CHAPTER 4

Demand Analysis

In This Chapter

Key Points

- 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).
- Pumpage is reported in 13 MAV periods. After reconciling reported pumpage periods to match consumption, the resulting 2008 pumpage was 2.23 MGD. (2,231,876 GPD).
- Metered consumption in 2008 was about 1.66 MGD. (1,658,244 GPD).

Accounting for water source and pressure zone, water service can be broken down into roughly five service areas, with metered consumption as follows:

FIGURE 4-1. Metered Consumption by Service District Area - 2008 GPD

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

2008 pumped water, metered demand and unaccounted-for water (UAFW) by Well Service Areas are shown below. Island-wide, unaccounted-for water was roughly 28.36% in 2008.

FIGURE 4-2. Pumped, Metered & Unaccounted-For Water by Well Service Area - 2008

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.				

Opportunities for conservation and efficiency improvement on Lana‘i are sufficient in degree to defer some new source development:

- Unaccounted-for water rates are high, particularly in the service areas of Wells 2 & 4. Much of this represents water losses which can be addressed by various repairs. In particular, as much as 200,000 GPD is estimated to be lost through leaking pipes in the Palawai Irrigation Grid.
- Island-wide, it is estimated that over 68% of pumpage, 1,131,512 GPD or more, is used for irrigation. Only about 44,401 of this is for agriculture. This indicates the potential for substantial savings from landscape efficiency programs. Even a modest program designed to reduce irrigation by 10% could result in over 100,000 GPD savings.
- per unit consumption rates in some areas are considerably higher than standards, also indicating opportunities for conservation.
- Analysis of building permit vintage indicates a theoretical “technical potential” for indoor savings of 175,192 GPD. If 57%, of this could be realized, it would represent 100,000 GPD.

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- Other conservation opportunities identified through the demand analysis include regular leak detection, regular water auditing, hotel conservation programs and incentives, and evaporation reduction from the brackish reservoir. These are addressed further, along with a conservation rate structure, in Chapter 5.

Forecasted demands range from 2.43 to 5.84 MGD, while build-out analysis points to demands as high as 7.13 MGD. Island-wide projections of demand in 2030 are shown in Figure 4-3. Projections broken out by well service area are also provided within this chapter.

FIGURE 4-3. Island-wide Projections for 2030 - Various Methods - Millions of Gallons Per Day (MGD)

Method	Low	High	Base Range
Time Trend	2.43	3.23	2.43 - 3.23
Forecast - Pumpage	2.98	5.84	3.03 - 4.10
Forecast Metered - Plus 12% UAFW LCTY, 15% MNPD	2.50	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 **Phase II Only Plus** Other Known Projects			5.66
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.			

- Without conservation, reclaimed water and/or other alternative sources, build-out of project districts plus other known projects at 2008 per unit consumption rates would result in total demands exceeding Lana‘i’s total sustainable yield.

Build-out proposals include a sizeable component of demand to be met by unidentified “alternate” sources, but do not include a component to be met specifically by conservation.

- The 2006 proposal included a total demand of 6,079,523 GPD worth of projects, 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.

- The 2009 proposal included 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".

- The need for this unidentified source could be even greater than shown, due to project district elements not included in proposals, known projects for which estimates came in since the proposals, and unaccounted-for water rates which are higher than shown. A revised analysis of the proposals, plus other known projects, plus portions of the project districts which had not been included in the proposals resulted in total demands as high as 7.13 MGD, requiring pumpage as high as 5.8 MGD or potentially over 6 MGD to meet all demands.

- Based on this total demand, an effort was made to estimate how much alternative source might be realistically available from reclaimed water and conservation.

- Four hundred thousand to seven hundred thousand gallons per day (400,000 to 700,000) GPD was deemed to be a reasonably prudent estimate of available reclaimed water for the planning period, depending upon the progress of build-out.

- Conservation opportunities identified between this chapter and the next are folded into the capital plan in Chapter 5, for an estimated savings of 485,000 GPD. A substantial portion of that potential came from the analyses on unaccounted-for water, use types and end uses performed in this chapter.

Although the Project Districts were approved in 1986, only a small fraction of approved units have actually been constructed.

- In Manele, 16 out of a total 282 single family units have been built, although one hundred sixty-one (161) have received Phase II approval. Sixty-nine (69) out of a total 184 multi-family units have been built, although ninety-one (91) have received Phase II approval. Two hundred fifty (250) out of 500 hotel units have been built. Manele also has acreage for an additional golf course. In Koele, 13 out of a total 535 single family units have been built, though 255 have Phase II approval. Thirty-five (35) out of a total 156 multi-family units have been built, though 100 have received Phase II approval. One hundred and four (104) out of 253 hotel units have been built.

- Despite such a low percent of build-out in terms of unit-counts, consumption at the Manele Project District already exceeds the total demand initially estimated.

Analysis of demand led to the following conclusions:

- Absent alternative means of meeting demand, such as conservation, use of reclaimed water or desalinization, build-out of existing and pending entitlements would result in pumpage exceeding sustainable yield.
- Projected demands based on escalation factors derived from community plan forecasts are lower than build-out demand estimates. However, build-out estimates to date have been lower than actual build-out would be if existing trends continue.
- A target unaccounted-for water for planning purposes was identified as 12% for the service areas of wells 6 & 8 (Lana‘i City, Koele and Kaumalapau), and 15% for the service areas of wells 1, 9

In This Chapter

& 14 (Manele brackish) and Wells 2 & 4 (fresh water to Manele and the Palawai Irrigation Grid).

- Unaccounted-for water analysis identified substantial opportunity for conservation, which could offset or “serve” about 485,000 GPD of projected demand. Specific measures are discussed in Chapter 5.
- Due to the high conservation opportunity, a forecast elasticity of 1 was selected for new source planning, although a forecast elasticity of 1.5 was utilized for estimation of possible demand in the allocation table in Chapter 7. The difference is assumed to be met by conservation and other measures.
- Reasonable estimates of total reclaimed water that may be available to serve as source by 2030 were between 400,000 and 700,000 GPD.
- One subordinate recommendation is made in terms of data maintenance and use. The *Periodic Water Reports* would be more useful if it were broken down differently, either by the 3 well service areas or the 5 districts listed above. Monthly reporting might also facilitate water auditing.

Historical Source Use and Demand

When examining water demand in a community, one of the first tasks is to consider the major drivers of water use and how they are changing. Lana'i is a good example of how economic changes drive changes in water use.

For most of its 0.81 to 1.46 million year existence, Lana'i was uninhabited. The only consumption of water was by natural systems. The first known established consumption by humans and domestic animals started when the Hawaiians arrived on Lana'i during the 15th Century (1400s). Water was then used for human and animal consumption, and for cultivation of taro, sweet potatoes, bananas and other crops, as well as use incidental to aquaculture and fishing. The peak population prior to European contact is estimated at 3,000 to 3,250 people.

The early 19th century saw the introduction of both Europeans and large feral ungulate mammals such as goats, sheep, cattle and European hogs. Ranching began in about 1865. This was the main economic activity until the first sugar plantation was established in 1898. Not long thereafter, in 1921, the first pineapple crop was planted. Pineapple was the main use of water on the island for the next half a century. Pineapple production peaked during the 1980s. During that same decade, the first Project District was established on Lana'i in 1986. By 1990, plans had been announced to shift from pineapple to tourism. Pineapple cultivation ended in the early 1990s, with the last harvest in 1992. For the past two decades, water consumption on Lana'i has been primarily driven by the resorts and by construction related to the resorts.

The longest available pumpage record for Lana'i goes back to 1926. Pumpage data from 1926 to 2001 were plotted in the report *Current Status of Lana'i's High Level Aquifer as Portrayed by Data From Its Wells*, (Tom Nance for Lana'i Water Company, September, 2001). This data is presented in Figure 4-6. The time period plotted in this figure coincides roughly with the period from the inception of the pineapple economy to its end, and this fact is clearly reflected in the demand curve shown.

A March, 1977 report from Anderson & Kelly to Lana'i Land Company characterized demands from 1948 through 1977. The plot of this data in Figure 4-7, shows consumption during the heyday of pineapple. Municipal demand was fairly flat. Irrigation demand represented the lion's share of total demand. Overall demand showed seasonal peaks and valleys typical of a demand curve primarily driven by irrigation. At the time, irrigation demand was about 1.94 MGD and city demand was about 0.364 MGD.

FIGURE 4-6. Lana'i Pumpage and Precipitation - 1926 to 2001. Source: *Current Status of Lana'i's High Level Aquifer as Portrayed by Data From*

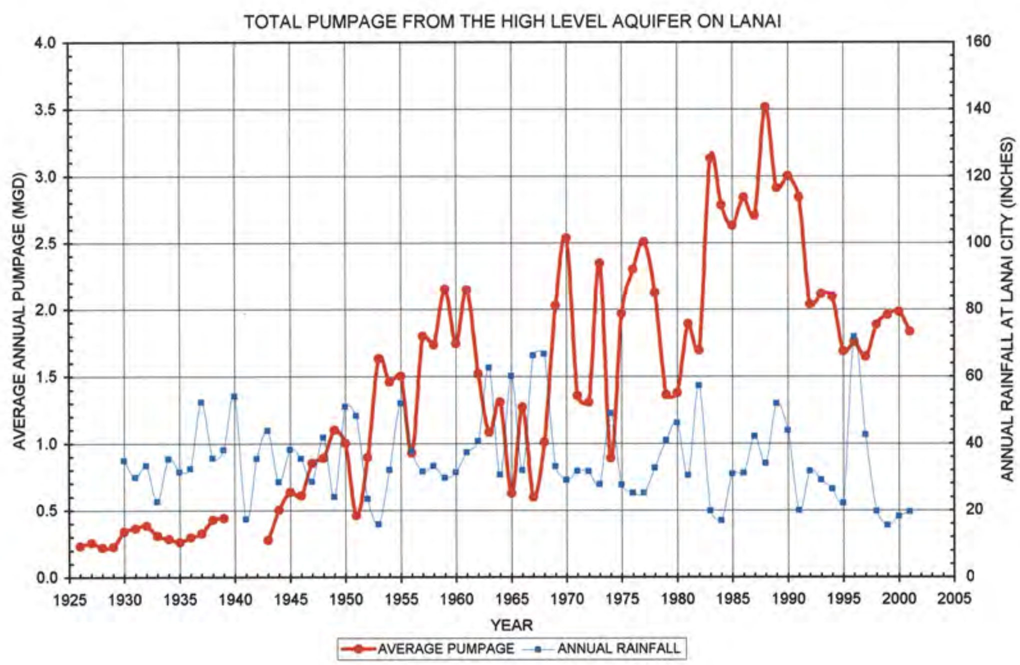
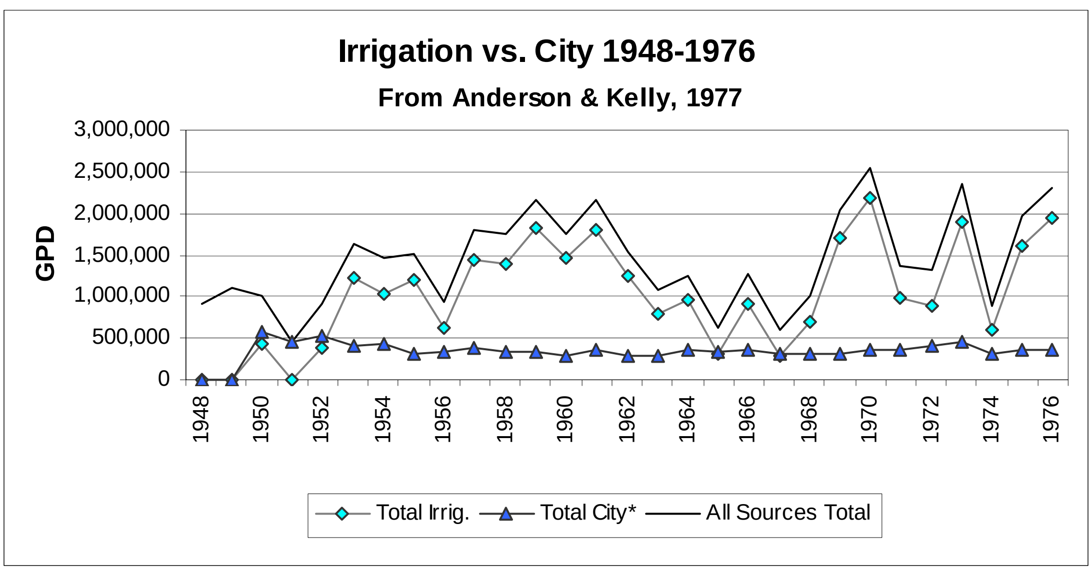


FIGURE 4-7. Lana'i Source Use 1948-1976; Source Anderson & Kelly Report to Lana'i Land Company, March 1977



Recent Production Records

Periodic Water Report

Pumpage data from 1985 to June of 2009 (Period 6, 2009), are shown in Figure 4-8 on the facing page. Annual average use on Lanaʻi is calculated using a moving average of the thirteen periods (13 MAV) in the Lanaʻi Water Company's *Periodic Water Report.* The upper graph in Figure 4-8 is a 13 period moving average. The lower graph shows the static of fluctuations between periods.

This report has historically referenced water deliveries in three areas, as shown in Figure 4-8:

- Lanaʻi City
- Manele, Aoki Diversified Agriculture and Ag Activities Near the Airport (formerly titled "Irrigation")
- Kaumalapau

Historical pumpage on Lanaʻi peaked at around 3.5 million gallons per day (MGD) in 1989, reflecting both pineapple use and the beginning of construction for the Project Districts. Pumpage dropped to just under 2 MGD with the end of the pineapple economy in about 1992. This decline was followed by a gradual rise to 2.24 MGD in calendar year 2008.

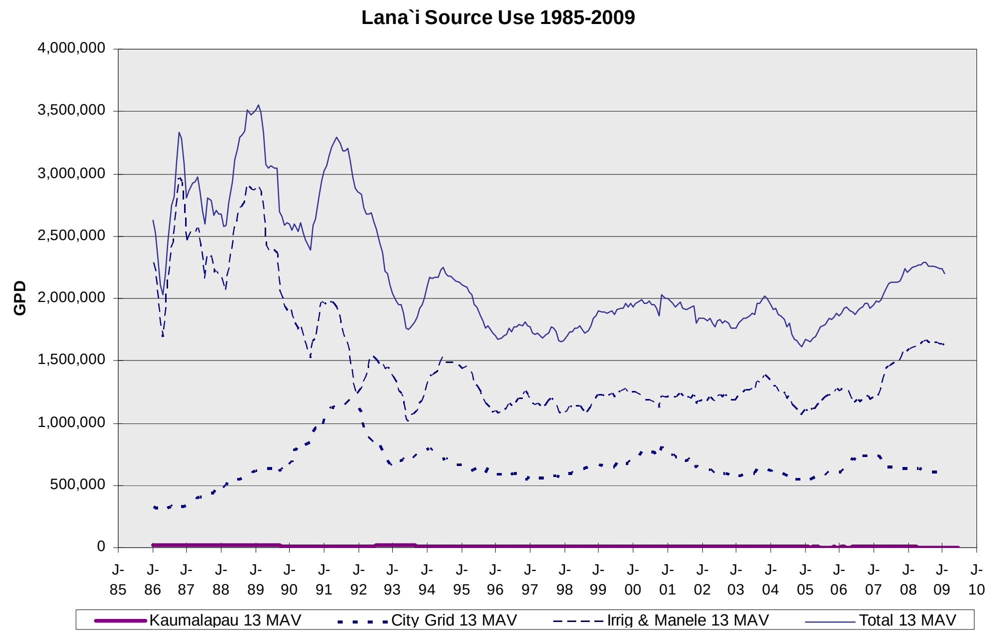
On a monthly basis historical withdrawals exceeded 4 MGD at times during the pineapple era, with one exceedence of 5 MGD in June of 1986. Irrigation use for the period entered peaked on a monthly basis in December of 1985. Irrigation use peaked on a moving annual average (13 MAV) basis in 1986, with additional peaks in 1988-1989. With the exception of two excursions between 2000 and 2005, monthly consumption has remained under 3 MGD since the end of the pineapple era.

The breakdown of water deliveries in the *Periodic Water Reports* is inherited from pineapple days. In the process of analyzing this data for the Water Use and Development Plan, it became clear that this structure is no longer the most direct portrayal of current service areas and districts. The *Periodic Water Report* would be more useful for analysis if it were revised to reflect either water served to the three well service areas, or the five service districts, defined by a combination of service area and major pressure zone, of Koele Project District (KOPD), Lanaʻi City (LCTY), Kaumalapau (KPAU), Manele-Hulopoʻe (MNPD) and the Irrigation Grid in Palawai (IGGP). This is one of the recommendations of this document.

The *Periodic Water Report* provides pumpage in thirteen, twenty-eight day periods. This has not always been the case. For most of the period prior to 1982, pumpage was reported in 12 monthly periods. Billing is reported on a bi-monthly basis for Lanaʻi Water Company, Inc. (LWCI) customers, and on a monthly basis for Lanaʻi Holdings, Inc. (LHI) customers. For analytical purposes, it was necessary to account for the fact that pumpage and billing are reported in different time frames. In order to reconcile these periods and compare pumpage to consumption over consistent periods, the amount of water reported in each period was divided by the number of days in the period, and then apportioned based on the number of days actually in each month. For example, if a period were actually 30 days, and ran from January 30 to March 1, 1/30 would be assigned to January, 28/30 to February and 1/30 to March. Re-assignment of pumpage to actual month and year changed overall pumpage from 2,241,222 GPD to 2,231,876 GPD for calendar year 2008. Adjustments were also made to account for the fact that some billing is performed bi-monthly, while other billing is monthly, changing metered demand from 1,658,224 to 1,660,326. In all cases, adjustments resulted in changes of less than half a percent.

Recent Production Records

FIGURE 4-8. Source Use On Lana'i 1985-2009 - 13 MAV and Monthly - in GPD



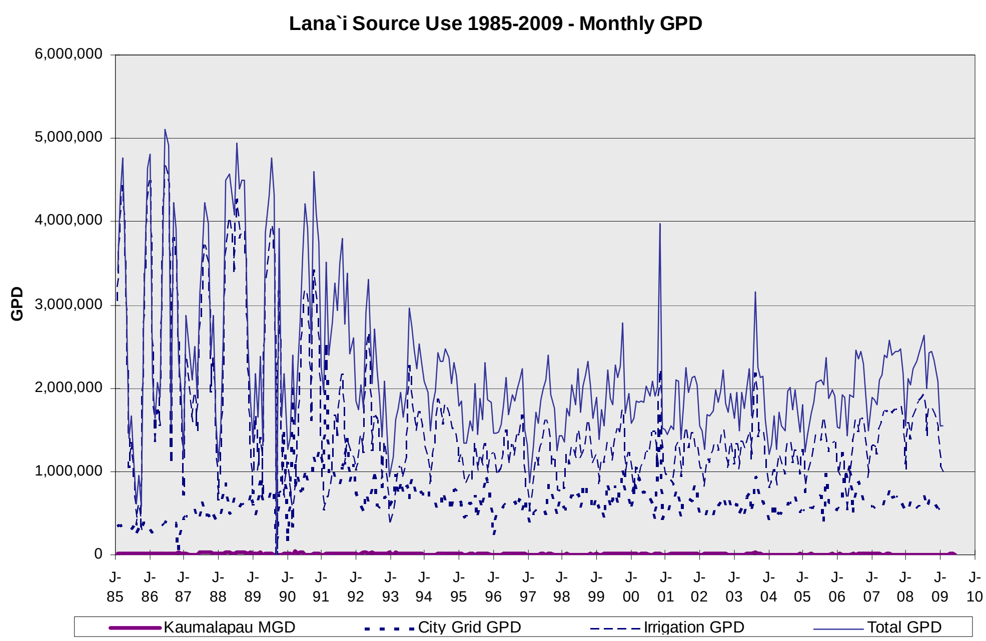
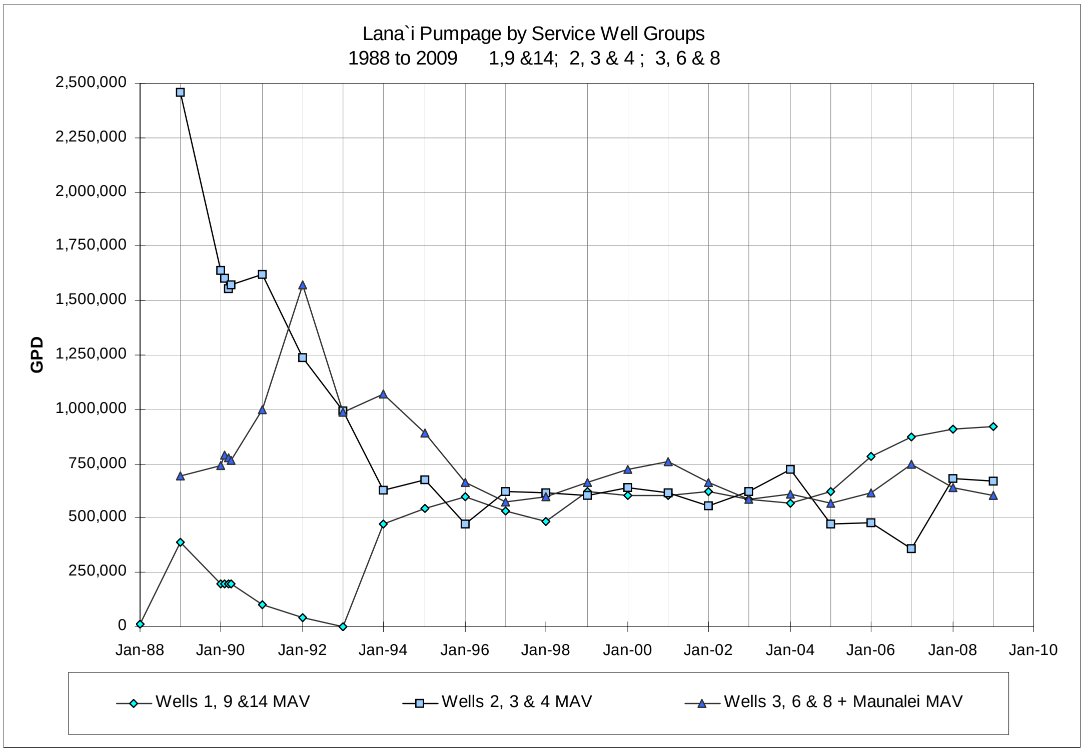


FIGURE 4-9. Annual Pumpage on Lana'i Broken Down By Well Service Areas



Production by Well Service Areas

Potable and brackish water service for the different regions on the island is divided into three main sets of sources. Figure 4-9 shows the relative pumpage by these groups of sources. Individual pumpage of each well was shown in Figures 3-60 to 3-77. The two potable water systems on Lana'i collectively use about 1.29 MGD. The brackish water system serving the Manele-Hulopo'e region uses about 0.94 MGD.

Lana'i City (LCTY), Koele (KOPD) and Kaumalapau (KPAU) receive potable water from Wells 6 and 8. Well 3 once served this area as well, but is currently out of service and will be replaced. Collective pumpage from Wells 6 and 8 was 605,046 GPD in 2008, with 54% coming from Well 6 and 46% from Well 8.

Manele-Hulopo'e (MNPD) and the Palawai Irrigation Grid (IGGP) receive potable water from Wells 2 and 4. Well 3 once provided water to this area as well. Well 2 is very rarely used due to safety issues. Collective pumpage from Wells 2 and 4 was 683,055 GPD in 2008, 99.7% of which came from Well 4.

Wells 1, 9 and 14 serve brackish water for irrigation to the Manele area (MNPD). Collective pumpage from these wells in 2008 was 943,776 GPD, with 43% coming from Well 14, 41% from Well 1 and 16% from Well 9. The use of these wells has been the subject of heated community debate. The question at issues is whether maximum irrigation use from the high level aquifer for the Manele Project District should or should not exceed 650,000 GPD, based on County Ordinance 2133 and other past agreements and putative stipulations. Appeals are still in progress and the dispute is still unresolved as of this draft.

Recent Production Records

FIGURE 4-10. Seasonal Variation in Potable Water Consumption By District - 2008 Data

	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08
IGGP	86,305	85,183	19,072	22,939	27,502	25,429	56,410	87,679	65,803	57,430	49,744	47,183
KOPD	143,578	143,677	116,983	116,983	183,690	183,690	171,442	171,442	153,672	153,672	124,901	124,901
KPAU	17,939	17,939	14,511	14,511	11,412	11,412	17,737	17,737	19,061	19,061	12,969	12,969
LCTY	366,590	366,590	336,940	336,940	387,218	387,218	389,009	389,009	367,659	367,659	300,271	300,271
MNPD	714,666	1,226,014	769,432	1,296,083	1,476,195	1,143,670	1,010,136	1,384,089	1,154,425	866,412	1,257,719	723,132
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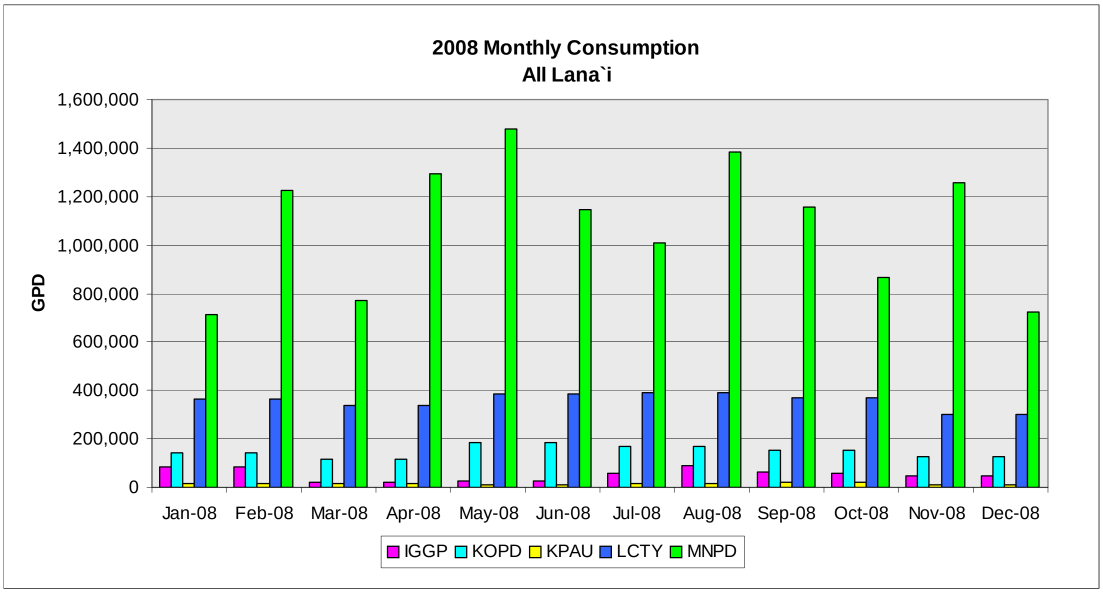
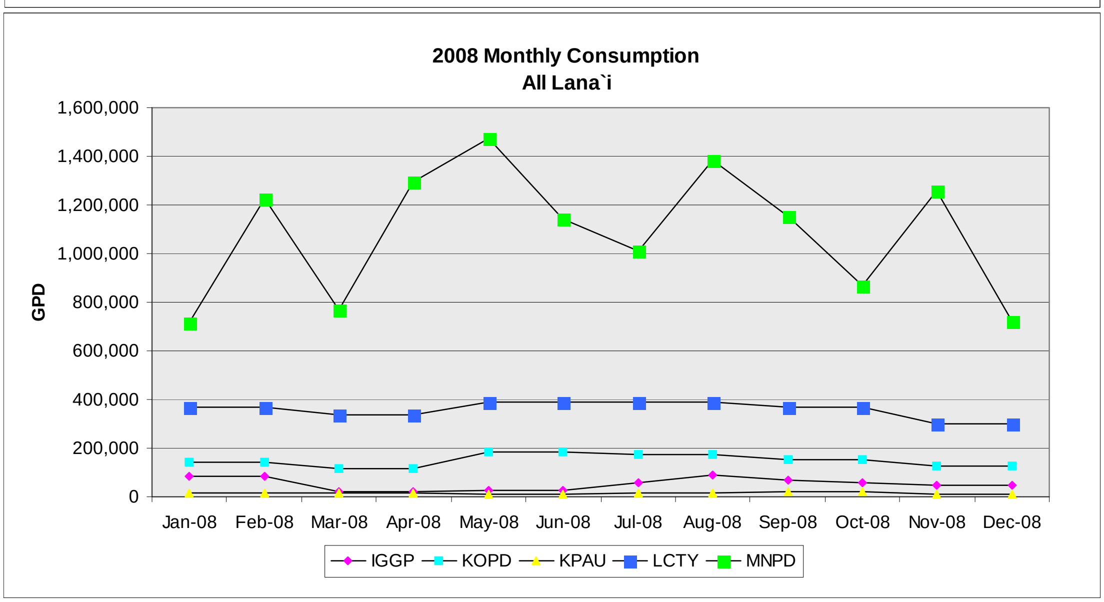
	1,329,079	1,839,403	1,256,938	1,787,455	2,086,017	1,751,419	1,644,733	2,049,955	1,760,620	1,464,234	1,745,604	1,208,456





Seasonal Variation in Consumption

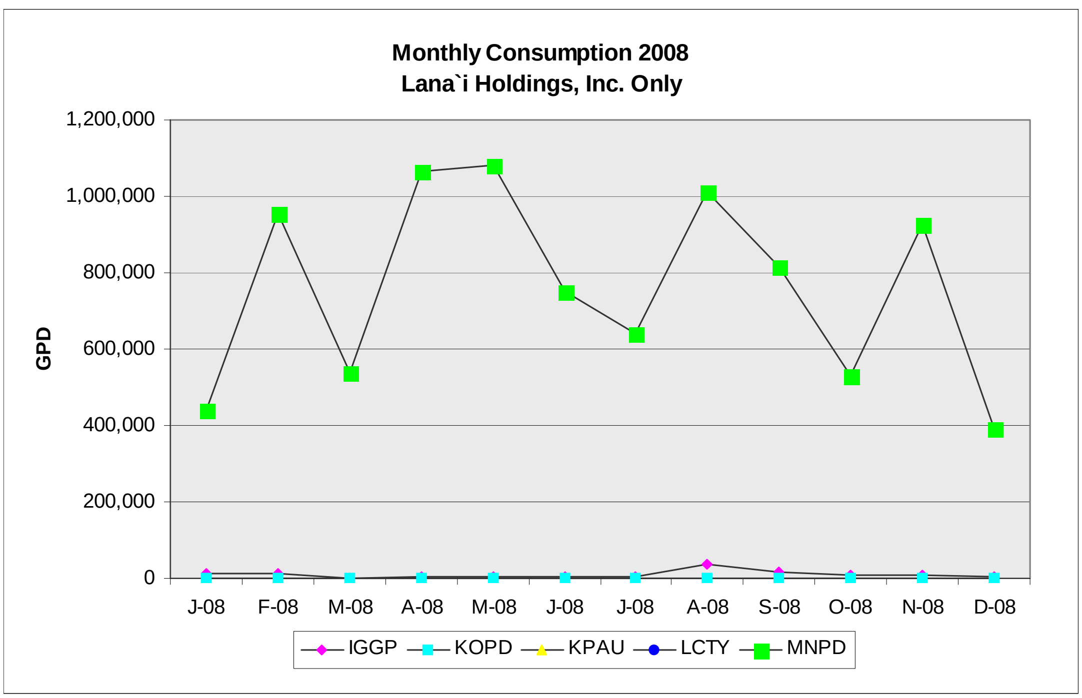
Average metered consumption on Lana‘i in 2008, according to the records provided, was 1,658,244 gallons per day (GPD). Meters are not read monthly, so some adjustments are necessary to break consumption into monthly increments, as described earlier. Small discrepancies are introduced between dividing by total number of days in a year, vs. applying pumpage to the days in each month of a period, dividing by those and then averaging, and in certain cases breaking these out further by class or district. As mentioned earlier, the differences are less than half of a percent. This analysis is valuable for considering seasonal trends.

As shown in Figure 4-10, water demand on Lana‘i shows a strong seasonal variation. Island-wide, metered consumption fluctuated 877,561 GPD from the lowest to the highest month, with the high minus the average at 425,691 GPD. This indicates that consumption is heavily influenced by irrigation demand.

The next question examined was whether any portion of this trend reflected irrigation use in meters which were not specifically dedicated to irrigation. In Figure 4-10, Lana‘i Water Company and Lana‘i Holdings demands for the Manele-Hulopo‘e areas are combined, which has the effect of flattening the areas with lower consumption. To examine seasonal trends in these user classes, as well as potential irrigation use by “non-irrigation” meters, these trends are further broken out in Figures 4-11 to 4-15.

Consumption of meters from Lana‘i Holdings, Inc. and Lana‘i Water Company Inc. are shown separately in Figures 4-11 and 4-12, below.

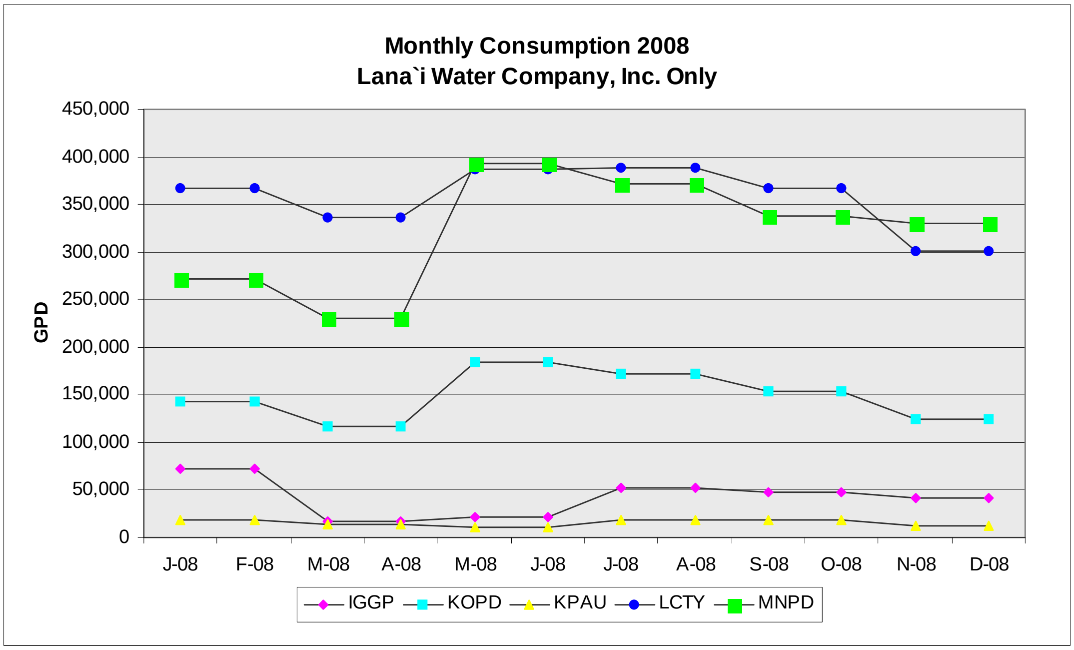
FIGURE 4-11. Seasonal Variation in Lana‘i Holdings, Inc. Consumption - 2008 Data



Note: This is a graph of Lana‘i Holdings meters only. Some communities are not visible in this graph because Lana‘i Holdings has few or no meters in those areas.

Recent Production Records

FIGURE 4-12. Seasonal Variation in Lana‘i Water Company, Inc. - 2008 Data



Lana‘i Holdings, which serves the majority of irrigation meters, has a distinct seasonal variation. The difference between the lowest and the peak months was 690,810, with peak minus average at 316,054 GPD.

Lana‘i Water Company meters also showed a marked seasonal response, with about 286,054 GPD between the lowest and highest months and 114,689 GPD between the peak and average months. These numbers indicate that irrigation is a substantial component of both potable consumption and non-potable use. As the graphs reveal, LHI meters are read monthly, while LWC meters are read bi-monthly.

Service District and Type of Use

With the help of Lana‘i Water Company staff, meters were assigned to use types. These are presented in the table in Figure 4-13, as printed from the billing database.

One small discrepancy is noted for data integrity purposes. One account registered a negative balance, in the amount of -1 GPD. This may be a data error or may simply reflect a meter replacement or billing adjustment. This was a construction meter in the Koele Project District area. To remain consistent with billing records and totals, and so as not to alter other totals previously run, the number was left as-is. One gallon per day was not deemed serious enough to invalidate either billing records or analyses. The discrepancy would not be worthy of note other than its appearance in Table 4-13.

FIGURE 4-13. Metered Consumption By Service District Area and Type of Use - 2008 GPD

IGGP	COMM	3,460	
	DEVEL	81	
	GOV	5,764	
	IRR-AG	28,044	
	IRR-DEV	6,225	
	IRR--GEN	8,932	
			52,505
KOPD	COMM	0	
	DEVEL	-1	
	HOT	30,961	
	IRR-AG	84	
	IRR-DEV	1,043	
	IRR-GEN	33	
	IRR-GOLF	14,286	
	IRR-HOT	51,880	
	IRR-MF	4,662	
	PQP	390	
	RES-MF	20,625	
	RES-SF	25,164	
			149,128
KPAU	COMM	14,058	
	IRR - SF	1,358	
	RES-SF	189	
			15,604
LCTY	COMM	43,311	
	DEVEL	296	
	GOV	10,180	
	HOT	3,125	
	IRR-AG	6,044	
	IRR-DEV	156	
	IRR-GEN	26,996	
	PQP	1,321	
	RES-MF	49,393	
	RES-SF	217,187	
			358,008
MNPD	COMM	21,179	
	DEVEL	34	
	HOT	238,016	
	IRR-AG	10,229	
	IRR-DEV	40,998	
	IRR-GEN	20,273	
	IRR-GOLF	596,009	
	IRR-HOT	1,280	
	IRR-MF	86,943	
	IRR-SF	36,388	
	PQP	6,507	
	RES-MF	9,847	
	RES-SF	15,295	
			1,082,999
		1,658,244	1,658,244

Recent Production Records

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FIGURE 4-14. Metered Consumption by Month and Type of Use

	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08
	31	29	31	30	31	30	31	31	30	31	30	31
AG	41,841	43,047	20,539	21,883	38,034	37,223	60,299	61,653	52,185	52,174	51,681	51,698
IRR	601,266	1,110,364	628,963	1,158,098	1,235,152	901,395	780,447	1,184,293	974,602	678,250	1,041,608	504,504
COMM	65,378	65,378	51,299	51,299	70,151	70,151	111,347	111,347	107,639	107,639	85,478	85,478
DEVEL	654	654	387	387	380	380	467	467	286	286	293	293
GOV	12,804	12,804	13,626	13,626	11,133	11,133	21,355	21,355	21,079	21,079	15,528	15,528
HOT	268,905	268,905	210,435	210,435	361,453	361,453	281,341	281,341	255,193	255,193	255,082	255,082
PQP	5,002	5,002	5,965	5,965	12,042	12,042	9,710	9,710	7,650	7,650	8,860	8,860
RES-MF	71,332	71,332	83,778	83,778	90,639	90,639	99,264	99,264	67,140	67,140	66,581	66,581
RES-SF	261,907	261,907	241,966	241,966	267,019	267,019	280,516	280,516	274,834	274,834	220,461	220,461
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	1,329,088	1,839,393	1,256,957	1,787,436	2,086,002	1,751,435	1,644,745	2,049,944	1,760,608	1,464,246	1,745,573	1,208,486

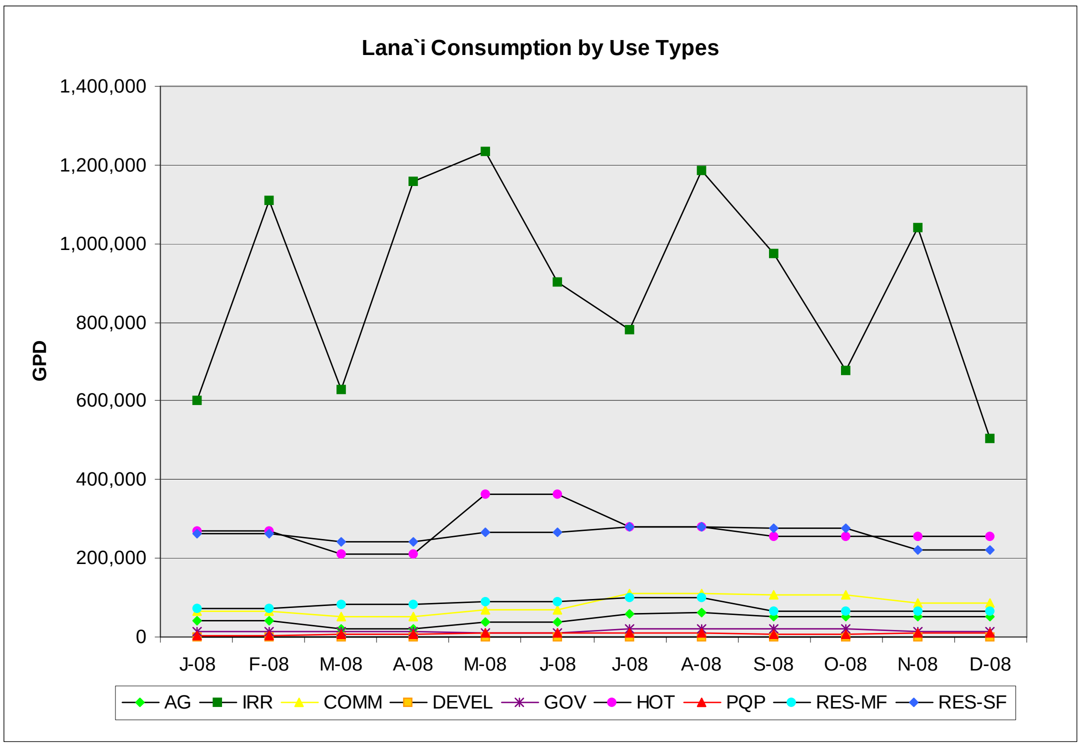
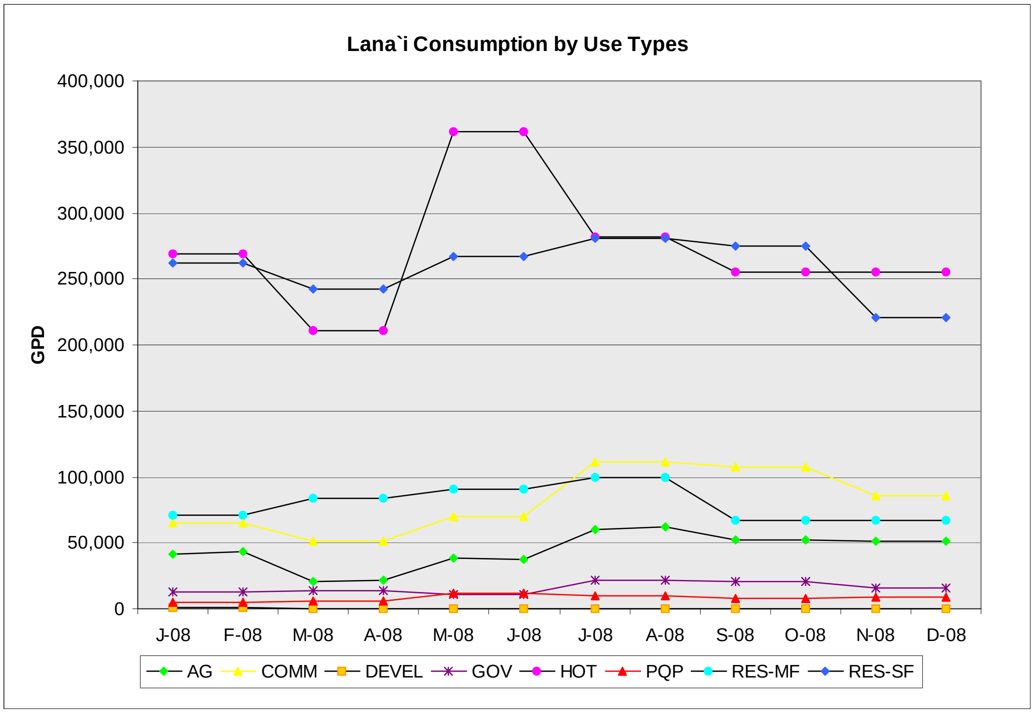


Figure 4-14 shows monthly consumption by type of use. As would be expected, the irrigation curve is dominant, with the most marked seasonal variation. Other uses appear flatter at this scale. However, as shown on the following page, these uses also demonstrate marked fluctuations. This indicates that irrigation use is a substantial component of the majority of meters, and not merely the specifically assigned irrigation meters.

FIGURE 4-15. Lana‘i Consumption By Use Type - Irrigation Meters Removed To Examine Seasonal Trends of Other Use Types



Removing the irrigation curve for closer examination, in Figure 4-15, one finds that with the exception of development use, all use types exhibit seasonal trends. Even the flatter looking trends here, government use and public-quasi-public use, exhibit marked seasonal variation if shown at sufficiently detailed scale. Marked seasonal increases are generally the result of a portion of water for each use going to landscape irrigation.

To derive a conservative estimate of irrigation use by hotel and single family meters, consumption by these meters was compared to Statewide System Standards. Amounts exceeding standards were assumed to reflect irrigation. Statewide system standards generally include some assumed irrigation use, so this adjustment would yield a conservative estimate of additional irrigation use. Based upon discussion with LWCI staff and community members, it was also assumed that 2/3 of water consumption at Manele Harbor was for irrigation. The results of this adjusted analysis are shown in Figure 4-16.

Combining agricultural use with other irrigation use, the adjusted analysis resulted in an estimated 1,131,512 GPD used for irrigation island-wide (1,087,111 general irrigation. + 44,401 agriculture) or about 68% of metered use. Most of that is used in the Manele Project District Area. This estimate is actually fairly close to estimated existing use for irrigation contained in the build-out proposal by Castle and Cooke submitted July 28, 2009. It is considered likely that actual irrigation use is higher still, given the seasonal fluctuations noted above.

All of non-potable water consumed, about 760,357 GPD is used for irrigation. With the adjustment below, it is estimated that 371,155 GPD of potable water is also used for irrigation. This is likely a conservative estimate.

FIGURE 4-16. Consumption by Meter-Assigned User Classes and Adjusted User Classes

	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
	-----------	-----------
	1,658,244	1,658,244

With irrigation representing such a high proportion of total use, opportunities to offset new source development with landscape and irrigation efficiency improvements look promising. Further analysis of landscape savings opportunities is warranted. Reductions between 10% to 25% are quite often possible in resort areas where empirical consumption is so much higher than standards, and have recently been demonstrated by some South Maui hotels. Savings of this order of magnitude could yield between 100,000 GPD and 400,000 GPD. More dramatic savings are possible.

Of roughly 1.1 MGD estimated total irrigation use, roughly 610,000 GPD was classed specifically as golf course use, of which 596,009 was attributed to the *Challenge at Manele*. That tally does not include clubhouse uses and landscaping, or irrigation along related service roads.

Prior to adjustments, the largest type of use other than irrigation is hotel use. After adjustments for irrigation, the largest use is residential use, followed by hotel use. Apart from the golf courses, the hotels are the largest individual customers on Lana‘i.

In terms of per unit consumption, residential use on a per-customer basis in the hot, dry Manele Project District area far exceeds that in Lana‘i City. Combined fresh and brackish use in Manele single family homes averaged 3,200 GPD during calendar year 2008, and about 3,700 during the 18 month period from January 2008 through June of 2009. Potable use was roughly 900 to 1,000 GPD, with the remainder brackish. The highest and lowest average uses were 9,492 and 662 GPD, respectively with essentially zero fresh water use on the lowest end. Despite such high average per unit consumption, the total metered use for SF residences in Manele is only about 8% of metered consumption from Wells 2 and 4. never the less, the single family homes in Manele utilize more water than all the agriculturally classed meters on the island.

In contrast, average consumption among single family homes in Lana'i City was 221 GPD. Fifty single family accounts in Lana'i City exceeded 500 GPD, and five accounts exceeded 1,000 GPD, with a high use of 1,699 GPD. Average single family use in Koele was 503 GPD, with a high of 2,138 GPD. However the newer, Project District homes tended to use more, with an average use of about 1,000 GPD. Residences in Kaumalapau were occupied too sporadically to derive a meaningful average use.

Multi-family use per unit patterns were a bit different. Multi-family use averaged 315 GPD in Lana'i City, 546 GPD in Manele and 722 in Koele, including irrigation. The multi-family numbers in Manele may underestimate irrigation, as they are restricted to meters specifically labelled for Multi-Family irrigation and may not include some common area use. In addition, many of the units appear to be unoccupied or only sporadically occupied.

End Uses

As the major general water use on the island, at about 1.13 MGD, irrigation should be carefully inventoried by acreage, purpose, plant material, presence or absence of rain shut-offs and soil moisture sensors, irrigation equipment and control systems, weather and evapotranspiration data, and other factors, in order to identify and site-specifically tailor appropriate and effective efficiency measures.

The hotels are the island's largest individual water customers, and as such, also represent one of the largest opportunities for demand side efficiency. It would be beneficial to conduct a site specific inventory of water uses and savings opportunities at each of the hotels. Water uses at hotels generally include irrigation, pools and water features, spas, salons and exercise centers, cooling, ice-making, cooking and washing in kitchens and restaurants, guest service policies, laundries and linen washing, gastronome, cleaning and maintenance, support facilities and other uses. Specific efficiency measures for each of these uses are available in industry literature. Some discussion of such measures is found in the next chapter of this plan.

A basic analysis of domestic end uses for residents and visitors is presented in the table in Figure 4-17. Information on building vintage and changes to plumbing codes over time was used to derive estimates of the prevalence and efficiencies of various appliances and fixtures. A weighted average per capita use was then derived based upon these efficiencies. These factors were then applied to de facto population, to derive estimated domestic needs for Lana'i.

Based upon this analysis, an estimated 358,338 GPD is used for typical indoor domestic uses on Lana'i. This estimate includes indoor domestic uses of visitors as well as residents. However, it does not include all non-irrigation uses. For example, water actually consumed in cooking or drinking, or water used for cooling at the hotels, would not be reflected in this estimate.

If 100% of the calculated savings potential were achieved, these domestic uses could be reduced to 183,146 GPD, a theoretical savings potential of 175,192 GPD. It should be noted that it is rarely possible to achieve full savings potential. Certain measures may not be cost-effective, or there may be errors in estimating penetration of appliance vintages and efficiencies, or behavioral patterns that don't conform to calculations. never the less, such analysis is useful for an order of magnitude estimate of potential savings. These results are discussed further in the Supply Options chapter of this document.

FIGURE 4-17. Residential End Uses

Building Vintage			Toilets		Shower		Bath		Faucets	
(From analysis based on 2007 Maui Tax Division data)	Count	Percent	Unit Water Use Gallons Per Flush	% * GPF	Unit Water Use Gallons per Minute	% * GPM	Unit Water Use Gallons per Bath		Unit Water Use Gallons Per Minute	% * GPM
Pre - 1950	601	26.72%	7.0	1.9	4.3	1.1	30.0	8.0	3.3	0.9
1950 - 1980	187	8.31%	5.0	0.4	4.3	0.4	30.0	2.5	3.3	0.3
1981 - 1993	791	35.17%	3.5	1.2	2.0	0.7	30.0	10.6	2.0	0.7
1994 - 2007	670	29.79%	1.6	0.5	1.7	0.5	30.0	8.9	1.7	0.5
Resulting Unit Water Use ==>				4.0		2.7		30.0		2.4
				~		~		~		~
Use Intensity				5.1		5.3		0.2		8.1
Daily Water Use Gallons per Capita				20.4		14.4		6.0		19.2
Daily Water Use If All Fixtures Were Highly Efficient				6.5		8.0		6.0		8.1
Savings If All Fixtures & Uses Were Water Efficient			1.6	12.2	1.7	5.4	30.0	0.0	1.7	5.4
Savings If All Fixtures Were Highly Water Efficient			1.28	13.8	1.5	6.5	30.0	0.0	1.0	11.1

	Dishwasher		% *		Washing Machine		% *	Total Indoor Domestic	
Appliance Vintage	%	GP Load	GPLoad		%	GP Load	GPLoad		
>10 Years	1.7%	14.0	0.2		1.7%	56.0	1.0		
</= 10 Years	58.8%	11.0	6.5		97.3%	43.0	41.8		
Conserving	39.5%	7.0	2.8		1.0%	27.0	0.3		
			~				~		
Unit Water Use ==>			9.5				43.1		
Use Intensity			0.1				0.4		
Daily Water Use Gallons per Capita			0.9				15.9	Daily Water Use Gallons per Capita	76.8
Daily Water Use If All Fixtures Were Efficient			0.7				10.0	Per Capita Water Use w/100% Efficient Fixtures	39.3
Savings If All Fixtures Were Water Efficient	7.0		0.2		27.0		5.9	Per Capita Savings If All Fixtures Highly Efficient	37.6
De facto Population	4,664.0								

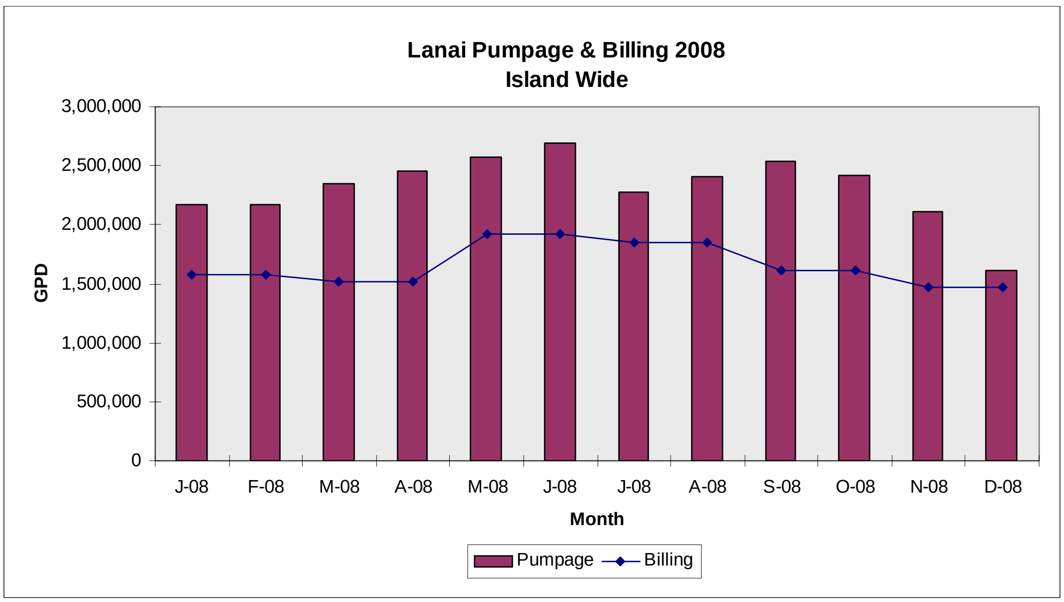
Daily Water Use		Daily Use With Highly Efficient Fixtures			Technical Savings Potential	
Toilets	95,003	Toilets	30,447		Toilets	64,556
Showers	67,236	Showers	37,079		Showers	30,157
Baths	27,984	Baths	27,984	* no chg	Baths	0
Faucets	89,388	Faucets	37,778		Faucets	51,610
Dishwashers	4,417	Dishwashers	3,265		Dishwashers	1,152
Clothes Washers	74,310	Clothes Washers	46,593		Clothes Washers	27,716
Total	358,338	Total	183,146		Total	175,192

Unaccounted-For Water

Unaccounted-For Water Island-wide

Unaccounted-for water consists of both losses and non-metered uses. Non-metered uses may include fire demand, street cleaning, illegal hook-ups, or legal services that are un-metered, as well as system leaks and losses. Unaccounted-for water is non-revenue water, and for this reason as well as resource protection, utilities strive to minimize it. However, some unaccounted-for water is unavoidable. Unaccounted-for water is typically higher in older systems than in newer ones. Based upon data provided, island-wide unaccounted-for water on Lanaʻi averaged about 28.36%, as shown in Figure 4-18.

FIGURE 4-18. Lanaʻi Pumpage and Billing - Island Wide Unaccounted-for Water



Unaccounted-For Water by Public Water System (PWS) Area

In an effort to locate this unaccounted-for water, pumpage vs. metered consumption in 2008 was plotted for the two Public Water Systems (PWSs): PWS 237, Koele, Lanaʻi City & Kaumalapau; and PWS 238, Manele-Hulopoʻe and the Irrigation Grid. This effort was undertaken before staff had data to differentiate potable vs. non-potable uses. The results are shown in Figures 4-19 & 4-20.

Recent Production Records

FIGURE 4-19. Unaccounted-for Water in PWS 237 - Koele, Lana'i City & Kaumalapau Regions

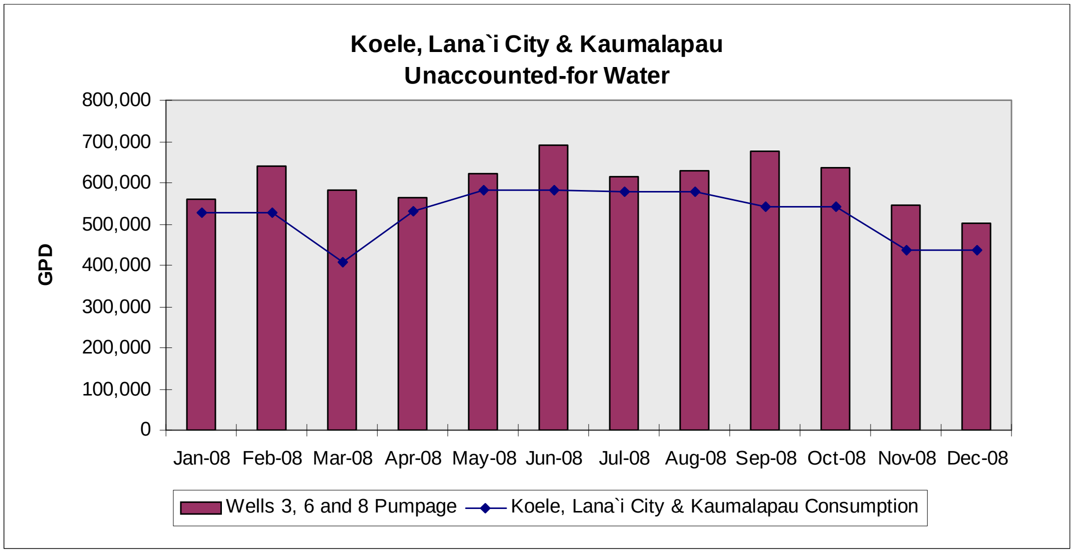
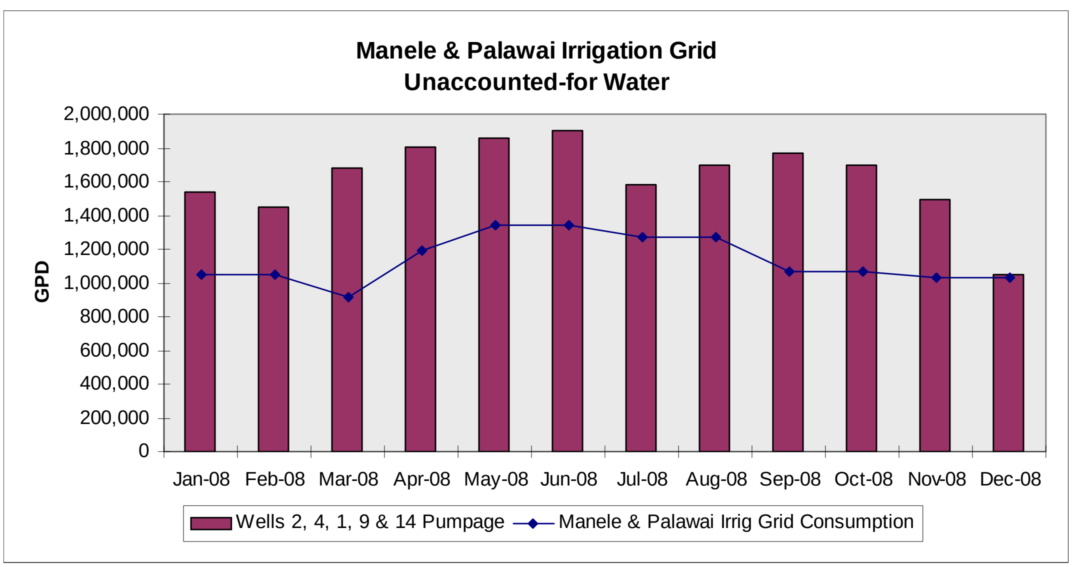


FIGURE 4-20. Unaccounted-for Water in PWS 238 - Manele & Palawai Irrigation Grid Regions



Demand Analysis

As described previously, the reading period dates in the *Periodic Water Reports* were used to re-aggregate pumpage to the actual month in which it occurred, and compare to billing for the same month. Using this re-assignment method, total pumpage in 2008 was 2,231,876 GPD. Of that, 1,626,573 GPD came from Wells 2 ,4, 1, 9 and 14, which collectively serve the Manele-Hulopoʻe area and the Palawai Irrigation Grid with potable and non-potable water; while 604,684 GPD came from Wells 3, 6 and 8, which serve Koele, Lanaʻi City and Kaumalapau. Metered consumption was also summed and re-aggregated to each month based upon meter read dates.

Unaccounted-for water in PWS 238, the Manele-Hulopoʻe and the Palawai Irrigation Grid averaged about 29.21%.

Unaccounted for water in PWS 237, the Koele, Lanaʻi City and Kaumalapau areas averaged about 13.52%.

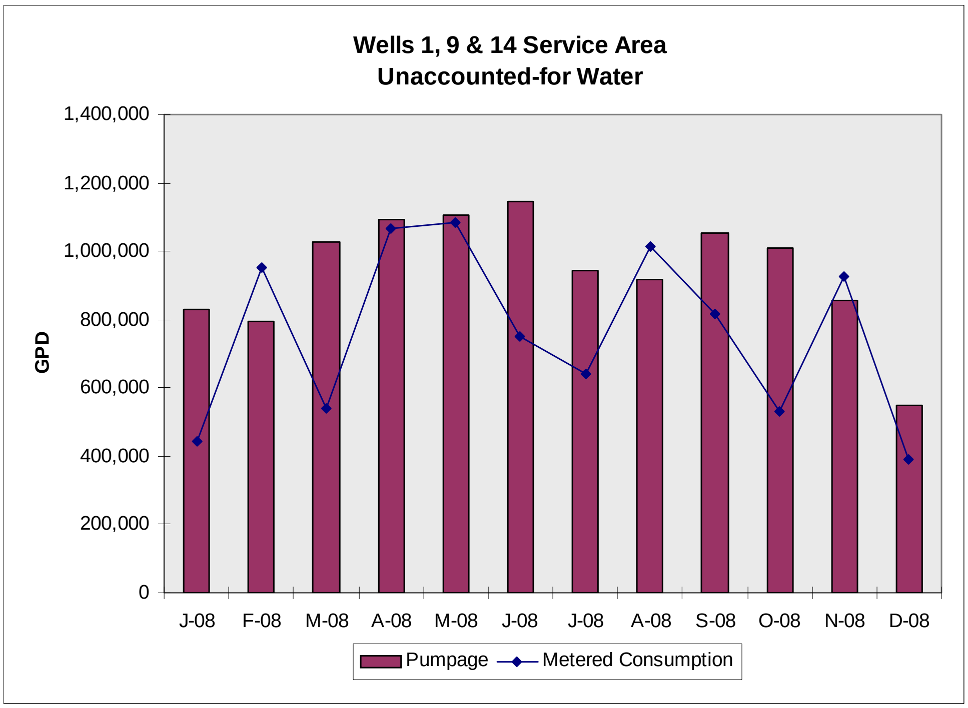
Based upon these results, it appeared that there may be substantial opportunity to offset capital investment for new source by investigating and reducing unaccounted-for water. Therefore, a second analysis was run .

With assistance from Lanaʻi Water Company, Inc. (LWCI), accounts were identified as either potable, non-chlorinated fresh water or brackish water accounts. Utilizing this information, it was possible to further locate unaccounted-for water by the three sets of sources serving different areas and uses. The results of this additional analysis are shown in Figures 4-21, 4-22 and 4-23, on the following pages.

Unaccounted-For Water By Well Service Area

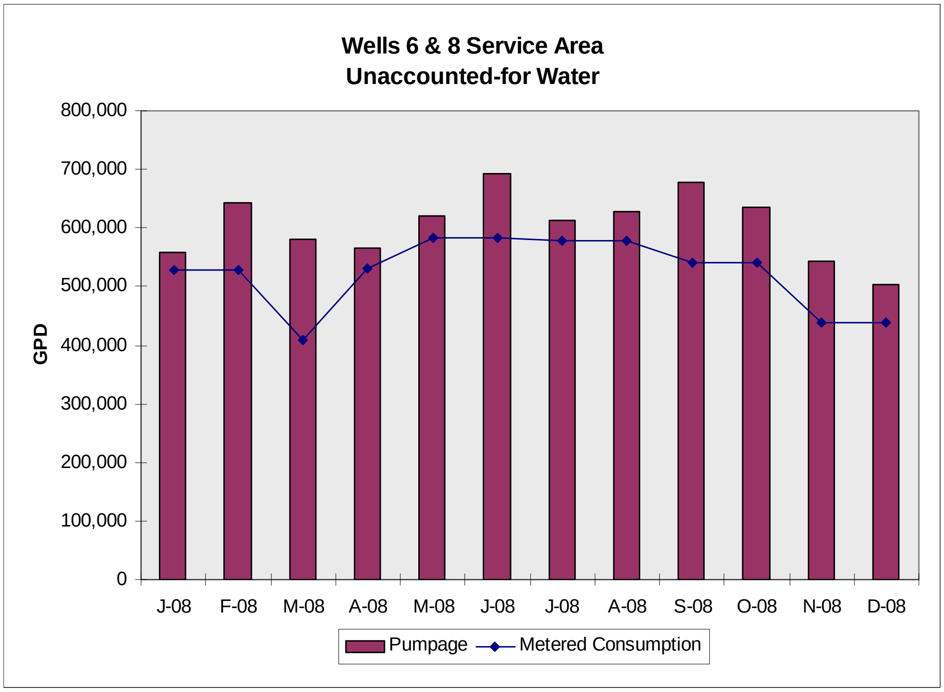
Unaccounted-for water for brackish Wells 1, 9 & 14 is shown in Figure 4-21. Unaccounted-for water for the brackish system averaged 18.76%. These losses were highly variable, reflecting reliance on the 15 MG brackish reservoir.

FIGURE 4-21. Unaccounted-For Water - Wells 1, 9 & 14 Service Area - 2008 Data



Two major sources of possible unaccounted-for water are identified. One source is un-metered roadside irrigation recently located and identified by LWCI. These will be metered soon, which should help to reduce unaccounted-for water on this system. The other major source of unaccounted-for water is the 15 million gallon (MG) open reservoir itself. This reservoir is uncovered and is located in a hot, shadeless, windy and drought-prone area. The operation of the reservoir also accounts for the variability of the unaccounted-for water. The reservoir is filled and then pumped down. The decision to fill the reservoir is made manually, rather than calling for water at a certain set point. The reservoir's capacity is more than nineteen times the 2008 metered daily brackish consumption of 760,357 GPD, so there are periods in which metered consumption exceeds source pumpage. Various methods to reduce evaporation from the reservoir are considered in the *Supply Options* Chapter of this document.

FIGURE 4-22. Unaccounted-For Water - Wells 6 and 8



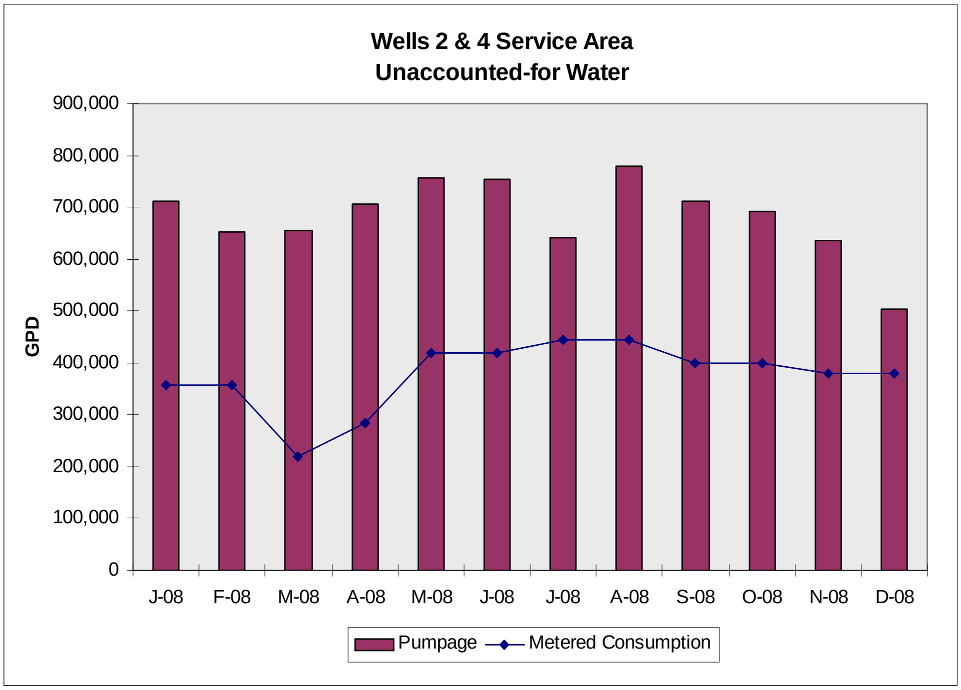
Unaccounted-for water in the areas served by Wells 6 & 8 averaged 13.52%, as shown in Figure 4-22. Potential sources of this unaccounted-for water included older pipe segments within Lana‘i City, made of asbestos-concrete or in some cases steel, as well as the long line to Kaumalapau, which is both old, substandard in size, as well as possible connections around the Kaumalapau tank and other normal losses.

Unaccounted-for water in the areas served by Wells 2 & 4 was considerably higher, at 44.61%. This data is shown in Figure 4-23. Most of these losses are believed to occur in the Palawai Irrigation Grid. Pipes in the Palawai Irrigation Grid date to the 1950’s and 1960’s. They are deteriorated, with frequent breaks and leaks. In addition, there are areas in the Palawai Irrigation Grid where pressures are high, which places more burden on these old pipes. Metered consumption in the Palawai Irrigation Grid is very low, but losses appear to be substantial, resulting in unnecessary pumping expense.

Although average unaccounted-for water for 2008 was 44.61%, it was noted that unaccounted-for water in December 2008 appeared to be lower, at 27%. Based on this data, it was hoped that recent installation of a PRV and replacement of a known leaking pipe segment may have resolved much of the leakage problem. To further examine the results of these measures, data were obtained for the first 6 months of 2009 to investigate whether the apparent reduction in losses at the end of 2008 would be maintained. Unfortunately, unaccounted-for water returned to roughly 2008 levels, with a year to date (YTD) average over the first six periods of 44.53%.

Recent Production Records

FIGURE 4-23. Unaccounted-For Water - Wells 2 and 4 - 2008 Data



Based on this information, certain repairs in the Palawai Grid were weighed against new sources in terms of cost benefit, as discussed in the *Supply Options* chapter of this document.

Island-wide, total losses were estimated at between 555,000 and 575,000 GPD. It would not be reasonable to expect to eliminate 100% of unaccounted-for water. However, the losses identified do appear to present some opportunities. A reduction to 15% overall unaccounted-for water might be a reasonable goal, with perhaps 12% as a goal for the Lana‘i City service region. At 2008 pumping rates, such a reduction could save 243,296 GPD. To the extent that unaccounted-for water is unmetered water as vs. losses, savings would be a bit lower. However, based upon the nature of unmetered losses identified as described by utility personnel in discussions, it seems likely that savings could still exceed 200,000 GPD. On Lana‘i, where some of the wells in use pump at or below this rate, this could potentially offset the capital and operational costs of a well, in addition to the potential resource savings.

Wastewater Production and Use

Wastewater flows are of interest in water planning both because they may represent potential source for certain planned uses, and because they provide information about the way water is used in systems.

There are three wastewater treatment facilities on Lana‘i. These are: the Lana‘i City Wastewater Treatment Facility, operated by the County of Maui; the “Auxiliary Wastewater Treatment Facility”, owned and operated by Castle & Cooke Resorts, LLC, which takes County effluent at Lana‘i City and treats it further in order to use it for Koele Golf Course irrigation; and the Manele Wastewater Treatment Plant, operated by Manele Water Resources, LLC, which provides treated water to the Manele Golf Course for irrigation. Between these facilities, 294,854 GPD of irrigation water is generated and used on the island’s golf courses, bringing the total irrigation estimate to 1,426,366 GPD.

The data in Figure 4-24 were entered from records obtained from both the County of Maui Public Works Department and LWCI. Production shown here is generally about 90% of wastewater influent, but some discrepancies were noted. Water served to Koele seems to have exceeded production by the Auxiliary Wastewater Treatment Facility in 2002, 2003 and 2007. Production at the Auxiliary Wastewater Treatment Facility also appears to have exceeded influent in 2004 and 2005. Such discrepancies would be possible on a daily basis, due to the use of storage. They should not be possible on an annual basis without further accounting for possible causes. Anomalies of this sort may diminish the clarity of auditing efforts. Nationwide, production is generally 65%, of influent, with about 35% of wastewater typically being solids. Due to data uncertainty, rather than rely on empirical data only, a range of 65% to 90% was used to estimate potential reclaimed water as a percent of plant influent.

FIGURE 4-24. Wastewater Influent and Reclaimed Water Production On Lana‘i

Year	County WWTF Annual Avg	Auxilliary WWTF Influent	Auxilliary WWTF Production	Auxilliary WWTF To Koele	Manele WWTF Influent	Manele WWTF Production
1993	280,455					
1994	274,825					
1995	287,214					
1996	310,381					
1997	298,332					
1998	311,699					
1999	310,556	255,385				
2000	313,970	239,286			108,433	83,705
2001	329,819	245,407			85,050	73,468
2002	330,337	227,767	217,712	218,402	84,249	74,927
2003	325,274	203,261	187,396	215,684	85,240	80,856
2004	303,333	198,767	210,734	258,931	87,835	83,409
2005	273,452	202,044	203,420	197,720	75,282	71,674
2006	281,534	211,580	202,556	194,203	82,273	77,424
2007	312,671	216,914	205,953	210,977	84,710	80,526
2008	308,412	245,456	234,093	224,447	77,281	72,940
	303,266	224,587	208,838	217,195	85,595	77,659

Flows at the wastewater treatment facilities on Lana‘i are plotted in Figures 4-25, 4-26 and 4-27. The Lana’i City County Wastewater Treatment Plant receives about 300,000 gallons of inflow per day. Of that, about 225,000 gallons goes to the Auxiliary Plant, which produces about 205,000 GPD for irrigation. The Manele Wastewater Treatment Plant receives about 85,000 GPD of wastewater and produces about 75,000 GPD of reclaimed water for Golf Course irrigation.

