agricultural purposes. In the years leading up to the Mahele, Chiefess Kekau'onohi claimed Ka'ohai as a personal land. But during the Mahele, Ka'ohai was claimed by Mataio Kekuana'oa, on behalf of his son, Moses Kekuaiwa. The award was confirmed and recorded by the King. He'e (octopus) was the kapu fish, and naio (Myoporum sandwicense) was the kapu wood. Kekuaiwa died prior to closure of the Mahele, and his father received the award in his name. Upon Kekuana'oa's death, Cheifess Ke'elikolani inherited the ahupua'a. Two awarded kuleana claims were noted in Ka‘ohai.

Kaunolu (meaning uncertain): Kaunolu Ahupua'a, like it's northern neighbor, Kalulu, spans both the kona and ko'olau regions of Lana'i. It contains 7,860 acres, and extends from the noted deep sea fishery of Kaholo, passes the steep sea cliffs of Pali Kaholo, crosses through the Palawai Basin, ascends the mountain to Pu'u Ali'i, one of the major peaks of Lana'i Hale, and then continues to the ocean on the windward shore. The leeward coast of Kaunolu hosts the major religious, political and social center of Lana'i, and was supplied by water sources in the Kaunolu-Kealia Kapu gulch. In the basin, a spring occurred at Pu'u o Miki, to which the gods resorted. Further inland, the bench lands and forest zone provided shelter for extensive residency and agricultural pursuits, while the deep valleys and mountain lands provided residents with springs and forest resources. Another of the major mountain heiau occurred in the leeward forest zone. On the windward side Kaunolu shared Hauola Gulch (in which water flowed seasonally), with Kalulu, and extended down to the shore where springs and rich reef-sheltered fisheries supported the native tenants. On its eastern, windward side, Kaunolu is bounded by Palawai Ahupua'a to the mountain peak of Lana'i Hale, where it joins with Kealia Aupuni, Kealia Kapu, and then continues down the mountain, through forest and basin, to the ocean. Kaunolu was originally claimed by Keali'iahonui, but relinquished to the Government Land inventory. No specific records documenting the kapu fish and wood were found for Kaunolu. Traditional accounts do celebrate the kawakawa fisheries of Kaholo, along with documentation of a wide range of other fishes known to the region. Thirteen awarded kuleana claims were noted in Kaunolu.

Kealia Aupuni (literally, The salt beds of the people/nation): This ahupua'a contains 4,679 acres. On its western side, it adjoins Kealia Kapu, and on its eastern side it is bounded by Palawai. It extends from the ocean to the mountain, taking in fisheries, open kula lands that were formerly cultivated, a portion of the basin, bench lands and mountain forest. Along the coast, each little gulch that forms a cove on the ocean is host to formal villages and temporary fishing camps which were used seasonally over the centuries. In the deep mountain gulches springs occurred, and both stone and forest resources were collected. At its summit, Kealia Aupuni meets Pu'u Ali'i and Lana'i Hale. Within the boundaries of Kealia Aupuni there also occurs a lele (an independent land division), which belongs to Pawili Ahupua'a (an ahupua'a found on the windward side of Lana'i). This lele provided residents of Pawili with fertile kula lands that supported dry land sweet potato cultivation. During the Mahele, Kealia Aupuni was relinquished by Kahanaumaika'i to the King, and in turn conveyed to the government inventory. Uhu (parrot fish) was the kapu fish, and koko (Euphorbia spp.) was the kapu wood.

Kealia Kapu (literally, The restricted salt beds): A small ahupua'a, containing 1,829 acres, situated on the kona side of Lana'i. Kealia Kapu is bounded on the west by Kaunolu, and on the east by Kealia Aupuni. Small villages occurred along the shore, where the adjoining western valley also hosted a spring. The kula lands of the basin were noted for sweet potato cultivation, and in the uplands mountain springs provided tenants with water for drinking and irrigation of crops. One point of traditional significance of Kealia Kapu is that it was reportedly the pu'uhonua (place of refuge) on Lana'i. In the uplands of Kealia Kapu a rain-making heiau is found, and a major petroglyph field also occurs. Uhu (parrot fish) was the kapu fish. No kapu wood was recorded by Ka'eo. During the Mahele, Kealia Kapu was claimed by and awarded to the chief, Ka'eo.

Mahana (literally, Warmth): Mahana Ahupua'a contains 7,973 acres, and makes up the central, northern section of the island. Extending from the reef-banked fisheries to the upland forests, Mahana is bounded by Maunalei on the east, and by Paoma'i on the west. Mahana was watered by a number of springs, seasonal streams and near-shore wells. Villages and areas of residence occurred along the coast, on the kula-middle lands and in the forest-mountain region. Ceremonial sites and other cultural features occur across the ahupua'a, and at one time it was host to an expansive dry land forest which was famed for its grove of purple-blossomed lehua trees (the latter of which was exterminated as a result of goat depredation). During the Mahele, Mahana was claimed by William C. Lunalilo, but was relinquished to the Government land inventory. The kapu fish was he'e (octopus), and the kapu wood was 'ahakea (Bobea). Six awarded kuleana claims were noted in Mahana.

Maunalei (literally, Mountain garland): Maunalei Ahupua'a holds the distinction of being the only land on Lana'i where a stream flowed year round. Deep in the upper valley and gorges, dense forest growth once captured rains from the clouds (thus the name, "Mountain garland," describing the cloud banks which nestled the mountain like a lei), and fed small streams that irrigated lo'i kalo (taro pond fields) into the late1800s. Maunalei contains 3,342.38 acres, and on its west side is bounded by Mahana Ahupua'a, while on the east and south sides, it is bounded by Kalulu. Native tenants lived upon and utilized most flat and gently sloping areas of Maunalei, with several major villages occurring along the coast, where springs were also found. Smaller settlements of single and extended families occurred in the uplands, and ceremonial sites occurred at various locations in the ahupua'a. Kamehameha I granted Maunalei to the foreigner, John Young, out of gratitude for service Young had provided him during his quest to unify the islands. In the settlement of John Young’s estate, Maunalei was given to his daughter, Pane (Fanny) Kekelaokalani. In the Mahele, the title of Maunalei was confirmed to Pane, and her kapu fish was he'e (octopus), the kapu tree was kukui (Aleurites moluccana). Pane Kekelaokalani bequeathed Maunalei to her daughter, Queen Emma Kaleleonalani, whose estate sold the ahupua'a to Walter M. Gibson in 1886. Although records note at least 71 claims to lo‘i kalo and one ‘auwai, only twelve awarded kuleana claims were noted in Maunalei.

Palawai (literally, Fresh water moss): The ahupua'a of Palawai is the third of three ahupua'a on Lana'i that spans both the kona (leeward) and ko'olau (windward) sides of the island. It contains 5,897 acres, hosted fisheries (including fish ponds), kula (dry land) agricultural field systems, forest resources, and numerous fresh water sources with springs and intermittent streams. In the near shore sections of Palawai, potable water sources were developed, and villages established all along the coast. On the leeward side, Palawai is bounded by Kealia Aupuni on the west, and by Kama'o on the east. At the mountain top, Palawai shares the highest peak, Lana'i Hale (site of a traditional spring), as a boundary point, and adjoins Kaunolu and Pawili, from the mountain to the windward coast. The basin region of Palawai Ahupua'a was also the site of the first foreign settlement on Lana'i in 1854, in the form of the original Mormon colony in Hawai'i. During the Mahele, Palawai was awarded to Chiefess Kekauonohi, and later inherited by her husband, Ha'alelea. The kapu fish was anae (mullet) and the kapu wood was 'ahakea (Bobea). Seven awarded kuleana claims were noted in Palawai.

Paoma'i (literally, Sick Pao): Paoma'i, situated in the northern region of Lana'i, contains 9,078 acres, and is bounded by Mahana on the east, and Ka'a on the west. The ahupua'a extends from the reef-lined fisheries, across the kula lands, and into the forest region. Major villages occurred along the coast, where access to fisheries, and near shore water sources sustained the people. On the kula lands a significant portion of the Lana'i dry forest occurred, and gulches hosted potable water that could be collected seasonally. In the uplands, the forest cover supplied people with access to necessary resources for daily life, and sheltered cultivated of crops. Several places in the uplands of Paoma'i were noted as gathering places for chiefly and community events. At the outset of the Mahele, Paoma'i was identified as belonging to the King, though Charles Kana'ina made a claim for the ahupua'a on behalf of his son, William C. Lunalilo. The kapu fish was he'e (octopus), and the kapu wood was 'aiea (Nothocestrum). At the close of the Mahele, no specific title was listed for Paoma'i, but it later appeared in the Government land inventory, and was sold as a Royal Patent Grant.

Pawili (literally, Strike and twist, as of the wind): The ahupua'a of Pawili (also written Paawili), is on the eastern (windward) side of Lana'i, and contains 1,930 acres. Pawili extends from the ocean to the mountain, where it meets Ha'alele Pa'akai, the second highest peak on Lana'i. Pawili is bounded on the south by Ka'ohai, and on the north by Palawai Ahupua'a. It also contains the only formal "Lele" (a detached land division, taking up a portion of another ahupua'a) recorded on the island of Lana'i. The lele of Pawili is situated in the ahupua'a of Kealia Aupuni, and afforded the people of Pawili with fertile lands in the Palawai Basin for the cultivation of crops like sweet potatoes. Along the coast of Pawili, which included an important reef-sheltered fishery, there occurred several villages, one of the major heiau on the island, and other ceremonial sites. Springs and wells were developed in the coastal region, and the deep valleys at the back of Pawili provided seasonal water sources as well. During the Mahele, William C. Lunalilo claimed Pawili, but relinquished it to the Government land inventory. No record of a kapu fish or wood was found in the historical documents. One awarded kuleana claim is noted in Pawili.

The total land area of these thirteen ahupuaa is 88,853.38 acres.

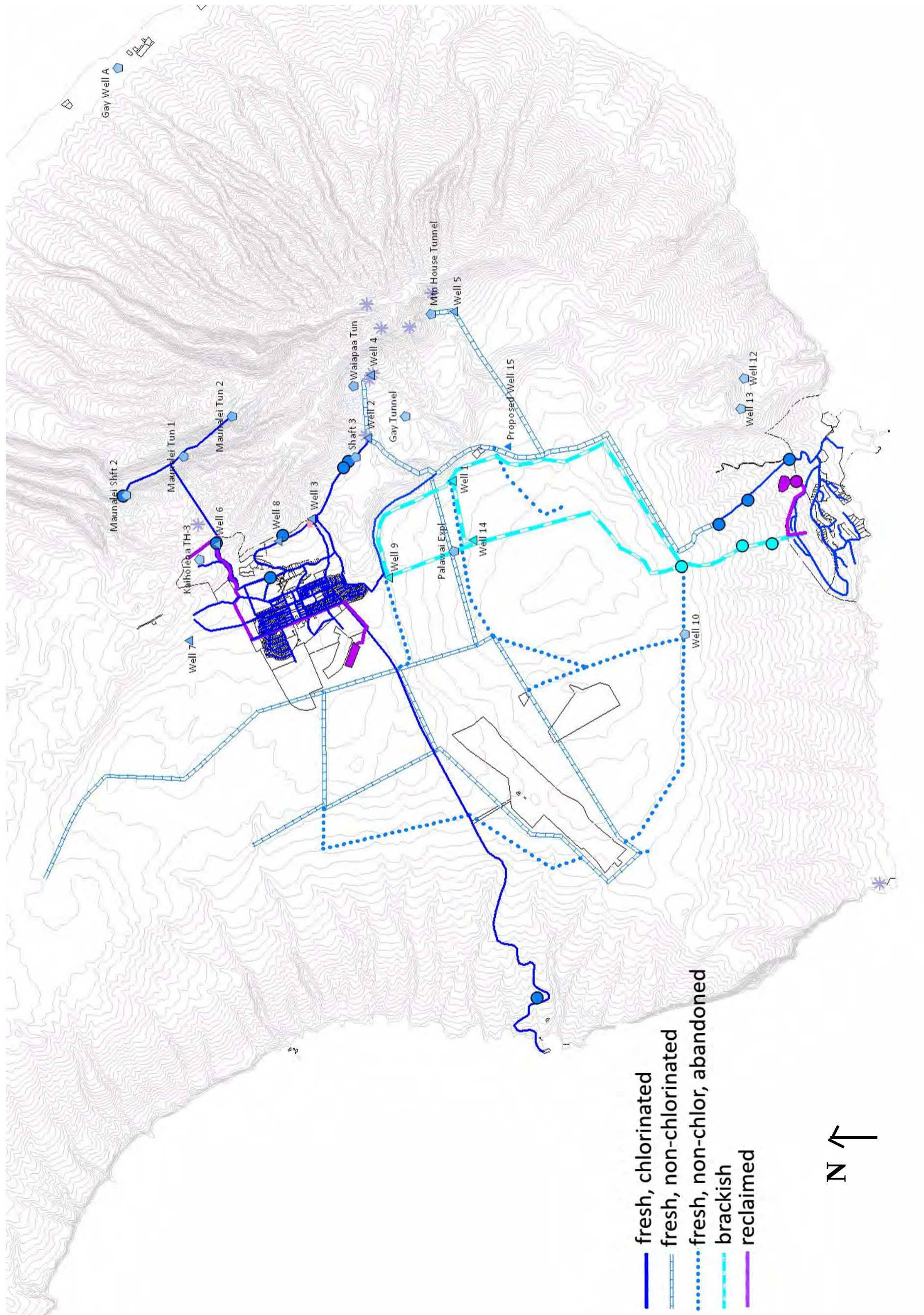
Water Systems

Lana‘i has five water systems. Two potable water systems, Lana‘i City to Kaumalapau (PWS 237) and Manele, Hulopo‘e and the Palawai Irrigation Grid (PWS 238), are regulated both by the State Department of Health under the Safe Drinking Water Act, and by the Public Utilities Commission (PUC). Potable water rates for these systems have not been updated since June of 1996. Shortly before finalization of this draft, in July of 2009, the Lana‘i Water Company received an Amendment to its Certificate of Public Convenience and Necessity, pursuant to §269-7.5 HRS, to provide non-potable water service in Manele-Hulopo‘e, as well as to set rates, rules and regulations. There are also two reclaimed water systems. One, Manele Water Resources, LLC, obtained a Certificate of Public Necessity and Convenience from the PUC to deliver reclaimed water for irrigation in the Manele-Hulopo‘e area, and was able to set rates in March of 2007. The other remains non-regulated and serves only the Koele Golf course. In addition to these five systems, “Lana‘i Holdings, Inc.” (LHI) is a private, non-regulated water company which consists of the potable and brackish sources serving these utilities, as well as Castle & Cooke designated uses on any of the above systems. The potable and brackish systems are wholly owned subsidiaries of LHI.

The following schematic, Figure 3-24, shows the approximate alignment of pipes, tanks and wells of the Lana‘i water systems.

Water Systems

FIGURE 3-24. Schematic Layout of Lana'i Water Systems. Blue is Potable, Aqua is Brackish, Purple is Reclaimed



Notes: This figure is also provided as an 11x17 exhibit in the large exhibits file. Since completion of the review draft in October, 2009, the chlorination point for Manele & the Palawai Irrigation Grid has been moved from Breaker #1 up to the Hi'i Tank site.

The five water systems on Lana'i collectively serve about 1,573 meters. Water rates for the potable systems are $1.10 for the first 25,000 gallons, and $1.62 thereafter. Water rates for the brackish system are $3.57 for the first 1,000 gallons per day, $4.64 for 1,000 to 2,500 gallons per day, and $5.72 above 2,500 gallons per day. Sewer rates are charged by unit, at a rate of $56.74 per single family, $42.21 per multi-family, and $92.12 per hotel unit. Non-food commercial customers are charged $9.98 per 1,000 gallons, while those that serve food are charged $10.07. The Harbor is charged $10.05 per thousand gallons.

Key system facilities issues include: the need for backup sources to meet reliability criteria and distribute withdrawals; the age and condition of the system; leaks and high pressures in certain areas - especially the irrigation grid; frequent loss of service in the MECO/Miki Basin area; the need for improved monitoring and maintenance; and the small customer base to support the necessary improvements and replacements.

Source capacity of each system is listed in Figure 3-25 below, and in more detail in Figure 3-26. System Standards require that sources be able to meet maximum day demand with an operating time of 16 hours simultaneously with maximum fire flow required independent of the reservoir, assuming the largest pump is down. The standby unit may be used to determine the total flow required. The system should also be able to provide for maximum day demand while simultaneously providing water for a two hour fire for the highest zoning density served, with credit given for 3/4 of reservoir storage.

Maximum day demand is defined as 1.5 times average day demand. The standard means that there should be sufficient source capacity to meet one and a half times average demand plus fire, essentially with 2/3 installed capacity. So, in order to meet system standards, about 2.25 times average day demand in source must be installed. Stated another way, about 44% of the full installed capacity, less the largest unit, should meet or exceed average day demand. With Well 3 down, Lana'i City fell short of pump capacity standards by 256,113 GPD in 2008. However, with the 2 MG tank, there was adequate fire protection.

FIGURE 3-25. System Capacities

System Area	Installed Capacity	2/3 Installed Capacity	Avg Day Metered Demand 2008	Max Day Demand 2008
Koele, City , K'pau Potable	2,016,000	1,344,000	522,742	784,113
Less Largest Pump	792,000	**528,000**	522,742	**784,113**
Manele Potable w/Well 2/Shaft 3	3,024,000	2,016,000	375,146	562,719
Less Largest Pump	1,296,000	**864,000**	375,146	**562,719**
Manele Brackish golf course & landscape	1,353,600	902,400	760,357	1,140,536
Less Largest Pump**	864,000	576,000	760,357	1,140,536** (N/A)

** The system standard which requires meeting maximum day demand in 16 hours pumping with the largest pump out only applies to potable systems, or systems serving livestock, and so would not apply to Manele brackish irrigation. The information is included here only to indicate the potential irrigation shortfall if a pump went out.

FIGURE 3-26. Source Capacities By District and Island-wide

Installed and Standard Source Capacities By District

Lana`i City, Koele & Kaumalapau		**Manele, Hulopo`e, Palawai, Irrigation Grid**		**Brackish - Manele, Irrigation Grid, Others**	
Source	**GPM**	**Source**	**GPM**	**Source**	**GPM**
Well 6	550	Well 2/ Shaft 3*	1,200	Well 1	340
Well 7	NIU	Well 3**	"550/OOS	Well 9	300
Well 8	850	Well 4	900	Well 12	NIU
Maunalei - Shaft 2	NIU	Well 5	NIU	Well 14	300
Tunnels	NIU	** Well 2/ Shaft 3 pump to be replaced with smaller pump*			
Well 3 (could serve either way)	550/OOS	*** Well 3 could serve either direction, Lana`I City or Manele & IGGP. However, it is out of service & will be replaced.*			
Total GPM	1,400	Total GPM	2,100	Total GPM	940
Total GPD Wells		**Total GPD Wells**		**Total GPD Wells**	
Total Lana`i City, Koele & Kaumalapau	2,016,000	Total Manele and IGGP	3,024,000	Total Brackish	1,353,600
Largest Pump Out	792,000	Largest Pump Out	1,296,000	Largest Pump Out	864,000
Max Day Capacity*		**Max Day Capacity ***		**Max Day Capacity ***	
2/3 Installed Less Largest Pump	528,000	2/3 Installed Less Largest Pump	864,000	2/3 Installed Less Largest Pump	576,000
Average Day Capacity **		**Average Day Capacity ****		**Average Day Capacity *****	
2/3 of 2/3 Installed Capacity less largest pump	**352,000**	2/3 of 2/3 Installed Capacity less largest pump	**576,000**	2/3 of 2/3 Installed Capacity less largest pump	**384,000**
Effluent				**Effluent**	
Lana`i City WWTF - R-3	500,000			Manele WWTF	140,000
Lana`i City Auxilliary WWTF R-1	400,000				
Total Koele, City and Kaumalapau	2,416,000	Total Manele & IGGP	4,377,600	Total Manele & IGGP	4,377,600
Total City, Koele, Kaumalapau Potable	2,016,000	Total Manele Potable	3,024,000	Total Manele & IGGP Brackish	1,353,600
Total **Potable** - Standards	**352,000**	Total **Potable** - Standards	**576,000**	Total **Brackish** - Standards***	**384,000**
				Installed Capacity	
* Statewide System Standards indicate that a system should meet max day demand (=Avg Demand x 1.5)				Total All Island Potable	5,040,000
PLUS fire flow in 16 hours pumping, with the largest pump out. Referred to as Max Day Capacity above.				Total All Island Brackish	1,353,600
** This means that 2/3 of the above should be able to meet Average Day Demand				Total All Island Effluent	540,000
*** Standards only apply to brackish water if people or animals depend upon them.				Total All Island	6,933,600

Reservoirs and storage should be sized to meet maximum day demand plus the highest applicable fire flow for a presumed two hour fire. A table of storage is shown in Figure 3-28.

Overall system capacities are summarized in Figure 3-27, below.

