

EXHIBIT "I-9"
PART I

Supply Options

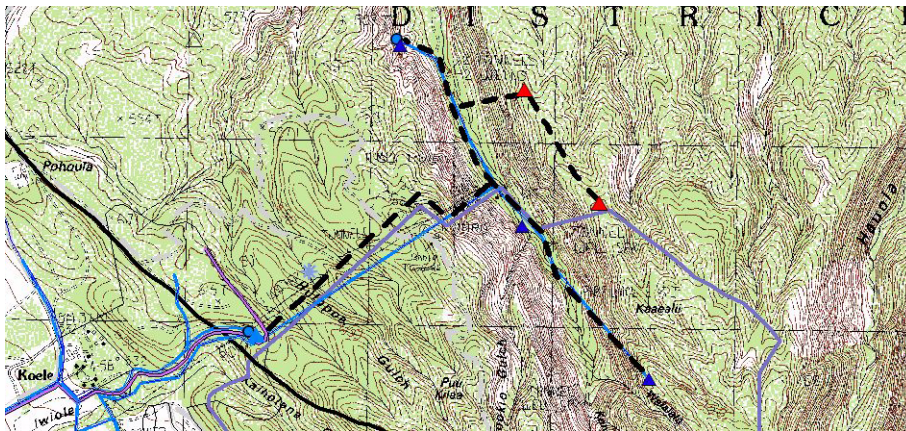
Windward Wells at Kauiki

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 Maunalei 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


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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
Drilling	\$1,020,000	\$3,400,000		HDA Estimate	Road improvements
Development	\$1,159,000	\$3,863,333		HDA Estimate	Drilling 12" well 1200 ft depth @ \$850/ft
Transmission Improvements	\$6,125,000	\$20,416,667		HDA Estimate	(1) pump 1 mgd @ \$550k, SCADA, ancillaries
Storage Improvements	\$250,000	\$833,333		HDA Estimate	7800 ft 10" hp line @ \$500 pif Kauiki thru Maunalei to Well #6
Design / Engineering	\$250,000	\$833,333		HDA Estimate	5000 ft 12" line @ \$445 pif Well#6 to Lanai City Tank
Contingencies	\$1,820,800	\$6,069,333		HDA Estimate	50kgal contact/control tank
					Hydrology study, engineering
					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		
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 @ \$0.40 per kwh
Chemicals/Materials		\$0,008		HDA Estimate	Vertical lift from el 700' water level to el 2060' hydraulic line at ridge*
Maintenance Expenses					150% Maui system average cost
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%				
First Year Cost w/Amortized Capital			\$/kgal		
			\$11,788		
Amortized Cap. Cost (Book Life)			\$8,692		
Fixed Op. Cost			\$0,368		
Variable Op. Cost			\$2,728		
		NPV \$/MMGD	Levelized \$/kgal		
Twenty-year Total NPV Cost	\$4,844	\$13,100			
Capital Cost (20 year Amort.)	36,416	\$8,692			
Fixed Op. Cost	2,016	\$0,481			
Variable Op. Cost	16,411	\$3,917			
		NPV \$/MMGD	Levelized \$/kgal		
Economic Life Total NPV Cost	\$6,631	\$12,267			
Capital Cost (Amort. per Econ. Life)	36,416	\$7,243			
Fixed Op. Cost	2,665	\$0,530			
Variable Op. Cost	22,550	\$4,485			

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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			
Variable Op. Cost		\$2.728			
	NPV \$/MMGD	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			
Variable Op. Cost	16.411	\$3.917			
	NPV \$/MMGD	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			
Variable Op. Cost	22.550	\$4.485			