Recent Production Records

FIGURE 4-25. Lana‘i City - County and Auxiliary Wastewater Treatment Plant Flows

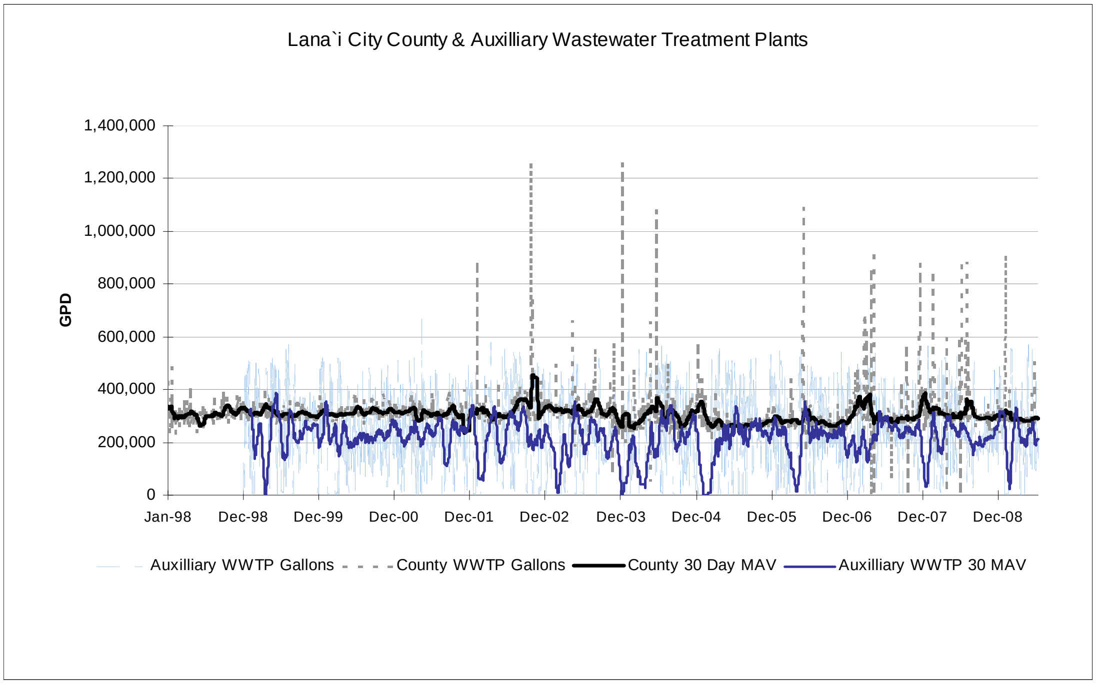


FIGURE 4-26. Lana‘i City Auxiliary Wastewater Treatment Plant - Influent Minus Production

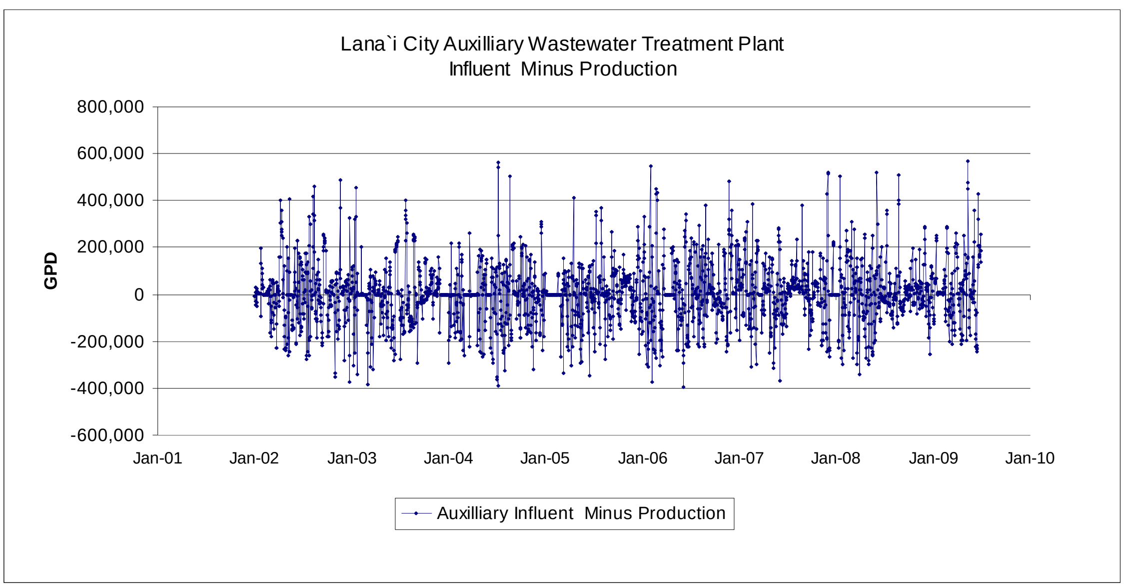
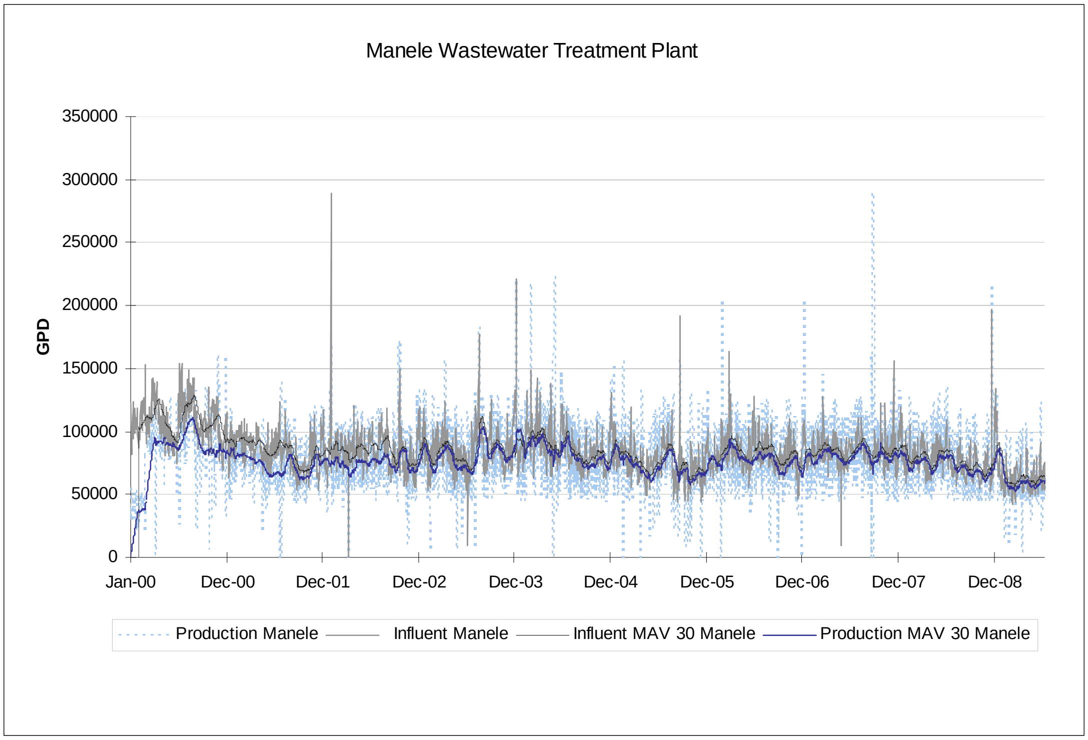


FIGURE 4-27. Manele Wastewater Treatment Plant Flows



Metered Consumption vs. Wastewater

Typically, only 10 or 15 percent of domestic indoor water use is considered consumptive. Below 85 or 90 percent of metered water use, water that does not return to the wastewater system in sewered areas is generally either used on the ground - whether for irrigation, fire suppression, construction watering, or etc. - or attributed to system losses.

Water pumpage, metered consumption and wastewater return flows are plotted in Figures 4-28 and 4-29.

In the service area of Wells 6 & 8 - 52.81% of pumped water and 60.57% of metered consumption returned to the wastewater plant as influent.

In the service area of Wells 2 & 4, only 11.35% of pumped water and 21.31% of billed water returned to the wastewater plant as influent. Since use in the irrigation grid would not be likely to return to a wastewater treatment plant in any case, this was identified and subtracted from metered use. Leaving out irrigation in the grid, 24.64% of metered water returned to the wastewater plant as influent.

These graphs seem to support the notion that the revised irrigation estimate discussed earlier, is likely to be conservative.

Recent Production Records

FIGURE 4-28. Lana'i City Pumped Water, Metered Consumption and Wastewater Influent Return

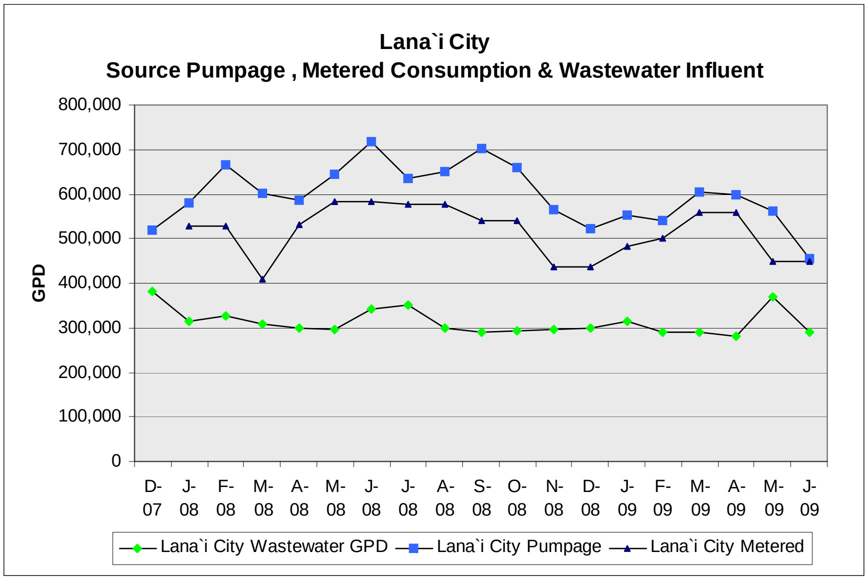
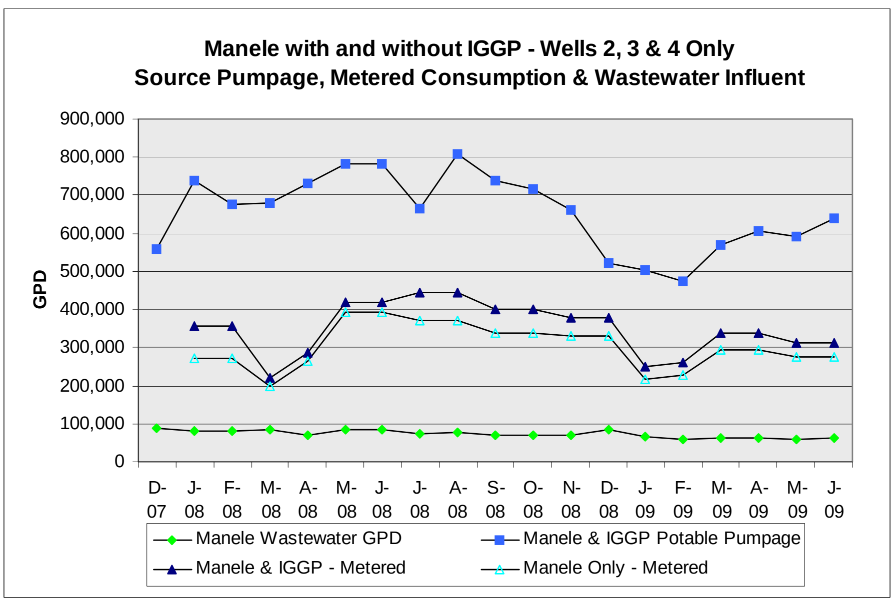


FIGURE 4-29. Manele Pumped Water, Metered Consumption and Wastewater Influent Return



Ways of Projecting Demand

The *Statewide Framework for Updating the Hawai'i Water Plan* suggests that the County Water Use and Development Plans consider multiple forecasts and scenarios. Accordingly, several forecasts and projection methods have been considered. This section discusses demand in terms of these projections and scenarios only. Analysis of demand should not be confused with water allocations. Demand analysis represents a review of trends and / or project build-outs. Allocations, on the other hand, reflect policy recommendations made by the Water Advisory Committee based upon a combination of forecasts, policy objectives and other considerations. These are discussed in the *Policy Issues* chapter of this document.

Methods of forecasting demand include analysis of time series, per capita use, econometric factors, land use build-out, end uses and other factors. These are described briefly below.

Time series forecasting looks at historical trends over time, with no explicit consideration of potential factors that may influence these trends. Such influential factors are assumed to be represented by fluctuations over the time frame utilized. The assumption embedded in this method is that change will occur at the same rate in the future as it has in the past. Therefore, a weakness in this method is that it can fail to predict when there are large shifts in the rate of change of factors that influence a given trend. For instance, on Lana'i, the decision to cease pineapple operations and focus on tourism created a drop in irrigation water consumption which would not have been predicted by a time series analysis. Nor would irrigation consumption continue over time to decline at the rate that it did while pineapple operations were being phased out. When such factors are known, adjustments can sometimes be made for these anomalous changes. For instance, time series trends of irrigation use on Lana'i could utilize irrigation data since pineapple ended. The advantage of time trend forecasting is that it can be done with limited data, and can apply to smaller regions for which disaggregated data may not be available.

Per capita analysis relies on population projections, and assumes that the same amount is used for each person. It requires population projections, a base year, and a population growth factor. This method is useful in water forecasting because population tends to be a strong indicator of water use. One weakness of this method is the assumption that each increment of population will consume the same amount of water. Per capita consumption is influenced by several factors, including socioeconomic status, climate, lot size, and type of employment. An economy that is growing in one way will have different demand patterns than an economy that is growing in another way. With the importance of tourism in the islands, de facto population seems to be a strong indicator that covers both population and some aspect of economic growth. However, even trends based on de facto population can be misleading on Lana'i due to shifts in consumption and population at the time of the end of the pineapple economy, as shown in Figure 4-31.

Econometric analysis involves statistical analysis of many factors that could influence consumption. It can yield a more accurate result, and has the advantage that if trends in one of the factors start to change, projections can easily be adjusted to reflect that change. One drawback of this method is that it requires a great deal of data, in consistent and usable format, which may not be available in sufficient disaggregation to look at smaller regions. Data used in econometric forecasting can include population, de facto population, employment, occupancy, rainfall, irrigated acreage, socioeconomic status of residences, and other factors.

Ways of Projecting Demand

Build-out analysis examines the potential consumption if all planned and proposed projects were fully developed. This is useful for estimating potential or ultimate needs over a planning period, and for understanding the potential impacts of projects and land use decisions. Build-out analysis typically does not provide adequate information on schedules, market influences or other factors to provide a meaningful forecast of growth trends over a given time frame. never the less, it is especially important to consider for areas like the island of Lana‘i, where build-out decisions can have a substantial impact on demand trends.

End use analysis involves looking at how water is used in a specific system. It requires more detailed data than other methods, but is most useful for evaluating the response of a system to demand side management programs or other conservation efforts, as well as to droughts, emergencies or other contingencies. Examples of the types of data reviewed in end use analysis include irrigated acreage, spas, pools, water features, plumbing code and age of homes and fixtures, etc. Using this type of analysis, theoretical savings versus cost estimates can be developed to help evaluate conservation measures. Again, the difficulty in this method lies in obtaining the appropriate data. There was not sufficient data for Lana‘i to provide a projection based upon end use analysis.

Demand for Lana‘i has been reviewed using the following methods:

1. Adjusted Time Trend Analysis based on historical water use.
   In performing time trend analysis, adjustments were made for the end of pineapple cultivation. Municipal and irrigation use were considered separately and irrigation time series analysis was performed using the period since the end of pineapple cultivation.
2. Modified Econometric Analysis.
   Analysis of water demand was performed using growth factors from the *Maui County Community Plan Update Program: Socioeconomic Forecast* prepared by SMS for the County of Maui Planning Department in 2006, for use in update of the general and community plans. Adjustments were made by Haiku Design and Analysis to derive the high and low forecasts based on a range of elasticities. This method is a combination of econometric and per capita analysis. The County forecast in the 2008 update was somewhat lower, but unless it was redistributed much differently, it was encompassed within the range established using the 2006 projections. At the time of this draft the 2008 breakdown by island was not yet available.
3. Build-out Analysis
   Build-out analysis and agreements from the *1997 Final Report of the Lana‘i Water Working Group - Draft WUDP* (1997 Draft) served as a starting point for analysis and discussions. As late as 2002, the Water Advisory Committee voted to retain both projection and policy numbers from this 1997 Draft. Subsequently, CCR proposals from 2004 and 2006 were considered. Also considered were scenarios in which projects were built-out at a pace consistent with time series and modified econometric demand forecasts. Analysis of proposals included a review of unit consumption rates, comparison to a list of CCR and non-CCR projects known to DWS, comparison to project district unit counts as approved, and determination of when the cumulative results of such proposals would result in various triggers or milestones being met, such as the CWRM trigger for re-opening designation proceedings. Each proposal iteration was the subject of several Water Advisory Committee meetings. An additional proposal was received on July 28, 2009 from Castle & Cooke Resorts. Although some analysis of this proposal is presented in this chapter, the Committee voted not to embark on a full consideration of the proposal at that late date in the process.

Adjusted Time Trend Analysis

As noted earlier, The *Periodic Water Reports (PWR)* have historically referenced three service areas for which water deliveries are subtotaled. These are: the “Lanaʻi City” area; the area entitled “Manele, Aoki Diversified Agriculture and Ag activities near the Airport”; and the “Kaumalapau” area. The category now called “Manele, Aoki Diversified Agriculture and Ag activities near the Airport” was initially called simply “Irrigation”. It was re-titled “To Manele District, ADA (Aoki Diversified Agriculture), & Agricultural Activities Near Airport” in 2001. This breakdown of demand dates back to the time when pineapple was cultivated. During the pineapple era, it would have been a fairly reasonable breakdown of municipal versus irrigation water. The category entitled “To Manele District, ADA & Agricultural Activities Near Airport” appears to cover all consumption other than Lanaʻi City and Kaumalapau, or essentially all of Manele potable (PWS 238) plus all brackish and effluent use. Kaumalapau is part of the Lanaʻi City system (PWS 237). Since there is a long history of reporting and public review according to this breakdown, trends of these three sectors were analyzed using a simple time series analysis, shown in Figure 4-30.

As can be seen clearly in Figures 4-1 and 4-3, as well as 4-20, the end of pineapple cultivation caused a steep decline in demand across all sectors of water use, especially irrigation. Since that time, consumption has started to trend gradually upward again.

If the decline in pumpage due to the end of pineapple were included in a time series analysis of recent decades would lead to distorted results, with the dramatic irrigation decline masking the more gentle and slightly upward moving trends for other uses. To avoid such distortion, the three sectors of demand traditional to the *Periodic Water Report*s were analyzed using slightly different time periods. Irrigation trends were derived using data from only the period after the end of pineapple cultivation. Municipal trends were also affected by this shift, but not as strongly, and so were examined both ways.

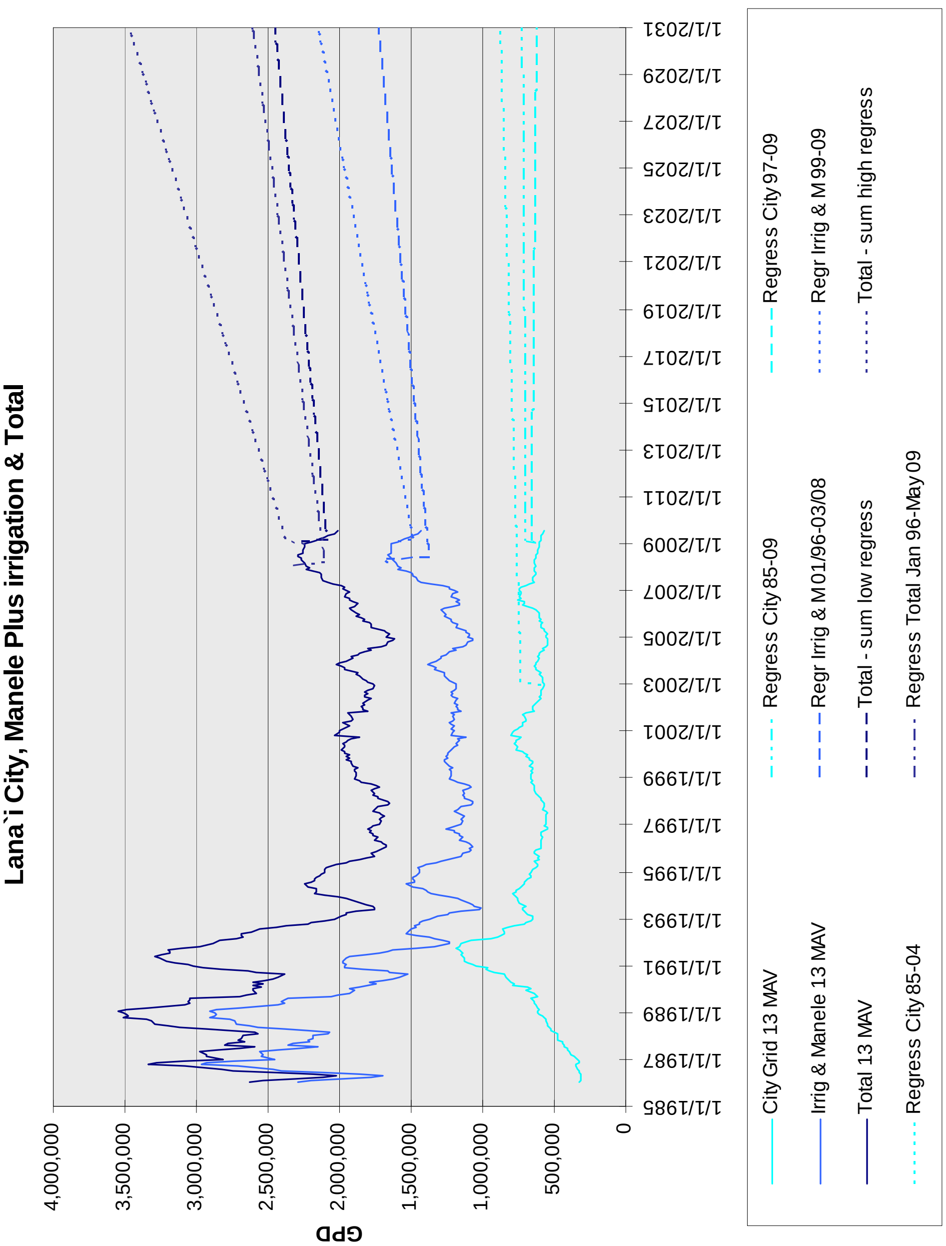
Due to analysis over different time periods, the lower and the higher of these separate trends were added to get low and high cases of the total projection, rather than projecting total use. This analysis yielded a projected range of roughly 2.4 to 3.3 MGD by the year 2030, as shown in Figure 4-30.

Consumption for Kaumalapau meters as classified for this Water Use and Development Plan analysis exceeded reported source use for Kaumalapau in the *Periodic Water Report*s, with metered MAV exceeding 15,000 GPD vs. 3,317 GPD in the *Periodic Water Report*. The lower projection resulted from use of the *Periodic Water Report* numbers, rather than meter breakdown, for projection. Investigation of this discrepancy led to the finding that certain meters, such as the meter for the “Kaumalapau Crusher”, are located above the Kaumalapau Tank, and so were classed one way in the billing analysis, but another way in the *Periodic Water Report*. Both data are accurate, and this discrepancy did not materially affect projections or other analyses in this report with the exception of Kaumalapau.

Based on this analysis, low and high case projections for the year 2030 ranged from 620,000 GPD to 871,000 GPD for Lanaʻi City, from 1.7 to 2.1 MGD for “Manele District, ADA (Aoki Diversified Agriculture), & Agricultural Activities Near Airport”, aka Irrigation, and from 0 to 20,000 GPD for Kaumalapau.

Adjusted Time Trend Analysis

FIGURE 4-30. Source Use and Projected Trends on Lana'i - Time Series of "Lana'i City", "Manele, Aoki Diversified Agriculture and Ag activities near the Airport", and "Kaumalapau" as Disaggregated by *Periodic Water Reports*



Modified Econometric Analysis

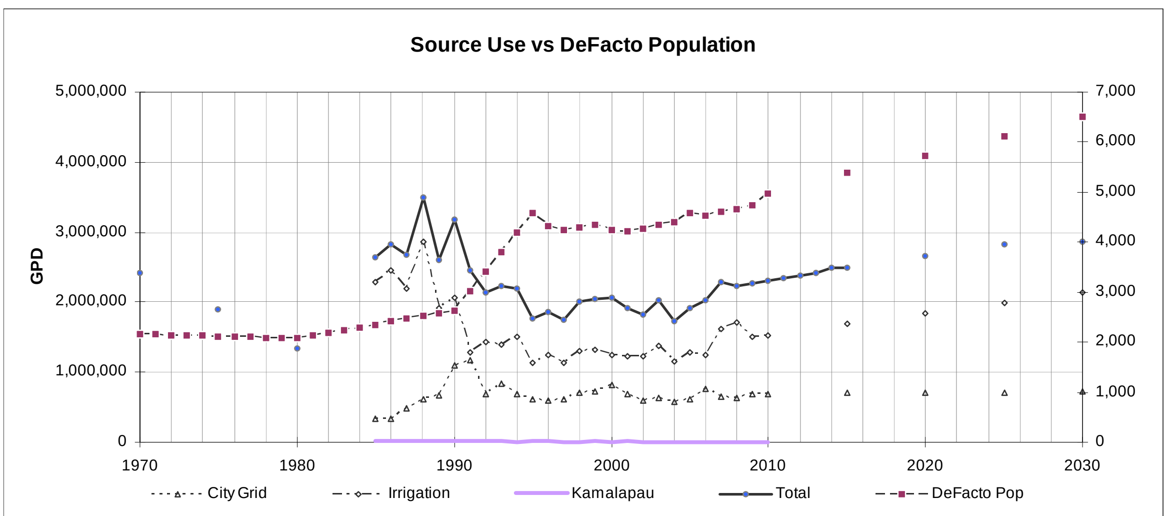
Factors Affecting Demand

Water demand within a community is generally affected by a number of factors. These are described briefly below.

Population usually has a fairly straightforward relationship to demand. As population increases, demand generally increases. However, this relationship can be masked by other factors. When a given land use or industry dominates a local economy, this can have a stronger impact on demand than population. For instance, if the relation of resident population to demand were measured over the period that brackets the end of pineapple, this examination would lead to a finding that the effects of population were minor as compared to changes in agricultural consumption. In fact, for a time there would appear to be a negative association, as plummeting irrigation use overshadowed and completely masked the population curve.

De Facto Population is the population of a region based on those present at a particular time, including temporary visitors, but excluding residents who are temporarily absent. On Lana'i, where tourism is the major economic activity, visitor counts can increase population by 30%. Therefore, de facto population is a stronger predictor of demand than resident population.

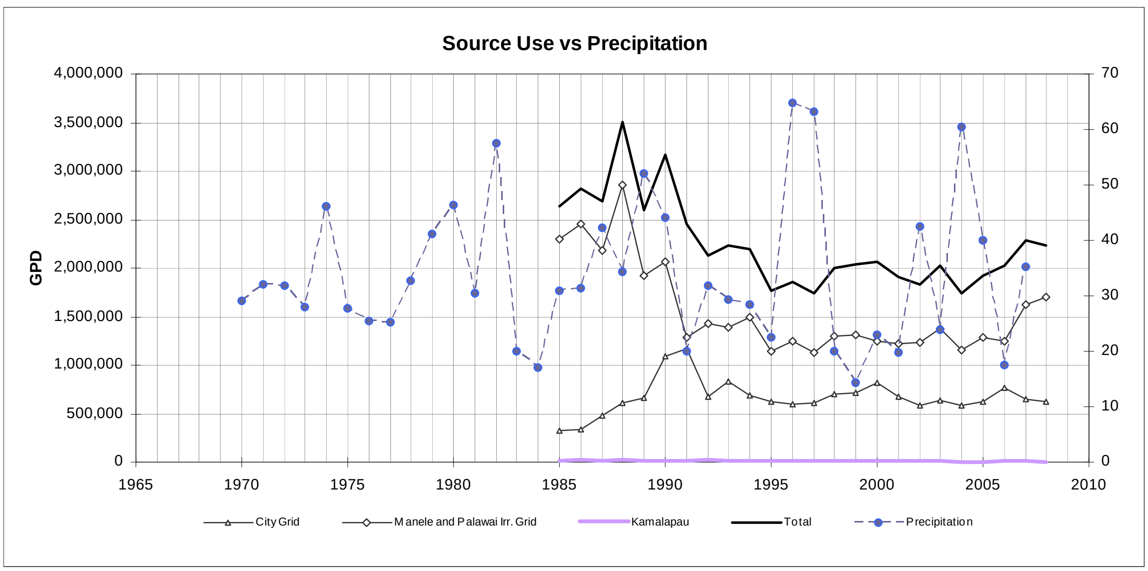
FIGURE 4-31. Source Use and De Facto Population



Modified Econometric Analysis

Climate Factors such as precipitation, temperature, wind, evapotranspiration, and seasonality can have a strong influence on demand patterns. Areas with low rainfall or higher temperatures will use more water per capita or per household than areas that are wet or cool. Rainfall on Lana‘i ranges from about 10 inches at Kaumalapau Harbor to about 42 inches at Lana‘ihale. Temperatures at sea level are typically 10 to 15 degrees higher than in Lana‘i City. This climate difference is also reflected in unit demand rates. A single family home in the hot dry area of the Manele Project District would be likely to use more water than a home in Lana‘i City, even if other factors were the same. Seasonal trends can also be pronounced even in areas with fairly stable climates. Demand increases during the hot, dry summer months.

FIGURE 4-32. Source Use and Precipitation



Demographic Factors include such measures as households, persons per household, household income, population age, etc. In general, more households are associated with higher demands. But this can be masked by economic changes, as discussed earlier. Higher household or per capita income is also associated in general with higher water demand. Those with higher income tend to have more acreage, are more likely to have non-essential water features, such as spas, pools, irrigated landscape etc., and to be less responsive to cost issues. Population density can be associated with higher demands. All things being equal, a square mile of land that is more highly populated will tend to use more water than a sparsely populated square mile. However, densely populated areas tend to use less water per unit than those with larger lots. A water-intensive industry, combined with sparse population in a given area, may result in higher consumption than a dense residential population alone.

FIGURE 4-33. Precipitation, De Facto Population and Demand on Lana'i 1985-1930

Year	Precip	Defacto Pop	City Grid	Irrigation	Kaumalapau	Water Total
1985	31.01	2,352	325,299	2,289,226	15,812	2,630,338
1986	31.47	2,407	336,835	2,451,918	20,363	2,809,116
1987	42.29	2,463	480,470	2,180,298	16,541	2,677,309
1988	34.25	2,518	618,566	2,870,867	22,609	3,512,042
1989	52.13	2,574	663,734	1,926,714	10,247	2,600,695
1990	43.98	2,629	1,044,910	1,964,790	14,054	3,023,754
1991	20.06	3,017	1,119,892	1,229,684	9,187	2,857,679
1992	31.85	3,406	649,969	1,369,042	19,909	2,038,921
1993	29.25	3,794	782,680	1,306,829	10,573	2,100,082
1994	28.3	4,183	663,555	1,437,118	8,585	2,109,258
1995	22.47	4,571	595,556	1,093,568	9,223	1,697,355
1996	64.82	4,239	572,606	1,190,364	9,909	1,772,879
1997	63.19	4,233	578,388	1,075,308	7,357	1,661,052
1998	20.06	4,294	662,120	1,227,522	6,146	1,895,788
1999	14.31	4,354	681,308	1,241,334	9,811	1,932,453
2000	23	4,156	783,756	1,202,486	8,854	1,995,099
2001	19.75	4,216	655,717	1,174,486	10,218	1,840,421
2002	42.58	4,277	567,818	1,187,249	7,857	1,762,925
2003	23.79	4,338	614,402	1,330,704	8,088	1,953,193
2004	60.44	4,398	557,816	1,105,607	5,305	1,668,728
2005	39.94	4,459	603,184	1,252,424	4,700	1,860,308
2006	17.55	4,527	741,151	1,202,904	8,115	1,952,169
2007	35.19	4,595	635,108	1,569,560	6,531	2,211,199
2008		4,664	601,486	1,636,420	3,316	2,241,222
2009 P7 YTD MAV		4,732	875,123	1,471,350	10,147	2,062,572
2010		4,800	889,995	1,483,727	10,225	2,383,947
2015		4,920	964,355	1,545,613	10,617	2,520,584
2020		5,207	1,038,634	1,607,431	11,007	2,657,072
2025		6,110	1,112,588	1,668,978	11,397	2,792,963
2030		6,513	1,186,542	1,730,526	11,786	2,928,854

* de facto pop by HDA method - consistent with DBEDT method

de facto = resident population + visitor census minus residents in transit

FIGURE 4-34. Population, Housing, Occupied Units, Visitor Counts, Occupancy & Employment on Lana‘i

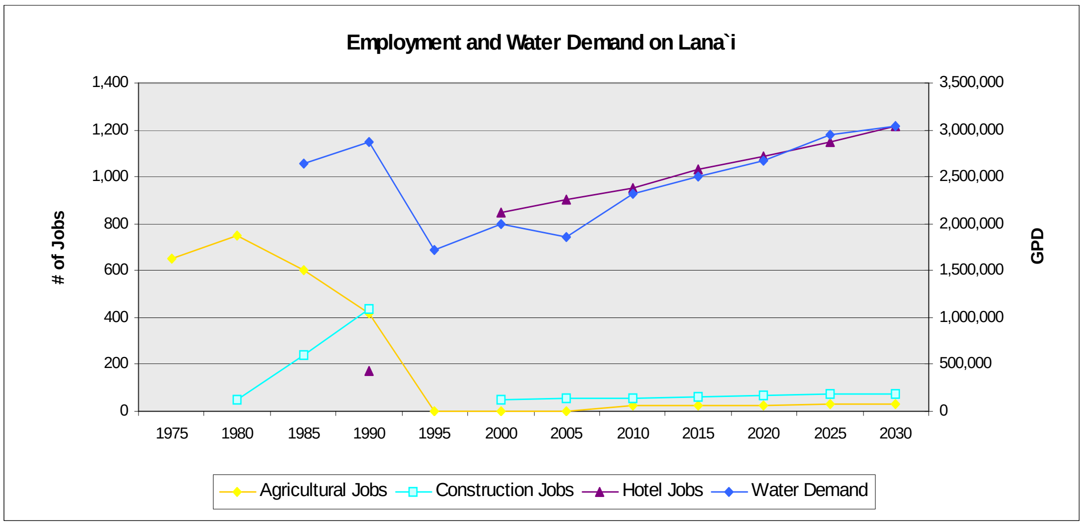
	Population **	De Facto Population **	Households **	Household Size * *	Visitor Census**	Visitor Arrivals**	Visitor Units**	Occupancy*	Occupied Units **
1970	2,204	2,200	647	3.4					
1975									
1980	2,119	2,129	611	3.06					
1985							10		
1990	2,426	2,629	847	2.86	68		113	30.00%	
1995	2,989	4,571	949				367		
2000	3,193	4,243	1,161	2.74	1,131		365	50.00%	
2005	3,452	4,587	1,285	2.69	1,224	95,024	368	54.50%	201
2010	3,735	4,963	1,415	2.64	1,325	102,920	368	59.00%	217
2015	4,046	5,377	1,555	2.6	1,466	113,811	368	65.30%	240
2020	4,308	5,725	1,680	2.56	1,577	122,796	368	70.20%	259
2025	4,598	6,110	1,817	2.53	1700	132054	368	75.70%	279
2030	4,901	6,513	1,955	2.51	1827	141856	368	81.40%	299

	Median ** HH Income	Wage & Salary Jobs**	Civilian Jobs**	Ag Jobs**	Constrx Jobs**	Hotel Jobs**	All Other Jobs**
1970							
1975				650			
1980				750	50		
1985				600	242		
1990	$29,877	1,534	1,623	416	433	173	601
1995				0			
2000	$43,271	1,630	2,088	0	50	850	1,188
2005	$50,156	1,753	2,257	0	53	903	1,302
2010	$58,955	1,891	2,442	24	58	954	1,407
2015	$63,385	2,045	2,615	26	63	1,031	1,527
2020	$68,377	2,162	2,816	27	66	1,086	1,637
2025	$73,629	2293	3006	29	71	1148	1759
2030	$78,463	2426	3204	31	75	1213	1885

** Source of these numbers is Socioeconomic Forecast: The Economic Projections for the Maui County General Plan 2030, published June 2006

<u>Economic Factors</u> include such measures as housing starts, jobs by industry, hotel occupancy, per capita income, etc. All of these measures can have an effect on water demand. More housing starts generally indicate a trend that is growing more quickly. Higher visitor counts or hotel occupancies can lead to higher demand, especially in an area such as Lana‘i, where tourism is both the economic base and the major consumer of water.

FIGURE 4-35. Employment and Water Demand on Lana‘i



	Ag Jobs**	Constrx Jobs**	Hotel Jobs**	All Other Jobs**	Water Demand
1970					
1975	650				
1980	750	50			
1985	600	242			2,637,564
1990	416	433	173	601	2,875,175
1995	0				1,722,507
2000	0	50	850	1,188	1,995,099
2005	0	53	903	1,302	1,860,308
2010	24	58	954	1,407	2,311,263
2015	26	63	1,031	1,527	2,504,062
2020	27	66	1,086	1,637	2,666,126
2025	29	71	1148	1,759	2,945,420
2030	31	75	1213	1,885	3,033,096

<u>Selected Factors</u> De facto population combines information on population growth with information about the visitor industry. This measure was considered to be a strong predictor especially on Lana‘i, where the visitor industry is both the largest water customer and the main source of employment. In addition, the SMS forecast method, described in the following pages, was driven in many ways by de facto population. Unlike some other candidate factors, data for de facto population were available both for a sufficiently long and consistent time period, appropriately disaggregated for use with water data. Therefore, the modified econometric analysis utilized de facto population to derive forecast coefficients.

County Socio-economic Forecast

Consumption was analyzed using data and methods found in *The Maui County Community Plan Update Program: Socio-economic Forecast,* prepared by the consulting firm SMS for the County Planning Department in June of 2006. This document utilized data from a number of sources:

- The 2030 series projections prepared by the State Department of Business, Economic Development and Tourism (DBEDT), as updated with data from the U.S. 2000 Census.
- Data from the Hawaii State Department of Labor and Industrial Relations on wage & salary jobs.
- Hawaii Health Survey Data for 2000 for demographic information.
- The 2005 Visitor Plant Inventory by DBEDT, as updated with SMS survey and real property data from the Real Property Tax Branch.
- Real Property Tax data and Planning Department data on permitted development, land uses, development projects, proposed housing and visitor units.

An updated forecast was prepared in 2008. However, as of this draft disaggregated data for Lana‘i had not yet been made available. In discussion with staff planners, it appeared that the revised forecast would be likely to lower estimates somewhat.

Data from the DBEDT 2030 series projects county-level trends. SMS, the consulting firm to the Planning Department, used this county-level data and the other sources of data listed to disaggregate long term trends into island and community plan regions. A low and high projection were developed based on visitor growth increasing at half or one and a half times the anticipated rate respectively.

Data for de facto population, disaggregated by SMS, were used to project water demand. In translating projected de facto population growth into water demand, one question that needs to be addressed is how much additional water each new unit of population growth represents. Using de facto population as the primary unit of growth, the question becomes, will each new person use the same amount of water as the people in the area use now? An *elasticity* of one means that a new person in an area is expected to use water at the same rates and amounts as the average person in that area currently uses. If this is the case, then water demand will increase in consistent proportion with de facto population. An elasticity of two would mean that new people in the area tend to use twice what people now use. The coefficient used to predict demand is raised to the power of the anticipated elasticity, so if people use twice as much water, the coefficient is squared. Normally in forecasting, the elasticity used is itself derived based on other trends. On Maui, calculated elasticities hovered mainly close to 1, ranging from roughly 0.8 to 1.3. However, the availability and character of data for Lana‘i were not adequate to rely upon associations between predictive factors. In order to address the lack of certainty regarding elasticities for Lana‘i, predictive runs were made using elasticities of 1, 1.5 and 2 for the high low and base case scenarios. Several factors can drive elasticities up or down. For instance, if new development has larger lots with irrigation and water features as compared to older development, elasticity is likely to be higher than 1.

Certain additional assumptions were made. Disaggregated resident population numbers, visitor census and residents-in-transit estimates were used to arrive at estimated de facto populations for the island of Lana‘i. The SMS forecast estimated de facto population by assuming the ratio of resident population to total de facto population to remain consistent with the ratio from the year 2000. Although the principle was the same, that de facto population would equal visitors plus on-island share of residents, the calculation differed from the standard DBEDT formula, which estimates de facto population as *residents + visitors - residents in transit* (residents *plus* visitors *minus* residents in transit). After some reviews by the Department of Water Supply's water forecasting consultant, Haiku Design and Analysis (HDA), it was decided to calculate de facto population trends using the DBEDT formula of *residents + visitors - residents in transit*. This did not precisely match the numbers listed for Lana'i's de facto population in the SMS document, but seemed more consistent with estimates made for other areas, and more likely to accurately reflect the economic shifts on the island.

Data for de facto population was given in five year increments, and historical interpolation between increments was performed using county-wide historical growth trend patterns. Escalation factors generated from this data were applied to water demands to arrive at future demand.

Results of forecasts, run using time trends and using community plan escalation factors applied to island-wide pumpage, are shown below and on the facing page. Time trend projections ranged from 2.4 to 3.23 and the community plan escalation from 2.98 to 3.62, for an overall range of 2.4 to 3.23.

A decision had to be made as to whether pumpage or metered consumption would be used as a base from which to project demand. Both have advantages and disadvantages. Using pumpage to project future demand can be useful when existing unaccounted-for water trends are expected to continue, or when billing data are either unavailable or unreliable. Implicit in such a forecast is an assumption that per capita consumption and unaccounted-for water would stay more or less the same over the projection period.

FIGURE 4-36. Island-wide Water Demand Projections with SMS / HDA Escalation Factors Applied to 2008

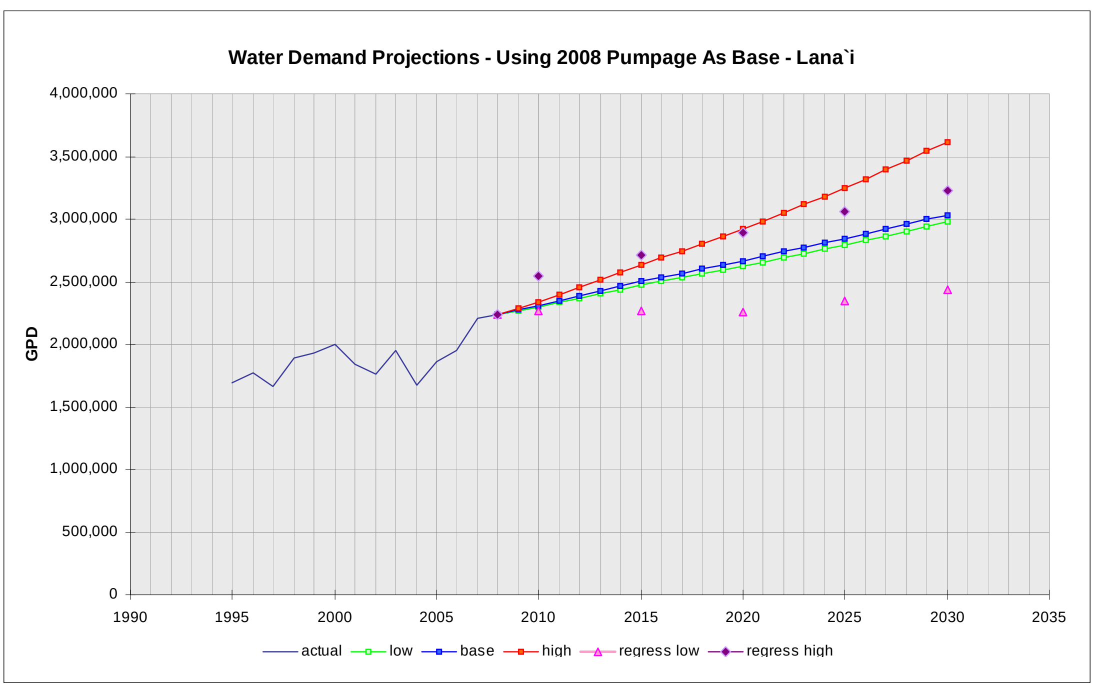


FIGURE 4-37. Total Pumpage Forecast Estimates *Uses 2008 pumpage as a base for Low, Base and High case forecasts. time trend regressions on pumpage also shown.*

	Actual	Low Case	Base Case	High Case	Regress Low	Regress High
1995	1,697,355					
1996	1,772,879					
1997	1,661,052					
1998	1,895,788					
1999	1,932,453					
2000	1,995,099					
2001	1,840,421					
2002	1,762,925					
2003	1,953,193					
2004	1,668,728					
2005	1,860,308					
2006	1,952,169					
2007	2,211,199					
2008	2,241,222	2,241,222	2,241,222	2,241,222	2,241,222	2,241,222
2009		2,270,184	2,276,243	2,290,680		
2010		2,299,146	2,311,263	2,340,138	2,263,286	2,546,116
2011		2,334,481	2,349,823	2,398,813		
2012		2,369,817	2,388,383	2,457,487		
2013		2,405,152	2,426,943	2,516,162		
2014		2,440,488	2,465,503	2,574,837		
2015		2,475,823	2,504,062	2,633,511	2,271,166	2,715,830
2016		2,505,441	2,536,475	2,690,361		
2017		2,535,059	2,568,888	2,747,210		
2018		2,564,677	2,601,300	2,804,060		
2019		2,594,295	2,633,713	2,860,909		
2020		2,623,913	2,666,126	2,917,759	2,260,134	2,887,992
2021		2,657,655	2,701,984	2,983,460		
2022		2,691,397	2,737,843	3,049,161		
2023		2,725,139	2,773,702	3,114,861		
2024		2,758,881	2,809,561	3,180,562		
2025		2,792,623	2,845,420	3,246,263	2,345,652	3,059,401
2026		2,829,458	2,882,955	3,320,451		
2027		2,866,293	2,920,490	3,394,638		
2028		2,903,129	2,958,026	3,468,825		
2029		2,939,964	2,995,561	3,543,012		
2030		2,976,799	3,033,096	3,617,200	2,431,170	3,230,809

Figures 4-36 and 4-37 show projected estimates based upon pumped demand escalated at an elasticity of 1. Projected source demands by this method ranged from 2.98 MGD for the low case to 3.62 MGD for the high case. This range was a bit higher than the time trend regression range of 2.43 to 3.23 MGD.

SMS forecast factors were applied to pumpage at these low case, base case and high case growth rates, with elasticities 1, 1.5 and 2, resulting in a range nine numbers for each method. Forecasts run this way with pumpage as the base ran from 2.98 to 5.84 MGD (with all but the highest estimate falling below 4.6 MGD). The base case range for this forecast projected pumpage between 3.03 MGD and 4.10 MGD. These results are shown in Figure 4-33.

Although the results of projections run using pumpage data are provided, the metered data ultimately proved more useful. With the benefit of metered consumption data, it is possible to get a handle on realistic consumptive needs, and to identify opportunities for specific loss-reduction measures to help meet anticipated demands. The selected forecasts project future demand using metered data, and are adjusted upward to account for targeted unaccounted-for water amounts.

Predictive runs on both pumpage and metered consumption are shown in Figures 4-38 to 4-46. These runs use base, high and low case community plan based escalation factors, applied at an elasticity of 1, 1.5 or 2..

Applying the derived escalation factors to metered demand without upward adjustment resulted in projections ranging from 2.20 to 4.32 MGD, with the base case prediction ranging from 2.2 to 3.04, and all but the highest scenario falling below 3.4 MGD.

Forecasts were adjusted upwardly by 12% for the service area of Wells 6 & 8, 15% for the service area of wells 2 & 4, and 15% for the service area of Wells 1, 9 & 14. This yielded a range of forecasts from 2.56 to 5.03 MGD, with the most likely, or base case scenario, ranging from 2.61 to 3.53 MGD. (vs. 3.03 to 4.01 using pumpage as base and taking the base case with elasticities from 1 to 2).

Prroposals by CCR assumed 12% UAFW across the board. A comparable 12% adjustment to forecasts of metered demand would result in a source requirement of roughly 2.5 to 4.9 MGD, with all but the highest scenario falling below 3.9 MGD.

Figure 4-46 shows the totals of well service areas projected separately, using metered demand as a base for escalation, with twelve percent unaccounted-for water added to the service area of Wells 6 & 8, an d 15% added to the service areas of Wells 1, 9 & 14 and Wells 2 & 4. Island-wide total demands by this method range from 2.56 MGD to 5.03 MGD, with the base case range from 2.61 to 3.53 MGD. This method was chosen as the base planning forecast, and is discussed in the next section.

Projections By Well Service Areas

Projections broken out by Well Service Area are shown on pages 4-38 to 4-46. Although unaccounted-for water between ten and fifteen percent is something of a standard industry target, it is well known that many older and smaller systems do not currently meet this target. Analysis of actual billing data showed that unaccounted-for water was currently 44.6% for fresh water service in Manele-Hulopoʻe and 18.76% for brackish water service to Manele. Twelve percent (12%) seemed a little low to be realistic for these districts, and yet the existing UAFW rates seemed too high to canonize. After examining potential measures to resolve UAFW, it was concluded that 15% might be an appropriate target for Manele-Hulopoʻe and the Palawai Irrigation Grid. The Well Service Area of Wells 6 & 8 (Lanaʻi City, Koele Project District and Kaumalapau), have existing UAFW of only 13.52%, so 12% seemed a reasonable target for that area. Failure to reach these targets would result in build-outs at even greater risk of exceeding sustainable yield than has been projected in build-out analysis discussed later.

Using metered consumption as a base and adding 12% for unaccounted-for water demand for the Well Service Areas of Wells 6 & 8 would range from 0.78 to 1.55 by 2030, with the most likely range from 0.8 to 1.1 MGD.

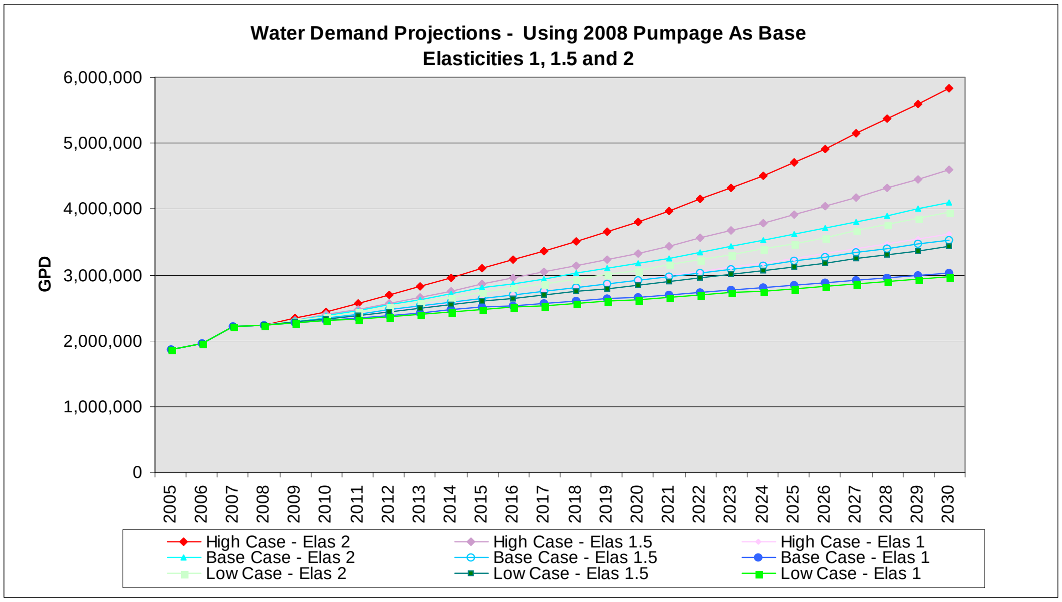
Using metered consumption as a base and adding 15% for unaccounted-for water, demand for the Well Service Areas of Wells 2 & 4 would range from 0.59 to 1.15 by 2030, with the most likely range from 0.6 to 0.81 MGD.

Using metered consumption as a base and adding 15% for unaccounted-for water, demand for the Well Service Areas of Wells 1, 9 & 14 would range from 1.19 to 2.33 MGD, with the most likely range between 1.21 and 1.64.

The forecast for Wells 1, 9 & 14 is somewhat problematic, given controversy over pumpage from brackish high level sources and declining water levels in these same sources. Although Manele Project District is not nearly built-out, brackish water use already exceeds that projected for the entire project in initial project approvals. The 1995 Phase II approval for residential and multi-family development of the Manele PD (95/PH2-001) noted that, at full build-out of the Project District, 0.65 MGD was anticipated to be utilized for golf course irrigation, to come from Wells 1, 9 & 14. Over and above this 0.65 MGD, 0.4 MGD was to be utilized for residential landscaping, of which only 0.15 MGDwas expected to come from high level brackish wells. Another 0.1 MGD was to come from basal Well 12 (which was not successful), and 0.15 was to come from the Manele Wastewater Treatment Plant, which currently serves about 0.073 MGD. The total pumpage envisioned from high level brackish sources was of 0.8 MGD at that time. The Lanaʻi Water Working Group report of February 1997 also recommended an allocation of 0.8 GPD from the high level aquifer for irrigation at Manele. Pumpage from the three brackish high level wells, 1, 9 & 14 was 943,776 GPD in 2008, although only half the hotel units and 17 out of 282 single family units have been built. Controversy surrounding the usage of potable and non-potable water from the high level aquifer, particular in regards to irrigation of Manele, continues. Fortunately, there appears to be much opportunity for conservation in Manele area landscaping.

Demand Analysis

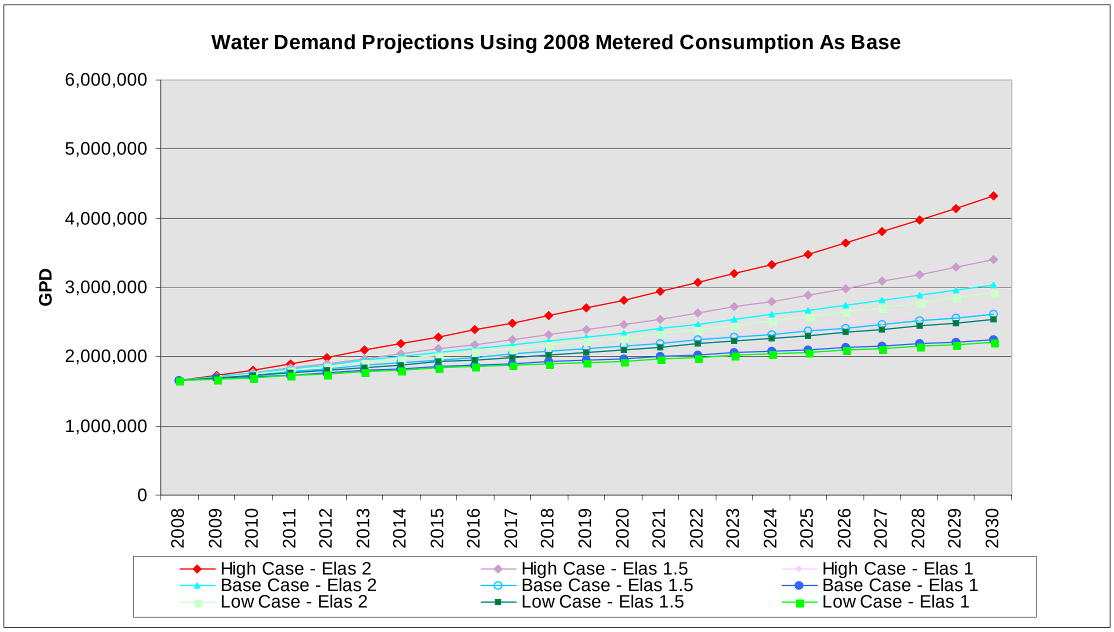
FIGURE 4-38. Island-wide Water Demand Projections Using SMS Forecast Factors with 2008 Pumpage as Base and Elasticities 1, 1.5, and 2



		Low Case			Base Case			High Case		
Year	Pumped Water Actual	Demand Elas.=1	Demand Elas =1.5	Demand Elas.=2	Demand Elas.=1	Demand Elas =1.5	Demand Elas.=2	Demand Elas.=1	Demand Elas =1.5	Demand Elas.=2
2005	1,860,308	1,860,308	1,860,308	1,860,308	1,860,308	1,860,308	1,860,308	1,860,308	1,860,308	1,860,308
2006	1,952,169	1,952,169	1,952,169	1,952,169	1,952,169	1,952,169	1,952,169	1,952,169	1,952,169	1,952,169
2007	2,211,199	2,211,199	2,211,199	2,211,199	2,211,199	2,211,199	2,211,199	2,211,199	2,211,199	2,211,199
2008	2,241,222	2,241,222	2,241,222	2,241,222	2,241,222	2,241,222	2,241,222	2,241,222	2,241,222	2,241,222
2009		2,270,184	2,284,805	2,299,520	2,276,243	2,293,957	2,311,810	2,290,680	2,315,817	2,341,230
2010		2,299,146	2,328,667	2,358,567	2,311,263	2,347,100	2,383,493	2,340,138	2,391,222	2,443,420
2011		2,334,481	2,382,556	2,431,621	2,349,823	2,406,081	2,463,686	2,398,813	2,481,716	2,567,485
2012		2,369,817	2,436,855	2,505,790	2,388,383	2,465,548	2,545,206	2,457,487	2,573,324	2,694,621
2013		2,405,152	2,491,560	2,581,073	2,426,943	2,525,497	2,628,053	2,516,162	2,666,033	2,824,830
2014		2,440,488	2,546,669	2,657,470	2,465,503	2,585,924	2,712,227	2,574,837	2,759,828	2,958,111
2015		2,475,823	2,602,178	2,734,981	2,504,062	2,646,825	2,797,728	2,633,511	2,854,699	3,094,464
2016		2,505,441	2,649,011	2,800,809	2,536,475	2,698,382	2,870,624	2,690,361	2,947,632	3,229,506
2017		2,535,059	2,696,123	2,867,420	2,568,888	2,750,269	2,944,458	2,747,210	3,041,553	3,367,433
2018		2,564,677	2,743,510	2,934,813	2,601,300	2,802,485	3,019,229	2,804,060	3,136,451	3,508,243
2019		2,594,295	2,791,172	3,002,990	2,633,713	2,855,027	3,094,938	2,860,909	3,232,315	3,651,937
2020		2,623,913	2,839,107	3,071,949	2,666,126	2,907,893	3,171,585	2,917,759	3,329,137	3,798,515
2021		2,657,655	2,894,046	3,151,464	2,701,984	2,966,756	3,257,473	2,983,460	3,442,214	3,971,508
2022		2,691,397	2,949,336	3,231,995	2,737,843	3,026,010	3,344,508	3,049,161	3,556,543	4,148,353
2023		2,725,139	3,004,973	3,313,542	2,773,702	3,085,654	3,432,691	3,114,861	3,672,110	4,329,050
2024		2,758,881	3,060,956	3,396,105	2,809,561	3,145,685	3,522,021	3,180,562	3,788,903	4,513,599
2025		2,792,623	3,117,282	3,479,684	2,845,420	3,206,100	3,612,499	3,246,263	3,906,908	4,702,000
2026		2,829,458	3,179,161	3,572,085	2,882,955	3,269,748	3,708,436	3,320,451	4,041,598	4,919,366
2027		2,866,293	3,241,444	3,665,696	2,920,490	3,333,813	3,805,631	3,394,638	4,177,801	5,141,644
2028		2,903,129	3,304,129	3,760,518	2,958,026	3,398,290	3,904,082	3,468,825	4,315,500	5,368,833
2029		2,939,964	3,367,212	3,856,551	2,995,561	3,463,178	4,003,791	3,543,012	4,454,681	5,600,934
2030		2,976,799	3,430,692	3,953,794	3,033,096	3,528,473	4,104,757	3,617,200	4,595,325	5,837,946

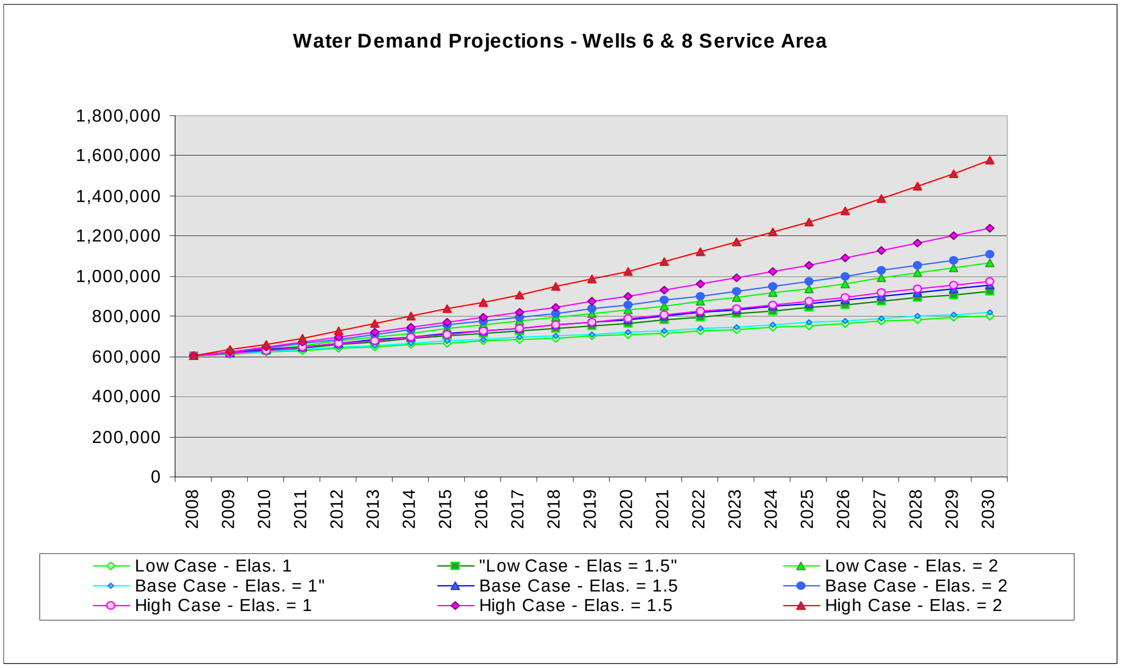
Modified Econometric Analysis

FIGURE 4-39. Water Demand Projections Using 2008 Metered Consumption as Base, with Elasticities 1, 1.5 & 2



	Low Case			Base Case			High Case		
	Demand	Demand	Demand	Demand	Demand	Demand	Demand	Demand	Demand
Year	Elas.=1	Elas.=1.5	Elas.=2	Elas.=1	Elas.=1.5	Elas.=2	Elas.=1	Elas.=1.5	Elas.=2
2008	1,658,224	1,658,224	1,658,224	1,658,224	1,658,224	1,658,224	1,658,224	1,658,224	1,658,224
2009	1,679,652	1,690,470	1,701,357	1,684,135	1,697,242	1,710,451	1,694,817	1,713,415	1,732,217
2010	1,701,080	1,722,922	1,745,044	1,710,046	1,736,561	1,763,487	1,731,410	1,769,205	1,807,826
2011	1,727,224	1,762,794	1,799,096	1,738,575	1,780,199	1,822,820	1,774,822	1,836,160	1,899,618
2012	1,753,368	1,802,968	1,853,971	1,767,105	1,824,197	1,883,134	1,818,233	1,903,938	1,993,683
2013	1,779,512	1,843,443	1,909,671	1,795,634	1,868,552	1,944,431	1,861,645	1,972,531	2,090,021
2014	1,805,656	1,884,216	1,966,195	1,824,164	1,913,260	2,006,709	1,905,057	2,041,928	2,188,632
2015	1,831,799	1,925,286	2,023,544	1,852,693	1,958,320	2,069,968	1,948,469	2,112,120	2,289,516
2016	1,853,713	1,959,937	2,072,248	1,876,674	1,996,465	2,123,903	1,990,530	2,180,879	2,389,431
2017	1,875,627	1,994,794	2,121,532	1,900,656	2,034,855	2,178,531	2,032,592	2,250,369	2,491,479
2018	1,897,540	2,029,855	2,171,395	1,924,637	2,073,488	2,233,852	2,074,654	2,320,581	2,595,661
2019	1,919,454	2,065,118	2,221,837	1,948,618	2,112,363	2,289,867	2,116,715	2,391,509	2,701,977
2020	1,941,368	2,100,584	2,272,858	1,972,600	2,151,477	2,346,576	2,158,777	2,463,145	2,810,426
2021	1,966,332	2,141,232	2,331,689	1,999,131	2,195,028	2,410,122	2,207,387	2,546,808	2,938,419
2022	1,991,297	2,182,140	2,391,272	2,025,662	2,238,869	2,474,518	2,255,998	2,631,397	3,069,263
2023	2,016,262	2,223,304	2,451,607	2,052,193	2,282,998	2,539,762	2,304,608	2,716,902	3,202,956
2024	2,041,227	2,264,725	2,512,693	2,078,724	2,327,413	2,605,855	2,353,218	2,803,314	3,339,499
2025	2,066,192	2,306,399	2,574,531	2,105,255	2,372,113	2,672,798	2,401,829	2,890,623	3,478,892
2026	2,093,445	2,352,182	2,642,896	2,133,026	2,419,205	2,743,779	2,456,718	2,990,277	3,639,716
2027	2,120,699	2,398,263	2,712,157	2,160,798	2,466,605	2,815,691	2,511,607	3,091,050	3,804,174
2028	2,147,952	2,444,642	2,782,313	2,188,569	2,514,310	2,888,533	2,566,497	3,192,931	3,972,265
2029	2,175,205	2,491,316	2,853,365	2,216,340	2,562,318	2,962,305	2,621,386	3,295,906	4,143,991
2030	2,202,459	2,538,283	2,925,313	2,244,112	2,610,629	3,037,007	2,676,275	3,399,966	4,319,350

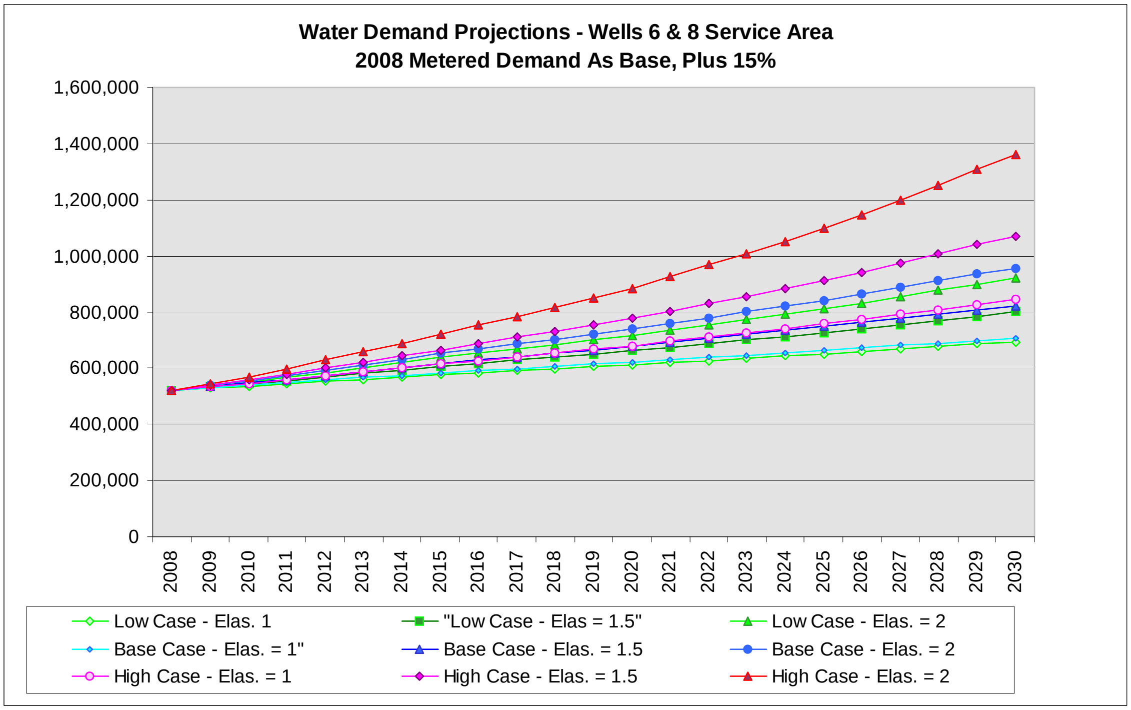
FIGURE 4-40. Wells 6 & 8 Service Area - Projections Using 2008 Pumped Demand



	Low Case			Base Case			High Case		
Year	Demand Elas.=1	Demand Elas.=1.5	Demand Elas.=2	Demand Elas.=1	Demand Elas.=1.5	Demand Elas.=2	Demand Elas.=1	Demand Elas.=1.5	Demand Elas.=2
2008	605,046	605,046	605,046	605,046	605,046	605,046	605,046	605,046	605,046
2009	612,865	616,812	620,784	614,500	619,283	624,102	618,398	625,184	632,044
2010	620,683	628,653	636,725	623,954	633,629	643,454	631,750	645,540	659,632
2011	630,223	643,201	656,447	634,364	649,552	665,103	647,590	669,970	693,125
2012	639,762	657,860	676,469	644,774	665,606	687,110	663,430	694,701	727,447
2013	649,301	672,628	696,793	655,184	681,790	709,476	679,270	719,729	762,598
2014	658,840	687,505	717,417	665,593	698,103	732,200	695,109	745,050	798,579
2015	668,379	702,491	738,342	676,003	714,544	755,282	710,949	770,662	835,389
2016	676,375	715,134	756,114	684,753	728,462	774,961	726,297	795,750	871,846
2017	684,371	727,852	774,096	693,503	742,470	794,893	741,644	821,105	909,081
2018	692,367	740,645	792,290	702,254	756,566	815,079	756,991	846,724	947,094
2019	700,363	753,512	810,695	711,004	770,750	835,517	772,338	872,604	985,886
2020	708,358	766,453	829,311	719,754	785,022	856,209	787,686	898,742	1,025,457
2021	717,467	781,284	850,777	729,435	800,913	879,396	805,422	929,269	1,072,158
2022	726,576	796,210	872,518	739,115	816,909	902,892	823,159	960,133	1,119,900
2023	735,686	811,230	894,532	748,796	833,011	926,698	840,896	991,332	1,168,681
2024	744,795	826,343	916,821	758,476	849,217	950,814	858,633	1,022,862	1,218,503
2025	753,904	841,549	939,384	768,157	865,527	975,239	876,370	1,054,719	1,269,364
2026	763,848	858,254	964,329	778,290	882,710	1,001,139	896,397	1,091,080	1,328,045
2027	773,792	875,069	989,601	788,423	900,005	1,027,378	916,425	1,127,850	1,388,051
2028	783,736	891,991	1,015,199	798,556	917,411	1,053,956	936,453	1,165,023	1,449,384
2029	793,680	909,021	1,041,124	808,689	934,928	1,080,874	956,481	1,202,597	1,512,042
2030	803,624	926,158	1,067,376	818,822	952,556	1,108,131	976,508	1,240,566	1,576,027

Modified Econometric Analysis

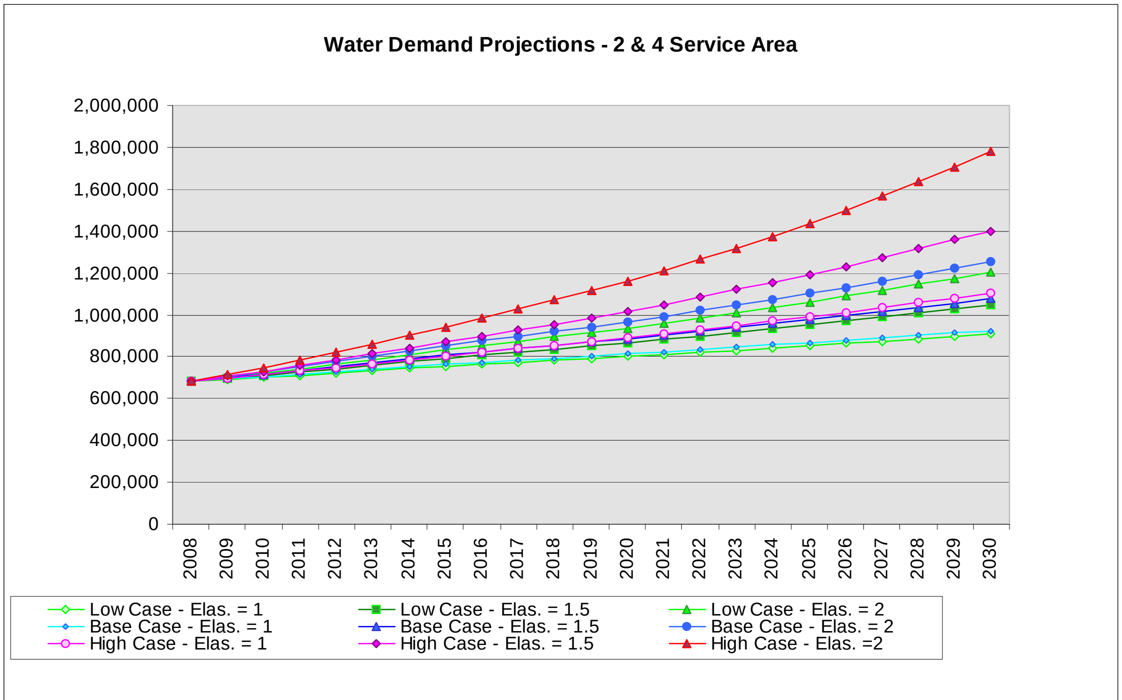
FIGURE 4-41. Wells 6 & 8 Service Area - Projections Using 2008 Metered Demand Plus 12%



	Low Case			Base Case			High Case		
Year	Demand Elas.=1	Demand Elas.=1.5	Demand Elas.=2	Demand Elas.=1	Demand Elas.=1.5	Demand Elas.=2	Demand Elas.=1	Demand Elas.=1.5	Demand Elas.=2
2008	594,025	594,025	594,025	594,025	594,025	594,025	594,025	594,025	594,025
2009	601,701	605,576	609,477	603,307	608,002	612,734	607,134	613,796	620,532
2010	609,377	617,202	625,127	612,589	622,088	631,733	620,242	633,782	647,617
2011	618,743	631,485	644,489	622,809	637,720	652,988	635,794	657,767	680,499
2012	628,108	645,877	664,147	633,029	653,482	674,595	651,345	682,047	714,196
2013	637,474	660,376	684,101	643,249	669,371	696,553	666,897	706,619	748,707
2014	646,839	674,982	704,349	653,469	685,387	718,863	682,448	731,479	784,033
2015	656,205	689,695	724,893	663,690	701,528	741,524	697,999	756,624	820,173
2016	664,055	702,108	742,341	672,280	715,193	760,845	713,067	781,256	855,965
2017	671,905	714,594	759,996	680,871	728,946	780,414	728,135	806,149	892,522
2018	679,755	727,154	777,858	689,462	742,785	800,232	743,202	831,301	929,843
2019	687,605	739,787	795,928	698,053	756,711	820,298	758,270	856,709	967,928
2020	695,455	752,491	814,205	706,644	770,723	840,613	773,338	882,372	1,006,778
2021	704,399	767,053	835,280	716,148	786,324	863,377	790,751	912,342	1,052,629
2022	713,342	781,707	856,625	725,652	802,029	886,446	808,165	942,644	1,099,501
2023	722,285	796,454	878,238	735,156	817,838	909,818	825,579	973,275	1,147,394
2024	731,228	811,292	900,121	744,660	833,748	933,495	842,993	1,004,230	1,196,307
2025	740,171	826,220	922,273	754,165	849,761	957,475	860,406	1,035,507	1,246,242
2026	749,934	842,621	946,764	764,113	866,631	982,903	880,069	1,071,206	1,303,854
2027	759,697	859,129	971,575	774,062	883,611	1,008,664	899,732	1,107,306	1,362,768
2028	769,460	875,743	996,707	784,010	900,700	1,034,758	919,395	1,143,802	1,422,983
2029	779,223	892,463	1,022,160	793,959	917,898	1,061,185	939,058	1,180,691	1,484,500
2030	788,986	909,288	1,047,934	803,907	935,205	1,087,946	958,721	1,217,969	1,547,319