Developed & Utilized Resources - System Infrastructure

FIGURE 3-27. Summary of System Capacities and Use

Lanaʻi City, Koele and Related Areas	MGD 2008
Total Installed Capacity	2.416
Installed Capacity of Potable Sources	2.016
Average Fresh Water Use	0.523 metered / 0.605 pumped
Average Reclaimed Use	0.209 to Koele Golf Course
Capacity of Brackish Sources in Use	0.000
Capacity of Reclaimed Water Facilities	0.400
Average Effluent Production	0.235
Potable Storage	2.786
Non Potable Storage	16.8 active / 22.8 total
Approximate Miles of Pipeline	35.59 miles

Manele, Hulopoʻe and Related Areas	MGD 2008
Total Installed Capacity	4.518
Installed Capacity of Potable Sources in Use	3.024
Average Potable Use	0.375 metered / 0.683 pumped
Average Brackish Use	0.760 metered / 0.944 pumped
Average Reclaimed Use	0.073 wtf production
Capacity of Brackish Sources in Use	1.354
Capacity of Reclaimed Water Facilities	0.140
Average Effluent Production	0.073
Potable Storage	2.000
Non Potable Storage	17.85 active / 19.35 total
Approximate Miles of Pipeline	43.04 miles*

(*Estimate does not include roughly 14.81 miles of abandoned or out-of-use pipeline in the Palawai Irrigation Grid)

FIGURE 3-28. Lana'i Tanks and Storage

TANK NAME	TANK CAPACITY IN MG	SPILLWAY ELEVATION	GROUND ELEVATION	YEAR BUILT	TANK MATERIAL	USE	Cl2 SITE	COMMENT
Lana`i City, Koele & Kaumalapau								
Maunalei Tank	0.030		1017	1992	Steel	Potable - PWS 237	N	*Not In Use*
Koele Tank	0.750	2057	2025	1995	Bolted Steel w Glass Fused Coating	Potable - PWS 237	N	SCADA
Lana`i City - Niniwai Tank		1878	1830	1951	Steel	Potable - PWS 237	N	*2 MG Not In Use*
New Lana`i City Tank	2.000	1980	1942	2008	Bolted Steel w Glass Fused Coating	Potable - PWS 237	N	Chlorinated at Well 6
Kaumalapau Tank	0.022		360	1992	Bolted Steel w Glass Fused Coating	Potable - PWS 237	Y	
Lana`i AWWTF R-1 Reservoir	10.000		1518.5			Non-Potable - Effluent		
Koele Clubhouse Lake 1	1.900		1761			Non-Potable - Effluent		Passive
Koele Clubhouse Lake 2	0.900		1741			Non-Potable - Effluent		Passive
Koele 8th Hole Lake/Reservoir	2.000		1739			Non-Potable - Effluent		
Koele 9th Hole Lake/Reservoir	1.100		1746			Non-Potable - Effluent		
Koele 13th Hole Lake/Reservoir	0.900		1991			Non-Potable - Effluent		
Koele 2nd Hole Lake/Reservoir	1.5					Non-Potable - Effluent		
Koele 3rd Hole Lake/Reservoir - Tee	0.900					Non-Potable - Effluent		
Koele 3rd Hole Lake/Reservoir - Green	0.400					Non-Potable - Effluent		
Koele 6th Hole Lake/Reservoir	1.300					Non-Potable - Effluent		
Koele 17th Hole Lake/Reservoir	0.400		1822			Non-Potable - Effluent		
Koele 18th Hole Lake/Reservoir	1.500		1746			Non-Potable - Effluent		
Potable Storage	**2.802**							
Non Potable Storage	22.800							Including Passive
Non Potable Active Storage	**16.800**							
Manele, Hulopo`e and Portions of Irrigation Grid								
Hi`i Reservoir	1.000	1823	1810.2		Concrete Lined		N	PE Cover
Hi`i Tank	0.500	1823.5	1791.5	1952	Welded Steel	Potable - PWS 238	N	
Manele Breaker Tank 1	0.100	1141	1127	1987	Bolted Steel w Glass Fused Coating	Potable - PWS 238	Y	Chlorination Site
Manele Breaker Tank 2	0.100	755.8	742	1987	Bolted Steel w Glass Fused Coating	Potable - PWS 238	N	
Manele Breaker Tank 3	0.300	341	326	1987	Bolted Steel w Glass Fused Coating	Potable - PWS 238	N	
Wells 9 & 1 Control Tank	0.050	1434.5	1420.5		Steel	Non-Potable - Brackish		Abandoned
Palawai Brackish Reservoir	15.000	1211	1239		Lined	Non-Potable - Brackish		
Effluent Reservoir	2.800		275		Lined	Non-Potable - Effluent		
Manele GC Pond	1.500		250			Non-Potable - Effluent		Passive
Potable Storage	**2.000**							
Non-Potable Storage	19.350							Passive
Non-Potable Active Storage	**17.850**							

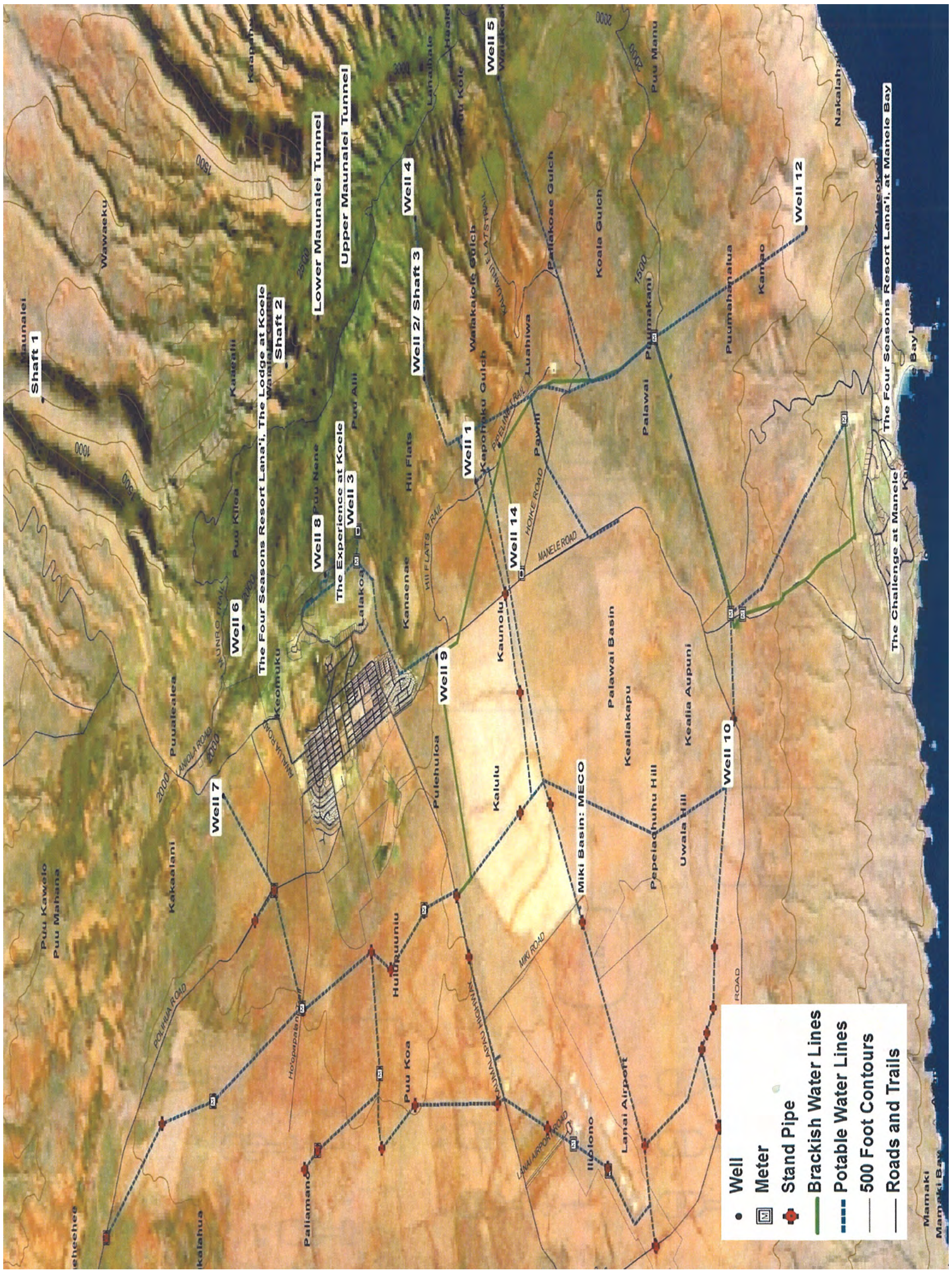
FIGURE 3-29. Lanaʻi Pump Inventory - Source

Well / Source	Pump & Motor Description	Pump Elevation	GPM	Calibrated GPM	24 Hrs	16 Hrs	44.44%	2008 Actual MAV in GPD	Character
6	Submersible Byron Jackson 23 Stage, 1800 RPM, 2500 V w ith 200 HP Type H 14" Motor installed 2006	863	550		792,000	528,000	352,000	327,912	Potable Drilled 1986
7								0	Proposed Potable Drilled 1987 **Not In Use**
8	Submersible Byron Jackson 11 MQH, 20 stage, 1800 RPM w ith 300 HP Type H, F1 Amp 74 Motor 2300 Volts	782	850	816	1,224,000	816,000	544,000	276,890	Potable Drilled 1990 pump low ered to 783' 09/09
2	Vertical Turbine Fairbanks Morse Pomona 3 Stages, 1780 RPM w ith 75 HP Ingersoll Rand Booster FL Amps 90 voltage 480 Frame-L365TP	1,335	1,200	1,152	1,728,000	1,152,000	768,000	2,418	Potable Drilled 1946 ***Rarely Used*** ***Confined Space Issues***
3	Submersible Byron Jackson #781-5-1808 22 Stage 1800 RPM 23 stage w /Byron Jackson Type H 300 HP 14" Motor	866						0	Potable Drilled 1950 **Out of Service**
4	Submersible Byron Jackson #841-S-0046, 13MQH, 15 stage, 1800 RPM w ith Byron Jackson Type H 300 HP 14" Motor Amp 74 2300 Volts	1,253	900	864	1,296,000	864,000	576,000	683,867	Potable Drilled 1950 Out of Service
5		1,293						0	Potable Drilled 1950 **Out of Service**
1	Submersible Crow n 340 GPM 9 Stage, 3,470 RPM, w ith Hitachi 100 HP Motor Installed 2005	516	340	300	489,600	326,400	217,600	393,981	Brackish Drilled 1945
9	Submersible Byron Jackson 16 stage 600-4114-931-R-005 6 MQH 3600 RPM w Franklin Electric 100 HP Motor Installed 2005 F1-Amp-148 480 Volt	466	300		432,000	288,000	192,000	151,440	Brackish Drilled 1990
12		-5						0	Brackish Drilled 1990 **Not In Use**
14	Submersible Byron Jackson Hitachi 125 HP Motor Installed 2003	400	300		432,000	288,000	192,000	404,714	Brackish Drilled 1995
		----------	----------		----------	----------	----------	----------	
	Source Capacity		4,440		6,393,600	4,262,400	2,841,600	2,241,222	

FIGURE 3-30. Lana'i Pump Inventory - Boosters and Totals

Boosters									
Maunalei	Byron Jackson Can Type Vertical Booster 11LQ 3600 RPM 6 Stages with Vertical Solid Shaft 20 HP 3600 RPM 444 VP Frame WP-1 Enclosure 225 Amp F1	481						0	Potable Booster Quasi-Source **Out of Service**
Well 2 / Shaft 3 Booster	Ingersoll Rand Booster Pump 40 HP								Potable Source **Rarely Used**
Manele SPS A - 2 Pumps	Dual submersible pumps. 18 HP constant speed motor at 91' Total Dynamic Head (TDH). Located at Road E. Pumps to SPS B.		295	ea.	424,800	283,200	188,800		Effluent Booster
Manele SPS B - 2 Pumps	Dual submersible pumps. 120 HP at 240' TDH. Located at Manele Terrace Subdivision. Pumps to SPS #2.		490	ea.	705,600	470,400	313,600		Effluent Booster
Manele SPS # 1 - 2 Pumps	Dual dry pit pumps. 75 HP at 190' TDH. Located at Hulopo`e Park. Pumps to SPS # 2.		550	ea.	792,000	528,000	352,000		Effluent Booster
Manele SPS # 2 - 2 Pumps	Dual dry pit pumps. 75 HP at 180' TDH. Located near the entrance to Manele Resort. Pumps to SPS # 3.		550	ea.	792,000	528,000	352,000		Effluent Booster
Manele SPS #3 - 2 Pumps	Dual dry pit pumps. 75 HP at 180' TDH. Located just below the sewage treatment plant, along the access road. Pumps to the headworks of the sewage treatment plant.		550	ea.	792,000	528,000	352,000		Effluent Booster
Koele WW - Green 4	Sim Flo 40 HP	1,992	1100	280	403,200	268,800	179,200		Effluent Booster
Koele WW - Green 17	Sim Flo 40 HP	1,748	800	280	403,200	268,800	179,200		Effluent Booster
		--------	--------	--------	--------	--------	--------	--------	
			4,335		4,312,800	2,875,200	1,916,800	0	
			8,775		**10,706,400**	**7,137,600**	**4,758,400**	**2,241,222**	
	Subtotal Potable In Use		**3,500**		**5,040,000**	**3,360,000**	**2,240,000**	**1,291,087**	
	Subtotal Brackish in Use		**640**		**1,353,600**	**614,400**	**409,600**	**545,421**	
	Subtotal Wastewater In Use		**3,535**		**3,909,600**	**2,606,400**	**1,737,600**		

FIGURE 3-31. Photo Schematic of Lana‘i Water Systems, Courtesy of Lana‘i Water Company, Inc.



Lanaʻi City Water System - Potable Uses

The Lanaʻi City Water System serves Koele, Lanaʻi City and Kaumalapau. The system has roughly 1,400 service connections, served by two wells, three tanks and roughly thirty-five miles of potable line. Source for this system is currently drawn from two active wells, Well 6 (aka Kaiholena Well 6 - USGS #5054-01) at 1,910' and Well 8 (USGS # 4753-01) at 1,902'. Well 3 was once an important source for this system, but has since been taken out of service. A replacement for this well is in progress as of this draft, and scheduled to be on-line in 2010.

The system is untreated with the exception of the standard required chlorination, which takes place at the sources, and again at Kaumalapau Harbor tank. Koele, Lanaʻi City and Kaumalapau represent three service zones on the system.

Koele is served by Wells 3 and 8, via the 750,000 gallon Koele Tank, with a spillway at 2057.5'. The low elevation limit of this pressure zone is about 1,740'. The Koele Tank primarily serves Koele Villas and lots and the Lodge at Koele, but water from this tank can drop to the City through a PRV.

Lanaʻi City is served primarily by Well 6. Well 6 feeds directly to the New Lanaʻi City Tank, with a spillway elevation of 1,980 feet. Water from Wells 3 (once replaced) and 8 can also contribute source to Lanaʻi City via a PRV from the Koele service area. Well 6 feeds directly to the New Lanaʻi City 2,000,000 gallon tank, with a spillway elevation of 1980'.

Kaumalapau is fed from Lanaʻi City via a 2-1/4" pipe to the 22,400 gallon steel storage tank at Kaumalapau, with a spillway elevation of 375'. This tank services Kaumalapau Harbor and small surrounding developments.

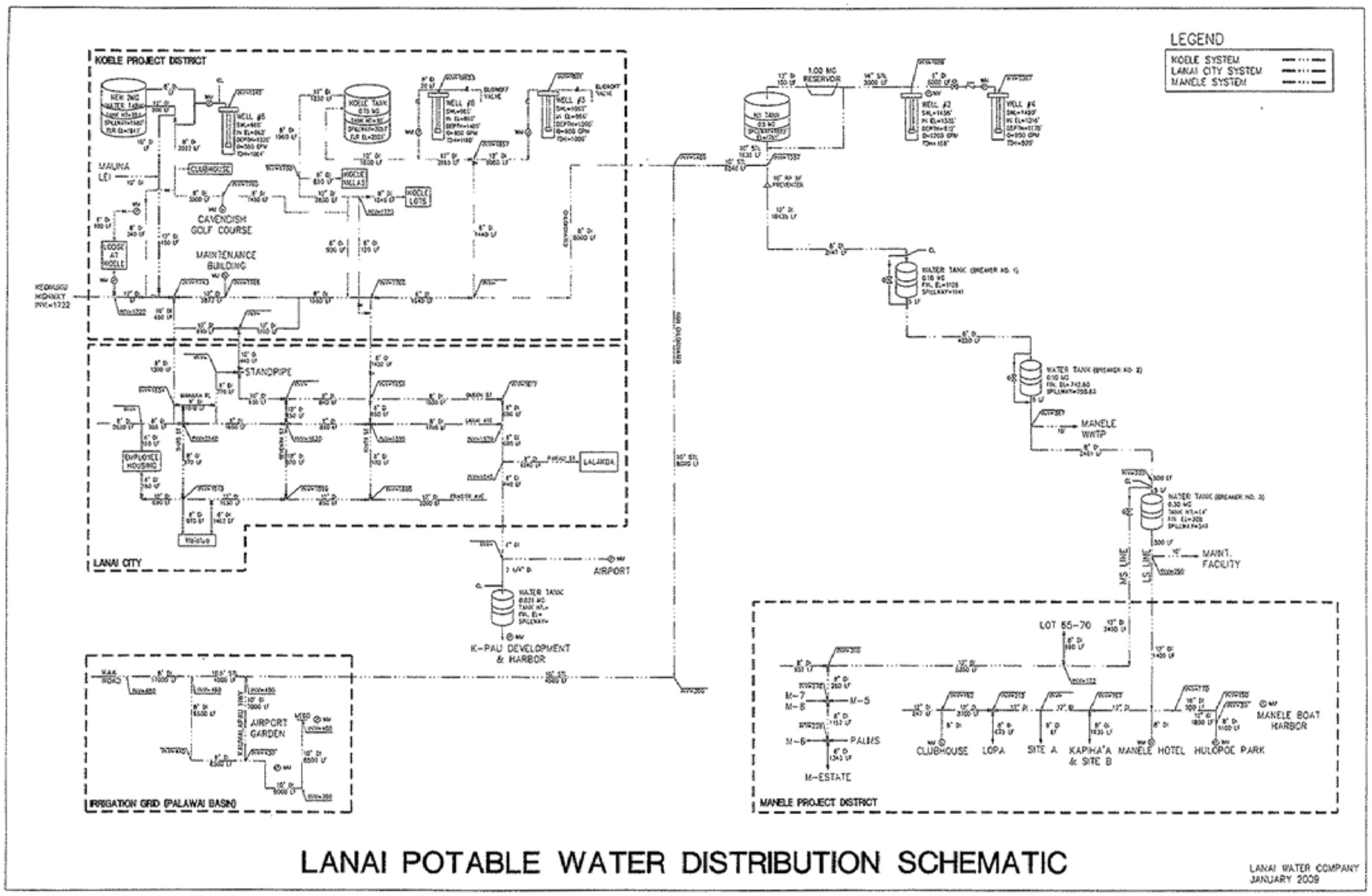
Lanaʻi City - Non Potable - Uses - Reclaimed Water

Two wastewater treatment plants serve Lanaʻi City. The County's Lanaʻi City Wastewater Treatment Facility has a capacity of about 500,000 gallons per day and treats water to R-3 quality. In calendar year 2008, the Lanaʻi City Wastewater Treatment Facility had an influent of about 308,412 gallons per day, and produced about 245,456 GPD of effluent.

From the Lanaʻi City Wastewater Treatment Facility, effluent proceeds to the CCR-owned Lanaʻi City Auxilliary Treatment Facility where it is further treated to R-1 quality water. The Auxilliary Treatment Facility has a capacity of about 400,000 GPD. In 2008, with an influent of 245,456 GPD, the Auxilliary Treatment Facility produced about 234,093 GPD of R-2 water.

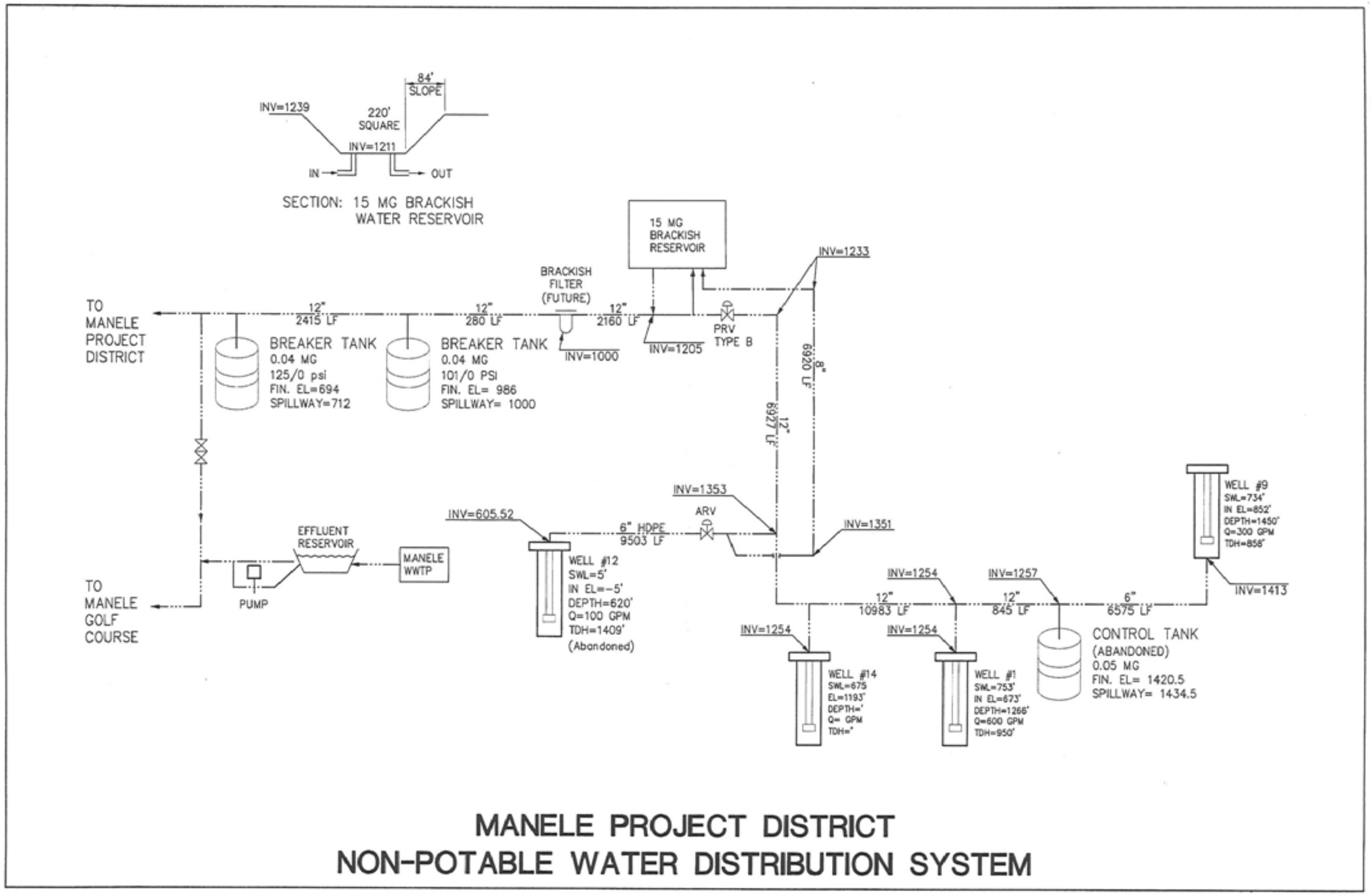
The Auxilliary Treatment Facility has a storage capacity of about 10 MG, with additional storage in water features at the "Experience At Koele" Golf Course of about 13.1 MG. The non-potable system has roughly three miles of waterline. About 209,721 gallons per day were pumped to the "Experience At Koele" Golf Course from the Auxilliary Water Treatment Facility during 2008.

FIGURE 3-32. Lana'i Potable Water System Schematic



Note: An 11x17 version of this figure is provided in the large exhibits file.

FIGURE 3-33. Manele Non-Potable System Schematic



Manele Water System - Potable Uses

The Manele Water System serves Manele Resort, Hulopo‘e Beach Park, and the Manele Small Boat Harbor, as well as the Palawai Irrigation Grid. It has roughly 200 service connections and is served by two wells, five tanks and roughly thirty-five miles of potable or non-chlorinated waterlines. Water for the Manele system is drawn primarily from Well 4 (aka Soule’s Bench Well, USGS #4952-02), with very occasional withdrawals from Well 2/Shaft 3 (USGS # 4953-01). From Well 4, at an elevation of about 2,327’, it proceeds to the 1 MG concrete Hi‘i Reservoir and 0.5 MG Hi‘i Tank at 1,823’. From Hi‘i, water is carried to Manele via three steel breaker tanks in series at spillway elevations of 1,141’, 755.8’ and 341’ respectively. Breaker Tanks 1 and 2 have capacities of 100,000 gallons each. Breaker Tank 3 has a capacity of 300,000 gallons. Water for the Palms and multi-family estates at the west end of Manele is channeled into a line just above Breaker Tank 3. From Breaker Tank 3, water continues to the Harbor, the Beach Park and the Hotel.

Manele Water System - Non Potable Uses

Brackish

Brackish water for landscaping at Manele comes from Wells 1 (USGS # 4853-02), 9 (USGS # 4854-01) and 14 (USGS # 4854-02) at 1,265’, 1,411’ and 1,193’ respectively. A 0.5 MG control tank exists after Well 9 at 1,420.5’ with a spillway elevation of 1,434.5’, but this control tank is currently by-passed to minimize unnecessary pumping costs. From Wells 1, 9 and 14, water proceeds to the 15 MG Reservoir with a spillway elevation of 1,211’. Water is then piped via two 40,000 gallon breaker tanks with spillway elevations of 1,000’ and 712’ toward Manele. Just above Manele, brackish water is blended with reclaimed effluent for golf course irrigation. There are roughly seven miles of brackish waterline.

