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CITY AND COUNTY OF HONOLULU
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September 28, 1999

Ms. Genevieve Salmonson, Director
Office of Environmental Quality Control
State of Hawaii
State Office Tower, Room 702
235 South Beretania Street
Honolulu, Hawaii 96813

Dear Ms. Salmonson:

Chapter 343, Hawaii Revised Statutes
Environmental Assessment (EA)/Determination
Finding of No Significant Impact

Recorded Owner	:	City and County of Honolulu
Applicant	:	U.S. Filter Corporation
Agent	:	Analytical Planning Consultants, Inc.
Location	:	Campbell Industrial Park, Ewa, Oahu
Tax Map Key	:	9-1-13: 7
Proposal	:	To treat wastewater from the Honouliuli Wastewater Treatment Plant
Determination	:	A Finding of No Significant Impact is Issued

Attached and incorporated by reference is the Final EA prepared by the applicant for the project. Based on the significance criteria outlined in Title 11, Chapter 200, Hawaii Administrative Rules, we have determined that preparation of an Environmental Impact Statement is not required.

We have enclosed a completed OEQC Bulletin Publication Form and four copies of the Final EA. If you have any questions, please contact Dana Teramoto of our staff at 523-4648.

Very truly yours,

Loretta Chee

JAN NAOE SULLIVAN
Director of Planning
and Permitting

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CITY & COUNTY OF HONOLULU

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FINAL

ENVIRONMENTAL ASSESSMENT

FOR

HONOULIULI WASTEWATER RECLAMATION PLANT

September 1999

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FINAL ASSESSMENT

FOR

HONOULIULI WASTEWATER RECLAMATION PLANT

RECEIVED

SEP 14 1999

DEPT. OF PLANNING AND PERMITTING
650 SOUTH KING ST.
HONOLULU, HI 96813

Prepared for U.S. Filter Corporation

By: Analytical Planning Consultants
Dames & Moore
Goodsill Anderson Quinn & Stifel

September 1999

SUMMARY

As the result of a "Consent Decree" between the Federal Environmental Protection Agency, the State Department of Health, and the City and County of Honolulu, the City issued a Request for Proposal to design, construct, finance and operate a 12 MGD wastewater reclamation plant and distribution system. Secondary treated water would be supplied from the Honouliuli Sewer Treatment Plant (HSTP). The contract was awarded to the U.S. Filter Corp. The plant will produce 2 million gallons of RO water to be used by industrial users in the Campbell Industrial Park and 10 million gallons of R1 (tertiary) water for non potable irrigation uses, mostly public landscaping and golf courses. The distribution system will consist of 27,000 feet of pipe for the R1 system and 25,000 feet of pipe for the RO system. All pipe will be placed underground. The R1 water will meet Dept. of Health specifications. The water will be coagulated, flocculated, filtered and disinfected before being used. The RO water is completely pure.

The plant and distribution system do not impact any endangered species or habitats. All construction is in or on previously disturbed ground where there are no historical artifacts. There are no health hazards or odors associated with the project. Use of the reclaimed water will reduce withdrawals of water from the stressed Ewa caprock aquifer and reduce the use of potable water. In summary there are no significant environmental impacts resulting from the project and the applicant is requesting a FONSI.

Errata

Honouliuli Wastewater Reclamation Plant

Final Environmental Assessment

1. Number 3 of "Design Standards" on page 2-12 should be corrected from "Standard Specifications for Public Works Projects, 1986" to "Standard Specifications For Public Works Construction, 1986".

2. Section 4.5.1.2 on page 4-48 should be changed to read as follows:

   Impacts and Mitigation Measures.

   The Honouliuli Wastewater Reclamation Plant is a public project, hence no change to any zoning designation or land use district boundary is required for the project.

3. On page 4-46 Section 4.4.4, "Governmental Approvals Required for Facility." The requirement for a "City Conditional Use Permit" should be removed.

4. Add the following comment to Section 4.2.2.1 under "Impacts and Mitigation Measures" on page 4-24.

   Where feasible and environmentally productive, siltation barriers will be established, as a part of the best management practices plan to protect the Honouliuli Stream from possible siltation during construction of the distribution pipeline system.

5. Add a new section as follows as pages 4-55 and 4-56:

   4.5.4 Best Management Practices Plan

   Construction Best Management Practices Plans (BMP) will be prepared by the contractors. The BMP will include the following items as appropriate.

   a. Location of construction. Construction will take place at the reclamation plant site and along the distribution pipelines.

   b. Description of any specific measures needed to protect the ecosystem at the site. Runoff will be controlled using silt fences, and temporary interceptor dikes and swales around the active work area.

c. Description of the type, composition and quantity of material to be excavated and its disposition. Some of the excavated material will be used on site as fill. The remainder will be disposed of at approved locations.

d. Description of the type, composition and quantity of fill material to be used. It is anticipated that gravel and sand will be used, as needed, as fill to stabilize foundations for the pipelines. Stockpiles of materials will be located away from drainage ways or other areas of concentrated flows. Sediment trapping devices such as fences, traps, basins or barriers shall be used around the base of all stockpiles

e. *Description of any de-watering activities necessary,* including a treatment and discharge plan and locations of de-watering treatment and discharge points

f. Construction Sequence (designed to minimize potential environmental impacts).

g. Construction Methods

h. Characteristics of any Discharge and Potential pollutants associated with the Proposed Construction a activity (typically including solid waste, sanitary waste, oily waste)

i. Proposed Control Measures or Treatment Methods (including a spill response plan).

j. Other Health and Safety Considerations, including noise control, dust control by watering and/or a fabric fence, and control of other physical hazards to workers and the general public.

k. Slopes will be protected with anchored plastic geotextile fabric, vegetative planting, mulching, or other soil stabilizing procedures.

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1.0 INTRODUCTION: PURPOSE AND NEED

In 1993, the EPA and the State of Hawaii brought an enforcement action against the City and County of Honolulu as a result of sewage spills that had occurred over a period of time. After a trial began on this matter, a settlement was reached among the parties, called a "Consent Decree." Pursuant to the terms of the Consent Decree, the City and County was required to pay a substantial initial fine with the possibility of additional fines in the future that would be waived if the City constructed a Supplemental Environmental Project (SEP) in the Ewa Plain using the secondary treatment produced by the Honouliuli STP. The secondary treated water presently flows through a one-mile outfall into the ocean at the rate of 26 mgd.

The Consent Decree established dates by which, ultimately, 13 mgd of the wastewater needed to be treated and its produce beneficially reused. If the project were not to be built, fines would accumulate at the rate of approximately $18,000 a day to a maximum of 2.5 million dollars.

To avoid the fines and to meet the need for additional water resources in the Ewa Plain, the City initiated this project through its issuance of a Request for Proposal No. RFP-028, in accordance with Hawaii Revised Statutes Section 103D-303. Pursuant to the Request for Proposal, U.S. Filter submitted a proposal to design, construct, finance, own, and operate a new wastewater reclamation plant and was awarded the contract.

The intent of the plant is to process up to 13 mgd of effluent from the HWTP and sell the resultant product, which will be RO water and R1 water, to the City, as well as to other private entities. The project will consist of a facility designed to process the effluent from the HWTP and a distribution system. The distribution system will consist of approximately 27,000 linear feet of pipe for the R1 system and approximately 25,000 linear feet of pipe for the R0 distribution system, which will run to Campbell Industrial Park (see figure 4-1).

OEQC bulletin publication form

Approving agency
Department of Planning and Permitting
C & C of Honolulu
Phone (808) 523-4107
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Applicant
U.S. Filter Corporation
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Pleasant Hill CA 94523

Phone (808) 381-2530
Mike Street
Consultant
APC

Trigger
Use of State or County lands

Summary

As the result of a "Consent Decree" between the Federal Environmental Protection Agency, the State Department of Health and the City and County of Honolulu issued a Request for Proposal

2.0 DESCRIPTION OF PROJECT

2.1 Concept

U.S. Filter, in an agreement with the City and County of Honolulu, plans to treat wastewater from the Honouliuli Wastewater Treatment Plant (WWTP) and produce two levels of reclaimed water. One of the levels of reclaimed water will meet standards for the R1 level as defined by the State of Hawaii, Department of Health Reuse Guidelines. The other level of water will be treated through a reverse osmosis process to meet industrial requirements. There is a clear and definite need for high level non-potable water in the Ewa area.

The Ewa district has undergone a significant amount of residential, commercial and industrial development in the recent past and this development will continue through the foreseeable future. This significant development has impacted available water resources in two areas: reduced recharge of the existing caprock aquifer because of the reduction of the agricultural activity, and the increasing demand on the aquifer for potable water purposes.

The reduction of agriculture in this region has markedly reduced the recharge of the existing aquifer. As a result of this action, the salinity of the aquifer has been gradually rising as withdrawals from existing wells continue. In addition, the Department of Land and Natural Resources (DLNR) has plans to limit new well permits and well permit renewals.

Located nearby the Honouliuli WWTP is Campbell Industrial Park, an area where large industrial facilities are operating. Many of the facilities consume large amounts of potable water for their industrial processes, where a high level non-potable water could be used instead.

Development in the Ewa area includes a number of golf courses that are currently using non-potable water from the caprock aquifer for irrigation purposes. Additionally, residential subdivisions are increasing the demand for non-potable water and accelerating the withdrawal of water from the existing aquifer.

The construction of a facility to address the non-potable water uses of the area will allow the conservation of potable water for human consumption and provide an alternative to the high continued levels of withdrawals from the Ewa caprock aquifer.

2.2 EXISTING FACILITIES

Honouliuli WWTP is located on Geiger Road between Ewa Beach and Ewa in leeward Oahu. The plant service area covers the western portion of Mamala Bay sewer district. All residential, commercial, industrial and agricultural areas are included in this district except for Pearl Harbor and Campbell Industrial Park.

The Honouliuli WWTP was put into operation in December 1984. It had a design capacity of 25 mgd and treated wastewater to the primary level only. The plant had installed a reuse system during the original construction which included a dual distribution system. One system was to deliver non-chlorinated secondary treated effluent. The other system was to deliver chlorinated secondary treated effluent. However, as the plant treated wastewater only to the primary level the distribution systems were rarely used (Figure 2-1).

The plant has been expanded over the years to meet increased flows, expected future flows, and to increase the level of treatment to secondary treatment. The initial expansion upgraded the pumping capacity, pretreatment and primary treatment and added odor control. The plant was now capable of handling 51 mgd with the upgrade of the effluent pumps and the addition of two primary clarifiers. The plant is still limited by its ability to handle the solids of a 51-mgd plant, and therefore is limited to flows of 38 mgd. A future expansion of the solids handling facilities will allow the plant to operate at 51 mgd. This future expansion will abandon the current incinerator and a new more cost-effective method will be installed.

Two wells were drilled on the plant site in order to reduce the use of potable water. The water is brackish and is connected to the aforementioned reuse distribution system for use in various processes and as wash water.

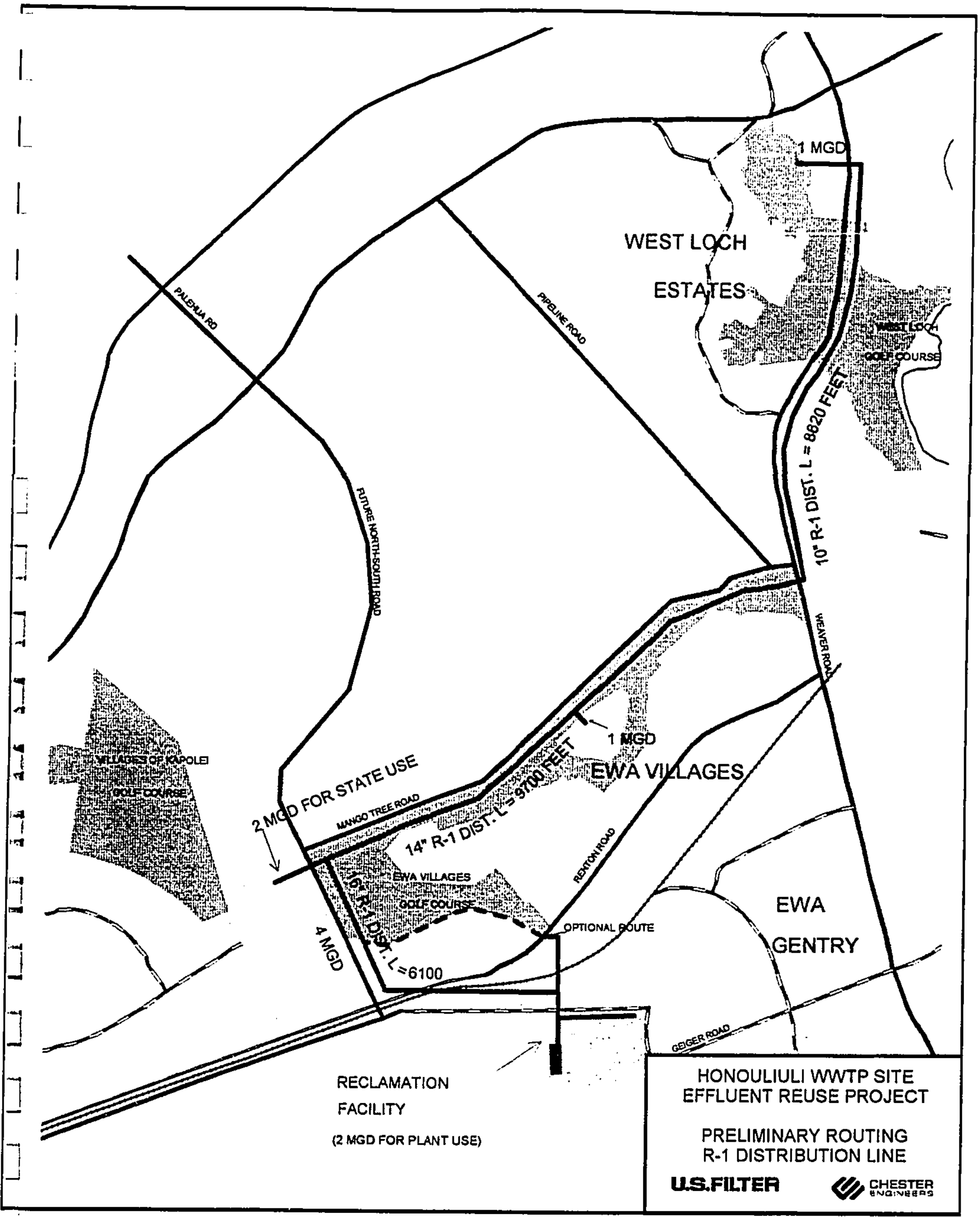
Partial secondary treatment has been added to Honouliuli WWTP. Flows up to 13 mgd are now treated and then mixed with the primary flows prior to final disposal through the existing ocean outfall. The secondary treatment facilities were built as a result of a State of Hawaii Department of Health consent order that required the City and County of Honolulu to build and operate the facilities in anticipation of potential wastewater reclamation and to service potential reuse customers. The City has future plans to expand the secondary treatment facilities to 26 mgd for reuse in the Ewa area.

2.3 U.S. FILTER WATER RECLAMATION FACILITY

The reclamation facility to be built at the Honouliuli WWTP will receive and process 13 MGD of secondary treated wastewater supplied from the WWTP. There will be two grades of water produced by the facility. One grade will meet the current Hawaii Department of Health reuse guidelines for R1 water and will be used primarily for irrigation purposes. The other grade of water is labeled as RO water to reflect the process used (reverse osmosis) for manufacturing this water. The RO water is intended to be used for industrial purposes such as make up water for cooling towers, process water for refineries, boiler feed water, etc. The R1 and RO systems will be designed within the State of Hawaii Department of Health "Guidelines for the Treatment and Use of Reclaimed Water".

The irrigation uses in the Ewa area include golf courses, landscaping, and agriculture. There are seven golf courses located in the vicinity of the proposed facility. Two of the courses are municipal, four are private, and one is federal.

The Honouliuli WWTP has its own brackish water wells on the facility grounds. The two wells have been shut down. Subsequently, the plant will require water for its non-potable uses including process water and wash down water. In addition, the plant is expected to expand in the near future.



HONOULIULI WWTP SITE
EFFLUENT REUSE PROJECT

PRELIMINARY ROUTING
R-1 DISTRIBUTION LINE

U.S.FILTER CHESTER ENGINEERS

2.4 R1 SYSTEM OVERVIEW

In reclaiming and reusing municipal wastewater, precautions must be taken to protect health and avoid public nuisances. To accomplish these objectives, the Hawaii State Department of Health issued guidelines for the treatment and use of reclaimed water. According to those guidelines, an R1 classification of reclaimed water is suitable for most reuse projects. To produce that quality of reclaimed water, the effluent of a municipal secondary treatment system must be chemically coagulated, flocculated, and filtered. After that, the wastewater must be disinfected.

The proposed tertiary treatment process saves valuable space by eliminating the use of flash mix and flocculation tanks and a tertiary clarifier required in a full treatment system. At the same time it produces a reliable, equivalent quality of R1 water. In the proposed treatment system, the use of an in-line mixer has been proven to be effective as a flash mix tank in providing the required chemical dispersion and coagulation. Because the concentration of suspended solids in the municipal secondary effluent and that generated in the tertiary coagulation process is expected to average 20mg/L or less, the use of a tertiary clarifier would have minimal effect in removing the suspended particulates and/or reducing the sand filter loadings. As such, it is more economical and will save space by directly filtering the coagulated wastewater. The sand filters will also provide the necessary sites to flocculate and aggregate the coagulated material, thereby eliminating the need for flocculation tanks.

The proposed Hydro-Clear Sand filters have been used since the mid-1970s in over 400 municipal tertiary systems. In those projects, they have clearly demonstrated the ability to consistently produce an effluent meeting or exceeding the DOH guidelines. The filters feature a single grade of fine sand that eliminates intermixing of media grades and they use a system that regenerates the media surface which results in longer filtration runs but at the same time allows in-depth flocculation and storage of solids in the filter bed. Moreover, the backlashing system effectively removes the accumulated solids from the media in a relatively short time, thereby reducing the off-line backlashing process required for other systems.

Disinfection of the wastewater will be with a UV system. Disinfection with chlorine was considered, but a chlorinated effluent potentially could have an effect on the environment and may increase the concentration of halogenated organics in the reclaimed water. In addition, the handling of chlorine gas requires a number of costly safety precautions. The proposed UV system eliminates these concerns and has been proven to effectively reduce the pathogenic counts of the reclaimed wastewater.

2.5 R1 PROCESS DESCRIPTION

Secondary treated effluent will be received at the R1 lift station and pumped via 2 submersible pumps (one active, one standby) to begin the reclamation process. Following the DOH guidelines, a direct filtration process will be used as the tertiary treatment system. In that process, polyaluminum chloride will be added to the wastewater using an in-line mixer and the coagulated material will be removed in a sand filter.

Filtrate from the clearwell will be taken to the disinfection system where it will undergo ultra violet treatment. The disinfected water will be pumped to the two one-million gallon storage tanks. Water from the storage tank will be pumped into the R1 distribution system. The storage will be monitored and sampled for adequate disinfection.

Although the system has been designed to produce a consistent water quality suitable for reuse, the system provides monitors and storage vessels that allow any water not meeting the treatment plant to be reprocessed or discharged with the normal effluent of the municipal treatment plant. This assures that the delivered reclaimed water meets the objectives of the guideline in protecting public health.

Turbidity monitors will be used on each of the filters to assure that sufficient coagulation, flocculation, and removal of the constituents are maintained. An enclosure will house the rapid mix tank, floc tank, filter cells, distribution channel, clearwell and mudwell. A nominal amount of flocculent will be added in the rapid mix tank to aid in the settling of solids. Hypochlorite will be added at this point to minimize algae and slime formation. The water then proceeds to the filtering system via the distribution channel. The water is distributed to the filter cells and filters down through the filter media to the underdrain and eventually to the clearwell. As the water level rises in the filter cells due to the accumulation of solids, an Air Mix Routine is used to extend the run time before backwashing is needed. Backwash water is taken from the clearwell and run through the filters then collected in the mudwells where it will be pumped to the preaeration tank. Filtrate from the clearwell will be taken to the disinfection system where it will undergo ultra violet treatment. The disinfected water will be pumped to the two one-million gallon storage tanks. Water from the storage tank will be pumped into the R1 distribution system. The storage will be monitored and sampled for adequate disinfection.

All screenings, non-conforming water, and backwash will be recycled to the preaeration basin or the R1/RO influent sump. The recycled streams will be monitored for flows and solids. In the event the streams produce an adverse impact on the wastewater plant, they will be discontinued. If an industrial discharge is detected, the recycle streams will be returned to the wastewater plant headworks.

2.6 RO SYSTEM OVERVIEW

Reverse osmosis (RO) with membrane microfiltration as the preferred pretreatment was selected for the boiler feedwater treatment system at the Honouliuli Wastewater Reclamation Facility. RO technology was selected as an alternative to ion exchange, thereby eliminating the need for the storage and handling of large quantities of acid, caustic, and regeneration waste on site. The use of RO technology allows for the reuse of RO wastewater, whereas ion exchange regeneration wastewater must be treated and is typically not suitable for reuse.

The supply of de-ionized water to the customers at Campbell Industrial Park will significantly reduce their need to store and handle acid, caustic, and regeneration waste at their facilities. Of particular importance to these customers is the reduction in silica afforded by the RO system. This reduction in silica will allow customers to eliminate treatment processes such as lime softening, thereby elimination the production of lime sludge.

The microfiltration pretreatment to the RO membranes significantly improves the performance of the RO system. Microfiltration removes such a high percentage of suspended solids (potential foulants) from the RO feedwater such that a more aggressive RO design can be used than is possible with conventional clarification/filtration technologies. For example, microfiltration pretreatment allows for the use of thin film composite (TFC) RO membranes rather than the more fouling- resistant cellulose acetate (CA) membranes on highly fouling- prone feedwaters such as secondary effluent. Several municipal installations and pilot studies have demonstrated the effectiveness of microfiltration as pretreatment for TFC RO membranes operating on secondary effluent.

The use of TFC membranes offers two important advantages over CA membranes. Thin film composite membranes operate a significantly lower pressure than CA membranes. This results in a lower demand on power and reduces operation costs, both significant issues in Hawaii. Additionally, TFC membranes exhibit a significantly higher rejection of silica than CA membranes do. The lower silica concentration in the product to the industrial customers reduces the degree of post-treatment required by the customers to meet their boiler feedwater quality specifications.

The high efficiency of solids removal via microfiltration allows the RO system to operate at higher membrane fluxes than is possible with convention pretreatment. Higher membrane fluxes translates into smaller, lower-cost RO systems. Additionally, the rate of membrane fouling, and therefore the rate of membrane cleaning, is reduced. Reduced fouling and cleaning rates translates into longer service time before membrane replacement is required.

Much of the equipment, including the microfiltration and RO units and chemical feed systems are skid-mounted or 'modularized', thereby simplifying the installation, operation, monitoring, and maintenance of the system. Modularization also enhances the flexibility of the process, particularly with respect to treatment capacity.

In summary, the microfiltration/RO process selected for the Honouliuli wastewater reclamation facility offers the following advantages:

- Proven CMF/RO process for secondary effluent treatment
- Eliminated the need to store and handle large quantities of acid, caustic, and regeneration waste Allows for reuse of RO reject water
- Reduces of eliminates treatment and polishing treatments required by industrial customers Minimizes power and space requirements
- Minimizes generation of membrane cleaning wastewater
- Maximizes membrane life Simplifies system operation and maintenance

2.7 RO PROCESS DESCRIPTION

The secondary effluent will be received at the RO lift station and pumped to the building housing the membranes and the microfiltration units. Chlorine will be added through the hypochlorite systems.

The RO stream will be prefiltered through 2 self cleaning strainers (500 microns screens) to remove debris that could adversely impact the microfilters. The strainers will be capable of backwashing themselves.

After running through the prefilters, the stream is run through the microfiltration membranes (CMF). The membranes use a 0.2 micro hollow fiber membrane with a shell-side feed. The membranes are cleaned using a gas backwash. The backwash water is sent to a concrete tank where it is then pumped to the preaeration tanks. The cleaning of the microfiltration membranes are done as necessary using citric acid, and a proprietary method using a caustic cleaner. The used cleaning solution will be sent to the backwash tank and then on to the preaeration tanks.

Filtrate from the CMF system is fed to the covered RO feed tank. Chlorination will take place to maintain a residual level of free chlorine to prevent microbiological growth on the membranes, the feed tank, and the upstream distribution system. The feed tank will provide surge capacity and residence time for disinfection prior to the RO process.

From the feed tank, water pumped to the RO units located within the same building and treated with an antiscalant and sodium bisulfite. The RO units consist of RO skids fully equipped with a high-pressure feed pump. After the RO treatment the water is then fed to the RO storage tank for distribution to the RO users.

2.7.1 Water Reclamation Meter Program

Each customer will have a flow control and meter at the point of delivery. The flow control will consist of a motorized valve to start and stop the flow to the customer. The valve position will be controlled by the USFOS SCADA system.

The customer meter will be a turbine type flow transmitter. The meter specification will be Edrco series 20/25 with model TF- 15275 transmitter or equal. The meter will have a local flow totalizer. A flow signal will be sent by the SCADA system to USFOS main control computer. The meter calibration program will be monthly for the first quarter of operation. After the first quarter of operation the meter calibration will be done at least once every 6 months.

The reclaimed water control plan is to be based upon customer storage level. As the level drops in the customer storage structure, the SCADA system will sense the level. When the valve open level position is reached, the USFOS SCADA system will open the supply water valve. The water meter will measure the gallons delivered. The SCADA system will adjust valve to maintain system delivery pressure. When the customer storage structure is full the SCADA system will close the supply valve.

2.7.2 Reclaimed Water Rate System

The Honouliuli Reclaimed Water System will have a rate structure based on gallons delivered. As the customer uses water, the flow meter will record the gallons delivered. The customer will be charged on a per 1000 gallon basis. There may also be an additional charge to cover the capital cost for the distribution equipment necessary to deliver the reclaimed water.

The charges for reclaimed water is a sensitive issue. The exact charges for the water is under development. The rates will be divided into to groups: R1 and RO. The only rate that has been established by the City & County of Honolulu and USFOS is $1.15 per 1000 gallons. It is projected that the R1 customer water rate will be similar to the Board of Water Supply non-potable water rates. Plus a possible distribution charge to install the equipment necessary to get the water from the USFOS distribution system to the customer system.

The RO system will deliver very high quality water for use in boilers and pure water processes. With the high RO water quality so high, the price per 1000 gallons will be higher than the R1 water. The estimated charge for RO will be about $5.00 per 1000 gallons. Plus a possible distribution charge to install the equipment necessary to get the water from the USFOS distribution system to the customer system.

2.7.3 Solids Balance for the Backwash Disposal

The USFOS treatment system is basically a wastewater tertiary treatment system. The secondary effluent system from the Honouliuli Wastewater Treatment Plant will be the USFOS plant influent. During the USFOS treatment process solids will be removed from the wastewater. The R1 system will uses Zimpro Hydro-clear sand filters. The RO system will use US Filter Reverse Osmosis system. Both processes will produce a backwash recycle load that contains secondary effluent suspended and dissolved solids to the plant. Below, Table 2-1 shows the projected backwash recycle characteristics.

Table 2-1.
Projected Backwash Recycle Characteristics

Parameter	R1 Waste	CMF Reject	RO Reject
Influent flow (gpm)	7000	2700	2300
Recycle flow (gpm)	285	375	925
TSS ppm	130	72	<1.0
TDS ppm	610	610	1500
BOD ppm	<30	<30	<30

2.7.4 Priority Pollutant Scan Requirement

The USFOS Honouliuli Water Reclamation Facility will be a wastewater tertiary treatment system. The water receive by the USFOS facility will be the secondary effluent from the Honouliuli Wastewater Treatment Plant. The Honouliuli Wastewater Treatment Plant NPDES permit has a priority pollutant scan requirement. The USFOS Honouliuli Water Reclamation Facility will have access to the priority pollutant scan data from Honouliuli Wastewater Treatment Plant.

2.7.5 Reverse Osmosis Reduction Potential

The Reverse Osmosis (RO) system will produce high quality industrial water. The use of this water will be for industrial purposes including boiler feed and pure water industrial applications. The RO water will not be for human consumption or contact.

The RO system equipment will consist of US Filter Memcor Continuous Micro Filtration Units (CMF) and US Filter Reverse Osmosis Units. The US Filter CMF units are a unique form of microfiltration proven effective on both municipal and water reuse applications. About 100 potable water installation in the U.S. use the CMF units to meet drinking compliance regulations. The Memcor CMF system removes particles as small as 0.2 microns and performs up to six 6 log removal of Giardia and Cryptosporidium. The water from the CMF will flow to the RO system.

The RO system membrane filtration is being use to remove the dissolved solids including Chlorides, Silica, hardness, metals and other chemical compounds. During this process, the RO system will remove up to an additional 2 log removal of Giardia and Cryptosporidium.

The end result is the US Filter RO system will provide at least a 4 log reduction of Giardia and Cryptosporidium.

2.8 R1 DISTRIBUTION SYSTEM

The R1 system will distribute approximately 10 mgd of reclaimed water from the Honouliuli Wastewater Treatment Plant. The Honouliuli Wastewater Treatment Plant will use about 2 mgd for in plant processes. Two pipelines shall convey the remaining R1 water to the customers. The first line will take about 4 mgd of R 1 water North from the plant, two (2) mgd of which is for State of Hawaii projects, which could include the Kapolei Sports Recreational Complex, the Kapolei Civic Center, the Kapolei Public Library, and highway landscape irrigation. The pipe shall continue north, conveying 2 mgd to the West Loch Golf Course and the Ewa Village Golf Course. A second pipe line will convey R1 water west along the railroad track to the Villages of Kapolei, along the drainage ditch to Campbell Industrial Park, through the industrial park. It is anticipated that Chevron will use about 1 mgd for cooling tower makeup. The second pipe line will also provide a R1 source for users along the pipe line route.

The R 1 distribution system shall consist of approximately 27,000 linear feet of PVC pipe. The R1 distribution system shall be designed and constructed in accordance with the "Design Standards of the Department of Wastewater Management, Volume I and II, City & County of Honolulu, July 1993" and Water Systems Standards, Volume I, II and III, City & County of Honolulu 1985". PVC pipe will comply with AWWA-C-900 for pipe 12 inches or less in diameter. PVC pipe 12 inches or greater in diameter will comply with AWWA C-905. The pipe will be buried with a minimum of 3 feet of cover material.

PVC pipe shall be of ductile iron equivalent O.D. type. PVC pipe shall be furnished complete with all couplings of the same type and composition as the pipe, gaskets and lubricants conforming to ASTM D-1869. All gaskets and lubricants shall be made from materials that are compatible with the plastic material and with each other when used together will not support the growth of bacteria. Fittings shall be ductile iron and conform to ANSI 21.10. Fittings shall be at least the class of the pipe to be installed. Joints for the fittings shall meet all applicable requirements of ANSI A-21.11 (Figure 2-2).

2.9 RO DISTRIBUTION SYSTEM ELEMENTS

The RO system will distribute approximately 2 mgd of industrial quality reclaimed water from the Honouliuli Wastewater Treatment Plant. The RO distribution system originates at the ground level storage tanks within the USFOS Reuse Facility. A pipeline will convey RO water west along the railroad track to the Villages of Kapolei, along the drainage ditch to Campbell Industrial Park, through the industrial park (Figure 2-3). It is anticipated the major industrial facilities will be the RO water customers. The potential customers include Tesoro Petroleum Refinery, Kalaeloa Cogeneration Plant, AES Power Plant, H-Power and Chevron Refinery. The RO system will be designed with enough capacity for a potential future HECO power plant in the Campbell Industrial Park.

The RO distribution system shall consist of approximately 25,000 linear feet of PVC pipe. The RO distribution system shall be designed and constructed in accordance with the "Design Standards of the Department of Wastewter Management, Volume I and II, City & County of Honolulu, July 1993" and Water Systems Standards, Volume I, II and III, City & County of Honolulu 1985". PVC pipe will comply with AWWA-C-900 for pipe 12 inches or less in diameter. PVC pipe 12 inches or greater in diameter will comply with AWWA C-905. The pipe will be buried with a minimum of 3 feet of cover material.

PVC pipe shall be of ductile iron equivalent O.D. type. PVC pipe shall be furnished complete with all couplings of the same type and composition as the pipe, gaskets and lubricants conforming to ASTM D-1869. All gaskets and lubricants shall be made from materials that are compatible with the plastic material and with each other when used together will not support the growth of bacteria. Fittings shall be ductile iron and conform to ANSI 21.10. Fittings shall be at least the class of the pipe to be installed. Joints for the fittings shall meet all applicable requirements of ANSI A-21.11.

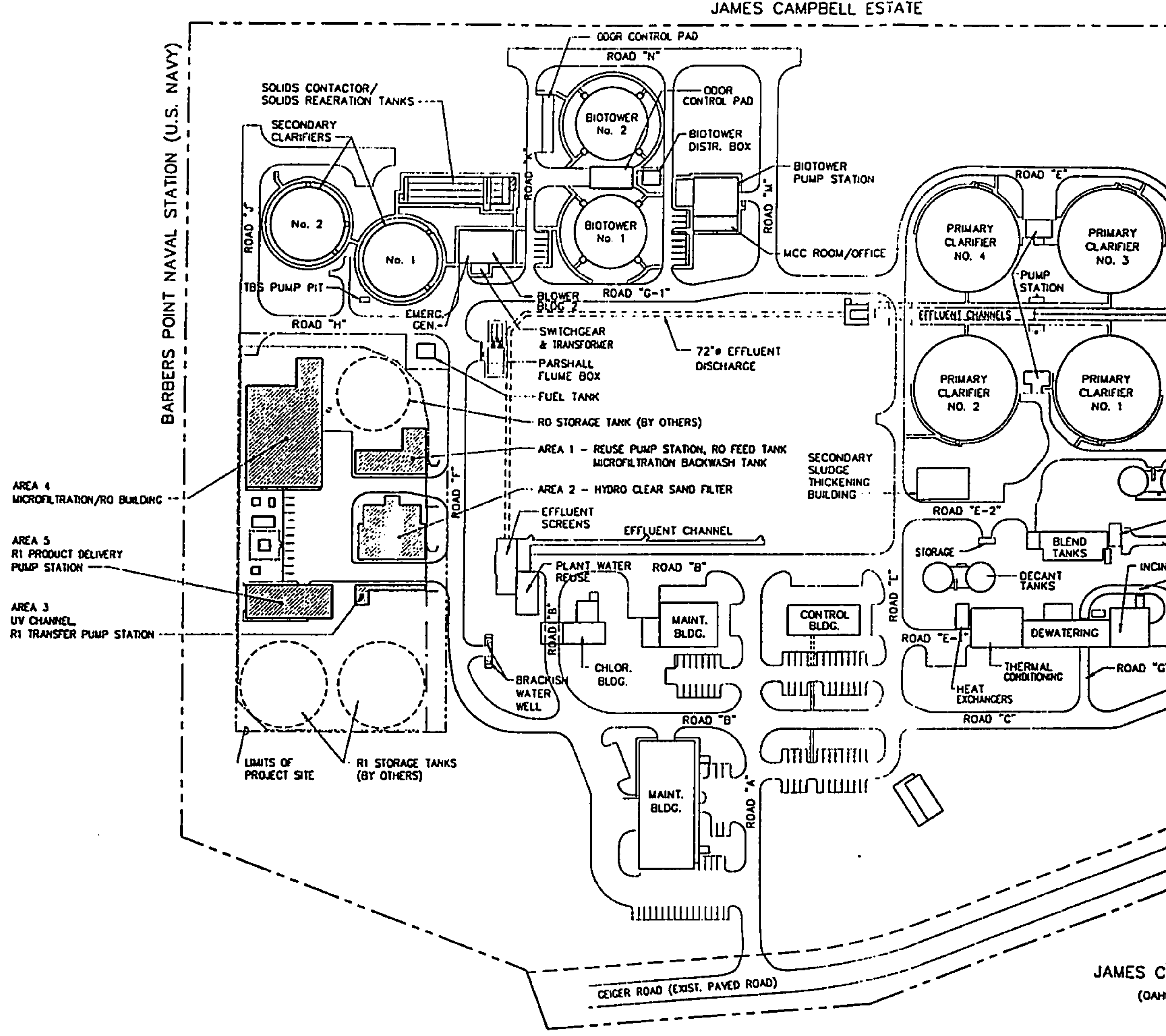
2.10 DISTRIBUTION SYSTEM OPERATIONS

The distribution systems will deliver RO and R1 water to customers based upon tank level. When the storage tank or lagoon level drops, the USFOS distribution system pumps will start or already be running. The supply valve will open and fill the tank or lagoon to the preset level and then close the valve.

Each customer will have a flow control and meter at the point of delivery. The flow control will consist of a motorized valve to start and stop the flow to the customer. The valve position will be controlled by the USFOS SCADA system.

The customer meter will be a turbine type flow transmitter. The meter specification will be Edrco series 20/25 with model TF-15275 transmitter or equal. The meter will have a local flow totalizer. The meter calibration program will be monthly fore the first quarter of operation. After the first quarter of operation, the meter calibration will be done at lease once every six months.

Figure 2.2



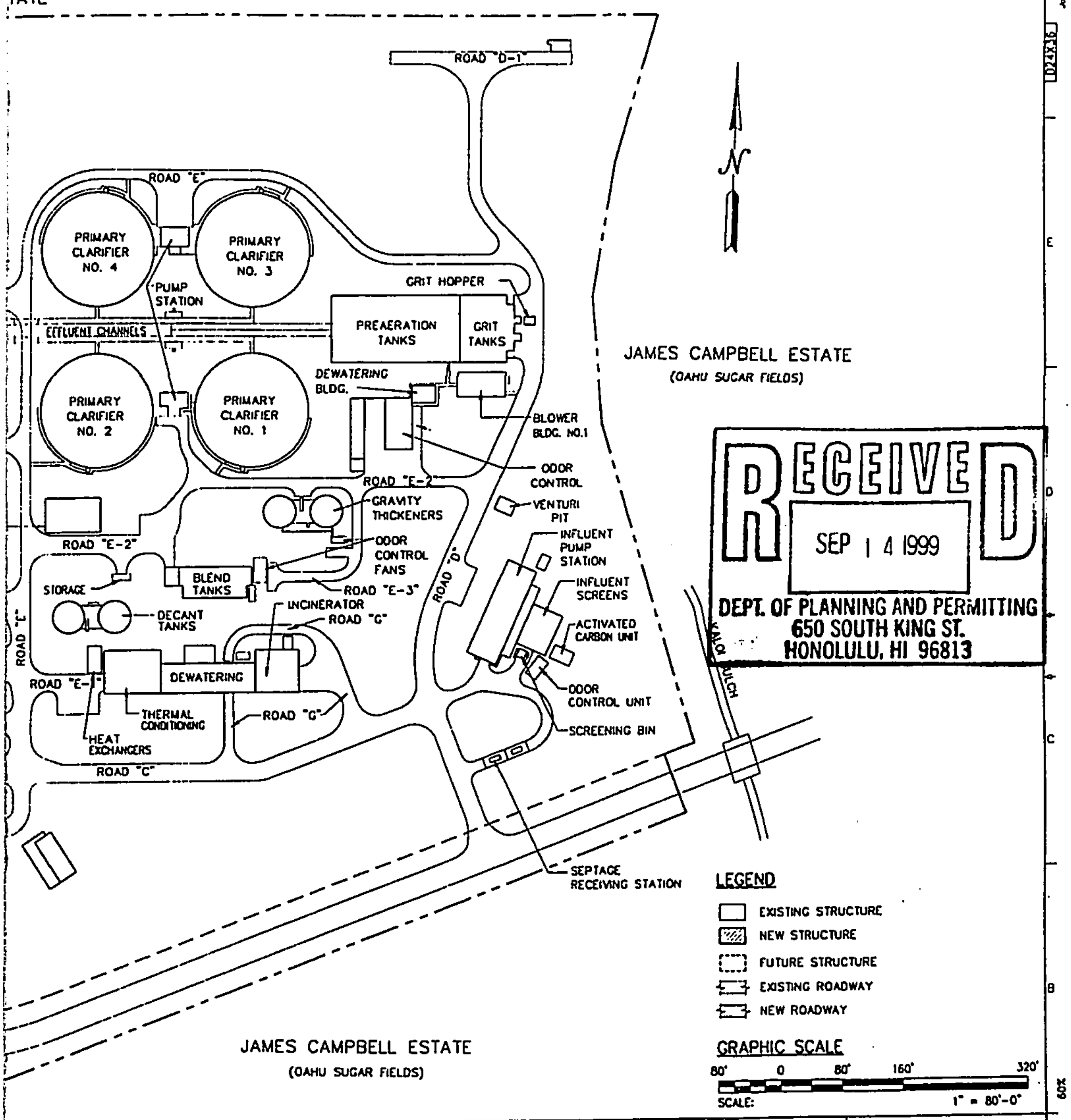
APPROVED:

DIRECTOR, DEPARTMENT OF DESIGN AND CONSTRUCTION
CITY AND COUNTY OF HONOLULU

DATE

NO.	REVISION	DATE	DRN	CHKD	APPD

Figure 2.2



COMPANY CONFIDENTIAL

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

Signature Date

REVISION DATE DRN CHKD APPD

INTERNAL DRAWING NO.