Demand Analysis

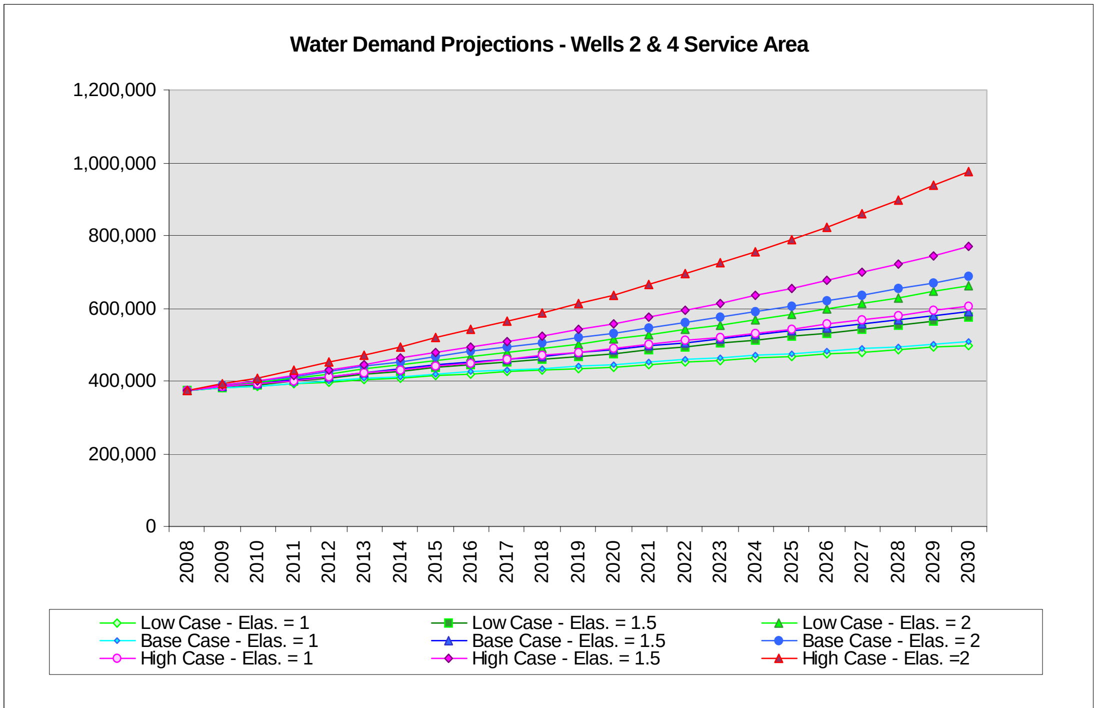
FIGURE 4-42. Wells 2 & 4 Service Area - Projections Using 2008 Pumped Demand



	Low Case			Base Case			High Case		
Year	Demand Elas.=1	Demand Elas.=1.5	Demand Elas.=2	Demand Elas.=1	Demand Elas.=1.5	Demand Elas.=2	Demand Elas.=1	Demand Elas.=1.5	Demand Elas.=2
2008	683,055	683,055	683,055	683,055	683,055	683,055	683,055	683,055	683,055
2009	691,882	696,338	700,822	693,728	699,127	704,568	698,128	705,789	713,534
2010	700,708	709,705	718,818	704,401	715,323	726,415	713,202	728,770	744,679
2011	711,478	726,129	741,083	716,153	733,299	750,855	731,084	756,350	782,490
2012	722,247	742,678	763,687	727,905	751,423	775,700	748,966	784,270	821,237
2013	733,016	759,350	786,631	739,657	769,693	800,949	766,848	812,524	860,921
2014	743,785	776,146	809,914	751,409	788,109	826,603	784,730	841,110	901,541
2015	754,554	793,063	833,537	763,161	806,670	852,661	802,613	870,024	943,097
2016	763,581	807,337	853,600	773,039	822,383	874,877	819,939	898,347	984,253
2017	772,607	821,695	873,901	782,917	838,197	897,380	837,265	926,971	1,026,289
2018	781,634	836,137	894,440	792,796	854,111	920,168	854,590	955,893	1,069,204
2019	790,661	850,663	915,218	802,674	870,124	943,241	871,916	985,109	1,112,997
2020	799,687	865,272	936,235	812,552	886,236	966,601	889,242	1,014,618	1,157,670
2021	809,971	882,016	960,469	823,481	904,175	992,777	909,266	1,049,080	1,210,393
2022	820,254	898,866	985,012	834,410	922,234	1,019,302	929,290	1,083,924	1,264,289
2023	830,538	915,823	1,009,865	845,338	940,412	1,046,178	949,313	1,119,145	1,319,360
2024	840,822	932,885	1,035,028	856,267	958,707	1,073,403	969,337	1,154,740	1,375,605
2025	851,105	950,051	1,060,500	867,196	977,120	1,100,978	989,360	1,190,704	1,433,024
2026	862,331	968,910	1,088,661	878,635	996,518	1,130,216	1,011,970	1,231,754	1,499,270
2027	873,557	987,892	1,117,191	890,075	1,016,043	1,159,838	1,034,580	1,273,264	1,567,014
2028	884,784	1,006,996	1,146,089	901,515	1,035,693	1,189,843	1,057,190	1,315,231	1,636,254
2029	896,010	1,026,222	1,175,357	912,954	1,055,469	1,220,231	1,079,800	1,357,649	1,706,991
2030	907,236	1,045,569	1,204,994	924,394	1,075,369	1,251,003	1,102,410	1,400,513	1,779,225

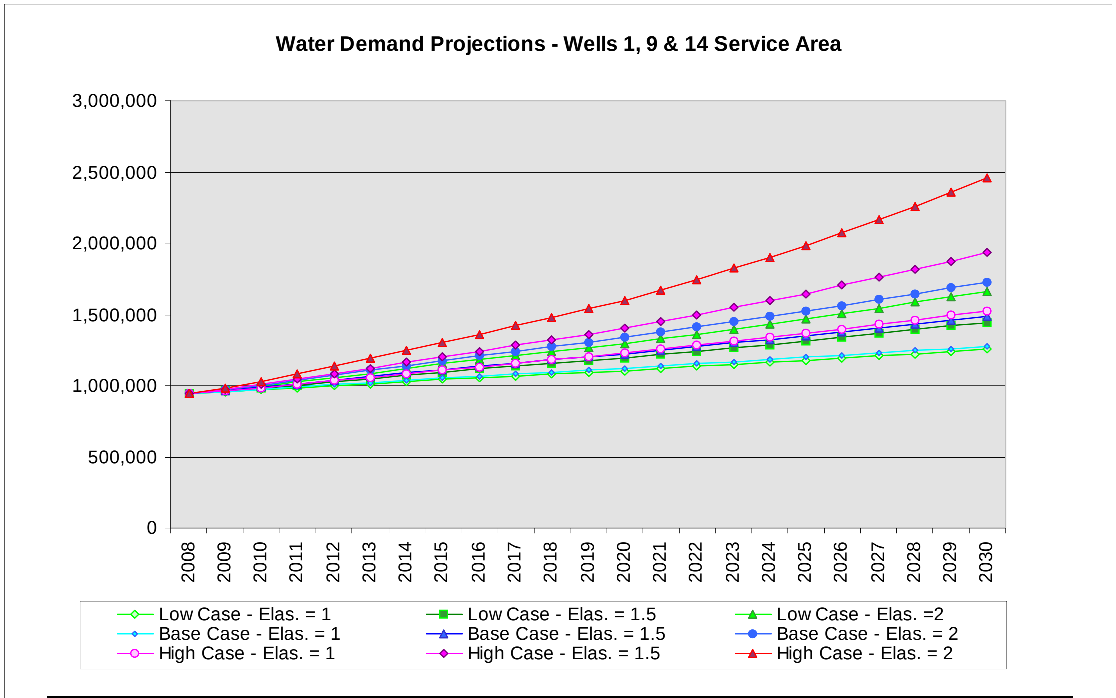
Modified Econometric Analysis

FIGURE 4-43. Wells 2 & 4 Service Area - Projections Using 2008 Metered Demand Plus 15%



	Low Case			Base Case			High Case		
Year	Demand Elas.=1	Demand Elas.=1.5	Demand Elas.=2	Demand Elas.=1	Demand Elas.=1.5	Demand Elas.=2	Demand Elas.=1	Demand Elas.=1.5	Demand Elas.=2
2008	441,348	441,348	441,348	441,348	441,348	441,348	441,348	441,348	441,348
2009	447,052	449,931	452,828	448,245	451,733	455,249	451,088	456,038	461,042
2010	452,755	458,568	464,456	455,141	462,198	469,365	460,827	470,887	481,166
2011	459,713	469,180	478,842	462,734	473,813	485,157	472,382	488,707	505,597
2012	466,671	479,873	493,448	470,328	485,523	501,210	483,936	506,747	530,633
2013	473,630	490,646	508,273	477,921	497,329	517,524	495,490	525,003	556,274
2014	480,588	501,498	523,317	485,514	509,228	534,100	507,045	543,474	582,520
2015	487,547	512,429	538,581	493,108	521,221	550,937	518,599	562,156	609,371
2016	493,379	521,651	551,544	499,490	531,374	565,292	529,794	580,457	635,964
2017	499,212	530,929	564,661	505,873	541,591	579,832	540,989	598,952	663,125
2018	505,044	540,260	577,932	512,256	551,874	594,556	552,184	617,639	690,854
2019	510,876	549,646	591,358	518,639	562,221	609,465	563,379	636,517	719,151
2020	516,709	559,086	604,938	525,022	572,631	624,558	574,574	655,584	748,015
2021	523,354	569,904	620,596	532,083	584,223	641,471	587,512	677,851	782,081
2022	529,998	580,792	636,454	539,144	595,891	658,611	600,450	700,365	816,906
2023	536,643	591,748	652,513	546,206	607,636	675,976	613,388	723,123	852,490
2024	543,287	602,773	668,771	553,267	619,458	693,567	626,326	746,122	888,832
2025	549,932	613,865	685,230	560,329	631,355	711,384	639,264	769,360	925,932
2026	557,186	626,050	703,426	567,720	643,889	730,277	653,873	795,884	968,737
2027	564,439	638,315	721,860	575,112	656,505	749,416	668,482	822,705	1,012,508
2028	571,693	650,659	740,533	582,503	669,202	768,804	683,092	849,821	1,057,247
2029	578,947	663,082	759,444	589,895	681,979	788,439	697,701	877,229	1,102,953
2030	586,200	675,582	778,593	597,287	694,838	808,321	712,310	904,925	1,149,626

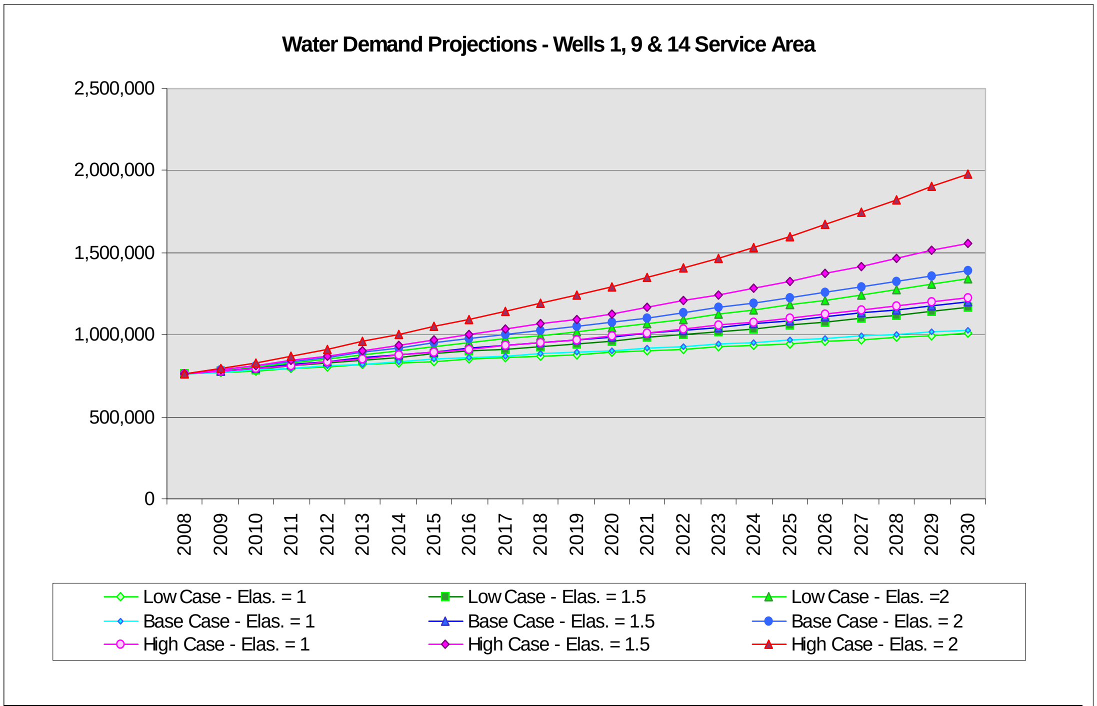
FIGURE 4-44. Wells 1, 9 & 14 Service Area - Projections Using Pumped Demand - Plus 15%



	Low Case			Base Case			High Case		
Year	Demand Elas.=1	Demand Elas.=1.5	Demand Elas.=2	Demand Elas.=1	Demand Elas.=1.5	Demand Elas.=2	Demand Elas.=1	Demand Elas.=1.5	Demand Elas.=2
2008	943,776	943,776	943,776	943,776	943,776	943,776	943,776	943,776	943,776
2009	955,972	962,129	968,325	958,523	965,983	973,501	964,603	975,188	985,889
2010	968,168	980,599	993,190	973,270	988,361	1,003,686	985,430	1,006,941	1,028,922
2011	983,047	1,003,292	1,023,953	989,508	1,013,198	1,037,455	1,010,137	1,045,048	1,081,165
2012	997,927	1,026,157	1,055,185	1,005,745	1,038,239	1,071,783	1,034,845	1,083,624	1,134,702
2013	1,012,807	1,049,193	1,086,887	1,021,983	1,063,484	1,106,670	1,059,553	1,122,663	1,189,533
2014	1,027,686	1,072,399	1,119,057	1,038,220	1,088,930	1,142,116	1,084,261	1,162,161	1,245,657
2015	1,042,566	1,095,774	1,151,697	1,054,458	1,114,575	1,178,120	1,108,969	1,202,110	1,303,075
2016	1,055,038	1,115,496	1,179,417	1,068,107	1,136,286	1,208,816	1,132,908	1,241,245	1,359,941
2017	1,067,510	1,135,334	1,207,467	1,081,756	1,158,135	1,239,908	1,156,847	1,280,794	1,418,022
2018	1,079,983	1,155,289	1,235,847	1,095,405	1,180,123	1,271,394	1,180,786	1,320,756	1,477,317
2019	1,092,455	1,175,359	1,264,556	1,109,053	1,202,249	1,303,275	1,204,726	1,361,124	1,537,826
2020	1,104,927	1,195,545	1,293,594	1,122,702	1,224,511	1,335,551	1,228,665	1,401,896	1,599,550
2021	1,119,136	1,218,680	1,327,078	1,137,803	1,249,297	1,371,718	1,256,331	1,449,512	1,672,398
2022	1,133,344	1,241,962	1,360,989	1,152,903	1,274,249	1,408,369	1,283,998	1,497,656	1,746,867
2023	1,147,553	1,265,391	1,395,329	1,168,003	1,299,365	1,445,502	1,311,665	1,546,321	1,822,958
2024	1,161,762	1,288,965	1,430,096	1,183,103	1,324,644	1,483,119	1,339,331	1,595,503	1,900,671
2025	1,175,970	1,312,684	1,465,291	1,198,203	1,350,085	1,521,219	1,366,998	1,645,194	1,980,007
2026	1,191,482	1,338,741	1,504,201	1,214,009	1,376,887	1,561,618	1,398,238	1,701,912	2,071,539
2027	1,206,993	1,364,968	1,543,620	1,229,815	1,403,865	1,602,547	1,429,478	1,759,267	2,165,140
2028	1,222,504	1,391,365	1,583,550	1,245,621	1,431,016	1,644,005	1,460,718	1,817,252	2,260,810
2029	1,238,015	1,417,929	1,623,989	1,261,427	1,458,340	1,685,992	1,491,958	1,875,861	2,358,547
2030	1,253,527	1,444,661	1,664,938	1,277,233	1,485,836	1,728,509	1,523,199	1,935,086	2,458,352

Modified Econometric Analysis

FIGURE 4-45. Wells 1, 9 & 14 Service Area - Projections Using Metered Demand Plus 15%



	Low Case			Base Case			High Case		
Year	Demand Elas.=1	Demand Elas.=1.5	Demand Elas.=2	Demand Elas.=1	Demand Elas.=1.5	Demand Elas.=2	Demand Elas.=1	Demand Elas.=1.5	Demand Elas.=2
2008	894,538	894,538	894,538	894,538	894,538	894,538	894,538	894,538	894,538
2009	906,097	911,933	917,806	908,515	915,586	922,712	914,278	924,311	934,454
2010	917,657	929,439	941,373	922,493	936,797	951,322	934,018	954,407	975,241
2011	931,760	950,948	970,532	937,883	960,338	983,330	957,437	990,526	1,024,759
2012	945,864	972,621	1,000,134	953,274	984,073	1,015,867	980,856	1,027,089	1,075,503
2013	959,967	994,455	1,030,182	968,664	1,008,000	1,048,933	1,004,274	1,064,092	1,127,473
2014	974,070	1,016,450	1,060,674	984,055	1,032,118	1,082,530	1,027,693	1,101,529	1,180,669
2015	988,174	1,038,606	1,091,611	999,445	1,056,426	1,116,655	1,051,112	1,139,394	1,235,092
2016	999,995	1,057,298	1,117,885	1,012,382	1,077,004	1,145,750	1,073,802	1,176,487	1,288,991
2017	1,011,817	1,076,102	1,144,472	1,025,319	1,097,713	1,175,220	1,096,492	1,213,973	1,344,041
2018	1,023,638	1,095,016	1,171,370	1,038,255	1,118,554	1,205,063	1,119,183	1,251,850	1,400,243
2019	1,035,459	1,114,039	1,198,582	1,051,192	1,139,525	1,235,281	1,141,873	1,290,112	1,457,596
2020	1,047,281	1,133,171	1,226,105	1,064,129	1,160,626	1,265,873	1,164,563	1,328,756	1,516,099
2021	1,060,748	1,155,099	1,257,842	1,078,441	1,184,120	1,300,153	1,190,787	1,373,889	1,585,146
2022	1,074,216	1,177,167	1,289,984	1,092,754	1,207,770	1,334,892	1,217,010	1,419,521	1,655,730
2023	1,087,683	1,199,373	1,322,532	1,107,066	1,231,575	1,370,088	1,243,233	1,465,647	1,727,851
2024	1,101,151	1,221,718	1,355,486	1,121,378	1,255,535	1,405,742	1,269,456	1,512,263	1,801,510
2025	1,114,618	1,244,199	1,388,844	1,135,691	1,279,649	1,441,855	1,295,679	1,559,362	1,876,706
2026	1,129,320	1,268,897	1,425,724	1,150,672	1,305,053	1,480,146	1,325,290	1,613,121	1,963,464
2027	1,144,022	1,293,756	1,463,087	1,165,654	1,330,623	1,518,939	1,354,900	1,667,483	2,052,181
2028	1,158,724	1,318,775	1,500,933	1,180,635	1,356,358	1,558,234	1,384,510	1,722,443	2,142,859
2029	1,173,426	1,343,954	1,539,263	1,195,616	1,382,256	1,598,031	1,414,120	1,777,994	2,235,498
2030	1,188,128	1,369,290	1,578,076	1,210,598	1,408,318	1,638,329	1,443,731	1,834,130	2,330,096

FIGURE 4-46. Well Service Area Projections - Combined Totals

Low Case - Elasticity 1

Year	Wells 6 & 8	Wells 2 & 4	Wells 1, 9 & 14	Total
2008	594,025	441,348	894,538	1,929,911
2009	601,701	447,052	906,097	1,954,850
2010	609,377	452,755	917,657	1,979,789
2011	618,743	459,713	931,760	2,010,216
2012	628,108	466,671	945,864	2,040,643
2013	637,474	473,630	959,967	2,071,071
2014	646,839	480,588	974,070	2,101,498
2015	656,205	487,547	988,174	2,131,925
2016	664,055	493,379	999,995	2,157,429
2017	671,905	499,212	1,011,817	2,182,933
2018	679,755	505,044	1,023,638	2,208,437
2019	687,605	510,876	1,035,459	2,233,941
2020	695,455	516,709	1,047,281	2,259,445
2021	704,399	523,354	1,060,748	2,288,500
2022	713,342	529,998	1,074,216	2,317,556
2023	722,285	536,643	1,087,683	2,346,611
2024	731,228	543,287	1,101,151	2,375,666
2025	740,171	549,932	1,114,618	2,404,721
2026	749,934	557,186	1,129,320	2,436,440
2027	759,697	564,439	1,144,022	2,468,158
2028	769,460	571,693	1,158,724	2,499,877
2029	779,223	578,947	1,173,426	2,531,596
2030	788,986	586,200	1,188,128	2,563,314

Base Case - Elasticity 1

Year	Wells 6 & 8	Wells 2 & 4	Wells 1, 9 & 14	Total
2008	594,025	441,348	894,538	1,929,911
2009	603,307	448,245	908,515	1,960,067
2010	612,589	455,141	922,493	1,990,223
2011	622,809	462,734	937,883	2,023,427
2012	633,029	470,328	953,274	2,056,631
2013	643,249	477,921	968,664	2,089,835
2014	653,469	485,514	984,055	2,123,038
2015	663,690	493,108	999,445	2,156,242
2016	672,280	499,490	1,012,382	2,184,153
2017	680,871	505,873	1,025,319	2,212,063
2018	689,462	512,256	1,038,255	2,239,973
2019	698,053	518,639	1,051,192	2,267,884
2020	706,644	525,022	1,064,129	2,295,794
2021	716,148	532,083	1,078,441	2,326,672
2022	725,652	539,144	1,092,754	2,357,550
2023	735,156	546,206	1,107,066	2,388,428
2024	744,660	553,267	1,121,378	2,419,306
2025	754,165	560,329	1,135,691	2,450,184
2026	764,113	567,720	1,150,672	2,482,506
2027	774,062	575,112	1,165,654	2,514,827
2028	784,010	582,503	1,180,635	2,547,149
2029	793,959	589,895	1,195,616	2,579,470
2030	803,907	597,287	1,210,598	2,611,792

High Case - Elasticity 1

Year	Wells 6 & 8	Wells 2 & 4	Wells 1, 9 & 14	Total
2008	594,025	441,348	894,538	1,929,911
2009	607,134	451,088	914,278	1,972,499
2010	620,242	460,827	934,018	2,015,088
2011	635,794	472,382	957,437	2,065,612
2012	651,345	483,936	980,856	2,116,137
2013	666,897	495,490	1,004,274	2,166,661
2014	682,448	507,045	1,027,693	2,217,186
2015	697,999	518,599	1,051,112	2,267,710
2016	713,067	529,794	1,073,802	2,316,663
2017	728,135	540,989	1,096,492	2,365,616
2018	743,202	552,184	1,119,183	2,414,569
2019	758,270	563,379	1,141,873	2,463,522
2020	773,338	574,574	1,164,563	2,512,475
2021	790,751	587,512	1,190,787	2,569,050
2022	808,165	600,450	1,217,010	2,625,625
2023	825,579	613,388	1,243,233	2,682,200
2024	842,993	626,326	1,269,456	2,738,775
2025	860,406	639,264	1,295,679	2,795,350
2026	880,069	653,873	1,325,290	2,859,232
2027	899,732	668,482	1,354,900	2,923,114
2028	919,395	683,092	1,384,510	2,986,997
2029	939,058	697,701	1,414,120	3,050,879
2030	958,721	712,310	1,443,731	3,114,762

Low Case - Elasticity 1.5

Year	Wells 6 & 8	Wells 2 & 4	Wells 1, 9 & 14	Total
2008	594,025	441,348	894,538	1,929,911
2009	605,576	449,931	911,933	1,967,440
2010	617,202	458,568	929,439	2,005,209
2011	631,485	469,180	950,948	2,051,613
2012	645,877	479,873	972,621	2,098,370
2013	660,376	490,646	994,455	2,145,477
2014	674,982	501,498	1,016,450	2,192,930
2015	689,695	512,429	1,038,606	2,240,729
2016	702,108	521,651	1,057,298	2,281,057
2017	714,594	530,929	1,076,102	2,321,625
2018	727,154	540,260	1,095,016	2,362,430
2019	739,787	549,646	1,114,039	2,403,472
2020	752,491	559,086	1,133,171	2,444,748
2021	767,053	569,904	1,155,099	2,492,056
2022	781,707	580,792	1,177,167	2,539,666
2023	796,454	591,748	1,199,373	2,587,575
2024	811,292	602,773	1,221,718	2,635,782
2025	826,220	613,865	1,244,199	2,684,284
2026	842,621	626,050	1,268,897	2,737,568
2027	859,129	638,315	1,293,756	2,791,200
2028	875,743	650,659	1,318,775	2,845,177
2029	892,483	663,082	1,343,954	2,899,486
2030	909,288	675,582	1,369,290	2,954,161

Base Case - Elasticity 1.5

Year	Wells 6 & 8	Wells 2 & 4	Wells 1, 9 & 14	Total
2008	594,025	441,348	894,538	1,929,911
2009	608,002	451,733	915,586	1,975,321
2010	622,088	462,198	936,797	2,021,082
2011	637,720	473,813	960,338	2,071,871
2012	653,482	485,523	984,073	2,123,077
2013	669,371	497,329	1,008,000	2,174,699
2014	685,387	509,228	1,032,118	2,226,733
2015	701,528	521,221	1,056,426	2,279,175
2016	715,193	531,374	1,077,004	2,323,570
2017	728,946	541,591	1,097,713	2,368,250
2018	742,785	551,874	1,118,554	2,413,213
2019	756,711	562,221	1,139,525	2,458,457
2020	770,723	572,631	1,160,626	2,503,980
2021	786,324	584,223	1,184,120	2,554,666
2022	802,029	595,891	1,207,770	2,605,690
2023	817,838	607,636	1,231,575	2,657,049
2024	833,748	619,458	1,255,535	2,708,742
2025	849,761	631,355	1,279,649	2,760,765
2026	866,631	643,889	1,305,053	2,815,573
2027	883,611	656,505	1,330,623	2,870,738
2028	900,700	669,202	1,356,358	2,926,259
2029	917,898	681,979	1,382,256	2,982,134
2030	935,205	694,838	1,408,318	3,038,360

High Case - Elasticity 1.5

Year	Wells 6 & 8	Wells 2 & 4	Wells 1, 9 & 14	Total
2008	594,025	441,348	894,538	1,929,911
2009	613,796	456,038	924,311	1,994,145
2010	633,782	470,887	954,407	2,059,075
2011	657,767	488,707	990,526	2,137,000
2012	682,047	506,747	1,027,089	2,215,883
2013	706,619	525,003	1,064,092	2,295,714
2014	731,479	543,474	1,101,529	2,376,482
2015	756,624	562,156	1,139,394	2,458,174
2016	781,256	580,457	1,176,487	2,538,199
2017	806,149	598,952	1,213,973	2,619,074
2018	831,301	617,639	1,251,850	2,700,790
2019	856,709	636,517	1,290,112	2,783,339
2020	882,372	655,584	1,328,756	2,866,712
2021	912,342	677,851	1,373,889	2,964,082
2022	942,644	700,365	1,419,521	3,062,530
2023	973,275	723,123	1,465,647	3,162,045
2024	1,004,230	746,122	1,512,263	3,262,615
2025	1,035,507	769,360	1,559,362	3,364,229
2026	1,071,206	795,884	1,613,121	3,480,210
2027	1,107,306	822,705	1,667,483	3,597,494
2028	1,143,802	849,821	1,722,443	3,716,067
2029	1,180,891	877,229	1,777,994	3,835,915
2030	1,217,989	904,925	1,834,130	3,957,024

Low Case - Elasticity 2

Year	Wells 6 & 8	Wells 2 & 4	Wells 1, 9 & 14	Total
2008	594,025	441,348	894,538	1,929,911
2009	609,477	452,828	917,806	1,980,111
2010	625,127	464,456	941,373	2,030,956
2011	644,489	478,842	970,532	2,093,863
2012	664,147	493,448	1,000,134	2,157,730
2013	684,101	508,273	1,030,182	2,222,555
2014	704,349	523,317	1,060,674	2,288,341
2015	724,893	538,581	1,091,611	2,355,086
2016	742,341	551,544	1,117,885	2,411,770
2017	759,996	564,661	1,144,472	2,469,128
2018	777,858	577,932	1,171,370	2,527,161
2019	795,928	591,358	1,198,582	2,585,867
2020	814,205	604,938	1,226,105	2,645,248
2021	835,280	620,596	1,257,842	2,713,718
2022	856,625	636,454	1,289,984	2,783,063
2023	878,238	652,513	1,322,532	2,853,283
2024	900,121	668,771	1,355,486	2,924,378
2025	922,273	685,230	1,388,844	2,996,348
2026	946,764	703,426	1,425,724	3,075,914
2027	971,575	721,860	1,463,087	3,156,522
2028	996,707	740,533	1,500,933	3,238,173
2029	1,022,160	759,444	1,539,263	3,320,867
2030	1,047,934	778,593	1,578,076	3,404,603

Base Case - Elasticity 2

Year	Wells 6 & 8	Wells 2 & 4	Wells 1, 9 & 14	Total
2008	594,025	441,348	894,538	1,929,911
2009	612,734	455,249	922,712	1,990,694
2010	631,733	469,365	951,322	2,052,420
2011	652,988	485,157	983,330	2,121,474
2012	674,595	501,210	1,015,867	2,191,671
2013	696,553	517,524	1,048,933	2,263,010
2014	718,863	534,100	1,082,530	2,335,492
2015	741,524	550,937	1,116,655	2,409,116
2016	760,845	565,292	1,145,750	2,471,887
2017	780,414	579,832	1,175,220	2,535,466
2018	800,232	594,556	1,205,063	2,599,851
2019	820,298	609,465	1,235,281	2,665,044
2020	840,613	624,558	1,265,873	2,731,044
2021	863,377	641,471	1,300,153	2,805,002
2022	886,446	658,611	1,334,892	2,879,948
2023	909,818	675,976	1,370,088	2,955,882
2024	933,495	693,567	1,405,742	3,032,804
2025	957,475	711,384	1,441,855	3,110,714
2026	982,903	730,277	1,480,146	3,193,326
2027	1,008,664	749,416	1,518,939	3,277,019
2028	1,034,758	768,804	1,558,234	3,361,796
2029	1,061,185	788,439	1,598,031	3,447,655
2030	1,087,946	808,321	1,638,329	3,534,597

High Case - Elasticity 2

Year	Wells 6 & 8	Wells 2 & 4	Wells 1, 9 & 14	Total
2008	594,025	441,348	894,538	1,929,911
2009	620,532	461,042	934,454	2,016,027
2010	647,617	481,166	975,241	2,104,023
2011	680,499	505,597	1,024,759	2,210,855
2012	714,196	530,633	1,075,503	2,320,332
2013	748,707	556,274	1,127,473	2,432,454
2014	784,033	582,520	1,180,669	2,547,222
2015	820,173	609,371	1,235,092	2,664,636
2016	855,965	635,964	1,288,991	2,780,920
2017	892,522	663,125	1,344,041	2,899,688
2018	929,843	690,854	1,400,243	3,020,939
2019	967,928	719,151	1,457,596	3,144,674
2020	1,006,778	748,015	1,516,099	3,270,893
2021	1,052,629	782,081	1,585,146	3,419,856
2022	1,099,501	816,906	1,655,730	3,572,137
2023	1,147,394	852,490	1,727,851	3,727,735
2024	1,196,307	888,832	1,801,510	3,886,649
2025	1,246,242	925,932	1,876,706	4,048,881
2026	1,303,654	968,737	1,963,464	4,236,054
2027	1,362,768	1,012,508	2,052,181	4,427,457
2028	1,422,983	1,057,247	2,142,859	4,623,090
2029	1,484,500	1,102,953	2,235,498	4,822,951
2030	1,547,319	1,149,626	2,330,096	5,027,041

Figure 4-46 shows the final sum of the three well service areas projected separately, with twelve percent unaccounted-for water added to the service area of Wells 6 & 8, and 15% added to the service areas of Wells 1, 9 & 14 and Wells 2 & 4. Island-wide total demands by this method range from 2.56 MGD to 5.03 MGD, with the base case range from 2.61 to 3.53 MGD.

The twelve percent target for Wells 6 & 8 is reasonable, and consistent with the CCR proposals, which also utilized twelve percent. This appears to be a reasonable target with existing unaccounted-for water at 13.52% and certain measures to reduce unaccounted-for water identified, such as leak detection and replacement of certain old line segments.

The fifteen percent target is reasonable for the areas of Wells 1, 9 & 15, which currently have 18.76% unaccounted-for water. Although it is less ambitious than the CCR proposal, which used twelve percent island-wide, it allows for a more conservative estimate. Measures to reduce this unaccounted- for water include the cover on the 15 MG brackish reservoir, leak detection, and metering of some previously unmetered services. With these measures, it seems that 15% might be a reasonable target.

The fifteen percent target for the areas of Wells 2 & 4 may seem highly ambitious, given 2008 calendar year unaccounted-for water of 44.61%. However, the sources of unaccounted-for water are clearly identified, and measures to address this high unaccounted-for water have been included in both the proposed capital and funding plans to be discussed in Chapter 5. Such measures include replacement of leaking pipes in the Palawai Grid, leak detection and others. The selected 15% is also more conservative than the 12% used in the CCR proposal.

Chapter 5 includes some discussion of loss reduction measures to reduce unaccounted-for water. Implementation of such loss reduction measures could be sufficient to defer the need for new well development.

Wastewater Projections

Two separate questions arise regarding wastewater generation in water planning. One is how much wastewater will be generated that will need treatment. Another, increasingly important question, is how much of the wastewater generated will actually be available for use as potential source. Buildout analysis answers the first question, predicting how much wastewater will be generated and need treatment. Projections on actual reclaimed water answer the second. While forecast estimates based on actual production go directly to potential reclaimed water source, build-out estimates, without adjustment, predict only wastewater that may need treatment. Both are presented in Figures 4-47 and 4-48, below.

FIGURE 4-47. Proposed and Projected Use of Reclaimed Water by Build-out vs. Projected Escalation Factors

Wastewater At 20 Year Build-out	2006 Proposal Wastewater By Standards	Existing Plus Calculated Addition from Units to 2030	2009 Proposal Wastewater By Standards	Existing Plus Calculated Addition from Units to 2030	Reclaimed SMS Forecast Factors Low	Reclaimed SMS Forecast Factors Low	Reclaimed SMS Forecast Factors Low
Koele PD / Lana`i City	256,000	876,308	832,910	827,758	310,923	316,803	377,812
Manele PD	360,000	248,745	375,938	248,745	96,879	98,711	117,721
	616,000	1,125,053	1,208,848	1,076,503	407,802	415,515	495,533

FIGURE 4-48. Lana'i City Reclaimed Water Projection

AWWTF - LCTY Year	Actual	Low Case Demand Elas.=1	Base Case Demand Elas.=1	High Case Demand Elas.=1
2005	203,420			
2006	202,556			
2007	205,953			
2008	234,093	234,093	234,093	234,093
2009		237,118	237,751	239,259
2010		240,143	241,409	244,425
2011		243,834	245,436	250,553
2012		247,525	249,464	256,682
2013		251,215	253,491	262,810
2014		254,906	257,519	268,939
2015		258,597	261,546	275,067
2016		261,690	264,932	281,005
2017		264,784	268,317	286,943
2018		267,877	271,703	292,881
2019		270,971	275,088	298,819
2020		274,065	278,474	304,756
2021		277,589	282,219	311,619
2022		281,113	285,964	318,481
2023		284,638	289,710	325,344
2024		288,162	293,455	332,206
2025		291,686	297,201	339,068
2026		295,534	301,121	346,817
2027		299,381	305,042	354,566
2028		303,228	308,962	362,315
2029		307,076	312,883	370,063
2030		310,923	316,803	377,812

FIGURE 4-48. Manele Reclaimed Water Projection

Manele Wastewater Year	Actual	Low Case Demand Elas.=1	Base Case Demand Elas.=1	High Case Demand Elas.=1
2005	71,674			
2006	77,424			
2007	80,526			
2008	72,940	72,940	72,940	72,940
2009		73,883	74,080	74,550
2010		74,825	75,219	76,159
2011		75,975	76,474	78,069
2012		77,125	77,729	79,978
2013		78,275	78,984	81,888
2014		79,425	80,239	83,797
2015		80,575	81,494	85,707
2016		81,539	82,549	87,557
2017		82,503	83,604	89,407
2018		83,467	84,659	91,257
2019		84,431	85,714	93,108
2020		85,395	86,768	94,958
2021		86,493	87,935	97,096
2022		87,591	89,102	99,234
2023		88,689	90,269	101,372
2024		89,787	91,436	103,511
2025		90,885	92,603	105,649
2026		92,084	93,825	108,063
2027		93,283	95,047	110,478
2028		94,482	96,268	112,892
2029		95,680	97,490	115,306
2030		96,879	98,711	117,721

Modified Econometric Analysis

FIGURE 4-49. Lanaʻi City AWWTF Reclaimed Water Production Projected to 2030

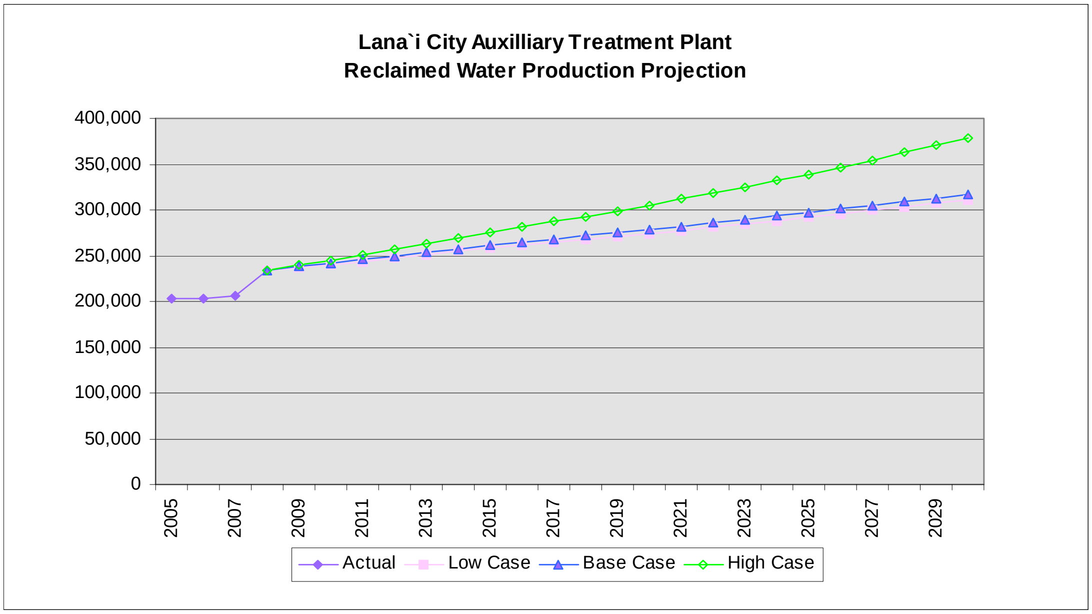


FIGURE 4-50. Manele Wastewater Treatment Facility Reclaimed Water Production to 2030

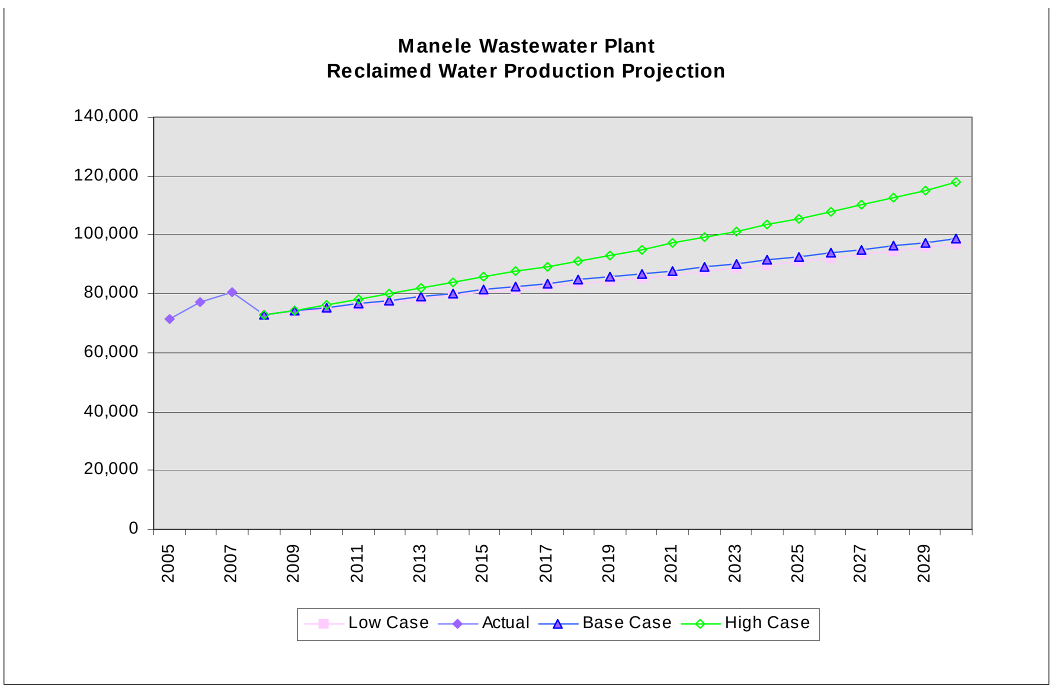


FIGURE 4-51. Wastewater Projections Compared to Build-out - Lana'i City and Koele

Koele PD / Lana`i City Reclaimed Water Use	2006 Proposal	Existing Plus Calculated Addition	2009 Proposal	Existing Plus Calculated Addition	Applying SMS Forecast Factors Low	Applying SMS Forecast Factors Base	Applying SMS Forecast Factors High
Present	1,212	234,093	1,212	234,093	234,093	234,093	234,093
2010	1,212	241,409	1,212	241,409	240,143	241,409	244,425
2015	1,685	397,363	1,618	373,913	258,597	261,546	275,067
2020	2,526	688,008	2,377	635,858	274,065	278,474	304,756
2025	2,773	771,893	2,627	719,843	291,686	297,201	339,068
2030	3,064	876,308	1,618	827,758	310,923	316,803	377,812
Build-out	4,233	1,254,773	4,233	1,254,773			

* treating 2010 as "present" but raising consumption based on forecast.

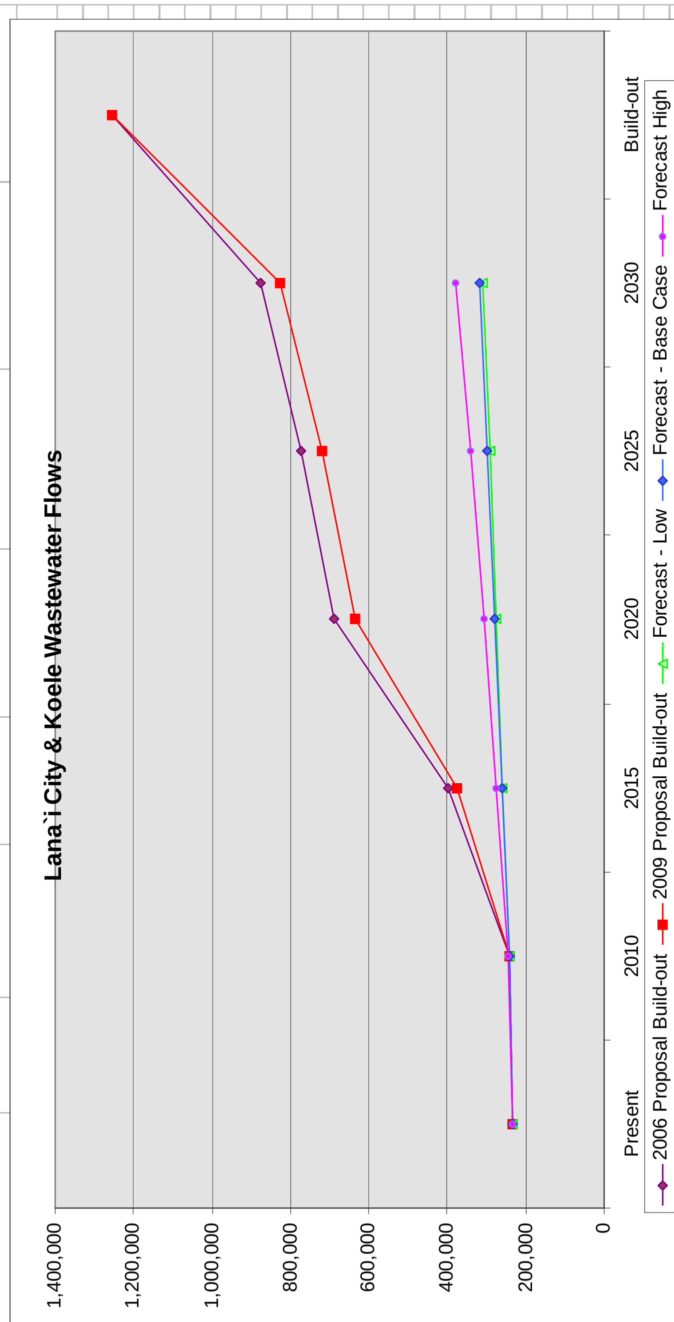
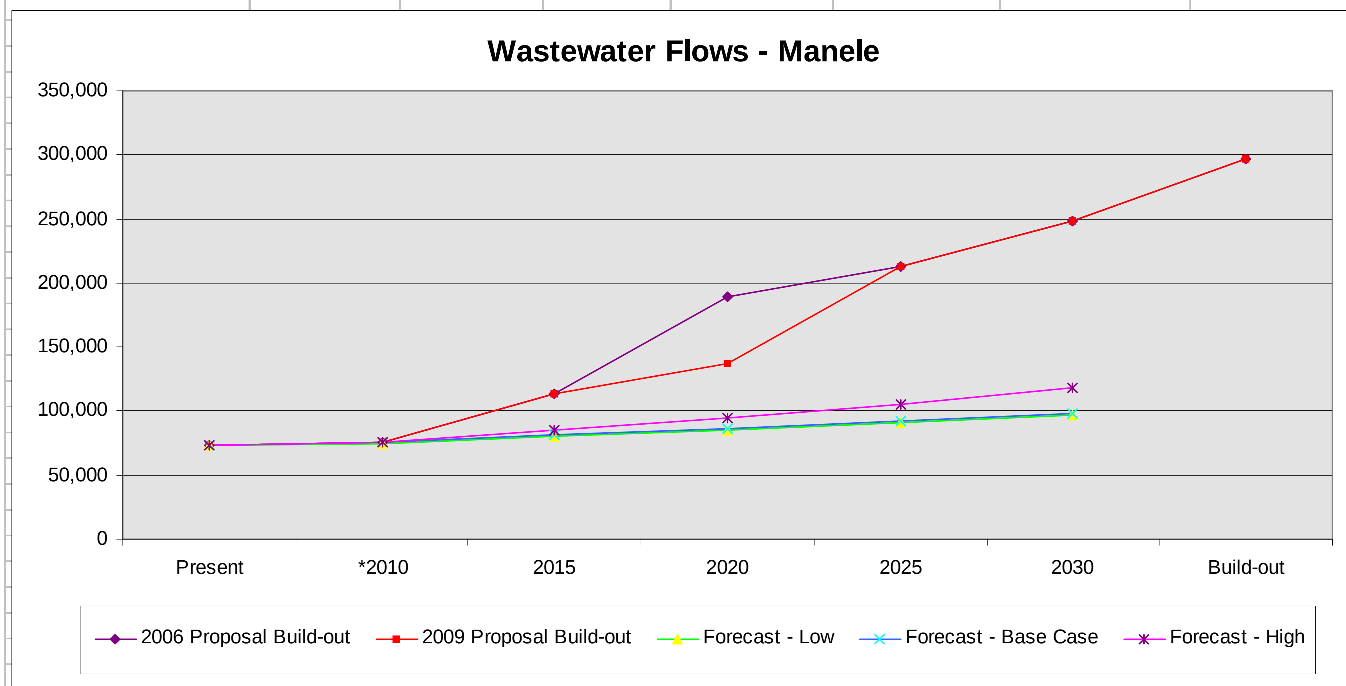


FIGURE 4-52. Wastewater Projections Compared to Build-out - Manele

Manele PD Reclaimed Water Use	2006 Proposal	Existing Plus Calculated Addition	2009 Proposal	Existing Plus Calculated Addition	Applying SMS Forecast Factors Low	Applying SMS Forecast Factors Base	Applying SMS Forecast Factors High
Present	335	72,940	335	72,940	72,940	72,940	72,940
***2010**	335	75,219	335	75,219	74,825	75,219	76,159
2015	425	114,076	425	114,076	80,575	81,494	85,707
2020	650	189,216	500	136,716	85,395	86,768	94,958
2025	335	213,091	725	213,091	90,885	92,603	105,649
2030	335	248,745	900	248,745	96,879	98,711	117,721
Build-out	966	296,586	966	296,586			

* treating 2010 as "present" but raising consumption based on forecast.



The preceding figures indicate anticipated wastewater generation based upon either forecast escalation coefficients or per-standards build-out analysis. Without adjustment, build-out estimates address only how much wastewater may need treatment, these estimates can be adjusted to reflect how much reclaimed water may be available as source. An effort is made to do this below.

Wastewater generated is not the same as reclaimed water available. Wastewater standards are meant to evaluate the amount of water that may need to be treated, and to size treatment facilities accordingly. Reclaimed water availability is lower than wastewater for two reasons. The first is that only a percent of metered demand actually returns as influent to the wastewater processing plant. This percent is known as the return rate. Return rates on Lana‘i are low, particularly in Manele. The standard for residential wastewater generation is 350 GPD per unit, roughly 58% of the standard for residential water use. In contrast, Manele return flows from metered water are less than 25%. This may be attributed to a number of factors, including low unit occupancy in vacation homes, high outdoor use, and high unaccounted-for water. If such trends continue, wastewater availability may remain below standard amounts. Another reason that reclaimed water availability is less than wastewater generated is the treatment process itself. Roughly 35% of wastewater is solids. Reclaimed water will be less than return flows, based on normal process reductions. The combination of normal treatment process reductions and low return rates on Lana‘i mean that wastewater standards can not be translated directly into available reclaimed flows. A conservative approach is needed in estimating available reclaimed water.

FIGURE 4-53. Wastewater Return Rates - Treatment Plant Influent as Percent of Metered or Pumped Water

Area	% Metered	% Pumped
Lana‘i City - Koele	60.57	52.81
Manele - Hulopo‘e - Irrigation Grid	21.31	11.35
Manele - Hulopo‘e without Irrigation Grid	24.64	

In the adjusted build-out estimates below, influent return flows for new growth were assumed to remain at the same percentage as flows for existing development. Available reclaimed water was assumed to be 65% of influent. This method should result in reasonable but conservative flow estimates, since percent return flows from metered use should increase with occupancy and landscape conservation.

Based upon this reclaimed water availability analysis, 400,000 to 700,000 GPD was deemed to be a reasonably prudent estimate of available reclaimed water for the planning period, depending upon the progress of build-out.

Modified Econometric Analysis

FIGURE 4-54. Range of Estimates of Available Reclaimed Water

2030 Wastewater Projection Method Using 35% Treatment Process Reduction	Lana`i City	Manele	Total
2006 Proposal per CCR - Anticipated Use of Reclaimed	256,000	360,000	616,000
2006 Proposal - Estimated Available Water If Proposal Were Built-out Using Wastewater Standards	651,533	187,213	838,746
2006 Proposal - Adjusted Reclaimed Build-out	612,007	121,209	733,216
2009 Proposal per CCR - Anticipated Use of Reclaimed	832,910	375,938	1,208,848
2009 Proposal - Estimated Available Water If Proposal Were Built-out Using Wastewater Standards	583,438	121,209	704,647
Forecast - Wastewater - Low Case	310,923	96,874	407,797
Forecast - Wastewater - Base Case	**316,803**	**98,711**	**415,514**
Forecast - Wastewater - High Case	377,812	117,721	495,533
Phase II Only Reclaimed Build-out	529,428	183,183	712,612
Phase II Only Adjusted Reclaimed Build-out	**501,464**	**119,507**	**620,971**

2030 Wastewater Projection Method Using 10% Treatment Process	Lana`i City	Manele	Total
2006 Proposal per CCR - Anticipated Use of Reclaimed	256,000	360,000	616,000
2006 Proposal - Estimated Available Water If Proposal Were Built-out Using Wastewater Standards	812,087	231,165	1,043,251
2006 Proposal - Adjusted Reclaimed Build-out	757,359	139,774	897,133
2009 Proposal per CCR - Anticipated Use of Reclaimed	832,910	375,938	1,208,848
2009 Proposal - Estimated Available Water If Proposal Were Built-out Using Wastewater Standards	717,801	139,774	857,575
Forecast - Wastewater - Low Case	310,923	96,874	407,797
Forecast - Wastewater - Base Case	**316,803**	**98,711**	**415,514**
Forecast - Wastewater - High Case	377,812	117,721	495,533
Phase II Only Reclaimed Build-out	643,019	225,585	868,603
Phase II Only Adjusted Reclaimed Build-out	**604,299**	**137,417**	**741,716**

Build-Out Analysis

Build-out analysis involves estimating how much water would be consumed if anticipated or proposed projects were fully developed. In this Chapter, build-out analysis includes review of State plans, approved project districts, pending projects, and company proposals.

System Standards

Standards for Drinking Water Demand

The Water Departments of the four counties of the State of Hawaii have promulgated *System Standards*, which govern the design and construction of water system facilities under their respective jurisdictions. Division 100 of these *System Standards* address planning issues, and provide guidelines and requirements for estimating domestic consumption and fire flows. Table 100-18 of the *System Standards* contains domestic consumption guidelines used for estimated demand of proposed projects. These guidelines are provided in Figure 4-55. In the sections analyzing projects to follow, these standards are used for estimating demand except where otherwise noted.

FIGURE 4-55. Statewide System Standards - Maui County Standards

System Standards - Maui County					
From - Division 100 - Planning - Table 100-18 Domestic Consumption Guidelines					
Average Daily Demand *					
Zoning	**Per Unit**	**Per Acre**	**Per 1,000 Square Feet**	**Per Student**	**Notes**
Single Family or Duplex	600	3,000			
Multi-Family Low Rise	560	5,000			
Multi-Family High Rise	560	5,000			
Commercial		6,000	140		
Commercial/Industrial Mix		6,000	140		
Commercial/Residential Mix		6,000	140		
Resort / Hotel	350	17,000			
Light Industry		6,000			
Schools, Parks		1,700		60	
Agriculture		5,000			

* Where two or more figures are listed for the same zoning, the daily demand resulting in higher consumption use shall govern the design unless specified otherwise.

Standards for Wastewater Demand

The County of Maui Wastewater Reclamation Division utilizes the standards presented in Figure 4-56, below, in estimating wastewater flows. These guidelines were used in deriving build-out wastewater estimates discussed above.

FIGURE 4-56. County of Maui Wastewater Flow Standards

Wastewater Flow Standards		
Type of Use	Units	Contribution (Gal/Unit/Day)
Apartment / Condo	Unit	255
Bar	Seat	15
Church, Large	Seat	6
Church, Small	Seat	4
Cottage or Ohana (600 sq. ft. max)	Unit	180
Day Care Center	Child	10
Factory	Employee	30
Golf Clubhouse	Golf Rounds	25
Hotel, Resort with Laundry	Room	350
Hotel, Average with Laundry	Room	300
Hotel, Average without Laundry	Room	250
Hospital	Bed	200
Industrial Shop	Employee	25
Laundry, Coin-operated	Machine	200
Office	Employee	20
Residence	Home	350
Restaurant, Average	Seat	80
Restaurant, Fast Food	Seat	100
Rest Home	Patient	100
Retail Store	Employee	15
School, Elementary	Student	15
School, High	Student	25
Storage, with Offices	Employee	15
Storage, with Offices & Showers	Employee	30
Store Customer Bathroom Usage	Use	5
Theater	Seat	5
Standards Used to Compute Units:		
Use	Unit Estimate	
Residential Occupancy	4 Persons per Unit	
Apartment / Condo / Occupancy	2.5 Persons per Unit	
Hotel Occupancy	2.25 Persons per Unit	
Hotel Employees	1 per Hotel room	
Office Employees	1 per 200 square feet of floor area	
Retail Warehouse Employees	1 per 350 square feet of floor area	
Strorage / Industrial Employees	1 per 500 square feet of floor area	

Consumption Per Unit Analysis

Before analyzing the impacts of proposed developments, one must establish reasonable unit quantities to use as a basis for estimating demands. Statewide System Standards are normally used to estimate the demands of proposed projects.

Adjustments to standards are made for planning purposes when empirical demands in an area are known to differ substantially from standards. This is the case in several areas on Lana‘i.

CCR proposals did not use system standards in all cases. Therefore, in analyzing build-out demands for Lana‘i, various estimates of water use per unit have been considered. These include the Statewide System Standards described above, per unit quantities suggested in several proposals from Castle & Cooke, and finally, empirical use patterns based upon a review of billing data provided. Figure 4-57 summarizes these comparisons.

There is always value in having a realistic assessment of empirical per unit consumption in a given location. Consumption is expected to be more or less than standards in different areas. Actual use patterns must be considered in order to verify that an analysis is realistic.

On the other hand, if existing use patterns vary widely from those anticipated based on use, climate and other factors, one must also consider the question of whether existing use is reasonable. At a certain point, planning for an overly large per unit demand increment can cross the line from realistic analysis into bad policy making. One wants to consider actual needs with a conservative margin. One doesn’t want to condone or perpetuate excessive use by planning for it.

The Lana‘i Water Advisory Committee spent much time discussing both the accuracy and the appropriateness of the various unit-quantity estimates presented here. In the end, it was decided to use both standards and empirical data for analytical purposes, with the common understanding that actual allocations would be set separately as a matter of policy after the review.

Build-out with existing per unit consumption rates, even without such high unaccounted-for water, could cause demand to exceed sustainable yields. The combination would definitely exceed sustainable yield. Measures to address unaccounted-for water were listed earlier. The most important measure to reduce high per unit consumption rates is conservation in the landscape, followed by indoor fixture replacements and hotel conservation programs.

FIGURE 4-57. Consumption Per Unit Analysis

	USAGE CATEGORY	System Standards Per Acre	System Standards Per Unit Or Other As Noted	CCR Proposal 2006 UNITS	CCR Proposal 2006 QUAN	CCR Proposal 2009 UNITS	CCR Proposal 2009 QUAN	Empirical Information From Billing	Notes
									County standards note that "Where two or more figures are listed for the same zoning, the daily demand resulting in higher consumption shall govern the design, unless specified otherwise." Thus, in most cases, per-acre standards would tend to be utilized, unless unit counts are high enough to exceed them. However, in practice, when analyzing anticipated demand, empirical information about the climate and water use patterns of an area are also used to select between and or make adjustments to per-acre and per-unit standards.
	RESIDENTIAL- SINGLE FAMILY								
1.0	**LANA`I CITY RESIDENTIAL (Wells 3, 6 & 8)**								
1.1	Lana`i City Residential - Existing								
	Single Family	3000	600	gpd/unit	350	gpd/unit	350	* 222 / 346	SF unit average in LCTY is 222 GPD. However, removing entries
1.2	Lana`i City Residential -New/Future								with consumption so low that they indicate only sporadic
	Single Family	3000	600	gpd/unit	600	gpd/unit	600		occupation, the average rises to 346 GPD. Total SF use in LCTY
1.4	Affordable Housing Property (Future)	3000	600	gpd/unit	600	gpd/unit	600		per billing analysis for this document was 217,186 GPD.
1.5	DHHL Property	3000	600	gpd/unit	600	gpd/unit	600		
1.7	Kaumulapau Subdivision (Future)	3000	600	gpd/unit	600	gpd/unit	600	*	Numbers not suitable to derive estimate for Kaumalapau.
4.0	**KOELE PD RESIDENTIAL**								
4.6	Koele Single Family	3000	600	gpd/unit	600	gpd/unit	600	* 503 / 1,000	PD Max 535 Units on 214 acres.
4.1	Koele PD Redevelopment Portion	3000	600	gpd/unit	600	gpd/unit	600		Koele generally shows use around 503 GPD. However, newer homes tend to use more. Several low readings from sporadic occupation may decrease the overall average.
6.0	**MANELE PD: POTABLE (Wells 2 & 4)**								
6.4	Manele Single Family Homes	3000	600	gpd/unit	600	gpd/unit	600	*1,020 / 3,700	PD Max 282 Units on 328 acres. C&CR proposed standards total 3,100 GPD / unit, which is more than 5x County per-unit standard. However, it reflects actual use. Fresh water consumption of these homes averages about 900 GPD, while combined potable and brackish consumption averages 3,700 GPD. In addition, one of the meters currently classed in MNPD - IRR - DEVEL waters lots 77-81, which appears to be a single family area. Not clear if this means another 19,413 GPD should be attributed to Manele SF beyond what is shown here.
7.0	**MANELE PD: NON-POTABLE WATER (Wells**								
7.1	Manele Single Family-Irrigation	included		gpd/unit	2,500	gpd/unit	2,500		Assuming 1/2 acre lots, combined C&CR proposed standard of 3,100 GPD is >2x County per-acre standard, which is usually suitable for hot dry areas, such as South Maui. Combined potable and brackish use appears to be 59,451 GPD.
1.0	**Lana`i CITY RESIDENTIAL (Wells 3, 6 & 8)**								
1.1	Lana`i City Residential - Existing								
	Multi Family	5000	560	gpd/unit	350	gpd/unit	350	* 296 / 797	The average water consumption by Lana`i City MF meters was 296 GPD. However, no information was available as to how many units were on each meter. As with several user classes above, there appeared to be a great number of meters with low enough averages to seem only sporadically used. Average use of the meters using over 100 GPD was 797 GPD.
1.2	Lana`i City Residential -New/Future								
	Multi Family	5000	560	gpd/unit	600	gpd/unit	600		

FIGURE 4-57. Consumption Per Unit Analysis - Continued

	USAGE CATEGORY	System Standards Per Acre	System Standards Per Unit Or Other As Noted	CCR Proposal 2006 UNITS	CCR Proposal 2006 QUAN	CCR Proposal 2009 UNITS	CCR Proposal 2009 QUAN	Empirical Information From Billing	Notes
	RESIDENTIAL- MULTI FAMILY								
4.0	**KOELE PD RESIDENTIAL**								
4.7	Koele Multi-Family	5000	560	gpd/unit	600	gpd/unit	600	722	PD Max 156 Units on 26 acres. 10 ac. now per proposal. MF use in KOPD totals 25,287. Assuming 35 units (27 Villas plus 8 Pines), average per-unit MF consumption is 722 GPD.
4.8	Koele Common Areas Irrigation	included	included	gpd/acre	2,000	gpd/acre	2,000		Normally irrigation is included in per-acre or per-unit estimate. County per-acre standards would allow for up to 50,000 GPD. However, these per-acres standards are usually only accurate in hot dry areas, more like Manele. 25,287 for a reported 10 acres currently irrigated would be within this standard, but still high for the climate at that location. Proposed standard of 600 GPD/unit plus 2,000 GPD / acre would result in 145,000 GPD at build-out, vs. 130,000 per standards.
6.0	**MANELE PD: POTABLE (Wells 2 & 4)**								
6.5	Manele Multi-Family	5000	560	gpd/unit	300	gpd/unit	300	1,403	PD Max 184 Units on 55 acres. Total residential & MF irrigation 96,791 for 69 units total. This does not include common area irrigation w/in the PD. Proposal is for 1,500 GPD per unit note even counting common area irrigation. Standards are normally expected to INCLUDE irrigation. No estimate is given of MF irrigated acreage apart from common area estimate.
7.0	**MANELE PD: NON-POTABLE WATER (Wells**								
7.2	Manele Multi-Family-Irrigation	included	included	gpd/unit	1,200	gpd/unit	1,200		Normally 560 gpd / unit or 5,000 gpd / acre includes irrigation. No acreage provided for this area as distinct from common areas.
7.3	Manele Common Areas Irrigation	included	included	gpd/acre	2,500	gpd/acre	2,500		Total irrigation 86,944 out of 96790 combined total above.
	COMMERCIAL								
2.0	**Lana`i CITY NON-RESIDENTIAL + CAVENDIS**								
1.6	Kaumulapau Harbor	6000		LS gpd	1	LS gpd	1		In this and all other such entries, "**LS gpd**" indicates a lump sum estimate in C&CR proposal. Harbor used 608 GPD in 2008.
	Kaumalapau Commercial								Total Kaumalapau commercial use 14,508, of which 628 was KPAU harbor.
2.1	Lana`i City Govt/Comm & Inst/ LtInd/ Airport/Lai	6000		LS gpd	1	LS gpd	1		Billng breakdown for this document divides these categories further. CCR proposal combined this with Irrigation Grid. Not clear why. Meters are attributed to Wells 6 & 8.
	Lana`i City Government								10,180 GPD in 2008. Average use per account was 679 GPD.
	Lana`i City Commercial								43,311 GPD in 2008. Average use per account was 760 GPD.
*2.3	Future Commercial & BCT	6000				LS gpd	1		
4.0	**KOELE PD: POTABLE (Wells 3, 6 & 8)**								
4.5	Koele PD-Commercial (Tennis & Stables)	included in resort		LS gpd	1	LS gpd	1		Billing breakdown for this document had tennis in hotel; stables and horse paddock in Ag. Horse paddock used 77 GPD in 2008. Stables used 1,430.
3.0	**IRRIGATION GRID (Wells 2 & 4)**				1				
**3.4	New Warehouse	6000	1,000/140 sq.	LS gpd	1				County standard is 6,000 GPD / acre or 1,000 GPD / 140 sq. ft.
3.5 (3.4 2009)	Future Use	6000	1,000/140 sq.	LS gpd	1	LS gpd	1		Not clear what this is in 2006 or 2009 proposal.
6.0	**MANELE PD: POTABLE (Wells 2 & 4)**								
6.6	Manele Commercial	6000	1,000/140 sq.	gpd/acre	5,000	gpd/acre	5,000		Manele Boat Harbor only item listed here. 21,179 GPD.
6.8	Manele Construction/Development	6000	1,000/140 sq.	LS gpd	1	LS gpd	1		Estimate 51,227 includes development irrig and nursery, (which was classed as MNPD-Ag for Billing database review), plus 34 GPD non-irrigation at trailer.

FIGURE 4-57. Continued. Consumption Per Unit - Continued

	USAGE CATEGORY	System Standards Per Acre	System Standards Per Unit Or Other As Noted	CCR Proposal 2006 UNITS	CCR Proposal 2006 QUAN	CCR Proposal 2009 UNITS	CCR Proposal 2009 QUAN	Empirical Information From Billing	Notes
INDUSTRIAL									
3.0	**IRRIGATION GRID (Wells 2 & 4)**				1				
**3.3	Additional Baseyard(2006) /Miki Basin Heavy In	6000	1,000/140 sq.	LS gpd	1	gpd/acre	6,000		3,460 currently at Miki Meters. More commercial in nature at present. Build-out is intended to be industrial.
HOTEL / RESORT									
4.0	**KOELE PD: POTABLE (Wells 3, 6 & 8)**								
4.2	Koele PD-Hotel	350	17,000	gpd/unit	500	gpd/room	600	* 304 / 812	30,961 GPD hotel meters excluding irrigation. 51,880 GPD with irrigation. Per proposal, 21 acres currently irrigated. PD Max 253 units on 21.1 acres.
4.3	Koele PD-Hotel(Future)	350	17,000	gpd/unit	500	gpd/room	600		
4.4	Koele PD-Hotel Irrigation		included	gpd/acre	NA	gpd/acre	2,800		Resort standard is meant to include irrigation. Irrigation averaged about 2,470 per acre in 2008.
5.0	**KOELE PD/LANA`I CITY: WASTEWATER**								
5.1	Koele Golf Course Irrigation Effluent		included	LS gpd	1	LS gpd	1		224,447 GPD in 2008 from AWWTF.
1.0	**Lana`i CITY RESIDENTIAL (Wells 3, 6 & 8)**								
	Hotel Lana`i	350	17,000	~	~	~	~	284	Not separated from other non-residential in proposal, but separated in billing data analysis. 3,125 GPD. For smaller hotels like this, per unit GPD is usually a more appropriate estimate than per acre.
6.0	**MANELE PD: POTABLE (Wells 2 & 4)**								
6.1	Manele Hotel	350	17000	gpd/room	600	gpd/room	600	952 / 3,341.216	PD Max 500 units on 56.6 acres. High and Low meters total 228,507. 2006 proposal indicates 88,000 potable and 2009 proposal says 63,500 potable. Asked if one was potable & other irrigation but was told both were actually used for both. High Meter 160,451, Low 68,056 GPD in 2008. In addition, clubhouse and golf maintenance building meters read 4,914 and 4,595 GPD respectively, for a total of 238,016.
6.2	Manele Hotel Irrigation		included	gpd/acre	8,000	gpd/acre	8,000		Two meters called MBH landscaping ("back-of-house") read 1,279 GPD collectively. 8"" Golf Meter, Hole #4 Golf Meter and Challenge Drive Golf Irrig totaled 596,009 GPD. For a total of 597,288 GPD. Grand total of all meters 835,304 GPD. This does include golf. Proposal notes 29 irrigated acres not including golf course, which is listed in PD ordinance as 172 acres. Too much uncertainty to derive a meaningful per-acre standard.
6.3	Manele Hotel (Future)		included	gpd/room	600	gpd/room	600		
7.0	**MANELE PD: NON-POTABLE WATER (Wells**								
7.4	Manele Golf Course Irrigation		included	gpd	1	gpd	1		See above. PD - 172 acres. Golf is normally included in overall resort 17,000 gp/ac estimate, but sometimes est. independently at 5,000 g p ac. Irrigation calcs best. Was hard to split Hotel irrigation from golf irrigation & other types within the PD.
8.0	**MANELE PD: WASTEWATER**								
8.1	Manele Golf Course Irrigation Effluent		included	gpd	1	gpd	1		2006 proposal estimates 80,800. 2009 proposal estimtes 78,200. Treatment plant production records indicate 72,940 in 2008.

FIGURE 4-57. Consumption Per Unit - Continued

GE CATEGORY	System Standards Per Acre	System Standards Per Unit Or Other As Noted	CCR Proposal 2006 UNITS	CCR Proposal 2006 QUAN	CCR Proposal 2009 UNITS	CCR Proposal 2009 QUAN	Empirical Information From Billing	Notes
-PUBLIC								
ON-RESIDENTIAL + CAVENDIS								
City Recreation Area		1,700	gpd/acre	1,375	gpd/unit	1,375		
ool Expansion		1,700	gpd/acre	1,375	gpd/unit	1,375		Not clear why estimate was less than standard. No account names in billing review database. Could not identify school specifically. Commercial and Government accounts totalled above.
)TABLE (Wells 3, 6 & 8)								
uture)		1,700	gpd/acre	1,700	gpd/acre	1,700		
Course & Maintenance		1,700	LS gpd	1	LS gpd	1		14,286 GPD in 2008.
POTABLE (Wells 2 & 4)								
Domestic use and Irrigation)		1,700	gpd/acre	1,700	gpd/acre	1,700		Hulopo`e Beach Park 19,968 GPD in 2008.
Use		1,700	LS gpd	1				
; (WWTP & Lift Stations)		1,700	LS gpd	1	LS gpd	1		Manele Utilities 6,812 GPD in 2008.
RID (Wells 2 & 4)				1				
erve		5000	LS gpd	1	LS gpd	1		
mmercial Uses		5000	LS gpd	1	LS gpd	1		28,044 GPD Ag in IGGP, 6,044 GPD in LCTY Community Garden in 2008.

State Water Projects Plan

FIGURE 4-58. State Water Projects Plan - Projected Water Requirements - GPD

Project	Pot or NonPot	2004	2005	2010	2015	2020
Lana‘i Agricultural Park	N	0	0	500,000	500,000	500,000
Manele Boat Harbor*	N	3,000	3,000	3,000	3,000	3,000
Subtotal Non-Potable		3,000	3,000	503,000	503,000	503,000
Manele Boat Harbor	P	2,000	2,000	2,000	2,000	2,000
Lana‘i High & Elementary School	P	14,400	14,400	14,400	14,400	14,400
DHHL Lana‘i**	P	12,500	12,500	12,500	12,500	12,500
Lana‘i Airport	P	1,200	1,500	1,900	2,900	3,900
Subtotal Potable	P	30,100	30,400	31,800	32,800	32,800
TOTAL	P	33,100	33,400	534,800	534,800	535,800

* SWPP identifies this as “non-potable using potable”

** Note that the estimate provided here is lower than that derived from project application materials submitted to the County.

The *State Water Projects Plan* (SWPP) indicates that the Lana‘i Agricultural Park of the Department of Agriculture will require an estimated 500,000 gallons of non-potable water over the long term. The most likely source of water for the agricultural park is fresh water from Wells 2 and 4, that is currently not chlorinated when served in the vicinity of the Palawai Irrigation Grid.

DHHL requests only 12,500 GPD to the year 2020. However, a per standards analysis of the fifty-acre DHHL Lands of Lana‘i project indicates that at build-out, this project will require 125,900 GPD. Adjustments for these two items are made in the final table compiling estimated project demands, presented after Castle & Cooke’s proposal.

The combined potable and non-potable estimates for Manele Harbor, in the amount of 5,000 GPD, are lower than the average use of 21,179 in 2008.

The projected airport requirement increases gradually, reaching 2,900 in the year 2015 and 3,900 in the year 2020. In calendar year 2008, consumption at the Department of Transportation’s airport meter averaged 1,502 GPD. There is also a meter at the airport tank. Total consumption between the two meters was 5,624 in 2008, and has exceeded 6,000 GPD in past.

Where projected demands noted in the State Water Projects Plan are lower than either existing demand or demand estimates based upon updated project plans, the latter have been used.

Project Districts

The island of Lana'i has two Project Districts: The Koele Project District and the Manele Project District.

The Koele Project District is a 618 acre area, located just north and east of Lana'i City, between the elevations of 1,700' and 1,800'. At full build-out, this Project District would have 535 single family units, 156 multi-family units, 253 hotel units, 11.5 acres of park, 1 acre of public facility space, 12 acres of open space, and a 332.4 acre golf course.

The Manele Project District is an 869 acre area located at sea level on the southeastern shore of Lana'i. At full build-out, this Project District would have 282 single family units, 184 multi-family units, 500 hotel units, 5.25 acres of commercial space, 66.33 acres of park, 2 acres of public facility space, 152.02 acres of open space, and a 172 acre golf course.

Figures 4-59 and 4-60 contain a simple build-out analysis of these Project Districts according to per acre standards. Build-out estimates are examined in two ways, both by per acre standards and by per unit standards. In deriving built and pending consumption according to per acre standards, the usual standards analysis was modified somewhat in two ways. Since there were no clear developed versus non-developed acreages, nor reliable maps from which to derive them, it was assumed that the percent of acreage developed within each land use class was equivalent to the percent of units developed. In addition, once both per unit and per acre standards had been calculated, the amount of water indicated by per unit standards was deemed "potable" in terms of source requirements. The per acre standards less the per unit standards were deemed "not necessarily potable". Although this is slightly different from the usual analysis, it provides useful information regarding source options nonetheless.

According to the modified per acre build-out analysis, the Manele Project District would consume 3.28 MGD, of which only 0.55 GPD would need to be potable water. This analysis does not account for the relative climates of these two areas. A standard per unit analysis yields a full build-out estimate of 1.51 MGD. The fresh water requirements are the same in either analysis. The "not necessarily potable" requirement in the per unit build-out is 0.96 MGD, vs. 2.74 in the per acre analysis. In the hot, dry area of Manele, exposed to both wind and salt, the per acre analysis is likely to be more appropriate. Therefore a per-standards estimate of 3.28 MGD is used. Existing consumption in the Manele Project District area totals 1.16 MGD, of which 0.32 MGD is fresh, 0.76 MGD is brackish and 0.07 is reclaimed. At these rates, the 3.28 MGD estimate could even prove to be low, depending upon landscaping build-out.

According to the modified per acre build-out analysis described above, the Koele Project District would consume 2.81 MGD at full build-out, of which only 0.52 MGD would need to be fresh water. The standard per unit analysis, places this figure a bit lower, at 2.18 MGD. Potable water requirements are identical in the two analyses, but non-potable water requirements drop from 2.3 to 1.67 MGD. In the high elevation, cool and moist area of Koele, the lower, per unit, analysis would likely be the more appropriate of the standard methods. However, further adjustments must be made to address the fact that no potable water use is permitted on the Koele Golf Course. Adjusting the analysis to account for a range of wastewater availability and use scenarios, the total anticipated water use by the Koele Project District would range from 0.74 MGD to 1.77 MGD. At present, water use at the Koele Project District is 0.37 MGD, of which 0.15 MGD is fresh and 0.22 MGD is reclaimed water. This seems to indicate that the lower estimated range is reasonable.