Reclaimed Water

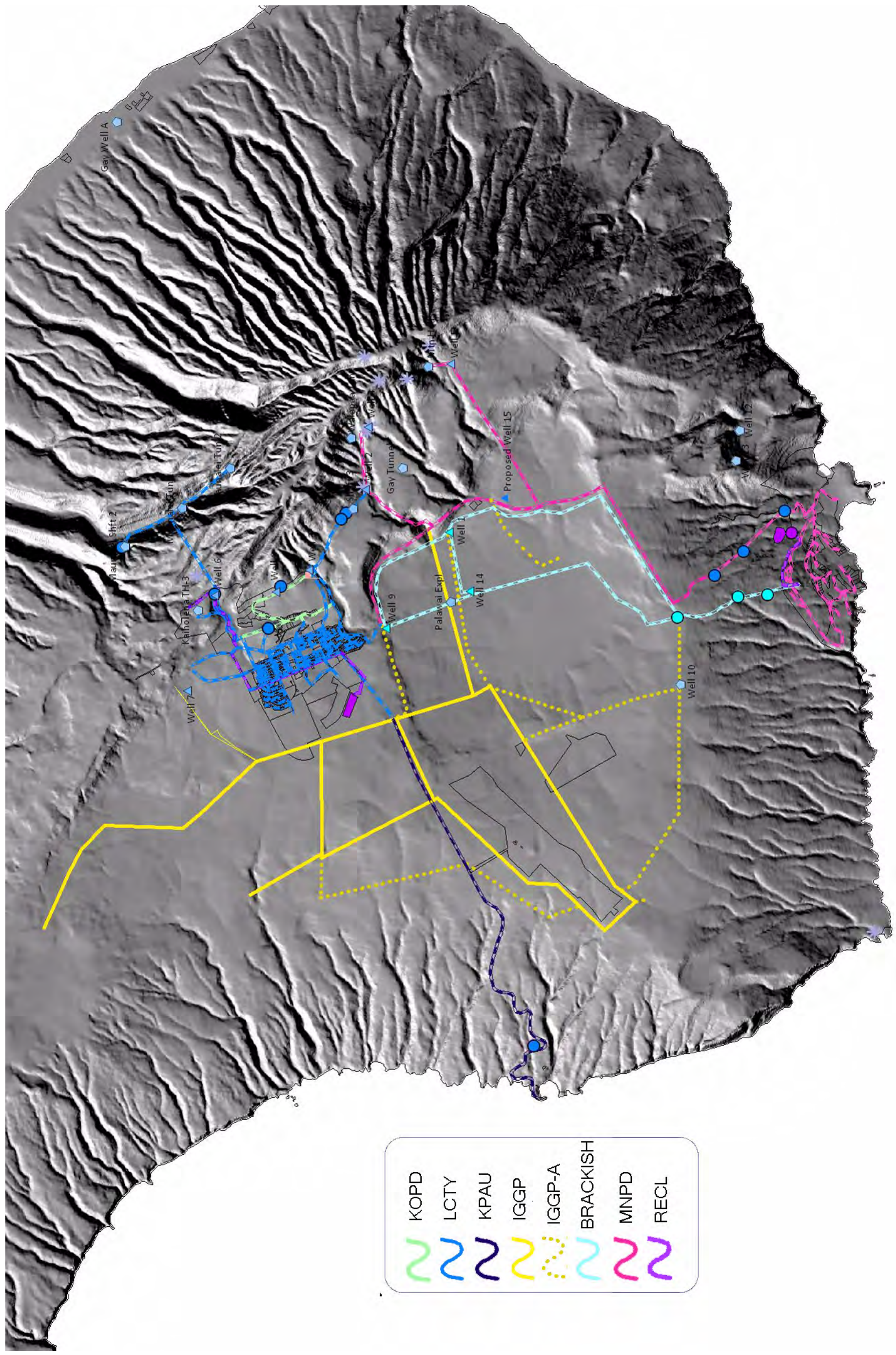
The Manele Wastewater Treatment Facility has a capacity of 140,000 GPD. During calendar year 2008, with an influent of 77,281 GPD, it produced 72,940 GPD of effluent. From the effluent reservoir, this water is pumped directly to the Manele Golf Course via roughly one mile of wastewater line.

FIGURE 3-34. Wastewater Facility Capacity, Influent and Effluent on Lana‘i - 2008

Name		Capacity	Average Influent	Average Production
Lana‘i City WWTF	R-3	500,000	308,412	
Lana‘i City Auxilliary WWTF	R-1	400,000	245,456	234,093
Manele WWTF	R-1	140,000	77,281	72,940

Water Systems

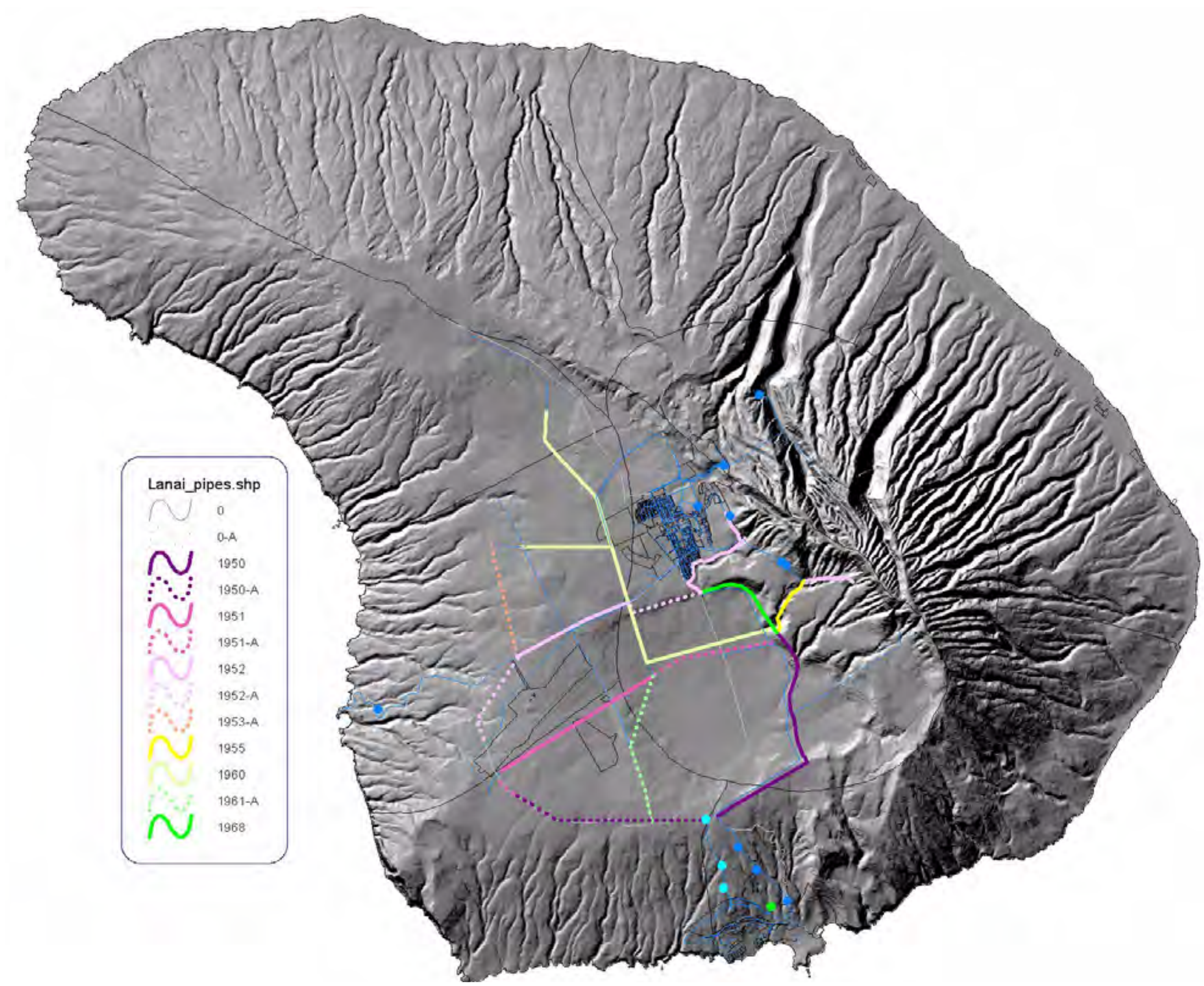
FIGURE 3-35. Lana‘i Water Systems By District



Pipelines

In all, Lana‘i has roughly 93.44 miles of pipeline, as measured from GIS plots. Of this, about 78.63 miles are active, and 14.81 miles are abandoned or out of use. The age and condition of some of these lines, combined with the lack of customer base to generate adequate revenues for necessary replacements, is a matter of serious concern to both Lana‘i Water Company, Inc. and the community it serves. Long segments of pipe in the irrigation grid, and to the west, south and east of Lana‘i City, are in need of repair, replacement or in some cases possibly abandonment. A portion of the line from Hi‘i tank down to the Palawai Basin is unburied and in a fire-prone area. In addition, some lines are either too small in diameter to satisfy system standards or constructed of problematic materials, such as asbestos-concrete or galvanized iron. These situations will be a challenge for the utility in the coming decade.

FIGURE 3-36. Palawai Grid Pipe Age Data Dotted lines in this image are abandoned**.**



Developed and Utilized Resources - Wells & Pumps

Lana‘i has 23 well holes, of which six or seven are currently in use for its two public water systems. Estimated 24 hour pumping capacity for utilized wells totals 6.934 MGD. At present, Wells 6 and 8 are used for domestic and municipal use in the Lana‘i City and Koele Project District areas, as well as for the Airport, Kaumalapau Harbor, north end game management and Miki lumber yard areas. This is PWS 237. Well 4, and occasionally Well 2/Shaft 3, are used for domestic and municipal use in the Palawai Irrigation Grid and the Manele Project District areas. This is PWS 238. Wells 1, 9 and 14 are used for irrigation of the Manele Golf Course and landscaped areas at Manele. Total reported pumpage for calendar year 2008 was 2,241,222 GPD.

Lana‘i City, Koele, Kaumalapau and Related Uses

Maunalei Sources

The combined Maunalei sources were once the primary source of drinking water for Lana‘i City. Gravity flow from the Upper Maunalei tunnel was conducted via a 2” line to the Lower Maunalei Tunnel, where the flows of the two tunnels combined. At one time, these combined tunnel flows were about 274,000 GPD. However, the average over the period of record entered in this report was closer to 150,000 GPD. From the Lower Maunalei Tunnel this combined tunnel water gravity flowed to the Maunalei Shaft 2 and booster station via a 4” line. The Maunalei shaft ran at a 30 degree slope into the dike complex from an elevation of 851’, where it met a concrete floor at 740’. From that point a deep well continued 259’ straight down. The well at one time had a submersible 170 GPM Anderson pump. Later reports indicated a 500 or 600 GPM pump to boost the shaft water to the booster. Reported historical flows were about 500,000 GPD. A 750 GPM booster pump lifted water from the Maunalei tank, via another series of 4” lines, 1,100’ up and over the ridge and back downward by an 8” line to the Koele 2 MG tank. The Shaft 2 pump was activated only when the Maunalei Tunnel flows were not adequate to keep the Maunalei Tank levels up. Chlorination facilities were located at the 21,000 gallon Maunalei tank. Although zero flows have been reported from Maunalei sources on the periodic pumping reports since 1995, the sources were used most heavily from 1948 to 1994. The 1998 sanitary survey report indicated that the sources were still utilized to serve a bee keeping operation and a boy scout facility. The tank can be chlorinated to accommodate such events. It is not clear from any of the available data whether the lower tunnel still flows at all. It may be possible to further develop pumping capacity in shaft two or the tunnels. It is not clear whether these sources could be utilized for additional development without modifications for two reasons: first the numeric groundwater model indicates that they will cease to run under most pumping scenarios; and second, they may be subject to becoming GWUDI (“*Groundwater Under the Direct Influence*” of surface water).

Well 6

Well 6 is currently the major source serving Lana‘i City, Koele Project District and related areas. From a pump elevation of 868’ (intake elevation 863’) , a 550 GPM pump with a 200 HP motor pumps water up to ground level at 1,910 feet and proceeds to the Lana‘i City 2 MG tank via a 10” ductile iron pipe. From the 2 MG tank it serves the Koele Lodge and Villas, and Lana‘i City. If necessary, water can also be pumped from the 2 MG tank to the higher elevation 0.73 MG Koele Tank, from where it can serve Koele, the City and the Palawai Irrigation Grid. Pipe connections also exist which could send this water toward Manele in an emergency. In calendar year 2008, Well 6 provided an average of 327,912 GPD to the Lana‘i City area. Chlorides in the well appear to be stable, though water levels are declining.

Well 7

Well 7 has never been in regular use. It is considered a future Lana'i City / Koele source, but could be used to serve areas makai of the city, Kaumalapau area, or even to offset pumpage from elsewhere, freeing water for Lana'i City or even Manele. It has a direct feed to the irrigation system at the north end of the old plantation.

Well 8

Well 8 is located above the City and *Experience at Koele* Golf Course at about 1,902' elevation. From a pump depth of 863' (intake 862'), the pump was recently lowered to 783' (September, 2009). Water from this well can be sent via 8" ductile iron lines either to the 0.75 MG Koele Tank, or directly to the Koele Lodge, the Koele Villas or the 2 MG City tank. Although it has an 850 GPM pump, with a 300 HP motor, Well 8 is currently pumped less than Well 6. During calendar year 2008, Well 8 provided about 276,890 GPD to the Koele Project District area and the surrounding area. Chlorides are marginally higher than those at Well 6, but both wells are fresh. Water levels show a slight declining pattern.

Manele, Hulopo'e, Palawai Irrigation and Related Uses

Well 2 / Shaft 3

Well 2 / Shaft 3 is a potable source, but was once a major source of the plantation's irrigation water. In a 1989 memo from R.C. Oda to J.H. Parker of Dole Foods, Mr. Oda wrote, "This complex above Kapohaku Gulch has been the plantation's major source of irrigation water, but deliveries have declined due to the continuing drought." In 2001, Tom Nance noted that the water levels had recovered about half way to the well's pre-use level with the facility's minimal use. (Tom Nance, *Current Status of Lana'i's High Level Aquifer as Portrayed by Datea From Its Wells*, September, 2001). The ground elevation at Well 2 is 1,510' and the pump elevation is at 1,335'. Water travels via a 16" ductile iron line to the Hi'i Reservoir or Hi'i Tank, or it can bypass these and continue directly in 8" and 12" lines to the Manele Project District or Palawai Irrigation Grid. The portal to Shaft 3 is located at 1,810'. Shaft 3 is drilled at a 30 degree slope with a slope length of about 620' - intersecting with Well 2 at an elevation of 1,510'. The complex has a 1,200 GPM vertical turbine pump, and a 75 HP Ingersoll Rand booster pump. Various reports have described proper operation of this complex and how to work with it. One is left with the impression that this complex was not the most convenient to use, even aside from safety issues. Nevertheless, this was a major source of water for the Plantation and one of the least expensive. As shown in Figure 3-9, Well 2/ Shaft 3 has one of the shortest lifts from the pump intake to the tank outlet, which explains why this complex was so economical. Historical estimates of safe yield for this source have ranged between about half a million gallons per day and 1.2 million gallons per day. Annual MAV pumpage has varied over the years from as little as 70,000 gallons to 700,000 gallons. Well 2 / Shaft 3 has been used only sparingly since 1996, in part due to safety issues in the shaft. In calendar year 2008, average pumpage was only 2,418 gallons per day. Water levels are stable, though rarely reported in recent years. Surprisingly for such high level water, there is a slight rising trend in historical chlorides. Replacement of Well 2 / Shaft 3 is planned.

Well 3

Well 3 is no longer in use and will be replaced. It has been out of service since period 5 of 2006. Well 3 was located such that it has the most flexibility of any source in the system, but it was most recently used primarily as backup for the Manele system, serving as a secondary backup for the City, Koele and related areas. From a pump elevation of 866', a 900 GPM pump drove water up to an 8" ductile iron line with an invert of 1,845', and from there it could proceed either to the Palawai Basin via 10" ductile iron lines, or to the Manele Project District via 12" and 8" ductile iron lines. Water from Well 3 could also be pumped through 8" and 12" ductile iron lines to the Koele and Lana'i City systems - either via the 0.75 MG Koele Tank or directly toward Koele Villas, Cavendish Golf Course, along West Loop Road and on into the city via Ninth Street. Various estimates of the well's safe yield given from 1957 to 1977 ranged from 65 MGY to 130 MGY or 178,000 to 356,000 GPD. Another estimate was 32 GPM per foot of drawdown. In past years Well 3 was pumped at a rate of about half a million gallons per day, but toward the end of its pumping years, pumpage was closer to 100,000 GPD. Water levels and chlorides are both stable.

Well 3 Replacement

As this document is drafted, a replacement for Well 3 is in progress, with completion expected in 2010. The well permit application indicates that Lana'i Holdings, Inc. intends to install the existing Well 3 pump into the new well hole. The well has been drilled, but testing is not yet complete and so a well completion report had not yet been submitted as of this draft. The information on the proposed permit indicates a ground elevation of 1,850', (1,852' at top of casing), and a total well depth of 1,400'. Anticipated water elevation was 1,010'. As with the previous Well 3, this well should be able to serve either the Koele / Lana'i City system or the Manele / Hulopo'e system. System connections are expected to be the same as for the original Well 3, described above.

Well 4

This is the island's most productive well, and the primary source serving the Manele, Hulopo'e, Palawai irrigation grid and related areas. Well 4 has been used for both drinking water and plantation irrigation, but is presently the major potable source for Manele. It has a 900 GPM pump with 300 HP motor, which lifts water from the 1,316' pump elevation to ground elevation at 2,327'. The water is transported through 6", 12" and 16" lines to Well 2 and then onward to the 1 MG Hi'i Reservoir or 0.5 MG Hi'i tank. The water can also bypass this storage and feed directly to the Manele Project District or Palawai Irrigation Grid, or theoretically with some valve and system adjustments, it could be fed back to Lana'i City if it were necessary. Keith Anderson, a hydrologist that consulted for Lana'i Water Company during the 1960s and 1970s, estimated safe yields for this well between 200,000 and 300,000 GPD. However, a 1974 Company report considered it the most productive well, with good recharge and ability to deliver 600 GPM (864,000 GPD). Historical annual average use of the well has reached as high as nearly 1 MGD, but in recent years pumpage has been in the 600,000 gallon range. During calendar year 2008, Well 4 provided an average of about 683,867 GPD. Water levels and chlorides seem stable.

Well 5

Well 5 has not seen much use since 1994. It is considered a potential backup or future source for the Manele area. Located at 2,296', there is currently no pump in the well. Safe yield estimates for this well have run from about 150,000 GPD to about 220,000 GPD. Historical reports have noted that it needs to be used with caution, and time is needed to allow water to recharge. Despite such caveats, it had a 900 GPM pump and fed into the system around the Palawai Basin. Although data on water levels and chlorides are limited, they seem to be stable.

Brackish Sources

Well 1

Well 1 is located at the 1,265' elevation. The elevation of the pump intake is 516'. Water from this well feeds via 8", 10" and 12" waterlines to the brackish 15 MG reservoir and then onward to Manele via 12" lines. Safe yield estimates for this source have ranged from 110,000 to 140,000 GPD or so. The well is fitted with a 340 GPM pump with a 100 horsepower Hitachi motor. Well 1 has been pumping around 400,000 GPD in recent years. Pumpage in calendar year 2008 was 393,981GPD. Water levels in Well 1 show a declining pattern.

Well 9

Well 9 is located at 1,411' and the pump had been located at 950' until October of 2003, when the pump was lowered 42' to about 908'. The pump has since been lowered again, to 466'. The well has a 300 GPM pump and 100 HP motor. Water from Well 9 goes to Manele PD via the 15 MG brackish reservoir. Average pumpage in 2008 was 151,440. Chloride levels look stable. Water levels show a declining trend.

Well 10

Well 10 was an experimental well only, drilled to test the extent of the utilizable aquifer at the edges of the Palawai Basin. Although there are discrepancies in reported chlorides, the results were high enough that the well was not considered promising, though it was at one time outfitted with a 300 GPM pump. No pump is currently reported. Ground elevation is 1,228'.

Well 12

Wells 12 and 13 were drilled in the southeast rift zone to the east of Manele Resort. Well 12 tested at less than 100,000 GPD, but was thought potentially useful for small amounts of local irrigation use. Well 12 is located at 605' elevation, with the pump 5' below sea level in a thin basal layer. Tests in 2003 revealed low production and high chlorides. (Initial chlorides were 708 mg/L, similar to those found in Well 14.) The well was outfitted with a 100 GPM submersible Plueger Worthington pump and 60 HP motor. There is one full MAV period of data for Well 12. Average pumpage for 1995 was about 14,000 GPD. Well 12 was not utilized during 2008.

Well 13

Well 13 was drilled at 695' in 1990, in the hope that it could be used for irrigation of Manele Project District. Pump tests indicated that production capacity would be too low to make it worth outfitting the well. It is not currently in use.

Well 14

Well 14 was drilled in the Palawai Basin in 1995. Tests in October 2003 revealed salinity in the 700+ parts per million (ppm) range (i.e. 700+ mg/L). At that time it was thought that the well was not likely to be appropriate for use. However, in April of 2004, pumpage started sporadically and at present the well is pumped regularly and mixed with water from Wells 1 & 9. Average daily pumpage for calendar year 2008 was 404,714 GPD. Chlorides run from 700 to 800 mg/L. Water levels show a declining trend, though the period of record is still rather short.

Well 15

As of this drafting, a permit has been approved for drilling of a "Well 15", (USGS # 4753-01). The proposed site for this well is in the leeward aquifer system, south of Well 1, at an elevation of 1,310'. Total anticipated well depth is 1,200' with an anticipated water level of 700'. The proposal anticipates a pumping rate of 350 GPM and a withdrawal of 250,000 GPD. The proposed use of the well is listed as municipal, though given the location, it seems more likely to be a brackish irrigation well. (This application was originally submitted as Well 11. It was later decided to change the name to Well 15, since there had once been a wellhole drilled under the name Well 11, though not in use.)

FIGURE 3-37. Location of Proposed Well 15 Relative to Other Well Sites

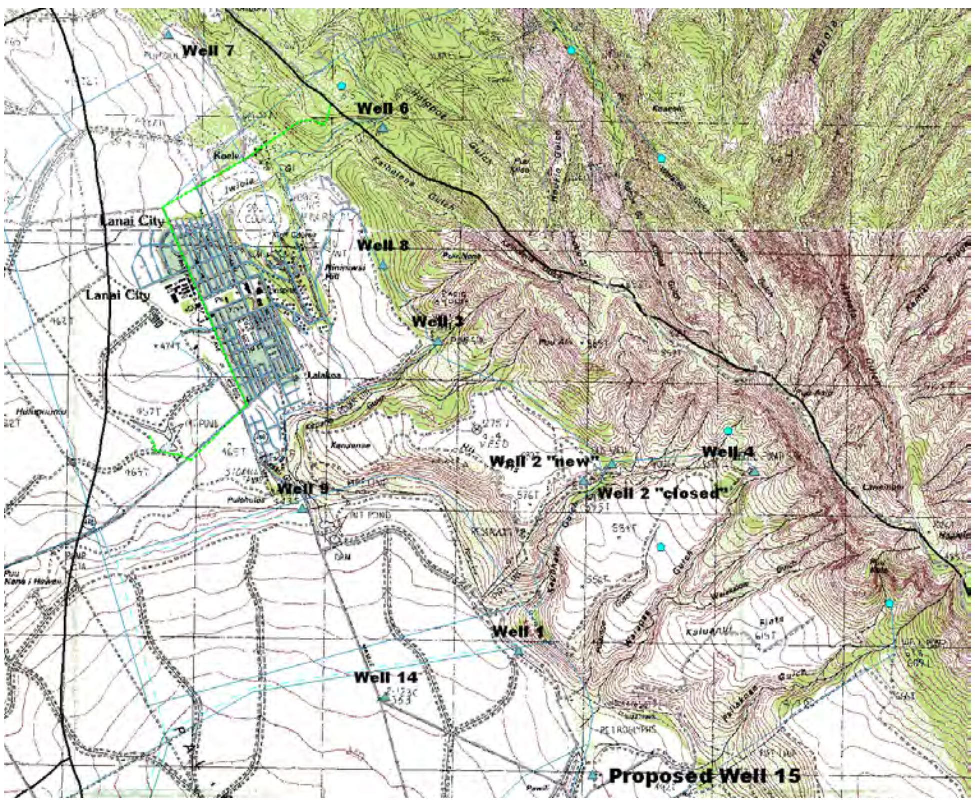


FIGURE 3-38. Well Holes on Lana'i . CWRM Data Base.