Potential Supply Options

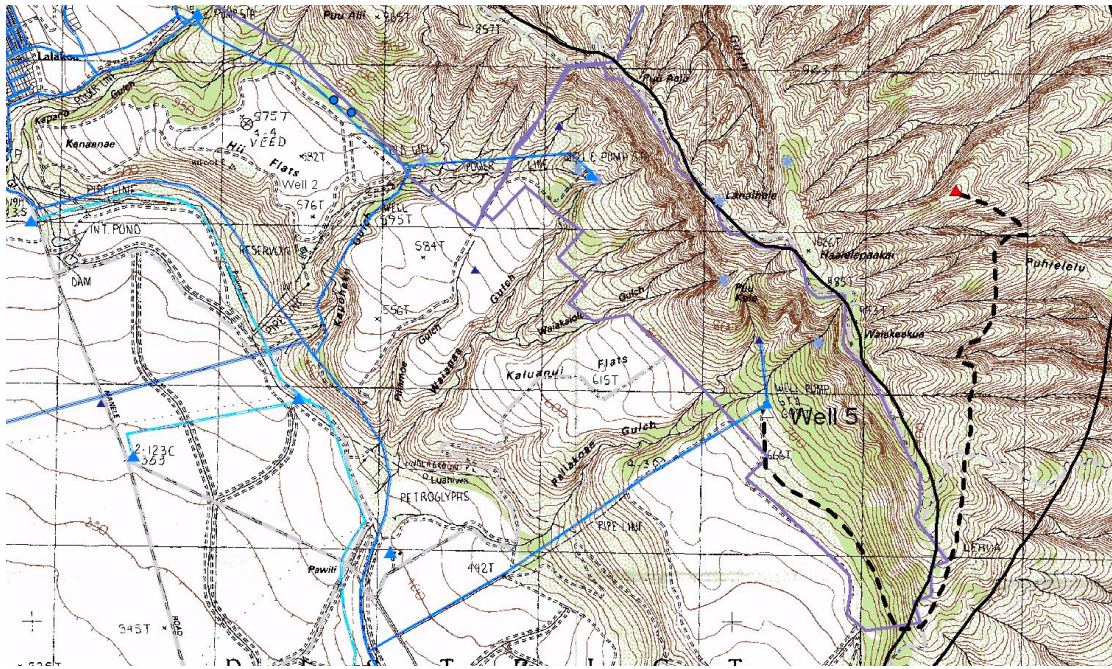
Windward Well at Kehewai Ridge

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



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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 p/f	
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 p/f 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%				
First Year Cost w/Amortized Capital			\$/kgal		
			\$9.744		
Amortized Cap. Cost (Book Life)		\$7.380			
Fixed Op. Cost		\$0.257			
Variable 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			
Variable 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			
Variable Op. Cost	17.424	\$3.466			

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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 pif
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 pif 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			
Variable 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			
Variable 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			
Variable Op. Cost	20.731	\$4.123			

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New Brackish Wells with Mixing to Provide Additional Potable Supply

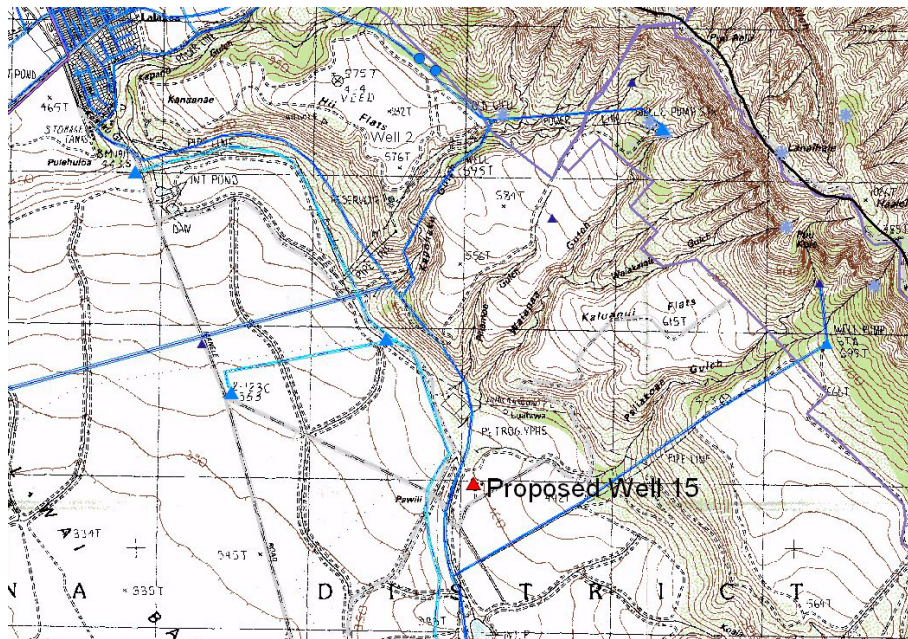
New wells that provide water with chloride levels marginally below water drinking standards could be mixed with fresher water to increase total potable water supply. This would require sufficient transmission, storage and control infrastructure to guarantee adequate mixing of brackish and potable water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


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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			
Variable 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			
Variable 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			
Variable Op. Cost	10.748	\$2.138			

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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.

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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/Klt 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%		
First Year Cost w/Amortized Capital		\$Kgal	\$14.317
Amortized Cap. Cost (Book Life)			\$3.124
Fixed Op. Cost			\$1.222
Variable Op. Cost			\$9.971
Twenty-year Total NPV Cost	NPV \$/MMGD	Levelized \$/kgal	79.777 \$19.056
Capital Cost (20 year Amort.)	13.086		\$3.124
Fixed Op. Cost	6.695		\$1.598
Variable Op. Cost	59.996		\$14.321
Economic Life Total NPV Cost	NPV \$/MMGD	Levelized \$/kgal	104.372 \$20.774
Capital Cost (Amort. per Econ. Life)	13.086		\$2.603
Fixed Op. Cost	8.849		\$1.760
Variable Op. Cost	82.437		\$16.397

Supply Options

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 Lana‘i 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 Lana‘i 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 Lana‘i 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.

Potential Supply Options

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.)					
Const. Per. Esc. Rate (Nom.)	3.00%				
AFUDC Interest Rate (Nom.)					
AFUDC Interest Rate (Nom.)	6.00%				
AFUDC Factor					
	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			
Variable 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		
Variable 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		
Variable Op. Cost	108.893		\$21.659		

Supply Options

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		
Variable Op. Cost			\$6.371		
	NPV \$/MMGD		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		
Variable Op. Cost	38.335		\$9.151		
	NPV \$/MMGD		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		
Variable Op. Cost	52.674		\$10.477		

Supply and Demand Side Efficiency Options

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 unaccounted-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 Kaunalapau, 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 Kaunalapau (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.