FIGURE 4-59. Koele Project District - System Standards Analysis of Project District as Approved by Ordinance

Use	Acres	Max Overall Density	= Max Units	Per-Standards Build-Out Consump (per unit =p-u, per acre = p-ac)	Units Built	Per-Standards Still Pending Consump	Comments
SFR	214	2.5 units/acre	535	535x600=321,000 p-u 214x3,000=642,000 p-ac 321,000 nnp	13	522x600=313,200 p 208.8x3,000=626,400 p-ac 313,200 nnp	97 WGR pg A2 notes 600 gpd/unit (acreage x% units not yet built)***a***
MFR	26	6 units/acre	156	156x560=87,360 p-u 26x5,000=130,000 p-ac 42,640 nnp	35	121x560=67,760 p 20.17x5,000=100,833 p-ac 33,073 nnp	97 WGR pg A2 notes 400 gpd/unit (acreage* %units not yet blt)***a***
HOT	21.1	12 units/acre	253	253x350=88,550 p-u 21.1x17,000=358,700 p-ac 270,150 nnp	102 20 ac. i	151*350=52,850 p 12.59x17,000=214,086 p-ac 161,236 *	97 WGR pg A2 500 gpd/unit (golf & water features normally part of per acre stand). 20 ac irrig already. *existing irrig would lv only 14,084
PQP	1	1 acre min.		1x1,700 p-ac, but deemed pot		1,700 p	assumed potable 20’ setbacks
PRK	11.5	-	-	11.5x1,700=19,550 p-ac, but deemed pot		19,550 p	assumed potable
GLF	332.4	-	-	332.4x5,000=1,662,000 nnp revised to 1,254,773 *		up to 1,020,680 wastewater	min 50 ac for 9 hole min 110 ac for 18 hole * based upon wastewater build-out
OS	12	-	-	0 (see comment)		0	<10% lot coverage OS assumed to be non-irrigated
Subtotal	**618**			**518,160 pot** **2,295,790 np or nnp** *b*		**455,060 pot** **507,509 np or nnp** *b*	No Potable Water allowed on GC
TOTAL				**2,813,950 tot by per acre** *** 1,151,950 tot excl. golf** **2,180,160 by per unit** **1,772,933 final est., discussed pg 49**		**962,569 tot by per acre***b* **455,060** by per unit **455,060** pumped final est *	No Potable Water allowed on GC **1,475,740** total remains by final est, but of that **1,020,680** is reclaimed.

a Normally this per acre standard would apply to acreage not yet developed, but as there was no data on this, it was assumed to be proportional to percent of units built and unbuilt

b “Where two or more figures are listed for the same zoning, the daily demand resulting in higher consumption use shall govern the design unless specified otherwise” - *Water System Standards* - pg 111-3. Normally either per acre or per unit is used depending upon circumstances. For Lana‘i, because unit consumption is high, per acre standards were used. Potable water needs were derived by per unit counts, with the difference assigned to “not necessarily potable”.

c per unit calculations consider built-but-unoccupied units as still pending. per acre calculations consider only units-not-yet-built as pending.

FIGURE 4-60. Manele Project District - System Standards Analysis of Project District as Approved by Ordinance

Use	Acres	Max Overall Density	= Max Units	Per-Standards Build-Out Consump	Units Built	Per-Standards Still Pending Consump	Comments
SFR	328	0.86 units/acre	282	282x600=169,200 p 328x3,000=984,000 p-ac 814,800 nnp	16	267x600=160,200 p 309.39 x3,000=928,170 p-ac 767,970 nnp	97WGR pgA2 600 domestic, 1,000 irr LWAC 9/22/2000 600 pot, 1,000 n-p 451,200 gpd by these LWAC standards ***a***
MFR	55	3.34 units/acre	184	184x560=103,040 p 55x5,000=275,000 p-ac 171,960 nnp	69	115x560=64,400 p 34.375x5,000=171,875 p-ac 107,475 nnp	97WGR pg A2 300pot, 300 non-pot LWAC 9/22/2000 400pot, 400 non-pot 147,200 by these LWAC standards ***a*** 10 ac irrig per '06 prop, 16 per '09
COM	5.25			140per1000sqft=19,210 p 5.25x6,000=31,500 p-ac 12,290 nnp		140per1000sqft=19,210 p 5.25x6,000=31,500 p-ac 12,290 nnp	Min area 0.5 acres, max lot coverage 60%. 0.6 cov*5.25 ac *43,560 ft/ac / 1000 *140 = 19,209.96. '06 prop say 5 ac exist. '09 said zero.
HOT	56.6	10 units/acre	500	500x350=175,000 p 56.6x17,000=962,200 p-ac 787,200 nnp	250	250x350=87,500 p 28.3x17,000=481,100 p-ac 393,600 nnp	Initially 50 acres. Ordinance 2743 stipulated that addt'l 6.6 acres would not enable room count to exceed 500, 17 ac irrig per '06 & '09 proposals
PQP	2			2x1,700=3,400 p		2x1,700 = 3,400 p	Minimum 2 acres, 50' setbacks assumed all potable.
PRK	66.33			66.33x1,700=112,761 p-ac assume 2/3 p - 75,174 assume 1/3 nnp - 37,587		64.33x1,700=109,361 p-ac assume 2/3 p - 72,907 assume 1/3 nnp - 36,454	Minimum 10 acres, minimum 350' wide. Assumed 2/3 potable. 2006 proposal noted 0 existing irrig park acres. 2009 proposal noted 2.
GLF	172			172x5,000=860,000 np		668,949 used btwn metered use and effluent production 2008. 191,051 np	Minimum 50 acres for 9 hole, minimum 110 acres for 18 hole. C&CR estimates 8,000 gpd/acre needed. No more than 0.65 MGD groundwater allowed for irrigation of Manele GC & associated landscaping.
OS	152.02			0			

FIGURE 4-60. Manele Project District - System Standards Analysis of Project District as Approved by Ordinance

Use	Acres	Max Overall Density	= Max Units	Per-Standards Build-Out Consump	Units Built	Per-Standards Still Pending Consump	Comments
Roads	32			32x1,700=54,400 nnp		35,591 nnp	assumes 40' rdway w/5' strip irrig at PRK intensity on either side or about 20% irrig area at 1,700 gp/acre/day nnp 334/966*32*1,700 = 18,809 assumed in use
Subtotal				**545,024** ***pot per acre*** **2,738,237** ***not nec pot per-ac***		**407,617** *pot per acre* **1,547,921** *nnp per-ac* ***a, b, c, d***	per unit stds
TOTAL				**3,283,261** *total per acre* **1,509,301** *total per unit*		**1,955,538** *total per acre* **573,642** *total per unit*	per acre stds - assumes 279,200 more effluent for golf
LWAC				**1,030,000** *c, d* **1,582,441** *e,* **2,620,450** *f*			**alternate totals given various scenarios. see notes.**

a Normally this per acre standard would apply to acreage not yet developed, but as there was no data on this, it was assumed to be proportional to percent of units built and unbuilt

b "Where two or more figures are listed for the same zoning, the daily demand resulting in higher consumption use shall govern the design unless specified otherwise" - *Water System Standards* - pg 111-3 Normally either per acre or per unit is used depending upon circumstances. For Lana'i, because unit consumption is high, per acre standards were used. Potable water needs were derived by per unit counts, with the difference assigned to "not necessarily potable".

c Despite high build-out analysis - 97 WGR stipulates that allocation for entire Manele PD not exceed 1.03 MGD. LWAC minutes of 9/22/2000 and 9/27/2002 reaffirmed this allocation.

d 1,030,000 is allocation for Manele Project District set in 1997 Working Group Report. Total use other than effluent for Manele PD is not to exceed 1.03 MGD per 1997 WGR.

e Despite agreement for total not to exceed 1.03 MGD at the time, per unit standards agreed upon in the minutes of the 9/22/00 LWAC meeting would lead project consumption to total 1,582,441 gpd.

f 2,620,450 as estimated in July 12, 2006 proposal from C&CR - which has 400 vs 500 hotel rooms as approved in PD, 300 vs 184 MF units as approved in PD, and 200 vs 282 SF units as approved in PD. Of this, 1,190,000 is presumed potable, 1,070,450 non-pot and 360,000 effluent.

Status of Project Districts

Project Districts are approved in phases. Phase I approvals result in the Project District ordinance. At this stage, the overall character of the project is set, including zoning, densities, set backs and other standards. Phase II approvals include review of preliminary site plans, with proposals for drainage, parking, utilities, grading, landscape planting, architectural design, elevations, lot coverage, net buildable areas, and other proposals. Phase III approvals include the final site plans with final details on the facilities and site development issues above.

When considering the impacts of a project build-out, it is helpful to know both the physical and regulatory status of a project. Development plans that are fully permitted have a stronger chance of occurring in a given time frame than those that have not yet received land use entitlements. Fully entitled units that are not yet built can represent a sort of pent demand. If accurate and updated data are not available, this pent demand may not be adequately considered in reviewing development proposals. These questions become more important in situations where build-out estimates begin to approach sustainable yields.

Early in the Water Use and Development Plan update process, the Lana‘i Water Advisory Committee spent considerable time discussing the need for a clear record, not only of general project approvals, but also of build-out status, and a common record of conditions, agreements and understandings affecting water, so that all parties could refer to and rely upon the same information. The information in Appendix D of this document was compiled at the request of the committee in response to this discussion. Similarly, Figure 4-61 on the following pages, estimates the status of Project District approvals on Lana‘i. As of this drafting, these references require further input and update from both the County of Maui Planning Department and Castle & Cooke Resorts, and can not be considered complete. A more thorough delineation of project status is anticipated with the Community Plan update.

Project Districts are normally built in segments, so that Phase II and III approvals generally roll in over time, rather than all at once. For tracking the status of project approvals and build-out, a map showing accurate unit counts and locations is a very useful tool. Maps from permit files varied widely, and often showed different lot counts than the subject approvals allowed. This is often done because plans are still in flux, and flexibility is desired. However, even if specific details of a plan are not set in stone, an accurate count of lots on a map would be of great assistance for tracking and managing anticipated demands as well as discretionary and administrative approvals. The reasons for this will becomeven more apparent in the compiled analysis and conclusions section of this chapter. After mapping the most recent project segments available, an attempt was made to map the status of different portions of the project within the approval process. This effort is discussed on page 4-79.

FIGURE 4-61. Status Of Koele Project District

Koele PD													
Use	Acreage	Max Overall Density	PD / Phase I Units		Phase II Units		Ph III Units		Subdivided Lots		Building Permits Approved	Units Actually Built	Units Occupied
SF	214	2.5 units/acre	**535**	A	**255**		**19**		**18**		**13**	**13**	**13**
92-PH2-0004					255								
93-PH3-0001													
Pu'u Lani Ridge - Puulani & Niniwai Streets							19	A	18	A	13	13	13
Land Court Consolidation 170 (LUCA 6.0163, 6.0168, 6.0169)													
K2 - Main proj entrance / Loop rd from Konawai to Kaunaoa							58	P	58	P			
K4 - East corner of Kaunaoa							9	P	9	P			
K8 - Makai of west end upper Loop Road, near Pines							4	P	4	P			
K9 - Puunene Hillside - west and mauka of upper Loop Rd.							9	P	9	P			
Pines at Koele SF Lots (4 SF and 6 MF lots)							4	P	4	P			
06-PH3-0006													
Pines at Koele SF Lots							20	P					
Future Phases Based on "Proposed Flexible Design Standards for Koele Project District"													
K1 - Makai of Kaunaoa, mauka of Queens, 9th to Konawai							46						
K3 - East side of Loop Road							24						
K5 - Niniwai Road - Future							35						
K6 - Center makai of upper Loop Road.							32						
K7 - East end and makai of upper Loop Road							11						
K8 - Makai of west end uppper Loop Rod, near Pines, future							19						
K9 - Puunene Hillside - w. & mauka of upper Loop Rd. future							4						
K10 - Mauka and east of upper Loop Road							13						
K11 - west of 6th St and mauka of Puulani Place							66						
Future Development					280		162		517		522	522	522
Subtotal approved SF					255		19	A	18	A	13	13	13
Subtotal pending - applied for - SF					0		104	P	84	P	0	0	0
Subtotal Future SF					280		412	F	433	F	522	522	522
SUBTOTAL SF					**535**		**535**		**535**		**535**	**535**	**535**

FIGURE 4-61. Status of Koele Project District Continued

Koele PD													
Use	Acreage	Max Overall Density	PD / Phase I Units		Phase II Units		Ph III Units		Subdivided Lots		Building Permits Approved	Units Actually Built	Units Occupied
MF	22	6 units/acre	**156**	A	**100**		**65**		**0**		**35**	**35**	**35**
92-PH2-0004					100								
93-PH3-0001													
Phase I A - Koele Villas - Model Units							7		- na -		7	7	7
Phase I-A - Koele Villas - A							20		- na -		20	20	20
Phase I-A - Koele Villas - B							18		- na -				
06-PH3-0006 - Pines at Koele													
Phase I-B - Pines at Koele							20		na / 6		8	8	8
Land Court Consolidation 170 (LUCA 6.0163, 6.0168, 6.0169)													
Pines at Koele (6 lots noted above)													
06--PH3-0012 - Koele Villas													
08-PH3-0013 - Koele Villas													
Future Development					56		91				121	121	121
Subtotal approved MF					100		65				35	35	35
Subtotal pending - applied for - MF					0		0				0	0	0
Subtotal Future SF					56		91				121	121	121
SUBTOTAL MF					156		156				156	156	156
Subtotal approved residential					355		84				48	48	48
Subtotal pending residential					0		104				0	0	0
Subtotal Future SF					336		503				643	643	643
SUBTOTAL RESIDENTIAL					691		691				691	691	691

FIGURE 4-61. Status Of Koele Project District Continued

Koele PD													
Use	**Acreage**	**Max Overall Density**	**PD / Phase I Units**		**Phase II Units**		**Ph III Units**		**Subdivided Lots**		**Building Permits Approved**	**Units Actually Built**	**Units Occupied**
Hotel	21.1	12 units/acre	**253**	A	104		104		104		104	104	n/a
89-PH2-0004 - Golf Course					102		102		102		102	102	n/a
04-PH2-0003 - Fitness Facility & Spa													
05-PH2-0008 - Well Being Center													
05-PH3-0019													
06-PH2-0012 - two 1,900 sq. ft. suites					2		2		2		2	2	n/a
Future Development					149		149		149		149	149	n/a
subtotal approved hotel					104		104		104		104	104	n/a
subtotal future hotel					149		149		149		149	149	n/a
SUBTOTAL HOTEL					253		253		253		253	253	n/a
Public	1												
Park	11.5												
00-PH3-0009 - 5 acre park					5		5		5		5	5	n/a
subtotal approved PD park					5		5		5		5	5	n/a
subtotal future park					6.5		6.5		6.5		6.5	6.5	n/a
SUBTOTAL PARK					11.5		11.5		11.5		11.5	11.5	n/a
GC	332.4												
89-PH2-0004 - Golf Course					102		102		102		102	102	102
91-PH1-0001													
Subtotal golf					102		102		102		102	102	102
Subtotal future golf					230.4		230.4		230.4		230.4	230.4	230.4
SUBTOTAL EXISTING AND FUTURE GOLF					332.4		332.4		332.4		332.4	332.4	332.4
OS	12												

FIGURE 4-62. Status of Manele Project District

Manele PD

Use	Acreage	Max Overall Density	PD / Phase I Max Units		Phase II Units		Ph III Units		Subdivided Lots		Building Permits	Units Actually Built	Units Occupied
SF	**145**		**282**	A	**161**	A	**61**		**61**		15	15	
												*17	
Phase II - 95-PH2/001					**161**								
Phase III - 96 PH3/0001					**64**		**61**		**61**		**15**	**15**	
Residential Phase 1-A													
SF - Phase I-A					**33**		**33**		**33**		**14**	**14**	
Hulopo`e Drive					10	A	10		11	A	2	2	
Kapihaa Estates					7	A	7		7	A	4	4	
Lapaiki Place					3	A	3		2	A	1	1	
Lopa Place					6	A	6		6	A	2	2	
Palawai Ridge					7	A	7		7	A	5	5	
Residential Phase IB													
SF - Phase I-B					**31**		**28**	**0**	**28**	A	**1**	**1**	
Kaluakoi Estates					7	A	7		7	A	1	1	
Ocean View Estates					18	A	18		18	A	0	0	
Pu`u Pehe *					6	A	3		3	A			
Recent Apps*					**63**		**63**	P	**63**	P	**0**	**0**	
M 5 - Further Subdivision of Pu'u Pehe					11	P	11	P	11	P			
M 6 - Ocean View Estates - Huawai Place					18	P	18	P	18	P			
M 7 - Kaunolu Place and Maunalei Drive					7	P	7	P	7	P			
M 8 - West Kaunola ?					13	P	13	P	13	P			
M 9 & M 10 - Far West End of Hulopo`e Drive					14	P	14	P	14	P			
Phase II 2000 PH 2 - 0001													
Phase III 2004 PH3 - 0007													
Phase III 2004 PH3 - 0014													
Phase III 2005 PH3 - 0001													
Phase III 2005 PH3 - 0007													
Semi- Future SF - SF Remaining in 95 PH2-00`					**34**		**28**		**-63**		**0**	**0**	
Future - Future Phase II Approval					**121**		**158**		**221**		**267**	**267**	
"Future" (east - lots not shown)													
"Future" (northwest - lots not shown)													
subtotal sf approved					64	A	61	A	61	A	15	15	0
subtotal sf pending - applied for					63	P	63	P	63	P	0	0	0
subtotal future					155	F	158	F	158	F	267	267	282
SF SUBTOTAL					**282**		**282**		**282**		**282**	**282**	**282**

Build-Out Analysis

FIGURE 4-62. Status of Manele Project District Continued

Manele PD													
Use	Acreage	Max Overall Density	PD / Phase I Max Units		Phase II Units		Ph III Units		Subdivided Lots		Building Permits	Units Actually Built	Units Occupied
MF	30	3.34 units / acre	**184**	A	**91**		**91**				**80**	**69**	
Phase II - 95-PH2/001													
Phase III - 96 PH3/0001													
Residential Phase 1-A													
MF - Phase I-A					**54**		**53**				**53**	**53**	
Terraces at Manele = Site A					27	A	27				26	26	
Fairway Terraces = Site B					26	A	26				27	27	
Future - MF under 95-PH2-001					1	P							
Phase II - 2000-PH2/0001													
Phase III 2004 PH3 - 0007													
Phase III 2004 PH3 - 0014													
Palms at Manele = Site C aka Terraces at Manele Incr 3 ?					**47**		**47**				**27**	**16**	
Palms Phase I					38	A	38	A			27	16	
Palms Phase II					9	P	9	P					
Phase III 2005 PH3 - 0001													
Phase III 2005 PH3 - 0007													
Future					83		84				104	115	
					--------		--------		---------		---------		--------
subtotal mf approved					91		91				80	69	
subtotal mf pending - applied for					10		9				0	0	
subtotal mf future					83		84				104	115	
MF SUBTOTAL					**184**		**184**				**184**	**184**	
subtotal sf & mf approved					**155**		**152**				**95**	**84**	
subtotal sf & mf pending - applied for					**73**		**72**				**0**	**0**	
					238		**242**				**371**	**382**	
RESIDENTIAL SUBTOTAL (MF AND SF)					**466**		**466**				**466**	**466**	

FIGURE 4-62. Status of Manele Project District Continued

Manele PD													
Use	**Acreage**	**Max Overall Density**	**PD / Phase I Max Units**		**Phase II Units**		**Ph III Units**		**Subdivided Lots**		**Building Permits**	**Units Actually Built**	**Units Occupied**
Comm	5.25											?	
Hotel	56.6	10 units / acre	**500**	A								250	
			- - - - - - - -									- - - - - - - -	
SUBTOTAL			**500**									**250**	
Public	0												
Park	66.33												
GC	138.577												
92/PH2-03													
Island Club Fitness Center at Challenge at Manele													
OS	152.02												
Roads	32												

Overall Digest Notes: Aug 21 1995 - applied 166 SF , 96 MF Phase 2 apps - Oct 95 revised to 166 SF and 54 MF units - Mar 19 03 - time ext and Ph 2 - as of then 39 SF lots subd, 43 MF lots built or in process; April 03 time ext granted til 07; Manele Sub'd Ph I A - 12 lots 5/98 (96-LPA-22); Ph 1 B - 3 lots; Land Court Consolidation 170, 20 lots: h III approval 01/05; As of 03/21/07 39 SF lots subdivided, 43 MF units either built or in process; July 23,2007 - revised to 161 SF lots and 54 MF units Phase 2.

A = approved P = Pending

Build-Out Analysis

An attempt was made to map the status of the project districts, according to status. All elements of the Project Districts have Phase I approval, as part of the ordinance. Some have Phase II approvals, while others have Phase 3 approval, subdivision approval, or in some cases building or occupancy approvals.

The first step was to plot project district sections which were not yet available from the Planning Department at the time of this draft. After that, each section could be identified as to whether it had Phase I approval, Phase II approval, Phase III approval, subdivision approval, building permits, landscaping, or was built and occupied. Several inconsistencies were noted, which made it difficlut to accurately plot phased approval status, particularly for Koele.

One example is found in the Koele Project District. One of the better maps that could be located was labelled “Overall Site Plan”. It noted specific locations of Project sections and phases, including lot alignment. Unfortunately, the text on the map refers to a total of 353 lots, while 388 are shown. The Koele Project District Ordinance allows for 535 SF homes, of which 255 have Phase II approval, and only 19 had Phase III approval as of this draft. Data gaps for Koele were wider than those for Manele. We were unable to locate a map which had a clear delineation of lots, in which the map had exactly the same count as the phase approval. DWS is not the main repository for such maps, so it may be that a particular set of information was inadvertently overlooked.

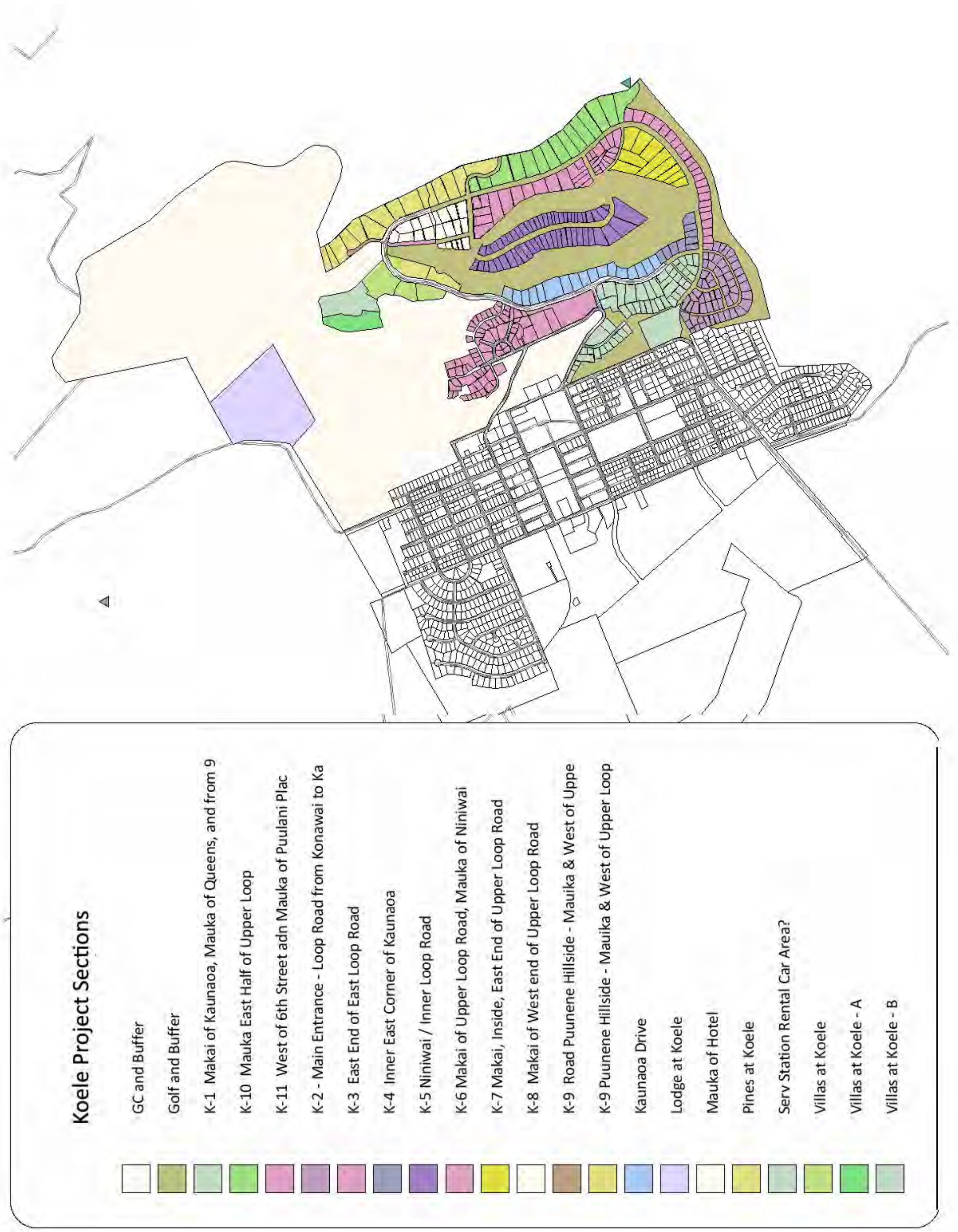
Data were generally more clear for Manele. However, there were some inconsistencies even there. For instance, Phases M-9 and M-10 of the Manele Project District have received some subdivision approvals. Fourteen (14) lots have received subdivision approval. However, the map that was available as of this draft showed thirty-two (32) lots in M-9 and M-10 phases.

The Project District approval process is intended to allow some flexibility to the developer within established parameters. Even so, a running tally of project approval status would be useful for auditing of both resource response at different levels of build-out and pending demands.

This is particularly important in light of the recommendations regarding allocation and build-out which were reached as a result of all this analysis and will be discussed in Chapter 7.

As this draft is being completed, the Planning Department is preparing for the Community Plan Process on Lanaʻi. It is anticipated and hoped that a more clear delineation of lots and lot counts than what has been shown here will be a part of that preparation.

FIGURE 4-63. Koele Project District General Site Plan



Build-Out Analysis

FIGURE 4-64. Manele Project District General Site Plan

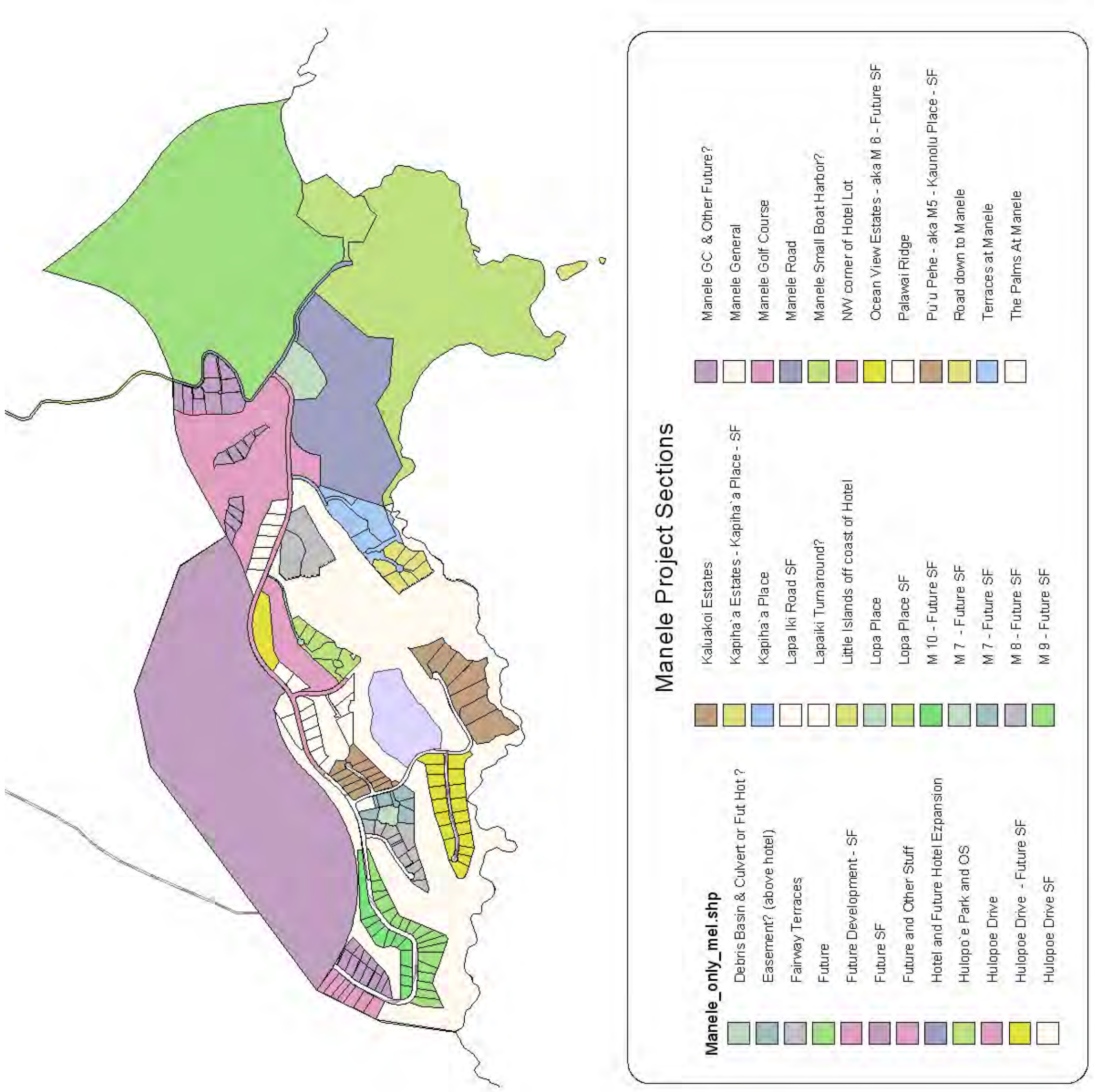


FIGURE 4-65. Koele Project Status - Phase 1, 2 and 3 - Partial Only

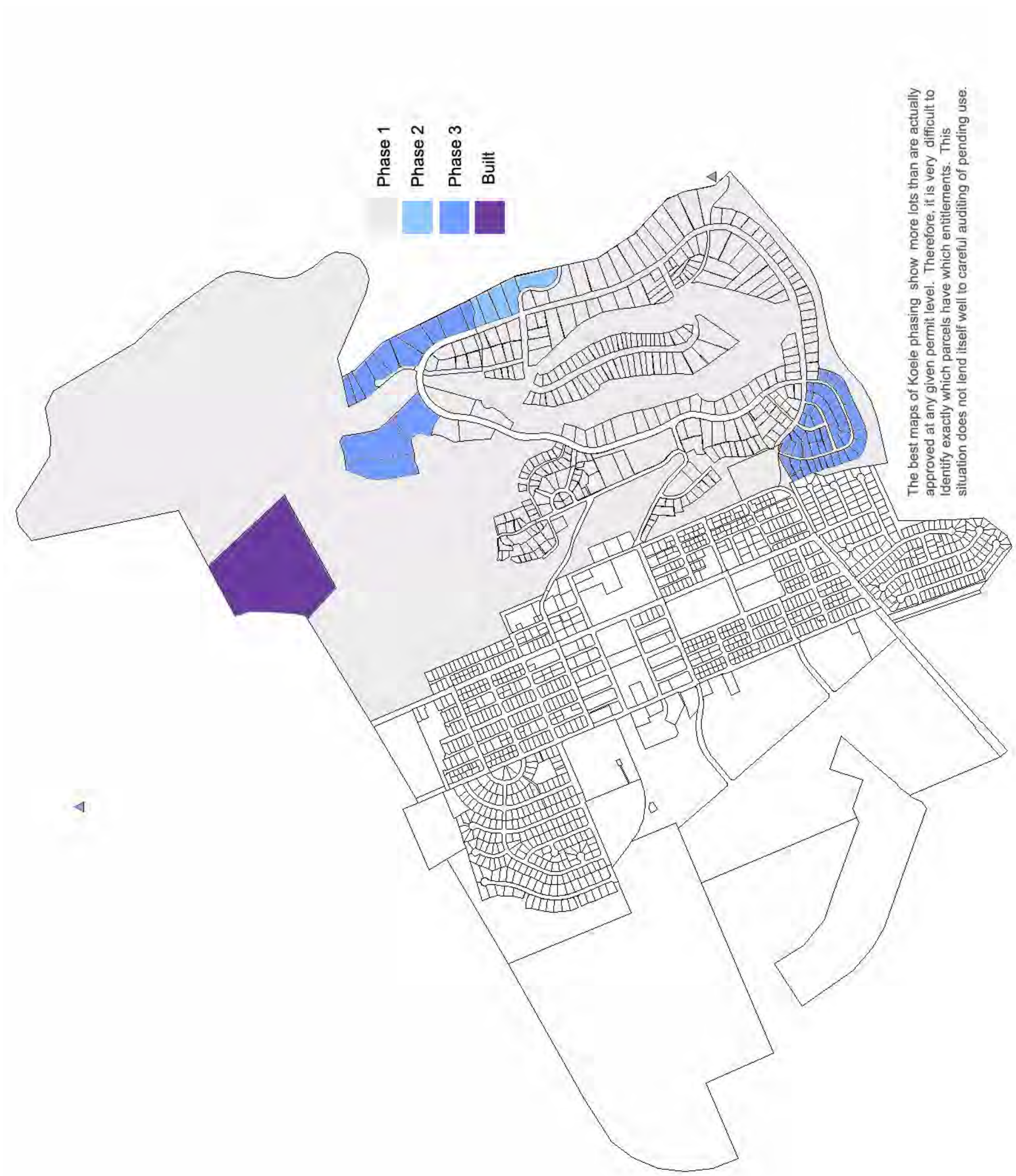
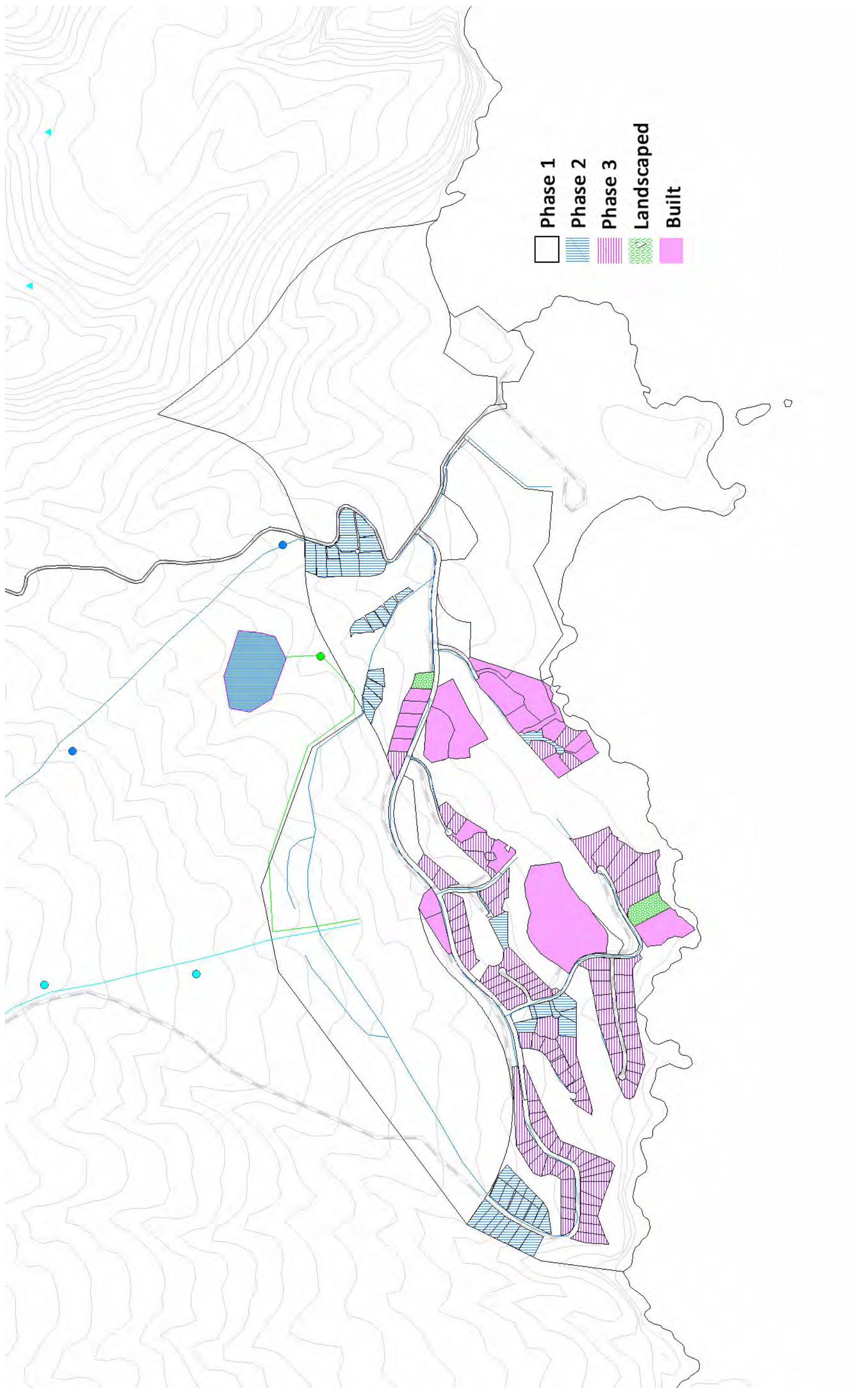


FIGURE 4-66. Manele Project Status - Phases 1, 2 and 3



Other Projects On Lana‘i - Discretionary Projects Submitted for Review

The Manele and Koele Project Districts are the major developments on Lana‘i, but they are not the only ones. Other projects in progress include the Department of Hawaiian Homelands’ development of a 50 acre residential site, an affordable housing development under Hawaii Revised Statutes (HRS) 201H-38, the completion or verification of completion of Lana‘i City Redevelopment Project under HRS 201 G-118, replacement of the Lana‘i City Senior Center, and others. Staff planners of the Department of Water Supply maintain a list of projects pending in the discretionary permit review process for each district, which is updated. The update as of June 30, 2009 is found in Figure 4-67, on the following pages.

FIGURE 4-67. Discretionary Projects Submitted For Review - Quarterly Update As Of 06/30/2009

Project Name	Acre/Units	Acre Cnsm GPD Unit Cnsm GPD	Proj'd use (gpd)	Potable	Non-Potable	Status	Comments
Koele							
Koele Project District Overall	**SF -** 214 ac at 2.5 unis/ac=535 **MF-**26 ac at 6 units/ac = 156 **Hotel -**21.1 ac at 12 units=253 **PQP -** 1 ac **Park -** 11.5 ac **GC -** 332.4 ac; min 50 ac for 11 holes; min 110 ac for 18 **OS -** 12 ac	SF 214 x3000=642000 MF 26x5000=130000 HTL 21.1x17000=358700 PQP 1x1700=1700 PARK 11.5x1700=19550 GC 332.4x5000=1662000 SF 535x600=321,000 MF 156x560=87,360 HTL 253x350=88,550 PQP 1x1700 = 1700 PARK 11.5 x1700=19550	**2,813,950 or 2,180,160**			**SF** 13 built (7800 gpd) 84 on SD process(50,400 gpd) 438 remaining (262,800 gpd) **MF** 35 built (19600 gpd) 6 lots on subdivision process (# of acres/units unkn) 67760 gpd remaining **HTL** 102 hot units built(35700 gpd) 2 applied for (700 gpd) 148 - proposed (51800 gpd) **Park** **5 acres - 8500 gpd** **6.5 remaining (**11050 gpd) **Est GPD remaining- 444,510 gpd**	Phase I - 468.3 acres Phase II - 618 acres, GC district added - land allocation increased by 150 acres additional 5 buildings with 20 MF units built - CO pending as of 2006
The Villas @ Koele 92/PH2-004 92/PD1-003 249001021 249001024 249001025-27 249001030 249002002 249018001-02	632 acres 100 townhse units 255 SF units	100x560=56,000 255x600=153,000	186,080	186,080		**SF** 13 built (7800 gpd) 242 remaining (145200 gpd) **MF** 27 built (15120 gpd) 73 remaining (40880 gpd) **Est remaining (186080 gpd)**	residential development as of 0509 - part of PD Per KIVA db, CO's for the following buildings are pending: Bldg 7 - 4 units Bldg 12 - 5 units Bldg 13 - 3 units Bldg 14 - 4 units Bldg 15 - 4 units total - 20 units

FIGURE 4-67. Discretionary Projects Submitted For Review - Quarterly Update As Of 06/30/2009 - Cont.

Project Name	Acre/Units	Acre Cnsm GPD Unit Cnsm GPD	Proj'd use (gpd)	Potable	Non-Potable	Status	Comments
Lodge at Koele Fitness Facility, Studio, & Spa PH2 20040003 249018001p	.092 ac	1200				0	time extension requested - withdrawn in 2005 part of PD - hotel
Lodge at Koele Luxury Suites PH2 2006/0001 249018001	1900 sq ft	2x350=700	700	700			part of PD - hotel
Pines At Koele 249021006		60x600=36,000	31,200	31,200		8 SF built	per KIVA db; 20 permited - issued in 12/2006; 40 building permits pending part of PD - permitted as SF
Subtotal- Koele			**217,980**	**217,980**	**0**		Pending portions of PD
Koele PD Hotel - future	148 units	148x350=51,800	51,800	51,800		proposed	C&C Proposal (2006) 07/12/06; est use - 74,000gpd (148units@500 gpd) part of PD - hotel
Koele PD - commercial - future			12,000	12,000		proposed	C&C proposal (2006) - not included in PD
Koele PD Redevelopment Portion	170 sf units	170x600=10,2000	102,000	102,000		proposed	C&C proposal (2006) - not included in PD
Sub total- Future Conceptual			**165,800**	**165,800**	**0**		
Total Koele PD			**383,780**	**383,780**			
Lana`i City and Related Areas							
Lands of Lana`i (DHHL) 249002057	50 ac 32 ac-136 SF 2 ac- 20 MF 5 ac- park & community ctr 2 ac-drainage 9 ac-roads **15 ac/35 units** **35 ac/80 units**	 32X3000=96000 2 x5000 =10000 5 x1700=8500 136x600 = 81,600 20x560 = 11,200 114500 - 15600= **98900**	98,900	98,900			per Stuart Matsunaga (808) 620-9283 this parcel was resubdivided according to Land Court rules. Phase I - 15 ac- 45 lots; Phase 2 -10 lots plus 1 lot for telecom facility. no plans yet for the remaining 35 acres, may build in 5-10 years. (draft EA submitted 3/01 for comments- see also State Water Projects Plan-application date 2001)

FIGURE 4-67. Discretionary Projects Submitted For Review - Quarterly Update As Of 06/30/2009 - Cont.

Project Name	Acre/Units	Acre Cnsm GPD Unit Cnsm GPD	Proj'd use (gpd)	Potable	Non-Potable	Status	Comments
Lands of Lana`i (DHHL) 249002057 (Phase I & 2A)	15 ac/45 units	15x3000=45000 45x600 = 27,000				19 built/occupied 7 under construction 19 vacant	as of 4/09, per DHHL
Lana`i City Redevelopment Project 77 TMKs Letter from the Director of Housing & Human Concerns	SF- 214 MF - 164 SR Hsg - 24	214x600=128,400 164x560=91,840 24x560= 13,440 233680 Remaining: 201 SF 120,600 30 MF 16,800	137,400	137,400		214 /SF - 13 /SF -Plantation - - - - - - 201 SF remaining 164 MF - 48 MF Courts 36 MF Kanepuu 48 MF Iwiole - - - - - 30 MF remaining 24 Sr. Housing - 24 Hale Kupuna - - - - - - 0 Sr. Housing remaining	Pursuant to Section 201G-118, HRS anticipated increase in use - 3,900 gpd based on system standards. est cons - entire proj = 233,680 resolution 96-31 amended 7 add'l SF 7 less MF short term rental units
Plantation Homes/new dwellings several tmks		13x600=7,800					13 SF- permitted between June 2006 and Dec.,2007 part of PD - SF
The Courts Apt 249004083	1.94 ac/48 units	11x4x560= 24,640				CO pending 24,640 est	11 buildings with 48 MF units built CO pending as of 2007 Part of Lana`i City Redevelopment Project
Kanepuu-New Apt 249014018	7.67 ac/48 units	12x3x560= 26,800				CO pending 20,160 est	12 buildings with 36 units built CO pending as of 2007 Part of Lana`i City Redevelopment Project
Iwiole Dormitory 249014001	83.98 ac/48 units	48 x 560 =				CO pending 26,880 est	13 buildings with 48 units built CO pending
Lana`i First Assembly of God CIZ 990003 249014009	.551 ac	.551x1700=937	937	937		under construction	
Lana`i Pines Sporting Clay 249002001(por) SUP 960008	14.9 ac	14.9x6000 =89,400	89,400	89,400			expansion of existing recreational facility
Lana`i Quarry 249002001(por) SUP 920011	14.8 ac	14.8x6000=88,800				operating	approved with conditions in 1998; time extension granted on 6/16/1999
Lana`i Kingdom Hall Meeting Room 249014021						completed	CO was issued on 9/25/07

FIGURE 4-67. Discretionary Projects Submitted For Review - Quarterly Update As Of 06/30/2009 - Cont.

Project Name	Acre/Units	Acre Cnsm GPD Unit Cnsm GPD	Proj'd use (gpd)	Potable	Non-Potable	Status	Comments
Proposed Improvements at Lana`i Airport	1.14 ac	1.14x6000 = 6840	6,840	6,840		DOE proposal	early consultation
Lana`i City Housing Project_201-H_county of Maui	73 ac/# of units not determined yet	73x3000 = 219,000	219,000	219,000		EA early consultation	rentals & for-sale markets; SF & MF (used SF/ac std) this is part of the 115 ac lot donated by CCR to the county (per 1997 WWG report 518 units can be constructed on 115 acre lot assuming max density of 4.5units/ac)
Lana`i Senior Center 249006006 CTB 2009/0004	0.34	0.34x6000 = 2040	3,000	3,000		as of 5/29/09, DHHC is awaiting approval from CCR to do any work-demolition & construction	DHHC project-est use between 2000 & 3000 gpd
Subtotal-Lana`i City & Related Areas			**552,477**	**552,477**	**0**		
Lana`i City School Expansion	1 acre	1x1700=1,700	1,700	1,700			CCR est - 13,750gpd
Lana`i City Residential - New	712 units	712x600=427,200	427,200	427,200		**SF - 712 remaining (427,200 gpd)**	C & C proposal - existing # of units as of 2/2006 is 1062, build-out is 1774 or approximately 712 more sf units (427,200 gpd or 1,064,400 gpd at full build out)
Affordable Housing Property	65 acres/292 units	65x3000=195,000 292x600 = 175,200	175,200	175,200		CCR proposal	not part of PD
Subtotal - Future Conceptual			**604,100**	**604,100**	**0**		
Total Lana`i City & Related Areas plus future conceptual projects			**1,156,577**	**1,156,577**	**0**		
Irrigation Grid/Palawai							
Miki Basin Heavy Industrial Area 249002001(por)	14 ac	14x6000=84,000					
Miki Basin Heavy Industrial Area 249002001(por) DBA 2008/0002 CIZ 2008/0003	6 ac	6x6000=36,000	36,000	36,000		DBA & CIZ still pending	CCR Proposal 2009 incl. 120,000 GPD for this.

FIGURE 4-67. Discretionary Projects Submitted For Review - Quarterly Update As Of 06/30/2009 - Cont.

Project Name	Acre/Units	Acre Cnsm GPD Unit Cnsm GPD	Proj'd use (gpd)	Potable	Non-Potable	Status	Comments
Subtotal - Irrigation Grid/Palawai			**36,000**	**36,000**			
Kaumalapau Subdivision	45 units	45x600=27,000	27,000	27,000		proposed	C&C Proposed 2006 (& 2009)
Agriculture Reserve			500,000		500,000	proposed	LWAC Committee Item
Other AG or Commercial Uses			20,000	20,000		proposed	C&C Proposal 2006 (& 2009)
Additional Baseyard			2,000	2,000		proposed	C&C Proposal 2006
New Warehouse			1,000	1,000		proposed	C&C Proposal 2006
Future Use			27,000	27,000		proposed	C&C Proposal 2006 (& 2009, but at 2000 gpd in 2009)
Total - Future Conceptual			**577,000**	**77,000**	**500,000**		
Total - Irrigation Grid/Palawai (incl future conceptual)			**613,000**	**113,000**	**500,000**		
Manele							
Manele Project District Overall	**869.2 ac total** **SF** 328 ac@0.86 units/ac =282 units **MF** 55 ac @3.34 units/ac= 184 units **Comml -** 5.25 ac **Hot** 56.6 ac @10 units/ac not to exceed 500 units **PQP -** 2 **Park-** 66.33 ac (min 10 ac) **GC** 172 ac **OS** 152.02 ac **Roads -** 32 ac	328x3000 = 984,000 55x5000=275,000 5.25x6000=31,500 56.6x17000=962,200 2x1700=3,400 66.33x1700=112,761 172x5000=860,000 282x600 = 169,200 184x560 = 103040 500x350 = 175,000				**SF** 15 built (9,000 gpd) 17 - on SD process (10,200gpd) 250 remaining (150,000 gpd) **MF** 69 built (38,640 gpd) 115 remaining (64,400 gpd) **HTL** 250 Htl built (87500 gpd) remaining - 0 **Est remaining - 340761 gpd**	SF 11 building permits issued on 6/2006 for The Palms at Manele _ not included in the MF built count yet **MF** 16 - Palms at Manele 26 - Terraces at Manele 27 - Fairway Terraces 69 Terraces @ Manele's Clusters 4, 7, 9 & 10 with 4 units each built - CO pending
Keiki Center and Spa at Manele Bay Hotel PH2 20040003 249017001(por)			1,200	1,200		req 2 yr time extension	amendment to preliminary design- modify Keiki ctr and eliminate spa fac - est use prior to modification 7,000 gpd - part of PD

FIGURE 4-67. Discretionary Projects Submitted For Review - Quarterly Update As Of 06/30/2009 - Cont.

Terraces at Manele Incr 3 249017008(por) DBA20000004 PH220000001 PH3 20040007 PH3 20040014 SM1 20000011	12.4ac 11 bldgs w ith 47-one and tw o story tow nhouse units	12.4x5000=62,000 47x560 = 26,320				26 units built	1.03 MGD - allocation for entire Manele PD ; LWAC recommends that 400 gpd of potable and 400 gpd of non potable w ater use be included in the CC&Rs for this project (tow nhouse units to be used as vacation or second homes(applicant's est use - 26,320 gpd) Clusters 4, 7, 9 & 10 w ith 4 unis each built - CO pending
Manele Bay Hotel - Hulopo'e Drive, Special Function Building, Pool Grill Expansion, New Br and Related Improvements 249017008 (por) SM1 20050002 PH 20050002			6,100	6,100		pending	
Manele Small Boat Harbor Ferry Improvement Project Draft EA 249017006 249017002(por)	14.5 ac		10,000	10,000		approved	additional comfort stations, new admin bldg, paved parking areas, utilities, landscaping
Palms @ Manele 249017008						16 units built	11 permitted on 6/2006
Adult Pool and Related Improvements at the Four Seasons PH2 2008/0001 SM1 2008/0013 249017001 por	0.2 ac	0.2 x 17000 = 3400	3,400	3,400		pending	applicant's est - 965 gpd pool requires 45,788 gallons to fill
Sub total - Manele PD			**20,700**	**20,700**	**0**		
Manele Hotel No. 2 (future)	150 units	150x350=52,500	52,500	52,500		proposed	C&C Proposal (2006); est use - 90,000gpd based on 600 gpd (included in PD)
Manele Hotel No. 2 irrigation (future)	12 ac		84,000		84,000	proposed	C&C Proposal (2006); est use - 84,000gpd- (12 acres @ 7,000gpd)
Subtotal Future Conceptual			136,500	52,500	84,000		
Total - Manele PD (incl future conceptual)			**157,200**	**125,700**	**84,000**		
			2,310,557	**1,779,057**	**584,000**		

Castle and Cooke Proposals

During the process of working with the Lana'i Water Advisory Committee to draft and review this document, several build-out proposals by Castle & Cooke (CCR) were discussed. The most recent of these that was reviewed by the Lana'i Water Advisory Committee was dated July 12, 2006. This is presented in Figure 4-68.

An additional proposal was submitted by CCR on July 28, 2009. This report was presented to the Lana'i Water Advisory Committee, which elected not to address the proposal for this iteration of the Water Use & Development Plan.

For informational purposes, a comparison of the 2009 proposal to the 2006 proposal is included here. The 2009 proposal has not had the benefit of full committee discussion and review. However key differences between these proposals are noted in Figures 4-69 to 4-71.

The 2006 proposal by CCR identified roughly 5.4 MGD in demands at build-out, before accounting for system losses. System losses were added to potable and brackish pumped water, resulting in a total demand of about 6.1 MGD. The proposal indicated that 616,000 GPD of wastewater, plus 1.3 MGD of "alternative source" would bring pumped demands down to about 4.16 MGD.

The 2009 proposal by CCR identified roughly 6.28 MGD in demands, before accounting for system losses. System losses were added to potable and pumped water, resulting in a total demand of about 6.97 MGD. The proposal indicated that roughly 1.21 MGD in wastewater and 1.55 MGD in "alternative" source would bring pumped demands down to about 4.21 MGD.

Neither proposal includes all elements of the Project Districts, nor all known other plans for development within the community.

Neither proposal identified the alternate water sources clearly. Calculated additional wastewater generation upon build-out of either proposal, or upon build-out of proposals plus existing entitlements not included, would not be adequate to cover both the amounts attributed to wastewater and the amounts attributed to alternative source. Neither proposal identifies sufficient water source to serve these projects at build-out levels, let alone at build-out with existing unaccounted-for water rates.

FIGURE 4-68. Castle & Cooke Proposal - (July 12, 2006 version)

Castle & Cooke Proposal July 12, 2006											
			DEMAND PROJECTIONS (AS OF 2006)								
USAGE CATEGORY		SOURCE	UNITS	UNITS	QUAN	EXST	5-YR	10-YR	15-YR	BUILDOUT	COMMENTS
SUMMARY OF DEMANDS:											
POTABLE WATER DEMAND											
1.0	**LANA'I CITY RESIDENTIAL**					**353,400**	**557,700**	**879,100**	**977,100**	**1,157,100**	
2.0	**LANA'I CITY NON-RESIDENTIAL+CAVENDISH**					**130,100**	**187,750**	**229,750**	**251,750**	**273,950**	
3.0	**IRRIGATION GRID**					**30,500**	**518,000**	**535,000**	**542,000**	**550,000**	
4.0	**KOELE PD: POTABLE**					**144,000**	**311,200**	**486,600**	**524,600**	**566,400**	
6.0	**MANELE PD: POTABLE**					**392,100**	**584,400**	**790,100**	**971,700**	**1,070,450**	
NON POTABLE WATER											
7.0	**MANELE PD: NON-POTABLE**					**672,600**	**846,900**	**883,000**	**1,064,500**	**1,190,000**	
SUMMARY OF SOURCE											
	LOSSES					10.9%	12.0%	12.0%	12.0%	12.0%	
	POTABLE HIGH LEVEL GROUNDWATER					**1,179,000**	**2,453,000**	**3,319,000**	**3,313,000**	**3,411,000**	
	NON-POTABLE HIGH LEVEL					**755,000**	**962,000**	**753,000**	**810,000**	**752,000**	
	ALTERNATE WATER SOURCE FOR NON POTABLE USE					**0**	**0**	**250,000**	**400,000**	**600,000**	
	ALTERNATE WATER SOURCE FOR POTABLE USE					**0**	**0**	**0**	**400,000**	**700,000**	
	ALTERNATE WATER SOURCE*					**0**	**0**	**250,000**	**800,000**	**1,300,000**	
	TOTAL GROUNDWATER PUMPED (EXCLUDE ALT. WATER					**1,934,000**	**3,415,000**	**4,072,000**	**4,123,000**	**4,163,000**	
SUMMARY OF WASTEWATER (SOURCE = DEMAND)											
5.0	**KOELE PD: WASTEWATER**					**199,000**	**218,000**	**238,000**	**247,000**	**256,000**	
8.0	**MANELE PD: WASTEWATER**					**80,800**	**165,000**	**237,000**	**273,000**	**360,000**	
SUMMARY OF TOTAL WATER SUPPLY/DEMAND						**2,213,800**	**3,798,000**	**4,797,000**	**5,443,000**	**6,079,000**	
(POTABLE, NON-POTABLE, ALTER. WATER, RECLAIMED											
*** - NOTE: For purposes of this proposal, "Alternate Water Source" refers to water other than ground water from the primary and secondary high level**											
1.0	**LANA'I CITY**	POT				353,400	557,700	879,100	977,100	1,157,100	
1.1	Lana'i City Residential - Existing	POT	each	gpd/	350	343,500	371,700	371,700	371,700	371,700	Increased water use 27% -

1.2	Lana'i City Residential - New	POT	each	gpd/ unit	600		60,000	295,800	320,400	427,200	Utilized COM standards.
1.3	County Lana'i City Recreation Area	POT	acres	gpd/ acre	1,375	9,900	11,000	11,000	11,000	11,000	Current use but unmetered.
1.4	Affordable Housing Property	POT	each	gpd/ unit	600	0	60,000	87,600	132,000	175,200	Based on 65 acres & 4.5 units/acre.
1.5	DHHL Property	POT	each	gpd/ unit	600	0	45,000	90,000	112,200	135,000	Based on 50 acres & 4.5 units/acre. 50% compl. In intermediate future.
1.6	Kaumulapau Harbor	POT	LS gpd	LS gpd	1		1,000	5,000	7,000	10,000	
1.7	Kaumulapau Subdivision	POT	each	gpd/ unit	600	0	9,000	18,000	22,800	27,000	50% developed in intermediate future.
2.0	**LANA'I CITY NON-RESIDENTIAL+CAVENDISH**	POT				130,100	187,750	229,750	251,750	273,950	
2.1	Lana'i City Govt / Comm & Inst / Lt Ind / Airport	POT	gpd	LS gpd	1	130,100	174,000	216,000	238,000	260,200	Existing demand updated due to better data. Future prorated w/population increase.
2.2	Lana'i City School Expansion	POT	gpd	gpd/ acre	1,375		13,750	13,750	13,750	13,750	
3.0	**IRRIGATION GRID**					30,500	518,000	535,000	542,000	550,000	
3.1	Agriculture Reserve	POT	LS gpd	LS gpd	1	30,500	500,000	500,000	500,000	500,000	
3.2	Other Ag or Commercial Uses	POT	LS gpd	LS gpd	1	0	7,000	14,000	17,000	20,000	
3.3	Additional Base Yard	POT	LS gpd	LS gpd	1	0	1,000	2,000	2,000	2,000	
3.4	New Warehouse	POT	LS gpd	LS gpd	1	0	1,000	1,000	1,000	1,000	
3.5	Future Use	POT	LS gpd	LS gpd	1	0	9,000	18,000	22,000	27,000	
4.0	**KOELE PD: POTABLE**	POT				144,000	311,200	486,600	524,600	566,400	
4.1	Koele PD Redevelopment Portion	POT	each	gpd/ unit	600	0	72,000	87,000	94,200	102,000	75 acres. 50% developed in intermediate future.
4.2	Koele PD-Hotel	POT	each	gpd/ unit	500	36,600	51,000	51,000	51,000	51,000	Assumes 20% increase in intermediate term.
4.3	Koele PD-Hotel (Future)	POT	each	gpd/ unit	500	0	0	74,000	74,000	74,000	
4.4	Koele PD-Hotel Irrigation	POT	acres	gpd/ acre	NA	58,500	60,000	60,000	60,000	60,000	More hardscape will be used in the future. Max use at 60,000 gpd
4.5	Koele PD-Commercial	POT	LS gpd	LS gpd	1	2,700	6,000	9,000	11,000	12,000	Assumes commercial use increase by 50% & 100%
4.6	Koele Single Family	POT	each	gpd/ unit	600	12,300	31,200	91,200	120,000	153,000	Existing demand increased by 25% - better data. Units incr. by 1.
4.7	Koele Multi-Family	POT	each	gpd/ unit	600	13,500	30,600	54,000	54,000	54,000	Existing demand increased by 25% - better data. Units decr. by 10.

4.8	Koele Common Areas Irrigation	POT	acres	gpd/ acre	2,000	4,400	20,000	20,000	20,000	20,000	
4.9	Koele Parks	POT	acres	gpd/ acre	1,700	0	20,400	20,400	20,400	20,400	Existing demand increased by 80% - better data. Units incr by 10.
4.10	Cavendish Golf Course	POT	gpd	LS gpd	1	16,000	20,000	20,000	20,000	20,000	Based on highest use of last 3 years + 4,000 gpd.
5.0	**KOELE PD: WASTEWATER**	WW				199,000	218,000	238,000	247,000	256,000	
5.1	Koele Golf Course	WW	LS gpd	LS gpd	1	199,000	218,000	238,000	247,000	256,000	Normal rainfall year. Present
6.0	**MANELE PD: POTABLE**	POT				392,100	584,400	790,100	971,700	1,070,450	
6.1	Manele Hotel	POT	rooms	gpd/	600	88,000	150,000	150,000	150,000	150,000	Assumed that full capacity of
6.2	Manele Hotel Irrigation	POT	acres	gpd/ acre	8,000	179,000	179,000	179,000	232,000	232,000	
6.3	Manele Hotel No. 2 (Future)	POT	rooms	gpd/ room	600	0	0	90,000	90,000	90,000	Existing demand increased by 80% - better data. Units incr by 10.
6.4	Manele Single Family Homes	POT	each	gpd/ unit	600	0	37,800	60,000	90,000	120,000	
6.5	Manele Multi-Family	POT	each	gpd/ unit	300	12,800	33,600	45,000	52,500	90,000	
6.6	Manele Commercial	POT	acres	gpd/ acre	5,000	17,300	25,000	35,000	45,000	51,250	Assume 50% increase in intermediate term
6.7	Manele Utilities	POT	LS gpd	LS gpd	1	12,900	40,000	66,000	79,000	92,000	Ultimate plant size at 4x current. Assume linear use.
6.8	Manele Construction / Development	POT	LS gpd	LS gpd	1	29,900	31,000	31,000	31,000	31,000	Increase reflects actual metered water use
6.9	Manele Parks (Including Hulopo'e	POT	acres	gpd/	1,700	23,000	34,000	56,100	112,200	112,200	Assumes 50% developed in
6.10	Manele Public Use	POT	LS gpd	LS gpd	1	29,200	54,000	78,000	90,000	102,000	Assume Public park use triples in ultimate phase.
7.0	**MANELE PD: NON-POTABLE WATER**					672,600	846,900	883,000	1,064,500	1,190,000	
7.1	Manele Single Family - Irrigation	NPHLG W and ALT	each	gpd/ unit	2,500	37,000	187,500	250,000	437,500	500,000	
7.2	Manele Multi-Family - Irrigation	NPHLG W and ALT	each	gpd/ unit	1,200	86,100	134,400	180,000	210,000	360,000	
7.3	Manele Common Areas Irrigation	NPHLG W and ALT	acres	gpd/ acre	2,500	40,400	40,000	40,000	40,000	40,000	Water use decr. by 180% to account for actual projected future use.

7.4	Manele Golf Course Irrigation	NPHLGW and ALT	gpd	gpd	1	509,100	485,000	413,000	377,000	290,000	Based on 650,000 gal/day less WW effluent.
8.0	**MANELE PD: WASTEWATER**	WW				80,800	165,000	237,000	273,000	360,000	
8.1	Manele Golf Course Irrigation	WW	gpd	gpd	1	80,800	165,000	237,000	273,000	360,000	WW effluent generation = 75% of domestic water usage based on 2002 data.

NOTES:

ITEM NO.	COMMENT
1.1 & 1.2	Per capita use: Actual=323 gpd/unit. Use 350 gpd/unit for existing and Maui County Std=600 gpd/unit for future units.
1.0	Includes single family, multiple family and common areas.
1.4	65 Acres of the 115 acres is allocated for affordable housing. The remaining 50 acres is allocated to school expansion (2.2)
2.1	Includes Commercial, Institutional, Light Industrial and Lana‘i Airport
2.2	Lana‘i City School Expansion. Expect that most water usage will be due to irrigation (assumption is 10 Acre out of 50 acres is landscape)
4.4	Koele Hotel irrigation is expected to decline because more hardscape will be used. A maximum of 60,000 gpd is used.
5.0 & 8.0	R-1 water includes both Lana‘i City WRF and the Manele District WRF. For existing 199,000 gpd to EAK and 80,800 gpd to CAM.
7.4 & 8.1	For 5/10/BO periods 650,000 gpd total irrigation water assumed for CAM. At CAM, the amount of brackish water use is reduced as the amount of R-1 water increases.
Summary	Loss of 12% is assumed for planning purposes. CCR goal is to minimize all losses and actual is expected to be less then 12%.
a	Includes Residential plus Kpau Harbor
"D"	For Manele PD refer to Table A-2 of 1997 Draft WUDP for determination of Manele PD NP irrigation and Potable Usage.

LEGEND

POT	POTABLE HIGH LEVEL GROUNDWATER
NPHLGW	NON-POTABLE HIGH LEVEL GROUNDWATER (WELLS #1,9,14)
ALT	ALTERNATE SOURCE (BASAL WELLS, DESAL, RUNOFF, WW INCREASE)
WW	WASTEWATER
GPD	GALLONS/DAY
LS gpd	LUMP SUM GALLONS/DAY

CATEGORIES

3.2	Lana‘i City Other Ag / Commercial		6.7	Manele Utilities	
		Kamalapau Harbor			Manele Wastewater Treatment
		ADA (Aoki Homes)			Manele Terrace Pump Station
		Miki Lumber Yard			Road E Lift Station
		Lana‘i Waste Disposal	6.8	Manele Construction/Development	
		Lana‘i AWWTP			Manele Crusher
		Airport			Manele Trailer Ice Machine
		MECO Powerplant			Rock Cutting
4.5	Koele Commercial				Development
		Koele Hotel Horse			MANELE RD MAKAI METR

		STABLES HORSE							Manele Road - Pine Trees			
		Koele Hotel Tennis							MANELE RD TREES TOPS			
		Exp at Koele Golf Course							Manele Standpipe			
		Exp at Koele Course							ROAD E STANDPIPE METER			
6.6	Manele Commercial						6.1	Manele Public Use				
		Trilogy							Hulopo‘e Beach Park - High			
		Manele Golf Course							Hulopo‘e Beach Park - Low			
		Manele Golf Course							Boat Harbor			
		Manele Golf Comfort							Kila Kila Boat Harbor			
		Future Commercial Use										
This Table is for planning purposes only. Castle & Cooke's development plans are subject to change, and therefore, it is intended that this Table be reviewed and revised on a periodic basis. The projected demand for the various uses and service areas indicated herein are only estimates and are not intended to limit consumption in specific locations or projects.												