DRAWN: JAS
DATE:
CHECKED: LAM
APPROVED:
APPROVED:
SCALE: AS NOTED

PROJECT: HONOULIULI RECLAMATION FACILITY
HONOULIULI WWTP, OAHU, HAWAII

DESCRIPTION: GENERAL SITE PLAN

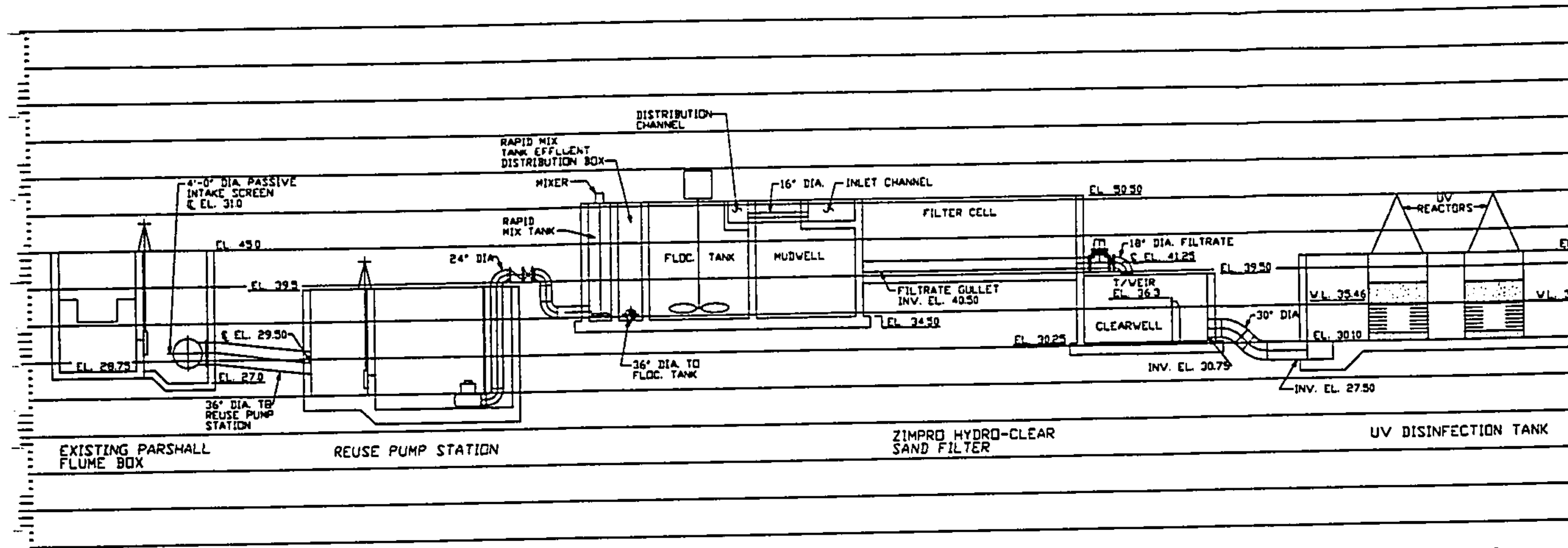
CLIENT: USFilter

ENGINEER: GMP ASSOCIATES, INC.
ENGINEERS / ARCHITECTS

PROJECT NO. 5467-30
DRAWING NO. G001
SHEET NO. OF
REV

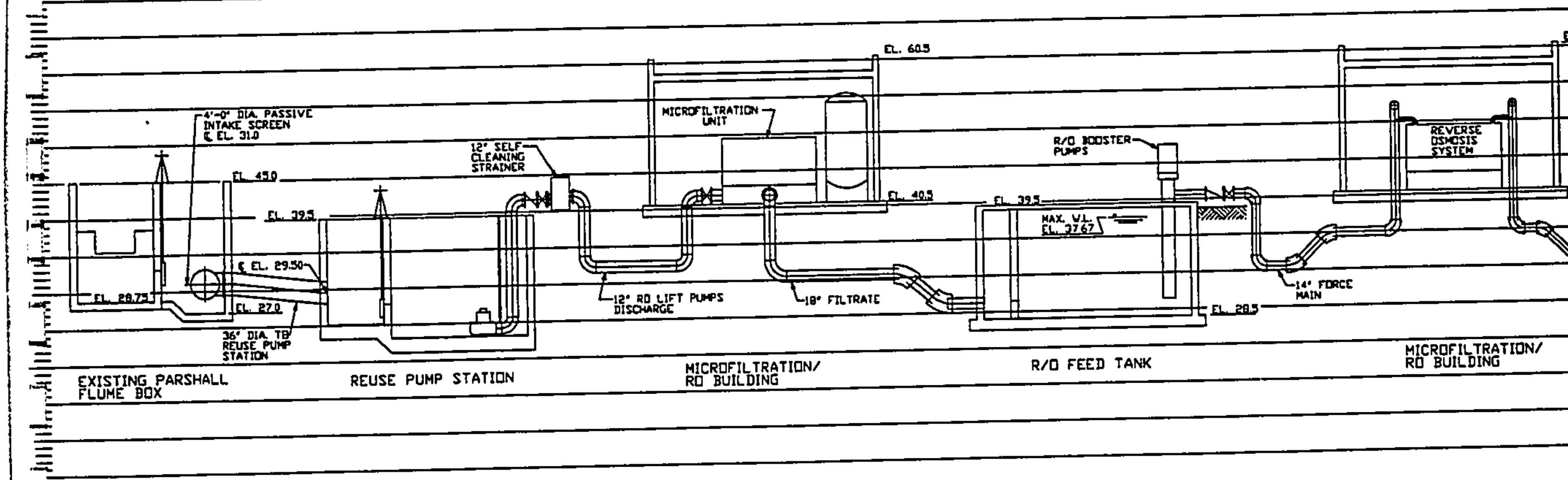
2501J041 05/20/99 11:27 60%

D24X36



HYDRAULIC PROFILE - R1 TREATMENT SYSTEM

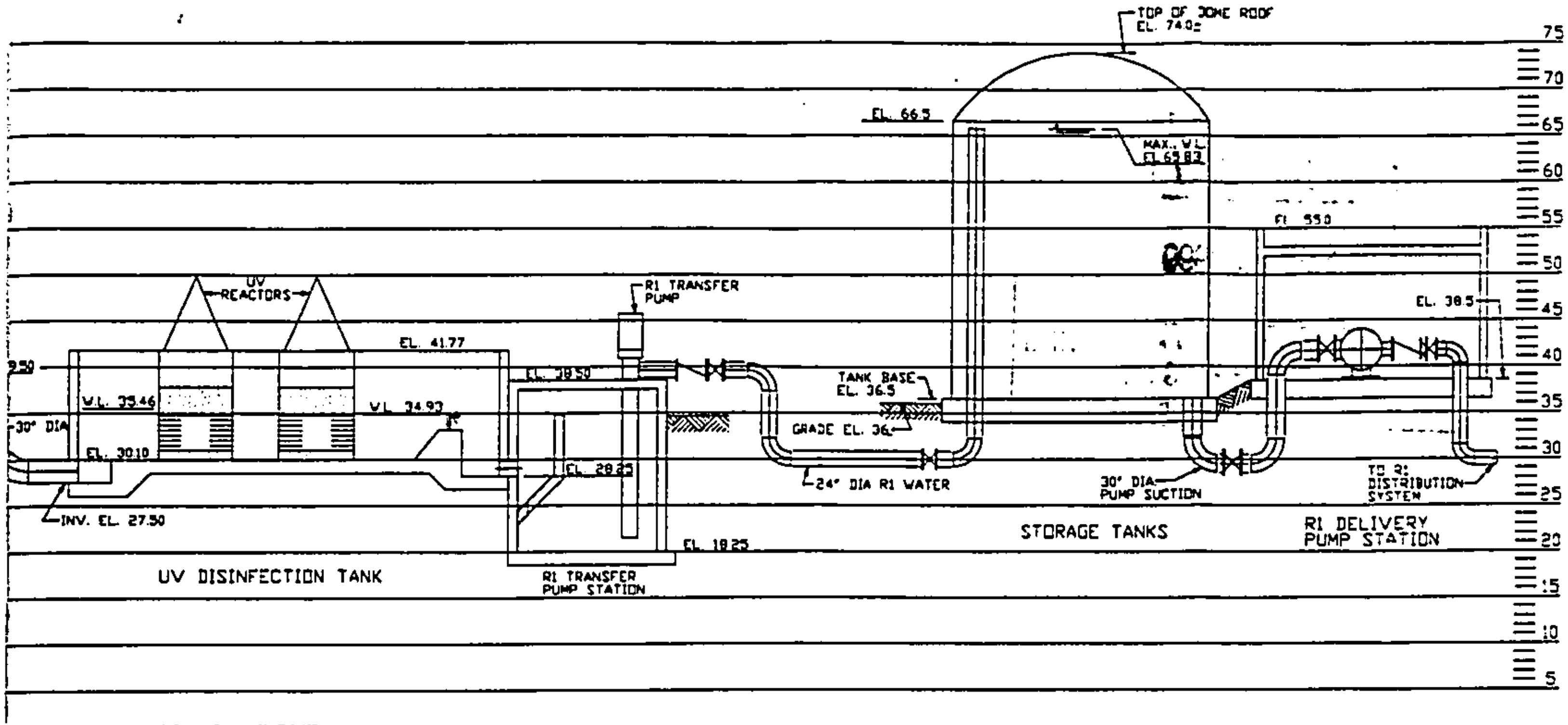
VERTICAL - 1" = 10'-0"
HORIZONTAL - NONE



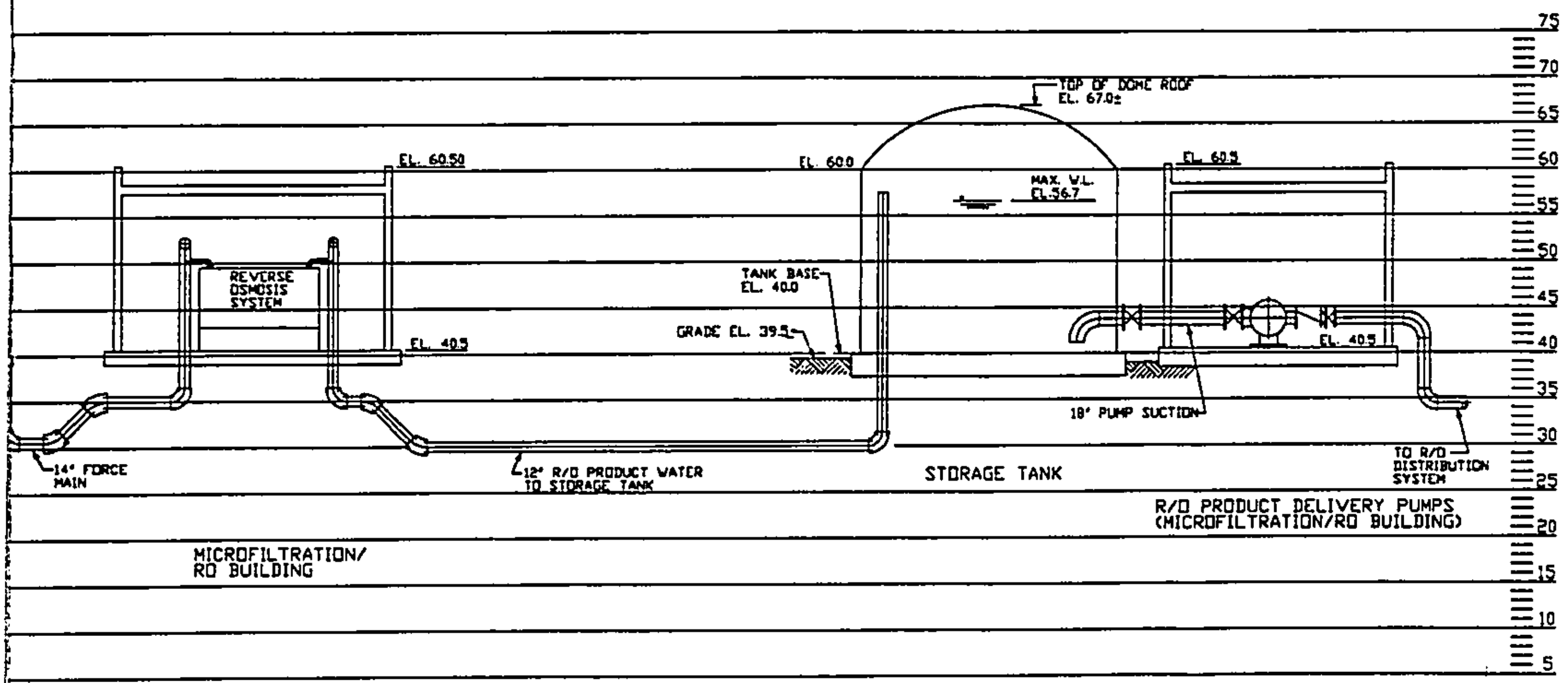
HYDRAULIC PROFILE - RO TREATMENT SYSTEM

VERTICAL - 1" = 10'-0"
HORIZONTAL - NONE

2	30% SUBMISSION CITY AND COUNTY OF HONOLU
⚠1	MODIFICATIONS PER UV DISINFECTION
NO.	REVISION



REATMENT SYSTEM



REATMENT SYSTEM

NO.	REVISION	DATE	DRN	CHKD	APPD
2	30% SUBMISSION CITY AND COUNTY OF HONOLULU	-17-99	ES	DEG	REL
△1	MODIFICATIONS PER UV DISINFECTION	-7-99	KHR	DEG	REL

COMPANY CONFIDENTIAL

INTERNAL DRAWING NO.

DRAWN	DATE
RVV	7/98
CHECKED	
DG	11/98
APPROVED	
DLM	11/98
APPROVED	
SCALE	

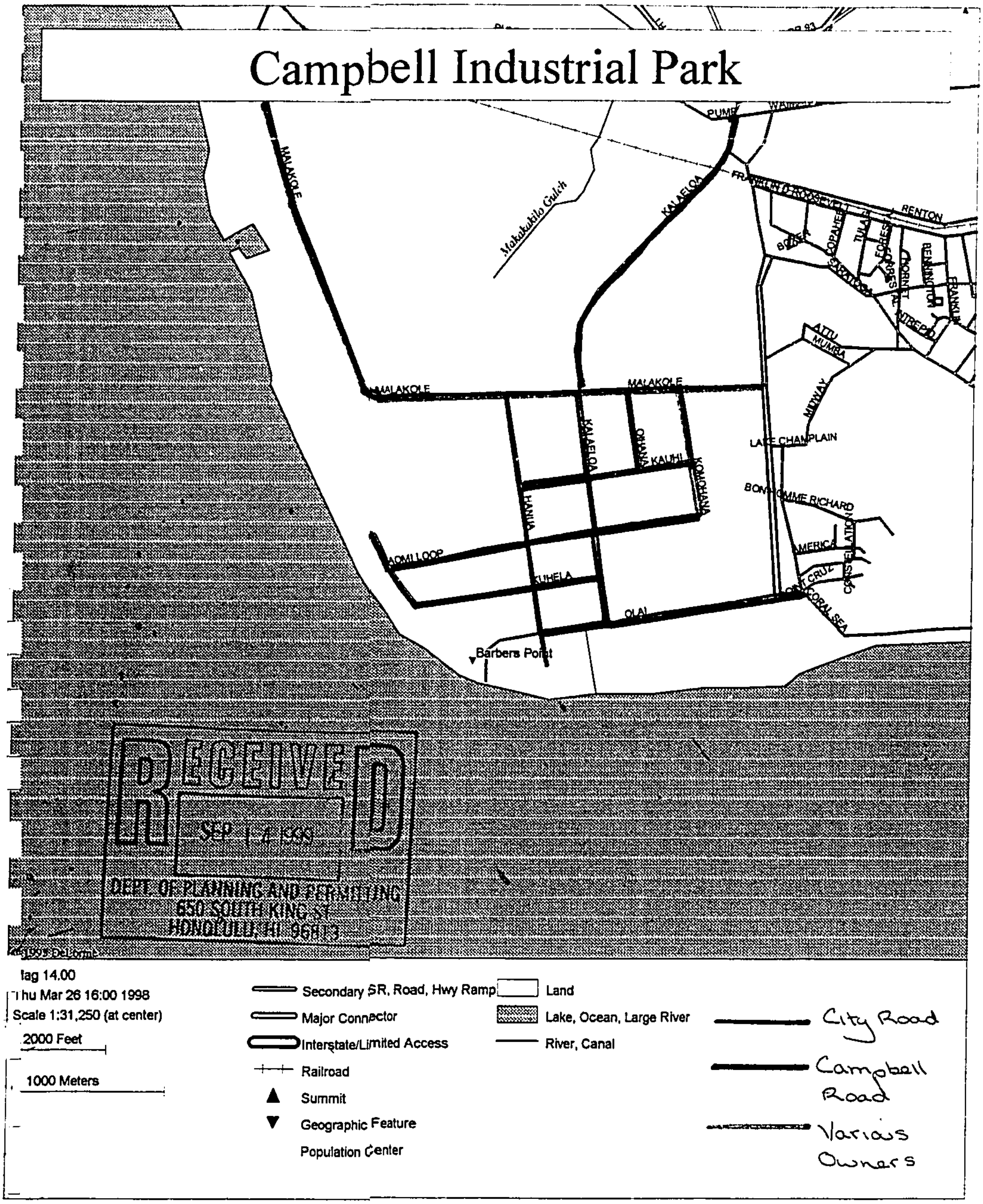
TITLE HONOULIULI WASTEWATER RECLAMATION FACILITY
WASTEWATER RECLAMATION FACILITY
HYDRAULIC PROFILE

CLIENT CITY AND COUNTY OF HONOLULU
HONOLULU, HAWAII

USFilter

PROJECT NO.	DRAWING NO.	SHEET NO.	REV
546716	1	OF	2

Campbell Industrial Park



The distribution flow will be measured as it leaves the USFOS facility and measured at each customer. Each day an inventory of water supplied and water delivered to customers will be made. Differences in the flow will indicate a possible leak and initiate a water leak investigation.

The distribution system will be inspected for leaks in the area indicated by the flow meter discrepancy. With a distribution system pressure between 40 and 80 PSI, the leak will be quickly identified. USFOS personnel will have equipment and supplies to repair the distribution system leaks.

Construction Methods: Construction of this facility will be of a routine nature. It will consist first of all of a facility that will be built on a slab that will hold modular membrane/filtration systems. The facility will consist of concrete housing and will be simple in nature. The distribution system will consist of PVC pipe that will run through the Ewa area from the plant to the areas to be served.

UNDERGROUND STORAGE TANKS

The USFOS facility will not have any underground fuel storage tanks. The fuel tank for the emergency generator will have a self-contained, above-ground tank.

DESIGN STANDARDS

The water reclamation facility and the transmission lines will be designed and built using the following documents:

1) *Design Standards of the Division of Wastewater Management*, Volume 1, July 1993 & Volume 2, July 1994;
2) *Water System Standards, Board of Water Supply*, Volumes 1 & 2, 1985 & Volume 3, 1991;
3) *Standard Details for Public Works Construction*, 1984, and *Standard Specifications for Public Works Projects* 1986; and
4) *Guidelines for the Treatment and Use of Reclaimed Water*, Hawaii State Department of Health, Wastewater Branch, November 22, 1993.

PROJECT SCHEDULE

Below is a schedule for the Honouliuli Reclaimed Water Project.

Date	Activity
December 24, 1998	Signed contract between the City & County of Honolulu and US Filter
January 1999 to June 1999	US Filter Honouliuli Water Reclamation Facility and distribution system design
July 1999 to July 2000	Construction of US Filter Honouliuli Water Reclamation Facility and distribution system
July 2000	US Filter Honouliuli Water Reclamation Facility and distribution system start-up

3.0 PROJECT ALTERNATIVES

3.1 ALTERNATIVE CONCEPTS TO COMPLY WITH CONSENT DECREE.

The City had limited alternatives in meeting the requirements of the Consent Decree. One alternative considered by the City was to deposit the effluent from the HWTP into a trench. While this alternative might have met the minimal requirements of the Consent Decree, it would be expensive to build and maintain, it would be done solely at City cost, and it would not be as suitable a use as will be made of the water by the operation of the U.S. Filter facility.

3.2 THE "NO ACTION" ALTERNATIVE

Given the requirements of the Consent Decree and the significant fines imposed by the decree if a supplemental and environmental project is not constructed in a timely manner, the City truly had no alternative but to undertake such a project because the "no action" alternative would subject the taxpayers to very substantial costs in the form of fines.

4.0 AFFECTED ENVIRONMENT, POTENTIAL IMPACTS AND PROPOSED MITIGATION MEASURES

The project, as described in Chapter 2.0, will consist of 1) a water reclamation facility producing R1 water (oxidized, filtered and disinfected); 2) a reverse osmosis (RO) facility producing essentially sterile water, both located at the Honouliuli Wastewater Treatment Plant (WWTP); 3) a system of pipelines to distribute R1 water to commercial users throughout the Ewa Plain; and 4) a storage and distribution system within CIP to distribute RO water to industrial users. The R1 product water will be delivered to West Loch Golf Course, Ewa Villages Golf Course, and West Loch Village to be used for irrigation. Other users will include the WWTP itself, the State of Hawaii, and other, as yet unidentified, golf courses and new developments on the Ewa Plain. The product water transmission pipeline systems, therefore, will extend from West Loch Golf Course in the east to Campbell Industrial Park in the west. The study area consequently covers a broad swath across the Ewa Plain (Figure 4-1), which is itself in large part coincident with the City and County of Honolulu's Ewa Development Plan area. Further, because of the porous nature of the caprock underlying the area, and the consequent potential for recharged water to seep into the ocean, the study area also includes marine waters from Pearl Harbor's West Loch to Barbers Point Harbor.

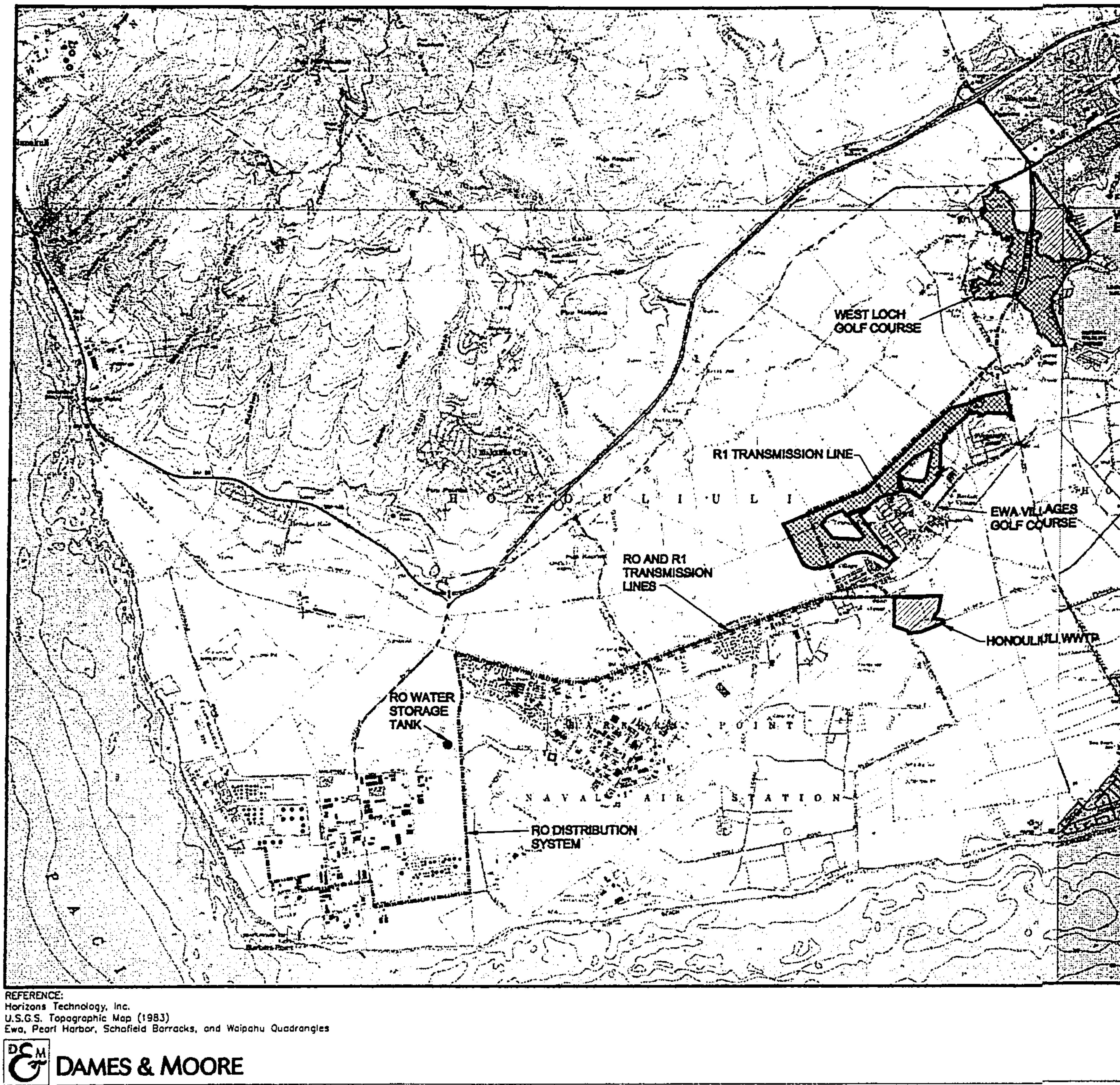
4.1 THE PHYSICOCHEMICAL ENVIRONMENT

The region may be characterized as a broad, flat, coastal plain with a relatively hot and dry climate (annual rainfall of about 20 inches). The plain consists of an exposed, emerged coral reef, presenting a relatively flat mini-karst topography (Dames & Moore, 1995). Historically, land use was predominantly agriculture, although water scarcity forces importation of water from the wetter, windward side of the island.

4.1.1 Geologic Conditions

4.1.1.1 Existing Conditions

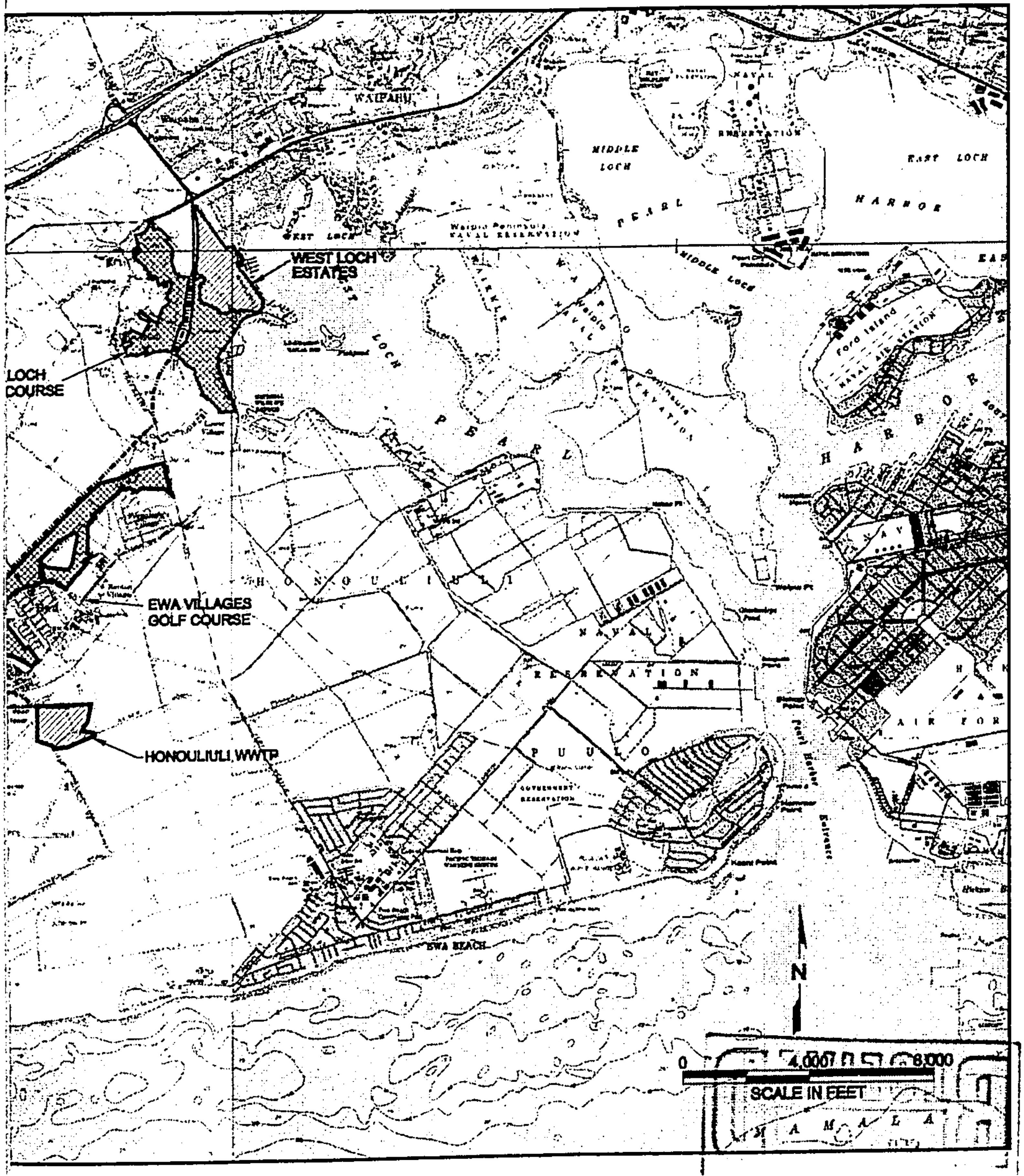
Geology: Oahu consists of the eroded remnants of two large shield volcanoes built during the Pliocene and Pleistocene epochs, Waianae and Koolau. The project area is located along the Ewa Coastal Plain of southwest Oahu. Specifically, the site lies within the nearshore coastal outwash plain associated with the lower southeastern slope of the older Waianae Volcano. The Ewa Plain covers an area of approximately 28 square miles and consists of an exposed, emergent limestone reef composed of sequences of relatively flat marine sedimentary deposits (calcareous silts, sands, and gravels and reef limestone layers) intercalated with terrestrial alluvium deposits (silts and clays derived from the upslope volcanics). About 75 percent of the plain is underlain by marine limestone and calcareous deposits that form the Ewa caprock, which is 100 to 200 feet thick throughout most of its extent (Lau et al., 1989). The sediments of the Ewa caprock occur as a wedge starting several miles inland and increase in thickness to a maximum of about 1000 feet at the southern coast near Iroquois Point (Yuen & Associates, 1989). The inland boundary is approximately parallel to Farrington Highway (see Figure 4-2). The caprock thins northward



REFERENCE:
Horizons Technology, Inc.
U.S.G.S. Topographic Map (1983)
Ewa, Pearl Harbor, Schofield Barracks, and Waipahu Quadrangles

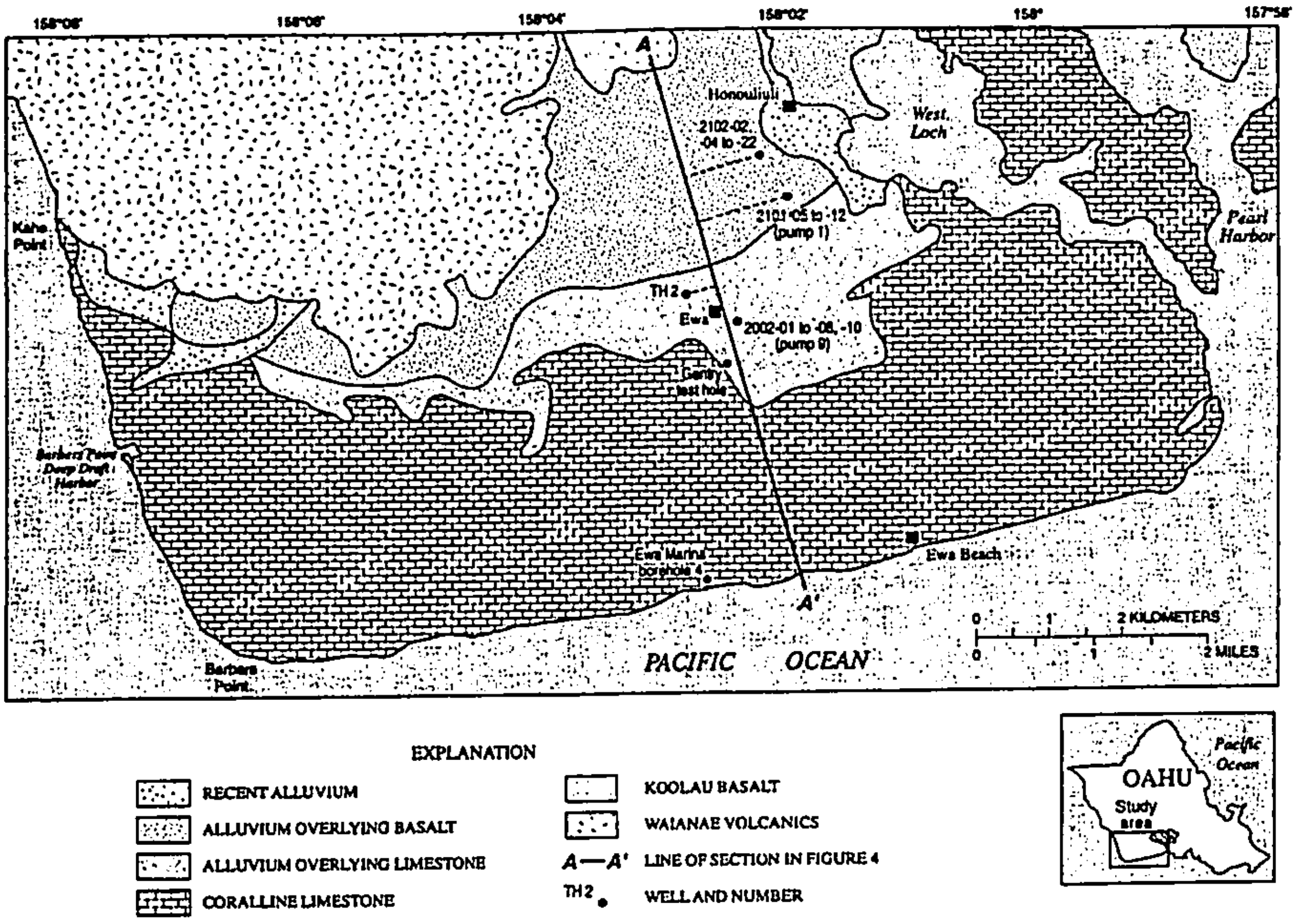
DAMES & MOORE
GROUP A DAMES & MOORE GROUP COMPANY

42470-001-0805 jsb 0105b.dwg 3/99

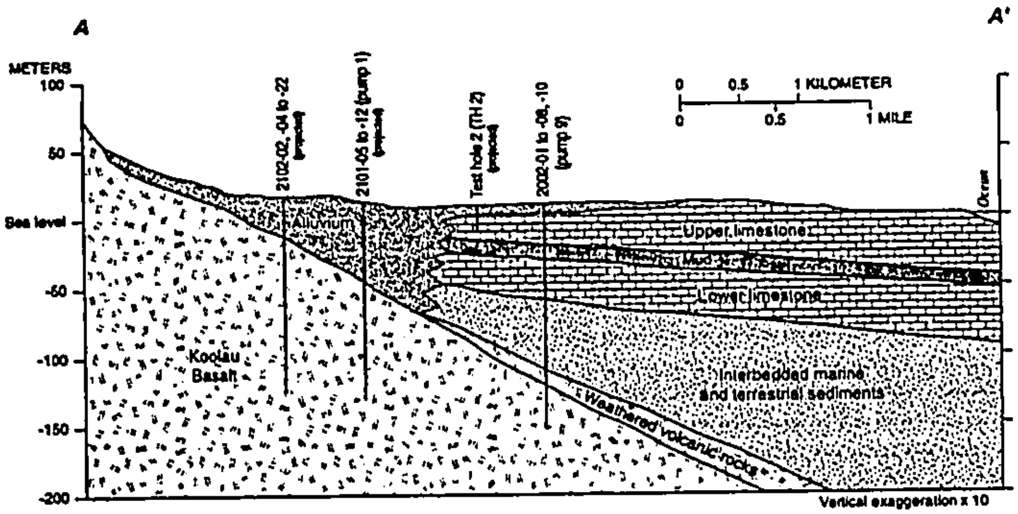


PROJECT FACILITIES AND
IDENTIFIED WATER REUSE AREAS

FIGURE 4-1



A. Surface Geology



SOURCE: Oki et al., 1998

B. Subsurface Stratigraphy

GEOLOGY OF THE EWA PLAIN

FIGURE 4-2

where it interfingers with the alluvium and underlying weathered volcanics. Figure 4-1 shows that the WWTP and its distribution pipeline systems essentially traverse the entire Ewa Plain from West Loch Golf Course in the northeast to Malakole west of Kapolei and Barbers Point Naval Air Station (BPNAS).

The youngest volcanics in the area of the WWTP are the postshield Kolekole Volcanics of the Waianae range (Sinton, 1986). These volcanic vents erupted approximately 2.9 million years ago at low elevations to the southeast of the Waianae Volcano, forming five cinder cones (Puu Kapolei, Puu Kapuai, Puu Kuua, Puu Makakilo, and Puu Palailai). The nearest vent is Puu Kapolei, approximately 2.27 miles from the WWTP. It is composed of various amounts of cinder and spatter (Stearns, 1939; Sinton, 1987; Presley et al., 1997). The lavas of the Kolekole Member range from alkali-olivine to hawaiite (i.e., alkalic basalts).

The subsurface geology is inferred from the U.S. Geologic Survey drilling records (Stearns and Vaksvik, 1935, 1938; Stearns and Chamberlain, 1967) for Well 257 (2201-03, 04, 07), Well 263 (2202-15 to 20), Well 264 (2102-02, 04 to 22), Well 268 (2101-05 to 12), and Ewa Plantation Well 273 (2002-01 to 08, and 10). These wells are 0.51 to 2.27 miles north, 2.67 miles west-northwest, and 2.27 to 2.85 miles east-northeast of the WWTP. Several of the stratigraphic sections from deep wells drilled in the Ewa Plain are presented in Table 4.1 (Stearns and Vaksvik, 1935, 1938; Stearns and Chamberlain, 1967).

