CHAPTER 4. PROPOSED ACTION

4.1 Project Need

Maui County's General Plan and the community plans for the Wailuku-Kahului, Kihei-Makena, and Haiku-Paia areas have described the projected planned growth in these areas in the next 20 years. This growth will result in increased water needs which are planned to be met by the implementation of the EMPLAN. This increase in water demand is prompted by the growth in agriculture, especially diversified agriculture, and expansion of the visitor industry, and the utilization of the undeveloped lands.

The "Draft Water Use and Development Plan for the Island of Maui-1992", prepared by M&E Pacific, Inc. indicated that water use within the area served by the Central Maui Water System would nearly double between 1990 and 2010. The EMPLAN was designed to meet this need. An evaluation of the alternatives listed on pages lends credence to the validity of the EMPLAN at this time. Of special note is the fact that the Iao aquifer is being utilized to its sustainable yield and no additional pumpage should be permitted.

4.2 Relocation of Well Sites

The original EMPLAN envisioned a total of 10 wells, two (Hamakuapoko 1 and 2) located west of Maliko Gulch in the Paia Aquifer System, and eight located from Maliko Gulch eastward to Kaupakulua Reservoir in the Haiku Aquifer System. Total installed capacity was to be 16 mgd, and average draft 10 mgd. The two Hamakuapoko wells have already been drilled and fitted with pumps but they still are considered integral to the EMPLAN. They serve as supplementary sources for Upcountry Maui with production limited to periods of drought. The initial expectation was that the two wells would have a capacity of 1 mgd (700 gpm) each for a total installed capacity of 2 mgd, but they have been fitted with 500 gpm (0.72 mgd) each. Without these wells, the remaining expected installed capacity in the EMPLAN is 14 mgd.

The wells sited east of Maliko Gulch were to be fitted with pumps having capacities of either 1.5 mgd (1042 gpm) or 2.0 mgd (1400 gpm). The first four wells located between East Kuiaha Road and Maliko Gulch were to have 1.5 mgd pumps, and the remaining four to the east, 2 mgd pumps. These pump sizes were selected without the benefit of a supporting data base. Even now the data base is sparse but strong enough to suggest that the anticipated pump capacities are too great for the state of the aquifer at the proposed locations. Additionally, the original sites are down gradient of former pineapple fields from which residual contamination by the nematocides EDB and DBCP may still be a threat. For these primal reasons--pump capacities and the threat of residual contamination--an alternative to the original plan is to relocate the wells to a line about one mile further inland just below East Maui Irrigation Company's Kauhikoa Ditch at an elevation of about 1,000 feet (see Fig. 3). Four well fields, each containing two wells rated at 1.5 to 2 mgd each, will be sited over a reach of approximately two miles between Lilikoi Gulch and Opaepilau Gulch.

In the relocation alternative, the western well fields, Lilikoi and Ohia, will be rated at 1.5 mgd per well, allowing for total capacity of the four wells of 6 mgd and an average daily yield of 4 mgd. The two easterly well fields, Kuiaha and Opaepilau, will be rated at 2 mgd per well for a total installed capacity of 8 mgd and average daily yield of 5.4 mgd. When all four well fields are in place, total installed capacity will be 14 mgd, and average daily yield will be 9.3 mgd.

The static water table elevation at the monitor well is 4.7 feet, which at a groundwater gradient of about 2 feet per mile implies that it will be about 7 feet at the Lilkoi-Ohia site lying one mile further inland. A water table elevation (or head under static conditions) of 7 feet above sea level will allow a pump capacity of 1.5 mgd. At the