FIGURE 4-69. Comparison of Demand Summaries - 2006 and 2009 Proposals

PROJECTED DEMAND AND ALLOCATIONS
2006 and 2009 DRAFTS

USAGE CATEGORY	DEMAND PROJECTIONS									
	EXST 2006 ACTUAL OR ESTIMATE (GPD)	EXST 2009 ACTUAL OR ESTIMATE (GPD)	2006 5-YR (GPD)	2009 5-YR (GPD)	2006 10-YR (GPD)	2009 10-YR (GPD)	2006 15-YR (GPD)	2009 15-YR (GPD)	2006 BUILDOUT 20-YR (GPD)	2009 BUILDOUT-20-YR (GPD)
SUMMARY OF DEMANDS:										
POTABLE WATER DEMAND	1,050,100	857,500	2159050	2,045,810	2,920,550	2,700,038	3,267,150	3,135,564	3,617,900	3,496,879
1.0 LANA`I CITY RESIDENTIAL (WELLS 3, 6 & 8)	353,400	322,200	557,700	509,700	879,100	789,700	977,100	883,500	1,157,100	1,064,700
2.0 LANA`I CITY NON-RESIDENTAIL + CAVENDISH (WELLS 3, 6 & 8)	130,100	75,200	187,750	111,510	229,750	140,838	251,750	178,964	273,950	228,529
3.0 IRRIGATION GRID (WELLS 2 & 4)	30,500	10,900	518,000	574,000	535,000	637,000	542,000	639,000	550,000	642,000
4.0 KOELE PD: POTABLE (WELLS 3, 6 & 8)	144,000	136,700	311,200	320,200	486,600	510,400	524,600	552,400	566,400	593,200
6.0 MANELE PD: POTABLE (WELLS 2 &4)	392,100	312,500	584,400	530,400	790,100	622,100	971,700	881,700	1,070,450	968,450
NON-POTABLE WATER DEMAND										
7 MANELE PD: NON-POTABLE WATER (WELLS 1, 9 &14)	672,600	808,600	846,900	981,900	883,000	1,125,000	1,064,500	1,285,000	1,190,000	1,572,500
SUMMARY OF SOURCE REQUIREMENTS										
LOSSES	10.90%	11.00%	12.0%	12.00%	12.0%	12.00%	12.0%	12.00%	12.0%	12.00%
POTABLE HIGH LEVEL GROUNDWATER	1,179,000	963,000	2,453,000	2,325,000	3,319,000	3,068,000	3,313,000	3,263,000	3,411,000	3,374,000
NON-POTABLE HIGH LEVEL GROUNDWATER	755,000	830,800	962,000	760,939	753,000	672,706	810,000	680,360	752,000	834,153
**ALTERNATE WATER SOURCE FOR NON-POTABLE USE	0		0		250,000		400,000		600,000	
**ALTERNATE WATER SOURCE FOR POTABLE USE	0		0		0		400,000		700,000	
ALTERNATE WATER SOURCE*	0	78,200	0	355,061	250,000	605,294	800,000	1,079,640	1,300,000	1,552,847
TOTAL GROUNDWATER PUMPED (EXCLUDE ALT. WATER AND WW)	1,934,000	1,793,800	3,415,000	3,085,939	4,072,000	3,740,706	4,123,000	3,943,360	4,163,000	4,208,153
SUMMARY OF WASTERWATER (SOURCE)										
5.0 KOELE PD/LANA`I CITY: WASTEWATER	199,000	222,200	218,000	392,261	238,000	625,794	247,000	706,015	256,000	832,910
8.0 MANELE PD: WASTEWATER	80,800	78,200	165,000	184,800	237,000	217,500	273,000	320,625	360,000	375,938
SUMMARY OF TOTAL WATER SUPPLY/DEMAND (POTABLE, NON-POTABLE, ALTER. WATER, RECLAIMED)	2,213,800	2,172,400	3,798,000	4,018,061	4,797,000	5,189,294	5,443,000	6,049,640	6,079,000	6,969,848

POT	POTABLE HIGH LEVEL GROUNDWATER
NPHLGW	NON-POTABLE HIGH LEVEL GROUNDWATER (WELLS #1, 9,14)
ALT	ALTERNATE SOURCE (BASAL WELLS, DESAL, RUNOFF, WWINCREASE)
WW	WASTEWATER

FIGURE 4-70. Facilities Comparison of 2006 and 2009 Proposals - Unit Counts or Acres

	USAGE CATEGORY	2006 EXST.	2009 EXST.	2006 5-YR	2009 5-YR	2006 10-YR	2009 10-YR	2006 15-YR	2009 15-YR	2006 BUILD-OUT (20-YR)	2009 BUILD-OUT (20-YR)	2006 UNITS	2009 UNITS
1.0	**Lana`i CITY RESIDENTIAL (Wells 3, 6 & 8)**												
1.1	Lana`i City Residential - Existing	1,062	1,062	1,062	1,062	1,062	1,062	1,062	1,062	1,062	1,062	gpd/unit	gpd/unit
1.2	Lana`i City	0	0	100	100	**493**	450	**534**	500	**712**	700	gpd/unit	gpd/unit
1.3	Country Lana`i City Recreation Area	8	8	8	8	8	8	8	8	8	8	gpd/acre	gpd/unit
1.4	Affordable Housing Property (Future)	0	0	**100**	50	**146**	100	**220**	150	**292**	240	gpd/unit	gpd/unit
1.5	DHHL Property	0	0	**75**	45	**150**	90	**187**	135	**225**	135	gpd/unit	gpd/unit
1.7	Kaumulapau Subdivision	0	0	15	15	30	30	38	38	45	45	gpd/unit	gpd/unit
2.0	**Lana`i CITY NON-RESIDENTIAL + CAVENDISH (Wells 3,6 & 8)**												
1.6	Kaumulapau Harbor	0	**3,300**	1,000	1,000	5,000	5,000	7,000	7,000	10,000	10,000	LS gpd	LS gpd
2.1	Lana`i City Govt/Comm & Inst/ LtInd/ Airport/Lana`i WWTP/Lana`i.	**130,100**	75,200	**174000**	97,760	**216,000**	127,088	**238,000**	165,214	**260,200**	214,779	LS gpd	LS gpd
2.2	Lana`i City School Expansion		0	10	10	10	10	10	10	10	10	gpd/acre	gpd/unit
*2.3	Future Commercial & BCT		0		5,000		5,000		5,000		5,000		LS gpd
3.0	**IRRIGATION GRID (Wells 2 & 4)**												
3.1	Agriculture Reserve	**30,500**	0	500000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	LS gpd	LS gpd
3.2	Other Ag or Commercial Uses	0	**10,900**	7000	**13,000**	14,000	**15,000**	17,000	17,000	20,000	20,000	LS gpd	LS gpd
**3.3	Additional Baseyard(2006) /Miki Basin Heavy Industrial(2009)	0	0	1000	10	**2,000**	20	2,000	20	2,000	20	LS gpd	gpd/acre
***3.4	New Warehouse	0		1000		1,000		1,000		1,000		LS gpd	
(3.4 in	Future Use	0	0	9000	**1,000**	**18,000**	2,000	**22,000**	2,000	**27,000**	2,000	LS gpd	LS gpd
4.0	**KOELE PD: POTABLE (Wells 3, 6 & 8)**												
4.1	Koele PD Redevelopment Portion	0	0	120	120	145	145	157	157	170	170	gpd/unit	gpd/unit
4.2	Koele PD-Hotel	102	102	102	102	102	102	102	102	102	102	gpd/unit	gpd/room
4.3	Koele PD-Hotel(Future)	0	0	0	0	148	148	148	148	148	148	gpd/unit	gpd/room
4.4	Koele PD-Hotel Irrigatiopn	20	**21**	20	**21**	20	**21**	20	**21**	20	**21**	gpd/acre	gpd/acre
4.5	Koele PD-Commercial (Tennis & Stables)	1	**1,400**	6000	6,000	9,000	9,000	**11,000**	9,000	**12,000**	9,000	LS gpd	LS gpd
4.6	Koele Single Family	14	**18**	52	52	152	152	200	200	255	255	gpd/unit	gpd/unit
4.7	Koele Multi-Family	27	27	51	51	90	90	90	**100**	90	**100**	gpd/unit	gpd/unit
4.8	Koele Common Areas Irrigation	10	10	10	10	10	10	10	10	10	10	gpd/acre	gpd/acre
4.9	Koele Parks (Future)	12	12	12	12	12	12	12	12	12	12	gpd/acre	gpd/acre
4.10	Cavendish Golf Course & Maintenance	**16,000**	13,800	20000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	LS gpd	LS gpd
5.0	**KOELE PD/Lana`i CITY: WASTEWATER**												
5.1	Koele Golf Course Irrigation Effluent	199,000	**222,200**	218000	**222,200**	238,000	238,000	247,000	247,000	256,000	256,000	LS gpd	LS gpd

FIGURE 4-70. Facilities Comparison of 2006 and 2009 Proposals - Unit Counts or Acres - Continued

Comparison of 2006 and 2009 DRAFTS		FACILITY PROJECTIONS - UNIT OR ACRE COUNTS										FLOW			
	USAGE CATEGORY	2006 EXST.	2009 EXST.	2006 5-YR	2009 5-YR	2006 10-YR	2009 10-YR	2006 15-YR	2009 15-YR	2006 BUILD-OUT (20-YR)	2009 BUILD-OUT (20-YR)	2006 UNITS	2009 UNITS	2006 QUAN	2009 QUAN
6.0	**MANELE PD: POTABLE (Wells 2 & 4)**														
6.1	Manele Hotel	250	250	250	250	250	250	250	250	250	250	gpd/roon	gpd/room	600	600
6.2	Manele Hotel Irrigation	17	17	17	17	17	17	29	29	29	29	gpd/acre	gpd/acre	8,000	8,000
6.3	Manele Hotel (Future)	0	0	0	0	150	0	150	150	150	150	gpd/roon	gpd/room	600	600
6.4	Manele Single Family Homes	0	**17**	63	63	100	100	150	150	200	200	gpd/unit	gpd/unit	600	600
6.5	Manele Multi-Family	51	**69**	112	112	150	150	175	175	300	300	gpd/unit	gpd/acre	300	300
6.6	Manele Commercial	**5**	0	5	5	7	7	9	9	10	10	gpd/acre	gpd/acre	5,000	5,000
6.7	Manele Utilities (WWTP & Lift Stations)	**12,900**	7,000	40000	40,000	66,000	66,000	79,000	79,000	92,000	92,000	LS gpd	LS gpd	1	1
6.8	Manele Construction/Development	29,900	**30,000**	31000	31,000	31,000	31,000	31,000	31,000	31,000	31,000	LS gpd	LS gpd	1	1
6.9	Manele Parks (Domestic use and Irrigation)	-	**2**	20	20	33	33	66	66	66	66	gpd/acre	gpd/acre	1,700	1,700
**6.10	Manele Public Use	29,200		54000		78,000		90,000		102,000		LS gpd		1	
7.0	**MANELE PD: NON-POTABLE WATER (Wells 1, 9 & 14)**														
7.1	Manele Single Family-Irrigation	8	**17**	75	**63**	100	100	**175**	150	200	200	gpd/unit	gpd/unit	2,500	2,500
7.2	Manele Multi-Family-Irrigation	51	**69**	112	112	150	150	175	175	300	300	gpd/unit	gpd/unit	1,200	1,200
7.3	Manele Common Areas Irrigation	16	16	16	16	16	**18**	16	**20**	16	**25**	gpd/acre	gpd/acre	2,500	2,500
7.4	Manele Golf Course Irrigation	Actual Current	603,000	650,000	650,000	650,000	650,000	650,000	650,000	650,000	650,000	gpd	gpd	1	1
8.0	**MANELE PD: WASTEWATER**														
8.1	Manele Golf Course Irrigation Effluent	Actual Current	78,200		184,800		217,500		320,625		375,938	gpd	gpd	1	1

FIGURE 4-71. Comparison of 2006 and 2009 Castle & Cooke Proposals - Demand

Comparison of 2006 and 2009 DRAFTS		DEMAND PROJECTIONS									
USAGE CATEGORY		EXST 2006 ACTUAL OR ESTIMATE (GPD)	EXST 2009 ACTUAL OR ESTIMATE (GPD)	2006 5-YR (GPD)	2009 5-YR (GPD)	2006 10-YR (GPD)	2009 10-YR (GPD)	2006 15-YR (GPD)	2009 15-YR (GPD)	2006 BUILDOUT-20-YR (GPD)	2009 BUILDOUT-20-YR (GPD)
1.0	**Lana`i CITY RESIDENTIAL (Wells 3, 6 & 8)**	**353,400**	322,200	**557,700**	509,700	**879,100**	789,700	**977,100**	883,500	**1,157,100**	1,064,700
1.1	Lana`i City Residential - Existing	**343,500**	309,000	371,700	371,700	371,700	371,700	371,700	371,700	371,700	371,700
1.2	Lana`i City		0	60,000	60,000	**295,800**	270,000	**320,400**	300,000	**427,200**	420,000
1.3	Country Lana`i City Recreation Area	9,900	9,900	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000
1.4	Affordable Housing Property (Future)	0	0	**60,000**	30,000	**87,600**	60,000	**132,000**	90,000	**175,200**	144,000
1.5	DHHL Property	0	0	**45,000**	27,000	**90,000**	54,000	**112,200**	81,000	**135,000**	81,000
1.7	Kaumulapau Subdivision	0	0	9,000	9,000	18,000	18,000	22,800	22,800	27,000	27,000
2.0	**Lana`i CITY NON-RESIDENTIAL + CAVENDISH (Wells 3,6 & 8)**	**130,100**	75,200	**187,750**	111,510	229,750	**1,408,383**	**251750**	178,964	**273,950**	228,529
1.6	Kaumulapau Harbor		**3,300**	1,000	1,000	5,000	5,000	7,000	7,000	10,000	10,000
2.1	Lana`i City Govt/Comm & Inst/ Ltlnd/ Airport/Lana`i WWTP/Lana`i...	**130,100**	75,200	**174,000**	97,760	**216,000**	127,088	**238000**	165,214	**260,200**	214,779
2.2	Lana`i City School Expansion		0	13,750	13,750	13,750	13,750	13750	13,750	13,750	13,750
*2.3	Future Commercial & BCT				5,000		5,000		5,000		5,000
3.0	**IRRIGATION GRID (Wells 2 & 4)**	**30,500**	10,900	518,000	**574,000**	535,000	**637,000**	542,000	**639,000**	550000	**642,000**
3.1	Agriculture Reserve	**30,500**	0	500,000	500,000	500,000	500,000	500,000	500,000	500000	500,000
3.2	Other Ag or Commercial Uses	0	**10,900**	7,000	**13,000**	14,000	**15,000**	17,000	17,000	20000	20,000
**3.3	Additional Baseyard(2006) /Miki Basin Heavy Industrial(2009)	0	0	1,000	60,000	2,000	120,000	2,000	120,000	2000	120,000
***3.4	New Warehouse	0		1,000		1,000		1,000		1000	
3.5 (3.4 in 2009)	Future Use	0	0	9,000	**1,000**	**18,000**	2,000	**22,000**	2,000	**27000**	2,000
4.0	**KOELE PD: POTABLE (Wells 3, 6 & 8)**	**144,000**	136,700	311,200	**320,200**	486,600	**510,400**	524,600	**552,400**	566400	**593,200**
4.1	Koele PD Redevelopment Portion	0	0	72,000	72,000	87,000	87,000	94,200	94,200	102000	102,000
4.2	Koele PD-Hotel	**36,600**	30,000	51,000	**61,200**	51,000	**61,200**	51,000	**61,200**	51000	**61,200**
4.3	Koele PD-Hotel(Future)	0	0	0	0	74,000	**88,800**	74,000	**88,800**	74000	**88,800**
4.4	Koele PD-Hotel Irrigatiopn	**58,500**	51,000	**60,000**	58,800	**60,000**	58,800	**60,000**	58,800	**60000**	58,800
4.5	Koele PD-Commercial (Tennis & Stables)	**2,700**	1,400	6,000	6,000	9,000	9,000	**11,000**	9,000	**12000**	9,000
4.6	Koele Single Family	12,300	**15,500**	31,200	31,200	91,200	91,200	120,000	120,000	153000	153,000
4.7	Koele Multi-Family	13,500	**20,600**	30,600	30,600	54,000	54,000	54,000	**60,000**	54000	**60,000**
4.8	Koele Common Areas Irrigation	4,400	4,400	20,000	20,000	20,000	20,000	20,000	20,000	20000	20,000
4.9	Koele Parks (Future)	0	0	20,400	20,400	20,400	20,400	20,400	20,400	20400	20,400
4.10	Cavendish Golf Course & Maintenance	**16,000**	13,800	20,000	20,000	20,000	20,000	20,000	20,000	20000	20,000
5.0	**KOELE PD/Lana`i CITY: WASTEWATER**	199,000	**222,200**	218,000	**392,261**	238,000	**625,794**	247,000	**706,015**	256000	**832,910**
5.1	Koele Golf Course Irrigation Effluent	199,000	**222,200**	218,000	**392,261**	238,000	**625,794**	247,000	**706,015**	256000	**832,910**

FIGURE 4-71. Comparison of 2006 and 2009 Castle & Cooke Proposals - Demand - Continued

Comparison of 2006 and 2009 DRAFTS		DEMAND PROJECTIONS									
USAGE CATEGORY		EXST 2006 ACTUAL OR ESTIMATE (GPD)	EXST 2009 ACTUAL OR ESTIMATE (GPD)	2006 5-YR (GPD)	2009 5-YR (GPD)	2006 10-YR (GPD)	2009 10-YR (GPD)	2006 15-YR (GPD)	2009 15-YR (GPD)	2006 BUILDOUT-20-YR (GPD)	2009 BUILDOUT-20-YR (GPD)
6.0	MANELE PD: POTABLE (Wells 2 & 4)	392,100	312,500	584,400	530,400	790,100	622,100	971,700	881,700	1,070,450	968,450
6.1	Manele Hotel	88,000	63,500	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
6.2	Manele Hotel Irrigation	179,000	165,600	179,000	179,000	179,000	179,000	232,000	232,000	232,000	232,000
6.3	Manele Hotel (Future)	0	0	0	0	90,000	0	90,000	90,000	90,000	90,000
6.4	Manele Single Family Homes	0	15,300	37,800	37,800	60,000	60,000	90,000	90,000	120,000	120,000
6.5	Manele Multi-Family	12,800	9,800	33,600	33,600	45,000	45,000	52,500	52,500	90,000	90,000
6.6	Manele Commercial	17,300	0	25,000	25,000	35,000	35,000	45,000	45,000	51,250	51,250
6.7	Manele Utilities (WWTP & Lift Stations)	12,900	7,000	40,000	40,000	66,000	66,000	79,000	79,000	92,000	92,000
6.8	Manele Construction/Development	29,900	30,000	31,000	31,000	31,000	31,000	31,000	31,000	31,000	31,000
6.9	Manele Parks (Domestic use and Irrigation)	23,000	21,300	34,000	34,000	56,100	56,100	112,200	112,000	112,200	112,000
***6.10	Manele Public Use	29,200		54,000		78,000		90,000		102,000	
7.0	MANELE PD: NON-POTABLE WATER (Wells 1, 9 & 14)	672,600	808,600	846,900	981,900	883,000	1,125,000	1,064,500	1,285,000	1,190,000	1,572,500
7.1	Manele Single Family-Irrigation	37,000	33,700	187,500	157,500	250,000	250,000	437,500	375,000	500,000	500,000
7.2	Manele Multi-Family-Irrigation	86,100	87,200	134,400	134,400	180,000	180,000	210,000	210,000	360,000	360,000
7.3	Manele Common Areas Irrigation	40,400	84,700	40,000	40,000	40,000	45,000	40,000	50,000	40,000	62,500
7.4	Manele Golf Course Irrigation	509,100	603,000	485,000	650,000	413,000	650,000	377,000	650,000	290,000	650,000
8.0	MANELE PD: WASTEWATER	80,800	78,200	165,000	184,800	237,000	217,500	273,000	320,625	360,000	375,938
8.1	Manele Golf Course Irrigation Effluent	80,800	78,200	165,000	184,800	237,000	217,500	273,000	320,625	360,000	375,938
	Subtotal Pumped Fresh	1,050,100	857,500	2,159,050	2,045,810	2,920,550	3,967,583	3,267,150	3,135,564	3,617,900	3,496,879
	Subtotal Pumped Brackish	672,600	808,600	846,900	981,900	883,000	1,125,000	1,064,500	1,285,000	1,190,000	1,572,500
	Pumped Subtotal	1,722,700	1,666,100	3,005,950	3,027,710	3,803,550	5,092,583	4,331,650	4,420,564	4,807,900	5,069,379
	PUMPED SUBTOTAL plus Anticipated Unaccounted-For Water - 12%	1,957,614	1,893,295	3,415,852	3,440,580	4,322,216	5,787,026	4,922,330	5,023,368	5,463,523	5,760,658
	RECLAIMED	279,800	300,400	383,000	577,061	475,000	843,294	520,000	1,026,640	616,000	1,208,848
	TOTAL pumped and reclaimed, but without losses	2,002,500	1,966,500	3,388,950	3,604,771	4,278,550	5,935,877	4,851,650	5,447,204	5,423,900	6,278,227
	Less Unidentified "Alternative" Sources per Proposals					4,072,216	5,181,732	4,122,330	3,943,728	4,163,523	4,207,811
	TOTAL plus Anticipated Unaccounted-For Water - 12% *(Losses are NOT counted twice)*	2,237,414	2,193,695	3,798,852	4,017,641	4,797,216	6,630,320	5,442,330	6,050,008	6,079,523	6,969,506

Compiled Analysis

Several sources of data pertaining to 20 year build-outs on Lana‘i have been reviewed and presented in preceding pages of this chapter. These include the Project Districts according to standards, other known proposed projects submitted to the Department of Water Supply for review, and company proposals. Analyses presented include forecasted trends, build-out per standards, build-outs per CCR proposed standards, and predictive analysis using hybrids of standards, proposals and forecasted trends, for both drinking water and wastewater. The results of these analyses are compiled and compared in Figures 4-69 to 4-71.

Comparison of Build-out Proposals with Build-out Plus Existing Partial Entitlements

Neither the 2006 nor the 2009 proposal from Castle & Cooke Resorts, LLC (CCR) included full build-out of the Project Districts at the maximum densities permitted. Conversely, some items not included in the Project District zoning ordinances were included in the proposals. In order to look at the whole picture, an additional analysis, dubbed the “build-out plus” scenario, was compiled. This “build-out plus” scenario included the sum of the 2006 proposal plus existing partial entitlements not included in CCR proposals. Figure 4-72 shows the “build-out plus” scenario compiled side by side with the 2006 and 2009 proposals. Total demands in the “build-out plus” scenario, 2006 proposal and 2009 proposal were 7.13 MGD, 6.08 MGD, and 6.97 MGD, respectively.

Comparison of Forecasts with Build-out Plus Existing Entitlements

Figure 4-72 compares time trend regressions and econometric forecasts, with the proposal “build-out plus” scenario. The majority of the trends converge between 3 and 4 MGD.

Build-out of Phase II Entitlements Only

Portions of the Project Districts have Phase II entitlements. An attempt was made to delineate these, in order to evaluate build-out of existing Phase II entitlements. It appears that build-out of existing Phase II entitlements, plus other known projects would represent about 5.59 MGD in total demand (4.99 without resource reserve) , of which about 3.58 MGD would have to be pumped. With 255 SF units at Koele and 161 at Manele having Phase II approvals, while less than 20 have been built in either Project District, restricting development to build-out of existing Phase II approvals plus other known projects outside the Project Districts should not create hardship.

Differences Between Proposals and Project District Entitlements

Differences between build-out of proposals and project district entitlements are delineated in Figure 4-77. The 2006 proposal for Koele includes 90 Multi-Family units, 425 Single-Family units and 250 Hotel units, while the PD allows for 156 Multi-Family, 535 Single-Family and 253 Hotel units. In Manele, the proposal calls for 200 Single-Family units, 300 Multi-Family, 400 Hotel units, and 10 acres of Commercial area, while the PD allows for 282 Single-Family units, 184 Multi-Family units, 500 Hotel units, and 5.25 acres of commercial. These differences reflect evolving company plans. Never the less, for the purpose of build-out analysis, it seemed advisable to examine the combined build-out of the proposals plus existing Project District entitlements.

A Note on System Losses In The Analysis

It should be noted that the build-out analysis included a standard 12% system loss island-wide. Actual average unaccounted-for water island-wide is about 28%. Projections and revised analysis were run with 12% assumed losses in the areas served by Wells 6 & 8 (Koele, Lana‘i City, Kaumalapau), but 15% in the Palawai Irrigation Grid and Manele-Hulopo‘e.

Offset of Demand with Reclaimed Water Use

Build-out of the proposed projects with current system losses could cause total demand to exceed sustainable yields. However, CCR proposes to offset pumped water use, such that both of its proposals remain under 4.3 MGD of pumped water. This is accomplished partially with reclaimed water. The 2006 proposal recommends 0.616 MGD of reclaimed water use. The 2009 proposal suggests 1.2 MGD of reclaimed water use. Analysis of reclaimed water availability suggests a range between 400,000 GPD and 700,000 GPD, depending upon the progress of build-out.

Offset of Demand with Alternate Sources of Water

The 2006 proposal recommends 1.3 MGD of alternate water use. The 2009 proposal recommends 1.55 MGD of alternate water use. These amounts are recommended above and beyond the reclaimed water use shown in the proposals. Neither plan identifies the source of the “alternate” water included. A large desalinization facility seems unrealistic within the planning period, based on costs and forecast trends.

Opportunities Identified By Demand Analysis

Notably missing from either proposal is conservation. Based upon analysis of unaccounted-for water and of landscape use, there appears to be great potential for conservation savings, which could contribute a portion of the water needed from “alternate” sources. Based upon analysis of the billing data, certain conservation opportunities have been identified for evaluation and inclusion in the source plan in Chapter 5 and the allocation discussion in Chapter 7. These are:

- Replacement of leaking pipe in the Palawai Irrigation Grid
- Landscape Conservation
- Fixture and appliance replacement program
- Cover on the 15 MG Reservoir to reduce evaporative losses
- Annual audit and leak detection
- Hotel incentives program
- Rate structure tiered to encourage conservation

FIGURE 4-72. Compiled Analysis

`		Build-Out Plus Estimate By Standards Review	Built-Out Already	Remaining	EXST 2006 ACTUAL OR ESTIMATE (GPD)	EXST 2009 ACTUAL OR ESTIMATE (GPD)	2006 BUILD-OUT TO 2030 20-YR (GPD)	2009 BUILDOUT TO 2030 20-YR (GPD)	2006 REMAINING	2009 REMAINING
1.0	**LANA`I CITY RESIDENTIAL (Wells 3, 6 & 8)**	**923,787**	**507,316**	**416,471**	**353,400**	**318,900**	**1,157,100**	**1,064,700**	**366,500**	**315,800**
1.1	Lana`i City Residential - Existing	362,862	268,127	94,735	343,500	309,000	371,700	371,700	28,200	62,700
1.2	Lana`i City Residential -New/Future	~	~	~		0	427,200	420,000	427,200	420,000
1.3	Country Lana`i City Recreation Area	13,600	9,900	3,700	9,900	9,900	11,000	11,000	1,100	1,100
1.4	Affordable Housing Property (Future)	257,025	0	219,000	0	0	175,200	144,000	175,200	144,000
1.5	DHHL Property	125,900	27,000	98,900	0	0	135,000	81,000	135,000	81,000
1.7	Kaumulapau Subdivision	27,000	~	45,000	0	0	27,000	27,000	27,000	27,000
	Lana`I City Re-Development Project	137,400	0	137,400					0	0
2.0	**LANA`I CITY NON-RESIDENTIAL + CAVENDISH (Wells 3,6 & 8)**	**163,334**	**87,472**	**47,905**	**130,100**	**75,200**	**273,950**	**228,529**	**143,850**	**153,329**
1.6	Kaumulapau Harbor	21,117	14,058	7,059		3,300	10,000	10,000	10,000	6,700
2.1	Lana`i City Govt/Comm & Inst/ Ltlnd/ Airport/Lana`i WWTP/Lana`i...	110,198	81,428	28,770	130,100	75,200	260,200	214,779	130,100	139,579
	Lana`i City Agriculture	8,179	6,044	2,135						
2.2	Lana`i City School Expansion	17,000	0	17,000		0	13,750	13,750	13,750	13,750
*2.3	Future Commercial & BCT	incl in 2.1	~	~				5,000	0	5,000
	Airport Improvements	6,840	0	6,840					0	0
3.0	**IRRIGATION GRID (Wells 2 & 4)**	**658,953**	**28,044**	**630,909**	**30,500**	**10,900**	**550000**	**642,000**	**519,500**	**631,100**
3.1	Agriculture	37,953	28,044	9,909	30,500	0	500000	500,000	469,500	500,000
	Agricultural Reserve	500,000		500,000						
3.2	Other Ag or Commercial Uses (included in forecasts above)				0	10,900	20000	20,000	20,000	9,100
**3.3	Additional Baseyard(2006) /Miki Basin Heavy Industrial(2009)	120,000	0	120,000	0	0	2000	120,000	2,000	120,000
***3.4	New Warehouse	1,000	0	1,000	0		1000		1,000	0
3.5	Future Use (included in forecasts above)	~	~	~	0	0	27000	2,000	27,000	2,000
									0	0
4.0	**KOELE PD: POTABLE (Wells 3, 6 & 8)**	**771,960**	**227,386**	**708,882**	**144,000**	**136,700**	**566400**	**593,200**	**422,400**	**456,500**
4.1	Koele PD Redevelopment Portion	102,000	0	102,000	0	0	102000	102,000	102,000	102,000
4.2	Koele PD-Hotel	35,700	35,700	0	36,600	30,000	51000	61,200	14,400	31,200
4.3	Koele PD-Hotel(Future)	52,850	0	52,850	0	0	74000	88,800	74,000	88,800
4.4	Koele PD-Hotel Irrigation	105,500	100,000	161,236	58,500	51,000	60000	58,800	1,500	7,800
4.5	Koele PD-Commercial (Tennis & Stables)	incl. in 4.2	~	~	2,700	1,400	12000	9,000	9,300	7,600
4.6	Koele Single Family	219,000	7,800	211,200	12,300	15,500	153000	153,000	140,700	137,500
4.7	Koele Multi-Family	87,360	19,600	67,760	13,500	20,600	54000	60,000	40,500	39,400
4.8	Koele Common Areas Irrigation	130,000	50,000	80,000	4,400	4,400	20000	20,000	15,600	15,600
4.9	Koele Parks (Future)	19,550	0	19,550	0	0	20400	20,400	20,400	20,400
4.10	Cavendish Golf Course & Maintenance	20,000	14,286	14,286	16,000	13,800	20000	20,000	4,000	6,200
									0	0
5.0	**KOELE PD / LANA`I CITY: WASTEWATER**	**303,749**	**224,447**	**79,302**	**199,000**	**222,200**	**256000**	**832,910**	**57,000**	**610,710**
5.1	Koele Golf Course Irrigation Effluent	303,749	224,447	79,302	199,000	222,200	256000	832,910	57,000	610,710

FIGURE 4-72. Compiled Analysis Continued

USAGE	CATEGORY	BUILD-OUT Estimate By Standards Review	Built-Out Already = EXST	Remaining	EXST 2006 ACTUAL OR ESTIMATE (GPD)	EXST 2009 ACTUAL OR ESTIMATE (GPD)	2006 BUILD-OUT TO 2030 20-YR (GPD)	2009 BUILDOUT TO 2030 20-YR (GPD)	2006 REMAINING	2009 REMAINING
6.0	**MANELE PD: POTABLE (Wells 2 & 4)**	**1,711,268**	**646,628**	**1,064,640**	**392,100**	**312,500**	**1,070,450**	**968,250**	**678,350**	**655,750**
6.1	Manele Hotel	87,500	87,500	0	**88,000**	63,500	150,000	150,000	62,000	86,500
6.2	Manele Hotel Irrigation	962,200	393,600	568,600	**179,000**	165,600	232,000	232,000	53,000	66,400
6.3	Manele Hotel (Future)	87,500	0	87,500	0	0	90,000	90,000	90,000	90,000
6.4	Manele Single Family Homes	169,200	9,600	159,600	0	**15,300**	120,000	120,000	120,000	104,700
6.5	Manele Multi-Family	103,040	38,640	64,400	**12,800**	9,800	90,000	90,000	77,200	80,200
6.6	Manele Co	31,500	21,179	10,321	**17,300**	0	51,250	51,250	33,950	51,250
6.7	Manele Utilities (WWTP & Lift Stations)	10,724	6,812	3,912	**12,900**	7,000	92,000	92,000	79,100	85,000
6.8	Manele Construction/Development	31,000	29,900	1,100	29,900	**30,000**	31,000	31,000	1,100	1,000
6.9	Manele Parks (Domestic use and Irrigation)	112,761	19,968	92,793	**23,000**	21,300	112,200	112,000	89,200	90,700
***6.10	Manele Public Use (per CCR. technically should be considered included)	102,000	29,200	72,800	29,200		102,000		72,800	0
	Manele Area Agricultural Use (uses forecast, no addt'l ag specifically planned)	13,843	10,229	3,614						
7.0	**MANELE PD: NON-POTABLE WATER (Wells 1, 9 & 14)**	**1,690,000**	**797,793**	**1,068,467**	**672,600**	**808,600**	**1,190,000**	**1,572,500**	**517,400**	**763,900**
7.1	Manele Single Family-Irrigation	600,000	4,800	771,460	**37,000**	33,700	500,000	500,000	463,000	466,300
7.2	Manele Multi-Family-Irrigation ! Based on 300 units. Only 184 apprvd. In PD.	360,000	107,475	252,525	86,100	**87,200**	360,000	360,000	273,900	272,800
7.3	Manele Common Areas Irrigation	80,000	80,000	0	40,400	**84,700**	40,000	**62,500**	-400	-22,200
7.4	Manele Golf Course Irrigation	650,000	605,518	44,482	509,100	**603,000**	290,000	**650,000**	-219,100	47,000
									0	0
8.0	**MANELE PD: WASTEWATER**	**98,711**	**72,940**	**25,771**	**80,800**	**78,200**	**360,000**	**375,938**	**279,200**	**297,738**
8.1	Manele Golf Course Irrigation Effluent	98,711	72,940	25,771	**80,800**	78,200	360,000	**375,938**	279,200	297,738
	RESOURCE RESERVE (600 Kgal recommended but not shown here.)									
	TOTAL	6,321,762	2,592,026	4,042,347	2,002,500	1,963,200	5,423,900	6,278,027	2,984,200	3,884,827
	without wastewater included	5,919,302	2,298,334	4,004,428	1,722,700	1,662,800	4,807,900	5,069,379	2,648,000	2,976,379
	Subtotal Pumped Fresh	4,229,302	1,496,846	2,368,807	1,050,100	854,200	3,617,900	3,496,679	2,130,600	2,212,479
	Subtotal Fresh Pumped Water With Losses	4,806,025	1,679,962	2,658,594	1,178,563	958,698	4,111,250	3,973,499	2,391,246	2,483,141
	Subtotal Pumped Brackish	1,690,000	797,793	1,068,467	672,600	808,600	1,190,000	1,572,500	517,400	763,900
	Subtotal Brackish Pumped Water w/Losses (CCR 10.9% 1st yr., calcs on lef	1,920,455	895,391	1,199,177	754,882	907,520	1,352,273	1,786,932	587,955	868,068
	PUMPED SUBTOTAL	5,919,302	2,294,639	3,437,274	1,722,700	1,662,800	4,807,900	5,069,179	2,648,000	2,976,379
	PUMPED SUBTOTAL with 12% Unaccounted-For Water	**6,726,480**	**2,575,352**	**3,857,771**	**1,933,446**	**1,866,218**	**5,463,523**	**5,760,431**	**2,979,200**	**3,351,210**
	Reclaimed	402,460	297,387	105,073	279,800	300,400	616,000	1,208,848	336,200	908,448
	Alternate Reclaimed Scenario - (not used in totals on this table)	1,151,359	307,033	844,326						
TOTAL PUMPED AND RECLAIMED w/losses - (No Unidentified Source On This Sprea		7,128,940	2,872,739	3,962,844	2,213,246	2,166,618	6,079,523	6,969,279	3,315,400	4,259,658

Demand Analysis

FIGURE 4-73. Forecasts Compared to Build-ouit

Well service areas - metered consumption - run seperately and combined

12% uafw added to service areas of wells 6 & 8. 15% uafw added to service areas of 2&4 and 1,9 & 14.

	Low Case			Base Case			High Case			Build
	Demand	Demand	Demand	Demand	Demand	Demand	Demand	Demand	Demand	Out
Year	Elas.=1	Elas.=1.5	Elas.=2	Elas.=1	Elas.=1.5	Elas.=2	Elas.=1	Elas.=1.5	Elas.=2	Analysis
2008	1,929,911	1,929,911	1,929,911	1,929,911	1,929,911	1,929,911	1,929,911	1,929,911	1,929,911	2,241,222
2009	1,954,850	1,967,440	1,980,111	1,960,067	1,975,321	1,990,694	1,972,499	1,994,145	2,016,027	2,297,769
2010	1,979,789	2,005,209	2,030,956	1,990,223	2,021,082	2,052,420	2,015,088	2,059,075	2,104,023	2,350,116
2011	2,010,216	2,051,613	2,093,863	2,023,427	2,071,871	2,121,474	2,065,612	2,137,000	2,210,855	2,639,032
2012	2,040,643	2,098,370	2,157,730	2,056,631	2,123,077	2,191,671	2,116,137	2,215,883	2,320,332	2,927,949
2013	2,071,071	2,145,477	2,222,555	2,089,835	2,174,699	2,263,010	2,166,661	2,295,714	2,432,454	3,216,865
2014	2,101,498	2,192,930	2,288,341	2,123,038	2,226,733	2,335,492	2,217,186	2,376,482	2,547,222	3,505,782
2015	2,131,925	2,240,729	2,355,086	2,156,242	2,279,175	2,409,116	2,267,710	2,458,174	2,664,636	3,794,698
2016	2,157,429	2,281,057	2,411,770	2,184,153	2,323,570	2,471,887	2,316,663	2,538,199	2,780,920	3,923,298
2017	2,182,933	2,321,625	2,469,128	2,212,063	2,368,250	2,535,466	2,365,616	2,619,074	2,899,688	4,051,898
2018	2,208,437	2,362,430	2,527,161	2,239,973	2,413,213	2,599,851	2,414,569	2,700,790	3,020,939	4,180,499
2019	2,233,941	2,403,472	2,585,867	2,267,884	2,458,457	2,665,044	2,463,522	2,783,339	3,144,674	4,309,099
2020	2,259,445	2,444,748	2,645,248	2,295,794	2,503,980	2,731,044	2,512,475	2,866,712	3,270,893	4,437,699
2021	2,288,500	2,492,056	2,713,718	2,326,672	2,554,666	2,805,002	2,569,050	2,964,082	3,419,856	4,616,509
2022	2,317,556	2,539,666	2,783,063	2,357,550	2,605,690	2,879,948	2,625,625	3,062,530	3,572,137	4,795,319
2023	2,346,611	2,587,575	2,853,283	2,388,428	2,657,049	2,955,882	2,682,200	3,162,045	3,727,735	4,974,130
2024	2,375,666	2,635,782	2,924,378	2,419,306	2,708,742	3,032,804	2,738,775	3,262,615	3,886,649	5,152,940
2025	2,404,721	2,684,284	2,996,348	2,450,184	2,760,765	3,110,714	2,795,350	3,364,229	4,048,881	5,331,750
2026	2,436,440	2,737,568	3,075,914	2,482,506	2,815,573	3,193,326	2,859,232	3,480,210	4,236,054	5,610,696
2027	2,468,158	2,791,200	3,156,522	2,514,827	2,870,738	3,277,019	2,923,114	3,597,494	4,427,457	5,889,643
2028	2,499,877	2,845,177	3,238,173	2,547,149	2,926,259	3,361,796	2,986,997	3,716,067	4,623,090	6,168,589
2029	2,531,596	2,899,498	3,320,867	2,579,470	2,982,134	3,447,655	3,050,879	3,835,915	4,822,951	6,447,536
2030	2,563,314	2,954,161	3,404,603	2,611,792	3,038,360	3,534,597	3,114,762	3,957,024	5,027,041	6,726,482

Note: this is re-analysis of build-out pumpage from the proposal - but is NOT the build-out plus scenario

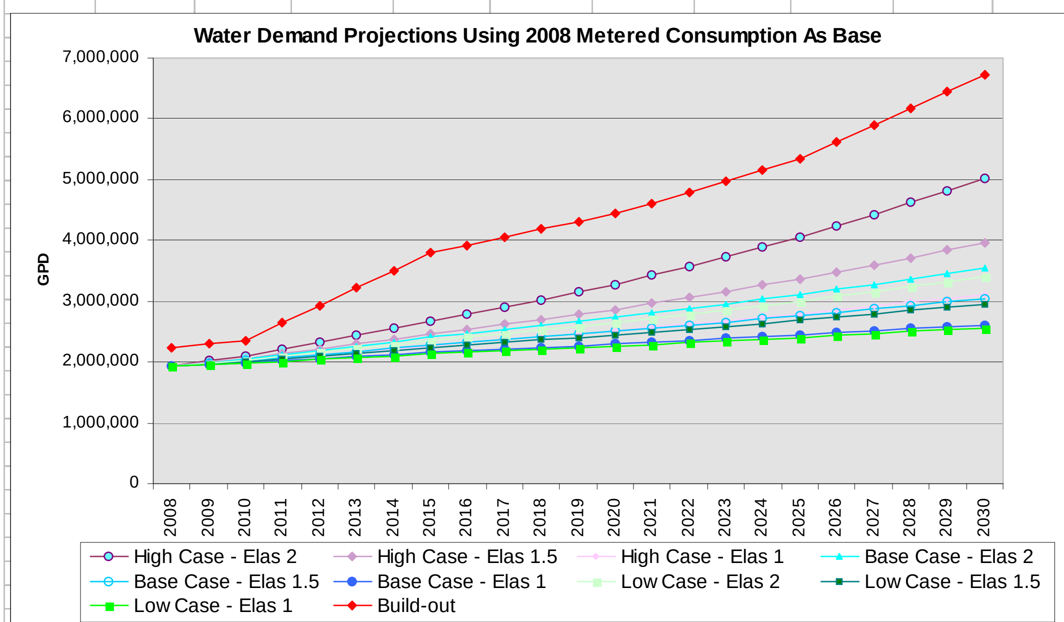


FIGURE 4-74. Build-out Analysis By 5 Year Increments

	Use Per Standards	Existing Units	Existing Demand	2015	2015 Demand	2020	2020 Demand	2025	2025 Demand	2030	2030 Demand	2030 PD Not in Proposal	2030 Demand w/ PD Not in Proposal
LANA`I CITY RESIDENTIAL (Wells 3, 6 & 8)			**361,127**		**521,072**		**636,560**		**743,910**		**851,060**		**923,787**
Lana`i City Residential - Existing		1,062	268,127	1,062	299,572	1,062	318,960	1,062	340,410	1,062	362,860		362,862
Lana`i City Residential -New/Future		0		100		493		534		712			
Country Lana`i City Recreation Area	1,700	8	13,600	8	13,600	8	13,600	8	13,600	8	13,600		13,600
Affordable Housing Property (Future)	600	0	0	100	60,000	146	87,600	220	132,000	292	175,200		257,025
DHHL Property	600	0	0	75	45,000	150	90,000	187	112,200	225	135,000		125,900
Kaumulapau Subdivision	600	0	0	15	9,000	30	18,000	38	22,800	45	27,000		27,000
Lana`i City Redevelopment Project			79,400		93,900		108,400		122,900		137,400		137,400
LANA`I CITY NON-RESIDENTIAL + CAVENDISH (Wells 3,6 & 8)			**120,076**		**133,875**		**143,038**		**152,994**		**163,336**		**163,336**
Kaumulapau Harbor		14,058	15,604		17,434		18,562		19,811		21,119		21,119
Lana`i City Govt/Comm & Inst/ Ltlnd/ Airport/Lana`i WWTP etc.			81,428		90,978		96,866		103,380		110,198		110,198
Lana`i City Area Agriculture			6,044		6753		7190		7673		8179		8,179
Lana`i City School Expansion	1,700	10	17,000	10	17,000	10	17,000	10	17,000	10	17,000		17,000
Future Commercial & BCT - All Other													
Airport Improvements			0		1,710		3,420		5,130		6,840		6,840
IRRIGATION GRID (Wells 2 & 4)			**528,044**		**592,333**		**659,361**		**656,604**		**658,953**		**658,953**
Agriculture			28,044		31,333		38,361		35,604		37,953		37,953
Agriculture Reserve	set	500,000	500,000		500,000		500,000		500,000		500,000		500,000
Other Ag or Commercial Uses													
Miki Basin Heavy Industrial Baseyard (2009)	6,000	0	0	10	60,000	20	120,000	20	120,000	20	120,000		120,000
New Warehouse	1000	0	0	1	1,000	1	1,000	1	1,000	1	1,000	1	1,000
Future Use		0	0		0		0		0		0		0
KOELE PD: POTABLE (Wells 3, 6 & 8)			**243,056**		**357,010**		**506,500**		**542,500**		**583,300**		**771,960**
Koele PD Redevelopment Portion	600	0	0	120	72,000	145	87,000	157	94,200	170	102,000	170	102,000
Koele PD-Hotel	350	102	35,700	102	35,700	102	35,700	102	35,700	102	35,700	102	35,700
Koele PD-Hotel(Future)	350	0	0	0	0	148	51,800	148	51,800	148	51,800	151	52,850
Koele PD-Hotel Irrigation	5,000	20	100,000	20	100,000	20	100,000	20	100,000	20	100,000	21	105,500
Koele PD-Commercial (Tennis & Stables)	incl	1											
Koele Single Family	600	14	8,400	52	31,200	152	91,200	200	120,000	255	153,000	365	219,000
Koele Multi-Family	560	27	15,120	51	28,560	90	50,400	90	50,400	90	50,400	156	87,360
Koele Common Areas Irrigation	5,000	10	50,000	10	50,000	10	50,000	10	50,000	10	50,000	26	130,000
Koele Parks (Future)	1,700	12	19,550	12	19,550	12	20,400	12	20,400	12	20,400	12	19,550
Cavendish Golf Course & Maintenance			14,286		20,000		20,000		20,000		20,000		20,000
KOELE PD/LANA`I CITY: WASTEWATER			**224,447**		**250,769**		**266,999**		**284,954**		**303,749**		**303,749**
Koele Golf Course Irrigation Effluent			224,447		250,769		266,999		284,954		303,749		303,749

FIGURE 4-74. Build-out Analysis By 5 Year Increments Continued

	Use Per Standards	Existing Units	Existing Resulting Flows	2015	2015 Resulting Flows	2020	2020 Resulting Flows	2025	2025 Resulting Flows	2030	2030 Resulting Flows	2030 Incl. Entitled	2030 Resulting Flows
D: POTABLE (Wells 2 & 4)			**519,241**		**645,644**		**749,716**		**1,130,932**		**1,252,267**		**1,711,268**
el	350	250	87,500	250	87,500	250	87,500	250	87,500	250	87,500	250	87,500
el Irrigation *	17,000	17	282,540	17	289,000	17	289,000	29	493,000	29	493,000	57	962,200
el (Future)	350	0	0	0	150	57	19,810	150	52,500	150	52,500	250	87,500
gle Family Homes	600	16	9,600	63	37,800	100	60,000	150	90,000	200	120,000	282	169,200
lti-Family	560	51	28,560	112	62,720	150	84,000	175	98,000	300	168,000	184	103,040
nmercial	6,000	5	31,500	5	30,000	7	42,000	9	54,000	10	61,500	5	31,500
ities (WWTP & Lift Stations)			6,812		8,045		8,838		9,745		10,724	0	10,724
nstruction/Development			29,900		31,000		31,000		31,000		31,000	0	31,000
ks (Domestic use and Irrigation)	1,700	2	3,400	20	34,000	22	37,400	66	112,200	66	112,200	66	112,761
olic Use			29,200		54,000	0	78,000	0	90,000		102,000	0	102,000
a Agriculture			10,229		11,429		12,168		12,987		13,843		13,843
D: NON-POTABLE WATER (Wells 1, 9 & 14)			**796,558**		**1,089,400**		**1,210,000**		**1,465,000**		**1,690,000**		**1,690,000**
gle Family-Irrigation	3,000	16	48,000	75	225,000	100	300,000	175	525,000	200	600,000	200	600,000
lti-Family-Irrigation	1,200	51	61,200	112	134,400	150	180,000	175	210,000	300	360,000	300	360,000
nmon Areas Irrigation	5,000	16	81,840	16	80,000	16	80,000	16	80,000	16	80,000	16	80,000
f Course Irrigation			605,518	650,000	650,000		650,000		650,000		650,000		650,000
D: WASTEWATER			**72,940**		**81,494**		**86,768**		**92,603**		**98,711**		**98,711**
f Course Irrigation Effluent		Current	72,940		81,494		86,768		92,603		98,711		98,711
E RESERVE			**600,000**		**600,000**		**600,000**		**600,000**		**600,000**		**600,000**
	Suggested		600,000		600,000		600,000		600,000		600,000		600,000
TOTAL			**3,465,489**		**4,271,597**		**4,858,942**		**5,669,497**		**6,201,376**		**6,921,764**
LESS EFFLUENT & RESERVES = PUMPED WATER			**2,068,102**		**3,339,334**		**3,905,175**		**4,691,940**		**5,198,916**		**5,919,304**
MPED WATER WITH ASSUMED 12% UAFW			**2,350,116**		**3,794,698**		**4,437,699**		**5,331,750**		**5,907,859**		**6,726,482**
				WELLS WITH LOSSES		WELLS WITH LOSSES		WELLS WITH LOSSES		WELLS WITH LOSSES		WELLS WITH LOSSES	
WELLS 2 & 4 SERVICE AREA			1,047,285	1,190,097	1,237,977	1,406,792	1,396,909	1,587,397	1,787,536	2,031,291	1,911,220	2,171,841	2,370,221
WELLS 6 & 8 SERVICE AREA			724,259	823,022	1,011,957	1,149,951	1,286,098	1,461,475	1,439,404	1,635,686	1,597,696	1,815,564	1,859,083
WELLS 1, 9 & 14 SERVICE AREA			796,558	905,180	1,089,400	1,237,955	1,210,000	1,375,000	1,465,000	1,664,773	1,690,000	1,920,455	1,690,000
WASTEWATER - using projection coefficients			**297,387**		**332,263**		**353,767**		**377,557**		**402,460**		**402,460**
WASTEWATER - using per-unit calculations (not used)			307,033		511,439		877,224		984,984		1,125,053		1,551,359
AGRICULTURAL RESERVE			500,000		500,000		500,000		500,000		500,000		500,000
RESOURCE RESERVE			600,000		600,000		600,000		600,000		600,000		600,000
L - Pumped with UAFW, Plus Effluent and Reserves			2,647,503		4,126,961		4,791,466		5,709,307		6,310,319		7,128,942

FIGURE 4-75. Differences Between Proposal Build-out and Compiled Build-out

	2030	2030 Demand	2030 PD Not in Proposal	2030 Demand w/ PD Not in Proposal	Basis / Notes
LANA`I CITY RESIDENTIAL (Wells 3, 6 & 8)		**851,060**		**923,787**	
Lana`i City Residential - Existing	1,062	362,860		362,862	forecast coefficients using LCTY+KPAU res demand. elas. = 1
Lana`i City Residential -New/Future	712				already included in forecast coefficients above.
Country Lana`i City Recreation Area	8	13,600		13,600	1,700 is per unit standard, vs. 1,375/ac proposed by CCR.
Affordable Housing Property (Future)	292	175,200		257,025	per unit standards. staff planner estimate from updated submitta
DHHL Property	225	135,000		125,900	per unit standards staff est. was 125,900. close enough.
Kaumulapau Subdivision	45	27,000		27,000	per unit standards. however, CCR est of 1,000 per unit is probably closer at this elevation.
Lana`i City Redevelopment Project		137,400		137,400	Discrepancies btwn. County & CCR records could not be resolved as of this draft. Assumes 201 SF & 30 MF remain.
LANA`I CITY NON-RESIDENTIAL + CAVENDISH (Wells 3,6 & 8)		**163,336**		**163,336**	
Kaumulapau Harbor		21,119		21,119	forecast coefficient for non-res uses in KPAU.
Lana`i City Govt/Comm & Inst/ Ltlnd/ Airport/Lana`i WWTP/Lana`i...		110,198		110,198	forecast coefficient all LCTY except res. Kpau already above.
Lana`i City Area Agriculture		8179		8,179	forecast coefficients on existing ag metered amount
Lana`i City School Expansion	10	17,000		17,000	per-acre standards.
Future Commercial & BCT - All Other					included in forecast above, two lines up.
Airport Improvements		6,840		6,840	techincally incl. in forecast above, two lines up. exist=o not to double count. assumed continuous growth.
IRRIGATION GRID (Wells 2 & 4)		**658,953**		**658,953**	
Agriculture		37,953		37,953	forecast coefficent on existing ag use.
Agriculture Reserve		500,000		500,000	agricultural reserve approved by committee.
Other Ag or Commercial Uses					already included in forecasts above.
Miki Basin Heavy Industrial Baseyard (2009)	20	120,000		120,000	per acre standards. Outdoor uses may be met by reclaimed.
New Warehouse	1	1,000	1	1,000	lump sum per CCR proposal.
Future Use		0		0	not tallied here. included above.
KOELE PD: POTABLE (Wells 3, 6 & 8)		**583,300**		**771,960**	
Koele PD Redevelopment Portion	170	102,000	170	102,000	per unit standards. assumes this is part of PD SF allowance.
Koele PD-Hotel	102	35,700	102	35,700	per unit standards.
Koele PD-Hotel(Future)	148	51,800	151	52,850	per unit standards. PD allows 253 rooms. prop is for 250.
Koele PD-Hotel Irrigation	20	100,000	21	105,500	which is 51,800.
Koele PD-Commercial (Tennis & Stables)					not tallied seperately. should be included in above.
Koele Single Family	255	153,000	365	219,000	per unit standards. proposal totals 425 SF units. PD allows max of 535 SF units.
Koele Multi-Family	90	50,400	156	87,360	per unit standards. PD allows 156 MF units. Prop is for 90.
Koele Common Areas Irrigation	10	50,000	26	130,000	per acre standards.not clear why common area irrigation is needed in addition to MF, Hotel & SF irrigation. Should be included already. may be double-counting. this is true in both PDs.
Koele Parks (Future)	12	20,400	12	19,550	per acre standards. 11.5 ac park x 1,700 gp/ac.
Cavendish Golf Course & Maintenance		20,000		20,000	actual rounded up as per CCR proposal.
KOELE PD/LANA`I CITY: WASTEWATER		**303,749**		**303,749**	
Koele Golf Course Irrigation Effluent		303,749		303,749	Forecast coefficients on 2008 AWTF Production. (vs deliveries)

FIGURE 4-75. Differences Between Proposal Build-Out and Compiled Build-Out Continued

	2030	2030 Demand	2030 PD Not in Proposal	2030 Demand w/ PD Not in Proposal	Basis / Notes
MANELE PD: POTABLE (Wells 2 & 4)		**1,238,424**		**1,711,268**	
Manele Hotel	250	87,500	250	87,500	per unit standards. - in last column rooms included in per-acre
Manele Hotel Irrigation	29	493,000	57	962,200	normally exceeds actual use, and includes irrigation,
Manele Hotel (Future)	150	52,500	250	87,500	PD allows 500 HOT units. Note that per-acre hotel standard
Manele Single Family Homes	200	120,000	282	169,200	per unit standards. PD allows 282 SF units. Prop is for 200.
Manele Multi-Family	300	168,000	184	103,040	per unit standards. PD allows 184 MF units. Prop is for 300.
Manele Commercial	10	61,500	5	31,500	use. PD only has 5.25 acres of commercial.
Manele Utilities (WWTP & Lift Stations)		10,724	0	10,724	forecast coefficients on actual would run 6,812 existing to 10,7
Manele Construction/Development		31,000	0	31,000	lump sum estimate per CCR proposal.
Manele Parks (Domestic use and Irrigation)	66	112,200	66	112,761	per acre standards. PD ord. has 66.33 acres park.
Manele Public Use		102,000	0	102,000	lump sum estimate per CCR proposal. Included in park or PQP
					PQP (public-quasi public) only 2 acres in Project District.
Manele Area Agriculture		13,843		13,843	forecast coefficients on existing ag amount
MANELE PD: NON-POTABLE WATER (Wells 1, 9 & 14)		**1,690,000**		**1,690,000**	
Manele Single Family-Irrigation	200	600,000	200	600,000	one from the other. the proposal allows for both, double
Manele Multi-Family-Irrigation	300	360,000	300	360,000	within county per-acre standards. But proposal adds per-unit
Manele Common Areas Irrigation	16	80,000	16	80,000	needed in addition to MF, Hotel & SF irrigation. Should be
Manele Golf Course Irrigation		650,000		650,000	actual total pumpage and project condition restrictions.
					actual gc irrigation is 596,009. +9,509 for clbhs & maint. bldg.
MANELE PD: WASTEWATER		**98,711**		**98,711**	
Manele Golf Course Irrigation Effluent		98,711		98,711	
RESOURCE RESERVE		**600,000**		**600,000**	
		600,000		600,000	
TOTAL		**6,187,533**		**6,921,764**	
LESS EFFLUENT & RESOURCE RESERVE = PUMPED WATER		5,185,073		5,919,304	for all but present, ag reserve is assumed to be pumping
PUMPED WATER WITH ASSUMED 12% UAFW		**5,892,128**		**6,726,482**	**UNLESS WASTEWATER DID MEET STANDARDS**
			WELLS WITH LOSSES		WELLS WITH LOSSES
WELLS 2 & 4		1,897,377	2,156,110	2,356,378	2,677,702
WELLS 6 & 8		1,597,696	1,815,564	1,859,083	2,112,594
WELLS 1, 9 & 14		1,690,000	1,920,455	1,690,000	1,920,455
WASTEWATER		**402,460**		**402,460**	**uses forecast coefficients**
PER UNIT WASTEWATER ALTERNATIVE CALC		1,125,053		1,551,359	uses per-unit standards at proposed build-out rates.
AGRICULTURAL RESERVE		500,000		500,000	
RESOURCE RESERVE		600,000		600,000	
		6,294,588		7,128,942	

Build-Out Analysis

FIGURE 4-76. Phase II Approvals Build-out.

	Use Per Standards	Phase II Units	Forecast Growth Plus Phase II GPD	Forecast Growth Plus Phase II GPD with UAFW 12% LCTY,KOPD,KPAU 15% MNPD, IGGP
LANA`I CITY RESIDENTIAL (Wells 3, 6 & 8)			**923,427**	**1,049,349**
Lana`i City Residential - Existing	existing	1,062	268,127	304,690
Lana`i City Residential -New/Future	orecast add't'l	0	94,375	107,244
Country Lana`i City Recreation Area	1,700	8	13,600	15,455
Affordable Housing Property (Future)	600	0	257,025	292,074
DHHL Property	600	0	125,900	143,068
Kaumulapau Subdivision	600	0	27,000	30,682
Lana`i City Redevelopment Project			137,400	156,136
LANA`I CITY NON-RESIDENTIAL + CAVENDISH (Wells 3,6 & 8)			**163,336**	**185,609**
Kaumulapau Harbor		14,058	21,119	23,999
Lana`i City Govt/Comm & Inst/ LtInd/ Airport/Lana`i WWTP/Lana`i...			110,198	125,225
Lana`i City Area Agriculture			8179	9,294
Lana`i City School Expansion	1,700	10	17,000	19,318
Future Commercial & BCT - All Other				0
Airport Improvements			6,840	7,773
IRRIGATION GRID (Wells 2 & 4)			**658,953**	**809,671**
Agriculture			37,953	44,651
Agriculture Reserve	set	500,000	500,000	588,235
Other Ag or Commercial Uses				34,432
Miki Basin Heavy Industrial Baseyard (2009)	6,000	0	120,000	141,176
New Warehouse	1000	0	1,000	1,176
Future Use		0	0	0
Reclaimed Water from Lana`i City to Palawai Grid				
Reclaimed Water from Lana`i City to Palawai Grid			see below	see below
KOELE PD: POTABLE (Wells 3, 6 & 8)			**330,936**	**376,064**
Koele PD Redevelopment Portion	600	0	0	0
Koele PD-Hotel	350	102	35,700	40,568
Koele PD-Hotel(Future)	350	0	0	0
Koele PD-Hotel Irrigation	5,000	20	100,000	113,636
Koele PD-Commercial (Tennis & Stables)	incl	1		0
Koele Single Family	600	125	75,000	85,227
Koele Multi-Family	560	65	36,400	41,364
Koele Common Areas Irrigation *	5,000	10	50,000	56,818
Koele Parks (Future)	1,700	12	19,550	22,216
Cavendish Golf Course & Maintenance			14,286	16,234
KOELE PD/LANA`I CITY: WASTEWATER			**316,798**	**316,798**
Koele Golf Course Irrigation Effluent			316,798	316,798

FIGURE 4-77. Phase II Approvals Build-out Continued

	Use Per Standards	Phase II Units	Forecast Growth Plus Phase II GPD	Forecast Growth Plus Phase II GPD with UAFW 12% LCTY,KOPD,KPAU
MANELE PD: POTABLE (Wells 2 & 4)			**641,767**	**755,020**
Manele Hotel	350	250	87,500	102,941
Manele Hotel Irrigation *	17,000	17	282,540	332,400
Manele Hotel (Future)	350	0	0	0
Manele Single Family Homes	600	161	96,600	113,647
Manele Multi-Family	560	101	56,560	66,541
Manele Commercial	6,000	5	31,500	37,059
Manele Utilities (WWTP & Lift Stations)			10,724	12,616
Manele Construction/Development			29,900	35,176
Manele Parks (Domestic use and Irrigation)	1,700	2	3,400	4,000
Manele Public Use			29,200	34,353
Manele Area Agriculture			13,843	16,286
MANELE PD: BRACKISH WATER (Wells 1, 9 & 14) & RECLAIMED WATER			**1,336,040**	**1,571,812**
Manele Single Family-Irrigation*	3,000	161	483,000	568,235
Manele Multi-Family-Irrigation*	1,200	101	121,200	142,588
Manele Common Areas Irrigation*	5,000	16	81,840	96,282
Manele Golf Course Irrigation			650,000	764,706
Manele PD: Wastewater				
Manele Reclaimed Water			see below	see below
Lana`i City Reclaimed Water sent to Manele			see below	see below
RESOURCE RESERVE			**600,000**	**600,000**
	Suggested		600,000	600,000
TOTAL WATER DEMAND AND RESERVATION			4,971,257	5,664,322
LESS RESOURCE RESERVE ONLY			4,371,257	5,064,322
RECLAIMED WATER LANA`I CITY			501,464	501,464
RECLAIMED WATER MANELE			119,507	119,507
;S EFFLUENT & RESERVES = PUMPED BEFORE CONSRV.			3,750,286	4,443,351
CONSERVATION TARGET - FRESH			402,000	402,000
CONSERVATION TARGET - BRACKISH			83,000	83,000
PUMPED WATER WITH ASSUMED UAFW	**After Conservation**		**3,265,286**	**3,958,351**
WELLS 2 & 4			943,720	1,207,691
WELLS 6 & 8			995,901	1,506,022
WELLS 1, 9 & 14			**1,008,867**	**1,244,639**
* Further adjustments need to be made to bring pumpage in this well service area down				
check well subtotal			2,948,488	3,958,351
ESTIMATED RECLAIMED USE			620,971	620,971
FURTHER REDUCTION - DESALINIZATION				300,000
AGRICULTURAL RESERVE			500,000	588,235
RESOURCE RESERVE			600,000	600,000

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 tables 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.

Details regarding the development of the resource develompent strategy water use tables are listed on the pages following the tables.

FIGURE 4-78. Base Case Resource Development Strategy Water Use Table (1 of 3)

RESOURCE DEVELOPMENT STRATEGY - SOURCE USE TO THE YEAR 2030

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

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

FIGURE 4-79. Base Case Resource Development Strategy Water Use Table (2 of 3)

RESOURCE DEVELOPMENT STRATEGY - SOURCE USE TO THE YEAR 2030

	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
Total Needed from Conservation		baseline existing	35,150	369,800	403,600	447,400	485,000	485,000
Breakdown by Source of Water								
Subtotal Potable		1,097,143	1,710,094	1,530,366	1,811,265	2,105,671	2,379,971	2,713,712
Subtotal Brackish		894,538	762,634	813,191	849,091	890,285	920,220	944,639
Subtotal Reclaimed		307,033	338,697	343,048	365,246	389,809	475,509	620,971
Subtotal Conservation		0	35,150	369,800	403,600	447,400	485,000	485,000
Subtoal Desalt		0	0	0	0	0	0	300,000
Check - Subtotal Source Requirement		2,298,713	2,846,576	3,056,405	3,429,203	3,833,164	4,260,700	5,064,322
Resource Reserve		600,000	600,000	600,000	600,000	600,000	600,000	600,000
Subtotal All Including Reserves		2,898,713	3,446,576	3,656,405	4,029,203	4,433,164	4,860,700	5,664,322
Breakdown by Water District								
Koele PD		403,557	446,259	464,556	512,286	554,221	598,724	704,805
Lanai City & Related Areas		424,560	467,422	604,154	895,876	1,069,155	1,186,079	1,223,015
Irrigation Grid / Palawai		61,771	654,580	624,960	627,654	637,854	792,655	793,087
Manele PD		1,408,826	1,278,315	1,362,735	1,393,387	1,571,935	1,683,242	2,343,415
General Island - Potable Resource Reserve		600,000	600,000	600,000	600,000	600,000	600,000	600,000
Check - Total		2,898,713	3,446,576	3,656,405	4,029,203	4,433,164	4,860,700	5,664,322
PUMPED ONLY Breakdown by Well Service Area								
Wells 6 & 8 Service Area (LCTY, KPAU, KOPD)		594,024	649,696	715,958	1,033,885	1,225,771	1,363,005	1,506,022
Wells 2 & 4 Service Area (MNPD, IGGP)		503,145	1,060,424	814,435	777,406	879,926	1,016,966	1,207,690
Wells 1, 9 & 14 Service Area (Brackish MNPD)		894,538	762,634	813,191	849,091	890,285	920,220	944,639
SUBTOTAL PUMPED		**1,991,706**	**2,472,754**	**2,343,583**	**2,660,383**	**2,995,981**	**3,300,191**	**3,658,351**

FIGURE 4-80. Base Case Resource Development Strategy Water Use Table (3 of 3)

RESOURCE DEVELOPMENT STRATEGY - SOURCE USE TO THE YEAR 2030

	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
Breakdown by Water District and Source of Water								
Koele PD		**403,557**	**446,259**	**464,556**	**512,286**	**554,221**	**598,724**	**704,805**
Potable		169,464	185,149	157,403	185,909	206,816	229,426	335,507
Brackish		234,093	258,235	261,552	278,477	297,204	316,798	316,798
Reclaimed								
Conservation			2875	45600	47900	50200	52500	52500
Koele PD - Check		*403,557*	*446,259*	*464,556*	*512,286*	*554,221*	*598,724*	*704,805*
Lana`i City & Related Areas		**424,560**	**467,422**	**604,154**	**895,876**	**1,069,155**	**1,186,079**	**1,223,015**
Potable		424,560	464,547	558,554	847,976	1,018,955	1,133,579	1,170,515
Brackish								
Reclaimed								
Conservation			2,875	45,600	47,900	50,200	52,500	52,500
Unidentified Alternate Source								
Lanai City Check		*424,560*	*467,422*	*604,154*	*895,876*	*1,069,155*	*1,186,079*	*1,223,015*
Irrigation Grid / Palawai		**61,771**	**654,580**	**624,960**	**627,654**	**637,854**	**792,655**	**793,087**
Potable		61,771	654,580	624,960	627,654	637,854	732,655	733,087
Brackish								
Reclaimed								60,000
Conservation								
Unidentified Alternate Source								
IGGP Check		*61,771*	*654,580*	*624,960*	*627,654*	*637,854*	*732,655*	*793,087*
Manele PD		**1,408,826**	**1,278,315**	**1,362,735**	**1,393,387**	**1,571,935**	**1,683,242**	**2,343,415**
Potable		441,348	405,819	189,448	149,726	242,046	284,311	474,603
Brackish		650,000	650,000	650,000	650,000	650,000	650,000	650,000
Brackish Beyond 650,000		244,538	112,634	163,191	199,091	240,285	270,220	294,639
Reclaimed from Manele Plant		72,940	80,462	81,496	86,769	92,605	98,711	119,507
Conservation		0	29,400	278,600	307,800	347,000	380,000	380,000
Reclaimed from Lana`i City Plant		0	0	0	0	0	0	124,666
Desalinization Plant								300,000
Manele Check		*1,408,826*	*1,278,315*	*1,362,735*	*1,393,387*	*1,571,935*	*1,683,242*	*2,343,415*
Potable Resource Reserve (half in each aquifer system)		**600,000**	**600,000**	**600,000**	**600,000**	**600,000**	**600,000**	**600,000**
Check Totals		**2,898,713**	**3,446,576**	**3,656,405**	**4,029,203**	**4,433,164**	**4,860,700**	**5,664,322**

Base Case Resource Development Strategy Water Use Table Footnotes

*** This method is adapted from the SES forecast analysis with base year 2008 at base case with elasticity of 1.5 forecast growth factors applied to present consumption.

** The last column totaling 5,664,332 corresponds to the last column in Figure 4-79, on pages 4-111 to 4-112. .

a . Present Source Requirement Although actual pumped is 2,241,222 this is due to high system losses, especially in the service areas of wells 2 and 4. For purposes of present source use with targeted capacity, 12% is seen as a realistic goal for the areas of Koele, Lana`i City and Kaumalapau, while 15% is seen as more realistic for the brackish system, and the service area of wells 2 & 4, which include potable Manele service and the Palawai Irrigation Grid

Estimated amounts use base case escalation factors with an elasticity of 1.5, except for brackish, which is targeted for reduction, and reclaimed as people are not likely to generate more waste.

Given that reduction of per-unit use in landscape irrigation is one goal of this plan, for brackish water, estimated demand is escalated using base case escalation factors with an elasticity of 1.

Reclaimed water is also escalated at an elasticity of 1, except in the last column, where it is estimated for build-out of Phase II.

b. 2010 Source use in 2010 reflects the following considerations:

Forecast used 2008 calendar year consumption, and escalated at elasticity of 1.5.

15% system losses were assumed for Manele and the Palawai Irrigation Grid. 12% system losses were assumed for Lana`i City and Koele.

Conservation measures assumed to be implemented during the 20+ year planning period include Palawai Grid Pipe Replacement; Toilet, fixture and appliance replacement program; Landscape Conservation; Cover on 15 MG brackish reservoir; Leak detection program and annual water audit; Hotel incentives program; Tiered rate structure, and other measures. Some of these measures are set for given dates, others are expected to roll in over the planning period, still others may be more effective if implemented early in one sweep, rather than roll-in, but are assumed to roll-in to allow some flexibility for implementation. In either case, the documented savings is intended to meet or exceed the target for that period.

Wherever conservation savings are anticipated, the total demand for fresh or brackish water, as indicated, is decreased by the amount shown.

Ultimate estimated conservation targets are as follows:

Lana`i City and Koele - Fresh - 80,000 + 11,000 + 12,000 + 2,000 = 105,000 reflecting fixture replacements, landscape conservation, leak detection and repair and hotel & landscape incentives programs

Manele and Palawai - Fresh - 200,000 + 50,000 + 20,000 + 15,000 + 12,000 = 297,000 reflecting Palawai Grid Pipe Replacement, landscape conservation, fixture replacement program, leak detection and repair, hotel & landscape incentives programs

Manele and Palawai - Brackish - 50,000 + 14,000 + 13,000+ 6000 = 83,000 reflecting landscape conservation, cover of brackish reservoir, leak detection and repair and landscape incentive programs

By the end of 2010, the following measures are assumed to have at least commenced - leak detection, water audit, and landscape conservation

Also within 2010, the hypalon cover for the brackish reservoir is assumed to have been installed.

c. 2015 Source use in 2015 reflects the following considerations:

By 2015, the Palawai Grid Pipe replacement is assumed to be installed. Estimated savings are 200,000 in the Palawai Grid/Manele area. Success can be evaluated by UAFW analysis.

By 2015, fixture replacement in the areas of Lana`i City and Koele is assumed to have been completed, whether or not all fixtures in Manele and Palawai are done at the same time, for a minimum savings of 100,000 GPD island wide.

Leak detection and repair, water audit, landscape conservation and incentive programs are assumed to be ongoing since 2010, and to roll in over the planning period.

d. 2020: Assumptions include:

By 2020 - plans to distribute withdrawals away from the leeward aquifer should be well along.

At this point - Palawai Grid Repair, 15 MG Reservoir Cover, Island-wide fixture and appliance replacement are in place. Leak detection and repair, landscape conservation and incentive programs are ongoing.

Conservation savings continue to roll in as more leaks are found or incentives offered, etc.

Management measures inside all Lana`i Hale fence increments should be resulting in lower animal head counts within the Hale. This can be measured by resuming regular survey of animal counts in the fenced area.

e. 2025: Assumptions include:

Before pumpage reaches 2.7 MGD, there must be a pumping well or wells in the windward aquifer

At this point - Palawai Grid Repair, 15 MG Reservoir Cover, Island-wide fixture and appliance replacement are in place. Leak detection and repair, landscape conservation and incentive programs are ongoing.

Conservation savings continue to roll in as more leaks are found or incentives offered, etc.

f. 2030: Assumptions include:

Landscape conservation implementation should have brought overall irrigation down by at least 111,000 gpd.

Incentive programs should have saved another 20,000 GPD at hotels, large landscapes and commercial properties.

Leak detection and repair should have saved another 40,000 GPD across the island.

CHAPTER 5

Supply Options

In This Chapter

Key Points

- This chapter discusses measures to provide for the range of projected demands identified in the *Demand Analysis* chapter. To meet reliability standards and serve the base case growth forecast, Lana‘i would require about 2.93 MGD in additional capacity by 2030. To meet reliability standards for build-out plus entitlements, 12.15 MGD in new capacity would be required.

- A list of potential supply options sufficient to meet either the high or low end of the forecast ranges is delineated and characterized, with some analysis of life cycle resource costs. A rough estimate of cost recovery requirements is provided for each scenario.

  New source options considered 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 and Demand Side Efficiency Options include:

- Loss Reduction - Repair of Palawai Grid Pipes
- Loss Reduction - Cover for the 15 MG Brackish Reservoir
    - Floating Cover
    - Aluminum Cover
    - Hypalon Balls
- Expanded use of Lana‘i City Reclaimed Water
    - Lana‘i City to Miki Basin
    - Lana‘i City to Manele
    - Lana‘i City to Manele via Miki Basin
- Various General Demand Side Management (DSM) Programs
    - Fixture replacements of toilets, showerheads, faucets, etc.
    - Replacements of appliances such as dishwashers, clothes washers, etc.
    - Landscape efficiency items: climate adapted-plants, moisture sensors, rain shut-offs, etc.

- A number of conservation options targeted to the largest user types on Lana‘i are discussed in the text.
- A list of system needs is developed costed and characterized, including source development, pipe replacements, storage improvements, pump improvements, needs for monitoring and telemetry, etc. These total roughly $100 million dollars for build-out or $10.4 million to meet base case forecasts.
- The proposed capital plan includes funds for approximately 485,00 GPD in potential efficiency savings, which are identified throughout the text and compiled in Figure 5-55 on page 5-85.
- Capital needs are converted to rough 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 May 2009 draft and March, 2010 *Lana‘i Water System Acquisition Appraisal.*
- To meet these capital needs, bi-monthly charges, water rates and new meter fees are developed and presented. Several potential rate designs are included. All have been tested against 2008 billing data.
- A basic source plan is presented on page 5-85. This plan is tied to demand triggers, rather than dates.

Installed Capacity Requirements

Source requirements were discussed in the *Demand Analysis* chapter of this document. Source requirements refer to the amount of water needed to meet demands plus seasonal and diurnal fluctuations, accounting for anticipated system losses.

For developing a capital plan, not only source requirements, but also installed capacity requirements must be considered. Installed capacity requirements are essentially source requirements plus sufficient additional capacity to meet infrastructure standards for redundancy and reliability.

According to *System Standards (Water System Standards*, State of Hawaii, 2002), wells should be designed to be able to meet maximum day demand (defined as 1.5 times average demand), in 16 hours pumping, with the largest pump out of service. In effect, this means that sufficient capacity should be installed to meet about 225% of average day withdrawals, or that any given installed source or set of sources should be assumed to utilize roughly 45% of its total installed capacity. In addition, the count of wells available to serve each area should be sufficient that wells can meet these requirements with the largest one out of service.

To derive installed capacity requirements, the starting source requirements selected were based upon actual metered demands plus an “industry-standard” assumed percent for system losses, as escalated either in the base case forecast scenario or the build-out scenario. To start, these demands were broken down by the three well service areas on the island, i.e. into: demands for the area served by Wells 6 & 8; demands for the area served by Wells 2 & 4; and demands for the area served by Wells 1, 9 & 14. Beginning installed capacity requirements used were derived as follows:

FIGURE 5-1. Starting Source Requirements for Capacity Requirement Calculation

Well Service Area	2008 Metered Demand	Assumed Losses For Projection	Equation	Starting Source Requirements
6 & 8	522,742	12%	x / 1-.12	594,025
2 & 4	375,146	15%	x / 1-.15	441,348
1, 9 & 14	760,357	15%	x / 1-.15	894,538

One fact that will jump out at some readers in the tables above is that for all wells, starting source requirements are lower than actual pumped demand. Current losses in all systems are higher than target losses used in the projection. This is a policy statement. Targets are lower than current unaccounted-for water (UAFW) of 45% for Wells 2 & 4 and 19% for Wells 1, 9 & 14. Rather than include such losses in projected needs, measures are identified as part of the plan to reduce them. CCR proposals assume 12% UAFW, so this is reasonably consistent.

FIGURE 5-2. Source Capacity Requirements By Well Service Area

Source Requirements for Base Case - Elasticity = 1

Year	Wells 6 & 8	Wells 2 & 4	Wells 1, 9 & 14	Total
2008	594,025	441,348	894,538	1,929,911
2009	603,307	448,245	908,515	1,960,067
2010	612,589	455,141	922,493	1,990,223
2011	622,809	462,734	937,883	2,023,427
2012	633,029	470,328	953,274	2,056,631
2013	643,249	477,921	968,664	2,089,835
2014	653,469	485,514	984,055	2,123,038
2015	663,690	493,108	999,445	2,156,242
2016	672,280	499,490	1,012,382	2,184,153
2017	680,871	505,873	1,025,319	2,212,063
2018	689,462	512,256	1,038,255	2,239,973
2019	698,053	518,639	1,051,192	2,267,884
2020	706,644	525,022	1,064,129	2,295,794
2021	716,148	532,083	1,078,441	2,326,672
2022	725,652	539,144	1,092,754	2,357,550
2023	735,156	546,206	1,107,066	2,388,428
2024	744,660	553,267	1,121,378	2,419,306
2025	754,165	560,329	1,135,691	2,450,184
2026	764,113	567,720	1,150,672	2,482,506
2027	774,062	575,112	1,165,654	2,514,827
2028	784,010	582,503	1,180,635	2,547,149
2029	793,959	589,895	1,195,616	2,579,470
2030	803,907	597,287	1,210,598	2,611,792

Installed Capacity Less Largest Pump Requirements for Base Case - Elasticity = 1

Year	Wells 6 & 8	Wells 2 & 4	Wells 1, 9 & 14	Total
2008	1,336,556	993,034	2,012,710	4,342,299
2009	1,357,441	1,008,550	2,044,160	4,410,151
2010	1,378,325	1,024,067	2,075,609	4,478,002
2011	1,401,321	1,041,152	2,110,238	4,552,711
2012	1,424,316	1,058,237	2,144,866	4,627,419
2013	1,447,311	1,075,322	2,179,495	4,702,128
2014	1,470,306	1,092,407	2,214,123	4,776,836
2015	1,493,302	1,109,492	2,248,751	4,851,545
2016	1,512,631	1,123,853	2,277,859	4,914,343
2017	1,531,960	1,138,215	2,306,967	4,977,142
2018	1,551,290	1,152,576	2,336,075	5,039,940
2019	1,570,619	1,166,937	2,365,183	5,102,739
2020	1,589,948	1,181,298	2,394,291	5,165,537
2021	1,611,333	1,197,187	2,426,493	5,235,013
2022	1,632,717	1,213,075	2,458,696	5,304,488
2023	1,654,102	1,228,963	2,490,899	5,373,963
2024	1,675,486	1,244,851	2,523,101	5,443,439
2025	1,696,870	1,260,739	2,555,304	5,512,914
2026	1,719,255	1,277,371	2,589,012	5,585,638
2027	1,741,639	1,294,002	2,622,721	5,658,361
2028	1,764,023	1,310,633	2,656,429	5,731,085
2029	1,786,407	1,327,264	2,690,137	5,803,808
2030	1,808,792	1,343,895	2,723,845	5,876,532

Source Requirements for Proposals Plus Entitlements

	Wells 6 & 8	Wells 2 & 4	Wells 1, 9 & 14	Total
Now	823,022	1,178,473	905,180	2,906,674
2015	1,149,951	1,393,805	1,237,955	3,781,710
2020	1,461,475	1,587,397	1,375,000	4,423,872
2025	1,635,686	2,016,533	1,664,773	5,316,992
2030	1,815,561	2,156,110	1,920,455	5,892,126
+Entitlements	2,112,592	2,677,702	1,920,455	6,710,749

Installed Capacity Less Largest Pump Requirements for Proposals Plus Entitlements

	Wells 6 & 8	Wells 2 & 4	Wells 1, 9 & 14	Total
Now	1,851,799	2,651,564	2,036,654	6,540,016
2015	2,587,390	3,136,060	2,785,398	8,508,848
2020	3,288,319	3,571,642	3,093,750	9,953,711
2025	3,680,294	4,537,199	3,745,739	11,963,232
2030	4,085,013	4,851,248	4,321,023	13,257,284
+Entitlements	4,753,332	6,024,830	4,321,023	15,099,185

"Installed Capacity Less Largest Pump Requirements" refers to the amount of capacity that would be required by this standard, assuming that an additional pump was out of service. The numbers here do not reflect the capacity of that additional pump. Rather, they reflect the amount of capacity required after a hypothetical pump is out of service.

Installed Capacity Requirements

Based upon total installed capacity requirements shown in Table 5-2, requirements for new capacity only, i.e. only the portion of capacity above and beyond that at present, are presented in Table 5-3.

FIGURE 5-3. Required Additions to Installed Capacity

Required Addition to Installed Capacity Less Largest Pump Requirements for Base Case - Elasticity = 1

Year	Wells 6 & 8	Wells 2 & 4	Wells 1, 9 & 14	Total
2008	544,556	-302,966	1,148,710	1,390,299
2009	565,441	-287,450	1,180,160	1,458,151
2010	586,325	-271,933	1,211,609	1,526,002
2011	609,321	-254,848	1,246,238	1,600,711
2012	632,316	-237,763	1,280,866	1,675,419
2013	655,311	-220,678	1,315,495	1,750,128
2014	678,306	-203,593	1,350,123	1,824,836
2015	701,302	-186,508	1,384,751	1,899,545
2016	720,631	-172,147	1,413,859	1,962,343
2017	739,960	-157,785	1,442,967	2,025,142
2018	759,290	-143,424	1,472,075	2,087,940
2019	778,619	-129,063	1,501,183	2,150,739
2020	797,948	-114,702	1,530,291	2,213,537
2021	819,333	-98,813	1,562,493	2,283,013
2022	840,717	-82,925	1,594,696	2,352,488
2023	862,102	-67,037	1,626,899	2,421,963
2024	883,486	-51,149	1,659,101	2,491,439
2025	904,870	-35,261	1,691,304	2,560,914
2026	927,255	-18,629	1,725,012	2,633,638
2027	949,639	-1,998	1,758,721	2,706,361
2028	972,023	14,633	1,792,429	2,779,085
2029	994,407	31,264	1,826,137	2,851,808
2030	1,016,792	47,895	1,859,845	2,924,532

Required Addition to Installed Capacity Less Largest Pump Requirements for Proposals Plus Entitlements

	Wells 6 & 8	Wells 2 & 4	Wells 1, 9 & 14	Total
Now	544,556	-302,966	1,148,710	1,390,299
2015	1,795,390	1,840,060	1,921,398	5,556,848
2020	2,496,319	2,779,642	2,301,750	7,001,711
2025	2,888,294	3,745,199	2,953,739	9,011,232
2030	3,293,013	4,059,248	3,529,023	10,305,284
+Entitlements	3,961,332	5,232,830	3,529,023	12,147,185

Projected installed capacity requirements are shown in Figure 5-4. Installed capacity requirements increase five times as much in the build-out scenario as in the base case forecast.

Forecast capacity requirements rise more slowly than may be expected at first glance, because after the existing year, unaccounted-forwater is assumed to drop from current levels to 12% for Lana‘i City and Kaumalapau, and 15% for the other service districts. While this may not occur by year two, it is the target over the planning period.

System Standards refer only to systems utilized for drinking water by either humans or livestock. Since neither humans nor livestock are served with drinking water from the brackish systems, the standards do not apply to them at this time. However, this provides information the margin of reliability of these systems.

Lanaʻi City, Koele & Kaumalapau - Wells 6 & 8 Service Area

Supply Objectives and General Alternatives

Lanaʻi City, the Koele Project District and Kaumalapau are served by Wells 6 and 8. Well 3 once provided back-up for this area, but is currently out of service. Well 7 is not in use.

