EXHIBIT "I-9" PART I

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

Maui County Water Use & Development Plan - Lana'i

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

Capacity (MGD)				
Installed Capacity		0.864		
Max. Day Capacity		0.648		
Enective Sustainable Capacity		100%		
Average Eacility 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 Design / Engineering Contingencies	\$250,000 \$250,000 \$1,820,800	\$833,333 \$833,333 \$6,069,333	HDA Estimate HDA Estimate	50kgal contact/control tank Hydrology study, engineering 20%
Total Plant Cost (\$10,924,800	\$36,416,000		
Const. Per. Esc. Rate (Nom.) AFUDC Interest Rate (Nom.)	3.00% 6.00%			
AFUDC Factor		1.000		
Total Capitalized Cost	Total \$10,924,800	Per MGD \$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 Maintenance Labor Fixed Operating Costs		\$0 \$0	HDA Estimate	
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
Chemicals/Materials		\$0.008	HDA Estimate	ndge" 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 (\$)	0.000/			
Cost of Capital	6.00%			
Eixed On Cost Eco. Bate (Nom.)	3.00%			
Effective Fixed Op.Cost. Disc. Rate	2.91%			
Var Op Cost Esc. Bate (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 \$/koal		
		640.400		
Twenty-year Total NPV Cost	54.844	\$13.100		
Iwenty-year Iotal NPV Cost	54.844 36.416	\$13.100		
I wenty-year Total NPV Cost Capital Cost (20 year Amort.) Fixed Op. Cost	54.844 36.416 2.016	\$8.692 \$0.481		
Iwenty-year I otal NPV Cost Capital Cost (20 year Amort.) Fixed Op. Cost Varible Op. Cost	54.844 36.416 2.016 16.411	\$13.100 \$8.692 \$0.481 \$3.917		
I wenty-year Total NPV Cost Capital Cost (20 year Amort.) Fixed Op. Cost Varible Op. Cost	54.844 36.416 2.016 16.411	\$8.692 \$0.481 \$3.917		
I wenty-year Total NPV Cost Capital Cost (20 year Amort.) Fixed Op. Cost Varible Op. Cost Economic Life Total NPV Cost	54.844 36.416 2.016 16.411 NPV \$M/MGD 61.631	\$13.100 \$8.692 \$0.481 \$3.917 Levelized \$/kgal \$12.267		
Capital Cost (20 year Amort.) Fixed Op. Cost Varible Op. Cost Economic Life Total NPV Cost	54.844 36.416 2.016 16.411 NPV \$M/MGD 61.631	\$13.100 \$8.692 \$0.481 \$3.917 Levelized \$/kgal \$12.267		
I wenty-year Total NPV Cost Capital Cost (20 year Amort.) Fixed Op. Cost Varible Op. Cost Economic Life Total NPV Cost Capital Cost (Amort. per Econ. Life)	54.844 36.416 2.016 16.411 NPV \$M/MGD 61.631 36.416	\$13.100 \$8.692 \$0.481 \$3.917 Levelized \$/kgal \$12.267 \$7.243 \$0.520		
I wenty-year Total NPV Cost Capital Cost (20 year Amort.) Fixed Op. Cost Varible Op. Cost Economic Life Total NPV Cost Capital Cost (Amort. per Econ. Life) Fixed Op. Cost Varible Op. Cost	54.844 36.416 2.016 16.411 NPV \$MMGD 61.631 36.416 2.665 22.550	\$13.100 \$8.692 \$0.481 \$3.917 Levelized \$/kgal \$12.267 \$7.243 \$0.530 \$4.485		

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

Capacity (MGD) Installed Capacity Max. Day Capacity Effective Sustainable Capacity Excilite Capacity Eactor		0.864 0.648 0.300		
Average Facility Output		0.300		
Capital Costs (\$)	Total	Per MGD		
Exploration/Land/Power	\$275,000	\$916,667	HDA Estimate	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
I ransmission improvements	\$1,350,000	\$4,500,000	HDA Estimate	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%	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	****	407.000		5 1/
Electrical Demand	\$29,376	\$97,920		energy cost*installed capacity
Chemicals/Materials		\$0		
Maintenance Expenses Amort of Capitalized Rebuild Costs		\$0 \$0		
		ΨŪ		
Total Fixed Op. Costs	\$40,334	\$134,445		
Variable Operating Costs (\$)		Per KGal		
Operating Labor				
Maintenance Labor		\$2 720	HDA calculation	5 kwb per koal per thousand feet vertical lift @ \$ 40 per kwb
Electrical Energy		ψ2.720		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 On Costs		\$2 728		
		ψ2.720		
Plant Life (Years)				
Functional Life	30			
Book Life	20			
Levelized Production Costs (\$)	20			
Cost of Capital	6.00%			
Discount Rate (Nom.)	6.00%			
Fixed Op.Cost Esc. Rate (Nom.)	3.00%			
Var On 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		
		evelized \$/kcol		
Economic Life Total NPV Cost	41.431	\$8.246		
	40.040	#2.00F		
Capital Cost (Amort, per Econ, Life) Fixed Op, Cost	2.665	\$3.225 \$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