WELL NO	WELL NAME	YEAR DRILLED	WELL TYPE	GROUND ELEV	WELL DEPTH	BOT HOLE	CASING DIAM	INIT HEAD	INIT CHLOR	TEST GPM	TEST DDOWN	PUMP GPM	RECENT PUMP GPM	PUMP ELEV	PUMP DEPTH
5149-01	Gay Well A	1900	PER	16	60	-44	6	2	821	400		0			
5053-01	Maunalei Tun 1	1911	TUN	1103				1103				0			
5053-02	Maunalei Tun 2	1911	TUN	1500				1500				0			
4852-01	Mtn House Tunnel	1918	TUN	2700				0				0			
4853-01	Gay Tunnel	1920	TUN	1920				0				0			
4952-01	Waiapaa Tun	1924	TUN	2220				0				0			
5154-01	Maunalei Shft 2	1936	TUN	851	372	479		735	31	20	2	0			
5253-01	Maunalei Shft 1	1936	TUN	294	293	1		2.4	374			0			
4853-02	Well 1	1945		1265	1274	-9	12	818		300	45	700	300	677	588
4953-01	Well 2	1946		1510	609	901	18	0				1400	1200	1330	180
4852-02	Well 5	1950		2296	1122	1174	18	1570				900	900	1293	1,003
4952-02	Well 4	1950		2327	1178	1149	18	1589		660	16	900	840		
4954-01	Well 3	1950		1850	1199	651	18	1078				300	900	812	1,038
5054-01	Kaiholena TH-3	1950						1064				0			
4953-02	SHAFT 3	1954	SHF					0				0			
5054-02	Well 6	1986	PER	1910	1310	600	16	1005	23	30	50	550	640	868	1,042
5055-01	Well 7	1987	PER	2100	1650	450	8	650	67			500	500	840	1,260
4555-01	Well 10	1989	ROT	1228	1020	208		208	330			300			
4552-01	Well 12	1990	PER	605	630	-25	12	5	708	160	8.2	100	100	-13	618
4553-01	Well 13	1990	PER	695	750	-55	12	20		12	12	0			
4854-01	Well 9	1990	ROT	1411	1451	-40	14	808		336	105.1	300	300	461	951
4954-02	Well 8	1990	ROT	1902	1490	412	14	1014	40	1110	37.9	800	640	863	1,039
4854-02	Palawai Expl	1995	ROT	1193	950	243	14	95	551.1	700	170			0	
4854-02	Well 14	1995	ROT	1193	950	244	14	551	700	300	32.7	300	300	361	833

Note: Initial Head as reported here is not always the same as Initial Water Level. The differences are:
Maunalei Shaft 2 Initial Water Level is 739' vs. 735',
Well 1 Initial Water Level is 876' vs. 818',
Well 4 Initial Water Level is 1,576' vs. 1,589',
Well 5 Initial Water Level is 1,548' vs. 1,570',
Well 9 Initial Water Level is 803' vs. 808'.
Palawai Exploratory Well tested at 710 ppm. chlorides.

PER - Percussion Drilled
TUN - Tunnel
SHF - Shaft
ROT - Rotary Drilled

FIGURE 3-39. Well Pumpage 1948-2008

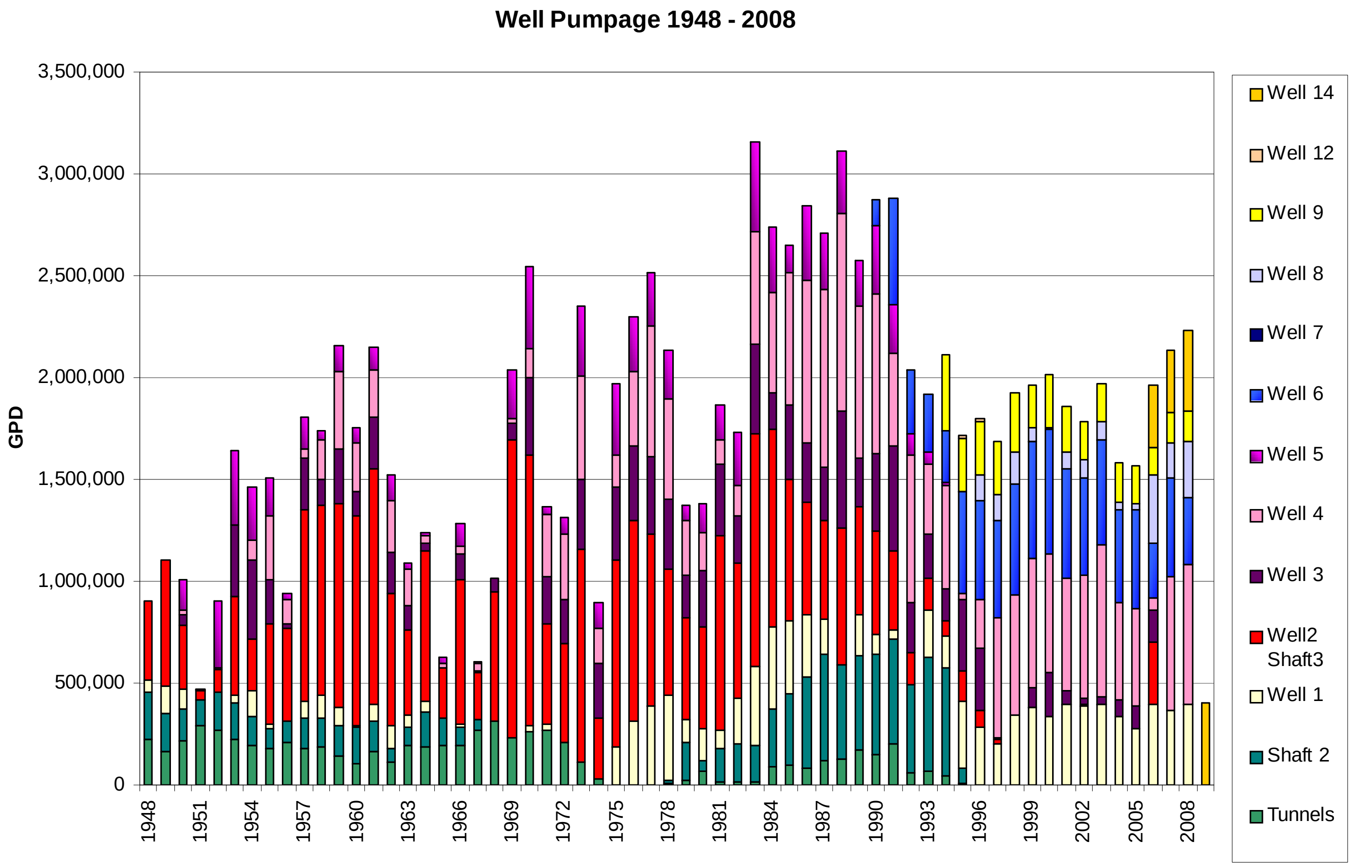
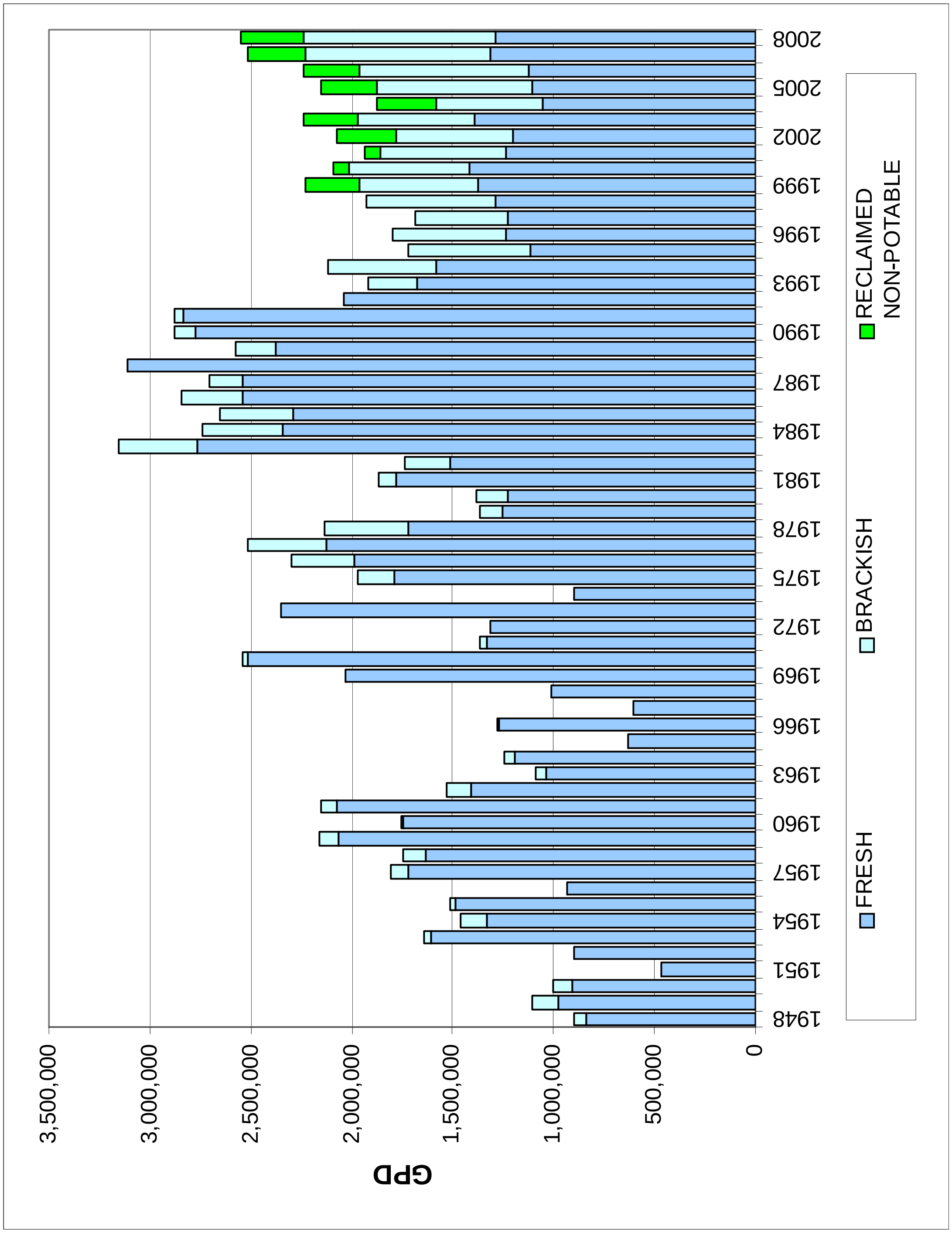


FIGURE 3-40. Potable, Brackish and Reclaimed Use 1948-2008



Water Systems

FIGURE 3-41. Potable, Brackish and Reclaimed Water Use on Lana'i

YEAR	FRESH	BRACKISH	RECLAIMED NON-POTABLE	TOTAL
1948	841,493	58,827		900,320
1949	978,123	128,986		1,107,110
1950	911,721	94,945		1,006,666
1951	467,827	19		467,847
1952	901,408	112		901,521
1953	1,605,085	36,000		1,641,085
1954	1,327,285	131,962		1,459,247
1955	1,488,233	21,874		1,510,107
1956	936,721	0		936,721
1957	1,717,501	85,427		1,802,929
1958	1,635,022	106,858		1,741,879
1959	2,067,436	89,792		2,157,227
1960	1,743,534	7,877		1,751,411
1961	2,073,326	77,282		2,150,608
1962	1,412,959	112,962		1,525,921
1963	1,035,603	54,003		1,089,605
1964	1,190,411	51,633		1,242,044
1965	628,425	0		628,425
1966	1,267,929	12,008		1,279,937
1967	605,729	22		605,751
1968	1,015,126	0		1,015,126
1969	2,035,000	0		2,035,000
1970	2,518,299	25,652		2,543,951
1971	1,334,156	29,855		1,364,011
1972	1,312,301	1,041		1,313,342
1973	2,353,307	85		2,353,392
1974	896,784	0		896,784
1975	1,787,159	186,526		1,973,685
1976	1,985,079	316,554		2,301,633
1977	2,121,939	390,689		2,512,628
1978	1,717,594	413,843		2,131,437
1979	1,252,835	116,786		1,369,621
1980	1,227,239	156,429		1,383,667
1981	1,778,975	87,988		1,866,963
1982	1,513,863	220,233		1,734,096
1983	2,769,565	385,881		3,155,446
1984	2,341,790	400,424		2,742,214
1985	2,291,841	357,154		2,648,995
1986	2,541,694	303,792		2,845,486
1987	2,539,017	169,038		2,708,055
1988	3,112,702	0		3,112,702
1989	2,377,393	198,468		2,575,860
1990	2,778,336	96,839		2,875,175
1991	2,830,921	48,201		2,879,121
1992	2,040,515	0		2,040,515
1993	1,679,570	235,279		1,914,849
1994	1,581,981	532,165		2,114,146
1995	1,115,975	602,097		1,718,071
1996	1,237,689	557,909		1,795,598
1997	1,223,283	460,157		1,683,440
1998	1,287,443	638,409		1,925,852
1999	1,377,387	586,321	265,313	2,229,021
2000	1,418,701	598,253	73,432	2,090,386
2001	1,236,517	623,173	73,468	1,933,158
2002	1,202,529	577,552	292,639	2,072,721
2003	1,388,046	583,051	268,252	2,239,350
2004	1,052,044	531,956	294,140	1,878,140
2005	1,103,347	773,182	275,094	2,151,624
2006	1,124,246	838,219	279,980	2,242,446
2007	1,309,528	916,507	286,479	2,512,514
2008	1,291,087	950,135	307,033	2,548,255

Well Performance and Status

The pumpage and behavior of each well in terms of chlorides and water levels are provided on pages 61-77 of this chapter, in Figures 3-43 to 3-59. In water levels graphs for all wells, the green line is the initial water level, the yellow line is the action level set in the Lana‘i Water Company, Inc.’s (LWCI’s) operating guidelines, the red line is the lowest allowable level set in the same guidelines, the pink is the CWRM trigger for designation proceedings, and the dotted black line is the pump level as of the drafting of this document. The red and pink lines are normally so close as to be indistinguishable at the scale presented.

Water levels for the brackish Wells 1, 9 & 14 show a declining trend. Water levels at Well 3 are stable, though the well has not been pumped in some time. Water levels in Wells 6 and 8 show more gradual declining trends, although the pump in Well 8 was recently lowered by 80’ (September, 2009). Water levels for Wells 2 and 4 appear relatively stable.

FIGURE 3-42. Low Water Levels vs. Pump Levels and High Water Levels vs. Action Levels

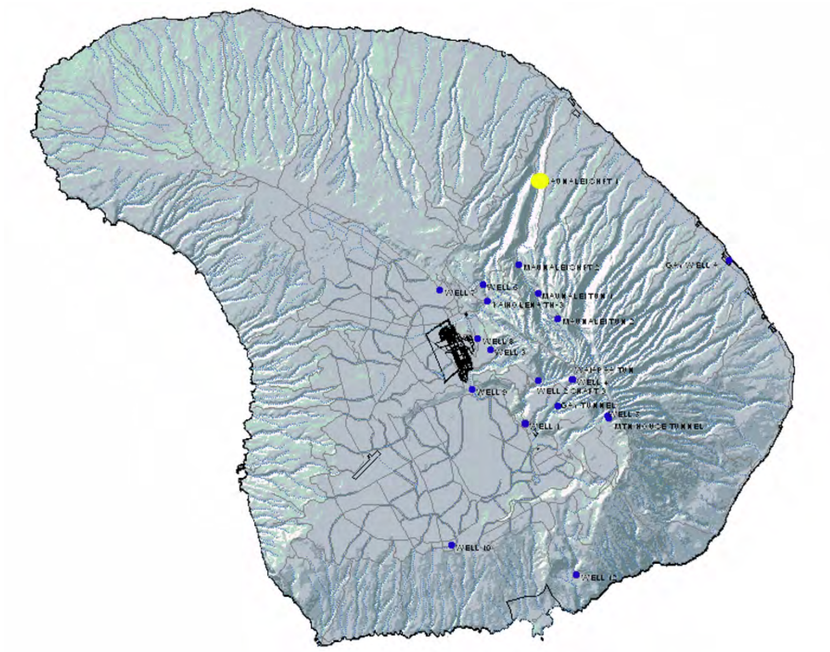
Well	Pump Intake Level	Low Water Level	Data * Date	Action Level	High Water Level	Data * Date
Maunalei Shaft 2	no data	668	P2, 1995	none	681	P2, 1995
Well 1	677**	555		550	575	
Well 2	1330	1,398	P10, 2006	1,050	1,441	
Well 3	812	874	P6, 2006	750	992	
Well 4	1316	1,457		1,100	1,495	
Well 5	1293	1,397	P10, 1993	1,100	1,491	
Well 6	868	913		750	924	
Well 7	840				973	P2, 2004
Well 8	863***	904		750	944	
Well 9	461	598		550	650	
Well 12						
Well 14	361	478		400	497	

* All water level data from Period 7, 2009 unless otherwise noted.

** Well 1 pump intake level is 677 per CWRM data. Water levels are lower than that. Follow up in progress as of this draft.

** Well 8 pump level as of Period 7 was 863.17’. Pump was lowered 80’ to 783.17’ in September, 2009.

FIGURE 3-43. Maunalei Shaft 1



Maunalei Shaft 1

Well No.	5253-01
Drilled	1936
Ground Elevation	294’
Depth	293’
Bottom of Hole	1
Initial Water Level	2.4’
Initial Chlorides	374 mg/L
Pump	Horizontal skimming shaft
Last Replaced	- - - - - -
Use	1937- ?

Notes:

Could never deliver more than 100,000 GPD without appreciable increase in chlorides.

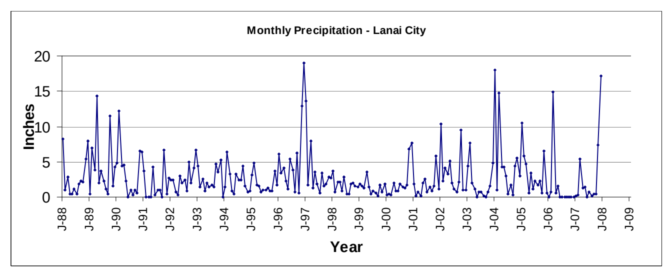
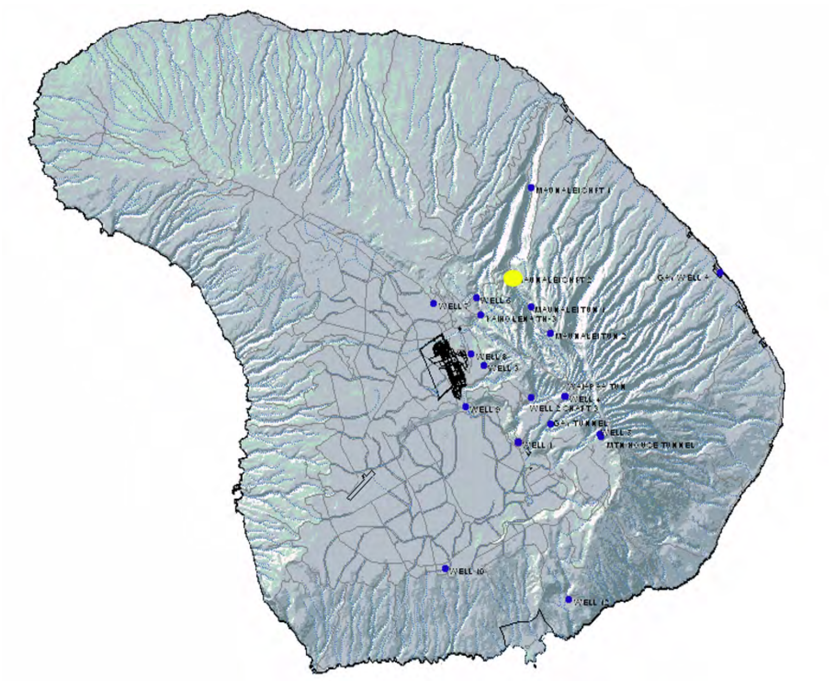
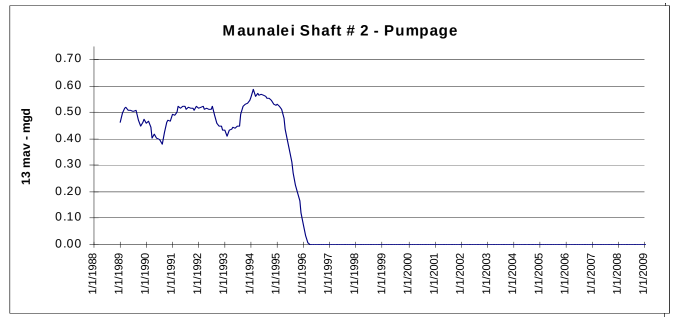
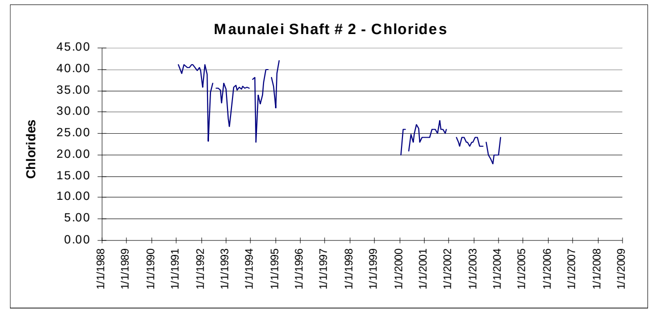
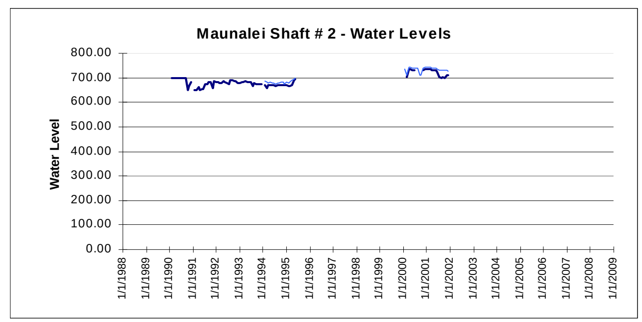


