EXHIBIT "I-9"

PART G

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

Supply Options

    - 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 Lana'i 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 Lana'i City and Koele. However, it would require expanded treatment capacity in Lana'i 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 Lana'i 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 Lana‘i 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 Lana‘i. 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.

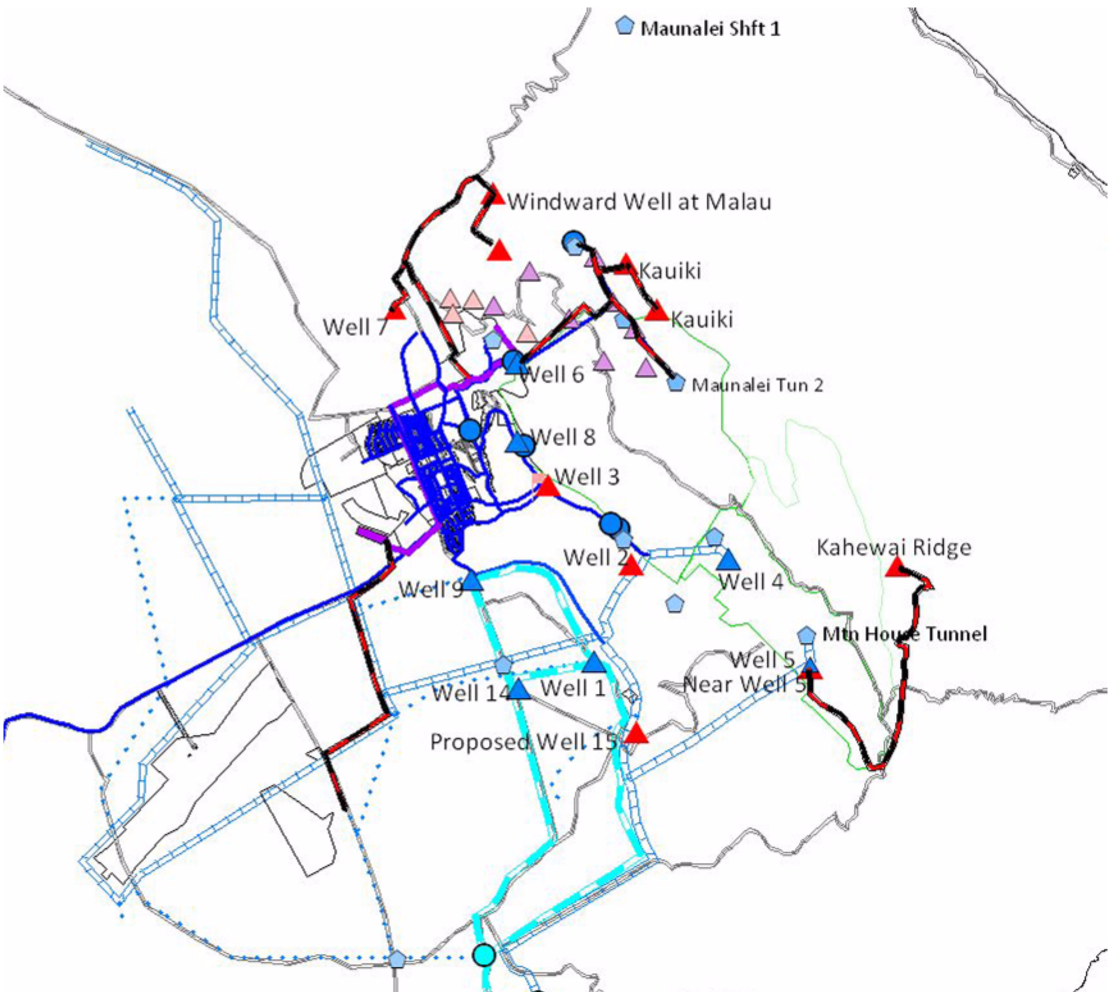
The potential magnitude of additional supply capacity that can be provided by new wells is limited by the sustainable recharge capacity of the source aquifers. Improvements in the distribution of pumping can increase the actual effective sustainable production. In order to fully develop the sustainable yield for high level potable water, it would be necessary to develop wells on the windward side of the Lana‘ihale. 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