Based upon pumped demand, with Well 3 out of service, the system does not currently meet standards for installed capacity. 2/3 of the capacity of the smaller pump is only 528,000 GPD, while 1.5 x metered demand is 783,113 GPD.

Depending upon whether growth occurs at the forecasted rate, or at the build-out pace proposed, the Lanaʻi City system could require between 0.47 and 2.76 MGD in additional installed capacity over the planning period. Assuming an average productivity of 300,000 GPD per well, this means that anywhere from 2 to 9 additional wells could be required to meet capacity standards.

Existing plans for this service area include the replacement of Well 3 and bringing Well 7 on line. The addition of these two wells would be adequate to meet base case forecasted demands, assuming both could deliver the estimated 300,000 GPD. The sum of proposed withdrawals from wells proposed in the Leeward aquifer is greater than the aquifer's sustainable yield. One or more wells may be developed purely for distribution of withdrawals, or a well in the Windward aquifer may be required instead.

Potential well sites for the build-out scenario are identified and characterized later in this chapter. Options considered for the service area of Wells 6 & 8 include recommissioning of Maunalei Shaft 2, drilling wells at or near the old Maunalei sources, drilling a well at Malau, wells in the Kauiki or watershed. Other options include desalinization, loss reduction and other measures listed above.

Supply side measures that would reduce losses specifically in this service area include replacement of substandard lines, including the line to Kaumalapau, old asbestos transmission lines above the city, and old steel lines within Lanaʻi City. Supply and demand side conservation measures that would affect all service areas, including this one, are discussed later in this chapter.

Manele & Palawai Irrigation Grid - Wells 2 & 4 Service Area

Supply Objectives and General Alternatives

Manele and the Palawai Irrigation Grid are supplied primarily by Well 4. Well 2 is rarely used at this time, because it is necessary to take a cable car down to the well to start and stop it. The defunct Well 3 once served as a backup to this system, although there is no dedicated storage for this set-up.

Well 4 has the smallest total capacity and is therefore the well which remains in service when the largest pump is assumed out of service for standards evaluaton. Well 4 has adequate capacity to meet max day demands. So this system technically meets standards for installed redundancy. However, with Well 2 rarely used due to logistical issues, one has to conclude that some work is needed to stabilize reliability.

This service area will require additional installed capacity of 0.35 MGD to 4.4 MGD to meet *System Standards* over the planning period, depending upon whether growth occurs at the forecasted rate, or at the build-out pace proposed.

Existing plans for this service area include the replacement of Well 2 and possible addition of a Well 2-B at the site of the old Shaft 3. In addition, the replacement of Well 3 will be able to make use of the old connection between these systems. These projects would be adequate to meet the base case forecasted requirements, but again, the sum of withdrawals from new wells proposed in the Leeward aquifer exceeds that aquifer's estimated yield. Here again, one or more wells may be developed purely for distribution of withdrawals or reliability.

Potential well sites for the build-out scenario are identified and characterized later in this chapter. Options considered for the service area of Wells 2 &4 include replacement of Well 5, new potable wells at the Well 5 site, or between Well 3 and the Hi‘i tank, or in the Windward aquifer. A well located along the existing water line between Well 3 and the Hi'i tank could provide production and backup to either the Lana‘i City system or the Manele / Palawai potable system.

Development of windward sources could also be used to supplement this service area. Windward source development options have been examined both along the old Maunalei transmission line, or in Kehewai Ridge with a new line that wraps from Kehewai Ridge around the Lana‘ihale to the south. In selecting windward well site and transmission route options, care has been taken to avoid work in the areas deemed by forestry experts to have the most valuable native habitat. In selecting sites in Maunalei and Kauiki, kuleana entitlements will have to be taken into account.

An expanded interconnection between the service areas of Wells 2 & 4 and Wells 3 & 6 could help to stabilize reliability in both areas. One item that is not included in the proposed capital plan that LWCI might wish to consider is a connection between Lana‘i City / Koele service area to the new Hi‘i storage when it is constructed. Expanded interconnection could allow unused capacity of the Lana‘i City / Koele system to be used to serve the Manele / Palawai system. In this case, additional production from Well 7 or from the Windward aquifer area could be used to provide backup or, to some extent, additional water to the Manele / Palawai system. If development proceeds according to the base case forecast, the replacement of Well 3 and Well 7, combined with such interconnection, would be enough to carry both systems beyond 2015.

Reduction of system losses could also go far toward firming capacities. Supply side measures that would reduce losses specifically in this service area include replacement of substandard lines, in particular the deteriorated lines in the Palawai Irrigation Grid. These lines are known to be leaking in several areas. If replacement of these lines could reduce losses from 44% to 15% as projected, this would save 202,000 GPD in pumped demand, and reduce the amount of installed capacity required by about 300,000 GPD. This measure compares favorably to new source development on a levelized cost basis.

Manele District Non-Potable System

Supply Objectives and General Alternatives

Water service for irrigation in the Manele Project District area currently consists of brackish water from Wells 1, 9 and 14, and 72,940 GPD of reclaimed water. Wells 1, 9 & 14 have some problems. Well 1 is pumping below design capacity to mitigate dropping water levels. Water levels in Wells 9 and 14 are also dropping. Well 10 and Well 12 appear to be non-productive.

Declining water levels indicate the need for increased distribution of withdrawals. Efforts are under way to develop a Well 15, in the hopes of providing additional capacity to this system.

Although *System Standards* do not apply to non-potable water service, it is still a good idea to plan for some redundancy. Some reliability is provided by the 15 MG brackish reservoir. The 15 MG brackish reservoir holds more than 13 times the current installed daily capacity requirement, and 7 times more than the build-out daily capacity requirement. Pumped water storage adds reliability, but it does not add source availability.

The service area of Wells 1, 9 and 14 would be expected to require an additional 0.7 MGD to 1.8 MGD in installed capacity depending upon whether growth occurs at the forecasted rate, or at the build-out pace proposed. However, this system is not required to meet *System Standards* for installed capacity. Source requirements based upon projected metered demand plus 15% range from 1.21 to 1.69 MGD, resulting in an increased source requirement of 0.316 to 0.795 MGD. According to the base case forecast, wastewater availability at Manele is expected to increase from 72,940 to 98,711 GPD, an increase of 25,771 GPD. This would not be adequate to meet even the base case projection of increased demand. Build-out of the CCR proposal plus entitlements could generate a total of 296,586 GPD in wastewater, or an increase of 223,646 GPD. After adjustments for treatment and low return rates discussed in the previous chapter, reclaimed water at Manele, even with buildout would be less than 150,000 GPD, an even greater shortfall.

If additional use of the brackish aquifer were an option, assuming that distribution of withdrawals could help to resolve dropping water levels, this would be met by three to seven new wells. However, the existing type and degree of use of brackish water from the high level aquifer is disputed, and significant increases in use are likely to be disputed as well. County Ordinance 2408 (1995), amending Chapter 19.70 of the Maui County Code stated that the total amount of non-potable water drawn from the high level aquifer that may be used for irrigation of the golf course, driving range or other associated landscaping should not exceed an average of 650,000 gallons per day. An issue remains unresolved as to whether "associated landscaping" is meant to include all non-potable irrigation at the Manele Project District, or only the Golf Course area itself. From a review of documents from 1989 through 1993 it appears that initial stipulations were that residential irrigation, would come from outside the High Level aquifer. (*Examples: Hearings Docket A89-649 re: Manele Golf Course, Table distributed by CCR to Maui Planning Commission 12/28/1992, showing 0.55 MGD of non-potable water from the high level aquifer for the Golf Course, and 0.4 MGD of irrigation water from sources outside the high level aquifer for irrigation of residential properties, October 12, 1995 letter from Department of Water Supply to Department of Planning regarding Manele Project District Residential and Multi-family Development, Increment I - Project District Phase 2 approval for 166 SF and 96 MF units, indicating their understanding that no water from the high level aquifer would be used for landscape irrigation pursuant to condition 7 of the District Boundary Amendment.*)

Options to meet increasing demand requirements for this service area include increased use of reclaimed water to the extent available, development of new brackish wells outside the high level aquifer to provide irrigation water or as feedstock for desalination, seawater desalination, irrigation efficiency improvements, covers to reduce evaporation from the 15 MG Brackish Reservoir, and a pipeline connecting Lanaʻi City Auxiliary Treatment Facility to the Manele Project District irrigation area. Even at full build-out, this last option would not be practical until toward the end of the planning period. If installed, it could provide up to about 0.5 MGD of reclaimed water to Manele, with the remainder of the available reclaimed water used in Lanaʻi City and Koele. However, it would require expanded treatment capacity in Lanaʻi City, which is unlikely to be funded by the County during the planning period. Althouth some delay and expense are involved, this option, combined with reductions in system losses and conservation measures, could meet projected source requirements for non-potable water in Manele. Much will depend on how new developments are landscaped and irrigated.

Koele Golf Course Non-Potable System

Supply Objectives and General Alternatives

This system provides non-potable water for irrigation purposes. Treated effluent from the Lanaʻi City Auxiliary Wastewater Treatment Facility is pumped to the *The Experience at Koele* Golf Course as its sole source of water for irrigation purposes. County Code 19.71.055, defines special situations and exceptions during which potable water may be used, as well as the approvals required for each.

Water demand for this system is characterized in the 2002 report, "Storage and Supply Master Plan for the Koele Golf Course" by R. M. Towill Corporation. (RMTC), and in related reports to CCR by RMTC. In normal rainfall conditions, demand averages 256,000 GPD, peaking in the summer at

486,000 GPD.

During 2008, the Auxiliary Water Treatment Facility provided 234,093 GPD to the golf course, indicating that current supply falls short of average needs by approximately 22,000 GPD. In drought conditions consumption is higher, averaging 346,000 GPD, with summer peaks of 511,000 GPD.

Anticipated reclaimed water generated by either the base case or build-out scenario is expected to resolve this shortfall for average periods. Reclaimed water estimates in the build-out scenario would cover current drought shortages, though these could also be met by additional use of storage. Although additional storage has not been evaluated in this document, storage systems could be evaluated further as necessary to enable increased use of effluent for the Golf Course. As suggested by RMTC (*2002*), such considerations should be kept in mind for coordination with Lanaʻi City and Koele Project District drainage improvements as well.

Potential Supply Options

Development of New Wells

The following pages discuss new wells which could be developed to provide additional water supply for Lanaʻi. Aside from additional supply, benefits provided by additional wells would include improved geographical distribution of well pumping, increased production redundancy for system reliability, and potentially increased flexibility of operations.

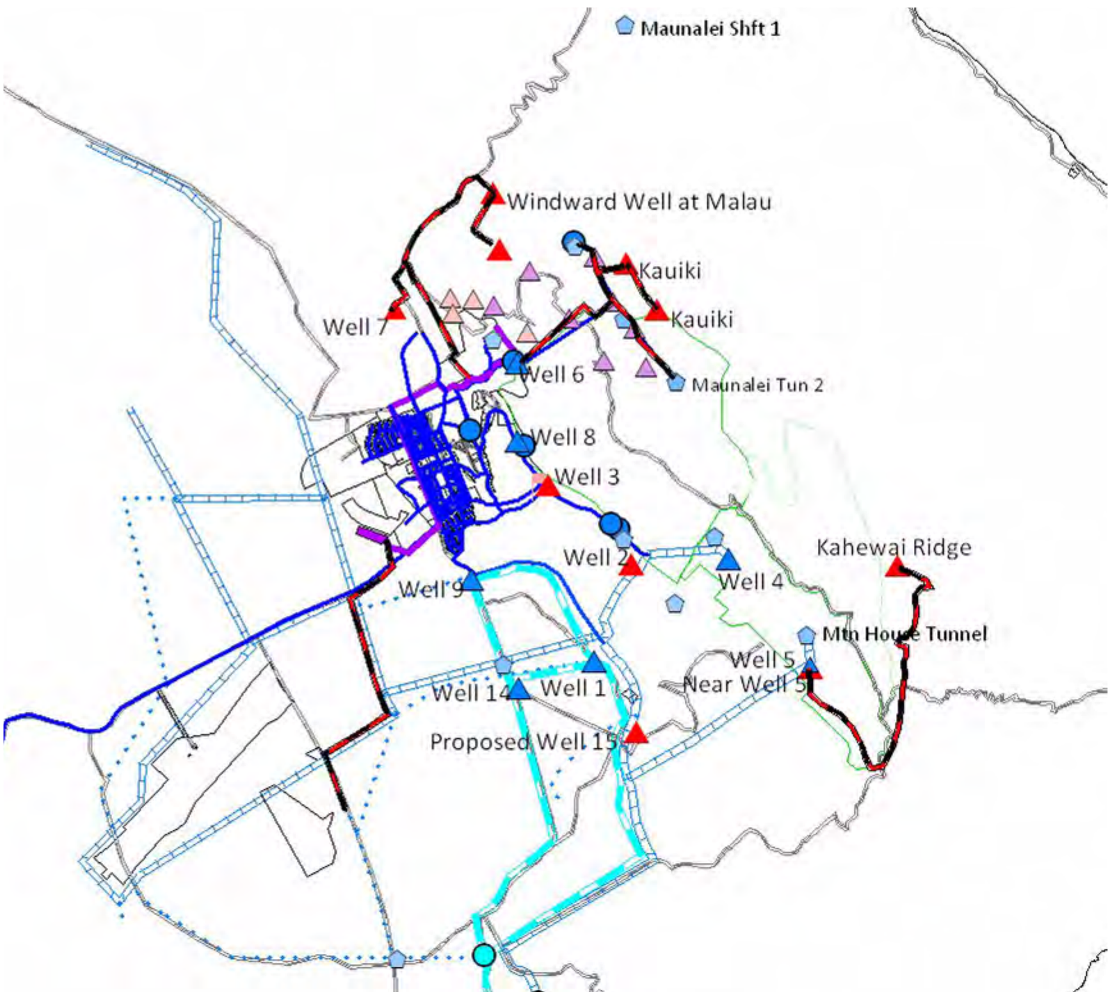
The potential magnitude of additional supply capacity that can be provided by new wells is limited by the sustainable recharge capacity of the source aquifers. Improvements in the distribution of pumping can increase the actual effective sustainable production. In order to fully develop the sustainable yield for high level potable water, it would be necessary to develop wells on the windward side of the Lanaʻihale. The need to distribute pumpage to the Windward Aquifer Sector becomes a mandate when pumpage in the Leeward Aquifer Sector approaches 2.7 MGD, or 90% of its sustainable yield. Included in the discussion of development of new wells is an option to recommission the existing Maunalei shaft and tunnels situated in the Windward Aquifer Sector.

Cost estimates for several new well development options are provided below. The costs of developing new wells include engineering, drilling, casing, pump equipment, and any necessary transmission or storage improvements, electrical supply extensions, and road improvements. Costs of operating wells include electricity for pumping, chemicals for disinfection treatment, well operation and maintenance.

Cost analyses are based on life cycle levelized costs based on the economic life of the project, assuming 6% cost of capital, 3% general annual inflation, 3% nominal fixed annual operating cost increase, 4% nominal electricity and variable cost annual increase and a 6% analysis discount rate. Variable operating costs include MECO electricity costs at $0.40 per KWH based on May 2008 prices (reflecting $125 per barrel crude oil price). Details regarding the assumptions in the characterization of project costs and cost analyses are documented in several tables including a summary table indicating the costs and unit life cycle costs for each project.

For new well development, the largest cost item over the life of the operation of the well is electricity for pumping. Levelized over the life of the well, electrical costs for some typical wells exceed capital costs by a factor of at least four. Life cycle electricity costs exceed capital costs even for options that include substantial transmission improvement capital costs.

FIGURE 5-4. Lana‘i Source Options Considered

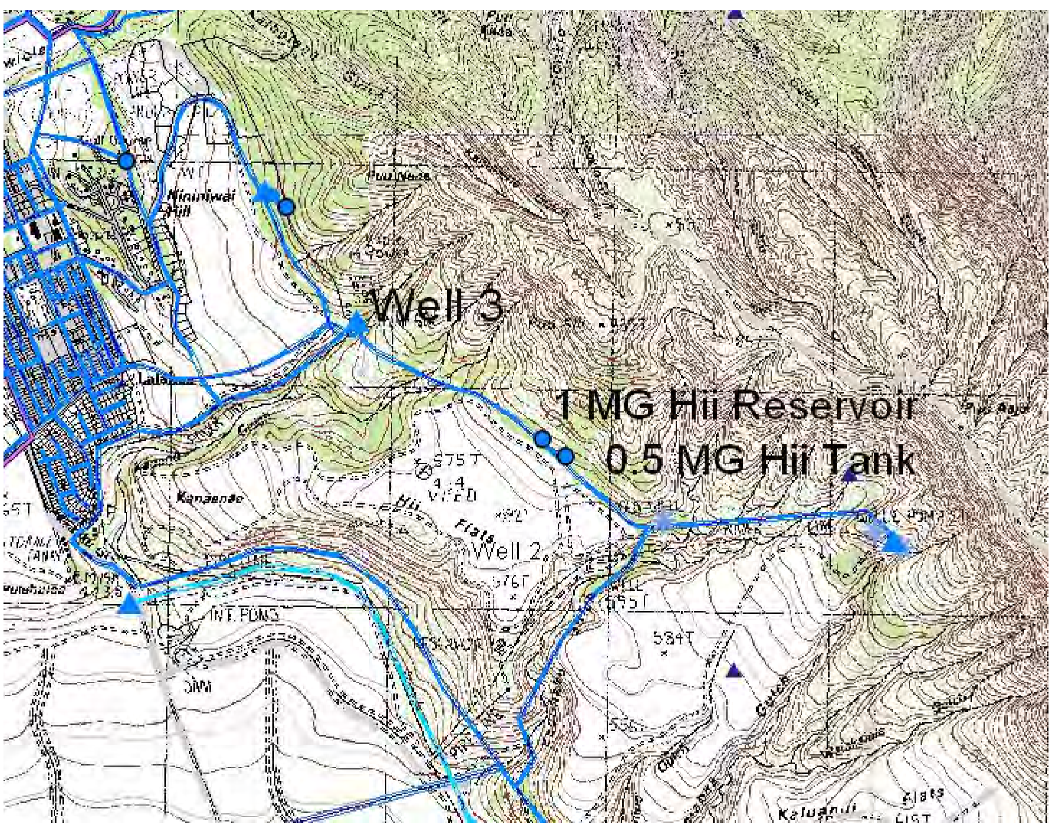


Leeward High Level Potable Well Development (near Hi'i Tank)

Cost analysis was performed for developing a new high level potable well near the existing water transmission line between Well 3 and the Hi'i Tank. This location was selected considering proximity to existing transmission, distribution of leeward water pumping, probability of low-level chloride potable source water and capability to serve either or both of the island's potable water systems.

The elevation of the well was assumed to be 1,800 ft. with a source water level of 1,100 ft. Well depth is assumed to be 1,200 ft. installed with a 0.864 MGD pump. Costs for hydrology and engineering to locate and design the well are included. Production is assumed to be 300,000 GPD. The capital cost, including engineering, drilling, development and ancillaries, water and power transmission connection and contingency, is $2.9 million. First year electrical energy cost is $1.41 per thousand gallons. The total thirty-year levelized costs are $4.49 per thousand gallons. This cost is comprised of $1.90 capital cost, $0.27 operating and maintenance cost and $2.32 electrical energy cost.

FIGURE 5-5. New High Level Well in Leeward Aquifer Near Hi'i Tank



Potential Supply Options

FIGURE 5-6. High Level Potable Well Near Hi‘i Tank

Capacity (MGD)				
Installed Capacity		0.864		
Max. Day Capacity		0.864		
Effective Sustainable Capacity		0.300		
Facility Capacity Factor		100%		
Average Facility Output		0.300		
Capital Costs ($)	Total	Per MGD		
Exploration/Land/Power	$30,000	$100,000	HDA Estimate	2500 ft power line to Hii Tank or alt. site
Drilling	$900,000	$3,000,000	HDA Estimate	(1) well 12" at 1200 ft @ $750 plf
Development	$1,159,000	$3,863,333	HDA Estimate	(1) pump 1 mgd @ $560k, SCADA, Ancillaries
Transmission Improvements	$150,000	$500,000		Feeder and connection to existing line
Storage Improvements	$0	$0		
Design / Engineering	$150,000	$500,000	HDA Estimate	Hydrology study for well location, well engineering
Contingencies	$477,800	$1,592,667	HDA Estimate	20%
Total Plant Cost (	$2,866,800	$9,556,000		
Const. Per. Esc. Rate (Nom.)	3.00%			
AFUDC Interest Rate (Nom.)	6.00%			
AFUDC Factor		1.000		
	Total	Per MGD		
Total Capitalized Cost	$2,866,800	$9,556,000		
Fixed Operating Costs ($)	Per Year	Per Y/MGD		
Dedicated Operating Labor	$5,479	$18,263		$0.05 per kgal based on estimated Lanai average
Apportioned Operating Labor		$0	HDA Estimate	
Maintenance Labor		$0		
Fixed Operating Costs				
Electrical Demand	$15,120	$50,400		5 Kwh/kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0		
Maintenance Expenses		$0		
Amort. of Capitalized Rebuild Costs		$0		
Total Fixed Op. Costs	$20,599	$68,663		
Variable Operating Costs ($)		Per KGal		
Operating Labor				
Maintenance Labor				
Electrical Energy		$1.400	HDA calculation	5 kwh per kgal per thousand feet vertical lift @ $.40 per kwh. Vertical lift from el 1100' water level to el 1800' line grad
Chemicals/Materials		$0.008	HDA Estimate	100% Maui system average cost
Maintenance Expenses				
Total Variable Op. Costs		$1.408		
Plant Life (Years)				
Functional Life	30			
Economic/Analysis Life	30			
Book Life	20			
Levelized Production Costs ($)				
Cost of Capital	6.00%			
Discount Rate (Nom.)	6.00%			
Fixed Op.Cost Esc. Rate (Nom.)	3.00%			
Effective Fixed Op Cost Disc Rate	2.91%			
Var. Op.Cost Esc. Rate (Nom.)	4.00%			
Effective Var. Op Cost Disc Rate	1.92%			
		$/kgal		
First Year Cost w/Amortized Capital		$3.876		
Amortized Cap. Cost (Book Life)		$2.281		
Fixed Op. Cost		$0.188		
Varible Op. Cost		$1.408		
	NPV $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost	19.055	$4.551		
Capital Cost (20 year Amort.)	9.556	$2.281		
Fixed Op. Cost	1.030	$0.246		
Varible Op. Cost	8.469	$2.021		
	NPV $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost	22.554	$4.489		
Capital Cost (Amort. per Econ. Life)	9.556	$1.901		
Fixed Op. Cost	1.361	$0.271		
Varible Op. Cost	11.636	$2.315		

Leeward High Level Potable Well Development (near Well 5)

Existing Well 5 is in a promising location but has problems associated with its well and/or pump installation. An analysis of the feasibility of refurbishing this well or drilling an adjacent new well could provide an economical new source. If this option is selected, the highlighted bright (blue-ish) green area is an area to avoid, due to remaining high quality native habitat.

The costs of drilling a new well adjacent to Well 5 and using existing access, transmission and power supply improvements were estimated. The elevation of the well and the elevation of the aquifer water level were assumed to be the same as Well 5. The project includes the costs of engineering, well drilling, development including ancillaries, connection to adjacent power and water transmission lines and contingencies.

Production is assumed to average 300,000 GPD. Incremental capitalized costs are $3.0 million. First year electrical energy cost is $1.61 per thousand gallons. The total thirty-year levelized costs are $4.91 per thousand gallons. This cost is comprised of $1.96 capital cost, $0.30 fixed operating and maintenance cost and $2.64 electrical energy cost.

FIGURE 5-7. High Level Potable Well Development Near Well 5

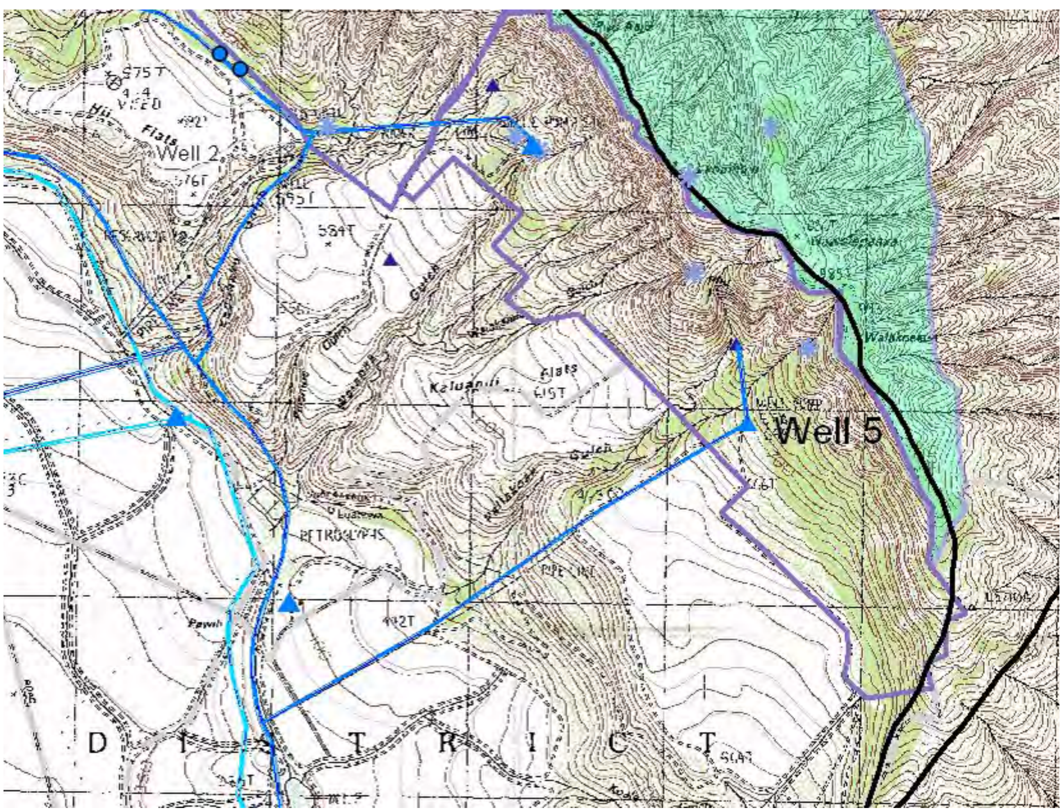


FIGURE 5-8. Leeward High Level Potable Well Development (near Well 5)

Capacity (MGD)				
Installed Capacity		0.864		
Max. Day Capacity		0.864		
Effective Sustainable Capacity		0.300		
Facility Capacity Factor		100%		
Average Facility Output		0.300		
Capital Costs ($)	Total	Per MGD		
Exploration/Land/Power	$5,000	$16,667	HDA Estimate	Connection to existing power line
Drilling	$900,000	$3,000,000	HDA Estimate	(1) well 12" at 1200 ft @ $750 plf
Development	$1,159,000	$3,863,333	HDA Estimate	(1) pump 1 mgd @ $550K, SCADA, ancillaries
Transmission Improvements	$100,000	$333,333		Feeder and connection to existing line
Storage Improvements	$250,000	$833,333		50Kgal contact tank, chlorinator
Design / Engineering	$50,000	$166,667	HDA Estimate	Well engineering
Contingencies	$492,800	$1,642,667	HDA Estimate	20%
Total Plant Cost (	$2,956,800	$9,856,000		
Const. Per. Esc. Rate (Nom.)	3.00%			
AFUDC Interest Rate (Nom.)	6.00%			
AFUDC Factor		1.000		
	Total	Per MGD		
Total Capitalized Cost	$2,956,800	$9,856,000		
Fixed Operating Costs ($)	Per Year	Per Y/MGD		
Dedicated Operating Labor	$5,479	$18,263		$0.05 per kgal based on estimated Lanai average
Apportioned Operating Labor		$0	HDA Estimate	
Maintenance Labor		$0		
Fixed Operating Costs				
Electrical Demand	$17,280	$57,600		5 kwh/kgal/kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0		
Maintenance Expenses		$0		
Amort. of Capitalized Rebuild Costs		$0		
Total Fixed Op. Costs	$22,759	$75,863		
Variable Operating Costs ($)		Per KGal		
Operating Labor				
Maintenance Labor				
Electrical Energy		$1.600	HDA calculation	5 kwh per kgal per thousand feet vertical lift @ $.40 per kwh Vertical lift from el 1500' water level to el 2300' tank
Chemicals/Materials		$0.008	HDA Estimate	150% Maui system average cost
Maintenance Expenses				
Total Variable Op. Costs		$1.608		
Plant Life (Years)				
Functional Life	30			
Economic/Analysis Life	30			
Book Life	20			
Levelized Production Costs ($)				
Cost of Capital	6.00%			
Discount Rate (Nom.)	6.00%			
Fixed Op.Cost Esc. Rate (Nom.)	3.00%			
Effective Fixed Op Cost Disc. Rate	2.91%			
Var. Op.Cost Esc. Rate (Nom.)	4.00%			
Effective Var. Op.Cost Disc. Rate	1.92%			
		$/kgal		
First Year Cost w/Amortized Capital		$4.168		
Amortized Cap. Cost (Book Life)		$2.353		
Fixed Op. Cost		$0.208		
Varible Op. Cost		$1.608		
	NPV $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost	20.666	$4.936		
Capital Cost (20 year Amort.)	9.856	$2.353		
Fixed Op. Cost	1.138	$0.272		
Varible Op. Cost	9.672	$2.309		
	NPV $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost	24.650	$4.906		
Capital Cost (Amort. per Econ. Life)	9.856	$1.960		
Fixed Op. Cost	1.504	$0.299		
Varible Op. Cost	13.290	$2.643		

Well 2 - B at Shaft 3 Site

Well 2 Shaft 3 is rarely operated for various reasons. LWCI intends to replace Well 2. In addition, a well at the site of Shaft 3 is considered. Some LWCI staff have posited that the behavior of water levels at the two sites indicate that these facilities may tap different dike compartments. Additional studies are planned to examine this hypothesis. If it proves to be the case, then in addition to replacing Well 2, an additional well, Well 2-B is intended.

The costs of drilling a new well at the Shaft 3 site and using existing access, transmission and power supply improvements were estimated. The elevation of the well and the elevation of the aquifer water level were assumed to be the same as Well 2/Shaft 3. The project includes the costs of engineering, well drilling, development including ancillaries, connection to adjacent power and water transmission lines and contingencies.

Production is assumed to average 300,000 GPD. Incremental capitalized costs are $1.9 million. First year electrical energy cost is $0.92 per thousand gallons. The total thirty-year levelized costs are $2.97 per thousand gallons. This cost is comprised of $1.25 capital cost, $0.20 fixed operating and maintenance cost and $1.51 electrical energy cost.

FIGURE 5-9. Well 2-B

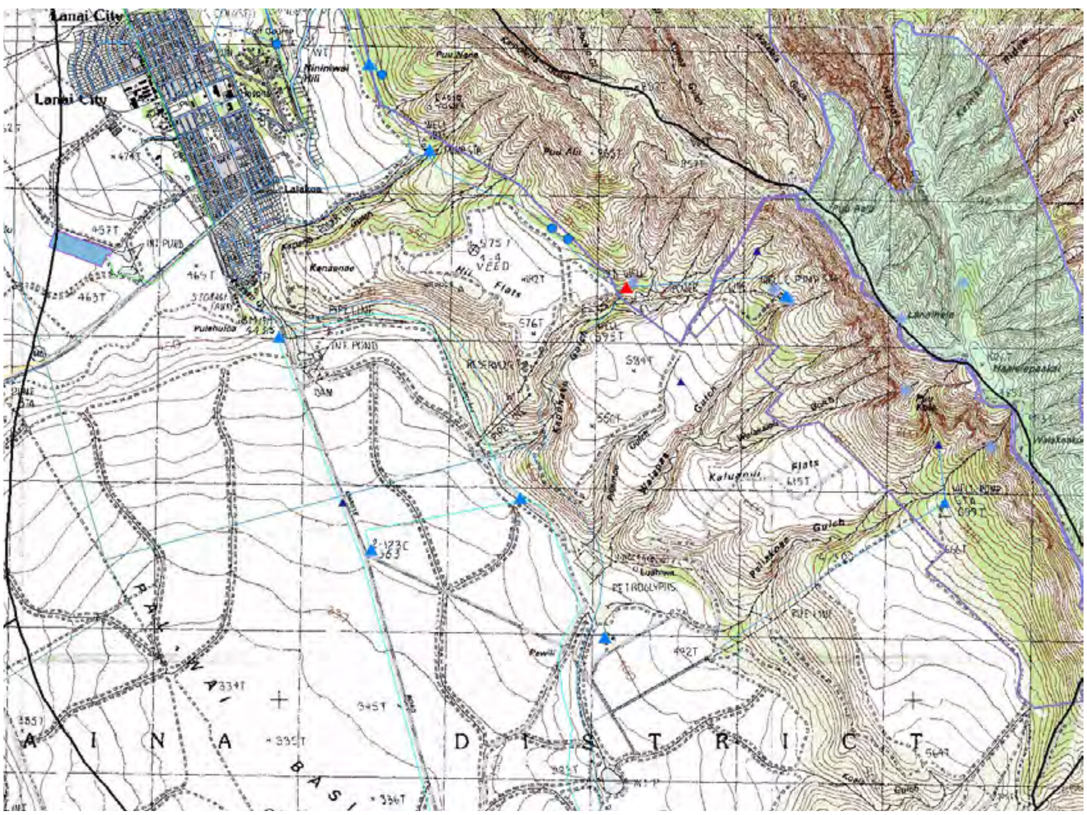


FIGURE 5-10. Well 2-B at Shaft 3 Site

Capacity (MGD)				
Installed Capacity		0.864		
Max. Day Capacity		0.864		
Effective Sustainable Capacity		0.300		
Facility Capacity Factor		100%		
Average Facility Output		0.300		
Capital Costs ($)	Total	Per MGD		
Exploration/Land/Power	$5,000	$16,667	HDA Estimate	Connection to existing power line
Drilling	$255,000	$850,000	HDA Estimate	(1) well 12" at 300 ft @ $850 plf
Development	$1,159,000	$3,863,333	HDA Estimate	(1) pump 1 mgd @ $550k, SCADA, ancillaries
Transmission Improvements	$100,000	$333,333		Feeder and connection to existing line
Storage Improvements	$0	$0		
Design / Engineering	$50,000	$166,667	HDA Estimate	Well engineering
Contingencies	$313,800	$1,046,000	HDA Estimate	20%
Total Plant Cost (	$1,882,800	$6,276,000		
Expenditure Pattern Year	Nom	Normalized		
Const. Per. Esc. Rate (Nom.)	3.00%			
AFUDC Interest Rate (Nom.)	6.00%			
AFUDC Factor		1.000		
	Total	Per MGD		
Total Capitalized Cost	$1,882,800	$6,276,000		
Fixed Operating Costs ($)	Per Year	Per Y/MGD		
Dedicated Operating Labor	$5,479	$18,263		$0.05 per kgal based on estimated Lanai average
Apportioned Operating Labor		$0	HDA Estimate	
Maintenance Labor		$0		
Fixed Operating Costs				
Electrical Demand	$9,936	$33,120		5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrica energy cost*installed capacity
Chemicals/Materials		$0		
Maintenance Expenses		$0		
Amort. of Capitalized Rebuild Costs		$0		
Total Fixed Op. Costs	$15,415	$51,383		
Variable Operating Costs ($)		Per KGal		
Operating Labor				
Maintenance Labor				
Electrical Energy		$0.920	HDA calculation	5 kwh per kgal per thousand feet vertical lift @ $.40 per kwh Vertical lift from el 1350' water level to el 1810' tank el
Chemicals/Materials		$0.000		
Maintenance Expenses				
Total Variable Op. Costs		$0.920		
Plant Life (Years)				
Functional Life	30			
Economic/Analysis Life	30			
Book Life	30			
Levelized Production Costs ($)				
Cost of Capital	6.00%			
Discount Rate (Nom.)	6.00%			
Fixed Op.Cost Esc. Rate (Nom.)	3.00%			
Effective Fixed Op.Cost. Disc. Rate	2.91%			
Var. Op.Cost Esc. Rate (Nom.)	4.00%			
Effective Var. Op.Cost. Disc. Rate	1.92%			
		$/kgal		
First Year Cost w/Amortized Capital		**$2.309**		
Amortized Cap. Cost (Book Life)		$1.248		
Fixed Op. Cost		$0.141		
Varible Op. Cost		$0.920		
	NPV $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost	**12.582**	**$3.005**		
Capital Cost (20 year Amort.)	6.276	$1.498		
Fixed Op. Cost	0.771	$0.184		
Varible Op. Cost	5.536	$1.321		
	NPV $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost	**14.901**	**$2.966**		
Capital Cost (Amort. per Econ. Life)	6.276	$1.248		
Fixed Op. Cost	1.019	$0.203		
Varible Op. Cost	7.606	$1.513		

Recommission Well 7

Well 7 is not presently in use. Although initial water levels appear to have been lower than those in many of the pumping wells, it offers some advantages. The fact that the well has already been drilled would help to keep costs of development down. Well 7 could readily be tied in to both the City system and the west end of the Palawai Irrigation Grid, offering operational flexibility. Well 7 could serve as a backup well to enhance system reliability.

The costs of bringing Well 7 on line were estimated assuming new transmission, storage and pump facilities. The well is at 1,775' elevation with a water level of 650'. The project includes the costs of engineering, refurbishing the pump site, development including ancillaries, connection to adjacent power and water transmission lines and contingencies.

Production is assumed to average 300,000 GPD. Capital costs are $2.7 million. First year electrical energy cost is $2.39 per thousand gallons. The total thirty-year levelized costs are $6.02 per thousand gallons. This cost is comprised of $1.78 capital cost, $0.35 fixed operating and maintenance cost and $3.89 electrical energy cost.

FIGURE 5-11. Recommission Well 7

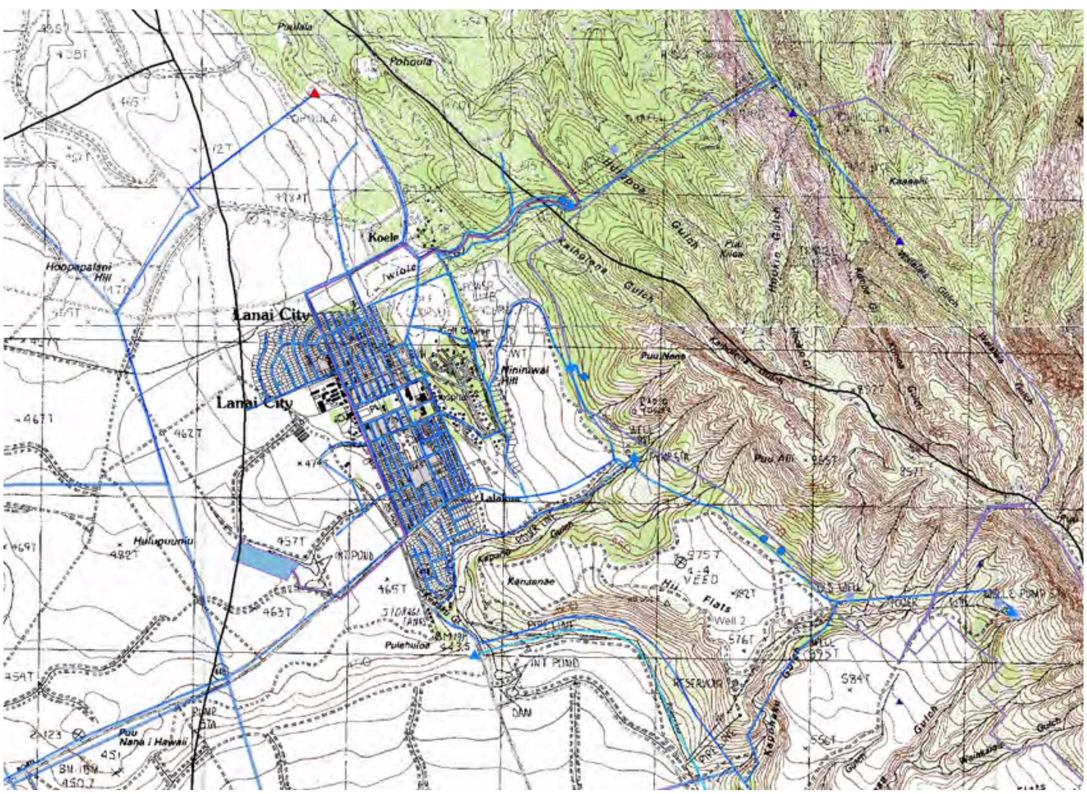


FIGURE 5-12. Recommission Well 7

Capacity (MGD)				
Installed Capacity		0.720		
Max. Day Capacity		0.720		
Effective Sustainable Capacity		0.300		
Facility Capacity Factor		100%		
Average Facility Output		0.300		
Capital Costs ($)	Total	Per MGD		
Exploration/Land/Power	$0	$0	HDA Estimate	Existing well site
Refurbish well site	$50,000	$166,667	HDA Estimate	Refurbish well site
Development	$1,159,000	$3,863,333	HDA Estimate	(1) pump 1 mgd @ $550k, SCADA, ancillaries
Transmission Improvements	$697,842	$2,326,140		2900 ft 8" line @ $200 plf to L.C Tank
Storage Improvements	$250,000	$833,333		50Kgal contact tank; chlorinator
Design / Engineering	$75,000	$250,000	HDA Estimate	Hydrology, siting, well engineering
Contingencies	$446,368	$1,487,895	HDA Estimate	20%
Total Plant Cost (	$2,678,210	$8,927,368		
Const. Per. Esc. Rate (Nom.)	3.00%			
AFUDC Interest Rate (Nom.)	6.00%			
AFUDC Factor		1.000		
	Total	Per MGD		
Total Capitalized Cost	$2,678,210	$8,927,368		
Fixed Operating Costs ($)	Per Year	Per Y/MGD		
Dedicated Operating Labor	$5,479	$18,263		$0.05 per kgal based on estimated Lanai average
Apportioned Operating Labor		$0	HDA Estimate	
Maintenance Labor		$0		
Fixed Operating Costs				
Electrical Demand	$21,240	$70,800		5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0		
Maintenance Expenses		$0		
Amort. of Capitalized Rebuild Costs		$0		
Total Fixed Op. Costs	$26,719	$89,062		
Variable Operating Costs ($)		Per KGal		
Operating Labor				
Maintenance Labor				
Electrical Energy		$2.360	HDA calculation	5 kwh per kgal per thousand feet vertical lift @ $.40 per kwh Vertical lift from el 1000' water level to el 1850' tank
Chemicals/Materials		$0.008	HDA Estimate	150% Maui system average cost
Maintenance Expenses				
Total Variable Op. Costs		$2.368		
Plant Life (Years)				
Functional Life	30			
Economic/Analysis Life	30			
Book Life	20			
Levelized Production Costs ($)				
Cost of Capital	6.00%			
Discount Rate (Nom.)	6.00%			
Fixed Op.Cost Esc. Rate (Nom.)	3.00%			
Effective Fixed Op.Cost Disc. Rate	2.91%			
Var. Op.Cost Esc. Rate (Nom.)	4.00%			
Effective Var. Op.Cost. Disc. Rate	1.92%			
		$/kgal		
First Year Cost w/Amortized Capital		**$4.742**		
Amortized Cap. Cost (Book Life)		$2.131		
Fixed Op. Cost		$0.244		
Varible Op. Cost		$2.368		
	NPV $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost	**24.508**	**$5.854**		
Capital Cost (20 year Amort.)	8.927	$2.131		
Fixed Op. Cost	1.336	$0.319		
Varible Op. Cost	14.245	$3.400		
	NPV $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost	**30.266**	**$6.024**		
Capital Cost (Amort. per Econ. Life)	8.927	$1.776		
Fixed Op. Cost	1.766	$0.351		
Varible Op. Cost	19.573	$3.893		

Windward Wells at Malau

The area north of Lana'i City along Commode Road near the ridge is in the northwest portion of the Windward aquifer. There are several possible well site locations in this area. This area is approximately one mile north of Well 6. This area is reasonably close to existing power and water transmission lines and would have economical road access.

Costs for a new potable well at this location were analyzed assuming a wellhead ground elevation of 1810 feet pumping from a water level of 1000 ft. to the Lana'i City tank elevation of 1850 feet. Production is assumed to be 300,000 GPD with a 0.864 MGD pump. Capital costs include engineering, drilling, well development and ancillaries, contact tank with chlorination, new 8" water transmission line to Lana'i City tank and contingency. First year electricity cost is $1.71 per thousand gallons. The total thirty-year levelized costs are $7.35 per thousand gallons. This cost is comprised of $4.23 capital cost, $0.31 fixed operating and maintenance cost and $2.81 electrical energy cost.

FIGURE 5-13. Windward Wells at Malau

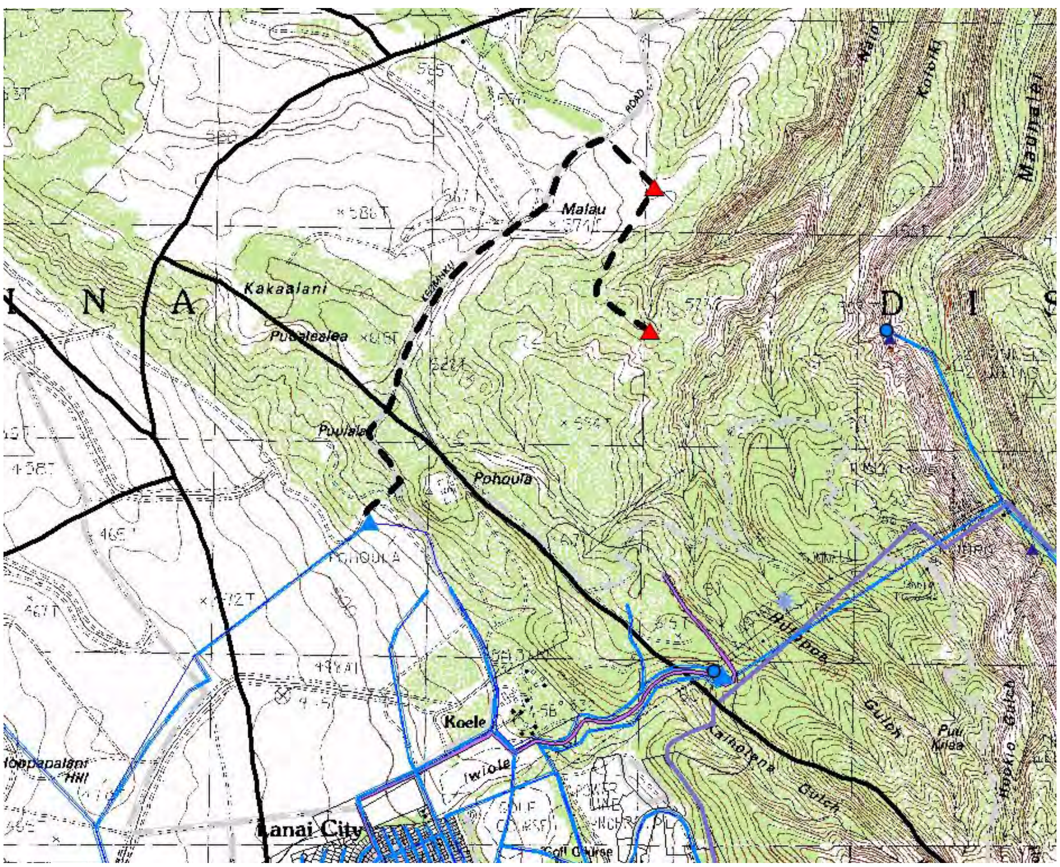


FIGURE 5-14. Windward Wells at Malau

Capacity (MGD)				
Installed Capacity		0.864		
Max. Day Capacity		0.864		
Effective Sustainable Capacity		0.300		
Facility Capacity Factor		100%		
Average Facility Output		0.300		
Capital Costs ($)	Total	Per MGD		
Exploration/Land/Power	$5,000	$16,667	HDA Estimate	Connection to existing power line
Drilling	$750,000	$2,500,000	HDA Estimate	(1) well 12" at 1000 ft @ $750 plf
Development	$1,159,000	$3,863,333	HDA Estimate	(1) pump 1 mgd @ $550k. SCADA, ancillaries
Transmission Improvements	$3,000,000	$10,000,000		15,000 ft 8" line @ $200 plf to L.C.Tank
Storage Improvements	$250,000	$833,333		50Kgal contact tank: chlorinator
Design / Engineering	$150,000	$500,000	HDA Estimate	Hydrology, siting, well engineering
Contingencies	$1,062,800	$3,542,667	HDA Estimate	20%
Total Plant Cost (	$6,376,800	$21,256,000		
Const. Per. Esc. Rate (Nom.)	3.00%			
AFUDC Interest Rate (Nom.)	6.00%			
AFUDC Factor		1.000		
	Total	Per MGD		
Total Capitalized Cost	$6,376,800	$21,256,000		
Fixed Operating Costs ($)	Per Year	Per Y/MGD		
Dedicated Operating Labor	$5,479	$18,263		$0.05 per kgal based on estimated Lanai average
Apportioned Operating Labor		$0	HDA Estimate	
Maintenance Labor		$0		
Fixed Operating Costs				
Electrical Demand	$18,360	$61,200		5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0		
Maintenance Expenses		$0		
Amort. of Capitalized Rebuild Costs		$0		
Total Fixed Op. Costs	$23,839	$79,463		
Variable Operating Costs ($)		Per KGal		
Operating Labor				
Maintenance Labor				
Electrical Energy		$1.700	HDA calculation	5 kwh per kgal per thousand feet vertical lift @ $.40 per kwh Vertical lift from el 1000' water level to el 1850' tank
Chemicals/Materials		$0.008	HDA Estimate	150% Maui system average cost
Maintenance Expenses				
Total Variable Op. Costs		$1.708		
Plant Life (Years)				
Functional Life	30			
Economic/Analysis Life	30			
Book Life	20			
Levelized Production Costs ($)				
Cost of Capital	6.00%			
Discount Rate (Nom.)	6.00%			
Fixed Op.Cost Esc. Rate (Nom.)	3.00%			
Effective Fixed Op.Cost Disc. Rate	2.91%			
Var. Op.Cost Esc. Rate (Nom.)	4.00%			
Effective Var. Op.Cost. Disc. Rate	1.92%			
		$/kgal		
First Year Cost w/Amortized Capital		**$6.999**		
Amortized Cap. Cost (Book Life)		$5.074		
Fixed Op. Cost		$0.218		
Varible Op. Cost		$1.708		
	NPV $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost	**32.722**	**$7.816**		
Capital Cost (20 year Amort.)	21.256	$5.074		
Fixed Op. Cost	1.192	$0.284		
Varible Op. Cost	10.274	$2.452		
	NPV $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost	**36.948**	**$7.354**		
Capital Cost (Amort. per Econ. Life)	21.256	$4.228		
Fixed Op. Cost	1.575	$0.313		
Varible Op. Cost	14.117	$2.808		

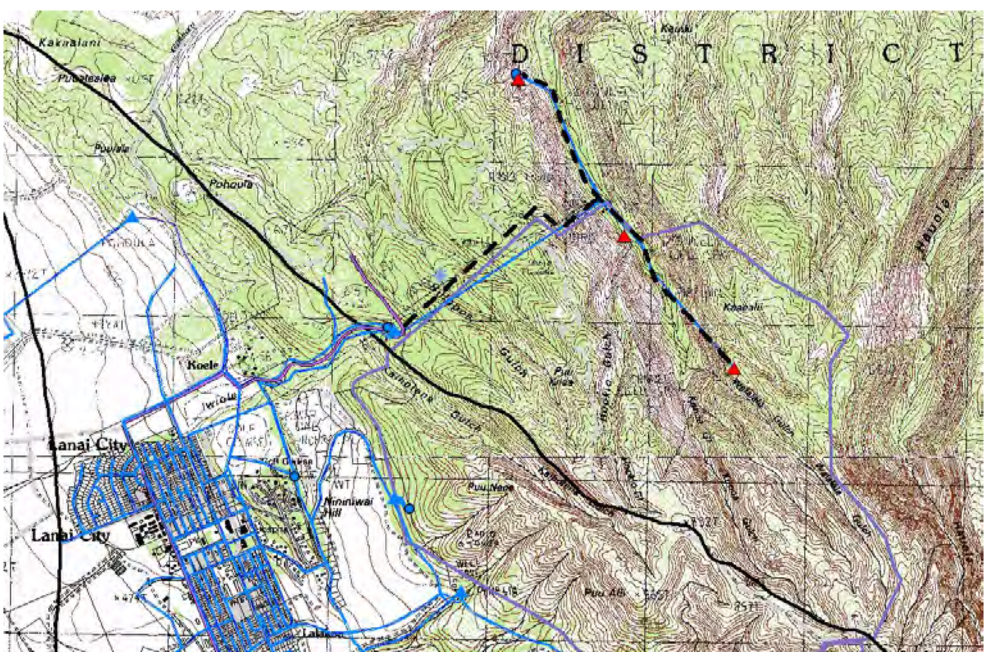
Recommission Windward Maunalei Shaft and Tunnels

The Maunalei Shaft #2 and the Maunalei Tunnels #1 and #2 are located two miles northeast of Lana‘i City in Maunalei gulch. Shaft #2 is located at the 850’ elevation. The tunnels are located at the 1,100’ and 1500’ elevation respectively. These windward aquifer sources draw water at approximately the same elevation as the water levels in the leeward high level potable aquifer sources. These were once major developed sources of water for the island. Existing but old high pressure water transmission lines connect these sources with one another and up the side of the gulch to the location of Well 6.

The cost of using Maunalei sources was evaluated with four assumptions. In this option, existing sources could be refurbished, but transmission would need replacement. Although this scenario is unlikely, it is examined here for the benefit of cost comparison. It assumes the need for source improvements, a booster pump station and control tank. The feasibility of recommissioning these water sources would have to be determined by further study.   Cost estimates include hydrology and feasibility study, engineering, new power and water transmission lines, source improvements, SCADA and ancillaries, booster station, control and contact storage tank and contingency.

Two principal cost elements for this project are the capital cost of the transmission improvements and electrical costs to pump water from the sources in the gulch up to the 2,060 foot hydraulic elevation at the ridge. Capitalized costs total $10.1 million in this scenario. First year electricity cost is $2.43 per thousand gallons. The total thirty-year levelized costs are $8.40 per thousand gallons. This cost is comprised of $4.02 capital cost, $0.38 fixed operating and maintenance cost and $3.99 electrical energy cost.

FIGURE 5-15. Recommission Windward Maunalei Shaft and Tunnels



Potential Supply Options

FIGURE 5-16. Recommissioning Windward Maunalei Shaft and Tunnels

Capacity (MGD)				
Installed Capacity		1.000		
Max. Day Capacity		0.750		
Effective Sustainable Capacity		0.500		
Facility Capacity Factor		100%		
Average Facility Output		0.500		
Capital Costs ($)	Total	Per MGD		
Exploration/Land/Power	$175,000	$350,000	HDA Estimate	Electrical controls, water utility power transmission ext. share Road improvements
Shaft / Tunnel Improvements	$750,000	$1,500,000	HDA Estimate	
Development / Booster Station	$1,500,000	$3,000,000	HDA Estimate	SCADA, ancillaries, booster station w/intake sump structure
Transmission Improvements	$5,500,000	$11,000,000	HDA Estimate	4500 ft 8" line @ $200 plf feeds to lift 4750 ft 10" hp line @ $500 plf Maunalei to ridge to Well #6 5000 ft 12" line @ $445 plf Well#6 to Lanai City Tank
Storage Improvements	$250,000	$500,000		50kgal contact/control tank
Design / Engineering	$250,000	$500,000	HDA Estimate	Hydrology study, engineering
Contingencies	$1,685,000	$3,370,000	HDA Estimate	20%
Total Plant Cost (	$10,110,000	$20,220,000		
Const. Per. Esc. Rate (Nom.)	3.00%			
AFUDC Interest Rate (Nom.)	6.00%			
AFUDC Factor		1.000		
	Total	Per MGD		
Total Capitalized Cost	$10,110,000	$20,220,000		
Fixed Operating Costs ($)	Per Year	Per Y/MGD		
Dedicated Operating Labor	$18,263	$36,525		$0.10 per kgal based on two times average due to remote location
Apportioned Operating Labor		$0	HDA Estimate	
Maintenance Labor		$0		
Fixed Operating Costs				
Electrical Demand	$30,250	$60,500		5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0		
Maintenance Expenses		$0		
Amort. of Capitalized Rebuild Costs		$0		
Total Fixed Op. Costs	$48,513	$97,025		
Variable Operating Costs ($)		Per KGal		
Operating Labor				
Maintenance Labor				
Electrical Energy		$2.420	HDA calculation	5 kwh per kgal per thousand feet vertical lift @ $.40 per kwh Vertical lift from el 850' water level to el 2060' hydraulic line at ridge"
Chemicals/Materials		$0.008	HDA Estimate	150% Maui system average cost
Maintenance Expenses				
Total Variable Op. Costs		$2.428		
Plant Life (Years)				
Functional Life	30			
Economic/Analysis Life	30			
Book Life	20			
Levelized Production Costs ($)				
Cost of Capital	6.00%			
Discount Rate (Nom.)	6.00%			
Fixed Op.Cost Esc. Rate (Nom.)	3.00%			
Effective Fixed Op.Cost Disc. Rate	2.91%			
Var. Op.Cost Esc. Rate (Nom.)	4.00%			
Effective Var. Op.Cost Disc. Rate	1.92%			
		$/kgal		
First Year Cost w/Amortized Capital		**$7.520**		
Amortized Cap. Cost (Book Life)		$4.826		
Fixed Op. Cost		$0.266		
Varible Op. Cost		$2.428		
	NPV $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost	**36.281**	**$8.666**		
Capital Cost (20 year Amort.)	20.220	$4.826		
Fixed Op. Cost	1.455	$0.347		
Varible Op. Cost	14.606	$3.486		
	NPV $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost	**42.213**	**$8.402**		
Capital Cost (Amort. per Econ. Life)	20.220	$4.022		
Fixed Op. Cost	1.923	$0.383		
Varible Op. Cost	20.069	$3.992		

Windward Wells at Maunalei Shaft and Tunnel Sites

Wells could be developed in the bottom of Maunalei gulch. This would require similar improvements as recommissioning the Maunalei #2 Shaft and tunnels described above, including new or repaired transmission lines and a new booster station.

Cost analysis was performed for several scenarios. Two scenarios assume that the existing transmission pipes, right of way and electrical lines to the Maunalei sources could be used with some improvements. Booster station construction and other improvements in these scenarios are similar to the recommissioning scenario described above. Costs were derived for approaches that include development of two and three wells, respectively. A third scenario assumes that construction of new high pressure transmission lines will be necessary.

In all three scenarios it is assumed that the new wells would be in the vicinity of the Maunalei 2 Shaft and/or Maunalei Tunnels along the existing collector line that serves these sources. Costs of hydrology and engineering studies to locate and design the wells is included. The wells are assumed to be at an elevation of 850 to 1100 ft. pumping from a water level of 800 to 1,000 ft. Pumping costs are estimated based on pumping water over the ridge at the location of the existing line at an elevation of 2,060 ft. Wells are assumed to be 500 ft. deep installed with 1 MG pumps.

For two wells relying on improvements to existing transmission with a total average output of 500,000 GPD. the capital cost is $6.8 million. First year electrical energy cost is $2.43 per thousand gallons. The total thirty-year levelized costs are $7.31 per thousand gallons. This cost is comprised of $2.69 capital cost, $0.62 fixed operating and maintenance cost and $3.99 electrical energy cost.

For three wells using existing transmission, the total average output is assumed to be 750,000 GPD. The capitalized cost is $8.0 million. First year electrical energy cost is $2.43 per thousand gallons. The total thirty-year levelized costs are $6.73 per thousand gallons. This cost is comprised of $2.12 capital cost, $0.62 fixed operating and maintenance cost and $3.99 electrical energy cost.

For three wells with new transmission pipe installed from the wells to the Lana‘i City tank the capital cost is $6.5 million. First year electrical energy cost is $2.43 per thousand gallons. The thirty-year levelized costs are $8.49 per thousand gallons. This cost is comprised of $3.87 capital cost, $0.62 fixed operating and maintenance cost and $3.99 electrical energy cost.

No picture is provided as these would be in the same area indicated on the previous page.

FIGURE 5-17. Two New Wells at Maunalei Shaft and Tunnel Sites Existing Transmission

Capacity (MGD)				
Installed Capacity		2.000		
Max. Day Capacity		1.000		
Effective Sustainable Capacity		0.500		
Facility Capacity Factor		100%		
Average Facility Output		0.500		
Capital Costs ($)	Total	Per MGD		
Exploration/Land/Power	$20,000	$40,000	HDA Estimate	Connection to existing power line
Drilling	$750,000	$1,500,000	HDA Estimate	(2) wells 12" 500ft deep @ $750/ft.
Development	$3,318,000	$6,636,000	HDA Estimate	(2) 1 MGD pumps@$500k", SCADA, Ancillaries Booster Pump Station, Intake sump well
Transmission	$1,200,000	$2,400,000	HDA Estimate	Repairs, improvements and connection to existing transmission line
Storage Improvements	$250,000	$500,000		50Kgal contact/control tank
Design / Engineering	$100,000	$200,000	HDA Estimate	Hydrolgy study for well location, well engineering
Contingencies	$1,127,600	$2,255,200	HDA Estimate	20%
Total Plant Cost (	$6,765,600	$13,531,200		
Const. Per. Esc. Rate (Nom.)	3.00%			
AFUDC Interest Rate (Nom.)	6.00%			
AFUDC Factor		1.000		
	Total	Per MGD		
Total Capitalized Cost	$6,765,600	$13,531,200		
Fixed Operating Costs ($)	Per Year	Per Y/MGD		
Dedicated Operating Labor	$18,263	$36,525		$0.10 per kgal based on two times average due to remote location
Apportioned Operating Labor		$0	HDA Estimate	
Maintenance Labor		$0		
Fixed Operating Costs				
Electrical Demand	$60,500	$121,000		5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0		
Maintenance Expenses		$0		
Amort. of Capitalized Rebuild Costs		$0		
Total Fixed Op. Costs	$78,763	$157,525		
Variable Operating Costs ($)		Per KGal		
Operating Labor				
Maintenance Labor				
Electrical Energy		$2.420	HDA calculation	5 kwh per kgal per thousand feet vertical lift @ $.40 per kwh Vertical lift from el 850' water level to el 2060' hydraulic line at ridge"
Chemicals/Materials		$0.008	HDA Estimate	150% Maui system average cost
Maintenance Expenses				
Total Variable Op. Costs		$2.428		
Plant Life (Years)				
Functional Life	30			
Economic/Analysis Life	30			
Book Life	20			
Levelized Production Costs ($)				
Cost of Capital	6.00%			
Discount Rate (Nom.)	6.00%			
Fixed Op.Cost Esc. Rate (Nom.)	3.00%			
Effective Fixed Op.Cost. Disc. Rate	2.91%			
Var. Op.Cost Esc. Rate (Nom.)	4.00%			
Effective Var. Op.Cost. Disc. Rate	1.92%			
		$/kgal		
First Year Cost w/Amortized Capital		**$6.089**		
Amortized Cap. Cost (Book Life)		$3.230		
Fixed Op. Cost		$0.431		
Varible Op. Cost		$2.428		
	NPV $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost	**30.500**	**$7.285**		
Capital Cost (20 year Amort.)	13.531	$3.230		
Fixed Op. Cost	2.363	$0.564		
Varible Op. Cost	14.606	$3.486		
	NPV $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost	**36.723**	**$7.309**		
Capital Cost (Amort. per Econ. Life)	13.531	$2.691		
Fixed Op. Cost	3.123	$0.621		
Varible Op. Cost	20.069	$3.992		

Supply Options

FIGURE 5-18. Three New Wells at Maunalei Shaft and Tunnel Sites - Existing Transmission

Capacity (MGD)				
Installed Capacity		2.000		
Max. Day Capacity		1.000		
Effective Sustainable Capacity		0.500		
Facility Capacity Factor		100%		
Average Facility Output		0.500		
Capital Costs ($)	Total	Per MGD		
Exploration/Land/Power	$20,000	$40,000	HDA Estimate	Connection to existing power line
Drilling	$750,000	$1,500,000	HDA Estimate	(2) wells 12" 500ft deep @ $750/ft.
Development	$3,318,000	$6,636,000	HDA Estimate	(2) 1 MGD pumps@$500k", SCADA, Ancillaries Booster Pump Station, Intake sump well
Transmission	$1,200,000	$2,400,000	HDA Estimate	Repairs, improvements and connection to existing transmission line
Storage Improvements	$250,000	$500,000		50Kgal contact/control tank
Design / Engineering	$100,000	$200,000	HDA Estimate	Hydrolgy study for well location, well engineering
Contingencies	$1,127,600	$2,255,200	HDA Estimate	20%
Total Plant Cost (	$6,765,600	$13,531,200		
Const. Per. Esc. Rate (Nom.)	3.00%			
AFUDC Interest Rate (Nom.)	6.00%			
AFUDC Factor		1.000		
	Total	Per MGD		
Total Capitalized Cost	$6,765,600	$13,531,200		
Fixed Operating Costs ($)	Per Year	Per Y/MGD		
Dedicated Operating Labor	$18,263	$36,525		$0.10 per kgal based on two times average due to remote location
Apportioned Operating Labor		$0	HDA Estimate	
Maintenance Labor		$0		
Fixed Operating Costs				
Electrical Demand	$60,500	$121,000		5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0		
Maintenance Expenses		$0		
Amort. of Capitalized Rebuild Costs		$0		
Total Fixed Op. Costs	$78,763	$157,525		
Variable Operating Costs ($)		Per KGal		
Operating Labor				
Maintenance Labor				
Electrical Energy		$2.420	HDA calculation	5 kwh per kgal per thousand feet vertical lift @ $.40 per kwh Vertical lift from el 850' water level to el 2060' hydraulic line at ridge"
Chemicals/Materials		$0.008	HDA Estimate	150% Maui system average cost
Maintenance Expenses				
Total Variable Op. Costs		$2.428		
Plant Life (Years)				
Functional Life	30			
Economic/Analysis Life	30			
Book Life	20			
Levelized Production Costs ($)				
Cost of Capital	6.00%			
Discount Rate (Nom.)	6.00%			
Fixed Op.Cost Esc. Rate (Nom.)	3.00%			
Effective Fixed Op.Cost. Disc. Rate	2.91%			
Var. Op.Cost Esc. Rate (Nom.)	4.00%			
Effective Var. Op.Cost. Disc. Rate	1.92%			
		$/kgal		
First Year Cost w/Amortized Capital		**$6.089**		
Amortized Cap. Cost (Book Life)		$3.230		
Fixed Op. Cost		$0.431		
Varible Op. Cost		$2.428		
	NPV $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost	**30.500**	**$7.285**		
Capital Cost (20 year Amort.)	13.531	$3.230		
Fixed Op. Cost	2.363	$0.564		
Varible Op. Cost	14.606	$3.486		
	NPV $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost	**36.723**	**$7.309**		
Capital Cost (Amort. per Econ. Life)	13.531	$2.691		
Fixed Op. Cost	3.123	$0.621		
Varible Op. Cost	20.069	$3.992		

FIGURE 5-19. Three New Wells at Maunalei Shaft and Tunnel Sites - New Transmission

Capacity (MGD)				
Installed Capacity		3.000		
Max. Day Capacity		2.000		
Effective Sustainable Capacity		0.750		
Facility Capacity Factor		100%		
Average Facility Output		0.750		
Capital Costs ($)	Total	Per MGD		
Exploration/Land/Power	$25,000	$33,333	HDA Estimate	Connection to existing power line
Drilling	$2,250,000	$3,000,000	HDA Estimate	(3) wells 12" 500ft deep @ $750/ft.
Development	$3,897,500	$5,196,667	HDA Estimate	(3) 1 MGD pumps@$500k", SCADA, Ancillaries
Transmission Improvements	$5,500,000	$7,333,333	HDA Estimate	4500 ft 8" line @ $200 plf Well feeds to lift
Storage Improvements	$250,000	$333,333		50kgal contact/control tank
Design / Engineering	$250,000	$333,333	HDA Estimate	Hydrolgy study for well location, well engineering
Contingencies	$2,434,500	$3,246,000	HDA Estimate	20%
Total Plant Cost (	$14,607,000	$19,476,000		
Const. Per. Esc. Rate (Nom.)	3.00%			
AFUDC Interest Rate (Nom.)	6.00%			
AFUDC Factor		1.000		
	Total	Per MGD		
Total Capitalized Cost	$14,607,000	$19,476,000		
Fixed Operating Costs ($)	Per Year	Per Y/MGD		
Dedicated Operating Labor	$27,394	$36,525		$0.10 per kgal based on two times average due to remote location
Apportioned Operating Labor		$0	HDA Estimate	
Maintenance Labor		$0		
Fixed Operating Costs				
Electrical Demand	$90,750	$121,000		5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0		
Maintenance Expenses		$0		
Amort. of Capitalized Rebuild Costs		$0		
Total Fixed Op. Costs	$118,144	$157,525		
Variable Operating Costs ($)		Per KGal		
Operating Labor				
Maintenance Labor				
Electrical Energy		$2.420	HDA calculation	5 kwh per kgal per thousand feet vertical lift @ $.40 per kwh Vertical lift from el 850' water level to el 2060' hydraulic line at ridge"
Chemicals/Materials		$0.008	HDA Estimate	150% Maui system average cost
Maintenance Expenses				
Total Variable Op. Costs		$2.428		
Plant Life (Years)				
Functional Life	30			
Economic/Analysis Life	30			
Book Life	20			
Levelized Production Costs ($)				
Cost of Capital	6.00%			
Discount Rate (Nom.)	6.00%			
Fixed Op.Cost Esc. Rate (Nom.)	3.00%			
Effective Fixed Op.Cost. Disc. Rate	2.91%			
Var. Op.Cost Esc. Rate (Nom.)	4.00%			
Effective Var. Op.Cost Disc. Rate	1.92%			
		$/kgal		
First Year Cost w/Amortized Capital		**$7.508**		
Amortized Cap. Cost (Book Life)		$4.649		
Fixed Op. Cost		$0.431		
Varible Op. Cost		$2.428		
	NPV $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost	**36.445**	**$8.705**		
Capital Cost (20 year Amort.)	19.476	$4.649		
Fixed Op. Cost	2.363	$0.564		
Varible Op. Cost	14.606	$3.486		
	NPV $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost	**42.668**	**$8.493**		
Capital Cost (Amort. per Econ. Life)	19.476	$3.874		
Fixed Op. Cost	3.123	$0.621		
Varible Op. Cost	20.069	$3.992		

Windward Wells at Kauiki

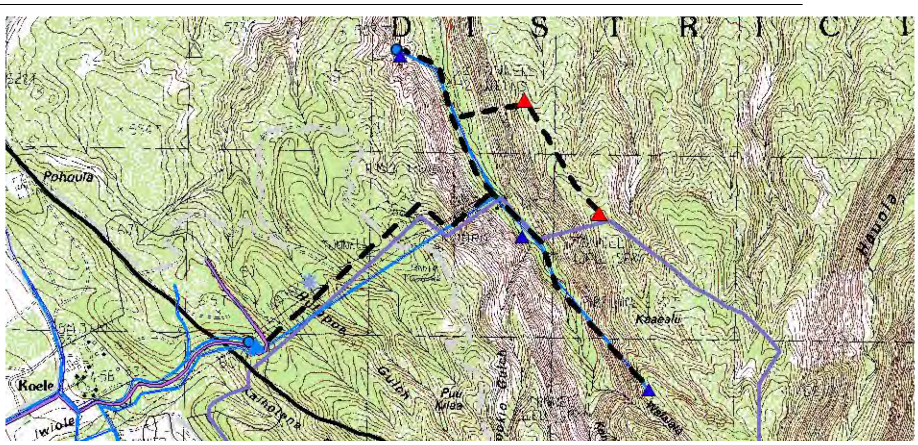
In order to explore the costs of developing wells further east in the Windward aquifer the costs of drilling and operating a well on the east side of Maunalei gulch were estimated. A site at Kauiki east and above the Maunalei gulch at 1750 feet elevation was characterized. Well drilling and development costs are assumed to be higher than other areas because of the remote location of the well site. Project costs include hydrology and engineering studies, well drilling, development including pump and ancillaries, power transmission (water utility share), high pressure water transmission line and contingencies.

Two scenarios were characterized. The first scenario includes the costs of developing new transmission lines from the wellhead, through Maunalei Gulch to the existing transmission line at Well 6. The second scenario assumes that this project would be incremental to previous development of transmission and booster station improvements to transmit water from sources in Maunalei Gulch. In this case transmission improvements would include high pressure transmission lines from the wellhead down into Maunalei gulch and connection with the existing transmission system at the booster station. Both scenarios assume installed well capacity of 1 MGD and average production of 300,000 GPD.

Assuming that the project includes construction of new transmission to the connection to the existing water system at Well 6, the capitalized costs are $10.9 million. First year electrical energy cost is $2.73 per thousand gallons. The total thirty-year levelized costs are $12.27 per thousand gallons. This cost is comprised of $7.24 capital cost, $0.53 fixed operating and maintenance cost and $4.49 electrical energy cost.

If the project is built after transmission and booster station improvements are developed for Mauanalei Gulch sources, the incremental capitalized costs would be $4.9 million. First year electrical energy cost would be $2.73 per thousand gallons. The total thirty-year levelized costs are $8.25 per thousand gallons. This cost is comprised of $3.23 capital cost, $0.53 fixed operating and maintenance cost and $4.49 electrical energy cost.