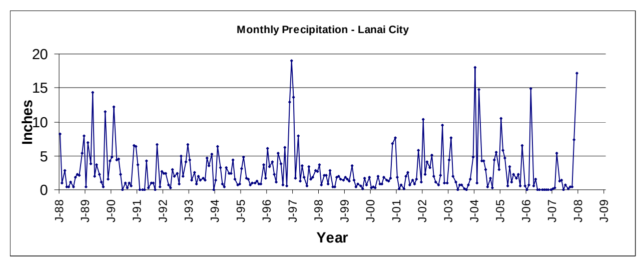
FIGURE 3-44. **Maunalei Shaft 2**











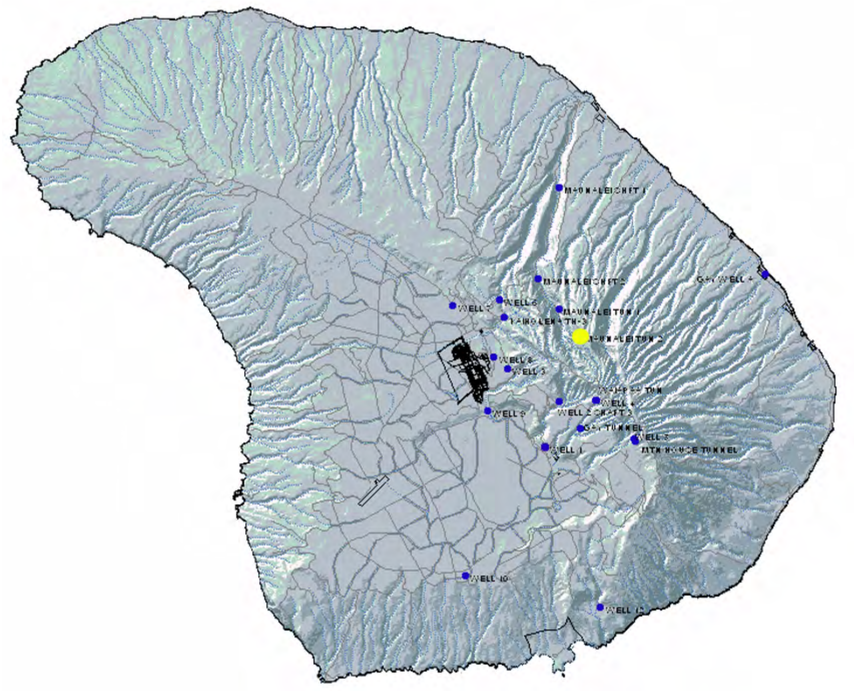
Maunalei Shaft 2

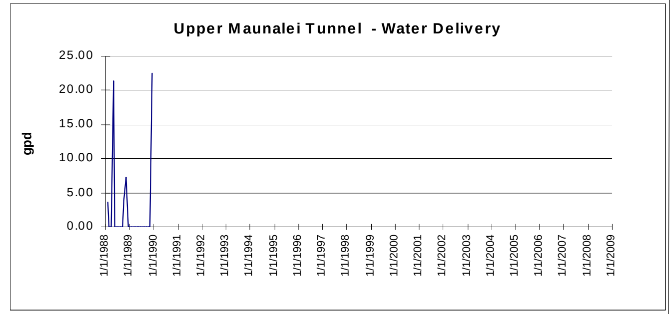
Well No.	5154-01
Drilled	1936
Ground Elevation	851' (875' at portal)
Depth	372'
Bottom of Hole	479'
Initial Water Level	739'
Initial Chlorides	31 mg/L
Pump	500 gpm electric line shaft
Last Replaced	1987 reconditioned
Use	1937- 1995 potable off line since 07/95

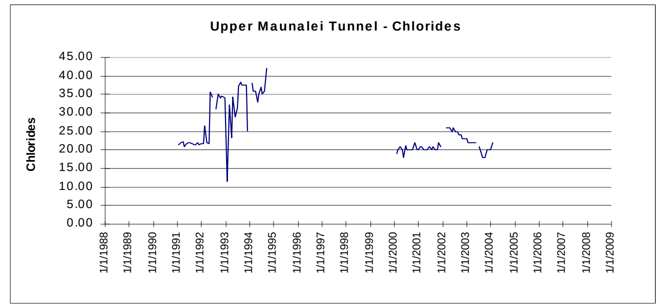
Notes:

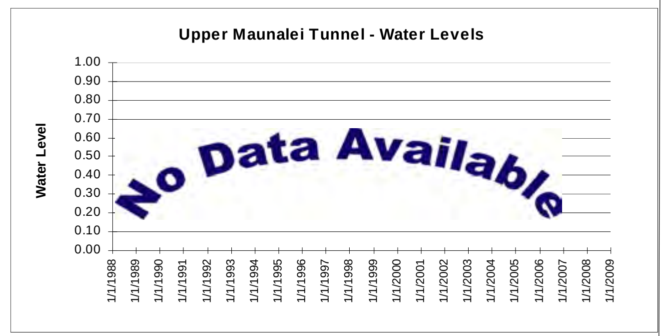
Shaft 2 was once the major source for Lana`i City. It had a 600 GPM submersible pump per 1991 sanitary survey, 900 GPM per 1998 sanitary survey. Not mentioned in 2005 sanitary survey. Booster Byron Jackson VLT vertical booster - variable 0 to 600 GPM 200 HP, 3600 RPM, 444 VP Frame, 225 Amp F1 Electric Motor. One hundred thirty five feet down from the entrance to shaft 2 is a vertical well. Water was pumped to a booster station. A 1989 report noted water levels dropping in both Maunalei Tunnels & Maunalei Shaft due to drought conditions. Periodic Water Reports indicate zero use starting in 1995.

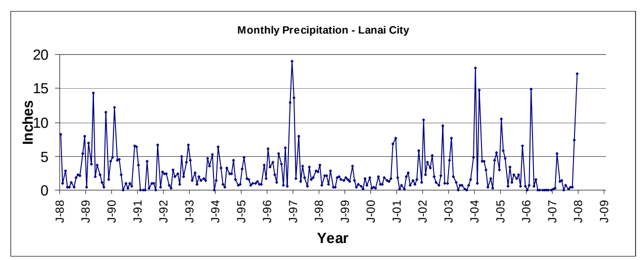
FIGURE 3-45. Maunalei Tunnel - Upper











Maunalei Tunnel 2 ("Upper")

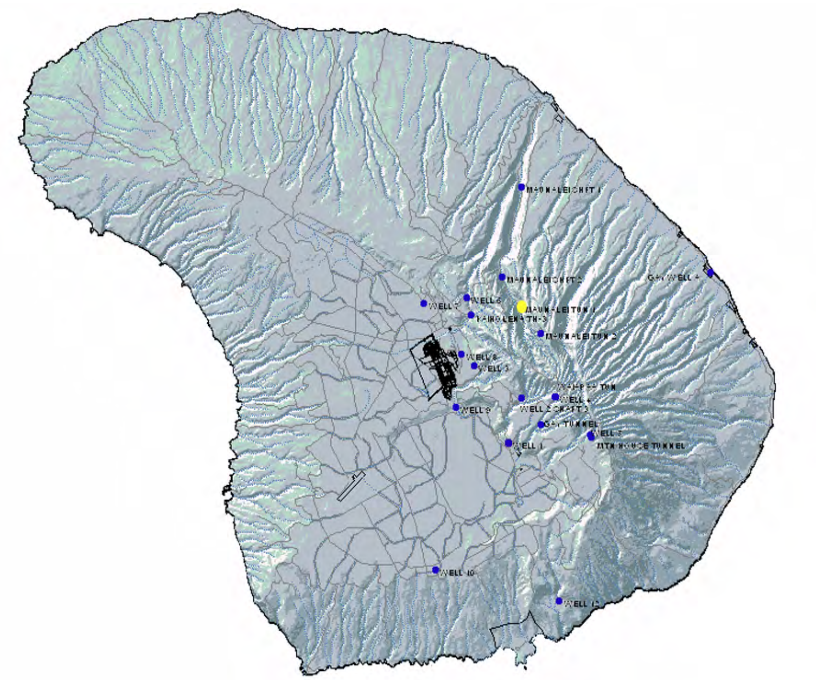
Well No.	5053-02
Drilled	1911
Ground Elevation	1,500'
Depth	- - - - - -
Bottom of Hole	- - - - - -
Initial Water Level	1,500
Initial Chlorides	- - - - - -
Pump	- - - - - -
Last Replaced	- - - - - -
Use	1926-1991 potable

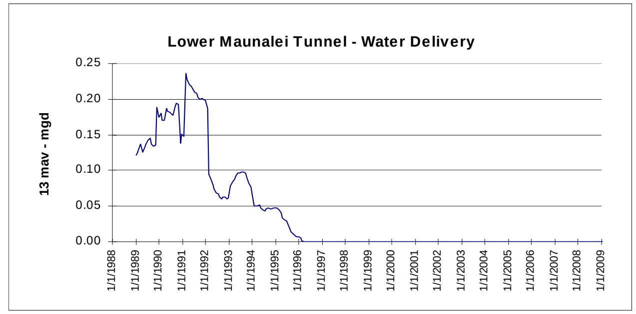
Notes:

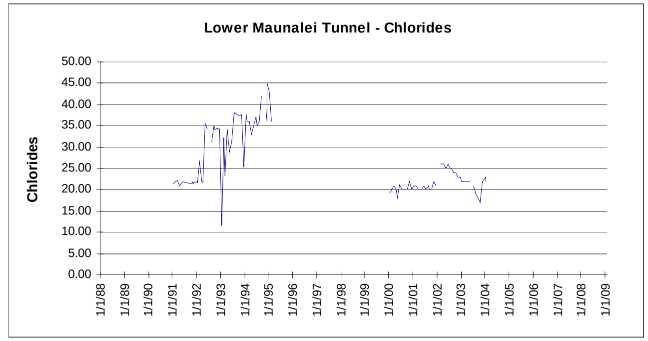
Was once major source for city. Combined yield of Upper & Lower tunnels was once about 275,000 GPD, with another 220,000 GPD from the shaft, or nearly half a million GPD from the combined Maunalei sources. A 1989 company report notes water levels dropping in both Maunalei Tunnels & Maunalei Shaft due to drought conditions. Periodic Water Reports indicate no flows as of 1995. However, 1998 Sanitary Survey indicates that the Lower Tunnel still provides water to a boy scout camp & a bee keeping facility. 30,000 gallon steel tank is chlorinated manually to accommodate events. Costs of using Maunalei to serve city considered too high. Tunnels could be GWUDI.

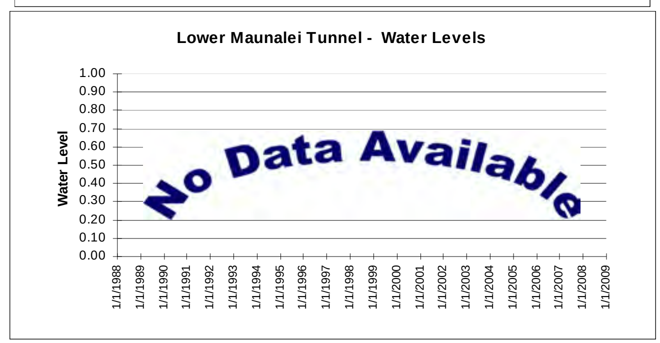
.

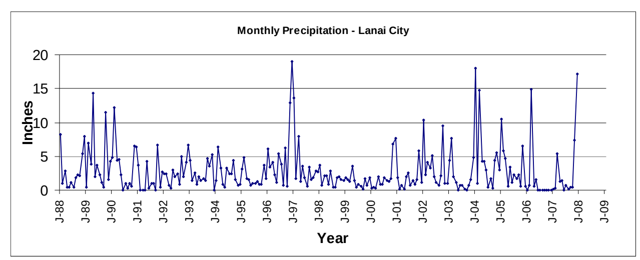
FIGURE 3-46. Maunalei Tunnel - Lower











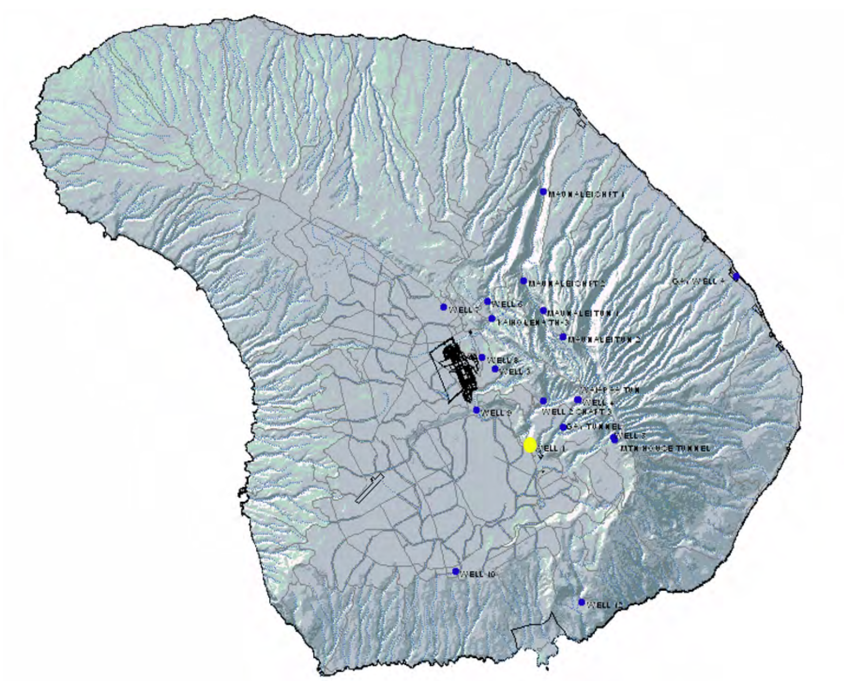
Maunalei Tunnel 1 ("Lower")

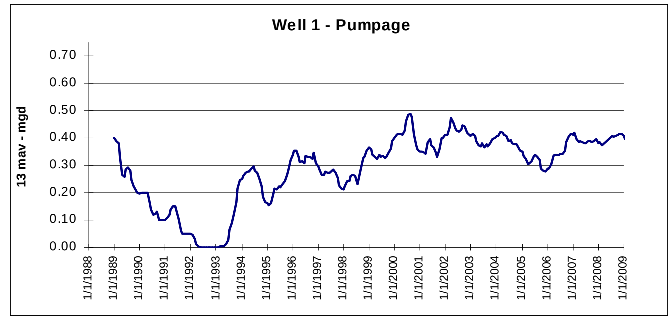
Well No.	5053-01
Drilled	1911
Ground Elevation	1,103'
Depth	- - - - - -
Bottom of Hole	- - - - - -
Initial Water Level	1,103
Initial Chlorides	- - - - - -
Pump	- - - - - -
Last Replaced	- - - - - -
Use	1926-1995 potable

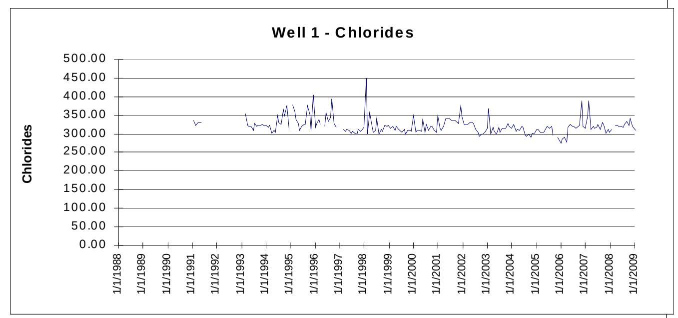
Notes:

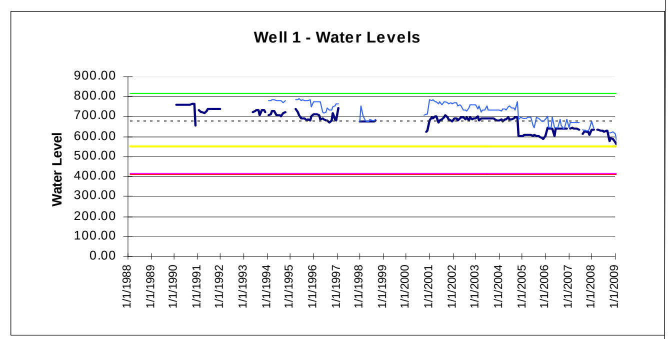
Was once major source for city. Combined yield of Upper & Lower tunnels was once about 275,000 GPD, with another 220,000 GPD from the shaft, or nearly half a million GPD from the combined Maunalei sources. A 1989 company report notes water levels dropping in both Maunalei Tunnels & Maunalei Shaft due to drought conditions. Periodic Water Reports indicate no flows as of 1995. However, 1998 Sanitary Survey indicates that the Lower Tunnel still provides water to a boy scout camp & a bee keeping facility. 30,000 gallon steel tank is chlorinated manually to accommodate events. Costs of using Maunalei to serve city considered too high. Tunnels could be GWUDI.

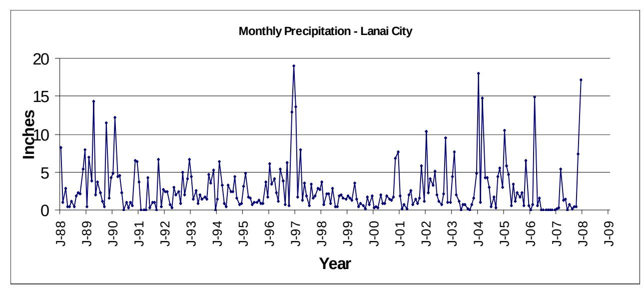
FIGURE 3-47. Well 1











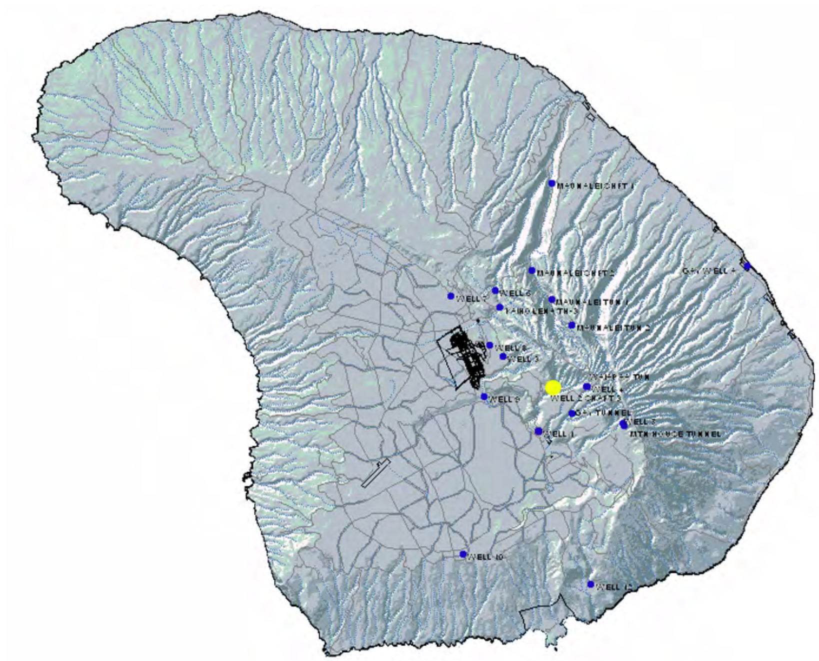
Well 1

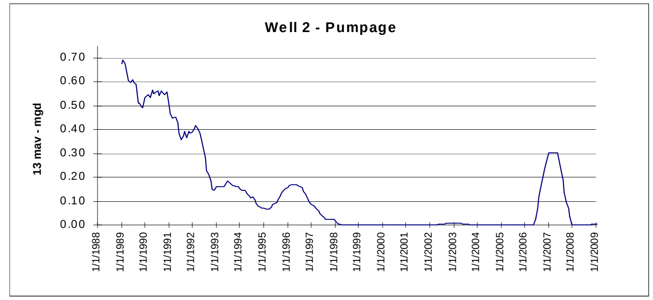
Well No.	4853-02
Drilled	1945
Ground Elevation	1,265
Depth	1,274
Bottom of Hole	-9
Initial Water Level	876
Initial Chlorides	- - - - - mg/L
Pump	340 GPM submersible Crown 3,470 RPM, 9 Stages Hitachi 100 HP Motor Installed 2005
Rebuilt and Drive Line	
Shaft Replaced	1987
Motor Replaced	2005
Used	1937-Present Irrigation - Manele

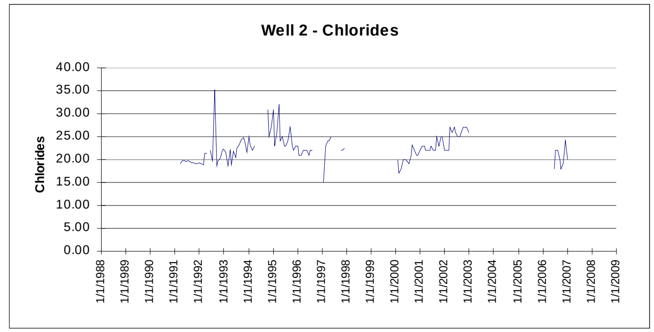
Notes:

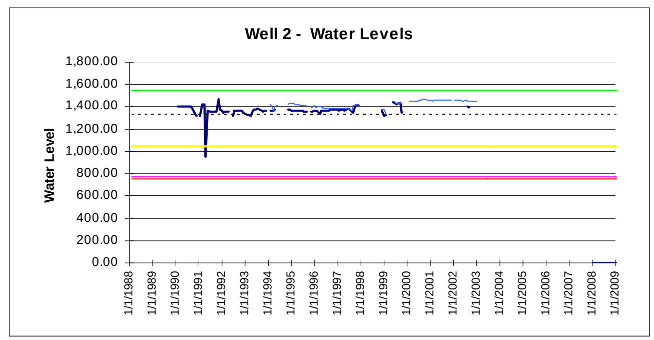
“Due for major overhaul” *JH Parker, 1989*
600 GPM pump 2002
Throttled back to 300 in October 2003
Replaced with 340 GPM pump in 2005

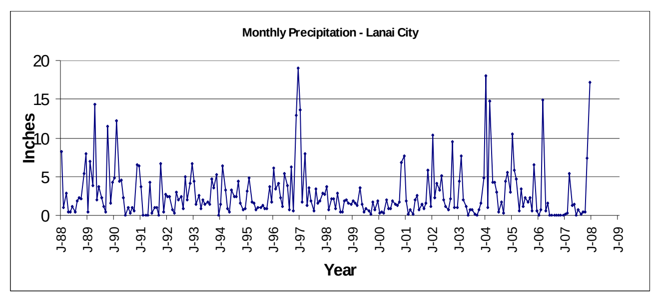
FIGURE 3-48. Well 2 / Shaft 3









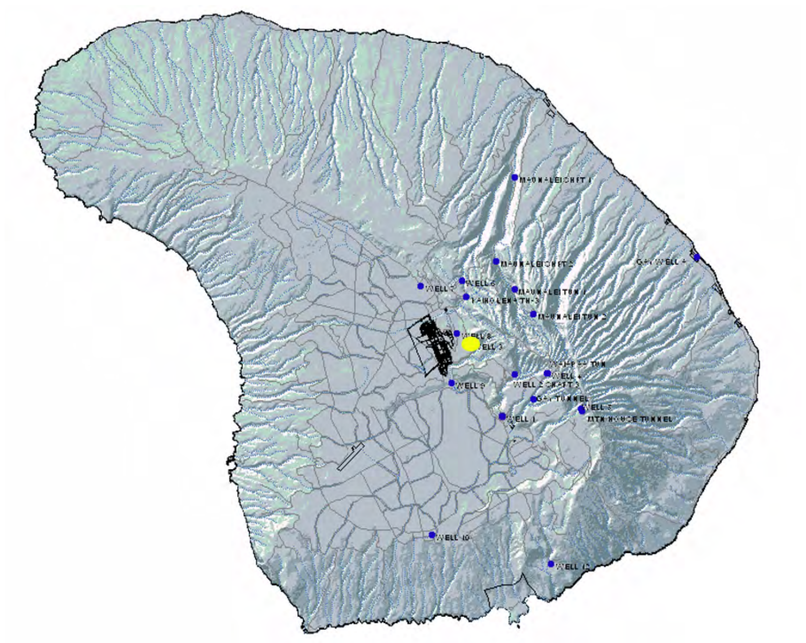


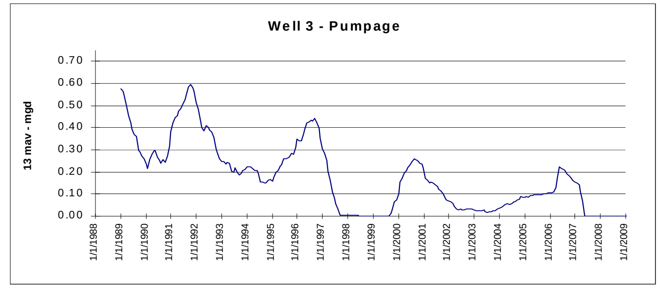
Well 2 / Shaft 3

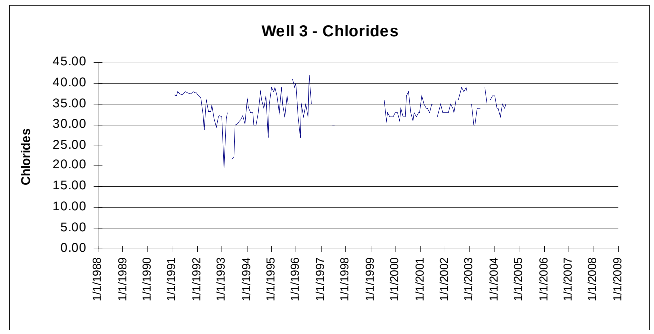
Well No.	4953-01
Drilled	1946
Ground Elevation	1,510'
Depth	609
Bottom of Hole	901'
Initial Water Level	- - - - - - -
Initial Chlorides	- - - - - - - mg/L
Pump	1200 GPM vertical turbine Fairbanks Morse Pomona Ingersoll Rand Booster 75 HP Electric motor FL Amp 90 480 Volt
Last Replaced	- - - - - -
Use	1946 - present Potable. Used for irrigation in past.