Stearns and Chamberlain's study best describes the subsurface geologic stratigraphy beneath the project area. Their stratigraphy represents the most detailed sections for this portion of the Ewa Plain with drill core recovery at 85 percent or better for Ewa Wells 1 and 2. The geologic logs indicate that the upper coralline (reef) limestone layer reaches a maximum thickness of about 200 feet at Ewa Well 1 (200 yards inland from Ewa Beach) and thins to about 100 feet at Ewa Well 2 located approximately 2.5 miles inland to the north. Stearns (1939), Stearns and Chamberlain (1967) and George A. L. Yuen & Associates, Inc. (1989), describe a thick sequence (up to 400 feet thick) of interbedded marine and terrestrial sediments of variable thickness that includes hard recrystallized reef limestones, marls (calcareous clay), basaltic sands, terrestrial muds and saprolite clay overlying weathered basaltic lava flows (see Figure 4-2). Overlying this sequence is a fossil reef about 50 feet thick (lower limestone unit), which in turn is overlain by an areally extensive brown mud (mud unit), 30 to 50 feet thick (Stearns and Vaksvik, 1935, 1938; Stearns and Chamberlain, 1967; Oki et al., 1998). This mud consists mainly of clay- and silt-sized particles deposited in a lagoonal environment (Stearns and Chamberlain, 1967). At the top of the stratigraphic section is a fossil reef (upper limestone unit) containing remains of various corals, mainly *Porites*, calcareous algae, mollusks, etc., up to 120 to nearly 200 feet thick. Locally, secondary calcite and/or dolomite have replaced the original skeletal material, thus reducing its permeability. Marine calcareous sediments associated with a sea-level highstand (e.g., Waimanalo and Leahi formations) are found as high as about 90 feet elevation west of Makakilo, while in the eastern portion of the project area a thick sequence of alluvium and colluvium constitutes the surface at higher elevations. At lower elevations alluvial sediments underlie the reef limestone and marl (calcareous clay) deposits. The alluvial sediments grade stratigraphically (downward) into volcanic clays or saprolite associated with the erosion and weathering of the underlying basaltic lava flows and the postshield cinder cones.

Table 4-1
Well Logs for Ewa Plain Wells
Honouliuli WWTP

Well I.D. Number	Elevation (feet amsl)	Depth (feet bgs)	Geology	Use
Well 257 (2201-03, 04, 07)	40±	0-25	Red Clay	
		25-35	Gravel, Boulders	
		35-50	Red Clay (Pa) Noncalcareous Older Alluvium	
		50-60	Gravel, Boulders	
		60-282	Koolau Shield-stage Lava (Tkb), Olivine Tholeiitic Basalt	
Well 263 (2202-15 to 20)	46±	0-90	Soil (Pa) Noncalcareous, Grades to Saprolite Clay/Olivine Tholeiitic Basalt (Tkb)	Mill Pump 7
		90-481		
Well 264 (2202-02, 04 to 22)	44±	0-90	Soil (Pa), Noncalcareous Older Alluvium	
		90-120	Red Clay (Pa) (average depth 46 to 76)	
		120-150	Gravely	
		150-444	Red Clay (Pa with Tkb), Saprolite Grading to Tholeiitic Basalt	
Well 268 (2101-05 to 12)	30±	0-100	Soil (Pa), Noncalcareous Older Alluvium	
		100-150	Brown Clay (Pa)	
		150-210	Blue Clay (Pa), Possibly Saprolite	
		210-215	Gravel	
		215-295	Red Clay (Saprolite) Grading to Olivine Tholeiitic Basalt (Tkb)	
		295-468	Olivine Tholeiitic Basalt (Tkb)	
Well 273 (2002-01 to 08, 10)	46±	0-15	Soil	Mill Pump 9
		15-110	Coral (Pls)	
		110-130	Brown Clay (Pa)	
		130-135	Coral (Pls)	
		135-140	Brown Clay (Pa)	
		140-160	Coral (Pls)	
		160-190	Brown Clay (Pa)	
		190-235	Coral (Pls)	
		235-330	Brown Clay (Pa)	
		330-370	Coral (Pls)	
		370-400	Brown Clay (Pa)	
		400-410	Coral (Pls)	
		410-435	Brown Clay (Saprolite) Grades to Olivine Tholeiitic Basalt (Tkb)	

Sources: Stearns, H.T. and K. Vaksvik, 1938; Stearns, 1939; Stearns, H.T. and T. Chamberlain, 1967; DLNR, 1992)

In 1989 on the basis of land and water utilization, George A. L. Yuen & Associates (1989) in conjunction with the DLNR Commission on Water Resource Management divided the Ewa Plain into five management sectors as follows.

1) *Honouliuli Sector* – is predominately covered by alluvium and was formerly cultivated for sugarcane land. The sugarcane was previously irrigated with water pumped from the Koolau basal aquifer.

2) *Puuloa Sector* – lies downgradient of the Honouliuli Sector and consists of exposed coralline limestone at the surface. It formerly contained sugarcane irrigated with water pumped from the caprock.

3) *Kapolei Sector* – lies west of the Honouliuli Sector and is covered by alluvium. It was formerly cultivated for sugarcane.

4) *BPNAS* – lies downgradient of Kapolei. BPNAS contains exposed coralline limestone at the surface.

5) *Malakole Sector* – lies west of Kapolei and BPNAS. The Malakole Sector consists mostly of exposed coralline limestone with some alluvium inland. It formerly had a few hundred acres of cultivated sugarcane that were irrigated with water from the Waianae aquifer.

The project site including its distribution systems traverses each of these management sectors and will be underlain by the two broad geological provinces, terrestrial alluvium (or colluvium) and fossil reef limestone deposits. The hydrogeologic setting is discussed in detail in the section on Water Resources.

Topography: The terrain within the WWTP and its associated distribution systems ranges from flat to slightly sloping from the northwest to the southeast at about 2 percent. Overall elevations range from 11 feet above mean sea level (amsl) near the coastline to 40 feet amsl at the West Lock Golf Course.

Soil: The Soil Conservation Service (SCS) describes a number of soil and rock materials underlying the project site and distribution system. The principal soil types include coral outcrops (CR); Mamala Series soil, specifically Mamala stony silty clay loam, 0-12 percent slopes (MnC); Honolulu Series soil, specifically Honouliuli clay, 0-2 and 2-6 percent slopes (HxA and HxB); Kaloko Series soil, specifically Kaloko clay and silty clay (Kfb); Pearl Harbor Series, specifically the Pearl Harbor clay (Ph); and fill (FL) material (Foot et al., 1972).

Within the Malakole, BPNAS and Puuloa sectors the soils consist mainly of coralline outcrops, calcareous sand, and Mamala stony silty clay loam. These stony soils are well drained to excessively drained, they have moderate to high permeability, and their erosion hazard is slight to moderate (Foot et al., 1972).

Within the Honouliuli and Kapolei sectors the soils consist of Honouliuli clay, Kaloko clay, and Pearl Harbor clay. The Honouliuli clay is well drained and occurs in the lowlands along the coastal plains. Honouliuli clay is dark, reddish-brown, very sticky and very plastic. It has a moderately low permeability, runoff is slow, and the erosion hazard is no more than slight (Foot et al., 1972). Kaloko clay occurs in isolated, slight depressions in the Ewa coastal plain, particularly in the Honouliuli Sector. It is a gray, noncalcareous, low permeability soil in which runoff tends to pond or be very slow, and erosion hazard is none to slight (Foot et al., 1972). The Pearl Harbor clay is on the lower coastal plain adjacent to the ocean. The Pearl Harbor clay consists of very dark gray, mottled clay that is very poorly drained. It has low permeability, runoff is very slow to ponded, and the erosion hazard is no more than slight in the surface layer and subsoil.

4.1.1.2 Potential Impacts and Mitigation Measures

Impacts relating to geology, topography, and soils were not identified as significant issues during scoping. The soils do not appear to be susceptible to erosion, even in the absence of Best Management Practice (BMP) Plans, since the soils are shallow and highly permeable for the most part, and the topography is relatively level. No significant concerns are anticipated in the excavation of these soils for the proposed buildings and pipelines. Mitigation will consist of contractor compliance with all relevant provisions of the Revised Ordinances of Honolulu, Chapter 14 Public Works Infrastructure Requirements (1990).

4.1.2 Climate and Air Quality

4.1.2.1 Climate

Northeasterly tradewinds prevail over Oahu during all months of the year. From November through March the tradewinds are occasionally interrupted by moderate to strong southerly winds, often accompanied by rainy weather. Under typical tradewind conditions, the Ewa Plain lies in the lee of the Koolau mountain range. As moist tradewinds approach the island, orographic lifting cools the air, and rain falls on the mountains. As a result, the leeward areas of the island are generally sunny and dry. Mean annual rainfall is about 20 inches. About ninety percent of the rainfall is recorded during the months from October through April. January is normally the wettest month of the year, averaging 4.3 inches of rain. The months from May through September average less than a half inch of rain each.

The mean annual temperature is 76 degrees, varying from a mean of 72 degrees in winter to 79 degrees during summer. Rarely do temperatures rise into the 90s, or fall into the 50s. Relative humidity is usually 75 to 85 percent, with the higher recordings during winter (NOCD, 1980).

4.1.2.2 Air Quality

Regulatory Setting: The U.S. Environmental Protection Agency (U.S. EPA) has promulgated National Ambient Air Quality Standards (NAAQS) for sulfur dioxide (SO_2), particulate matter less than or equal to 10 microns in aerodynamic diameter (PM_{10}), nitrogen dioxide (NO_2), carbon monoxide (CO), lead (Pb), and ozone (O_3). These are commonly termed the "criteria pollutants," and information about their effects is included as Appendix A. In July 1997, the EPA revised the NAAQS for O_3 and PM_{10} and promulgated a NAAQS for particulate matter less than or equal to 2.5 microns in aerodynamic diameter ($PM_{2.5}$) (40 CFR 50). Two levels of protection are provided by the NAAQS. Primary NAAQS were set at levels to protect public health, while secondary NAAQS were established at levels designed to protect public welfare, including agricultural crops, building materials, national parks and forests. Similarly, the State of Hawaii has promulgated its own ambient air quality standards that were patterned after the NAAQS (HAR §11-59). The State Ambient Air Quality Standards (SAAQS) are more stringent than the NAAQS for three pollutants: NO_2, CO and O_3. The State of Hawaii also promulgated a 1-hour ambient standard for hydrogen sulfide (H_2S).

Table 4-2 summarizes the NAAQS and SAAQS. The revised NAAQS for O_3 and PM are fully implemented; however, the one-hour O_3 standard will continue to apply for Oahu until three consecutive years of monitoring data demonstrate compliance with the O_3 standards. The new $PM_{2.5}$ standard is currently being implemented. The implementation plan is contained on the web page www.rtpnc.epa.gov/naaqsfin/impfac.htm.

Table 4-2
National and State Ambient Air Quality Standards

Pollutant	Averaging Time	SAAQS	NAAQS	
			Primary	Secondary
Ozone[1]	1 Hour	100 µg/m³	0.12 ppm (235 µg/m³)	Same as Primary Std.
	8 Hours	-	0.08 ppm (157 µg/m³)	Same as Primary Std.
Carbon Monoxide	8 Hours	5,000 µg/m³	9.0 ppm (10 mg/m³)	-
	1 Hour	10,000 µg/m³	35 ppm (40 mg/m³)	-
Nitrogen Dioxide	Annual	70 µg/m³	0.053 ppm (100 µg/m³)	Same as Primary Std.
Sulfur Dioxide	Annual	80 µg/m³	0.03 ppm (80 µg/m³)	-
	24 Hours	365 µg/m³	0.14 ppm (365 µg/m³)	-
	3 Hours	1300 µg/m³	-	0.5 ppm (1300 µg/m³)
Hydrogen Sulfide	1 Hour	35 µg/m³	-	-
Suspended Particulate Matter (PM_{10})[2]	24 Hours	150 µg/m³	150 µg/m³	Same as Primary Std.
	Annual	50 µg/m³	50 µg/m³	Same as Primary Std.
Suspended Particulate Matter ($PM_{2.5}$)[3]	24 Hours	-	65 µg/m³	Same as Primary Std.
	Annual	-	15 µg/m³	Same as Primary Std.
Lead	Calendar Quarter	1.5 µg/m³	1.5 µg/m³	Same as Primary Std.

Notes:
1. Compliance with the 8-hour standard is based on the three-year average of the fourth highest daily maximum 8-hour concentrations.
2. Compliance with the revised 24-hour standard is based on the 99th percentile of 24-hour concentrations, averaged over three years.
3. Compliance with the 24-hour standard is based on the 98th percentile of 24-hour concentrations in a year, averaged over three years. Compliance with the annual average is based on the three-year average of the annual arithmetic mean.

Existing Conditions: The Island of Oahu has been designated by the U.S. EPA as either meeting the NAAQS or being unclassifiable for SO_2, CO, NO_2 and O_3 (40 CFR Part 81.312). Area designations have not been established for PM_{10} and Pb, and designations for $PM_{2.5}$ must await collection of three years of monitoring data for this pollutant.

The State of Hawaii currently maintains and operates a network of nine National Air Monitoring Stations/State and Local Air Monitoring Stations (NAMS/SLAMS) on the Island of Oahu. Three of these stations are located on the Ewa Plain, with the Kapolei station being closest to the Honouliuli Wastewater Treatment Plant. The Kapolei station was established in February 1991, and measures SO_2, CO, NO_2 and PM_{10}. With the promulgation of the $PM_{2.5}$ standard, the State of Hawaii plans to locate several $PM_{2.5}$ monitors on Oahu, including one at the Kapolei station that is expected to commence data collection for this pollutant in 1999. The primary purpose of the NAMS/SLAMS data collection program is to measure background air quality.

See Figure 4-3 for the location of the Kapolei air monitoring station. Table 4-3 summarizes the highest short-term and annual average pollutant concentrations measured at this monitoring station during the five-year period 1993-1997. No exceedances of the NAAQS or SAAQS were recorded at this (or any other) station in the study area during this period.

Table 4-3
Background Air Quality Data - Kapolei Monitoring Station

Pollutant	Averaging Time	1993 $\mu g/m^3$	1994 $\mu g/m^3$	1995 $\mu g/m^3$	1996 $\mu g/m^3$	1997 $\mu g/m^3$
Carbon Monoxide	8 Hours	841	926	784	734	720
	1 Hour	3,078	5,700	2,166	1,739	1,796
Nitrogen Dioxide	Annual	12	8	8	2	8
Sulfur Dioxide	Annual	3	1	2	2	2
	24 Hours	19	11	17	14	20
	3 Hours	62	36	57	45	61
Suspended Particulate Matter (PM_{10})	24 Hours	60	97	78	52	42
	Annual	24	30	24	19	13

In 1997, the Hazard Evaluation and Emergency Response (HEER) Office of the Hawaii Department of Health (DOH, 1997) investigated the health effects associated with elevated levels of the six criteria pollutants described in Appendix A. The levels of these substances measured by HEER were found to be typical of coastal urban areas of the United States, and did not indicate any potential short-term (acute) or long-term (chronic) health hazards in this area.

An application for a covered source air permit was submitted to DOH in November 1995, addressing all emissions from the WWTP, including emergency generators, diesel pumps and odor control systems. Although it remains inactive, potential emissions from an on-site incinerator are also addressed in the permit application.

Environmental Impacts and Mitigation Measures: The DOH Clean Air Branch has not established specific quantitative thresholds to evaluate the significance of impacts for a land development project (CAB 1998). In this analysis, the major stationary source levels defined in the Prevention of Significant Deterioration (PSD) regulations (40 CFR Part 52.21) were used as significance thresholds for air pollutant emissions. These emission levels are provided in Table 4-4.

Table 4-4
Emission Significance Thresholds

CO (tpy)	NO_x (tpy)	SO_x (tpy)	PM_{10} (tpy)	VOC (tpy)
250	250	250	250	250

Construction: Construction activities associated with the proposed project would produce air pollutants mainly from two different types of sources: exhaust emissions from construction equipment and vehicles, and fugitive dust emissions due to earth movement. The emissions associated with construction activities are, by their nature, of short-term duration, and would cease upon completion of project build-out. Air emissions could affect human and ecological receptors. Potential human receptors that could be affected by project construction activities include construction workers themselves, residents near the plant or pipelines, or others temporarily using or transiting the project area and its immediate surroundings.

Construction would involve site work at the Honouliuli WWTP and trenching for the pipelines. The area to be disturbed is about 3.5 acres.

A maximum of 30 construction workers will be required for approximately 12 months. These workers are assumed to commute as average of 20 miles each way to and from work.

For this analysis, it has been estimated that earthmoving activities would spread over half of the construction period. The construction emission factor recommended by EPA for this activity is 1.2 tons/acre of total suspended particulate matter (TSP) per month of construction, from "Compilation of Air Pollutant Emission Factors" (AP-42, Section 13.2.3) (EPA 1995). The corresponding emission rate for PM_{10} was estimated to be 36% of the TSP emissions (see AP-42, Table 13.2.2-1) (EPA 1995). Using these assumptions, the calculated PM_{10} emissions due to earth movement will be about 9 tons per year (tpy).

Construction equipment exhaust emissions were also estimated using appropriate EPA emission factors (EPA 1991). The types of equipment to be used and the duration of their usage were estimated as per Appendix B. The appropriate equipment exhaust emission factors were obtained from the EPA document "Nonroad Engine and Vehicle Emissions Study" (EPA 1991).

Table 4-5 summarizes the estimated maximum construction air pollutant emissions. Actual construction equipment to be employed is not known with certainty, as a contractor has not been selected. Likewise, construction and equipment use schedules are unavailable. Representative equipment was selected, and usage estimated.

Table 4-5
Summary of the Estimated Maximum Construction Air Pollutant Emissions

Sources	Estimated Emissions (tpy)				
	CO	VOC	NO_x	SO_x	PM_{10}
Fugitive Dust Emissions					9.0
Equipment Emissions	2.75	0.67	5.54	0.49	0.68
Vehicular Emissions	7.85	0.98	1.44	Neg.	Neg.
Total	10.60	1.65	6.98	0.49	9.68
Significance Thresholds	250	250	250	250	250

A standard 40-hour, five-day workweek was assumed, with 10 holidays per year, giving 250 workdays per year. The construction crew was assumed to comprise 30 workers during the entire year. Each worker was assumed to drive a private, light-duty, gasoline-fueled vehicle (LDGV) to the site. This is a very conservative assumption, as workers would undoubtedly car-pool. Workers were further assumed to commute 40 miles per day. It was further assumed that an average of ten heavy-duty, diesel-fueled vehicles (HDDV) (cement trucks, water trucks, flatbed trucks, etc.) would daily travel the same distance to the site. Other equipment would remain on-site and be used according to the schedule in Appendix B.

The estimated emissions for all pollutants, including localized fugitive dust emissions (PM_{10}), are well below the corresponding significance levels. The low level of air pollutant emissions would not cause significant impacts to human or ecological receptors. Much of the CO and VOC emissions are vehicular in origin, and would be exhausted over many miles of roadways. This would constitute a regional impact, rather than a site-specific impact. That portion of the construction work associated with the pipelines would also be spread over many miles, similarly diluting air emissions.

The estimated construction impacts would be below the corresponding significance levels. Therefore, mitigation measures are not required to protect the public health or welfare. When fugitive dust emissions become a nuisance however, mitigation is warranted. Construction contractors typically spray water as appropriate to minimize airborne particulate matter. Alternatively, dust generation may be minimized by exposing the smallest possible area at any given time, and by halting site work during high wind conditions. The contractor will be required to strictly comply with Hawaii Department of Health rules (HAR Chapter 43, Section 10) and the grading permit. Proper maintenance of construction vehicles and equipment will serve to minimize combustion emissions. Equipment idling should be kept to a minimum when equipment is not in use.

To ensure compliance with DOH regulations, an effective dust control plan will be implemented during construction. Dust control measures may include watering the work area, use of wind screens, keeping adjacent roadways clean, and covering open-bodied trucks. Other dust control measures may include mulching or stabilizing inactive exposed areas, and scheduling permanent paving or landscaping early in the construction schedule.

Operations

Once the facilities are operational, air quality impacts will be limited to the effects of the vehicular exhaust emissions of the additional workers traveling to the WWTP (currently estimated to be four employees) and emissions from occasional tests of the emergency stand-by generators (exempt from emission standards by HAR Chapter 60). These impacts will be insignificant, and mitigation measures are unwarranted.

Dispersion of reclaimed water as mist in irrigation operations by the end-users may expose humans and ecological receptors to contact or ingestion of the water. Possible consequences are discussed below in biological and public health sections of this chapter.

4.1.3 Water Resources

4.1.3.1 Existing Conditions

Groundwater Characteristics: Groundwater in Hawaii exists in two principal types of aquifers. The first and most important type, in terms of drinking water resources, is the basal confined basalt aquifer. The basal aquifer is confined and exists as a lens of fresh water that floats on and displaces seawater within the pore spaces, fractures, and voids of the basalt that forms the underlying bulk of each Hawaiian island. The second type is the caprock aquifer, which consists of various kinds of unconfined and semi-confined groundwater.

Under the US EPA's Sole Source Aquifer Program, the Southern Oahu Aquifer is designated a sole source aquifer comprised of three aquifer sectors that include Pearl Harbor, Central Oahu, and part of Honolulu. The site is located within the western portion of the Pearl Harbor Aquifer, which according to Mink and Lau (1990) is further divided into five systems (i.e., Waimalu, Waiawa, Waipahu, Ewa, and Kunia). The facility and its distribution system are located within the lower coastal portion of the Ewa and Waipahu aquifer systems.

Hydrogeology:

Basal Aquifer

Lava flows make up the bulk of Oahu, and they form the most important aquifers (Stearns and Vaksvik, 1935; Visher and Mink, 1964). The aquifer beneath the site is part of the basal groundwater floating on seawater that forms a lens-shaped body commonly called a Ghyben-Herzberg lens. Beneath the site, basal water occurs within the interconnected pore space of a thick sequence (up to 2,000 feet thick) of many thin flows less than one to three meters thick that formed the flanks of the volcanic edifice. The flows are composed of both pahoehoe and aa lava of the middle and upper members of the Waianae Volcano. The middle member has an exposed thickness of 1,800 feet in Heleakala Ridge (Stearns and Vaksvik, 1935). The middle basalt is very permeable and forms the reservoir for most of the water confined in the Waianae range by dikes. The basal aquifer beneath the project area is relatively thick, and contains a layer between 500 and 800 feet thick of fresh water that has accumulated within the basalt aquifer (using the Ghyben Herzberg lens principle). Recharge occurs mainly in the high rainfall, highland area upgradient of the site via direct infiltration or temporary storage in dike compartments and subsequent percolation to the aquifer.

Groundwater in the basal aquifer is currently used as a fresh to low salinity (i.e., chloride concentration < 500 milligrams per liter) drinking water source (Mink and Lau, 1990, DLNR, 1992). The aquifer is considered irreplaceable and highly vulnerable to contamination. It is effectively separated from contact with seawater and the shallow fresh water system by the weathered surface of the volcanics. The basal aquifer beneath the project area is presumed to be relatively thick, and contains a layer between 500 and 800 feet thick of fresh water that has accumulated within the basalt aquifer (using the Ghyben Herzberg lens principle). Recharge occurs mainly in the high rainfall, highland area upgradient of the project area via direct infiltration or temporary storage in dike compartments and subsequent percolation to the aquifer.

Precipitation in the project area should have little or no influence in recharge or storage to the underlying confined basal aquifer. In the inland recharge areas, fresh groundwater has a predominantly downward flow component. Fresh groundwater in the volcanic aquifers moves from inland recharge areas toward coastal discharge areas. Between the recharge and discharge areas, flow is predominately horizontal (Oki et al., 1998). The landward inflow of seawater into the basal aquifer is derived from the ocean from deep circulation in the volcanic rocks. Giambelluca's (1983, 1986) water budget model estimated recharge to the noncaprock part of southern Oahu at about 313 million gallons per day (mgd).

Ewa Caprock Aquifer

The Ewa Caprock Aquifer is a distinct water-bearing formation. The primary aquifer in the caprock is the highly permeable upper coralline limestone layer (referred to as "Limestone Aquifer 1"; George A. L. Yuen & Associates, 1989). *Aquifer 1* is underlain by a low permeability marl confining layer or aquitard. It is not in direct contact with the basal basalt aquifers beneath the project area (i.e., Waipahu and Ewa Aquifer Systems; Mink and Lau, 1990). Groundwater within *Aquifer 1* is unconfined with water levels ranging from less than a foot to several feet above sea level. At Honouliuli groundwater discharges as springs into West Loch. All plantation caprock wells and most recent caprock wells exploit the upper limestone of *Aquifer 1* due to its high permeability and moderate salinity levels (Bauer, 1996). Alluvial groundwater may be available in the Honouliuli area, but its development is not easy due to the generally lower permeability of the alluvium.

Below the clay aquitard are other coralline limestone deposits (referred to as "Aquifer 2"; George A. L. Yuen & Associates, 1989), and intercalated alluvial deposits consisting of sand, mud, and clay that contain very brackish to very saline water. The base of *Aquifer 2* is a second confining layer or aquiclude of the caprock overlying the volcanic basement. *Aquifer 2*, even though saline, is differentiated because it has been employed as a source of cooling water and for injection (George A. L. Yuen & Associates, 1989).

The water balance of the caprock aquifer is complicated because little recharge originates from precipitation on the upper limestone or from stream discharges that flow from the southern Waianae during storms. The caprock receives fresh groundwater from leakage from the underlying basal aquifers and recharge from infiltration of rainfall or irrigation water (Visher and Mink, 1964). Eyre (1987) estimated a net inflow of 30 mgd leaking into the caprock (Kapolei Sector) from the Waianae basal lens during the plantation era (after removing plantation pumpage), and 33 mgd for pre-development (prior to 1879) time (8 mgd of rainfall and 25 mgd natural groundwater flow from Schofield high-level basal groundwater). The caprock aquifer was not considered fully exploited until the 1930s when Ewa Plantation had drilled approximately 70 artesian basal wells (clustered as pumping batteries) through the Ewa Plain caprock sediments to irrigate sugarcane lands south of Farrington Highway (Stearns and Vaksvik, 1935). Initially the groundwater had salinity concentrations of 800 to 900 mg/l chloride, although quality improved as a result of Oahu Sugar Company irrigation practices, reaching a low of about 500 mg/l chloride by 1960 (George A. L. Yuen & Associates, 1989). According to Yuen and others, by 1981 salinity had begun to rise with increased pumpage (e.g., annual average withdrawal of 31 mgd), reaching 700 mg/l chloride. They indicated that the quality of the groundwater in the uppermost caprock aquifer is sustained by and dependent upon excess irrigation over the alluvium as well as the limestone portion of the Ewa Plain. With the demise of Oahu Sugar Company new sources of irrigation recharge are required to sustain the water quality in the upper caprock aquifer. Unless recharge to the aquifer is provided by other means such as irrigation water from the Honouliuli WWTP, sustainable yield of agriculturally acceptable water will sharply decline in the Ewa Plain. Because there is not enough natural recharge to sustain all of the demands proposed for the groundwater resource, the future of the groundwater resource in the Ewa Plain will depend on how the aquifer is managed.

Groundwater in the caprock aquifer is currently used as an irrigation water source due to its moderate salinity (i.e., chloride concentration between 1000-5000 milligrams per liter) (Mink and Lau, 1990, DLNR, 1992). The aquifer is considered replaceable and highly vulnerable to contamination. It is effectively separated from contact with the basal fresh groundwater system by the low permeability marls and alluvial clays, and the weathered surface of the volcanics.

Numerous studies (Stearns and Vaksvik, 1935; Visher and Mink, 1964; Eyre, 1987; Tom Nance Water Resources Engineering and Mackie Martin & Associates Pty. Ltd., 1991; Nichols et al., 1996; Oki et al., 1998) have approximated the groundwater gradient flow direction for various portions of the project area. In general the groundwater flow direction is from north to south towards the Pacific Ocean, although locally there is also a south-southeast component near West Loch at Pearl Harbor (Tom Nance Water Resources Engineering and Mackie Martin & Associates Pty. Ltd., 1991). Groundwater at the project area occurs at between 2 to 22 feet above mean sea level (DLNR, 1992).

The first artesian well drilled in the Hawaiian Islands was Well 267 (2101-04), at Honouliuli Village (Wentworth, 1945). This well was drilled in 1879 for James Campbell; it encountered fresh water at about 250 feet below sea level, and had a standing head of about 15 feet amsl. Prior to 1989, only in the Puuloa Sector was the caprock groundwater developed and used for irrigation (George A. L. Yuen and Associates, Inc., 1989). In Malakole the highly brackish groundwater of the caprock aquifer was used for washing coral, and in some instances it was and still is used for cooling purposes. The aquifer beneath Malakole also receives some injected fluids. Prior to 1989, no irrigation water was pumped from the Kapolei Sector, and no groundwater is extracted in the BPNAS Sector. In Kapolei this has changed with the installation of Kapolei irrigation wells (2003-01, 02, 04, 05, 07).

There are approximately 87 non-drinking water wells within a quarter-mile of the project area listed on the Underground Injection Control Maps for the Ewa Plain area (DLNR UIC Maps, 1998). Approximately 24 of the wells have been sealed, 11 are observation wells or used for other purposes, and the remaining are irrigation wells (Table 4-6). There are approximately 11 domestic drinking water wells within a quarter-mile and upgradient of the project area (DLNR UIC Maps, 1998). The nearest drinking water supply well is 2101-13 (Honouliuli Well), 0.48 miles upgradient of the project area (Figure 4-3).

Groundwater recharge studies for the Ewa limestone aquifer have assessed the quality and quantity of groundwater recharged with Honouliuli wastewater irrigation water during a 3-year demonstration project (Lau et al., 1989). They indicated that aquifer recharge by Honouliuli

Table 4-6
Wells Within a Quarter Mile of Project Facilities or Reuse Areas
Honouliuli WWTP, Ewa, Oahu, Hawaii

Well ID Number	Well Name or Location	Date Constructed	Elevation (amsl)	Distance from Site (miles)	Gradient/Direction	Depth (feet bgs)	Owner	Status, Date
Non-Drinking Water Wells								
3-1806-05	Barbers Point	1959	40	0.27	Downgradient/NW	8	So Pipe&Casg	Industrial, 1974
3-1806-06	Barbers Point	1959	50	0.06	Downgradient/West	18	Chevron USA	Industrial, 1974
3-1806-07	Barbers Point	1972	300	0.02	Downgradient/West	6	Dill-Conoco	Disposal, 1974
3-1806-08	Barbers Point	1972	215	0.02	Downgradient/West		Dill-Conoco	Observ, 1974
3-1806-09	Barbers Point	1986	103	0.17	Upgradient/NE	18	C&C H-Power	Other, 1986
3-1806-10	Barbers Point	1986	15	0.17	Upgradient/NE	18	C&C H-Power	Other, 1986
3-1806-11	AES Prod #1	1989	115	0.04	Upgradient/NE	20	AES Inc	
3-1806-12	AES 1B	1990	124	<0.01	Upgradient North	20	AES Inc	Industrial
3-1806-13	AES 1C	1990	124	0.03	Upgradient/NE	20	AES Inc	Industrial
3-1806-14	AES 1D	1990	125	<0.01	Downgradient/South	20	AES Inc	Industrial
3-1805-03	HIRI Firewell	1985	10	0.04	Upgradient/North	50	Hawn Ind Refin	Other, 1985
3-1905-03	Barbers Point	1966	56	<0.01	Downgradient/South	70	Hawn Tel Co	Disposal, 1974
3-1905-04	Ewa Desalt Plant	1987		0.09	Downgradient/South	380	State Dowald	Other
3-1905-05	Ewa Caprock	1987				80	State Dowald	Other
3-1904-01	Barbers Point	1965	5	0.11	Upgradient/North	8	Oahu Sugar	Irrigation, 1974
3-1902-03	Honouliuli 1	1991	36	0.16	Downgradient/SE	51	C & C Honolulu	Other
3-1902-04	Honouliuli 2	1991	36	0.16	Downgradient/SE	51	C & C Honolulu	Other
3-2002-01	Ewa	1891	47	0.27	Downgradient/SW	507	Ewa Plantn	Sealed, 1966
3-2002-02	Ewa	1891	46	0.27	Downgradient/SW	523	Ewa Plantn	Sealed, 1946
3-2002-03	Ewa	1899	46	0.27	Downgradient/SW	551	Ewa Plantn	Sealed, 1946
3-2002-04	Ewa	1899	46	0.27	Downgradient/SW	550	Ewa Plantn	Sealed, 1946
3-2002-05	Ewa	1900	46	0.27	Downgradient/SW	522	Ewa Plantn	Sealed, 1946
3-2002-06	Ewa	1900	46	0.27	Downgradient/SW	518	Ewa Plantn	Sealed, 1946
3-2002-07	Ewa	1908	46	0.27	Downgradient/SW	498	Ewa Plantn	Sealed, 1942
3-2002-08	Ewa	1908	46	0.27	Downgradient/SW	497	Ewa Plantn	Sealed, 1942
3-2002-10	Ewa	1944	40	0.27	Downgradient/SW	213		Industrial, 1974
3-2001-02	Ewa	1987	28	0.77	Downgradient/SW	38	Gentry Pacific	Irrigation, 1987
3-2001-06	Palm Villa I	1990	41	0.48	Downgradient/SW	60	Gentry Pacific	Irrigation
3-2101-01	Honouliuli		20	0.26	Upgradient/North	325	Kahua Meat Co	Industrial, 1981
3-2101-02	Honouliuli		25	0.56	Downgradient/SE		Ewa Plantn	Sealed, 1938
3-2101-03	Honouliuli		13	0.33	Upgradient/NNE	355	State DOT	Observation, 1974
3-2101-04	Honouliuli	1879	15	0.11	Upgradient/North	273	Honolulu City	Sealed, 1939
3-2101-05	Honouliuli B	1890	30	0.11	Downgradient/South	456	Ewa Plantn	Sealed, 1952

Table 4-6 (Continued)
Wells within a Quarter Mile of Project Facilities or Reuse Areas
Honouliuli WWTP, Ewa, Oahu, Hawaii

Well ID Number	Well Name or Location	Date Constructed	Elevation (amsl)	Distance from Site (miles)	Gradient/Direction	Depth (feet bgs)	Owner	Status, Date
3-2101-06	Honouliuli C	1890	30	0.11	Downgradient/South	451	Ewa Plantn	Sealed, 1952
3-2101-07	Honouliuli D	1890	30	0.11	Downgradient/South	468	Ewa Plantn	Sealed, 1952
3-2101-08	Honouliuli E	1890	30	0.11	Downgradient/South	462	Ewa Plantn	Sealed, 1952
3-2101-09	Honouliuli F	1890	31	0.11	Downgradient/South	448		Observation, 1977
3-2101-10	Honouliuli G	1899	30	0.11	Downgradient/South	462	Ewa Plantn	Sealed, 1952
3-2101-11	Honouliuli	1899	30	0.11	Downgradient/South	450		
3-2101-12	Honouliuli A	1901	30	0.11	Downgradient/South	452	Ewa Plantn	Sealed, 1952
3-2102-01	Honouliuli	1880		0.37	Upgradient/NW		Ewa Plantn	Sealed, 1940
3-2102-02	Honouliuli P3&4A	1890	44	0.38	Upgradient/North	332	Ewa Plantn	Irrigation, 1974
3-2102-03	Honouliuli	1891		0.02	Upgradient/North		Ewa Plantn	Sealed, 1938
3-2102-04	Honouliuli P3&4B	1891	44	0.38	Upgradient/North	326	Ewa Plantn	Irrigation, 1974
3-2102-05	Honouliuli P3&4C	1891	44	0.38	Upgradient/North	369	Ewa Plantn	Irrigation, 1974
3-2102-06	Honouliuli P3&4D	1891	44	0.38	Upgradient/North	405	Ewa Plantn	Irrigation, 1974
3-2102-07	Honouliuli P3&4E	1891	44	0.38	Upgradient/North	410	Ewa Plantn	Irrigation
3-2102-08	Honouliuli P3&4F	1891	44	0.38	Upgradient/North	410	Ewa Plantn	Irrigation, 1974
3-2102-09	Honouliuli P3&4G	1891	44	0.38	Upgradient/North	410	Ewa Plantn	Irrigation
3-2102-10	Honouliuli P3&4H	1891	44	0.38	Upgradient/North	413	Ewa Plantn	Irrigation
3-2102-11	Honouliuli P3&4I	1891	44	0.38	Upgradient/North	433	Ewa Plantn	Irrigation, 1974
3-2102-12	Honouliuli P3&4J	1891	44	0.38	Upgradient/North	432	Ewa Plantn	Irrigation
3-2102-13	Honouliuli P3&4K	1891	44	0.38	Upgradient/North	436	Ewa Plantn	Irrigation
3-2102-14	Honouliuli P3&4L	1891	44	0.38	Upgradient/North	430	Ewa Plantn	Irrigation, 1974
3-2102-15	Honouliuli P3&4M	1899	44	0.38	Upgradient/North	441	Ewa Plantn	Irrigation, 1974
3-2102-16	Honouliuli P3&4N	1899	44	0.38	Upgradient/North	435	Ewa Plantn	Irrigation
3-2102-17	Honouliuli P3&4O	1899	44	0.38	Upgradient/North	442	Ewa Plantn	Irrigation
3-2102-18	Honouliuli P3&4P	1899	44	0.38	Upgradient/North	444	Ewa Plantn	Irrigation, 1974
3-2102-19	Honouliuli P3&4Q	1921	44	0.38	Upgradient/North	416	Ewa Plantn	Irrigation, 1974
3-2102-20	Honouliuli P3&4R	1921	44	0.38	Upgradient/North	419	Ewa Plantn	Irrigation
3-2102-21	Honouliuli P3&4S	1921	44	0.38	Upgradient/North	425	Ewa Plantn	Irrigation, 1974
3-2102-22	Honouliuli P3&4T	1921	44	0.38	Upgradient/North	420	Ewa Plantn	Irrigation, 1974
3-2201-01	Pearl Harbor		20			175	Foster M	Sealed, 1966
3-2201-03	Honouliuli Bat A	1891	40			230	Ewa Plantn	Irrigation, 1974
3-2201-04	Honouliuli Bat B	1891	40			226	Ewa Plantn	Irrigation, 1974
3-2201-05	Pearl Harbor	1892	11			170	B Mau & Assn	Sealed, 1961
3-2201-06	Waipahu	1893	25			436	Robinson Est	Sealed, 1965
3-2201-07	Honouliuli Bat C	1921	40			282	Ewa Plantn	Irrigation, 1974
3-2201-08	Pearl Harbor B	1923	12			154	B Mau & Assn	Sealed, 1961

Table 4-6 (Continued)
Wells within a Quarter Mile of Project Facilities or Reuse Areas
Honouliuli WWTP, Ewa, Oahu, Hawaii

Well ID Number	Well Name or Location	Date Constructed	Elevation (amsl)	Distance from Site (miles)	Gradient/Direction	Depth (feet bgs)	Owner	Status, Date
3-2201-09	Waipahu	1945	83			107	Honolulu BWS	Sealed, 1949
3-2201-10	Waipahu	1949	84			113	Honolulu BWS	Observation, 1974
3-2201-12	Waipahu	1955	32			145	Gora G	Sealed, 1966
3-2201-14	Pearl Harbor	1969	18			185	Harris Rug Cl	Industry, 1974
3-2202-01	Honouliuli		23	0.89	Upgradient/NNW	500	Akana L	Irrigation, 1974
3-2202-03	Honouliuli P5&6B	1896	50	0.89	Upgradient/NNW	304	Ewa Plantn	Irrigation, 1974
3-2202-04	Honouliuli P5&6B	1896	50	0.89	Upgradient/NNW	305	Ewa Plantn	Irrigation, 1974
3-2202-05	Honouliuli P5&6C	1896	50	0.89	Upgradient/NNW	310	Ewa Plantn	Irrigation, 1974
3-2202-06	Honouliuli P5&6D	1896	50	0.89	Upgradient/NNW	304	Ewa Plantn	Irrigation, 1974
3-2202-07	Honouliuli P5&6E	1896	50	0.89	Upgradient/NNW	306	Ewa Plantn	Irrigation, 1974
3-2202-08	Honouliuli P5&6F	1896	50	0.89	Upgradient/NNW	303	Ewa Plantn	
3-2202-09	Honouliuli P5&6G	1896	50	0.89	Upgradient/NNW	312	Ewa Plantn	Irrigation, 1974
3-2202-10	Honouliuli P5&6H	1897	50	0.89	Upgradient/NNW	307	Ewa Plantn	Irrigation, 1974
3-2202-11	Honouliuli P5&6I	1897	50	0.89	Upgradient/NNW	306	Ewa Plantn	Irrigation, 1974
3-2202-12	Honouliuli P5&6J	1897	50	0.89	Upgradient/NNW	308	Ewa Plantn	Irrigation, 1974
3-2202-13	Honouliuli P5&6K	1897	50	0.89	Upgradient/NNW	308	Ewa Plantn	Irrigation, 1974
3-2202-14	Honouliuli P5&6L	1897	50	0.89	Upgradient/NNW	308	Ewa Plantn	Irrigation, 1974
3-2202-21	Honouliuli P.15	1939	150		Upgradient/NNW	156	Ewa Plantn	Irrigation, 1974
Drinking Water Wells								
3-2101-13	Honouliuli	1955	3	0.48	Upgradient/NE	225	Wood K	Domestic, 1974
3-2201-02	Honouliuli		17	0.73	Upgradient/North	356	Takiguchi T	Domestic, 1974
3-2201-11	Pearl Harbor	1954	4	0.85	Upgradient/NNE	175	Asato H	Domestic, 1974
3-2201-13	Pearl Harbor	1959	5	0.87	Upgradient/NNE	200	Nakata D	Domestic, 1974
3-2202-02	Honouliuli		16	0.65	Upgradient/NNW	395	Dumlao B	Domestic, 1974
3-2202-15	Mill Pump 7 A	1899	46	0.59	Upgradient/NNW	468	Ewa Plantn	Domestic, 1974
3-2202-16	Mill Pump 7 B	1900	46	0.59	Upgradient/NNW	476	Ewa Plantn	Domestic, 1974
3-2202-17	Mill Pump 7 C	1900	46	0.59	Upgradient/NNW	475	Ewa Plantn	Domestic, 1974
3-2202-18	Mill Pump 7 D	1900	46	0.59	Upgradient/NNW	475	Ewa Plantn	Domestic, 1974
3-2202-19	Mill Pump 7 E	1900	46	0.59	Upgradient/NNW	481	Ewa Plantn	Domestic, 1974
3-2202-20	Mill Pump 7 F	1900	46	0.59	Upgradient/NNW	475	Ewa Plantn	Domestic, 1974

DLNR, 1993, Ground Water Index.