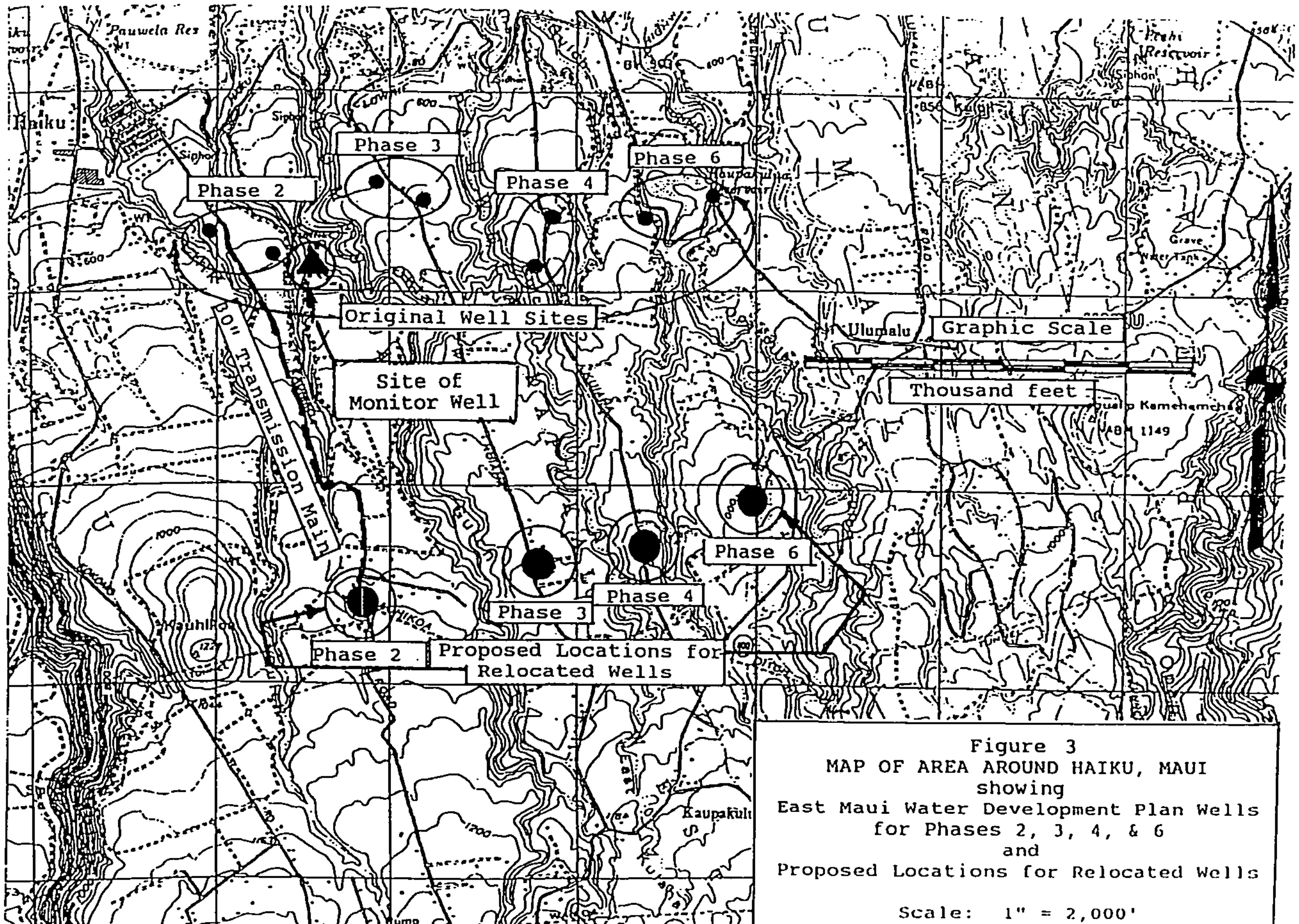

Figure 3
MAP OF AREA AROUND HAIKU, MAUI
showing
East Maui Water Development Plan Wells
for Phases 2, 3, 4, & 6
and
Proposed Locations for Relocated Wells

Scale: 1" = 2,000'

proposed Kuiaha and Opaepilau well fields, the expected static head will be about 8 feet, sufficiently high to sustain pump capacities of 2 mgd.

4.3 Hydraulics and Economics of the Proposed Relocated Wells

The EMPLAN prepared by Norman Saito Engineering Consultants (9/92) proposes developing 10 basal wells, two in the Paia aquifer west of Maliko Gulch and eight along the 650-feet elevation in the Haiku aquifer between Lilikoi Gulch and Opaepilau Gulch. The wells are to extend from the ground surface to below sea level. Chapter 4.2 discusses the proposal to relocate the eight wells in the Haiku aquifer system to an elevation of about 1,000 feet.