FIGURE 5-20. Windward Wells at Kauiki



Potential Supply Options

FIGURE 5-21. Windward Wells at Kauiki - New Transmission

Capacity (MGD)				
Installed Capacity		0.864		
Max. Day Capacity		0.648		
Effective Sustainable Capacity		0.300		
Facility Capacity Factor		100%		
Average Facility Output		0.300		
Capital Costs ($)	Total	Per MGD		
Exploration/Land/Power	$300,000	$1,000,000	HDA Estimate	Electrical controls, water utility power transmission ext. share Road improvements
Drilling	$1,020,000	$3,400,000	HDA Estimate	Drilling 12" well 1200 ft depth @ $850/ft
Development	$1,159,000	$3,863,333	HDA Estimate	(1) pump 1 mgd @ $550k, SCADA, ancillaries
Transmission Improvements	$6,125,000	$20,416,667	HDA Estimate	7800 ft 10" hp line @ $500 plf Kauiki thru Maunalei to Well #6 5000 ft 12" line @ $445 plf Well#6 to Lanai City Tank
Storage Improvements	$250,000	$833,333		50kgal contact/control tank
Design / Engineering	$250,000	$833,333	HDA Estimate	Hydrology study, engineering
Contingencies	$1,820,800	$6,069,333	HDA Estimate	20%
Total Plant Cost (	$10,924,800	$36,416,000		
Const. Per. Esc. Rate (Nom.)	3.00%			
AFUDC Interest Rate (Nom.)	6.00%			
AFUDC Factor		1.000		
	Total	Per MGD		
Total Capitalized Cost	$10,924,800	$36,416,000		
Fixed Operating Costs ($)	Per Year	Per Y/MGD		
Dedicated Operating Labor	$10,958	$36,525		$0.10 per kgal based on two times average due to remote location
Apportioned Operating Labor		$0	HDA Estimate	
Maintenance Labor		$0		
Fixed Operating Costs				
Electrical Demand	$29,376	$97,920		5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0		
Maintenance Expenses		$0		
Amort. of Capitalized Rebuild Costs		$0		
Total Fixed Op. Costs	$40,334	$134,445		
Variable Operating Costs ($)		Per KGal		
Operating Labor				
Maintenance Labor				
Electrical Energy		$2.720	HDA calculation	5 kwh per kgal per thousand feet vertical lift @ $.40 per kwh Vertical lift from el 700' water level to el 2060' hydraulic line at ridge"
Chemicals/Materials		$0.008	HDA Estimate	150% Maui system average cost
Maintenance Expenses				
Total Variable Op. Costs		$2.728		
Plant Life (Years)				
Functional Life	30			
Economic/Analysis Life	30			
Book Life	20			
Levelized Production Costs ($)				
Cost of Capital	6.00%			
Discount Rate (Nom.)	6.00%			
Fixed Op.Cost Esc. Rate (Nom.)	3.00%			
Effective Fixed Op.Cost Disc. Rate	2.91%			
Var. Op.Cost Esc. Rate (Nom.)	4.00%			
Effective Var. Op.Cost. Disc. Rate	1.92%			
		$/kgal		
First Year Cost w/Amortized Capital		**$11.788**		
Amortized Cap. Cost (Book Life)		$8.692		
Fixed Op. Cost		$0.368		
Varible Op. Cost		$2.728		
	NPV $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost	**54.844**	**$13.100**		
Capital Cost (20 year Amort.)	36.416	$8.692		
Fixed Op. Cost	2.016	$0.481		
Varible Op. Cost	16.411	$3.917		
	NPV $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost	**61.631**	**$12.267**		
Capital Cost (Amort. per Econ. Life)	36.416	$7.243		
Fixed Op. Cost	2.665	$0.530		
Varible Op. Cost	22.550	$4.485		

Supply Options

FIGURE 5-22. **Windward Wells at Kauiki - Incremental Cost**

Capacity (MGD)				
Installed Capacity		0.864		
Max. Day Capacity		0.648		
Effective Sustainable Capacity		0.300		
Facility Capacity Factor		100%		
Average Facility Output		0.300		
Capital Costs ($)	Total	Per MGD		
Exploration/Land/Power	$275,000	$916,667	HDA Estimate	Electrical controls, water utility power transmission ext. share Road improvements
Drilling	$1,020,000	$3,400,000	HDA Estimate	Drilling 12" well 1200 ft depth @ $850/ft
Development	$1,159,000	$3,863,333	HDA Estimate	(1) pump 1 mgd @ $550k, SCADA, ancillaries
Transmission Improvements	$1,350,000	$4,500,000	HDA Estimate	2600 ft 10" hp line @ $500 plf Kauiki to Maunalei boosters Check valve at Maunalei transmission connection
Storage Improvements	$0	$0		
Design / Engineering	$250,000	$833,333	HDA Estimate	Hydrology study, engineering
Contingencies	$810,800	$2,702,667	HDA Estimate	20%
Total Plant Cost (	$4,864,800	$16,216,000		
Const. Per. Esc. Rate (Nom.)	3.00%			
AFUDC Interest Rate (Nom.)	6.00%			
AFUDC Factor		1.000		
	Total	Per MGD		
Total Capitalized Cost	$4,864,800	$16,216,000		
Fixed Operating Costs ($)	Per Year	Per Y/MGD		
Dedicated Operating Labor	$10,958	$36,525		$0.10 per kgal based on two times average due to remote location
Apportioned Operating Labor		$0	HDA Estimate	
Maintenance Labor		$0		
Fixed Operating Costs				
Electrical Demand	$29,376	$97,920		5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0		
Maintenance Expenses		$0		
Amort. of Capitalized Rebuild Costs		$0		
Total Fixed Op. Costs	$40,334	$134,445		
Variable Operating Costs ($)		Per KGal		
Operating Labor				
Maintenance Labor				
Electrical Energy		$2.720	HDA calculation	5 kwh per kgal per thousand feet vertical lift @ $.40 per kwh Vertical lift from el 700' water level to el 2060' hydraulic line at ridge"
Chemicals/Materials		$0.008	HDA Estimate	150% Maui system average cost
Maintenance Expenses				
Total Variable Op. Costs		$2.728		
Plant Life (Years)				
Functional Life	30			
Economic/Analysis Life	30			
Book Life	20			
Levelized Production Costs ($)				
Cost of Capital	6.00%			
Discount Rate (Nom.)	6.00%			
Fixed Op.Cost Esc. Rate (Nom.)	3.00%			
Effective Fixed Op.Cost. Disc. Rate	2.91%			
Var. Op.Cost Esc. Rate (Nom.)	4.00%			
Effective Var. Op.Cost. Disc. Rate	1.92%			
		$/kgal		
First Year Cost w/Amortized Capital		**$6.966**		
Amortized Cap. Cost (Book Life)		$3.871		
Fixed Op. Cost		$0.368		
Varible Op. Cost		$2.728		
	NPV $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost	**34.644**	**$8.275**		
Capital Cost (20 year Amort.)	16.216	$3.871		
Fixed Op. Cost	2.016	$0.481		
Varible Op. Cost	16.411	$3.917		
	NPV $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost	**41.431**	**$8.246**		
Capital Cost (Amort. per Econ. Life)	16.216	$3.225		
Fixed Op. Cost	2.665	$0.530		
Varible Op. Cost	22.550	$4.485		

Windward Well at Kehewai Ridge

In order to explore the cost of developing a ground water source in the south portion of the Windward aquifer, sites were located at Kehewai Ridge at 2,250 feet and 2,750 feet elevations. There are no previous wells in this immediate area and success of drilling a well in this area is uncertain. A lower elevation well site in this area might provide more economy in terms of water pumping costs but a higher elevation site might be more likely to hit high level aquifer water and/or draw from a higher elevation dike compartment. Road access, power transmission and water transmission to this area would have to be developed. Well drilling and development costs for this project are assumed to be higher than other areas due to the remote location. Project costs include hydrology and engineering studies, road development, well drilling, development including ancillaries, power line and water transmission line, control and contact storage tank and contingencies.

For the 2,250 foot elevation site, production is assumed to be 300,000 GPD. Capitalized costs are $9.3 million. First year electrical energy cost is $2.11 per thousand gallons. The total thirty-year levelized costs are $9.99 per thousand gallons. This cost is comprised of $6.15 capital cost, $0.37 fixed operating and maintenance cost and $3.47 electrical energy cost.

For the 2,750 foot elevation site costs are slightly higher. Production is also assumed to be 300,000 GPD. Capitalized costs are $9.7 million. First year electrical energy cost is $2.51 per thousand gallons. The total thirty-year levelized costs are $10.96 per thousand gallons. This cost is comprised of $6.40 capital cost, $0.43 fixed operating and maintenance cost and $4.12 electrical energy cost.

FIGURE 5-23. Windward Well at Kehewai Ridge

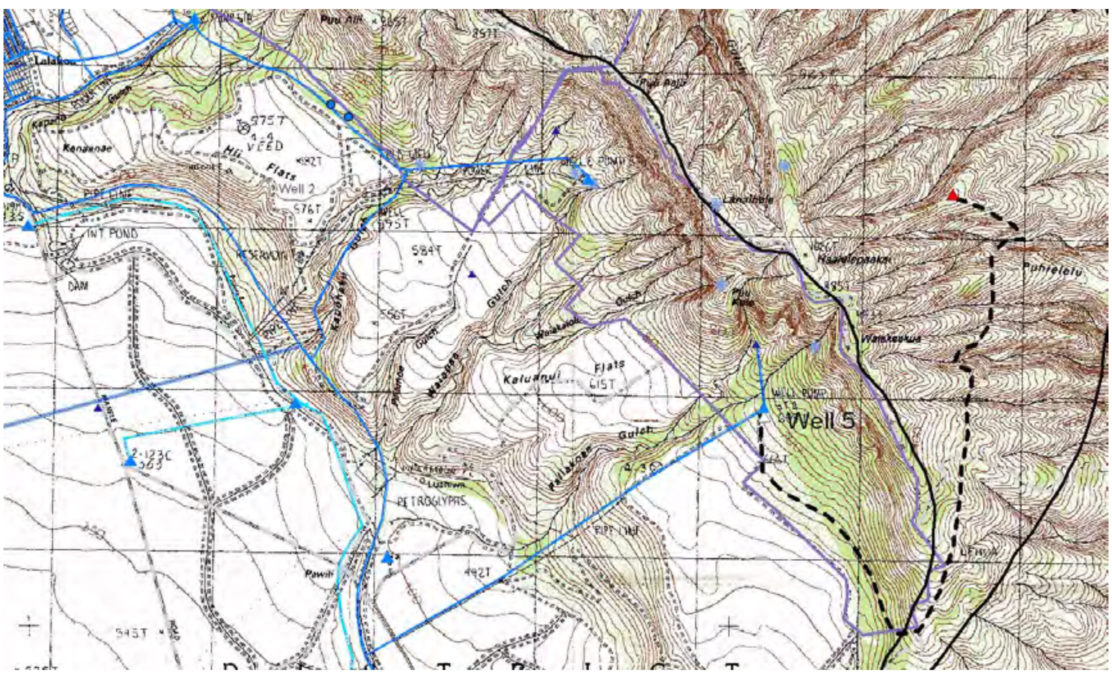


FIGURE 5-24. Windward Well at Kehewai Ridge - 2,250' Elevation

Capacity (MGD)				
Installed Capacity		0.864		
Max. Day Capacity		0.864		
Effective Sustainable Capacity		0.300		
Facility Capacity Factor		100%		
Average Facility Output		0.300		
Capital Costs ($)	Total	Per MGD		
Exploration/Land/Power	$100,000	$333,333	HDA Estimate	Water utility share line extension, electrical controls
Drilling	$1,120,000	$3,733,333	HDA Estimate	(1) well 12" at 1400 ft @ $800 plf
Development	$1,159,000	$3,863,333	HDA Estimate	(1) pump 1 mgd @ $550k, SCADA, ancillaries
Transmission Improvements	$4,950,000	$16,500,000		21,000 ft 8" line @ $200 plf to Well#5 15,000 ft. access road @ $50
Storage Improvements	$250,000	$833,333		50Kgal contact tank; chlorinator
Design / Engineering	$150,000	$500,000	HDA Estimate	Hydrology, siting, well engineering
Contingencies	$1,545,800	$5,152,667	HDA Estimate	20%
Total Plant Cost (	$9,274,800	$30,916,000		
Const. Per. Esc. Rate (Nom.)	3.00%			
AFUDC Interest Rate (Nom.)	6.00%			
AFUDC Factor		1.000		
	Total	Per MGD		
Total Capitalized Cost	$9,274,800	$30,916,000		
Fixed Operating Costs ($)	Per Year	Per Y/MGD		
Dedicated Operating Labor	$5,479	$18,263		$0.05 per kgal based on estimated Lanai average
Apportioned Operating Labor		$0	HDA Estimate	
Maintenance Labor		$0		
Fixed Operating Costs				
Electrical Demand	$22,680	$75,600		5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0		
Maintenance Expenses		$0		
Amort. of Capitalized Rebuild Costs		$0		
Total Fixed Op. Costs	$28,159	$93,863		
Variable Operating Costs ($)		Per KGal		
Operating Labor				
Maintenance Labor				
Electrical Energy		$2.100	HDA calculation	5 kwh per kgal per thousand feet vertical lift @ $.40 per kwh Vertical lift from el 1200' water level to el 2250' wellhead
Chemicals/Materials		$0.008	HDA Estimate	150% Maui system average cost
Maintenance Expenses				
Total Variable Op. Costs		$2.108		
Plant Life (Years)				
Functional Life	30			
Economic/Analysis Life	30			
Book Life	20			
Levelized Production Costs ($)				
Cost of Capital	6.00%			
Discount Rate (Nom.)	6.00%			
Fixed Op.Cost Esc. Rate (Nom.)	3.00%			
Effective Fixed Op.Cost Disc. Rate	2.91%			
Var. Op.Cost Esc. Rate (Nom.)	4.00%			
Effective Var. Op.Cost Disc. Rate	1.92%			
		$/kgal		
First Year Cost w/Amortized Capital		**$9.744**		
Amortized Cap. Cost (Book Life)		$7.380		
Fixed Op. Cost		$0.257		
Varible Op. Cost		$2.108		
	NPV $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost	**45.004**	**$10.750**		
Capital Cost (20 year Amort.)	30.916	$7.380		
Fixed Op. Cost	1.408	$0.336		
Varible Op. Cost	12.681	$3.027		
	NPV $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost	**50.200**	**$9.992**		
Capital Cost (Amort. per Econ. Life)	30.916	$6.149		
Fixed Op. Cost	1.861	$0.370		
Varible Op. Cost	17.424	$3.466		

FIGURE 5-25. Windward Well at Kehewai Ridge - 2,750' Elevation

Capacity (MGD)				
Installed Capacity		0.864		
Max. Day Capacity		0.864		
Effective Sustainable Capacity		0.300		
Facility Capacity Factor		100%		
Average Facility Output		0.300		
Capital Costs ($)	Total	Per MGD		
Exploration/Land/Power	$100,000	$333,333	HDA Estimate	Water utility share line extension, electrical controls
Drilling	$1,440,000	$4,800,000	HDA Estimate	(1) well 12" at 1800 ft @ $800 plf
Development	$1,159,000	$3,863,333	HDA Estimate	(1) pump 1 mgd @ $550k, SCADA, ancillaries
Transmission Improvements	$4,950,000	$16,500,000		21,000 ft 8" line @ $200 plf to Well#5 15,000 ft. access road @ $50
Storage Improvements	$250,000	$833,333		50Kgal contact tank; chlorinator
Design / Engineering	$150,000	$500,000	HDA Estimate	Hydrology, siting, well engineering
Contingencies	$1,609,800	$5,366,000	HDA Estimate	20%
Total Plant Cost (	$9,658,800	$32,196,000		
Const. Per. Esc. Rate (Nom.)	3.00%			
AFUDC Interest Rate (Nom.)	6.00%			
AFUDC Factor		1.000		
	Total	Per MGD		
Total Capitalized Cost	$9,658,800	$32,196,000		
Fixed Operating Costs ($)	Per Year	Per Y/MGD		
Dedicated Operating Labor	$5,479	$18,263		$0.05 per kgal based on estimated Lanai average
Apportioned Operating Labor		$0	HDA Estimate	
Maintenance Labor		$0		
Fixed Operating Costs				
Electrical Demand	$27,000	$90,000		5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0		
Maintenance Expenses		$0		
Amort. of Capitalized Rebuild Costs		$0		
Total Fixed Op. Costs	$32,479	$108,263		
Variable Operating Costs ($)		Per KGal		
Operating Labor				
Maintenance Labor				
Electrical Energy		$2.500	HDA calculation	5 kwh per kgal per thousand feet vertical lift @ $.40 per kwh Vertical lift from el 1500' water level to el 2750' wellhead
Chemicals/Materials		$0.008	HDA Estimate	150% Maui system average cost
Maintenance Expenses				
Total Variable Op. Costs		$2.508		
Plant Life (Years)				
Functional Life	30			
Economic/Analysis Life	30			
Book Life	20			
Levelized Production Costs ($)				
Cost of Capital	6.00%			
Discount Rate (Nom.)	6.00%			
Fixed Op.Cost Esc. Rate (Nom.)	3.00%			
Effective Fixed Op.Cost. Disc. Rate	2.91%			
Var. Op.Cost Esc. Rate (Nom.)	4.00%			
Effective Var. Op.Cost. Disc. Rate	1.92%			
		$/kgal		
First Year Cost w/Amortized Capital		**$10.489**		
Amortized Cap. Cost (Book Life)		$7.685		
Fixed Op. Cost		$0.296		
Varible Op. Cost		$2.508		
	NPV $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost	**48.907**	**$11.682**		
Capital Cost (20 year Amort.)	32.196	$7.685		
Fixed Op. Cost	1.624	$0.388		
Varible Op. Cost	15.087	$3.601		
	NPV $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost	**55.073**	**$10.962**		
Capital Cost (Amort. per Econ. Life)	32.196	$6.404		
Fixed Op. Cost	2.146	$0.427		
Varible Op. Cost	20.731	$4.123		

New Brackish Wells with Mixing to Provide Additional Potable Supply

New wells that provide water with chloride levels marginally below water drinking standards could be mixed with fresher water to increase total potable water supply. This would require sufficient transmission, storage and control infrastructure to guarantee adequate mixing of brackish and potable water sources.

The costs of implementing this approach would include the same components as new potable wells with the addition of any necessary improvements required to assure adequate mixing.

New Brackish Well for Irrigation Use Without Treatment

For non-potable water needs a well could be developed in the leeward lower level aquifer area. There are existing plans to drill a well (proposed Well 15) about 4000 feet southeast of Well 1 at an elevation of 1350 feet. It is expected that the aquifer water elevation will be about 700 feet.

The costs of developing the proposed Well 15 were estimated for purposes of comparison with other potential water sources. The project includes engineering, well drilling, development including ancillaries, connection with existing adjacent transmission and contingency. Production was assumed to be 300,000 GPD. Capitalized costs are $2.7 million. First year electrical energy cost is $1.30 per thousand gallons. The total thirty-year levelized costs are $4.16 per thousand gallons. This cost is comprised of $1.76 capital cost, $0.26 fixed operating and maintenance cost and $2.14 electrical energy cost.

FIGURE 5-26. Proposed Brackish Well 15

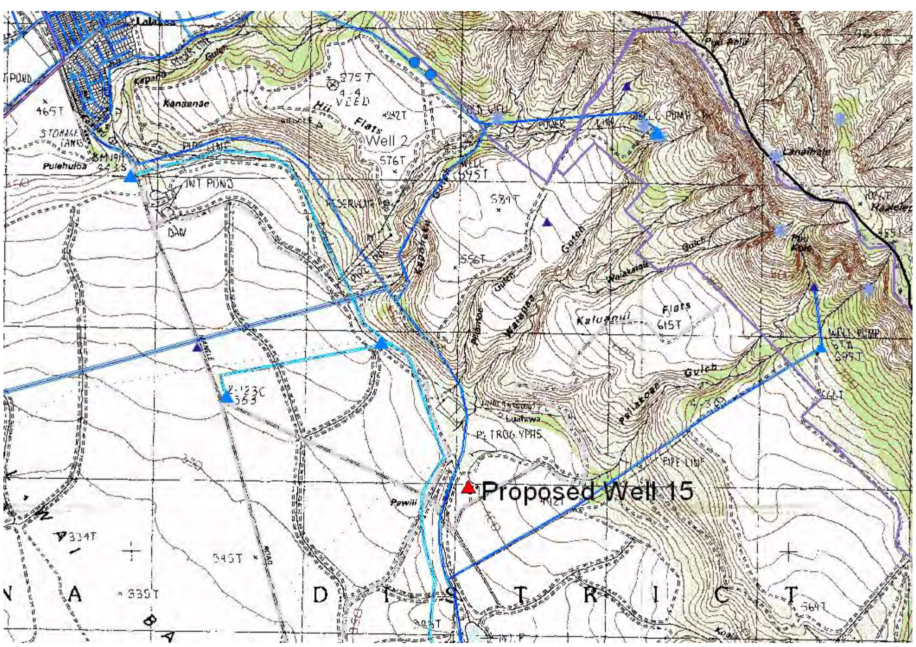


FIGURE 5-27. Proposed Brackish Well 15

Capacity (MGD)				
Installed Capacity		0.864		
Max. Day Capacity		0.864		
Effective Sustainable Capacity		0.300		
Facility Capacity Factor		100%		
Average Facility Output		0.300		
Capital Costs ($)	Total	Per MGD		
Exploration/Land/Power	$5,000	$16,667	HDA Estimate	Connection to existing power line
Drilling	$900,000	$3,000,000	HDA Estimate	(1) well 12" at 1200 ft @ $750 plf
Development	$1,159,000	$3,863,333	HDA Estimate	(1) pump 1 mgd @ $550k, SCADA, ancillaries
Transmission Improvements	$100,000	$333,333		Feeder and connection to existing line
Storage Improvements	$0	$0		
Design / Engineering	$50,000	$166,667	HDA Estimate	Well engineering
Contingencies	$442,800	$1,476,000	HDA Estimate	20%
Total Plant Cost (	$2,656,800	$8,856,000		
Const. Per. Esc. Rate (Nom.)	3.00%			
AFUDC Interest Rate (Nom.)	6.00%			
AFUDC Factor		1.000		
	Total	Per MGD		
Total Capitalized Cost	$2,656,800	$8,856,000		
Fixed Operating Costs ($)	Per Year	Per Y/MGD		
Dedicated Operating Labor	$5,479	$18,263		$0.05 per kgal based on estimated Lanai average
Apportioned Operating Labor		$0	HDA Estimate	
Maintenance Labor		$0		
Fixed Operating Costs				
Electrical Demand	$14,040	$46,800		5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0		
Maintenance Expenses		$0		
Amort. of Capitalized Rebuild Costs		$0		
Total Fixed Op. Costs	$19,519	$65,063		
Variable Operating Costs ($)		Per KGal		
Operating Labor				
Maintenance Labor				
Electrical Energy		$1.300	HDA calculation	5 kwh per kgal per thousand feet vertical lift @ $.40 per kwh Vertical lift from el 700' water level to el 1350' line hyd. hd.
Chemicals/Materials		$0.000		
Maintenance Expenses				
Total Variable Op. Costs		$1.300		
Plant Life (Years)				
Functional Life	30			
Economic/Analysis Life	30			
Book Life	20			
Levelized Production Costs ($)				
Cost of Capital	6.00%			
Discount Rate (Nom.)	6.00%			
Fixed Op.Cost Esc. Rate (Nom.)	3.00%			
Effective Fixed Op.Cost. Disc. Rate	2.91%			
Var. Op.Cost Esc. Rate (Nom.)	4.00%			
Effective Var. Op.Cost. Disc. Rate	1.92%			
		$/kgal		
First Year Cost w/Amortized Capital		**$3.592**		
Amortized Cap. Cost (Book Life)		$2.114		
Fixed Op. Cost		$0.178		
Varible Op. Cost		$1.300		
	NPV $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost	**17.654**	**$4.217**		
Capital Cost (20 year Amort.)	8.856	$2.114		
Fixed Op. Cost	0.976	$0.233		
Varible Op. Cost	7.822	$1.867		
	NPV $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost	**20.894**	**$4.159**		
Capital Cost (Amort. per Econ. Life)	8.856	$1.761		
Fixed Op. Cost	1.290	$0.257		
Varible Op. Cost	10.748	$2.138		

New Brackish Wells with Desalination

Desalination facilities can reduce the chloride level of brackish water to potable drinking standards. The cost of desalination is very dependent on the amount of required reduction in chloride level. Desalinating a brackish water source that is close to potable standards is much less expensive than desalination of seawater.

Cost estimates are documented below for desalination of seawater and 50% seawater to potable standards. Costs for desalination of 50% seawater are about 25% lower than costs for desalination of pure seawater. The cost of desalination of slightly brackish water would be substantially less but cost estimates are not currently available. Costs for this approach would include not only the costs of desalination but also the costs of new well development including the components identified above for new potable well development.

FIGURE 5-28. Desalination of Brackish Water to Potable Quality

Capacity (MGD)				
Installed Capacity		0.250	Towill	
Max. Day Capacity		0.250		
Effective Sustainable Capacity		0.250		
Facility Capacity Factor		100%		
Average Facility Output		0.250		
Capital Costs ($)	Total	Per MGD		
Basic Plant Cost	$3,271,500	$13,086,000	Towill	$2003 Towill estimate escalated to $2007 at 3%
Site Improvements		$0		
Transmission Improvements		$0		
Treatment Improvements		$0		
Storage Improvements		$0		
Engineering Costs		$0		
Contingencies	$0	$0	Towill	Included in capital cost estimate
Total Plant Cost (	$3,271,500	$13,086,000		
Const. Per. Esc. Rate (Nom.)	3.00%			
AFUDC Interest Rate (Nom.)	6.00%			
AFUDC Factor		1.000		
	Total	Per MGD		
Total Capitalized Cost	$3,271,500	$13,086,000		
Fixed Operating Costs ($)	Per Year	Per Y/MGD		
Dedicated Operating Labor	$80,438	$321,750	Towill	O&M. Annual silica cleaning, equipment: escalated to $2007
Apportioned Operating Labor		$0		
Maintenance Labor		$0		
Fixed Operating Costs				
Electrical Demand	$31,160	$124,640	HDA Calculation	5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electric energy cost*installed capacity
Chemicals/Materials		$0		
Maintenance Expenses		$0		
Amort. of Capitalized Rebuild Costs		$0		
Total Fixed Op. Costs	$111,598	$446,390		
Variable Operating Costs ($)		Per KGal		
Operating Labor				
Maintenance Labor				
Electrical Energy		$9.971	Towill / HDA	Towill estimate of energy consumption with HDA estimate of power cost at $0.40 per Kwh
Chemicals/Materials				
Maintenance Expenses				
Total Variable Op. Costs		$9.971		
Plant Life (Years)				
Functional Life	30			
Economic/Analysis Life	30			
Book Life	20			
Levelized Production Costs ($)				
Cost of Capital	6.00%			
Discount Rate (Nom.)	6.00%			
Fixed Op.Cost Esc. Rate (Nom.)	3.00%			
Effective Fixed Op.Cost. Disc. Rate	2.91%			
Var. Op.Cost Esc. Rate (Nom.)	4.00%			
Effective Var. Op.Cost. Disc. Rate	1.92%			
		$/kgal		
First Year Cost w/Amortized Capital		**$14.317**		
Amortized Cap. Cost (Book Life)		$3.124		
Fixed Op. Cost		$1.222		
Varible Op. Cost		$9.971		
	NPV $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost	**79.777**	**$19.056**		
Capital Cost (20 year Amort.)	13.086	$3.124		
Fixed Op. Cost	6.695	$1.598		
Varible Op. Cost	59.996	$14.321		
	NPV $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost	**104.372**	**$20.774**		
Capital Cost (Amort. per Econ. Life)	13.086	$2.603		
Fixed Op. Cost	8.849	$1.760		
Varible Op. Cost	82.437	$16.397		

Desalination of Seawater

Desalination of seawater offers essentially unlimited ultimate source capacity but is more expensive than other available options. Cost estimates for a 250,000 GPD desalination facility are provided below for producing potable water from seawater, producing potable water from 50% seawater and producing slightly brackish water (for irrigation purposes) from seawater.

For a 250,000 GPD facility on Lanaʻi to desalinate seawater to 225 PM chlorides (potable water) the capital cost is estimated to be $3.4 million. First year electrical energy cost is $13.17 per thousand gallons. The total thirty-year levelized costs are $26.29 per thousand gallons. This cost is comprised of $2.69 capital cost, $1.92 operating and maintenance cost and $21.66 electrical energy cost.

For a 250,000 GPD facility on Lanaʻi to desalinate seawater to 400 PM chlorides (non-potable irrigation water) the capital cost is estimated to be $3.3 million. First year electrical energy cost is $6.37 per thousand gallons. The total thirty-year levelized costs are $14.72 per thousand gallons. This cost is comprised of $2.65 capital cost, $1.58 operating and maintenance cost and $10.48 electrical energy cost.

For a 250,000 GPD facility on Lanaʻi to desalinate 50% seawater to 225 PM chlorides (potable water) the capital cost is estimated to be $3.3 million. First year electrical energy cost is $9.97 per thousand gallons. The total thirty-year levelized costs are $20.77 per thousand gallons. This cost is comprised of $2.60 capital cost, $1.76 operating and maintenance cost and $16.40 electrical energy cost.

FIGURE 5-29. Desalination of Seawater to Potable Quality

Capacity (MGD)				
Installed Capacity		0.250	Towill	
Max. Day Capacity		0.250		
Effective Sustainable Capacity		0.250		
Facility Capacity Factor		100%		
Average Facility Output		0.250		
Capital Costs ($)	Total	Per MGD		
Basic Plant Cost	$3,381,750	$13,527,000	Towill	$2003 Towill estimate escalated to $2007 at 3%
Site Improvements		$0		
Transmission Improvements		$0		
Treatment Improvements		$0		
Storage Improvements		$0		
Engineering Costs		$0		
Contingencies	$0	$0	Towill	Included in capital cost estimate
Total Plant Cost (	$3,381,750	$13,527,000		
Const. Per. Esc. Rate (Nom.)	3.00%			
AFUDC Interest Rate (Nom.)	6.00%			
AFUDC Factor		1.000		
	Total	Per MGD		
Total Capitalized Cost	$3,381,750	$13,527,000		
Fixed Operating Costs ($)	Per Year	Per Y/MGD		
Dedicated Operating Labor	$80,438	$321,750	Towill	O&M, Annual silica cleaning, equipment; escalated to $2007
Apportioned Operating Labor		$0		
Maintenance Labor		$0		
Fixed Operating Costs				
Electrical Demand	$41,160	$164,640	HDA Calculation	5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0		
Maintenance Expenses		$0		
Amort. of Capitalized Rebuild Costs		$0		
Total Fixed Op. Costs	$121,598	$486,390		
Variable Operating Costs ($)		Per KGal		
Operating Labor				
Maintenance Labor				
Electrical Energy		$13.171	Towill / HDA	Towill estimate of energy consumption with HDA estimate of power cost at $0.40 per Kwh
Chemicals/Materials				
Maintenance Expenses				
Total Variable Op. Costs		$13.171		
Plant Life (Years)				
Functional Life	30			
Economic/Analysis Life	30			
Book Life	20			
Levelized Production Costs ($)				
Cost of Capital	6.00%			
Discount Rate (Nom.)	6.00%			
Fixed Op.Cost Esc. Rate (Nom.)	3.00%			
Effective Fixed Op.Cost. Disc. Rate	2.91%			
Var. Op.Cost Esc. Rate (Nom.)	4.00%			
Effective Var. Op.Cost. Disc. Rate	1.92%			
		$/kgal		
First Year Cost w/Amortized Capital		**$17.732**		
Amortized Cap. Cost (Book Life)		$3.229		
Fixed Op. Cost		$1.332		
Varible Op. Cost		$13.171		
	NPV $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost	**100.072**	**$23.903**		
Capital Cost (20 year Amort.)	13.527	$3.229		
Fixed Op. Cost	7.295	$1.741		
Varible Op. Cost	79.250	$18.917		
	NPV $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost	**132.062**	**$26.285**		
Capital Cost (Amort. per Econ. Life)	13.527	$2.691		
Fixed Op. Cost	9.642	$1.918		
Varible Op. Cost	108.893	$21.659		

FIGURE 5-30. Desalination of Seawater to Brackish Quality Suitable for Irrigation Use

Capacity (MGD)				
Installed Capacity		0.250	Towill	
Max. Day Capacity		0.250		
Effective Sustainable Capacity		0.250		
Facility Capacity Factor		100%		
Average Facility Output		0.250		
Capital Costs ($)	Total	Per MGD		
Basic Plant Cost	$3,334,500	$13,338,000	Towill	$2,964,000 Towill estimate escalated to $2007 at 3%
Site Improvements		$0		
Transmission Improvements		$0		
Treatment Improvements		$0		
Storage Improvements		$0		
Engineering Costs		$0		
Contingencies	$0	$0	Towill	Included in capital cost estimate
Total Plant Cost (	$3,334,500	$13,338,000		
Const. Per. Esc. Rate (Nom.)	3.00%			
AFUDC Interest Rate (Nom.)	6.00%			
AFUDC Factor		1.000		
	Total	Per MGD		
Total Capitalized Cost	$3,334,500	$13,338,000		
Fixed Operating Costs ($)	Per Year	Per Y/MGD		
Dedicated Operating Labor	$80,438	$321,750	Towill	O&M: Annual silica cleaning, equipment: escalated to $2007
Apportioned Operating Labor		$0		
Maintenance Labor		$0		
Fixed Operating Costs				
Electrical Demand	$19,910	$79,640	HDA Calculation	5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0		
Maintenance Expenses		$0		
Amort. of Capitalized Rebuild Costs		$0		
Total Fixed Op. Costs	$100,348	$401,390		
Variable Operating Costs ($)		Per KGal		
Operating Labor				
Maintenance Labor				
Electrical Energy		$6.371	Towill / HDA	Towill estimate of energy consumption with HDA estimate of power cost at $0.40 per Kwh
Chemicals/Materials				
Maintenance Expenses				
Total Variable Op. Costs		$6.371		
Plant Life (Years)				
Functional Life	30			
Economic/Analysis Life	30			
Book Life	20			
Levelized Production Costs ($)				
Cost of Capital	6.00%			
Discount Rate (Nom.)	6.00%			
Fixed Op.Cost Esc. Rate (Nom.)	3.00%			
Effective Fixed Op.Cost. Disc. Rate	2.91%			
Var. Op.Cost Esc. Rate (Nom.)	4.00%			
Effective Var. Op.Cost. Disc. Rate	1.92%			
		$/kgal		
First Year Cost w/Amortized Capital		**$10.654**		
Amortized Cap. Cost (Book Life)		$3.184		
Fixed Op. Cost		$1.099		
Varible Op. Cost		$6.371		
	NPV $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost	**57.693**	**$13.781**		
Capital Cost (20 year Amort.)	13.338	$3.184		
Fixed Op. Cost	6.020	$1.437		
Varible Op. Cost	38.335	$9.151		
	NPV $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost	**73.969**	**$14.723**		
Capital Cost (Amort. per Econ. Life)	13.338	$2.653		
Fixed Op. Cost	7.957	$1.583		
Varible Op. Cost	52.674	$10.477		

Supply and Demand Side Efficiency Options

Total water system demand needs can be met by supply side efficiency options or measures, such as increasing supply, or reducing losses; or by demand-side measures, aimed at reducing water needs. These options are sometimes called Demand Side Measures (DSM) and Supply Side Measures (SSM).

Leak Detection and Repair

Leak detection programs can reduce water system losses. Reducing losses reduces water system operating expenses and expands available deliverable production capacity. Leak detection efforts are effective on both the customer and the utility “side of the meter.” Leak detection efforts on the customer premises can be implemented as a DSM program. Leak detection efforts for the water supply system can be implemented as an ongoing maintenance program or as a specifically commissioned project.

Unaccounted-for Water Auditing

Unaccounted-for water analysis is good utility practice. Whether such unaccounted-for water represents actual system losses or merely un-metered uses, a regular audit and examination of unaccounted-for water can help to identify problem areas.   Regular unaccounted-for water auditing could be made easier by certain changes to the Periodic Water Report. In order to arrive at unccounted-for water, meter pumpage and consumption meter read dates had to be reconciled.   These could both be reported on a monthly basis. This was the practice prior to 1981. In addition, summarized subtotals, rather than being reported by “Lana‘i City”, “Manele, Aoki Diversified Agriculture and Ag Activities Near the Airport”, and Kaumalapau, could be reported by the 5 districts noted in this document, which represent distinct sets of sources and pressure zones. These are Lana‘i City and surrounding areas (LCTY); Koele Project District area (KOPD), Palawai Irrigation Grid (IGGP), Manele Project District area (MNPD), and Kaumalapau (KPAU). Sources for each of these areas should be noted in the reports in such a way that these can be distinguished. It would also be useful to regularly subtotal estimated irrigation use in each district and from each set of sources, versus domestic use.

Pipe Replacement

In the course of seeking the causes of unaccounted-for water described in the previous chapter, several old and leaking pipes were identified. Some of these may create significant system loss. The most dramatic example of such potential is the Palawai Grid line. Repair of this line is estimated to result in over 200,000 GPD in savings. A list of pipe repair priorities totalling roughly twelve million was generated and is included in the capital program and discussion later in this chapter.

Use of Reclaimed Water

As discussed previously, sufficient reclaimed water availability to offset between 400,000 and 600,000 GPD or more of potable or brackish use is seen as likely during the planning period. A number of options for reclaimed use are considered in the section to follow, ranging from use of 60,000 GPD to 500,000 GPD.

Pipe Replacement to Reduce System Losses

Unaccounted-for water analysis in the previous chapter led to examination of the source value of pipe replacements in the Palawai Grid. Unaccounted-for water in this area was 44.61% in 2008. To the extent that this represents losses rather than un-metered uses, this represents substantial and expensive operating loss for this service area.

Several options were considered for repairs in this area. For evaluation on a levelized cost basis, the capital cost of this replacement is estimated at about $3.8 million dollars. Water savings are estimated at 202,000 GPD. First year electrical energy savings are $1.49 per thousand gallons. The total thirty-year levelized costs are $2.34 per thousand gallons. This cost is comprised of $4.54 in capital costs, a savings of $.07 in operating and maintenance cost and a savings of $2.14 in electrical energy cost.

FIGURE 5-31. Palawai Grid Pipe Replacement

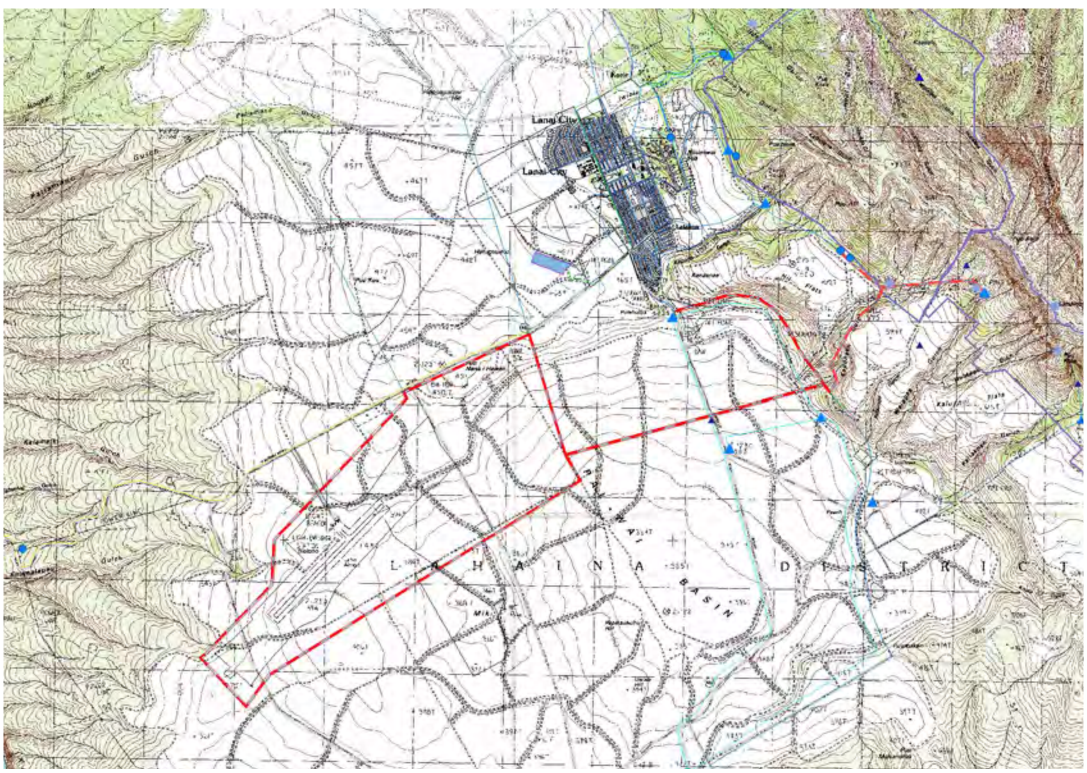


FIGURE 5-32. Palawai Grid Pipe Replacement

Capacity (MGD)				
Installed Capacity		0.202		
Max. Day Capacity		0.202		
Effective Sustainable Capacity		0.202		
Facility Capacity Factor		100%		
Average Facility Output		0.202		
Capital Costs ($)	Total	Per MGD		
Exploration/Land/Power	$0	$0		
Refurbish well site	$0	$0		
Development	$0	$0		
Transmission Improvements	$3,200,000	$15,841,584		Per CIP Pipe Replacement Estimate
Storage Improvements	$0	$0		
Design / Engineering	$0	$0		
Contingencies	$640,000	$3,168,317		20%
Total Plant Cost (	$3,840,000	$19,009,901		
Const. Per. Esc. Rate (Nom.)	3.00%			
AFUDC Interest Rate (Nom.)	6.00%			
AFUDC Factor		1.000		
	Total	Per MGD		
Total Capitalized Cost	$3,840,000	$19,009,901		
Fixed Operating Costs ($)	Per Year	Per Y/MGD		
Dedicated Operating Labor		$0		$0.05 per kgal based on estimated Lanai average
Apportioned Operating Labor		$0		
Maintenance Labor		$0		
Fixed Operating Costs				
Electrical Demand	-$3,737	-$18,500		5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0		
Maintenance Expenses		$0		
Amort. of Capitalized Rebuild Costs		$0		
Total Fixed Op. Costs	-$3,737	-$18,500		
Variable Operating Costs ($)		Per KGal		
Operating Labor				
Maintenance Labor				
Electrical Energy		-$1.480	HDA calculation	Per Well Production Cost Spreadsheet
Chemicals/Materials		-$0.008	HDA Estimate	150% Maui system average cost
Maintenance Expenses				
Total Variable Op. Costs		-$1.488		
Plant Life (Years)				
Functional Life	20			
Economic/Analysis Life	20			
Book Life	20			
Levelized Production Costs ($)				
Cost of Capital	6.00%			
Discount Rate (Nom.)	6.00%			
Fixed Op.Cost Esc. Rate (Nom.)	3.00%			
Effective Fixed Op.Cost. Disc. Rate	2.91%			
Var. Op.Cost Esc. Rate (Nom.)	4.00%			
Effective Var. Op.Cost. Disc. Rate	1.92%			
		$/kgal		
First Year Cost w/Amortized Capital		**$2.999**		
Amortized Cap. Cost (Book Life)		$4.538		
Fixed Op. Cost		-$0.051		
Varible Op. Cost		-$1.488		
	NPV $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost	**9.782**	**$2.337**		
Capital Cost (20 year Amort.)	19.010	$4.538		
Fixed Op. Cost	-0.277	-$0.066		
Varible Op. Cost	-8.950	-$2.136		
	NPV $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost	**9.782**	**$2.337**		
Capital Cost (Amort. per Econ. Life)	19.010	$4.538		
Fixed Op. Cost	-0.277	-$0.066		
Varible Op. Cost	-8.950	-$2.136		

Covering Open Reservoirs to Reduce Evaporative Losses

Open reservoirs lose water due to evaporation. Estimates for evaporative losses for reservoirs in Hawaii are typically 1/4” per day. Several types of reservoir covers are available. Floating covers are less expensive than structural “roof” covers but require more maintenance and more frequent replacement.

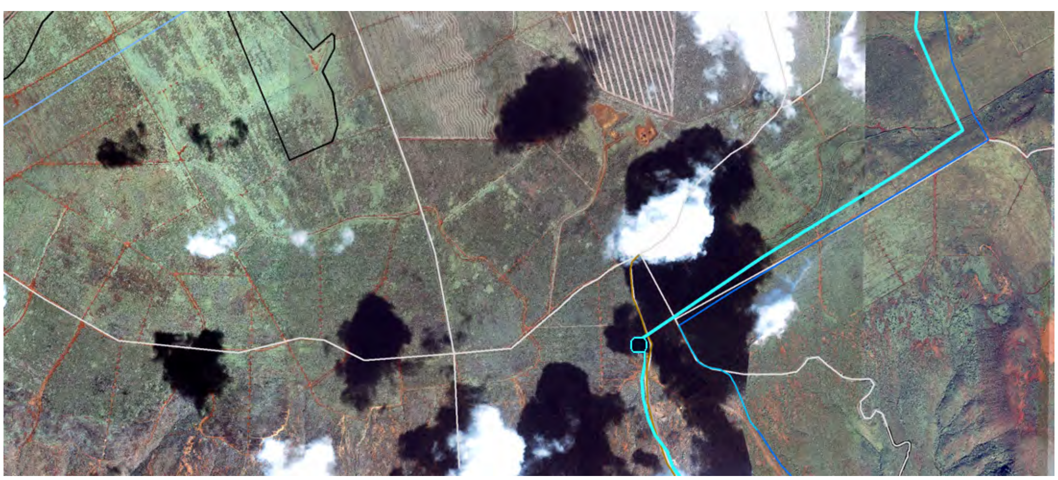
Life cycle costs were estimated for both floating and structural aluminum covers for the 15 MG Manele Reservoir. Cost estimates for installation on Lana’i were obtained from suppliers and Hawaii installers. The Manele Reservoir loses about 17,000 GPDGPD to evaporation. The analysis assumes that covering the reservoir would completely eliminate evaporative losses and would allow precipitation to continue to enter the reservoir.

For a floating reservoir installed costs, including engineering, site and foundation work, materials, installation and contingency, would be about $366,000. The cover is assumed to have a functional life of 10 years. No fixed operating or variable costs are assumed. The total ten-year levelized unit costs would be $10.31 per thousand gallons of reduced losses.

For a structural aluminum roof cover, installed costs, including engineering, site and foundation work, materials, installation and contingency, would be about $4.0 million. The cover is assumed to have a functional life of 30 years. No fixed operating or variable costs are assumed. The total thirty-year levelized unit costs would be $60.67 per thousand gallons of reduced losses.

An additional option evaluated involved the use of Hypalon balls to form a non-structural floating cover. This project was evaluated at roughly $450,000 for materials and an additional $45,000 for contingencies, for a total of $495,000. This cover was somewhat more cost-effective than other cover options. The total lifetime levelized cost of this option would be $13.14 per thousand gallons of reduced losses.

FIGURE 5-33. **Hi‘i Reservoir Cover**



Supply and Demand Side Efficiency Options

FIGURE 5-34. Floating Cover For Hi'i Reservoir

Capacity (MGD)				
Installed Capacity		0.017		Avoided evaporative losses for 10,000 sq meters @ 1/4"/day
Max. Day Capacity		0.017		
Effective Sustainable Capacity		0.013		80% average reservoir surface area
Facility Capacity Factor		100%		
Average Facility Output		0.013		
Capital Costs ($)	Total	Per MGD		
Design / Engineering	$5,000	$378,788	HDA Estimate	
Cover and anchoring system	$317,308	$24,038,462	Quote from Lemna	Lump sum estimate from manufacturer; 10,000 sq. meters cover adjusted from quote on 13,000 sp. meter cover @
Site Improvements and Installation	$10,000	$757,576	HDA Estimate	
		$0		
		$0		
		$0		
Contingencies	$33,231	$2,517,483	HDA Estimate	10%
Total Plant Cost (	$365,538	$27,692,308		
Const. Per. Esc. Rate (Nom.)	3.00%			
AFUDC Interest Rate (Nom.)	6.00%			
AFUDC Factor		1.000		
	Total	Per MGD		
Total Capitalized Cost	$365,538	$27,692,308		
Fixed Operating Costs ($)	Per Year	Per Y/MGD		
Dedicated Operating Labor		$0		
Apportioned Operating Labor		$0		
Maintenance Labor		$0		
Fixed Operating Costs				
Electrical Demand		$0		
Chemicals/Materials		$0		
Maintenance Expenses		$0		
Amort. of Capitalized Rebuild Costs		$0		
Total Fixed Op. Costs	$0	$0		
Variable Operating Costs ($)		Per KGal		
Operating Labor				
Maintenance Labor				
Electrical Energy				
Chemicals/Materials				
Maintenance Expenses				
Total Variable Op. Costs		$0.000		
Plant Life (Years)				
Functional Life	10			
Economic/Analysis Life	10			
Book Life	10			
Levelized Production Costs ($)				
Cost of Capital	6.00%			
Discount Rate (Nom.)	6.00%			
Fixed Op.Cost Esc. Rate (Nom.)	3.00%			
Effective Fixed Op.Cost. Disc. Rate	2.91%			
Var. Op.Cost Esc. Rate (Nom.)	4.00%			
Effective Var. Op.Cost. Disc. Rate	1.92%			
		$/kgal		
First Year Cost w/Amortized Capital		**$10.301**		
Amortized Cap. Cost (Book Life)		$10.301		
Fixed Op. Cost		$0.000		
Varible Op. Cost		$0.000		
	NPV $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost	**27.692**	**$6.615**		
Capital Cost (20 year Amort.)	27.692	$6.610		
Fixed Op. Cost	0.000	$0.000		
Varible Op. Cost	0.000	$0.000		
	NPV $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost	**27.692**	**$10.308**		
Capital Cost (Amort. per Econ. Life)	27.692	$10.301		
Fixed Op. Cost	0.000	$0.000		
Varible Op. Cost	0.000	$0.000		

FIGURE 5-35. Aluminum Cover for Hi‘i Reservoir

Capacity (MGD)				
Installed Capacity		0.017		Avoided evaporative losses for 10,000 sq meters @ 1/4"/day
Max. Day Capacity		0.017		
Effective Sustainable Capacity		0.013		80% average reservoir surface area
Facility Capacity Factor		100%		
Average Facility Output		0.013		
Capital Costs ($)	Total	Per MGD		
Lump Sum Project Estimate	$3,657,856	$277,110,303	Quote from Temcor and Hawaii Rep.	Lump sum estimate from manufacturer; 10,000 sq. meters area covered by aluminum low dome structure
		$0		
		$0		
		$0		
Contingencies	$365,786	$27,711,030	HDA Estimate	10%
Total Plant Cost (	$4,023,642	$304,821,333		
Const. Per. Esc. Rate (Nom.)	3.00%			
AFUDC Interest Rate (Nom.)	6.00%			
AFUDC Factor		1.000		
	Total	Per MGD		
Total Capitalized Cost	$4,023,642	$304,821,333		
Fixed Operating Costs ($)	Per Year	Per Y/MGD		
Dedicated Operating Labor		$0		
Apportioned Operating Labor		$0		
Maintenance Labor		$0		
Fixed Operating Costs				
Electrical Demand		$0		
Chemicals/Materials		$0		
Maintenance Expenses		$0		
Amort. of Capitalized Rebuild Costs		$0		
Total Fixed Op. Costs	$0	$0		
Variable Operating Costs ($)		Per KGal		
Operating Labor				
Maintenance Labor				
Electrical Energy				
Chemicals/Materials				
Maintenance Expenses				
Total Variable Op. Costs		$0.000		
Plant Life (Years)				
Functional Life	30			
Economic/Analysis Life	30			
Book Life	30			
Levelized Production Costs ($)				
Cost of Capital	6.00%			
Discount Rate (Nom.)	6.00%			
Fixed Op.Cost Esc. Rate (Nom.)	3.00%			
Effective Fixed Op Cost Disc Rate	2.91%			
Var. Op.Cost Esc. Rate (Nom.)	4.00%			
Effective Var. Op Cost Disc. Rate	1.92%			
		$/kgal		
First Year Cost w/Amortized Capital		**$60.630**		
Amortized Cap. Cost (Book Life)		$60.630		
Fixed Op. Cost		$0.000		
Varible Op. Cost		$0.000		
	NPV $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost	**304.821**	**$72.810**		
Capital Cost (20 year Amort.)	304.821	$72.760		
Fixed Op. Cost	0.000	$0.000		
Varible Op. Cost	0.000	$0.000		
	NPV $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost	**304.821**	**$60.671**		
Capital Cost (Amort. per Econ. Life)	304.821	$60.630		
Fixed Op. Cost	0.000	$0.000		
Varible Op. Cost	0.000	$0.000		

FIGURE 5-36. Hypalon Balls - Cover for Hi'i Reservoir

Capacity (MGD)				
Installed Capacity		0.017		Avoided evaporative losses for 10,000 sq.meters @ 1/4"/day
Max. Day Capacity		0.017		
Effective Sustainable Capacity		0.014		85% reduction in evaporative losses
Facility Capacity Factor		100%		
Average Facility Output		0.014		
Capital Costs ($)	Total	Per MGD		
Lump Sum Project Estimate	$450,000	$32,085,561	Lump Sum Quote	Lump Sum Quote for materials delivered to site per LWCI
		$0		
		$0		
		$0		
Contingencies	$45,000	$3,208,556	HDA Estimate	10%
Total Plant Cost (	$495,000	$35,294,118		
Const. Per. Esc. Rate (Nom.)	3.00%			
AFUDC Interest Rate (Nom.)	6.00%			
AFUDC Factor		1.000		
	Total	Per MGD		
Total Capitalized Cost	$495,000	$35,294,118		
Fixed Operating Costs ($)	Per Year	Per Y/MGD		
Dedicated Operating Labor		$0		
Apportioned Operating Labor		$0		
Maintenance Labor		$0		
Fixed Operating Costs				
Electrical Demand		$0		
Chemicals/Materials		$0		
Maintenance Expenses		$0		
Amort. of Capitalized Rebuild Costs		$0		
Total Fixed Op. Costs	$0	$0		
Variable Operating Costs ($)		Per KGal		
Operating Labor				
Maintenance Labor				
Electrical Energy				
Chemicals/Materials				
Maintenance Expenses				
Total Variable Op. Costs		$0.000		
Plant Life (Years)				
Functional Life	10			
Economic/Analysis Life	10			
Book Life	10			
Levelized Production Costs ($)				
Cost of Capital	6.00%			
Discount Rate (Nom.)	6.00%			
Fixed Op.Cost Esc. Rate (Nom.)	3.00%			
Effective Fixed Op.Cost Disc. Rate	2.91%			
Var. Op.Cost Esc. Rate (Nom.)	4.00%			
Effective Var. Op.Cost Disc. Rate	1.92%			
		$/kgal		
First Year Cost w/Amortized Capital		**$13.129**		
Amortized Cap. Cost (Book Life)		$13.129		
Fixed Op. Cost		$0.000		
Varible Op. Cost		$0.000		
	NPV $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost	**35.294**	**$8.430**		
Capital Cost (20 year Amort.)	35.294	$8.425		
Fixed Op. Cost	0.000	$0.000		
Varible Op. Cost	0.000	$0.000		
	NPV $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost	**35.294**	**$13.138**		
Capital Cost (Amort. per Econ. Life)	35.294	$13.129		
Fixed Op. Cost	0.000	$0.000		
Varible Op. Cost	0.000	$0.000		

Reclaimed Water Use

Three options were examined for utilization of “excess” reclaimed water from Lana‘i City to offset potable or brackish irrigation use. These were: utilizing reclaimed water for irrigation of the planned Miki Industrial Park; sending “excess” reclaimed water from Lana‘i City directly to Manele for irrigation use; and a two-stage project in which reclaimed water is piped to Miki Basin in Phase I and from Miki onward to Manele in Phase II.

Estimated costs for a recycled line to Miki Basin, included transmission and contingency in the amount of $1,536,000 for an assumed use of about 60,000 GPD, and a thirty year functional life. First year energy costs are approximately $0.40 per thousand gallons. For 60,000 GPD of reclaimed water, the total thirty-year levelized cost is $5.77 per thousand gallons. This cost is comprised of $5.09 in capital cost, $0.02 operating and maintenance cost and about $0.66 in energy costs per thousand gallons.

The cost of a recycled water line to Manele was estimated at $16,896,000, comprised of $10,000,000 in treatment plant upgrade, $4.08 million in transmission and $2.82 million in contingencies. The functional life of this project is estimated at thirty years. First year energy costs are estimated at about $0.40 per thousand gallons. For an assumed 500,000 GPD, the total costs per thousand gallons are $7.40, comprised of $6.72 in capital costs, $0.02 in operating and maintenance and about $0.66 in energy costs per thousand gallons.

A Phase I line to Miki Basin, to be followed by connection to Manele is slightly more expensive to install, due to the extra size. The estimated capital costs is $2,304,000 including transmission and contingencies. The amount of production is still assumed to be about 60,000 GPD. The functional life of the project is estimated at thirty years. First year energy costs are estimated at about $0.40 per thousand gallons. For an assumed 60,000 GPD, the total costs per thousand gallons are $8.32, comprised of $7.64 in capital costs, $0.02 in operating and maintenance and about $0.66 in energy costs per thousand gallons.

Phase II of this project, from Miki Basin to Manele would cost an estimated $15,456,000, including $10,000,000 in treatment plant upgrade, $2,880,000 in transmission and $2,576,000 in contingencies. The project is presumed to send 440,000 GPD to Manele, with a functional life of thirty years. First year energy costs are estimated at about $0.40 per thousand gallons. The total costs per thousand gallons is $7.66, comprised of $6.99 in capital costs, $0.02 in operating and maintenance and about $0.66 in energy costs per thousand gallons.

Supply and Demand Side Efficiency Options

FIGURE 5-37. Reclaimed Water Line from Lana'i City to Miki Basin

Capacity (MGD)					
Installed Capacity			0.060		
Max. Day Capacity			0.060		
Effective Sustainable Capacity			0.060		
Facility Capacity Factor			100%		
Average Facility Output			0.060		
		Total	Per MGD		
Capital Costs ($2002)					
WWTP R-1 Upgrade		$0	$0		
			$0		
			$0		
Transmission		$1,280,000	$21,333,333	HDA Estimate	16000lf@$80plf for transmission, assumes no marginal distribution cost at Miki Basin (new project area)
			$0		
			$0		
Contingencies		$256,000	$4,266,667	HDA Estimate	20%
Total Plant Cost (		$1,536,000	$25,600,000		
Expenditure Pattern	Year	Nom	Normalized		
	Serv Date	1	100.0%		
	-1	0	0.0%		
	-2	0	0.0%		
	-3	0	0.0%		
	-4	0	0.0%		
	-5	0	0.0%		
	-6	0	0.0%		
	-7	0	0.0%		
	-8	0	0.0%		
Const. Per. Esc. Rate (Nom.)		3.00%			
AFUDC Interest Rate (Nom.)		6.00%			
AFUDC Factor			1.000		
		Total	Per MGD		
Total Capitalized Cost		$1,536,000	$25,600,000		
		Per Year	Per Y/MGD		
Fixed Operating Costs ($2002)					
Dedicated Operating Labor		$0	$0		
Apportioned Operating Labor			$0		
Maintenance Labor			$0		
Fixed Operating Costs					
Electrical Demand		$248	$4,140		5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials			$0		
Maintenance Expenses			$0		
Amort. of Capitalized Rebuild Costs			$0		
Total Fixed Op. Costs		$248	$4,140		
			Per KGal		
Variable Operating Costs ($2002)					
Operating Labor					
Maintenance Labor					
Electrical Energy			$0.331	HDA per DEM	FY04 Reuse Elec Cost $123,110 for 536,003 Kgal Increased by 45% to reflect $2008 $0.34/KWH de-escalated to $2004
Chemicals/Materials			$0.050	HDA per DEM	FY04 UV Bulbs and Muriatic Acid
Maintenance Expenses			$0.017	HDA per DEM	FY04 Expenses $9,674 for 536,003 Kgal
Total Variable Op. Costs			$0.398		
Plant Life (Years)					
Functional Life		30			
Economic/Analysis Life		30			
Book Life		20			
Levelized Production Costs ($2002)					
Cost of Capital		6.00%			
Discount Rate (Nom.)		6.00%			
Fixed Op.Cost Esc. Rate (Nom.)		3.00%			
Effective Fixed Op.Cost. Disc. Rate		2.91%			
Var. Op.Cost Esc. Rate (Nom.)		4.00%			
Effective Var. Op.Cost. Disc. Rate		1.92%			
			$/kgal		
First Year Cost w/Amortized Capital			**$6.520**		
Amortized Cap. Cost (Book Life)			$6.111		
Fixed Op. Cost			$0.011		
Varible Op. Cost			$0.398		
		NPV2002 $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost		**28.058**	**$6.702**		
Capital Cost (20 year Amort.)		25.600	$6.111		
Fixed Op. Cost		0.062	$0.015		
Varible Op. Cost		2.395	$0.572		
		NPV2002 $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost		**28.974**	**$5.767**		
Capital Cost (Amort. per Econ. Life)		25.600	$5.092		
Fixed Op. Cost		0.082	$0.016		
Varible Op. Cost		3.291	$0.655		

FIGURE 5-38. Reclaimed Water Line to Manele

Capacity (MGD)					
Installed Capacity			0.500		
Max. Day Capacity			0.500		
Effective Sustainable Capacity			0.500		
Facility Capacity Factor			100%		
Average Facility Output			0.500		
Capital Costs ($2002)		Total	Per MGD		
WWTP R-1 Upgrade		$10,000,000	$20,000,000	DEM Rough Estimate	
			$0		
			$0		
Transmission		$4,080,000	$8,160,000	HDA Estimate	34000lf@$120plf for transmission, assumes no marginal distribution cost at Manele (new project area)
			$0		
			$0		
Contingencies		$2,816,000	$5,632,000	HDA Estimate	20%
Total Plant Cost (		$16,896,000	$33,792,000		
Expenditure Pattern	Year	Nom	Normalized		
	Serv Date	1	100.0%		
	-1	0	0.0%		
	-2	0	0.0%		
	-3	0	0.0%		
	-4	0	0.0%		
	-5	0	0.0%		
	-6	0	0.0%		
	-7	0	0.0%		
	-8	0	0.0%		
Const. Per. Esc. Rate (Nom.)		3.00%			
AFUDC Interest Rate (Nom.)		6.00%			
AFUDC Factor			1.000		
		Total	Per MGD		
Total Capitalized Cost		$16,896,000	$33,792,000		
Fixed Operating Costs ($2002)		Per Year	Per Y/MGD		
Dedicated Operating Labor		$0	$0		
Apportioned Operating Labor			$0		
Maintenance Labor			$0		
Fixed Operating Costs					
Electrical Demand		$2,070	$4,140		5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials			$0		
Maintenance Expenses			$0		
Amort. of Capitalized Rebuild Costs			$0		
Total Fixed Op. Costs		$2,070	$4,140		
Variable Operating Costs ($2002)			Per KGal		
Operating Labor					
Maintenance Labor					
Electrical Energy			$0.331	HDA per DEM	FY04 Reuse Elec Cost $123,110 for 536,003 Kgal Increased by 45% to reflect $2008 $0.34/KWH de-escalated to $2004
Chemicals/Materials			$0.050	HDA per DEM	FY04 UV Bulbs and Muriatic Acid
Maintenance Expenses			$0.017	HDA per DEM	FY04 Expenses $9,674 for 536,003 Kgal
Total Variable Op. Costs			$0.398		
Plant Life (Years)					
Functional Life		30			
Economic/Analysis Life		30			
Book Life		20			
Levelized Production Costs ($2002)					
Cost of Capital		6.00%			
Discount Rate (Nom.)		6.00%			
Fixed Op.Cost Esc. Rate (Nom.)		3.00%			
Effective Fixed Op.Cost. Disc. Rate		2.91%			
Var. Op.Cost Esc. Rate (Nom.)		4.00%			
Effective Var. Op.Cost. Disc. Rate		1.92%			
			$/kgal		
First Year Cost w/Amortized Capital			**$8.476**		
Amortized Cap. Cost (Book Life)			$8.066		
Fixed Op. Cost			$0.011		
Varible Op. Cost			$0.398		
		NPV2002 $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost		**36.250**	**$8.659**		
Capital Cost (20 year Amort.)		33.792	$8.066		
Fixed Op. Cost		0.062	$0.015		
Varible Op. Cost		2.395	$0.572		
		NPV2002 $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost		**37.166**	**$7.397**		
Capital Cost (Amort. per Econ. Life)		33.792	$6.721		
Fixed Op. Cost		0.082	$0.016		
Varible Op. Cost		3.291	$0.655		

Supply and Demand Side Efficiency Options

FIGURE 5-39. Reclaimed Water Line to Miki as Phase I of Project to Manele

Capacity (MGD)					
Installed Capacity			0.060		
Max. Day Capacity			0.060		
Effective Sustainable Capacity			0.060		
Facility Capacity Factor			100%		
Average Facility Output			0.060		
Capital Costs ($2002)		Total	Per MGD		
WWTP R-1 Upgrade		$0	$0		
			$0		
			$0		
Transmission		$1,920,000	$32,000,000	HDA Estimate	16000lf@$120plf for transmission, assumes no marginal distribution cost at Miki Basin (new project area)
			$0		
			$0		
Contingencies		$384,000	$6,400,000	HDA Estimate	20%
Total Plant Cost (		$2,304,000	$38,400,000		
Expenditure Pattern	Year	Nom	Normalized		
	Serv Date	1	100.0%		
	-1	0	0.0%		
	-2	0	0.0%		
	-3	0	0.0%		
	-4	0	0.0%		
	-5	0	0.0%		
	-6	0	0.0%		
	-7	0	0.0%		
	-8	0	0.0%		
Const. Per. Esc. Rate (Nom.)		3.00%			
AFUDC Interest Rate (Nom.)		6.00%			
AFUDC Factor			1.000		
		Total	Per MGD		
Total Capitalized Cost		$2,304,000	$38,400,000		
Fixed Operating Costs ($2002)		Per Year	Per Y/MGD		
Dedicated Operating Labor		$0	$0		
Apportioned Operating Labor			$0		
Maintenance Labor			$0		
Fixed Operating Costs					
Electrical Demand		$248	$4,140		5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials			$0		
Maintenance Expenses			$0		
Amort. of Capitalized Rebuild Costs			$0		
Total Fixed Op. Costs		$248	$4,140		
Variable Operating Costs ($2002)			Per KGal		
Operating Labor					
Maintenance Labor					
Electrical Energy			$0.331	HDA per DEM	FY04 Reuse Elec Cost $123,110 for 536,003 Kgal Increased by 45% to reflect $2008 $0.34/KWH de-escalated to $2004
Chemicals/Materials			$0.050	HDA per DEM	FY04 UV Bulbs and Muriatic Acid
Maintenance Expenses			$0.017	HDA per DEM	FY04 Expenses $9,674 for 536,003 Kgal
Total Variable Op. Costs			$0.398		
Plant Life (Years)					
Functional Life		30			
Economic/Analysis Life		30			
Book Life		20			
Levelized Production Costs ($2002)					
Cost of Capital		6.00%			
Discount Rate (Nom.)		6.00%			
Fixed Op.Cost Esc. Rate (Nom.)		3.00%			
Effective Fixed Op.Cost. Disc. Rate		2.91%			
Var. Op.Cost Esc. Rate (Nom.)		4.00%			
Effective Var. Op.Cost. Disc. Rate		1.92%			
			$/kgal		
First Year Cost w/Amortized Capital			$9.575		
Amortized Cap. Cost (Book Life)			$9.166		
Fixed Op. Cost			$0.011		
Varible Op. Cost			$0.398		
		NPV2002 $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost		**40.858**	**$9.759**		
Capital Cost (20 year Amort.)		38.400	$9.166		
Fixed Op. Cost		0.062	$0.015		
Varible Op. Cost		2.395	$0.572		
		NPV2002 $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost		**41.774**	**$8.315**		
Capital Cost (Amort. per Econ. Life)		38.400	$7.638		
Fixed Op. Cost		0.082	$0.016		
Varible Op. Cost		3.291	$0.655		

FIGURE 5-40. Reclaimed Water Line as Phase II from Miki to Manele

Capacity (MGD)					
Installed Capacity			0.440		
Max. Day Capacity			0.440		
Effective Sustainable Capacity			0.440		
Facility Capacity Factor			100%		
Average Facility Output			0.440		
Capital Costs ($2002)		Total	Per MGD		
WWTP R-1 Upgrade		$10,000,000	$22,727,273	DEM Rough Estimate	
			$0		
			$0		
Transmission		$2,880,000	$6,545,455	HDA Estimate	24000lf@$120plf for transmission, assumes no marginal distribution cost at Manele (new project area)
			$0		
			$0		
Contingencies		$2,576,000	$5,854,545	HDA Estimate	20%
Total Plant Cost (		$15,456,000	$35,127,273		
Expenditure Pattern	Year	Nom	Normalized		
	Serv Date	1	100.0%		
	-1	0	0.0%		
	-2	0	0.0%		
	-3	0	0.0%		
	-4	0	0.0%		
	-5	0	0.0%		
	-6	0	0.0%		
	-7	0	0.0%		
	-8	0	0.0%		
Const. Per. Esc. Rate (Nom.)		3.00%			
AFUDC Interest Rate (Nom.)		6.00%			
AFUDC Factor			1.000		
		Total	Per MGD		
Total Capitalized Cost		$15,456,000	$35,127,273		
Fixed Operating Costs ($2002)		Per Year	Per Y/MGD		
Dedicated Operating Labor		$0	$0		
Apportioned Operating Labor			$0		
Maintenance Labor			$0		
Fixed Operating Costs					
Electrical Demand		$1,822	$4,140		5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials			$0		
Maintenance Expenses			$0		
Amort. of Capitalized Rebuild Costs			$0		
Total Fixed Op. Costs		$1,822	$4,140		
Variable Operating Costs ($2002)			Per KGal		
Operating Labor					
Maintenance Labor					
Electrical Energy			$0.331	HDA per DEM	FY04 Reuse Elec Cost $123,110 for 536,003 Kgal Increased by 45% to reflect $2008 $0.34/KWH de-escalated to $2004
Chemicals/Materials			$0.050	HDA per DEM	FY04 UV Bulbs and Muriatic Acid
Maintenance Expenses			$0.017	HDA per DEM	FY04 Expenses $9,674 for 536,003 Kgal
Total Variable Op. Costs			$0.398		
Plant Life (Years)					
Functional Life		30			
Economic/Analysis Life		30			
Book Life		20			
Levelized Production Costs ($2002)					
Cost of Capital		6.00%			
Discount Rate (Nom.)		6.00%			
Fixed Op.Cost Esc. Rate (Nom.)		3.00%			
Effective Fixed Op.Cost. Disc. Rate		2.91%			
Var. Op.Cost Esc. Rate (Nom.)		4.00%			
Effective Var. Op.Cost. Disc. Rate		1.92%			
			$/kgal		
First Year Cost w/Amortized Capital			**$8.794**		
Amortized Cap. Cost (Book Life)			$8.385		
Fixed Op. Cost			$0.011		
Varible Op. Cost			$0.398		
		NPV2002 $M/MGD	Levelized $/kgal		
Twenty-year Total NPV Cost		**37.585**	**$8.978**		
Capital Cost (20 year Amort.)		35.127	$8.385		
Fixed Op. Cost		0.062	$0.015		
Varible Op. Cost		2.395	$0.572		
		NPV2002 $M/MGD	Levelized $/kgal		
Economic Life Total NPV Cost		**38.501**	**$7.663**		
Capital Cost (Amort. per Econ. Life)		35.127	$6.987		
Fixed Op. Cost		0.082	$0.016		
Varible Op. Cost		3.291	$0.655		

Demand-Side Measures

Demand-Side measures refer to actions taken on the "customer's side of the water meter." These include reducing water use by using more efficient appliances or changing water use patterns.

Many water utilities encourage conservation and water use efficiency by implementing demand-side-management (DSM) programs. These programs use a variety of methods to promote efficiency including incentives to customers, provision of free or low-cost efficient fixtures or appliances, direct installations or conservation rate designs.

Landscape Conservation Measures

Nationwide, estimated outdoor use per-capita is 31.7 GPD. Outdoor use per household varies from 10% to 75% of household consumption. However, even in hot dry areas such as Phoenix, Scottsdale and Tempe Arizona, outdoor use per household is estimated at under 200 GPD on average. A typical 18 hole golf course in Pima County, Arizona uses about 500,000 GPD. (Source: *Water Use and Conservation*, Amy Vickers, WaterPlow Press, Amherst, Massachusetts, 2001).

An area such as Manele is expected to have higher than average water consumption, due to the hot, dry nature of its climate. Residential per unit consumption in Manele is considerably higher than that in high-use communities in South Maui, such as Maui Meadows. This need not be the case. A relatively lush appearance can be attained without creating desert-scapes or replacing foliage with cacti and pebbles. The high level of outdoor consumption on Lana‘i presents an opportunity for demand side savings.

Reduction in water consumption for landscapes can have several benefits. Such reductions can lower system peaking factors, reduce draft from sensitive aquifers, and lower both utility and customer facility costs, to name a few. Even a 10% reduction in irrigation water use could save over 110,000 GPD. Greater savings could quite possibly be attainable.

Landscape conservation begins with a thorough landscape water audit. An inventory should be made delineating the following items as a minimum:

- Irrigated acreage, soils and soil infiltration rates,
- Plant materials,
- Size and irrigation demands of watering zones, weather station or evapotranspiration data (ET data),
- Irrigation equipment and controllers in each zone,
- Watering times, settings, operating pressures and gallons per minute of each zone,
- Condition of equipment, overspray areas, tilted heads, missing heads, etc.,
- Distribution uniformity of equipment,
- Condition of plant materials.

The principles of landscape conservation are well known and will not be iterated in detail here. A draft conservation ordinance, including landscape conservation measures is provided in Appendix E of this plan. Also attached in Appendix I are checklists for landscape conservation, golf courses and hotels. Some general “bullet points” include:

- Turf should be limited to active play or picnic areas.
- Where turf is used, mower blades should be set high.
- Mulching mowers should be used where possible. These return grass clippings to the lawn. Grass clippings contain about 85% water and 5% nitrogen. Leaving them on the lawn helps hold in moisture, reduce evaporation and keep grass cool.
- The majority of landscaped areas should be planted with native species that are adapted to the natural rainfall in the area, or with drought tolerant non-invasive non-native species. In Manele, plant species which are salt tolerant would also be appropriate.
- Thirsty plants should be limited to showcase areas. Plants in these areas can be planted in low areas or small basin-like forms to encourage water to pool.
- Mulches should be used both for decorative value and to reduce evaporative losses, cool soil and control weeds. Mulches can also slow erosion and reduce soil compaction. Plants with similar water requirements should be grouped so that irrigation circuits can be controlled more effectively.
- Irrigation circuits should be designed, timed and operated to prevent overspray or watering of non-planted areas.
- Watering should not occur in the heat of the day, nor during rainfall or other periods when soil moisture may already be adequate.
- Automated irrigation systems should be equipped with controllers capable of multiple programming for different zones, equipped with rain shut-off devices, and smart controllers capable of responding appropriately to either soil moisture or evapotranspiration conditions.
- Maintenance should include frequent leak detection efforts and rapid repairs.
- Distribution uniformities should be at least 85% for drip, 70% for rotors and 60% for spray heads.Discharge limitations for various types of irrigation emitters, as well as other measures, are included in the draft conservation ordinance attached as Appendix E.
- Design planted areas, particularly grassed areas to utilize natural runoff, and position plants in such a way that they receive runoff. A series of swales, basins, berms or microberms to direct flows toward planted areas can help to make use of whatever natural rainfall is present on site. Recessed or concave planting areas receive and retain rainfall better than raised beds.

Nationwide, one of the most effective conservation measures has been the low-tech option of limiting the number of times a week that watering can occur. Conventional wisdom is also that one should prune sparingly, to avoid growth accelerations that can increase water requirements. On Lana‘i, there is an example of a landscape that reduced consumption by allowing a very short bursts of light water spray a few times during the heat of the day to keep plants cool, but reserved deep watering for infrequent evenings. This is not the generally encouraged practice. In fact oscillating sprinklers and other sprinkler heads that produce fine mists or sprays are generally discouraged. However, it may merit further study. It should be noted that this practice was combined with very active pruning, which is also not a generally recommended practice for water conservation as noted above. The intense care taken on the property may mean that the method is not adaptable to those with less intensive maintenance. Nor is it clear how much of the reduced irrigation use came from these techniques versus more intensive monitoring and management of irrigation equipment. The reduction in water use achieved brought overall consumption more in line with that in Maui Meadows, one of Maui's highest per-unit use areas. Although the reduction in consumption achieved was laudable, it is not clear whether these techniques can or ought to be broadly replicated in Manele.

Landscape conservation measures that have been used with some success in South Maui hotels in recent years include:

- Installation of high-end smart controller systems,
- Installation and use of on-site weather stations,
- Replacement of irrigation nozzles,
- Installation of sub-surface drip systems under sod,
- Installation of drip irrigation under shrubs,
- Replacement of decorative plantings with drought tolerant natives, and installation of high-efficiency re-circulating water purification systems in water features.

The Grand Wailea Resort reported a 37% drop in irrigation consumption through the use of such measures.

Hotel Conservation

The hotels on Lana'i are the largest customers of Lana'i's water utility. Much of hotel use is irrigation use, but even leaving irrigation use aside, hotels are large customers. As such, an effort should be made by the water utility to partner with the hotel properties to achieve conservation both in the landscape and throughout hotel facilities.

An axiom in water conservation field is that "you can't save what you don't measure". As with irrigation, conservation at the hotels should begin with a detailed inventory of existing and proposed water uses at the hotels. The inventory should detail fixture units and counts, water uses and water using appliances and equipment in spas, restaurants, guest rooms, landscapes, laundries, cooling and other areas throughout the facility, locations and purposes of controls, sub-meters, water filters or recycling systems, locations and amounts of irrigated acreage, irrigation system elements, controllers, circuits and settings, acreage and volume of pools, filtration equipment, etc.

The hotels could benefit by being registering with the Green Building Certification Institute for LEED credits. The focused attention on conservation that comes with such an effort can result, not only in cost and resource savings, but also in an advertising boost, as "green" design and operation become increasingly marketable. In designing a conservation program, the hotels could aim to obtain 7 out of 10 water efficiency credits as a target. Certainly the future hotels should be designed built and commissioned in a manner that qualifies for a minimum of 7 out of 10 Water Efficiency credits.