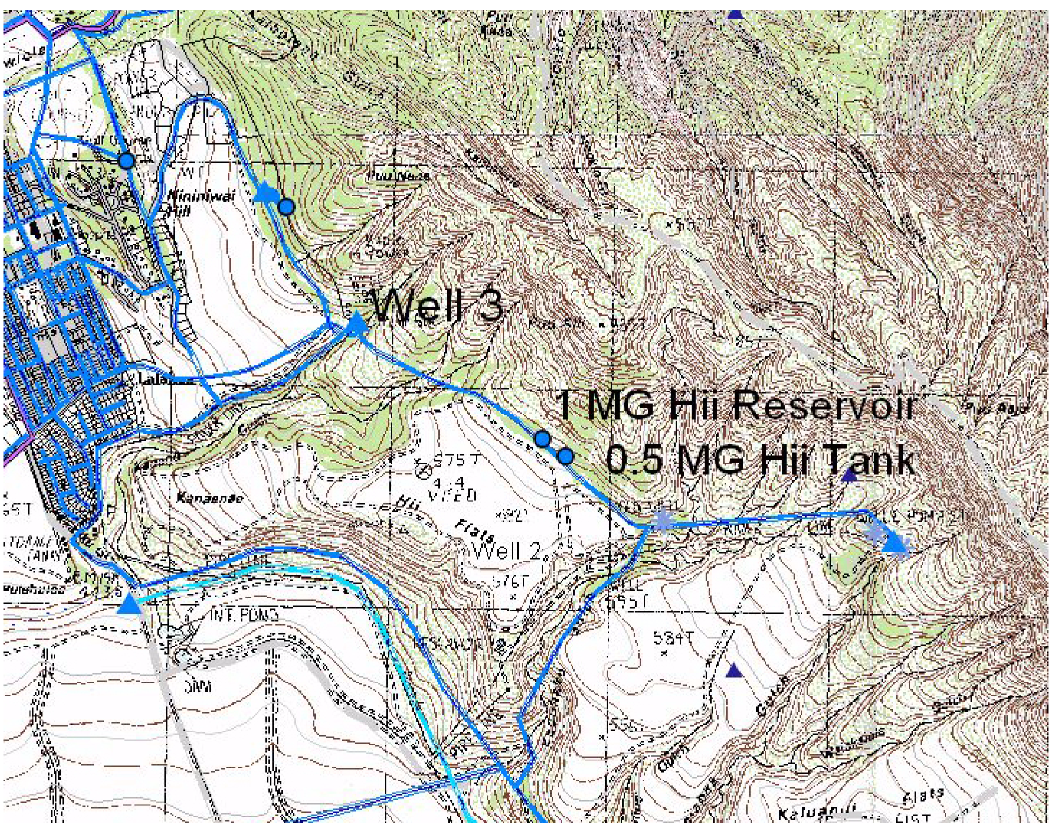


Leeward High Level Potable Well Development (near Hiʻi Tank)

Cost analysis was performed for developing a new high level potable well near the existing water transmission line between Well 3 and the Hiʻi 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 Hiʻi 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. 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	$150,000	$500,000		Feeder and connection to existing line
Storage Improvements	$0	$0		
Design / Engineering	$150,000	$500,000	HDA Estimate	Hydrolgy 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	150% 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