BWS	Board of Water Supply.
-	not listed.
bgs	below ground surface.
amsl	above mean sea level.

chlorinated, primary-treatment wastewater was feasible for the Ewa unconfined caprock limestone aquifer.

Surface Water Quality

Surface waters in the form of perennial stream flows do not occur on the Ewa nearshore coastal outwash plain. The nearest surface water bodies include 1) several small reservoirs in the Kapolei and Honouliuli sectors that lie to the north and northwest of the project area; 2) Honouliuli Stream, which skirts the northeastern boundary of the project area; 3) Apokaa Pond, ponds and wetlands, and a National Wildlife Refuge adjacent and east of the project area next to West Loch; and 4) Pearl Harbor also east of the project area (Figure 4-3).

Honouliuli Stream though perennial in its upper reaches is intermittent (ephemeral) at its lower reaches nearest the project area. According to the *Hawaii Stream Assessment* (National Park Service, 1990), Honouliuli Stream is one of the 26 channelized streams (lined, partly lined or having an altered stream course) on Oahu. Honouliuli does not add significant recharge to the caprock because its course is limited to a small fraction of the northeasterly corner of the plain. Information regarding the environmental resources of the stream is contained in section 4.2.2.1.

Recharging the Caprock Aquifer

The Ewa Caprock Aquifer has been a long-standing water source for southern Oahu, but the water quality of the aquifer is being threatened with the gradual increase in the salinity level of pumped caprock aquifer water in recent years, particularly since the recharge from sugarcane irrigation has stopped. A major project objective is to use reclaimed water from the Honouliuli WWTP to irrigate portions of the Ewa Plain. Several case studies including several sponsored by the Water Resources Research Center, University of Hawaii (ICF Kaiser Engineers, Inc., Carbon Group, Ltd., and Tom Nance Water Resources Engineering, 1962; Lau et al., 1986 and 1989; Lau, 1989; Kumagai, 1996) have proposed recharging the caprock aquifer with reclaimed water and repumping for reuse. Lau et al (1989) showed that primary effluent from Honouliuli WWTP could be used satisfactorily to recharge the caprock aquifer with spreading fields planted in California grass or sugarcane. Their study showed that effluent infiltrated and percolated through three feet of vegetated, permeable soil and then through 30 feet of permeable limestone stabilized groundwater chlorides to 245 milligrams per liter (mg/l), stripped virtually all effluent nitrogen, and deactivated effluent bacteria (Kumagai, 1996).

According to Kumagai, Oahu generates about 110 mgd of wastewater and less than three percent of it is reclaimed and reused for irrigation. Most of the remainder is disposed of through ocean outfalls (Kumagai, 1996).

4.1.3.2 Impacts and Mitigation Measures

With respect to impacts on sustainable water resources, the most important consideration is protection of the basal drinking water aquifer. This aquifer is effectively separated from contact with seawater below and the shallow fresh water caprock system above by low permeability marls and alluvial clays and the weathered surface of the volcanics. Recharge occurs mainly in the high rainfall, highland area upgradient of the project area via direct infiltration or temporary storage in dike compartments and subsequent percolation to the aquifer. Reclaimed water supplied by the Honouliuli WWTP for irrigation on the Ewa Plain should have little or no influence in recharge or storage to the underlying basal aquifer.

Use of reclaimed water for irrigation on the Ewa Plain will affect the caprock aquifer, and that is one of the primary intended purposes of the project. The primary aquifer in the caprock is the highly permeable upper coralline limestone, *Aquifer 1*, which is underlain by a low permeability marl confining layer or aquitard. All plantation caprock wells and most recent caprock wells exploit the upper limestone of *Aquifer 1* due to its high permeability and moderate salinity levels. The caprock receives fresh groundwater from leakage from the underlying basal aquifers and recharge from infiltration of rainfall or irrigation water. The quality of the groundwater in the uppermost caprock aquifer is sustained by and dependent upon excess irrigation over the alluvium as well as the limestone portion of the Ewa Plain. With the demise of Oahu Sugar Company new sources of irrigation recharge are required to sustain the water quality in the upper caprock aquifer. Unless recharge to the aquifer is provided by other means such as irrigation water from the Honouliuli WWTP, sustainable yield of agriculturally acceptable water will sharply decline in the Ewa Plain. Recharge of the caprock aquifer will allow additional withdrawals from this aquifer for irrigation and other purposes. In some situations, the availability of additional caprock water will allow substitution of this source for the potable water now being used thus preserving drinking water for better uses and avoiding development costs associated with further basal aquifer development.

In terms of impacts to the quality of the caprock water, the studies by Lau et al. (1989) showed that primary effluent from the Honouliuli WWTP could be used satisfactorily to recharge the caprock aquifer. The proposed recharge is with R-1 water - secondary treated water, which has been further oxidized, filtered and disinfected. This water is already suitable for all uses to which caprock water is presently put. Additional purification will occur naturally as this water percolates through the ground, and may result in an improvement in caprock water quality.

4.1.4 Natural Hazards

4.1.4.1 Existing Conditions

Earthquake/Seismic Zonation: A number of strong earthquakes have occurred in the Hawaiian Islands over historic time. Wyss and Koyanagi (1992) have compiled the macroseismic data for 56 moderate to large Hawaiian earthquakes that occurred between 1823 and 1989. For this compilation, the magnitudes (M) of the earthquakes range from 4.7 to 7.9, but most are 6± 0.6 M. The maximum intensities (I) range from V to XII, and some of the radii of the felt areas are as much as 370+ miles, the extent of the chain of Hawaiian islands (Wyss and Koyanagi, 1992). The two largest earthquakes (M>7) ruptured the south coast of Hawaii in April 1868 and November 1975. Major to large shocks (M≥6.75) also occurred off the island of Maui. The study by Wyss and Koyanagi (1992) implies that based on the historical seismicity data, it is clear that the seismic hazard on the Island of Hawaii is very serious. They discussed the approximate relationship of intensity to magnitude and hypocentral distance for Hawaiian earthquakes. They indicated that the April 4, 1868 earthquakes on the Island of Hawaii may have produced an intensity of approximately V on Oahu (Wyss and Koyanagi, 1992).

During the last two decades more destructive earthquakes may have occurred in Hawaii than in any county in the contiguous United States (Wyss and Koyanagi, 1992). The Maui-Oahu region has experienced three damaging earthquakes within historical times. Chock et al. (1989) indicated that the unified building codes (UBC) for the region appear to be inadequate for the perceived seismic risk. The epicenters of most of the recorded earthquakes in this region tend to occur far from volcanic centers and rift zones, and it has long been known that large fracture zones associated with the transform faults from the East Pacific Rise occur in this region (i.e., Molokai Fracture Zone). Furumoto et al. (1990) suggested that the earthquakes in the central region are tectonic in type and that the Molokai Fracture Zone is suspected to contribute to the seismic activity. The Maui earthquake of 1938, 21.02°N, 156.09°W, had a magnitude of 6.75 (Gutenberg and Richter, 1949; Holman, 1982). Furumoto et al. (1990) estimate that a major earthquake affecting Oahu is most likely to occur along a fault that is part of the Molokai Fracture Zone and joins the epicenters of the 1871 and 1938 earthquakes. This line is estimated at about 43.5 miles southeast of Oahu.

Seismic zonation for the State of Hawaii is governed by the building codes of the various counties that comprise the State of Hawaii (Miyasato, 1991). According to the Hawaii State Earthquake Advisory Board, the general intent of these codes is to provide minimum standards for structures to assure public safety. A seismic zone is generally a large regional area within which absolute seismic design requirements for structures are uniform, or in which absolute levels of seismic hazard are similar (Miyasato, 1991). The zones are based on historical seismicity defined in terms of maximum Modified Mercalli Intensity (MMI) experienced in the past. In the Applied Technology Council map, effective peak acceleration (EPA), representing a generalization of peak ground acceleration at rock sites, was used as the design ground motion criteria (Table 4-7). The resulting criteria for selection of seismic zones as specified in the 1988 UBC is as follows (ICBO, 1989).

Table 4-7
1988 UBC Seismic Zonation Criteria

Zone	Maximum 475-Year Return Period Effective Peak Ground Acceleration (in g)
0	0.05
1	0.075
2A	0.150
2B	0.200
3	0.300
4	0.400

In 1978, Dames & Moore estimated an EPA of 0.12g for a 475-year return period for the Prince Kuhio Towers, in Honolulu, Oahu (Dames & Moore, 1978). This value is greater than the 0.075g maximum limit for Zone 1, Oahu's designation at that time.

In 1990, the Structural Engineers Association of Hawaii (SEAOH) submitted a proposal to the ICBO to change the Oahu seismic zone assignment in the UBC to Zone 2A. This code is currently accepted by the ICBO. Site seismicity for the whole island of Oahu is shown as Zone 2A as mapped in the International Conference of Building Officials (ICBO, 1988). This seismic designation does not pose any problem for the plant or distribution system.

Flood and Tsunami Hazard. According to the Flood Insurance Rate Maps (FIRMs), the project area is located mostly within Zone D, areas in which flood hazards are undetermined. Where Honouliuli Stream drains into West Loch (near West Loch Golf Course) the project area is located within Zones AE and X. Zone AE areas are base flood elevations determined as special flood hazard areas inundated by the 100-year flood. Zone X areas are areas that may experience a 500-year flood (i.e. areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year floods).

The project area is mostly outside of the tsunami inundation area as depicted in the Oahu Tsunami Evacuation Maps 17 and 18 (Kahe Point to Ewa Beach and Ewa Beach to Airport), the project area is mostly outside of the anticipated tsunami flood hazard area (Tsunami Warning Center, 1998). A very limited portion of the planned RO pipeline distribution system at CIP may be within the tsunami flood hazard area (Oahu Map 17). As the distribution system will be buried it is unlikely that significant impact to the system would occur during a possible tsunami.

Volcanic Hazard: There are no active volcanoes on the Island of Oahu, and according to Presley et al. (1997) the nearest post-erosional volcanic vent erupted approximately 2.9 million years ago. Volcanic hazards are not considered significant issues.

4.1.4.2 Impacts and Mitigation Measures

Protection of project facilities from earthquakes will consist of compliance with UBC seismic zone 2A structural requirements. The reclamation plant is outside all flood and tsunami hazard areas. The small portion of the RO pipeline that may be within the tsunami flood hazard area will be buried, and no additional mitigation is necessary. Volcanic hazards to the project are minimal and no special mitigation measures are warranted.

4.2 THE BIOLOGICAL ENVIRONMENT

The Ewa Plain and surrounding waters contains a variety of natural and man-made ecosystems including wetlands, estuaries, ponds, coral reefs, harbors, kiawe scrub forests, coastal strand vegetation, urban communities and industrial parks, golf courses and maintained landscaping. Species present range from common, introduced nuisance species to protected endangered and threatened species of plants, waterbirds, marine turtles and whales. Portions of the Ewa Plain potentially affected by this project include areas immediately surrounding the project facilities and areas where the reclaimed water will be used.

4.2.1 Terrestrial Flora and Fauna

4.2.1.1 Existing Conditions

The Honouliuli WWTP site was cleared and graded during construction of the various existing facilities. Construction of the reclamation facility is proposed in the southwestern portion of the WWTP in an area formerly used by the City and County Department of Parks and Recreation as a temporary plant nursery. Existing habitat consists of introduced landscaping plants. Fauna consists of the typical introduced species common to urban areas of Oahu. Elsewhere in the Ewa Plain, however, there are biological resources of concern including threatened and endangered species, migratory birds, and sensitive habitats (NASBP EIS).

The dominant vegetation zone on the Ewa Plain is kiawe and lowland scrub. Other vegetation zones include coastal strand, coastal salt flat, seasonal fresh-water ponds, sinkholes, mangrove swamps, and marine wetlands (Botanical Consultants, 1984). Endemic plant species (native plants found only in Hawaii) occurring on the Ewa Plain include the sub-shrub *hinahina* (*Heliotropium anomalum* var. *argentum*) and the herb *nama* (*Nama sandwichensis*) in the coastal strand zone, and the small shrub-like sandlewood tree (*Santalum ellipticum*) in the kiawe and lowland scrub zone (Ogden, 1994). Indigenous plant species (native plants found in Hawaii and elsewhere) in the coastal strand zone include the seaside heliotrope herb (*Helitropium currassavicum*) and the *`ohelo kai* shrub (*Lycium sandwichensis*).

Birds are the dominant forms of wildlife. They include at least 17 ubiquitous introduced species (most common: zebra dove, Japanese white-eye, northern cardinal, red-crested cardinal, and red-vented bulbul) and five indigenous species (black-crowned night heron, great frigate bird, Pacific golden plover, sanderling, wandering tattler and ruddy turnstone). The latter four are migratory and considered regular visitors to Hawaii. Migratory birds, though not necessarily protected as endangered or threatened species, are protected under a variety of state, federal and international laws, regulations, treaties and conventions. Other wildlife includes feral dogs and cats, rodents and mongooses and introduced freshwater fish species including mosquito fish and tilapia.

4.2.1.2 Impacts and Mitigation Measures

Site work during construction will take place within the Honouliuli WWTP compound and along existing rights-of-way already disturbed by prior excavations and grading. No sensitive habitats or protected species will be directly affected, and no mitigation measures are warranted.

Once operational, the facilities could affect terrestrial biota in either routine or contingency modes. Flora and fauna could be exposed to R1 water as direct spray or runoff from irrigated areas or through a pipeline failure. For fauna, the water would generally be a benefit on the hot, dry Ewa Plain, while the dissolved constituents and bacterial concentrations would not represent a health hazard. R-1 water is approved for numerous human uses, many involving physical contact, if not actual ingestion. Ingestion of reclaimed water by wildlife has not been shown to have detrimental effects at the 20 Hawaii golf courses where this practice is currently employed (see Appendix D). For flora, the water and dissolved nutrients would be a growth stimulant.

4.2.2 Stream and Wetland Ecosystems

4.2.2.1 Streams

Existing Conditions: Honouliuli Stream, which formerly provided water to Oahu Sugar Company lands, skirts the northeastern boundary of the project area (Figure 4-3). Honouliuli Stream, though perennial, is interrupted. That is, it does not flow continuously from the mountains to the ocean year-round. It is intermittent in its lower reaches. Interrupted streams may, however, have significant resources associated with their perennial segments.

Hawaii's stream resources, including Honouliuli Stream, were the subject of a comprehensive inventory called the *Hawaii Stream Assessment* (National Park Service 1990). Each of Hawaii's 376 perennial streams was inventoried to identify valuable "beneficial uses" related to their intrinsic "resources." Each stream was given a ranking for each of four resource categories. Rankings were Outstanding, Substantial, Moderate, Limited, Unknown and Without. Resource categories assessed included:

- Aquatic Resources. Hawaii's streams support a small but unique aquatic fauna, most of which have a life cycle involving both the stream and the sea. Of the 176 streams with biological information, seventy were ranked as Outstanding based on the presence of certain native species thought to be indicators of high quality habitat. Because at least some of the native species traverse or use the entire length of the stream in their life history, interrupted streams such as Honouliuli do not provide good habitat. Honouliuli Stream was given a rank of Without for aquatic resources.
- Riparian Resources. The quality of the riparian environment directly determines the quality of the stream and the nearshore waters. Native species, native forests, waterbird habitat and wetlands were inventoried; thirty streams were ranked Outstanding. Honouliuli Stream's riparian resources include detrimental plants such as mangroves and detrimental animals such as wild pigs. It has no remaining native forest. On the other hand, it supports populations of at least two endangered and threatened species of birds, at least one rare plant, and wetlands which are partially protected due to their National Wildlife Refuge status. It was given a rank of Substantial for riparian resources.
- Cultural Resources. Archaeological resources, historic sites and current taro cultivation were inventoried. Ninety-four streams were identified as sensitive or highly sensitive to development. Honouliuli Bridge is a category 1 bridge (worthy of protection), and associated with the stream are roughly 10 archaeological sites scattered in clusters. Honouliuli Stream was ranked Limited, of low sensitivity to development for these resources.
- Recreational Resources. Eighteen streams were considered to have Outstanding recreational resources statewide, while 84 were ranked regionally (by island) Outstanding. Honouliuli Stream's recreational opportunities are limited to relatively low quality fishing experiences. It ranked Moderate for recreational resources.

Streams were further listed as candidates for protection on the basis of diversity (ranked Outstanding in at least three of the four resources areas) or as Blue Ribbon Resources (one of the best examples of at least one resource area). Honouliuli Stream was not listed as a candidate for protection on either basis.

Impacts and Mitigation Measures: During construction of the pipelines and distribution system near West Loch it's possible that a small quantity of silt could be delivered to the stream, and from there be transported into the wetlands where it would likely settle out. Significant erosion and sedimentation is unlikely however, due to the very limited volumes of earth movement, the flat topography of the area, the porous nature of the soil and the infrequent heavy rainfall. The wetlands and West Loch itself are well-adapted to sediment delivery, especially pulses during heavy rainfall events, and impacts from this project would be insignificant.

Once the system is operational R-1 water could enter the stream as runoff or from a break in a line. From the stream it would flow into the wetlands and then into Pearl Harbor. Even in the event of a break however, volumes would be small because of flow monitoring devices that would trigger valve closures. The water itself would be low in suspended matter and pathogens, but high in dissolved plant nutrients. Its effect in Pearl harbor would likely be undetectable because of the limited volumes and the high ambient nutrient values in the harbor. Biostimulatory effects on marine algae are unlikely as primary productivity in most of the harbor is limited by the availability of light in these highly turbid waters rather than by the availability of nutrients.

4.2.2.2 Wetlands

Existing Conditions: Wetlands serve as reservoirs for storm-water, groundwater recharge areas, filters for water-borne pollutants before they reach groundwater and/or inshore waters, habitat for waterbirds, and open space. There are several definitions of wetlands. For the purposes of this environmental assessment, we use the regulatory definition of the U.S. Army Corps of Engineers: "Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas."

The "Corps of Engineers Wetlands Delineation Manual" (1987) provides the following diagnostic environmental characteristics of wetlands:

1) *Vegetation.* The prevalent vegetation consists of macrophytes that are typically adapted to areas having hydrologic and soil conditions described in the above definition. Hydrophytic species, due to morphological, physiological, and/or reproductive adaptation(s), have the ability to grow, effectively compete, reproduce, and/or persist in anaerobic soil conditions.
2) *Soil.* Soils are present and have been classified as hydric, or they possess characteristics that are associated with reducing soil conditions.
3) *Hydrology.* The area is inundated either permanently or periodically at mean water depths ≤ 6.6 feet, or the soil is saturated to the surface at some time during the growing season of the prevalent vegetation.

There have been several comprehensive surveys of wetlands in Hawaii, including Elliott and Hall (1977) and Ahuimanu Productions (1977). Elliott and Hall identified one wetland within the present study area: Pearl Harbor-West Loch. Ahuimanu Productions summarized the series of wetlands adjacent to West Loch:

> Numerous fishponds and a 31 acre salt evaporation pond were found on the west shore of West Loch (Honouliuli) early in this century. At the suggestion of Federal and State biologists, the salt pond was set aside as a wildlife sanctuary by the U.S. Navy in 1971. More recently, this site was selected as one of two areas to be developed as waterbird refuges to compensate for 186 acres of silted coral mudflats that were lost in the construction of the reef runway at Keehi Lagoon. The original pond was extensively modified by the State Department of Transportation and the Federal Aviation Administration, under direction from the USF&WS. Modification involved development of separate impoundments, construction of roads, drainage channels and nesting islets and development of a pumping system to supply water. The site became a unit of the Pearl Harbor National Wildlife Refuge in 1976.
>
> Immediately north of the Honouliuli refuge is a series of four 1-2 acre fishponds, now in production of Malaysian prawns. This wetland was formerly a single pond, but extensive diking in recent years has allowed independent use of the four different water impoundments. Water is supplied by a well and the ponds drain into West Loch.
>
> Further north along the Honouliuli shoreline are three fishponds, the largest of which is essentially unchanged in shape from its historical configuration. This pond is now encircled with mangrove, which is turn is backed up by a small area of marshland, dominated by California grass, pickleweed, bulrush and other sedges.

Other wetlands exist on Waipio and Waiawa peninsulas

> The diversity of Pearl harbor wetland areas insures availability of a wide range of invertebrate and vertebrate organisms as potential food for waterbirds.... Mangrove mudflats throughout Pearl Harbor are covered and exposed with fluctuations in tides, providing ephemeral feeding habitat for waterbirds.... Most fishes characteristic of estuarine waters in Hawaii are found in waters over the mangrove mudflats in Pearl Harbor...mullet, milkfish, barracuda, and aholehole.... Tilapia and mosquito fish were found in numerous drainage ditches, fishponds, prawn ponds, marshlands and watercress ponds.... Bullfrogs and toads were observed....Invertebrates ...observed on mangrove mudflats were those characteristic of saline impoundments (i.e., grapsid crabs, portunid crabs, snapping shrimp, mud shrimp, annelid worms, etc.). Marshlands in Honouliuli and Waipio Peninsula support a variety of aquatic insects....We found crayfish and freshwater prawns in ...ponds, watercress farms and stream drainages....

The wetlands support a community of non-waterbird avifauna.

> The habitat associated with wetland areas of Pearl Harbor supports an unusual variety of exotic birds, including game species, cage birds and long-established varieties that are widely distributed throughout the islands.

Waterbirds move among the sites so the wetlands of the area may be considered as linked.

> Hawaiian stilt are found in Pearl harbor wetlands in far greater numbers than all other endangered waterbirds put together. In some recent surveys, nearly half of the recorded Statewide population of this species was distributed throughout the Pearl Harbor sites. Recent construction of two new refuge units promises to increase the importance of Pearl Harbor to the survival of this species. As many as 268 stilt have been counted in the Honouliuli unit of the Pearl Harbor NWR since its construction....The other Honouliuli wetlands provide very little stilt habitat, although small numbers are occasionally found in flooded pastureland or in the small marsh bordering the Honouliuli fishpond.
>
> Coots find far less suitable habitat in the Pearl Harbor areas than do stilt....Hawaiian Gallinule are even less common in Pearl Harbor areas than are coots....Hawaiian Ducks (Koloa) appear only recently on count records in the Pearl Harbor wetlands....Black-crowned Night Herons ('Auku'u) have been recorded at all Pearl Harbor wetlands that have been visited in past years....Cattle egrets were first found nesting in the Pearl Harbor area (West Loch) in January, 1963, four years after their introduction to the island....The large numbers and variety of migratory waterfowl recorded in Pearl Harbor wetlands reflects the diversity of habitat available....On the average, the Pearl Harbor population of wintering Pintails and Shovelers together runs between 100-200 birds....The list of less common migratory waterfowl is longer....The list of migratory shorebirds that have been recorded at the Pearl Harbor wetlands is longer than for any other site in the State.

Impacts and Mitigation Measures:

The Hawaiian Waterbirds Recovery Plan (USFWS, 1985) addresses the needs of the stilt, coot, gallinule and duck populations. Objectives of the Plan relate to habitat protection, but also management of water, vegetation, predators/competitors, new species introductions, human disturbance, disease epidemics, toxic substances, and disaster reaction.

No construction will take place in any wetland area. Construction-related impacts, if any, would be attributable to siltation and possible shoaling of the bottom. This could potentially increase predators' access to nesting sites. The very limited quantities of silt which could be generated by trenching for the pipelines and distribution systems however, would not be expected to significantly alter the bathymetry of the wetland systems in the area.

Operations-related impacts would be attributable to an alteration of the quantity or quality of the water in the wetlands. Additional water input would be insignificant to the hydraulics of the refuge system because of the mechanical devices present to control water level fluctuations. As for other wildlife, the R-1 water is not expected to present an ecological risk.

4.2.3 Coastal Marine Ecosystems

The marine areas in the vicinity of the study area extend from the inner waters of Pearl Harbor's West Loch, west along the Ewa coastline and north to Barbers Point Harbor.

4.2.3.1 Existing Conditions

Water Quality: Honouliuli Stream (along with 2 other intermittent streams, five continuous streams and five large springs) feeds a Class 2 water quality limited segment (Pearl Harbor). (The purpose of Class 2 is to protect recreational and aesthetic uses. A "water quality limited segment" is one that does not meet ambient water quality standards.). A unique set of state water quality standards, with higher limits than anyplace else in the state, apply to Pearl Harbor. Fresh water inputs are estimated at 50 million gallons per day (mgd) during the dry season, and 100 mgd during the wet season, making this a "wet embayment" for water quality standards purposes. West Loch has the poorest water quality in Pearl Harbor due to high rates of sediment input. Freshwater discharging into the harbor tends to float on the heavier saltwater, creating an estuarine system with a constant seaward flow at the surface. Outside Pearl Harbor, the currents tend to drive the plume of lower salinity water exiting the harbor mouth towards the north around Keahi Point.

The Pearl Harbor reef flats and reef communities are in Class II. The objective of class II marine bottom ecosystems is that "their use for protection including propagation of fish, shellfish, and wildlife, and for recreational purposes not be limited in any way," despite the fact that actions which may permanently or completely modify, alter, consume, or degrade these bottom types may be approved by the Director of Health.

Elsewhere along this coast, freshwater generally reaches the ocean by sheet flow except for a few gulches which run after heavy rains. The porous limestone caprock also supports numerous fresh or brackish water springs that tend to discharge close to shore. The Honouliuli outfall currently disposes of about 25 mgd of advanced primary treated wastewater effluent offshore.

The nearshore waters offshore of Ewa are classified by the State DOH as Class A Open Coastal Waters (DOH, 1992). The objective of Class A waters is to protect their use for recreation and aesthetic enjoyment. This classification allows other uses as long as they are compatible with the protection and propagation of fish, shellfish, and wildlife, and with recreation in and on these waters. It does not allow any discharges that have not received the best degree of treatment or control compatible with the criteria established for this class. Coastal waters in this area are fertilized by nutrient rich water seeping from springs below sea level. The nutrients originate in upland agricultural fertilization, leaching from cesspools and septic tanks, domestic waste injection wells, and increasingly from urban applications of fertilizers. This nutrient subsidy promotes the thick growths of benthic algae (*limu*) that make this coast the most popular seaweed harvesting area on Oahu. Nearshore waters are often turbid due to wave action suspending sediments.

A single anchaline pond (Ordy Pond), slightly less than one acre in size, and an unnamed seasonal lowland pond are present on NASBP (Dept. of the Navy, 1999). Both are designated Class 2 inland waters by the DOH. The objective of Class 2 inland waters is to protect their use for recreational purposes, propagation of fish and aquatic life, and agricultural and industrial water supplies, shipping, navigation, and propagation of shellfish. As part of the planned base closure, Ordy Pond will be transferred to the USFWS.

Barbers Point Harbor receives seepage of low salinity groundwater through the porous limestone harbor walls. For water quality standards purposes, Barbers Point Harbor is a Class A embayment with a Class II (deep draft commercial harbor) bottom type.

Biota: Pearl Harbor is polluted by sediment runoff, high-nutrient runoff and seepage, as well as domestic wastewater, industrial and thermal discharges. The biota is characterized by hearty and opportunistic species. More sensitive species such as corals are found only in limited quantities where conditions will support growth. Some recreational fishing takes place, however, and baitfish are sometimes abundant, especially in the western end of West Loch.

Marine macroinvertebrates found offshore of Ewa include reef-building corals, several species of sea cucumber, sea urchins, and colonial soft corals (Ogden, 1994). Marine vertebrates include reef fish, although abundance and diversity are low. Marine macroalgae are very abundant offshore.

4.2.3.2 Impacts and Mitigation Measures

During construction there may be a very small amount of silt delivered to Pearl Harbor (discussed above) or to the area near CIP. Typical erosion control measures are expected to minimize and contain any silt-containing runoff.

During operations recharge water or pipeline leaks could deliver high nutrient water to coastal ecosystems. Offshore waters in this area however, are already adapted to high nutrient input from groundwater seepage at the coastline. This is evidenced by the luxuriant growths of benthic algae, which bring collectors from around the island. A minor additional nutritional subsidy would not be expected to negatively affect coastal ecosystems in this area.

4.2.4 Protected Habitats and Areas

4.2.4.1 Existing Conditions

The Pearl Harbor National Wildlife Refuge is composed of two units of man-made wetlands totaling 61 acres. It was established by a cooperative agreement with the U.S. Navy in 1976. The James Campbell National Wildlife Refuge, composed of two units totaling 142 acres of wetlands, was established by a lease agreement with the James A. Campbell Estate.

There are several anchaline ponds on the Ewa Plain (E28, E29, E30 on Figure 4-3), at least one of which (E29) contains the federal species of concern, *Metabetaeus lohena*,

4.2.4.2 Impacts and Mitigation Measures

Construction-related impacts, if any, would be attributable to minor siltation and possible shoaling of the bottom. This could potentially increase predators' access to nesting sites. The very limited quantities of silt which could be generated by trenching for the pipelines and distribution systems however, would not be expected to significantly alter the bathymetry of the wetland systems in the area.

Operations-related impacts would be attributable to an alteration of the quantity or quality of the water in the wetlands. Additional water input would be insignificant to the hydraulics of the refuge system because of the mechanical devices present to control water level fluctuations. As for other wildlife, the R-1 water does not present an ecological risk.

4.2.5 Threatened and Endangered Species

Endangered and threatened species information and locations in the project area were obtained from The Nature Conservancy of Hawaii's (TNCH) Hawaii Heritage Program Database. Species locations are shown on Figure 4-3, by TNCH site number. Numbers are organized by USGS Topographic Quadrangle Map, so to avoid redundancy we have prefaced the site number with the initials of the Quad map on which its found. For example, PH5, is site 5 on the Pearl Harbor Quad map. E5 is site 5 on the Ewa Quad map.

4.2.5.1 Terrestrial Plants

Existing Conditions: Location E1, east (*mauka*) of Camp Malakole, harbors a population of the federally endangered *'akoko* shrub (*Chamaesyce skottsbergii* var *skottsbergii*). Populations in the vicinity of the deep draft harbor have been destroyed, and additional populations will be lost as the harbor expands. A colony of this plant formerly grew within CIP, on the west side of Honua Street, but has been destroyed. Other colonies were reported from the east side of Saratoga Street in CIP (E12) and on BPNAS (E13, E19).

The rare *Ophioglossum concinnum* (*pololei*)was recorded from location E4, on an unimproved road about 200 feet north of the OR&L right of way north of the NAS Barbers Point boundary. It has not been observed since 1912.

The endemic round-leafed chaff-flower shrub (*Achyranthes splendens* var. *rotundata*), a federally listed endangered species, occurs at low elevations in open, dry forest remnants, open thickets, on talus or rocky slopes, or on coralline plains (Wagner, Gerbst, and Sohmer, 1990). Several populations exist on the Ewa Plain; two are in CIP (E6, E8), one in Camp Malakole (E7) and one is at NASBP (E5). The *Achyranthes* at location E8 occurs in *Myoporum sandwicense* (*naio*) coastal dry shrubland. In addition, *pua pilo* (*Capparis sandwichiana* var *zoharyi*), an endemic shrub federally listed as a species of concern, occurs in kiawe and lowland scrub zones (Ogden, 1994), and is known to exist in the same area as the *A. splendens.*

The federally endangered *naupaka* (*Scaevola coriacea*) was formerly seen near the site of Barbers Point Beach Park (E11), but the last siting was in 1919.

The federally endangered *'ihi 'ihi* or *'ihi la'au* (*Marsilea villosa*) used to occur under kiawe trees just north of the Honouliuli WWTP site, approximately in the path of the proposed pipelines. The plant has not been seen there since 1932, and the area has since been graded.

Impacts and Mitigation Measures:

All construction, both within the WWTP compound as well as along the pipelines, will be done in areas previously disturbed. There will be no impacts to threatened or endangered species of vegetation.

Once the system is operational, the areas to be irrigated will be landscaped golf courses and common areas, not native ecosystems. Routine operations will have no effect on protected species. Any pipeline break would occur along already disturbed roadways and likewise would not be expected to affect protected plant species (Figure 4-3).

4.2.5.2 Terrestrial Wildlife

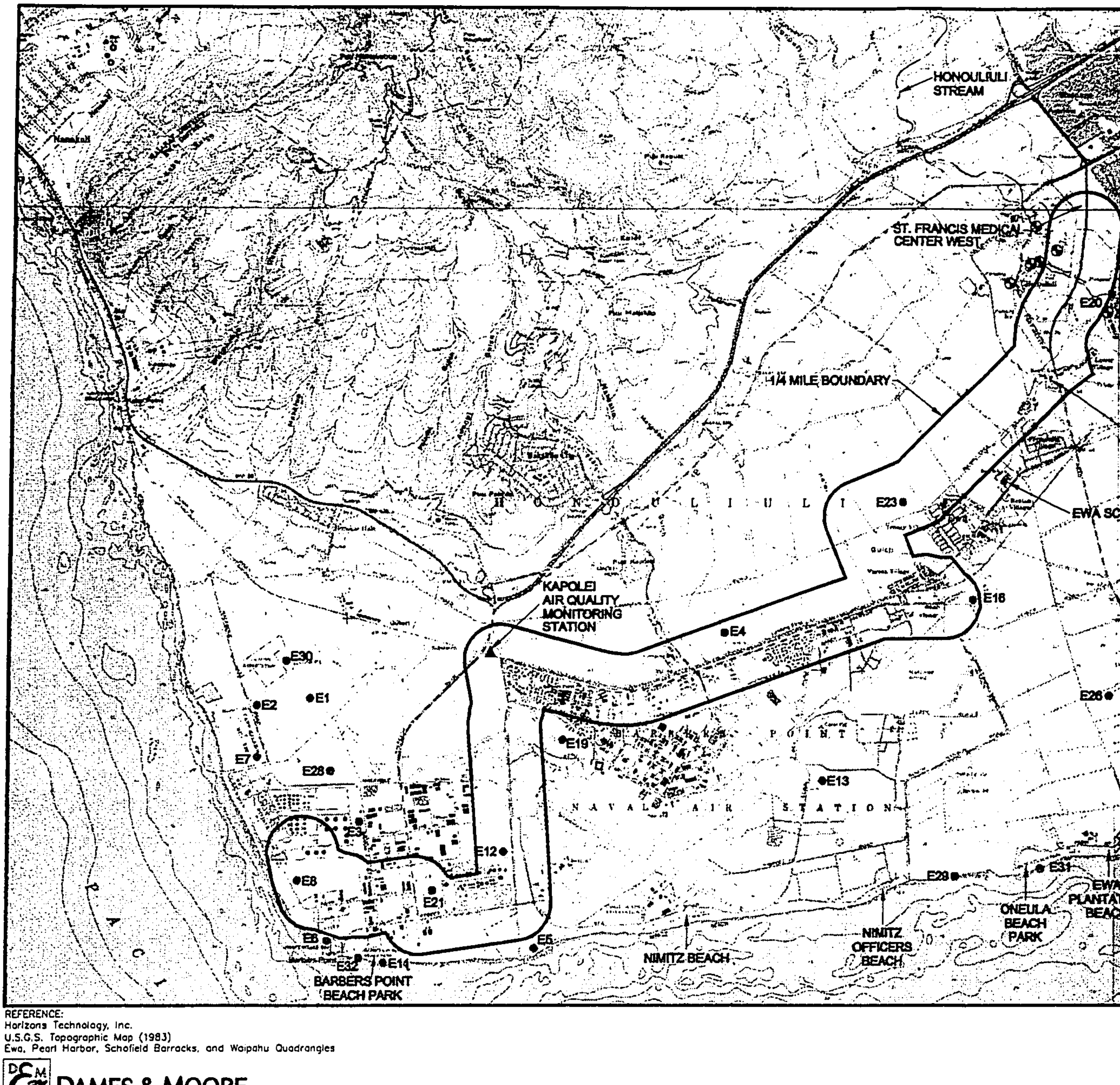
Existing Conditions: Site PH5 is the Honouliuli Unit of the Pearl Harbor National Wildlife Refuge. Four federal and state listed endangered waterbirds occur there: Hawaiian Gallinule, *'alae-'ula* (*Gallinula chloropus sandvicensis*); Hawaiian Coot, *'alae ke'oke'o* (*Fulica alai*); Hawaiian Stilt, *ae'o* (*Himantopus mexicanus knudseni*); and Hawaiian Duck, *koloa* (*Anas wyvilliana*). Stilt, gallinule and coot have also been seen at other wetlands near West loch (E20) and in CIP E21).

The federally proposed endangered Oahu *'elepaio* (*Chasiempis sandwichensis ibidis*) was last seen on the Ewa Plain in 1984 (E26) at a location which formerly harbored several rare plants (*Torulinium odoratum* ssp *auriculatum*, *Lipochaeta lobata* var. *lobata* [*nehe*], *Portulaca villosa* [*'ihi*], and the endangered *Centaurium sebaeoides* [*'awiwi*]. It's been 60-80 years since any of these were seen there.

The state-listed endangered Hawaiian short-eared owl (*Asio flammeus sandwichensis*), which is a federally listed species of concern, may occur or range over the area.

A pupillid land snail (*Lyropupa perlonga*), a federal species of concern, was observed near Malakole Road (E22). The obscure pentarthrum weevil (*Pentarthrum obscurum*), another federal species of concern, was last seen northwest of Tenney Village (E23) in 1974.

Impacts and Mitigation Measures: To the extent that the irrigation water and its contained dissolved nutrients are applied to areas presently not irrigated, the consequent additional plant growth and habitat may provide supplemental prey and forage areas for owls and waterbirds. The impacts should be beneficial. The DOH guidelines for water reuse prohibit ponding of reclaimed water, which could allow residual microbial populations to multiply.