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

Capacity (MGD) Installed Capacity Max. Day Capacity Effective Sustainable Capacity		0.864 0.864 0.300		
Average Facility Output Capital Costs (\$)	Total	0.300 Per MGD		
Exploration/Land/Power Drilling Development Transmission Improvements	\$100,000 \$1,120,000 \$1,159,000 \$4,950,000	\$333,333 \$3,733,333 \$3,863,333 \$16,500,000	HDA Estimate HDA Estimate HDA Estimate	Water utility share line extension, electrical controls (1) well 12" at 1400 ft @ \$800 plf (1) pump 1 mgd @ \$550k, SCADA, ancillaries 21,000 ft 8" line @ \$200 plf to Well#5 15,000 ft access road @ \$50
Storage Improvements Design / Engineering	\$250,000 \$150,000	\$833,333 \$500,000	HDA Estimate	50Kgal contact tank; chlorinator 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.) AFUDC Interest Rate (Nom.) AFUDC Factor	3.00% 6.00%	1 000		
Total Capitalized Cost	Total \$9,274,800	Per MGD \$30,916,000		
Fixed Operating Costs (\$) Dedicated Operating Labor Apportioned Operating Labor Maintenance Labor	Per Year \$5,479	Per Y/MGD \$18,263 \$0 \$0	HDA Estimate	\$0.05 per kgal based on estimated Lanai average
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 Maintenance Expenses Amort. of Capitalized Rebuild Costs		\$0 \$0 \$0		
Total Fixed Op. Costs	\$28,159	\$93,863		
Variable Operating Costs (\$) Operating Labor		Per KGal		
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 Maintenance Expenses		\$0.008	HDA Estimate	150% Maui system average cost
Total Variable Op. Costs		\$2.108		
Plant Life (Years)	20			
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%			
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) Fixed Op. Cost Varible Op. Cost		\$7.380 \$0.257 \$2.108		
Twenty-year Total NPV Cost	NPV \$M/MGD 45.004	Levelized \$/kgal \$10.750		
Capital Cost (20 year Amort.) Fixed Op. Cost Varible Op. Cost	30.916 1.408 12.681	\$7.380 \$0.336 \$3.027		
Economic Life Total NPV Cost	NPV \$M/MGD 50.200	Levelized \$/kgal \$9.992		
Capital Cost (Amort. per Econ. Life) Fixed Op. Cost Varible Op. Cost	30.916 1.861 17.424	\$6.149 \$0.370 \$3.466		