Fixture replacements can save on electricity as well as water. A list of WaterSense certified high-efficiency toilets and other fixtures may be found at http://www.epa.gov/WaterSense/pp/index.htm. Fixture retrofits to consider include:

- Retrofit toilets with high efficiency models that use 1.28 gallons per flush or less
- Retrofit urinals with high efficiency models that use 0.5 gallons per flush or less.
- Install showerheads with a flow rate of 2 gpm at 60 psi or less in all units.
- Retrofit bathroom sink faucets with fixtures that do not exceed 1 gpm at 60 psi. (even more efficient models are available)

Cooling / HVAC systems should be reviewed. New systems should be constructed, commissioned and operated in a manner that conserves water as well as energy. Single pass cooling should not be permitted. Recent data indicate that increasing energy efficiency in coolers can also increase water efficiency. Cooling systems should be specified to qualify for LEED certification for energy efficiency and controllability, as well as the specific water conservation measures listed below for multi-pass systems:

- Installation of control systems and sub-metering to monitor and manage water quality and other parameters in make-up water and blow-down.
- Installation of appropriate treatment systems to manage water quality in cooling tower make-up water.
- Operation of cooling towers with greater than 5 cycles of concentration.
- Minimization of drift losses with baffles or drift eliminators.
- Establishment of a proactive cooling system maintenance and monitoring program.

Around the hotel, in kitchens, restaurants, snack shops and other areas, ice making, cooking and washing can be made more efficient with the following measures:

- Ice machines which use water for cooling should be replaced with efficient air-cooled models.
- Refrigeration systems should be air-cooled or closed-system recirculating systems.
- Pre-rinse spray valves on dishwashers shall have a flow rate equal to or less than 1.6 gpm at 60 psi.
- Food steamers should be self-contained "boilerless" or "connectionless" models.
- Wok stoves should be "waterless woks".
- Ware washing units should have flow rates of less than 1 gallon per rack.
- If tunnel washers or multi-load washer extractors are used, they should utilize no more than 2 gallons of water per pound of laundry.
- If regular commercial clothes washers are used, install washers that are *Energy Star* and *WaterSense* certified, or have a water factor (gallons/cubic foot of laundry) of not more than 6.

Guests should be encouraged to conserve. This can be done in a manner that actually enlaces the guest experience. For instance, guided and interpreted, or self-guided “tours” or walks to native plantings, educational materials and displays explaining local resources, even interactive experiences teaching about traditional uses of plants and guiding guests in small projects can create a sense of appreciation for the value and beauty of local resources.

As a minimum, guests should be encouraged to conserve by

- Placing tent cards in rooms to encourage guests to re-use sheets and towels.
- Ensuring adequate towel rack space to enable & encourage guests to hang towels neatly. This will also help encourage them not to require daily washing.
- Placing tent cards in restaurants informing guests that water is available upon request, rather than automatically.

Landscape conservation has been discussed above. In general,

- All irrigated areas shall be equipped with smart controllers capable of self-adjusting to account for moisture conditions, and of multiple programming for separation of turf and non-turf areas.
- Irrigation valves and circuits should be arranged such that plants with different water requirements are watered separately and appropriately (hydrozones).
- Landscaping should be designed and / or renovated so as to qualify for LEED credit WEc1.1 as a minimum.
- To the extent possible in landscaping, select native plant species that are adapted to the natural rainfall and salt conditions in the area. The project is located in Plant Zones 3 and 5. The use of climate-adapted native plants conserves water and protects watersheds from the spread of invasive plant species.

Even water features can be made more efficient. High efficiency filtration systems are available for pools and fountains.

For the new hotels, and in the event that the existing hotels are renovated, wastewater systems should be designed or renovated to qualify for LEED credit WEc2.

Once an inventory of water uses and conservation opportunities has been made, and measures undertaken, it is important to take stock of the actual performance of conserving measures. A useful tool is an annual tally of what has been done, the goal of each measure taken, and how the results panned out. Document the recorded savings or reductions in peak factors, to assist in fine-tuning facility management for conservation as time goes on. An annual inventory of uses, performance, and changes made to fixtures or processes such as treatment, recycling, or other measures to conserve, as well as water use impacts of each, should become a regular practice.

New hotels or expanded facilities should be conditioned upon implementation of such measures. Existing hotels should be encouraged in these directions with incentives such as rebates, as well as pricing signals. Some funds were budgeted to support this in the capital plan discussed in this chapter.

A variety of potential programs were characterized in terms of costs per thousand gallons saved. These included toilet replacement rebate and direct installations, leak detection audits, faucet and fixture giveaway programs, and various outdoor irrigation efficiency and control measures. Several of these programs appear to be cost effective measures in comparison with new source development.

Growth Management

One approach to meeting water demand is to manage the amount of growth and land development by general land use planning procedures. Decisions regarding where growth is allowed to occur and what types of developments are permitted are within the scope of land use planning. However, these decisions are informed by the status of both infrastructure and resources of many sorts, water among them. In the case of water, a unique situation exists, in that the State Water Code HRS §174C-31(a)(2) states that the Water Use and Development plans shall set forth the allocation of water to land use in each county. The Lanaʻi Water Advisory Committee discussed allocations at length. These discussions included review of project proposals discussed in the *Demand* chapter of this document, as well as resource issues discussed in the *Existing Resources and Systems* and *Source Water Protection* chapters of this document. The results of these discussions, along with some recommendations, are presented in the *Policy Issues* chapter of this document.

Water Source Protection

Water source protection is an important component of any water system management plan. For the Island of Lanaʻi water source protection has been identified as an especially important component because of the importance of vegetation in maintaining the amount of total effective precipitation. The importance and impacts of water source protection measures are discussed the next chapter, on *Source Water Protection*.

Summary of Levelized Costs

Several measures to increase available source have been discussed. Some of these measures include high capital investments up front, but low operating costs. Others include low initial investments, but high operating costs. Some measures create large additional capacity, while other measures create only a little. In order to develop a meaningful comparison of the value of these projects, total costs over the economic life of each project, including inflation and cost of capital where applicable, are derived and levelized to costs per 1,000 gallons of water produced.

In the tables on the following three pages, a summary of costs of new source development, supply side measures and demand side measures are presented in terms of cost per thousand gallons. Figure 5-42 examines new and replacement source options. Figure 5-43 examines loss reduction options, and Figure 5-44 examines demand side management options. In all cases measures are presented in order of least to most expensive on a life time basis.

Some explanation of the column headings may be of use. For the new and replacement source projects and loss reduction projects in Figure 5-42 and 5-43, respectively, installed capacity refers to the capacity of the equipment installed, whereas effective capacity refers to the average day yield anticipated accounting for limitations. Average output is the amount of water assumed in the economic analysis. For the purposes of comparison, this is assumed to be the same thing. The capital cost is the total cost in millions of dollars. The unit cost is millions of dollars per millions of gallons per day, or dollars per gallon per day. Variable costs are principally the costs of electricity and chemicals, or amortized filter costs for treatment plants. These costs are proportional to the amount of production. Economic plant life is assumed to be 30 years for new sources. It is the estimated life of the project before additional major expenditures would be anticipated, recognizing that some portions of projects have longer lives than others. The Unit NPV, or net present value is the capital fixed operating and variable operating cost in terms of $per gallon per day of operating the facility over 30 years expressed in current dollars. The levelized cost is the cost over thirty years in terms of thousands of gallons. Capital, Fixed and Variable operating costs are expressed in terms of levelized dollars per thousand gallons. Capital costs refer to the up-front investment to construct or install a facility. Fixed operating costs refer to expense to operate that are present in the same amount regardless of how much water is being produced, such as labor for metering and maintenance and fixed demand charges for electricity. Variable operating costs are those which increase with increased production such as electrical charges, chemicals or, in the case of treatment, amortized filter costs.

FIGURE 5-41. Summary of New and Replacement Source Options Levelized Costs

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

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

FIGURE 5-42. Summary of Loss Reduction Options - Levelized Costs

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
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

FIGURE 5-43. Summary of Demand Side Management Options - Levelized Costs

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 filtration	$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)

Existing Near Term Source Plans

Existing near term source plans include the replacement of Well 3, replacement of Well 2 and Shaft 3 with Wells 2-A and 2-B, recommissioning of Well 7 and installation of Well 15.

Based upon system standards, as shown on Figure 5-21, these wells would be adequate to firm the system and handle redundancy requirements for natural growth, as forecast in the Base Case SMS Forecast. However, they could not all be used at design capacity without exceeding the sustainable yield of the Leeward aquifer. For more optimal distributions of withdrawals, as well as more use from new or replacement sources, it would be advisable to seek windward aquifer sources within the planning period. One good option cost-wise might be the installation of a well in the Windward aquifer at Malau.

On a levelized basis, the most cost-effective measure to improve source availability turns out to be replacement of the pipes in the Palawai Grid, as discussed in the next section. Although this was not part of the near term source plan, it is now recommended, along with some other measures to be discussed in the proposed plan section.

FIGURE 5-44. Base Case Forecast Installed Capacity Requirements and Plans

Installed Capacity Less Largest Pump Requirements for Base Case - Elasticity = 1

Year	Wells 6 & 8	Wells 2 & 4	Wells 1, 9 & 14	Total
Now Less Lrgst Pump	792,000	1,296,000	864,000	2,952,000
2009	1,357,441	1,008,550	2,044,160	4,410,151
2010	1,378,325	1,024,067	2,075,609	4,478,002
2011	1,401,321	1,041,152	2,110,238	4,552,711
2012	1,424,316	1,058,237	2,144,866	4,627,419
2013	1,447,311	1,075,322	2,179,495	4,702,128
2014	1,470,306	1,092,407	2,214,123	4,776,836
2015	1,493,302	1,109,492	2,248,751	4,851,545
2016	1,512,631	1,123,853	2,277,859	4,914,343
2017	1,531,960	1,138,215	2,306,967	4,977,142
2018	1,551,290	1,152,576	2,336,075	5,039,940
2019	1,570,619	1,166,937	2,365,183	5,102,739
2020	1,589,948	1,181,298	2,394,291	5,165,537
2021	1,611,333	1,197,187	2,426,493	5,235,013
2022	1,632,717	1,213,075	2,458,696	5,304,488
2023	1,654,102	1,228,963	2,490,899	5,373,963
2024	1,675,486	1,244,851	2,523,101	5,443,439
2025	1,696,870	1,260,739	2,555,304	5,512,914
2026	1,719,255	1,277,371	2,589,012	5,585,638
2027	1,741,639	1,294,002	2,622,721	5,658,361
2028	1,764,023	1,310,633	2,656,429	5,731,085
2029	1,786,407	1,327,264	2,690,137	5,803,808
2030	1,808,792	1,343,895	2,723,845	5,876,532

Additional Capacity Required to Meet System Standards

Year	Wells 6 & 8	Wells 2 & 4	Wells 1, 9 & 14	Total
Now Less Lrgst Pump	792,000	1,296,000	864,000	2,952,000
Additional Capacity Required to Meet Standard Redundancies				
2009	565,441	-287,450	1,180,160	1,458,151
2010	586,325	-271,933	1,211,609	1,526,002
2011	609,321	-254,848	1,246,238	1,600,711
2012	632,316	-237,763	1,280,866	1,675,419
2013	655,311	-220,678	1,315,495	1,750,128
2014	678,306	-203,593	1,350,123	1,824,836
2015	701,302	-186,508	1,384,751	1,899,545
2016	720,631	-172,147	1,413,859	1,962,343
2017	739,960	-157,785	1,442,967	2,025,142
2018	759,290	-143,424	1,472,075	2,087,940
2019	778,619	-129,063	1,501,183	2,150,739
2020	797,948	-114,702	1,530,291	2,213,537
2021	819,333	-98,813	1,562,493	2,283,013
2022	840,717	-82,925	1,594,696	2,352,488
2023	862,102	-67,037	1,626,899	2,421,963
2024	883,486	-51,149	1,659,101	2,491,439
2025	904,870	-35,261	1,691,304	2,560,914
2026	927,255	-18,629	1,725,012	2,633,638
2027	949,639	-1,998	1,758,721	2,706,361
2028	972,023	14,633	1,792,429	2,779,085
2029	994,407	31,264	1,826,137	2,851,808
2030	1,016,792	47,895	1,859,845	2,924,532

Anticipated Capacity Additions

Source Option	Wells 6 & 8	Wells 2 & 4	Wells 1, 9 & 14	Total
Well 3	432,000	432,000		864,000
Well 2-A		864,000		864,000
Well 2-B		864,000		864,000
Well 15			576,000	576,000
Recommission Well 7	864,000			576,000
NEAR TERM ADDITIONS	1,296,000	2,160,000	576,000	3,744,000
Deficit			1,283,845	
Base Case WW Addition			387,723	
Remaining Deficit	None	None	896,122	None
Resulting Installed Less Largest Pump	2,088,000	3,456,000	1,440,000	4,320,000
For Brackish System Only - Standards Don't Apply - Checking Requirements vs. Source				
Forecast Source Requirement	803,907	597,287	1,210,598	2,611,792
* *Shown for all systems for information, though this exercise applies only to brackish systems.*				
Capacity over Avg Day Forecasted Requirement			229,402	

System Maintenance and Replacement Needs

Any twenty year plan must consider system replacement needs as well as new source, in order to determine feasibility and costs.

Anticipated costs of system replacement needs can be estimated in a number of ways. One way is to schedule replacements based on installation dates of system elements. The estimated useful life of a facility depends upon size, material and location, but if these factors are known, a replacement schedule can be derived.

Another accepted way to schedule capital improvements is based upon inspection and condition assessment of actual facilities. For example, such flaws as rust or caving tank roofs are clearly visible upon inspection. Similarly, frequent breaks, pressure or water quality complaints, or high unaccounted-for water can also help to target problem pipes for replacement. In this method, items are budgeted based on condition and performance. This method generally applies to near-term budgeting.

A third method is to estimate an average annual requirement and budget for that. For example, on Lana‘i, with just under 80 miles of active pipeline, and an average useful life of fifty years - roughly 1.6 miles of pipe should be replaced per year. This is a valid method for a long term budget approximation. Depending upon the segments to be replaced, this will be more in some years and less in others, but it reflects the average pace of replacement necessary to maintain a system the size of Lana‘i’s. Similar calculations can be done for other system facilities.

Usually, replacement schedules are drafted based upon a combination of these two methods, as is the case with the plan presented here.

Once projects have been identified, it must be determined whether and how they can be funded.

Typically, new or expanded source is funded by new meter fees. These may be called “Water System Development Fees”, “Facilities Capacity Charges”, “Tap-In Charges”, or simply “New Meter Fees”, but they refer to the charge paid to add a new meter to the system. This philosophy is sometimes encapsulated in the phrase “growth pays for growth”.

Replacement, renovation or repair of existing facilities is typically funded by rates and monthly or bi-monthly charges.

In preparing this plan, funding had to be distributed between Lana‘i Water Company, Inc. (LWCI) and Lana‘i Holdings, LLC. (LHI). LWCI purchases source delivery from it’s parent company, LHI. Part of this arrangement is that LHI develops and drills new or expanded capacity. According to utility personnel, once source projects have been developed, LWCI must budget cost recovery for LHI to maintain, repair or replace them. Under the current structure, some costs are recovered by the utility, while others are borne by the company. Costs of projects in this plan have been assigned to either LHI or LWCI based upon discussions with utility personnel.

Once system needs are identified, and recovery needs determined, a rate and fee structure is designed to accommodate them.

Projects necessary for system maintenance have been identified and are classed in the following broad categories:

- Source
- Supply and Demand Side Efficiency
- Storage
- Pipeline and Valves
- Pumps
- SCADA Telemetry and Monitoring Needs

Source

The following projects, although source related, are anticipated to be funded through LWCI rates and fees because they involve replacement or renovation of existing source.

Well 3 Replacement Well 3 is out of service and in need of replacement. This source once delivered half a million gallons per day, but toward the end of its life pumpage was closer to 100,000 gallons per day. Well 3 had one particularly useful feature, which was that it could effectively serve either the Koele and Lana‘i City systems, Kaumalapau or supplement the service areas of Wells 2 & 4. The Well 3 Replacement will be located in the same area as the existing Well 3. It is expected to have an installed capacity of 864,000 GPD, with an average day capacity of 384,000 gallons and an average water delivery of 300,000 GPD. Installation costs provided by utility personnel total $1.7 million. Well 3 Replacement is expected to be on-line in the third quarter of 2010.

Well 2 Renovation Well 2-Shaft 3, although technically on line, is rarely used due to issues of both safety and facility condition. Well 2-Shaft 3 was once the island’s main source of irrigation water. Based upon water levels, Well 2-Shaft 3 should be the most economical source to operate. The Well 2 renovation involves replacement of the Well 2 portion of Well 2-Shaft 3. This project involves moving the pump facilities, controls and telemetry to the surface and renovating the well and pump facility. Anticipated capacity is 864,000 GPD installed, with an average day capacity of 384,000 gallons and an average water delivery of 300,000 GPD. Estimated costs provided by utility personnel are $900,000. Well 2 Renovation is expected to be on-line in 2012. Because of the project listed below, this Well 2 Renovation is also referred to as Well 2-A.

Well 2-B Well 2-B involves replacing the old Shaft 3 with a well drilled to tap into the old Shaft 3 source. Based on the behavior of water levels at Well 2 and Shaft 3, LWCI personnel believe that Well 2 and Shaft 3 tap separate dike compartments, and can be operated as two separate sources. Anticipated costs are $2,382,880. Anticipated capacity is 864,000 installed, with an average day capacity of 384,000 gallons and an average water delivery of 300,000 GPD. Well 2-B is expected to be on-line in the fourth quarter of 2014.

Well 1 Replacement or Renovation Well 1 was drilled in 1945. By 2030 it will be an 85 year old well. The pump and shaft were last replaced in 2005. Water levels in Well 1 are declining, as they are in Wells 9 & 14. Part of the purpose of Well 15 is to distribute withdrawals in the hopes that water levels in these wells can stabilize, as well as for additional redundancy.

Well 4 Replacement or Renovation Well 4 is the island's most productive well at present. Although Well 4 appears to be in working order, replacement or renovation remains on the fringes of LWCI's plans, because by the year 2030 it will be an 80 year old well. It was drilled in 1950. The pump motor was last replaced in 2006. Project costs are estimated only roughly, at $1.75 million. The existing pump is 900 GPM, or 1,296,000 GPD installed capacity. The size of the replacement pump would be determined based upon water levels at the time it is replaced.

The following projects would be funded by LHI as expansion source.

Well 15 Water levels in all three pumping brackish wells, Wells 1, 9 & 14, are declining. An additional well is required to distribute withdrawals, as well as to provide redundancy for the brackish system. Costs are estimated at $2,656,800. Anticipated installed capacity is 864,000, with an average day capacity of 384,000 gallons. No additional source availability is assumed to result from this project.

Recommission Well 7 Well 7 could provide both reliability and improved distribution of withdrawals on the north end of the Leeward aquifer. Well 7 has the advantage of being situated such that, with transmission improvements, it could serve either Lana‘i City or the Irrigation Grid. Estimated costs to renovate Well 7 and construct transmission to the Lana‘i City system are $2,678,210.

Well 5 Replacement Well 5 was drilled in 1950. By the late 1980s, water deliveries from this well were declining, and the well was used mainly for backup. When it was in use, it had to be used with caution, and given time to allow water to recharge. Although Well 5 has been out of use since 1994, it was seen as a possible re-instated future source for years. More recently, general thinking has been that it would be more likely to replace this source than to revitalize the old well. Costs are estimated at $2,956,800. The costs of this project would be borne by LHI.

In addition to these three quasi -replacement sources, new source projects identified and described earlier in this chapter would be funded by LHI.

- High Level Potable Well Near Hi‘i Tank (between Hi‘i Tank and Well 3)
- Windward Well at Malau
- Windward Well at Maunalei
- Windward Well at Kehewai Ridge - 2,250’
- Windward Well at Kehewai Ridge - 2,750’
- Windward Well at Kauiki
- Windward Wells at Kauiki (Incremental)

Supply and Demand Side Efficiency

Indoor Conservation Technical domestic savings potential was evaluated in the *Demand Analysis* chapter of this WUDP. The theoretical potential water savings from indoor conservation was estimated at 175,192 GPD. $1,480,419 is included in the designed rate structure for a “Direct Install” program to replace all existing, non-conserving toilets, showerheads and faucet aerators and clothes washers on the island. Replacement of clothes washers could be traded for an equivalent savings opportunity in the commercial or other sectors, such as tunnel washers, pre-rinse spray valves, efficiency improvements in cooling, or other efficiency measures. Estimated costs included funds for contracting the installation out and associated internal administration. Since residential dishwashers are not addressed in this program, their estimated savings potential is subtracted from the total estimated technical savings potential, resulting in a theoretical savings from this plan of 174,040 GPD.

It is never possible to achieve full theoretical technical potential with a conservation program. Assumptions in program design assume that only a portion of technical potential is achieved. Assuming that roughly 100,000 GPD in savings were actually attained (about 57% of technical potential), an estimated $2,337,600 in savings would result from this investment of roughly $1.5 million. This savings is comprised of $212,000 in pumping costs, and the avoided installation of roughly 1/3 of a well, using the Well at Malau as a median priced example. Although net present value cost estimates were not calculated, the savings promise to be substantial enough that the measure is anticipated to be cost-effective.

<u>Incentives for Landscape or Hotel Conservation</u> Landscape is the largest use of water on the island, estimated at over 1.1 MGD. Hotels are the largest customers, with over 0.27 MGD in metered uses on the meters specifically classed as hotel alone. Roughly half of that is thought to be used outdoors for irrigation of hotel properties, water features, and the like. Both represent major opportunities for efficiency savings.

Measures for landscape efficiency have been discussed in general terms above. In addition, the pricing structure designed to support necessary expenditures over the next 20 years should have the effect of flattening at least the more excessive landscape or other uses. One means to mitigate and avert potential rate shock is to assist those most affected with incentives and assistance to conserve. $225,000 has been included for this purpose. $25,000 would be spent to hire an expert conservation consultant to identify the most critical measures, with the bulk of the funds going to actual efficiency incentives or rebates for these sectors.

<u>Leak Detection Equipment</u> Unaccounted-for water analysis in the *Demand Analysis* chapter of this document documented high losses in the Palawai Irrigation Grid. However, long before that, the Lana‘i Water Advisory Committee discussed high pressures, frequent water service interruptions due to pipe breaks at the MECO plant in the Miki Basin area. LWCI personnel described “walking the lines” to find visible leaks. A leak in a buried pipe that has become visible at the surface has usually been growing for some time. All of the circumstances listed are indications of severely leaky pipes. Moreover, high pressures reported in the Grid would put additional burden on pipes in poor condition. An unfortunate finding of the unaccounted-for water analysis was that even with recent repairs and replacements, unaccounted-for water remained high in the Palawai Irrigation Grid as of the first 6 billing periods in 2009. Leaks can go on for a long time without detection, if not actively sought. In highly permeable or sandy soils, even severe leaks can go undetected indefinitely.

One way to minimize such losses is a regular system audit with leak detection equipment. In the proposed capital plan, $150,000 is included for leak detection equipment. This should be enough to obtain a digital correlator, some correlating loggers, a pipe locator, a leak detector and some leak loggers.

Water losses are costly in terms of energy consumption, wear on pumps and facilities, service interruptions, lost revenues and lost opportunities to do useful things with the water. These costs can be insidious. A standard Water Audit Worksheet from the American Water Works Association was used to examine the leaks indited on Wells 2 & 4, with the result that annual economic losses from these leaks were roughly $300,000.

Storage

Replace Hi‘i Tank and Hi‘i Reservoir with New 2 MG Tank The 0.5 MG Hi‘i Tank is old and in need of replacement. The tank is in poor condition, with rust on the roof and near the base of the tank. A portion of the base appears to be missing or cracked. These deficiencies were mentioned in the Sanitary Survey of the Manele System. The Hi‘i Reservoir is also about fifty years old, has a concrete lining and a cover. A concrete reservoir of this age could also be one source of unaccounted-for water, if cracks have begun to develop in the concrete.

Hypalon Balls To Reduce Evaporative Losses at 15 MG Brackish Reservoir Lana‘i Water Advisory Committee members frequently expressed concern about unaccounted-for water at or around the 15 MG brackish water reservoir in Palawai Irrigation Grid. Unaccounted-for water in the brackish system is about 19%. Three options to reduce evaporative losses were evaluated. An aluminum cover, a floating cover and hypalon balls. The most cost effective appeared to be the floating cover. In discussions with utility personnel, there was concern that the floating cover might not be as easy to work with logistically as the hypalon balls. Floating covers can be difficult to remove when they start to disintegrate. Hypalon was selected for inclusion in the capital proposal. Anticipated savings are 14,000 GPD.

Pipeline Replacement

Nine pipeline projects totalling roughly $11,946,921 were identified and reviewed. Of these, eight were included in the capital proposal.

Replace Broken and Leaking Pipe In the Central Palawai Irrigation Grid As noted above, unaccounted-for water on this portion of the system is 44.61%. Due to the high pressures, frequent breaks and visible leaks discussed above, it is believed that the lion’s share of this unaccounted-for water actually is lost to leakage. Even a reduction in losses, leaving 15% unaccounted-for water would result in over 200,000 GPD in savings from Wells 2 and 4. The costs of these losses to the utility are over $200,000 per year. By offsetting electrical costs for 200,000 GPD of pumpage, while at the same time adding 200,000 gallons of source availability, this option, pencils out as the most economical of all the source options, on a levelized cost basis.

The project also includes segments upstream of the Palawai Irrigation Grid, from Well 3 to Well 2, from Well 4 to Well 2, and from Wells 2 and 4 to the Hi‘i Reservoir. Portions of these upstream segments do not meet system standards.

Both fire protection and potable water for the planned industrial park are required in the area as well, meaning that at least some portions of these replacements may receive developer funding. For instance, 12" line from Hi'i Tank to Miki Basin could be developer funded, while the rest of the project would be funded by the utility. An alternate option would be to make a dual connection, running a potable 8" line to the Kaumalapau system, and an 8" line from Hi'i to the Miki Basin.

Apart from Miki Basin, most of the uses in the Palawai Irrigation Grid could be served by irrigation grade rather than potable grade lines. Meters requiring potable service could be relocated to the Kaumalapau line for potable water. Mapping the actual locations of meters served by these lines within the grid led to this option. This could reduce the cost of the replacement.

On-site storage poses some questions. In discussion with utility personnel, it appeared that the currently favored option might be to provide on site storage with pumping capability for fire protection. Gravity flow is generally preferred, and might be a better option. Since some storage is likely to be required as a condition of the proposed industrial park development, it may be possible to combine the required tank with the replacement of the Hi'i Tank and reservoir. The developer could cover all or part of that replacement, up to whatever would be necessary to serve the Industrial Park without detriment to Manele, according to standards. This option would require a 12" transmission line, but would provide better fire flow to the site. It is important to note in this regard that the project as priced involves an 8" line, which is adequate combined with other projects here to meet the needs of current uses. Never the less, a 12" line may be the better choice.

The estimated cost used in the plan is $3,740,920. This includes potable grade ductile iron lines the same sizes as existing lines upstream of the reservoir, and 8" irrigation grade line downstream of the reservoir.

If ductile iron lines suitable for potable use are selected, or if the line is upgraded to 12", whether potable or irrigation grade, to provide fire protection, the cost could go up. But in these cases it may also be that all or a portion of these project upgrades could be developer-funded. It would be advisable to consult with developers and make these decisions before the upgraded line is installed.

<u>Replace Asbestos-Concrete Pipe Segments in Lana'i City, including PRV on 10" Asbestos Line</u> To the northeast of Lana'i City, some of the old transmission lines are asbestos. These are at an age where repairs become necessary from time to time, especially at the joints. Working with asbestos creates safety hazards for field crews, as well as inefficiencies and inconveniences on the job due to the need for special precautions. The estimated cost of the project is $972,041.

<u>Upgrade Kaumalapau Line</u> The line to Kaumalapau is old and undersized to provide fire protection to the Kaumalapau Harbor and residences. Portions of this line are in poor repair. The estimated costs to upgrade this line is $3,958,217.

<u>Potable Line Connecting Miki Basin to the Kaumalapau Waterline</u> This project could be a requirement of the proposed Miki Industrial Park. However, the existing MECO facility in Miki Basin has substandard service and would also benefit.

Potable Line Connecting Well 7 to Upper End of Lanaʻi City Service Area Well 7 has the advantage of flexibility, in that it could serve either the city or the west end of the Palawai Irrigation Grid service area. There is also an advantage in the fact that the well has been drilled for some time, which should afford some cost savings. This project would be paid for by LHI.

Replace Old Steel Pipe Segments in Lanaʻi City About 1.62 miles of pipe in Lanaʻi City are old wound steel pipes. These are due for replacement. Estimated project costs are $1,202,755.

Connect Well 7 To West End Grid This is part of a phased project. Connecting Well 7 to the West end of the Palawai Irrigation Grid would enable services on that side to be served by Well 7. Although these services do not use much, this would provide some relief to Wells 2 & 4. Leaks on this end of the Palawai Irrigation Grid are not believed to be as severe as they are in the Miki Basin, where pressures were extremely high for a long time. Never the less, the line is of the same general vintage and will be well past due for replacement within the planning period.

Re-route Brackish Line to Save Electrical Costs This project is not included in the capital plan. It was evaluated for inclusion, as it was determined that roughly $29,250 in electrical costs per year could be saved if two hills along the transmission route could be avoided. The benefits of the re-alignment were not sufficient to warrant replacing the entire line. The benefits of replacing portions of the line, to attain part of the possible savings, were also examined. None of the options examined warranted line replacement or retrofit. However, it is suggested that when the brackish line does become due for replacement, it be re-routed as shown in Figure 5-48.

Pumps

Rolling Pump Replacement At present there are six or seven operating source pumps, depending upon whether Well 2 is counted, with four or five likely to commence or resume operations in the near future, those being Well 3 (relocated), Well 2-A and 2-B, Well 15, and possibly Well 7. A total of twelve operating source pumps with an assumed lifetime of fifteen years per pump leads to a replacement rate of about 0.8 pumps per year, or 4 pumps every 5 years. Since some of these will be new, not all are deemed to require replacement within the planning period. An estimated twelve pump replacements over the twenty year period were included in the capital plan, at a cost of $2,400,000.

Motor Control and Electrical Center Upgrades Regular maintenance, assessment and replacement of parts such as motors, electrical controls, impellers or other elements as needed can help to extend the operating life of pumps. An annual allowance of $50,000 is included within the capital plan, for a total of $1,000,000.

SCADA, Telemetry and Other Monitoring Equipment

Monitoring Replacements and Upgrades An annual allowance of $25,000 is included to allow for regular replacement and upgrade of telemetry, SCADA, controls, flow meters or other monitoring equipment, for a total over the planning period of $500,000.

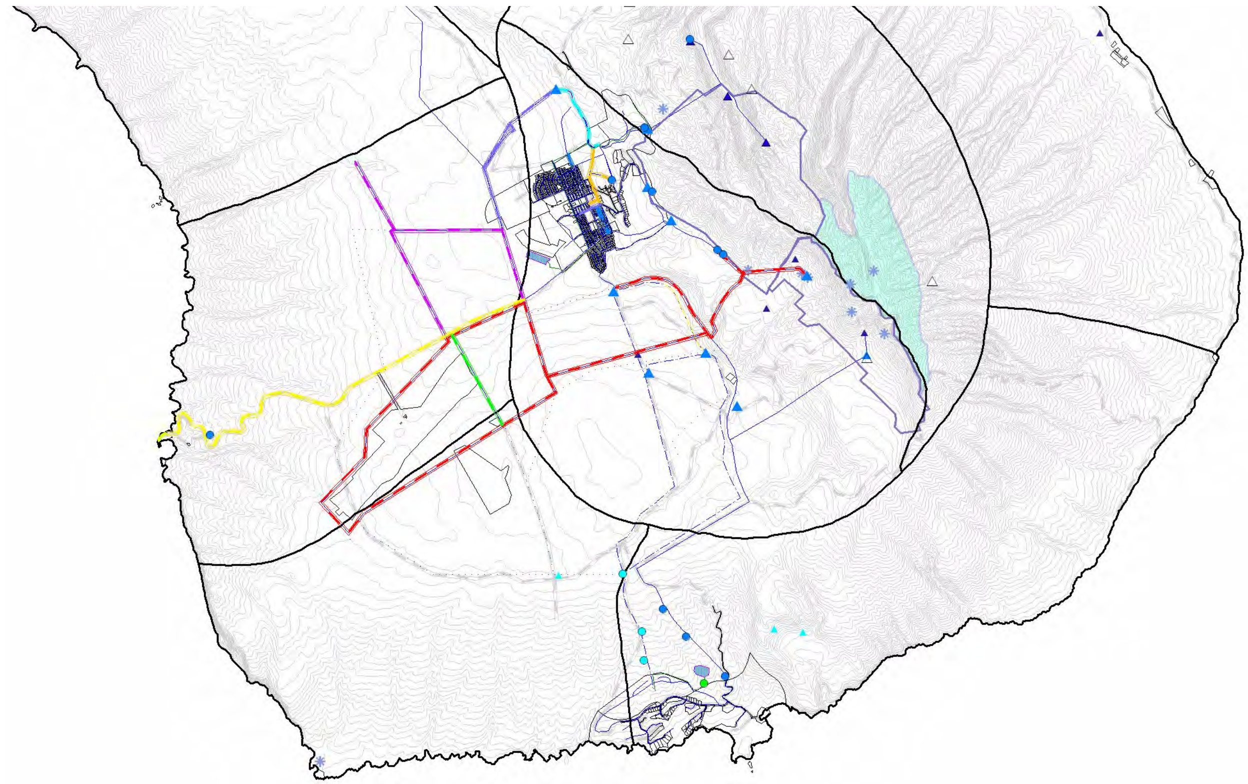
FIGURE 5-45. Pipeline Projects

PRIORITY	DESCRIPTION	DISTRICT	INSTALL DATE	MATERIAL	DIAM	REPLACE ONLINE DATE	LENGTH MILES	LENGTH FEET	REPLACEMENT DIAMETER	ANTICIPATED COSTS	COMMENT
Replace Broken & Leaking Pipe in Central Palawai Irrigation Grid											
1	IGGP '4th' Leg - St A to St S -5401 to 5229	IGGP	1960	Concrete	12	0	1.850	9,769.849	6	$146,547.74	
1	IGGP '4th' Leg - Stations Y, S, J, P and rain gague	IGGP	1960		0	0	0.870	4,595.615	6	$68,934.23	
1	IGGP Loop Line along Kaumalapau Rd	IGGP	0		0	0	0.958	5,057.262	6	$75,858.93	
1	Manele Trans - Well 3 to Well 2 by fields 5401-02	MNPD	1968	Concrete Cylinder	16	0	1.415	7,473.349	12	$1,233,102.59	Near city but to Manele. One map says this leg is 8" transite.
1	Revised Mid-East Alignment Per John	IGGP	0		0	0	0.206	1,088.763	6	$16,331.45	
1	Revised West End Alignment Per John	IGGP	0		0	0	3.146	16,610.208	6	$249,153.12	
1	Second Leg - 5513-14 and 5507-08	IGGP	1951	Cement Mortar Lined	0	0	2.536	13,392.114	6	$200,881.71	
1a	Pipeline from Well 2 / Shaft 3 to Trnamission Main	MNPD	1955		0	0	0.875	4,617.825	12	$761,941.13	
1a	Pipeline from Well 4 to Well 2	MNPD	1952		0	0	0.721	3,807.123	12	$628,175.30	
1a	Pipeline from Wells 2 and 4 to Hii	LCTY	0		0	0	0.413	2,181.779	12	$359,993.54	
							12.990	68,593.887		3,740,920	
Replace Asbestos-Concrete Pipe Segments in Lana`i City											
2	6th Street Waterline - From Queens St. to Alapa St	LCTY	0	Asbestos	10	0	0.031	162.213	10	$25,143.02	
2	Line fr Cavendish Mtr Line to Koele	LCTY	0	Asbestos	12	0	0.114	601.841	12	$99,303.77	
2	Line fr Old Lanai Tank down to Line that Enters Qu	LCTY	0	Asbestos	10	0	0.270	1,427.991	10	$221,338.61	
2	Part of 12" Main Above Alapa to N. End Queens	LCTY	0	Asbestos	12	0	0.185	977.430	12	$161,275.95	
2	Queens Avenue	LCTY	0	Asbestos	12	0	0.158	833.334	12	$137,500.11	
2	Queens St to Lanai Ave Waterline - btwn 8th and 9t	LCTY	0	Asbestos	10	0	0.120	631.275	10	$97,847.63	
2	Waterline Connecting 6th Street Line to Queens St	LCTY	0	Asbestos	10	0	0.033	174.356	10	$27,025.18	
2	Waterline from Maunalei Line to Top of 6th Street	LCTY	0	Asbestos	12	0	0.233	1,227.921	12	$202,606.97	
							1.144	6,036.361		972,041	
Upgrade Line to Kaumalapau to Meet System Standards											
3a	KPAU Trans 3rd Leg - below WWTP to Top of Runway	KPAU	1962			0	1.757	4,707.121	8	$663,704.06	
3	KPAU Trans - top of runway to Airport Road	KPAU				0	0.865	4,568.984	8	$644,226.74	
3	Airport Road to Kaumalapau Tank Waterline	KPAU				0	2.656	14,024.948	8	$1,977,517.67	
3	Kaumalapau Tank to Kaumalapau Harbor Waterline	KPAU				0	0.904	4,771.408	8	$672,768.53	
										$3,958,217.00	
Connect Potable Kaumalapau Waterline to Miki Basin											
4	Waterline from Kaumalapau Line to Miki Basin	IGGP	0		0	0	1.179	6,227.393	8	$878,062.41	
										$878,062.41	
Commission Well 7 and Connect to System											
5	Connect Well 7 to City fr. In by Koele to 2MG tk	LCTY	0	Ductile Iron	12	0	0.604	3,190.322	8	$449,835.40	
5	Connect Well 7 to City (portion to line by Koele)	LCTY	0	Ductile Iron	12	0	0.333	1,758.911	8	$248,006.45	
							0.937	4,949.233		697,842	

FIGURE 5-45. Pipeline Projects - Continued

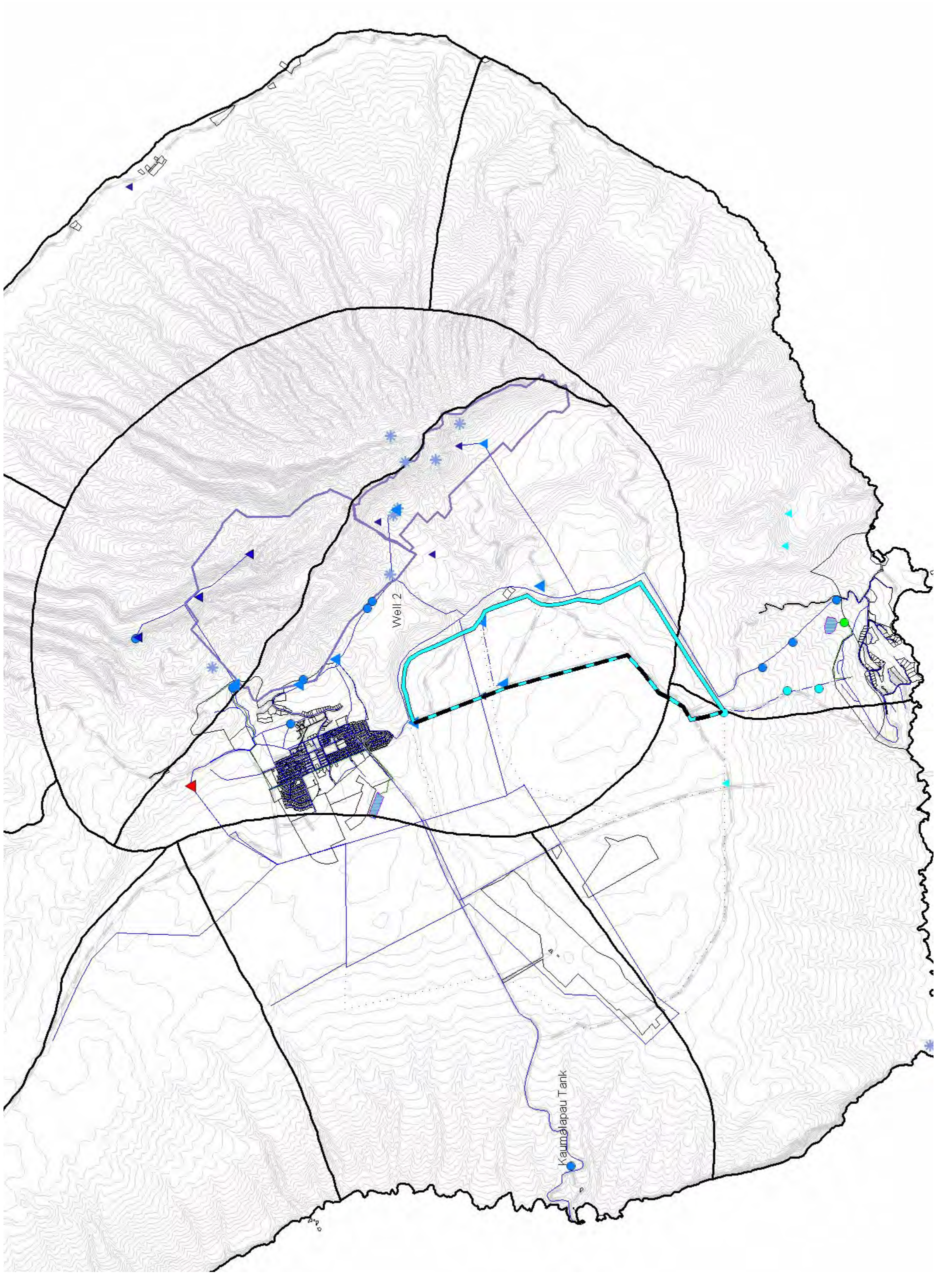
Replace Old Steel Pipe Segments in Lana`i City										
6	N of Lanai Avenue Waterline - fr Koele line to 3rd	LCTY	0	Steel	8	0	0.199	1,051.637	8	$148,280.82
6	Ninth Street Waterline - Lanai Avenue to Fraser Av	LCTY	0	Steel	10	0	0.190	1,001.682	8	$141,237.16
6	Ninth Street Waterline - Puulani Place to Lanai Av	LCTY	0	Steel	10	0	0.120	632.279	8	$89,151.34
6	Olapa Street Waterline - 9th to Kaumalapau Hwy	LCTY	0	Steel	8	0	0.332	1,752.642	8	$247,122.52
6	Palawai Lane Waterline	LCTY	0	Steel	8	0	0.335	1,767.013	8	$249,148.83
6	Potable Line North of City from Fraser to Lana`i	LCTY	0	Steel	0	0	0.186	981.787	8	$138,431.97
6	Potable Line North of City fr Lana`i Ave to Koel	LCTY	0	Steel	0	0	0.254	1,343.137	8	$189,382.32
							1.616	8,530.177		1,202,755
Connect Well 7 to West End Grid										
7	Connection for Well 7 to West End Grid (Re-aligned	IGGP	0		0	0	1.935	10,215.809	6	$153,237.14
							4.658	24,590.565		153,237
Replace Old Pipe In West End of Palawai Irrigation Grid		**Estimated Cost: $6.17 Million**								
8	IGGP '4th' Leg - St P to N - crosses 5325 & 5313	IGGP	1960		0	0	1.252	6,613.055	6	$99,195.83
8	IGGP '4th' Leg- Stns Y,S,J,P, rain gauge 5311-5223	IGGP	1960		0	0	0.841	4,440.507	6	$66,607.61
8	Revised West End Alignment Per John	IGGP	0		0	0	1.350	7,125.360	6	$106,880.40
8	West North West End of Grid	IGGP	0		0	0	0.887	4,684.214	6	$70,263.21
							23.390	118,928.184		342,947
										11,946,021

FIGURE 5-46. Pipeline Projects



Legend:
Red - Replace Broken and Leaking Pipe in the Central Palawai Irrigation Grid
Orange - Replace Asbestos-Concrete Pipe Segments in Lana‘i City, including PRV on 10” Asbestos Line
Yellow - Upgrade Kaumalapau Line
Green - Connect Miki Basin to Potable Kaumalapau Waterline
Aqua - Connect Well 7 to Upper End of Lana‘i City Service Area
Blue - Replace Old Steel Pipe Segments in Lana‘i City
Violet - Connect Well 7 to West End Grid

FIGURE 5-47. Alternate Route for Future Brackish Line



Aqua colored line is existing brackish line.
Dashed aqua and black colored line is proposed re-route upon replacement.

Supply Options

FIGURE 5-48. Initial Twenty Year Project List

See also Storage & Line Replacement projects, as these also have options that increase source availability.

Year	Project	Phase	Project Description	Budget	Antic Capacity GPM	24 Hrs	16 Hrs	Avg Day Capacity	Effective Assumed Source Pumping In Addition	1996 Model	Comment
[illegible]	Well 3 Replacement	Drill	Drill replacement for Well 3	1,000,000							
2009	Well 3 Replacement	Pump	Install pump	200,000							
2010	Well 3 Replacement	Develop & Equip	Install motors, controls, telemetry, site piping & appurtenances	500,000	600	864,000	576,000	384,000	0	Yes	GPD Reliability for existing capacity.
2010	Well 15	Design & Exploratory Drilling		1,155,000							
2011	Well 2 A - Renovation	Move pump & controls to surface		400,000							
2011	Well 2-B	Study	Determine interconnectivity between well 2 and shaft 3	500,000							
2011	Well 15	Develop & Equip	Install motors, controls, telemetry, site piping & appurtenances	1,501,800	400	576,000	384,000	256,000	0	No	Distribution of withdrawals to address declining water levels in Wells 1, 9 & 14.
2012	Well 2 A - Renovation	Equip and Develop		500,000	600	864,000	576,000	384,000	0	Yes	Renovation of existing well to firm non-firm capcity.
2013	Well 2-B	Design & Exploratory Drilling	Drill Well 2-B at site of existing Shaft 3	623,880							
2014	Well 2-B	Develop & Equip	Install motors, controls, telemetry, site piping & appurtenances	1,259,000	600	864,000	576,000	384,000	300,000	Yes	Although this is also "firming non-firm" capacity, LWCI hopes to gain effective capacity if water levels prove independent.
In Plan But Not Really Scheduled											
2016	Well 7 Renovation	Design, Pump Replacement, Site Renovation		575,000							
2017	Well 7 Renovation (see Trans in pipelines	Develop & Equip	Equip with Control Tank, Telemetery, MCC, Site Pipine Etc., and Connect to Lana`i City Upper Level	1,405,368	600	864,000	576,000	384,000	300,000	Yes	Although levelized cost estimates assume 500,000 GPD, it should be noted that water levels in wells on this side of the system are dropping with lower pumping rates than this, Could be only 300,000 GPD.
2018	Well 4 Replacement or Renovation	Design & Exploratory Drilling	Drill replacement for Well 3	750,000							
2020	Well 4 Replacement	Develop & Equip	Install motors, controls, telemetry, site	1,000,000	900	1,296,000	864,000	576,000	0	Yes	Tentative budget to replace or renovate existing old well.
2022	Well 1 Replacement or Renovation	Design & Exploratory Drilling	Drill replacement for Well 3	750,000							
2024	Well 1 Replacement	Develop & Equip	Install motors, controls, telemetry, site	1,000,000	300	432,000	288,000	192,000	0	Yes	Tentative budget to replace or renovate existing old well.
	Well 5 Replacement	Design & Exploratory Drilling	Drill replacement for Well 5 or Other	1,155,000							
	Well 5 Replacement	Develop & Equip	piping & appurtenances	1,801,800	600	864,000	576,000	384,000	300,000	Yes	Assuming Wells 2-B and 7 increase effective capacity as hoped, at this point, development of additional wells in the Leeward aquifer will be for distribution of withdrawals. If a 600,000 gallon (10% of total sustainable yield) resource reserve is maintained, with 300,000 GPD of that from each aquifer, the added yield of this well would be only 113,310 GPD.
Reclaimed Water Use											
	Reclaimed Line to Miki	Transmission	Provide irrigation source for Miki Basin	1,536,000				60,000	60,000		Costs for all options are presented, but the chosen one within the planning period is the line from Lana`i City to Miki Basin to offset potable water use for irrigation in that area, particularly at the new Industrial Park & Airport.
	Reclaimed Line to Manele	Transmission	Provide irrigation source for Manele	16,896,000				500,000	500,000		
	Reclaimed Line to Miki as Phase I	Transmission	Iirrigation source for Miki Basin & Manele	2,304,000				60,000	60,000		
	II	Transmission	Iirrigation source for Miki Basin & Manele	15,456,000				440,000	440,000		
New Source Alternatives - Unscheduled											
	High Level Potable Well Near Hi`i Tank	Design & Exploratory Drilling	Drill well between Hi`i Tank and Well 3.	1,080,000							
	High Level Potable Well Near Hi`i Tank	Develop & Equip	Install motors, controls, telemetry, site piping & appurtenances	1,636,800	600	864,000	576,000	384,000	186,690	No	Well for distribution of withdrawals in Leeward aquifer. Pumpage from the Leeward aquifer is already > 1.9 MGD. By this point, sustainable yield would have been reached, without resource reserve.
	Windward Well at Malau	Design & Exploratory Drilling	Drill well in windward aquifer at Malau near Keomoku Road.	905,000							
	Windward Well at Malau	Develop & Equip	Install motors, controls, telemetry, site piping & appurtenances	1,971,800							
	Windward Well at Malau	Transmission	Install roughly 15,000' of pipeline to connect Malau Well to system.	3,600,000	600	864,000	576,000	384,000	300,000	No	
	Windward Wells at Maunalei	Design & Exploratory Drilling	Recommission or drill new wells in Windward aquifer near Maunalei sources.	1,270,000							
	Windward Wells at Maunalei	Develop & Equip	Install motors, controls, telemetry, site piping & appurtenances	5,481,000							
	Windward Wells at Maunalei	Transmission	Install or repair existing transmission as necessary.	1,250,000	1,800	2,592,000	1,728,000	1,152,000	750,000	Partially	Assumes 3 wells in Maunalei, with use of existing transmission lines, but with repairs, improvements & connection to that line. Costs vary depending upon whether or not existing transmission lines can be utilized. IF completely new transmission is required, then Wells at Kohewai Ridge are cheaper, as is reclaimed water line from Lana`i City to Manele. Reclaimed line would not be cost-effective until the proposed

FIGURE 5-48. Initial Twenty Year Project List - Continued

Year	Project	Phase	Project Description	Budget	Antic Capacity GPM	24 Hrs	16 Hrs	Avg Day Capacity	Effective Source Addition	Assumed Pumping In '96 Model	Comment
	Windward Well at Malau	Design & Exploratory Drilling	Drill well in windward aquifer at Malau near Keomoku Road.	905,000							
	Windward Well at Malau	Develop & Equip	Install motors, controls, telemetry, site piping &	1,971,800							
	Windward Well at Malau	Transmission	Install roughly 15,0000' of pipeline to connect Malau Well to system.	3,600,000	600	864,000	576,000	384,000	**300,000**	No	
	Windward Wells at Maunalei	Design & Exploratory Drilling	wells in Windward aquifer near Maunalei sources.	1,270,000							
	Windward Wells at Maunalei	Develop & Equip	Install motors, controls, telemetry, site piping & appurtenances	5,481,000							
	Windward Wells at Maunalei	Transmission	Install or repair existing transmission as necessary.	1,250,000	1,800	2,592,000	1,728,000	1,152,000	**750,000**	Partially	Assumes 3 wells in Maunalei, with use of existing transmission lines, but with repairs, improvements & connection to that line. Costs vary depending upon whether or not existing transmission lines can be utilized. IF completely new transmission is required, then Wells at Kehewai Ridge are cheaper, as is reclaimed water line from Lana`i City to Manele. Reclaimed line would not be cost-effective until the proposed build-out scenario was reached in Lana`i City & Koele.
	Windward Well at Kehewai Ridge - 2,250' Elevation	Design & Exploratory Drilling	Drill well in windward aquifer at	1,370,000							
		Develop & Equip	telemetry, site piping &	1,954,800							
	Windward Well at Kehewai Ridge - 2,250' Elevation	Transmission	Install roughly 15,0000' of pipeline to connect well to	5,950,000	600	864,000	576,000	384,000	**300,000**	No	Although the transmission route may appear strange for this option, the project has been designed to avoid damage to the core remaining intact native habitat on Lana`i.
	Windward Well at Kehewai Ridge - 2,750' Elevation	Design & Exploratory Drilling	Drill well in windward aquifer at Kehewai Ridge.	1,370,000							
	Windward Well at Kehewai Ridge - 2,750' Elevation	Develop & Equip	Install motors, controls, telemetry, site piping &	2,018,800							
	Windward Well at Kehewai Ridge - 2,750' Elevation	Transmission	Install roughly 15,0000' of pipeline to connect well to	5,950,000	600	864,000	576,000	384,000	**300,000**	No	Although the transmission route may appear strange for this option, the project has been designed to avoid damage to the core remaining intact native habitat on Lana`i.
	Windward Wells at Kauiki	Design &	Drill well in windward aquifer at	1,570,000							
	Windward Wells at Kauiki	Develop & Equip	Install motors, controls, telemetry, site piping & appurtenances	1,929,800							
	Windward Wells at Kauiki	Transmission	Install roughly 15,0000' of pipeline to connect well to system.	7,425,000	600	864,000	576,000	384,000	**300,000**	No	Costs shown include replacement of Maunalei Transmission. If this is not necessary, or for subsequent incremental wells, costs are reduced considerably. Costs without Maunalei transmission would be $4,864,800 per new well, vs. $10,924,800 as shown. Even if existing Maunalei transmission can be used, at some point it may need to be up-sized.
	Windward Wells at Kauiki - Incremental	Design & Exploratory Drilling	Drill well in windward aquifer at Kauiki.	1,545,000							
	Windward Wells at Kauiki - Incremental	Develop & Equip	Install motors, controls, telemetry, site piping &	1,559,000							
	Windward Wells at Kauiki - Incremental	Transmission	Install roughly 15,0000' of pipeline to connect well to	1,760,800	600	864,000	576,000	384,000	**300,000**	No	As noted above, costs of incremental wells become lower. However, with a resource reserve, at this point all available source within the Windward aquifer as well as the Leeward aquifer would essentially have been developed.
	Windward Wells at Kauiki - Incremental	Design & Exploratory Drilling	Drill well in windward aquifer at Kauiki.	1,545,000							
	Windward Wells at Kauiki - Incremental	Develop & Equip	Install motors, controls, telemetry, site piping &	1,559,000							As noted above, costs of incremental wells become lower. However, at this point all 3 MGD within the Windward aquifer as well as the

FIGURE 5-48. Initial Twenty Year Project List - Continued

Year	Project	Phase	Project Description	Budget	Antic Capacity GPM	24 Hrs	16 Hrs	Avg Day Capacity	Effective Source Addition	Assumed Pumping In '96 Model	Comment
	Windward Wells at Kauiki - Incremental	Transmission	Install roughly 15,0000' of pipeline to connect well to system.	1,760,800	600	864,000	576,000	384,000	**300,000**	No	Leeward aquifer would have been developed, with only 77,912 additional source available from this well if a resource reserve is maintained.
	Supply and Demand Side Management Projects										These projects are not capitalized. However, they would add to expenses needing to be recovered, so are added here. Assumes replacement of all non-conserving toilets and other fixtures. These projects plus the hypalon cover and replacement of Palawai Grid line bwlow combine to an estimated 485,000 GPD in
	Direct Install / Rebate of Toilets and Other Efficient Fixtures for Residences, Hotels and Others			1,480,419					**100,000**		
	Incentive Program for Hotel and Landsape Customers			225,000					**15,000**		
	Leak Detection & Water Audit Program - Equipment			150,000					**43,000**		
	Landscape Conservation Program			675,000					**111,000**		
	Portion of Watershed Fence Project - For Third Increment Only			3,000,000							
	Storage Projects										
	Replace Hi`i 0.5 MG Tank & Line Hi`i Reservoir OR		Replace 0.5 MG Hi`i Tank and re-line 1 MG Hi`i reservoir								* Not selected per discussions wutility. Cost would be $1.415 million.
	Replace Hi`i Tank & Reservoir with 2 MG Tank		Replace 0.5 MG Hi`i tank and 1 MG Hi`i reservoir with 2 MG	5,000,000							
	Replace Kaumalapau Tank		Design & Construct tank to serve needs of Kaumalapau. Construct tank, appurtenances,	75,000							
2012	Hypalon Balls at 15 MG Brackish Res.		Install hypalon balls to reduce evaporative losses at 15 MG	495,000					**14,000**		Estimated 14,000 GPD reduction in losses.
	Line Replacement										
	Replace Broken & Leaking Pipe in Central Palawai Irrigation Grid			3,740,920					**202,000**		Eliminating losses increases available capacity without additional strain to the aquifer. Levelized costs estimated based upon higher installation costs than are now shown, ($3.84 million, assuming ductile iron pipe. This was the most cost-effective resource option even with the ductile iron pipe assumption.) Costs shown here involve high-pressure PVC.
	Replace Asbestos-Concrete Pipe Segments in Lana`i City & PRV on 10" Asbestos Line			972,041							
	Upgrade Kaumalapau Line			3,958,217							
	Connect Potable Kaumalapau Line to Miki Basin			878,062							
	Connect Well 7 to Distribution Systems			697,842							
	Replace Steel Segments in Lana`i City			1,202,755							
	Connect Well 7 to West End Grid			153,237							
	Replace Old Pipe In West End of Palawai Irrigation Grid			342,947							
	PRV Valve Above Miki Industrial			9,000							
	Replace Kaumalapau PRV			9,000							
	Replace PRV below Hi`i			9,000							
	Replace Ninth St. PRV			9,000							
	Other PRV Replacement as Needed			9,000							
	Pump Replacement										
	Rolling Pump Replacement			2,400,000							7 currently operating source pumps, plus 2 or 3 more likely to operate in near future, plus new source pumps for well s15 and 2b - a total of 12 source pumps w assumed lifetime of 15 years per pump. 200K for replacement 20 years
	Rolling Upgrades to Motor Control & Electrical Centers			1,000,000							Regular maintenance, assessment and replacement of parts such motors, electrical or other needs can help extend the life of pumps. Some annual budget is necessary to insure this. $50 K per year for 20 years

FIGURE 5-48. Initial Twenty Year Project List - Continued

Year Project	Phase	Project Description	Budget	Antic Capacity GPM	24 Hrs	16 Hrs	Avg Day Capacity	Effective Source Addition	Assumed Pumping In '96 Model	Comment
SCADA, Telemetry & Monitoring Needs Replacements & Upgrades			500,000					Contingency for telemetry or other system monitoring needs, such as large flow meters, etc. 25K per year over 20 years.		
							From Rates & Monthly Charges **Improvement**		From New Meter Fees **Expansion**	
		ESTIMATED 20 YEAR SYSTEM CAPITAL NEEDS	**101,066,889**				**36,312,479**		**64,754,410**	**With Build-Out Scenario**
		Assumes that a 20 year roll-in, with a return on equity of 10% would work out to an average carrying cost of about 5%	**5,053,344**				**1,815,624**			
		Annual Revenues					914,116			660,932 from B&C report and Balance Sheet submitted for PUC Docket 2008-032, plus 253,184, from Pro Forma statement submitted for
		Annual Loss Currently Covered by C&CR					843,920			767,761 from B&C report and Balance Sheet submitted for PUC Docket 2008-032, plus 76,159, from Pro Forma statement submitted for
		Increase in Cost of Labor					80760			Source: Brown & Caldwell Report Lana`I Water System Acquisition Appraisal, May 2009 Draft
		New Facilities and Rolling Stock					197,038			Source: Brown & Caldwell Report Lana`I Water System Acquisition Appraisal, May 2009 Draft
							----------		OR TOTAL **5,335,010**	**With Base Case Development Only**
		Subtotal Additional Revenue					**2,035,834**			
		Annual Revenue Requirements					**3,851,458**			

Revenue Requirements To Cover Capital Expenditures

The total cost of projects identified and included in the Capital Plan in the event that the build-out scenario were chosen is $99,530,889. This amount is further divided into “Maintenance” or “Expansion” projects. Maintenance projects are those which would be funded by the utility through its rates and monthly or bi-monthly charges. Expansion projects are those which would be covered either by LHI, or other developers as needed. These projects are typically recouped in “New Meter Fees”. These are sometimes called “Facility Capacity Charges”, “Tap-In Charges”, or “Water System Development Fees”. They are the same thing. The term “New Meter Fee” has been used here. Developer-funded or in-kind projects are not included in this analysis. One example is a possible on-site storage tank for fire protection at the Miki Basin. If this is built, it would be funded by the developer. Neither LWCI nor LHI would be likely to fund construction of such a project. However, such projects once dedicated to the utility become the responsibility of LWCI to maintain, operate and or replace.

In the previous draft of this chapter, the total amount of projects to be covered by rates and charges within the planning period was estimated at $34,776,479. Some of the projects are specifically scheduled, others are unscheduled and assumed to roll in gradually over the twenty year period. Assuming a twenty year roll-in, with a 10% return on equity, the carrying costs work out to an average of about 5% per year. Annual carrying costs for maintenance and demand management projects were estimated at $1,738,824 per year.

Previously it was thought that sufficient reclaimed water to warrant a line from Lana‘i to Manele would not be available until after the 20 year time frame, so reclaimed water costs had not been added into the base case forecast for the twenty year time period. Since the October 2009 draft of this document, the use of 60,000 gallons of reclaimed water at Miki Basin had been added in to the near term plan. The potential added charges could be covered through either rates or new meter fees, so the change was examined both ways. If covered by rates, this would bring annual revenue requirements to $1,815,624.

Some additional costs are assumed based upon Table 4-5 of the May 29, 2009 DRAFT *Lana‘i Water System Acquisition Appraisal* for LWCI, and on the 2008 *Pro Forma* Statement of Income for Non-Potable Brackish Operations in PUC Docket 2008-03222. These sources list existing annual as roughly $660,932 per year for LWCI and $253,184 for LHI. Existing annual revenue losses covered by CCR are estimated at $767,761 per year for LWCI and $76159 for LHI, for a total existing operating expense of about $1,758,036. Increased costs of labor and cost of new facilities and rolling stock are also taken from the DRAFT *Lana‘i Water System Acquisition Appraisal*. Increased costs of labor are estimated at $80,760. Revenue requirements for new facilities and rolling stock are estimated at $197,038.

Adding revenue requirements for the annual carrying cost of the proposed program ($1,738,824), plus existing revenue requirements ($1,758,036), assumed increases in cost of labor ($80,760), new facilities and rolling stock ($197,038), one arrives at an average annual revenue requirement of $3,774,658 in 2008 dollars. With the addition of the Miki Basin project, the annual revenue requirement would be $3,851,458.

Billing data were broken down into user classes and evaluated for relative percentage of total water sales by classes and usage amounts. These percents were then applied to overall revenue requirements to derive starting revenue targets for each use and consumption class. Assignment of costs was adjusted to provide for discounted rates for low water use in all classes, to encourage conservation, and to discourage excessive irrigation. The resulting charges per thousand gallons of water are presented in Figures 5 -55 and 5-56. Rates are shown with and without financing of the Miki Basin reclaimed project, since it could be financed by rates or fees. Bi-monthly meter charges were not re-calculated, and are presented in Figure 5-54.

FIGURE 5-49. Proposed Bi-Monthly Charges Based Upon Capital Plans

Bi- Monthly Meter Fees		
	Relative	Bi-Monthly
Meter Size	Capacity	Rate ($)
5/8"	1	25
3/4"	1.5	37.5
1"	2.5	62.5
1-1/2"	5	125
2"	8	200
2-1/2"	12	300
3"	16	400
4"	25	625
6"	50	1250
8"	80	2000
hydrant meters 3" charged daily $28.69 / day	25	625

The rate design shown in Figures 5-50 and 5-51 includes rates for both potable and brackish service, and is steeply tiered to encourage conservation. A relatively low “lifeline” rate is maintained across the low end of all use classes.

Certain policy recommendations are reflected by the rate design. It is designed for equity, especially for those whose uses reflect only basic necessity for livelihoood. It is designed to strongly encourage conservation. A third policy statement is made in the balance of costs between fresh and potable brackish water. Although the brackish and potable systems are registered separately under the PUC, this rate design addresses both, adding additional tiers to the brackish system as well as the potable. One might tend to think that potable water should be more expensive than brackish water, since it is of higher quality. At present, the brackish sources are generally less expensive than the potable on Lana‘i. However, water levels of the brackish sources on Lana‘i have been declining much more rapidly than those of the fresh sources. Continuing decline in water levels will make these sources more costly. All of the water on Lana‘i comes from one aquifer system. Nor is it clear that irrigation in Manele, where the brackish source is used, need be cheaper than irrigation in Lana‘i City. Although the rate design spreadsheet was set up such that these sources of water can be charged differently, the draft structure presented below sets irrigation charges for brackish and potable water at the same rate.

After the rate in the first column of rates in Figure 5-50 were presented, CCR expressed some concern about the relative fraction of cost that was assigned to the Manele Golf Course. All other rate columns, including the second column in Figure 5-51, have brought that fraction down, in varying amounts. The rate designs in Figure 5-56 have more tiers, to help address the irrigation question fairly.

FIGURE 5-50. **Possible Rates Based Upon Replacement and Operating Needs**

Rates Per 1,000 Gallons	$ / Kgal No Miki Proj	$ / Kgal w / Miki Proj
Res SF <=200	1.25	1.35
Res SF >200 - 500	1.95	2.00
Res SF >500-1,000	2.55	2.60
Res SF >1,000-1,500	4.65	5.15
Res SF >1,500-2,000	6.75	6.75
ResSF >2,000	7.95	8.00
Res MF <800	1.25	1.35
Res MF >800-2000	1.95	2.00
Res MF >2000	3.45	5.00
*assumes 4 units per meter		
Ag <5000	1.25	1.25
Ag >5000	1.85	1.85
Hotel <+200 GPD/room	1.25	1.35
Hotel >200 to 350 GPD /room	1.95	2.50
Hotel >350 to 500 GPD /room	3.50	5.60
Hotel >500 GPD / room	7.15	7.15
Commercial, Gov`t. & PQP <500	1.25	1.35
Commercial, Gov`t. & PQP >500-1,000	1.95	2.50
Commercial, Gov`t. & PQP >1,000-2,000	2.65	3.50
Commercial, Gov`t. & PQP >2,000-5,000	4.65	5.65
Commercial, Gov`t. & PQP >5,000	6.65	7.25
Irrig & Devel <500	3.70	2.50
Irrig & Devel >500-1000	4.75	3.50
Irrig & Devel >1,000-2000	5.80	5.60
Irrig & Devel >2,000 -5000	6.85	7.00
Irrig & Devel >5,000	7.95	8.00
Brackish Irrig & Devel <500	3.70	2.50
Brackish Irrig & Devel >500-1000	4.75	3.50
Brackish Irrig & Devel >1,000-2000	5.80	5.50
Brackish Irrig & Devel >2,000 -5000	6.85	7.25
Brackish Irrig & Devel >5,000	7.95	8.00

Revenue Requirements To Cover Capital Expenditures

FIGURE 5-51. Possible Rates Based Upon Replacement and Operating Needs

Rates Per 1,000 Gallons	No Miki Proj	No Miki Proj	w Miki Proj	w Miki Proj
Res SF <=200	1.75	1.80	2.00	1.95
Res SF >200 - 500	2.85	2.85	2.85	2.85
Res SF >500-1,000	4.05	4.05	5.00	5.00
Res SF >1,000-1,500	5.75	5.75	5.75	6.00
Res SF >1,500-2,000	7.00	7.00	7.50	7.50
ResSF >2,000	8.75	8.75	9.25	9.25
Res MF* <800	1.75	1.75	2.00	2.00
Res MF >800-2000	2.85	2.85	2.85	2.85
Res MF 2,000 - 4,000	4.05	4.05	4.50	4.50
Res MF 4,000 - 8,000	5.75	5.75	5.75	5.75
Res MF >8000	7.00	7.00	7.50	7.50
*assumes 4 units per meter				
Commercial Gov`t. , PQP <500	2.05	2.05	2.25	2.25
Commercial and Gov`t. , PQP >500-1,000	2.85	2.85	2.85	2.85
Commercial and Gov`t. , PQP >1,000-2,000	3.65	3.65	3.65	3.65
Commercial and Gov`t. PQP >2,000-5,000	4.75	4.75	5.00	5.00
Commercial and Gov`t. PQP >5,000	5.15	5.15	5.15	5.15
Hotel <+200 GPD / room	2.05	2.05	2.25	2.25
Hotel 200 to 350 GPD / room	2.85	2.85	2.85	2.85
Hotel 350 to 500 GPD /room	4.75	4.75	5.00	5.05
Hotel >500 GPD / room	6.50	6.50	7.25	7.25
Ag <500	1.75	1.05	1.10	1.10
Ag <5000	1.05	1.10	1.10	1.15
Ag >5000	1.05	1.15	1.25	1.25
Irr & Devel <500	4.35	4.35	4.35	4.50
Irrig & Devel >500-1000	5.35	5.35	5.35	5.35
Irrig & Devel >1,000-2000	6.50	6.50	6.50	6.50
Irrig and Devel >2,000 -5000	7.70	7.70	7.70	7.70
Irrig and Devel >5,000	8.50	8.50	8.50	8.50
Brackish Irr & Devel <500	4.35	4.35	4.50	4.50
Brackish Irrig & Devel >500-1000	5.35	5.35	5.65	5.65
Brackish Irrig & Devel >1,000-2000	6.50	6.50	6.50	6.50
Brackish Irrig and Devel >2,000 -5000	7.70	7.70	7.70	7.70
Brackish Irrig and Devel >5,000	8.75	8.75	8.75	8.75
Manele GC <50,000	4.30	4.30	4.45	4.45
Manele GC 50,000 - 100,000	5.35	5.35	5.50	5.50
Manele GC 100,000 - <250,000	6.50	6.50	6.50	6.50
Manele GC 250,000 - < 500,000	7.70	7.70	7.70	7.70
Manele GC >500,000 - 650000	8.75	8.75	8.75	8.75
Manele GC >650,000	15.00	15.00	15.00	15.00

Cost recovery on an estimated $64,754,410 based upon build-out meter counts would lead to a cost of $27,621.75 or $28,261.60 for a new 5/8" meter, even without the reclaimed project. Clearly most of the community can not and will not pay that. It would be impossible to fund the proposed build-out scenario without in-kind contribution. The bulk of the costs of a build-out scenario would probably be recovered through real estate sales, rather than new meter fees.

FIGURE 5-52. Projected Costs Per Meter - Based on Full Build-0ut Within 20 Years

Meter Size	Relative Capacity	Build-Out New Fee Rate	Build-Out New Fee Rate w / Miki
5/8"	1	$27,621.75	$28,261.60
3/4"	1.5	$41,432.63	$42,392.40
1"	2.5	$69,054.38	$70,654.00
1-1/2"	5	$138,108.75	$141,308.00
2"	8	$220,974.00	$226,092.80
2-1/2"	12	$331,461.00	$339,139.20
3"	16	$441,948.00	$452,185.60
4"	25	$690,543.75	$706,540.00
6"	50	$1,381,087.50	$1,413,080.00
8"	80	$2,209,740.00	$2,260,928.00
hydrant meters 3" charged daily	25	$690,543.75	$706,540.00
		- - - - - - - -	- - - - - - - -
		daily rate	daily rate
hyd meter charged daily		$1,891.90	$1,935.73

Alternatively, the improvements needed to the year 2030 according to the base case forecast would require only $5,335,010 in cost recovery over the planning period, and could be accommodated with a meter fee structure that started at $532 per meter without the reclaimed project. The projects included in this theoretical new meter fee are Well 15, Renovation and Recommissioning of Well 7, and the connection of Well 7 to the Lana'i System. With the Miki Basin reclaimed project, the cost recovery would rise to $6,871,010, and can be accommodated with a fee structure starting at $686 for a 5/8 inch meter.

FIGURE 5-53. Projected Costs Per Meter - Based on Base Case Forecast

Meter Size	Relative Capacity	New Meter Fee Base Case	New Meter Fee Base w/Recl.
5/8"	1	$532	$686
3/4"	1.5	$798	$1,029
1"	2.5	$1,331	$1,715
1-1/2"	5	$2,661	$3,430
2"	8	$4,258	$5,488
2-1/2"	12	$6,387	$8,232
3"	16	$8,516	$10,976
4"	25	$13,306	$17,150
6"	50	$26,613	$34,300
8"	80	$42,580	$54,880
hydrant meters 3"	25	$13,306	$17,150
hyd meters charged daily		$28.69 / day	$46.99 / day

Revenue Requirements To Cover Capital Expenditures

FIGURE 5-54. Basic Source Plan

		Average Day Ability to Meet	Cumulative Aquifer	Cumulative Leeward	Cumulative Windward	Conservation and
Options in Order of Levelized Cost w/Adjustments	Gal	Demand	Withdrawals	Aquifer	Aquifer	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 K

**** 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.

The source plan on the previous page has not been adjusted for Miki Basin, since it already accounts for additional water to be generated at the treatment plants.

Conclusion

Several issues have been addressed in this chapter.

A list of options has been delineated that can meet either the base case or build-out forecast. These options have been characterized based on costs and other factors. Even at presumed build-out of Phase II, the source plan assumes only 313,938 GPD in new reclaimed water will become available island-wide, with only 267,371 of that in Lanaʻi City. For this reason, transmission for 500,000 GPD from Lanaʻi City to Manele is not included in the 2030 source plan. The basis for these assumptions is discussed in Chapter 4, specifically the base case forecast and Phase II build-out forecasts from Figure 4-54 on page 4-59 are used in the source plan table above. Aside from normal growth at Manele, Koele and within Lanaʻi City, the only capital plan designed specifically to offset potential pumpage with reclaimed water within the planning period is the Miki Basin project. The possible use of reclaimed water has also been mentioned in relation to or more new developments in Lanaʻi City. This may be useful to the extent that this is possible and can off-set water that would otherwise be pumped.

A few rate and fee structures to address system inadequacies and repairs necessary over the next twenty years have been provided. These rates addresses both potable and brackish systems, and are steeply tiered to encourage conservation. These rate and fee structures were designed to enable the utility to meet fore-casted growth in a self sufficient manner.

Based on discussions with utility personnel, certain source replacement projects are covered by LWCI, through it's rate structure. The source projects included in this rate structure are Well 3 replacement, Well 2-A, replacing Well 2; Well 2-B, replacing Shaft 3, and replacements of Wells 1 and 4. All other source construction is assumed to be paid for by LHI, and covered by the "New Meter Fee". The reclaimed project to Miki Basin was treated flexibly. Both adjusted rates and fees have been designed to enable this project so that it can be funded in either fashion or provide flexibility to accommodate one of similar cost.

Approximately 485,000 GPD in conservation potential has been identified. A substantial investment has been added to the capital plan to enable these savings to be realized with the proposed rate structure.

Although conservation programs and watershed protection are not normally capitalized, they do need to be recovered within the rates, so these have been included in the proposed rate structure.

With regard to watershed expenses, the inclusion of a portion of the funding necessary to construct Increment 3 of the Lanaʻihale Fence in the capital plan would mean that according to the proposed rate structure, utility rate-payers would be making a contribution to help insure that the third increment of the Lanaʻihale fence gets built. A corollary of this contribution should be that continued development entitlements are contingent upon timely construction of this fence.

Conclusion

Two sets of “New Meter Fee” structures have been derived. The “New Meter Fee” structure covers source investments made by LHI. The base case “New Meter Fee” includes only Well 15 and the connection of Well 7 to the distribution system, because these were existing and near-term plans for source and could meet the base-case scenario. These sources could be traded for other selections with some minor adjustments. This new meter fee remains quite reasonable, starting at $532 or $686 per 5/8” meter, depending upon how the Miki Basin reclaimed project is funded.

Long term source projects are in the “New Meter Fee” for the build-out scenario. The purpose of this analysis was to examine what sort of cost recovery might be necessary if the utility were to fund the sources intended in the build-out plan. According to this analysis, “New Meter Fees” would be prohibitively expensive, in excess of $25,000 for a 5/8” meter, if build-out were to occur within the planning period. It would not be possible to recover this cost from a “New Meter Fee”. If the utility had to fund source development, these sources could not get built at this pace, and build-out would not occur over the twenty year planning period. If these sources are built, they will likely have to be dedicated as in-kind contributions.

Although several new sources have been identified, they would not be sufficient to meet build-out of the full CCR proposals at existing unaccounted-for water and per-unit consumption rates. The ability to build-out these plans will depend upon how successful the company is at bringing these rates down, as well as upon performance of the resource with changes to pumpage distribution and amounts, the state of the watershed, climatic influences and other factors.

Supply Options