REFERENCE:
Horizons Technology, Inc.
U.S.G.S. Topographic Map (1983)
Ewa, Pearl Harbor, Schofield Barracks, and Waipahu Quadrangles

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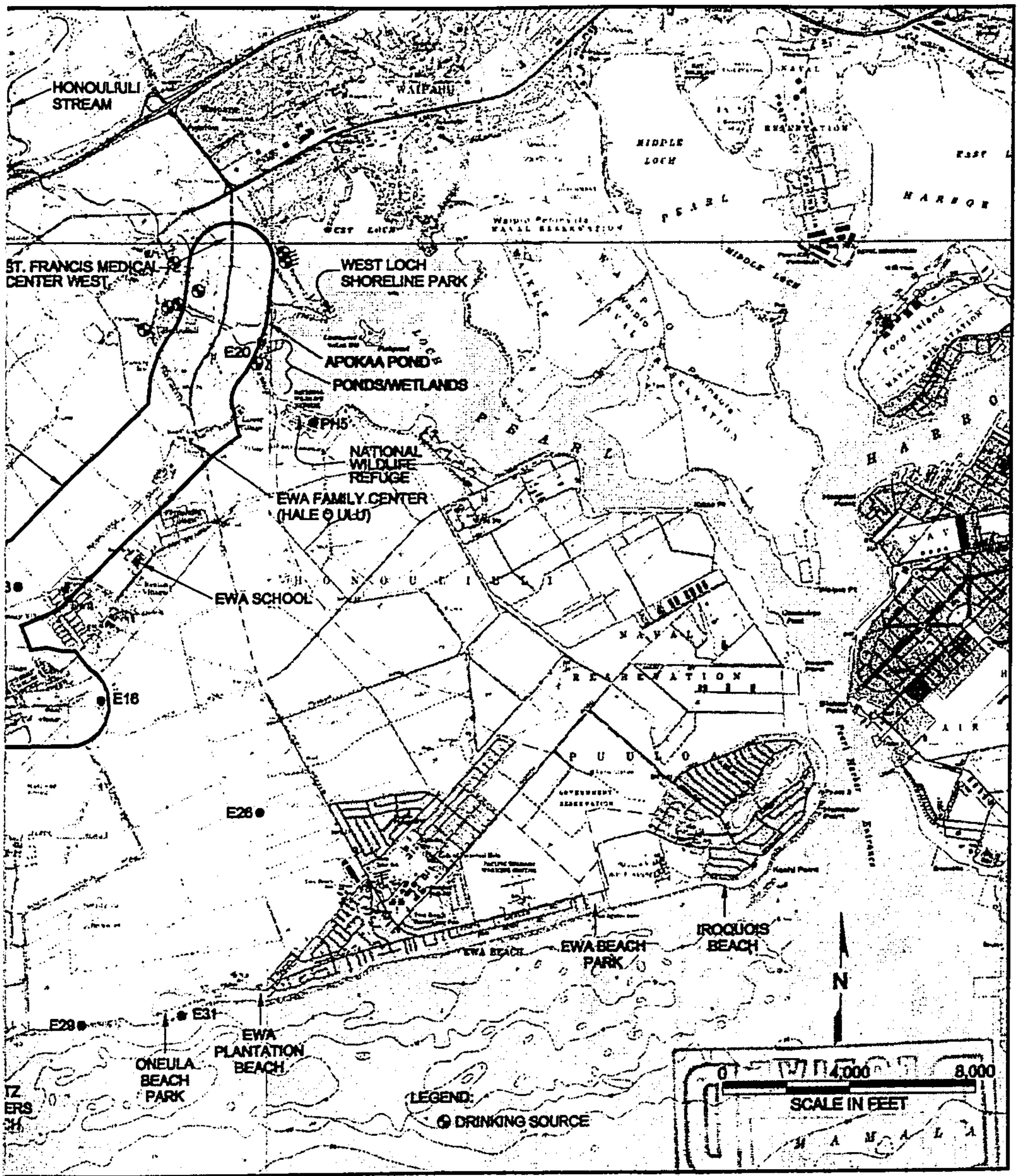
GROUP A DAMES & MOORE GROUP COMPANY 42470-001-0805 jsb 0105c.dwg 3/99



SENSITIVE HUMAN AND ECOLOGICAL RECEPTORS

FIGURE 4–3

4.2.5.3 Marine Species

Existing Conditions: The threatened green sea turtle (*Chelonia mydas*) is known to frequent the area immediately offshore, which is known for an abundance of seaweed. The humpback whale (*Megaptera novaeangliae*), a state and federally listed endangered species, may be present in the vicinity from November to May; however, densities offshore of NASBP are among the lowest in Hawaii (Ogden, 1994). The Hawaiian Monk seal (*Monachus schauinslandi*) has been seen at Oneula Beach park (E31) and at Barbers Point Beach Park (E32).

Impacts and Mitigation Measures: Any impacts to turtles should be indirect and positive. That is, if reclaimed water reaches the ocean it will provide additional nutrients for algal growth. No impacts on other protected marine species are anticipated.

4.3 THE HUMAN ENVIRONMENT

The region is presently in transition from agricultural to urban uses, and is the location of Oahu's fastest growing residential communities.

4.3.1 Social and Economic Resources

4.3.1.1 Demographics

Existing Conditions: The State of Hawaii has approximately 1.2 million residents and receives nearly 7 million visitors a year. Oahu has approximately 871,469 residents (1995 figures), or nearly 75 percent of the state population. The Ewa DP area has approximately 51,286 residents, and is projected to grow from having 5.1 percent (1990) to 12 percent (2020) of the island's population.

Future Conditions: The State periodically updates its forecasts of population growth, and these provide the basis for projections of economic growth, infrastructure needs, revenues, etc. The latest projections (DBEDT, 1997) are called the "2020 Series." These projections "...represent an extension into the future of important trends affecting Hawaii, with the help of some basic assumptions about how those trends appear to be changing. It provides policy makers, business and the public with a base scenario for growth and change of the state's economy and population over the next quarter century." Key conclusions regarding population are:

- The resident population of Hawaii, which includes members of the armed forces and their dependents but excludes visitors, is projected to rise from 1.18 million in mid-1995 to 1.49 million in mid-2020, an average annual 1.0 percent increase from 1995. The de facto population, which includes visitors present but excludes residents temporarily absent, is projected to grow from 1.29 million in 1995 to 1.72 million in 2020.

- Resident population on Oahu is projected to rise from 870,900 in 1995 to 1,050,600 in 2020, an average 0.8 percent increase annually for the next 25 years.

Impacts and Mitigation Measures:

Construction of the proposed facilities will have no significant effects on population or demographics.

Operation of the proposed facilities will have indirect effects on population growth. It will allow planned development of the Ewa Plain to proceed with less impact to potable aquifers.

4.3.1.2 Employment

Existing Conditions: Economic activity on Oahu is concentrated in the Primary Urban Center (Honolulu area), which has about three-quarters of island jobs and about half of the population. Projections to the year 2020 anticipate a decrease in job share in Honolulu to approximately 69 percent. The job share in the Secondary Urban Center in the Ewa DP area is expected to grow at a rate of 4 percent a year, going from 3 percent of island jobs in 1990 to 10 percent in 2020. The City of Kapolei is expected to become the major employment center for the region.

For the Ewa DP area, the potential civilian labor force numbers 25,556 (71 percent of its population). Unemployment is 5 percent. Twenty-one percent of the residents commute for more than 45 minutes each way to and from work.

Impacts and Mitigation Measures: Construction of the project will employ a maximum of about 30 workers for about one year. Once operational the proposed project will increase staffing requirements at Honouliuli WWTP. An estimate was prepared (GMP Assoc., 1997) of future staffing needs. During the initial phase of development approximately 7,900 man-hours per year will be needed to operate the water reclamation facility. This translates to about 4 additional staff positions.

4.3.1.3 Household Income

Existing Conditions: Household annual incomes in the Ewa DP area average $44,759, with 9 percent in the state's lowest (i.e., incomes of less than $15,000) and 12 percent in the highest (i.e., incomes of $75,000 or greater) income brackets. Homeowners in the Ewa DP area who pay more than 35 percent of their household income on housing comprise 21 percent; renters who pay more than 35 percent of household income on housing comprise 36 percent. Five percent of the population is below the poverty level (U.S. Bureau of Census, 1991, 1992).

Impacts and Mitigation Measures: Workers, during construction or operations, will not necessarily be from the Ewa area, but from Oahu in general. The overall direct impact will be insignificant.

4.3.1.4 Housing

Existing Conditions: Housing in Ewa has expanded rapidly since the early 1990s as sugar plantation lands have been converted to residential developments. Housing developments in the Ewa DP area include Ewa Villages, Ewa Beach, Makakilo, Ewa by Gentry, West Loch, Iroquois Point (Navy Housing), and Kapolei. In 1990, the Ewa DP area had 11,734 housing units with a 3 percent vacancy rate. A typical household size was 3.93. Owner-occupied homes comprised 52 percent while renter-occupied comprised 47 percent. Mean housing value was $232,270 (U.S. Bureau of the Census, 1991,1992).

Impacts and Mitigation Measures: As of 1995, 30,000 new homes had been permitted for building in the Ewa DP area (C&C of Honolulu, 1995 Development Plan Status Review). Given the very minor impacts of this project to demographics or employment, housing impacts will likewise be insignificant.

4.3.1.5 Economy

Existing Conditions: The new *Atlas of Hawaii* (University of Hawaii at Hilo, 1998) summarizes the present state of and outlook for Hawaii's economy, as follows:

> The contemporary economy of Hawaii is structured around the state's dominant source of export earnings, tourism. It also encompasses a variety of highly specialized "niche" sectors that capitalize on Hawaii's unique natural and multicultural assets and on the technical and professional skills pool centered on Oahu....Today Hawaii's trade consists of the export of tourism-related services and the re-export of merchandise, primarily to tourists, in exchange for imported goods for local consumption. A substantial volume of imported building materials varies with local construction and investment cycles.
>
> In 1995 Hawaii's Gross State Product (GSP), the market value of all goods and services produced, was $33 billion. Adjusted for inflation, annual growth of GSP averaged 4.4 percent between 1960 and 1990....Although economic growth averaged less than 1 percent annually between 1990 and 1995, it is expected to rise gradually to an annual rate of 2.5 percent.

The conclusion reached is that Hawaii's economic future will depend on the growth of service exports from knowledge-based industries.

The "2020 Series" projections (DBEDT, 1997) for the economy anticipate slower economic growth than in the past. The annual average growth of real (i.e., inflation adjusted) Gross State Product (GSP), which is the value of all final goods and services produced in Hawaii, was 4.3 percent from 1958 to 1995. The annual average real GSP growth from 1995 to 2020 is projected to be 1.8 percent.

Another view of the economy is provided by DBEDT in their "Economic Trends and Outlook" available on the internet (www.hawaii.gov/dbedt/outlook/): "Growth of personal income is a good indicator of our total economy. It accounts for 78 percent of GSP. Hawaii's personal income grew at 2.1 percent in the first half of 1997."

Based on current trends, DBEDT expects that the visitor industry will see moderate growth, with the number of visitor arrivals increasing 1.6 percent in 1998 and 1999, and rising to 2.0 percent in 2000. Real gross state product should expand at a 1.1 percent annual rate through the year 2000. The declining trend in jobs is expected to stabilize in 1997 and to reverse course in 1998 and beyond.

Low growth projections are forecast by most if not all of the leading economists in the state (Bank of Hawaii, 1998; Hawaii Economic Revitalization Task Force, 1997). The State Council of Revenues which makes the official revenue projections for the state currently predicts a net revenue growth of 0.6% for the fiscal year which began on July 1. Due to recent slight increases in tax revenues, the Council may increase that to 1 or 1.5%.

Impacts and Mitigation Measures: It appears that a reasonable baseline growth rate for Oahu's population and economy will be 1-2% per year for the foreseeable future. The project will reduce the demand for potable water needed by increasing economic activity on the Ewa Plain.

4.3.2 Fiscal Implications

The proposed project is a result of a consent decree that allows the City and County of Honolulu to avoid significant fines that could be imposed by the U.S. EPA. Consequently, the "no-action" alternative has significant economic disincentives.

The project has a number of aspects with positive fiscal impacts. Creation of jobs and purchase of supplies and materials will stimulate tax revenues to the City and State. Additional tax revenues will be generated by the sale of reclaimed water and payment of property taxes to the City. Indirectly, the use of reclaimed water will free a large amount of potable water for other uses, avoiding incremental costs of potable water development. Recharge of the Ewa caprock aquifer will also reduce the need to pump water from the windward side of Oahu.

4.3.3 Recreational Resources and Open Space

4.3.3.1 Parks and Beaches:

Existing Conditions: Locations of parks and beaches are included on Figure 4-2. The information on uses of these areas is from Clark (1977) and AECOS, (1981). At Pearl Harbor Park in Pearl Harbor, the water is too polluted for swimming, but some pole fishing and crabbing are done. Iroquois Beach, west of the harbor mouth, is used by military personnel for diving, snorkeling, board surfing and swimming. Ewa Beach Park is used for diving, pole fishing, snorkeling, board surfing, swimming, and throw-netting. It is known island-wide as an excellent place to collect seaweed. Further west, Ewa Plantation Beach is used for diving snorkeling, board surfing and swimming, but access is limited to members of the Ewa Recreation Association and Ewa Sugar Company employees. Oneula Beach Park supports diving, board surfing and swimming. Nimitz Beach, a man-made beach on Barbers Point Naval Air Station, is divided into officers and enlisted beaches. It is used for diving, trapping, snorkeling, board surfing and swimming. Barbers Point Beach Park at CIP is used for diving, shell collecting, pole fishing, trapping, swimming and throw-netting. Around Barbers Point Harbor, fishing is mostly by pole and line. Some surfing also takes place in the area.

Kapolei has a district park and there are smaller community parks scattered throughout residential areas.

Impacts and Mitigation Measures:

The primary impact on parks in the region will be the availability of additional non-potable water for irrigation of fields and landscaping.

4.3.4 Aesthetics

4.3.4.1 Odors

Existing Conditions: Under existing conditions, odors are evident at the WWTP, primarily due to the solids treatment processes.

Impacts and Mitigation Measures: This project will not generate odors. The source water will be secondary effluent which has been oxidized.

4.3.4.2 Visual

Existing Conditions: Visual landmarks and significant vistas identified in the Ewa Development Plan (C&C of Honolulu, 1996) include distant vistas of the shoreline from the H-1 Freeway, mountain and ocean views, and views of central Honolulu and Diamond Head. The DP recommends streetscape plantings to screen views to all service, parking, and industrial areas.

Impacts and Mitigation Measures: The proposed project will not affect views from surrounding areas. The WWTP site itself is already industrial in nature, and the new facilities will be similar in appearance. The availability of additional water at the WWTP will allow creation of a more effective landscape buffer.

4.3.5 Noise

4.3.5.1 Sound Measurement and Regulations

Noise is generally defined as loud, unpleasant, unexpected or undesired sound that is typically associated with human activity and which interferes with or disrupts normal activities. Although exposure to high noise levels has been demonstrated to cause hearing loss, the principal human response to environmental noise is annoyance. The response of individuals to similar noise events is diverse and influenced by the type of noise, the perceived importance of the noise and its appropriateness in the setting, the time of day and the type of activity during which the noise occurs, and the sensitivity of the individual. Table 4-8 summarizes a range of typical noise levels.

Some land uses are considered sensitive to noise. Noise sensitive receptors are land uses associated with indoor and/or outdoor activities that may be subject to stress and/or significant interference from noise. They often include residential dwellings, mobile homes, hotels, motels, hospitals, nursing homes, educational facilities and libraries.

Significance Criteria: The State of Hawaii has adopted standards to limit noise from stationary and construction noise sources (Hawaii Administrative Rules, Chapter 46).

Stationary Noise Source: The maximum permissible sound levels for stationary noise sources are summarized in Table 4-9. The applicable limits are a function of the zoning district and the time of day. The sound levels are measured at any point at or beyond the property line of the noise source. The noise level shall not exceed the maximum permissible sound level for more than ten percent of the time within any twenty-minute period.

Construction Noise Sources: Construction activity is permitted between the hours of 7:00 a.m. and 6:00 p.m. Monday through Friday, and 9:00 a.m. and 6:00 p.m., on Saturday. No specific sound level limit has been establish for construction during the permitted hours

4.3.5.2 Existing Noise

Current noise sources at the WWTP include vehicular traffic and equipment, mainly pumps. The project will increase vehicular traffic and equipment noise during construction, but there will no significant difference during operation.

4.3.5.3 Impacts and Mitigation Measures

Construction noise associated with the project components would have the ability to raise ambient sound levels in areas of sensitive receptors. The effects of this type of noise depend on receptors that are close to the project site. The WWTP site is very near a just-completed golf course, and new home construction is taking place nearby. The construction of new homes in the. area is expected to continue for some time into the future. Project construction would result in a temporary increase in the ambient noise level in the vicinity of construction activity. Noise would result from the operation of construction equipment and, to a lesser degree, noise generated by vehicle traffic traveling to and from the construction area. At the present time, there is enough distance between the WWTP and other uses that construction noise will be attenuated to reasonable levels where sensitive receptors might be located. The excavations for the pipelines will create unavoidable noise along existing rights-of-way. Since the Hawaii Administrative Rules exempt construction activity from the sound level limits, the impact is not considered significant.

Table 4-8.
Sound Levels of Typical Noise Sources and Noise Environments (A-Weighted Sound Levels)

Noise Source (at a Given Distance)	Scale of A-Weighted Sound Level in Decibels	Noise Environment	Human Judgment of Noise Loudness (Relative to a Reference Loudness of 70 Decibels*)
Military Jet Take-off with After-burner (50 ft) Civil Defense Siren (100 ft)	140 130	Carrier Flight Deck	
Commercial Jet Take-off (200 ft)	120		Threshold of Pain *32 times as loud
Pile Driver (50 ft)	110	Rock Music Concert	*16 times as loud
Ambulance Siren (100 ft) Newspaper Press (5 ft) Power Lawn Mower (3 ft)	100		Very Loud *8 times as loud
Motorcycle (25 ft) Propeller Plane Flyover (1,000 ft) Diesel Truck, 40 mph (50 ft)	90	Boiler Room Printing Press Plant	*4 times as loud
Garbage Disposal (3 ft)	80	High Urban Ambient Sound	*2 times as loud
Passenger Car, 65 mph (25 ft) Living Room Stereo (15 ft) Vacuum Cleaner (3 ft) Electronic Typewriter (10 ft)	70		Moderately Loud *70 decibels (Reference Loudness)
Normal Conversation (5 ft) Air Conditioning Unit (100 ft)	60	Data Processing Center Department Store	*1/2 as loud
Light Traffic (100 ft)	50	Private Business Office	*1/4 as loud
Bird Calls (distant)	40	Lower Limit of Urban Ambient Sound	Quiet *1/8 as loud
Soft Whisper (5 ft)	30	Quiet Bedroom	
	20	Recording Studio	Just Audible
	10		Threshold of Hearing

Source: Compiled by Dames & Moore.

Table 4-9
Maximum Permissible Sound Levels

Zoning District	Daytime (7:00 a.m. to 10:00 p.m.)	Nighttime (10:00 p.m. to 7:00 a.m.)
Class A	55 dBA	45 dBA
Class B	60 dBA	50 dBA
Class C	70 dBA	70 dBA

Class A Zoning District: Includes all areas equivalent to lands zoned residential.

Class B Zoning District: Includes all areas equivalent to lands zoned for multi-family dwellings, apartments, business, commercial, hotel, resort or similar type.

Class C Zoning District: Includes all areas equivalent to lands zoned agriculture, country, industrial, or similar type.

The proposed project will generate unavoidable noise during construction activities. Implementation of the following measures would reduce noise levels near the project site and minimize impacts.

1) The construction contractor shall be required to comply with all provisions of Hawaii Administrative Rules, Chapter 46.

2) The construction contractor shall be required to limit noise from construction to an average of 75 dBA between the hours of 7:00 a.m. and 6:00 p.m. Monday through Friday, and 9:00 a.m. and 6:00 p.m., on Saturday. This can be accomplished through the following measures: The construction contractor should select equipment that will perform the necessary tasks with the lowest sound level and with the lowest acoustic height possible. All construction equipment should fitted with "manufacturer-recommended" mufflers and operate in accordance within the parameters of the manufacturers acoustical specifications.

The contractor will also be required to comply with the City and County noise regulations, including those specified in the grading permit.

Once operational, the project facilities will have stationary noise sources similar to but fewer than those of the existing WWTP. These sources will be selected, designed and operated in such a manner as to comply with the Hawaii Administrative Rules. No significant impacts are expected from stationary equipment. Given that the project will generate only four new jobs, noise associated with new traffic in the vicinity will be insignificant.

4.3.6 Public Health and Safety

4.3.6.1 Background and Regulatory Requirements

Reclaimed water has been used worldwide for non-potable purposes and in at least one case (Windhoek, South Africa) for drinking water. Israel reclaims over 70% of its wastewater, and a number of other countries routinely use reclaimed wastewater. In the U.S., a national policy encouraging reclamation of wastewater was articulated in the 1972 amendments to the Federal Water Pollution Control Act (PL 92-500). In 1974, Hawaii's policy promoting recycling of wastewater was established in HRS 344 (Environmental Policy Act). In 1971, the City and County of Honolulu adopted the Water Quality Management Plan for Oahu which included a strategy of water reclamation. Inherent in all of these activities, strategies and plans is a recognition that adequate treatment is required to render the reclaimed water suitable for its intended uses, and to assure there are no health risks to the general public. The level of treatment required depends on the proposed use and the human exposures associated with that use. The proposed project will produce two products: RO water, which is essentially sterile and presents no public health risk, and R1 water, the most highly treated class of reclaimed water. This water undergoes a typical secondary treatment process, and then is oxidized to break down organics, filtered to remove particles, and disinfected with ozone. This level of treatment is designed to produce water suitable for all approved uses of reclaimed water. The criteria defining R1 water are expressed in terms of the concentrations of viruses and bacteria remaining in the product water (Appendix C).

In comparison with drinking water, R1 water is permitted to have a small number of bacteria and viruses. For example, drinking water is not permitted to contain total or fecal coliform bacteria, whereas R1 water can have an average of 2.2 fecal bacteria per 100 milliliters. Even this however, is a small fraction of what might be expected in typical stream flows or storm water runoff.

Protection of the public health is the most important consideration in the distribution and use of reclaimed water. People potentially coming into contact with reclaimed water at the WWTP, along the pipelines (in the event of a leak), or at the site of its reuse, include residents, commercial/industrial workers, recreational users of golf courses or other facilities where reclaimed water is applied, people transiting areas of reuse, or people consuming crops exposed to reclaimed water.

In 1993 the Hawaii State Department of Health drafted guidelines for the treatment and reuse of reclaimed water (DOH,1993). These guidelines expanded upon the regulations in Chapter 62 of Title 11, Hawaii Administrative Rules, that guide subsurface disposal and effluent irrigation of treated wastewater. The extensive and comprehensive guidelines were produced by various committees of scientists, engineers, public health specialists, water managers and others, who investigated the experiences, results and regulatory safeguards developed in water reuse projects elsewhere. The resulting guidelines have the following objectives:

- Protect public health and avoid public nuisance;
- Prevent environmental degradation of aquifers and/or surface waters;

- Specify appropriate water reclamation methodologies for identified reclaimed water uses;
- Facilitate the use of reclaimed water in greater amounts by disseminating knowledge of the conditions under which DOH can attest to the safety of reclaimed water use; and
- Facilitate acceleration of planning, design, permitting, and implementation of water reclamation projects.

The proposed project produces two products, R-1, the highest quality of reclaimed water, and ultra-pure water produced by reverse osmosis (RO water). The RO water is higher in quality than typical potable drinking water, and there are no restrictions on its use. It is expensive to produce, and usually only produced where ultra-pure water is needed for industrial processes, or where other sources of potable water are unavailable. The approved uses for R-1 water include the uses intended in this project: golf course landscapes, roadside and median landscapes, and a number of other uses including, among others:

- Freeway and cemetery landscapes
- Parks, elementary schoolyards, athletic fields and landscapes around some residential property
- Ornamental plants for commercial use
- Food crops above ground and not contacted by irrigation
- Pastures for milking and other animals
- Orchards and vineyards bearing food crops
- Restricted recreational ponds
- Decorative fountains
- Fire fighting
- Commercial and public laundries
- Industrial processes with exposure of workers

The complete list of approved uses is contained in Appendix C. It can be seen from these uses that dermal exposure is safe, but ingestion of R-1 water or some agricultural products directly exposed to it should be minimized.

4.3.6.2 Impacts and Mitigation Measures

Use of reclaimed water will be in accordance with the DOH Guidelines.

4.4 THE BUILT ENVIRONMENT

4.4.1 Archaeological Resources

Pacific Legacy, Inc. conducted archaeological archival research for the proposed project. Their report is included in its entirety in Appendix E. Significant conclusions are summarized here.

The study included obtaining general information for the Honouliuli area including specific information regarding archaeological projects conducted in Ewa. This information was used as a means of predicting the likelihood of sites and deposits that may be encountered during the project.

There are several significant archaeological sites in the area, including Puu o Kapolei (between Barbers Point and Makakilo) and Kalanamaihiki fishing shrine. Traditionally, Puu o Kapolei may have been the most important cultural place on Ewa. Puu o Kapolei is a volcanic cone that in ancient times had several uses and may have had a *heiau*. It was the primary landmark for travelers between Pearl Harbor and west Oahu. The Ewa district was an *alii* stronghold, due in large part to the fishponds that once lined Pearl Harbor.

The Kalanamaihiki fishing shrine is near the end of the small tongue of land that juts out opposite Laulaunui Island in the West Loch of Pearl harbor. It consists of several large stones.

An archaeological reconnaissance survey of the entire WWTP site was conducted in 1975. No sites were identified.

Prehistoric surface remains are not expected within the project area due to impacts of residential and road development, ranching, sugarcane cultivation, and military activities. Because most of the pipelines will be buried in areas currently used as public rights-of-way, no surface sites or features are likely to be encountered. It is possible that excavations will expose sinkholes that have been filled in by alluvium moving downslope, numerous cultivation activities and by various residential and commercial developments. These sinkholes often contain archaeological deposits, including human burials. If any human remains are uncovered, all work will stop in the immediate area and members of the State Historic Preservation Division will be notified immediately. Should any sinkholes be uncovered, extreme care will be exercised, as human remains may be present.

4.4.2 Historical Sites and Uses

By the 1850s cattle ranching was firmly established at Ewa with an estimated 12,000 head of cattle. By 1877, James Campbell was said to have some 32,000 head of wild cattle. The sugar industry in Hawaii began to rapidly expand in the 1890s and severely altered the appearance of the Ewa Plain. Construction for the Oahu Railway & Land railroad began in 1889 and eventually went around the island. This opened up Ewa and the rest of Oahu for sugar, pineapple, and eventually military use. By the 1920s, Honouliuli was used almost exclusively for sugar cultivation and ranching. Land was reclaimed by inducing erosion from adjacent upslopes.

The Oahu Railway & Land Company (OR&L) right-of-way is on the National Register of Historic Places. It is significant for its use in the development of the sugar industry in Ewa and the rest of Oahu. The excavation for the pipelines should not impact any portion of the existing railway or the raised railway bed.

4.4.3 Public Infrastructure, Utilities and Services

4.4.3.1 Electricity

Existing Conditions: HECO is a public utility which provides Oahu homes and businesses with electricity. Kahe Power Plant, located approximately 4 miles northwest of NASBP, is the primary electric generating facility for the entire island.

Other power-generating facilities include the privately owned Kalaeloa and AES plants and the City-owned H-POWER refuse-to-energy plant, all located in CIP. These facilities sell to HECO power that is distributed through a grid system consisting of overhead and underground power lines. The primary transmission line from the Kahe Plant is a 138 kilovolt (kV) overhead line to the Waiau substation in Pearl City which serves the eastern portion of the island.

Impacts and Mitigating Measures: Electrical demands during construction and operation will not exceed existing capacity. There will be no significant impact to HECO's capability to meet peak electricity demands.

4.4.3.2 Potable Water

Existing Conditions: The C&C of Honolulu Board of Water Supply (BWS) is the local water utility agency on Oahu. The regional system is municipally owned, operated and maintained. BWS's regional potable water system consists of supply wells, storage reservoirs, booster pump stations, and transmission lines that carry water to distribution systems. This system serves existing and planned developments in Makakilo, Kapolei and Ewa.

The recently completed Farrington Booster Pump Station was installed to meet increased water demands for the continued development of Kapolei. This pump station transports water from the eastern side of the system to the western side, serving Kapolei, Makakilo, CIP, and other areas to the west.

Impacts and Mitigating Measures: During construction, the demand for potable water will not exceed 100 gallons per minute. During operations demand will limited to personal use by staff for drinking and washing. The existing potable water supply to the WWTP will be adequate to supply these needs. Make-up water to the system will be secondary treated water from the WWTP.

The major project impacts to potable water use will be the substitution of RO and R1 water for potable water in irrigation and process applications. Ultimately 13 million gallons per day of reclaimed water will displace on a one-for-one basis 13 million gallons per day of potable water, which can then be used for direct consumption or other higher priority uses.

4.4.3.3 Wastewater

Existing Conditions: The regional wastewater collection, treatment, and disposal system is owned and operated by the C&C of Honolulu Department of Environmental Services. A network of sanitary sewers serves developments within the region, conveying wastewater to the

Honouliuli WWTP located along Geiger Road. Developments to the north of Geiger Road, including those in Kapolei, are served by gravity sewers. South of Honouliuli WWTP, only developments to the east are served by a sanitary sewer system. The gravity sewers in the southern community of Ewa Beach flow to pump stations, ultimately discharging to a force main on Fort Weaver Road. This force main eventually connects to a gravity trunk sewer on Geiger Road, which conveys flows to the plant. CIP is unsewered and has on-site individual wastewater disposal facilities, such as septic tanks with leaching fields.

The Honouliuli WWTP has a designed primary treatment capacity of 38 MGD. The current inflow to the plant is approximately 25 MGD. A portion of the inflow, 13 MGD, is processed by secondary treatment. This portion is then blended with the remaining 12 MGD of the primary-treated flows and ocean-discharged as advanced primary-treated effluent.

In addition to the current 25 MGD inflow to Honouliuli, a flow of approximately 8 MGD is allocated to future projects. These projects are primarily residential developments such as Gentry Homes, Mililani Mauka, and other planned housing expansion in Ewa. The remaining available capacity of the Honouliuli WWTP is thus about 5 MGD.

Impacts and Mitigating Measures: During construction, portable chemical toilets will be used. During operation, the four new employees will represent an insignificant increase in daily wastewater flows.

4.4.3.4 Solid Waste

Existing Conditions: The C&C of Honolulu's Division of Refuse Collection and Disposal in the DPW is responsible for refuse pick-up, transferral, hauling, and disposal from residential areas of the island. Commercial establishments, condominiums, and multi-family residential developments contract with private haulers to dispose of refuse at DPW disposal sites. Currently, DPW has two main disposal facilities, the 1,800 TPD H-POWER refuse-to-energy-plant at CIP and the Waimanalo Gulch Landfill in the Ewa District. The current estimated island-wide municipal solid waste (MSW) generation rate is about 2,800 TPD.

The H-POWER plant accepts and processes MSW into a refuse-derived fuel which is burned for commercial power generation. Ash from the plant and noncombustible solid waste, or waste which cannot be processed into fuel, are disposed of at the Waimanalo Gulch Landfill. The estimated capacity of the landfill is 5-7 years; there are, however, plans to expand the facility to provide a 20-year capacity based on currently received tonnages.

Impacts and Mitigating Measures: As there is no demolition involved in the project, solid waste from construction will be minimal. What waste is generated will be disposed of at the Waimanalo Landfill. Operational solid waste will be disposed of at the Landfill or at H-POWER, as appropriate.

4.4.3.5 Non-potable Water

Existing Conditions: The primary existing regional non-potable water sources for irrigation consist of wells drawing from the caprock aquifer. Other regional non-potable water sources include brackish basal wells, along with highly saline and salt water sources that withdraw from the caprock aquifer below the upper limestone layer. These are used mainly for industrial applications. Well construction and pump installation for withdrawal of groundwater anywhere in the state requires a permit from the State Commission of Water Resource Management (CWRM).

A water use permit from the CWRM is required in designated water management areas (e.g., groundwater control areas). Due to the concerns about upland potable supply well water quality, CWRM designated the Ewa caprock aquifer a groundwater control area along with the Pearl Harbor basal aquifer it overlies. As such, the number of well drilling permits issued in the area is restricted, as is the amount of groundwater withdrawn. Since 1993, the CWRM has been issuing *short-duration water use permits* due to uncertainties in the caprock's sustainable yield and the availability of reclaimed water. Current water use permit holders for the Ewa caprock aquifer include the Estate of James Campbell and various developers, such as Gentry Properties and the State Housing Finance and Development Corporation's Kapolei Village.

The concern about existing potable supply water quality is that as basal groundwater is withdrawn for irrigation and other uses, salinity will increase in the upland wells. Also, the use of upland basal wells for irrigation may not be the most reasonable and beneficial use of that water, which is of potable quality.

The existing non-potable wells are connected to transmission systems which support roadway and selected common area landscaping in the various developments. The Kapolei Village golf course is also irrigated from the non-potable system.

Impacts and Mitigation Measures: This project is designed to increase the supply of non-potable water for use throughout the Ewa Plain.

4.4.3.6 Drainage

Existing Conditions: The Kaloi Gulch Drainage Basin is approximately 6,000 acres and has an estimated peak runoff of 10,000 cubic feet per second (CFS). The master planned concept for handling gulch runoff is to channel it through planned developments east of NASBP and ultimately to the ocean via the Ewa Marina project. Due to very limited market demand, housing and associated developments planned for the Ewa Marina complex have not been implemented and are presently unscheduled. Consequently, development of the upland areas of the Kaloi Gulch Basin has been difficult since there is no means to handle the associated increase in storm water runoff. Another concern has been compliance with NPDES requirements, especially at the Ewa Marina ocean terminus (Helber Hastert & Fee, Planners, March 1997).

The area of the Kapolei Drainage Basin is about 2,100 acres, having an estimated peak flow of 4,600 cfs. Runoff from this basin empties into the NASBP coral pit. Due to infiltration within the basin, the runoff discharged to the pit is estimated at 3,000 cfs.

Impacts and Mitigation Measures: The proposed project will not affect drainage at the WWTP site or along the pipelines.

4.4.3.7 Communications

Existing Conditions: GTE Hawaiian Tel is the main island-wide telephone company. Their service in the Ewa region is provided via overhead lines which are shared under the joint pole agreement established with the other utility systems.

Impacts and Mitigation Measures: There is adequate capacity at the WWTP site to accommodate the additional employees needed for the reclamation project.

4.4.4 Governmental Approvals Required for Facility

Contractor shall obtain and maintain all approvals, clearances, and permits required for the development, design, construction, testing, operation, and maintenance of the Facility.

Required approvals, clearances, and permits include, but are not limited to, the following:

- City Construction Plans review/approval (Department of Planning and Permitting)
- City Conditional Use Permit
- City Grubbing, Grading, Excavation, and Stockpiling Permit
- City Building Permit
- City Liquefied Petroleum Gases Permit, as applicable

- State Permit to Perform Work Upon State Highway, including plans review/approval
- State Permit for Construction to Cross or enter the State Energy Corridor, including plans review/approval
- State Underground Storage Tank Notification, as applicable
- State Permit to Construct and Operate Wastewater Reclamation System, including reports, plans, and submittals review/approval
- State Hazardous Substance Notification and reporting, as applicable
- State Air Conditioning/Ventilation Permit
- State Stream Channel Alteration Permit

- State/Federal Environmental Impact Statement (EIS) Process
- State/Federal National Pollutant Elimination System (NPDES) Permit, including City, as applicable

4.4.4.1 Existing Conditions

Existing Conditions: H-1 Freeway is the major east-west corridor, with peak-hour, peak direction volumes of about 2,800 vehicles. Another east-west connector, Farrington Highway, accommodates large volumes of traffic in the Kapolei area and farther west. Fort Weaver Road is one of the most heavily traveled north-south roadways through Ewa. It connects primarily residential communities in eastern Ewa to Farrington Highway and the H-1 Freeway. It is a four-lane highway with a speed limit of 45 mph.. The WWTP is accessed off Geiger Road which intersects with Fort Weaver Road. Near Fort Weaver Road, Geiger Road is four lanes, but it reduces to two lanes before passing the WWTP. The speed limit is 35 mph.

The most recent traffic counts from the Department of Transportation show that approximately 44,000-48,000 vehicles enter the intersection of Fort Weaver Road and Geiger road daily. Most of these (30,000-38,500) pass through on Fort Weaver Road. The daily vehicle count on Geiger Road is about 6,000-6,400. (The eastern leg of the intersection is Iroquois Road.) Peak hour traffic on Fort Weaver Road is about 2,800 vehicles in the morning and 2,500 vehicles in the afternoon. Corresponding peak hour traffic on Geiger Road is about 1,200 in the morning and about 1,000 in the afternoon.

The present transportation system in Ewa has sufficient capacity for existing traffic volumes during peak-hour traffic; however, this network of roads is affected by the bottlenecks and lack of capacity on the corridor from Pearl City to downtown Honolulu (C&C of Honolulu, 1996). These regional transportation planning considerations are being evaluated by the Oahu Metropolitan Planning Organization (OMPO), a joint city-state agency responsible for planning and use of federal transportation funds. In addition, a consortium of landowners and developers has been working to identify Ewa highway improvement needs and how much of the costs each developer must contribute. The update to the Ewa Region Highway Transportation Master Plan (1992) will document the consortium's findings, along with providing a study of the proposed North-South Road and an analysis of methods of financing these improvements.

4.4.4.2 Impacts and Mitigation Measures

Due to the minimal increase in staffing required for operation of the proposed project, impacts to traffic and parking are anticipated to be negligible. There is adequate parking available within the Honouliuli WWTP to accommodate the additional employees. However, five standard stalls and one handicapped parking stall will be added in compliance with the Land Use Ordinance due to construction of the Chemical Storage Building and R-1 Pump Station.

4.5 THE REGULATORY ENVIRONMENT

4.5.1 Land Use and Zoning Designations

4.5.1.1 Existing Conditions

Zoning throughout the project area is shown on Figure 4-4. Construction of the new facilities will take place with the Urban State Land Use District, zoned R-5 by the City. To the west of the WWTP, the pipelines lie in rights-of-way adjacent to residential, agriculture and industrial zoned areas. To the east of the WWTP, the pipelines lie in rights-of-way adjacent to residential and agriculture zoned areas.

4.5.1.2 Impacts and Mitigation Measures

No change to any zoning designation or land use district boundary is required for the project.

4.5.2 Existing and Planned Land Uses

The latest edition of the *Atlas of Hawaii* (University of Hawaii at Hilo, 1998) encapsulates recent regional development trends:

Originally planned by the Campbell Estate in the 1950s as a response to the impending demise of large-scale agriculture, urbanization of the Ewa Plain under public/private partnership had become a part of government policy by the 1970s. The goal is to establish a growth center with its own harbor and diversified employment base on about 32,000 acres, approximately 8 percent of Oahu's land. As of early 1996, a number of industries had invested in Barbers Point Harbor and the James Campbell Industrial Park, and a tourist resort had opened at Ko'olina, but relatively few jobs have materialized for new residents. In contrast, residential development in Kapolei has been nothing short of dramatic: between 1990 and 1994, nearly 5,000 new housing units were built - almost twice as many as on the rest of Oahu. There are plans for 40,000 additional units to be constructed by 2012.

> The present rate of growth will continue to put enormous strain on infrastructure ....especially transportation....Perhaps more serious is the problem of water supply, the solution for which depends on continued diversion of massive amounts of water from Windward Oahu and public funding of costly new distribution facilities.