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

Capacity (MGD)				
Installed Capacity		0.864		
Ffective Sustainable Capacity		0.864		
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) wen 12 at 1800 ft @ \$800 pn (1) pump 1 mod @ \$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%
	60 050 000	£00 400 000		
Total Plant Cost (\$9,658,800	\$32,196,000		
Const. Per. Esc. Rate (Nom.)	3.00%			
AFUDC Interest Rate (Nom.)	6.00%			
AFUDC Factor	Tatal	1.000		
Total Capitalized Cost		\$22 106 000		
Total Capitalized Cost	\$9,656,600	\$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		
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 \$0		
Amon. of Capitalized Rebuild Costs		\$ 0		
Total Fixed Op. Costs	\$32,479	\$108,263		
Variable Operating Costs (\$)		Per KGal		
Operating Labor				
Operating Labor Maintenance Labor Electrical Energy		\$2 500	HDA calculation	5 kwh per kgal per thousand feet vertical lift @ \$.40 per kwh
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
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials		\$2.500 \$0.008	HDA calculation	5 kwh per kgal per thousand feet vertical lift @ 5.40 per kwh Vertical lift from el 1500' water level to el 2750' wellhead 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses		\$2.500 \$0.008	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 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses		\$2.500 \$0.008	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 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses Total Variable Op. Costs		\$2.500 \$0.008 \$2.508	HDA calculation HDA Estimate	5 kwh per kgal per thousand feet vertical lift @ \$.40 per kwh Vertical lift from el 1500' water level to el 2750' wellhead 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses Total Variable Op. Costs Plant Life (Years)		\$2.500 \$0.008 \$2.508	HDA calculation HDA Estimate	5 kwh per kgal per thousand feet vertical lift @ \$40 per kwh Vertical lift form el 1500' water level to el 2750' wellhead 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses Total Variable Op. Costs Plant Life (Years) Functional Life	30	\$2.500 \$0.008 \$2.508	HDA calculation	5 kwh per kgal per thousand feet vertical lift @ 540 per kwh Vertical lift from el 1500' water level to el 2750' wellhead 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses Total Variable Op. Costs Plant Life (Years) Functional Life Economic/Analysis Life	30 30	\$2.500 \$0.008 \$2.508	HDA calculation	5 kwh per kgal per thousand feet vertical lift @ 5.40 per kwh Vertical lift from el 1500' water level to el 2750' wellhead 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses Total Variable Op. Costs Plant Life (Years) Functional Life Economic/Analysis Life Book Life	30 30 20	\$2.500 \$0.008 \$2.508	HDA calculation HDA Estimate	5 kwh per kgal per thousand feet vertical lift @ \$.40 per kwh Vertical lift from el 1500 water level to el 2750 wellhead 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses Total Variable Op. Costs Plant Life (Years) Functional Life Economic/Analysis Life Book Life Levelized Production Costs (\$) Cost of Capital	30 30 20 6.00%	\$2.500 \$0.008 \$2.508	HDA calculation HDA Estimate	5 kwh per kgal per thousand feet vertical lift @ \$.40 per kwh Vertical lift from el 1500 water level to el 2750 wellhead 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses Total Variable Op. Costs Plant Life (Years) Functional Life Economic/Analysis Life Book Life Levelized Production Costs (\$) Cost of Capital Discount Rate (Nom.)	30 30 20 6.00% 6.00%	\$2.500 \$0.008 \$2.508	HDA calculation HDA Estimate	5 kwh per kgal per thousand feet vertical lift @ \$40 per kwh Vertical lift from el 1500' water level to el 2750' wellhead 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses Total Variable Op. Costs Plant Life (Years) Functional Life Economic/Analysis Life Book Life Levelized Production Costs (\$) Cost of Capital Discount Rate (Nom.) Fixed Op.Cost Esc. Rate (Nom.)	30 30 20 6.00% 3.00%	\$2.500 \$0.008 \$2.508	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 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses Total Variable Op. Costs Plant Life (Years) Functional Life Economic/Analysis Life Book Life Levelized Production Costs (\$) Cost of Capital Discount Rate (Nom.) Fixed Op. Cost Esc. Rate (Nom.) Effective Fixed Op.Cost. Disc. Rate	30 30 20 6.00% 6.00% 3.00% 2.91%	\$2.500 \$0.008 \$2.508	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 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses Total Variable Op. Costs Plant Life (Years) Functional Life Economic/Analysis Life Book Life Levelized Production Costs (\$) Cost of Capital Discount Rate (Nom.) Fixed Op. Cost Esc. Rate (Nom.) Effective Fixed Op.Cost. Disc. Rate Var. Op. Cost Esc. Rate (Nom.)	30 30 20 6.00% 6.00% 3.00% 2.91% 4.00%	\$2.500 \$0.008 \$2.508	HDA calculation HDA Estimate	5 kwh per kgal per thousand feet vertical lift @ \$.40 per kwh Vertical lift from el 1500 water level to el 2750 wellhead 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses Total Variable Op. Costs Plant Life (Years) Functional Life Economic/Analysis Life Book Life Levelized Production Costs (\$) Cost of Capital Discount Rate (Nom.) Fixed Op.Cost Esc. Rate Var. Op.Cost Esc. Rate (Nom.) Effective Fixed Op.Cost. Disc. Rate	30 30 20 6.00% 6.00% 3.00% 2.91% 4.00% 1.92%	\$2.500 \$0.008 \$2.508	HDA calculation HDA Estimate	5 kwh per kgal per thousand feet vertical lift @ \$.40 per kwh Vertical lift from el 1500 water level to el 2750 wellhead 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses Total Variable Op. Costs Plant Life (Years) Functional Life Economic/Analysis Life Book Life Levelized Production Costs (\$) Cost of Capital Discount Rate (Nom.) Fixed Op.Cost Esc. Rate (Nom.) Effective Fixed Op.Cost. Disc. Rate Var. Op.Cost Esc. Rate (Nom.) Effective Var. Op.Cost. Disc. Rate	30 30 20 6.00% 6.00% 3.00% 2.91% 4.00% 1.92%	\$2.500 \$0.008 \$2.508 \$/kgal \$10.489	HDA calculation HDA Estimate	5 kwh per kgal per thousand feet vertical lift @ \$.40 per kwh Vertical lift from el 1500' water level to el 2750' wellhead 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses Total Variable Op. Costs Plant Life (Years) Functional Life Economic/Analysis Life Book Life Levelized Production Costs (\$) Cost of Capital Discount Rate (Nom.) Fixed Op. Cost Esc. Rate (Nom.) Effective Fixed Op.Cost. Disc. Rate Var. Op.Cost Esc. Rate (Nom.) Effective Var. Op.Cost. Disc. Rate	30 30 20 6.00% 3.00% 2.91% 4.00% 1.92%	\$2.500 \$0.008 \$2.508 \$10.489 \$7.005	HDA calculation HDA Estimate	5 kwh per kgal per thousand feet vertical lift @ \$.40 per kwh Vertical lift from el 1500 water level to el 2750 wellhead 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses Total Variable Op. Costs Plant Life (Years) Functional Life Economic/Analysis Life Book Life Levelized Production Costs (\$) Cost of Capital Discount Rate (Nom.) Fixed Op. Cost Esc. Rate (Nom.) Effective Fixed Op.Cost. Disc. Rate Var. Op.Cost Esc. Rate (Nom.) Effective Var. Op.Cost. Disc. Rate First Year Cost w/Amortized Capital Amortized Cap. Cost (Book Life) Eiged Op. Cost	30 30 20 6.00% 6.00% 3.00% 2.91% 4.00% 1.92%	\$2.500 \$0.008 \$2.508 \$10.489 \$7.685 \$0.266	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 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses Total Variable Op. Costs Plant Life (Years) Functional Life Economic/Analysis Life Book Life Levelized Production Costs (\$) Cost of Capital