In the Saito Engineering Plan, the eight Haiku wells are to be constructed in four phases. Each phase comprises two wells pumping from the basal aquifer. The 700 gpm, 150 hp pumps would discharge into a piping system leading to small stabilizing reservoirs, each serving two wells. Water from the stabilizing reservoirs flows into a 36-inch transmission main to the Baldwin 560-foot reservoir which serves as the control reservoir.

The proposed installed pumping capacity of 700 gpm (1 mgd) at each of the eight wells as originally located are too high to sustain production at acceptable salinity levels.

Basal heads increase farther inland. At the 1,000-foot elevation, heads will be seven to eight feet and this is more likely to sustain production levels in the range of 1.5 to 1.75 mgd without long-term deterioration of salinity levels.

Figure 3 shows the locations of the eight Haiku wells of the EMPLAN and the proposed locations for the relocated wells about 5,000 feet inland of the original well sites.

The relocation of well sites to higher elevations involves deeper wells, deeper pump settings, and increased lift requiring more power for the pumps. The well depths at the original sites are around 700 feet. At the proposed relocated elevation of 1,000 feet above mean sea level, well depths increase by 350 feet. Pumping lift is increased by 54%.

The EMPLAN provides for a 36-inch diameter transmission system from the east of Haiku along Haiku Road extending westward to Kahului with a controlling elevation of 560 feet. If well sites are relocated to the 1,000-foot elevation, a transmission main must reach from the relocated sites down to the planned transmission system.

Figure 3 shows a likely alignment for this transmission main along Kauhikoa Road. This would connect the Phase 2 relocated well sites. Later phases at the relocated sites extending eastward would connect to the Kauhikoa Road transmission main.

The transmission main from the relocated sites to Haiku Road is 7,000 feet long. For this study, the installed capacity of each well is 1,200 gpm (1.71 mgd). For the eight wells, the total installed capacity is 13.71 mgd. For this flow rate, velocity in the 30-inch diameter pipeline is 4.4 feet per second. Flow velocity in a 24-inch diameter pipe exceeds six feet per second, the economic limit.

The EMPLAN provides for the 36-inch transmission main through Phase 6. For this study, the 36-inch transmission main along Haiku Road for phases 3, 4, and 6 is replaced by equivalent lengths of 16-inch, 20-inch, and 24-inch mains. The Phase 2, 36-inch main between Kauhikoa Road and the west end of the Phase 2 development is retained because it is required for either development scheme.

The two existing wells in the Paia aquifer (Hamakuapoko Wells 1 and 2) included in the EMPLAN are contaminated with Volatile Organic Compounds (VOC) to a level that requires treatment. This may also be the case in the adjacent Haiku aquifer. For that reason, this study includes costs of granular activated carbon (GAC) adsorption facilities in separate tables.

The component costs for each development phase are taken from the EMPLAN. These were modified by replacing the 36-inch transmission main components along Haiku Road by water mains appropriately sized for that phase. The cost of the transmission west of Phase 2 was included in both development schemes.

Table I summarizes the phase-by-phase capital costs for the two development schemes and Table I-A shows the costs including GAC facilities.

TABLE I
CAPITAL COSTS FOR EACH DEVELOPMENT PHASE
(THOUSAND DOLLARS)

DEVELOPMENT PHASE	ORIGINAL SITE (650' ELEV)	RELOCATED SITE (1000' ELEV)
2	5,470	7,050
3	3,515	4,240
4	3,690	4,260
6	3,355	4,155
TOTALS	$ 16,030	$ 19,705

TABLE 1-A
CAPITAL COSTS FOR EACH DEVELOPMENT
INCLUDING GAC ADSORPTION FACILITIES
(THOUSAND DOLLARS)

DEVELOPMENT PHASE	ORIGINAL SITE (650' ELEV)	RELOCATED SITE (1000' ELEV)
2	9,470	11,050
3	7,515	8,240
4	7,690	8,260
6	7,355	8,155
TOTALS	$ 32,030	$ 35,705

Capital costs for the relocated sites are higher due to increased well depths. Increased drilling costs, deeper pump settings and more powerful pumps are big factors. There is also the additional 7,000 feet of transmission main. Not included is the need for a pressure regulating scheme.