4.5.2.1 Current Land Uses

The current pattern of land use in the project area is a consequence of several contributing factors, including state and county land use regulations, availability of public infrastructure, land ownership, initiative of private developers, particularly Campbell Estate, and the environmental attributes of the region.

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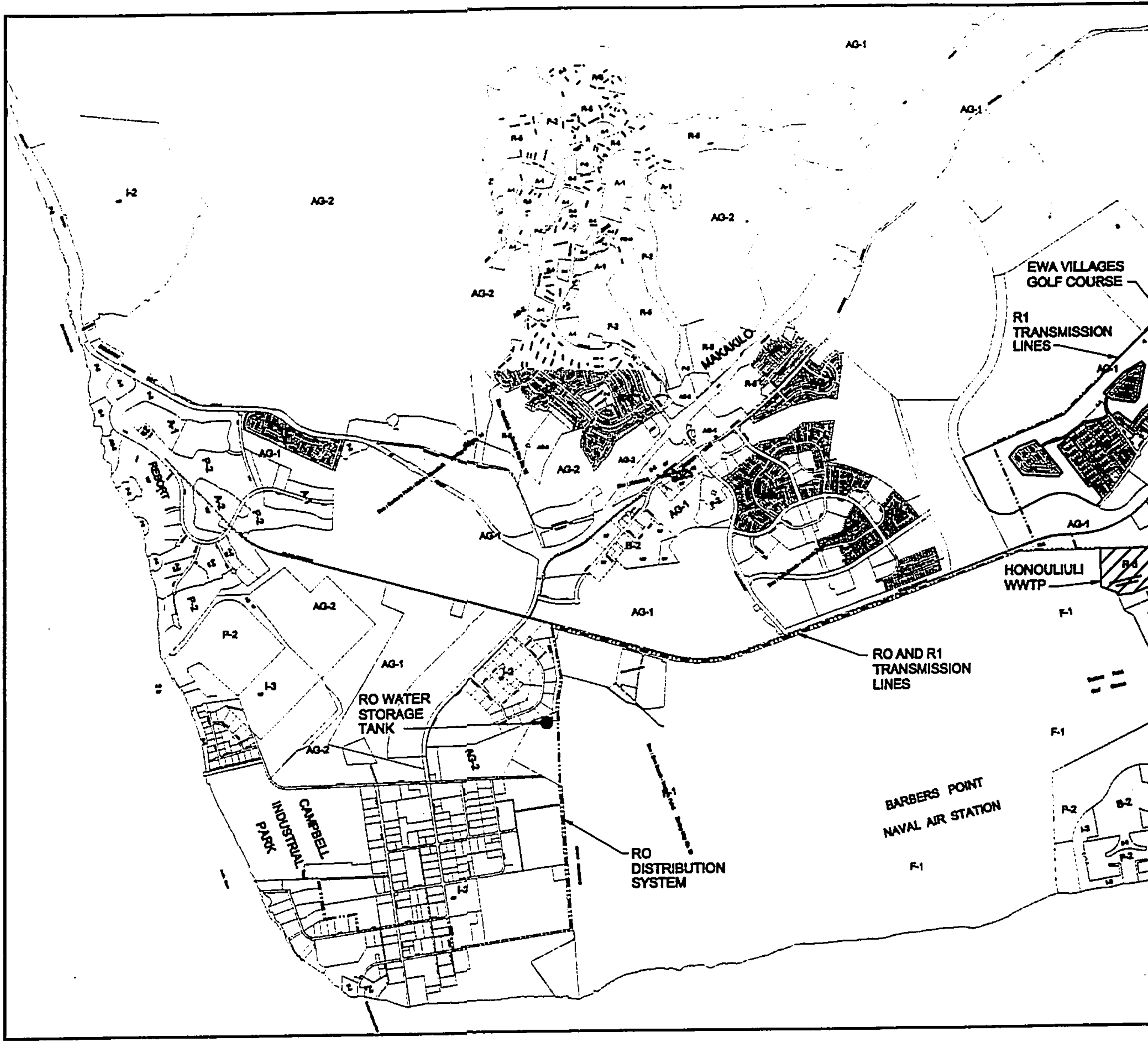

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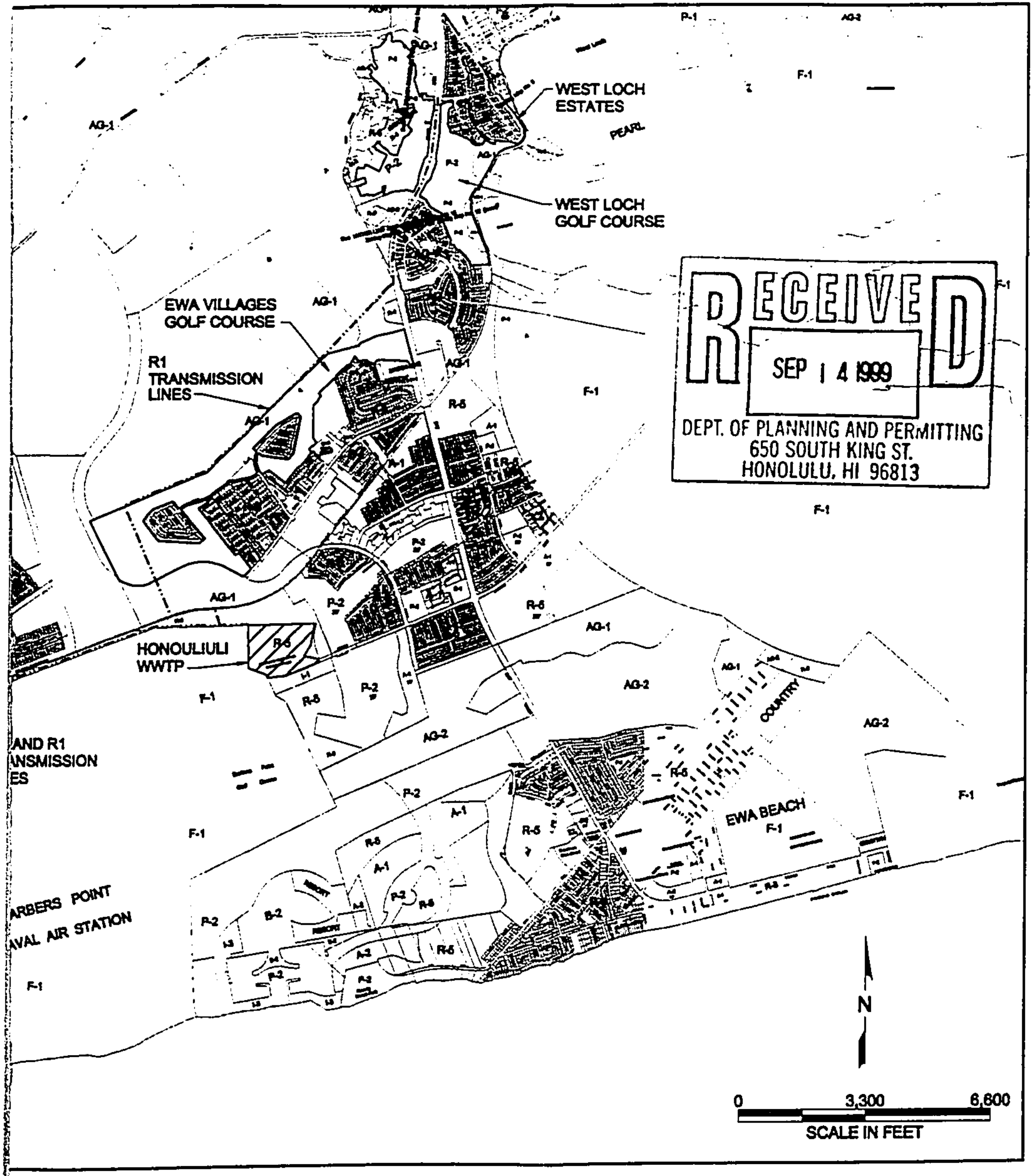
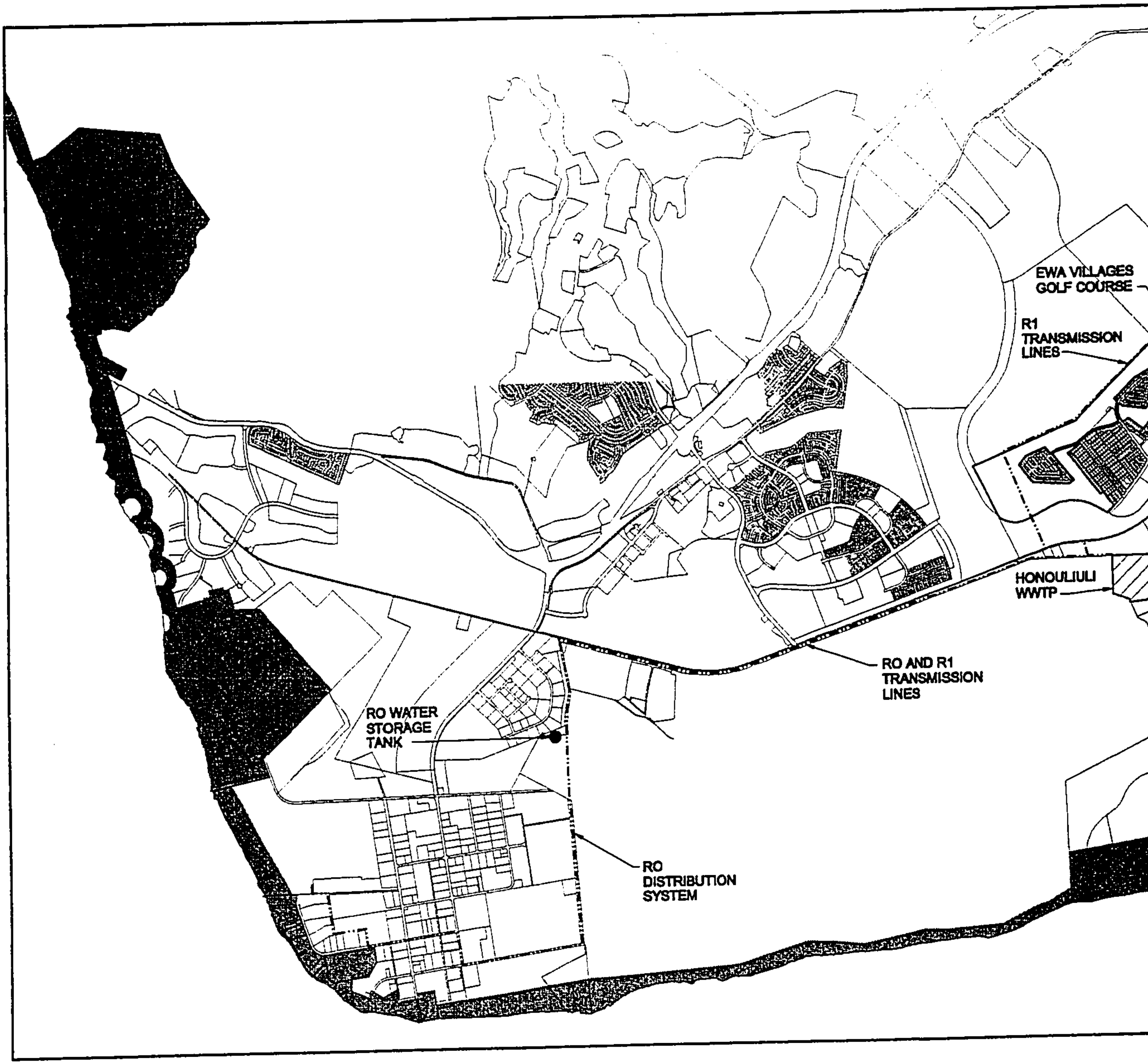


ZONING
FIGURE 4-4



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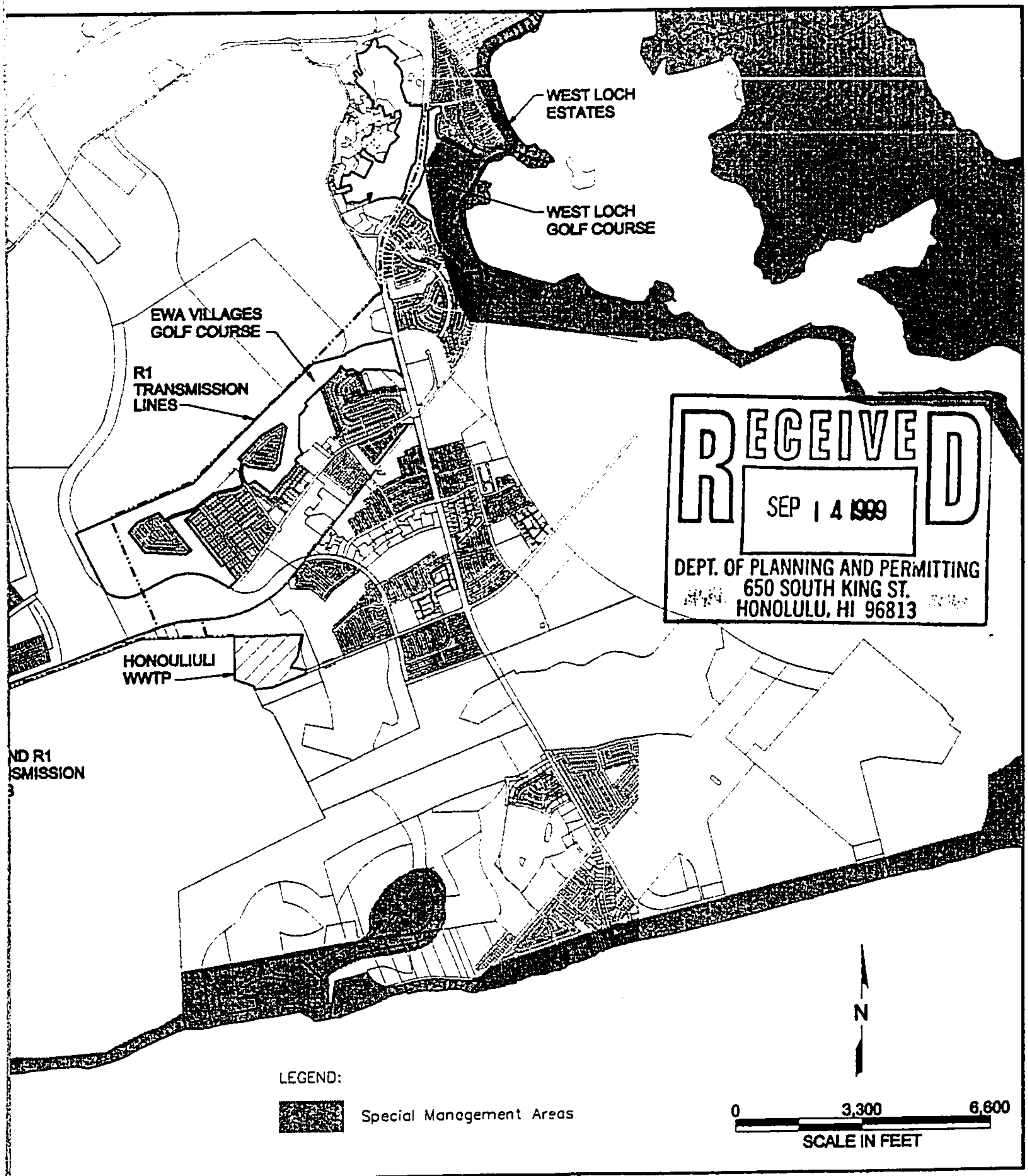

SPECIAL MANAGEMENT AREAS

FIGURE 4-5

Campbell Industrial Park

In 1958, Campbell Estate opened the 1,367-acre James Campbell Industrial Park (CIP), the largest industrial park and only heavy industrial park in Hawaii. The park has more than 300 tenants and provides nearly 4,000 jobs. The park's tenants represent a range of industries, including manufacturing, recycling, import/export, power generation, construction, warehousing and distribution (Campbell Estate 1998). Major recent industrial uses in the park include the City and County's H-POWER facility and the first privately-owned electrical power generating station (AES Barbers Point Cogeneration facility) built under contract to HECO (Helber Hastert & Fee, 1993).

Kapolei Business Park

The 895-acre Kapolei Business Park is the Estate of James Campbell's new, light industrial park adjacent to the City of Kapolei. It features flexible lot sizes intended for light manufacturing, processing, suppliers, wholesalers, warehousers and distribution companies. It is zoned I-2. At completion it is expected to generate over 6,000 jobs.

Barbers Point Harbor

This state-owned harbor has been developed to divert some shipping from overcrowded Honolulu Harbor. It presently handles the largest volume of bulk cargo in the state. Facilities include a 1,600-foot pier, 30 acres of paved back-up area with related infrastructure, and a bulk cargo ship unloader.

Barbers Point Naval Air Station

NAS Barbers Point is roughly three miles long and two miles wide and covers approximately 3,700 acres. About one-third of the land area is utilized for three runways and associated taxiways, aprons, and aircraft tie-down areas. North of the runways is an urban core consisting of residential, commercial and supporting services areas. To the east of the urban core is an industrial support area consisting of maintenance shops, warehouses, and paved areas (Helber Hastert & Fee, 1997).

Residential Communities

Kapolei has been one of the fastest growing areas in the State. A number of communities in the area are in the process of being developed and others are in the planning and approval process. Existing residential communities in the region include Ewa Beach, Ewa Villages, Ewa by Gentry, West Loch Estates, Villages of Kapolei, Makakilo, and Honokai Hale.

4.5.2.2 Planning Framework and Regulatory Status

In Hawaii, regulatory controls over land use are effected by both state and county governments.

State Land Use Districts: At the state level, land use districts are established to control broad scale land use patterns. Districts include Urban, Rural, Agriculture, and Conservation. The Honouliuli WWTP site is designated Urban and Agricultural, but the reclamation facility will be located on the Urban portion.

State land use district designations in the study area are exclusively agriculture and urban (LUC, 1998). Coastal lands, including Barbers Point Naval Air Station, Campbell Industrial Park, Barbers Point Harbor and Kahe Point, are all in the urban district except for a small band of agriculture land extending down Waimanalo Gulch to the sea. With only a few exceptions, the remaining agriculture lands are small remnant parcels destined for urban expansion. Several larger agriculture areas are found between Makakilo and Honouliuli, and the area inland of CIP and the Barbers Point Harbor.

County General Plan: At the County level, land use regulation evolves from broad principles established in a general plan. The *City and County of Honolulu General Plan* (1992) is a statement of the long-range social, economic, environmental, and design objectives for the general welfare and prosperity of the people of Oahu. In addition, the Plan provides broad policy directives intended to facilitate attainment of the objectives. Objectives and policies are divided into eleven major areas. Of relevance to the present discussion are the objectives and policies concerning population, economic activity and physical development:

- With respect to population, an objective of the City is to "Encourage development within the secondary urban center at Kapolei and the Ewa and Central Oahu urban-fringe areas...." A specific goal for the year 2010 distribution of Oahu's residential population is for the Ewa area to have 12.0-13.3% of the island's population (119,000 to 132,900 residents). As of 1990, the Ewa district had 5.1 % (42,983 residents) of Oahu's residential population.
- With respect to economic activity, a policy of the City is to "Direct major economic activity and government services to the primary urban center and the secondary urban center at Kapolei."
- With respect to physical development and urban design, a key City objective is "To develop a secondary urban center in Ewa with its nucleus in the Kapolei area." Policies supporting this objective include funding public projects to facilitate development of the area, encouraging development of a residential, commercial and employment center at Kapolei, encouraging development of Barbers Point as a major industrial center, and encouraging development of the Ewa Marina Community.

Long-Range Plans: Changes to the region will result from background growth consequent to implementation of the land use plans now in place. These include the C&C of Honolulu's *Ewa Development Plan*, the *Kapolei Area Long Range Master Plan*, and the *Naval Air Station Barbers Point Community Redevelopment Plan*. These are discussed below.

Ewa Development Plan: The City's *General Plan* is implemented through Development Plans (DP) which establish long-range land use patterns. The City and County of Honolulu's *Development Plan Common Provisions* specify general design principles and controls for new development. For land use planning purposes, Oahu is divided into eight geographic areas. The Ewa area encompasses the present study area. The City has embarked upon a Development Plan revision process; the Ewa Development Plan revision, the first in the series, was completed in 1997. This Plan strongly supports development of the secondary urban center.

Ewa's role in Oahu's development pattern is defined as follows:

> Ewa plays a key role in implementing the directed growth policies of the General Plan of the City and County of Honolulu. Campbell Industrial Park opened in the early 1960's, bringing industry and jobs to the leeward coast which previously had been predominantly a sugar economy and plantation lifestyle. In the 1970's, residential growth began in Ewa with the development of Makakilo and Ewa Beach.

The "Vision Statement" for Ewa reiterates the intention for the area to experience tremendous growth through the year 2020. Population should increase from its 43,000 people in 1990 to almost 125,000 in 2020, with nearly 28,000 new housing units. "Job growth will be equally impressive, rising from 17,000 jobs to over 64,000 in 2020." The deep draft harbor and major industrial center at Campbell Industrial Park/Barbers Point are projected to have over 7,000 jobs. Civilian reuse of BPNAS is projected to have almost 6,000 jobs.

General Policies of the DP for development of industrial centers and uses in Ewa are as follows:

> "Honouliuli should remain a smaller industrial area, used primarily for wastewater treatment. It includes 13 acres of land in the Ewa by Gentry project which is designated for light industrial use."

Kapolei Area Long Range Master Plan: This document provides a long range land use plan for the Ewa Plain. It incorporates the plans of private developers and public agencies. The time frame is through 2050. The plan will continue to evolve in response to economic, social, environmental and political forces.

The concept for development of Ewa is to create a "balanced" community providing a full range of urban services, housing, jobs, businesses and public facilities consistent with a true urban center. This supports the *General Plan* of the City and County of Honolulu. The expectation is that population in the area will double in the next twenty years.

Barbers Point Redevelopment Plan: A major land use just to the east of CIP is Barbers Point Naval Air Station (NASBP). In 1993, the Base Realignment and Closure (BRAC) Commission recommended the closure of Naval Air Station Barbers Point. The recommendation was confirmed soon after, with closure to be completed by July 1999. A Redevelopment Commission was formed, and a NASBP Redevelopment Plan (Helber Hastert & Fee 1997) drafted. The intention of the plan is to integrate base lands into the surrounding region.

County Land Use Ordinance: Implementation of the DP's broad land use goals is done through zoning, as established by the City and County of Honolulu's *Land Use Ordinance* (LUO). Designations of land uses in the DP usually precede designations of zoning precincts. This is the case in the study area, which is in transition from agriculture to urban land uses.

The Honouliuli WWTP site is zoned Residential (R-5) and Restricted Agriculture (AG-1). The reclamation facility will be in the Residential portion, which coincides with the State's Urban District. The entire WWTP site is designated a Public Facility on the City and County's Development Plan Land Use Map.

Within the study area, Campbell Industrial Park and the Kahe Power Plant lands are zoned I-2, Intensive Industrial. The area surrounding Barbers Point Harbor is zoned I-3, Waterfront Industrial. Much of the other lands in the vicinity are either agriculture or residential. Federal government lands, including BPNAS, are designated F-1 and not regulated by the City.

4.5.3 Required Permits and Approvals – Summary

The following permits and approvals have been identified:

City and County of Honolulu
Building Permit for Building, Electrical, Plumbing, Sidewalk/Driveway, and Demolition Work
Grubbing, Grading, Excavation and Stockpiling Permit
Certificate of Occupancy
Permit to Excavate Public Right-of-Way
Sewer Connection Permit
Street Usage Permit
Construction Dewatering Permit (if necessary)
Environmental Assessment

State of Hawaii
Permit to Perform Work Upon State Highway
Permit for Construction to Cross or Enter the State Energy Corridor
Historic Site Review
Permit to Construct and Operate Wastewater/Reclamation System

State/Federal
National Pollutant Discharge Elimination System (NPDES) Permit (for construction)

5.0 CONSULTATION

The following individuals, associations and agencies have been consulted with and informed about the reclamation project.

Honolulu Board of Water Supply

State Department of Health

Makakilo Neighborhood Board

Ewa Neighborhood Board

Councilman John DeSoto

State Senator Brian Kanno

State Representative Mark Moses

Department of Planning and Permitting

Department of Design and Construction

Department of Environmental Services

State Water Commission

6.0 DETERMINATION AND REASONS SUPPORTING THE DETERMINATION

The proposed project wold not have a significant effect on the environment and therefore preparation of an environmental impact statement is not required. The "significance criteria", Section 12 of Hawaii Administrative Rules Title 11, Chapter 200, "Environmental Impact Statement Rules", were reviewed and analyzed. Based on the analysis the following were concluded:

1. No irrevocable commitment to loss or destruction of any natural or cultural resource would result.

   All construction for both the reclamation plant and the distribution pipelines is located on previously disturbed land and no natural or cultural resources are present.

2. The action would not curtail the range of beneficial uses of the environment.

   The project will occupy previously developed industrial land and road right-of-way. As such, there will be no curtailment of beneficial use to the environment.

3. The proposed action does not conflict with the State's long-term environmental goals and guidelines.

   The proposed project implements the State's environmental goals by reclaiming sewer wastewater for beneficial use in agriculture and industry. The use of this water will reduce the demands on the Ewa caprock aquifer.

4. The economic or social welfare of the community or State would not be substantially affected.

   The use of reclaimed or water for agricultural and industrial purpose,s instead of drawing water from the Ewa caprock and basil aquifers, will result in an economic and social benefit to the community and to the State.

5. The proposed action does not substantially affect public health.

   The reclaimed water will meet all Department of Health quality standards. There are no health hazards associated with the utilization of the reclaimed water for irrigation and industrial purposes.

6. No substantial secondary impacts such as population changes or effects on public facilities.

   The reclaimed water will be used only for industrial and irrigation purposes, and is not for human consumption. As such, in and of itself, it will not have an impact on population. The plant utilizes water from the wastewater treatment plant and does not generate the need for any additional public facilities.

7 No substantial degradation of environmental quality is anticipated.

There will be no degradation of the environment. In fact, reclaiming the water for beneficial uses will have a positive impact on the environment.

8. The proposed action does not involve a commitment to larger actions, nor would cumulative impacts result in considerable impact on the environment.

The current project is self contained and is limited to 12 million gallons per day. It is expected however that recycling wastewater will have a positive impact upon the environment in the Ewa plain and that additional amounts of water will be re-cycled in the future.

9. No rare, threatened or endangered species or their habitats would be affected.

The issue of endangered species has been thoroughly reviewed in the draft environmental assessment in section 4. With regard to plants, all construction within the W. W. T. P. compound, as well as along the pipelines, will be done in areas previously disturbed. There will be no impacts that will threaten any endangered species of vegetation. Once the system is operational, the areas to be irrigated will be landscaped golf courses and common areas, not native ecosystems.

With regard to wildlife, neither the plant or the water distribution lines will impinge on any areas used as habitats by endangered wildlife. To the extent that the irrigation water and its contained dissolved nutrients are applied to various areas presently not irrigated, the consequent additional plant growth and habitat may provide supplemental prey and forage areas for owls and water birds. The impacts should be beneficial.

There will be no impact on Marine species.

10. Air quality, water quality, or ambient noise levels would not be detrimentally affected.

Current noise sources at the W. W. T. P. include vehicular traffic and equipment, mainly pumps. The project will increase vehicular traffic and equipment noise during construction, but there will be no significant difference during operation.

The estimated construction impacts on air quality will be below the corresponding significance levels established by the DOH; therefore, mitigation measures are not required to protect the public health and welfare. If the fugitive dust becomes a problem, mitigation measures will be initiated. Contractors will be required to comply with Department of Health rules and regulations. Once the facilities are operational their quality impacts will be limited to the effects of the vehicle emissions of the additional four workers that will be employed at the reclamation plant.

There are no impacts on air quality resulting from the construction or operation of the distribution system.

The reclamation process will provide an increase in overall water quality.

11. The project would not affect environmentally sensitive areas, such as flood planes, tsunami zones, erosion prone areas, geologically hazardous lands, estuaries, fresh waters, or coastal waters.

The location of the reclamation plant and the distribution pipelines are all in previously disturbed areas. None of the construction or the operation of the plant will have any impact on the environmentally sensitive areas defined in paragraph 11.

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APPENDIX A
BACKGROUND INFORMATION ON CRITERIA AIR POLLUTANTS

Criteria Air Pollutants

This appendix provides a brief background on the pollutants for which ambient standards have been developed.

O_3 - Ozone is the main constituent in photochemical air pollution. It is formed in the atmosphere by chemical reaction of nitrogen oxides (NO_x) and volatile organic compounds (VOCs) in the presence of sunlight. In the upper atmosphere, O_3 shields the earth from harmful ultraviolet radiation, however at ground level it can cause harmful effects in humans and plants.

NO_2 - Nitrogen dioxide is a brownish, highly corrosive gas with a pungent odor. It is formed in the atmosphere from emissions of nitrogen oxides (NO_x). Sources of nitrogen oxides include electric utilities, industrial boilers, motor vehicle exhaust, and combustion of fossil fuels. NO_2 is also a component in the atmospheric reactions that produce ground-level ozone.

PM_{10} - This pollutant is particulate matter that is 10 microns or less in aerodynamic diameter. The EPA revised the NAAQS for particulate matter in 1987 to cover only PM_{10}, because these smaller-sized particles have the greatest potential for respiratory health impacts.

CO - Carbon monoxide is a colorless, odorless, tasteless gas under atmospheric conditions. It is produced by the incomplete combustion of carbon fuels with the majority of emissions in urban areas from transportation sources.

Pb - Lead is a naturally occurring substance found in the environment that has been used as an ingredient in paint and gasoline. Particulates of Pb and its compounds enter the air mainly from vehicle exhaust. Lead can be inhaled or ingested and can accumulate in the blood, bone, and soft tissue. The elimination of Pb in gasoline sold in the United States has greatly reduced the amount of Pb in ambient air.

SO_x- Sulfur oxides are colorless gases which include SO_2. Emissions of SO_x are largely from sources that burn fossil fuels such as coal and oil. On the Island of Hawaii, a significant source of SO_x emissions is from the on-going eruption of Kilauea Volcano.

APPENDIX B
AIR EMISSIONS DATA

Table B-1. Source Data for Construction Equipment

	Number	Rated	Load	Hours	Days .	Total	EPA Nonroad Emission Factors (g/hp-hr) (e)					
Equipment type (a)	quipment	HP (b)	Factor (c)	Per Day (d)	Per Week (d)	Weeks (d)	CO	VOC	NO_x	SO_x	PM_{10}	Source Category
Air compressor	1	200	0.48	8	5	52	5.00	1.20	8.00	0.93	1.00	Air compressor
Excavator	2	56	0.57	8	5	26	5.20	0:70	10.75	0.93	1.44	Excavator
Crane	1	194	0.43	8	5	13	4.20	1.26	10.30	0.93	1.44	Crane
Forklift	1	215	0.30	8	5	52	6.06	1.57	14.00	0.93	1.60	Forklift
Grader	1	125	0.61	8	5	13	3.80	1.50	9.60	0.87	1.00	Grader
Compactor	1	5	0.43	8	5	13	3.10	0.80	9.30	0.93	0.90	Plate compactor

Notes: (a) All equipment is diesel-fueled, unless otherwise indicated.
(b) Source of Data: SCAQMD 1993
(c) Source of Data: EPA 1997
(d) Usage assumed.
(e) Source of Data: EPA 1991

Table B-2. Estimated Maximum Emissions for Construction Equipment (a)

	Emissions (tons/year)				
Equipment Type	CO	VOC	NO_x	SO_x	PM_{10}
Air compressor	1.10	0.26	1.76	0.20	0.22
Excavators (2)	0.38	0.05	0.79	0.07	0.11
Crane	0.20	0.06	0.49	0.04	0.07
Forklift	0.90	0.23	2.07	0.14	0.24
Grader	0.17	0.07	0.42	0.04	0.04
Compactor	0.00	0.00	0.01	0.00	0.00
Total Emissions	2.75	0.67	5.54	0.49	0.68

Table B-3. Emission Source Data for Construction Vehicles

	Total Trips	Round Trip	MOBILE5b Emission Factors (g/mile) (c)					
Vehicles	Per Year (a)	Distance (miles) (b)	CO	VOC	NO_x	SO_x	PM_{10}	Source Category
Employee Vehicles	7500	40	20.80	2.36	1.40	neg.	neg.	LDGV
Trucks	2500	40	8.80	1.77	8.86	neg.	neg.	HDDV

Notes: (a) Assumptions given in text.
(b) The round trip distance was assumed to be 40 miles per vehicle.
(c) Source Data: The MOBILE5b model outputs.

Table B-4. Estimated Maximum Emissions for Construction Vehicles (a)

	Emissions (tons/year)				
Vehicles	CO	VOC	NO_x	SO_x	PM_{10}
Employees Vehicles	6.88	0.78	0.46	neg.	neg.
Trucks	0.97	0.20	0.98	neg.	neg.
Total Emissions	7.85	0.98	1.44	neg.	neg.

APPENDIX C
EXCERPTS FROM THE HAWAII DEPARTMENT OF HEALTH'S "GUIDELINES FOR THE TREATMENT AND USE OF RECLAIMED WATER"

Reclaimed Water Quality Definitions

The guidelines define three levels of reclaimed water quality that are associated with different levels of treatment. The definition of R-1 water (highest quality) is as follows:

R-1 water (characterized by significant reduction in viral and bacterial pathogens) means reclaimed water that has been oxidized, filtered, and disinfected to meet the following criteria:

A. A disinfection process that, when combined with the filtration process, has been demonstrated to reduce the concentration of plaque-forming units of F-specific bacteriophage MS2, or polio virus, per unit volume of water in the wastewater to one ten thousandth (1/10,000) of the initial concentration in the filter effluent throughout the range of qualities of wastewater that will occur during the reclamation process.

B. Fecal coliform bacteria densities as follows:

   (1) The median density measured in the disinfected effluent does not exceed 2.2 per 100 milliliters utilizing the bacteriological results of the last seven days for which analyses have been completed; and

   (2) The density does not exceed 23 per 100 milliliters in more than one sample in any 30-day period; and

   (3) No sample shall exceed 200 per 100 milliliters.

Suitable Uses For Reclaimed Water

SUITABLE USES OF RECLAIMED WATER	R1	R2	R3
[illegible] Spray [illegible] Drip & Surface [illegible] Subsurface [illegible] Spray with [illegible]			
Golf course landscapes	A	U/B	N
Freeway and cemetery landscapes	A	A	N
Parks, elementary schoolyards, athletic fields and landscapes around some residential property	A	U	N
Roadside and median landscapes	A	U/B	N
Non-edible vegetation in areas with listed public exposure	A	AB	U
Sod farms	A	AB	N
Ornamental plants for commercial use	A	AB	N
Food crops above ground & not contacted by irrigation	A	U	N
Pastures for milking and other animals	A	U	N
Fodder, fiber, and seed crops not eaten by humans	A	AB	DU
Orchards and vineyards bearing food crops	A	D/U	DU
Orchards and vineyards not bearing food crops during irrigation	A	AB	DU
Timber and trees not bearing food crops	A	AB	DU
Food crops undergoing commercial pathogen destroying process before consumption	A	AB	DU
[illegible] IMPOUNDMENTS [illegible]			
Restricted recreational impoundments	A	N	N
Basins at fish hatcheries	A	N	N
Landscape impoundments without decorative fountain	A	A	N
Landscape impoundments with decorative fountain	A	N	N
[illegible] OTHER USES [illegible]			
Flushing toilets and urinals	A	N	N
Fire fighting	A	N	N
Commercial and public laundries	A	N	N
Cooling saws while cutting pavement	A	N	N
Decorative fountains	A	N	N
Washing yards, lots and sidewalks	A	N	N
Flushing sanitary sewers	A	A	N
High pressure water blasting to clean surface	A	N	N
Industrial process without exposure of workers	A	A	N
Industrial process with exposure of workers	A	N	N
Cooling or air conditioning system without tower, evaporative condenser, spraying, or other features that emit vapor or droplets	A	A	N
Cooling or air conditioning system with tower, evaporative condenser, spraying, or other features that emit vapor or droplets	A	N	N
Industrial boiler feed	A	A	N
Water jetting for consolidation of backfill material around potable water piping during water shortage	A	N	N
Water jetting for consolidation of backfill material around piping for reclaimed water, sewage, storm drainage, and gas; and electrical conduits	A	A	N
Washing aggregate and making concrete	A	A	N
Dampening roads and other surfaces for dust control	A	A	N
Dampening brushes and street surfaces in street sweeping	A	A	N

Precautions for R1 Water Reuse

1. Reclaimed water may be used only on approved areas;
2. A copy of the regulations shall be provided to all persons supplied with reclaimed water, and their written agreement shall be obtained to comply with all applicable provisions;
3. Signs shall be posted where reclaimed water is used pursuant to the "Public Education and Employee Training Plan" specified in the guidelines;
4. Adequate measures shall be taken to avoid ponding of reclaimed water;
5. Reclaimed water shall always be managed to avoid conditions conducive to proliferation of mosquitoes and other disease vectors, and to avoid creation of a public nuisance or health hazard;
6. No discharge, runoff or overspray shall extend beyond the approved use area boundaries;
7. Spray of reclaimed water shall not be allowed to contact an external drinking water fountain;
8. The following precautions pertain to the use of R-1 water only:

a. There shall be no irrigation within a minimum of 50 feet of any drinking water supply well;
b. The outer edge of the impoundment shall be located at least 100 feet from any drinking water supply well; and
c. Drainage shall be controlled to prevent reclaimed water from coming within 50 feet of a drinking water supply well.

Suitable Uses For Reclaimed Water

SUITABLE USES OF RECLAIMED WATER	R1	R2	R3
IRRIGATION: (S)pray, (D)rip & Surface, S(U)bsurface, (A)ll=S, D & U, Spray with (B)uffer, (N)ot allowed, /= or			
Golf course landscapes	A	U/B	N
Freeway and cemetery landscapes	A	A	N
Parks, elementary schoolyards, athletic fields and landscapes around some residential property	A	U	N
Roadside and median landscapes	A	U/B	N
Non-edible vegetation in areas with listed public exposure	A	AB	U
Sod farms	A	AB	N
Ornamental plants for commercial use	A	AB	N
Food crops above ground & not contacted by irrigation	A	U	N
Pastures for milking and other animals	A	U	N
Fodder, fiber, and seed crops not eaten by humans	A	AB	DU
Orchards and vineyards bearing food crops	A	D/U	DU
Orchards and vineyards not bearing food crops during irrigation	A	AB	DU
Timber and trees not bearing food crops	A	AB	DU
Food crops undergoing commercial pathogen destroying process before consumption	A	AB	DU
SUPPLY TO IMPOUNDMENTS: (A)llowed, (N)ot allowed			
Restricted recreational impoundments	A	N	N
Basins at fish hatcheries	A	N	N
Landscape impoundments without decorative fountain	A	A	N
Landscape impoundments with decorative fountain	A	N	N
SUPPLY TO OTHER USES: (A)llowed, (N)ot allowed			
Flushing toilets and urinals	A	N	N
Fire fighting	A	N	N
Commercial and public laundries	A	N	N
Cooling saws while cutting pavement	A	N	N
Decorative fountains	A	N	N
Washing yards, lots and sidewalks	A	N	N
Flushing sanitary sewers	A	A	N
High pressure water blasting to clean surface	A	N	N
Industrial process without exposure of workers	A	A	N
Industrial process with exposure of workers	A	N	N
Cooling or air conditioning system without tower, evaporative condenser, spraying, or other features that emit vapor or droplets	A	A	N
Cooling or air conditioning system with tower, evaporative condenser, spraying, or other features that emit vapor or droplets	A	N	N
Industrial boiler feed	A	A	N
Water jetting for consolidation of backfill material around potable water piping during water shortage	A	N	N
Water jetting for consolidation of backfill material around piping for reclaimed water, sewage, storm drainage, and gas; and electrical conduits	A	A	N
Washing aggregate and making concrete	A	A	N
Dampening roads and other surfaces for dust control	A	A	N
Dampening brushes and street surfaces in street sweeping	A	A	N

Precautions for R1 Water Reuse

1. Reclaimed water may be used only on approved areas;
2. A copy of the regulations shall be provided to all persons supplied with reclaimed water, and their written agreement shall be obtained to comply with all applicable provisions;
3. Signs shall be posted where reclaimed water is used pursuant to the "Public Education and Employee Training Plan" specified in the guidelines;
4. Adequate measures shall be taken to avoid ponding of reclaimed water;
5. Reclaimed water shall always be managed to avoid conditions conducive to proliferation of mosquitoes and other disease vectors, and to avoid creation of a public nuisance or health hazard;
6. No discharge, runoff or overspray shall extend beyond the approved use area boundaries;
7. Spray of reclaimed water shall not be allowed to contact an external drinking water fountain;
8. The following precautions pertain to the use of R-1 water only:

a. There shall be no irrigation within a minimum of 50 feet of any drinking water supply well;
b. The outer edge of the impoundment shall be located at least 100 feet from any drinking water supply well; and
c. Drainage shall be controlled to prevent reclaimed water from coming within 50 feet of a drinking water supply well.