Discount Rate (Nom.) Effective Fixed Op.Cost Disc. Rate Var. Op.Cost Esc. Rate (Nom.) Effective Var. Op.Cost. Disc. Rate First Year Cost w/Amortized Capital Amortized Cap. Cost (Book Life) Fixed Op. Cost	30 30 20 6.00% 6.00% 3.00% 2.91% 4.00% 1.92%	\$2.500 \$0.008 \$2.508 \$10.489 \$7.685 \$0.296 \$2.508	HDA calculation HDA Estimate	5 kwh per kgal per thousand feet vertical lift @ \$.40 per kwh Vertical lift from el 1500 water level to el 2750 wellhead 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses Total Variable Op. Costs Plant Life (Years) Functional Life Economic/Analysis Life Book Life Levelized Production Costs (\$) Cost of Capital Discount Rate (Nom.) Fixed Op.Cost Esc. Rate (Nom.) Effective Fixed Op.Cost. Disc. Rate Var. Op.Cost Esc. Rate (Nom.) Effective Var. Op.Cost. Disc. Rate First Year Cost w/Amortized Capital Amortized Cap. Cost (Book Life) Fixed Op. Cost	30 30 20 6.00% 6.00% 3.00% 2.91% 4.00% 1.92%	\$Argal \$10.489 \$7.685 \$0.296 \$2.508	HDA calculation HDA Estimate	5 kwh per kgal per thousand feet vertical lift @ 5.40 per kwh Vertical lift from el 1500 water level to el 2750 wellhead 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses Total Variable Op. Costs Plant Life (Years) Functional Life Economic/Analysis Life Book Life Levelized Production Costs (\$) Cost of Capital Discount Rate (Nom.) Fixed Op. Cost Esc. Rate (Nom.) Effective Fixed Op. Cost. Disc. Rate Var. Op. Cost Esc. Rate (Nom.) Effective Var. Op.Cost. Disc. Rate First Year Cost w/Amortized Capital Amortized Cap. Cost Varible Op. Cost	30 30 20 6.00% 6.00% 3.00% 2.91% 4.00% 1.92%	\$4,500 \$0.008 \$2.508 \$10.489 \$7.685 \$0.296 \$2.508 Levelized \$kgal	HDA calculation HDA Estimate	5 kwh per kgal per thousand feet vertical lift @ \$.40 per kwh Vertical lift from el 1500' water level to el 2750' wellhead 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses Total Variable Op. Costs Plant Life (Years) Functional Life Economic/Analysis Life Book Life Levelized Production Costs (\$) Cost of Capital Discount Rate (Nom.) Fixed Op. Cost Esc. Rate (Nom.) Effective Fixed Op.Cost. Disc. Rate Var. Op.Cost Esc. Rate (Nom.) Effective Var. Op.Cost. Disc. Rate First Year Cost w/Amortized Capital Amortized Cap. Cost Varible Op. Cost Varible Op. Cost	30 30 20 6.00% 6.00% 3.00% 2.91% 4.00% 1.92% NPV \$M/MGD 48.907	\$2.500 \$0.008 \$2.508 \$10.489 \$7.685 \$0.296 \$2.508 Levelized \$/kgal \$11.682	HDA calculation HDA Estimate	5 kwh per kgal per thousand feet vertical lift @ \$.40 per kwh Vertical lift from el 1500 water level to el 2750 wellhead 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses Total Variable Op. Costs Plant Life (Years) Functional Life Economic/Analysis Life Book Life Levelized Production Costs (\$) Cost of Capital Discount Rate (Nom.) Fixed Op. Cost Esc. Rate (Nom.) Effective Fixed Op.Cost. Disc. Rate Var. Op.Cost Esc. Rate (Nom.) Effective Var. Op.Cost. Disc. Rate First Year Cost w/Amortized Capital Amortized Cap. Cost (Book Life) Fixed Op. Cost Varible Op. Cost Varible Op. Cost	30 30 20 6.00% 6.00% 3.00% 2.91% 4.00% 1.92% NPV \$M/MGD 48.907 32.196	\$1.685 \$2.508 \$2.508 \$10.489 \$7.685 \$0.296 \$2.508 \$11.682 \$7.685	HDA calculation HDA Estimate	5 kwh per kgal per thousand feet vertical lift @ \$.40 per kwh Vertical lift from el 1500 water level to el 2750 weilhead 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses Total Variable Op. Costs Plant Life (Years) Functional Life Economic/Analysis Life Book Life Levelized Production Costs (\$) Cost of Capital Discount Rate (Nom.) Effective Fixed Op. Cost. Disc. Rate Var. Op. Cost Esc. Rate (Nom.) Effective Var. Op.Cost. Disc. Rate Var. Op. Cost Esc. Rate (Nom.) Effective Var. Op.Cost. Disc. Rate First Year Cost w/Amortized Capital Amortized Cap. Cost (Book Life) Fixed Op. Cost Varible Op. Cost Twenty-year Total NPV Cost Capital Cost (20 year Amort.) Fixed Op. Cost	30 30 20 6.00% 6.00% 3.00% 2.91% 4.00% 1.92% NPV \$M/MGD 48.907 32.196 1.624	\$/kgal \$2.508 \$2.508 \$10.489 \$7.685 \$0.296 \$2.508 Levelized \$/kgal \$11.682 \$7.685 \$0.388	HDA calculation HDA Estimate	5 kwh per kgal per thousand feet vertical lift @ 5.40 per kwh Vertical lift from el 1500 water level to el 2750 wellhead 150% Maui system average cost
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Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses Total Variable Op. Costs Plant Life (Years) Functional Life Economic/Analysis Life Book Life Levelized Production Costs (\$) Cost of Capital Discount Rate (Nom.) Fixed Op. Cost Esc. Rate (Nom.) Effective Fixed Op.Cost. Disc. Rate Var. Op.Cost Esc. Rate (Nom.) Effective Var. Op.Cost. Disc. Rate Var. Op.Cost Esc. Rate (Nom.) Effective Var. Op.Cost. Disc. Rate First Year Cost w/Amortized Capital Amortized Cap. Cost (Book Life) Fixed Op. Cost Varible Op. Cost Capital Cost (20 year Amort.) Fixed Op. Cost Varible Op. Cost	30 30 20 6.00% 6.00% 3.00% 2.91% 4.00% 1.92% NPV \$M/MGD 48.907 32.196 1.624 15.087 NPV \$M/MGD 55.073 2.2.196	\$1.685 \$0.296 \$2.508 \$2.508 \$10.489 \$7.685 \$0.296 \$2.508 Levelized \$/kgal \$11.682 \$7.685 \$0.388 \$3.601 Levelized \$/kgal \$10.962 \$6.10.962	HDA calculation HDA Estimate	5 kwh per kgal per thousand feet vertical lift @ \$.40 per kwh Vertical lift from el 1500 water level to el 2750 weilhead 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses Total Variable Op. Costs Plant Life (Years) Functional Life Economic/Analysis Life Book Life Levelized Production Costs (\$) Cost of Capital Discount Rate (Nom.) Effective Fixed Op.Cost Disc. Rate Var. Op.Cost Esc. Rate (Nom.) Effective Fixed Op.Cost. Disc. Rate Var. Op.Cost Esc. Rate (Nom.) Effective Var. Op.Cost. Disc. Rate First Year Cost w/Amortized Capital Amortized Cap. Cost (Book Life) Fixed Op. Cost Varible Op. Cost Varible Op. Cost Twenty-year Total NPV Cost Capital Cost (20 year Amort.) Fixed Op. Cost Varible Op. Cost Economic Life Total NPV Cost	30 30 20 6.00% 6.00% 3.00% 2.91% 4.00% 1.92% NPV \$M/MGD 48.907 32.196 1.624 15.087 NPV \$M/MGD 55.073 32.196	\$2.500 \$0.008 \$2.508 \$2.508 \$10.489 \$7.685 \$0.296 \$2.508 \$11.682 \$7.685 \$0.388 \$3.601 Levelized \$/kgal \$10.962 \$6.404 \$0.427	HDA calculation HDA Estimate	5 kwh per kgal per thousand feet vertical lift @ 5.40 per kwh Vertical lift from el 1500 water level to el 2750 weilhead 150% Maui system average cost
Operating Labor Maintenance Labor Electrical Energy Chemicals/Materials Maintenance Expenses Total Variable Op. Costs Plant Life (Years) Functional Life Economic/Analysis Life Book Life Levelized Production Costs (\$) Cost of Capital Discount Rate (Nom.) Fixed Op. Cost Esc. Rate (Nom.) Effective Fixed Op.Cost. Disc. Rate Var. Op. Cost Esc. Rate (Nom.) Effective Var. Op.Cost. Disc. Rate Var. Op. Cost Esc. Rate (Nom.) Effective Var. Op.Cost. Disc. Rate First Year Cost w/Amortized Capital Amortized Cap. Cost (Book Life) Fixed Op. Cost Varible Op. Cost Twenty-year Total NPV Cost Capital Cost (20 year Amort.) Fixed Op. Cost Economic Life Total NPV Cost Capital Cost (Amort. per Econ. Life) Fixed Op. Cost	30 30 20 6.00% 6.00% 3.00% 2.91% 4.00% 1.92% NPV \$M/MGD 48.907 32.196 1.624 15.087 NPV \$M/MGD 55.073 32.196 2.146 20.731	\$/kgal \$2.508 \$2.508 \$10.489 \$7.685 \$0.296 \$2.508 Levelized \$/kgal \$11.682 \$7.685 \$0.388 \$3.601 Levelized \$/kgal \$10.962 \$0.388 \$3.601	HDA calculation HDA Estimate	5 kwh per kgal per thousand feet vertical lift @ 5.40 per kwh Vertical lift from el 1500 water level to el 2750 wellhead 150% Maui system average cost