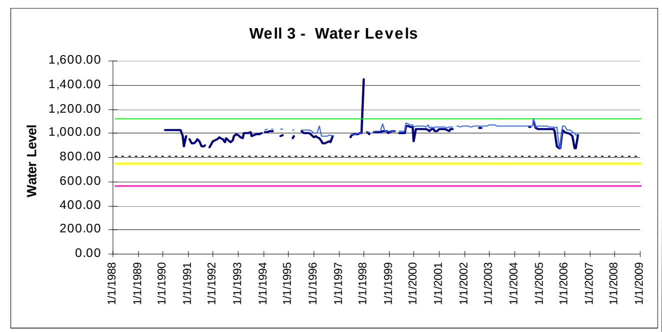
Notes: Well 2 / Shaft 3 was once the major source for the plantation Water deliveries declined during the 1980s "due to drought". By 1989, the pump was nearing need of replacement. A 1989 report listed the pump as an electric powered line shaft.

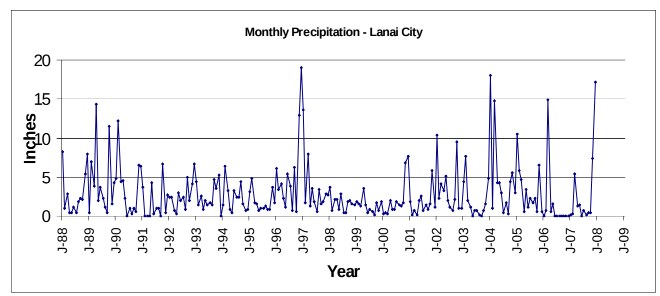
FIGURE 3-49. Well 3 - Old









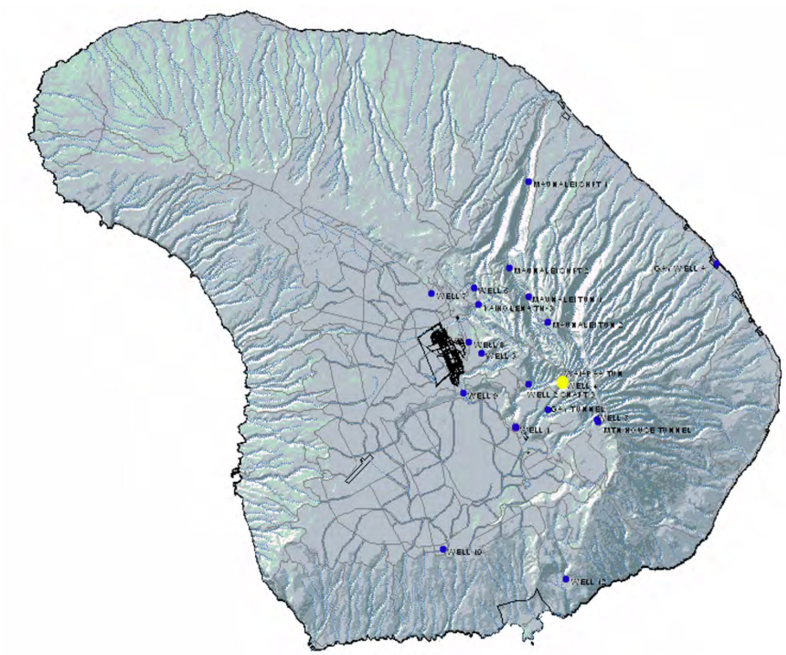


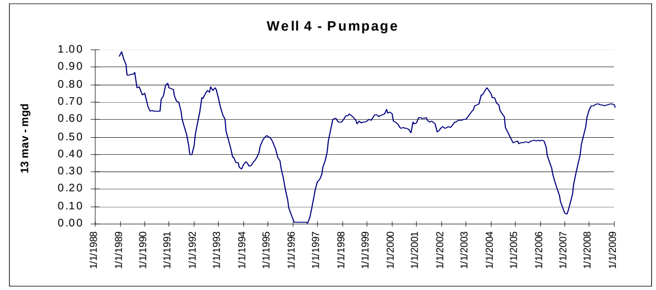
Well 3 – "Old" (No Well Completion Report for New Well 3 Yet)

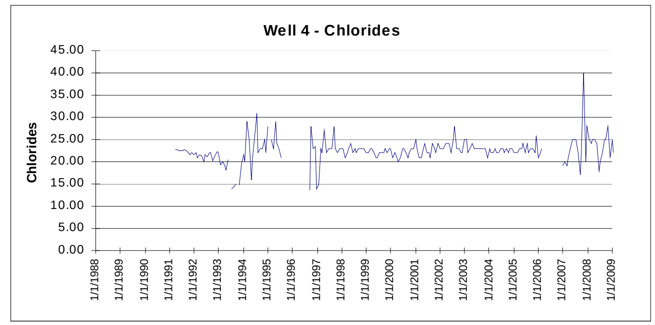
Well No.	4954-01
Drilled	1950
Ground Elevation	1,850'
Depth	1,199
Bottom of Hole	651'
Initial Water Level	1,078'
Initial Chlorides	- - - - - - - mg/L
Pump	900 GPM Byron Jackson submersible 300 HP electric motor FL Amp 74
Last Replaced	1978
Use	1950 - present Potable. Used for irrigation in past. Could serve City or Manele.

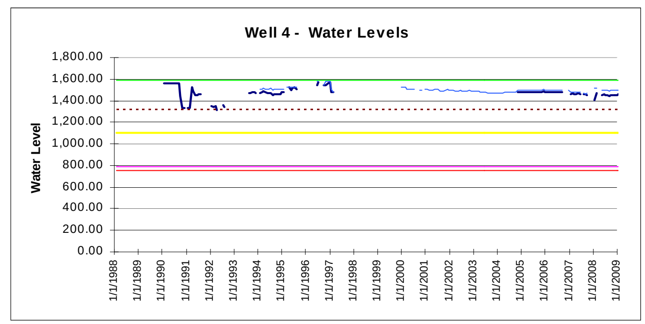
Notes:

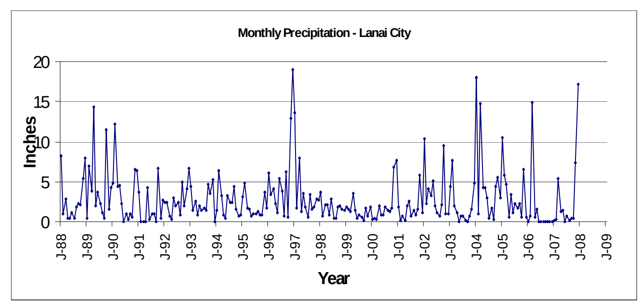
FIGURE 3-50. Well 4









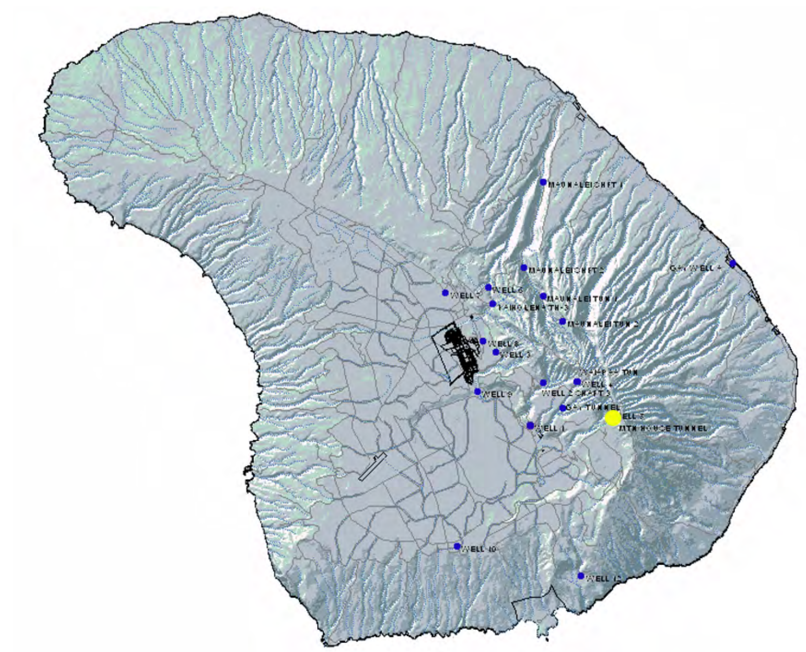


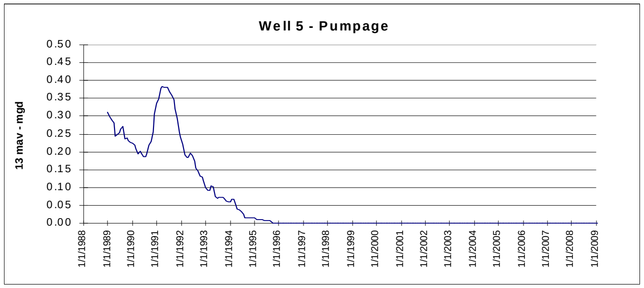
Well 4

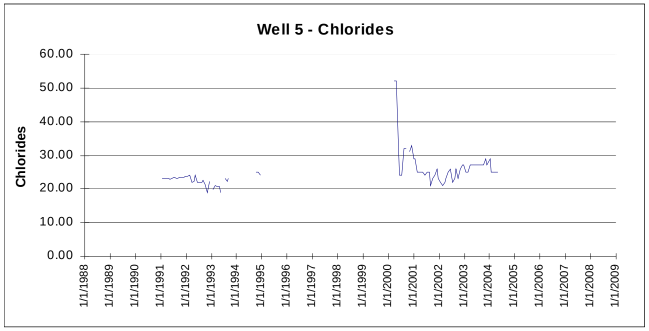
Well No.	4952-02
Drilled	1950
Ground Elevation	2,327’
Depth	1,178’
Bottom of Hole	1,149’
Initial Water Level	1,576’
Initial Chlorides	- - - - - - - mg/L
Pump	900 GPM submersible Byron Jackson 300 HP electric motor 2300 volts
Last Replaced	Motor Replaced 2006, 1984
Use	1950 - present Potable. Can be used for irrigation too.

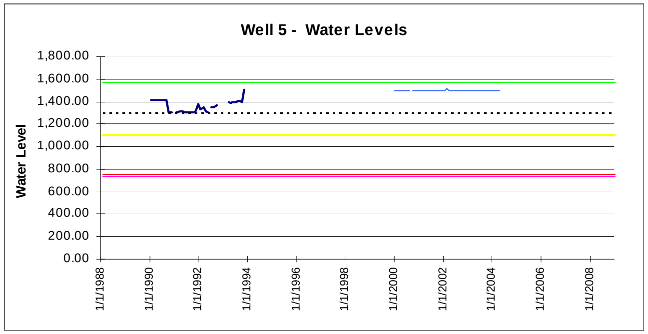
Notes: As of the 1989 report, this was the “best” well on the island, carried 20% of the withdrawal load. Per 1999 sanitary survey, average flow was 1,000 GPM.

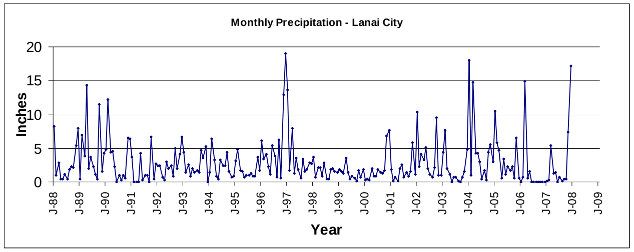
FIGURE 3-51. Well 5









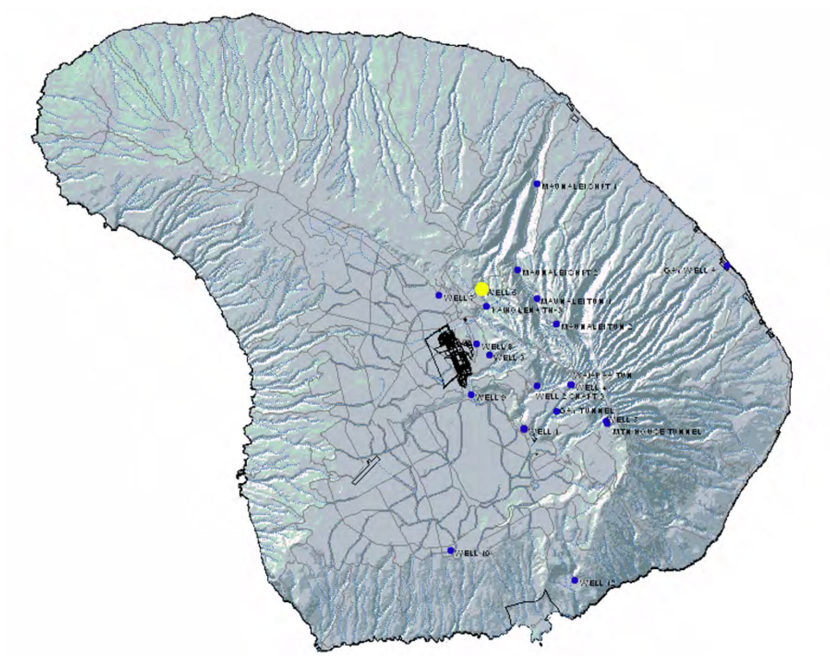


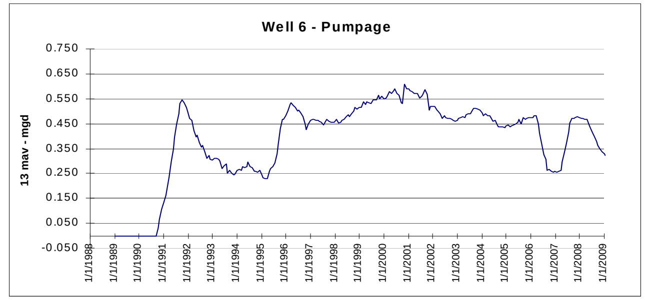
Well 5

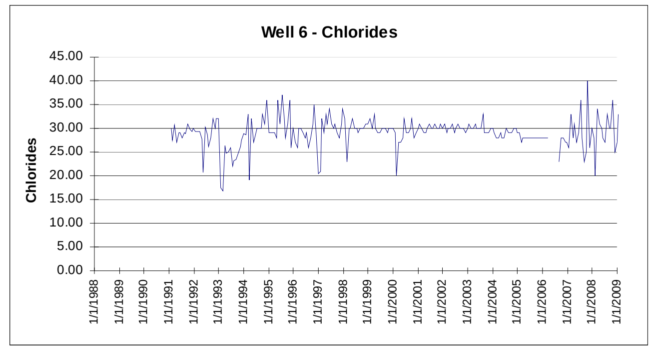
Well No.	4852-02
Drilled	1950
Ground Elevation	2,296’
Depth	1,122’
Bottom of Hole	1,174’
Initial Water Level	1,548’
Initial Chlorides	- - - - - - - mg/L
Pump	900 GPM submersible Byron Jackson
Last Replaced	1984
Use	Not in use since 1994. Potable or Irrigation. Was used for irrigation - especially as back-up for south slopes

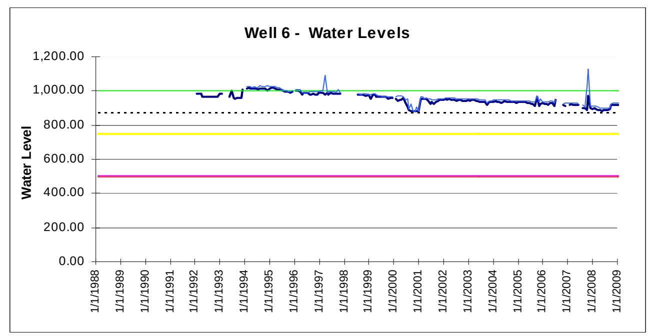
Notes: Water deliveries from this pump were declining by the late 1980s.

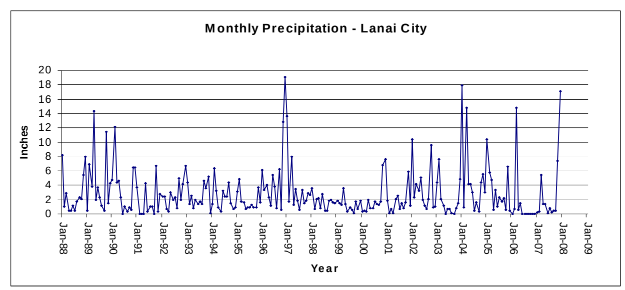
FIGURE 3-52. Well 6









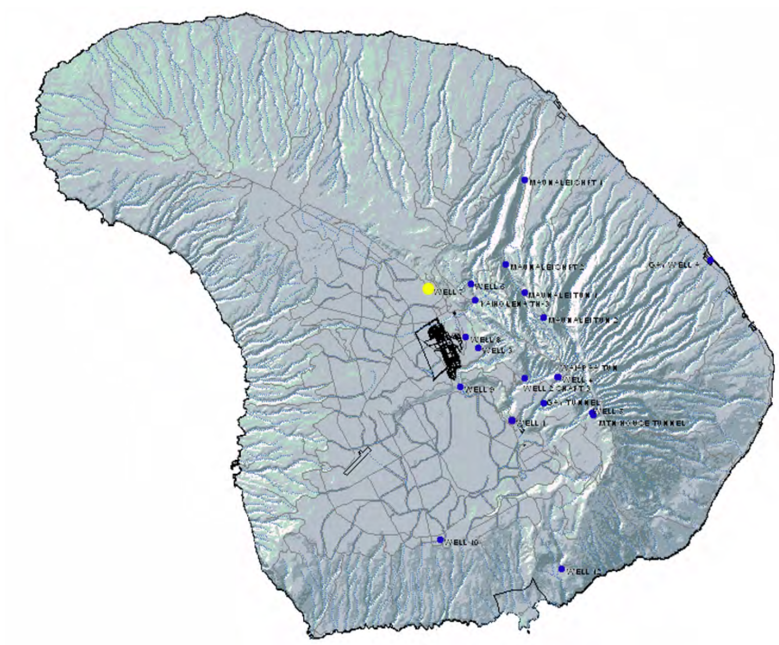


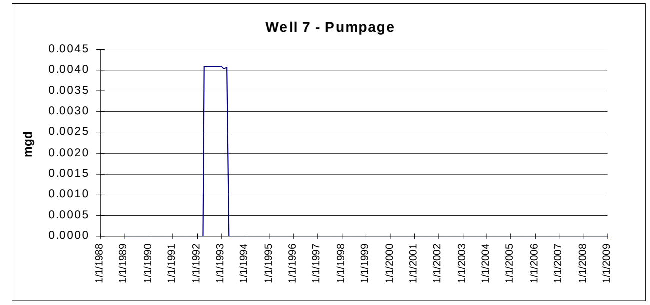
Well 6

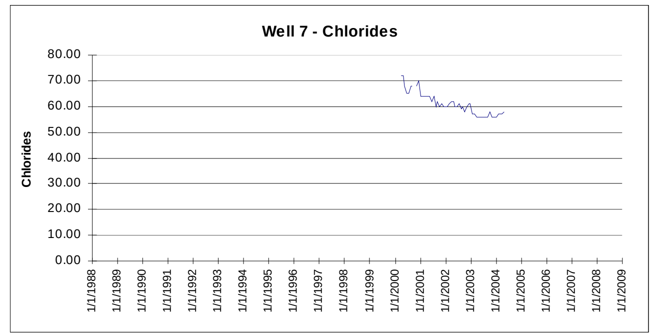
Well No.	5054-02
Drilled	1986
Ground Elevation	1,910’
Depth	1,310’
Bottom of Hole	600’
Initial Water Level	1,005’
Initial Chlorides	23 mg/L
Pump	550 GPM submersible Byron Jackson 1800 RPM
Motor	200 HP Type H 14” Volt
Last Replaced	2006
Use	1990-present Potable Municipal

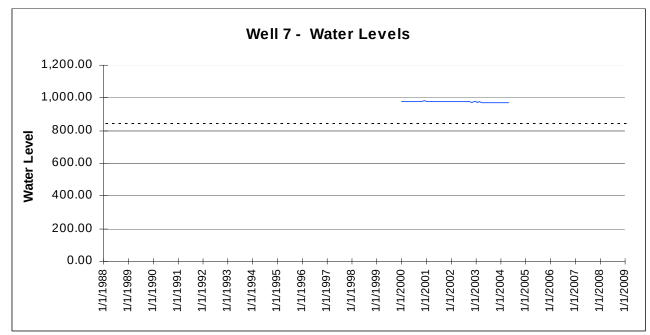
Notes: Currently serves Lana`i City & related areas.
1998 & 2005 sanitary survey noted 900 GPM submersible pump.