The annual costs for the two development schemes were developed for two operational availability levels. Table 2 and Table 2-A show costs for 90-percent operational level. Table 2 does not include GAC operations. Table 2-A includes GAC operations. Table 3 and Table 3-A show the costs for two-thirds operational level.

The following assumptions were used to develop the annual costs:

1. Twenty-year life for all capital cost facilities.
2. Six percent annual interest rate.
3. Electric power at $ 0.15 per kwhr.
4. Operating cost includes annual power plus 10 percent for maintenance and repair.
5. Annual cost of GAC operations at 90-percent availability is $ 120,000.00 per well at the original sites and $ 130,000.00 per well at the inland sites. At 67-percent availability, the GAC cost of operations is $ 100,000.00 per well at the original sites and $ 120,000.00 per well at the inland sites.

TABLE 2
SUMMARY OF ANNUAL COSTS
90 PERCENT OPERATIONAL AVAILABILITY

ITEM	ORIGINAL SITE (650' ELEV)	RELOCATED SITE (1000' ELEV)
Operating Cost	$ 935,000	$ 2,718,000
Amortization	1,400,000	1,720,000
Annual Cost	2,335,000	4,438,000
Annual Production (million gal)	2,253	4,505
Cost/Million Gal	1,036	985

TABLE 2-A
SUMMARY OF ANNUAL COSTS
90 PERCENT OPERATIONAL AVAILABILITY
GAC ADSORPTION OPERATION INCLUDED

ITEM	ORIGINAL SITE (650' ELEV)	RELOCATED SITE (1000' ELEV)
Operating Cost	$ 1,210,000	$ 2,718,000
GAC Operating Cost	960,000	1,040,000
Amortization	2,800,000	3,112,000
Annual Cost	4,970,000	6,870,000
Annual Production (million gal)	2,253	4,505
Cost/Million Gal	2,205	1,525

TABLE 3
SUMMARY OF ANNUAL COSTS
67 PERCENT OPERATIONAL AVAILABILITY

ITEM	ORIGINAL SITE (650' ELEV)	RELOCATED SITE (1000' ELEV)
Operating Cost	$ 697,000	$ 2,024,000
Amortization	1,400,000	1,720,000
Annual Cost	2,097,000	3,744,000
Annual Production (million gal)	1,677	3,354
Cost/Million Gal	1,250	1,116

TABLE 3-A
SUMMARY OF ANNUAL COSTS
67 PERCENT OPERATIONAL AVAILABILITY
GAC ADSORPTION OPERATION INCLUDED

ITEM	ORIGINAL SITE (650' ELEV)	RELOCATED SITE (1000' ELEV)
Operating Cost	$ 864,000	$ 2,024,000
GAC Operating Cost	800,000	960,000
Amortization	2,800,000	3,115,000
Annual Cost	4,464,000	6,099,000
Annual Production (million/gal)	1,677	3,354
Cost/Million Gal	2,662	1,818

Future Planning Considerations for the Relocated Well Sites

The movement inland of the line of wells will result in higher pressures in the transmission main along Kauhikoa Road. Assuming the ground elevation of the relocated stabilizing tanks to be 1,050 feet, the difference of elevation to the Baldwin Tank is 490 feet. Pressure will exceed 200 psi at the lower end of the pipeline. This can be alleviated by a pressure-regulating valve or pressure-breaking tank at a suitable elevation. This can be done by the design engineer when engineering plans are prepared. Planning can also be directed toward creating another pressure zone.

The inland location poses the need to connect the four phases to the 30-inch transmission main in an area with a sparse road network. The stabilizing tank for Phase 2 can connect directly to the transmission main. Connecting phases 3, 4, and 6 will involve crossing the intervening gulches. These engineering problems can best be addressed when the various phases come up for development.