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



Maui County Water Use & Development Plan - Lana'i

FIGURE 5-27. Proposed Brackish Well 15

Capacity (MGD)				
Installed Capacity		0.864		
Max. Day Capacity		0.864		
Effective Sustainable Capacity		0.300		
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 Transmission Improvements	\$1,159,000	\$3,863,333	HDA Estimate	(1) pump 1 mgd @ \$550k, SCADA, anchanes Feeder and connection to existing line
Storage Improvements	\$100,000	\$035,555 \$0		r codor and connection to existing into
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 Day Eas Data (Nam.)	2.00%			
AFUDC Interest Rate (Nom.)	3.00%			
AFUDC Factor	0.0078	1.000		
	Total	Per MGD		
Total Capitalized Cost	\$2,656,800	\$8,856,000		
	5.4	5. 1000		
Fixed Operating Costs (\$)	\$5.470	\$19.262		\$0.05 per knal based on estimated Lanai average
Apportioned Operating Labor	40,479	\$10,203	HDA Estimate	40.00 per kgar based on estimated Lanar average
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 expective
		# 0		energy cost installed capacity
Chemicals/Materials		\$0 \$0		
Amort of Capitalized Rebuild Costs		\$0 \$0		
Total Fixed Op. Costs	\$19,519	\$65,063		
Veriable Organization Organization		Por KGal		
Operating Labor		i ei Koai		
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)	20			
Functional 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.) Effective Var. Op.Cost. Disc. Rate	4.00%			
		\$/kgal		
First Year Cost w/Amortized Capital		\$3.592		
Amortized Con. Cost (Pook Life)		\$2 114		
Fixed On Cost		φ2.114 \$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		
Canital 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.