APPENDIX D
HAWAII GOLF COURSES IRRIGATING WITH RECLAIMED WATER

GOLF COURSES (9/98)
REUSE PROJECTS

Facility/File Number	Name	MGD	ACRES	ISLAND
Heeia WWTP; #301; R-2	Alii and Kona Country Club	0.450	100	Hawaii
Waikoloa Beach Resort; #540; R-2	Waikoloa Beach Resort	0.500	270	Hawaii
Punalu'u Water & Sanitation; #535; R-2	Sea Mountain	0.020	120	Hawaii
South Kohala WW Corp.; R-2	Mauna Kea Golf Course	0.250	188	Hawaii
Poipu WRF; #428; R-2	Kiahuna	0.130	140	Kauai
Hyatt Regency Kauai; #409; R-2	Poipu Bay	0.243	167	Kauai
Lihue Puhi WRF; #439; R-1	Puakea	0.300	195	Kauai
Princeville Resort STP; #431; R-2	Princeville Resort	0.500	141	Kauai
Wailua WWTP; #309; R-2	Wailua	0.250	200	Kauai
Lihue WWTP; #308; R-2	Kauai Lagoons Resort	1.500	398	Kauai
Manele Bay WWTP; #701; R-1	Manele Bay	0.060	25	Lanai
Lanai Auxilliary WRF; #311; R-1	Koele	0.200	200	Lanai
Pukalani WWTP; #118; R-2	Pukalani Country Club	0.240	160	Maui
Maui Prince Hotel STP; R-2	Makena Club	0.070	380	Maui
Lahaina WWTP; #313; R-1	Kaanapali GC	1.000	170	Maui
Kihei; #312; R-1	Silversword	1.000	120	Maui
Kaluakoi, Ke Nani & Paniole Hale; #603; R-2	Kaluakoi Resort	0.110	120	Molokai
East Hon WWTP; #202; R-1	Hawaii Kai GC	0.200	150	Oahu

MCBH WWTP; #330; R-2	Klipper	0.300	200	Oahu
Kuilima Resort/ Turtle Bay Hilton; #237; R-2	Kuilima	0.160	175	Oahu

Total=20; Total Volume=7.483 mgd

APPENDIX E
ARCHAEOLOGICAL STUDY

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REPORT OF
ARCHAEOLOGICAL ARCHIVAL RESEARCH FOR THE HONOULIULI WASTEWATER TREATMENT PLANT WATER RECLAMATION PROJECT, ISLAND OF O`AHU

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April 1999

ABSTRACT

Pacific Legacy, under contract to Dames and Moore, conducted archival research for the proposed Honouliuli Wastewater Treatment Plant Water Reclamation Project in `Ewa on the island of O`ahu. The purpose of this project was to gather enough data to be able to predict if any archaeological resources may be present in the project area and the likelihood of these resources being impacted by the project. The Honouliuli Wastewater Treatment Plant Water Reclamation Project will consist of construction of a reclamation facility within the existing plant area, and placing approximately 12 miles of pipeline from the Plant through residential areas to commercial and recreation areas.

Archival research and a review of previous archaeological studies in the area indicate that the 'Ewa Plain has undergone dramatic and extensive alterations over its long land use history. There is extremely little likelihood that any surface archaeological sites will be present within the project area. The only exception to this is the Oahu Rail and Land Company Right-of-Way, which is listed on the National Register of Historic Places and must be considered in planning pipeline construction.

While there is little likelihood of encountering surface archaeological sites, there is the possibility of encountering subsurface resources in the form of sinkholes containing cultural materials and possibly human burials. It is recommended that an archaeologist be retained to assist the contractor in the event that subsurface archaeological resources are encountered.

1.0 INTRODUCTION

Pacific Legacy, Inc., at the request of Dames and Moore, Inc., conducted archaeological archival research for the proposed Honouliuli Wastewater Treatment Plant water Reclamation Project, in Honouliuli *ahupua`a*, `Ewa District, island of O`ahu. The district of `Ewa is the largest district on O`ahu. The proposed project will involve the construction of wastewater reclamation facilities within the existing Honouliuli Wastewater Treatment Plant, and approximately 12 miles of pipeline that will lead from the treatment plant to various commercial and recreational areas on the `Ewa Plain (Figure 1).

The Honouliuli Wastewater Treatment Plant was constructed between 1979 and 1984 for the primary treatment of 25 MGD of wastewater from the `Ewa district of O`ahu. The plant is located on the west side of Fort Weaver Road, along Geiger Road and is currently operated by the City and County of Honolulu.

1.1 SCOPE OF WORK

The archival research conducted for this project included obtaining general information for the Honouliuli area including specific information regarding archaeological projects conducted in `Ewa. This information is used as a means of predicting the likelihood of sites and deposits that may be encountered during the project.

Tasks for the current project were performed as follows:

(1) a review of the relevant previous archaeological research conducted in the immediate area;

(2) review of historic documents and literature pertaining to the area; and

(3) preparation of a final report summarizing information and predicting sites types likely to be identified, and recommendations for future work.

1.2 ENVIRONMENTAL SETTING

The district of `Ewa has undergone numerous changes in modern times. Located on the southwestern side of O`ahu, the district of `Ewa (or the `Ewa Plain, as it is often called) was formed by "a broad elevated coral reef partly covered by alluvium carried out from the mountains" (Macdonald et al. 1983: 420). Elevation of the `Ewa Plain ranges from sea level to over 200 feet (60.96 m) above mean sea level (AMSL). Approximately 20 inches (50.80 cm) of rain falls annually, with the majority occurring between November and February. Temperatures range between 60° and 90°F with the highest temperatures occurring in August and September (Armstrong 1983).

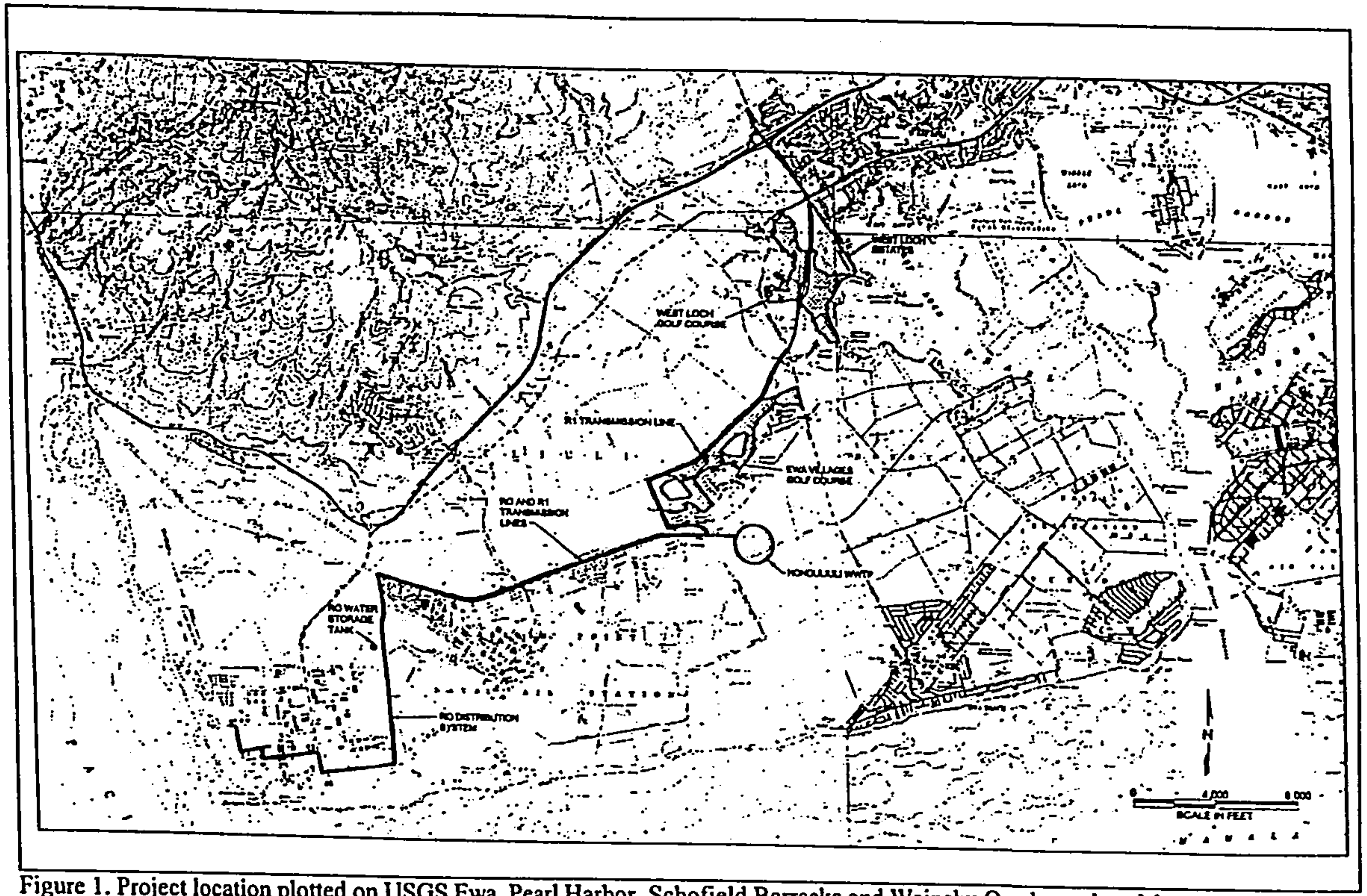

Figure 1. Project location plotted on USGS Ewa, Pearl Harbor, Schofield Barracks and Waipahu Quadrangules. Map courtesy of Dames & Moore, April 1999.

The only permanent running water at Honouliuli is located in Honouliuli Gulch, located on the northeast side of the *ahupua`a*, adjacent to the *ahupua`a* of Hō`ae`ae.

1.2.1 Vegetation

Vegetation throughout the `Ewa Plain consists of a variety of alien plants including: lantana (*Lantana camara*), *koa haole* (*Leucaena glauca*), *pānini* (*Opuntia megacantha*), *klu* (*Acacia farnesiana*), *`ilima* (*Sida fallax*), *kiawe* (*Prosopis pallida*), finger grass (*Chloris* sp.), natal grass (*Tricholaena rosea*), and various ornamental trees and bushes.

1.2.2 Soils

Soils in the region of `Ewa include: the Waipahu Series, Honouliuli Series, Pearl Harbor Series, Kaloko Series, Ewa Series, Mamala Series, Filled Land, and Coral Outcrop (Foote et al. 1972). Each of these soils are briefly discussed below.

> **Coral Outcrop** This series consists of coral or cemented calcareous sand on the island of Oahu. The coral reefs formed in shallow ocean water during the time the ocean stand was at a higher level. Small areas of coral outcrop are exposed on the ocean shore, on the coastal plains, and at the foot of the uplands. Elevations range from sea level to approximately 100 feet. . .This land type is used for military installations, quarries, and urban development (Foote et al. 1972:29).
>
> **Ewa Series** This series consists of well-drained soils in basins and on alluvial fans on the islands of Maui and Oahu. These soils developed in alluvium derived from basic igneous rock. They are nearly level to moderately sloping. Elevation ranges from near sea level to 150 feet. . .These soils are used for sugarcane, truck crops, and pasture (Foote et al. 1972:29).
>
> **Fill Land** This series consists mostly of areas filled with bagasse and slurry from sugar mills. A few areas are filled with material from dredging and from soil excavation. Generally, these materials are dumped and spread over marshes, low-lying areas along the coastal flats, coral sand, coral limestone, or areas shallow to bedrock. . .This land type is used mostly for the production of sugarcane (Foote et al. 1972:31).
>
> **Honouliuli Series** This series consists of well-drained soils on coastal plains on the island of Oahu in the Ewa area. These soils developed in alluvium derived from basic igneous material. They are nearly level and gently sloping. Elevation ranges from 15 to 125 feet. . .These soils are used for sugarcane, truck crops, orchards and pasture (Foote et al. 1972:43).
>
> **Kaloko Series** This series consists of poorly drained soils on coastal plains on the islands of Kauai and Oahu. These soils developed in alluvium derived from basic igneous rock; the alluvium has been deposited over marly lagoon deposits. The soils are nearly level. Elevations range from sea level to 20 feet. . .These soils are used for irrigated sugarcane and pasture (Foote et al. 1972:58).
>
> **Mamala Series** This series consists of shallow, well-drained soils along the coastal plains on the islands of Oahu and Kauai. These soils formed in alluvium deposited over coral limestone and consolidated calcareous sand. They are nearly level to moderately

sloping. Elevations range from near sea level to 100 feet on Oahu but extend to 850 feet on Kauai. . .These soils are used for sugarcane, truck crops, orchards, and pasture (Foote et al. 1972:93).

Waipahu Series This series consists of well-drained soils on the marine terraces on the island of Oahu. These soils developed in old alluvium derived from basic igneous rock. They are nearly level to moderately sloping. Elevations range from near sea level to 125 feet. . .These soils are used for sugarcane and homesites (Foote et al. 1972:134).

Pearl Harbor Series This series consists of very poorly drained soils on nearly level coastal plains on the island of Oahu. These soils developed in alluvium overlying organic material. Elevations range from near sea level to 5 feet. . .These soils are used for taro, sugarcane, and pasture (Foote et al. 1972:112).

2.0 ARCHIVAL RESEARCH

The information discussed below was obtained from a document and literature search conducted at the State Historic Preservation Division, Department of Land and Natural Resources Library at Kapolei, The State of Hawai`i Library and The State Bureau of Conveyances. Materials obtained from this search were used in the current document to assess possible impact to cultural resources. Based on these results, recommendations will be presented for further archaeological work.

2.1 TRADITIONAL HISTORY

Several works have summarized the traditions of `Ewa. Among these are Sterling and Summers (1978), Kelly (1991), and Charvet-Pond and Davis (1992). The reader is referred to these for more detailed information. Presented below is a brief discussion, highlighting the themes of the `Ewa Plain.

Sterling and Summers (1978) relates an interesting legend regarding the creation and name of the `Ewa Plain:

> When Kane and Kanaloa were surveying the islands they came to Oahu and when they reached Red Hill saw below them the broad plains of what is now Ewa. To mark the boundaries of land they would throw a stone and where the stone fell would be the boundary line. When they saw the beautiful land lying below them, it was their thought to include as much of the flat level land as possible. They hurled the stone as far as the Waianae range and it landed somewhere in the Waimanalo section. When they went to find it, they could not locate the spot where it fell. So Ewa (strayed) became known by that name. The stone that strayed (Sterling and Summers 1978:1).

The stone was eventually found at Pili o Kahe. The spot marks the boundary between Honouliuli and Wai`anae. It is said that the hill on the `Ewa side is the male and the hill on the Wai`anae side is the female (Sterling and Summer 1978: 1).

Traditionally, Pu`u o Kapolei may have been the most important cultural place on `Ewa. Pu`u o Kapolei is a volcanic cone that in ancient times had several uses (the residence of *kamapua`a,* a landmark, and a point for solar observation). The *pu`u* was said to have a *heiau* (possibly dedicated to the sun) which was destroyed prior to McAllister`s O`ahu survey (1933). Tuggle and Tuggle (1997:28) claim that Pu`u o Kapolei may have been the term for the whole region of `Ewa and not just the hill. This is based on the fact that Pu`u o Kapolei was the primary landmark for travelers between Pearl Harbor and west O`ahu with the trail passing inland of it.

The *ahupua`a* of `Ewa was known for its taro (*kalo*). In fact, `Ewa was said to have its own taro that was favored by the inhabitants of the region. This particular type of taro was known as *Kaikoi* and was the famous type of taro grown in `Ewa (Handy and Handy 1972). Sterling and Summers (1978) also discuss this type of taro. In a newspaper article taken from *Na Wahi Pana o Ewa,* by Ka Loea Kalaiaina, dated June 3, 1899, the merits of the `Ewa taro are discussed:

> The native of Ewa, whether man or woman, will know just how to do it (pound *poi*) until your palate is pleased. This is one thing on the ka-i koi taro of Ewa. That is the taro that visitors gnaw on and find it so good that they want to live until they die in Ewa. The poi of ka-i koi is so delicious (Sterling and Summers 1978: 8).

Of the lands used to cultivate taro, Handy (1940) writes:

> Large terrace areas are shown on the U.S. Geological Survey map of Oahu (1917) bordering West Loch of Pearl Harbor, the indication being that these are still under cultivation. I am told taro is still grown here. This is evidently what is referred to as "Ewa taro lands" (Handy 1940: 82).

Traditionally, the `Ewa district was an alii stronghold. This is attributed to the fact that Pearl Harbor was abundant with marine resources.

> The primary reason for `Ewa's prominence in history and as an ali`i stronghold was undoubtedly the existence of the great number of fishponds at different points around Pearl Harbor, which was `Ewa territory. . .The Pearl Harbor ponds were stocked with various kinds of fish, but especially mullet, because these inland waters were the summer home of the mullet of Oahu (Handy and Handy 1972:470).

2.3 HISTORIC LAND USE

Kamehameha gave the entire *ahupua`a* of Honouliuli to Kalanimoku, after he conquered O`ahu, with the right that he could pass it on to his heirs. Later, Kalanimoku passed on the land to his sister Wahinepi`o.

The entire *ahupua`a* of Honouliuli (Land Commission Award 11216, Apana 8; approximately 43,250 acres) was awarded to a granddaughter of Kamehameha I, Mikahela Kekau`ōnohi, one of the wives of Kamehameha II and daughter of Wahinepi`o (who she likely claimed the land through). Kekau`ōnohi was awarded land on all of the Hawaiian Islands including the *ahupua`a* of Honouliuli and Waimalu on O`ahu (LCA records on file at the State of Hawai`i, Bureau of Conveyances; Vol. 9, pg. 659). "About 150 acres of the *ahupua`a* (Honouliuli) were excluded as part of *kuleana* awards to commoners" (Tuggle and Tuggle 1997:34). A total of 72 awards were made, all of which appear to be in or adjacent to Honouliuli Gulch (Tuggle and Tuggle 1997:34), which is not within or near the project area.

By the 1850's cattle ranching was firmly established at `Ewa with an estimated 12,000 head of cattle. By 1877, James Campbell was said to have some 32,000 head of wild cattle (Briggs 1926, quoted in Kelly 1991: 162). The sugar industry in Hawaii began to rapidly expand in the 1890's and severely altered the appearance of the `Ewa Plain and the rest of the islands. Construction for the Oahu Railway & Land (OR&L) railroad began in 1889 and eventually went around the island. This opened up `Ewa and the rest of O`ahu for sugar, pineapple, and eventually military use.

In 1888, Benjamin F. Dillingham's company, Oahu Railway and Land Company, began construction of the OR&L railroad that was to extend westward from Honolulu. By 1890 it extended to Pearl City, by 1895 it extended to Wai`anae, and by 1899 it extended to Kahuku, the farthest point form Honolulu (National Register of Historic Places Nomination Form; see Appendix A). The railroad carried both passengers and freight. The railroad was instrumental in the development of several sugar plantations (Ewa Plantation Company, Kahuku Plantation Company, Oahu Sugar Company, and the Waialua Agricultural Company) as well as James Dole's pineapple efforts in central Oahu. During World War II, the Oahu Railway, as it became to be known, transported supplies, munitions, troops, and defense workers. At its height, the Oahu Railway consisted of 175 miles of track. After World War II, railroad business declined dramatically - in 1947 all operations outside of Honolulu were abandoned, a pineapple shuttle from Pier 34 to the cannery ceased operation in 1972. A portion of the railroad right-of-way between Nānākuli and Honouliuli was placed on the National Register of Historic Places on December 1, 1975 (see Appendix A).

By the 1920s, Honouliuli was used almost exclusively for sugar cultivation and ranching. The `Ewa Plantation Company controlled approximately 12,000 acres which included sugar cane, a sisal plantation, residential areas for several thousand people, and a limestone quarry. The O`ahu Sugar Company controlled 3,000 acres, although not all of it was planted in sugar. Honouliuli Ranch, the largest land holder, controlled approximately 20,000 acres with much of it considered waste because it contained gullies and rocks. Six thousand acres were reportedly planted in pineapple, or remained as forest and wetland.

Frierson (1973) indicates that the Ewa Plantation Company drastically altered the landscape in an attempt to increase the amount of fertile agricultural land. Prior to the rainy season, the plantation excavated drainage ditches from the lower slopes of the Wai`anae range down to the lowlands. Vertical channels were cut into the adjacent slopes to encourage erosion. Frierson writes that "enough soil was washed down the ditches and deposited on the plain to reclaim 373 acres in a few years" (Frierson 1973:17).

In 1893 the first sisal or *malina* (*Agave sisalana*) plants were imported from Florida (approximately 20,000 plants) and experimentally planted in an area southeast of Pu`u o Kapolei. The Hawaiian name, *malina,* means marine, indicating that the plant was used in the manufacturing of marine ropes (Neal 1965: 225). The Hawaiian Fibre Company was established in 1898 to utilize the sisal grown on the 300 acre plantation in `Ewa (Tuggle and Tuggle 1997: 37). The production of sisal in `Ewa continued into the 1920s.

2.3 ARCHAEOLOGICAL BACKGROUND

The first archaeological sites identified on `Ewa were recorded by J. Gilbert McAllister (1933). Among these were Sites 138, 139, 141, 145 and 146. Brief descriptions follow.

Site 138. Puu Kapolei heiau, on Puu Kapolei hill, Honouliuli.

> The stones from the heiau supplied the rock crusher which was located on the side of this elevation, which is about 100 feet away on the sea side. There was formerly a large rock shelter on the sea side where Kamapuaa is said to have lived with grandmother (McAllister 1933:108).

Site 139. Kalanamaihiki fishing shrine at Kapapapuhi, Honouliuli.

> Near the end of the small tongue of land that juts out opposite Laulaunui Island in the west loch of Pearl Harbor, are two large rough stones about 2.5 feet in size, with six or seven smooth stones averaging 1 foot in size in a small pile adjoining the larger stones. The entire site is covered with akulikuli and would not be noticed or considered if the Hawaiians did not know of its former sacredness (McAllister 1933:108).

Site 141. Kaihuopalaai.

> The site is named for Kaihuopalaai, said to be the daughter of Konikonia and his wife Hinaaimalama. Fornander (37, vol5, p. 270) writes "...on Oahu, Kaihuopalaai saw a goodly man by the name of Kapapaapuhi (site 139) who was living at Honouliuli, Ewa; she fell in love with him and they were united, so Kaihuopalaai has remained in Ewa to this day. She was changed into that fishpond in which mullet are kept and fattened, and *this fish is used for that purpose to this day" (McAllister 1933:108).*

Site 145. Puuloa.

Puuloa, site where the first breadfruit in Hawaii is said to have been planted. As noted by Thrum:

> Tradition credits the introduction of the breadfruit trees in these islands to Kahai, a son of Moikeha, who brought a species from Upolu, in the Samoan Group, on his return voyage from Kahiki, and planted same at Puuloa, Oahu (McAllister 1933:109).

Site 146. The Ewa Coral Plains.

> Site 146, Ewa coral plains, throughout which are remains of many sites. The great extent of old stone walls, particularly near the Puuloa Salt Works, belongs to the ranching period about 75 years ago. It is probable that the holes and pits in the coral were formerly used by the Hawaiians. Frequently the soil on the floor of the larger pits was used for cultivation, and even today one comes upon bananas and Hawaiian sugar cane still growing in them. They afford shelter and protection, but I doubt if previous to the time of Cook there was ever a large population there (McAllister 1933:109).

2.4 PREVIOUS ARCHAEOLOGY

A vast number of archaeological studies have been conducted on the `Ewa Plain in recent years. These investigations are related to the expansive development that has taken place on the `Ewa Plain in the last 20 years. Only a limited number of investigations will be presented here. For a complete synthesis of the cultural resources recorded on the `Ewa Plain prior to 1995, the reader is directed to Tuggle and Tuggle (1997). Additional information can be obtained from Haun (1991) and Tuggle (1995).

In 1975, Clark and Connolly (1975), conducted an archaeological reconnaissance survey for the Honouliuli sewage treatment plant and ocean outfall (this is the treatment plant in the current study). They surveyed the entire parcel proposed for the facility. No sites were identified.

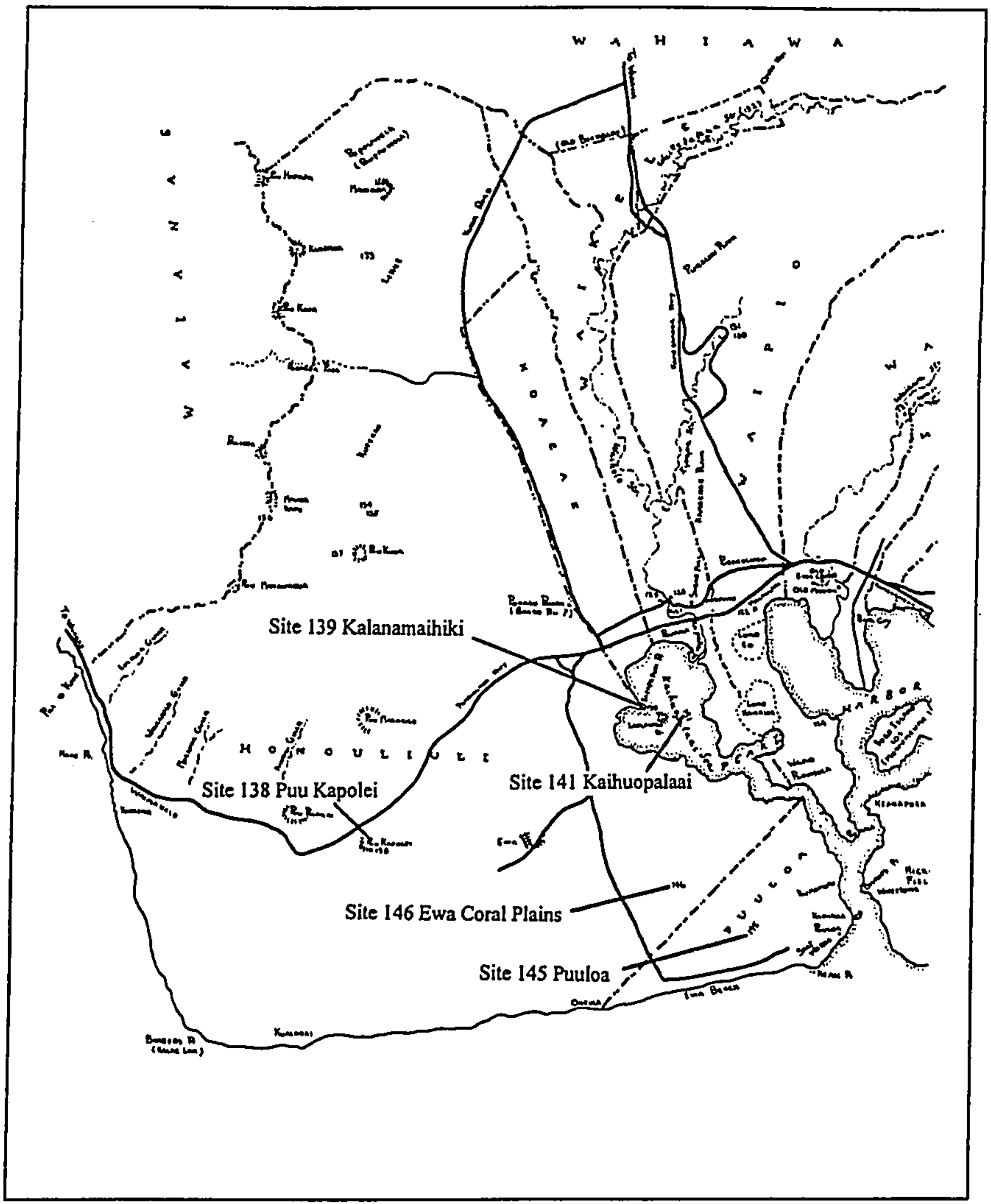

Figure 2. Map showing archaeological sites recorded by McAllister (1933). After Sterling and Summers (1978).

Clark and Connolly did not survey the corridor that extended *makai* from the plant to the ocean since it passed through sugarcane fields. However, they did survey the beach portion where the outfall would be located. No cultural features were identified. They concluded that if any significant cultural resources would be impacted, they would be located on the beach and not on the plain itself.

In 1978 A. Sinoto (1978) of the Bishop Museum conducted archaeological test excavations at Barbers Point. While excavating limestone sinkholes, Sinoto recovered the remains of numerous fossil bird bones "including the skeletal remains of many extinct species, such as large flightless geese, eagles, ibises, finches" (Kirch 1985:117). Later studies have indicated that human alteration of the environment (i.e. land clearing of the native vegetation) and direct predation may have led to the extinction of these species.

In 1979, Bert Davis (1979) conducted archaeological investigations in an area totaling approximately 1,099 acres. This area was previously surveyed by Jourdane (1979) for the proposed `Ewa Marina Community Development. The survey resulted in the identification of 18 previously unrecorded archaeological sites (State Site Numbers 3201-3218) composed of 107 features including sinkholes, mounds, platforms, and enclosures. A second survey, performed in an area previously utilized for sugar cane cultivation, did not identify any archaeological sites.

In 1983, Hommon and Ahlo (1983) conducted archaeological subsurface testing at the proposed `Ewa Marina Community Development Area (TMK 9-1-12:2-3, 5-17, 23, 28). The project area is located south of the area previously surveyed by Davis (1979) and Jourdane (1979). A total of five trenches were excavated. No cultural remains were identified.

In 1987, Paul H. Rosendahl, Inc, (Dicks et al. 1987) conducted an archaeological reconnaissance survey with subsurface testing on a 216 acre parcel for the proposed West Loch Estates Golf Course and parks. A total of seven archaeological sites were identified (State Sites 3318 to 3324). These sites consisted of prehistoric and historic burials and habitation sites located on Hō`ae`ae Point and on the slopes and uplands surrounding the Honouliuli Stream floodplain. Other sites recorded were remnants of an agricultural system including irrigated pondfield cropping of the floodplain, and dryland cultivation in the surrounding slopes and uplands.

Also in 1987, Rosendahl (1987), conducted an archaeological surface survey with subsurface testing immediately adjacent to the area mentioned above (Dicks et al. 1987) as part of the Environmental Impact Statement. The survey resulted in the identification of four archaeological sites including a small cemetery related to the sugarcane industry, a historic surface artifact collection area that pre-dates the sugarcane industry and a probable exposed midden pit.

In 1988, The Bishop Museum (Davis 1988) conducted archaeological testing for the Ewa Gentry project at Honouliuli. The project was situated in an area previously utilized for sugar cane cultivation. A surface survey previously conducted by Kennedy (1988) for the same area failed to identify any archaeological sites. No archaeological sites were identified during testing.

Cultural Surveys Hawaii (Hammatt et al. 1990) conducted archaeological investigations for the proposed `Ewa Villages project site, immediately north of the Honouliuli Wastewater Treatment Plant. A total of 616 acres were surveyed and a total of nine sites were identified, all associated with the sugar cane industry and the supporting plantation. Site types identified were: a historic cemetery, reservoir, a communal bath house, OR&L tracks, village store and saimin stand, and a roundhouse.

In 1990, Archaeological Consultants of Hawaii, Inc (Kennedy et al. 1991) conducted an archaeological inventory survey for the proposed Puuloa Golf Course (TMK: 9-1-01:27&6). The project area is at the south end of Fort Weaver Road and north of The Pacific Tsunami Warning Center. The survey resulted in the recording of 72 prehistoric, historic and modern sites. Most of the sites were sinkholes containing cultural material, C-shapes, enclosures and mounds. Kennedy and Denham (1992) conducted data recovery at sites slated to be impacted during construction of the golf course. It was concluded that initial occupation of the area occurred between A.D. 1020-1480. Three of the sites (3910, 3921 and 3770) were judged no longer significant following data recovery. All other sites slated for data recovery were considered significant and recommended for preservation.

In 1991, the Bishop Museum (Goodman and Cleghorn 1991) conducted an archaeological surface survey in conjunction with a historical documents and literature search for the Laulani Fairways Housing project at Pu`uloa. The project area is located to the east of the Honouliuli Wastewater Treatment Plant and is approximately 300 acres in size. No surface cultural remains were identified during the survey.

In 1991, the Bishop Museum (Jayatilaka et al. 1992) conducted an archaeological survey with subsurface testing on a 270-acre parcel for the proposed Hawaii Prince Golf Course (TMK 9-1-10). No surface archaeological remains were identified during the survey. Eleven backhoe trenches and four backhoe scrapes were excavated. No cultural remains were identified and no further work was recommended.

In 1993, Pantaleo and Sinoto (1993) conducted an archaeological inventory survey for a proposed offsite drainage system at the `Ewa Gentry development in Honouliuli. Only one historic site was identified, a concrete drainage ditch that measured 4,600 feet long, 150 feet wide and between 20 and 25 feet deep. No other significant cultural remains were recorded.

Also in 1993, the Bishop Museum (Goodman et al. 1993) conducted an archaeological reconnaissance survey of a proposed commercial project. The project area is located east of the Honouliuli Wastewater Treatment Plant, and to the west of Fort Weaver Road, surrounded to the north, south and west by sugarcane fields. No cultural remains were identified.

In 1996, Scientific Consultant Services (Spear 1996), conducted an archaeological survey for an area north of the Honouliuli Treatment Plant, and west of the Tenney and Varona plantation villages. The survey concentrated on two short, shallow gulches present in an area formerly used for sugarcane cultivation. No archaeological sites were identified during the survey.

Tuggle and Tuggle (1997) authored a synthesis of cultural resource studies conducted on the `Ewa Plain. Although the manuscript was prepared for the Barbers Point Naval Air Station, it examines the prehistory and history, the previous archaeology, and the natural resources found on the `Ewa Plain. Their manuscript was used in the preparation of this document and proved to be invaluable. It is highly recommended for anyone planning to work in the region.

Paul H. Rosendahl conducted three archaeological data recovery projects (1988, 1989, and 1990) at West Loch Estates Residential Increment I, Golf Course and Shoreline Park located in Honouliuli, `Ewa District, Island of O`ahu (Wolforth et al. 1998). This "work included excavations at Sites 3319, 3320, and 3321; backhoe trenching at Sites 3322 (buried fishpond) and 3324 (extensive pondfield system); and monitoring of construction activities " (Wolforth et al. 1998:ii). The other sites identified were an artifact concentration, human skeletal remains and temporary habitations. Excavations uncovered ash lenses, midden deposits, possible post holes, rock alignments, and a segment of the OR&L railway. Radiocarbon dates obtained from test excavations indicates that the pondfields were in use between the 10th and 17th centuries A.D.

2.5 SITE PREDICTABILITY

Based upon the information presented above, it is possible to predict the types of sites likely to be encountered during the course of the project. Prehistoric surface remains are not expected within the project area due to impacts of residential and road development, ranching, sugarcane cultivation, and military activities. In fact, since most of the pipelines will be placed in areas that are currently used as public rights-of-way, no surface sites or features are likely to be encountered whatsoever.

However, it is possible that excavations will expose sinkholes that have been filled in by alluvium moving downslope, numerous cultivation activities and by various residential and commercial developments. These sinkholes often contain archaeological deposits (i.e. human remains, hearths and extinct bird bones). Numerous sinkholes have been recorded on Barbers Point Naval Air Station and at other areas in `Ewa. Human burials may also be uncovered during the course of pipeline excavations. Sink holes and human burials are the most probable site types that may be encountered during the course of the project.

3.0 RECOMMENDATIONS

Based upon the archival research, it is easily seen that most of the `Ewa plain has been disturbed either through sugar cane cultivation or increased urbanization. Indeed it is nearly impossible to find an undisturbed area on the `Ewa Plain. The following recommendations are derived from the archival research and the review of the previous archaeological studies.

It is extremely doubtful that any unrecorded sites are present within the boundary of the Treatment Plant facility. The area for the original treatment plant was surveyed by Clark and Connolly (1975) and no sites were encountered. It is also unlikely that any subsurface cultural deposits are present at the Treatment Plant site given the previous use of the land for sugarcane cultivation and the construction of the facility.

The pipelines that are proposed will all be placed on the edge (public easement) of roadways and within *previously excavated portions of the OR&L corridor. It is* quite doubtful that any surface sites will be encountered along the pipeline corridors. However, excavations for the pipelines may impact buried cultural deposits on the `Ewa Plain. This is contingent upon the depth of excavations and placement of the pipelines (i.e. through old sugar cane fields).

The Oahu Railway & Land Company (OR&L) right-of-way is on the National Register of Historic Places (NRHP). The railway, which was started in February of 1889 (formally opened in November of the same year), is significant for its use in the development of the sugar industry in `Ewa and the rest of O`ahu. The narrow gauge railway is well preserved and formerly contained 175 miles of track. The 13 mile long stretch from Nānākuli to Honouliuli "is the longest stretch of continuous railroad in Hawaii" (NRHP Nomination Form 1984; see Appendix A). The excavation for the pipeline should not in any way impact any portion of the existing railway or the raised railway bed. If the proposed construction will have an impact on the railway, another route will need to be proposed.

Human skeletal remains have been recovered primarily from the base of sinkholes throughout the `Ewa District (West Beach, the Deep Draft Harbor, Ewa Marina, Barbers Point Naval Air Station and, at Pu`uloa). If any human remains are uncovered, all work should stop in the immediate area and members of the State Historic Preservation Division should be notified immediately. Should any sinkholes be uncovered, extreme care and caution should be exercised since human remains could be present. Sensitive cultural resources may also be present within the sinkholes and archaeological testing and data recovery may be required should sinkholes containing cultural material be encountered.

It is recommended that an archaeologist be retained by the development contractor to assist the construction crew in treating archaeological resources that may be encountered during construction. The archaeologist would orient the construction crew regarding what types of archaeological resources may be encountered and what actions the construction crew should perform if resources are encountered. The archaeologist should also perform periodic monitoring of trench excavations, and be on-call to assist in treating any inadvertent discoveries that are made.

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1998 Archaeological Data Recovery at West Loch Estates Residential Increment I, and Golf Course and Shoreline Park. Land of Honouliuli, `Ewa District, Island of O`ahu. Final Report. Paul H. Rosendahl, Inc. Hilo, Hawai`i.

APPENDIX A.