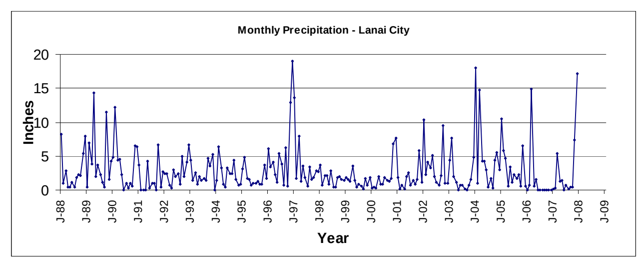
FIGURE 3-53. **Well 7**









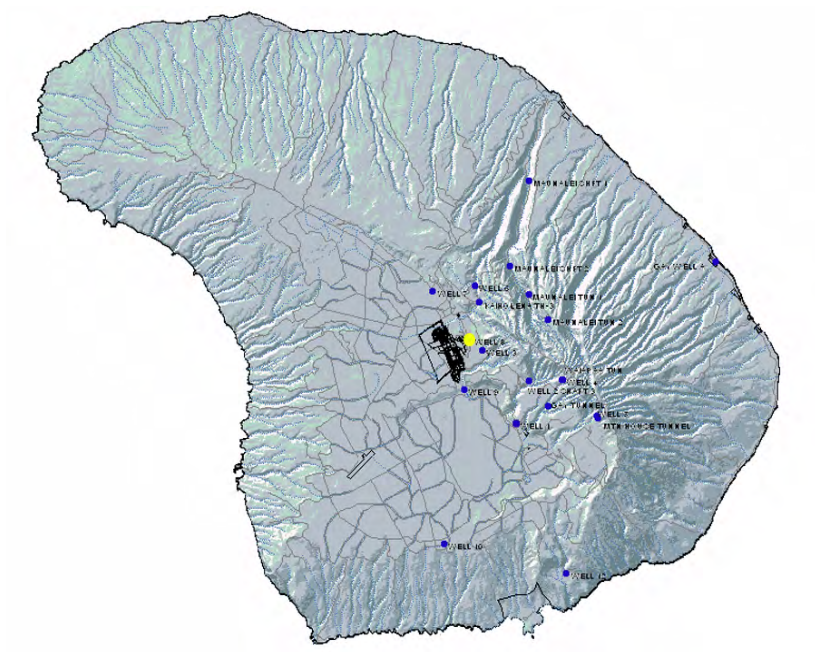


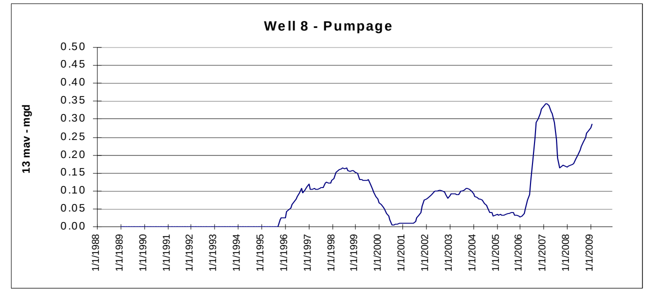
Well 7

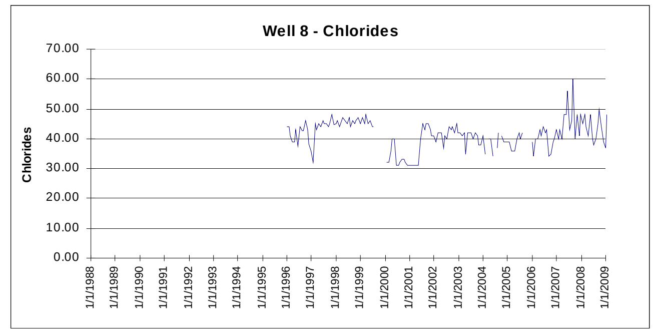
Well No.	5055-01
Drilled	1987
Ground Elevation	2,100'
Depth	1,650'
Bottom of Hole	450'
Initial Water Level	650'
Initial Chlorides	67 mg/L
Pump	Was 500 GPM Layne Bowler Vertical turbine oil lubricated Cumming NTA 8559 Prime Mover Engine 230 Net BHP, 1800 RPM
Last Replaced	1987
Use	Not in use Potable Irrigation or Municipal

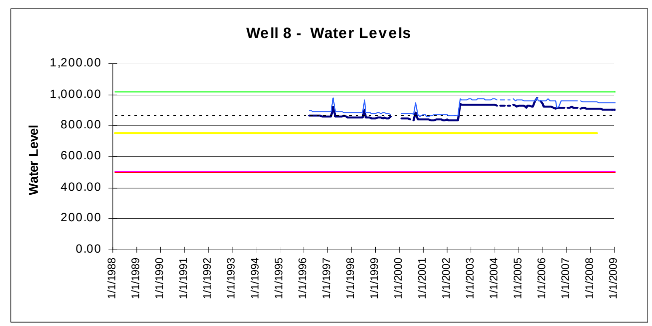
Notes: Had direct feed to the irrigation system at the north end of the plantation.

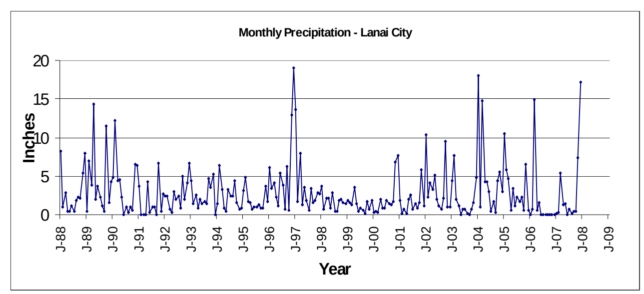
FIGURE 3-54. Well 8











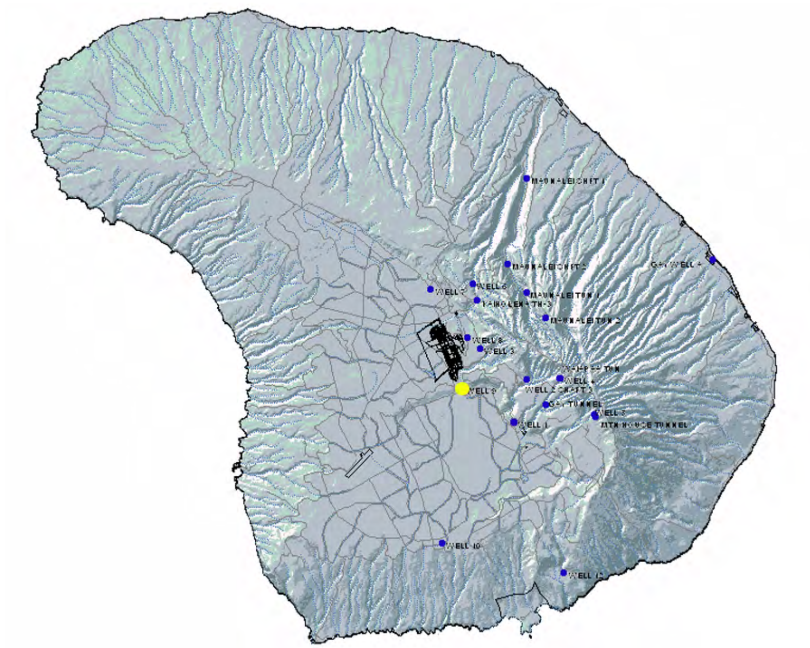
Well 8

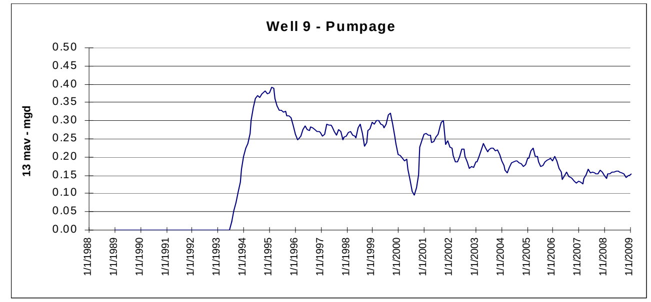
Well No.	4954-02
Drilled	1990
Ground Elevation	1,902
Depth	1,490'
Bottom of Hole	412'
Initial Water Level	1,014'
Initial Chlorides	40 mg/L
Pump	850 GPM submersible Byron Jackson 300 HP Type H 14" Byron Jackson Motor F1 Amp 74 2300 Volt
Last Replaced	1991
Use	1995-present Potable. Municipal.

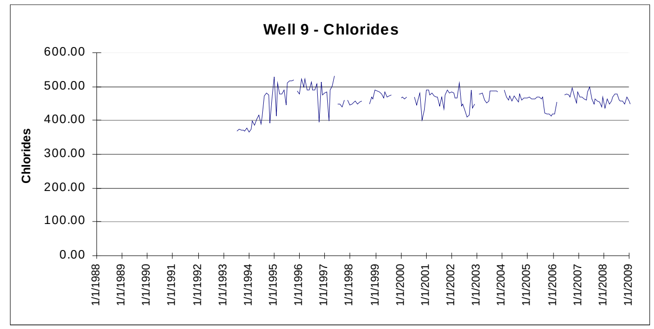
Notes

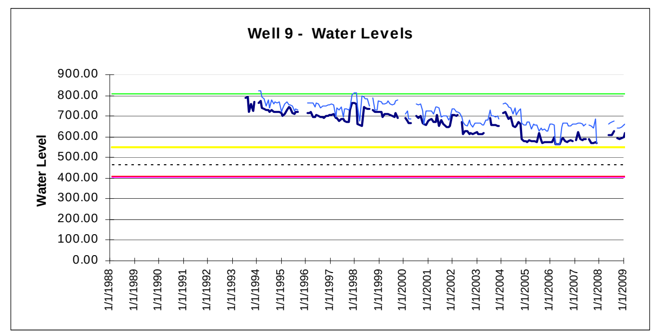
1998 sanitary survey noted avg flow of 705 GPM.
Rise in water levels reported in 2002 appears to have been due to a change in measurement method.

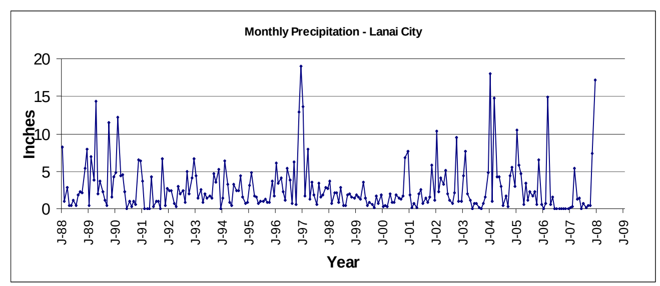
FIGURE 3-55. Well 9







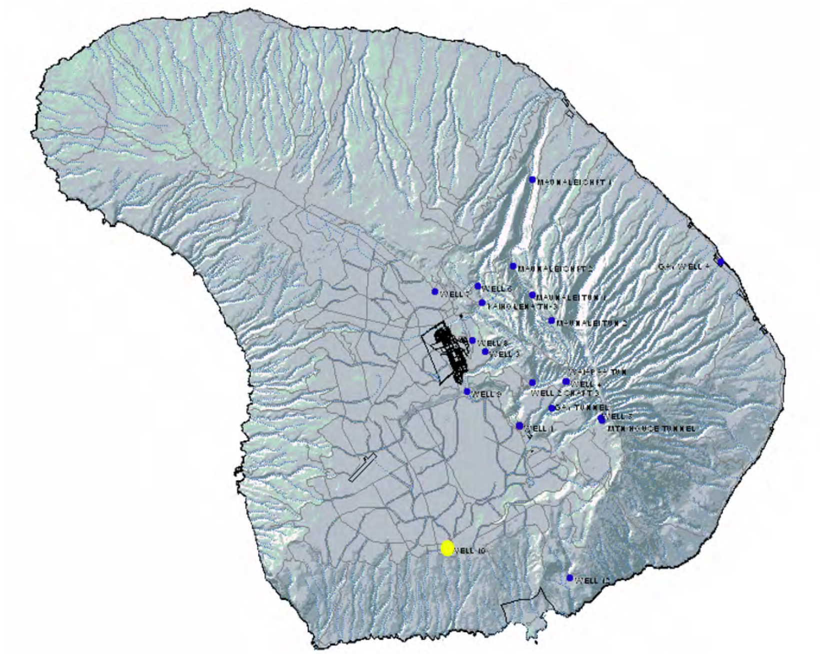




Well 9

Well No.	4854-01
Drilled	1990
Ground Elevation	1,411
Depth	1,451'
Bottom of Hole	-40'
Initial Water Level	808
Initial Chlorides	- - - - - - mg/L
Pump	300 GPM submersible Byron Jackson Franklin Electric 100 HP F1 Amp 148 480 Volt
Last Replaced	Motor, 2005, Pump, 1993
Use	1994-present Manele GC & Landscape Irrigation Pump lowered 42' in 10/2003

FIGURE 3-56. Well 10



This experimental well was drilled in part to try to test the extent of the utilizable aquifer at the edges of the Palawai Basin.

Well 10

Well No.	4555-01
Drilled	1989
Ground Elevation	1,228'
Depth	1,020'
Bottom of Hole	208'
Initial Water Level	208'
Initial Chlorides	1,300 or 330 mg/L *
Pump	300 GPM
Last Replaced	1993
Use	
Notes:	*Discrepancy between CWRM database and Lana`i Water Resources Report. Lana`I WR report est of 1,300 mg/L makes more sense at that elevation.

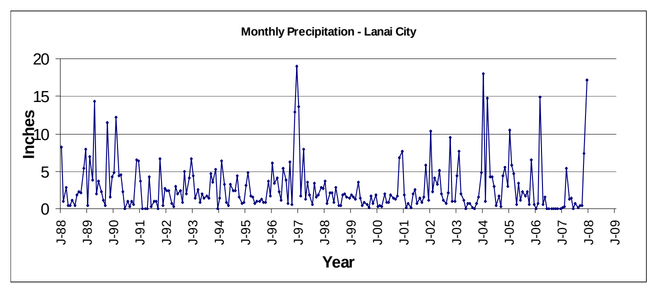
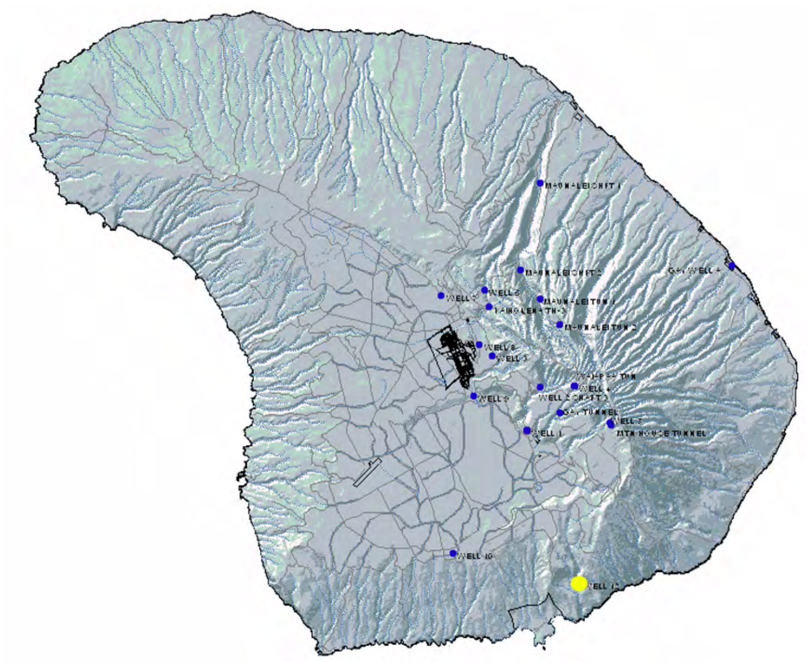
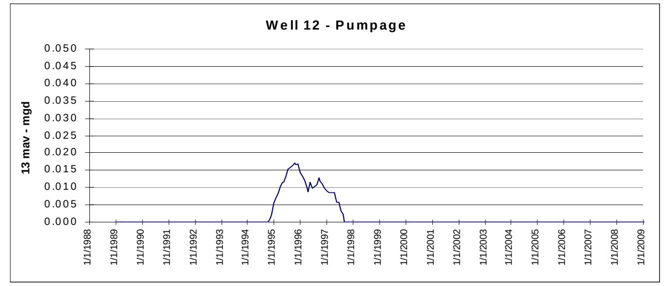
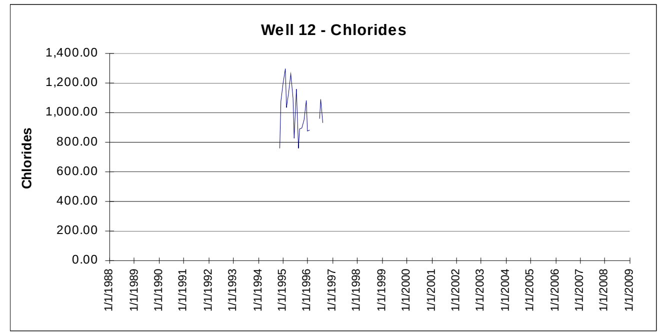
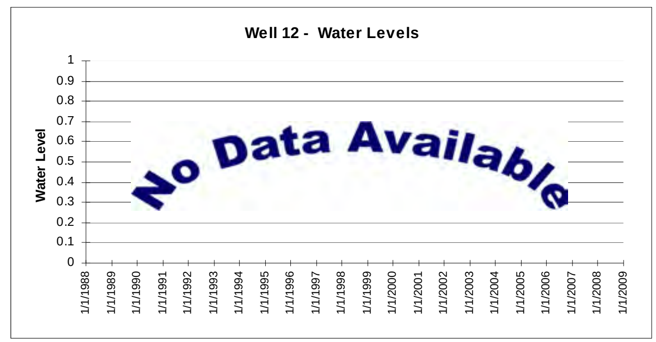


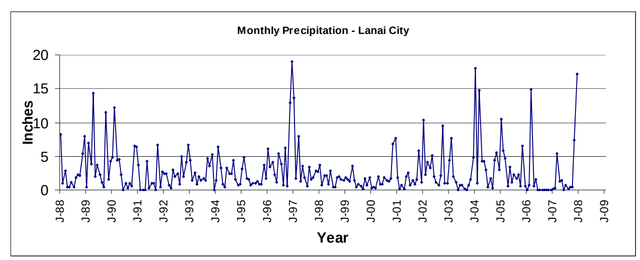
FIGURE 3-57. Well 12







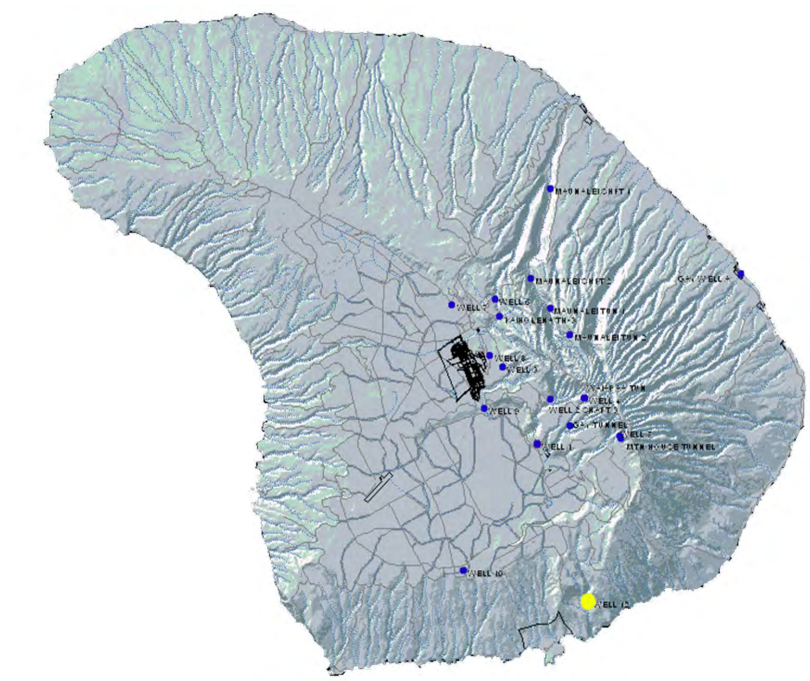




Well 12

Well No.	4552-01
Drilled	1990
Ground Elevation	605'
Depth	630'
Bottom of Hole	-20'
Initial Water Level	55'
Initial Chlorides	708 mg/L
Pump	Was 100 GPM submersible Pflueger/Worthington 3600 RPM Pfleuger 60 HP water-filled hi temp Winding F1 Amp 90 480 volt
Last Replaced	1993
Use	Not in use
Notes:	Intended for Manele GC & landscape irrigation.

FIGURE 3-58. Well 13



Well 13

Well No.	4553-01
Drilled	1990
Ground Elevation	695'
Depth	750'
Bottom of Hole	- 5'
Initial Water Level	20'
Initial Chlorides	- - - - - - mg/L
Pump	- - - - - -
Last Replaced	
Use	Not in use

Notes: Was Intended for Manele GC & landscape irrigation. Pump tests showed production capacity too low.

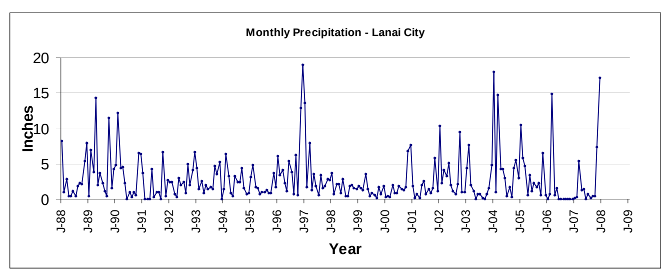
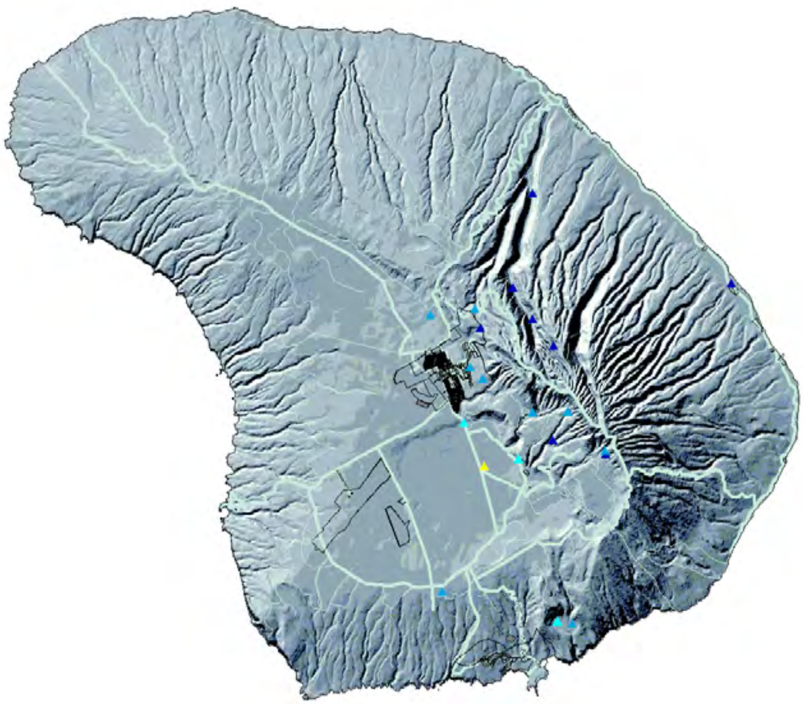
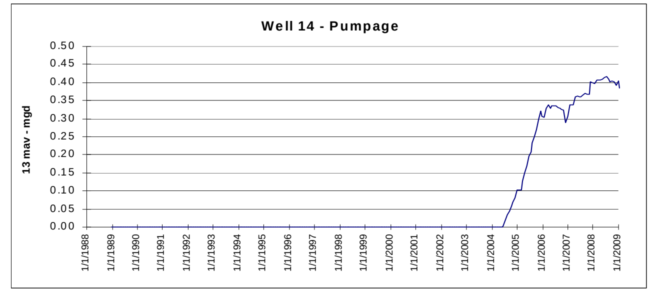
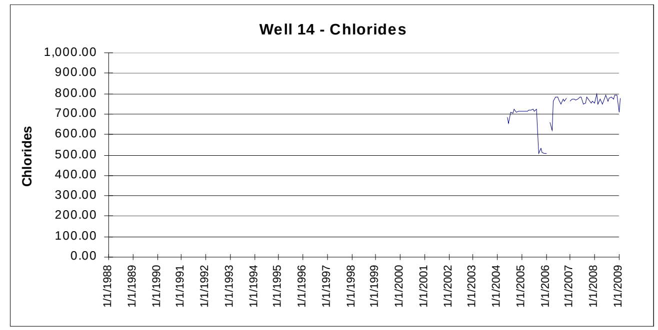
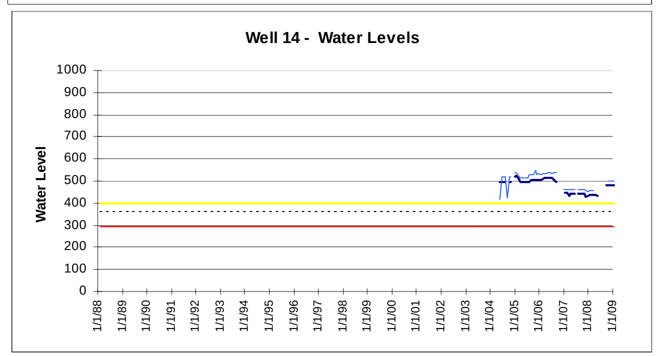


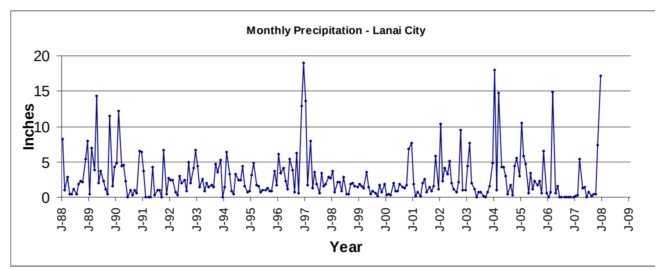
FIGURE 3-59. Well 14











Well 14

Well No.	4854-02
Drilled	1995
Ground Elevation	1,193'
Depth	950'
Bottom of Hole	244'
Initial Water Level	551.1'
Initial Chlorides	710 mg/L
Pump	Submersible Byron Jackson 300 GPM, 125 HP Hitachi Motor 480 Volts
Last Replaced	2003
Use	Manele Irrigation

Notes:

System Finance And Economics

A cursory analysis of the financial situation of the Lana‘i Water Company reveals that existing rates and fees are not adequate to fully recover current operating and maintenance costs. Nor would they provide enough revenue to cover necessary plant replacements.