Instald Capacity 0.250 0.250 0.250 0.250 Feter/ve_sustainable Capacity 0.250 0.25	Capacity (MGD)				
Max. Log Capacity Electron 0.250 100% Flexibly Capacity Factor 0.250 100% Average Factor Variable Capacity Column Site Improvements 13 1.000, 00 Baic Plant Cost Site Improvements 30 Transmission Improvements 30 Engineering Costs Construences 30 Total Provements 30 Const Per Eac Rate Nom) 0.055 0005 AFUDC Interest Rate Nom) 0.055 30, 313,080,000 Free Total Cost 32,71,500 0,005 AFUDC Interest Rate Nom) 0.055 30, 313,080,000 Free Operating Costs () Per VMD0 0,005 Dedicated Operating Costs () Per VMD0 30 Dedicated Operating Costs () Per VMD0 0,005 Filed Operating Costs () Per VMD0 30 Dedicated Operating Costs () Per VMD0 30 Dedicated Operating Costs () Per VMD0 30 Dedicated Operating Costs () Per VMD0 30 Chemicate/Materials Mathemance Labor S111,508 Flied Operating Costs () Per VMD0 30 Cost Rest Rate Nom, Net	Installed Capacity		0.250	Towill	
Effective Sustainable Capacity Average Facility Output 0.220 100% Pacility Capacity Factor Average Facility Output 0.220 100% Basic Finant Cost Site Improvements 33.271,500 \$13.808.000 Tewit Site Improvements 30 30 300% Treatment Improvements 50 50 Foreit Total Plant Cost Engineering Costs 50 50 Foreit ArUDC Interest Rate (Non.) AFUDC Interest Rate (Non.) 3.00% AFUDC Interest Rate (Non.) AFUDC Interest Rate (Non.) AFUDC Interest Rate (Non.) 3.00% 3.31.060 1.000 Foreit Decist (3) Decistat Cogniting Labor Apportioned Operating Lobor Apportioned Operating Lobor Apportioned Operating Lobor Apportioned Operating Lobor Apportioned Costs (3) Per Year Per YAG0 Total Eved Op. Costs \$111.598 \$44.530 Interus Application Applicatio	Max. Day Capacity		0.250		
Pacify Capacity Capaci	Effective Sustainable Capacity		0.250		
Average Facility Output Total Packado Basic Plant Cost (S) S3.271.500 \$13.080,000 Towill \$2000 Towill Basic Plant Cost (S) S3.271.500 \$13.080,000 Towill \$2000 Towill State improvements S0 S0 Towill \$2000 Towill \$2000 Towill Contingencies S0 S0 Towill Included in capital cost estimate Contingencies S0 S0 Towill Included in capital cost estimate Contingencies S0 S0 Towill Included in capital cost estimate Contingencies S0 S0 Towill Included in capital cost estimate Contingencies S0 S0 Towill Included in capital cost estimate Field Operating Costs (N) Per Vacc Per Vacc S0,430 S0 Dedicated Operating Costs (S) Per Vacc S0,971 Towill Hold consummer escalated to 500 Amort. of Capital Costs (S) S0,971 Towill HOA Towill estimate cost and y s demand cost fact energy continuetation of entrop continuetation with HOA estimate Coherricals/Materials S0 S0,971 Towill estimate cost and y s demand cost fact energy continuetation of entrop continuet	Facility Capacity Factor		100%		
applied Losts (s) Total Cost \$312,082,000 Twell 5000 Twell Finded of the capital cost exclused to 5000 of at 3% Storage Improvements 500 500 500 500 500 Twell Included in capital cost exclused Total Paint Cost (\$32,71,500 \$13,08,000 Twell Included in capital cost exclused to 5000 Twell ArUDC Interest Rate (Nom.) A.S00% 1.000 Twell Twell Forded operating Costs (S) Per Yace Per Yace Per Yace Twell OddA.Annual sitica cleaning, equipment exclused to 520 ArUDC Interest Rate (Nom.) A.S00 532,71,500 530 Twell Forded operating Costs (S) Per Yace Per Yace Start Yace Yace Yace Yace Yace Yace Yace Yace	Average Facility Output	Total	0.250 Bor MGD		
Bask Improvements S3 / 1000 S1 / 1000 Per / M000 S1 / 1000 Per / M000 S1 / 1000 S1 / 10000 S1 / 1000 S1 / 1000	Japital Costs (\$)	F2 071 500	Per MGD	Towill	\$2003 Towill estimate escalated to \$2007 at 3%
Suit improvements 50 Engineering Costs 50 Contingencies 70 Contingencies 70 Cont	Site Improvemente	\$3,271,500	\$13,066,000	1044	
Traininisolin Improvements 50 Trainine Improvements 50 Engineering Costs 50 Contingencies 50 So 30 Total Plant Cost (S3.271,500 513.086,000 Const, Per, Esc. Rate (Nom) AFUDC Interest Rate (Nom) Apportioned Operating Labor Maintenance Labor Fixed Operating Costs (S) Chemicals/Materials Amont C Capitalized Rebuild Costs Total Fixed Op. Costs Total Fixed Op. Costs Total Fixed Operating Labor Maintenance Expenses Total Variable Op. Costs Total Variable Op. Costs S9 971 Total Variable Op. Cost S9 971	Site improvements		\$ 0		
Interainent improvements S0 Storage improvements S0 Engineering Costs S0 Contingencies S0 Total Plant Cost (S3.271.500 Const. Per. Esc. Rate (Nom.) 3.00% AFUDC Interest Rate (Nom.) 0.00% AFUDC Interest Rate (Nom.) 0.00% AFUDC Interest Rate (Nom.) 0.00% AFUDC Interest Rate (Nom.) 8.00% Apportioned Operating Labor S0 Maintenance Labor S0 Flued Operating Costs (S) Per Kall Operating Costs (S) Per Kall Operating Labor S0 Maintenance Labor S0 Total Pained Costs (S) Per Kall Operating Labor S0 Maintenance Labor S0 Total Variable Operating Labor S0 Maintenance Labor S0 Electrical Energy S0 Chemicals/Materials S0 Maintenance Labor S0 Finst Year Cost (Kom.) 1.00% S0 S0 <	Transmission Improvements		\$0		
Storage Improvements Engineering Costs S0 S0 Towill Included in capital cost estimate Total Plant Cost (S3.271,500 S13.088,000 Included in capital cost estimate AFUCC Contingences 3.00% AFUCC Interest Rate (Nom) AFUCC Costs 1.000 Total Per Word For Will Cost Total Capitalized Cost S3.271,500 S13.088,000 For Will Cost Cost Fixed Operating Lobor Approtione Costs (S) Dedicated Operating Lobor Maintenance Expenses Per Yam Per YM000 Cost Fixed Operating Costs (S) Definition Desting Labor Approtione Costs S111,500 S124,640 HDA Calculation S/Au/Yan/Xi H afficiency/drived sys demand cost fact onegr continuated inspecty Chemicals/Materials S111,500 S446,390 S0 S/Au/Yan/Xi H afficiency/drived sys demand cost fact onegr continuated inspecty Correcting Labor Maintenance Expenses S0 S0 S0 S/Au/Yan/Xi H afficiency/drived sys demand cost fact onegr continuated inspecty Correcting Labor Maintenance Expenses S0 S0 S0 S0 S0 Total Fixed Operating Costs (S) Correcting Labor Maintenance Expenses S0 S0 S0 Total Fixed Operating Labor Maintenance Cabor Electrical Energy S0 S0 S0 Chemicals/Materials S0 S0 S0 S0 Dab	Treatment Improvements		\$0		