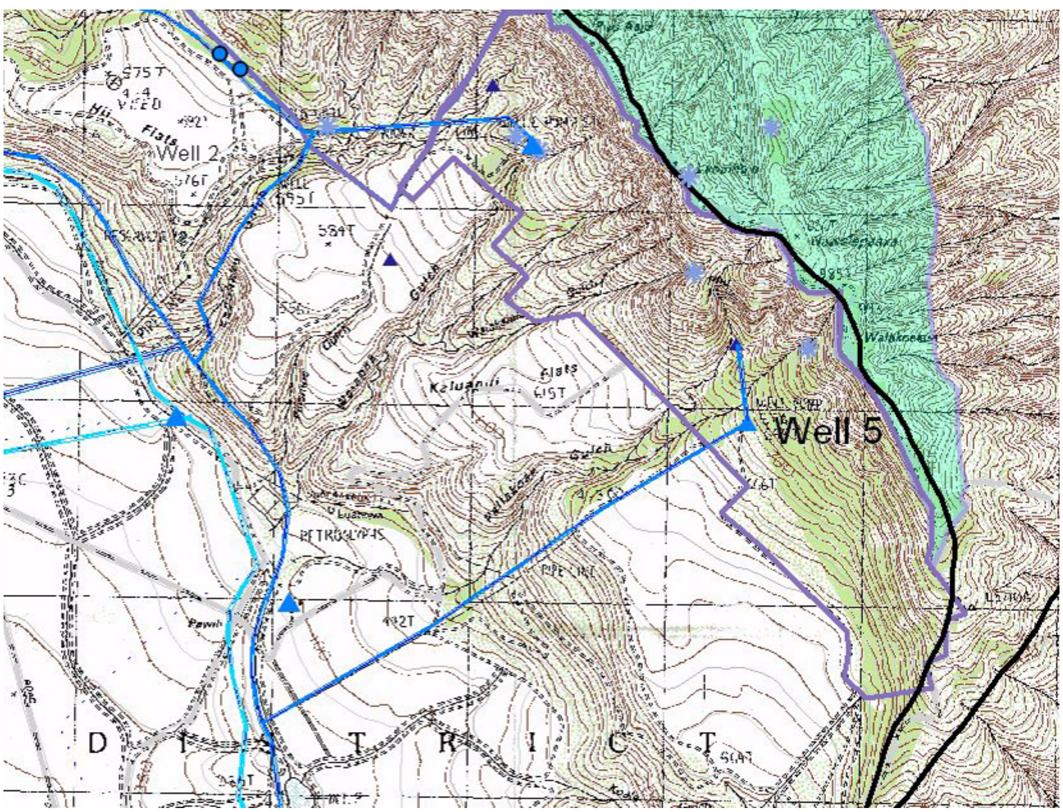


FIGURE 5-8. Leeward High Level Potable Well Development (near Well 5)

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		

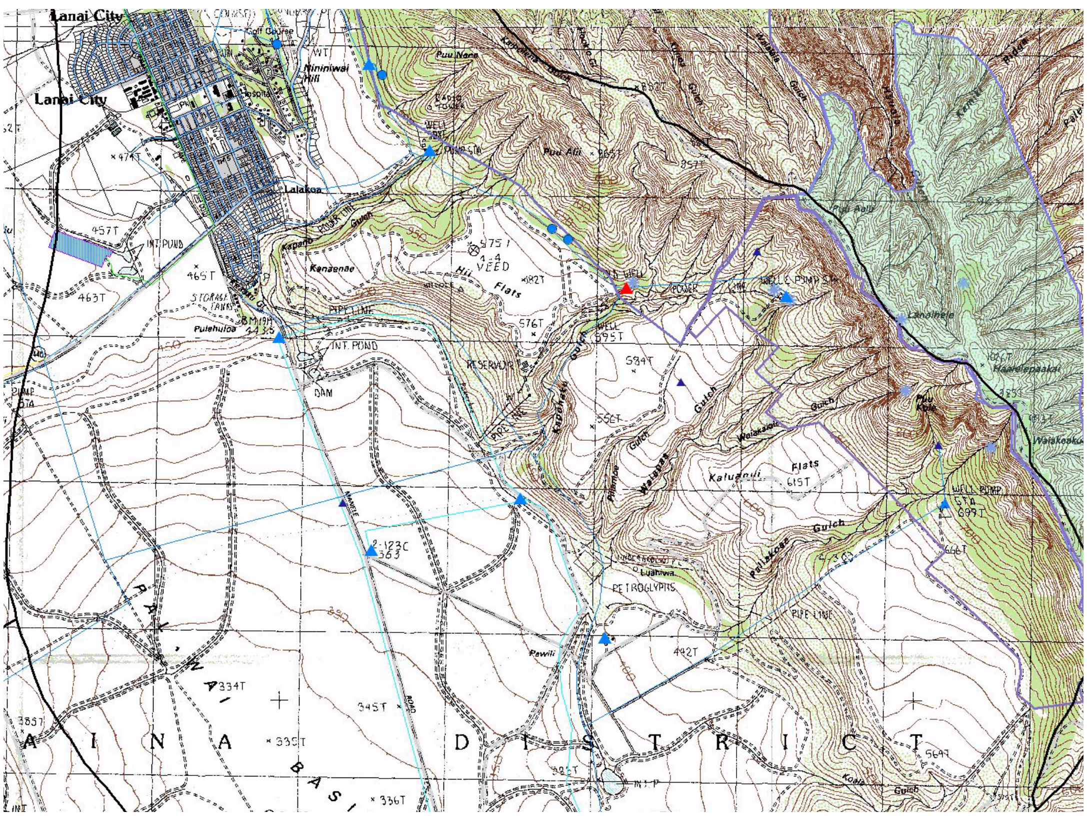
Well 2 - B at Shaft 3 Site

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**



Potential Supply Options

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		