Rates and fees for potable water from the Lana‘i Water Company, Inc., Brackish Water System, and for wastewater from Manele Water Resources, LLC are provided in Figures 3-61 to 3-63. Income and Balance Statements are provided in Figures 3-64 through 3-68. Annual water revenues for LWCI have recently been estimated at roughly $660,000. This represents only 46% of operating costs. Over half of the required revenues are borne by the parent company. These costs do not include most of the capital requirements for major asset replacements and additions delineated in this plan.

Both the Lana‘i Water Company, Inc. (LWCI), and Manele Water Resources, LLC are wholly owned subsidiaries of Lana‘i Holdings, Inc. (LHI). Source water production is metered and purchased by LWCI from LHI. A major cost component for LWCI operations, as shown in Figure 3-43 below, is purchase of source delivery. This was reflected in the 1995 PUC filing for potable water rates, as well as the 2008 PUC filing for brackish water rates. LWCI purchases water delivery from LHI at the following rates:

Potable water for Lana‘i City / Koele System 237	$2.12 / 1,000 gallons
Potable water for Manele / Hulopo‘e System 238	$2.12 / 1,000 gallons
Brackish water for Manele / Hulopo‘e System	$2.93 / 1,000 gallons

The last rate case for the potable systems was in 1995. Costs reported for that rate case are shown in Figure 3-60. Revenues for plant replacement were not reflected in this breakdown. Existing rates do not provide recovery of all existing and anticipated system costs. The rates were not structured for full cost recovery, but with the intention that the water utility would be subsidized by the parent company. Recent filings for Non-Potable Water Service by LWCI, as well as for rates for Manele Water Resources, LLC, were also structured with intention that these systems would be subsidized by the parent company, rather than achieve full cost recovery. In addition, current rates do not reflect the need to replace broad areas of the system that are fully depreciated. Long stretches of pipe between the City and Kaumalapau and within the Palawai Irrigation Grid are not only fully depreciated, but also in poor repair. Revenues going forward will need to accommodate replacement of plant facilities. Some system replacement may be provided for in the process of accommodating new or intensified development.

In order to evaluate the magnitude of system replacement needs, Department of Water Supply staff obtained maps of Lana’i water systems and facilities and, with consultation from Lana‘i Water Company staff, entered this information into a GIS system with known data on age, material and condition. Based upon information provided, over thirty million dollars worth of replacement and expansion needs were identified over the next 30 years. These are described and discussed further in Chapter 5 of this document. These estimates are consistent in general magnitude with other estimates that have been discussed. Brown & Caldwell identified over $15 million in asset replacement alone (not including expansion) needed over the next twenty years (*DRAFT Lanai System Acquisition Appraisal*, Brown & Caldwell, May 29, 2009) , and an older plan by R.M. Towill Corporation identified $10.45 million in a five year plan (*Castle and Cooke Resorts LLC's Proposed Water Supply and Demand Plan for the Island of Lana'i,* December 2004, RM Towill Corporation).

For the purpose of examining specific capital options and /or demand side management options, an effort was made to estimate the marginal costs of serving water from the various existing sources of the island. The marginal costs of production are the increase in total costs as a result of producing one extra unit. The weighted district marginal costs of production per thousand gallons, based on the calculations in the table in Figure 3-69, were about $2.17 for Lana'i City and Koele districts, $1.77 for Manele potable district, and about $1.71 for the brackish Manele system. The estimated costs are lower than the costs charged, because they do not include all the costs of serving water from these wells, but only the marginal costs of production of the wells, primarily electrical power costs of pumping. Large capital replacements, administrative costs, "purchase of water" agreements and other costs are not reflected. What is reflected is the relative marginal cost of serving water based on elevation, water levels and system parameters. These relative costs are informative for resource planning and considering long term capital and operating investments discussed in Chapter 5.

Costs of operating these wells are affected by energy costs, which have been volatile in recent years. In addition, the status of the aquifer itself can affect pumping costs. As water levels in an aquifer decline, water must be lifted greater distances to the surface. This results in increased pumping expenses. A comparison of Figure 3-9 (page 3-12) and Figure 3-69 (page 3-89) helps to illustrate this point. The blue columns on page 3-12 illustrate the pumping lift of each well. In general, the shorter the column, the more economical the well. As water levels decline, pumps are asked to produce a greater lift, (a longer column), so declining water levels render wells more expensive to pump. Figure 3-9 (page 3-12) is a snapshot of aquifer status at each well, showing high and low water levels as of Period 7, 2009. In contrast, the table in Figure 3-69, uses the the lowest water level reported in recent years. Since lower water levels increase pumping lift, the lowest water levels result in the most expensive actual pumpage on a given well, yielding a conservative estimate of marginal costs. Even with these differences, Figure 3-9 illustrates the crux of the information in Figure 3-89. Both figures indicate that Well 2 could be the most economical well to operate, if safety and other logistical issues were resolved.

Although water levels have been declining in several wells, in most cases they remain hundreds of feet from the levels which would trigger designation proceedings. Pumps at several wells are likely to be lowered again during the planning period. Costs of pumping will rise with increasing pump-depth as well as with increasing costs of electricity. If water levels were to reach designation triggers with the same pumping distribution and energy costs as 2008, cost of production would be $2.95, rather than $2.17 for Lana'i City, $3.07, rather than $1.77 for Manele and the Palawai Irrigation Grid, and $2.02, rather than $1.71 for brackish water.

With a small customer base, many miles of fully depreciated or nearly depreciated pipe needing replacement, and rising costs to provide source, it appears that LWCI will either need substantial financial subsidy from its affiliates or increased rates and fees, or both, in order to maintain a reasonable level of service over coming decades.

FIGURE 3-60. Lana'i Company Operating Costs from PUC Rate Case 1995

Legend reads left to right, and refers to slices clockwise from right, starting with Purchased Water at 40.44%, Depreciation at 5.38%, Salaries, Wages and Benefits at 29.21%, Contract Services at 5.16%, etc.

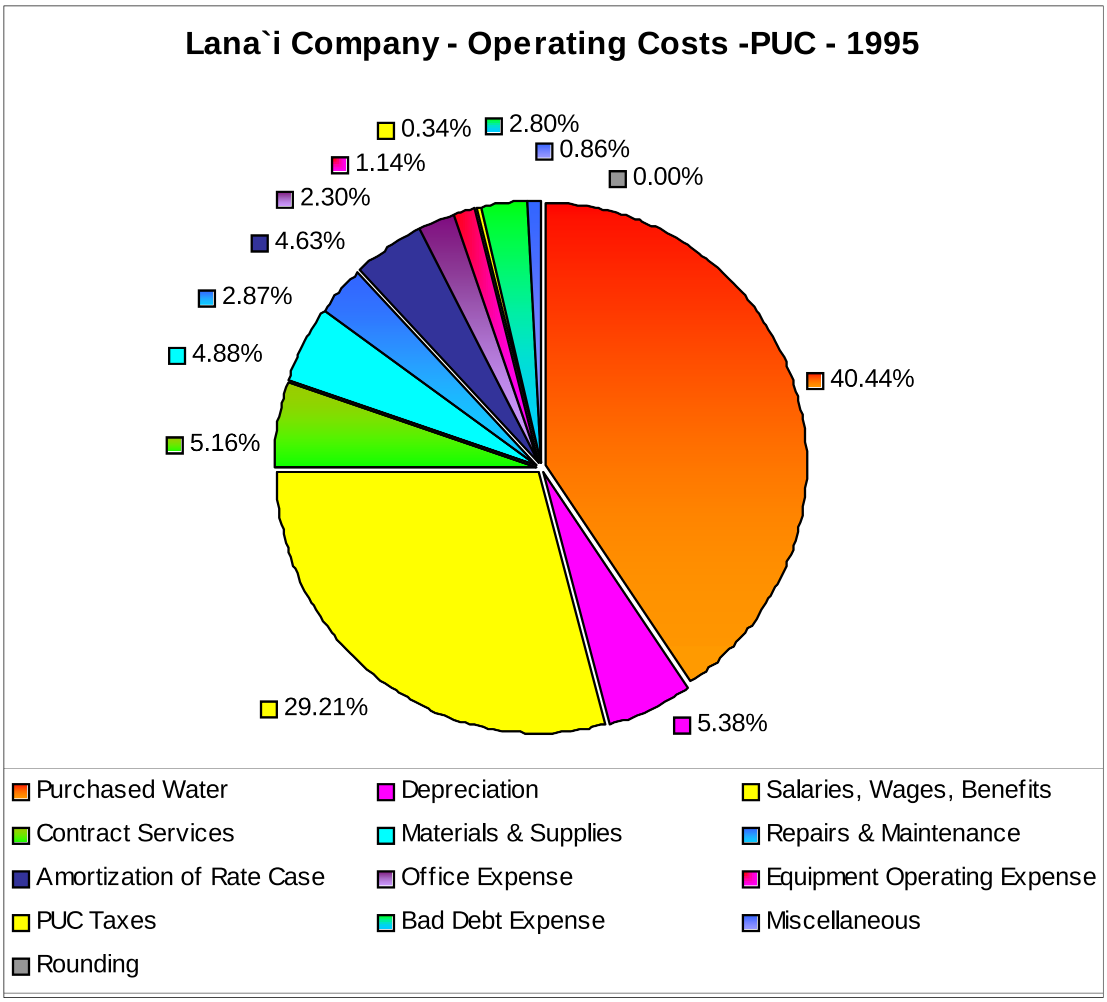


FIGURE 3-61. Current Rates & Charges - Potable Water

Use Charge (2 Month Billing Cycle)	Rate (per kgal)
First 25,000	$1.10
Over 25,000	$1.62

Tap-in-Charge per Connection	
Single Family Unit	$600.00
Multi Family Unit	$475.00
Commercial	$600.00
5/8" meter	$475.00
3/4" meter	$5,400.00
1-1/2" meter	$8,900.00
2" meter	$17,800.00
3" meter	$57,000.00
4" meter	$89,100.00
6" meter	$178,200.00
8" meter	$285,100.00
Agriculture	
5/8" meter	$700.00
3/4" meter	$1,000.00
1 inch meter	$1,700.00
1-1/2 inch meter	$3,500.00
2 inch meter	$5,700.00
Fee for inspection $30	
Fee for meter reinstallation dependent upon costs to company.	

Service Charge per 2 Month Billing Cycle	Rate
5/8"	$5.00
3/4"	$5.00
1"	$10.00
1-1/2"	$10.00
2"	$25.00
3"	$50.00
4"	$75.00
6"	$150.00
8"	$250.00
10"	$250.00
Hydrant	$80.00

FIGURE 3-62. Charges for Brackish Water - Manele-Hulopo‘e As of July 31, 2009. PUC Docket 2008-0322.

Single Family			
	Tier 1	<1,000 GPD per lot	$3.57
	Tier 2	>1,000 GPD, <2,500 GPD	$4.64
	Tier 3	>2,500 GPD	$5.72
Multi Family			
	Tier 1	<1,000 GPD per unit	$3.57
	Tier 2	>1,000 GPD, <2,500 GPD	$4.64
	Tier 3	>2,500 GPD	$5.72
Homeowner’s Association			
	Tier 1	<1,000 GPD per acre	$3.57
	Tier 2	>1,000 GPD, <2,500 GPD	$4.64
	Tier 3	>2,500 GPD	$5.72
All Other			
	Tier 1	<1,000 GPD per acre	$3.57
	Tier 2	>1,000 GPD, <2,500 GPD	$4.64
	Tier 3	>2,500 GPD	$5.72

Service Charge (meter reading) charge per meter per two month billing cycle

Meter Size	Rate Every Two Months
0.625	$ 5.00
0.75	$ 5.00
1.00	$ 10.00
1.50	$ 10.00
2.00	$ 25.00
3.00	$ 50.00
4.00	$ 75.00
6.00	$150.00
8.00	$250.00
10.00	$250.00

Water Facilities Capacity Charge Per Connection

Single Family Lot	$14,500
Multi Family Unit	$ 7,000
All Other	$14,500

FIGURE 3-63. Manele Water Resources, LLC. Fees for Sewer and Reclaimed Water As Of April 13, 2007. PUC Docket Number 2006-0166.

Monthly Flat Rate for Sewer Service

Residential		
	Single-Family	$56.74/ Month Per Dwelling
	Multi-Family	$42.21/Month Per Dwelling
Hotel		$92.12/Month per Guest room

Monthly Useage Charges:

Commercial/Recreational*		
	Non-Food Service	$ 9.98 per 1,000 Gallons of Potable Water Used
	Food Service	$10.07 per 1,000 Gallons of Potable Water Used
	Boat Harbor	$10.05 per 1,000 Gallons of Wastwater Pumped from DLNR Station

* These customers will also be charged a fixed service charge of $12.00 per month.

R-1 Reclaimed Water Sales

User Charge	$0.25/1,000 Gallons

FIGURE 3-64. Balance Sheet and Income Statement for Lana'i Water Company Inc. As Submitted for PUC Docket 2008-032

Exhibit H

Docket No. 2008-________

Applicant's Balance Sheet and Income Statement

LANAI WATER COMPANY

	10/31/2008	12/31/2007
Balance Sheet (unaudited)		
ASSETS:		
Cash	300.00	300.00
Accounts Receivable, net	83,297.57	211,440.39
Total Current Assets	83,597.57	211,740.39
Property, Plant & Equip	5,781,185.89	4,907,569.89
Accumulated Depreciation	1,260,213.36	1,194,784.79
Net Property, Plant & Equip	4,520,972.53	3,712,785.10
TOTAL ASSETS	4,604,570.10	3,924,525.49
LIABILITES & EQUITY:		
Accounts Payable	12,176,318.77	10,791,983.25
Accrued Liabilties	29,772.42	41,553.25
Income Taxes Payable	(270,078.93)	(329,851.28)
Total Current Liabilities	11,936,012.26	10,503,685.22
Deferred Taxes	(2,869,874.75)	(2,540,023.47)
Total Noncurrent Liabilities	(2,869,874.75)	(2,540,023.47)
Capital Stock	1,000.00	1,000.00
Other Paid-in-Capital	2,594,531.23	2,594,531.23
Retained Earnings - Beginning	(8,513,490.49)	(7,997,569.29)
- current p&l	(422,431.15)	(515,921.20)
- other	1,878,823.00	1,878,823.00
Retained Earnings - Ending	(7,057,098.64)	(6,634,667.49)
Total Equity	(4,461,567.41)	(4,039,136.26)
TOTAL LIABILITIES & EQUITY	4,604,570.10	3,924,525.49
Income Statement (unaudited)		
Net Sales	478,790.98	660,932.22
Cost of Sales/Operations (excludes selling cost; include selling depr/amort)	1,171,301.06	1,506,704.70
Operating Profit	(692,510.08)	(845,772.48)
Income Tax Provision	(270,078.93)	(329,851.28)
Net Income (Loss)	(422,431.15)	(515,921.20)

FIGURE 3-65. ***Pro Forma*** **Statement of Income for Non-Potable Brackish Operations of Lana'i Water Company, Inc., As Submitted for PUC Docket 2008-03222.**

Exhibit I
Docket No. 2008-_______

Applicant's *Pro Forma* Statement of Income (Non-Potable Operations)

OPERATING REVENUES		
Non-potable Water Revenues	$	253,184
Service Charges		2,340
Total Operating Revenues		255,524
COST OF OPERATIONS		
Purchased Water		166,014
Depreciation		2,695
Contract Labor		23,549
Amortization of Rate Case		100,000
Bad Debt Expense		5,110
PUC Taxes		16,315
Community Education		18,000
Total Operating Expense		331,683
NET OPERATING INCOME (LOSS) BEFORE INCOME TAXES		(76,159)
Income Taxes		
NET OPERATING INCOME (LOSS)	$	(76,159)
AVERAGE RATE BASE		45,362
RATE OF RETURN		-59.56%

FIGURE 3-66. Pro-Forma Balance Sheet - Lana'i Water Company Inc. Non-Potable Operations, As Submitted for PUC Docket 2008-0322

Exhibit J
Docket No. 2008-______

Applicant's *Pro Forma* Balance Sheet (Non-Potable Operations)

ASSETS

UTILITY PLANT:		
In service	$	53,896
Less accumulated depreciation		(9,882)
Total utility plant		44,014
Regulatory asset - net		200,000
TOTAL	$	244,014

LIABILITIES AND MEMBER'S EQUITY

LIABILITIES - Payable to affilitiates	$	320,173
MEMBER'S EQUITY		(76,159)
TOTAL	$	244,014

FIGURE 3-67. ***Pro-Forma*** **Income Statement for Manele Water Resources, LLC. As Submitted for PUC Docket 2006-0166**

	Proposed Rates	Reference
OPERATING REVENUES:		
Sewer service revenues and applicable service charges	$ 458,781	MWR-202
R-1 water revenues	6,951	MWR-202
Total Operating Revenues	465,732	
COST OF OPERATIONS:		
Aqua Engineers Contract	279,185	MWR-206
Utilities - Electric	155,420	MWR-205
Insurance - Property	79,760	MWR-207
Maintenance - Equipment	31,590	MWR-208
Maintenance - Sewer Line	19,306	MWR-209
Chemicals	14,277	MWR-210
PUC tax expense	29,737	MWR-211
Admin salary allocation	8,892	MWR-212
Taxes - RPT	7,362	MWR-213
Utilities - Water	7,957	MWR-215
Amortization of rate case	6,667	MWR-216
Depreciation expense	541,444	MWR-204
Contract labor	3,318	MWR-214
Total Operating Expenses	1,184,915	
NET OPERATING INCOME (LOSS) BEFORE INCOME TAXES	(719,182)	[1]
Income Tax Expense		
NET INCOME (LOSS)	(719,182)	[2]; (a)
AVERAGE RATE BASE	2,105,933	[3]
RATE OF RETURN: NET OPERATING INCOME (LOSS) BEFORE DEPRECIATION & INCOME TAXES	-34.15%	[1] / [3]
RATE OF RETURN: NET INCOME (LOSS)	-34.15%	[2] / [3]

(a) Since MWR is not requesting to earn a return on a rate base in this filing, the net loss represents the revenue requirement deficiency.

FIGURE 3-68. Pro Forma Balance Sheet for Manele Water Resources, LLC. As Submitted for PUC Docket 2006-0166

Manele Water Resources, LLC
Balance Sheet - Proforma
For the twelve months ending June 30, 2007

Docket No. 2006-0166
Exhibit H
Page 1 of 1

ASSETS

UTILITY PLANT:	
In service	$ 10,969,054
Less accumulated depreciation	(9,133,843)
Total utility plant	1,835,211
Regulatory asset - net	13,333
TOTAL	$ 1,848,544

LIABILITIES AND MEMBER'S EQUITY

LIABILITIES - Payable to affiliates	$ 2,566,727
MEMBER'S EQUITY	(718,182)
TOTAL	$ 1,848,544

FIGURE 3-69. Estimated Operational Costs By Well. (Well Production Only - Does Not Include All Costs).

Groundwater Wells

Rough Operational Cost Estimates

AREA OF USE -->	LANA`I CITY & RELATED AREAS, KOELE PROJECT DISTRICT: POTABLE USES				MANELE PROJECT DISTRICT AND IRRIGATION GRID (PALAWAI BASIN & AREA MAKAI OF LANA`I CITY AWWTF): POTABLE USES				MANELE PROJECT DISTRICT IRRIGATION			
WELL NO. -->	**6**	**3**	**8**	**7**	**4**	**2**	**3**	**5**	**1*** **	**9**	**14**	**12**
2008 Annual Pumpage (gal/year)	119,360,000	0	100,788,000	Not Used	248,927,700	880,000	0	Not used	143,409,000	55,124,000	147,316,000	Not Used
2008 Daily Pumpage (gal/day)	327,912	0	276,890	Not Used	682,000	2,000	0	Not used	393,000	151,000	404,000	Not used
Design Pumping Rate (gpm)	550	900	850	500	900	1200	900	900	600/300	300	350	100
Production Capacity Based on 16-Hour Operation (gal/day)	528,000	864,000	816,000	480,000	864,000	1,152,000	864,000	864,000	865,000	288,000	336,000	96,000
Pump Setting (ft) (Pump Intake Elevation)	863	866	783		1253	1335	866	1293	516	466		-5
Depth of Well (ft)	1320	1200	1489	1492	1178	(1) 812 (2) 596	1200	1122	1266	1450		620
Low Water Level *	880	874	910	650	1441	1350	874	1496	555	591	433	5
Ground El (CWRM)	1910	1850	1902	1775	2327	1510	1850	2296	1265	1411	1194	605
Grnd. El. Dest. Tank	1942	2025	2025	1942	1810	1810	1791		1353	1353	1353	
Pumping Lift (ft.)	1062	1151	1115	1292	886	460	976	800	798	820	920	600
(Kwh / kgal / kft)	5.00	5.00	5.00		5.00	5.00	5.00		5.00	5.00	5.00	
$ per Kwh	$0.400	$0.400	$0.400		$0.400	$0.400	$0.400		$0.400	$0.400	$0.400	
$ per Kgal (electricity)	$2.12	$2.30	$2.23		$1.77	$0.92	$1.95		$1.60	$1.64	$1.84	
Weighted District Cost	$2.17				$1.77				$1.71			