Engineering Costs S0 S0 Towill Included in capital cost estimate Total Plant Cost (S3.271,500 \$13.086,000 Contingencies S0 \$10.000 AFUDC Interest Rate (Nom.) S00% 1.000 AFUDC Factor 1.000 Total Capitalized Cost S3.271,500 \$13.086,000 Evel Coperating Costs (S) Per Vari Per VM6D Dedicated Operating Labor \$80,438 \$32,1760 Towill Apportioned Operating Labor \$33,160 \$124,640 HDA Cakulation \$NewingatXI efficiency/serviced we demand cost feet entry consumption with HDA estimate S0 Total Fixed Op. Costs \$11,1588 \$446,390 Variable Operating Costs (S) Per KG# \$9,971 Towill HDA Chemicals/Materials \$00 \$9,971 Towill HDA Variable Op. Costs \$9,971 Towill HDA You'li estimate of every consumption with HDA estimate Chemicals/Materials \$00 \$0 \$9,971 You'li estimate of every consumption with HDA estimate Chemicals/Materials \$00 \$0,00% \$1,220 \$0,00%	Storage Improvements		\$0		
Contingencies S0 S0 Towil Include in capital cost estimate Total Plant Cost (\$3,271,500 \$13,086,000 AFUDC Creating Costs (\$) Per VMCD AFUDC Creating Costs (\$) Total Per VMCD S0,271,500 \$13,086,000 Total Capitalized Cost \$3,271,500 \$10,080,000 S0,271,500 Towil AFUDC Creating Labor \$32,71,500 \$10,080,000 S0,271,500 Towil Apportioned Operating Labor \$80,438 \$22,750 Towil CAM. Annual siles cleaning, explorment excitated to 500 Fixed Operating Costs (\$) Per Year Per VMCD S0 S0 Chemicals/Materials \$0 S0 S0 S14,007,001/01,001/01,000 Maintenance Expenses \$0 S0 S0 S0,40 per Kon Aront. of Capitalized Rebuild Costs \$9,971 Towil /HDA S0,40 per Kon Variable Op. Costs \$9,971 Towil /HDA S0,40 per Kon Variable Op. Costs \$9,971 Towil /HDA S0,40 per Kon Variable Op. Costs \$9,971 Towil /HDA S0,40 per Kon Variable Op. Costs \$9,971 Towil /HDA S0,40 per Kon Variable Op. Cost \$9,971 Towil /HDA S0,40 per Kon Variable	Engineering Costs		\$0		
Total Plant Cost (S3.271.500 S13.086.000 Const. Par. Esc. Rate (Nom.) AFUDC Factor 3.00% 6.00% 1.000 Total Capitalized Cost S3.271.500 Total Capitalized Cost S3.271.500 S13.086.000 Fixed Operating Labor Approtoned Operating Labor Amintenance Expenses Per YMCD OMM. Annual slica cleaning, explement: excatated to S20 S0 Approtoned Operating Labor Amintenance Expenses S11.160 S124.640 HDA Cabulation Fixed Operating Labor Maintenance Expenses S0 S0 Anond: of Capitalized Robuild Costs S111.598 S446.390 Chemicals/Materials S0 S0 Total Fixed Op. Costs S111.598 S446.390 Variable Operating Labor Maintenance Expenses S0 Total / HDA Maintenance Expenses S0 S0 Total Fixed Op. Costs S111.598 S446.390 Chemicals/Materials S0 Tovil / HDA Maintenance Expenses S0 S0 Total Variable Op. Costs S9.971 Tovil / HDA Plant Life (Years) S0 S0,066 First Year Cost WAmortized Capital S0,066 Discourt Rate (Nom.) 5.00% S0.00 S13.086 S0.00 S13.24 First Year Cost (Monortized Capital <t< td=""><td>Contingencies</td><td>\$0</td><td>\$0</td><td>Towill</td><td>Included in capital cost estimate</td></t<>	Contingencies	\$0	\$0	Towill	Included in capital cost estimate
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Effective Var. Op. Cost. Disc. Rate 1.92% 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 Twenty-year Total NPV Cost 79.777 \$19.056 Capital Cost (20 year Amort.) 13.086 \$3.124 Fixed Op. Cost \$1.222 Varible Op. Cost \$19.056 Capital Cost (20 year Amort.) 13.086 \$3.124 Fixed Op. Cost \$59.996 \$14.321 Varible Op. Cost \$59.995 \$14.321 NPV SM/MGD Levelized S/kgal Fronomic Life Total NPV Cost \$50.996	Var. Op.Cost Esc. Rate (Nom.)	4.00%			
Sixgal First Year Cost W/Amortized Capital \$14.317 Amortized Cap. Cost (Book Life) \$3.124 Fixed Op. Cost \$12.22 Varible Op. Cost \$9.971 Twenty-year Total NPV Cost 79.777 Fixed Op. Cost \$3.124 Fixed Op. Cost \$9.971 Capital Cost (20 year Amort.) 13.086 Fixed Op. Cost \$9.965 Varible Op. Cost \$9.996 Varible Op. Cost \$9.996 Fixed Op. Cost \$9.996 Fixed Dp. Cost \$9.996 Fixed Dp. Cost \$9.996 Fixed Dp. Cost \$9.996	Effective Var. Op.Cost. Disc. Rate	1.92%			
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 Twenty-year Total NPV Cost 79.777 Capital Cost (20 year Amort.) 13.086 Fixed Op. Cost 6.695 Varible Op. Cost 59.996 Varible Op. Cost 59.996 St1.24 \$1.222 Varible Op. Cost 13.086 St1.24 \$1.232 Fixed Op. Cost 6.695 St1.24 \$14.321 Varible Op. Cost 59.996 St1.24 \$14.321			\$/kgal		
Amortized Cap. Cost (Book Life) \$3.124 Fixed Op. Cost \$1.222 Varible Op. Cost \$9.971 Twenty-year Total NPV Cost 79.777 \$19.056 Capital Cost (20 year Amort.) 13.086 Fixed Op. Cost 6.695 Varible Op. Cost 51.24 Fixed Op. Cost 6.695 Varible Op. Cost 51.98 Varible Op. Cost 51.29 Varible Op. Cost 51.23 Fixed Dp. Cost 6.695 6.095 \$14.321 NPV SM/MGD Levelized Singal Fronomic Life Total NPV Cost 104.372	First Year Cost w/Amortized Capital		\$14.317		
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 Fixed Op. Cost 6.695 Varible Op. Cost 59.996 Varible Op. Cost 59.996 Stata \$21.222 Varible Op. Cost 104.372 Stata \$20.774	Amortized Cap. Cost (Book Life)		\$3,124		
Varible Op. Cost \$9.971 NPV SM/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 SM/MGD Levelized \$kgal Fronomic Life Total NPV Cost 104 4372	Fixed Op. Cost		\$1.222		
NPV SM/MGD Levelized \$/kgal Twenty-year Total NPV Cost 79.777 \$19.056 Capital Cost (20 year Amort.) 13.086 \$3.124 Fixed Op. Cost 6.895 \$15.99 Varible Op. Cost 59.996 \$14.321 NPV SM/MGD Levelized \$/kgal Economic L ife Total NPV Cost 104.372 \$20.774	Varible Op. Cost		\$9.971		
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 SM/MGD Levelized \$/kgal Economic L ife Total NPV Cost 104.372 \$20.774		NEW SMALCO			
Capital Cost (20 year Amort.) 13.086 \$3.124 Fixed Op. Cost 6.695 \$1.598 Varible Op. Cost 59.996 \$14.321 NPV SM/MGD Levelized \$kgal Economic Life Total NPV Cost	Twenty-year Total NPV Cost	79 777	\$10 AFE		
Capital Cost (20 year Amort.) 13.086 \$3.124 Fixed Op. Cost 6.695 \$1.598 Varible Op. Cost 59.996 \$14.321 NPV SMMGD Levelized \$Agal Fconomic Life Total NPV Cost 104.372 \$20.774	rwoniy-year rotari 4F V COSt	10.111	¢12.000		
Frxeu Op. Cost 0.695 \$1.595 Varible Op. Cost 59.996 \$14.321 NPV \$M/MGD Levelized \$kgal Fconomic Life Total NPV Cost 104.372 \$20.774	Capital Cost (20 year Amort.)	13.086	\$3.124		
งสามหะ Op. Cost 59:996 จิ 14.321 NPV SM/MGD Levelized \$/kgal Economic Life Total NPV Cost 104.372 \$20.774	Fixed Op. Cost	6.695	\$1.598		
NPV SM/MGD Levelized \$kgal Fconomic Life Total NPV Cost 104.372 \$20.774	varible Op. Cost	29.996	\$14.321		
Economic Life Total NPV Cost 104 372 \$20 774		NPV \$M/MGD	Levelized \$/kool		
	Economic Life Total NDV/ Cost	104 272	\$20 774		
Canital Cost (Amort per Econ Life) 13.086 \$2.603	Canital Cost (Amort per Econ Life)	13 086	\$2 603		
Fixed On Cost 8849 \$1750	Eixed On Cost	8 849	\$1 760		
Variale On Cost 82.437 \$16.997	Varible On Cost	82 437	\$16 397		
	vanue op. oost	02.437	φ10.381		