NATIONAL REGISTER OF HISTORIC PLACES - NOMINATION FORM

Oahu Railway and Land Company Right -of-Way

NPS Form 10-900

EXP. 10/31/84

United States Department of the Interior
National Park Service

For NPS use only

received

date entered

National Register of Historic Places Inventory—Nomination Form

See instructions in *How to Complete National Register Forms*
Type all entries—complete applicable sections

1. Name

historic Oahu Railway and Land Company Right-of-Way

and/or common

2. Location

street & number None ___ not for publication

city, town Leeward coast of Oahu from Halawa Stream to Auyong Homestead Road at Nanakuli ___ vicinity of ~~congressional district~~

state Hawaii code county Honolulu code

3. Classification

Category
- ___ district
- ___ building(s)
- ___ structure
- _X_ site
- ___ object

Ownership
- _X_ public
- ___ private
- ___ both

Public Acquisition
- ___ in process
- ___ being considered

N/A

Status
- _X_ occupied
- ___ unoccupied
- ___ work in progress

Accessible
- ___ yes: restricted
- _X_ yes: unrestricted
- ___ no

Present Use
- ___ agriculture
- ___ commercial
- _X_ educational
- ___ entertainment
- ___ government
- ___ industrial
- ___ military
- _X_ museum
- _X_ park
- ___ private residence
- ___ religious
- ___ scientific
- ___ transportation
- ___ other:

4. Owner of Property

name State of Hawaii Department of Transportation — City and County of Honolulu Department of Parks and Recreation

street & number 869 Punchbowl Street — 650 South King Street

city, town Honolulu ___ vicinity of state Hawaii

5. Location of Legal Description

courthouse, registry of deeds, etc. Bureau of Conveyances

street & number 1151 Punchbowl Street

city, town Honolulu state Hawaii

6. Representation in Existing Surveys

title State Historic Sites Inventory (Portion of this property listed on National Registe
has this property been determined eligible? ___ yes _X_ no

date 1982 ___ federal _X_ state ___ county ___ local

depository for survey records Department of Land and Natural Resources

city, town Honolulu state Hawaii

Description

Condition
___ excellent
___ good
X fair
___ deteriorated
___ ruins
___ unexposed

Check one
___ unaltered
X altered

Check one
X original site
___ moved date ___

Describe the present and original (if known) physical appearance

The O.R. & L. Right-of-Way consists of 25.5 miles of raised roadbed 40' wide running from Halawa Stream at Pearl Harbor on the easternmost point to the intersection of Farrington Highway and Auyong Homestead Road in Nanakuli at the westernmost point.

The west end of the right-of-way is 13 miles long and is currently listed on the National Register of Historic Places. This 13-mile long section has narrow gauge steel rails (36 inches inside dimension) intact. The raised roadbed is composed of mixed materials. The remaining 12.5 miles of the right-of-way has only a raised roadbed without tracks. The Hawaiian Railway Society is currently planning to reconstruct trackage on this existing roadbed. The rails which will be used originally were a part of the Oahu Railway System. During World War II, they were used to build a railway at the Naval munitions facility at nearby West Loch in Pearl Harbor. The Federal Government Service Administration is donating the tracks to the State of Hawaii for use by the Hawaiian Railway Society.

The roadbed and tracks where they exist are in fair condition. This is due to the maintenance performed by the U.S. Naval Ammunition Depot that hauled munitions over the line until October 1968.

The only alteration has been the removal of the track from 12.5 miles of the roadbed.

Significance

Period
___ prehistoric
___ 1400–1499
___ 1500–1599
___ 1600–1699
___ 1700–1799
_X_ 1800–1899
_X_ 1900–

Areas of Significance—Check and justify below
___ archeology-prehistoric
___ archeology-historic
___ agriculture
___ architecture
___ art
_X_ commerce
___ communications
___ community planning
___ conservation
___ economics
___ education
___ engineering
___ exploration/settlement
_X_ industry
___ invention
___ landscape architecture
___ law
___ literature
___ military
___ music
___ philosophy
___ politics/government
___ religion
___ science
___ sculpture
___ social/humanitarian
___ theater
_X_ transportation
___ other (specify)

Specific dates 1889, 1895, 1947, 1950 **Builder/Architect** Charles H. Kluegel, George P. Denison
Ben F. Dillingham

Statement of Significance (in one paragraph)

The Oahu Railway and Land Company right-of-way is significant for its associations with the operation of the O.R. & L. Co. railroad and the development of the sugar and pineapple industries. This narrow gauge right-of-way is a well preserved remnant of the earlier 175 miles of tracks laid by this company that had a tremendous effect on the economic development of not only the Island of Oahu but the State of Hawaii as well. The 13-mile long Nanakuli to Honouliuli portion of the right-of-way is the longest stretch of continuous railroad track in Hawaii. It is also one of the longest stretches of narrow-gauge railroad track in place in the United States.

Historic Sketch: The principal force behind the creation of the Oahu Railway and Land Company was Benjamin Franklin Dillingham. He had originally come to Hawaii from Massachusetts in 1865 as a sailor. He stayed in the Islands to become a successful businessman and developer. In the late 1870s, he became interested in a colonization project for the lands along the western and northern coasts of Oahu. The area was dry and most believed the land to be infertile and worthless. In 1879, however, when it was proven feasible to irrigate the lands with artesian water, Dillingham's plans took on new life.

He realized that even with water readily available any agricultural development would fail unless an efficient means of transportation for the crops from the fields to Honolulu was developed. At that time, Oahu's road system was practically non-existent so Dillingham saw that a railroad was the answer.

The Hawaiian government shared Dillingham's view on the importance of developing rail systems for the kingdom. In 1878, the legislature passed a law "to promote the construction of railways." It set forth the conditions under which railroad corporations could be established and authorized the minister of the interior to guarantee such corporations a profit of five percent annum on the cost of their roads and equipment.

Dillingham was not the first to build a railroad under the new law. Captain Thomas Hobron built the Kahului Railroad Company on Maui in 1881 and Samuel G. Wilder on Hawaii built a line from Mahukona to Niulii. Dillingham's line, however, was to prove most important and successful in the Islands.

In 1886, Dillingham went to England in an attempt to secure capital for his enterprise. British financiers, however, were alarmed over the unstable internal politics in the Hawaiian Kingdom and refused to back him.

He returned to Hawaii, and with the help of several prominent businessmen, convinced the legislature to enact a law authorizing the minister of the interior "to contract with B. F. Dillingham, his associates and successors and their assigns, or such corporation as shall be formed and organized by him or them under the laws of this Kingdom . . . for the constructing and operating on the Island of Oahu a steam railroad . . . for the carriage of passengers and freight."

Most persons thought he would fail. An earlier authorization to Charles Wilson to construct and operate a railroad through Honolulu from Pearl River Lagoon on the west to Niu on the east had failed before the first spike could be driven.

Dillingham teamed with Samuel C. Allen, James B. Castle, Robert Lewers, John H. Paty, and Mark P. Robinson to organize the Oahu Railway and Land Company which was chartered on February 4, 1889.

Construction of the railroad began immediately. Dillingham threw himself into the project with vigor, acting as both financier and construction worker. He spared little expense, either of himself or his finances. He brought in Hawaii's first steam shovel to speed the work. Part of the reason for his haste was a promise he had somewhat recklessly made to one of his friends on his 44th birthday, when the legislature had awarded him the railroad franchise. He promised them all a ride on his railroad on his next birthday, and he meant to keep that promise.

Charles H. Kluegel, an experienced civil engineer directed the survey work and construction of the railroad. He was assisted by George P. Denison who later became general manager of the line. The first track of German-made steel rails was laid in August 1889 and by September 4, 1889, Dillingham's 45th birthday a few miles of track was ready for use. Some flatcars had arrived, but one essential item--a locomotive--had not been delivered. Dillingham, to make good his promise, had to purchase outright from the Hawaiian government, a small saddle-tanker locomotive which was supposed to have pulled sand cars from the Moiliili Quarry in Honolulu.

The little engine had not even been unpacked from its crate, and in their haste to get it ready, Dillingham's men neglected to remove the packing grease from the boiler. When at last the promised ride was made, with Dillingham's guests dressed in their Sunday best and grouped on the flatcars, the engine's smokestack spewed out a cloud of black greasy soot and smoke over everyone.

Despite the wounded vanity of his friends, Dillingham had made good his promise and his success was assured. By November, the tracks extended as far as Aiea, and the line was formally opened to the public on November 16, King Kalaukaua's birthday. Some four thousand persons rode on the line that day in new passenger coaches pulled by the overdue Baldwin locomotives.

The tracks continued to snake their way westward around the island. They were completed to Pearl City by January 1, 1890; to Waianae by July 4, 1895; and to Kahuku, the furthest point from Honolulu, on January 1, 1899.

Dillingham's prediction of an agricultural boom was soon realized. He pushed his plantation developments (Ewa Plantation Company, Kahuku Plantation Company, the Oahu Sugar Company and the Waialua Agricultural Company), and carried the produce of others to the economic benefit of all.

The first sugar crop carried by the Oahu Railway and Land Company was that from the Ewa Plantation--2,849 tons. By 1895, sugar production on Oahu had climbed to 21,000 tons per year, with nine plantations in operation. The O.R. and L. carried just about all of their produce to Honolulu. Millions of dollars were put into the sugar operations, made possible by the O.R. and L. It, in turn, prospered. It was one of the few railroads in the United States to never miss a dividend to its stockholders. By 1915, the O.R. & L. Co. was paying taxes equal to the amount of taxes collected on all Oahu in 1892.

Not only sugar benefited from the railroad. Dillingham was interested in diversified agriculture and was an early supporter of James Dole's efforts to make pineapple a paying crop. Dillingham pushed a branch line up to the highlands of Wahiawa, where pineapple thrived. In Honolulu, Dole was able to set up a cannery on land provided by Dillingham. By 1914, the O.R. & L. Co. was carrying 32,000 tons of pineapple a year.

Another boost to the line's fortunes came as a result of the development of Pearl Harbor and Schofield Barracks. The military came to be one of the railroad's most important customers.

The Oahu Railway, as it came to be known, did well in the passenger business also. In 1891, passengers totaled 133,644. By 1908, this total rose to 446,318; by 1915, nearly 1,000,000; 1922, 1,400,000. The 1930s saw a vast improvement in the roadway system in Hawaii, the automobile began to cut into the railroad's passenger totals. This trend was drastically reversed by World War II. In 1941 the passenger tickets sold was less than a million. By the end of 1942, however, this total rose to 2,365,601 and 1943 saw an all time high of 2,642,516.

The Oahu Railway and Land Co. performed yeoman service during the war by carrying supplies, munitions, troops, and defense workers. The railroad received many awards, Letters of Appreciation, and Commendations from all quarters of the military as well as the government.

The equipment used on the railroad was exclusively narrow-gauge (36 inches, inside dimension of track). The locomotive's manufacturers were predominately Baldwins or American, with a sprinkling of the other less popular machines. From the original little saddle-tanker used by Dillingham to take his friends on a train ride, the total number of locomotives on the roster stood at 26 in 1943, 52 passenger coaches, 6 combination coaches, 1 parlor car, 3 mail cars, 2 gasoline motor cars, and 1,359 freight cars of all decriptions. The highest total length of active track was 174.96 miles in 1934.

Over this right-of-way, the O.R. & L. Co. brought the materials to build the military installations, the men and women to operate them, and the ammunition to defend them. During the War years of 1944 and 1945 nearly 2 million passengers a year were hauled to and from their employment/assignment at Pearl Harbor, Schofield Barracks, Barbers Point, Naval Ammunition Depot, and outlying facilities.

After World War II, the railroad business fell off drastically. The post war demand for private vehicles, trucks and buses all but closed the door on rail transportation. On December 12, 1947, all operations outside Honolulu was abandoned. The Oahu Railway did maintain a pineapple shuttle from pier 34 to the cannery, this ceased in 1972.

In 1950, the track and right-of-way from Pearl Harbor to the Naval Ammunition Depot access road in Nanakuli was purchased by the U.S. Navy for "National Defense" for one dollar ($1.00). The N.A.D. railroad continued to use and maintain this 25.50 mile section of track. A 6.50 mile segment from Pearl Harbor to Waipahu was ceded to the State of Hawaii in the early 1950s. After a heavy flood in 1954, the 6 mile portion of track also reverted to the State. The Waikele branch of N.A.D. no longer was served by the railroad. This left a 13 mile portion which was active until October of 1968. This, too, was received by the State of Hawaii in the fall of 1980.

Major Bibliographical Reference

kendal, Ralph S. *The Hawaiian Kingdom, Vol. III, 1874-1893: The Kalakaua Dynasty*, Honolulu, University of Hawaii Press, 1967.

Hungerford, John B. *Hawaiian Railroads: A Memoir of the Common Carriers of the Fiftieth State*, Reseda, California, Hungerford Press, 196

10. Geographical Data

Acreage of nominated property

Quadrangle name

Quadrangle scale

UMT References

	Zone	Easting	Northing		Zone	Easting	Northing
A				B			
C				D			
E				F			
G				H			

Verbal boundary description and justification

List all states and counties for properties overlapping state or county boundaries

state code county code

state code county code

11. Form Prepared By

name/title John M. Knaus, Vice President

organization Hawaiian Railway Society date April 15, 1983

street & number P.O. Box 1208, Ewa Station telephone (808) 548-7460

city or town Ewa Beach state Hawaii

12. State Historic Preservation Officer Certification

The evaluated significance of this property within the state is:

___ national ___ state ___ local

As the designated State Historic Preservation Officer for the National Historic Preservation Act of 1966 (Public Law 89-665), I hereby nominate this property for inclusion in the National Register and certify that it has been evaluated according to the criteria and procedures set forth by the National Park Service.

State Historic Preservation Officer signature

title date

For NPS use only

I hereby certify that this property is included in the National Register

date

Keeper of the National Register

date

Attest:

Chief of Registration

APPENDIX F
RESPONSE TO COMMENTS ON DRAFT ENVIRONMENTAL ASSESSMENT

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HAWAII 96843

July 23, 1999

99 JUL 23 PM 1:51
DEPT OF PLANNING AND PERMITTING
CITY & COUNTY OF HONOLULU

TO: MS. JAN NAOE SULLIVAN, DIRECTOR
DEPARTMENT OF PLANNING AND PERMITTING

FROM: CLIFFORD S. JAMILE

SUBJECT: YOUR TRANSMITTAL OF JUNE 16, 1999 REGARDING THE DRAFT ENVIRONMENTAL ASSESSMENT FOR THE HONOULIULI WASTEWATER RECLAMATION PROJECT, EWA, OAHU, TMK: 9-1-13: 07

Thank you for the opportunity to review and comment on the Draft Environmental Assessment (EA) for the proposed wastewater reclamation project. We support the City's efforts to develop the reclamation facility to provide nonpotable water for industrial and irrigation use.

We have the following comments to offer:

1. There are two 6-inch compound meters (Premise I.D. No. 1029594) serving the project site.

2. The existing water system cannot provide adequate fire protection. The applicant is required to install a fire hydrant in front of the proposed facility. The construction drawings should be submitted for our review and approval.

3. The availability of water will be confirmed when the building permit application is submitted for our review and approval. When water is made available, the applicant will be required to pay our Water System Facilities Charges for resource development, transmission, and daily storage.

4. If a three-inch or larger water meter is required, the construction drawings showing the installation of the meter should be submitted for our review and approval.

5. The on-site fire protection requirements should be coordinated with the Fire Prevention Bureau of the Honolulu Fire Department.

6. Ultraviolet radiation does not provide a residual disinfectant level in the product water. We have concerns regarding the maintenance of adequate levels of disinfection throughout the system including the storage and distribution mains.

Pure Water . . . our greatest need – use it wisely

7. Board of Water Supply (BWS) approved reduced pressure principle backflow prevention assemblies will be required after all potable domestic water meters serving any of the parcels concurrently served by the reclaimed water system.

8. The U.S. Filters R-1 reclaimed water infrastructure plan should be incorporated with BWS's Integrated Resource Plan's Ewa Nonpotable Water Master Plan currently in progress.

9. The pipeline along Mango Tree Road from the reclamation facility to Fort Weaver Road should be oversized to serve future users. The existing BWS 16-inch water line along Fort Weaver Road could be converted to a nonpotable line and connect to the Mango Tree Road R-1 pipeline providing transmission capacity to the makai properties.

10. The peaking factor for the R-1 line should be a factor of three times the average day demand to reflect the BWS nonpotable water system standards and the DOH reuse guidelines that minimize human contact which suggests that irrigation should occur primarily at night.

If you have any questions, please contact Barry Usagawa at 527-5235.

PHONE (BUS): (808) 536-5695
FAX: (808) 599-1553

apc
ANALYTICAL PLANNING CONSULTANTS, INC.
928 NUUANU AVENUE, SUITE 502 • HONOLULU, HI 96817

September 10, 1999

Mr. Clifford S. Jamile
Manager and Chief Engineer
Honolulu Board of Water Supply
630 So. Beretania Street
Honolulu, HI 96813

Dear Mr. Jamile

Thank you for reviewing the Draft Environmental Assessment for the Honouliuli Wastewater Reclamation Plant. Listed below are the responses to the comments by the Board of Water Supply.

1. The applicant is aware of the two 6-inch water meters serving the project site.
2. The applicant will install a fire hydrant in front of the facility. Plans will be submitted to the BWS for review and approval.
3. The applicant will pay all required Water System Facilities Charges.
4. It is not anticipated that a three inch or larger water main will be required. If it is the applicant will submit drawings to the BWS for review and approval.
5. On site fire protection is being coordinated the Honolulu Fire Department.
6. Hypochlorite will be added periodically into the distribution system at various locations in order to maintain adequate levels of disinfection throughout the system including the storage and distribution mains.
7. The Developer will comply with all legal design requirements for the distribution and use of the reclaimed water.
8. The reclaimed water facility is included as a part of the Oahu Integrated Resource Plan.

9. The pipeline along Mango Tree Road will be able to supply water to more than the currently planned customers. The applicant cannot use the existing BWS line along Fort Weaver Road at this time. Use of this line will be reviewed if the capacity of the planned reclamation plant is increased.

10. The distribution system is sized to handle the amount of non potable water that can be processed by the planned reclamation plant plus a peak demand factor of 1.5.

    The system as designed will permit irrigation of the golf courses at night.

If there are any questions please contact me at 536-5695.

Sincerely,

Donald Clegg

Donald Clegg
President

CLB

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P.O. BOX 621
HONOLULU, HAWAII 96809

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND DIVISION
STATE PARKS
WATER RESOURCE MANAGEMENT

JUL 28 1999

Ref:PS:EH

Ms. Jan Naoe Sullivan, Director
Department of Planning and Permitting
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Ms. Sullivan:

Subject: Draft Environmental Assessment (DEA) for Honouliuli Wastewater Reclamation Plant

We have reviewed the subject DEA document and offer the following comments for your consideration.

Engineering Branch:

Please include the following State Projects in the first paragraph, Section 2.8-R1 Distribution System on page 2-9, as possible users of R1 water:

Kapolei Sports Recreational Complex
Kapolei Civic Center
Kapolei Public Library
North-South Road Landscape Irrigation

Commission on Water Resource Management:

Please see attached memorandum.

Thank you for the opportunity to comment on the subject document.

Should you have any questions or require further assistance, please contact staff planner Ed Henry at 587-0380.

Very truly yours,

TIMOTHY E. JOHNS
Chairperson

Attachment

c.c. Engineering Branch
CWRM

apc

PHONE (BUS): (808) 536-5695
FAX: (808) 599-1553

ANALYTICAL PLANNING CONSULTANTS, INC.
928 NUUANU AVENUE, SUITE 502 • HONOLULU, HI 96817

September 10, 1999

Mr. Timothy E. Johns, Chairperson
Department of Land and Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, HI 96809

Dear Mr. Johns

The Final Environmental Assessment (FEA) includes the addition of the possible users of R-1 water included in your response to the Draft Environmental Assessment (DEA). Thank you for taking the time to review the Draft Environmental Assessment.

Sincerely,

Donald Clegg

Donald Clegg
President

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

TIMOTHY E. JOHNS, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JANET E. KAWELO

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND RESOURCES
ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND
STATE PARKS
WATER RESOURCE MANAGEMENT

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

HISTORIC PRESERVATION DIVISION
Kakuhihewa Building, Room 555
601 Kamokila Boulevard
Kapolei, Hawaii 96707

99 JUL 22 AM 8:48

DEPT [illegible]
[illegible]
[illegible] HONOLULU

July 6, 1999

Jan Naoe Sullivan, Director
Department of Planning and Permitting
City and County of Honolulu
650 South King Street, 7th Floor
Honolulu, Hawaii 96813

LOG NO: 23730 ✓
DOC NO: 9907EJ01

Dear Ms. Sullivan:

SUBJECT: **Chapter 6E-8 Historic Preservation Review -- City and County of Honolulu Draft Environmental Assessment (DEA) for Honouliuli Wastewater Reclamation Project**
Honouliuli, 'Ewa, O'ahu
TMK: 9-1-13:007

Thank you for the opportunity to review the DEA for the Honouliuli Wastewater Reclamation Project. The project proposes to build a reclamation facility and install 2 reclaimed water distribution lines, one running from the Honouliuli treatment plant north to the West Loch Golf Course and Ewa Village Golf Course and the second line running west along the existing OR&L railroad track to the Villages of Kapolei then along the existing drainage ditch to Campbell Industrial Park.

Archival research on previous archaeological and land use history is provided in Appendix E of the DEA and indicates that the likelihood of finding any surface archaeological sites within the project area and pipeline corridor is extremely low. These lands were commercially cultivated with sugar cane which altered the land for many years. The one exception is the proposed RO distribution line which runs along a portion of the Oahu Rail and Land Company (OR&L) Right-of-Way, a significant historic site listed on the National Register of Historic Places. According to section 4.4.2 of the DEA, however the pipeline, which will be installed in subsurface trenches, will not impact any portion of the existing railway or the raised railway bed.

Because the reclamation facility will be built within the existing Honouliuli Treatment Plant and the reclaimed water distribution lines are proposed for areas that have been extensively modified, and because no impact to the existing OR&L railway or railway bed is planned, we believe that this project will have "no effect" on historic sites.

If you have any questions please call Elaine Jourdane at 692-8027.

Aloha,

Don Hibbard, Administrator
State Historic Preservation Division

EJ:jk

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 3378
HONOLULU, HAWAII 96801

BRUCE S. ANDERSON, Ph.D., M.P.H.
DIRECTOR OF HEALTH

RECEIVED
'99 JUL 23 AM 8:09
DEPT. OF PLANNING
& PERMITTING
C & C OF HONOLULU

In reply, please refer to:
File:

July 23, 1999

97-253A/epo

Ms. Jan Naoe Sullivan, Director
Department of Planning and Permitting
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Ms. Sullivan:

Subject: Draft Environmental Assessment (DEA)
Honouliuli Wastewater Reclamation Project
Ewa, Oahu
TMK: 9-1-13: 7

Thank you for allowing us to review and comment on the subject project. We have the following comments to offer:

Wastewater

1. The Environmental Assessment (EA) referred to RO water as "completely pure" and "essentially sterile". There is no RO water classification in the Department of Health's wastewater reuse guidelines. The guidelines specifically require that reclaimed water used for industrial process water be at the R-1 level. The effluent quality for a micro filtration-RO system shall be based on the R-1, R-2 or R-3 classification. All design and monitoring requirements in the reuse guidelines shall be complied with.

   For a micro filtration-RO treatment system to be considered equivalent to an R-1 treatment system, it has to be demonstrated that it can consistently provide 4 log or greater virus removal rate.

2. The R-1 treatment system proposes to use Hydro-Clear Sand Filters. For such shallow bed filters, the reuse guidelines require that an R-1 "direct filtration" process

be provided. The EA discusses the use of a "contact filtration" process, but the preliminary construction plans submitted by US Filter to the Department of Health showed a "direct filtration" process. Please clarify.

3. The figures for the amount of wastewater reused on Oahu should be updated.

All wastewater plans must conform to applicable provisions of the Department of Health's Administrative Rules, Chapter 11-62, "Wastewater Systems." We do reserve the right to review the detailed wastewater plans for conformance to applicable rules.

Should you have any questions on these comments, please contact Mr. Tomas See of the Wastewater Branch at 586-4294.

<u>Groundwater</u>

1. Please assess the impact of the caprock aquifer recharge to the basal aquifer. Low permeability marl and clays and the weathered surface of the volcanics, believed to separate the caprock aquifer from the basal aquifer, may not be continuous. Would this condition adversely affect the basal aquifer?

2. Please assess the effect of caprock aquifer recharge on groundwater gradients.

If there are any questions regarding these comments, please contact Mr. Jaime Rimando of the Underground Injection Control Section, Safe Drinking Water Branch at 586-4258.

<u>Permit Requirements</u>

1. A National Pollutant Discharge Elimination System (NPDES) <u>general</u> permit is required for the following discharges to waters of the State:

    a. Storm water discharges relating to construction activities, such as clearing, grading, and excavation, for projects equal to or greater than five acres;

    b. Storm water discharges from industrial activities;

    c. Construction dewatering activities;

    d. Noncontact cooling water discharges less than one million gallons per day;

e. Treated groundwater from underground storage tank remedial activities;

f. Hydrotesting water;

g. Treated effluent from petroleum bulk stations and terminals; and

h. Treated effluent from well drilling activities.

Any person requesting to be covered by a NPDES general permit for any of the above activities should file a Notice of Intent with the Department's Clean Water Branch at least 30 days prior to commencement of any discharge to waters of the State.

2. After construction of the proposed facility is completed, a NPDES individual permit will be required if the operation of the facility involves any wastewater discharge into State waters.

Any questions regarding these comments should be directed to Mr. Denis Lau, Branch Chief, Clean Water Branch at 586-4309.

Sincerely,

Thomas E. Arizumi

for GARY GILL
Deputy Director for
Environmental Health

c: CWB
WWB
SDWB

PHONE (BUS): (808) 536-5695
FAX: (808) 599-1553

apc
ANALYTICAL PLANNING CONSULTANTS, INC.
928 NUUANU AVENUE, SUITE 502 • HONOLULU, HI 96817

September 10, 1999

Mr. Gary Gill, Deputy Director
Department of Health
State of Hawaii
P.O. Box 3378
Honolulu, HI 96801

Dear Mr. Gill

Thank you for reviewing the Draft Environmental Assessment for the Honouliuli Wastewater Reclamation Plant. Listed below are the responses to the comments by the Department of Health.

Wastewater

1. Industrial users require water that is cleaner than R-1 standards for boiler use. The RO water is equivalent to distilled water in purity and will have a substantially lower viral content than that permitted for R-1 water. For classification purposes however, the RO water will be classified as R-2 water, and as such, the 4 log virus removal rate does not apply.

   Further, unlike R-1 water which is permitted to be used in numerous human contact applications, the RO product water will not be used in any application involving human contact. It is boiler water, purified to reduce scaling and other chemical deposits in industrial equipment. Under normal operating conditions, there will be no exposure pathway to create either human health or ecological risks.

2. The FEA will be revised to state that a "direct filtration process" will be used in the reclamation process and not "contract filtration".

3. The figures in the DEA for the amount of wastewater reused on Oahu were obtained from the Wastewater Branch of the DOH and are latest available.

Groundwater

1. The caprock aquifer does not recharge the basalt aquifer. In fact flow is in the opposite direction, that is, from the basalt aquifer into the lower caprock aquifer. There will be no adverse effect on the basal aquifer.

2. The typical caprock gradient is extremely flat. Near the coastline, this allows the gradient flow to reverse direction and flow inland due to tidal flux. Irrigation recharge to the caprock will have a positive effect on groundwater gradients within the caprock and no effect on the heads or gradient in the basal aquifer.

Permit Requirements

1. NPDES Permits

   a. The total area to be disturbed is approximately 3.5 acres including the reclamation facility and the trenches. Therefore, an NPDES permit for construction site storm water discharges will not be required.

   b. No storm water discharges from industrial activities will be generated.

   c. No excavations will intersect the water table, and therefore no de-watering will be necessary.

   d. No cooling water will be used in the reclamation process.

   e. the action does not involve UST remediation.

   f. The pipelines may require hydrotesting. Potable water would be used for this purpose. A NOI will be filed at least 90 days before any discharge to surface water commences. The NOI will not be required if the discharge is to the City's storm water drainage system, which operates under an individual NPDES permit. In that case, the effluent limitations on that permit will be complied with.

   g. The action does not involve petroleum bulk stations or terminals.

   h. The action does not involve well drilling.

2. No wastewater will be discharged into State waters.

If there are any questions please contact me at 536-5695.

Sincerely,

Donald Clegg

Donald Clegg
President

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

TIMOTHY E. JOHNS
CHAIRPERSON

BRUCE S. ANDERSON
ROBERT G. GIRALD
BRIAN C. NISHIDA
DAVID A. NOBRIGA
HERBERT M. RICHARDS, JR.

LINNEL T. NISHIOKA
DEPUTY DIRECTOR

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT
P.O. BOX 621
HONOLULU, HAWAII 96809

JUL 15 10 21 AM '99

July 14, 1999

TO:	Mr. Dean Uchida, Administrator Land Division
FROM:	Linnel T. Nishioka, Deputy Director Commission on Water Resource Management (CWRM)
SUBJECT:	Draft Environmental Assessment (DEA) for Honouliuli Wastewater Treatment Plant
FILE NO.:	99-221

Thank you for the opportunity to review the subject document. Our comments related to water resources are marked below.

In general, the CWRM strongly promotes the efficient use of our water resources through conservation measures and use of alternative non-potable water resources whenever available, feasible, and there are no harmful effects to the ecosystem. Also, the CWRM encourages the protection of water recharge areas which are important for the maintenance of streams and the replenishment of aquifers.

[X] We recommend coordination with the county government to incorporate this project into the county's Water Use and Development Plan.

[ ] We recommend coordination with the Land Division of the State Department of Land and Natural Resources to incorporate this project into the State Water Projects Plan.

[X] We are concerned about the potential for ground or surface water degradation/contamination and recommend that approvals for this project be conditioned upon a review by the State Department of Health and the developer's acceptance of any resulting requirements related to water quality.

[ ] A Well Construction Permit and/or a Pump Installation Permit from the Commission would be required before ground water is developed as a source of supply for the project.

[ ] The proposed water supply source for the project is located in a designated water management area, and a Water Use Permit from the Commission would be required prior to use of this source.

[ ] Groundwater withdrawals from this project may affect streamflows which may require an instream flow standard amendment.

[ ] We recommend that no development take place affecting highly erodible slopes which drain into streams within or adjacent to the project.

[ ] If the proposed project includes construction of a stream diversion, the project may require a stream diversion works permit and amend the instream flow standard for the affected stream(s).

[ ] If the proposed project alters the bed and banks of a stream channel, the project may require a stream channel alteration permit.

[X] OTHER:

The following policy statement on water reclamation was adopted by the Commission on March 13, 1996:

It is the policy of the Commission on Water Resource Management (Commission) to promote the viable and appropriate reuse of reclaimed water in so far as it does not compromise beneficial uses of existing water resources.

I. Ewa Caprock

Recognizing that reclaimed water is a valuable resource in the Ewa Plain, direct or indirect reuse will be championed by the Commission. It is the policy of the Commission that the water resources of the Ewa Caprock Aquifer will be allocated only for nonpotable uses.

If there are any questions, please contact the Commission staff at 587-0225.

apc

PHONE (BUS): (808) 536-5695
FAX: (808) 599-1553

ANALYTICAL PLANNING CONSULTANTS, INC.
928 NUUANU AVENUE, SUITE 502 • HONOLULU, HI 96817

September 10, 1999

Linnel T. Nishioka, Deputy Director
Commission on Water Resource Management
Department of Land and Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, HI 96809

Dear Ms. Nishioka

Thank you for responding to the Environmental Assessment which was submitted to the Department of Planning and Permitting for the proposed water reclamation plant at the Honouliuli Waste Water Treatment plant. You letter and comments, as outlined below, have been included in the Final Environmental Assessment.

1. The reclamation project is being incorporated into the Oahu Integrated Resource Planning (IRP) process and will be included into the IRP submitted to the Water Commission. The water from the reclamation plant will meet all Department of Health and Environmental Protection Agency water quality standards. These standards will insure that the ground and surface water resources in the area will not be degraded.

2. It is noted that the Water Commission adopted a policy statement on March 13, 1996 stating:

    a.) "It is the policy of the Commission on Water Resource Management (Commission) to promote the viable and appropriate reuse of reclaimed water in so far as it does not compromise the beneficial uses of existing water resources."

    b.) "Recognizing that reclaimed water is a valuable resource in the Ewa Plain, direct of indirect reuse will be championed by the Commission. It is the policy of the Commission that the water resources of the Ewa Caprock Aquifer will be allocated only for nonpotable uses.

If there are any questions please contact me at 536-5695.

Sincerely,

Donald Clegg

Donald Clegg
President

DEPARTMENT OF PLANNING AND PERMITTING
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET • HONOLULU, HAWAII 96813
TELEPHONE: (808) 523-4414 • FAX: (808) 527-6743

JEREMY HARRIS
MAYOR

JAN NAOE SULLIVAN
DIRECTOR

LORETTA K.C. CHEE
DEPUTY DIRECTOR

1999/CLOG-3680(DT)
1999/ED-5

July 23, 1999

Mr. Donald Clegg
Analytical Planning Consultants, Inc.
928 Nuuanu Avenue, Suite 502
Honolulu, Hawaii 96817

Dear Mr. Clegg:

Draft Environmental Assessment (EA)
Honouliuli Wastewater Reclamation Plant (HWRP)
Tax Map Key: 9-1-13: 7

We have reviewed the above Draft EA and have the following comments:

1. The final EA should describe how the use is permitted as a "public use" as defined under the Land Use Ordinance. The use is not otherwise allowed under the R-5 Residential District.

2. A drainage report may be required from our Wastewater Branch when the construction plans are submitted to our department for approval.

3. What type(s) of best management practices will be implemented prior and during construction?

4. Runoff from the proposed 6-stall parking lot should be directed to landscaped areas.

5. Page 2-12 of "Design Standards," Item 3, incorrectly states that the "Standard Details for Public Work Construction" is in two volumes. This should be corrected to state, "Standard Details for Public Works Construction, September 1984 and Standard Specifications for Public works Construction, dated September 1986."

Please contact Dana Teramoto of our staff at 523-4648 if you have any questions regarding this letter.

Very truly yours,

JAN NAOE SULLIVAN
Director of Planning
and Permitting

JNS:am

cc: U.S. Filter Corporation
Office of Environmental Quality Control

posse doc no. 5942
hwrp.djt

apc
PHONE (BUS): (808) 536-5695
FAX: (808) 599-1553
ANALYTICAL PLANNING CONSULTANTS, INC.
928 NUUANU AVENUE, SUITE 502 • HONOLULU, HI 96817

September 10, 1999

Mrs. Jan Sullivan, Director
Department of Planning and Permitting
City and County of Honolulu
650 South King Street, 7th Floor
Honolulu, HI 96813

Dear Mrs. Sullivan,

Thank you for reviewing the Draft Environmental Assessment for the Honouliuli Wastewater Plant. Listed below are the responses to the comments by the Department Planning and Permitting.

1. The reclamation plant qualifies as a "public use" for the following reasons.

   a. Construction of the plant by the City was mandated by a court ordered consent decree. As Such, the plant fulfills a City government activity for public benefit in accordance with public policy.

   b. U.S. Filter is constructing and operating for the City, what in effect, is a City water reclamation plant. The City must approve the design, construction, and operation of the plant. The plant will revert to the City in 20 years.

   c. Much of the reclaimed water will be used by the City.

   d. The plant is located on City property.

2. A drainage report has been submitted to the Department of Planning and Permitting for approval

3. A "Construction Best Management Practices (BMP) Plan" will be prepared by the contractor. The BMP Plan will include the following items as appropriate:

   a. Location of construction

b. Description of any specific measures needed to protect the ecosystem at the site.

c. Description of the type, composition and quantity of material to be excavated and its disposition

d. Description of the type, composition and quantity of fill material to be used, including locations of stockpiles.

e. Description of any de-watering activities necessary, including a treatment and discharge plan and locations of de-watering treatment and discharge points

f. Construction Sequence (designed to *minimize* potential environmental impacts).

g. Construction Methods

h. Characteristics of any Discharge and Potential pollutants associated with the Proposed Construction a activity (typically including solid waste, sanitary waste, oily waste)

i. Proposed Control Measures or Treatment Methods (including a spill response plan).

j. Other Health and Safety Considerations, typically including noise control, dust control (usually by watering), and control of other physical hazards to workers and the general public.

4. In accordance with best management practices, runoff from the parking area will be directed to landscaped areas.

5. The FEA will correct the reference to the "Standard Details for Public Work Construction " to the "Standard Details for Public Work Construction, September 1984 and Standard specifications for Public Works Construction, dated September 1986.

If there are any further questions please contact me at 536-5695.

Sincerely,

Donald Clegg

Donald Clegg
President

END

CERTIFICATION

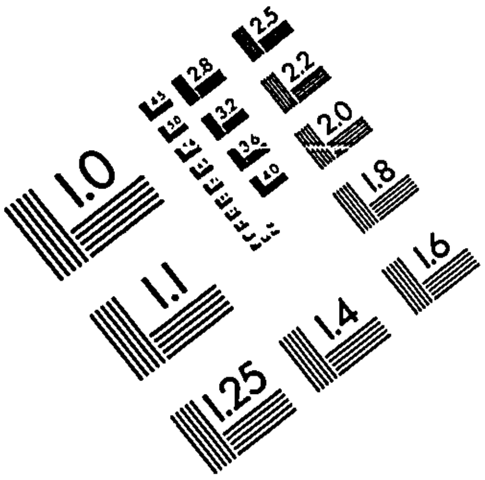
I HEREBY CERTIFY THAT THE MICROPHOTOGRAPH APPEARING IN THIS REEL OF FILM ARE TRUE COPIES OF THE ORIGINAL DOCUMENTS.

2004

DATE

Joelle Kaai

SIGNATURE OF OPERATOR



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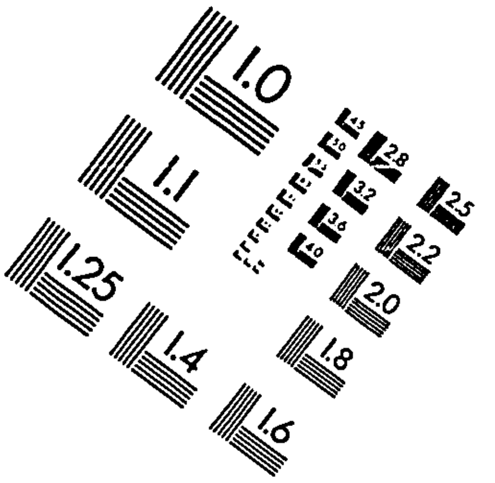

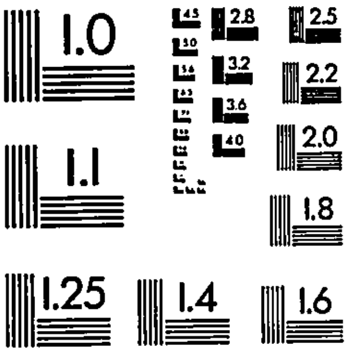

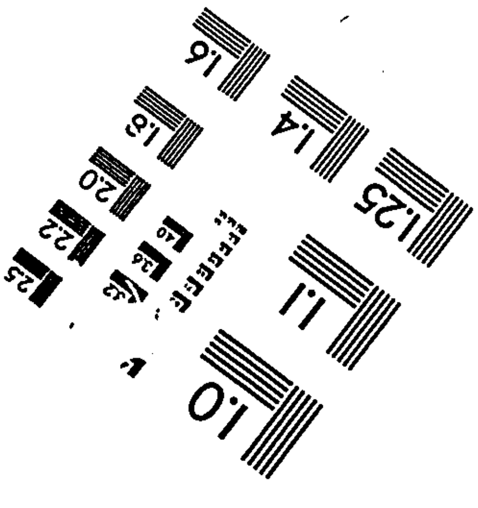

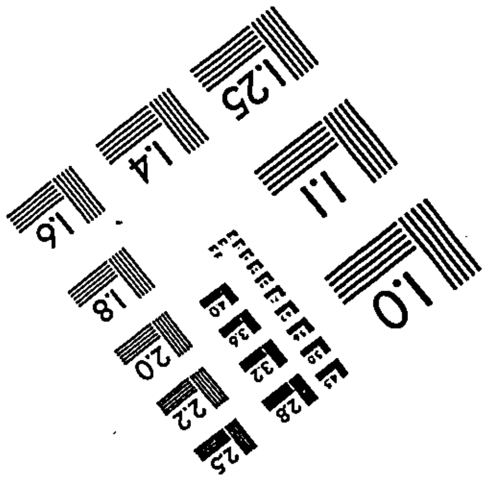

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