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

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.

Linstalled Canacity		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		
reament improvements		φU		
Storage Improvements		\$0		
Engineering Costs		\$0		
Contingencies	\$0	\$0	IOWIII	Included in capital cost estimate
Total Plant Cost (\$3 381 750	\$13 527 000		
Total Flant Gost (ψ0,001,700	ψ10,021,000		
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		
Final Onestina Costs (C)	Por Voor	Por V/MGD		
Dedicated Operating Labor	\$80.438	\$321 750	Towill	O&M Annual silica cleaning, equipment: escalated to \$200
Apportioned Operating Labor	φ00, 4 30	\$321,750		call, Annual billou blouning, cquipment, booulated to \$200
Maintenance Labor		\$0 \$0		
Fixed Operating Costs		ΨŪ		
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		
		D 1/0 1		
Variable Operating Costs (\$)		Per KGal		
Operating Labor				
Maintenance Labor		\$13 171	Towill / HDA	Towill estimate of energy consumption with HDA estimate of
Electrical Energy		φ13.171		power cost at \$0.40 per Kwh
Chemicals/Materials				
Maintenance Expenses				
Total Variable On Costa		\$12 171		
Total valiable Op. Costs		\$15.171		
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%			
Fffective Var. On Cost. Disc. Rate	4.00%			
Enderro Val. op.ood. Did. Hate	1.0270	\$/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		
		l evelized \$/kgal		
Twenty-year Total NPV Cost	100 072	\$23 003		
wenty-year rotarine v COSt	100.072	<i>423.303</i>		
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	l evelized \$/kgal		
Economic Life Total NPV Cost	132 062	\$26 285		
ECONOMIC LIFE FOLD INF V COSL	132.002	420.20J		
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 5-29. Desalination of Seawater to Potable Quality

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

Capacity (MGD) Installed Capacity Max. Day Capacity Effective Sustainable Capacity Facility Capacity Factor Average Facility Output Capital Costs (\$)	Total	0.250 0.250 0.250 100% 0.250 Per MGD	Towill	
Basic Plant Cost Site Improvements Transmission Improvements Treatment Improvements Storage Improvements	\$3,334,500	\$13,338,000 \$0 \$0 \$0 \$0	Towill	\$2,964,000 Towill estimate escalated to \$2007 at 3%
Engineering Costs Contingencies	\$0	\$0 \$0	Towill	Included in capital cost estimate
Total Plant Cost (\$3,334,500	\$13,338,000		
Const. Per. Esc. Rate (Nom.) AFUDC Interest Rate (Nom.)	3.00% 6.00%			
AFUDC Factor	Total \$3,334,500	1.000 Per MGD \$13.338.000		
	¢0,001,000	• 10,000,000		
Fixed Operating Costs (\$) Dedicated Operating Labor Apportioned Operating Labor Maintenance Labor Eived Operating Costs	Per Year \$80,438	Per Y/MGD \$321,750 \$0 \$0	Towill	O&M, Annual silica cleaning, equipment: escalated to \$2007
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 Maintenance Expenses Amort. of Capitalized Rebuild Costs		\$0 \$0 \$0		
Total Fixed Op. Costs	\$100,348	\$401,390		
Variable Operating Costs (\$) Operating Labor Maintenance Labor		Per KGal		
Electrical Energy Chemicals/Materials		\$6.371	Towill / HDA	Towill estimate of energy consumption with HDA estimate of power cost at \$0.40 per Kwh
Maintenance Expenses				
Total Variable Op. Costs		\$6.371		
Functional Life	30			
Economic/Analysis Life Book Life	30 20			
Levelized Production Costs (\$)	6.00%			
Discount Rate (Nom.)	6.00% 3.00%			
Effective Fixed Op.Cost. Disc. Rate	2.91%			
Var. Op.Cost Esc. Rate (Nom.) Effective Var. Op.Cost. Disc. Rate	4.00% 1.92%			
First Year Cost w/Amortized Capital		\$/kgal \$10.654		
Amortized Cap. Cost (Book Life) Fixed Op. Cost Varible Op. Cost		\$3.184 \$1.099 \$6.371		
Twenty-year Total NPV Cost	NPV \$M/MGD 57,693	Levelized \$/kgal \$13.781		
Capital Cost (20 year Amort.)	13.338	\$3.184		
Fixed Op. Cost Varible Op. Cost	6.020 38.335	\$1.437 \$9.151		
Economic Life Total NPV Cost	NPV \$M/MGD 73.969	Levelized \$/kgal \$14.723		
Capital Cost (Amort. per Econ. Life) Fixed Op. Cost Varible Op. Cost	13.338 7.957 52.674	\$2.653 \$1.583 \$10.477		

5-40

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 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.